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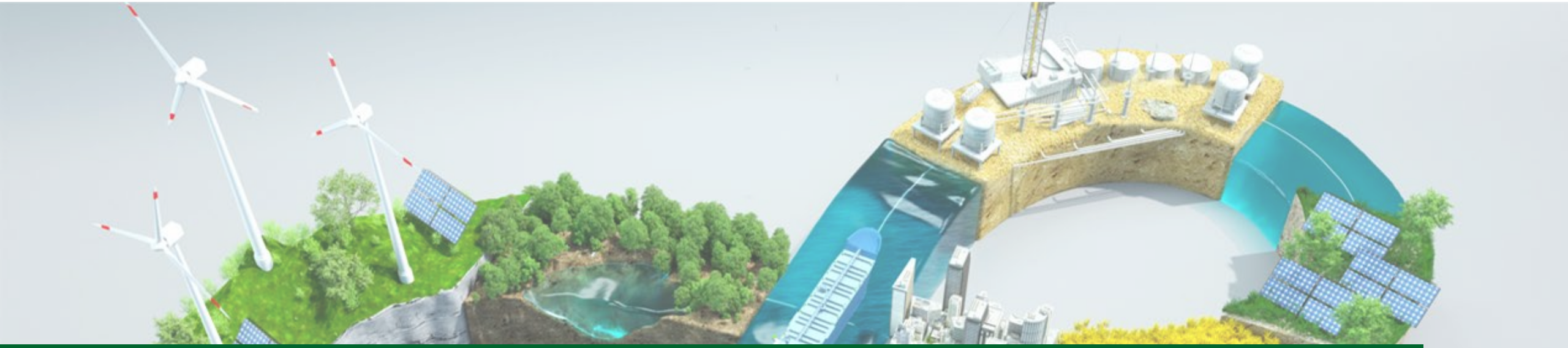

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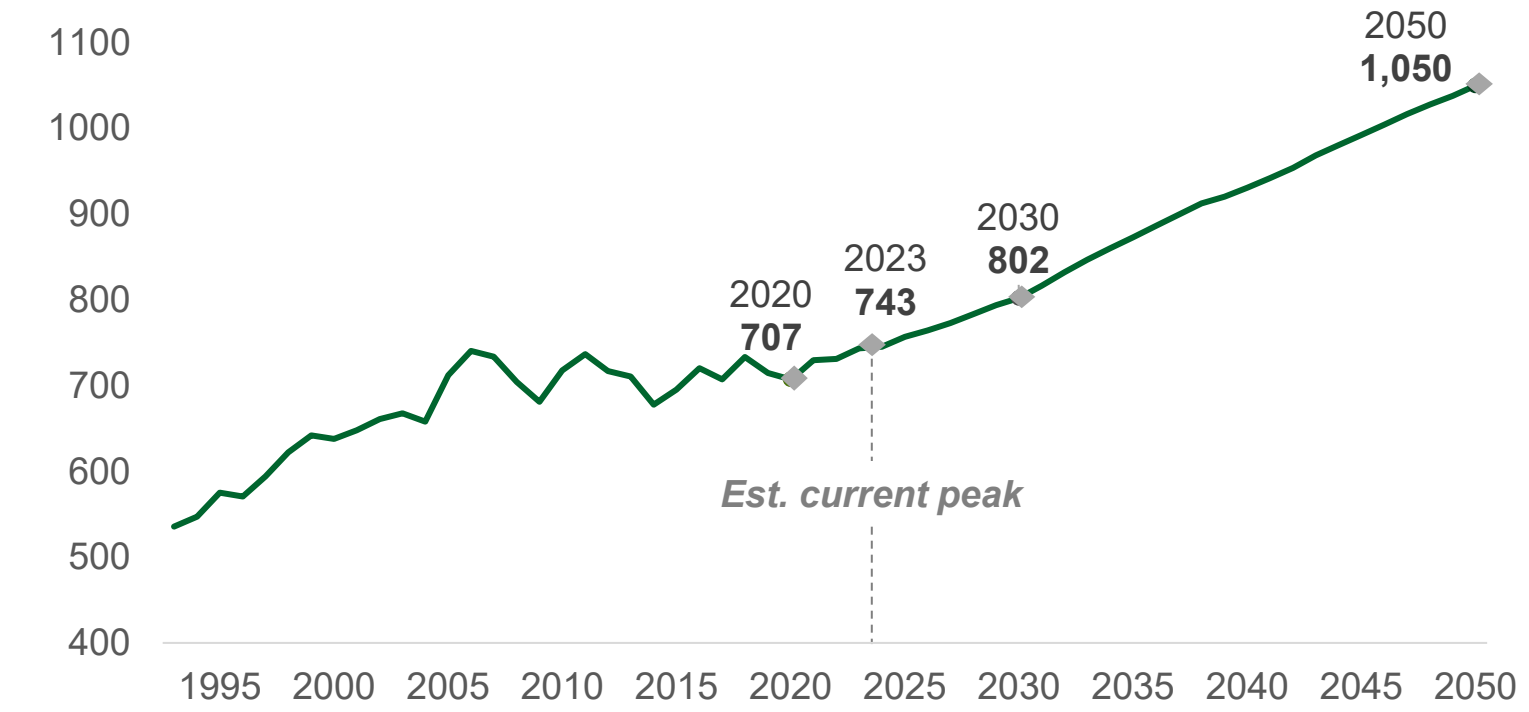
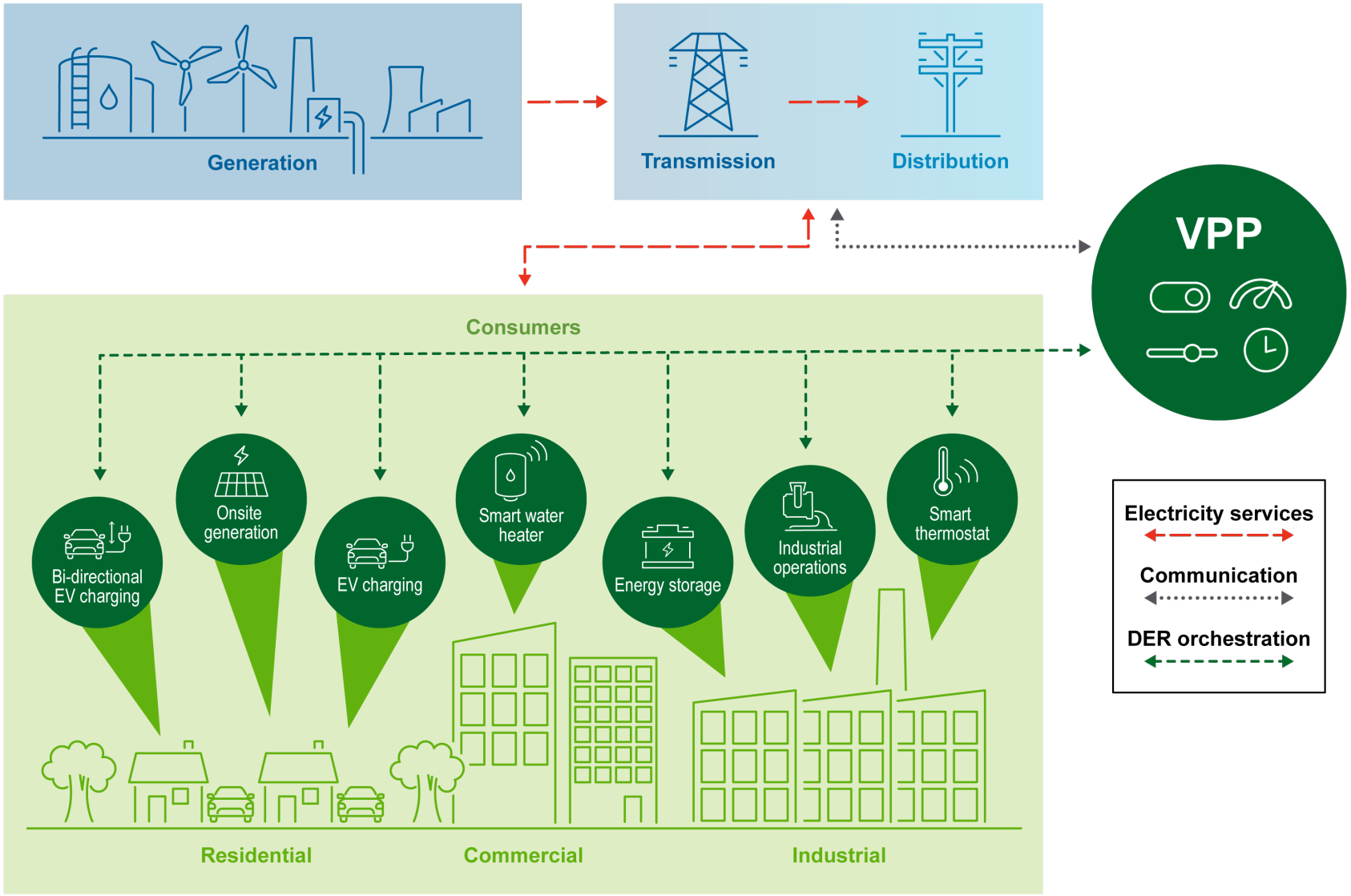
US peak demand is expected to grow by ~60 GW between 2023 and 2030

US system peak demand, historical and projected, 1995-2050 (GW)

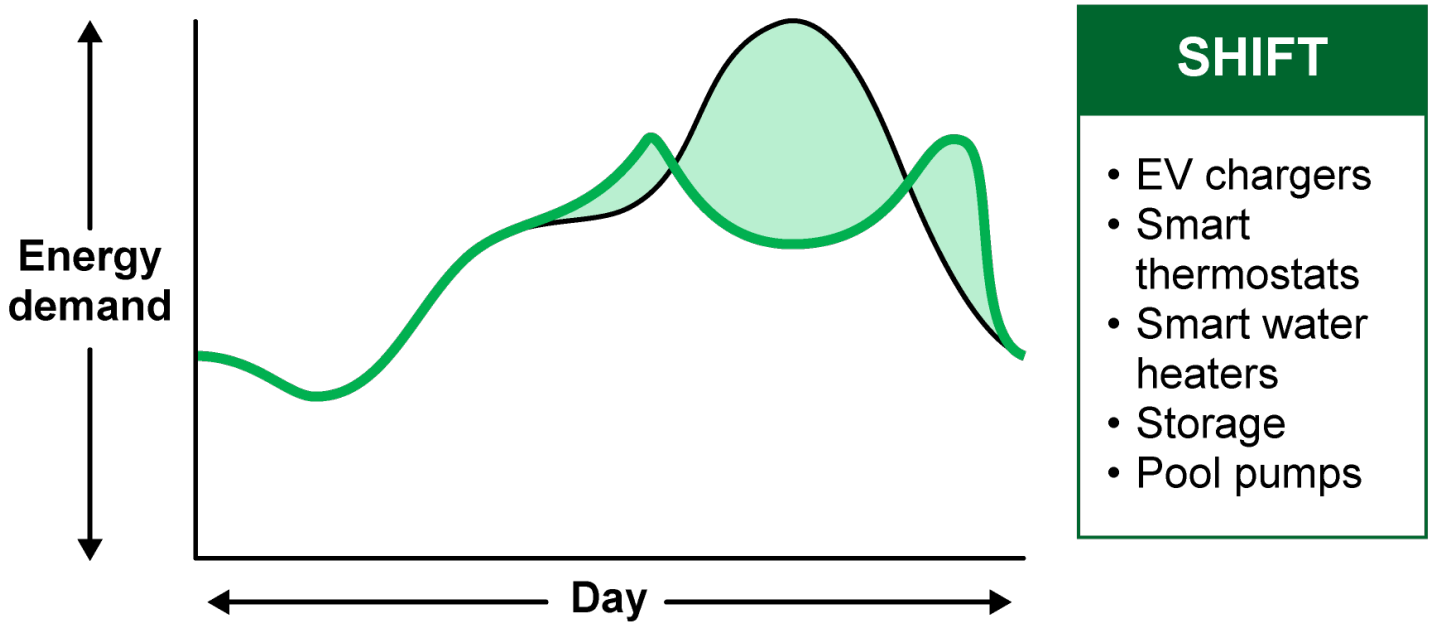


Source: Historical energy demand sourced from AEO; forecasted energy sourced from OP-NEMS mid-case scenario.

What is a virtual power plant (VPP)?



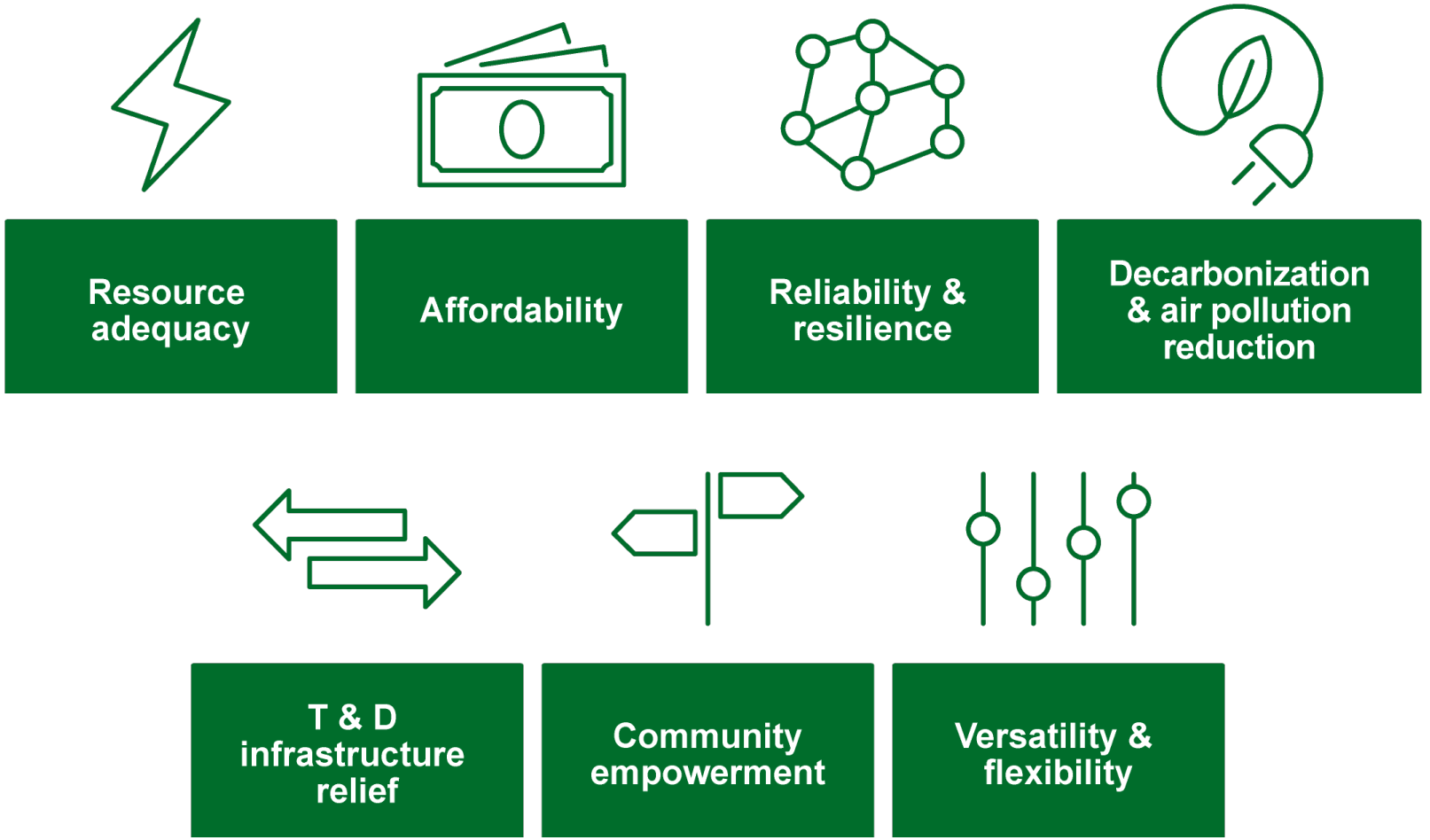
One critical function of VPPs is to use distributed energy resources (DERs) to reduce demand peaks



Source: Adapted from Lawrence Berkeley National Laboratory and NASEO-NARUC Grid-Interactive Buildings Working Group.

VPPs provide resource adequacy at a low cost, build resilience, reduce emissions, alleviate T&D congestion, and empower communities

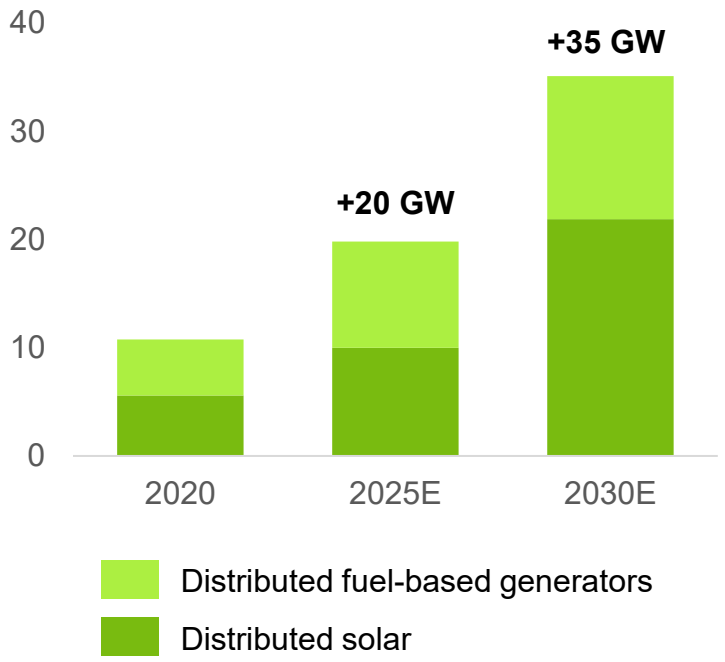
VPP value proposition



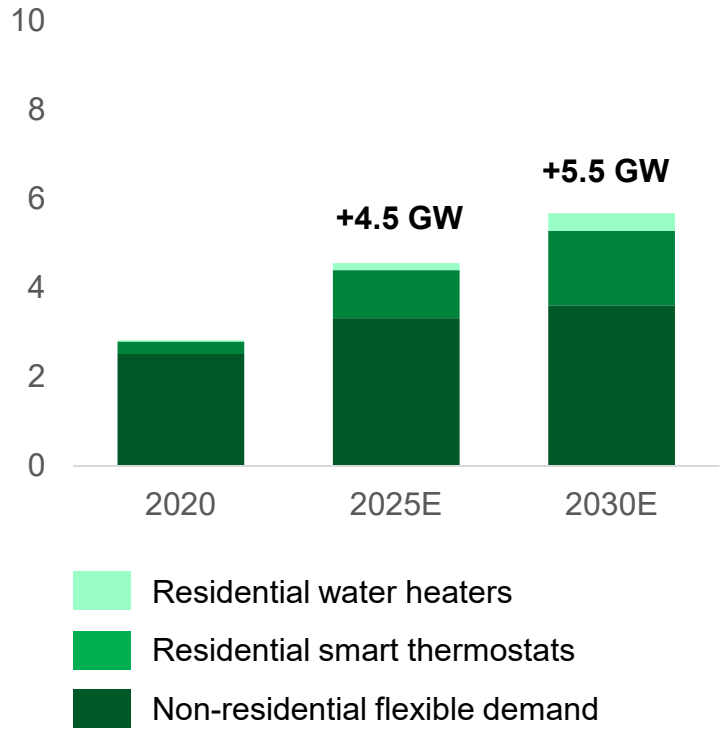
Annual capacity additions are accelerating across generation, flexible demand, and storage DERs

Annual DER capacity additions - Generation, Flexible demand, Storage (2020-2030E)

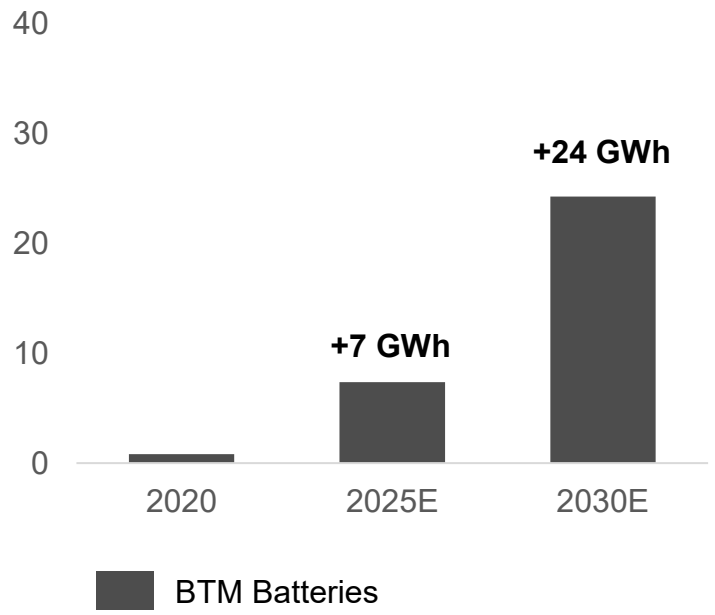
Nameplate generation capacity additions, GW



Flexible demand capacity additions, GW



Nameplate storage capacity additions, GWh

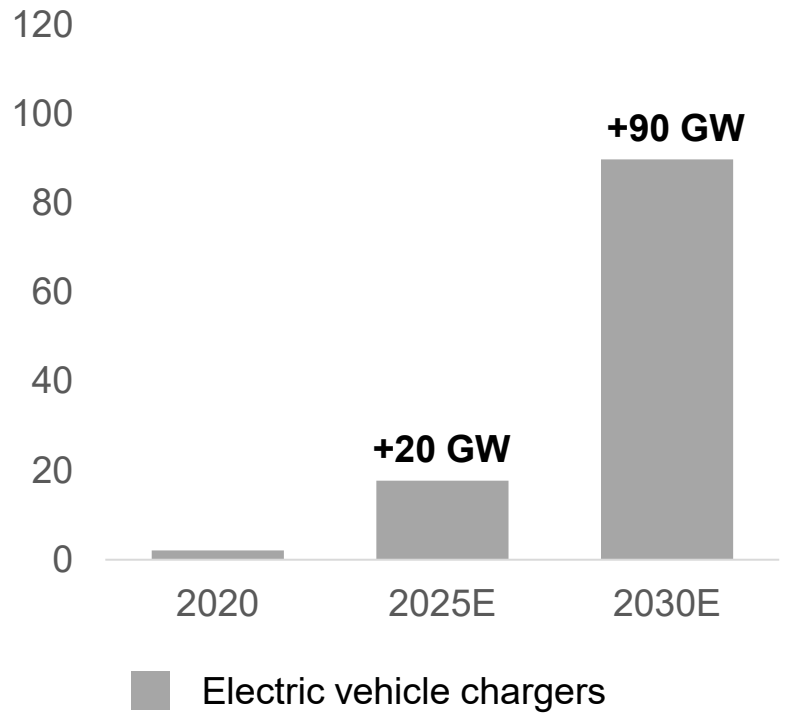


Source: WM refers to “Wood Mackenzie Power & Renewables”; Solar: NREL dGen (capacity growth), WM (capacity); “Mid-case, no nascent techs, current policies” scenario used for solar capacity growth projections; Fuel-based generation: OP-NEMS (capacity growth), WM (capacity); Non-resi. flexible demand: WM (capacity); Resi. ST flexible demand: WM (capacity); Resi. WH flexible demand: WM (capacity); BTM battery storage: BNEF (capacity).

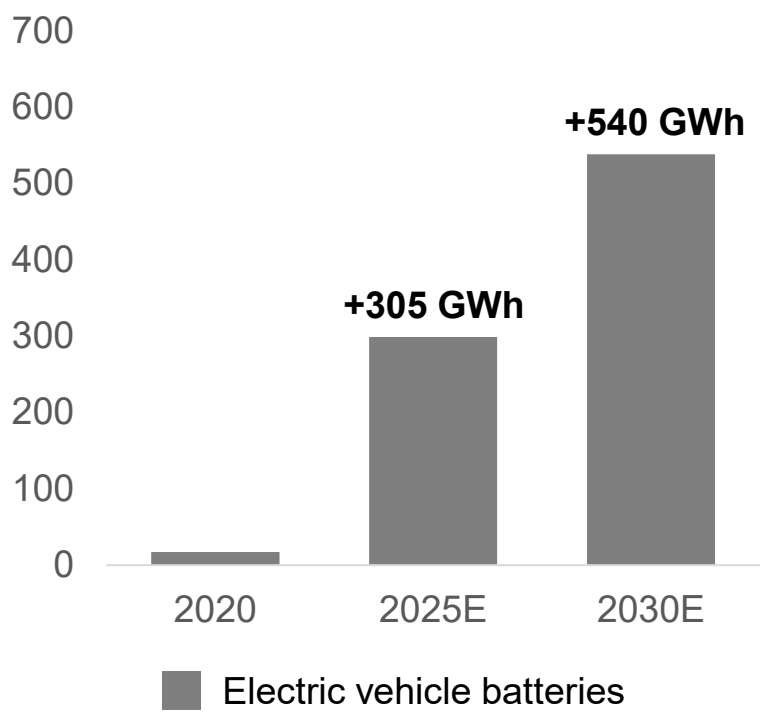
Each year, EV chargers and EV batteries will add 20-90 GW of demand and 305-540 GWh of storage capacity (nameplate)

Annual EV charger and EV battery capacity additions – Demand, Storage (2020-2030E)

Nameplate demand capacity additions, GW



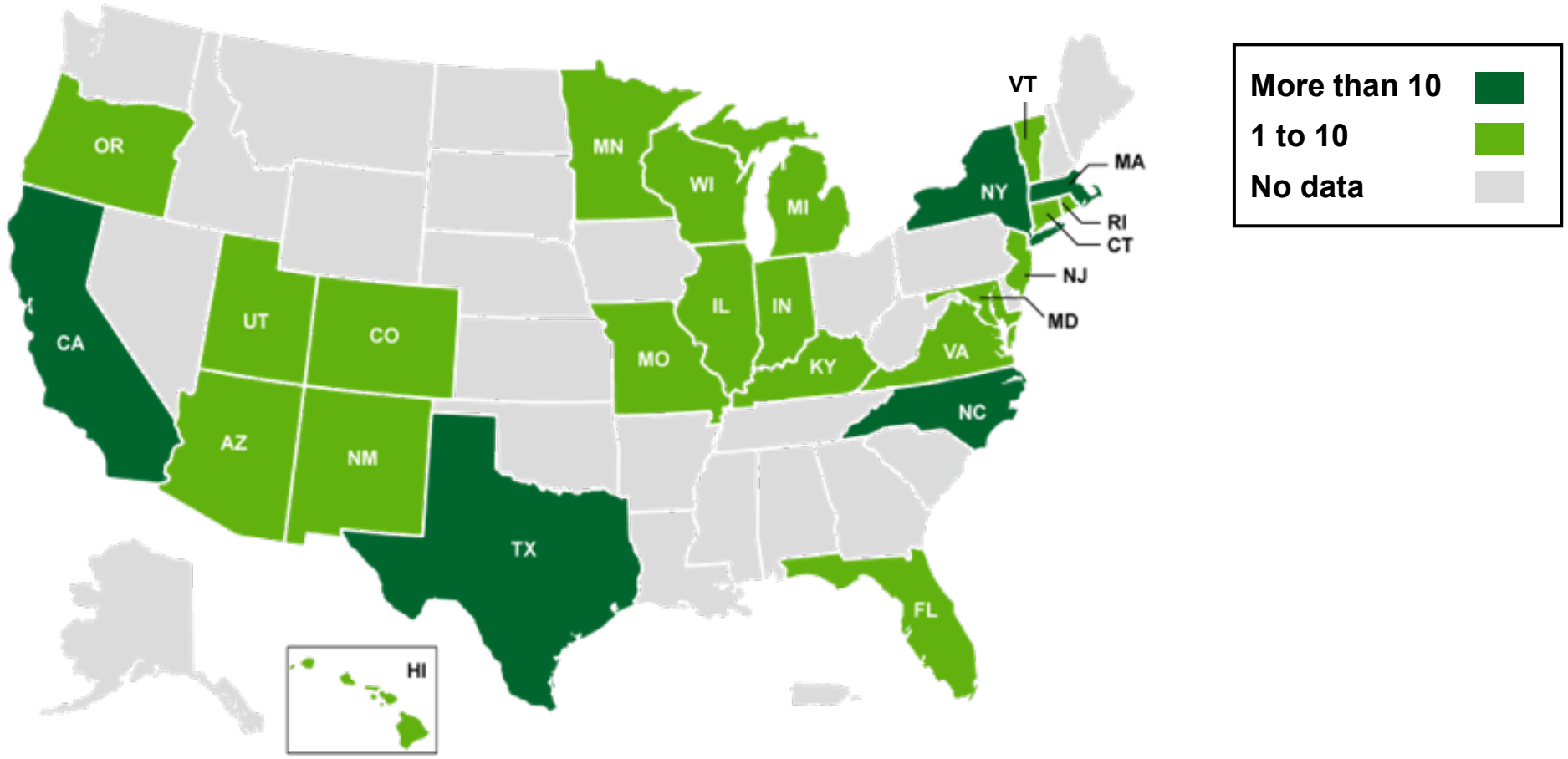
Nameplate storage capacity additions, GWh



Note: Conversion of DER nameplate capacity (generation, demand, or storage) to DER contribution to VPP capacity varies by DER type (see Chapter 1, Clarification of Terms). For example, EV & EV charger contributions depend on state of charge, driving patterns, VPP enrollment, and load mgmt. approach. EV charger estimates based on NREL projections for 2025 and 2030 charging port count, NREL estimates of equipment and installation costs, and DOE AFDC capacity estimates.
Source: WM refers to "Wood Mackenzie Power & Renewables"; EV chargers: NREL (Number Ports); DOE AFDC (Capacity per Port); EVs: EERE/NREL/ORNL (non-resi. EV capacity/DER); EIA (2019 LDV EVs); EV-Database (resi. EV capacity/DER); Kelley Blue Book (resi. EV price); OP-NEMS (EV stock); VTO (non-resi. EV price).

VPPs are concentrated in a few states with favorable market mechanisms in wholesale and retail markets

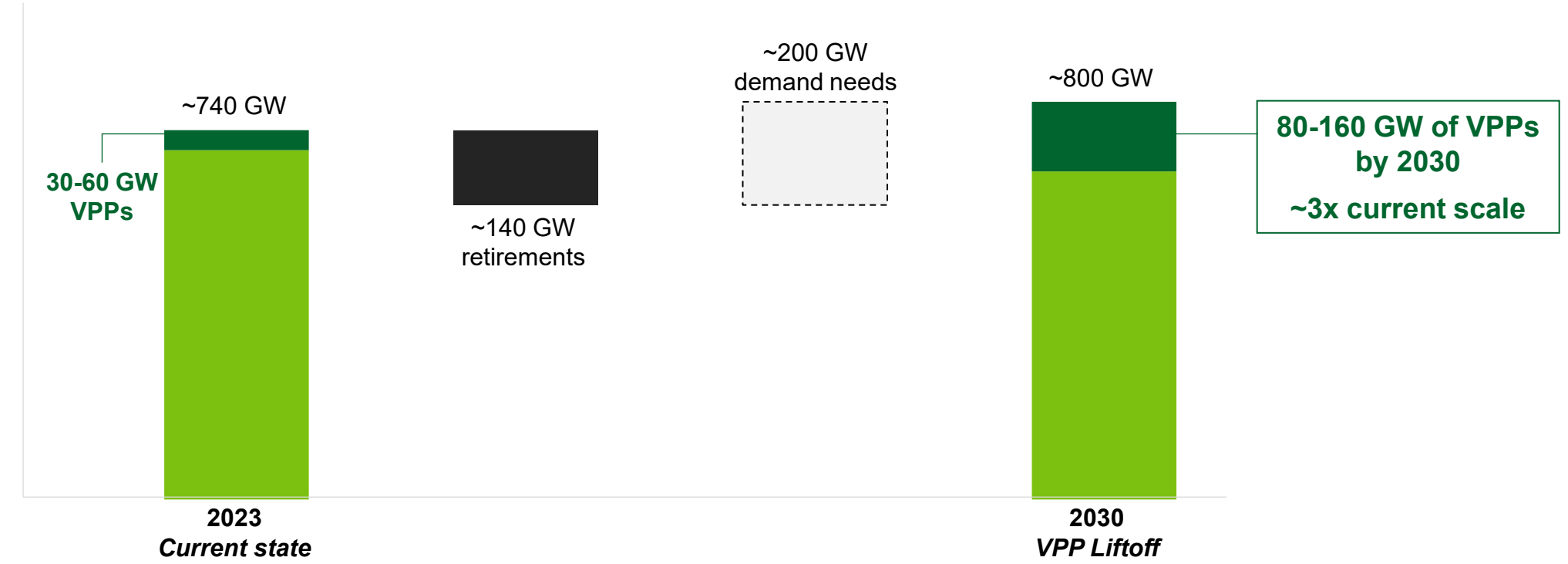
Number of 3rd party VPPs procured by utilities in each state (2022)



Source: Wood Mackenzie Grid Edge Service. Industry interviews.

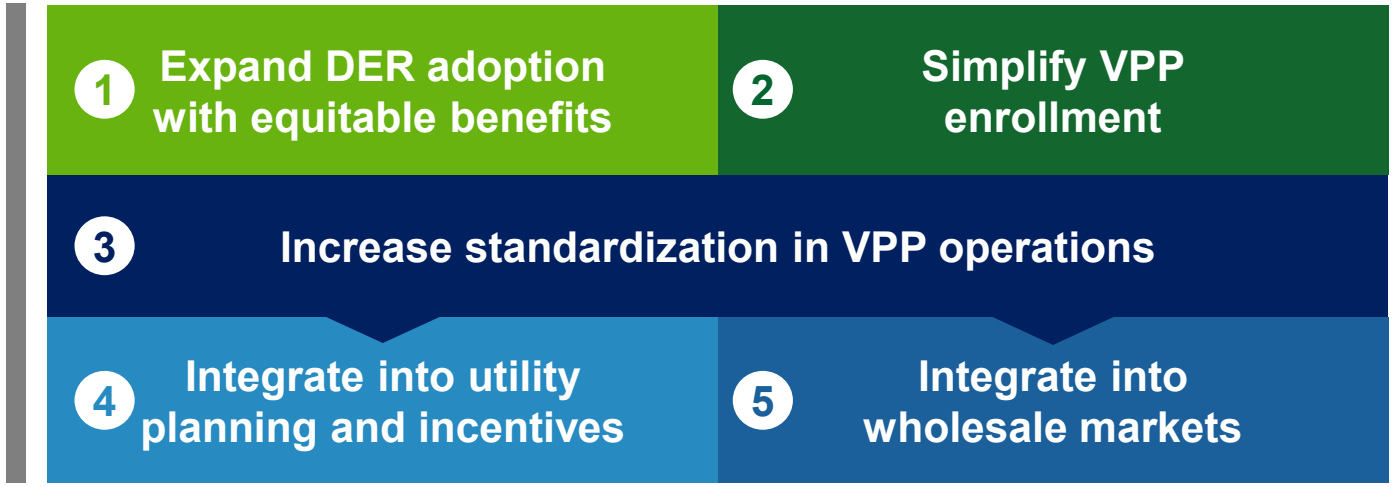
Tripling current VPP scale by 2030 could address 10-20% of peak load nationally while saving ~$10B per year in grid spending

U.S. peak electricity demand, GW



Five imperatives will accelerate Liftoff for VPPs, including increased DER enrollment, standardized VPP ops, and improved market integration

Imperatives for VPP liftoff



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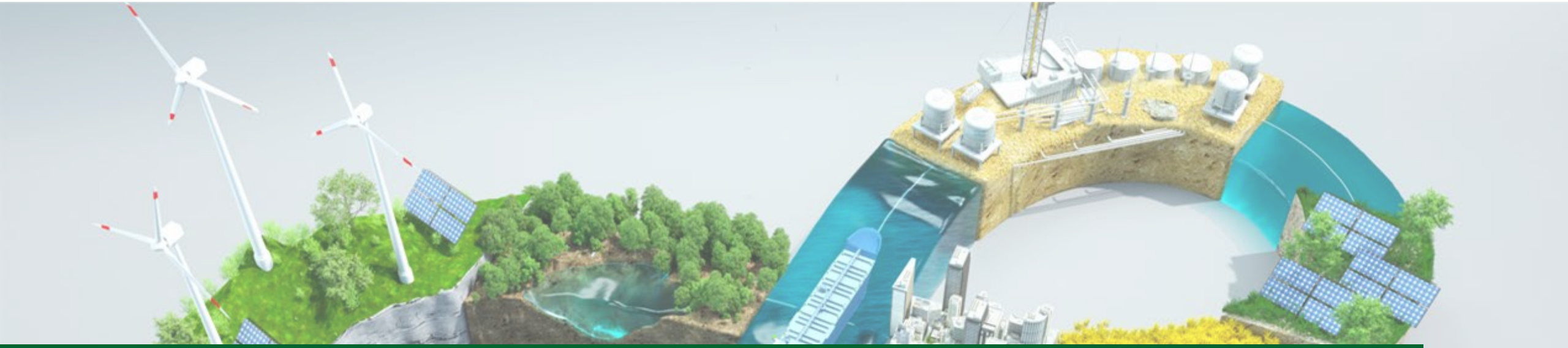

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