The New Energy Future

EXECUTIVE SUMMARY

The global energy industry is facing a turbulent future. Decentralization, growth in renewables, electrification of transport and digitalization are creating a transition to a new energy future. Business models and regulatory frameworks that under-pinned centralized power generation and distribution are under pressure, or even broken in some cases.

This disconnect between the current business model and regulatory policies presents a challenge to all players in the utility industry.

In the context of this upheaval, Clareo and Chrysalix interviewed more than 20 senior industry executives across the energy value chain and leaders of startups to get their perspectives on the changes at hand, their business imperatives and what the future may hold.

Four areas for consideration by the industry:

FORCES OF CHANGE IN NEW ENERGY

Four primary trends are driving change in the New Energy Future: decentralization, de-carbonization, electrification and digital transformation.

Decentralization: Across many industries, new technologies are profoundly impacting today's markets by bringing the provision of goods and services closer to the point of consumption, and the energy industry is no exception. Decentralization manifests itself in the move from centralized generation, transmission and distribution to distributed energy resources of smaller scale power generation and storage. These include solar, battery storage, electric vehicles and other resources that reside behind the customer's meter. The decentralization trend has been driven in part by new modular technologies and declining renewable costs, and in part by the increased recognition of the benefits for matching local demand with local generation.

The U.S. EIA has forecasted that total U.S. small-scale solar PV capacity (1 MW or less) will grow from 12.8 GW at the end of 2016 to 24.2 GW at the end of 2019, an 89% increase. The forecast 2019 capacity includes 14.5 GW in the residential sector and 9.7 GW in the commercial and industrial sectors.

While small scale solar is forecasted to be about 40% of the total solar capacity in 2019 (electric power large scale solar generation capacity will likely exceed 35.8 GW in 2019) and remain a small share of the over power mix in the U.S., forecasters expect continued declines in the costs of energy storage to fuel greater adoption of behind-the-meter solar as an economical solar-plus-storage combination.[1]

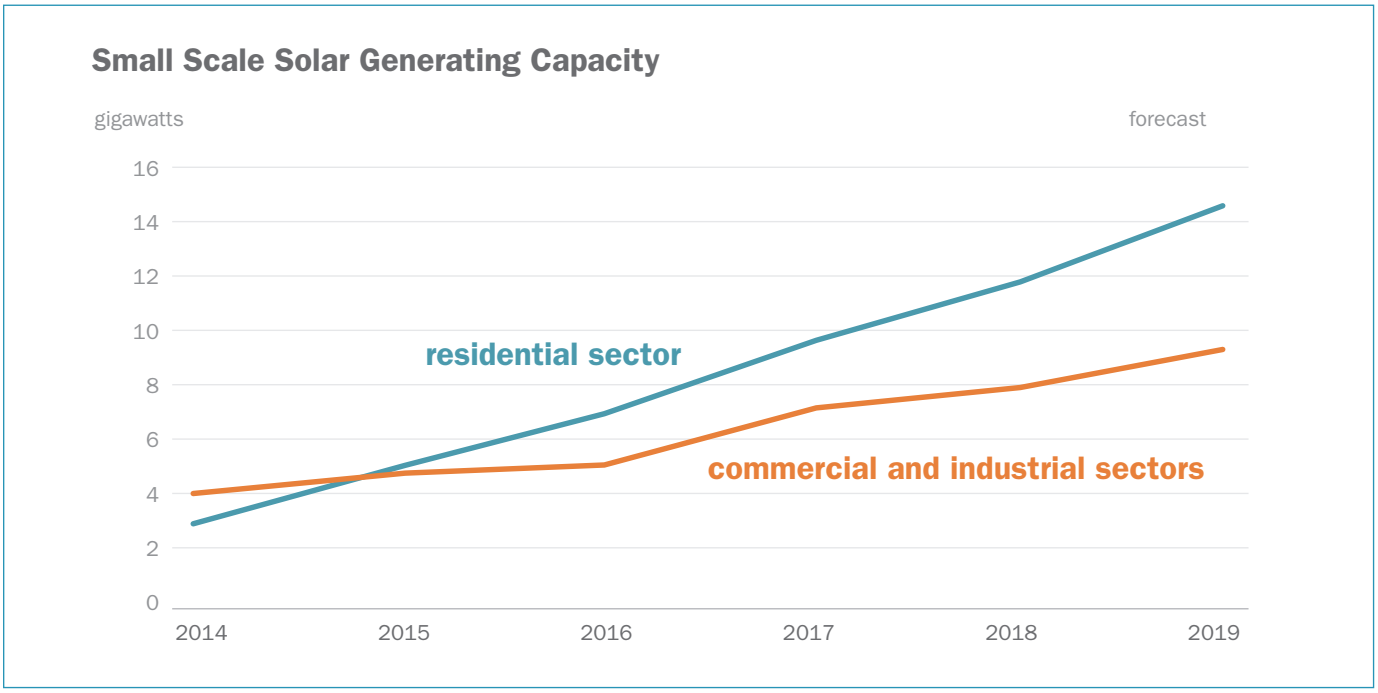
Decentralisation will add complexity to the power sector and require change in business models as energy economics become more localized. The traditional regulatory model no longer fits, and as regulatory bodies adapt at various speeds, this is creating a moving target for incumbent players.

"As a utility, one of our main challenges is modernization of the grid to successfully manage the integration of rapidly increasing Distributed Energy Resources"

— Executive, US West Coast Utility

Rapid Growth of Renewable Capacity: In much of the U.S. now, wind and solar energy are the cheapest forms of energy, even when subsidies are excluded.[2] While energy storage will be needed for further growth in intermittent renewables and add to the overall cost, a recent solicitation for new energy generation in Colorado received record low bids combining renewables and storage that came in well below U.S. costs for conventional energy.

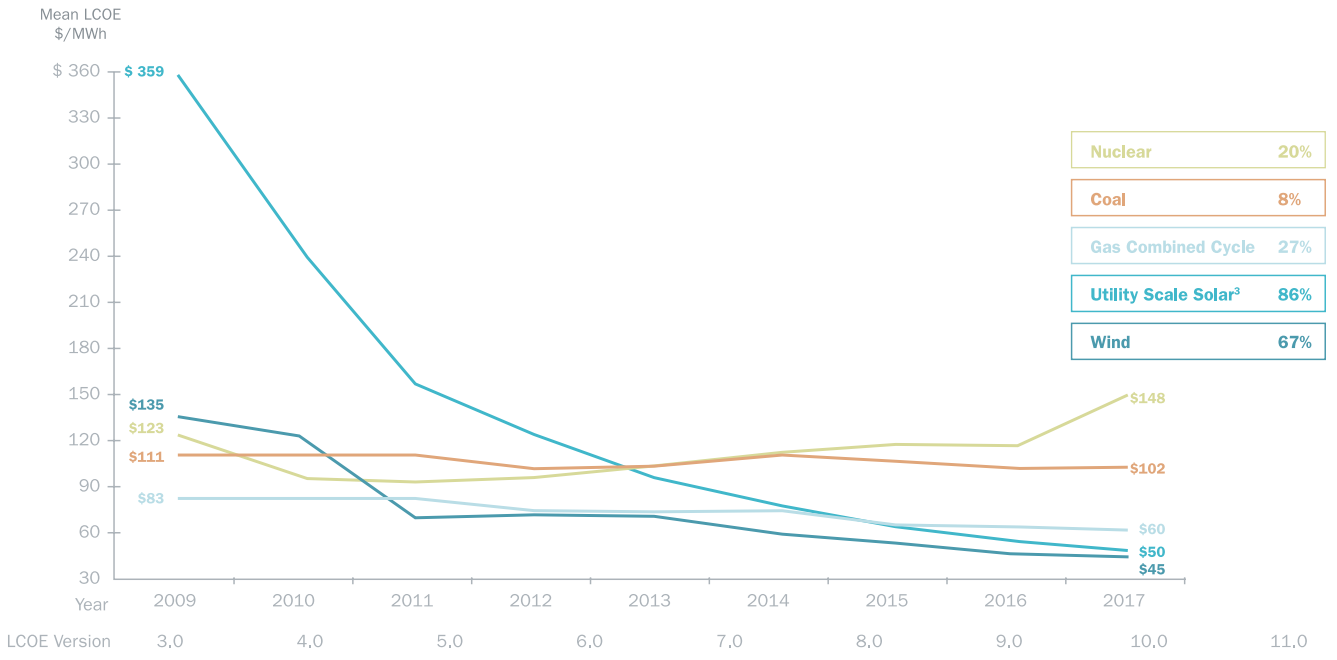
In addition, policy decisions continue to impact the growth of renewables. Despite the U.S. withdrawal from the Paris Agreement, more than a dozen U.S. states and more than 300 cities have pledged to reduce greenhouse-gas emissions in line with the Paris accord.[3]



Source: U.S. Energy Information Administration, Short-Term Energy Outlook

Renewable Energy—Historical Cost Declines

Selected Historical Mean LCOE Values



Source: Lazard, Levelized Cost of Energy 2017

"Fringe trends are no longer fringe, such as contracted renewables and energy efficiency — they are transformative to the industry"

— Executive, US Fortune 100 energy company

Globally, future energy generation capacity will be overwhelmingly renewable. Rapid deployment of solar photovoltaics (PV), led by China and India, will help solar become the largest source of low-carbon capacity by 2040, by which time the share of all renewables in total power generation reaches 40%.[4]

The low marginal cost of renewables is pushing down market electricity prices, making traditional forms of energy like coal and nuclear power unprofitable in some markets. Additionally, the increase of behind the meter renewables is decreasing demand, creating havoc with the economics of variable rate based providers across the value chain. Generation, transmission, and distribution players that have traditionally depended on high variable rates face the danger of a "utilities death spiral" – the need to cover their fixed costs with decreasing amounts of kWhs, further increasing their breakeven costs, making it easier for renewables to undercut them, leading to more behind the meter solar, and thus leading to further decrease in demand.

"We've got to get people to understand that utilities still have to recover their cost. Behind the meter players are providing some of their own energy – but they're not necessarily providing their own peak. And peak generation is what the utility has to bill to."

— Executive, US Midwest Utility

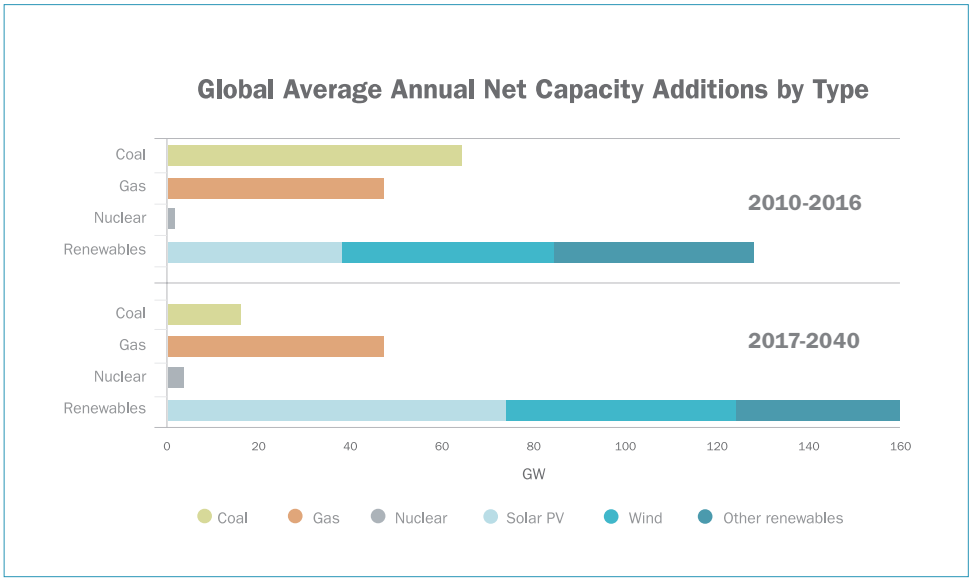
In Europe, there has been a more rapid move to de-carbonization, resulting in dramatic changes. The transition there from carbon fuels to cleaner energy, coupled with a phasing out of nuclear energy and introduction of large subsidies for renewable energy, have caused major losses among utilities and massive write downs of power generation assets.[5]

As renewable power becomes a greater mix of the overall power generated, we are also beginning to see examples of distortions in the market due to their intermittent nature. California has paid Arizona to take its excess solar and wind power. South Australia's aggressive renewables mandate caused an unprecedented 36-hour blackout in September 2016, costing nearly $400 million. This drives home that while renewables are

making major headway, a reliable base load of generation and energy storage are necessary to minimize risk.

Because of this, fossil fuels will continue to play a role in global power generation in the near term. In fact, Germany is building new coal generation, a result of the low price of coal there and the need for baseload generation as nuclear power is phased out. Longer term, BP's Energy Outlook predicts that coal remains globally the largest source of energy for power in 2040, with a share of almost 30%.

As a result, evolving market mechanisms such as new rate models or capacity auctions will be needed to deal with the challenges of renewable integration. The regulatory system will need to adapt, and energy players will have to monitor this evolving space.



Source: World Energy Outlook 2017, IEA

Electric Vehicles: The importance of electric vehicles cannot be ignored. EVs are expected to be over fifty percent of passenger vehicle sales by 2040[6] (though we have more rapid predictions that could accelerate this to as early as 2025), having major implications on the industry as a whole. Although forecasts suggest that in aggregate global load increase will be small, electric vehicles will change the bottlenecks of the system, creating significant changes in regional and point-of-time demand requirements. This will create opportunities for different parts of the energy value chain such as utility sales for products and services while posing challenges for others such as transmission and distribution. It is a double-edged sword: there is a concern EV charging could exacerbate peak demand problems, while on the other side, there is the opportunity to level load by timing when charging occurs; and using vehicle battery storage to stabilize the grid. Charging stations create a new business opportunity that is currently complex to implement due to a patchwork of regulation.

"EV's can be a new market, but it can also be a problem. It depends where you are in the utility. For the wires companies within utilities, it is not clear how they will get compensated. Will there be cost recovery? How does the surge get dealt with? Who pays for the upgrade of substation?"

— Executive, Global Energy Company

Digital Transformation: New ways of working are being unlocked by the rapid advent of digital technologies in both customer business models and operations.

The utility business model of the past relied on economies of scale, with assets that were centrally planned and managed. However, digital technologies and new regulation are enabling a more distributed model, and empowering customers. More and more consumers now expect anytime, anywhere information and the ability to participate with their own onsite power generation, or to opt out with micro-grids. And they want more control of their energy. With energy management devices, rooftop solar, electric vehicles, storage and demand response, consumers are moving from passive users of electricity to active energy participants.

"I call it the customer behavior evolution - customers are changing and they demand other things—they demand ownership."

— Executive, European energy company

Separately, the digital transformation will also allow utilities to operate more efficiently. The operational attributes of the digital utility will include:

- Better alignment of supply and demand through smart grid systems that manage distributed energy resources
- More efficient operations via the use of Artificial Intelligence and Machine Learning to optimize asset, maintenance or workflow management
- Greater system knowledge through using “digital twins” of generation and grid assets
- Greater productivity through using real-time data and leveraging Virtual/Augmented Reality technologies to facilitate field force work
- Enhanced cyber security for threat detection and response

BUSINESS CHALLENGES AND LEVERS

Considering these trends in the energy market, our panel of executives highlighted unique challenges from across the energy value chains to adapt to the new environment.

Industry Player	Power Generation	Utilities	Large Suppliers	Startups
Business challenges	• Declining demand for electricity and the shape of demand • Evolving energy economics for new technologies • Changing regulations that impact generation technology choice	• Challenging revenue models with shrinking demand, as customers become “prosumers” who generate and store some of their own power	• Selling products that are increasingly commoditized or less necessary • Keeping up with innovation	• Long utility sales cycles that drain resources
Primary levers to address challenges	• Drive greater efficiencies through innovative technologies, such as digital twins • Seek government support to adapt existing regulatory models • Adopt a mix of generation assets to transition to a new, lower-carbon energy future	• Employ innovations in cost management and opportunities to harden or modernize the grid • Pursue products & services outside regulatory constraints • Define new roles for utilities in managing grid assets	• Partner with startup companies that provide access to new technologies and talent • Offer digital products and services	• Partner with large suppliers, but do so effectively, ensuring viabliity of long-term projects • Reduce market adoption risk by engaging customer up front, making products to solve their problems, not great ideas to push the market

One of the greatest challenges that unites them all, is having to work within an outdated regulatory system. The regulatory model is drastically out of step with the pace of innovation, holding energy companies back from evolving to the energy system of the future. For example, in some cases, it rewards utilities for building out capacity even when energy usage from the grid is declining. In other areas, it is attempting to select technologies and approaches that end up being outdated during the regulatory cycle.

"Regulators are demanding innovation, such as mandating a certain level of renewables. The flip-side is that we don't know if that approach is effective. We'd like to get the benefits of the interest and assertiveness of the regulatory commission without having them be experts on implementation."

— Head of Corporate Strategy, US Energy Company

With an eye to the future, another challenge is the threat of disruption. Barriers to entry have decreased and the risk of faster and more nimble competitors is present.

"Has the Uber of Energy already been created, or is it still awaiting to be created?"

— CEO, Battery Storage Start-up

What new business models and technology will take hold? Will micro-grids take off? Will peer-to-peer power generation, enabled by blockchain-based trading platforms disrupt incumbent models? How should incumbents react to the change?

INNOVATION PRIORITIES FOR NEW ENERGY

Energy companies facing this new energy future are turning to innovation in new technologies, products and services, and internal capabilities in an effort to adapt or reposition their companies for growth.

Making today's grid work for a new world.
There's a general consensus in the industry that investments in new technologies and solutions are necessary to adapt and build optionality. These investments are aimed at building new capabilities to improve resiliency, reduce operational costs and increase efficiency to evolve to an "intelligent grid."

For example, investments to upgrade the electricity grid are necessary to incorporate the increasing number of distributed energy resources and two-way power flows.

The growth of electric vehicles is viewed by many in the industry as another promising opportunity for new growth. EV's will create

additional load on the system, provide new capabilities through EV battery charging and storage to better manage supply and demand, and generate additional revenue from new products and services. Entirely new offerings will have to be developed.

"Business models could be very different to what they are today, which is difficult to manage with investors. The investors have to come to grips with it, because if we do what we've always done, we don't have a future."

— Senior Executive, U.S. Energy Company

AI and machine learning innovation also presents new opportunities. Energy value chain players are all eyeing artificial intelligence and machine learning as a core capability that can create significant value for the industry: optimizing grid assets, driving greater efficiencies in the system and improving customer service.

"100% of our innovation is around AI and Machine Learning. We're supplying this innovation to utilities. If you are not working on Machine Learning today, you will be obsolete in three years. But the innovation is easy, the business value and actionable outcomes are the critical items to nail."

— CEO, Data Analytics Startup

Many energy companies are turning to innovation to ensure they play a part in the new energy future. As one executive stated, fringe trends are no longer fringe – they are transformative to the industry. Utilities and power generation companies are developing both external and internal innovation strategies. Externally, some are partnering with external innovation providers such as venture capital funds. Internally, an increasing trend has been the creation of internal innovation groups, that emulate startup working styles.

Advocating for change in the old business model.
We also heard how utilities are actively exploring changes to their business model. An example is rate structures and rate designs that reflect changing energy use and are more targeted to different customer segments. And with more customer-facing technology, utilities are also exploring ways to provide their customers with more than just "kWhs" but full energy solutions.

"We can't continue to sell electricity as a kwh commodity. Rate structures and our business models need to change"

— Executive, US Midwest Utility

To accelerate the business model discussion, both internally and with regulators, utilities have been seeking to engage in pilots of new technology with customers. These pilots can help to demonstrate the applicability to the entire customer base and lower the costs of learning relative to large technology implementations.

Finally, as part of their shifting business model, large, incumbent energy firms are also focusing on changing their company culture. Actions have included efforts to engage employees in innovation crowd-sourcing and contests, training, surveys of employee perspectives on innovation and innovation metrics to track performance. Long-term commitment and consistent engagement with employees are needed to get results, and to see business units taking the initiative with innovation projects on their own.

LOOKING AHEAD

"The future of the energy industry will be a more challenging environment in which to operate: a "distributed, digitally-informed but massively complex system that is highly heterogeneous due to the multiplicity of utility, community and customer assets and different forms of participation."

— Senior Executive, Large Energy Services Company

Utilities will be planning for an uncertain future as the nature of projects and who participates changes. There will be corporations, communities, campuses, industrial facilities, commercial buildings and individual customers with different needs and goals, and programs of their own. Large incumbent players in the industry will need to evolve to survive the sweeping changes that have already begun to alter the energy ecosystem. That will mean developing new capabilities, new products and services to participate on the grid edge, while modernizing and maintaining the grid to support this evolution.

This requires an aggressive strategy to develop new capabilities and build a culture of innovation in-house that provides a space for experimentation and learning, while at the same time convincing stakeholders – customers, regulators, partners and shareholders – that incumbent players have a contribution to make in the shift to a more distributed and complex energy future. Companies must simultaneously leverage their positions in the current industry model while building new capabilities and talent for a new model, and one not without risks. Balancing these competing tensions will be difficult, especially in large companies with finely tuned business models and operating disciplines optimized for the current market environment.

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At Clareo our mission is to help businesses adapt and grow.

We help leaders adapt their businesses and create new ways to grow in rapidly changing markets. Together, we build the plans and capabilities that deliver results. We assist clients in improving strategy execution, finding radical efficiency gains, developing entrepreneurial capabilities, taking new ideas to market, exploring plausible futures, and investing in business ecosystems.

Our clients across the energy sector choose Clareo when they want bold new ideas fueled by a network of leading experts. Working alongside our clients, we create compelling strategies that lead to action.

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