

Utility Business Models for Microgrids

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Do Microgrids Constitute the First Phase in the Evolution to a Distributed Grid?

**Formation of
Natural
Microgrids**

**Upgrading of
Existing
Microgrids with
Smart-Grid
Technologies**

**Improved
Business Case
for Newer
Microgrids
Leads to Wider-
Scale Adoption**

Based on "Utility 2.0 and the Dynamic Microgrid", Mani Vadari and Gary Stokes, *Fortnightly Magazine*, November 2013

Drivers for Microgrid Development

Protection of Mission Critical Facilities

**Reliability Concerns Stemming from Aging Infrastructure /
Superstorms**

Cybersecurity

Past

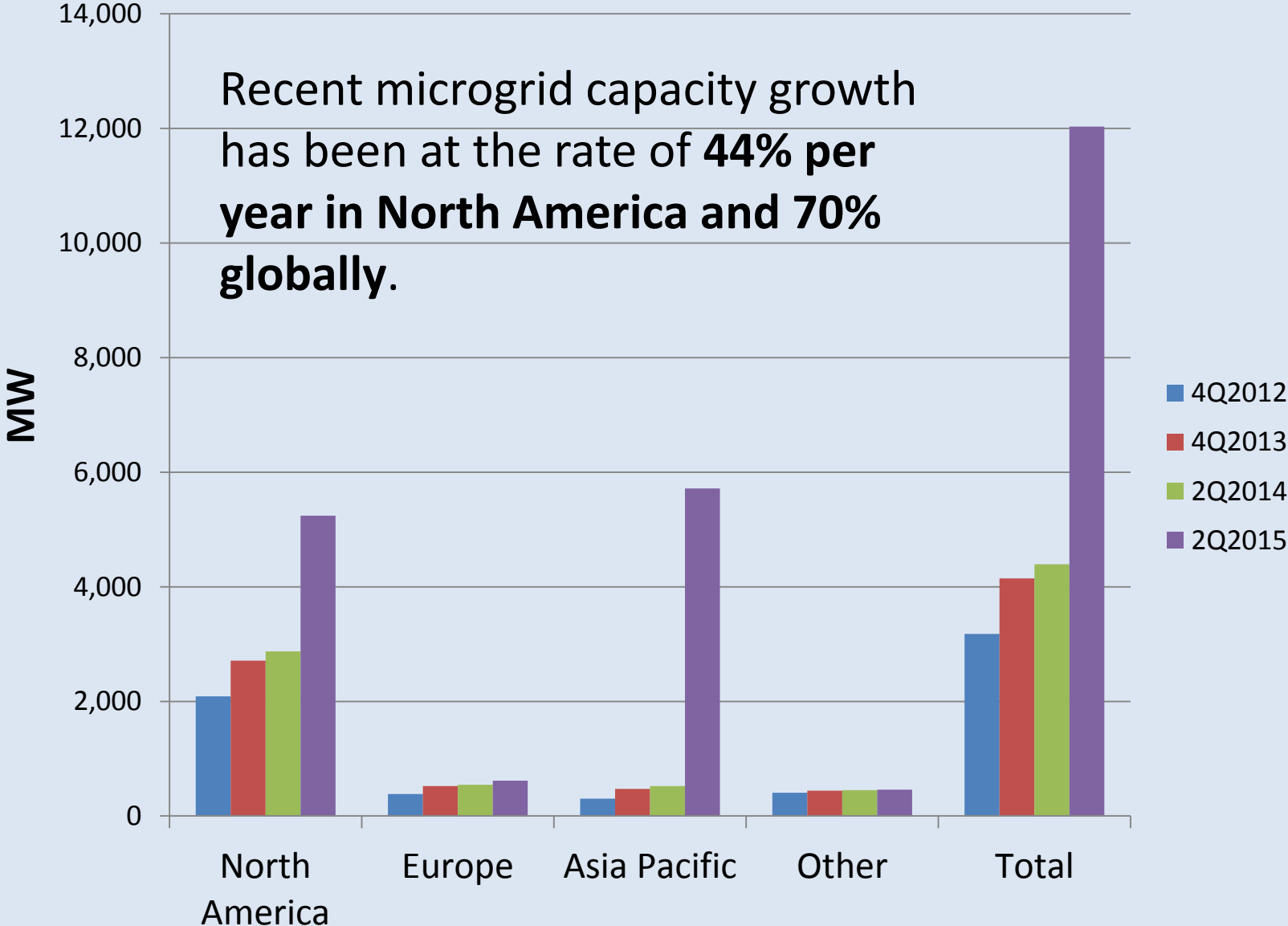
Future

State/Federal Incentives

Declining Cost of Distributed Energy Resources

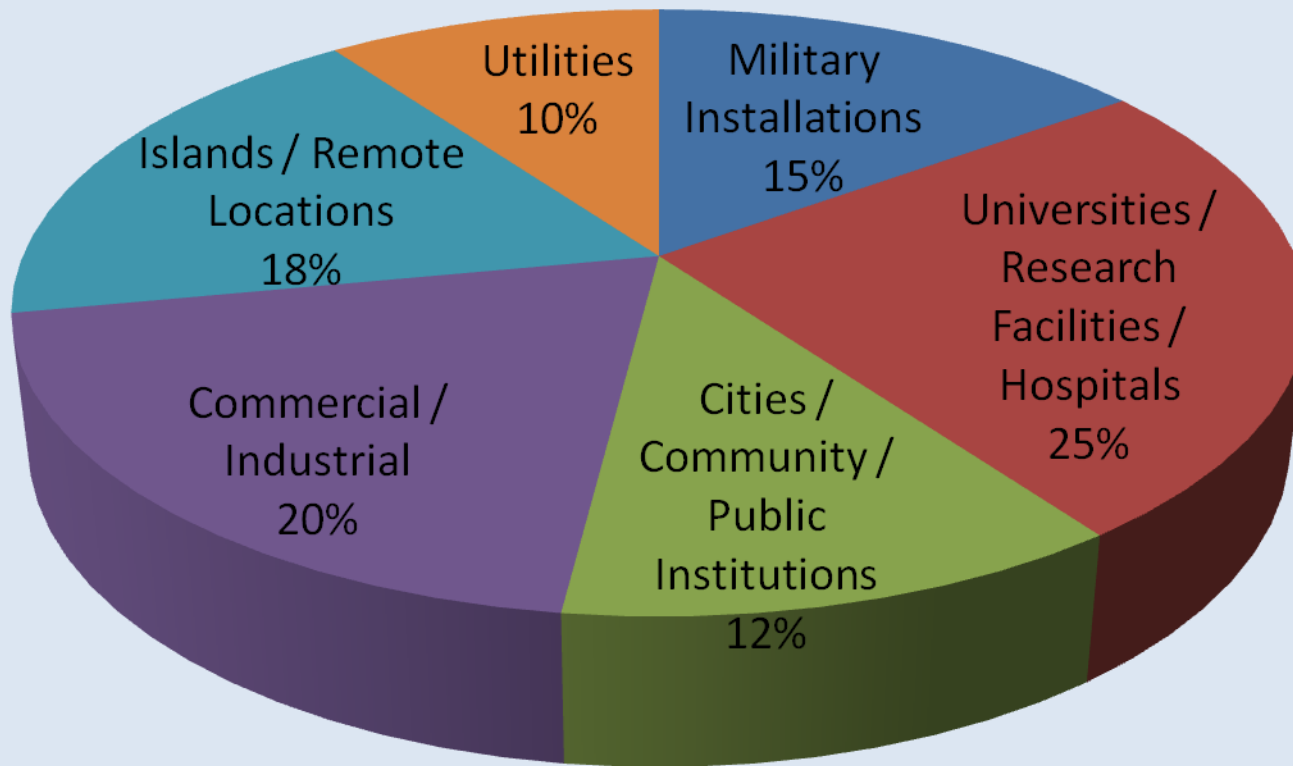
**Evolution of More Effective Microgrid Control
Technologies**

Global Trends in Microgrid Capacity



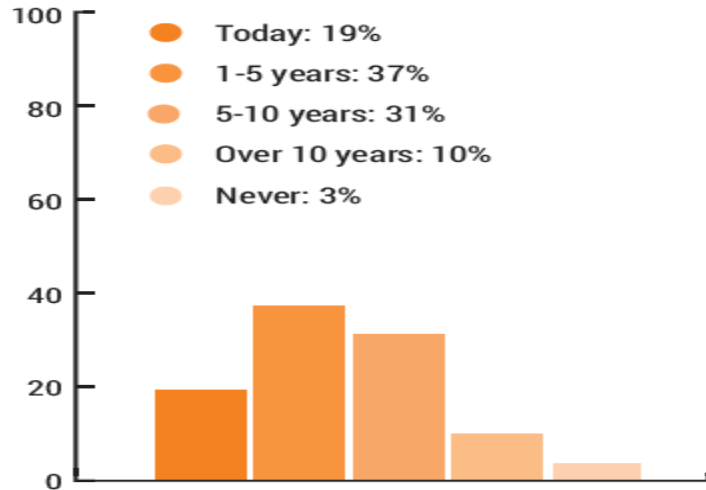
Source Data: Navigant

Who Is Building Microgrids in the U.S.?

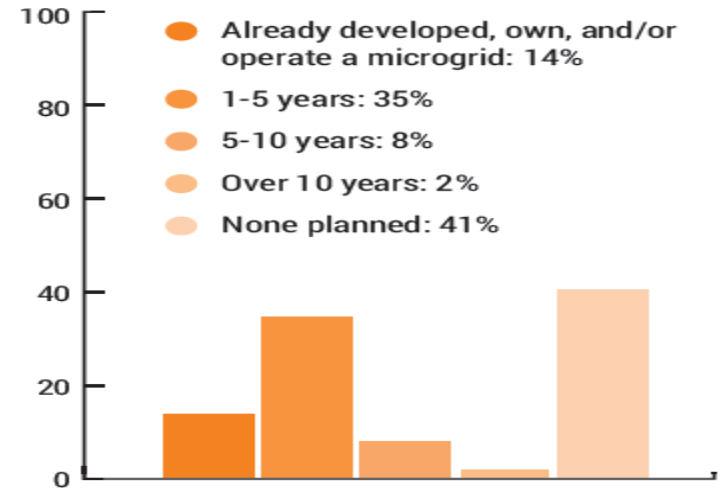


The Current Outlook

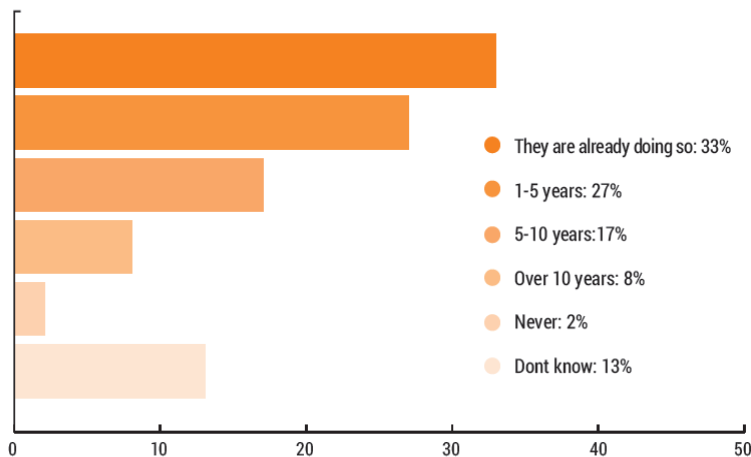
Q When will microgrids become a viable business opportunity for utilities?



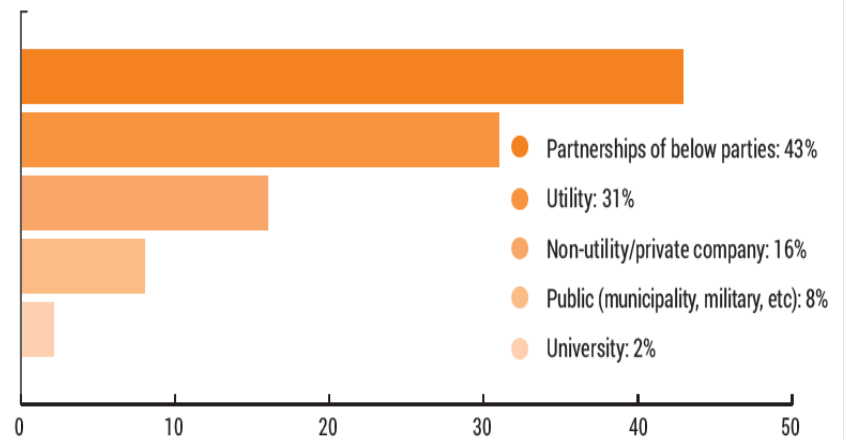
Q When does your utility plan to develop, own, and/or operate any microgrids?



Q When do you expect non-utility entities in your service territory to develop microgrids?



Q In the future, who do you think should be the dominant owner/operator of microgrids?



Who Benefits from Microgrids?

Factories



Data Centers



Hospitals



Remote Sites

Critical Loads

Mines



Military Bases



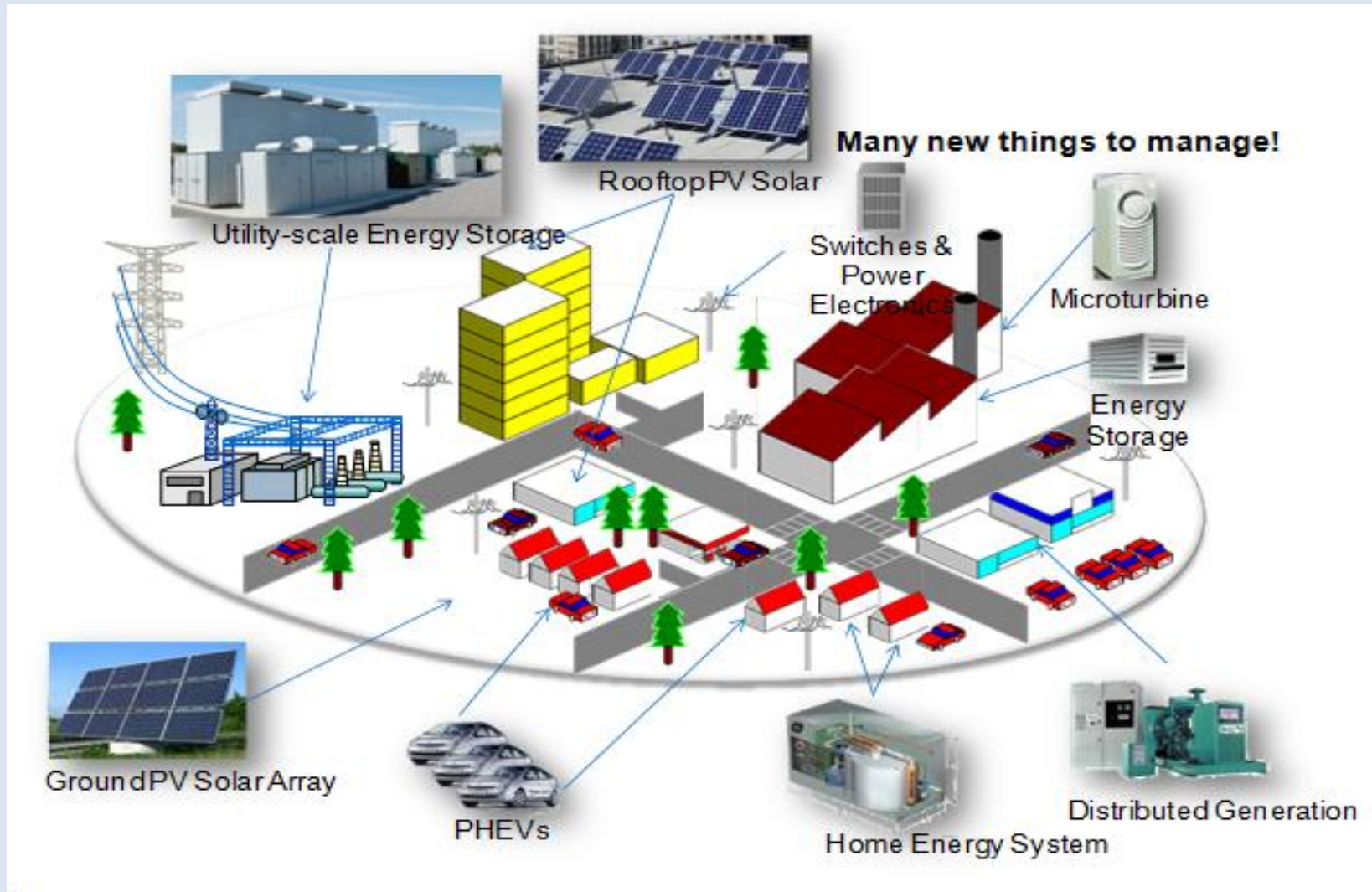
Vulnerable Areas

Extreme Weather Events / Natural Disasters



Targeted Facilities

Potential Elements of a Microgrid Campus



Benefits for Utilities

- Improved system reliability
- New source of ancillary services
- Reduced needs for capital infrastructure investment
- Greater capacity to accommodate intermittent renewable resources
- **Ownership provides new revenue stream**

Benefits of Utility Involvement

1. Systems would be **less encumbered by legal and regulatory uncertainty** / could be deployed within the current regulatory framework
2. Uninhibited customer recruitment and participation would allow DERs to be **optimally sized**
3. **Cost savings** by avoidance of duplicate wires investment
4. Able to **leverage utility's knowledge and expertise** to strategically locate microgrids and maximize overall value to grid
5. Microgrids potentially enable utilities to **offer differentiated products and services tailored to specific customer needs**

Unbundled Utility Model

- Utility owns and maintains distribution facilities serving the microgrid (not generation or storage)
- Will likely operate or direct the microgrid control system
- Will actively partner with customers and energy providers to facilitate and manage load aggregation and energy supply

Potential Areas for Partnering

Interconnection
Facilities

System
Design



Project
Financing

Microgrid
Management

The Current Regulatory Environment for Microgrids

- General regulatory climate has been **favorable to DG and net metering**, but **ambivalent about microgrids**
- Most frequently cited barrier: requirement for microgrid to have **electricity marketer or public utility status** as precondition for sales to others
- Second most frequently cited barrier: **franchise violations** when selling to utility customers or running wires across public rights-of-way
- **Interconnection issues** exist, but these are **generally considered manageable** (many standards have already evolved to accommodate DG)
- A common regulatory perception: if utilities are doing their jobs, then microgrids should not be necessary

Key Challenges

- **Standby Charges**
 - Who pays (i.e. all customers on microgrid, owners, generators, etc.)
 - What is appropriate level?
 - In what manner (tariff design)
- **Recovery of System Costs**
 - Engineering Studies
 - Distribution System Upgrades
- **Siting**
- **Relationship with Incumbent Utility**

The Ideal Regulatory Environment for Microgrids

- **Establish a clear (but sufficiently broad and flexible) definition of microgrids**, with corresponding rights and responsibilities within the electrical grid
- Support an **equitable methodology for compensation of services** provided by microgrids to the regulated grid, and for standby-services provided to the microgrids by regulated entities
- **Support unbundling and the growth of a diversity of services** on the grid, both by and to microgrids, and where these are competitively provided, allow market-based pricing and/or unregulated offerings
- Establish and maintain a **level playing field** for all services provided on the grid, with utilities, their affiliates, and third parties given the right to provide any or all of these services, subject to appropriate codes-of-conduct
- **Allow utilities to own, operate, and/or partner with microgrids** – either completely, or in part

The Business Case: Typical Microgrid Costs

- Equipment and Installation
- Interconnection Costs
- Operating Costs
 - Administration
 - O&M
 - Insurance
- Incremental Fuel Expenses
- Less Incentives (Tax Breaks, Subsidies, etc.)

Microgrid Benefits by Recipient

Benefit	Participant	Utility	Society
Reduced Power Outages On-Site	X		X
Reduced Purchases of Grid-Sourced Electricity	X		
Reduced Purchases of Heating Fuel	X		
Ancillary Services	X		
Sales of Excess Electricity to Macro-Grid	X		
Participation in Demand-Response Programs	X		
Deferred T&D Capacity Investments		X	
Reduced Operating Reserves		X	
Lower SO _x , NO _x , CO ₂ Emissions			X
Reduced Line Losses			X

Ancillary Services

Earnings Potential for Each of These Services Will Depend Upon the Structure of the Electricity Market and the Size of the Microgrid

**Reactive Supply and
Voltage Support**

**Regulation and
Load Following**

System Black Start

Supply of Reserves

- **Frequency Responsive Spinning Reserve**
- **Supplemental Reserve**
- **Backup Supply**

Network Stability

Degrees of Reliability and Time Without Power

Reliability

99.0%

99.9%

99.99%

99.999%

99.9999%

99.99999%

99.999999%

99.9999999%

Time Without Power

3.7 days per year

9 hours per year

53 minutes per year

5 minutes per year

32 seconds per year

3 seconds per year

0.32 seconds/year

0.032 seconds/year

Estimated Average Electric Customer Interruption Costs US 2008\$ By Customer Type and Duration

Interruption Cost	Interruption Duration				
	Momentary	30 minutes	1 hour	4 hours	8 hours
Medium and Large C&I					
Cost Per Event	\$6,558	\$9,217	\$12,487	\$42,506	\$69,284
Cost Per Average kW	\$8.0	\$11.3	\$15.3	\$52.1	\$85.0
Cost Per Un-served kWh	\$96.5	\$22.6	\$15.3	\$13.0	\$10.6
Cost Per Annual kWh	9.18E-04	1.29E-03	1.75E-03	5.95E-03	9.70E-03
Small C&I					
Cost Per Event	\$293	\$435	\$619	\$2,623	\$5,195
Cost Per Average kW	\$133.7	\$198.1	\$282.0	\$1,195.8	\$2,368.6
Cost Per Un-served kWh	\$1,604.1	\$396.3	\$282.0	\$298.9	\$296.1
Cost Per Annual kWh	1.53E-02	2.26E-02	3.22E-02	\$0.137	\$0.270
Residential					
Cost Per Event	\$2.1	\$2.7	\$3.3	\$7.4	\$10.6
Cost Per Average kW	\$1.4	\$1.8	\$2.2	\$4.9	\$6.9
Cost Per Un-served kWh	\$16.8	\$3.5	\$2.2	\$1.2	\$0.9
Cost Per Annual kWh	1.60E-04	2.01E-04	2.46E-04	5.58E-04	7.92E-04

Source: "How to Estimate the Value of Service Reliability Improvements," Sullivan, Michael J., Matthew G. Mercurio, Josh A. Schellenberg, and Joseph H. Eto

Cost Recovery

How Much Will the Microgrid Customer Pay?

Electricity Bill

- Levelized Cost of Microgrid-Produced Electricity
- Cost of Distribution Services Provided by Distribution Operator
- Interconnection Costs
- Profits Retained by Microgrid Owner/Operator
- Less Revenues for Services Provided by Microgrid to Macrogrid

Microgrid Benefits

A Balancing Act



Private capital providers for microgrids must get a **return** on their investment, but microgrid users must have an **incentive** to be part of one.

The Regulated Business Case

Three Alternatives

<p>Maintain current rate structure for microgrid customers</p> <p>•<u>Advantage:</u> Customers pay no additional cost for added reliability/security</p> <p>•<u>Disadvantage:</u> Utility may not attain allowed return for services provided</p>	<p>Set customer rates based on allowed return</p> <p>•<u>Advantage:</u> Risk to utilities minimized</p> <p>•<u>Disadvantage:</u> Customer may feel that incremental services (e.g., greater reliability) do not justify higher rates</p>	<p>Establish performance-based rates</p> <p>•<u>Advantage:</u> Benefits/risks will be shared by utility and customers</p> <p>•<u>Disadvantage:</u> Utility may not get sufficient return and customers may feel that services are overpriced</p>
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Cost Recovery Methods

What Are Utilities Currently Doing?

Company	Socialized Costs and Benefits	Socialized Costs / Targeted Benefits	External Grants, Tax-Breaks, Funding	Special Tariffs Targeted to Microgrid	Below-the-Line Earnings from 3 rd Party
Constellation	Company-Owned				Bloom Energy
Dominion	Kitty Hawk			Military Bases	
Duke			Research Grants	Back-up Service	
Oncor		Benefits to Microgrid Only			
PEPCO		Benefits to DG Owners			
PG&E			DoD / DoE for Current Projects	Future Projects	
SDG&E	Residual Costs		Most Covered by Awards/Grants	Future Projects (Some Costs)	

Thank You!

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