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Amping up innovation

Leading global utilities are using R&D and innovation to advance their market competitiveness — but investment levels remain low.

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The global utilities sector, which has a market capitalization of US\$2.1 trillion, is at the front end of a dramatic energy transition that will radically alter future market strategies, business models, and customer interactions. As we noted in our 2019 [Global power strategies report](#) on the world's 40 largest utilities (which we call the Global Top 40, or GT40), long-held hypotheses about market direction, pace, impacts, and requirements have been overturned. Companies are acutely focused on devising market responses to the challenges of that transition by decarbonizing the generation mix, embedding grid intelligence, redefining customer value propositions, and elevating technology's role in enabling energy supply, delivery, and consumption.

As our colleagues Blair Sheppard, Daria Zarubina, and Alexis Jenkins have [written](#), industries — including utilities — were already facing a need to reconfigure their businesses to deal with the impact of forces such as digitization. But the COVID-19 pandemic has had the effect of intensely pulling the future forward, while disrupting the stability of revenue sources. The unprecedented challenges of the pandemic have transformed workplaces, threatened employee health, necessitated new regulations, transformed consumer behavior, and, in some instances, sundered supply chains.

Like many other business sectors, utilities experienced sharp reductions in core demand, followed by recovery. After February 2020, weather-adjusted electricity demand notably declined in the spring, only to rebound during the summer as lockdowns were relaxed and high temperatures boosted total demand. But these outcomes masked underlying dichotomies. For example, residential

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demand is substantially increasing while commercial and industrial demand is precipitously receding. Although demand impacts are steadying now, it is clear utilities will face challenges to business stability, revenue predictability, and customer bill levels for years to come.

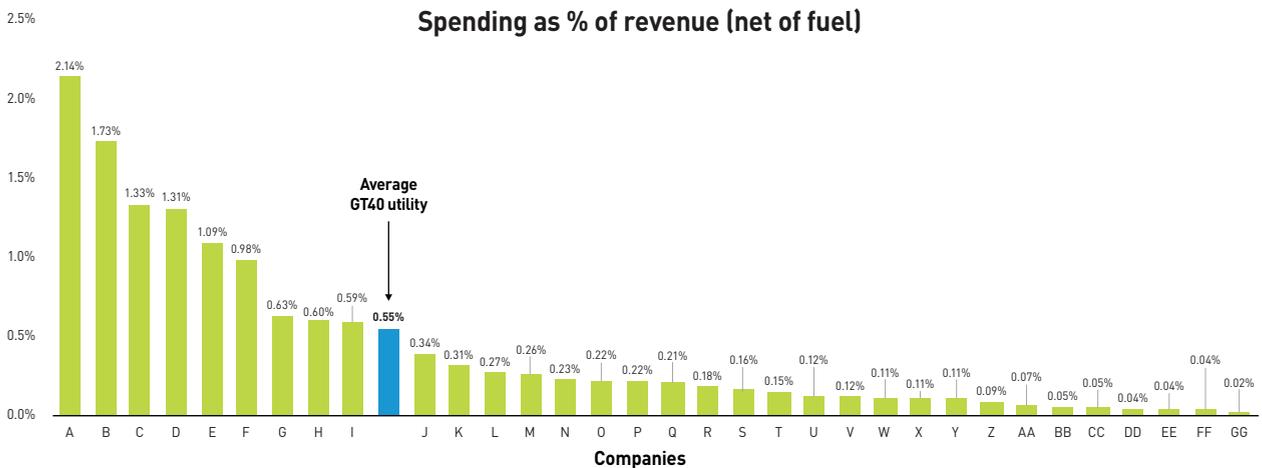
How can the global utilities sector cope with such effects? It has a powerful tool at its disposal that it has not yet fully deployed: research and development (R&D).

Companies focused on creating or satisfying customer needs (e.g., those in pharmaceuticals, automotive, and consumer goods) or providing next-stage technology (e.g., those in electronics, software, and industrial goods) have long embraced the strategic value of R&D and innovation to successful market positioning. These companies focus on the commercialization of products, services, and solutions that are appealing to existing or potential customers. Compared with their peers in utilities, they see R&D and innovation through a more purposeful lens.

The [2018 Global Innovation 1000 study](#) by Strategy&, PwC's strategy consulting business, found the 20 highest-spending innovators in the industrial, technology, and consumer sectors on average invest 4.3 percent of revenues on R&D and innovation, and companies in the pharmaceutical industry invest far more. R&D and innovation can differentiate growth and brand value for the most successful companies in their industries.

But utilities have historically not acted like competitive companies. Although the GT40 spent an estimated \$2.1 billion on R&D and innovation in 2018

Innovation investment among GT40 utilities



Note: Sample does not include AGL Energy, CLP Holdings, Orsted, or Power Assets Holdings due to data inavailability. E.ON, FirstEnergy, and Fortis are excluded due to restructuring impacts.
Note: Spending includes internal and external research and development and enterprise program expenses, as well as equity investment in startups or venture capital funds.
Source: FERC Form 1 filings, FERC Form 60 filings, Bloomberg, company annual reports, company sustainability reports, and PwC Strategy& analysis

— reflecting an 8 percent compound annual growth rate (CAGR) from a small base in 2013 — current spending levels will be inadequate for the evolving necessities of a more competitive future marketplace. Compared with their industrial peers, the GT40 utilities substantially lag in sustained investment in R&D and innovation, spending only about 0.5 percent of revenues annually (net of fuel costs) (see chart above).

North American GT40 utilities account for roughly 10 percent of the total spent by GT40 companies on R&D and innovation — despite making up half of the peer group and 30 percent of revenue. They spend only about 0.2 percent of revenues on R&D and innovation, compared with the roughly 0.7 percent spent by their counterparts in Europe and Asia-Pacific. Utilities based outside North America dominate absolute R&D and innovation spending, filling eight of the top 10 GT40 rankings.

This state of affairs cannot continue. Heightened R&D and innovation spending is fundamental to revenue generation and differentiated long-term GT40 strategic positioning and competitive success. Further, the industry needs to reimagine the role of R&D and innovation. Regarding it as a means of improving efficiency and operations, although that is important, is no longer sufficient.

Instead, the world’s largest utilities need to increase their investment in R&D

and innovation — by a factor of four. At the same time, they need to elevate the role R&D and innovation play as a centerpiece of strategy, solution development, and “go-to-market” models, and think about how these elements should enhance future business execution and value capture. And they need to reimagine R&D and innovation across a range of options reflecting ambition and aptitude.

Utilities usually increase their R&D and innovation spending as their business expands. When R&D and innovation spend stalls or declines, the ability of utilities to maintain progress toward strategic goals is diminished. Too many utilities are maintaining or even decreasing spending levels — at a time when market challenges are increasing. Those who fail to invest at available revenue capacity could face greater business risk as industry peers and new market entrants seek distinctive market differentiation.

GT40 peers can take several actions to advance future market positioning: emphasize the commerciality of R&D and innovation; utilize the venture capital community as partners; capitalize on global innovation sources; and selectively stand up corporate venture capital capabilities.

Elevate commercialization

Utilities are in the early growth stages of shifting from being traditional commodity providers to being innovative solutions architects. Companies are focused on identifying new roles, markets, products, services, and relationships. For example, NextEra Energy has aggressively pursued integrating batteries with its renewable resources to optimize asset performance (energy storage) and value (avoided costs).

Utilities have typically focused on the operationalization of new technologies, adopting them for internal purposes and deploying them to enhance resiliency or productivity through digitization. This focus sees technology as a solution impacting systems, equipment, and devices, rather than one that impacts markets, business models, and customers.

But the focus needs to move from reliability and cost to growth and value. Utilities can't realize their market positioning aspirations if they regard technology solely as an internal enabler. The industry may not appreciate that commercialization is the North Star that guides the transformation of knowledge

into marketplace benefit.

This doesn't mean utilities need to reinvent themselves to follow in the footsteps of Alphabet, Amazon, Apple, or Microsoft, which have deployed innovation to reshape how the world works and interacts. Rather, they need to absorb lessons from such companies as Airbnb, Tesla, and Uber, which created new offering categories and new business models with a strong orientation toward extracting value from their distinct go-to-market approach.

The focus of innovation should be on converting ideas into value. For “new energy services utilities” — companies that emphasize customer solutions enabled through technology, networks, and products — the concept of innovation moves beyond ideation to commercialization. For example, Enel has installed more than 80,000 electric charging stations globally to meet the infrastructure needs of residential, commercial, and transportation customers while integrating demand management and flexibility services to optimize customer energy acquisition and utilization and create new revenue streams from energy management.

Commercial success for utilities that adapt their innovation systems will come in several forms: new arrangements with partners and collaborators; broadened customer base and relationships; increased market and customer share; expanded products and services; and new revenues and margin sources.

Engage venture capital

Historically, the GT40 focused on directing spending for R&D and innovation toward specific enterprise purposes. Now resources are often being directed toward investing in startup companies, as utilities partner with venture capital funds seeking to create technology learning laboratories, identify winning industry solutions, and accelerate solution deployment.

Utilities can engage with venture capital in multiple ways: They can directly invest in a fund; coinvest with a fund; or simply create a knowledge-sharing relationship with fund management. The choice among these options depends on whether utilities perceive venture capital funds' role as that of a thought leader, risk taker, innovation catalyst, or partner.

Venture capital has supported approximately 650 funding events in the global utilities sector since 2015, and the average deal size has increased during that

time. Since 2015, dozens of funds have plowed in more than \$10 billion, excluding renewables project development and financing, with overall investment increasing at a CAGR of 8.9 percent.

Battery storage funding accounted for \$1.4 billion in 2019 alone; investment in lithium-ion batteries grew at a CAGR of 133 percent from 2015 to 2019. Other areas of growth include grid optimization platforms, smart charging technologies, and solar thin film. Across all regions in 2019, European venture capital funding led the way, particularly in battery storage technologies. North American venture capital funds have focused on multiple dimensions of the intelligent grid, including distributed generation, data analytics, microgrids, advanced metering, and grid optimization.

Some “club” venture capital funds have attracted the interests of utilities globally. For example, Energy Impact Partners (EIP) has attracted \$1.4 billion in funding and has about 20 utility partners in North America, Europe, and Asia-Pacific. Oil and gas companies are also entering the venture capital sphere, moving downstream into energy consumption while upstream businesses shrink as a result of zero-carbon-emissions pressures, excess supply, price declines, and changing usage patterns. Companies including Shell, BP, Equinor, and Chevron are creating their own venture capital arms focused on new energy solutions, e.g., over-the-horizon supply technologies such as hydrogen.

By establishing relationships with venture capital funds — through direct investment or coinvestment — utilities will extend their market reach and accelerate commercial offerings.

Expand innovation channels

Pioneering thinking for new energy solutions appears everywhere — at universities, in OEMs, in startups, and in government. No single group monopolizes creative thinking. And that provides a challenge to utilities. How can they source needed capabilities from multiple entities?

A fulsome ecosystem exists beyond geographic or institutional boundaries whose expertise is available and accessible to utilities through direct engagement. GT40 utilities need to become more active members of the global R&D and innovation community so they can expand their horizons and shrink market

discovery windows. They need to explore technology frontiers and better attune their sensing mechanisms.

Some utilities have long-standing relationships with local universities, such as Atlanta-based Southern Company's relationship with the Georgia Institute of Technology, and others rely on government sources for R&D support. Most utilize industry groups, such as the Electric Power Research Institute (EPRI), that pursue common interests for the collective benefit of U.S. and global utilities in such areas as digitization of business segments. Few look to the OEM community for insights, believing that sharing information would inevitably have adverse economic consequences.

Numerous R&D and innovation clusters exist beyond Sand Hill Road. Silicon Valley has a disproportionate number of software developers and design engineers, but Boston, Toronto, Seattle, Tel Aviv, London, Paris, Singapore, and other global cities are hotbeds of power sector R&D and innovation. Many companies maintain global innovation centers so they can access or incubate startups. Électricité de France (EDF) has centers in France, Germany, England, Malaysia, Italy, and China; Germany's RWE maintains a presence in the U.S., England, Poland, Germany, and Israel.

The GT40 utilities need to be more active in establishing global scouting centers and channels to monitor startup activity, identify over-the-horizon technologies and use cases, nurture embryonic solutions providers, define paths for continuous startup engagement, and short-list interesting entities for expanded engagement and potential investment.

Whereas leveraging venture capital funds enables companies to syndicate risk, participating directly in startups and having access to innovation clusters provide other distinct advantages. Being more immersed in the technology community can lead to early trendspotting, preferred technology access, and concentration of investment options.

All utilities need to embrace R&D and innovation as continuous, pervasive, and boundaryless. While continuing to rely on internal perspectives to drive technology spending priorities, companies should broadly syndicate R&D and innovation engagement among multiple partners to enrich the flow of insights and experiences.

Dedicate corporate capital

Increased capacity (e.g., through management agility and financial acumen) and capability (e.g., through market origination and partnering) are not intended to supplant external relationships. Rather, they are complementary means of enhancing market participation and extending strategic presence.

A number of GT40 companies are already positioning themselves as serial investors by coinvesting through venture capital funds. These external relationships are being supplemented by organic investment arms that can expand capabilities for deal origination, enhance companies' attractiveness to startups, align opportunities with priorities, and enable more flexibility in investment portfolio decisions. Ten (25 percent) of the GT40 utilities have created internal corporate venture capital units to engage directly with startups, sometimes in collaboration with other venture capital funds. These internal units identify, evaluate, fund, incubate, and monetize new energy solutions startups and provide targeted investment to the clean-tech community.

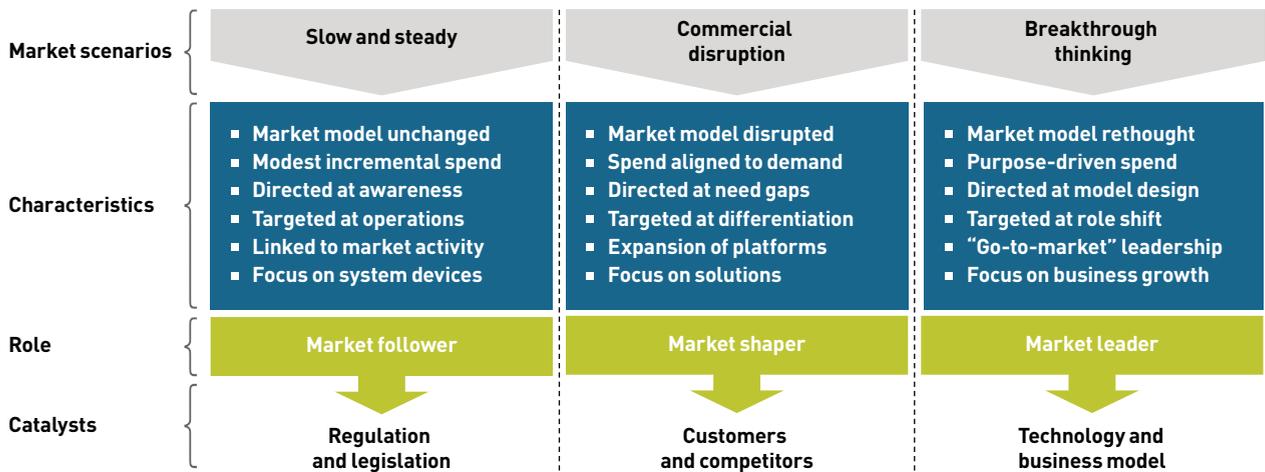
In anticipation of integrating demand management and smart grid communications platforms, Engie New Ventures has invested in multiple smart grid solution companies, such as Connected Energy and Kiwi Power. Companies including E.ON, Iberdrola, NextEra Energy, and KEPCO have made similar investments across the new energy solutions value chain.

GT40 companies in North America, Europe, and Asia-Pacific are directly investing in a range of technologies, particularly in storage, smart grid, and electric transport-related startups. For example, Southern Company provides project funding for Bloom Energy, which produces solid oxide fuel cells. And E.ON invested in AutoGrid, an analytical platform designed to optimize the balancing of distributed energy resources.

Whether through external or internal venture capital, European GT40 utilities are outpacing their regional counterparts in investment activity, having made 60 deals in the last seven years. This advantage in executed deals expanded over the last several years, with total deals exceeding combined North American and Asia-Pacific transactions by almost three times.

Despite inorganic successes to date, the GT40 need to think more expansively about R&D and innovation investment potential and further extend their

Future scenarios for utilities



Source: PwC Strategy&

market presence to identify more opportunities and scale new energy solutions businesses. And they need to do so in an environment in which competition for investment is expanding

Planning for future scenarios

We see three possible scenarios unfolding that could drive how GT40 companies position themselves for R&D and innovation advancement — “slow and steady,” “commercial disruption,” and “breakthrough thinking.” Each scenario causes evolution along three principal dimensions: structure, focus, and spend (see diagram above).

In the “slow and steady” scenario, the status quo is likely to be maintained, which will result in moderate market evolution. Responsibility for R&D and innovation is unchanged, and external engagement is limited. Market shifts are evolutionary, rather than revolutionary, and spending stays around the current 0.5 percent of revenue.

The “commercial disruption” scenario reflects faster market evolution that requires shifts in conventional thinking. R&D and innovation responsibility becomes more visible, the market ecosystem broadens, and spending gradually grows to 1 to 2 percent of revenue as strategic commitment grows.

The “breakthrough thinking” scenario reflects rapid acceleration in market

change and more competitors in the market. Responsibility for R&D and innovation is elevated, the market ecosystem becomes highly integrated, and spending growth dramatically exceeds historical levels, approaching levels of 3 to 4 percent of revenue (net of fuel).

Under these scenarios, R&D and innovation mature from less-structured support activities to highly coherent and disciplined systems. This evolution leverages the foundational work already completed by companies and creates strategic tailwinds to the GT40 toward business models, market offerings, and customer relationships not yet imagined.

To be successful, GT40 utilities need to quickly prepare for the “commercial disruption” scenario, which amounts to a doubling or quadrupling of the current annual R&D and innovation investment (0.5 percent of revenue, net of fuel). This scenario should become the new table stakes, as 16 of the GT40 currently spend less than \$5 million on R&D annually even while the average market capitalization of companies in the GT40 exceeds \$10 billion.

Utilities will make a meaningful difference in their market positioning advancement only when they begin to think and act more like technology companies (into which they are rapidly evolving) and consumer companies (which they publicly aspire to be someday), and achieve “breakthrough thinking.” For now, the GT40 need to further mature their R&D and innovation philosophies and intentions to the “commercial disruption” scenario while they work toward broader and more aggressive strategies leading to even more enhanced investment.

In 2020, traditional market norms were knocked off-center as COVID-19 created unexpected business challenges. Long-time tenets are still under pressure, e.g., load may permanently lessen, customer value priorities may continue to shift, and migration paths to zero carbon emissions may shorten. All these changes impact energy consumption, pricing, and margins. But several conditions will not change, because immediate ubiquitous product substitution is difficult to foresee and government policies still hold the key to robust economic recovery.

In a post-COVID-19 world, growth in current R&D and innovation spending is a necessary ingredient for revenue recovery. Anticipated changes

to which technologies advance and how businesses compete are shifting and accelerating.

If the largest companies do not boost their R&D and innovation strategies, they may underspend themselves into diminished readiness for a rapidly unfolding future, having insufficient capabilities to compete against entrenched competitors in equipment, software, and solutions.

But it's not simply a matter of throwing more resources at the problem — utilities have to rethink how they value R&D and innovation. They must regard them as differentiating capabilities foundational to their competitive future if they are to avoid degrading current positioning or forgoing future opportunities. If utilities reimagine R&D and innovation as core contributors to business success, they can be ready for the future before the market transition fully unfolds. +

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