# Distributed
# ENERGY RESOURCE MANAGEMENT

## Addressing Key Challenges as Smart Grid Meets the Internet of Things

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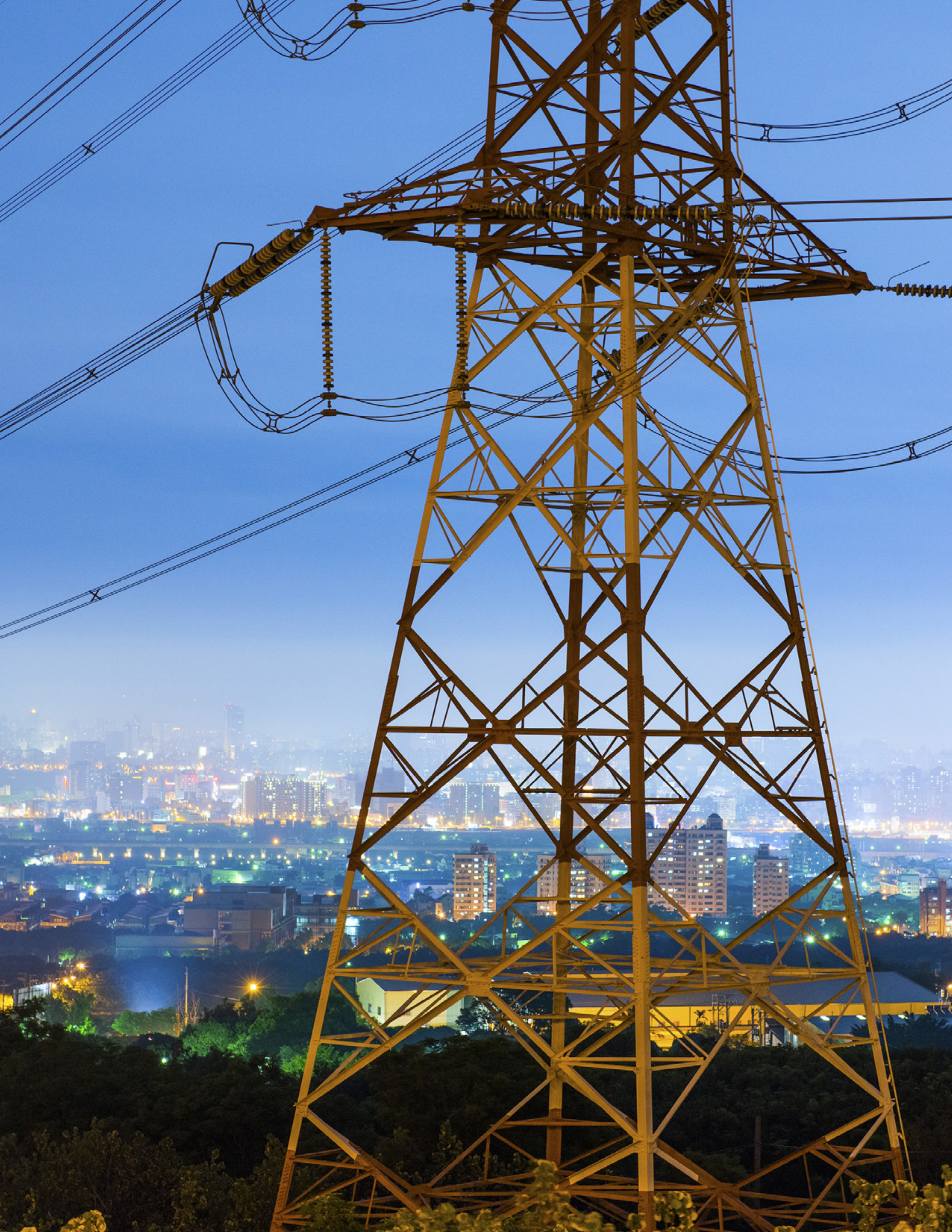

The era of distributed energy resources (DER) is fully upon the utility industry. Globally, renewable resources accounted for almost two-thirds of net new power capacity in 2016 according to **the International Energy Agency** (IEA).[1] Domestically, major policy reforms like those in California, Hawaii and New York led the way, with more than seventeen states with distributed energy projects underway in 2016. Utility Dive's **"2018 State of the Electric Utility Survey"** found strong support for DER across utilities of all types and sizes in every region in North America.[2] A full 91 percent of participants said they expect moderate to significant DER expansion on their own systems.

The adoption of DERs has been incentivized by improved customer economics. The cost to install solar, for example, has **dropped** by more than 70 percent since 2010.[3] Managing assets in this ever-expanding universe presents very real challenges to the utilities responsible for delivering safe, reliable, affordable and clean electricity to customers.

## MORE DISTRIBUTED THAN EVER

Resources today can be found virtually anywhere in a utility enterprise. Energy storage resources, for example, may be in a substation, at a solar farm inside or outside the enterprise, in a residential garage or on a big commercial customer's campus. With the growing adoption of resources like electric vehicles, rooftop solar and smart lighting, some utilities are encountering – and in some cases, considering ways to manage – DER behind the meter.

And it doesn't stop there. With the growth of the smart cities movement and the internet of things (IoT) promising to make intelligent devices and systems nearly ubiquitous in some communities, utilities will continue to face shifting paradigms. Utilities will likely discover additional external resources they may want to control. In other cases, utilities will need to decide which outside resources and devices they should allow to connect with their resources.

## ALL THE SMART THINGS...

The internet of Things, simply put, is the concept of connecting any device with an on and off switch to the Internet and/or to each other. IoT has enabled energy services providers to connect to millions of "things" – smart thermostats, lighting systems, hot water heaters and other distributed energy resources (DERs) in customers' factories, office buildings and homes – allowing them for the first time to oversee assets (and data) that reach across and into the homes and workplaces of their customers. As of 2017, there were 8.4 billion devices within the internet of things and that number is expected to reach 20.4 billion by 2020, according to **Gartner**.[4]

Managing DER, then, is a vital aspect of managing the utility of the future in an increasingly intelligent and interconnected era – one that brings challenges, threats and opportunities for which utilities need to anticipate and prepare.

> For the purposes of this paper, then, we will consider a DER to be any power generation source or controllable load that can provide an alternative to or an enhancement of the traditional electric power grid.

## WHAT'S A DISTRIBUTED "RESOURCE" ANYWAY?

long history of distributed resources like combined heat and power (CHP) systems or small natural gas-fueled generators, many think mainly of *generation* when they hear the term. Energy storage, too, is a long-recognized form of DER, while other physical assets, like electric vehicle charging stations and smart inverters, are newer forms. Beyond these physical or tangible resources, DER can also include systems and programs, like demand response (DR) or energy efficiency – technologies whose affect is to increase or otherwise manage utility capacity.

With this understanding of DER, as noted above, DERs can be widely distributed, even beyond the traditional delineation of grid edge or utility enterprise. The utility's role in managing resources now may encompass controllable loads and engagement with a wide variety of assets, such as HVAC systems, electric water heaters in homes and businesses, distributed "small" wind turbines and rooftop solar panels. Coordinating control frequently involves collaboration with the customers or third parties who own the equipment.

## DERMS: ONE SYSTEM TO MANAGE THEM ALL?

To realize the promise of DERS – such as avoiding infrastructure investments on the T&D side, improving resilience and integrating distributed energy – utilities must prepare well. For example, if customers adopt solar panels at a pace beyond the utility's ability to integrate and control it all, the result could be lost revenue and poor operational performance.

DERMS arose to address practical challenges to unify, aggregate and control distributed resources. Though the definition and distinctions between DERMS, virtual power plants and other forms of management systems continue to evolve, in this paper we're looking broadly at systems that can address the key challenges of meeting energy supply and demand through DER.

Since DERMS can add value in managing resources in many scenarios, let's examine three of the most urgent challenges facing DER adopters and identify the characteristics their DERMS systems must provide to meet those needs. Today's power providers must require DERMS that:

- are scalable to accommodate the growing number of DERS coming online each year,
- can flexibly connect to all these existing systems as well as to future technologies and
- are cyber secure and resilient to aggressive and sophisticated threats

## CONTROLLING A GROWING NUMBER OF ASSETS

These resources are coming – and fast. The sheer number of distributed resources projected to come online in just the next few years is staggering. GTM Research **forecasts** that from 2018 to 2020 U.S. distributed solar installations will grow from 2 million to nearly 3.8 million and behind-the-meter battery storage **will grow** from around 200 MW to almost 1,400 MW.[5] Energy Innovation **predicts** electric vehicles to dominate more car sales, going from today's one percent of new car sales to over 50 percent by 2035.[6]

What should utilities consider when planning for DERMS that will scale effectively?

Scalability must address both equipment and data. A good DERMS will be one designed to address these issues when it's time to expand. It provides a unifying structure that places no limitations or restrictions on number of devices or hardware that can be added to support scaling up. Similarly, the database support should be designed to adapt to unlimited numbers of customers within the architecture. The DERMS should adhere to open standards as well, so that new customers or data can smoothly integrate with any relational database.

## PLAN FOR A FLEXIBLE FUTURE

There are so many different types of resources to manage. How can utilities prepare for this diversity? Legacy architecture often is unprepared to fully support all the new types of controls across their system. Even though the grid was not built for two-way electricity flow or to accommodate intermittent and unpredictable energy sources, more and more utilities are expected to turn their grids into a network that can do just that.

Consider demand response, a form of DER that energy providers have been using for decades to reduce peak load. Despite its wide adoption – global DR capacity is expected to grow from nearly 39 GW in 2016 to 144 GW by 2025 according to a 2016 **Navigant** report – obstacles remain to fully realizing its potential through DERMS.[7]

It's a very different sort of resource than the DER they may manage on the utility side of the meter with their distribution management system (DMS). A DMS can't "see" on the customer side, so the two approaches remain siloed from each other. Today, and increasingly in the future, utilities need a DERMS that can address both sides, integrating readily with DMS and DR.

DERMS can leverage AMI as a suitable communication mechanism (with its two-way communication between utility and customer resources). AMI together with a robust DERMS platform provides utilities with insight and intelligence regarding downstream devices and allow for control of any type of distributed resource.

Even if the existing management system does not have the controls built out to talk to those other more sophisticated types of devices of systems, a DERMS can bridge that gap, providing the strong, fundamental architecture they will need. In fact, this approach is better equipped for this task than the existing distribution management system or SCADA that control substations and provide high voltage/low voltage protection. DERMS can view the customer side in ways DMS and SCADA often cannot due to their legacy architecture.

Beyond DR, utilities need DERMS that can readily manage many types of DER their customers embrace. Many of these elements are becoming connected through the IoT, that increasingly interconnected world beyond the traditional utility enterprise. And as the technologies of IoT continue to mature, the way we connect these devices and span the distance between the devices, the edge, and the cloud is essential.

It's not enough to just update legacy utility software. A robust DERMS platform must be able to overcome the problem of not having the correct, integrated architecture. As tools as technologies mature and the industry evolves, DERMS should enable each customer to exercise their personal preferences and increase overall satisfaction.

Other key characteristics required include:

- **Vendor Neutral and Device Neutral.** Look for standards-based architecture that works with any back-office and operational systems. This equips the utility for any change, whether it's a move to a new CIS vendor or the addition of a new energy management system. This provides optimal future flexibility to choose different energy management systems and tools as technologies mature and the industry evolves, enabling each customer to exercise their personal preferences and increase overall satisfaction.
- **Pluggability.** The ideal DERMS for any utility is one that works with existing systems. Which are the most indispensable systems to which you must integrate? For example, look for a DERMS that can integrate directly to the utility's system of record (SOR) for the data required for programs like DR.
- **Granularity.** The optimal DERMS approach allows very granular control of the distributed resources both in front of and behind the meter – beyond the high side of the transformer.

## STRENGTHENING CYBER RESILIENCY

The exponential growth in the number of distributed energy resources connected to the grid potentially increases the grids vulnerability to cyber threats—each end point becomes a potential access point. A smart home, for example, contains many connected devices. A digital garage door opener may be connected with an added device that can deactivate the home alarm upon entry – a convenient feature for someone coming home in a rush. If the garage door opener were hacked, the entire alarm system could potentially be deactivated. The digital intruder could gain access to devices – TVs, thermostats, door locks, home alarms and the like – as well as to customer information – possibly even to manufacturers' back-end systems.

While devices provide an advanced, fully functional modern experience to the end-user they must also communicate through specific pathways and have sufficient cybersecurity protections built in to deny would be cyber-criminals access. The DERMS must enable utilities to manage and mitigate risk in their "house," giving customers peace of mind that the grid is resilient and that their power sources are secure and reliable. How can you recognize a resilient DERMS?

### Cybersecurity is a complex and specialized topic. At a minimum, look for:

- A solution provider that doesn't just understand cybersecurity, but whose entire foundation is built on cybersecurity and whose enhanced security approach utilizes a "defense in depth" approach and spans all aspects of development and deployment activities, ranging from physical security, to personnel, training, and all phases of the software development lifecycle. Look for a solution provider that will stand behind their product, provide regular support and security patching, and continue to support you and your mission well into the future.
- Only consider systems that are built utilizing Service Oriented Architecture (SOA) design and implementation techniques. These systems deliver long-term value through ease of integration with other "best in breed" security solutions that are already in place within your IT organization. Additionally, these systems provide reduced software lifecycle development and maintenance cost and schedule, seamless web services support, scalability to meet demand variations, and robust error detection and handling.

- Look for a system that is continually tested in simulations of real-world attacks such as penetration testing. On a regular basis security teams should conduct targeted attacks and document findings. The best method to identify real-world vulnerabilities to cyberattacks, both internal and external, is to thoroughly test all potential attack vectors. This approach help to determine the degree to which a system is vulnerable and allows for mitigations to be put in place before the actual attack occurs.
- A system that is flexible enough to be deployed within your own secure data center, conforming to your very specific and tailored IT security guidelines, but is also offered as a secure, cloud-based deployment which is FedRAMP-certified, continually monitored by a host of highly-qualified IT-security specialists, and continually undergoes security assessment by accredited independent third party assessors.

## LOOKING AHEAD

In an era of economic and regulatory uncertainty and rapid technological advancements, utilities want to future-proof their investments with approaches that are flexible and prepared to integrate with new technologies in the future. DERMS hold promise as a tool offering integrated control of legacy and future distributed resources. By prioritizing solutions that offer scalability, flexibility and cyber resiliency utilities can prepare to leverage all their assets no matter where DERs may lead.

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Footnotes

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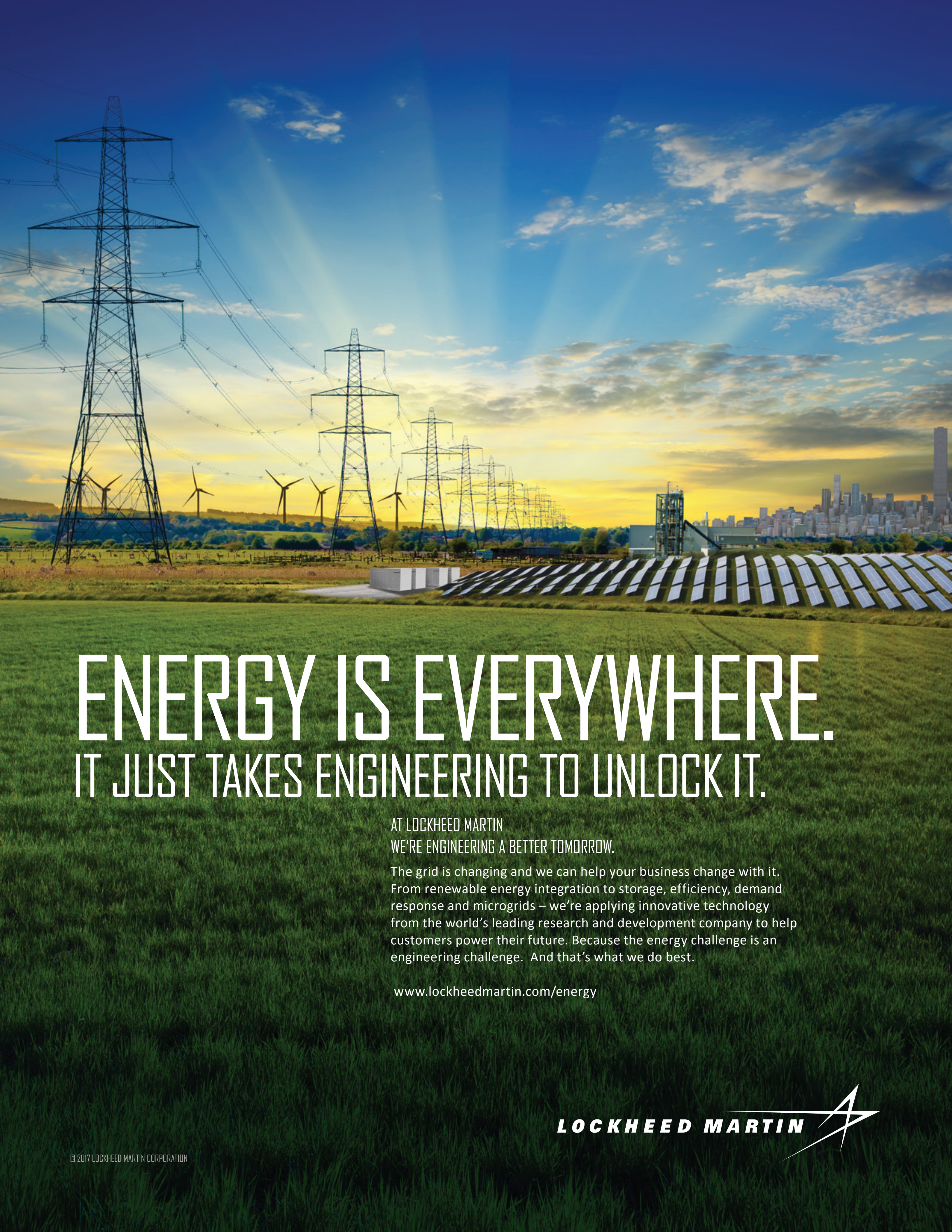
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