SMART, SECURED AND SUSTAINABLE UTILITIES

POWER AND WATER UTILITIES ARE THE KEY ENABLERS OF OUR ECONOMIES. TO ENSURE SMOOTH FUNCTIONING OF OUR ECONOMIC ACTIVITIES, BUILDING A RESILIENT AND ROBUST UTILITIES SECTOR IS KEY. BY SHARAD SOMANI, PARTNER, HEAD OF INFRASTRUCTURE, ASIA PACIFIC, AND ABHISHEK DUBEY, ASSOCIATE DIRECTOR, INFRASTRUCTURE ADVISORY, KPMG IN SINGAPORE.

Certainly, increased digitalisation, global disruptions, and an acceleration towards decarbonisation in recent times have made this endeavour more challenging for the sector. In addition, there is also a need to cope with a shift in demand profiles, changes in supply sources and various natural and man-made disruptions. At the same time, ensuring supply security and competitiveness remains a top priority.

As we envision the future of the sector, technology will become a big enabler in optimising monitoring, reporting and operations as businesses strive to respond more effectively to the dynamic environment. What would the utilities of the future look like and what are the tools needed to take businesses forward? To address these issues, we will first need to explore the key challenges facing the industry.

Impact of Covid-19

In the initial days of the Covid-19 pandemic, countries across the globe implemented stringent measures to contain the spread of infection. These included extended lockdowns that brought industries and commercial activities to a complete halt. Businesses across sectors, especially manufacturing, mobility and transport, were forced to cease their operations, leading to a sharp reduction in industrial energy demand.

Meanwhile, with more people staying home, domestic household demand saw a sharp increase. In response to changing load patterns, the utilities industry had to react quickly to manage steep variations in energy consumption.

Decarbonisation and energy transition

The power sector is a major contributor to greenhouse gas (GHG) emissions. Hence, its decarbonisation efforts are central to global aspirations of achieving net-zero by 2050. To make this a reality, the electricity generation sector will need to be decarbonised by as early as 2040. As energy companies embrace the role they play in the global energy transition journey, more of them are also starting to understand climate-related risks and their threats.

In addition, utility companies are facing more scrutiny from customers, investment rating agencies and institutional investors on their energy transition efforts. These stakeholders are also demanding more accurate and timely reporting on corporate environmental, social and governance (ESG) performance. Consequently, many utility companies have started exploring green, social and accountable debt financing to help fulfil ESG and other related goals. This is because their ESG, decarbonisation and energy transition plans have become a significant part of the financing for future investments.

The emergence of prosumers

A greater adoption of distributed energy resources (DERs) over the years has driven a shift among consumers towards being prosumers. The rise of DERs and related technologies, such as rooftop solar panel systems connected to the grid, means that instead of being mere consumers, customers can also play a role as "producers" supplying energy to the utilities. This helps consumers in reducing their energy costs and further optimising their consumption loads through time-based tariffs.

As customers become more aware and involved, they are demanding greater information, better service levels and higher cost savings. They are also looking for the flexibility to optimise their power consumption. Amid this trend, the utilities sector will be forced to re-evaluate their business models, come up with new consumer service innovations and develop alternate revenue streams. This challenge is even more critical in developed markets with a liberalised utilities industry, as the scale of change will demand an overhaul of traditional business models.

Growing urbanisation

In 1950, about 751m of the world's population lived in cities. By 2018, that number stood at 4.2bn. And by 2050, it is expected to increase

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by a further 2.5bn, with about 66% of the global population living in cities.[1]

This underscores the need for the utilities sector to build their networks in a manner that can keep up with increasing demand and expectations from large and densely populated urban areas. The problem is expected to become more urgent amid changing ways of work, digital disruptions across various sectors and a rising number of data centres to support the growth of data, cloud-based analytics and digital tokens.

At the same time, many technology companies are making the commitment towards 100 per cent renewable energy (RE100), with more recognising the need for green data centres. This means that the utilities sector must not only procure green sources of energy but will also have to look at supplementing these with batteries and storage solutions to address the intermittent nature of such sources. The emergence of mini and micro grids, smart demand side management tools and distributed generation technologies would also mean the standard generation, transmission and distribution model may have to be re-evaluated.

Natural disasters and geopolitics

With climate change, the world is witnessing increasing frequency and intensity of natural disasters. Such weather events can adversely impact utility supply and demand. Going forward, the utilities sector may find it challenging to ensure that the critical services they are supplying remain running during extreme climate events with a demand-supply mismatch.

In the past two years, the pandemic has also put further strain on economic recovery. There also remains some uncertainty on global supply chains and their impact on businesses. To cope with this, utility companies must move away from tactical contractual arrangements and strike long-term strategic partnerships that leverage innovative technology for effective whole-of-system solutions. To further address these evolving needs, companies should also build resilience into their supply chain with proactive planning and stress testing of operations while moving towards agile supply chains and upgrading their technology.

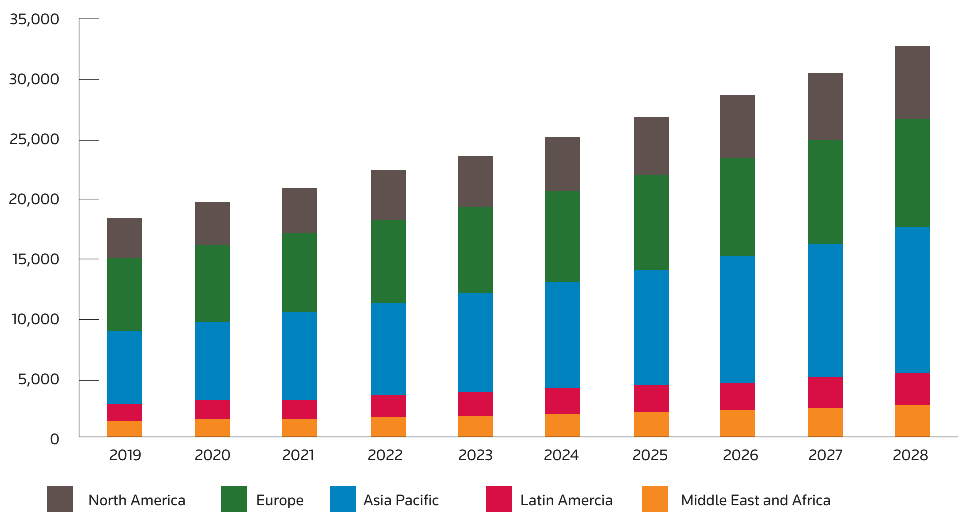
Disrupting utilitiesAgainst this backdrop, the utilities sector will require sustainable strategies and technological solutions to navigate these operational challenges and complexities. With rapid advancements in semiconductor technologies, computing power, storage capacity, and internet bandwidth, there has been a dramatic reduction in the costs of implementing digital technologies in recent years.

This presents an opportunity for the utilities sector, especially in developing countries, to leapfrog from labour-intensive non-digital operations to automated processes. Utilities and regulators across the globe are increasingly investing in sensor infrastructure, network and communication technologies and big data analytics.

Spending by utilities on digital technologies globally is expected to show strong growth and is projected to be highest in the Asia-Pacific region. These emerging technologies are able to help the sector optimise costs, drive operational efficiency and build cyber resilience. According to KPMG's CEO Outlook Pulse Survey 2021, energy leaders globally are planning to make bigger investments in automation, AI and collaboration technologies.

In the future, stakeholders expect the utilities industry to become more proactive in capitalising on a multitude of technological

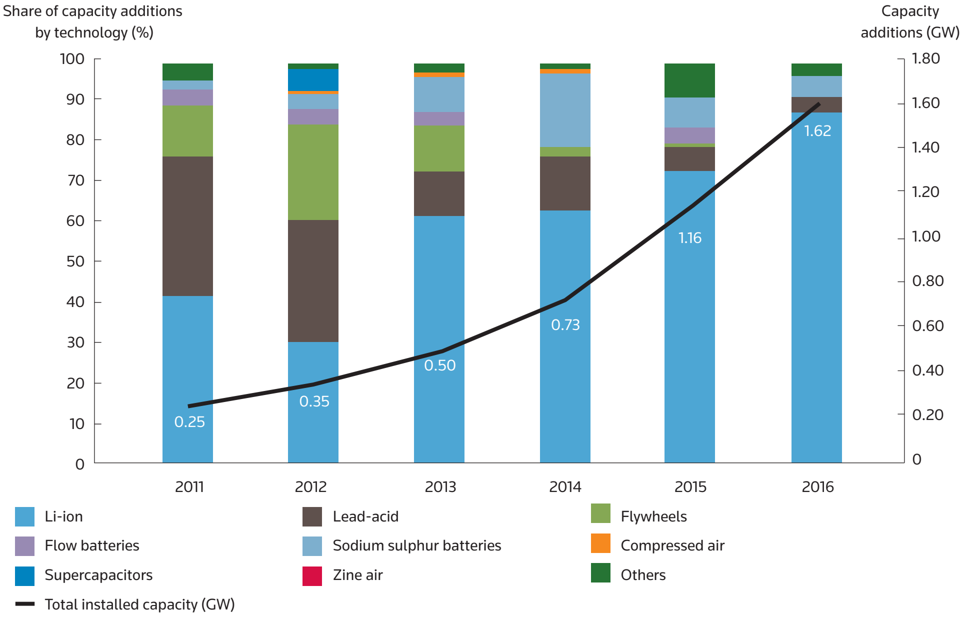
FIGURE 1 - DIGITAL TECHNOLOGY SPEND US$m



Source - Energy utilities spending on IT, Analytics, and cybersecurity solutions across the world

https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/utilities-face-greatest-threat-as-climate-risks-intensify-66613890

FIGURE 2 - BATTERY TECHNOLOGIES



Source - Energy utilities spending on IT, Analytics, and cybersecurity solutions across the world
https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/utilities-face-greatest-threat-as-climate-risks-intensify-66613890

solutions to meet the following three goals: enhanced productivity, increased resilience, and improved ESG performance.

Increasing efficiency and productivity

With rising demand, the utilities sector is constantly looking at how to increase load and power generation across the grid. At the same time, this has led to an enormous amount of operational data being available. This is an opportunity to leverage "Big Data" to generate deeper insights that can help in anticipating unforeseen scenarios.

- *Data-driven decision-making* – Leveraging the Internet of Things (IoT) with machine learning (ML) and artificial intelligence (AI) capabilities can lead to more refined and quality data sets, providing utility companies with another lens to optimise their operational efficiency and asset productivity. Additionally, AI enables trends and oddities in the data to be identified in a timely manner, which acts as a powerful tool for predictive analysis. Companies can develop a 360-degree view of operations, resources, and assets in real-time to drive more informed decision-making.
- *Forecasting and predictive analysis* – IoT, AI, ML and Big Data analytics can also be used in energy management. The use of Big Data analytics can guide utility companies in their decisions regarding power generation, energy load and performance estimation. Regulators can also access real-time data through blockchain technology, which does not allow the data to be tampered with. This can improve operational efficiency and reporting.
- *Advanced metering infrastructure* – Another technology that has been widely used across utility companies globally is smart meters. These meters utilise data aggregated by digital twins and geographic information systems (GIS) to facilitate bilateral communication between meters and the central system.
- *Automation and robotics* – The use of digital twin technology has also helped utility companies harness the value of data by bridging the gap between the physical and virtual. This enables them to replicate, anticipate and automate energy systems. Having a digital twin improves operational efficiency and enhances predictive maintenance capabilities as it provides real-time insights on power outages, line disturbances and grid stability. Drone technology has also become beneficial in helping companies monitor assets and infrastructure remotely.

Building resilience

As an industry prone to frequent external threats, the utilities sector will need to find ways to build resilience to survive and thrive amid uncertainty. Tapping technology such as smart grids, battery storage and 5G will be critical in this aspect.

- *Smart micro-grid and energy management* – A smart grid enables data exchange to be carried out swiftly across utility networks through advanced metering devices, 5G connectivity and cloud computing. Having this capability can help the sector in addressing threats in real-time. It also facilitates forecasting and allows demand patterns to be simulated by leveraging past data. With this algorithm-driven demand-side management, power can be automatically rerouted.

With rising demand, the utilities sector is constantly looking at how to increase load and power generation across the grid

TABLE 1 - TECHNOLOGY COMPLEXITY ASSESSMENT

Technology	Technology and infrastructure complexity	Operational complexity	Cost complexity	Talent complexity
Blockchain	**High** Fast-growing and ever-evolving blockchain standards	**High** The space is unregulated in various global jurisdictions	**High** Energy intensive operations	**Medium** Technology is not labour intensive but requires highly skilled developers
Internet of things	**Medium** Multi-stage approach required for implementation	**Medium** Challenges regarding reliability, security and communication	**Medium** The technology needs to work in tandem with complementing technologies to deliver quality data	**High** Qualified software engineers are needed for reliable implementation
5G	**Medium** Small-cell nodes need to be deployed in densely populated areas	**High** Networks need to be regularly configured, tested and updated	**High** R&D and hardware is capital intensive	**High** Requires trained personnel in 5G and other complementing technologies
Augmented and virtual reality	**Medium** Fast-evolving technology but ready enough to be adopted	**Low** Saves time and reduces coordination efforts; PUB, Singapore reported 40% time-savings	**Low** Nominal up-front cost and low service cost	**Low** Can be easily operated by personnel after basic training
Artificial intelligence	**Medium** Large quality data sets are needed to develop AI models Cloud servers are addressing issue	**Medium** Time saving through preventive maintenance and process optimisation; PUB, Singapore was able to save 64 man-days per year	**Medium** Cost is high but falling as ease of use increases	**Medium** Requires high skilled personnel, but once developed, AI models work independent of human intervention
Battery energy storage systems (BESS)	**Low** Tech in general is widely available offers sizing flexibility and can be deployed where most needed	**Low**	**Medium** Cost reduction trend, but the upfront cost is still high	**Medium** Initial set-up requires trained professionals after which supervision can be done through software/ virtually

Source: KPMG Analysis and Research

- *Battery storage* – Systems can be used to respond to energy demand quickly and are also flexible in size. They can provide reliable and cheap electricity in isolated grids and off-grid locations. Hence, they not only add stability to a grid but also allow for optimal integration while increasing the share of renewable electricity sources.

The market today is largely dominated by lithium-ion batteries due to the cost disruptions from the electric vehicle (EV) industry. Further improvements in existing battery technologies and the emergence of alternate storage approaches can be expected to boost energy transition efforts

- *5G and digital twin* – Another technology that will boost the resilience of the utilities sector is 5G. 5G has the ability to cope with large datasets generated and collected by IoT, AI, blockchain and augmented reality/virtual reality – all in real-time.

Driving ESG performance

With more expectations on companies to take climate action, there will be a similar expectation towards having reliable and trusted climate accounting. Stakeholders such as customers, employees, and investors want to see ESG reporting that is backed by actions and verifiable progress, while regulators are also looking for proof of compliance.

Digital technologies can provide traceability and accountability on ESG goals across the value chain. For example, digital twins and IoT can ensure data transparency, while robotics and automation can provide real-time information on a company's carbon footprint.

- *Influencing sustainable consumer behaviour* – Utility companies have a role to play in encouraging consumers to reduce waste and save resources such as energy and water. For example, some companies are nudging customer behaviour by showing them how their consumption patterns compare with neighbours in similarly sized homes, alongside other energy-saving targets. This is one way of driving positive behaviour change.

With a range of mature and emerging technologies available, many utility companies have started to explore various use cases to improve their operations and business models. In addition to data analytics and remote monitoring, companies are looking at incorporating other emerging capabilities, such as AR. However, the pace of adoption varies across the sector. There are some companies that have yet to start on their digital transformation journey and these would be the ones that would benefit from knowledge exchanges and collaboration opportunities.

Case for technology adoption

In thinking about the utilities of the future, companies will need to embrace a digital mindset when reassessing their operating models and offerings. As they chart their digital adoption roadmap, they will need to build core competencies around new technologies and emphasise innovation in bringing new service models across the value chain.

However, utility companies also need to be cognisant of the complexities involved with technology adoption and the impact it can deliver. This also requires a deep look at how new systems and processes can be integrated seamlessly with older ones. Companies should be prepared to face implementation challenges and even failures. To navigate these challenges at the enterprise level, companies should understand the technology complexity and impact matrix.

TABLE 2 - IMPACT OVERVIEW OF CRITICAL TECHNOLOGIES

Technology	Operational efficiency & productivity	Financial performance	Environment and sustainability	Health & safety	Customer experience
Blockchain	**High** Data security and access to the right personnel	**Medium** High running cost due to energy intensive operations savings resulting from increased data security	**Low** High energy consumption during blockchain mining	No impact	No impact
Internet of things	**High** Enables meaningful data gathering and system optimisation	**High** Enables service and maintenance savings; a German company noted 30% savings	**Medium** Gathers data from almost all parts of the value chain, thereby helping make fast and accurate decisions leading to energy cost reduction	**High** Helps avoid physical human intervention in remote areas	**Medium** Improves service reliability by sending real-time consumption data, endpoint device data to utility companies for maintenance
5G	**High** Enables smart grid and monitoring of energy usage	**Medium** Reduces cost of asset management	**High** Helps save energy by enabling remote control of water pumps, power plants	**Medium** Many operations can be managed remotely, eliminating field mishaps	**High** Helps forecast energy usage, avoiding extra costs for customers
Augmented and virtual reality	**Medium** Increased productivity of field workforce and improved collaboration	**Medium** Helps in operations and maintenance	**High** When combined with digital twins, can lead to predictive maintenance and hence energy and cost savings	**High** Enables predictive analysis and helps avoid on-field mishaps during faults	No impact
Artificial intelligence	**High** Enables effective management and drives value from continuous data generated	**Medium** Reduces need for new lines by increasing system efficiency, helps in predictive maintenance	**High** Leads improved renewable energy generation forecast, consumer load demand forecast	No impact	**High** Optimise energy consumption of consumers, improve safety and stability; an Argentina based company improved customer service with 70% faster issue resolution
Energy storage: Power utilities as service providers, other utilities as power users	**High** increases flexibility in energy sources and enables use of variable sources	**Medium** Potential savings from frequency response capacity and fuel costs	**High** Enables greater penetration of variable renewable energy sources	No impact	**Medium** Help provide reliable and cheap electricity to off-grid communities

Source: KPMG Analysis and Research

Please note that the complexity and impact matrix presented are representative examples and are not exhaustive.

Complexity and impact matrix

- This assessment provides insights into the implementation complexity of various technologies across dimensions.
- *Technology impact assessment* – This assessment provides insights into the level or quantum of impact delivered by a particular technology.

The above sample technology complexity and impact assessment matrices could help utility companies understand various options available to them as they chart their digital transformation journey. After all, the utilities sector operates 24/7 and often has no margin for error.

Before embarking on major transformative efforts, companies will have to carefully think through aspects such as management commitment, stakeholder support, employee buy-in, and capability development among others. This will help in laying out a calibrated, phased roadmap towards the set targets with defined objectives.

Conclusion

In an increasingly complex and uncertain world, the utilities of the future will need to do more to be reliable, safe, inclusive, transparent, and responsive. This involves adopting best practices that allow them to operate efficiently and sustainably. At the same time, there will be an urgency to reassess current needs and develop future-ready capabilities.

The utilities industry has always prioritised having a flexible and inter-operable infrastructure, developing remote operations capability, leveraging data for better real-time visibility and deeper customer insights. Going forward, adopting new digital technologies will become a necessity to keep up with increasing expectations to drive operational efficiency, build greater resilience and improve ESG performance.

These efforts need to be strongly supported and encouraged by the financing community as well as regulators. The financing community, flush with funds for ESG and digital transformation, could scrutinise and support the plans by utility companies to be future-ready. The effective convergence of regulatory guidance, financing prowess and technological innovation will help prepare the utilities of the future to be resilient, robust, and responsive. ■

Footnote

1 - https//population.un.org/wup/Publications/Files/WUP2018-Highlights.pdf