Solar + CHP

Increased Resilience, Sustainability & Productivity

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More ELECTRIC

2x

faster growth of electricity demand compared to energy demand by 2040

Source : IEA WEO

More DIGITIZED

10X

more connected devices than connected people by 2020

Source : Internet World Statistics, Mc Kinsey

More DECARBONIZED

86%

of investments in power generation through 2040 will be in zero-carbon fuels

Source : BNEF 2017

More DECENTRALIZED

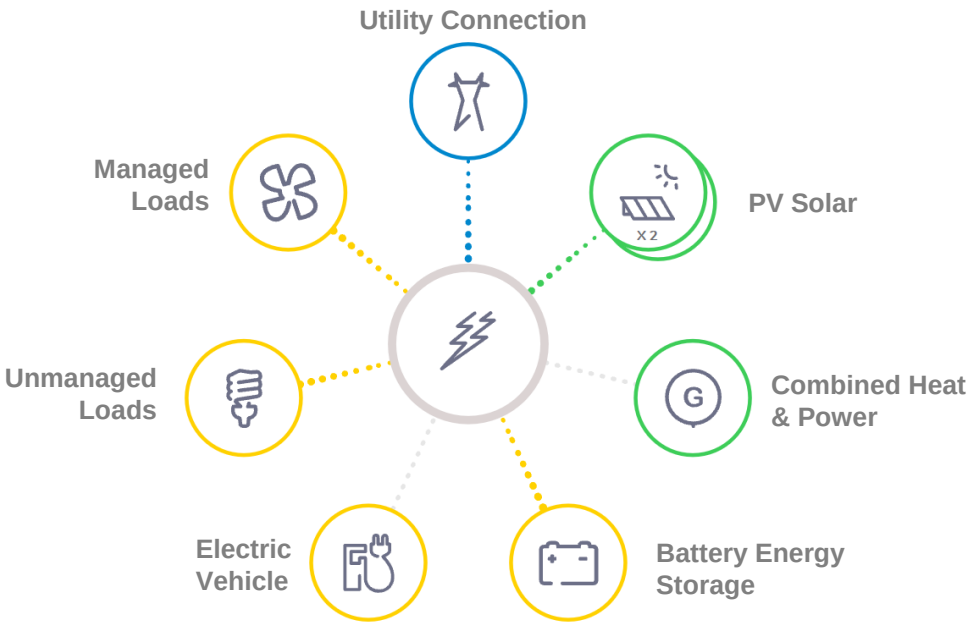
12%

of generating capacity from distributed generation in 2025 of which solar will be 65%

Source : Frost & Sullivan

New Energy Landscape

Data demystifies energy, unlocking new ways to optimize energy and meet business objectives

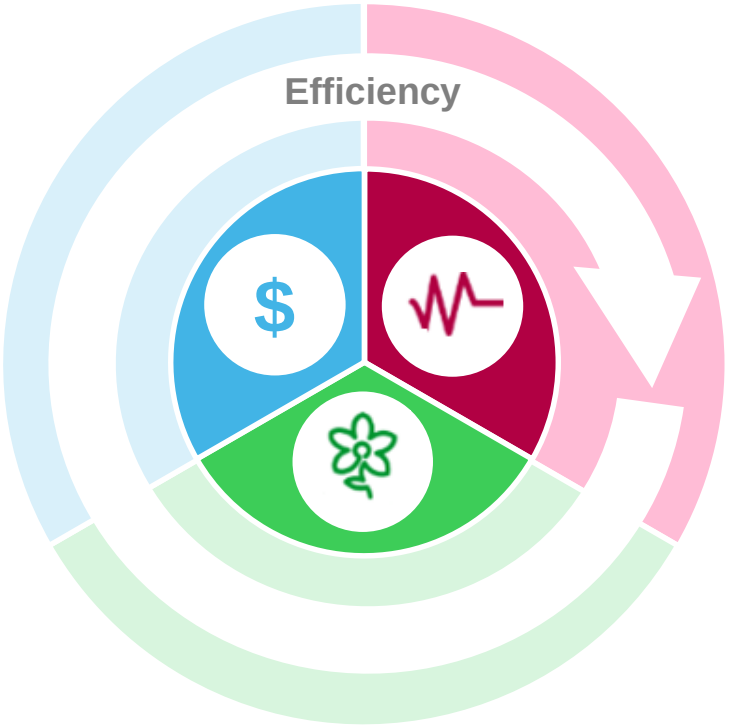


- Consumer-Centric
- Load-Centric
- Flexible, Modular, and Scalable

Microgrid is about making wise choices at the intersection between energy smartly acquired, locally produced and efficiently consumed

Integrated Energy Outcomes

Historically passive consumers are thinking about energy in new ways



Cost

- Lower / More Predictable Energy Costs
- Energy / Fuel Source Arbitrage
- Flexibility drives savings / incremental revenue

Resilience

- Serve loads during times of grid stability
- Oasis for employees / customers – shelter in place
- Protect power sensitive / critical assets from poor power quality

Sustainability

- Reduce carbon footprint
- Improve brand image
- Attract / Service carbon sensitive customers

Integrated Energy Outcomes

Supply mix considerations

CHP

Technology	Electrical Output	Emissions	Load Following Ability	Technology Maturity
Natural Gas Reciprocating Engine	Synchronous	Medium	Medium	High
Fuel Cell	Inverter	Low	Low-Medium	Medium-High
Microturbine	Inverter	Low	Medium-High	Medium-High
Gas Turbine	Synchronous	Low	Medium-High	High
Diesel Reciprocating Engine	Synchronous	High	High	High
Battery Energy Storage	Inverter	Zero	High	Low-Medium
Solar PV	Inverter	Zero	Low	High
Wind Turbine	Inverter	Zero	Low	High

Orchestrating a Diverse Supply Mix

Get used to it!

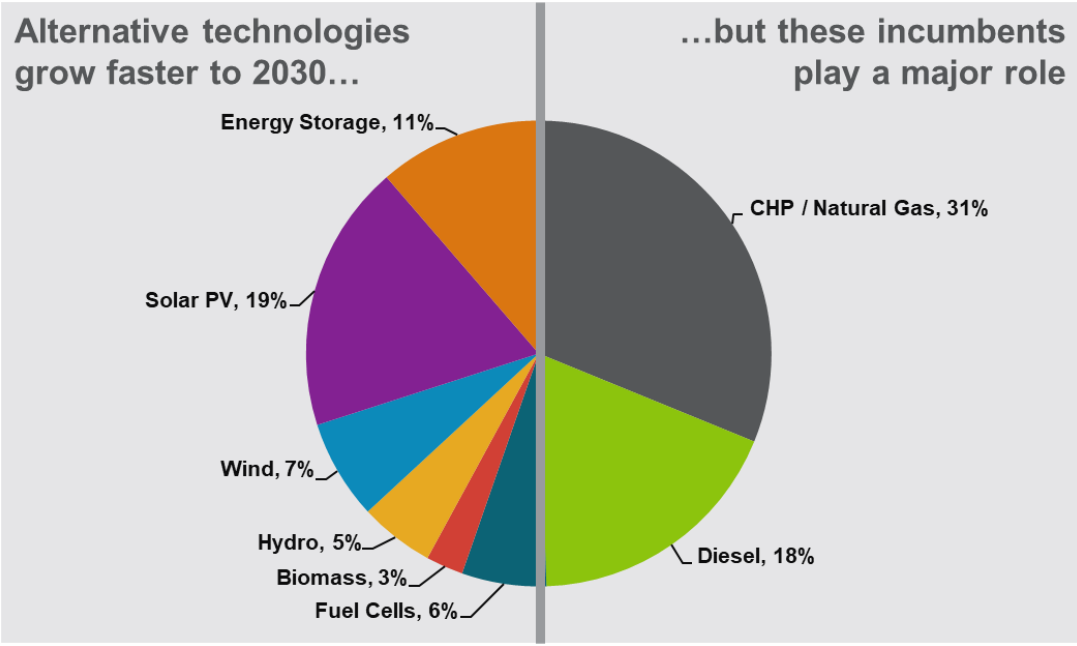
Diverse DER are complementary

PV and storage rightly make headlines

- Combined, they represent 30% of new annual microgrid capacity today, forecast to grow to 54% in 2026

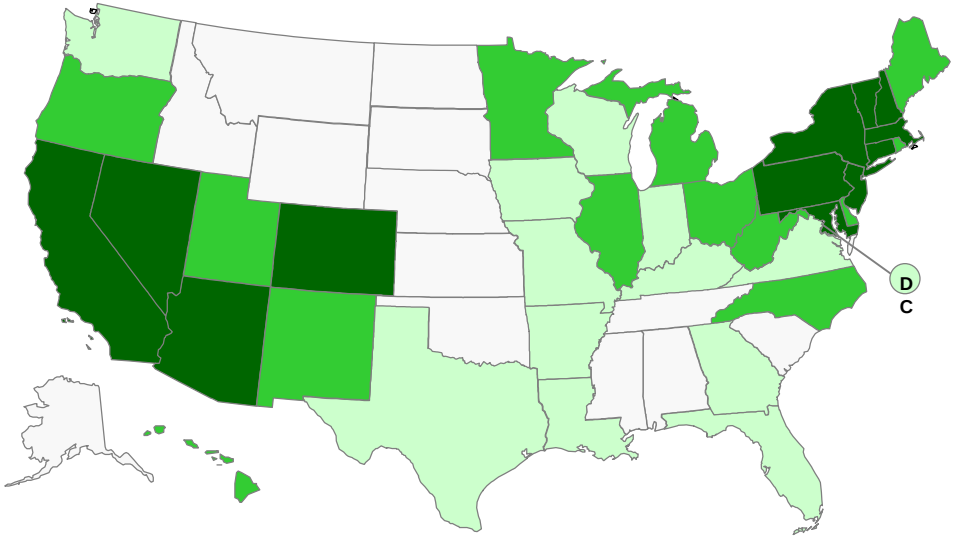
However, fossil incumbents play key roles

- Long duration dispatchable power for windless winter stretches; see Hurricanes Sandy (2012) and Harvey (2017).
- Energy density: gensets can deliver 4,500 times more energy per square foot than PV.
- Fuel price volatility and carbon emissions are significant risks/barriers, but both can be mitigated.



Source: Navigant Research

Catalysts for a New Energy Landscape in the US



1. Levelized Cost of Energy at or below Grid Parity (Deutsche Bank)
2. Credits for Net Excess Generation – Net Metering (DSIREUSA)
3. Aggregated, Virtual, or Community Net Metering (NCSL.org)
4. Prone to Power Outages / Severe Weather (US Blackout Tracker)
5. High MWs per Net Meter (EIA-826)
6. Forecasted Growth in non-Resi Solar PV systems (GTM)
7. Potential for Self-Supply (ScottMadden Mgmt Consultants)

Case Study: Montgomery County, Maryland

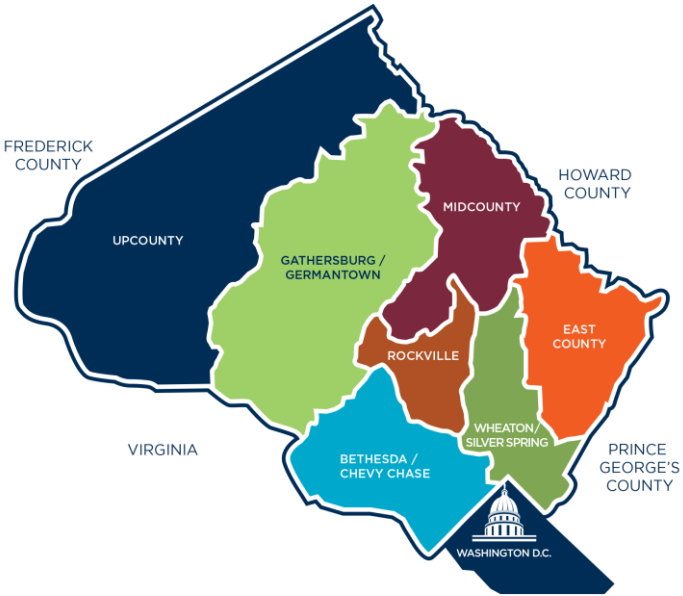
Approximately **1M people**

High-tech, knowledge-based **economy**

400+ facilities, 9M sq ft of real estate, 3k vehicles, 9k employees

Leader in Advanced Energy

- 11 megawatts of solar across 18 sites
- One of the largest green power purchasers in the US, acquiring more than 430,000,000 kWh of clean energy annually
- Procure 100% clean energy for County facilities
- Inaugural Partner in the U.S. DOE's Combined Heat and Power for Resiliency Accelerator



 #EcoStruxure #Microgrid

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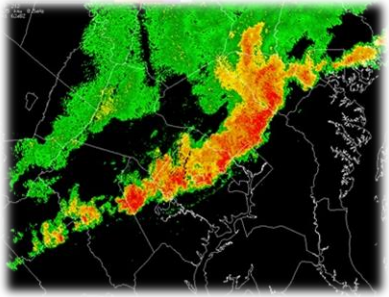
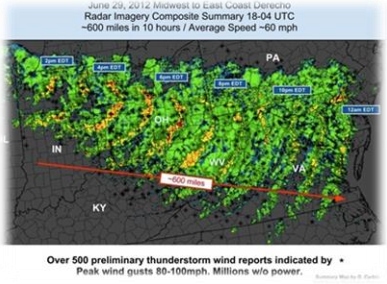
Challenges

- Better Resilience
  - **February 6, 2010** - snowstorm 108,000 without power in Montgomery County. Almost 10,000 in Montgomery County still without power after three days.
  - **July 25, 2010** –¼ million out in Montgomery County. Utility perspective 1953 lines down, 4 substations locked out, nearly 100 poles destroyed.
  - **June 29, 2012** – Derecho, ¼ million without power in Montgomery County, Over half a million regionally. 71 County facilities without power, 550 traffic signals out, over 8 days for some residents.
- Higher Sustainability
  - Valued by constituents: Jobs, taxes, quality of life
- More Predictable Energy Costs
  - Capital Procurement not an option
  - Variable energy costs difficult to budget
- Without exposing County to new risks
  - Technology risk
  - Rebate, Tax Credit & Incentive uncertainty
  - Approach new to utilities and permitting officials
  - Difficulty in constructing “in situ”





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The Solution

- Improve the resilience of county operations with majority of energy local produced and ability to island > 7 days without grid support
- Upgrade existing aging electrical infrastructure without capex
- Control energy cost exposure
- Reduce greenhouse gases and other emissions
- Provide a contract vehicle to peer jurisdictions
- Structured as a P3 built upon an enhanced Power Purchase Agreement
- Competitively solicited as energy supply + other tech
  - Schneider Electric selected as the energy performance contractor/prime.
  - Duke Energy Commercial Renewables provides capital and owns the system for 25 years
  - REC Solar Canopy construction

Public Safety Headquarters

- Large electrical upgrades
- New 2 MW Solar
- Load management with BAS
- New Cogen
- Integrate Existing gas generator
- DC fast charging
- Improved HVAC

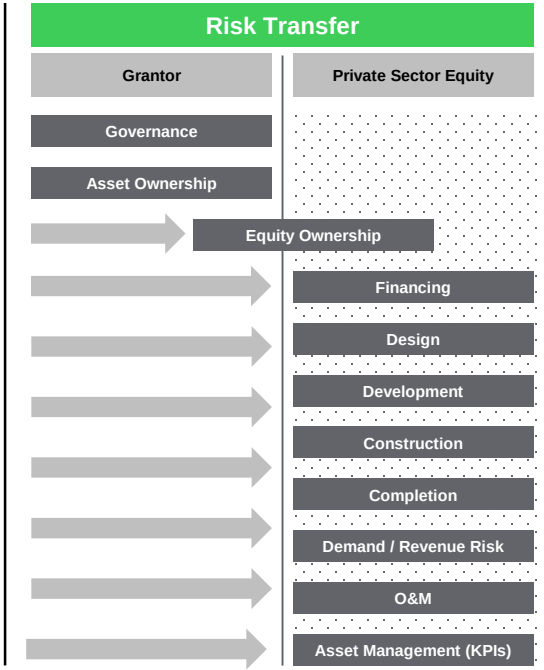
Montgomery County Correctional Facility

- Minor Electrical Upgrades
- New 250 kW Cogen
- Integrate existing Diesel
- Potential future canopy installation over parking

Energy as a Service

Delivering integrated energy outcomes in an off balance sheet –performance driven model

- With energy technology, regulation, and business model in flux a solution for delivering energy outcomes is much more than a question of finance.
- Energy as a Service not only addresses financial aspects but efficiently transfers the risks associated with new technology, shifting regulation and incentives, and asset operation and optimization to others whose business models are setup to mitigate them – without sacrificing governance.
- It provides a single point of accountability for project delivery across design, financing, construction, operations & maintenance.
- Inherent is the ability to enforce standards for construction quality and service performance.



Clear risk transfer and alignment of objectives

How Do we Quantify the Value?

USGBC PEER Standard

- Independent assessment of performance
- Certified Sustainability Rating from USGBC
- Independent assessment of project value
- Basis for case studies and marketing materials
- Recognition by GBCI and USGBC and candidate for **Annual Galvin Award**

Overall PEER Score — 97%

Performance Categories	Max Points	Estimated Points
PEER Estimated Total Score	300	292.2
Energy Efficiency and Environment	100*	100
Reliability and Resiliency	100*	98.7
Operational Effectiveness	100*	93.5

* Able to achieve 100 leveraging bonus points

Additional Value Streams

- Water savings of $5 million
- Reliability and resiliency
- Reduction in power quality events – low voltage, voltage imbalance – that damage equipment
- Insurance cost reduction

Finding Additional Savings or Profits

- Leverage external service for economic dispatch
- 2MW plus solar of excess generation
- Capacity avoidance and sales- ~$140K
- Export power - ~$150K

Reliability and Resiliency

PEER Score 98.7 out of 100

Metric	Benchmark	Project Design
SAIDI, min	181	2
SAIFI	1.2	0.06
Protected Equipment	Exposed overhead lines	Electrical system is underground and enclosed, sump pumps protect equipment in basement
Redundant Supply	Two overhead feeds from same substation	Local generation 2x peak demand, redundant site substations with a cross tie
Redundant Site Distribution	Four of the six site distribution panels have redundant distribution feeds and auto-transfer from the redundant on-site generation bus	No change to site distribution
Islanding	None	Black start, auto

Energy Efficiency & Environment

PEER Score 100 out of 100

Metric	Benchmark	Project	Benefits
Power Efficiency (MMBtu/MWh)	10.5	4.2	Saved 64,000 MMBtu, equivalent to 560 Net Zero Homes
CO_2 (lbs./MWh)	1,330	460	Saved 4,500 tons, equivalent to removing 850 passenger vehicles
NO_x (lbs./MWh)	1.4	1.7	None
SO_2 (lbs./MWh)	2.5	0.07	Saved 13 tons
Water (gal/MWh)	540	73	Saved 5 million gallons
Waste (% recycled)	38%	99%	58% reduction in solid waste to landfills, specifically coal ash

Operational Effectiveness

PEER Score 93.5 out of 100

Metric	Benchmark	Project	Benefits
Energy Savings	NA	$66/MWh	$680,000 in annual savings
System Energy Efficiency (SEE)*	47%	117%	Saved 100,000 MMBtu or 875 net-zero homes
Demand Response Capability	15%	160%	Reduce demand on electricity systems
Load Duration Curve	40%	67%	Increased asset utilization
Waste Identification & Failure Analysis	NA	Process for Both	Process for minimizing waste and addressing failures

$$* SEE = \frac{Total\ energy\ delivered\ (electric, cooling\ \&\ heating)}{Total\ fossil\ fuel\ consumed}$$

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