BEHIND-THE-METER RESOURCES, AGGREGATIONS AND MARKET PARTICIPATION

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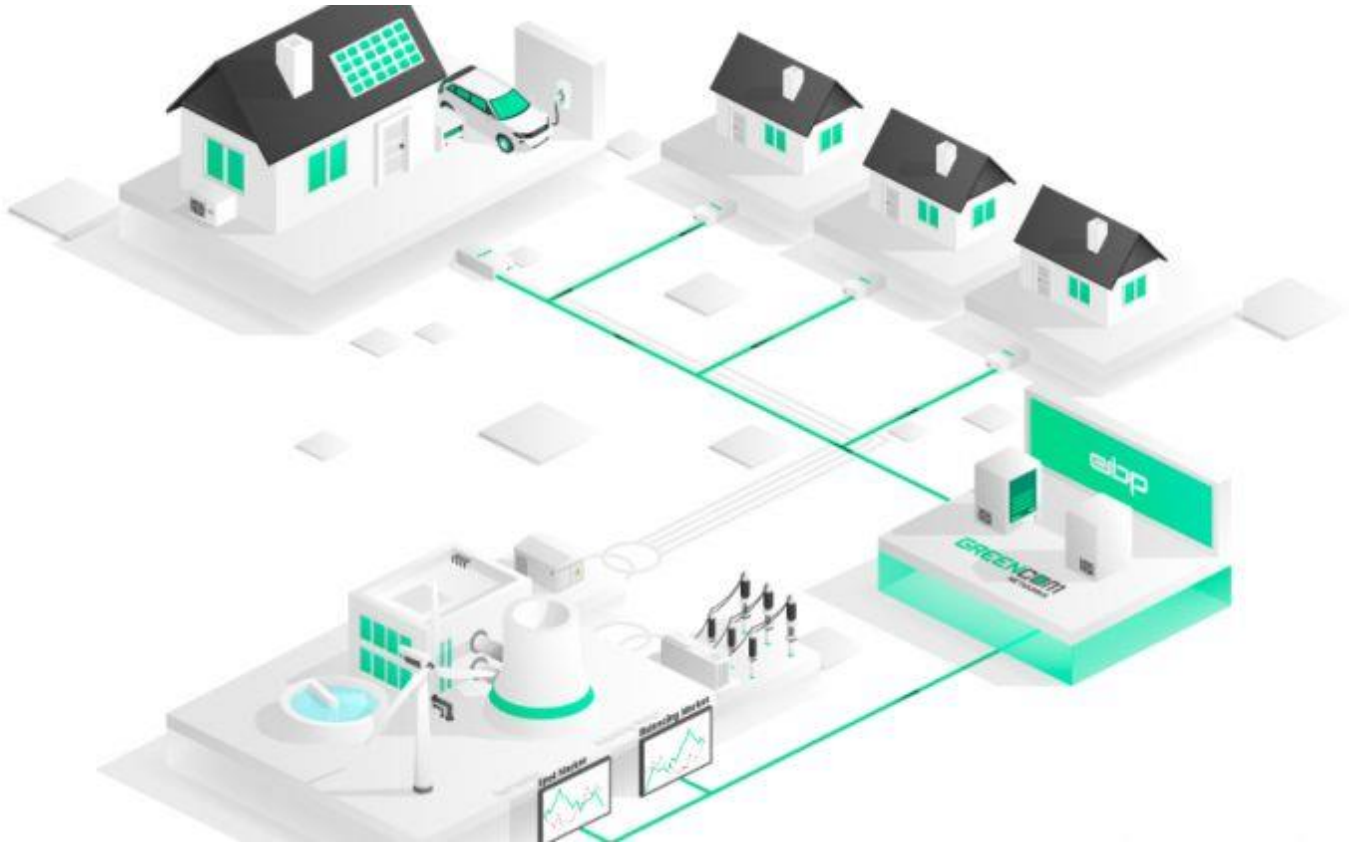
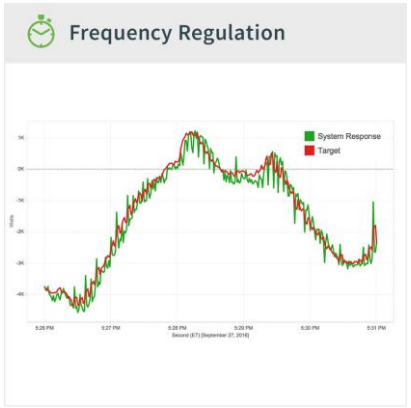
VIRTUAL POWER PLANTS

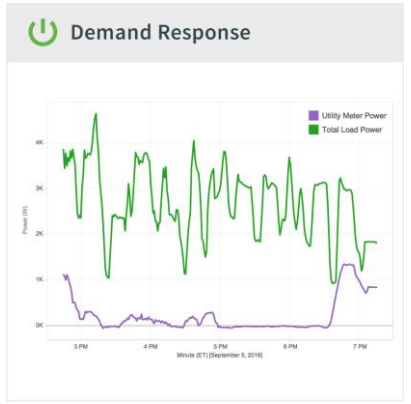
- Combine Distributed Energy Resources with cloud-based software controls to provide services to support the grid
- May include front-of-meter and behind-the-meter resources
- May be autonomous, tariff-based (e.g., APS Schedule R-Tech), or market dispatched (e.g., CA's Demand Response Auction Mechanism)

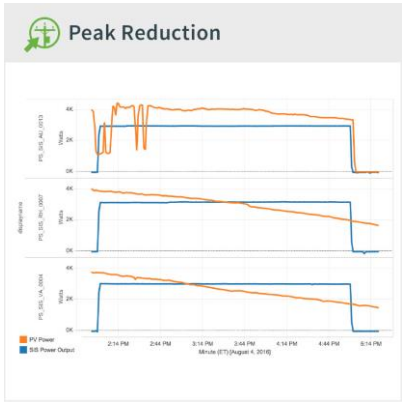


Source: https://www.greencom-networks.com/en

VPP GRID SERVICES







- Can be tailored to provide services in wholesale markets, and/or T&D services
- Aggregations can be homogeneous or incorporate portfolios of DERs, including:
  - Solar, energy storage, EVs, DR, smart appliances, DG
- Resources can be located anywhere on the grid, depending on granularity of need
- Response can be automatic, or manual depending on need and portfolio
- Typically cloud-based software with big data/ machine learning and AI capabilities

Source: http://www.sunverge.com/grid-services/

ADVANTAGES OF BTM VPPS

- Scalable and customizable to meet grid needs
- Can be deployed quickly, depending on installed base & customer potential
- Flexible siting: near load for local needs, or anywhere in the grid for system needs
- Shared benefits, costs and risks between utility and consumers/providers
- Competition among providers drives innovation and agility

Source: https://sonnenusa.com/en/

DRAWBACKS OF BTM VPPS

- Regulatory uncertainty creates risks for third party providers
  - Program changes, availability of incentives, changes to tariffs, rules and codes may severely impact provider business models
- Relies on providers to acquire customers to meet need
- Requires greater planning effort
- Market player viability and volatility, especially with nascent markets
- Requires appropriate rules to prevent market manipulation

Source: https://www.mandalayhomes.com/how-we-build/

EXAMPLES OF VPPS: EXISTING & PROPOSED

- California
  - SCE's Local Capacity Requirements program (85 MW)
  - Demand Response Auction Mechanism (avg annual IOU procurement of 179 MW)
- Arizona
  - APS Schedule R-Tech pilot (10,00 customers)
  - Sonnen/Mandalay Homes Jasper development (2,900 homes/11.6 MW, 23 MWh)
- New England
  - SunRun ISO-NE Capacity Auction Award (5,000 homes/20MW)
  - Green Mountain Power/Tesla (600 homes)
- Australia
  - AGL South Australia VPP (1,000 homes, 5 MW, 12 MWh)
  - Tesla/South Australia VPP (50,000 homes, 250 MW, 650 MWh)
- Europe
  - tiko/Swisscom Virtual Energy Storage (6,500 homes, 40MW)
  - Next Kraftwerke VPP (5,500 units, 4,500 MW)

Source: https://www.stem.com

CASE STUDY: BTM STORAGE IN DRAM

CAISO/CPUC Demand Response Auction Mechanism (DRAM) Pilot:

Source: https://advmicrogrid.com

- Wholesale Market Demand Response Program
- Day-Ahead & Real-Time market participation
- CAISO dispatches resources, IOUs provide settlement data
- Pilot status since 2015, program rules being re-evaluated to improve performance
- More than 52,000 customers enrolled for 2017
- Average annual August capacity procured (2015 – 2019) – 179 MW

DRAM CASE STUDY: STEM'S AI ENABLED VPP

- 2.4 MW capacity in current DRAM
- Over 100 Commercial & Industrial customers in 3 IOU territories have participated in events since 2015
- Participation in both day-ahead and real-time markets
- As of 2018, Stem was dispatched over 1,000 times in the real-time market

Source: https://www.stem.com

CASE STUDY: SONNEN/MANDALAY HOMES

- Sonnen and Mandalay Homes to build 2,900 homes incorporating solar plus storage in Prescott, AZ
- Homes also include latest energy efficiency and smart appliances
- Solar and storage to provide up to 11.6 MW/ 23 MWh
- DER to reduce peak capacity & potentially provide other grid services
- Takes advantage of APS Sched. R-Tech

https://www.greentechmedia.com/articles/read/sonnen-virtual-power-plant-us-2900-home-project#gs.gkxf4a

BARRIERS TO BTM VPP

- Conventional thinking
  - Not understanding value/capabilities/limitations of DER
  - Bias against customer-owned resources
- Misalignment of IOU financial motives & policy goals
- Inability of regulations to keep pace with technology development and market evolution
  - Lack of agility w/r/t tariff and program design
  - Regulations/rules designed for conventional resources applied to DER
  - Conflicting policy goals

Source: http://www.sunverge.com

A SPECIAL CASE FOR ENERGY STORAGE

- Make sure tariffs align with policy goals/utility operational objectives
- Recognize capabilities and limitations of ESS
  - Build margin/renewable integration vs operational GHG reductions
  - Value flexibility/ability to provide grid services versus charging constraints
    - ITC/Solar plus Storage rules
    - Operational requirements (cycling/capacity factor)
- Multiple use applications
  - Time-differentiated
  - Capacity differentiated
  - Simultaneous

Source: https://www.stem.com

THANK YOU!

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