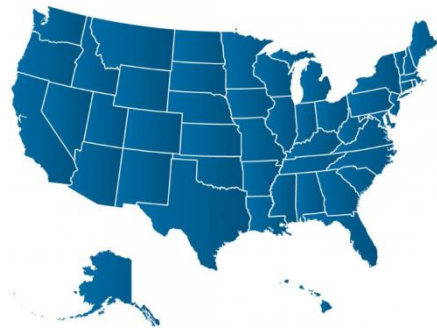




U.S. SMART GRID



Situation and Perspectives

Bruno Prestat - EDF R&D & EPRI

Basile Bouquet - EDF R&D & French Consulate S.F.

Pascal Sitbon - EDF Inc. & EPRI



Outline and Key Points on U.S. Smart Grid

Proactive Federal Policies as a Key Components of the U.S. Smart Grid Deployment (Smart Metering, DA, Storage, etc.)

Data Analytics are new Possible Ways for Utilities to Improve Electric System's Operations and Bring New Services to Customers

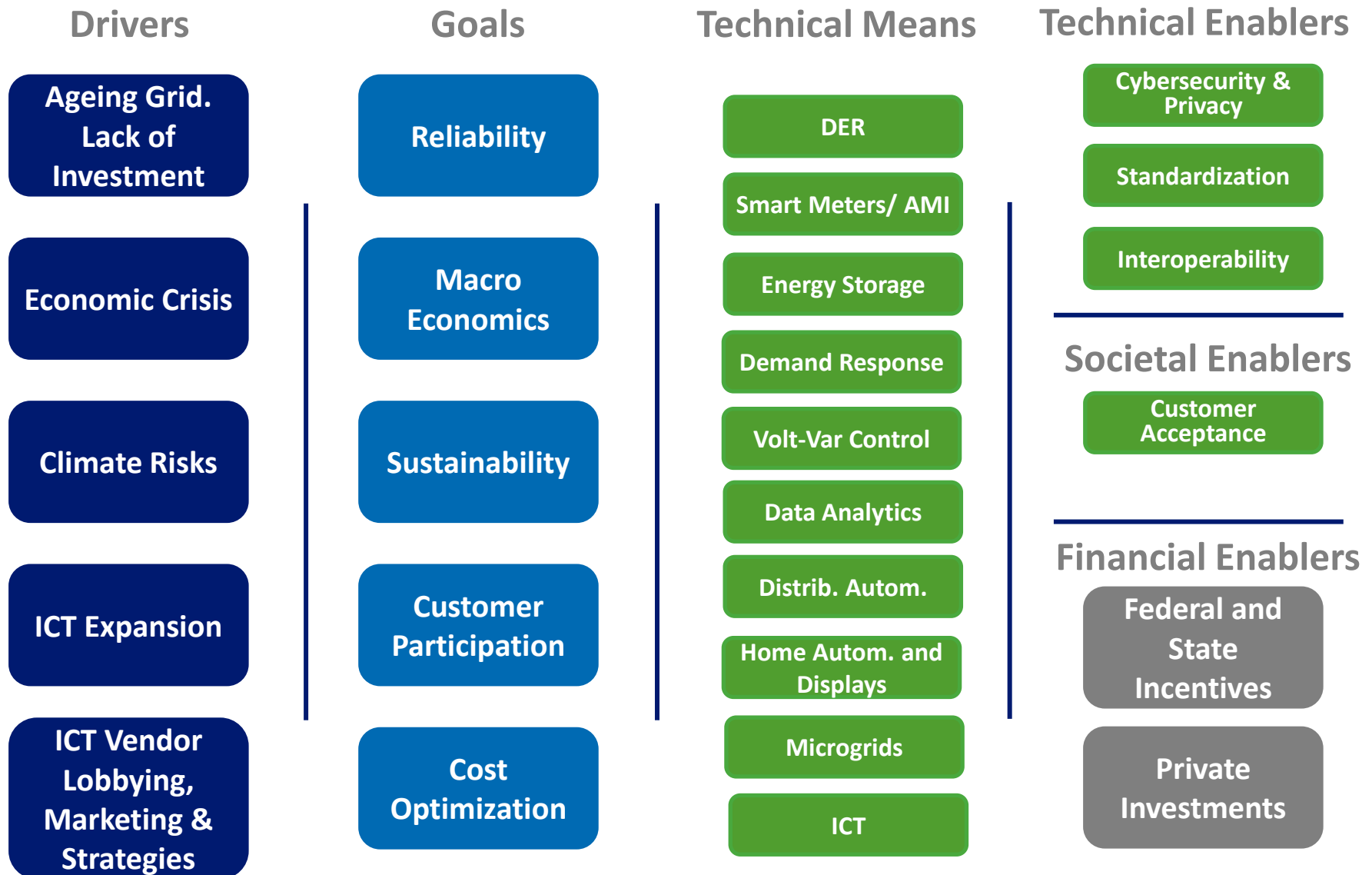
ICT Expansion Brings New Players in the Energy Sector and Allows New Energy Services

U.S. as a Leading Nation in Smart Grid Cyber Security

Standardization and Interoperability: an Obvious Need, Significant Progress, but Still not Fully Achieved

Microgrids: Expected Resilience, Reliability and Cost Effectiveness

U.S. Smart Grid: Drivers, Goals, Means and Enablers



Drivers toward Smart Grid

#1 - Ageing Grid. Lack of Investment

#2 - Economic Crisis

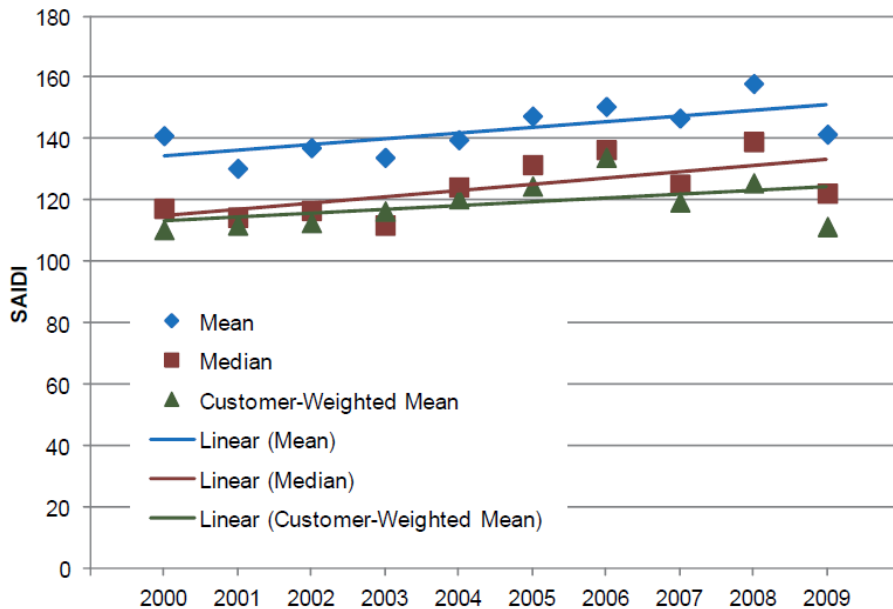
#3 - Climate Risks

#4 - ICT Expansion

#5 - ICT Vendor Lobbying, Marketing and Strategies

Driver #1: Ageing Grid. Lack of Investment

U.S. Administration: "Power outages cost consumers about \$150 bn annually"



Source: Berkeley Nat. Lab.

" Smart grid investment of \$338 bn to \$476 bn could yield \$2 trillion in benefits by 2030 "



" Electricity infrastructure gap estimated to be \$107 bn by 2020 (\$11 bn per year) "



SAIDI: 140 min. SAIFI: 1.2 (excl. major events)
Large dispersion between areas

Huge investment gap to fill in Smart Grid leverage effect expected



Driver #2: Economic Crisis

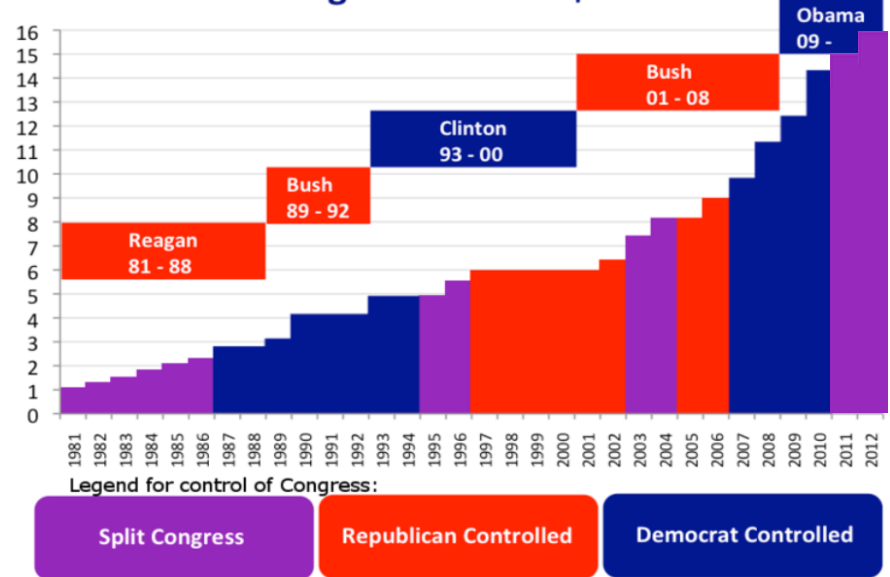
U.S. Unemployment Rate



SOURCE: WWW.TRADINGECONOMICS.COM | BUREAU OF LABOR STATISTICS

Source: *TradingEconomics.com*

US Public Debt Ceiling Since 1981 - \$ Trillions



“Each of us has a part to play in a new future that will benefit all of us. As we recover from this recession, the transition to clean energy has the potential to grow our economy and create millions of jobs—but only if we accelerate that transition. Only if we seize the moment. And only if we rally together and act as one nation—workers and entrepreneurs; scientists and citizens; the public and private sectors.”

—President Obama, June 15, 2010

Obama:
 “No area holds more promise than American Energy”

Driver #3: Climate Risks

Integrating Renewable Energies

29 states have Renewable Portfolio Standards
 21 states have incentives towards EV or PHEV
 Cap and Trade Mechanisms (CA, MA, NH, NY...)

Storm Sandy as a Catastrophic Reminder

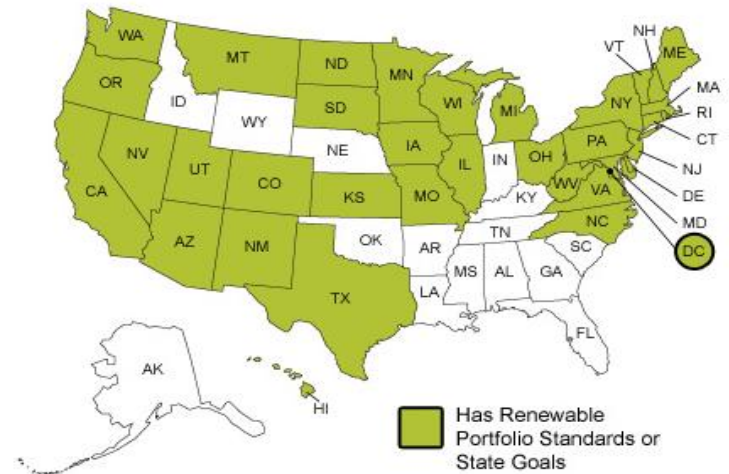
N.Y.: a **\$5.7B** plan to make the state's electric system stronger, smarter and greener by 2020



Source: Reuters

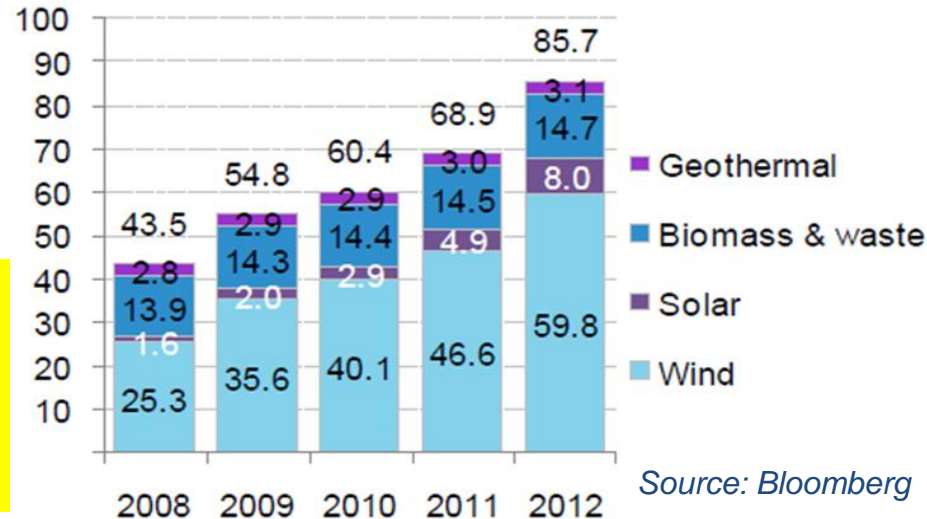
Sandy raises urgent needs: resilience of the electric grid, and resilience of U.S. cities

Most States Have Renewable Portfolio Standards, Mandates, or Goals, 2010



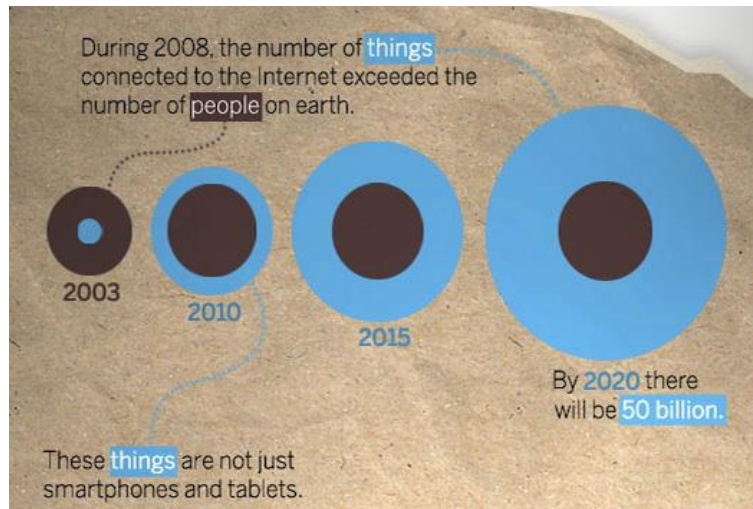
Source: Database of State Incentives for Renewables & Efficiency (accessed January 2010).

Non-Hydro Renewable Energies (GW)

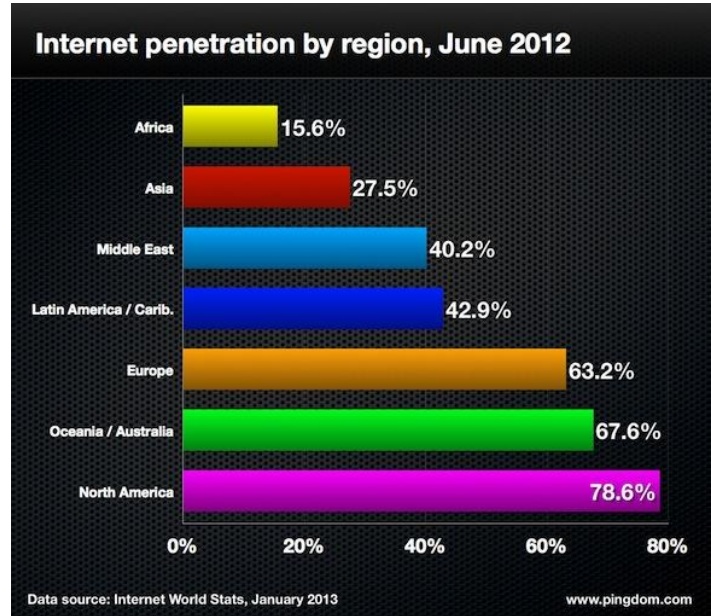


Driver #4: ICT Expansion

2 bn internet users in 2013
Internet traffic 2013: 667 exaoctets, 10^{18} octets
149 trillions of Instagram pics
137M Americans have a Smart Phone



Source: Semanticweb.com



New areas (education, finance, health, etc.) => less frontiers between activities and emergence of common techniques for data processing (ex. Hadoop), visualization tools...



Driver #5: ICT Vendor Lobbying, Marketing and Strategies

Major ICT players influence the deployment of the smart grid

Some ICT Vendors propose services in the core of utilities' businesses

Distributech 2013 Sponsors

<p>Diamond Sponsor:</p> 	<p>Emerald Sponsor:</p> 	<p>Water Reception Sponsor:</p> 	<p>Press Work Room and Coffee Voucher Sponsor:</p> 
<p>Sapphire Sponsor:</p> 	<p>Opal Sponsor:</p> 	<p>Utility University Sponsor:</p> 	<p>Wi-Fi Sponsor:</p> 
<p>Ruby Sponsor:</p> 	<p>Aquamarine Sponsor:</p> 	<p>Social Networking Sponsor:</p> 	<p>Breakfast Roundtable Sponsor:</p> 
<p>Amethyst Sponsor:</p> 	<p>Citrine Sponsor:</p> 	<p>Badge Mailing Insert Sponsor:</p> 	
<p>Emerald Sponsor:</p> 	<p>Blue Topaz Sponsor:</p> 	<p>Conference Proceedings and Show Video Sponsor:</p> 	

Duke Energy
Revenue: \$20bn
Market Size: IN, KY, OH, SC, NC, FL



IBM
Revenue: \$105bn
Market Size: 150 Countries

Proactive Federal Policies as a Key Components of the U.S. Smart Grid
Deployment (Smart Metering, DA, Storage, etc.)

Obama's Fundamental Acts and Policies in Energy

Energy Independence and Security Act

2007 Clean renewable fuels, protection of consumers, products efficiency, buildings, and vehicles, CCS, modernization of the electric grid...

American Recovery and Reinvestment Act (ARRA)

2009 Jobs creation, economy stimulation, energy conservation, long term growth...
Total ARRA funding: **\$840 bn**
Funds allowed to U.S. DOE: **\$35 bn**

SMARTGRID.GOV

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Search

SmartGrid.gov is the gateway to information on federal initiatives that support the development of the technologies, policies and projects transforming the electric power industry.

ShareThis 11.21

What is the Smart Grid?
Information for Consumers

Recovery Act Smart Grid Programs
Program Progress and Results

Federal Smart Grid Initiatives
Policies and Programs

Smart Grid Resource Center
Reports and Documents

U.S. DoE: leadership and information transparency

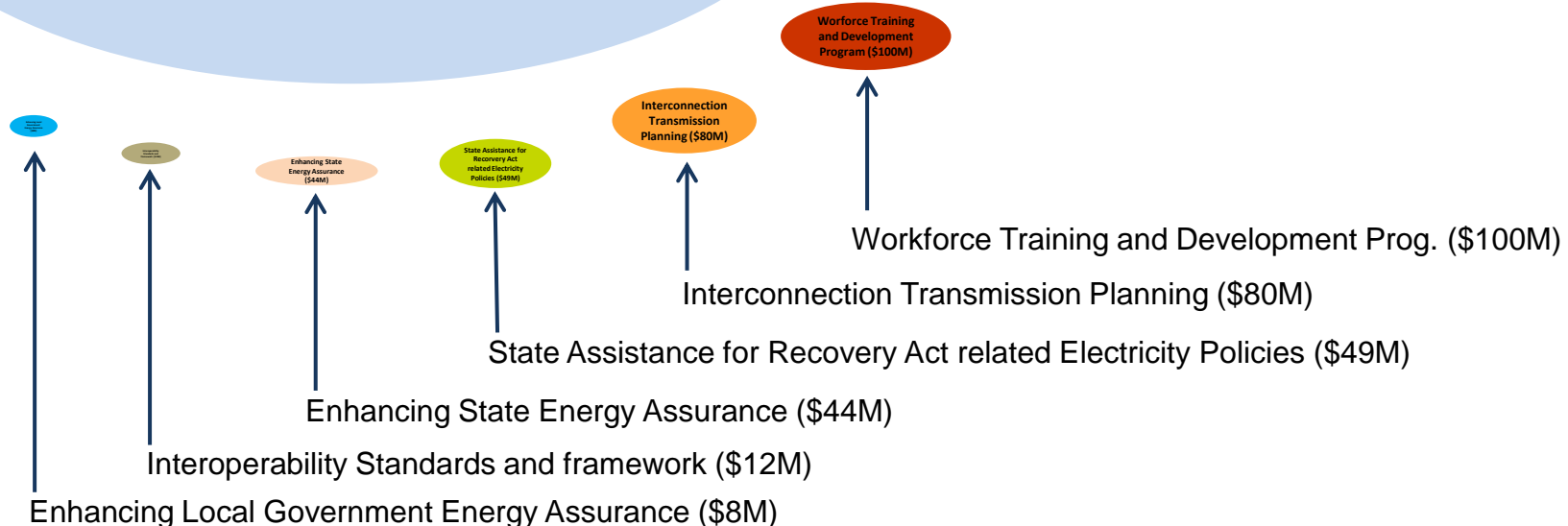


Distribution of ARRA Funds for Grid Modernization

\$4.5 bn allowed by the DOE's Office of 'Electricity Delivery and Energy Reliability', in charge of the grid modernization

Smart Grid Investment Grant – SGIG - \$3.4 bn
Helping deployment of mature technologies

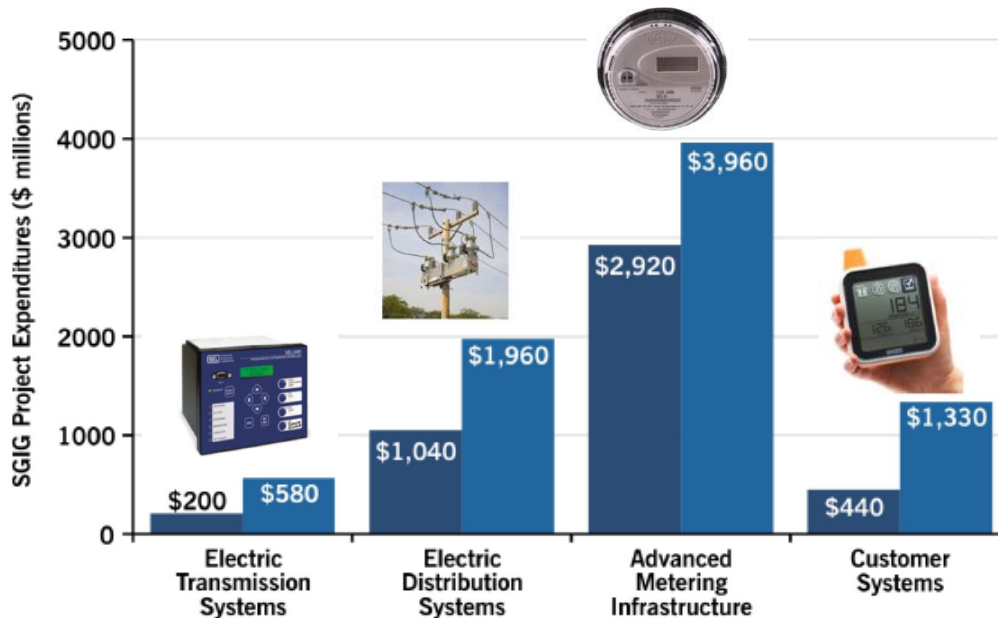
Smart Grid Demonstration Program SGDP - \$620 M
Helping development of new technologies



Smart Grid Investment Grant (SGIG)

Total value of 99 Smart Grid pilot projects: **\$7.8bn**
(DoE funds: \$3.4bn + private funds: \$5.4bn)

SGIG: “Reduced uncertainty for decision makers resulting from analysis of costs and benefits”



SGIG Expenditures by Type of Project
(federal + recipient expenditures through March 2012)

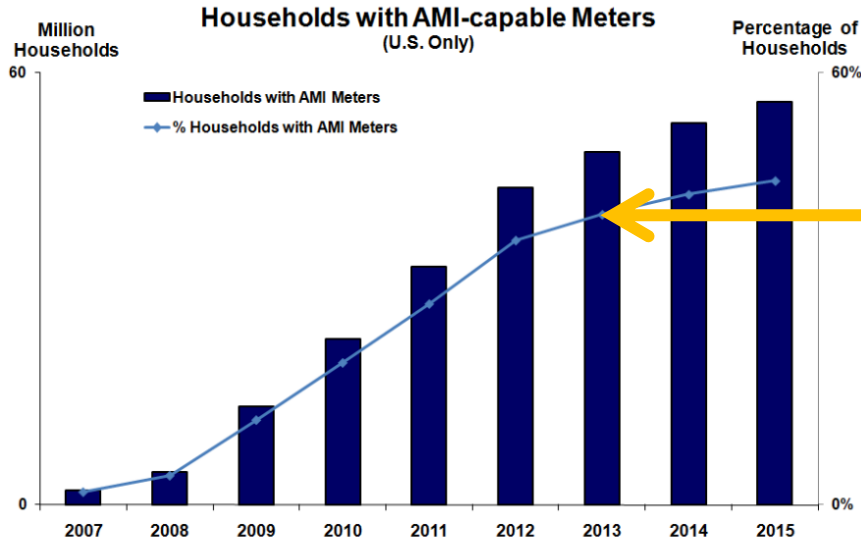
Source: U.S. DOE

SGIG Projects by Type of Recipient

Source: U.S. DOE

SGIG funds have boosted U.S. smart metering and distribution grid automation

Smart Meters Deployment



© 2011 Parks Associates

Source: Parks Associates

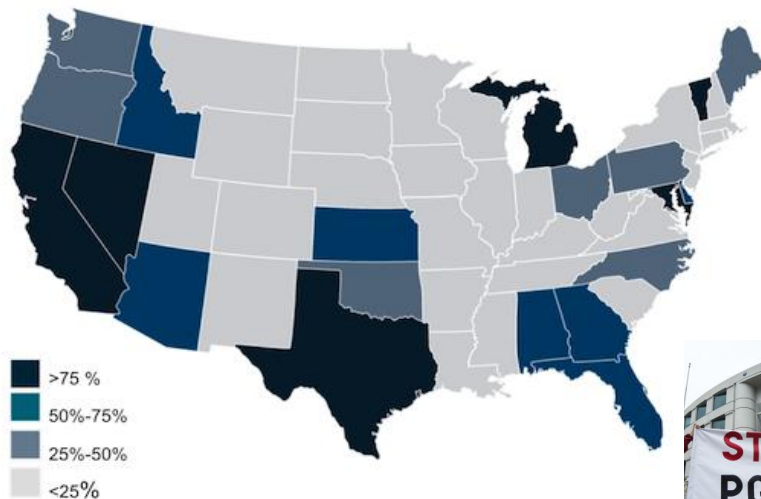
Current figure: **40+M** AMI smart meters

Shipping of smart meters is declining: some states are saturated (CA), while some others lag behind

Smart meter penetration show large differences among U.S. States and Utilities

Some developments have been postponed

United States Smart Meter Penetration by 2014



Source: GTM

Chicago Tribune

BUSINESS

Home > Featured Articles > Comed

ICC lets ComEd delay smart meters until 2015

December 05, 2012 | By Julie Wernau | Tribune reporter



U.S. statistics show less than 1% opt-out

Smart Grid Demonstration Program (SGDP)

32 projects selected by the DOE

Total value of pilot projects: **\$1.6 bn** (DoE funds: \$0.6 bn + private funds: \$ 1bn)

Smart Grid Demonstration Projects.

Total Value of \$1.6 Billion.



U.S. DOE website : SGIG and SGDP projects and budgets



Source: U.S. DOE

Example: SCE got \$40M for Irvine SG demo (SGDP)

At-A-Glance

Recipient: Southern California Edison Company (Irvine Smart Grid Demonstration)

HQ State: California

States Benefitted:

- California

NERC Region:

Total Budget: \$79,242,416

Federal Share: \$39,621,208

SGDP funds have boosted new technologies (energy storage...)

Energy Storage Development

Numerous demonstration projects, favorable regulations, active innovation and manufacturing

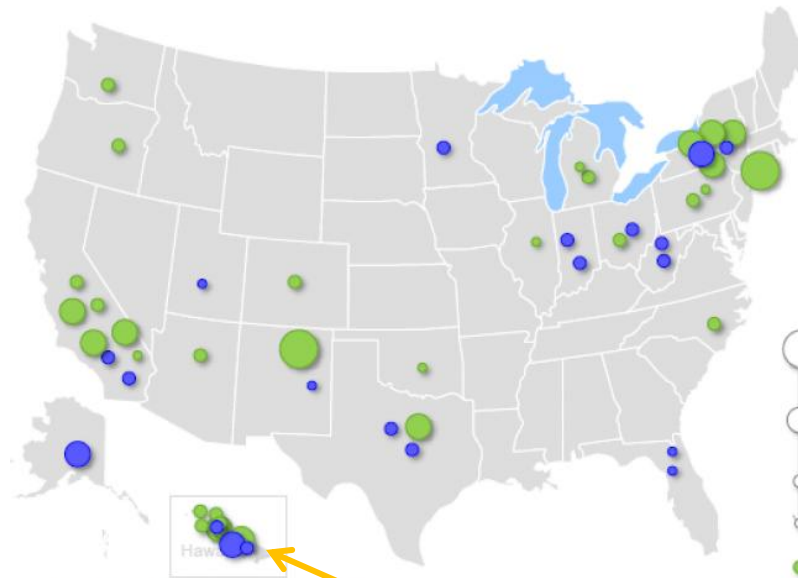
Pay-for-Performance (FERC Order #755) to favor ES for ancillary services

CA's AB 2514 to determine appropriate targets, if any, for each LSE to procure energy storage systems. 2015 and 2020 targets

Regional Utility-Scale Battery Activity

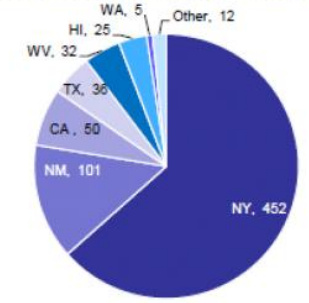
Source: Semptra Generation

Planned and Operating Battery Projects in the US (>500 kW)

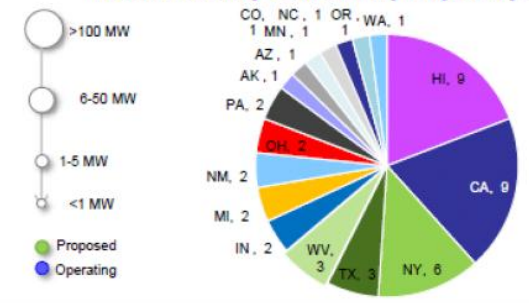


Note: Only shows battery projects >500 kW in size
Source: IHS Emerging Energy Research

Planned Battery Capacity By State (MW)



Number of Utility-Scale Battery Projects by State



New York, Hawaii, and California are attracting the most battery project activity, driven by a combination of federal government funding, regulatory shifts, renewables growth, and state policy support

Recent regulation in California

Hawai'i: 12+ batteries, 30+ MW of installed capacity

California PUC requires SCE to procure at least 50 MW of new electrical capacity in LA Basin from energy storage systems

15 February 2013

EDF – June 2013

Demand Response

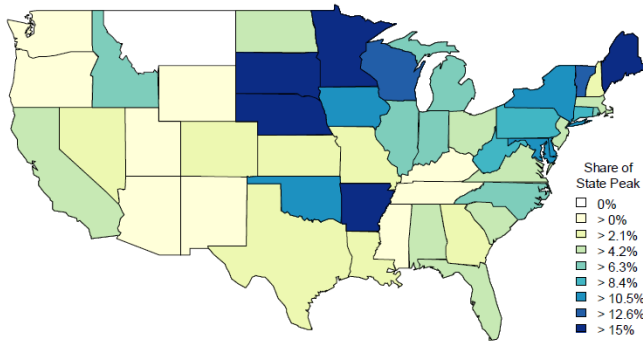
Potential peak reduction through DR:
53 GW

Different kinds of DR programs
(dispatchable vs. non dispatchable)

Different ways to monetize it

U.S DOE puts emphasis on Dynamic Pricing through SGDP

Peak Demand Reduction Capability (as Reported to FERC)



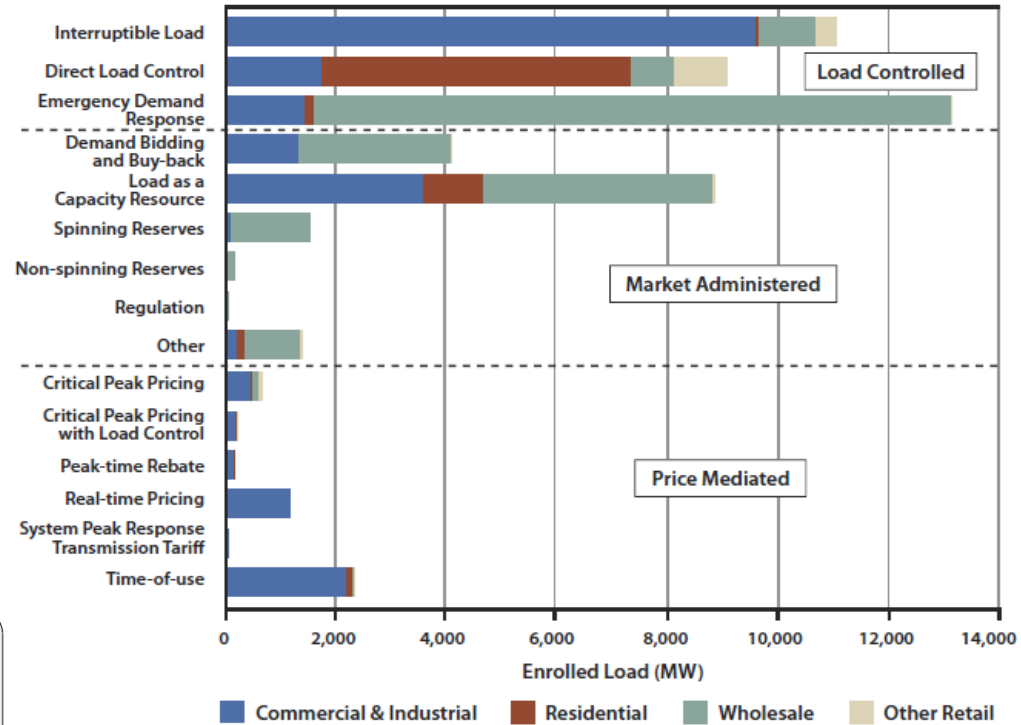
This amounts to 53 GW of peak reduction capability (6% of U.S. peak)

Source: Derived from reported DR capability in 2010 FERC Assessment of Demand Response & Advanced Metering and state system peak projections in 2009 FERC National Assessment of Demand Response Potential

Note: For further discussion, see Kelly Smith and Ryan Hledik, "DR Drivers," Public Utilities Fortnightly, January 2012

Source: FERC and Brattle Group

Enrolled load by type of DR program and Customer Class



Source: Federal Energy Regulatory Commission, *Assessment of Demand Response and Advanced Metering Staff Report* (Washington, DC, 2011).

Residential has a large but mostly untapped potential for DR

Federal Goals and Criteria

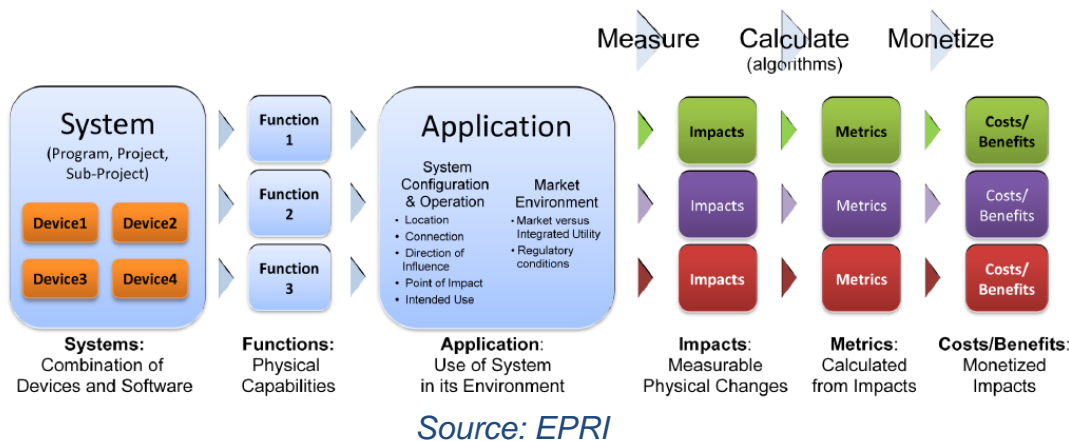
Smart Grids: opportunity to become the world leader and to boost U.S. exports.

Macro-economic indicators matter for U.S. DOE

Two ways to measure Smart Grid development:
“build metrics”: project status
“impact metrics”: costs/benefits analysis

DOE’s six criteria:

1. Job Creation and Marketplace Innovation
2. Peak Demand and Electricity Consumption
3. Operational Efficiency
4. Grid Reliability and Resilience
5. DER and Renewable Energy
6. Carbon Dioxide Emissions



Buy American!



A Desk Guide to the Buy American Provisions of the American Recovery and Reinvestment Act of 2009:

Public Guidance on Implementation, Documentation, Non-compliance and Enforcement

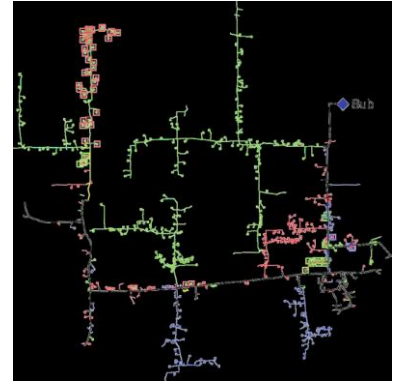
March 2011

Federal level needs to get outcomes from public spending
 U.S. utilities currently evaluating benefits and defining their strategies

Data Analytics are new Possible Ways for Utilities to Improve Electric System's Operations and Bring New Services to Customers

Data Analytics for Utilities

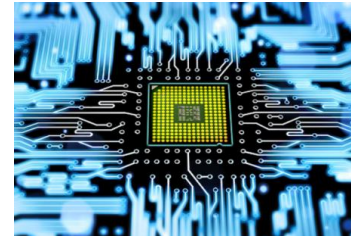
Data Analytics: technologies, services and processes that enable utilities to transform data into actionable insights



“The big question is what to do with all of this data. How do you use this data, and how do you present this data to someone that could actually use this data? Those are really, really tough questions that most utilities are facing right now if they’re deploying smart meters.” -Mary Rich, smart grid Systems Manager, CenterPoint Energy

Only the half of the utilities which have installed smart meters analyze the data collected from the meter (GTM Research)

The idea is not that new but there are significant improvements in underlying technologies: Moore’s law, GIS, high perf. computing, connectivity, mobility, data mining, visualization...



Source: EPRI

Data Analytics for Utilities

Rapid development of customer applications based on data analytics

South Calif. Edison's Budget Assistant



Identification of numerous use cases for power system optimization

Asset Health Data Federation & Visualization In Action at TVA



• with credit to Ron Parsons, Southern Company

- Outage Detection
- Customer Information
- Post Outage Recovery
- Field Crew Data Access
- Cond. Based Maintenance
- Load Profiling
- Revenue Protection
- Automatic Modeling
- Situational Awareness
- PQ Monitoring

A way to make customers understand and confirm the benefits of smart grids?

Some low hanging fruits, but various conditions for full value assessment: technical, management, security requirements, privacy, regulations...

ICT Expansion Brings New Players in the Energy Sector and Allows New Energy Services

New Market Players and New Services

Smart meters, utilities' APIs, Green Button: new enablers to develop energy services market

U.S. DOE is very active: Apps for Energy challenge, Green Button...

Standardization

Easy access

Easy to manipulate

Low Cost

Foster creativity to develop new customer services



People Power has mobile applications that allow users to view energy consumption data from their phones

Plotwatt develops computer algorithms that can detect changes in energy consumption patterns and can make an assumption on what device was turned on at any moment



GETTING STARTED
Dragging the slider at the bottom of the Energy Timeline allows you to look at energy usage from other time periods.

Low Hanging Fruit
Always On
Your Always On power (things using energy 24/7) has risen over the last few days. If unchanged, this will add \$15 per month to your electricity bill.
Heating & A/C
Adjusting your thermostat by 1 degree will save you \$.30 tomorrow and approximately \$10 over the next month.

New Market Players and New Services

New services of consumption visualization managed by Distribution Companies



New market players exploit IT development in Smart Grids to penetrate the energy sector

For Utilities: data analytics, visualization...

For End-users: energy use, ways to reduce it...

SaaS, B2B2C – B2B – B2C



Green Button and HAN (Zigbee...) present opportunities for new players to develop products for end-users independently. SaaS, B2C



U.S. as a Leading Nation in Smart Grid Cyber Security

Cyber Security and Privacy – Situation in the U.S.

15 years of U.S. Critical Infrastructures Cyber Security (1998)
NISTIR 7628 starting point of Smart Grid Security & Privacy



Enforced regulation in the U.S.:

- NERC CIP for Generation, Transmission (*in place*)
- States Utility Councils for Distribution (*in progress*)



Electric Utilities can get significant fines if not compliant

12/31/2012	FERC	NP13-19-000 View NOP >> View Order >>	SERC	Unidentified Registered Entity	NCRXXXXX	\$950,000	SERC200900312	CIP-007-1
							SERC200900310	CIP-007-1
							SERC200900283	CIP-004-1

Source: <http://www.nerc.com/filez/enforcement/index.html>

International Initiatives: ISO/IEC 27019

Towards an international standard for energy industry?



ISO/IEC DTR 27019

Information security management guidelines based on ISO/IEC 27002 for process control systems specific to the energy industry

U.S. regulation is already in place. Towards a unified international standard?

Cyber Security and Privacy – General Trends

For Immediate Release

February 12, 2013

Government involvement (White House)
Certification and compliance
Privacy is a real concern and a possible
obstacle to adoption

Executive Order -- Improving Critical Infrastructure Cybersecurity

EXECUTIVE ORDER

IMPROVING CRITICAL INFRASTRUCTURE CYBERSECURITY



*“DHS (...) shall recommend to the Secretary ways to minimize or mitigate such risks, in a publicly available report, to be released **within 1 year** of the date of this order”*

Collaboration and convergence: EPRI Smart Grid Cyber Security and Privacy collaboration has 30+ members



U.S. DOE, National Labs, R&D Centers, and Academics deeply involved (mostly specific projects and lab. Activities)

U.S. DOE / NESCOR with EPRI



Massachusetts
Institute of
Technology



U.S. Workforce development: Pentagon x5

The Washington Post

Pentagon to boost cybersecurity force

By Ellen Nakashima,

The Pentagon has approved a major expansion of its cybersecurity force over the next several years, increasing its size more than fivefold to bolster the nation's ability to defend critical computer systems and conduct offensive computer operations against foreign adversaries, according to U.S. officials.

Cyber security of critical infrastructures is a top priority for U.S. Government

Cyber Security and Privacy - Market

Smart Grid Cyber Security Market to Reach **\$3.7Bn** by 2015 (Pike Research), **\$1.5Bn** in North-America

Compound Annual Growth Rate 2011-2018: ~ 10%

EPRI: \$3.7M budget in 2013 (estimate)



Emerging startups:

- Cylance announces \$15M funding
- Morta Security raises seed funding

Smart Grid Cybersecurity: Cylance Raises \$15M

The startup with DHS cyberexperts and SCADA hackers on board raises \$15 million to secure critical infrastructure from cyberattack.



Morta Security Closes Oversubscribed Round for Its Disruptive Cyber Security Platform



MARKETWIRE Press Release: Morta Security – Wed, Feb 13, 2013 9:00 AM EST

Growing market attracting now major investors (Koshla Ventures, etc.)

Standardization and Interoperability: an Obvious Need, Significant Progress, but Still not Fully Achieved

Standards Supporting Smart Grids

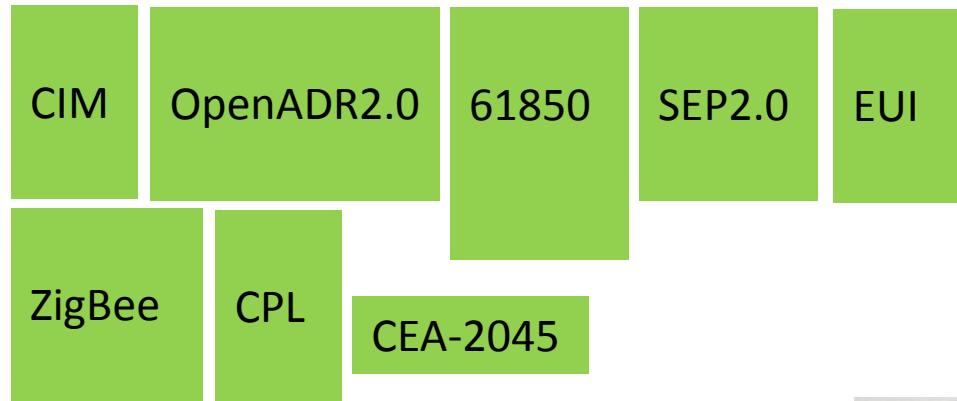
Interoperability Categories



A clear trend towards more interoperability and standardization. EPRI representing utilities in standardization groups



Utilities have learned that architectures and standards are not always sufficient to implement the desired plug-and-play integration



Source: <http://www.gridwiseac.org>

Emerging standards like OpenADR2.0 (a, b...), CEA-2045, EUI (Green Button)... with expansion at international level



U.S. utilities realize that they have to get more involved in standardization working groups, through EPRI or directly

Microgrids: Expected Resilience, Reliability and Cost Effectiveness

Microgrids: Expected Resilience, Reliability and Cost Effectiveness

Lots of experiments and developments: universities, utilities, military bases...

Universities / campus



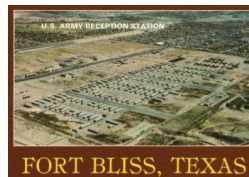
Utilities



Military bases + field operations



Over 40 military bases either have operating microgrids or are planning and demonstrating microgrids



Microgrids: Expected Resilience, Reliability and Cost Effectiveness

Main Drivers (civil + military)

- Security / independence
- Resilience toward climate events
- Reliability of legacy electric grid
- Cost of in-house generation vs. grid
- Market opportunities: DR markets

Specific Military Drivers

- Resilience toward cyber attacks
- Renewable: achieving DoD's goals
- Reducing weight in field operations
- Saving human losses (fuel convoys)

Active Vendors



Market Development (world, Navigant)
\$40Bn in 2020 / CAGR: 17%

U.S. DOE and DOD in favor of Microgrids



Questions

- Security assessment?
- Who gets the benefits?
- Utilities' grid costs allocation?
- Cost effectiveness?
- Quality of service?
- How to ensure competition in supply?

Thank You for Your Attention!

Contact:

Bruno Prestat - EDF R&D Resident Researcher at EPRI

bruno.prestat@edf.fr bprestat@epri.com