Itron

GRID RESILIENCY:
PREPARING FOR THE

UNEXPECTED & THE INEVITABLE

A RESOURCEFULNESS INSIGHT REPORT
2021 EDITION

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CEO PERSPECTIVE

THERE IS ONLY ONE PATH TO A RESILIENT AND RELIABLE GRID.

Welcome to the *2021 Itron® Resourcefulness Insight Report*, the latest installment in our Resourcefulness Report series. Itron began this series nine years ago, commissioning independent research to gain insights into what utility executives and consumers think about issues surrounding how energy and water are delivered and used.

Based on the response we received from our 2019 edition that focused on disaster preparedness, it was clear to us that this new report must focus on how climate disruption, directly and indirectly, is threatening the resilience and reliability of the grid. The findings of our research are contained in the following pages—as are some possibilities for enhancing grid resiliency and reliability with **the right technology, insights and investment**.

This report first examines the increasing impacts on the grid from **natural disasters**—the direct result of climate disruption—and then proceeds to explore the growing methods and implications of how we are responding, including the increasing adoption of **renewable energy sources (DERs)** and **electric vehicles (EVs)**.

Each of these topics carries with it enormous implications for the grid. Climate disruption is raising temperatures and sea levels, and resulting disasters are happening at increasing rates. During the summer of 2021 alone, one in three Americans had personally experienced a weather disaster.[1] And as this report bears witness, the impacts of climate disruption are tragically evident everywhere, including in the five countries we surveyed: Australia, France, Germany, Indonesia and the United States.

Renewables and EVs are no less disruptive. Take EVs: The International Energy Administration projects that as many as 245 million EVs[2] may be sold worldwide by 2030. At peak charging, an EV requires as much electricity as an entire household.[3] That's like adding enough capacity to power a country nearly the size of Indonesia, the fourth largest nation on earth. We have less than a decade to figure this out.

Meanwhile, one in four utility executives surveyed for this report say the pandemic forced them to delay investments and upgrades they'd already determined to be priorities. Hopefully, as nations everywhere continue to drive toward carbon neutrality, infrastructure funding will follow suit.

As this report makes clear, **modernizing the grid is the one path to achieving resilient and reliable energy and water services**. Fortunately, the utility executives we surveyed have identified strategic investments and upgrades that can help address not just one or two of these challenges, but all three. Those investments are detailed here.

For utilities, a modern grid offers more than a way out of an intractable problem. By adding intelligence to the grid edge, service providers **can know more, predict better, invest more wisely and deliver a better customer experience**. With that intelligence will come possibilities for new services and revenue streams—and a new future for utilities and consumers alike.

Sincerely,

Tom Deitrich

President and CEO, Itron

[1] Nearly 1 in 3 Americans experienced a weather disaster this summer, Washington Post, Sept. 4, 2021
[2] Electric car sales this year resist Covid-19's blow to global car market, IEA.org, June 15, 2020
[3] Reimagining the grid, Southern California Edison, December 2020

ABOUT THIS STUDY

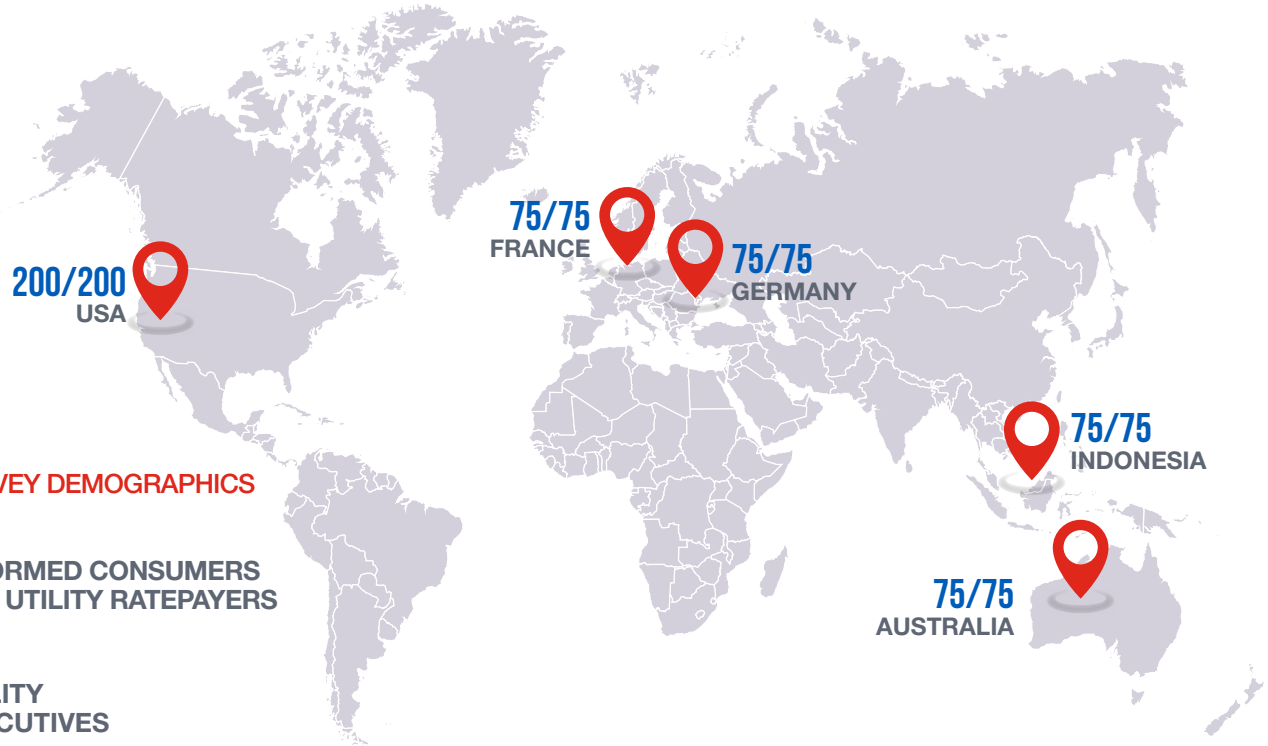
This report spotlights concerns about multiple converging impacts on the resiliency and reliability of the grid. It builds on findings from surveys conducted for the 2018 Itron Resourcefulness Report and the subsequent 2019 Resourcefulness Insight Report focusing on disaster preparedness. Inspired by findings from these surveys, Itron commissioned additional research to explore the topic further.

The report consolidates consumer and utility executive perceptions about forces that impact the grid and the ability of utilities to address them, as well as consumer intentions regarding adoption of renewable energy and electric vehicles. A total of 1,000 online surveys were completed by 500 consumers and 500 utility executives in June of 2021.

UTILITY EXECUTIVE RESPONDENTS were mid-level managers or higher who have input on decision making for energy and water utility operations in the United States, Australia, France, Germany and Indonesia. Their areas of responsibility include selling products, buying commodities, working in operations, strategic planning, customer service and administrative services.

CONSUMER RESPONDENTS who completed this survey are responsible for paying for utilities in their household, whose income averaged the equivalent of $50,000 USD annually. Respondents reported having a college degree or higher and were interested in current events, including news relating to city planning, construction, government, manufacturing and utility development.

The results of these surveys provide a unique view of what both groups think about emerging trends that are likely to impact the ability of utilities to provide reliable and resilient access to energy in the future.



SURVEY DEMOGRAPHICS

500
INFORMED CONSUMERS AND UTILITY RATEPAYERS

500
UTILITY EXECUTIVES

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

THE GRID IS EVOLVING FAST—BECAUSE IT MUST.

The direct and indirect consequences of climate disruption will profoundly shape the way power is delivered in the coming decade and beyond. The proliferation of electronic vehicles and renewable energy sources—along with increasingly frequent and costly disasters—have the potential to overwhelm an already stressed, aging grid.

UTILITY EXECS SEE A NEED TO UPGRADE THE GRID….

Aging infrastructure and integrating renewables are top concerns today. But in five years, accommodating EVs (especially ensuring capacity at charging stations) will be No. 1. Consumers are less concerned, possibly because they don't realize the impact these challenges can have on their customer experience.

…BUT THE PANDEMIC HAS DELAYED INVESTMENT.

The top barrier to upgrading the grid is slowing investment due to COVID-19.

DISASTERS ARE A BIGGER WORRY FOR UTILITIES.

Concern levels over disaster impacts are far higher among utilities (88%) than consumers (56%). This may reflect human tendencies to focus on imminent threats, and utility execs know they're responsible for grid resiliency and reliability, not consumers.

RENEWABLES ARE IN THE MIX, AND GROWING.

Distributed energy resources (DERs) will power more energy five years from now, which makes the challenges of accommodating two-way power flow a chief concern for 86% of utility execs and a top investment priority for 87%.

EVs ARE A GROWING CONCERN, THOUGH MORE FOR UTILITIES THAN CONSUMERS.

Though execs are more confident in their grid's resiliency than consumers are, they also know firsthand the impact of EV charging on the grid. (Consumers generally aren't worried about EV impacts.) Curiously, the prospect of EV fleet charging, a likely significant stressor, doesn't register as a major concern for execs. This may simply reflect the lack of EV fleets on the road today.

VIEWS ARE CONSISTENT ACROSS COUNTRIES—EXCEPT FOR INDONESIA.

Opinions are largely uniform among utility execs and consumers, though both groups in Indonesia express higher concern levels and greater enthusiasm for EVs.

EXECUTIVE SUMMARY

A MODERNIZED GRID ANSWERS EVERY CONCERN.

Preparing for disasters, integrating DERs and accommodating EVs all benefit from the same thing: infrastructure upgrades. Collectively, upgrades can also help utilities meet environmental mandates. What's more, utility executives in all countries surveyed seem aligned on their investment priorities, with automated metering infrastructure (AMI) and distribution automation (DA) appearing at the top of everyone's list.

SOME INVESTMENTS ADDRESS MULTIPLE CHALLENGES.

If grid modernization is the answer to hardening the grid against these challenges, then certain investments will provide the best benefit, according to the survey results.

MORE INTELLIGENCE, MORE POSSIBILITIES.

Solutions that create a more intelligent and resilient grid will equip utilities for the challenges to come, while opening new opportunities for better service, better responsiveness and even new revenue streams.

The chart below summarizes those investments. By focusing on those upgrades first, utilities may well see the greatest ROI across the board.

TECHNOLOGY SOLUTIONS ARE HERE TODAY

Preparing for disasters, integrating DERs and accommodating EVs all benefit from the same thing: **infrastructure upgrades**. Based on survey responses, some investments can help solve more than one challenge with technology that exists today.

	DISASTERS	DERs	EVs
AMI	●	●	●
Distribution automation	●	●	●
Analytics/data analysis	●		○
Real-time monitoring	●	●	●
Edge intelligence	○	●	●
Consumer pricing programs		●	●
Sensors (temp, consumption, pressure, wind, pole, tilt, line)	●		
Outage detection/ management	●	●	
Voltage optimization		●	
Grid/battery storage		●	
Residential charging			●

● Listed by utility execs as a priority investment for addressing the use case indicated

○ Not listed by utilities as a priority investment, but likely to be helpful for this use case

INTRODUCTION

INTRODUCTION

AMID DISRUPTION FROM A CHANGING CLIMATE, THE CHANCE TO BUILD A BETTER GRID

UPGRADES ARE OVERDUE, AND THE NEED TO ACT IS GROWING URGENT.

"**The pace of change has never been this fast, and it will never be this slow again.**"
Justin Trudeau, Prime Minister of Canada, Davos World Economic Forum, 2018.

For a world reeling from non-stop disruption, Trudeau's message holds both a promise and a warning. It's a promise, because the fact that change is accelerating is undeniable, and those who can harness it will emerge stronger and more resilient.

It's a warning for everyone else.

Everything is riding on the grid. One problem with infrastructure is that, in developed nations especially, no one seems to appreciate it until it fails. Reliable energy, clean and plentiful water, always-on connectivity, and safe natural gas delivery amount to table stakes. No matter how difficult and expensive it may be to build and maintain this infrastructure, it's all taken for granted until the moment it's not available. But by that time, appreciation transforms into frustration, worry and fear.

That's because virtually every aspect of a society relies on infrastructure, and to a great extent, all infrastructure relies on the power grid. It simply cannot operate, or be properly maintained, without power. And this makes a reliable, resilient grid essential to a safe and sustainable way of life.

Why failure is not an option. That reliance on the fabric of power generation and transmission comes at a cost. When power fails, commerce grinds to a standstill, supply chains shut down, and essential services are crippled. A data center without power loses $8,851 per minute.[4] An hour of downtime can cost large manufacturers $5 million.[5] Retailers suffer costly spoilage, and healthcare providers scramble to care for patients.[6] It adds up fast. In 2021, the U.S. Department of Energy put the total cost of grid failures at between $28 billion and $169 billion annually.[7] That's only one country for one year.

Our response to climate disruption will define the future. But a force greater than humankind itself is putting the grid under more duress than it has ever known. The impacts of a changing climate, and the way we are working to mitigate those impacts, are all converging in one place. How we manage energy and water will play a critical role in addressing climate disruption. And how we equip the grid for those efforts will make every difference.

[4] Average Cost of a Data Center Outage, Data Center Frontier, Jan. 25, 2016
[5] S&C's 2018 State of Commercial & Industrial Power Reliability Report, S&C Electric with Frost & Sullivan, 2018
[6] A Day Without Power: Outage Costs for Businesses, bloomenergy.com, Oct. 8, 2019
[7] Infrastructure Report Card 2021: Energy, infrastructurereportcard.org

INTRODUCTION

This report examines these three converging impacts—the damage from natural disasters, the adoption of distributed energy resources (DERs)—and growing demand from electric vehicles (EVs)—which are profoundly influencing the grid today.

The three are inexorably intertwined. The first—disasters—is a result of a disrupted climate. We know disasters are happening, and will happen, yet they still feel unexpected when they occur. The other two—DERs and EVs—are both responses to climate disruption, and the challenges they present are inevitable and profound.

Their influence will only intensify in the years to come. What utilities and consumers do with that realization now will help determine how successfully we are able to navigate the coming decades.

HOW CLIMATE DISRUPTION IS SHAPING THE GRID

CAUSE

CLIMATE CHANGE
is contributing to rising temperatures and sea levels

RESULT

NATURAL DISASTERS
are growing more frequent and devastating due to climage change effects

RESPONSE

DERS
like WIND, SOLAR + HYDRO can cut 70% of energy sector emissions by 2050[i]

EVS
can help reduce transportation-related emissions 45%-77% by 2050[ii]

SOURCES: (i) climateaction.org (ii) nrdc.org

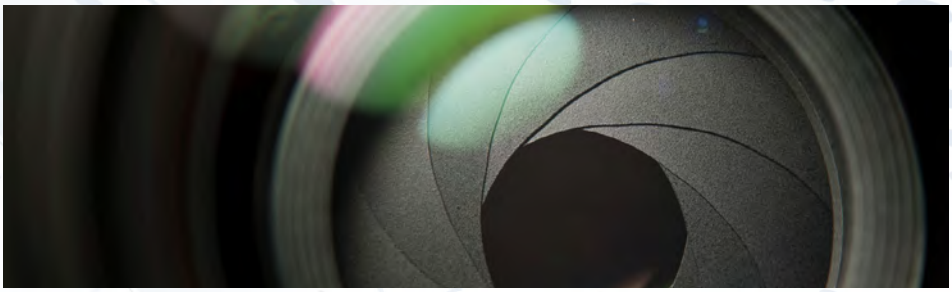
The following pages explore how these three trends are likely to define the future of the grid, and how they may impact investment strategies, technology priorities, and even the role consumers play in energy consumption and generation. They also show how upgrading the aging grid—already a top concern and priority for utility executives worldwide—can help address all of them.

PERSPECTIVES

TRACKING TOP CONCERNS

CHANGE IS DISRUPTIVE, AND UTILITIES KNOW IT

RENEWABLES, AN AGING GRID, EVs AND DISASTERS. TAKE YOUR PICK: THEY'RE ALL TOP CONCERNS.



Top concerns among utilities

Integrating renewables **23%**

Upgrading aging grid **22%**

Impact of EVs **21%**

Disaster response **21%**

Today's utility executives have change on their minds: changing trends in energy sources, changing modes of transportation and the changing nature of disasters. These all rank highly among concerns cited by utilities, with between 21% and 23% of respondents citing these factors as the "greatest challenges to the reliability and resiliency of the grid today." Just as many are worried about how an aging grid will be able keep up with that change, with 22% naming upgrading the grid infrastructure as the greatest challenge to reliability and resiliency.

They're all driven by change. It appears every concern represents an equally urgent imperative, since they're all the result of fundamental shifts in how energy is generated, delivered and consumed. As we will explore later in this report, three of the top concerns are responses to the manifestation of climate disruption, and the fourth—upgrading an aging grid—may hold the answer to addressing all of them.

TOMORROW'S CHALLENGES WILL SHIFT

In five years, accommodating EVs tops other concerns.

If handling demand from EVs and EV fleets is one of the top concerns among utilities today, it will be the top concern five years from now, with 24% expecting it to be the greatest challenge to grid resiliency and reliability. Execs still expect integrating renewables (19%), upgrading grid infrastructure (21%) and responding to natural and man-made disasters (20%) will continue to loom large as concerns.

Top challenges will change in five years—except in the United States. A country-by-country look at the top challenges now and in 2026 shows executives in many countries share similar concerns, with a greater focus on meeting EV demands five years from now. But among U.S. utilities, the chief concern remains constant today and in 2026: it's all about upgrading the aging grid.

UTILITIES AREN'T JUST MILDLY CONCERNED

THE RESULTS SHOW UNIVERSALLY HIGH LEVELS OF CONCERN OVER THESE GRID STRESSORS.

	TODAY	IN 5 YEARS
 UNITED STATES	Upgrading grid	Upgrading grid
 AUSTRALIA	Upgrading grid	Managing EV demand & upgrading grid
 FRANCE	Integrating renewables	Meeting EV demand
 GERMANY	Complying w/ carbon mandates	Meeting EV demand
 INDONESIA	Integrating renewables	Integrating renewables

Nearly nine out of 10 utility executives are extremely or very concerned about the three biggest challenges and their potential impact on the grid.

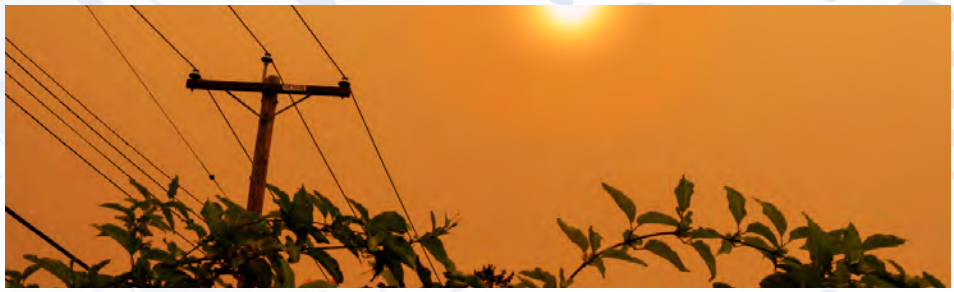
The prospective impact of disasters (88%), demand from EVs (85%) and integrating renewables (86%) all are the focus of significant levels of concern. Another concern to surface among execs: complying with environmental mandates (90%). No matter where you look, there are overwhelming expressions of concern for all of these challenges.

For consumers, renewable energy and a modern grid are priorities. During a rough 2021, they're understandably more concerned about disasters (20%) than the impact of EVs (16%). This may simply have to do with the direct and memorable effects that disastrous weather events have had on grid reliability—something consumers experience firsthand—than it does with the more abstract notion that more EVs will eventually impact the grid.

For now, consumers' top concerns are how their utilities will integrate renewables like wind and solar (29%), and upgrading grid infrastructure (24%). Both issues are topical, and whether consumers realize it or not, they are inexorably intertwined.

IS THE GRID READY FOR WHAT'S COMING?

UTILITIES SAY YES. CONSUMERS AREN'T AS CONVINCED.



After the historical and deadly failure of the Texas grid in February 2021, and the conclusion that above-ground power lines have caused more than 1,500 wildfires in recent years, it's natural to wonder if utility executives feel their piece of the grid is prepared for current and future challenges.

The answer is overwhelmingly yes. Across all utility industry respondents, better than eight in 10 say they're prepared to manage the emerging challenges of disasters, EVs and DERs. Confidence is highest in Germany, where 92% of execs say they're extremely or very prepared. Australia and France aren't far behind at 91%. Confidence in Indonesia meets the overall average—84%. U.S. executives, perhaps chastened by the troubles of recent years and concerned over what's to come (see sidebar), drop to 78%. In the United States, one of five executives say their grid is somewhat prepared (19%) or not at all (3%.)

Only 47% of consumers overall say their utility is extremely/very prepared for these challenges

Consumers aren't as optimistic. Significant differences emerge geographically. In Australia, just 21% of consumers are as confident as their utilities, which may be one reason why Australia announced a $1 billion Grid Reliability Fund in 2019.[8] Utilities in France (41%) and the U.S. (44%) are rated roughly 2X better. Consumer confidence is highest in Germany (64%) and Indonesia (68%).

That utility executives would be more confident in their preparedness than consumers isn't entirely surprising. No one can expect consumers to fully understand or appreciate what it takes to equip, operate and maintain an electrical grid. And recent grid troubles may have shaken consumer confidence in the preparedness of utilities.

Both groups seem to realize change is coming.

[8] Grid Reliability Fund, energy.gov.au

CONFIDENT, YET CONCERNED

UTILITY EXECS GRAPPLE WITH THE PROSPECT OF AN UNPREDICTABLE FUTURE.

It's an interesting dichotomy: On one hand, more than eight of 10 utility executives say they're extremely or very prepared to manage future grid impacts. But roughly the same percentage of execs also express overwhelming concern about the forces that are likely to define the future of the grid, from integrating renewables and accommodating EVs to natural and man-made disasters.

Utility execs have rightly identified these emerging disruptors as potentially formidable threats to a resilient and reliable grid. And while it's heartening to know they feel prepared today, they clearly see the potential for trouble on the horizon.

Some impacts are more predictable than others. Perhaps one reason for their concern is that the impacts of these emerging grid stressors are yet to be fully realized. Forecasts are useful in determining the uptake rate of both EVs and renewables, but disasters are much harder to predict with certainty. And unlike gradually increasing EV adoption or rooftop solar use, disasters hit swiftly and bring with them immediate capital costs. Another potential factor: Utilities likely recognize that when the grid fails, the buck often stops with them.

So it makes sense that even if executives are feeling prepared today, they acknowledge that they can't rely on today's grid for years to come. Which further explains why another concern ranks for utilities as both a chief challenge and a priority: *upgrading their aging grid*.

84% OF UTILITY EXECS SAY THEY'RE EXTREMELY/VERY PREPARED FOR CHALLENGES

BUT THEY'RE STILL CONCERNED ABOUT IMPACTS TO THE GRID

85% Extremely/very concerned about EVs	**86%** Extremely/very concerned about Integrating Renewables	**88%** Extremely/very concerned about More Frequent Disasters	**90%** Extremely/very concerned about Meeting Environmenal Mandates

DISASTERS

CONVERGING IMPACTS

CONVERGING IMPACTS: DISASTERS

IS CATASTROPHIC FAILURE JUST ONE DISASTER AWAY?

THE EFFECTS OF CLIMATE DISRUPTION CONTINUE TO TEACH US THAT THE GRID IS VULNERABLE.

ARE WE LISTENING? There's no other way to say it: Disasters just keep getting worse. Hurricane Harvey, a record-setting superstorm that battered the Gulf Coast for two merciless weeks and caused $125 billion in damage,[9] seemed to set a new bar for natural disasters in 2017.

Yet since then, it's almost as if nature has viewed that bar as a kind of goal to beat. In the past three years, so many devastating storms, blizzards, wildfires, heatwaves, floods and deep freezes have accumulated in the record books, virtually everywhere in the world, that tallying their impacts is a full-time job.[10]

JUST AMONG THE COUNTRIES WE SURVEYED, 2021 IS ALREADY SHAPING UP TO BE A DIFFICULT YEAR.

In March, **Australia** was beset with a once-in-a-100-year flood,[11] which followed historic brush fires.

In just the first three weeks of 2021, **Indonesia** recorded 185 natural disasters, most of which involved floods, hurricanes and landslides.[12] Since then, the country has seen earthquakes, forest fires and even volcanic eruptions.[13]

In **France**, some 235,000 insurance claims resulted from nearly two weeks of devastating storms and floods in June, representing an estimated total of $650 million (USD) in losses.[14]

A 500-year storm hit **Germany** and its neighbors in July, delivering a month's worth of rain in a single day, destroying extensive infrastructure and killing 167 people. A new study found that climate change made the floods up to nine times more likely to occur.[15]

9 2019 Itron Resourcefulness Insight Report: Disaster Preparedness
10 Billion-Dollar Weather and Climate Disasters: Overview, National Oceanic and Atmospheric Association
11 Center for Disaster Philanthropy, Australian Flooding, March 23, 2021
12 Indonesia's latest natural disasters are a 'wake-up call', environmentalists say, abc.net.au, Jan. 21, 2021
13 Indonesia's Most Volatile Volcano Mount Merapi Erupts, Forbes, Aug. 8, 2021
14 France's storms of June 2021: loss estimate, Atlas Magazine, July 9, 2021
15 Heavy rainfall which led to severe flooding in Western Europe made more likely by climate change, worldweatherattribution.org, Aug. 23, 2021

CONVERGING IMPACTS: DISASTERS

FUELED BY CLIMATE DISRUPTION, NATURE IS RAGING

In western regions of the **United States**, crews were battling more than 6,900 wildfires as of Aug. 30,[16] and rolling blackouts have become increasingly common.[17] The fires are fueled in part by a historic drought and several weeks of "heat dome" temperatures in the Pacific northwest—heat so extraordinary that Lytton, British Columbia, reached a high temperature of 49.6 °C (121.3 °F),[18] hotter than any temperature ever recorded in Canada, Europe[19] or South America.[20] In addition to hundreds of deaths, the extreme heat had unthinkable consequences for the grid, even causing power lines to melt.[21]

Complicating matters for community leaders, utilities and consumers is new research that suggests rising temperatures may be making storms intensify more quickly, which in turn makes it harder for communities in their paths to respond in time.[22] Hurricane Ida, which arrived in New Orleans on Aug. 29, 2021, the 16th anniversary of Hurricane Katrina, is a recent example. Damage to the energy infrastructure in Louisiana was so severe that one report describes a "shattered grid,"[23] and more than 1 million people were left without power or water for days, prompting New Orleans authorities to coordinate evacuations nearly a week after the storm because they feared survivors would perish without access to air conditioning and clean water.[24] Ida wasn't finished: Two days and 1,000 miles after leaving New Orleans, the storm flooded New York City subways and drowned residents in their basement apartments.[25]

16 CalFire Current Year Statistics, as of Aug. 30, 2021
17 Why California Keeps Having Blackouts, The Wall Street Journal, Aug. 23, 2020
18 US-Canada heatwave: Visual guide to the causes, bbc.com, July 2, 2021
19 'Hard to comprehend': Experts react to record 121 degrees in Canada, Washington Post, June 30, 2021
20 Literally hotter than the Sahara: How Western Canada became one of the hottest corners of the globe, nationalpost.com, July 2, 2021
21 PHOTOS: The Record-Breaking Heat Wave That's Scorching The Pacific Northwest, NPR, June 29, 2021
22 We're Hitting the Limits of Hurricane Preparedness, The Atlantic, Aug. 29, 2021
23 Ida left more than 1 million without power, possibly for weeks. And now comes the scorching heat, CNN.com, Aug. 31, 2021
24 New Orleans begins evacuating residents amid outages as power could come back on in coming days, Washington Post, Sept. 3, 2021
25 How the Storm Turned Basement Apartments Into Death Traps, The New York Times, Sept. 2, 2021

CONVERGING IMPACTS: DISASTERS

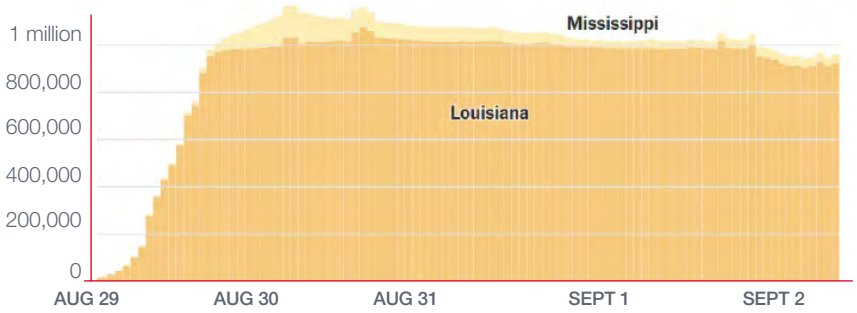
THE TEXAS SNOWPOCALYPSE

Recent electric grid failures have shown that **disasters aren't just a warm weather phenomenon**

In Texas, a gravely expensive lesson. But as the epic failure of the Texas electric grid in February 2021 shows, disasters aren't just a warm weather phenomenon. They can happen anywhere and at any time, appear suddenly, and expose vulnerabilities in power transmission and delivery that previously were too easily overlooked. Worse, they can come at a terrible cost. The crippled Texas grid, which failed at the moment the state saw some of the coldest days in recorded history, left 4.5 million Texans without heat,[26] costing as many as 700 lives and leaving economic damages of up to $129 billion.[27] The catastrophe showed that failure points abound in the Texas grid—from power generators that weren't properly winterized to a lack of incentives for utilities to invest in upgrades—and that the difficult lessons Texas learned can be useful to operators of grids all over the world, even those in warm weather climates.

It shows, too, how a conclusion drawn in the 2019 edition of this report on disaster preparedness seems to prove itself correct over and over: "*We can no longer plan for future worst-case scenarios based on past worst-case scenarios*." It has become grimly evident that the severity—and even the unpredictability—of disasters is escalating.

NUMBER OF CUSTOMERS WITHOUT POWER BY HOUR



The New York Times. Source: PowerOutage.org

[26] The Texas Blackout Is the Story of a Disaster Foretold, Texas Monthly, Feb. 21, 2021
[27] Texas regulators want to prepare the state's electricity grid for extreme weather. But that's a moving target in a warming world., The Texas Tribune, Aug. 16, 2021

CONVERGING IMPACTS: DISASTERS

UTILITIES ARE FAR MORE CONCERNED ABOUT DISASTERS THAN CONSUMERS

THE RESULTS SHOW A 2X DIFFERENCE, BUT IT'S HARD TO KNOW WHY.

88% of utility executives surveyed are extremely or very concerned with the impact of disasters on the grid

Most people have a hard time **worrying about something that isn't imminent**

Nearly nine out of 10 utility executives (88%) surveyed are extremely or very concerned with the impact of disasters on the grid. Concern is highest among execs in France (97%), which was battered this summer by historic flooding,[28] with two months of rain falling in just two days. Germany (93%) saw devastating floods as well, and its concern ratings are nearly as high.

But consumers express far less concern—just 56% overall. And once outlier Indonesia (at 89%) is removed from the mix, the average falls to just 46%. In fact in France, one in four consumers say they're slightly or not at all concerned about the impacts of disasters on the grid.

Indonesia, once again, stands out. Both utilities (at 93%) and consumers (89%) surveyed express the highest levels of concern. Perhaps both groups are aligned because Indonesia had seen 137 natural disasters, including earthquakes, forest fires and tornadoes, in June 2021 alone.[29] And consumers there may believe their island home is particularly susceptible to rising sea levels and the effects of climate disruption on natural disasters. In any case, both groups are almost equally concerned.

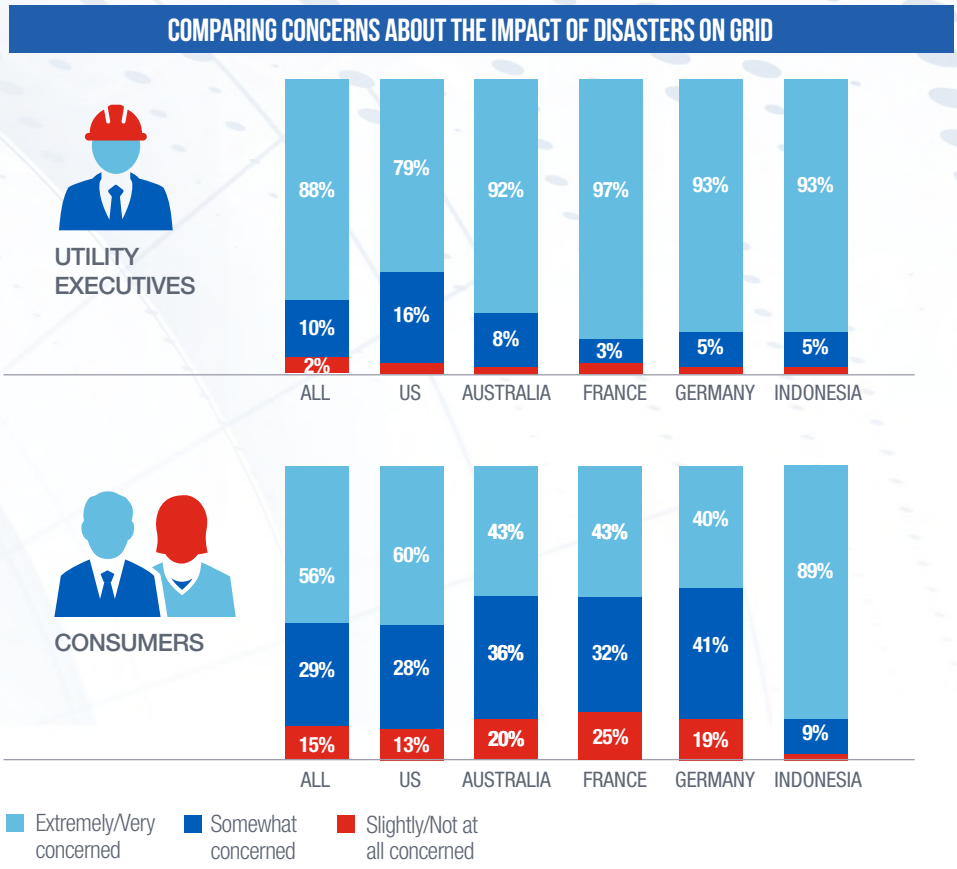
So why is concern so much lower among consumers? Studies show most people have a hard time worrying about something that isn't imminent.[30] And as our research from 2019 revealed, 87% of consumers said they'd been impacted in some way by a natural disaster in the previous five years.[31] Perhaps making it through a disaster (relatively) unscathed has conditioned them not to worry, instead putting their trust in utilities and first responders to prepare for, respond to, and recover from the next wildfire, flood, storm or earthquake.

It may simply be that utility executives recognize that when a disaster hits, they're on point to deal with a multidimensional crisis. And they are likely very aware that citizens, regulators and media will judge them by how well they manage that crisis. Follow-on studies will reveal shortcomings in their preparation, and holes in their response networks. If you're a utility, once the disaster is past, the fallout lingers. And a failing grid is hard to hide.

[28] Belgium, Netherlands and France also hit by deadly flooding, dw.com, July 15, 2021
[29] Indonesia – Over 70 Floods and Landslides Recorded in June 2021, Says Disaster Agency, FloodList, July 8, 2021
[30] Why You Don't Really Care About the Next 'Big One', Bloomberg CityLab, July 21, 2015
[31] Disaster Preparedness: 2019 Itron Resourcefulness Insight Report

CONVERGING IMPACTS: DISASTERS

UTILITY VS. CONSUMER CONCERN ABOUT DISASTER IMPACTS ON GRID



For more details on utility and consumer perceptions regarding disasters and how they impact the reliability and resilience of the grid, download ***Disaster Preparedness, the 2019 Edition of the Itron Resourcefulness Insight Report****.*

CONVERGING IMPACTS: DISASTERS

IS THE ENERGY-WATER NEXUS AT A BOILING POINT?

As violent storms drenched the Australian state of Victoria in June 2021, residents who had already been without power for days received an urgent warning from local water authorities: **Don't drink the water, even if you boil it.**[32]

Disasters often knock out power, which can be serious enough. But power failures can also threaten the ability of utilities to deliver safe, clean water—which is essential to sustaining human life.

It's just one way energy and water are intertwined. But the relationship between the two is even more fundamental than what most consumers may realize.

Can't have one without the other. The United States offers as good a case study as any. Utilities in the U.S. require water—lots of it—to deliver 92% of all the electricity they generate.[33] So thirsty is energy generation and delivery that consumers use more water to power their light switches and outlets than for taps, shower heads and toilets.[34] At the same time, providing a safe, reliable supply of water requires a lot of power.

That's the energy-water nexus: Ttwo essential needs that can't live without each other. But they can do a better job of coexisting.

Constraining...and liberating. Electricity generation needs water for hydropower production and as a coolant for thermoelectric power. Water generation requires energy to transport, treat, heat and repurpose. This relationship can be both mutually constraining and liberating: A strain on one leads to a strain on the other, but conserving one conserves the other.

[32] Victoria's Wild Storms Show How Easily Disasters Can Threaten Our Water Supply, PreventionWeb.net, June 21, 2021
[33] Planning for sustained water-electricity resilience over the U.S.: Persistence of current water-electricity operations and long-term transformative plans, Science Direct, Water Security, Volume 7, August 2019, 100035
[34] The Water-Energy Nexus in Texas, Margaret A. Cook, Webber Energy Group, Nov. 17, 2016

CONVERGING IMPACTS: DISASTERS

POWER AND WATER NEED EACH OTHER. MODERNIZING THE GRID WILL REDUCE STRESS ON BOTH SIDES

Population booms, emerging affluence, climate disruption and public policies are stressing the nexus. Analysis performed in 2019 explored a new modeling approach that for the first time, accounted for future climate conditions and water scarcity. Using this model, researchers determined that an additional 5.3% to 12% of power-generating capacity will be needed to meet future demands and reliability requirements.[35]

Renewables offer an answer. Improvements on both sides—upgrades that make for a smarter, more sustainable and more resilient grid and a more efficient and intelligent water delivery infrastructure—will improve the picture vastly.

> Researchers have found that using the right approach, developing regions can deliver water to once water-scarce areas. "There is a delicate balance between energy and water resources," write energy-water nexus pioneers Dr. Michael Webber and Dr. Kelly Sanders in an article in Earth Magazine. "Large water infrastructure projects bring water to people who might not otherwise have it, but they also stress the energy infrastructure and impact efforts to move toward alternative sources. However, conservation, reclaimed water projects, and desalination powered with renewable energy could achieve energy, water and climate objectives, simultaneously."[36] A prime example? Saudi Arabia's solar-powered desalination plant, the world's largest.[37]

Other recent research corroborates Weber's and Sanders's assertions, noting that solar and wind power require just 1% to 2% of the water needed to generate electricity from coal and natural gas.[38] In a world moving toward renewable energy, the nexus may be safe after all.

[35] Grid reliability under climate change may require more power generation capacity, Science Daily, Nov. 21, 2019
[36] The energy-water nexus: Managing water in an energy-constrained world, earthmagazine.org, June 13, 2013
[37] Water in Saudi Arabia: Desalination, Wastewater, and Privatization, US-Saudi Business Council, Jan. 7, 2021
[38] The progressive water savings from switching to renewable energy, Anthropocene Magazine, Daily Science, Oct. 29, 2019

DISTRIBUTED ENERGY RESOURCES

CONVERGING IMPACTS

CONVERGING IMPACTS: DISTRIBUTED ENERGY RESOURCES

RENEWABLES ARE HERE TO STAY

BY 2045, DERs WILL GENERATE HALF THE WORLD'S ENERGY. TIME TO GET READY.

Countries everywhere are working to **achieve carbon neutrality**, and two are already carbon negative.

With 137 countries worldwide addressing climate disruption by committing to carbon neutrality targets, renewables like solar, wind, geothermal and hydropower are lynchpins in the global effort to reduce CO2 emissions.[39] Leading the race to go carbon neutral are Bhutan and Suriname—they're now actually carbon negative—with Uruguay aiming to get there by 2030, and Finland, Austria, Iceland, Germany and Sweden all targeting 2045 or sooner.[40] By then, nearly half (45%) of the world's electricity is expected to be generated by renewables of all kinds, but especially hydropower, wind power and solar.[41]

Scientists and world leaders see carbon neutrality as the best hope for stemming the destructive tide of climate disruption and its existential threat to nature, national security and even humankind itself.[42]

Like it or not, renewables are, as a Zpryme report recently noted, "a genie we can't put back in the bottle."[43]

For utilities, a growing challenge. If grid reliability and resilience are the goals of every utility, integration of these distributed energy resources (DERs) has frequently been seen more as an obstacle than an enabler. By changing the direction of power flow, DERs can add complexity and variability that traditional, centralized energy distribution networks have managed to avoid for more than a century.

Navigant Research has called the integration of renewable energy "one of the most disruptive factors affecting the grid of today and the future."[44] A Zpryme survey bears this out. Utility execs specifically worry that adding renewables to the grid will lead to a host of problems, with power quality the No. 1 concern followed by backfeed, voltage surges, voltage sag and customer experience.[45]

[39] Race to Net Zero: Carbon Neutral Goals by Country, visualcapitalist.com, June 8, 2021
[40] Ibid.
[41] Renewable Energy, Center for Climate and Energy Solutions
[42] John Kerry Says Climate Change Is An 'Existential' Crisis, npr.org, April 23, 2021
[43] Managing the Growing Renewables Crisis, Zpryme, April 8, 2021
[44] DERs and DERMS platforms take center stage in grid transformation, UtilityDive.com, May 14, 2019
[45] Managing the Growing Renewables Crisis, Zpryme, April 8, 2021

CONVERGING IMPACTS: DISTRIBUTED ENERGY RESOURCES

THOSE WHO MANAGE THE GRID KNOW WHAT'S COMING.[46]

59% of utilities already were using **customer-generated power** as part of an integrated resource plan

Power quality is a top concern because solar and batteries are inverter-based devices, which could lead to the voltage distortions that, left unaddressed, can shorten the life of the grid. Transmission and distribution systems will need to handle more variable power supplies, which could threaten grid reliability and resilience. And since most renewable resources will be located far from customers, transmitting DER-generated power to urban load centers will require investment in new lines and new technologies.

Beyond lower emissions. Yet as more DERs become part of the grid, utilities are observing benefits that extend beyond the primary goal of reducing greenhouse gas emissions. Many are seeing improved consumer-level resiliency, lower system losses and reduced demand charges.[47]

Those benefits are more easily realized when utilities deploy distributed intelligence strategies and other technologies that give them greater control and insight over DERs. A 2020 survey from Zpryme and Itron found that 59% of utilities already were using customer-generated power as part of an integrated resource plan—and making use of a modern grid allows them to add value to the customer experience, from outage notification and management to load disaggregation and proactively identifying electrical issues on the customer side of the meter.[48]

A more resilient grid. The very nature of DERs also tends to require more widespread distribution of power generation and transmission. On one hand, that's a challenge for grid operators. On the other, it's a potential advantage, because it can make them less prone to large-scale failure when disasters strike.[49]

In the following pages, we'll look at how utilities and consumers view renewables, and what those perceptions could mean for the grid of tomorrow.

[46] Reimagining the grid, Southern California Edison, December 2020
[47] Challenges and Solutions of Renewable DER Integration, T&D World, March 31, 2020
[48] Are Customers Ready to Leverage Distributed Intelligence?, Industry Insights, Itron.com, Dec. 8, 2020
[49] Research and analysis into the benefits of renewables, International Renewable Energy Agency

CONVERGING IMPACTS: DISTRIBUTED ENERGY RESOURCES

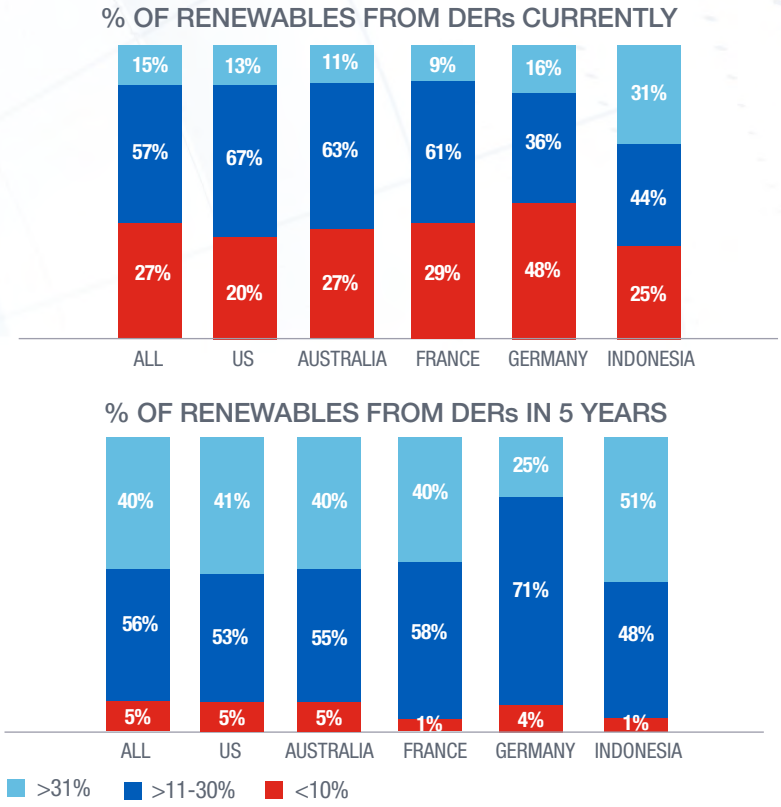
RENEWABLES ARE IN THE MIX

LOOK FOR MORE USE OF DERs IN THE FUTURE.

For 15% of utilities in our survey, renewable energy from DERs makes up more than a third of the energy mix. Another 57% report that renewables are responsible for 11% to 30% of their energy sources. In five years, the percentage of utilities deriving a third or more of their energy from renewables is expected to grow to 40% overall, increasing in every country we surveyed.

Indonesia remains an outlier. Its top-level renewables mix is expected to grow from 31% today to 51% in five years—well ahead of the other four countries.

SURVEY RESULTS: PERCENT OF RENEWABLES IN ENERGY MIX FROM DERs



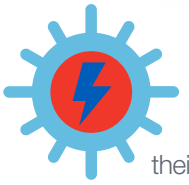
CONVERGING IMPACTS: DISTRIBUTED ENERGY RESOURCES

CONSUMERS ARE ON BOARD

MORE THAN A QUARTER OF THOSE WE SURVEYED GENERATE THEIR OWN ELECTRICITY.

If utility executives want an indication of where renewables are headed, they need only look at their customers. Of the consumers we surveyed, 26% say they generate their own electricity. Among our sample of college-educated, informed consumers, customer-generated energy participation is highest in Indonesia (37%) and Australia (35%), and lowest in France (16%).

Battery storage is popular. Among consumers who generate their own electricity, 67% say they have battery storage. For the 95% of residential solar systems that are grid-tied, this gives consumers a way to store for later use any excess electricity that isn't sent back to the grid and offers a hedge against grid failures.[50]



Of consumers generating their own electricity, **76% are interested in selling it back to the grid**. 7% already do.

WHAT'S PREVENTING MORE CONSUMERS FROM GOING SOLAR?

80% say they'd generate their own electricity if obstacles disappear.

Despite the cost of solar panels dropping by 20% over the past five years, consumers still name it as their top barrier to generating their own electricity. (It's not hard to understand why one in four cite cost as a barrier: In the United States, installing a 10 kilowatt panel system costs $20,424 on average, after federal tax credits.[51] That's more than twice the cost of a new roof.[52]) Citing another barrier closely related to cost, another 14% say there's not enough ROI from solar. Others note they simply don't know how to go about it or don't have time to research it. This likely tends to funnel adoption toward committed early adopters.

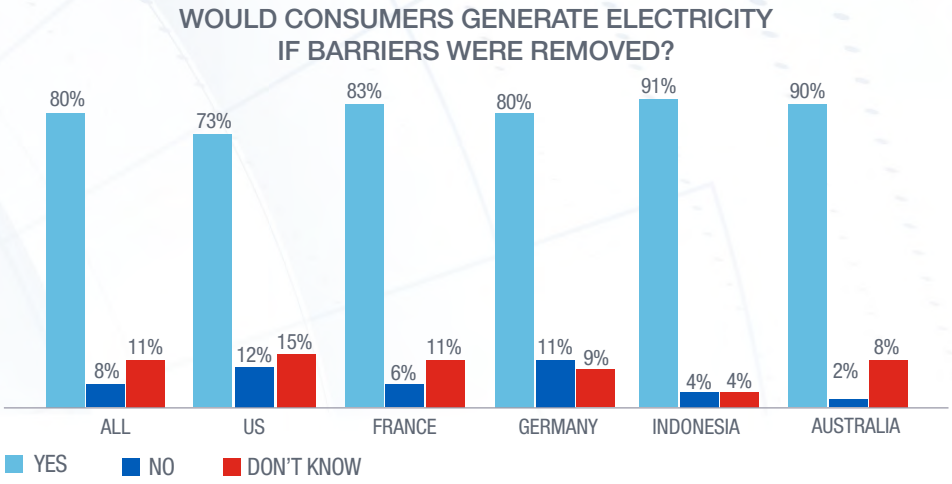
But remove those obstacles, and four out of five consumers are on board. The biggest resistance is in the United States; the least in Australia and Indonesia.

[50] Solar Systems: Grid-Tied vs. Battery Backup, suncityenergy.com, June 23, 2021
[51] The cost of solar panels in 2021: what price for solar can you expect?, energysage.com, July 2021
[52] How much does a roof replacement cost?, forbes.com, June 15, 2021

CONVERGING IMPACTS: DISTRIBUTED ENERGY RESOURCES

FOR UTILITIES, AN OPPORTUNITY

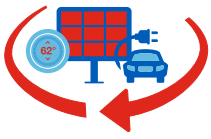
Solar doesn't have to represent only headaches for utilities. It can also bring new business models. Supporting solar can create a new kind of relationship with customers in which utilities can offer value-added services, such as EV charging or smart thermostats. Some utilities are even investing in solar distribution businesses, and others see benefit from consumers taking more control over and care with their energy use.[53] The thinking: As consumers generate more of their own power, new opportunities are certain to arise for innovative energy providers.



AS DER INTEGRATION GROWS, SO DO CONCERNS

Utilities aren't blind to the challenges.

Integrating more DERs into the energy mix has left 86% of utility executives across our survey sample **extremely or very concerned**



The prospect of integrating more DERs into the energy mix has left 86% of utility executives across our survey sample extremely or very concerned. Concern levels are relatively consistent (ranging from 91% to 95%) in Australia, France, Germany and Indonesia.

U.S. execs aren't quite as concerned. But only 77% of U.S. execs are similarly concerned, and nearly one out of five (19%) say they're only somewhat concerned. Do utilities in the United States have a better DER integration plan? Or are they simply so focused on grid upgrades aimed at improving grid resiliency that they assume many DER challenges will work themselves out?

One reason may be that U.S. utilities trail behind other countries in terms of concerns about meeting environmental mandates. 84% of U.S. execs are extremely or very concerned about meeting mandates, compared to Indonesia and Germany (95%), France (93%) and Australia (92%).

[53] Are utilities missing the rooftop solar opportunity?, utilitydive.com, Jan. 6, 2014

ELECTRIC VEHICLES (EVs)

CONVERGING IMPACTS

CONVERGING IMPACTS: ELECTRIC VEHICLES

THE REVOLUTION WILL BE ELECTRIFIED

EVS ARE COMING... FAST.

In 2021, Ford unveiled the F-150 Lightning, an all-electric version of America's best-selling pickup, and the outlook for EV adoption shifted into overdrive. Here was a set of wheels even non-EV fans could see themselves driving—a working truck that happens to run on a battery. (And in an intriguing twist, the F-150 Lightning not only gets its juice from the grid, but also helps owners when the grid fails: In outages, the truck can serve as a generator to power a home for up to 10 days.)[54]

The EV market in America and beyond would have taken off without the F-150 Lightning, but an iconic gas-guzzler going electric sent a message to drivers everywhere: Buckle up.

Here they come. EVs are one of the latest innovations in the global effort to reduce carbon emissions. Studies suggest EVs can eliminate as much as 77% of transportation-related CO2 emissions by 2040, assuming adoption occurs as swiftly as predicted.[55]

[54] 2022 Ford F-150 Lightning, ford.com
[55] Study: Electric Vehicles Can Dramatically Reduce Carbon Pollution from Transportation, and Improve Air Quality, nrdc.org, Sept. 17, 2015

CONVERGING IMPACTS: ELECTRIC VEHICLES

BY ALL ACCOUNTS, EVs ARE ON THEIR WAY

More than 500 EV models will be available worldwide by 2022

90% of fleet managers believe **electrification is "inevitable."**

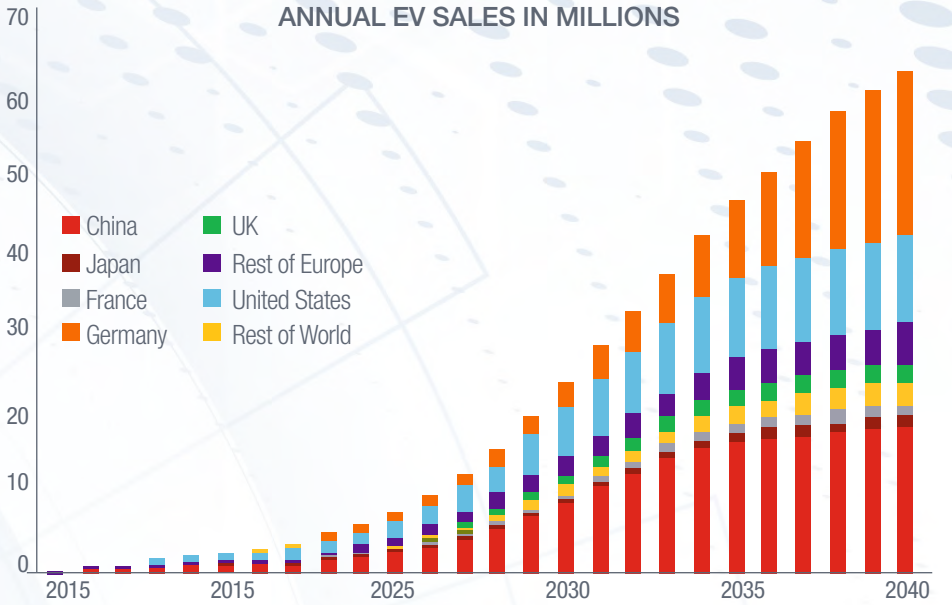
Even though America lags behind other regions in terms of EV sales growth,[56] the tide has turned and appears to be unstoppable.

- Global EV sales grew 43% in 2020, and though more than 3 million EVs were sold in 2020, within seven years the global EV market is expected to reach 233.9 million units.[57]
- By 2022, more than 500 EV models will be available worldwide.
- By 2025, every new Jaguar will be electric,[58] and by then four out of 10 General Motors vehicle models will be battery powered; by 2035, GM will sell only zero-emission vehicles—with virtually all automakers, including global competitors Volkswagen, Honda and others, accelerating their switch to selling only EVs.[59]
- More than 20 million EVs are expected in California by 2045, which to the grid in the Golden State will feel like adding an entirely new city twice the size of Los Angeles.[60]
- A recent study revealed fleet vehicle managers are actively electrifying their fleets, with most planning to buy EVs when it's time to replace service vehicles.[61] Another study found 90% of fleet managers believe electrification is "inevitable."[62]

[56] Today's electric vehicle market: Slow growth in U.S., faster in China, Europe, pewresearch.org, June 7, 2021
[57] Electric Vehicle (EV) Market by Vehicle Type (Passenger Vehicles, LCVs, HCVs, Two-wheelers, e-Scooters & Bikes), Propulsion Type (BEV, FCEV, PHEV, HEV), End Use (Private, Commercial, Industrial), Power Output, Charging Standard, and Geography - Global Forecast to 2027, Meticulous Research, April 2021
[58] Why electric cars will take over sooner than you think, bbc.com, June 1, 2021
[59] General Motors Pledges a Zero-Emissions Light-Duty Vehicle Fleet by 2035, greentechmedia.com, Jan. 28, 2021
[60] Reimagining the grid, Southern California Edison, December 2020
[61] Steep Climb Ahead: How Fleet Managers Can Prepare for the Coming Wave of Electrified Vehicles, rmi.org, 2021
[62] The Impact of Growing Fleet Electrification on Fleet Management, utilityproducts.com, July 2, 2021

CONVERGING IMPACTS: ELECTRIC VEHICLES

PROJECTED ANNUAL GLOBAL ELECTRIC VEHICLE SALES



Source: Bloomberg New Energy Finance, Katusa Research, U.S. Global Investors

More cars, more electricity. If every motorist in the United States switched to an electric passenger vehicle, utilities would have to find a way to generate 25% more electricity.[63] This is the inescapable calculus that utilities everywhere are facing. In the coming decade and beyond, as not only more electric passenger cars but also buses and trucks hit the road, the grid must increase its capacity by that much or more.

Challenges and opportunities. Like DERs, EVs present implications for utilities. The necessary grid upgrades could cost between $1,700 and $5,800 per EV—a cost that ultimately will be passed on to ratepayers, although those capital costs must still be incurred up front.[64] Baked into that expense, however, will be a host of improvements that will benefit an aging grid already struggling to meet today's demands:[65] New generation and transmission infrastructure, upgraded distribution networks, more accurate load forecasting, improved failover strategies, smarter load balancing, enhanced edge intelligence, and innovative, data-driven approaches to orchestrate EV and fleet charging at scale. These changes are also likely to present utilities with new revenue and service opportunities as societies become even more dependent on the grid than they are today.

[63] Electric Cars Are Coming, and Fast. Is the Nation's Grid Up to It?, The New York Times, Aug. 3, 2021
[64] The Costs of Revving Up the Grid for Electric Vehicles, bcg.com, Dec. 20, 2019
[65] The grid's big looming problem: Getting power to where it's needed, The Washington Post, June 29, 2021

CONVERGING IMPACTS: ELECTRIC VEHICLES

EVS ARE A TOP CONCERN FOR UTILITIES

EXECS APPEAR TO RECOGNIZE THE IMPACTS TO COME.

In the following pages, we'll look at what utilities and customers say about different aspects of EVs, and how they may change the course of grid infrastructure investment and management in the future.

Asked about the impacts that EV adoption may have on grid reliability and resiliency over the next five years, between 77% and 95% of utility executives surveyed express the highest levels of concern.

In the United States, three out of four executives surveyed say they're extremely or very concerned about EV impacts on the grid. Yet in European countries like France (91%) and Germany (85%), per capita adoption of plug-in vehicles is higher, so the need to address EV demands may seem more pressing there. (Plug-in EVs represented just 2% of overall new car sales in the United States in 2020, compared to 13.5% of new car sales in Germany, and 16% in France.)[66] Simply put, it's very possible that EVs are much more top of mind for European utilities at the moment.

What about Australia and Indonesia? Utility executives surveyed in Australia and Indonesia turned out the highest concern levels of all: 95%. But EV penetration in those countries is smaller, particularly in Australia where EVs were responsible for just .07% of vehicle sales in 2020.[67]

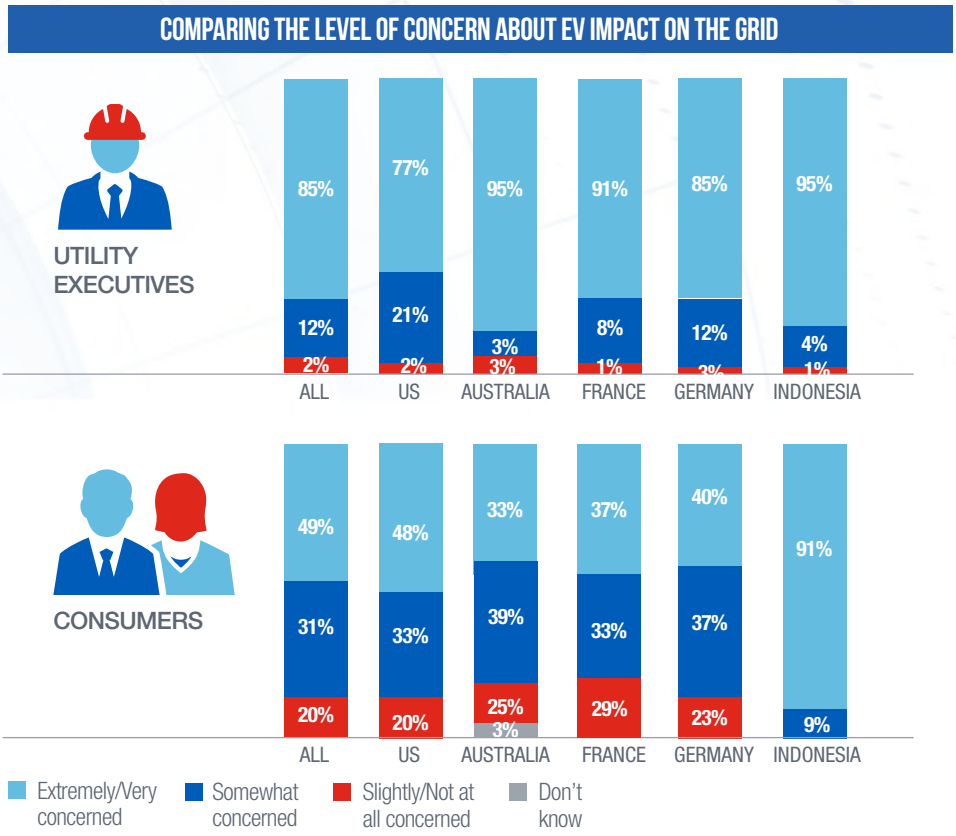
Indonesia is a different story. In 2019, just 24 electric passenger vehicles and 30 electric taxis were sold in the entire country. What is selling? Electric motorbikes—15,500 of them in 2019 alone, though these represent just 0.2% of all vehicles sold there that year.[68] But the concern expressed by utility executives clearly is aimed at future demand: Indonesian utilities are facing projections that their grid will need to support 250,000 new electric passenger cars a year by 2030, along with 1.9 million two-wheel electric bikes.[69]

[66] Today's electric vehicle market: Slow growth in U.S., faster in China, Europe, pewresearch.org, June 7, 2021
[67] How many electric cars are there in Australia?, carsguide.com.au, April 21, 2021
[68] Growth Opportunity Analysis of the Indonesian Electric Vehicle (EV) Market, 2019, Frost & Sullivan, September 2020
[69] Growing demand for electric vehicles a boost for Indonesia's economy, The Jakarta Post, May 28, 2021

CONVERGING IMPACTS: ELECTRIC VEHICLES

CONSUMERS EXPRESS LESS CONCERN

Just 49% of consumers say they're extremely or very **concerned about the impact EVs may have**



Consumers are far less concerned about the impact EVs may pose to the grid. Overall, just 49% of consumers in our survey say they're extremely or very concerned, though skewing that average is Indonesia, where 91% of consumers report highest levels of concern. Other countries show far less, between 33% in Australia and 48% in the United States. In Australia, France and Germany, roughly one out of four consumers say they're only slightly or not at all concerned.

CONVERGING IMPACTS: ELECTRIC VEHICLES

CONSUMERS HAVE YET TO SEE GRID IMPACTS OF EVs

EV ownership is still relatively rare, so it follows that most consumers likely haven't given the issue much thought. But 43% of consumers we surveyed say they are extremely or very likely to buy an EV in the next five years, primarily due to environmental impact (42%) and lower operating costs (25%). As EV adoption grows and scheduled charging or other measures may be enacted to balance demands on the grid, consumers may grow more concerned about how EVs are affecting the customer experience.

But what about Indonesia? The shift to EVs is part of a national carbon reduction strategy for this unique Southwest Asian island country, the world's fourth most populous.[70] An archipelago of 17,000 islands, Indonesia is home to a capital city larger in population than London, as well as uncontacted tribes in Papua. Perhaps awareness that PLN, the state-owned utility, will have to install 31,000 charging stations[71] to meet government goals makes consumers here more aware of challenges than in other countries. What's more, one study found Indonesian electricity users, especially in rural areas, thought the grid was less than reliable.[72] So even just the mention of new stressors may trigger concern.

Even though EVs didn't register as the top concern for utilities today, executives clearly expect charging passenger cars and fleet vehicles to have an impact at some point. Overall, 81% of execs expect charging electric vehicles of all types will have a significant or very large impact on the grid.

This seems like a no brainer, which is likely why ensuring adequate capacity at EV charging stations was the No. 1 cited challenge for preparing the grid for EVs. Next was prioritizing technology investments and upgrades to the distribution network.

But interestingly, managing fleet charging infrastructure and depots ranked sixth on the list, with just 10% of executives naming it the top challenge. Could they be missing something?

[70] Indonesia has set an ambitious target for electric vehicles: what factors can support the nation's shift to an electric-dominated transport sector?, Climate Works Australia, April 26, 2021
[71] Consumers' concerns hamper electric vehicle adoption in Indonesia: Experts, The Jakarta Post, Oct. 15, 2020
[72] Perceived and Reported Reliability of the Electricity Supply at Three Urban Locations in Indonesia, MDPI, Oct. 14, 2017

CONVERGING IMPACTS: ELECTRIC VEHICLES

UTILITIES NATURALLY SEE A BIG IMPACT FROM CHARGING
BUT ARE THEY THINKING ENOUGH ABOUT FLEETS?

As many as **8 million fleet vehicles** will be hooking up to the grid by 2030

Just like EVs themselves, plug-in fleets are still relatively new, but McKinsey expects as many as 8 million fleet vehicles will be hooking up to the grid by 2030.[73] Already major fleet operators, from Amazon, DHL and UPS to various national postal services and even IKEA, together have purchased or announced orders for hundreds of thousands of light-commercial vehicles such as vans and small trucks, as well as heavier-duty EVs such as buses and larger trucks.[74] As more electrified commercial vehicles become available, fleets of all sizes are likely to follow suit.

All this requires charging stations. In California alone, energy commissioners expect they'll have to add 157,000 chargers to accommodate medium- and heavy-duty buses and trucks by 2030. That's on top of the 1.2 million chargers they expect will be needed for passenger vehicles.[75]

They'll all be tapping an already stressed grid, and fleet charging stations will carry some unique requirements. Fleet vehicles, for instance, are often concentrated in fleet yards located near other fleet yards, which means charging them may require the possible addition of a substation built specifically to provide enough capacity to accommodate several fleets plugging in between shifts. Or utilities may have to create several centralized charging centers, some augmented by stored solar power to relieve stress on the larger grid. In some cases, the demands of fleet charging could be so significant that fleet operators may be incentivized to modify their operating schedules to accommodate in-route charging breaks during the work day, or even change their normal operating hours so their vehicles can charge at off-peak times.

When it comes to EV fleets, the considerations are many, even if utility execs aren't fully considering them—at least not yet.

[73] Charging electric-vehicle fleets: How to seize the emerging opportunity, mckinsey.com, Marc 10, 2020
[74] Global EV Outlook 2021, International Energy Agency, 2021
[75] Report Shows California Needs 1.2 Million Electric Vehicle Chargers by 2030, California Energy Commission, June 9, 2021

CONVERGING IMPACTS: ELECTRIC VEHICLES

WHO SHOUD BUILD PUBLIC CHARGING STATIONS?

UTILITIES? EV MAKERS? GOVERNMENT? THE ANSWER MAY BE 'ALL OF THE ABOVE.'

Everyone agrees that someone has to build the millions of charge points that must be installed to accommodate an electrified future. It's just hard to get agreement on who it should be.

It's not a trivial question. PwC estimates that installing just one fast-charging Level 3 or Level 4 outlet can cost up to $96,000.[76]

Most consumers say **utilities (58%)** and **EV manufacturers (57%)** should be responsible for **building charging stations**

Most consumers we surveyed say utilities (58%) and EV manufacturers (57%) should be responsible for building those stations, followed by state government (42%), federal government (38%) and fuel companies (34%). Consumers in the United States and Indonesia think it primarily should fall on EV manufacturers.

It turns out everyone may be right. Collaboration between several of these groups already is underway, with utilities and energy companies actively building a network of charging stations stretching 1,200 miles from Detroit to Colorado. General Motors is teaming up with partners, using funding from utilities, governments and private-public partnerships, to build hundreds of fast-charging stations. And retailers like Walmart are installing stations outside their stores, giving customers a chance to plug in while they shop.[77]

[76] The US needs a robust EV-charging infrastructure. Who will build it?, pwc.com, April 22, 2021
[77] Ibid.

CONVERGING IMPACTS: ELECTRIC VEHICLES

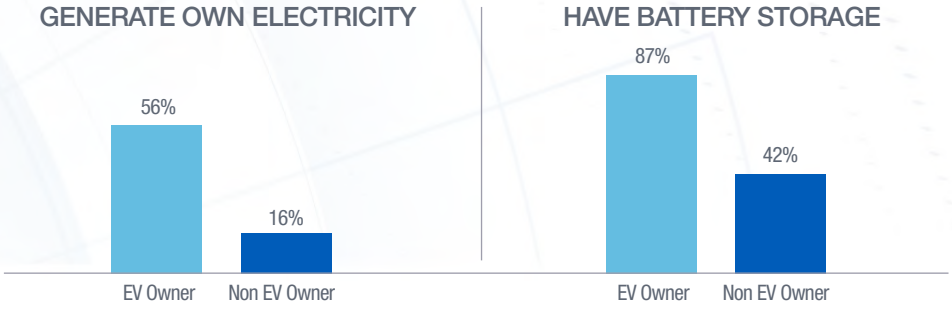
ARE EV OWNERS THE ENERGY CUSTOMERS OF THE FUTURE?

THEY MAY IMPACT THE GRID IN MORE WAYS THAN ONE.

EV owners may not just be the energy takers of tomorrow. They may also have something to give.

For this report, we looked at the number of consumers who own EVs and those who generate their own electricity, and an interesting correlation emerged: EV owners are 3.5 times more likely to generate their own electricity than people who don't own EVs. What's more, consumers who own an EV are twice as likely to have battery storage than non-EV owners.

This may signal an emerging kind of energy consumer: One who will grow increasingly dependent on the grid to charge their EVs, but who will also contribute to power generation, whether for their own use or to sell it back to the grid.



GAME PLAN

A MODERN GRID SOLVES EVERY IMPACT

THE GAME PLAN: A MODERN GRID SOLVES EVERY IMPACT

THE FUTURE LIES IN A MODERN GRID

EVERY CHALLENGE CAN BE ADDRESSED BY UPGRADING THE AGING GRID.

The confluence of challenges described in this report might at first seem disparate and disconnected, presenting unique problems that require unique and separate solutions. But in fact they're all linked, and not just by a warming climate.

They're linked by the fact that upgrading the aging grid, which is a top concern expressed by the utility executives we surveyed, can address all of these challenges. Every one of these major grid disruptors—disasters, DERs and EVs—can be addressed by modernizing the assets that make up the grid and the networks that connect those assets.

For utilities to ensure that the grid of the future is reliable and resilient, standing still is not an option.

UTILITIES WANT PROVEN SOLUTIONS—AND SOME GUIDANCE

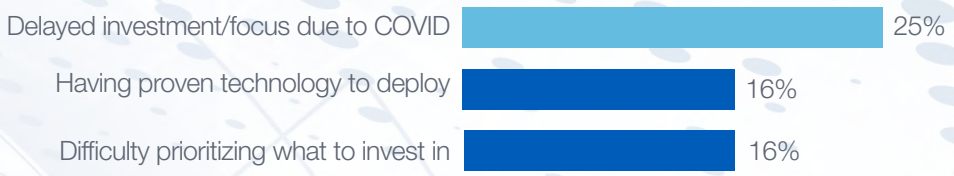
After pandemic-related delays, execs will be ready to upgrade.

Among the utility executives we surveyed, 25% say pandemic-related delays have been a top barrier to investing in grid upgrades. With increases in infrastructure spending, this barrier should recede.

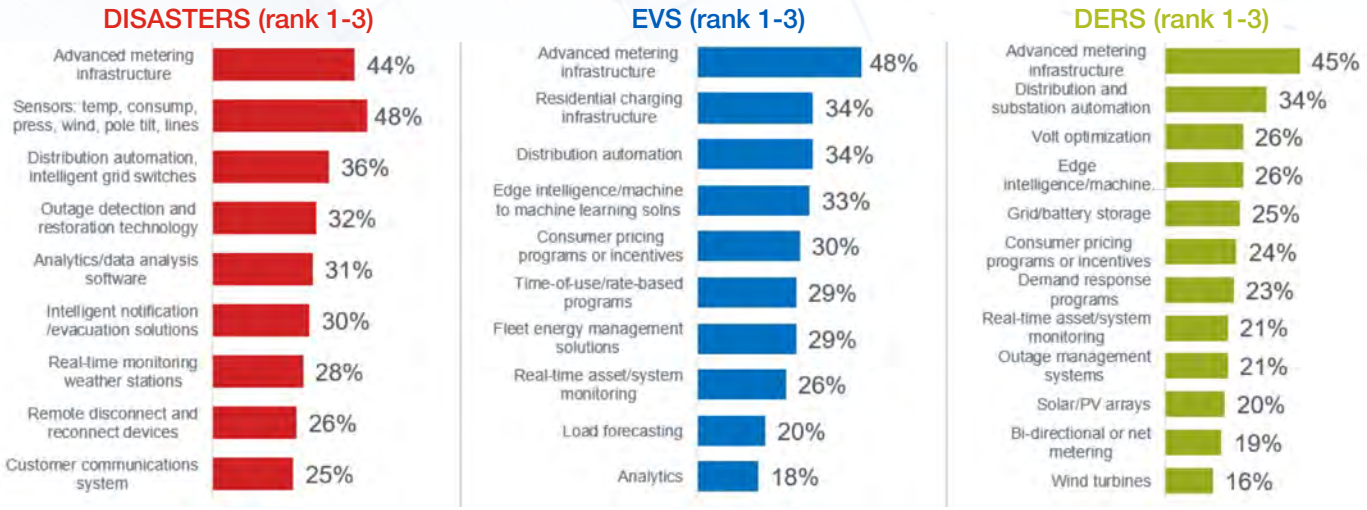
Getting to work. At that point, utilities are likely to focus on mitigating other top barriers to investment, including having proven technology to deploy and prioritizing what to invest in. And facing such a daunting array of challenges, one in 10 say they simply don't know where to start. The following pages are aimed at providing some helpful guidance.

THE GAME PLAN: A MODERN GRID SOLVES EVERY IMPACT

TOP THREE BARRIERS TO INVESTING IN GRID RESILIENCY AND RELIABILITY



INVESTMENT PRIORITIES OVER NEXT FIVE YEARS, GROUPED BY CHALLENGE



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INVESTMENT PRIORITIES FOCUS ON THE EDGE

AMI IS A TOP TECHNOLOGY NOW, AND WILL BE IN THE FUTURE.

Execs name AMI as their **No. 1 deployed technology**

Six out of every 10 meters currently in the field **unable to send critical data to the head end system**

For utilities worldwide, modernization will likely begin at the edge. Advanced metering infrastructure (AMI), for instance, is the top tech investment currently deployed overall among the utilities surveyed—and across all three key challenges addressed in this report. Execs name AMI as their No. 1 deployed technology for addressing EVs (48%), disasters (47%) and DERs (42%).

Five years from now, the picture looks much the same. AMI remains the top investment priority when utility execs are asked about EVs (48%) and DERs (45%), and is the No. 2 priority when preparing for disasters (44%).

Miles to go. It's promising that AMI remains a priority to help deal with the fallout and response to climate disruption. But utilities have a long way to go when it comes to driving intelligence to the edge, with nearly six out of every 10 meters currently in the field unable to send critical data to the head end system.[78] And many of those that have deployed smart meters haven't yet made use of the intelligence they provide. Investments in AMI technology today and in the future are likely to pay off in a reliable and resilient grid.

SOME SOLUTIONS WILL HELP PREPARE THE GRID FOR SPECIFIC CHALLENGES

Certain upgrades will have a targeted purpose.

Survey results show that utility executives have a pretty clear idea of what they need to address these emerging sources of disruption. And while many upgrades can benefit all three challenges (*see chart on page 47*), some are clearly intended to address specific needs.

- Sensor technology, for instance, will be crucial for **disaster preparedness and response**. So will outage detection and restoration technology, and intelligent notification and evacuation solutions.
- Similarly, execs preparing for the **demands of EVs** expect to prioritize residential charging infrastructure upgrades, consumer pricing programs or incentives, time-of-use programs and load forecasting.
- Managing the complexities of **DER growth** will require specific investments in voltage optimization, grid/battery storage, demand response programs, outage management systems, and solutions for bi-directional or net metering.

[78] Report Analyzes Global Market for Smart Electric Meters, T&D World, Nov. 25, 2019

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PRIORITIES VARY SLIGHTLY COUNTRY BY COUNTRY

Utilities appear generally aligned around priority investments for addressing the impact of disasters, DER adoption and EV growth. France is perhaps the only outlier, citing fleet management solutions as its top priority for addressing EVs. This may be the result of heightened awareness of EVs in France, with the France Relance incentive program boosting sales and the transportation ministry targeting the end of 2022 for charging points to be installed in "all areas of the motorway network."[79]

TOP 3 TECH PRIORITIES FOR DISASTERS

US	Australia	France	Germany	Indonesia
AMI	Sensors	Sensors	Sensors	AMI
Sensors	Distribution automation	Outage detection	Distribution automation	Sensors
Notify/evac. solutions	AMI	Real-time weather	AMI	Outage detection

TOP 3 TECH PRIORITIES FOR DERs

US	Australia	France	Germany	Indonesia
AMI	Distribution automation	Distribution automation	AMI	AMI
Distribution automation	AMI	AMI	Distribution automation	Distribution automation
Consumer programs	Consumer programs	Volt optimization	Edge intelligence	Grid-battery storage
			Volt optimization	

TOP 3 TECH PRIORITIES FOR EVs

US	Australia	France	Germany	Indonesia
AMI	AMI	Fleet mgmt solutions	AMI	AMI
Edge intelligence/M2M	Distribution automation	Residential charging	Consumer programs	Edge intelligence/M2M
Distribution automation	Edge intelligence/M2M	Distribution automation	Time of use programs	Residential charging

[79] Electric vehicles sales in France tripled in past two years, euractiv.com, July 23, 2021

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THERE ARE ANSWERS IN THE INSIGHTS

ONLY BY GAINING MORE VISIBILITY AND CONTROL CAN UTILITIES PLAN FOR THE WORLD TO COME.

Utilities have no control over who buys EVs, so it can be difficult to forecast where additional capacity may be needed and when. The challenge is similar with DERs. Most utilities can't control who installs rooftop solar panels in their service area. But they need to understand where the greatest concentration of solar is so they can make necessary investments across their service area and plan for cloudy days.

Utilities need to understand what's happening. With so many variable forces affecting both demand and supply, utilities need a complete operational view of the grid. That requires advanced grid-edge intelligence from smart Industrial IoT (IIoT) devices that provide granular data on status, usage and more.

It's little wonder, then, why technologies like distribution automation (DA), analytics and data analysis software, edge intelligence and machine-to-machine learning solutions, and real-time assessment and monitoring factor prominently across the investment plans of utilities overall.

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WHERE TO BEGIN?

FOCUS ON THE UPGRADES THAT ADDRESS ALL USE CASES.

Faced with finite funding and multiple competing needs, utility executives may feel overwhelmed by the prospect of modernizing the grid to deal with several concurrent impacts. With disasters, DERs and EVs all competing for investment dollars, where should utilities place their bets?

The answer may have come from utility executives themselves. In voicing their priorities for each of the three challenges, execs named several potential investments that address all of them. AMI, DA and real-time monitoring appear as priorities across all use cases in survey responses. And several others, including analytics/data analysis and edge intelligence, are cited in two but actually would add value to all three.

The chart below summarizes those investments. By focusing on those upgrades first, utilities may well see the greatest ROI across the board.

A DAUNTING CHALLENGE

16% of utility executives we surveyed say **difficulty prioritizing what to Invest in** is a key barrier to upgrading the grid

Another 10% say they simply **don't know where to begin**

TECHNOLOGY SOLUTIONS ARE HERE TODAY

Preparing for disasters, integrating DERs and accommodating EVs all benefit from the same thing: **infrastructure upgrades**. Based on survey responses, some investments can help solve more than one challenge with technology that exists today.

	DISASTERS	DERs	EVs
AMI	●	●	●
Distribution automation	●	●	●
Analytics/data analysis	●		○
Real-time monitoring	●	●	●
Edge intelligence	○	●	●
Consumer pricing programs		●	●
Sensors (temp, consumption, pressure, wind, pole, tilt, line)	●		
Outage detection/ management	●	●	
Voltage optimization		●	
Grid/battery storage		●	
Residential charging			●

● Listed by utility execs as a priority investment for addressing the use case indicated

○ Not listed by utilities as a priority investment, but likely to be helpful for this use case

CONCLUSION

MORE INTELLIGENCE. MORE POSSIBILITIES.

CONCLUSION: MORE INTELLIGENCE. MORE POSSIBILITIES.

PREPARING FOR THE UNEXPECTED AND THE INEVITABLE

THE ANSWERS TO ALL THESE CHALLENGES ARE AVAILABLE TODAY.

It's abundantly clear that we have no choice but to evolve the grid in a way that makes it more resilient and reliable. Fortunately, we have ideas about where the impacts are coming from—and despite the unexpected nature that disasters can sometimes represent, we have plenty of data to help us map that future with confidence.

The truth is, a modern grid solves a multitude of problems. It delivers to utilities far more intelligence and insight into what's happening, and even what will happen on the grid. And it ushers in a new era of services and revenue streams that meet consumers where they are today, and prepares them for where they will be tomorrow. **A modern grid delivers more intelligence and more possibilities**.

This report explored the unexpected impacts of disasters and the inevitable implications of DERs and EVs. And it outlined what utility executives see as the primary concerns of those three challenges, and the investments required to address them.

There is no turning any of these disruptors back to where they came from. All utilities, governments, communities and consumers can do is pursue their priorities with conviction. Because change is happening faster than ever, and it will never again be this slow.

ADDITIONAL RESOURCES

DISASTERS

A Year of Fire and Ice Has Proven Grid Modernization Cannot Wait, Opinion, Morning Consult

Disaster Preparedness: 2019 Itron Resourcefulness Insight Report

DERS

Distributed Intelligence: Creating the Future for Utilities, Itron white paper

Renewable energy: How utilities' new green business models are becoming a success – and are simple to implement, Zpryme

Delivering Intelligent Connectivity, Itron and Zpryme infographic

EVS

Steep Climb Ahead: How Fleet Managers Can Prepare for the Coming Wave of Electrified Vehicles, Rocky Mountain Institute, 2021

Global EV Outlook 2020, International Energy Agency

The Future of Transportation is Electric, poweroverenergy.org, 2021

ENERGY AND WATER TRENDS

2018 Itron Resourcefulness Report: An Analysis of International Energy and Water Trends

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