

Solar + Energy Storage + e-Mobility: Betting on the New Energy Trifecta, and the COVID-19 Reset

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- Leaders in renewables, EV demand and grid-connected storage
- Over 500 sector-dedicated analysts and consultants globally, including 75 specifically to power and renewables
- Located close to clients and industry contacts



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1. Key findings



Key findings – We're entering a brave new world of DERs, Covid-19 notwithstanding

Residential solar market on a sustained growth trajectory

Post-Covid slump, 2020-2022, residential growth will resume double-digit growth due to both emerging markets with strong resource fundamentals like Florida and Texas and markets where recent policy developments have increased our near-term forecasts.

Residential storage has strong upside with changing tariffs and resilience needs

The confluence of changing utility tariffs, reductions in NEM compensation, grid services opportunities, and California's rooftop solar mandate will push the U.S. residential storage market past the 1 GWh mark in 2021 (a year later than previous outlook due to the Covid slowdown).

More than 7 million EVs will be on the road in North America by 2025

By 2030, increased EV penetration is expected to increase energy usage to 70+ TWh. This increase both creates challenges for grid operators and opportunities for more granular control. EVs can undoubtedly create many benefits for electric utilities, such as revenue growth, smart charging and V2G opportunities.

The emergence of DERs will change the way the grid operates, adding new layers of flexibility.

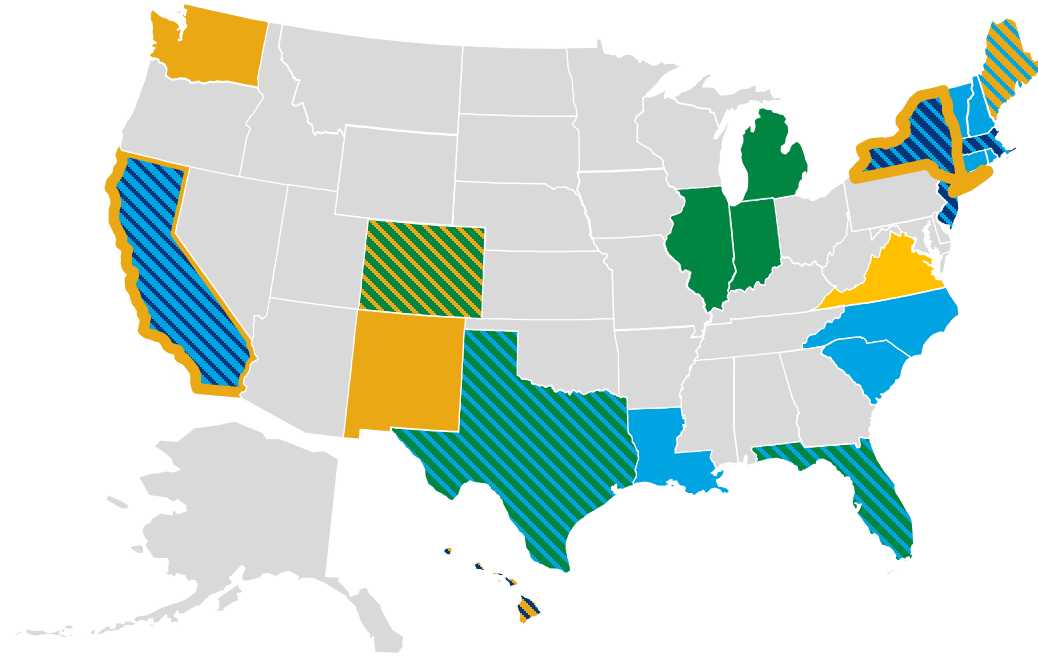
We forecast that BTM flexibility for VPP orchestration has the potential to grow to 150+ GW. Value stacking bundles multiple value streams and can improve the economics of DERs, but policies regarding value stacking are yet to be defined.

2. State of distributed solar, storage and EVs today

U.S. residential solar drivers

Resilience:
PSPS – California
Hurricanes, storms – Northeast, Gulf coast

Rate design changes:
California
Northeast
Southwest



Emerging economics:
Midwest
Southeast
Southwest

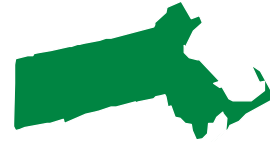
State targets and mandates:
New solar home – California
100% clean energy targets – CA, CO, HI, ME, NM, NY, VA, WA, DC, PR



Residential storage is expanding beyond California and Hawaii



Settlement incentive in SRP territory, APS pilots and storage rewards program



SMART incentive



Xcel Energy pilot under 2019/2020 Demand Side Mgmt. Plan



Liberty Utilities Pilot



JEA storage incentive, proposals for resilience support



Storage Roadmap: Bridge Incentive, Pilot Programs



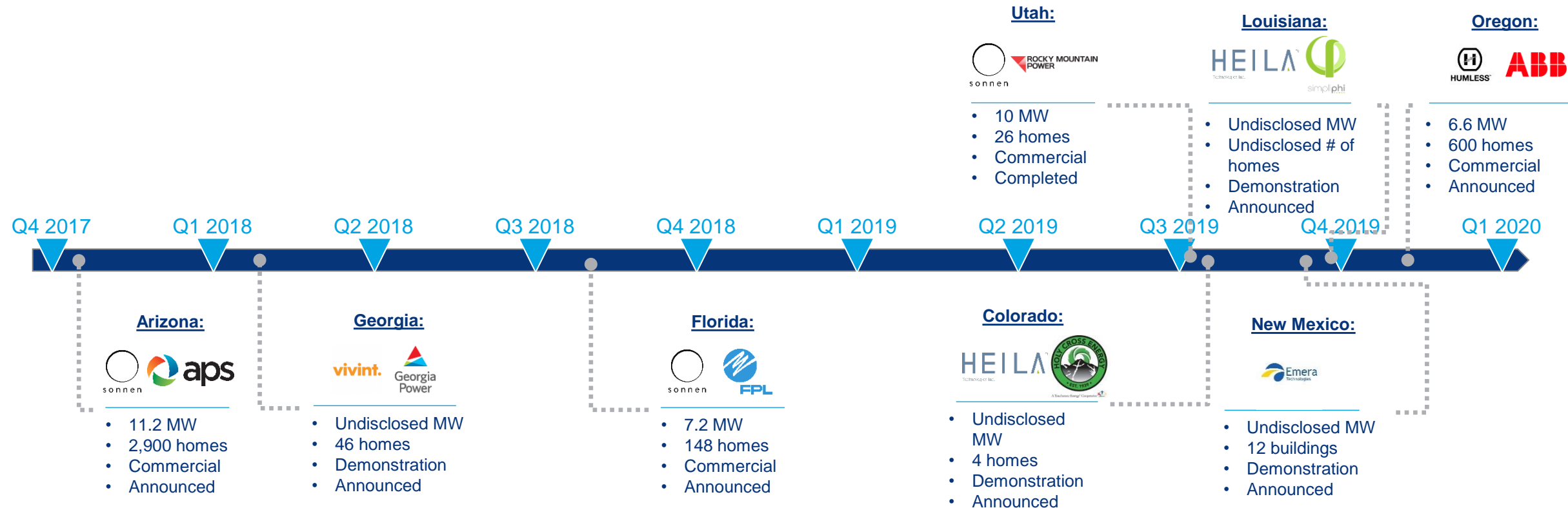
MEA storage incentive



Green Mountain Power Pilot

Repeatable, scalable microgrid solutions: VPP & residential development

Solar, storage and microgrid controls are turning new residential developments into microgrids

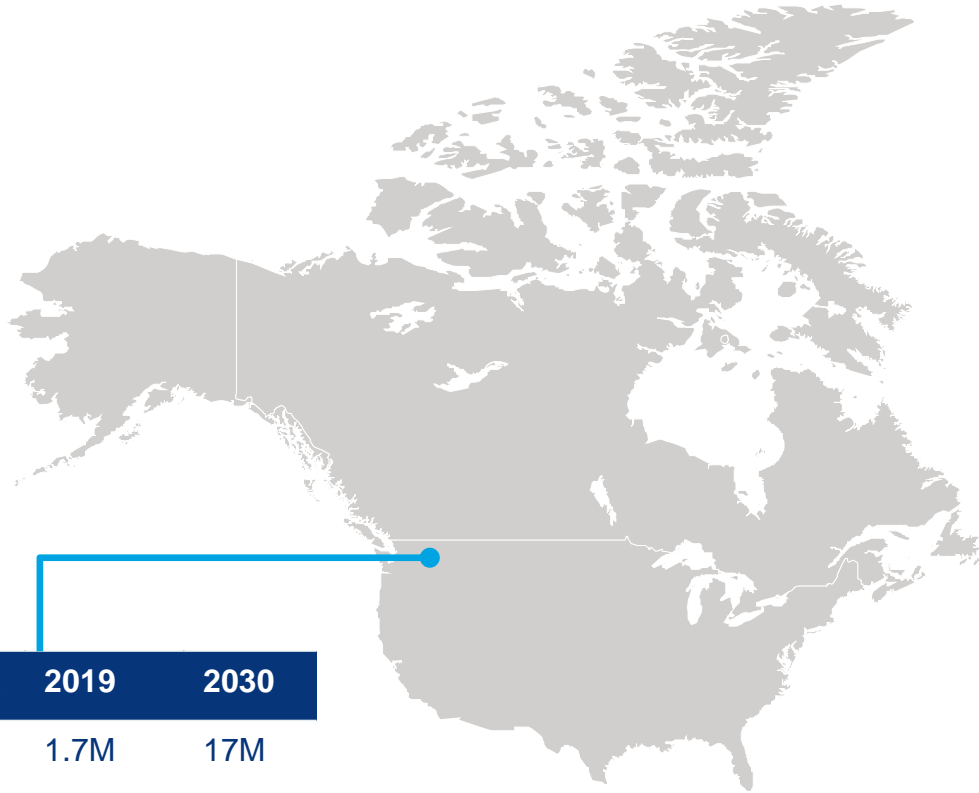


The growth of solar and storage developers working with residential builders to incorporate systems into new housing developments signals a new business model to bring systems online at scale and create flexible grid assets for utilities. Sonnen and Vivint have announced three residential development-scale distributed solar-plus-storage installations since 2017. Four additional projects were announced in the South and Western US in Q3 2019. Each project is designed as a utility-operated microgrid: each building has microgrid capabilities and they can all be aggregated and managed by the utility. While the exact architecture of these microgrids will continue to be refined, the installation of DERs at new residential developments to create virtual power plants run by the utility could overcome franchise rights and business model barriers to building scalable, repeatable residential microgrids in new developments incorporating both utilities and third-parties.



More than 17 million EVs will be on the road in North America by 2030

EV charging business models are shaping the grid profoundly

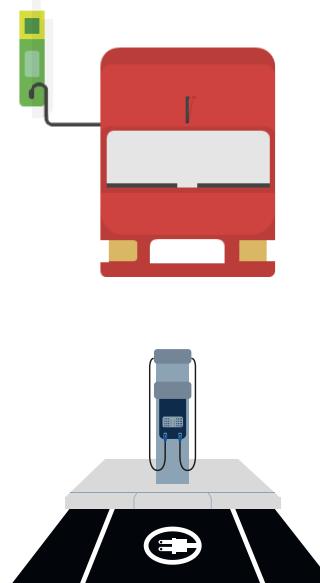


North America	2019	2030
Light-duty EVs	1.7M	17M
Residential chargers	1.3M	9.9M
Public chargers	0.13M	1M



Energy Revenues

We expect an EV customer to use about 10 kWh more per day offering utilities \$0.70 to \$2.26 in bundled energy revenue per EV per residential customer per day or \$255 to \$825 per year depending on local rates.



Smart charging and vehicle-to-grid (V2G)

Smart charging and V2G operational practices offer opportunities for customer, utilities and energy management firms to mitigate negative grid and rate impacts that may arise from uncontrolled charging for operators and customers respectively.

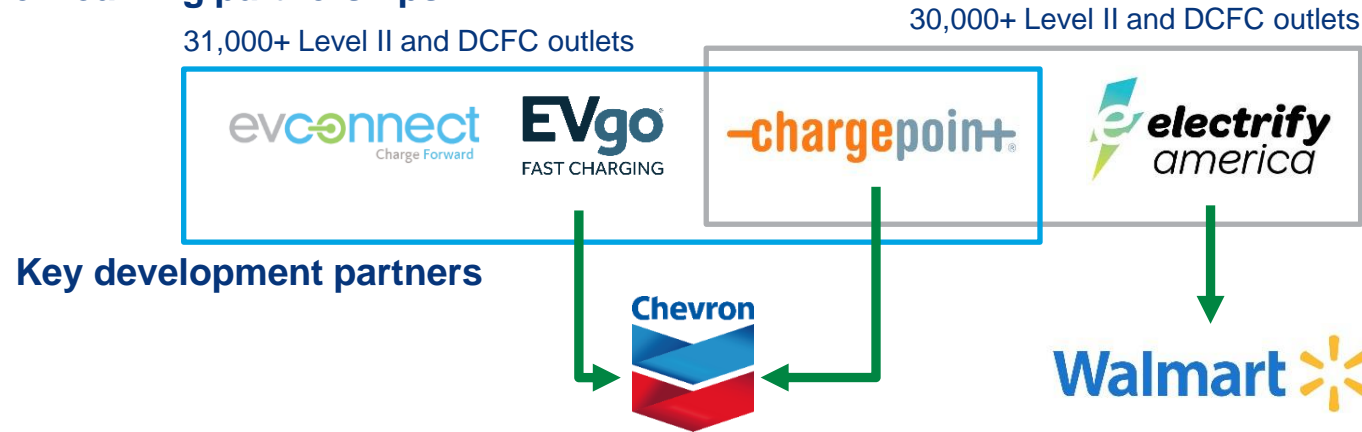
Supporting infrastructure

Like all other interconnections to the grid, EV chargers can require local physical grid upgrades. For residential customers, new infrastructure opportunities are limited in the short-term as 1.3 kW (level I) to 7.2 kW (level II) home chargers rarely require significant changes to electrical services to the home.

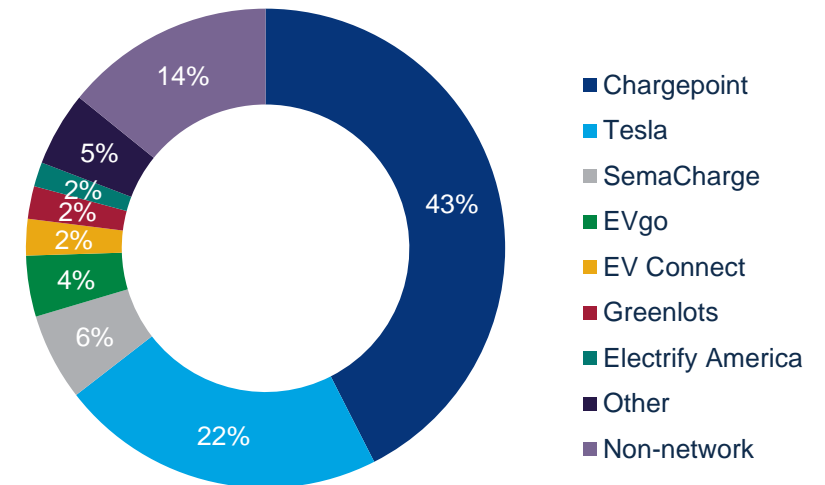
Network providers partner to enable e-roaming and charger development

Growing interest in direct-current, fast charging (DCFC) infrastructure among development partners

e-Roaming partnerships



US public charging infrastructure operator market share, 2018



e-Roaming partnerships connect over 50.7% of the public charger market

Key development partners

- Chevron's DCFC activity
- 120 DCFC chargers at Walmart's

3. New energy trifecta: Flexing the grid

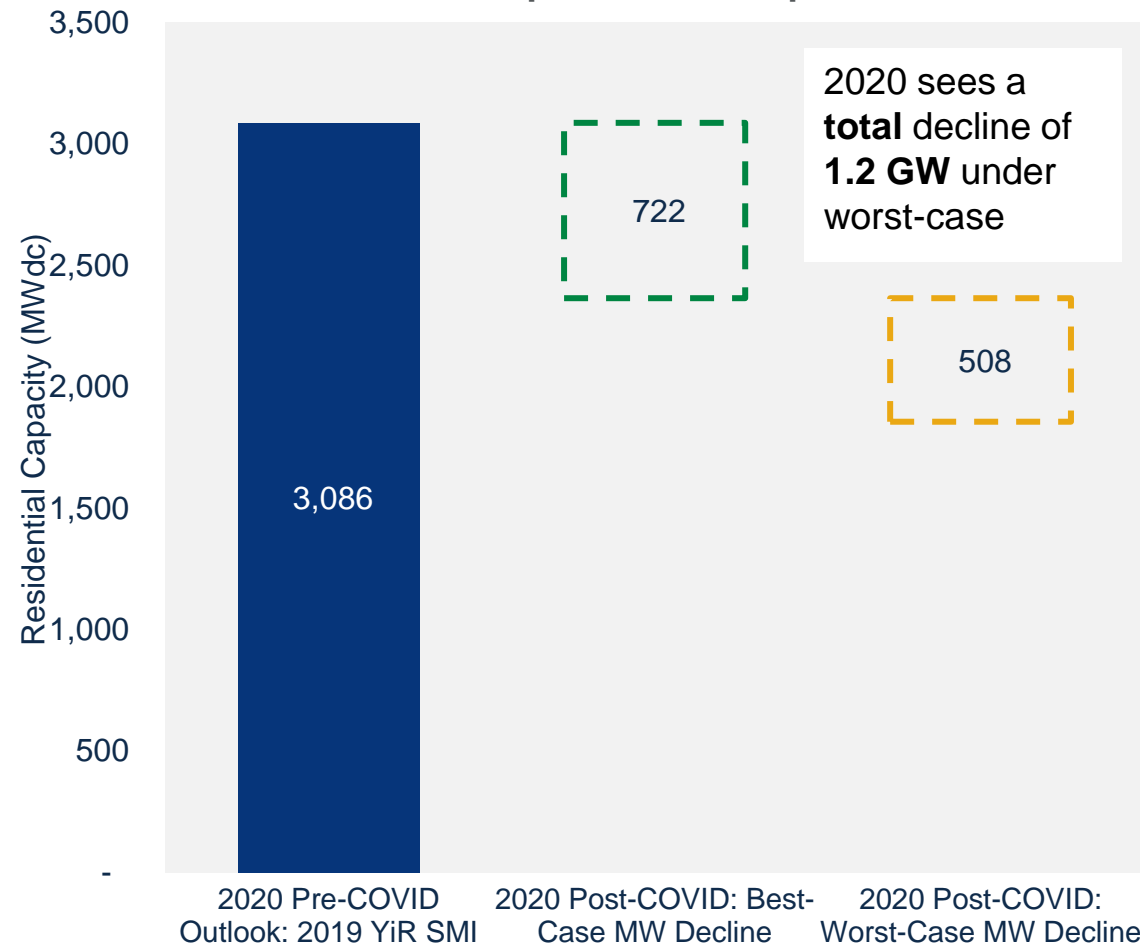
U.S. residential solar: On an upswing as economics opens up new geographies

Record-setting capacity added in 2019, up 15% over 2018. Covid-19 lockdown will slow down the momentum

Residential PV pre-COVID capacity, 2015-2025E



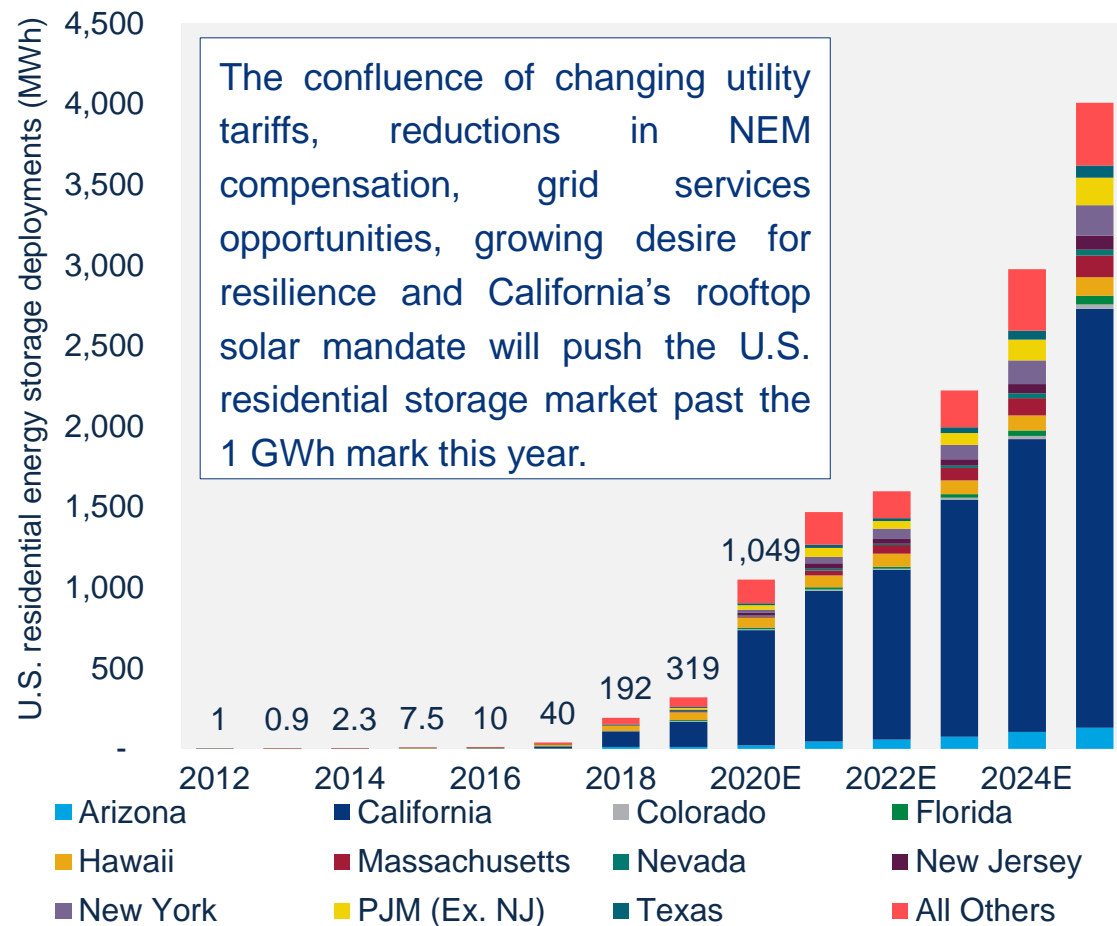
2020 residential PV forecast: pre-COVID vs. post-COVID



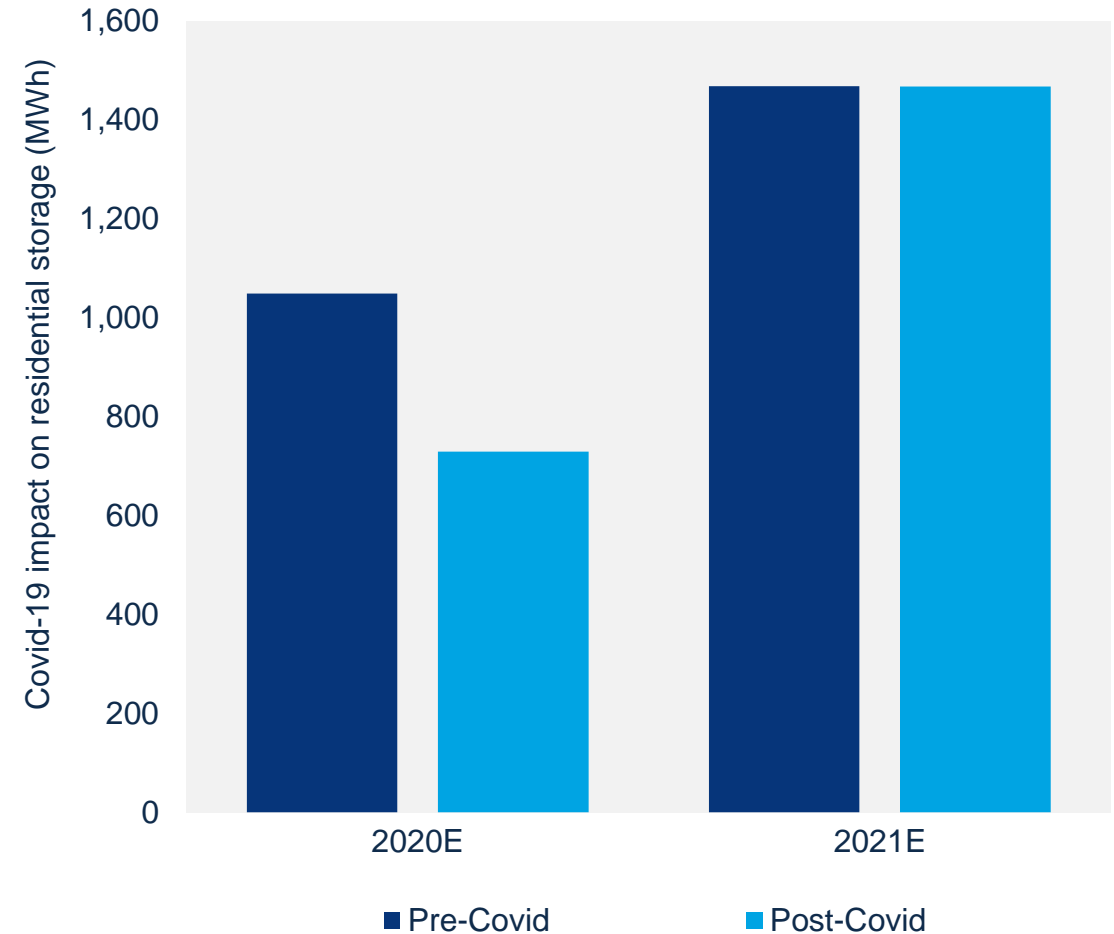
Residential storage was expected to eclipse the 1 GWh annual threshold in 2020

Covid-19 has changed that

Residential storage pre-COVID capacity, 2012-2025E (MWh)

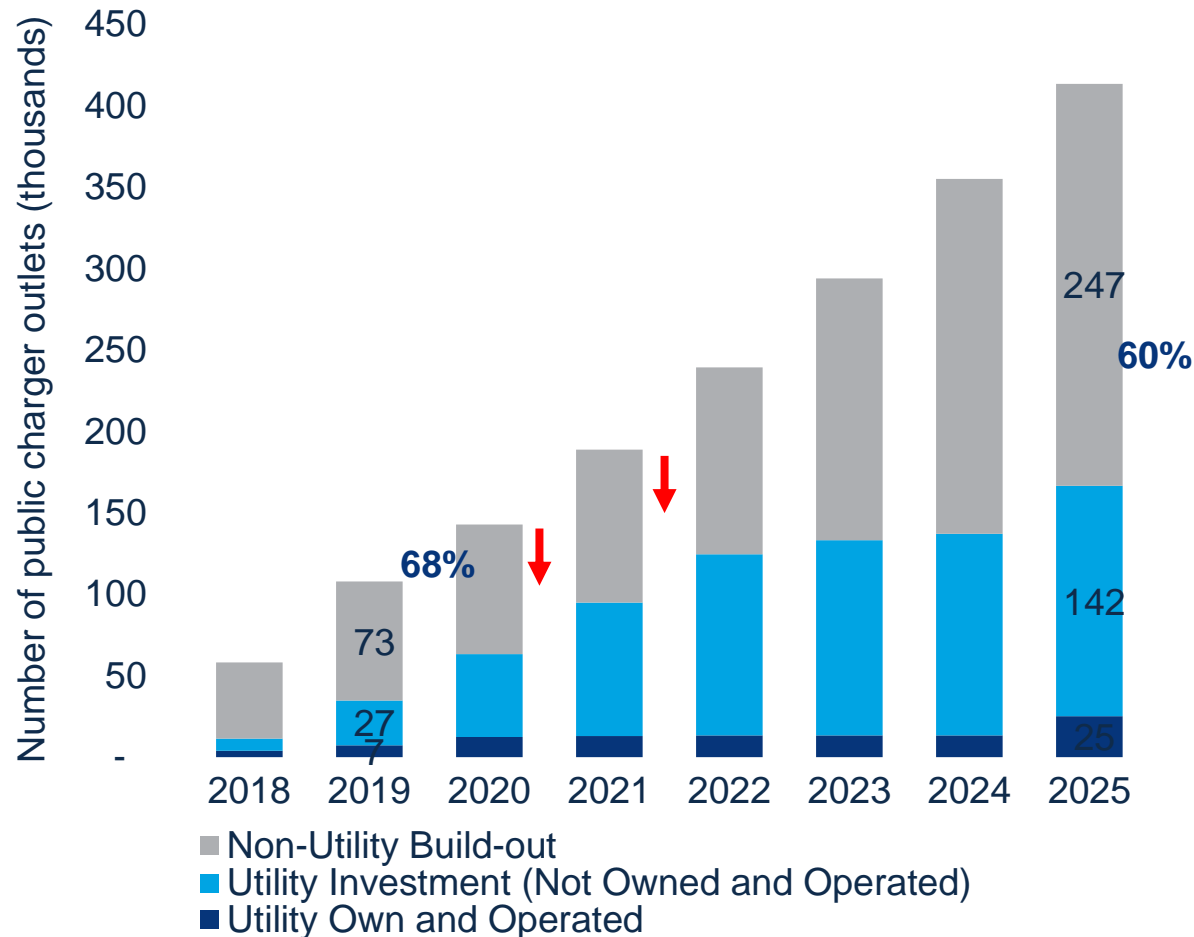


2020-21 residential storage forecast: pre-COVID vs. post-COVID

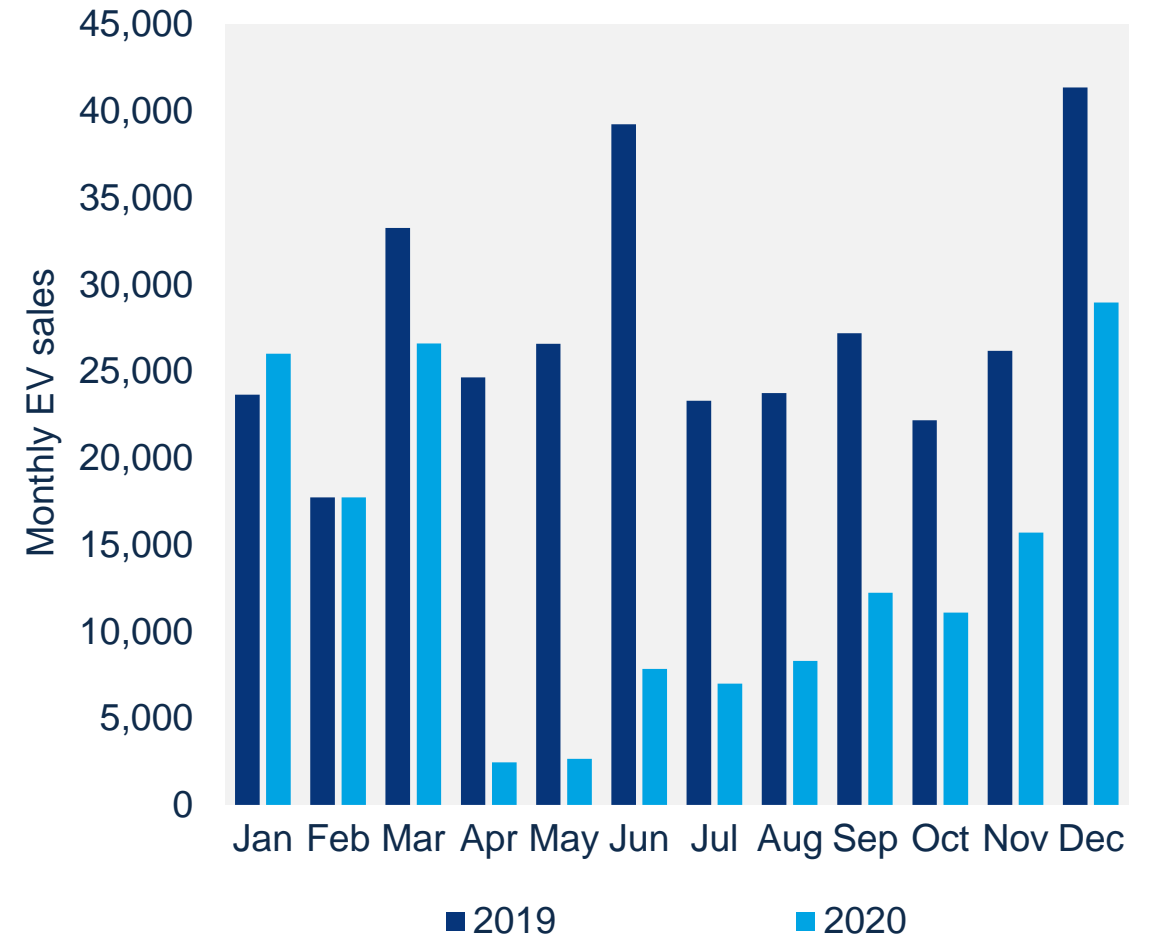


Network operators dominate operations and customer-facing services, but regulated utilities play an increasingly sizable role in funding development of chargers

U.S. public charger installations by funding source



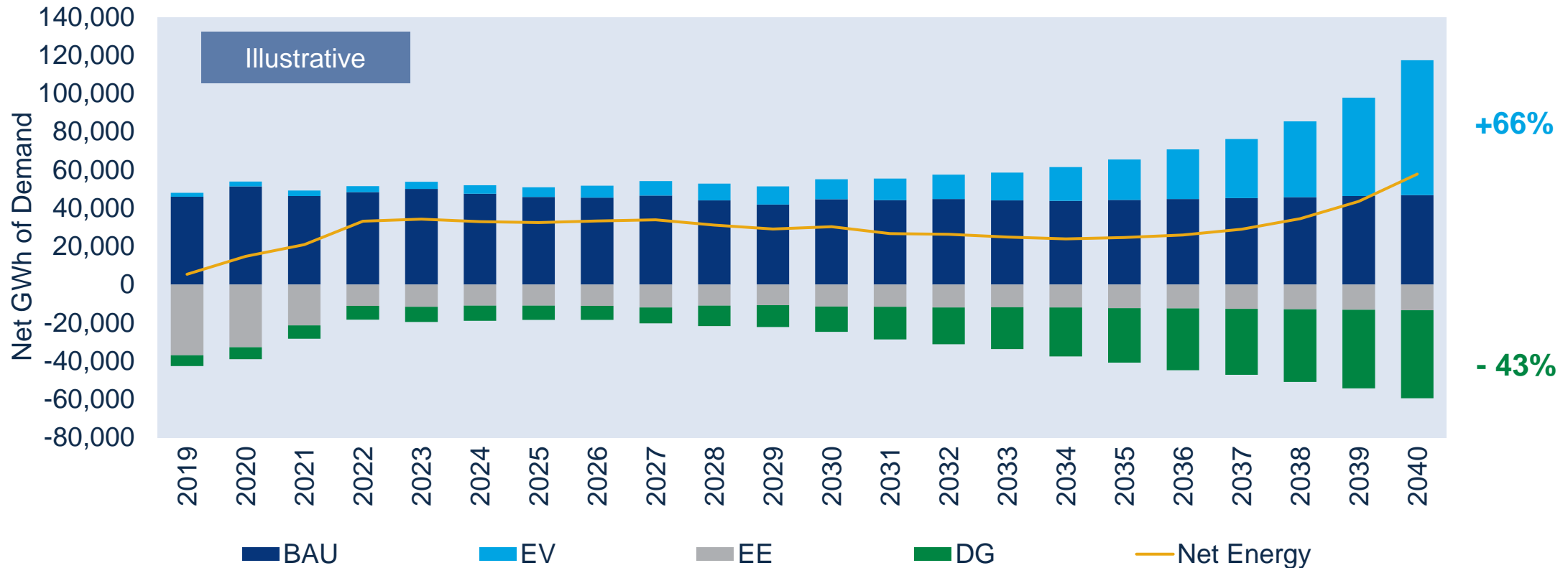
US EV sales – 2019 and 2020



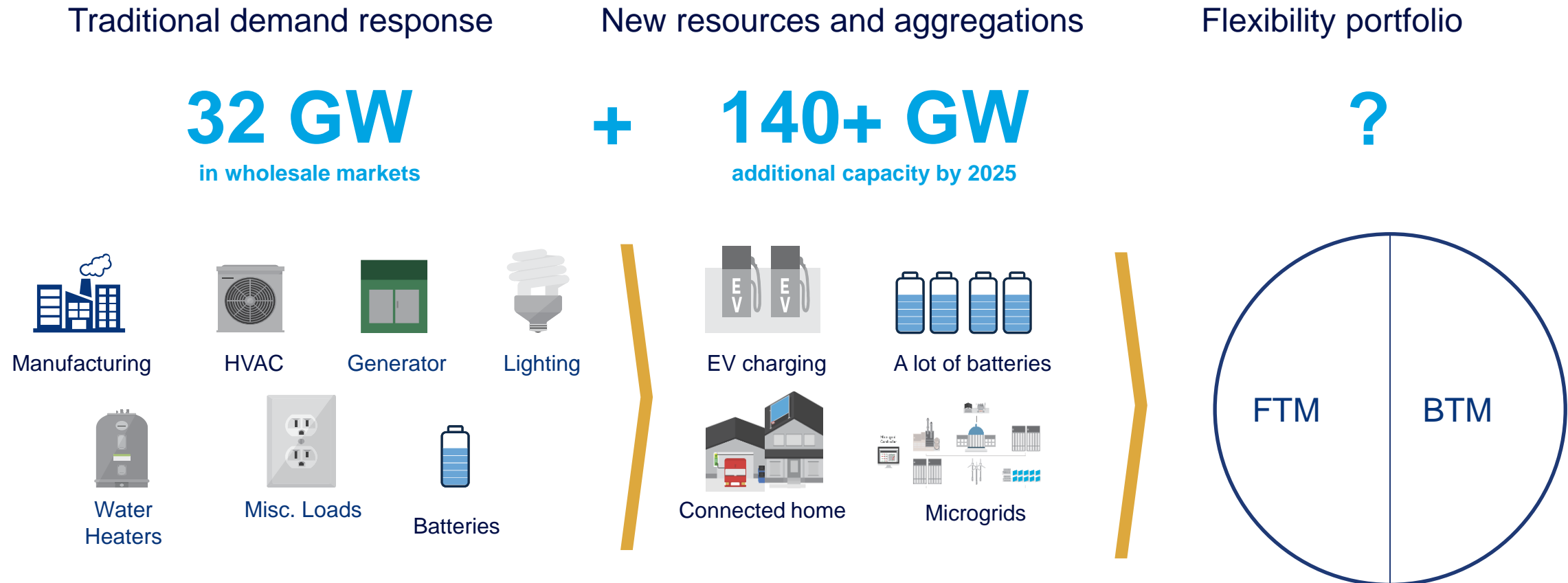
Electrification of transport reverses the downward load contraction trend

WoodMac's base case includes only 16% power market load growth from 2019 to 2040

United States bulk power system load growth, 2019-2040



Evolution of Grid Flexibility in the US

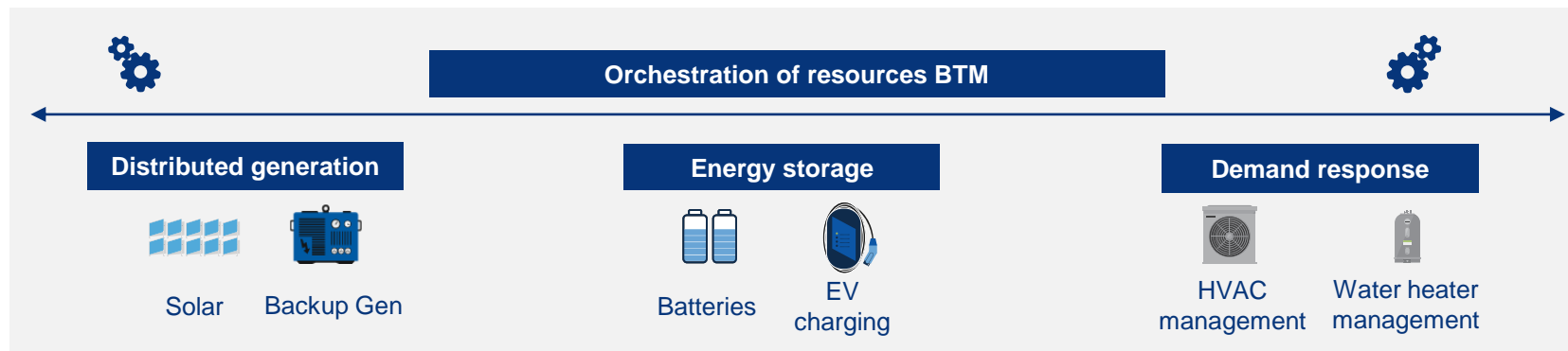



Grid flexibility potential and challenges:

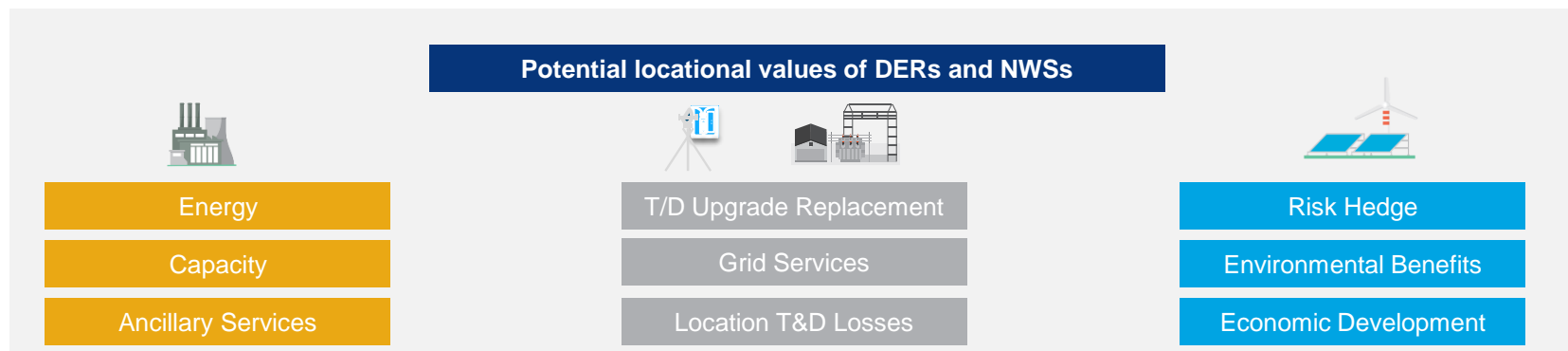
- Value stacking bundles multiple value streams and can improve the economics of DERs, but policies regarding value stacking are yet to be defined; a main concern is double counting
- Customer acquisition costs required to build a flexibility portfolio of DERs are high.
- The intelligent software layer to optimally orchestrate DERs and enable flexibility has not been proven effective at scale.

New energy trifecta – Mission critical for grid flexibility

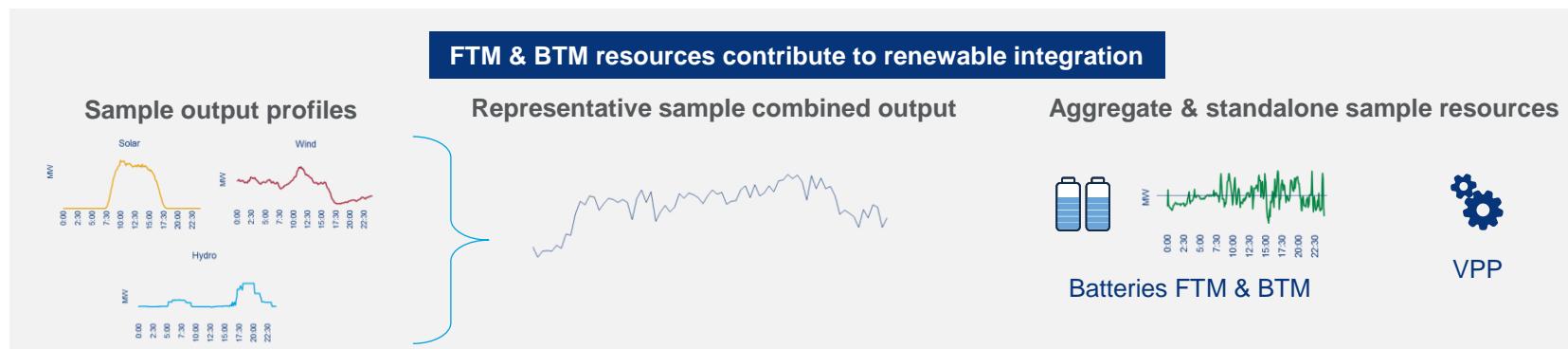
 DER aggregation for VPPs



 Non-wires solutions (NWS) T&D investment deferral



 Renewables firming and smoothing





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