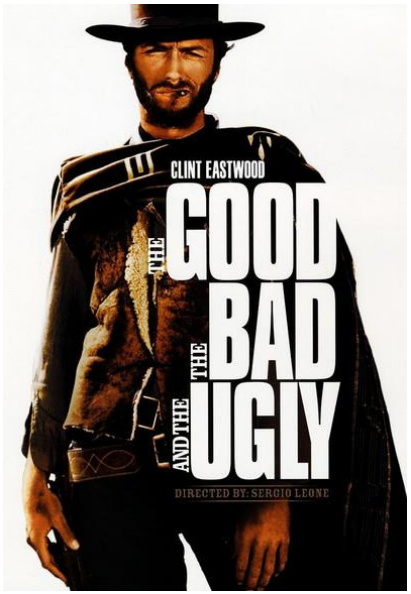
The Good, The Bad and The Ugly: Emerging Market Considerations for Microgrids



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Lori Smith Schell, Ph.D., ERP
Empowered Energy

174 N. Elk Run, Durango, CO 81303 USA
Tel: (970) 247-8181 • Fax: (970) 247-3761
E-Mail: LSchell@EmpoweredEnergy.com

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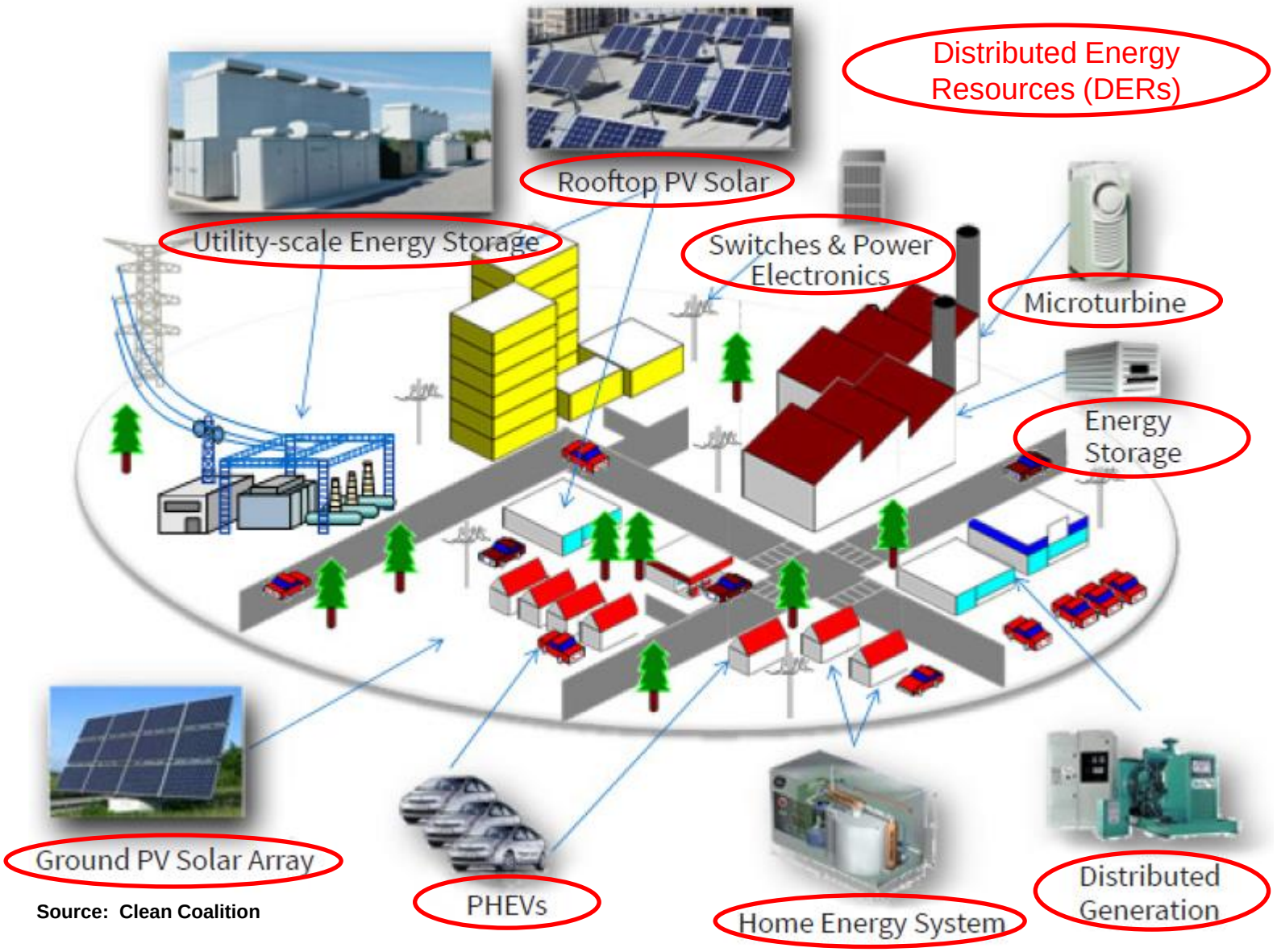
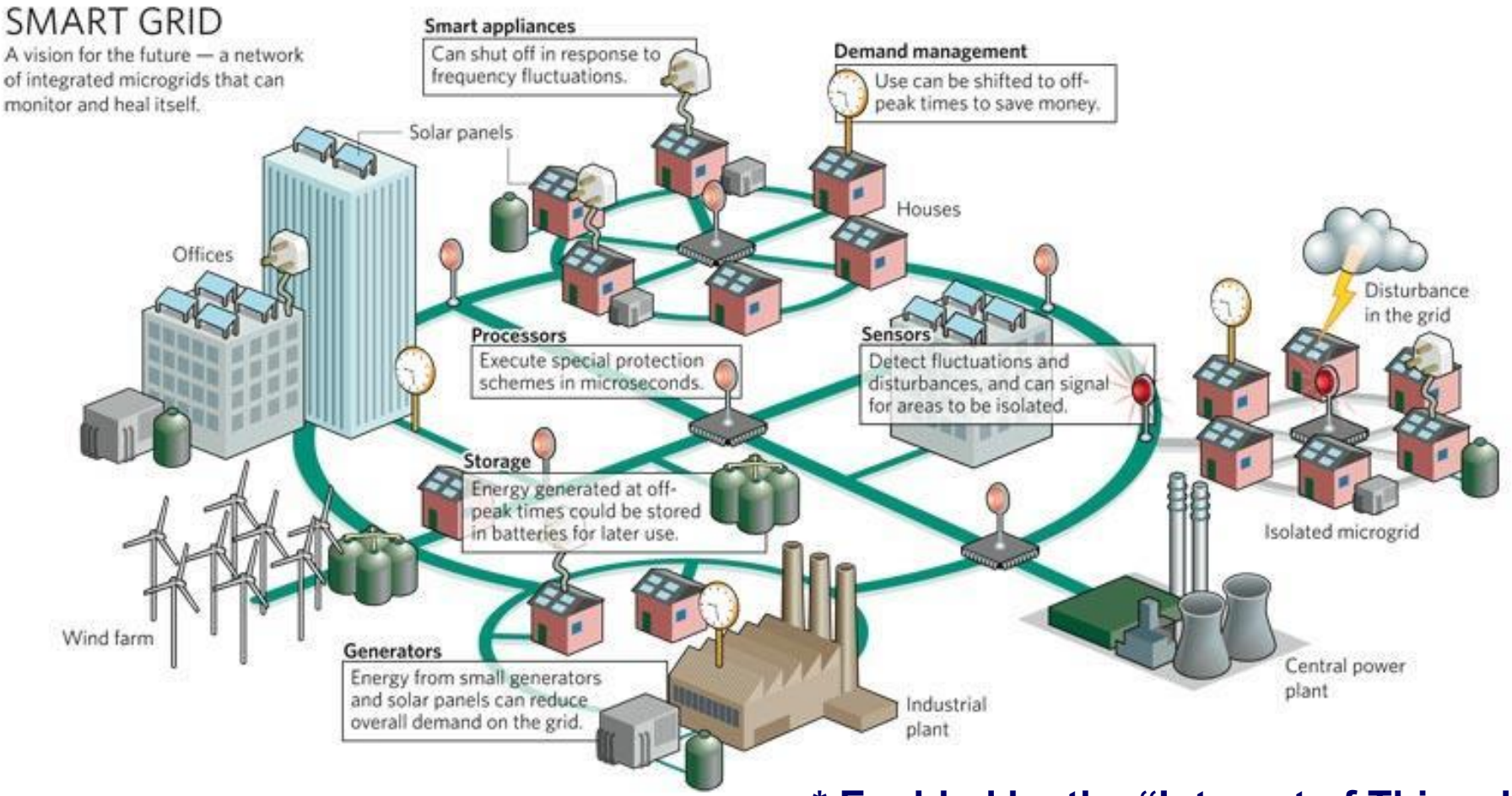
Physical & Financial Market Transformation: From Grid 1.0…

To Microgrid Building Blocks…



Source: Clean Coalition

To a Fully Integrated Grid 2.0: Can Be Done, Won't Be Easy*



*** Enabled by the "Internet of Things"**

The Good, The Bad and The Ugly: 1966 "Spaghetti" Western

- A bounty hunting scam set during the Civil War
- Pits two men in an uneasy alliance against a third in a race to find a fortune in Confederate gold buried in a grave in a remote cemetery
- The Good: Knows the name on the grave
- The Ugly: Knows the name of the cemetery
- The Bad: Knows neither; is trying to find out both…
- "Cooperation," "trust," "vision."

Clint Eastwood * Lee Van Cleef * Eli Wallach

"People with ropes around their necks don't always hang."

- Drivers of microgrid development include:
  - Increasingly severe and destructive weather events; desire for increased grid resiliency & energy security
    - Protection of critical facilities when grid fails is a key driver
  - Aging grid infrastructure requires massive investment; enables consideration of non-traditional investments
  - Declining DER costs (e.g., renewables, storage)
  - Improved control technologies/connectivity; access to information for behavioral demand & supply response
  - Increased push for across-the-board electrification; transportation "smart charging" and vehicle-to-grid
  - Climate change concerns and CO_2 reduction goals.

“You’re smart enough to know that talking won’t save you.”

U.S. 2012 Billion-dollar Weather and Climate Disasters

U.S. Drought/Heatwave
Summer 2012
(covering over half the U.S.
during 2012)

Southern Plains/Midwest/Northeast
Severe Weather
May 25-30, 2012

Western Wildfire
Summer-Fall

Midwest/Ohio Valley
Severe Weather
April 28 - May 1, 2012

Sandy
October 2012

Plains/East/Northeast
Derecho and
Severe Weather
June 29 - July 2, 2012

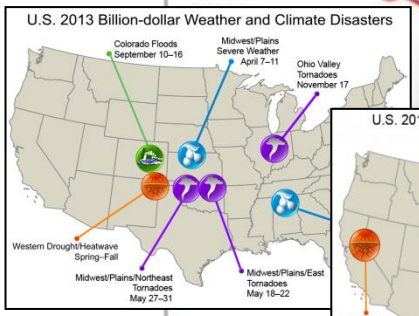
Southeast/Ohio Valley
Tornadoes
March 2-3, 2012

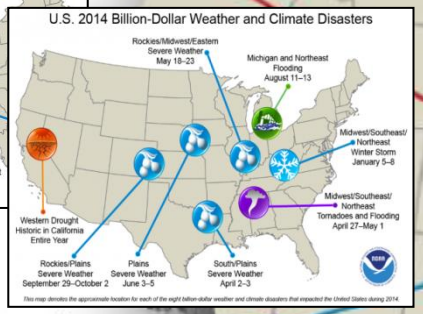
Rockies/Southwest
Severe Weather
June 6-12, 2012

Midwest Tornadoes
April 13-14, 2012

Texas Tornadoes
April 2-3, 2012

Hurricane Isaac
August 2012





Source: **EnergyEfficiencyMarkets.com, 2014, *Think Microgrid – A Discussion Guide for Policymakers, Regulators and End Users*, p.16. http://3_36990_ThinkMicrogridSpecialReport.pdf**

“I'm…happy you’re working with me and we're together again.”

- New York’s Reforming the Energy Vision
  - Restructure NY-ISO at distribution grid level

THE DISTRIBUTED SYSTEM PLATFORM (DSP)

The DSP is an intelligent network platform that will provide safe, reliable and efficient electric services by integrating diverse resources to meet customers' and society's evolving needs.

Key Functions of the DSP

- Design and plan distribution system that integrates DERs as primary means of meeting system needs
- Plan for and accommodate new distributed generation and demand response
- Balance production and load in real time
- Monetize system & social values
- Coordinate interactions between customers, with the distribution system and with energy services markets (DSP markets and NYISO)

Source: Rocky Mountain Institute, *New York's Reforming the Energy Visions (REV) Initiative – Overview and Status Update*, Lena Hansen, Principal, November 13, 2014. http://demandresponsesmartgrid.org/Resources/Documents/EF%20Webinars/NY%20REV%20Webinar%2014.11.13%20FINAL%20SLIDES.pdf

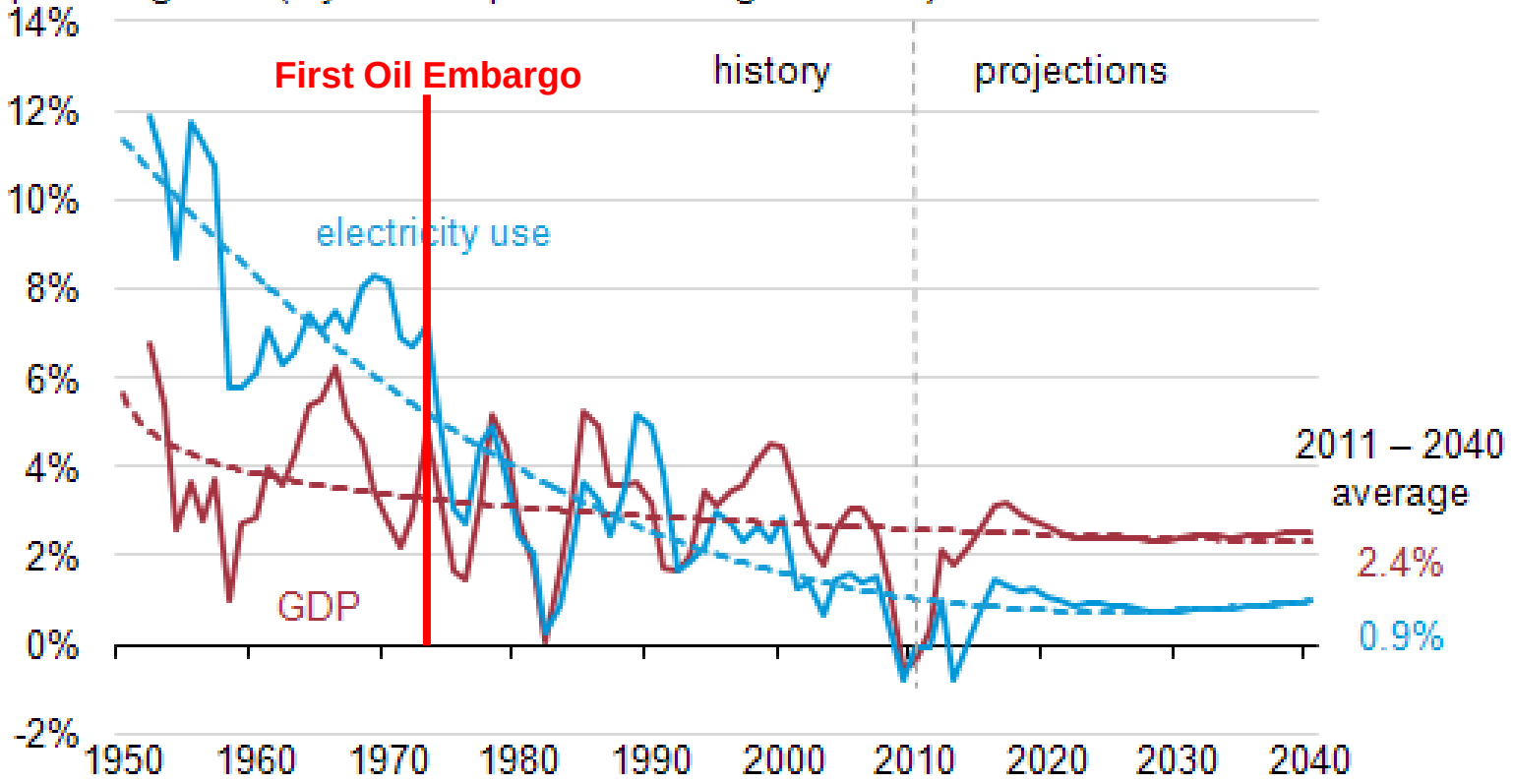
"But if you miss, you had better miss very well."

- Deterrents to microgrid investment include:
  - Regulatory requirements can be onerous and many
  - Each market has unique requirements
    - Microgrid technologies and system configurations must be carefully chosen to meet these unique requirements
  - To date, costs have been higher than anticipated
  - Utility buy-in needed to avoid obstructionist policies
    - Issues: Interconnection, stranded costs, stand-by charges
  - Grid integration issues for non-islanded microgrids
    - Ancillary services requirements
  - Misaligned incentives foster conflicting interests.

“I’m looking for the owner of that horse.”

- Slow demand growth = market share battles

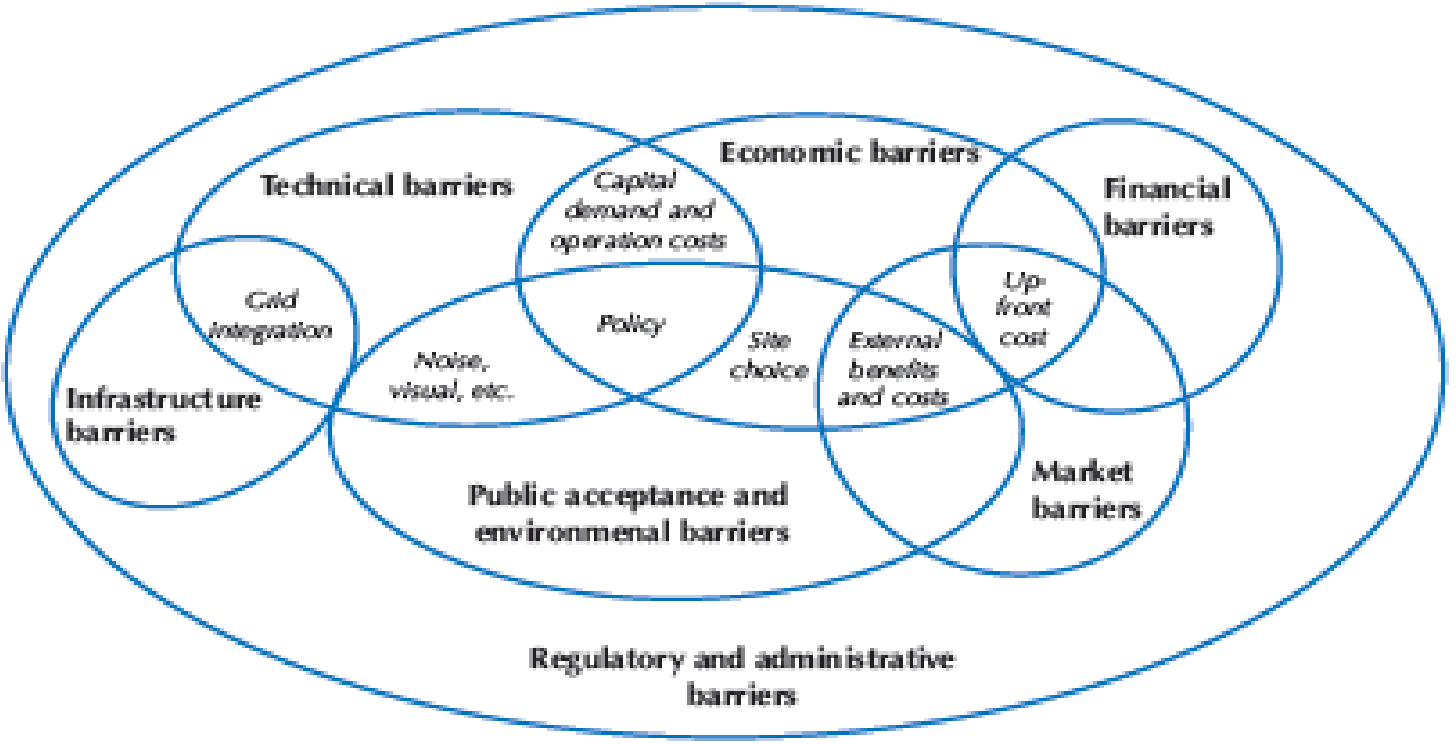
U.S. electricity use and economic growth, 1950 - 2040
percent growth (3-year compound annual growth rate) and trend lines



Source: U.S. Energy Information Administration, Annual Energy Outlook 2013 Early Release

“I have a feeling it’s really gonna be a good, long battle.”

Figure 3.5 Barriers to RE technology deployment



Key point: ***Market Transformation Is Never Easily Accomplished***

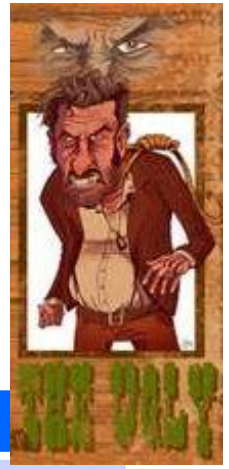
Different types of barriers to RE technology deployment are closely linked and may work together to hinder deployment.

Source: International Energy Agency, Deploying Renewables 2011 – Best and Future Policy Practice, p. 74. http://www.iea.org/publications/freepublications/publication/Deploying_Renewables2011.pdf

“I’ll sleep better knowing my good friend is by my side...”

Source: Microgrid Knowledge, March 10, 2015, *Microgrids: Are They Mainstream Yet?*, Schneider Electric, http://microgridknowledge.com/microgrids-mainstream-yet/

“One name is as good as another. Not wise to use your own name.”



♦ ♦ Microgrid market segments and drivers ♦ ♦

✓ ***Main driver***

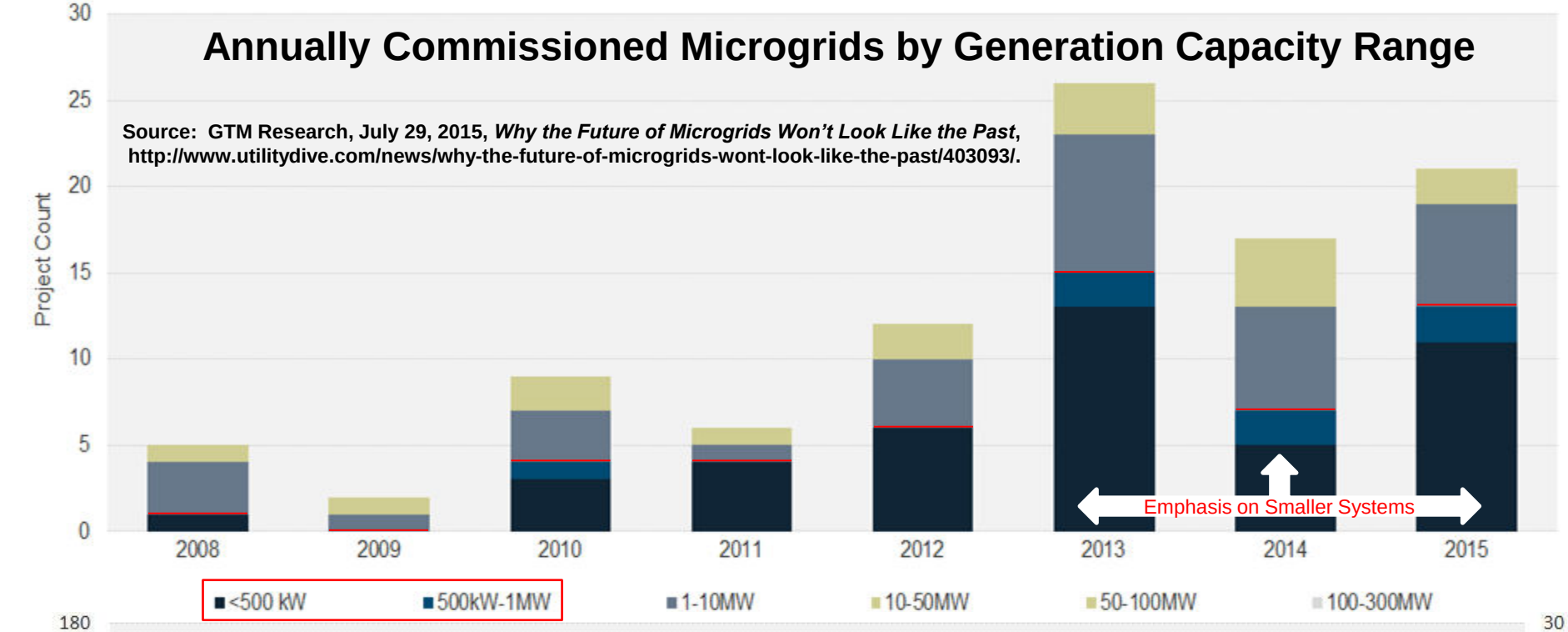
(✓) ***Secondary driver***

		Main drivers				
		Social	Economic	Environmental	Operational	
	Segments	**Typical customers**	Access to electricity	Fuel & cost savings	Reduce CO2 footprint and pollution	Fuel independence	Uninterrupted supply
Off-grid	Islands	(Local) utilities		✓	✓	✓	(✓)
Weak grid	Remote research centers	Governmental research institutions		✓		✓	✓
Weak grid	Rural electrification	Governmental development institutions development banks	✓	✓		✓	
Weak grid	Remote communities and residential installations	(Local) utilities, residence owners		✓	✓	✓	(✓)
Grid-connected	Industries and tertiary	Mining companies, IPPs, oil & gas companies, hotels & resorts, buildings		✓	(✓)	✓	✓
Grid-connected	Defense	Governmental defense institutions		(✓)	(✓)	✓	✓
Grid-connected	Institutions and campuses	Private education institutions, IPPs, government education institutions		✓	✓		(✓)

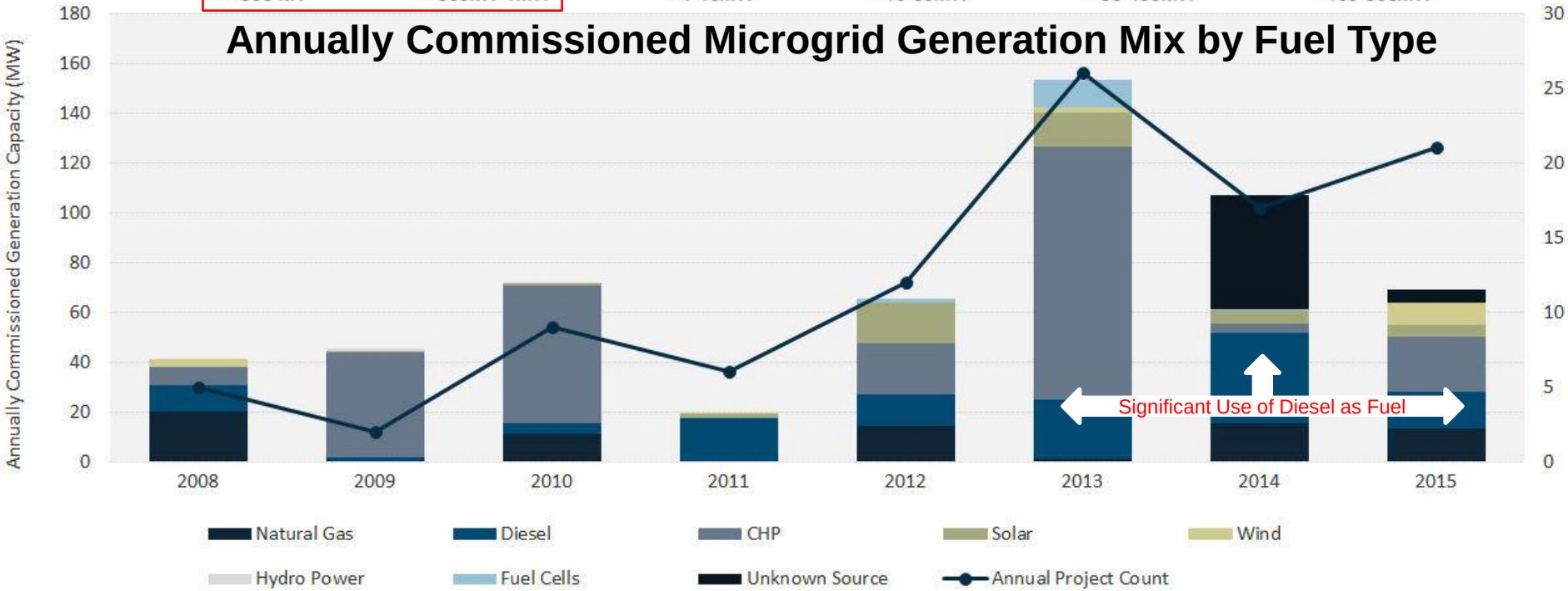
Source: ABB, September 2014, *Microgrids and Renewable Energy Integration: Overview*, http://new.abb.com/power-generation/microgrids-solutions/microgrid-communities

Annually Commissioned Microgrids by Generation Capacity Range

Source: GTM Research, July 29, 2015, *Why the Future of Microgrids Won't Look Like the Past*, http://www.utilitydive.com/news/why-the-future-of-microgrids-wont-look-like-the-past/403093/.



Annually Commissioned Microgrid Generation Mix by Fuel Type

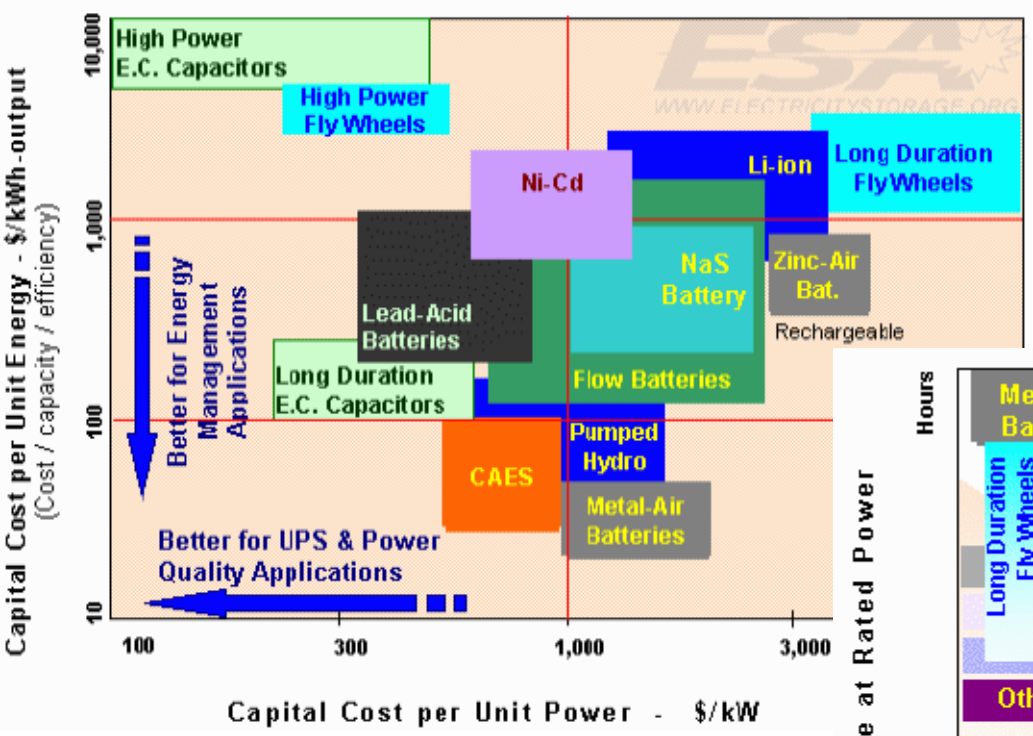


“You may run the risks, my friend, but I do the cutting.”

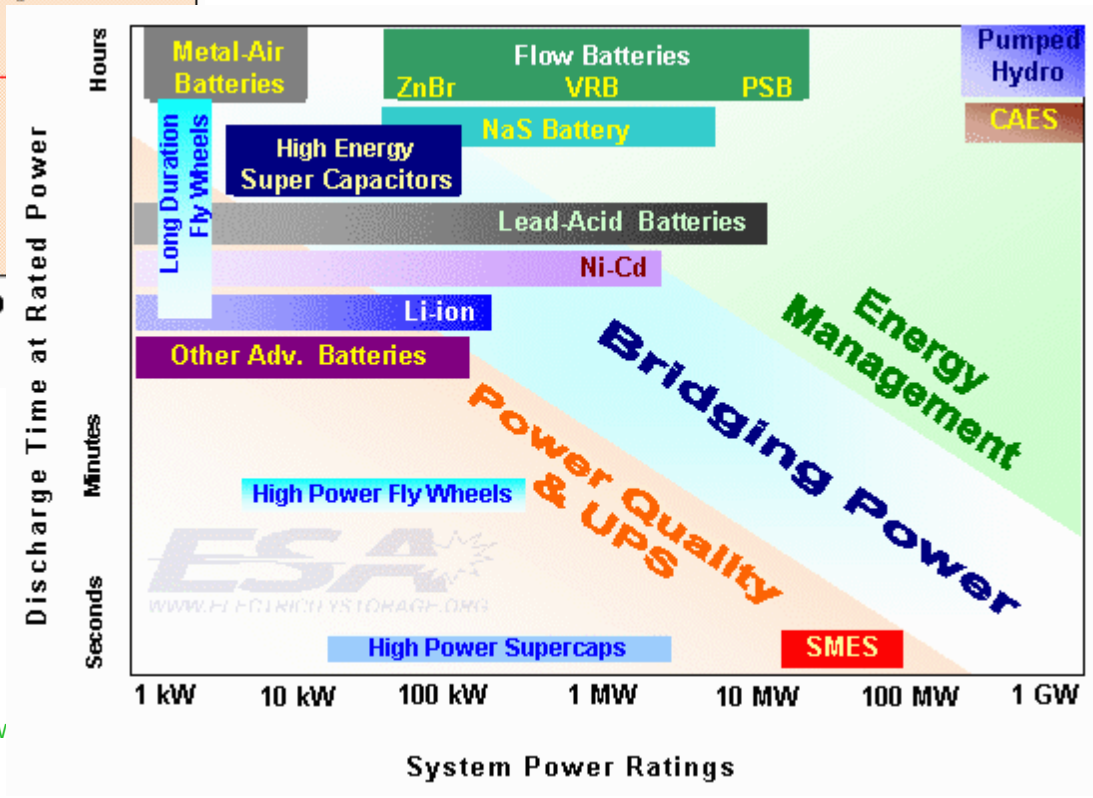
- Differential extension of Investment Tax Credit (“ITC”) may result in differential technology mix
  - 5-Year (solar, wind) vs 2-Year (geothermal, biomass)
- Tax equity limits potential investor pool
- New financing vehicles diversify multiple risks
  - Securitization diversifies credit, cash flow, geographic, operational, and regulatory risks
- Standardization reduces due diligence time and transaction costs (e.g., contracts, controls)
  - Contracts, controller technology, other

“Such ingratitude, after all the times I’ve saved your life.”

- Energy storage and microgrids: Best friends forever?



- Power vs. Energy
- Capacity vs. Flow



"$200,000 is a lot of money. We're going to have to earn it."

Emerging Structures and Models

Hybrid Models / Public-Private Partnerships (PPP)

Pros	Cons
• Reduces disincentives and service-equivalency challenges • Avoids franchise and right-of-way challenges • Allows service innovation and price competition	• Complex business structures • Mixed capital access

100% Utility Ownership

Pros	Cons
• Avoids disincentives • Simple business structure • Easy capital access • Avoids franchise and right-of-way challenges	• Raises service equivalency, cross-subsidy challenges • Precludes service innovation and price competition

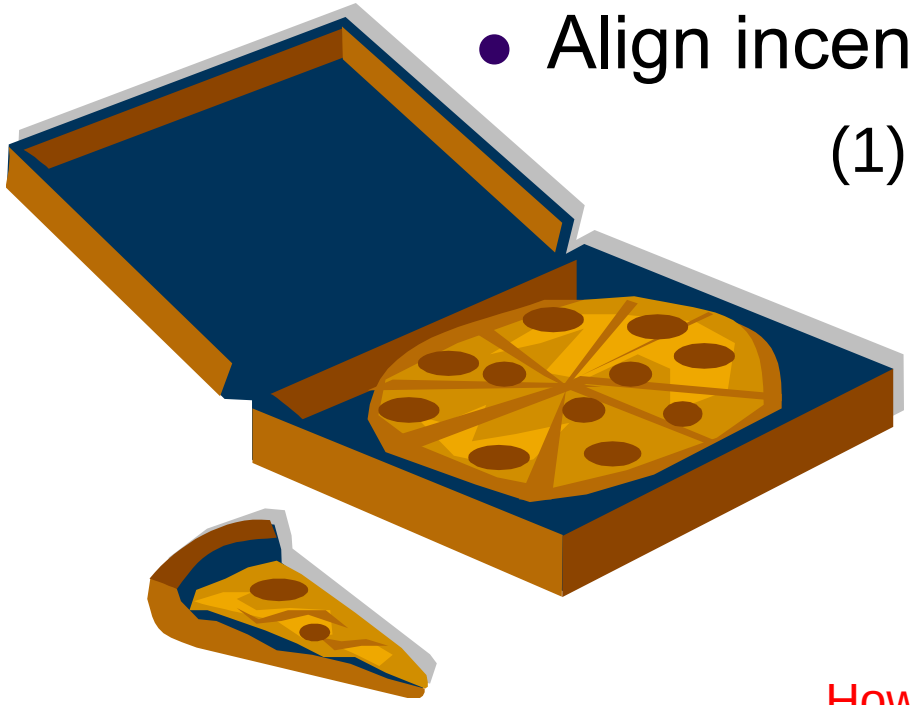
100% Nonutility Ownership

Pros	Cons
• Avoids disincentives • Simple business structure • Easy capital access • Allows service innovation and price competition	• Raises franchise and right-of-way challenges

Source: Microgrid Institute, July 28, 2015, *Regulatory and Business Models for Community Microgrids*, IEEE PES General Meeting, Denver, Colorado, http://microgridmedia.com/regulatory-and-business-models-for-community-microgrids/

“When I’m paid, I always see the job through.”

- Align incentives or fail…



(1) Revenue Requirement: How much revenue does the utility need to cover its cost of service? (What services does it provide?)

How big is the pizza? (Take out or eat in?)

(2) Cost Allocation: Which costs go where?

How are the ingredients arranged?

(3) Rate Design: Who pays how much?

How big a piece of pizza does each customer get?

"Two people can dig a lot quicker than one. Dig."

- New Jersey/Sandia: 50 MW TransitGrid
  - To allow islanding of Newark-NYC rail facilities
- Connecticut: Microgrid Grant and Loan Program
  - $53 million; projects now assessed on individual merits
- Energy Resiliency Investment Programs
  - Maryland: Resiliency through Microgrids Task Force
    - 2014 findings strongly supported public-purpose microgrids
  - Massachusetts: $40 million Community Clean Energy Resiliency Initiative
  - New Jersey: $200 million Energy Resilience Bank
  - New York Prize: $40 million; community microgrids.

“After a meal there’s nothing like a good cigar.”

- Key microgrid success factors:
  - Ironically, importance of regulators increases
    - Strength of policy commitment ~ rate of change
  - Aligning incentives is crucial
    - Market provision of all types of DERs minimizes total cost
    - Complementary and dynamic demand response offsets supply
    - Integration of electrified transportation; vehicle-to-grid
    - Energy storage reduces “edginess” physically and mentally
  - Smarter smart phones are the key to demand-side customer engagement
    - Existence of supply-side controls is a given
    - Recipe for success is already in our hands.

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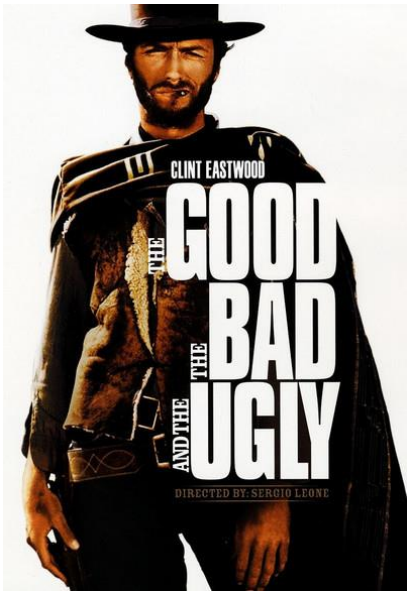

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