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Friction-free Energy:

Digital transformation strategies for the utilities industry to navigate the energy transition

Table of contents

INTRODUCTION

In December 2015, the Paris Agreement was created to combat the effects of global warming. A binding agreement that focuses on greenhouse gas emissions mitigation, adaptation and finance beginning in 2020, it must be ratified by 55 nations before going into effect. As of June 2016, 177 nations and the EU have signed the document with 19 of them having already ratified it. Assuming the remaining 36 signatures are collected, the agreement would set a number of regulations in motion that will force many industries to reconsider their current processes and practices.

Indeed, throughout the world, and well before the ambitious framework came into existence, the global energy system was in transition. The transformation from fossil fuels to sustainable energy is no longer a dream but a necessary reality.

To help drive forward this reality, however, requires the ability to manage the dynamic changing landscape emerging within the energy market. For example, in a renewable energy system, solar, wind and geothermal sources play primary roles in the transition. Yet these forms of energy are typically distributed instead of centralized, and are intermittent and difficult to predict due to weather conditions. In addition, new energy users are appearing on the market, such as electric vehicles and heat pumps, which have different energy requirements than today's traditional energy devices and can, potentially, double our electricity consumption. Other possible scenarios are energy-generating buildings and new energy chains.

Whether and how these various market dynamics materialize is anyone's guess, but one point is certain: an entirely new energy ecosystem is emerging where energy flows will be bidirectional, predictions will be crucial, and management will be transferred to local levels of society.

To add to the complexity of these changes, ever-increasing regulatory requirements are continuing to emerge. To ensure that old energy sources are completely phased out to make way for the emerging ones, government bodies are becoming increasingly vigilant in implementing ever tougher regulations.

This white paper provides a detailed analysis of the challenges the global utilities industry faces as the current energy system slowly fades away and transforms into something new. It also investigates how technology is developing very quickly and explains how energy consumers are changing from grid connectors to "prosumers." It concludes that the energy transition can be accelerated by using information and communications technology (ICT) as a game changer.

THE ENERGY TRANSITION IS ALREADY UNDERWAY

As resources dwindle, not only is the long-term supply of fossil energy limited, but the economic gains derived from it are minimal as well. However, the growing scarcity is not the main driver in the transition of the global energy system. Why continue utilizing fossil energy when there are affordable alternatives available? The Stone Age did not end because we ran out of stones. The main force driving the energy transition involves the changing climate conditions and the Paris Agreement that will lead to new legislation and regulations and compliance costs for energy providers that reach millions of euros.

American economist and social theorist Jeremy Rifkin describes the era we are living in as the third industrial revolution[1], where energy and Internet technology meet, and can potentially create thousands of new businesses and open up millions of new jobs. To fully realize this new revolution, five pillars must be in place:

1. A switchover to renewable energy
2. Transformation of buildings from energy users to energy generators
3. Utilization of local storage as part of the energy grid
4. Smart grids that are based on Internet technology
5. Transformation of electrical vehicles to run energy generators

As the energy transition unfolds, we are witnessing disruptions to the current system, which offer both an opportunity and a challenge for the global utilities industry. Change is coming quickly, so it is important to remove friction from operational processes to enable new business models: a friction-free energy transition would benefit everyone involved.

Typically, investments in the current energy system are made based on long-term solutions that address our requirements for the next 40-50 years. The challenge within the current model is where to invest since experts are predicting that the use of traditional approaches to network planning will require major grid reinforcements to cope with the large volumes of distributed generation. Many executives must consider how they will answer several of the following questions:

- Should investments be used for more copper in the ground? Or, should they be invested instead in smartening up the grid? This is not only about investments costing tens of billions of euros versus hundreds of millions of euros, but it is also about investing in operational technology (OT) or transforming IT from a supporting role to a mission critical one.
- Should only electricity grids be considered or should investments be made in the current natural gas grids for the near future? What are the risks of a quick transformation versus the risks of a long-term one?
- Is it necessary to fully focus on a digital grid with demand response management and storage? Battery storage is currently quite expensive—around US$350/kWh—but the price may fall quickly when new production initiatives go live.
- How can electric vehicles (EVs) be utilized in the mix? Having a storage strategy will be critical, but what does it call for and are EVs used? Is there storage at the substation level and what about regulation? How fast will the market for solar vehicles grow?

All of these considerations represent huge challenges for today's global players who are going to need to implement new market strategies to survive. One example of a company already doing what it can to survive and thrive within these market dynamics is Dutch energy provider Alliander. It has implemented a strategy that calls for launching start-ups under the holding and working on developing concrete responses to the aforementioned questions. An interesting example here is the Open Smart Grid Platform (OSGP), an award-winning initiative[2] that drives innovation and opens the ecosystem to third parties to develop new products and services to support the move to a low-carbon economy.

One outcome of the energy transition is that energy will be available across the globe for a low price or potentially at no cost at all. This will be disruptive for current energy suppliers that will need to transform into energy services companies when an entirely new set of competitors have entered the market, such as Google, Apple and Tesla. These non-traditional companies are viewed as the new contenders in the energy market.

Another example from the Netherlands is sustainable energy supplier Eneco, which is focusing solely on new energy services to survive. It has been very successful with the "Toon", a smart home system with an integrated thermostat. The Rotterdam-based energy provider also cooperates with several start-ups and recently closed an agreement with Tesla for re-selling the Power Wall, an in-home energy storage solution.

Perhaps the biggest challenge faced by global energy markets is the fact that the current energy system is mission critical and closely connected to society at large. Any changes to the system need to be real-time and balanced to avoid outages. Balancing these changes requires moving from a centrally organized model to a distributed one, which will bring major changes to grid operators. The full impact of this change can be seen in Figure 1.

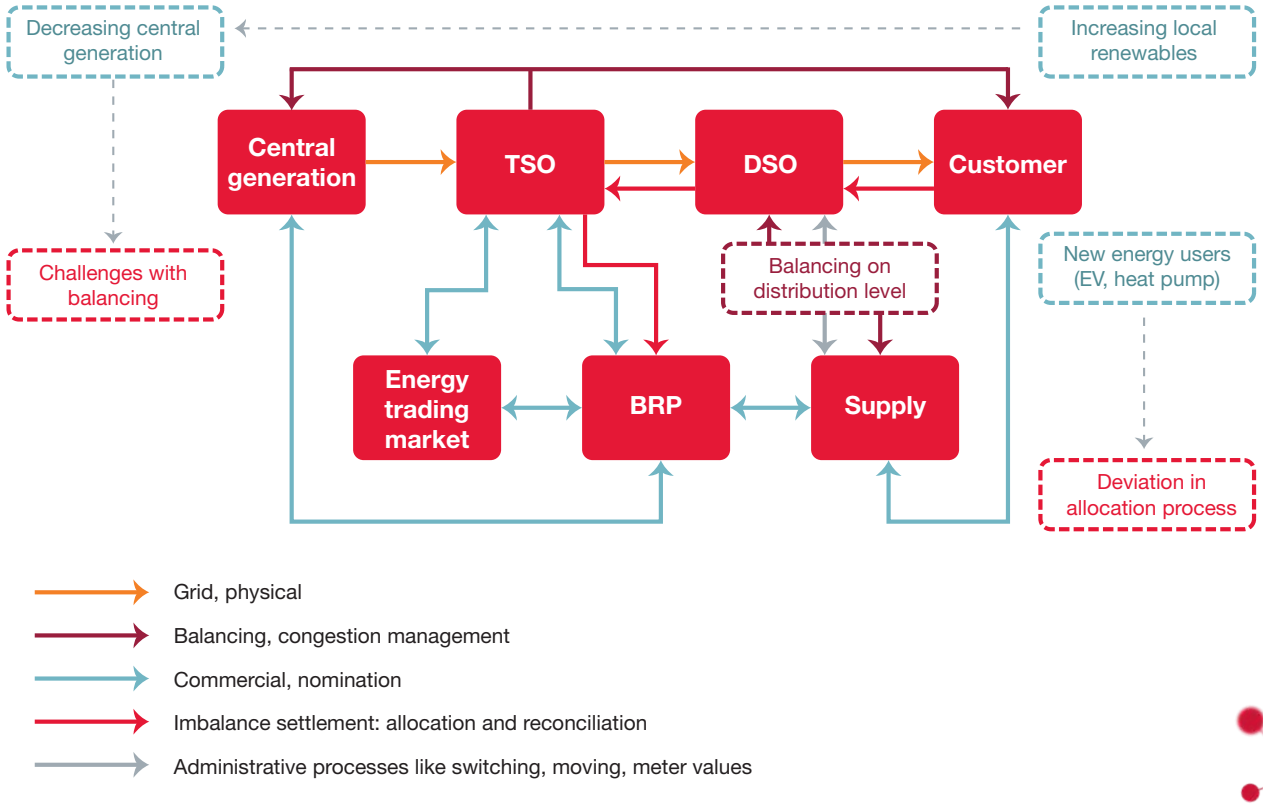


Figure 1: Energy market processes and the impact resulting from the energy transition

A connected world multiplies the challenges

Analysts have been predicting the energy transition will be heavily influenced by an explosive growth in smart devices generating all sorts of new data, coupled with five drivers:

- Internet of Things (IoT)
- Big data and predictive analytics
- Renewables
- Demand-side management
- IT and OT integration

Technology is the thread that these five drivers have in common. IoT and big data are being touted as the next big developments. With the growing availability of sensors and devices, this space is set to explode. In fact, the market research and analyst firm IDC predicts 200 billion smart devices will be active on the global market in 2020. The mushrooming of new devices translates to data growing exponentially to 1 zettabyte in 2020. On the other hand, there are specific energy-related topics such as renewables, and, as a consequence, demand-side management. When Rifkin's third industrial revolution accelerates, the main challenge for the utilities industry will be IT/OT integration: two very different business worlds will need to be connected to facilitate the energy transition with challenges such as mission-critical systems needing to be integrated into the IT landscape via the Internet as well as security and privacy issues. The latter two are particularly critical areas. It goes without saying that if security and privacy are not rigorously considered, this could have a big impact.

Power to the people: building a new energy system together

The energy consumer has typically been a stakeholder who was not directly involved in energy transition decisions, nor included in projects and pilots involving changes to the model, since energy suppliers have often been local monopolies. Traditionally, the consumer was at the point where the grid ended. The image of the individual behind the meter has been somewhat of a mystery—at least to the utilities provider. However, several trends, such as peer-to-peer trading, crowdsourcing, the movement "from products to services," and a technology push have changed the role of the consumer in the energy decision-making chain forever. And, more importantly, the low-carbon society starts with the consumer. All these trends are helping create new business models and value chains with "power to the people" as the credo[3]. The trends will not only impact the various energy markets, but they will drive and accelerate the energy transition itself. A case in point is the work CGI is doing to support the UK Department of Energy and Climate Change and its GB Smart Meter Implementation Programme, which will support the rollout of 53 million smart gas and electricity meters in the UK.

Thus, energy suppliers need to involve consumers in accelerating the energy transition. This will start at the consumer level, and if the industry comes in too late, it may lead to an unstable grid, more outages and economic consequences. Another outcome resulting from these new business models involves revenue streams. Traditional energy suppliers will find themselves out of business when the revenue model of distribution system operators (DSOs) changes. One scenario has consumers adding storage to their homes, making them almost self-sufficient in generating the energy they need. These individuals will place a request with a DSO to reduce their supply of electric power from the grid since they require less energy, therefore paying less for their energy consumption.

A consumer-centric project

To limit power grid imbalances, CGI developed a Central Energy Management System (CEMS) for smart grids. It is connected to home energy computers and provides residents with the most current energy information, including the latest energy prices, supply and demand as well as weather forecasts. It is also linked to various smart devices in homes such as solar panels, smart energy meters, electric car charging points and smart devices for home appliances (including washing machines).

Residents can use the information provided by CEMS to make better choices in terms of their energy consumption. They can determine when supply and prices are high or low, helping them to select the right energy resources at the right time. They can also set their smart washing machines to start automatically when electricity prices are low, or tap into solar-generated energy when electricity prices are high.

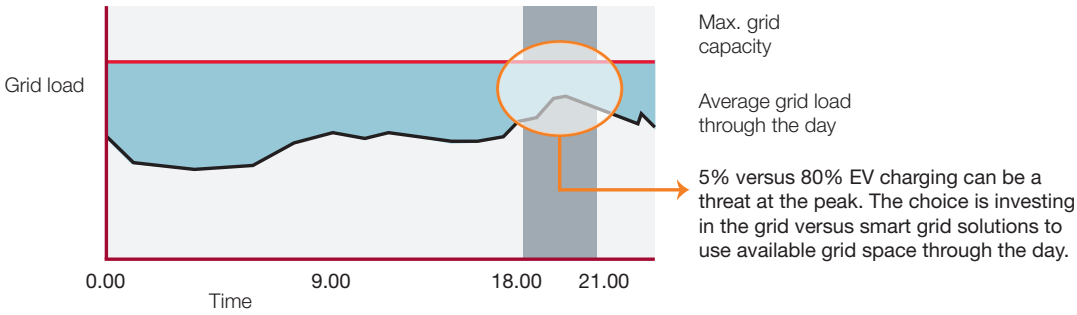


Figure 2: Energy market processes and the impact caused by the energy transition

However, a portfolio of different connections may create friction in DSOs' existing business model and impact the grid design. A DSO may challenge this as it will lead to short-term issues such as growing peaks or more outages. A better reaction to the changing situation is to launch pilots and learn how a new business model might impact business in order to be ready for the future.

Let's take a moment to revisit the investment challenges faced by DSOs: invest in additional copper or smart ICT? What happens when EVs, which are supposed to charge when they are parked at home, start arriving at the end of the day when the peak energy consumption period surges upward? Calculations for the Netherlands indicate that 5% of all vehicles on the road can be electrically powered and the current grid can support charging them at peak times. Otherwise, the grid has enough capacity during the entire day to use the off-peak time to charge 80% of all vehicles on the road without needing to consider any grid investment, as shown in Figure 2. For this scenario, smart ICT is needed to schedule, measure and remotely manage the charging process. Additional grid investments are very expensive—EUR 32-71 billion for a country such as the Netherlands—as concluded by a study of the Dutch association of DSOs[4]. Otherwise, ICT solutions are estimated to cost hundreds of millions of euros; far below the billions needed for grid investments and offer a clear business case. In fact, it makes an even better business case when car batteries are used to balance the electricity grid.

Electric vehicles as virtual power plants?

What role do electric vehicles (EVs) play in generating energy? To answer the question, EVs must first be on the road to facilitate the concept. From a Dutch perspective, EVs have been very successful in entering the market with 95,000 of them in use as of May 2016[5]. As of July 2016, EV sales in the European market were led by Norway, followed by the Netherlands. These vehicles are involved in several "smart charging" projects to avoid peaks ("peak shaving") such as during the early evening. Another option calls for using the EV battery as an integrated storage and electricity generator in the energy system that acts as a virtual power plant (VPP). It is about cooking on the battery of your EV, also known as vehicle-to-grid. However, there are many complications involved, such as battery ownership, battery life impact and fiscal rules for company-owned cars. Still, let's imagine a situation in a small country with eight million cars where every automobile is electric with Tesla-like batteries—with 10% of energy available for use in a flexible way every day. In this case, roughly 68 GWh* could be used from a new VPP, which translates to 21% of the total electricity consumed by the Dutch nation.

What is certain is that the price per KWh storage will drive the final solution; the lower the battery price, the more flexibility in the energy system. The current price per kWh is around USD 350; however, a study by American global investment banker Jefferies indicates it may drop to far below USD 100 when Tesla's Gigafactory in Nevada reaches its peak production in 2020.

*The Netherlands has eight million cars. If they were to make 10% of energy available on an 85 kWh Tesla battery, this translates to 68 GWh of electricity.

The Netherlands and the local energy market

The Netherlands is a small, flat country (about17 million inhabitants; 41,543 sq. km), making it ideal for piloting new energy concepts.

Some facts about the Dutch energy market:

- The market was liberalized between 1998 and 2004. Subsequently, this was followed by the unbundling of the grid and the supply side.
- EDSN is the central hub for administrative data exchange between DSOs, suppliers and meter companies. CGI has developed the hub and has been managing it for more than 10 years.
- Electricity connection points: 8 million
- Natural gas connection points: 7 million
- Renewable generation: About10% of total usage
- Smart grid pilots: 30+
- Electric vehicles: 95,000 (May 2016)

Technology as an accelerator

When looking at the challenges ahead collectively, four conclusions can be reached:

1. The energy transition could take many paths during its evolution towards a low-carbon society. Though it is unclear which energy scenario will prevail, we still need to begin acting now.
2. Innovations involving energy storage can act as an accelerator.
3. Currently, most changes are short term and business case driven so that new initiatives are not undertaken or prematurely stopped. Another mindset is needed to consider sustainable initiatives that act as accelerators.
4. Transforming to become digital enterprises is the top IT priority of network utilities in the coming year, as identified in the annual CGI Global 1000 outlook[6]. Trends such as IoT, big data analytics and IT/OT integration are essential to this transformation and will be the accelerators for new business models.

CGI believes companies should focus on the current technology trends that can serve as accelerators. To develop the necessary technology and to ensure it is in place at the right time, innovation, collaboration and entrepreneurship are prerequisites.

In fact, innovation has always been about collaboration. Real innovations are developed when two or more organizations work together. In the utilities industry, an IoT innovation, such as EV charging, is successful where a DSO, a hardware vendor, a system integrator and end-users cooperate, ensuring that each stakeholder's interest is considered in creating a new value chain. Interoperability and an open protocol are essential for this type of collaboration. Interoperability is the property of a product or system, whose interfaces are completely understood, to work with other products or systems, present or future, without any restricted access or implementation[7]. More importantly, using IoT possibilities may increase revenue streams, and for network utilities, it may enable an entirely new way to manage the grid.

The challenge is in determining the appropriate platform approach that is required to support future business models. When it comes to new products and services and an entirely new energy ecosystem with many small players based on technology, a platform will need to be in place that introduces new products and services quickly from an energy services point of view.

FRICTION-FREE ENERGY

The following concept is an inspiring approach to support a new technology: "Friction-free Economy" (Ted Lewis, 1997): "…friction-free economy is an economy with no production and distribution cost, no competitors and infinite resources…" Applying this vision to the energy transition, supported by IoT and big data analytics technology, will lead to a new revolution creating friction-free energy. We will have the ability to further automate or even remove processes—reducing marginal cost to (almost) zero and enabling new business services and models.

In other words, the journey to accelerate the energy transition begins with market facilitation processes. Traditionally, these processes have followed and supported the energy markets, including procedures such as meter data exchange as well as allocation and reconciliation. When looking at the Dutch market, it involves the processes of roughly 40 parties. The expectation that consumers are going to generate their own energy (solar, wind, geo thermal) indicates that consumers are transforming into "prosumers" who are going to become active on the energy market, either acting alone or via an energy supplier, service provider, broker and/or aggregator. The impact of this development is that market facilitation will no longer be contained to around 40 parties, but will explode to potentially involve eight million "market parties." It will be both a challenge and an opportunity. From an ICT perspective, an opportunity arises because ICT can currently support this complex model with the help of cloud computing.

Friction-free energy

Accelerating the energy transition and creating a low-carbon society

Remove all friction from the operational process ("keeping up") to cope with changes created by the energy transition. Productivity will increase and costs will decrease drastically so that new products and services can be developed ("stepping up").

CGI's optimized network utility (ONU)[8] approach addresses many aspects of the energy transition, especially those impacting network utilities. It details a vision on how to achieve friction-free energy (FFE) and how to realize a low-carbon society.

CGI's view is based on its experience in several smart grid projects that have involved co-creating and developing solutions in collaboration with its clients and partners. Key aspects that will facilitate the current big change range from adopting a holistic approach for all innovation programs to piloting new technologies and building knowledge.

A clear vision to drive the transition

An important aspect in approaching energy transition projects involves combining a strong market vision, deep industry knowledge and a hands-on mentality. CGI has been acknowledged as a leader in terms of its smart grid industry knowledge and IT-OT integration services (Ovum)[9]. Along with a strong focus, a market vision has been developed regarding current and future energy markets. But vision alone is not enough; it is important to collaborate and create ecosystems to allow for big changes: think big, but start small. A strong example is the "Your Energy Moment" project[10], initiated by Enexis in cooperation with several partners, including CGI, where a differentiating pilot was developed and executed from 2012–2016. The project was successful due to its vision (knowing where to go), open collaboration (issues were solved together) and hand-on mentality (results delivery). And more importantly: end users were actively involved in creating the project.

From a results perspective, academic research was performed on data generated from the project, which is of big value for future business models and grid investments. This knowledge, combined with a clear vision, will help to define the roadmap to smart energy systems as well as determine both the short-term and long-term benefits that can accrue for ROI evaluation. Thus, it will help ensure that technologies and systems deployed today are fit for future needs and that their value can be efficiently exploited for short-term and long-term benefits.

Start small, make a quick start

Though thinking big is strongly encouraged, it is still wise to take small steps to reach the bigger picture. It will allow you to make adjustments as you gain new insights along the way to implementing your vision. CGI has a vast array of intellectual property solutions that exploit IoT technology and big data analytics. They involve a variety of domain areas such as smart metering, electric vehicles and renewables management. Many IoT-based solutions enable friction-free energy and are accelerators for new business models and business services that can be developed quickly. A good example is the solution that CGI executed for Energias de Portugal Renewables (EDPR), the third largest wind energy company in the world. EDPR chose CGI as a partner in 2006, with the goal of initiating a control and management system for 48 wind farms across Iberia. Together with EDPR, CGI delivered the Wind Energy Management System (WEMS) based on our Renewables Management System (RMS). WEMS also needed to rapidly scale up to manage 50 more wind farms in the following six months. Since then, RMS has become integral to the management of hundreds of EDPR wind farms across Portugal, Spain, France, Belgium, Poland, Romania, USA and Brazil. EDPR believes that RMS plays a key role in supporting its expansion plans and driving continuous improvement in business efficiency.

Facilitating business insight for Vitens

CGI executed a leak detection project for Vitens, a Dutch water company with 5.5 million customers and 49,000 kilometers of pipes. Based on a number of data sources, which focus on the water grid, sensors, other geographical data sources and open data, CGI's solution allowed the company to pinpoint the location of leaks more precisely (up to 6 km^2). Previously, this could only be done for a much larger area (up to 900 km^2).

OPEN INVITATION TO COLLABORATE

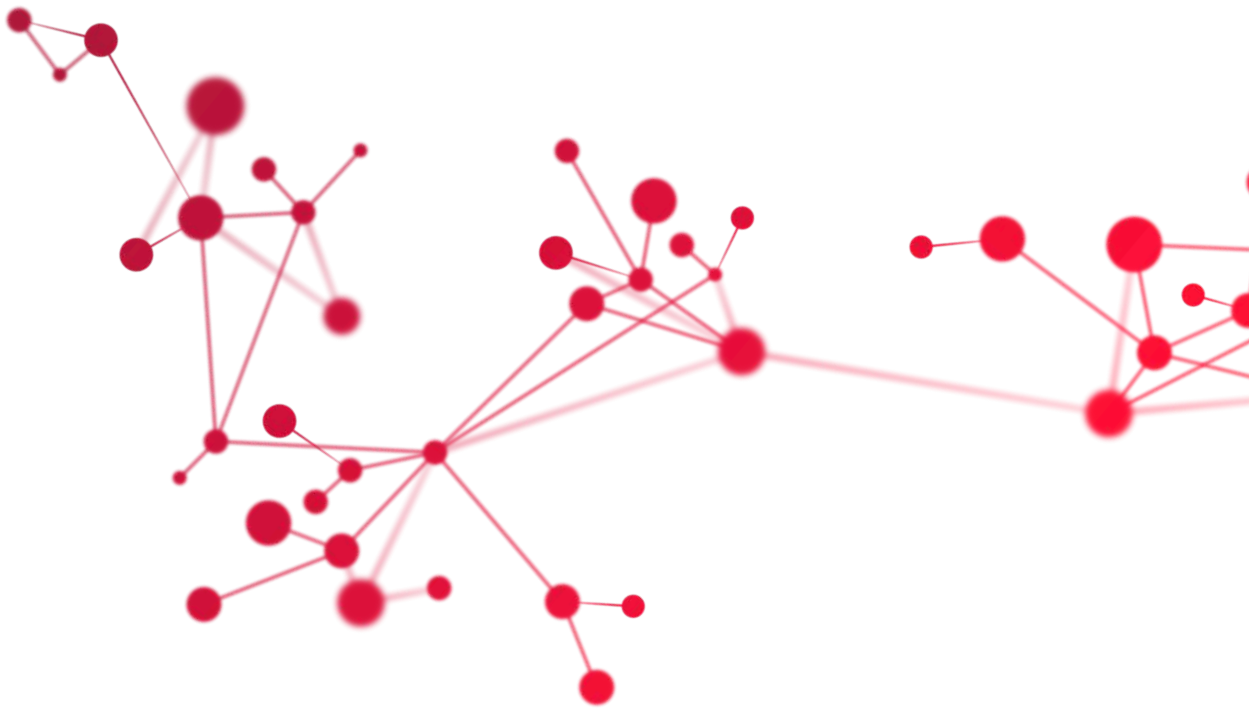
Network Utilities have the opportunity to take a leading role to accelerate the energy transition and to help slow the effects of global climate change. Information technology, and particularly IT-OT integration, will be a game changer and will certainly accelerate the transition. Companies that take action and create ecosystems in a collaborative way will be in a better position for the future.

To enable a friction-free energy transition, defining a clear vision provides a great opportunity to develop efficient and effective solutions. From a technology point of view, a stable and secure platform is vital to quickly develop new business models and services. “Think big, start small” is what has been described and promoted throughout this white paper: industry leaders will think about the future, define the roadmap for getting there, and add a “just do it” mentality in the execution of the vision. The most important factors for success will be clear vision, industry knowledge and a hands-on mentality.

Each journey is unique, taking into account factors such as the current organization, local market conditions and technological maturity. Other factors such as the cost of installing new layers of technology, consumer attitudes, industry policies and the objectives of those responsible for energy regulation also need to be considered.
Utility suppliers should make extensive use of trials and pilots to prove technology concepts and new, collaborative business models, along with new energy services that help address the increasing complexities of energy transition. The entire process will be incremental and will involve accumulating new knowledge to overcome uncertainties as the marketplace changes.

CGI is helping clients on this journey and to take the steps needed as the energy market transitions and to accelerate the revolution and arrive at a low-carbon society.

To learn more about CGI and our approach to energy options, download the brochure, Optimized Network Utility.



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About CGI

Founded in 1976, CGI is one of the largest IT and business process services providers in the world, delivering high-quality business consulting, systems integration and managed services. With a deep commitment to providing innovative services and solutions, CGI has an industry-leading track record of delivering 95% of projects on time and within budget, aligning our teams with clients' business strategies to achieve top-to-bottom line results.

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