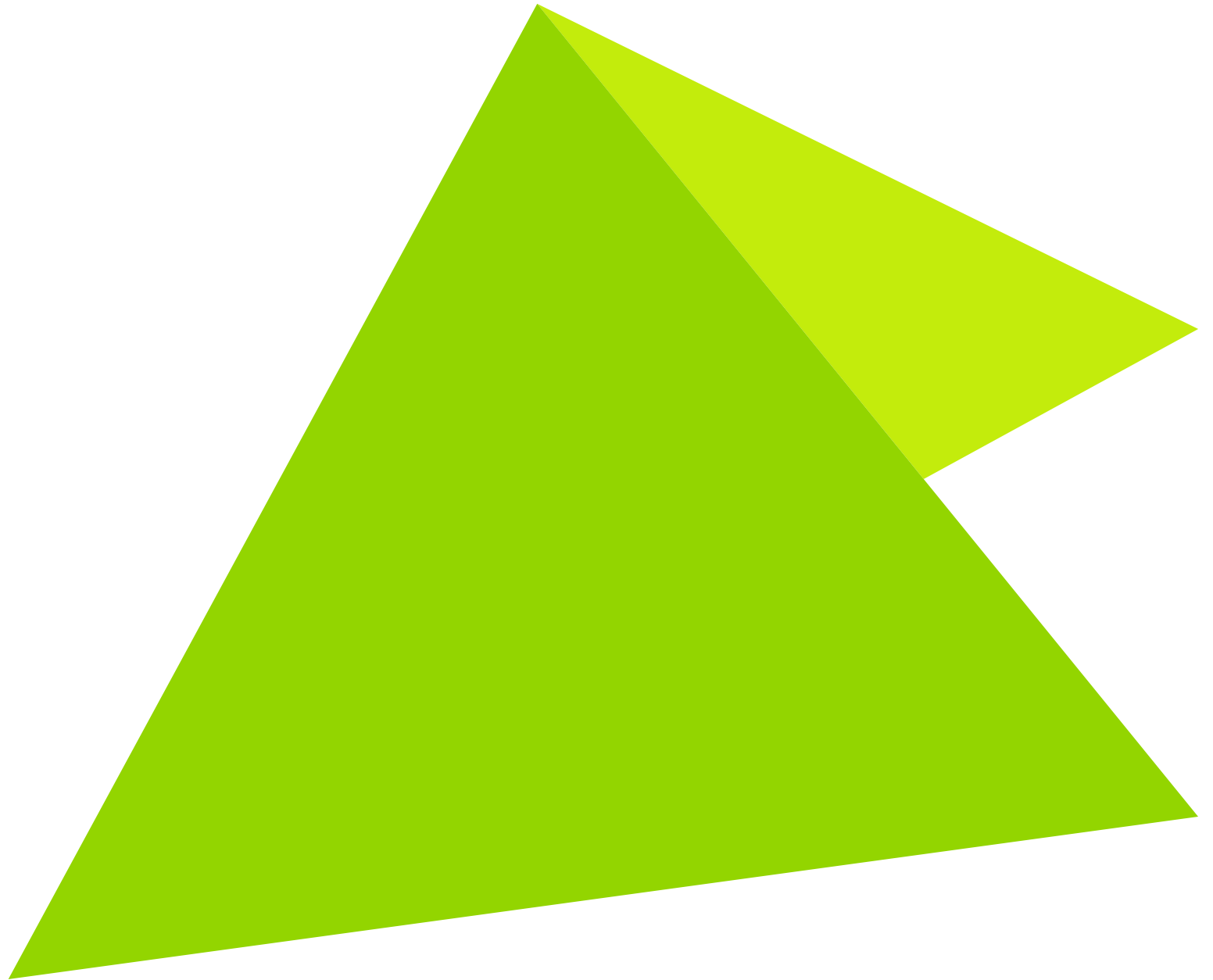




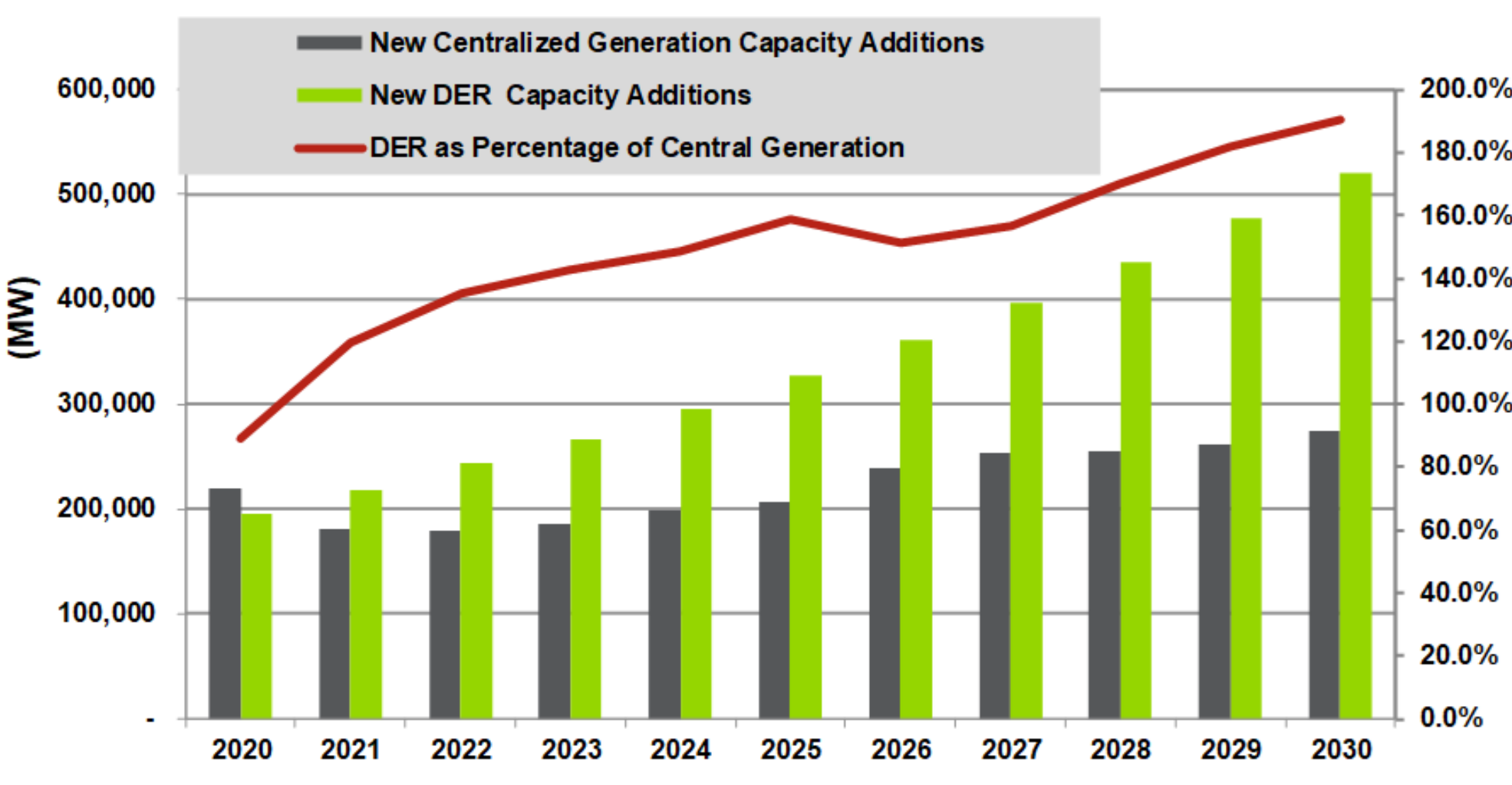
Key Trends Driving Microgrids Today

Peter Asmus,
Research Director

October 27, 2021



Global Shift In Energy Sources Already Underway



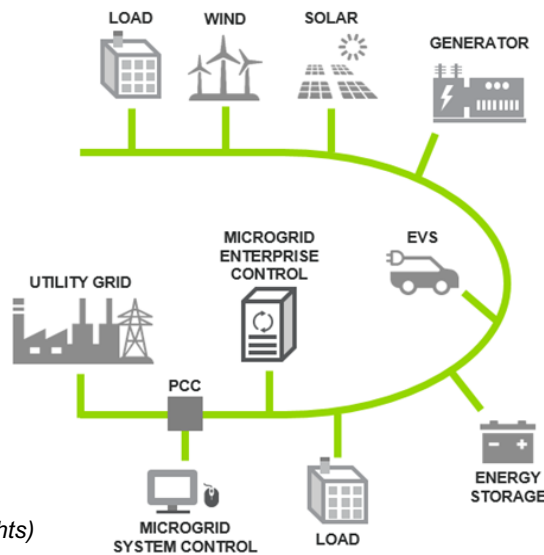
(Source: Guidehouse Insights)

DER Growth = Need for Digital Platforms for Orchestration

Microgrids, VPPs & DERMS

- **What is a microgrid?**

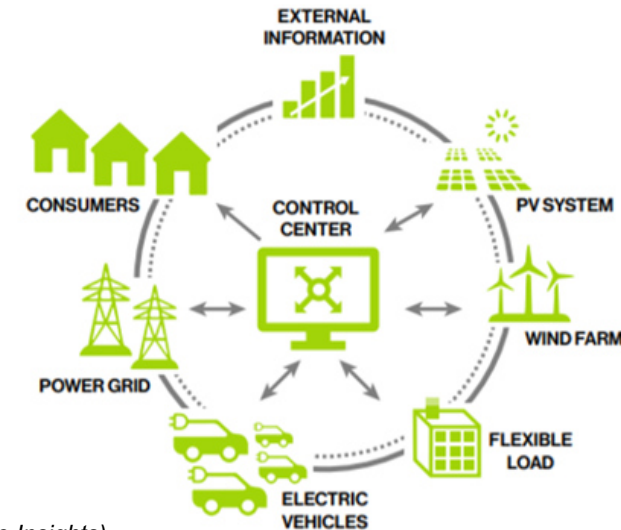
A group with clearly defined electrical boundaries of low voltage DER and loads that can be operated in a controlled, coordinated way either connected to the main power network or in islanded mode.



(Source: Guidehouse Insights)

- **What is a Virtual Power Plant (VPP)?**

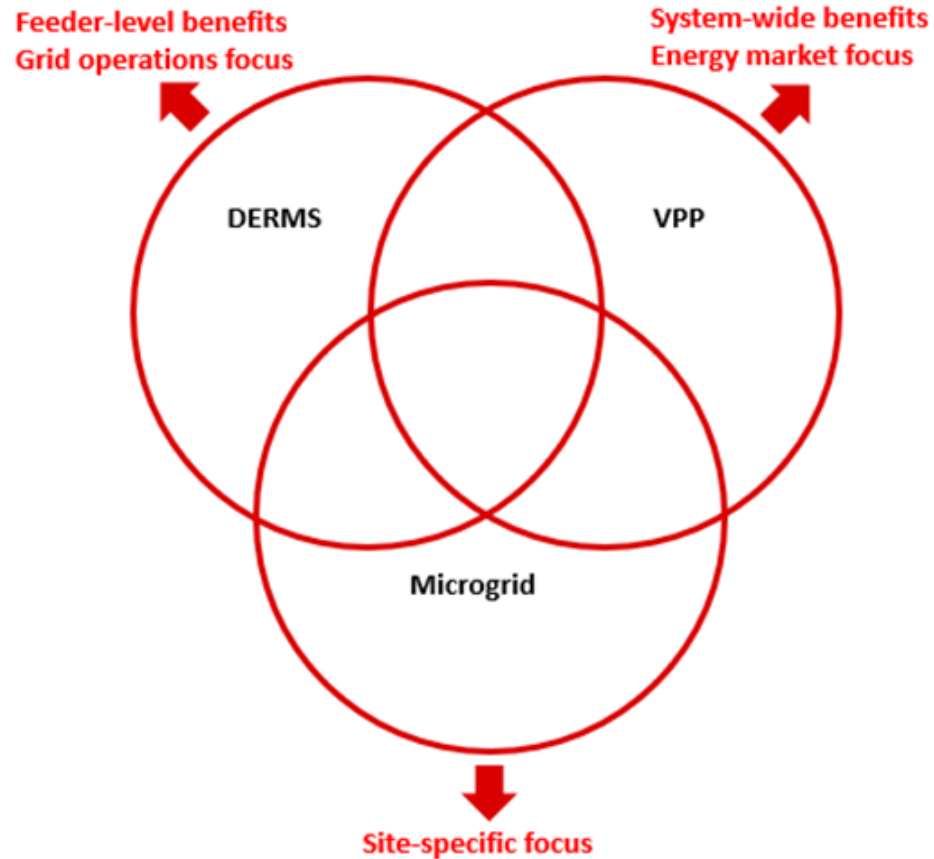
An aggregated system of energy assets remotely and automatically optimized by a software-based platform to dispatch services for distribution or wholesale market.



(Source: Guidehouse Insights)

DER Digital Platforms are Converging

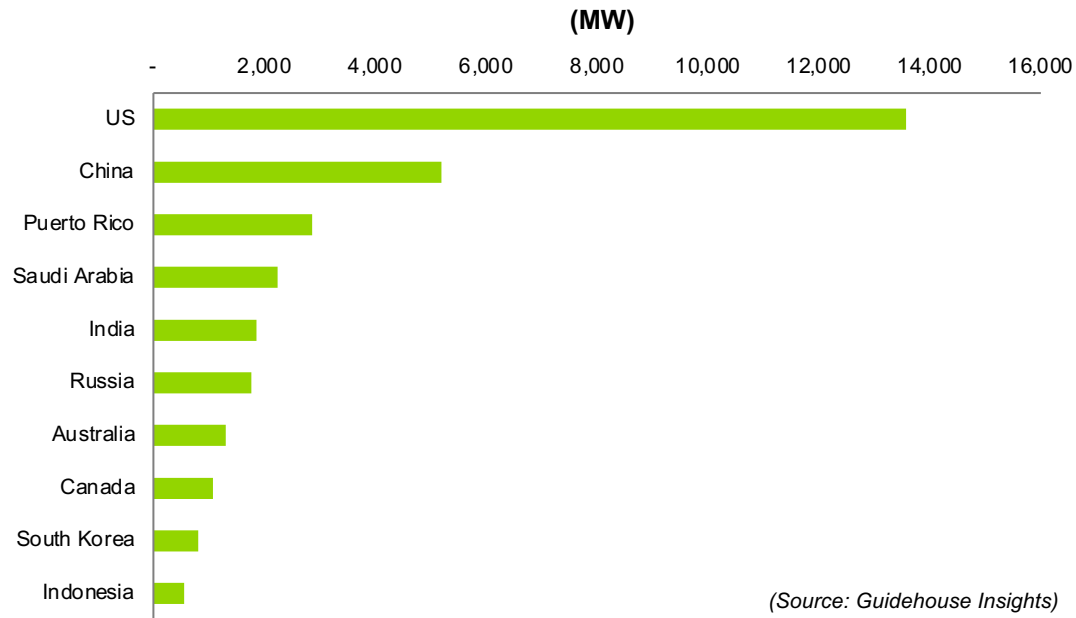
Energy storage Playing Key Role in Overlap



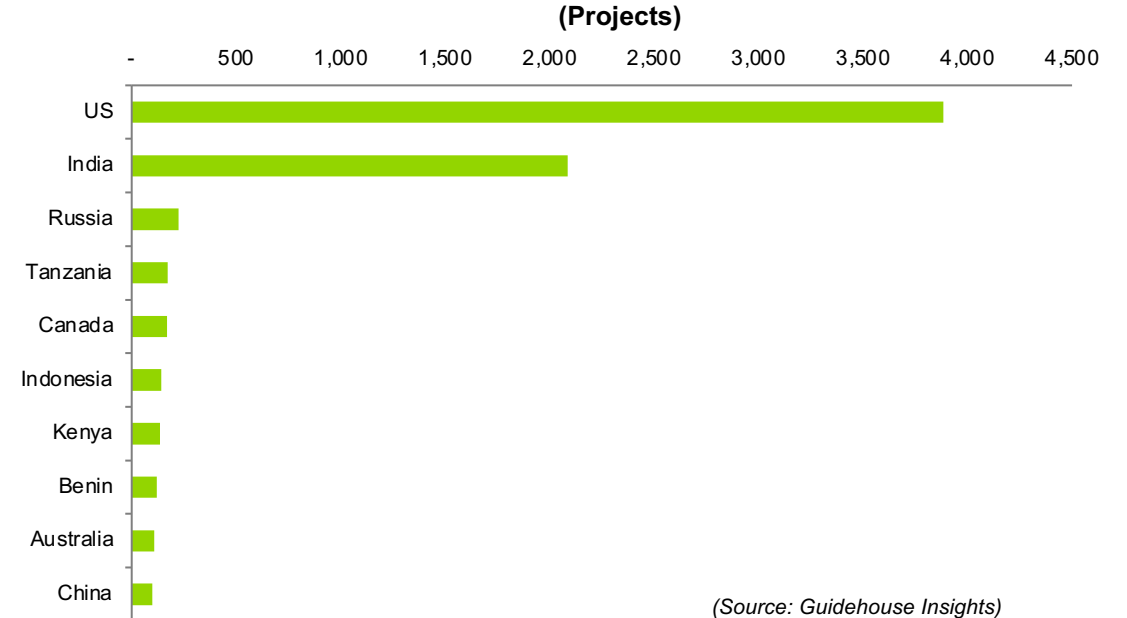
- **Microgrids** offer site specific resiliency first, but can integrate renewables and provide other infrastructure services (i.e. thermal energy, water)
- **VPPs** require traditional grid infrastructure and markets that allow for ancillary services (demand response, frequency regulation).
- Distributed Energy Management Systems (**DERMS**) view the world of DER assets from the utility point of view. Focused on grid reliability issues solved through active power management (i.e. voltage spikes and sags on a specific feeder)
- *All three concepts can be integrated into a single site or project. Microgrids are most relevant to Alaska.*

Global Microgrid Leaders by Country

Top 10 Countries by Total Capacity, World Markets: 1Q 2021



Top 10 Countries by Project Count, World Markets: 1Q 2021

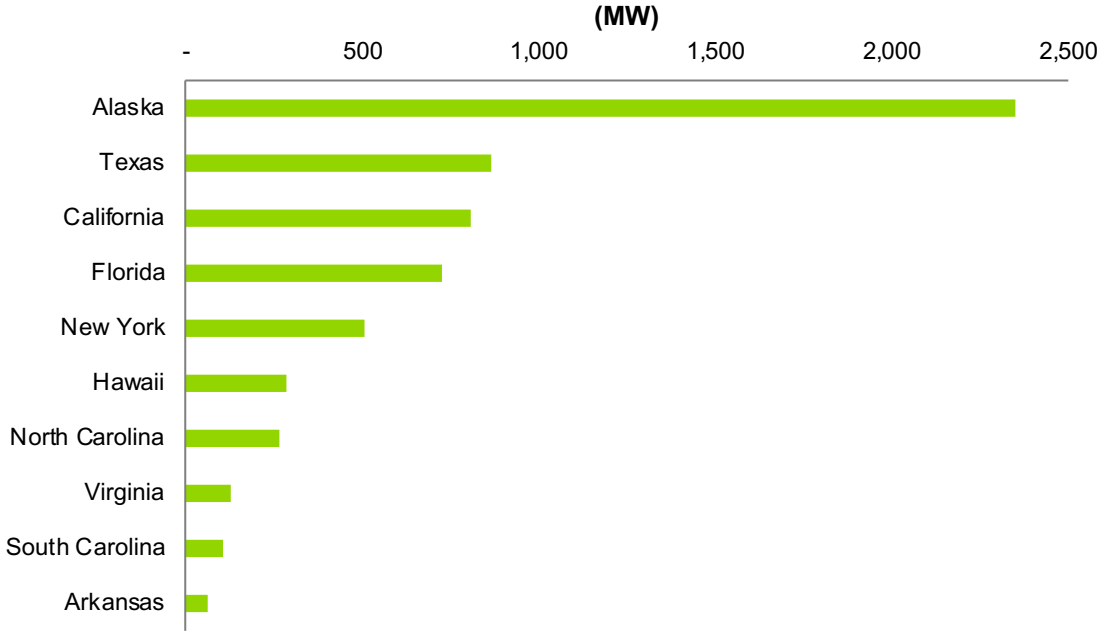


Analyst Insights

Looking at the top 10 countries' total capacity and project count, nearly all regions are represented except for Western Europe. Although North America, led by the US, has the most microgrids currently online, Asia Pacific is close behind and shows the most growth potential by rapidly increasing populations in China and India, and island nations such as South Korea, Australia, and Indonesia. Puerto Rico has experienced robust microgrid growth in recent years due to its susceptibility to natural disasters. Russia's microgrids are nearly all remote entries serving rural communities near the arctic circle, typically for remote communities or mining or oil & gas extraction. Microgrids in Africa provide power to communities where grid infrastructure is weak or absent.

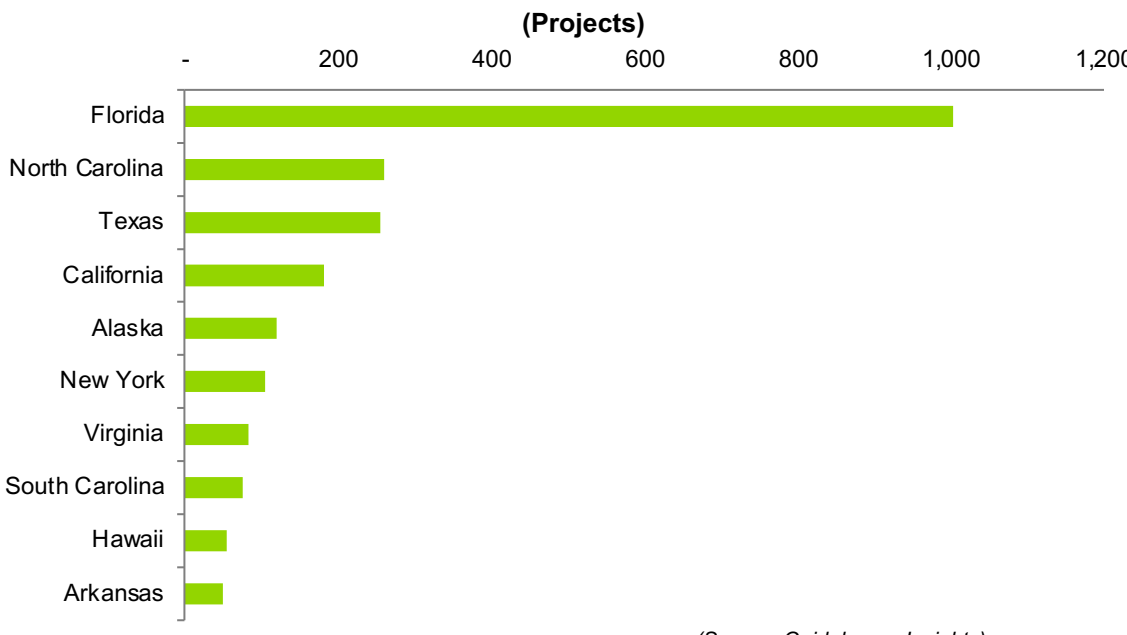
Global Microgrid Leaders by US State

Top 10 States by Total Capacity, US Market: 1Q 2021



(Source: Guidehouse Insights)

Top 10 States by Project Count, US Market: 1Q 2021



(Source: Guidehouse Insights)

Analyst Insights

Alaska leads in the US in installed microgrid capacity largely due to its remote location, needed resilience for cold weather conditions, and high cost of delivered electricity and diesel. California and New York have historically favorable renewable energy policies and regulatory environments, making them consistent contenders for the Top 10 capacity and project count year after year for grid-tied systems. Despite strong resistance to renewable and DER, Florida and Texas have large microgrid capacity and project counts due to significant expansion by individual developers, PowerSecure and Enchanted Rock, respectively.

Key Trends Driving Microgrid Adoption Today

Energy as a Service

- One of the long-standing challenges facing microgrids is the ability of potential customers to pay the upfront capital costs.
- Though PPAs have been used for years, these contracts typically only addressed supply, not demand; new EaaS contracts take a more comprehensive view
- “Pay as you go” business models for remote microgrids have been a game changer

Commercial & Industrial Customers

- C&I customers traditionally shun new innovations – microgrids -- due to risk and ROI
- Declines in solar PV and battery costs have made microgrids more attractive
- These customers know the true value of resiliency due to increasing outages
- C&I is now fastest growing microgrid market

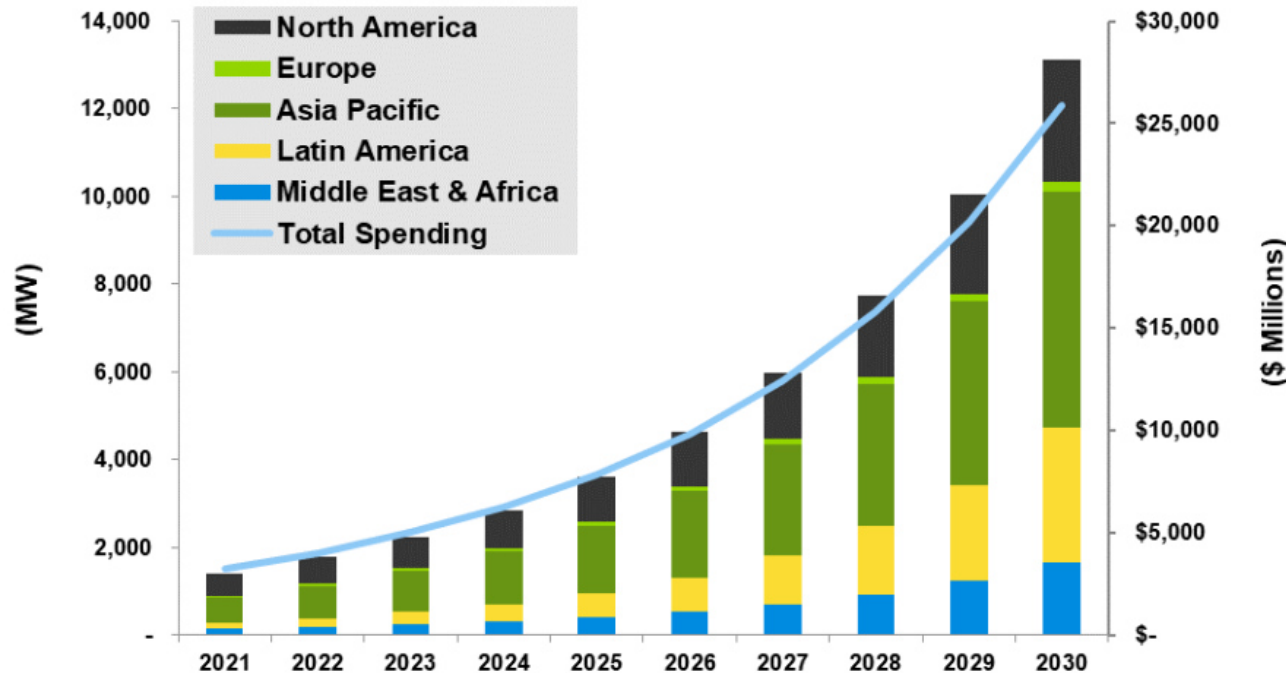
Electric Vehicle Charging

- EV mandates and goals are being established by federal, state and local governments
- Climate change and increased grid outages threaten the transportation sector in new ways due to electrification
- Microgrids can provide the clean energy resilience EV charging systems need
- EVs can also serve as an energy storage resource for microgrids

Energy as a Service Microgrids

Vendor Offers Becoming Mainstream

Microgrid EaaS Capacity and Spending by Region, World Markets: 2021-2030



(Source: Guidehouse Insights)

- The primary EaaS market segments included in this forecast are:
 - *Pay as you Go*;
 - *PPAs*;
 - *Advanced EaaS*;
 - *Energy savings performance contracts (ESPCs)/enhanced use leases*.
- The microgrid EaaS market represents a \$3.3 billion market in 2021. By 2030, annual spending is expected to reach \$25.9 billion.

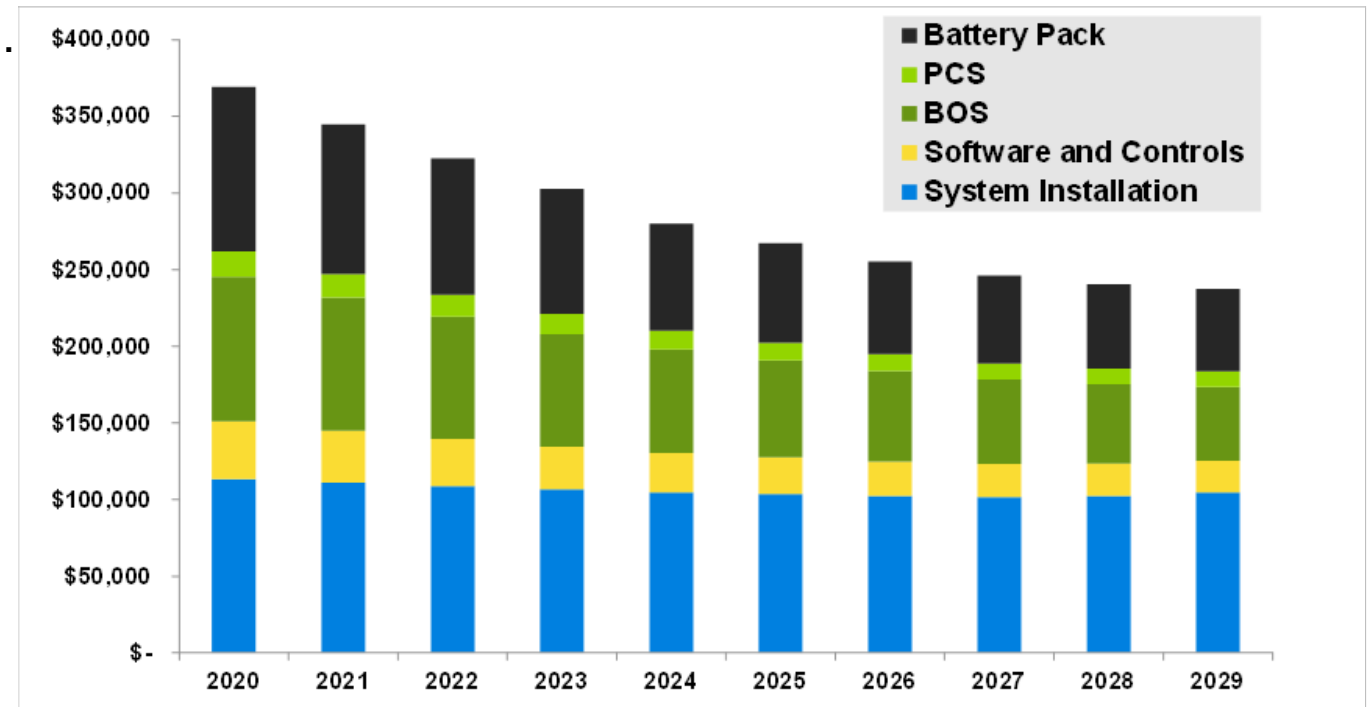
C&I Microgrids Now Fastest Growing Segment Worldwide

Reduced Costs and Increased Outages Driving Adoption

Past Challenges for C&I Customers:

- Large industrials often pay the lowest electric rates of any customer class.
- This market segment often is required to make a valid value proposition in the absence of government funding.
- Internal competition for capital outlays is fierce within these companies and subject to intense scrutiny from CFOs.

C&I Building Li-Ion Battery System Pricing, 250 kW/500 kWh System, US Base Case: 2020-2029

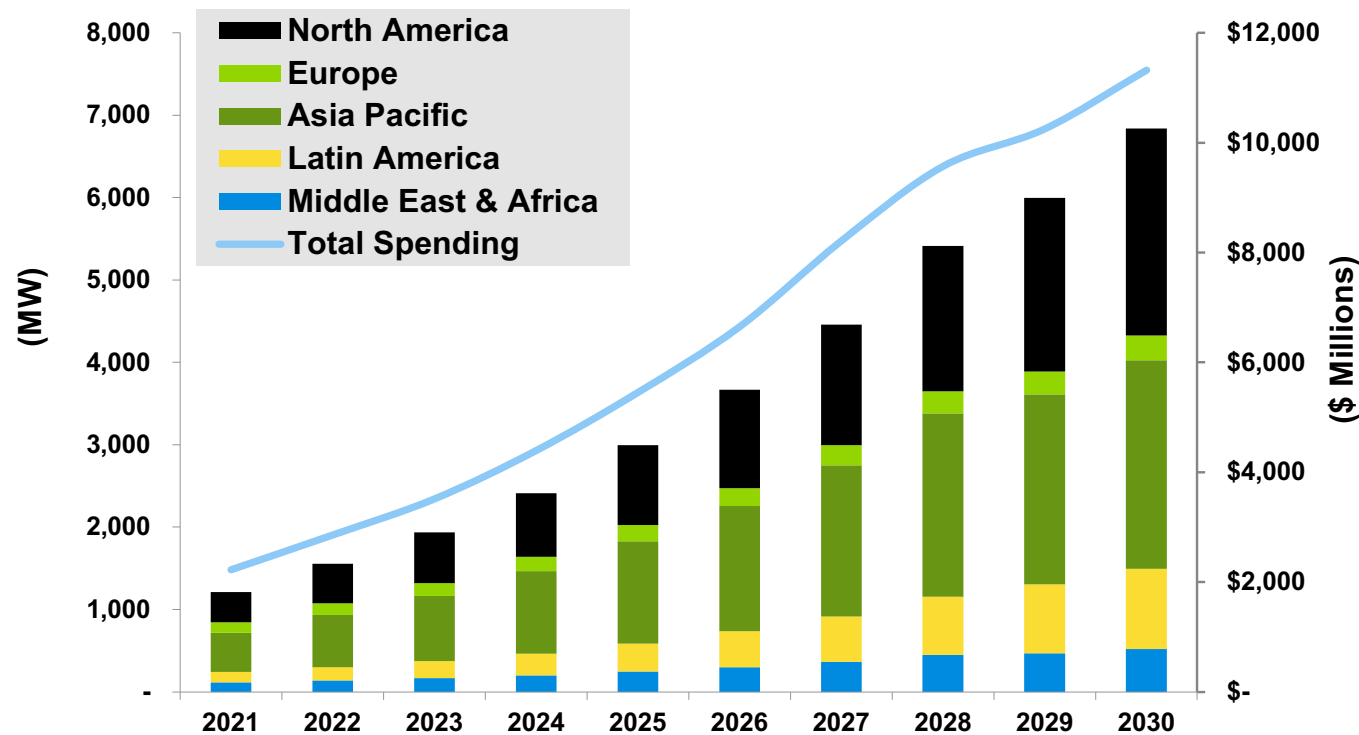


(Source: Guidehouse Insights)

Investors Now Driving C&I Shift to Clean Energy

Sustainability and Resiliency Are Being Linked

Total C&I Microgrid Capacity and Implementation Spending, World Markets: 2021-2030



(Source: Guidehouse Insights)

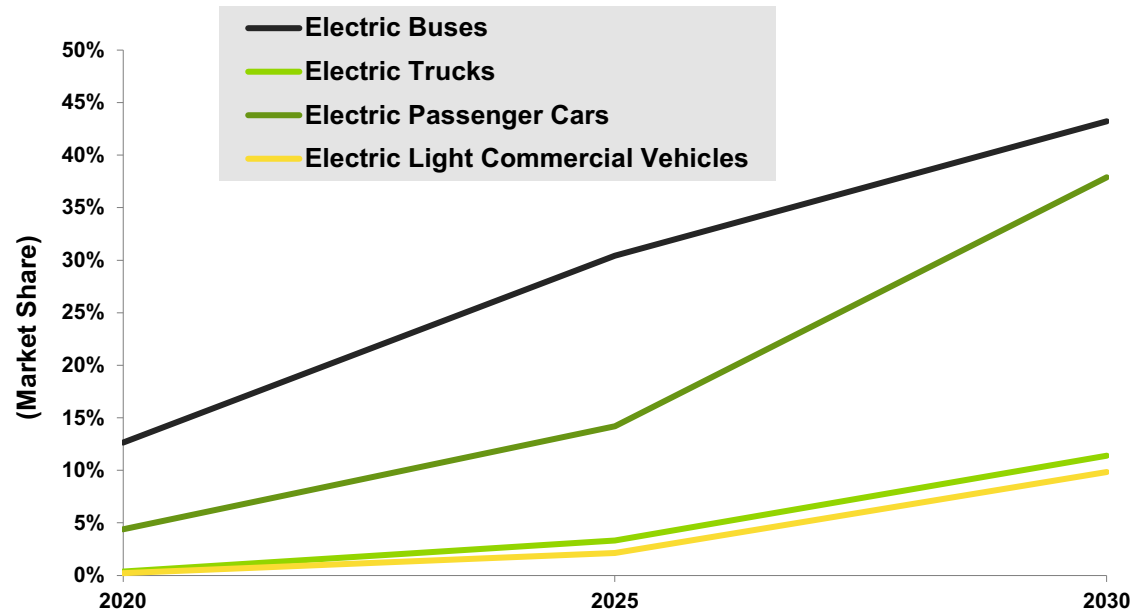
Today's C&I Market Drivers:

- Clients are fiscally sound and value innovation in business models, especially EaaS.
- Reliability is highly valued in C&I—more so than in any other microgrid segment, with the exception of military projects.
- Project portfolios with a single client can scale up rapidly, replicating commercial success within shorter development cycles than slow-moving segments (utilities, military and community projects).

EV Growth Requires Clean & Resilient Electricity Supplies

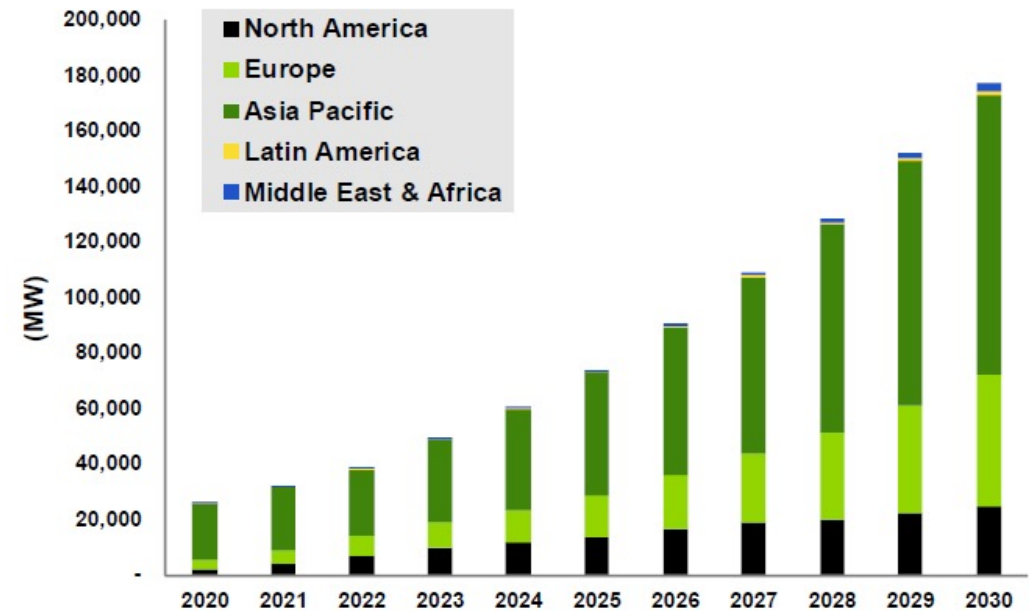
Microgrids are Perfect Solution for EV Charging

EV Market Share by Segment, World Markets: 2020, 2025, 2030



(Source: Guidehouse Insights)

EV Charging Load by Region, World Markets: 2020-2030



(Source: Guidehouse Insights)

Modular Systems, Distributed Controls & Hydrogen

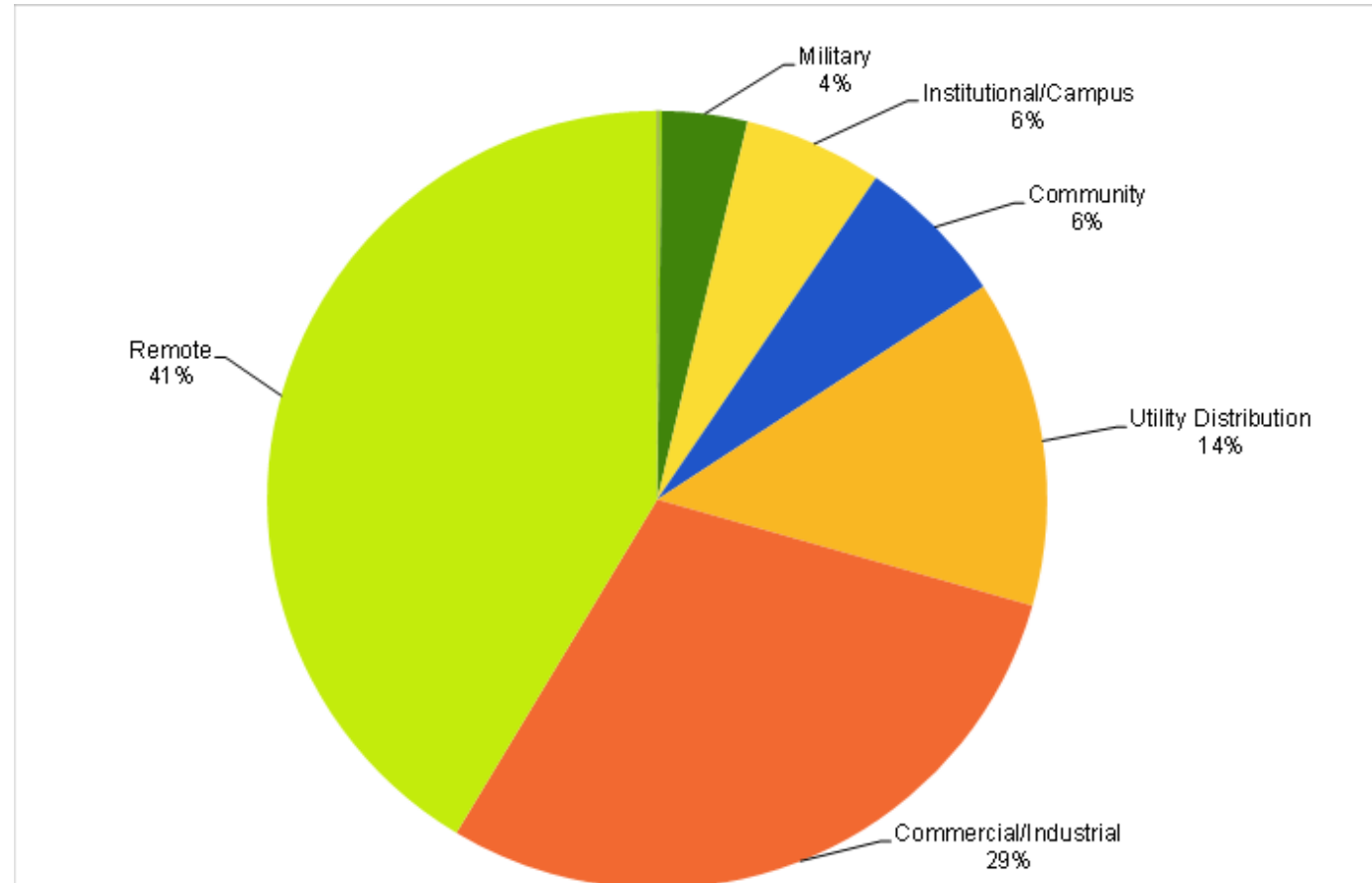
Three More Trends to Monitor

- **Increased interest in modular, plug-and-play systems reduce customized engineering costs and could speed up deployments of microgrids (< 4 MW)**
 - Dovetails with EaaS and C&I trends
- **Shift in controls approach from top-down to bottoms-up reflect increased reliance on variable renewables**
 - Distributed or decentralized approaches push intelligence to devices and grid edge
 - Enhanced flexibility for microgrid designs
 - Innovators are start-ups but acquisitions and partnerships between large and small vendors are also increasing
- **Need for Long Duration Storage Growing with 100% Clean Energy Goals**
 - Most common battery deployed in a microgrid is lithium ion, which provides resilience for 2 to 4 hours
 - Flow batteries are one option, but many suppliers have gone bankrupt over the past 5 years
 - Distributed hydrogen being deployed in remote systems and Stone Edge Farm in Sonoma, California

Microgrids Have Come of Age

Remote Microgrids Still Leading the Way

Microgrid Capacity by Segment, World Markets: 1Q2021



(Source: Guidehouse Insights)

Contact

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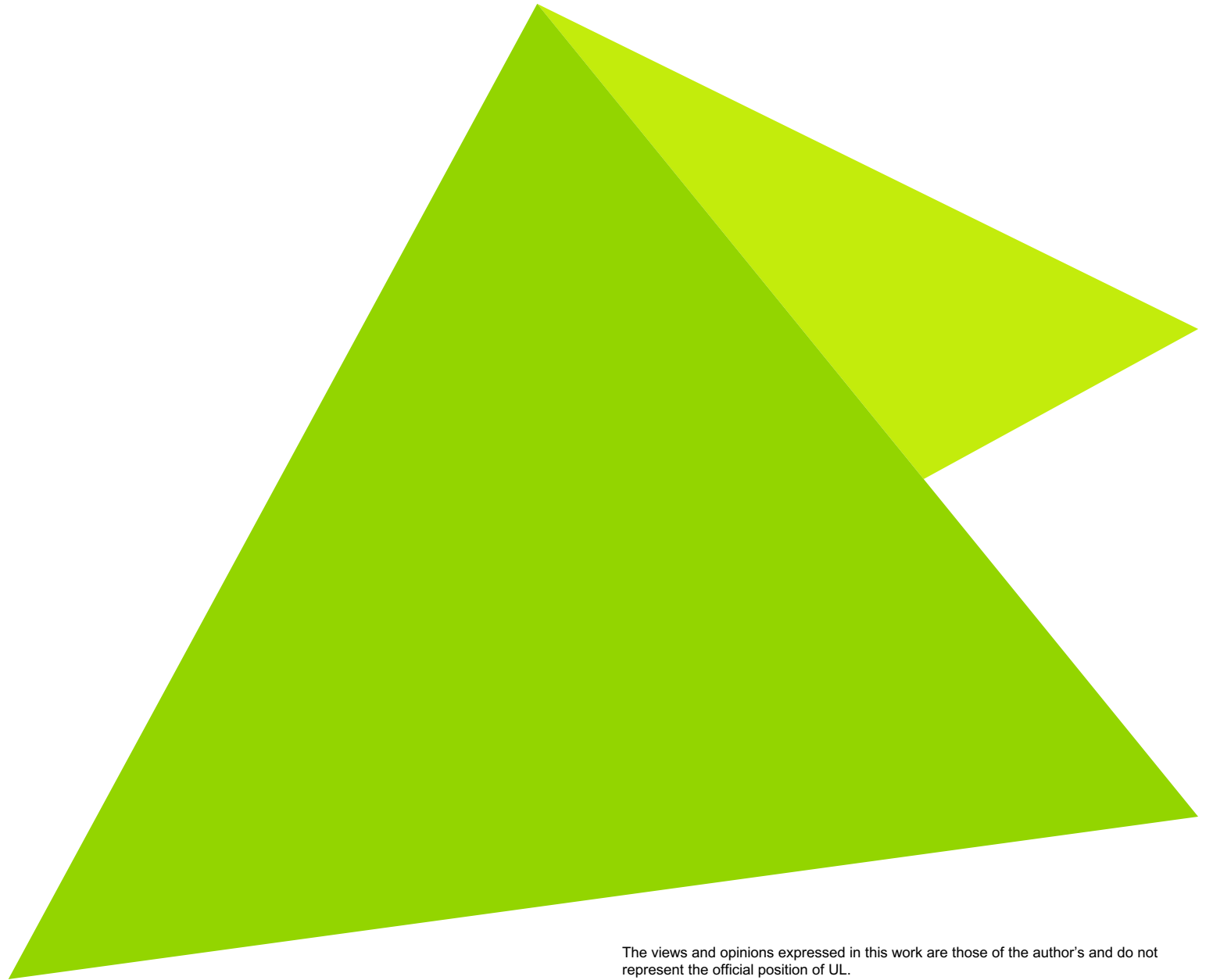
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