Community Microgrid Models

Keeping up with innovation in energy technology and customer needs

AMERICAN BAR ASSOCIATION
Section of Environment, Energy, and Resources

Microgrid Institute

ABA Smartgrids Webinar
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Presentation agenda

1. Microgrid Institute intro and current work
2. Defining and understanding microgrids
3. Microgrid trajectory and trends
4. Community microgrid business models

Microgrid Institute

1. What is Microgrid Institute?

Microgrid Institute is a collaborative organization that focuses on key factors affecting microgrids and distributed energy.

Our efforts address markets, regulation, financing, and project feasibility and development.

- **Multidisciplinary collaboration** with industry leaders
- Independent, objective **thought leadership**
- Studies, analysis, **project development support**

Microgrid Institute

Current projects and initiatives

- NY Prize Community Microgrid feasibility assessments
  (two award contracts pending)
- Olney Town Center microgrid R&D project
  (Nov. 2014 – Oct. 2016)
- Minnesota CHP Stakeholder Engagement
  (Aug. 2014 – Aug. 2015)
- Resilient Communities Initiative
  (June 2014 – Ongoing)
- Microgrid Finance Initiative
  (1Q 2015 – Ongoing)

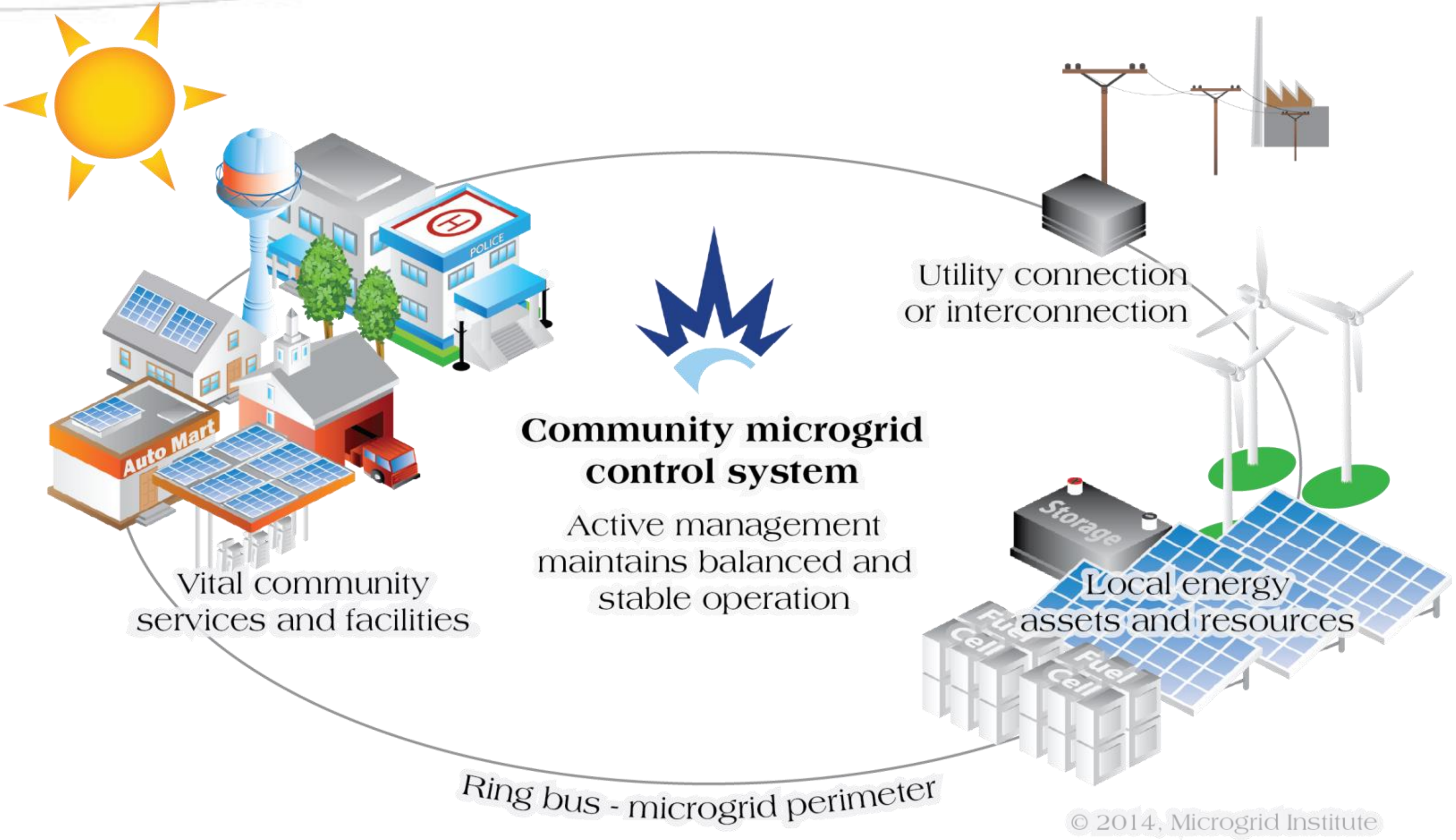
Microgrid Institute

2. What is a microgrid?

Microgrid Institute definition

A microgrid is a small energy system capable of ***balancing captive supply and demand*** *resources to maintain stable service within a defined boundary.*

A ***community microgrid*** *provides resilient and stable energy supplies for vital community facilities and assets.*

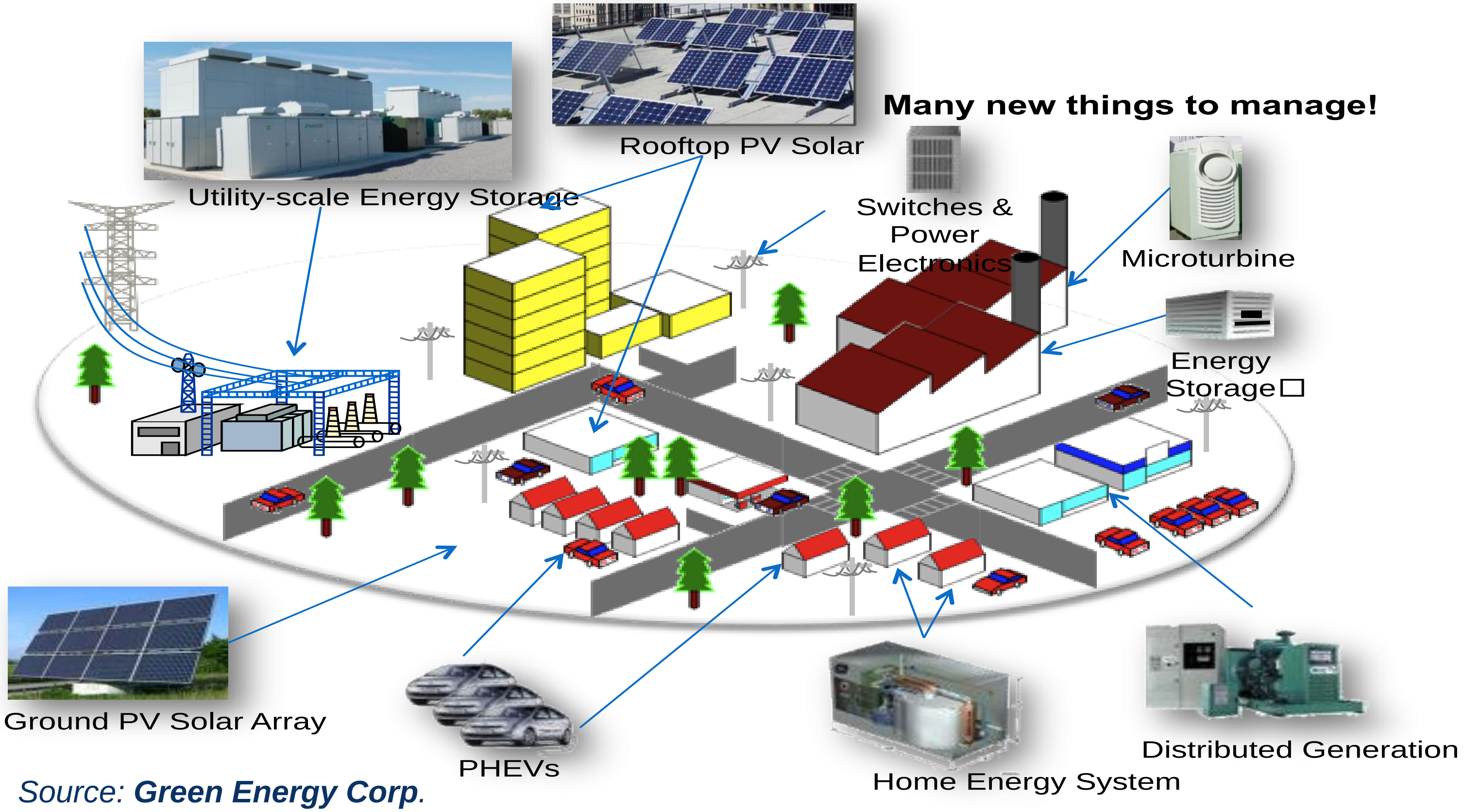


What is a microgrid?

U.S. DOE definition

*"A **microgrid** is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode."*

~DOE Microgrid Exchange Group, October 2010



Source: **Green Energy Corp.**

Types of microgrids

- ***Utility-integrated campus microgrids:*** *fully interconnected with a local utility grid, but can also maintain some level of service in isolation from the grid, such as during a utility outage. Typical examples serve university and corporate campuses, prisons, and military bases.*
- ***Community microgrids:*** *integrated into utility networks. Such microgrids serve multiple customers or services within a community, generally to provide resilient power for vital community assets.*
- ***Off-grid microgrids:*** *including islands, remote sites, and other microgrid systems not connected to a local utility network.*
- ***Nanogrids:*** *serving single buildings or assets, such as commercial, industrial, or residential facilities, or dedicated systems, such as water treatment and pumping stations.*

3. Microgrid trajectory and trends

~Timeframe:	1980s-Present	2000s-Present	2010-Present	Present-2020+	2015+
	Self-Generation	**Demand Response**	**Distributed Generation**	**Microgrids**	**Distribution Service Markets**
Technology	Aeroderivative turbines, cogeneration/CHP, diesel gensets, etc.	DR energy management systems, submetering, distributed controls, smart metering/ smart grid integration	Rooftop PV, microturbines, fuel cells, energy storage, smart inverters, smart grid integration	DG and storage systems; microgrid controls; energy management systems; distributed sensors and controls	Advanced smart grid; distributed sensors and controls; micro-market clearing and settlement
Policy	PURPA, State IRP, etc.	EPAct 2005, FERC Order 2000 & 745, IRP & efficiency/ conservation policies	PURPA, EPAct, ARRA	In progress (FERC Order 1000 policy on non-transmission alternatives (NTA), ARRA, state policies emerging (CT, NY, NJ, MA, MD, CA, etc.)	NY REV "distribution service platform provider (DSPP)"
Contracting	Turnkey EPC, power purchase agreements (PPA)	Energy service contracting, aggregation, conservation service agreements,	DG PPAs, leasing	Microgrid service agreements; hybrid models including PPP, utility/non-utility	Spot- and forward-market contracting; energy service provider (ESP) contracts
Market Settlement	Bilateral trading, regional wholesale market settlement for energy and capacity	Regional market settlement	None (possibly ISO/RTO market settlement)	Emerging models: • ISO/RTO settlement for DERs • Intra-microgrid ancillary services agreements • Transactive energy and DSO models being considered	Micro-markets for local TE transactions
Pricing & Tariffs	Interruptible rates, standby rates, and sometimes deferral rates to discourage self-generation	Dynamic rates, conservation/ efficiency incentives, locational marginal pricing (LMP)	Net-metering tariffs, standby rates, DG interconnection fees, and sometimes fixed-cost charges	In progress (derived from IPP, DR, and DG tariffs, plus FERC incentive tariffs for NTAs?)	DOE Pacific Northwest Demonstration Project: Regional "transactive" price signals

Microgrid drivers

Centralized utility grids are vulnerable

- U.S. utility grids are reliable, but not necessarily resilient *(SAIDI ignores "events")*
- Weather events etc. can cause widespread disruptions of extended duration
- Cybersecurity and EMF disruptions can have widespread effects

Distributed energy technologies = new options for resilience

- Rapidly advancing technologies improve the full suite of technologies that make microgrids work – from PV to software controls
- Federal, state, and local government agencies are pursuing various approaches to encourage innovation and development

Cities, buildings, and customers are getting smarter

- Increasing focus on efficiency, sustainability, performance
- Advanced automation and interoperability
- Modern customers require modern services

Public mandate to achieve greater resilience

- Applying lessons from Superstorm Sandy
- Exploring models and approaches for improving community resilience and serve other local objectives

Eliminating energy poverty worldwide

- Electrifying remote and under-served communities and islands
- Saving costs by displacing diesel, kerosene, etc.
- Improving living standards and supporting economic development

Resilience for vital local services

*Microgrid systems help communities to achieve **local resilience for vital services** and interdependent community assets:*

- Hospital, police, fire, ambulance
- City water and wastewater
- Emergency ops and public shelters
- Gasoline, grocery, pharmacy
- Telecom c.o., Internet, cell towers
- Lighting, street lights, traffic lights
- Pumping, refrigeration, HVAC

Modern resilient communities support public safety, convenience, and economic growth

Key trend:

Nested Microgrid Architecture

In many towns and cities, ***critical facilities are dispersed across a wide area.*** *Multi-nodal systems can be made more cost-efficient by grouping clustered nodes into control groups.*

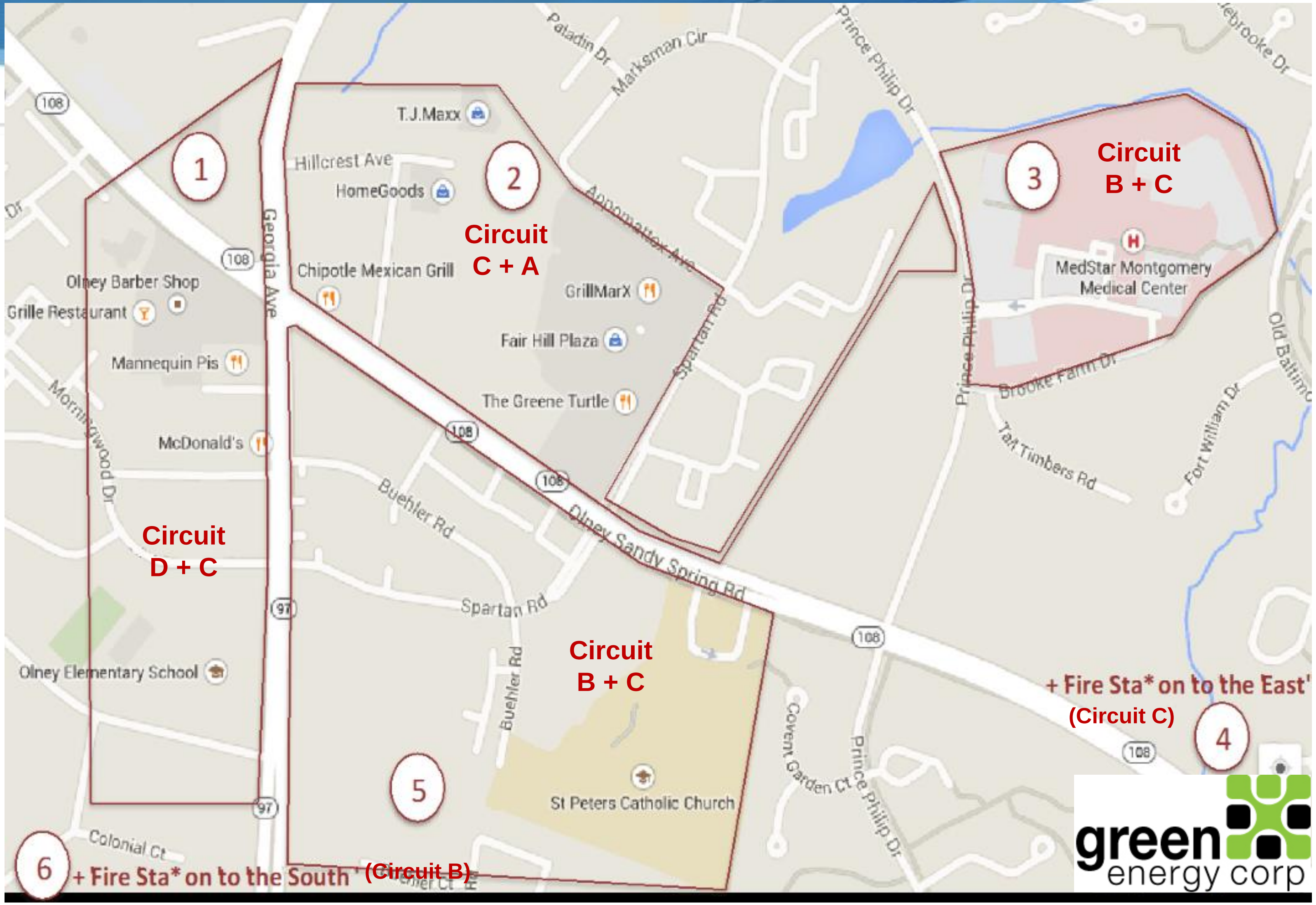
Olney Town Center Overview

Olney Town Center Microgrid Nodes

- *Six separate node groups*
- *Each to island during outage*
- *All would operate as a portfolio during normal operations, allowing resource optimization for economic benefits*
- *Market participation constrained by microgrid objectives:*

-Improve reliability to achieve SAIDI < 2 min

- Increase efficiency and reduce CO² footprint by 20%+



green energy corp

Nested Architecture: Benefits and Costs

Benefits:

- *Increased resiliency with more vital community assets*
- *Reduced need for undergrounding*
- *Lower costs through standardization, volume procurement*
- *Portfolio management yields better economics*

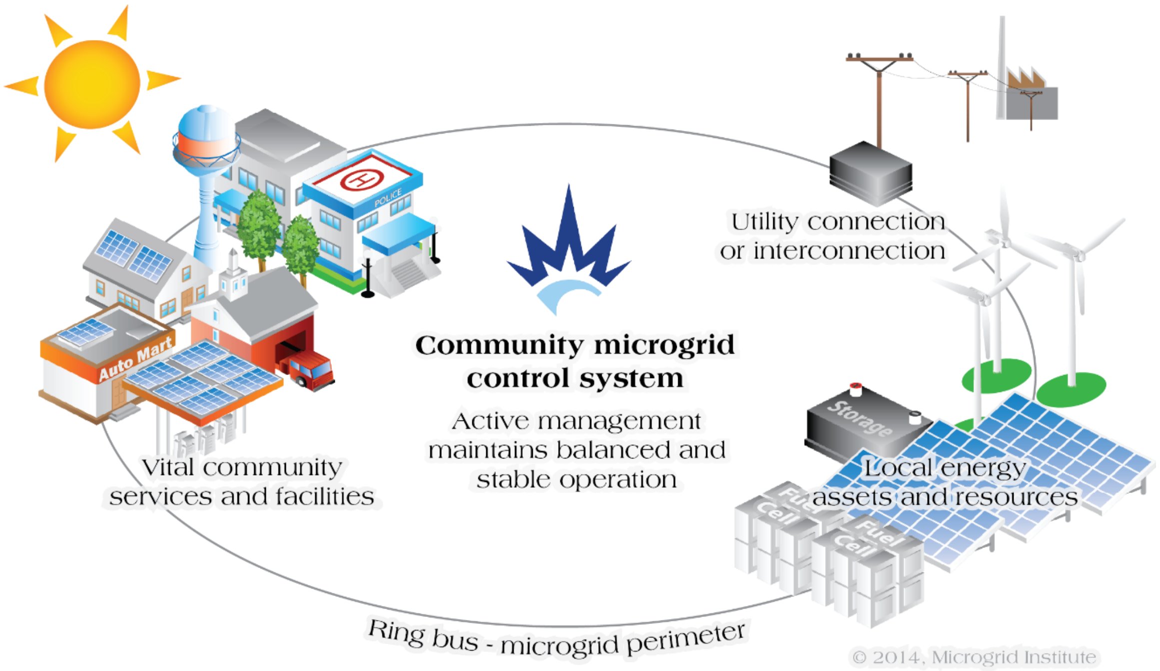
Costs:

- *More points of coupling = more interconnection and safety equipment*
- *Non-critical loads require disconnect during islanding*

4. Community microgrid business models

***Community microgrids** raise substantial questions re: Business models:*

- Asset ownership and financing
- Tariffs, contracts, and market trades
- Responsibility for services, etc.



Microgrids and the utility compact

Challenges	Possible Options
Utility compact requires "equivalent" services for all customers within a class ("cross-subsidy" concerns)	➢ Microgrid service surcharges and special tariffs for microgrid customers ➢ Cost allocation based on "radiating" benefits ➢ Hybrids and public-private partnerships (PPP) • Utility rate-base financing for "standard" distribution-system investments and R&D • Private third-party financing for competitive assets (DG, storage, behind-the-meter DSM, etc.) • Public funding for "premium" non-competitive services
Stranded asset risks	Public, non-utility, or utility system-benefits financing for at-risk investments

Microgrids and the utility franchise

Challenges	Possible Options
Utility franchise laws limit non-utility participation	➢ Utility service models – Microgrids as a service (Maas); utilities retain ownership of distribution systems and customer relationships ➢ Shared ownership models – Microgrid customers form cooperative entity; utilities may provide franchise exceptions, system leasing, service agreements, etc. ➢ Amendments to franchise and submetering statutes, and municipal franchise agreements ➢ Municipalization of community utility networks

Microgrids and utility ownership restrictions

(*in deregulated markets*)

Challenges	**Possible Options**
Deregulation laws prohibit or limit utility ownership of DG, energy storage	➢ Non-utility financing and ownership; PPAs, third-party leasing, service agreements ➢ Regulatory waivers ➢ Policy amendments to establish conditions that qualify for exceptions (*e.g.*, "public purpose microgrids" (MD))

Conclusion:

New solutions require new models

Analogy: Mass transit vs. private automobile

Transportation		Electricity Service	
Public transportation	**Private automobile**	**Central utility grid**	**Microgrid**
Station/stop-to-station/stop, available per generic schedule	Door-to-door transportation when needed	Commodity service, few or no options	Custom service, many options
Zero capital cost for customers; costs supported by ongoing public subsidies	High up-front capital cost with no (or temporal) public subsidies	Zero capital cost for customers; socialized legacy grid	Up-front capital cost for customers; new infrastructure for advanced capabilities; limited or no socialization or public subsidies

A microgrid is to the utility grid as a Tesla is to a bus pass

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