NRECA/CRN Smart Grid Demonstration Project

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Rural Electric Cooperatives

- Owned by the members they serve
- Not-for-profit

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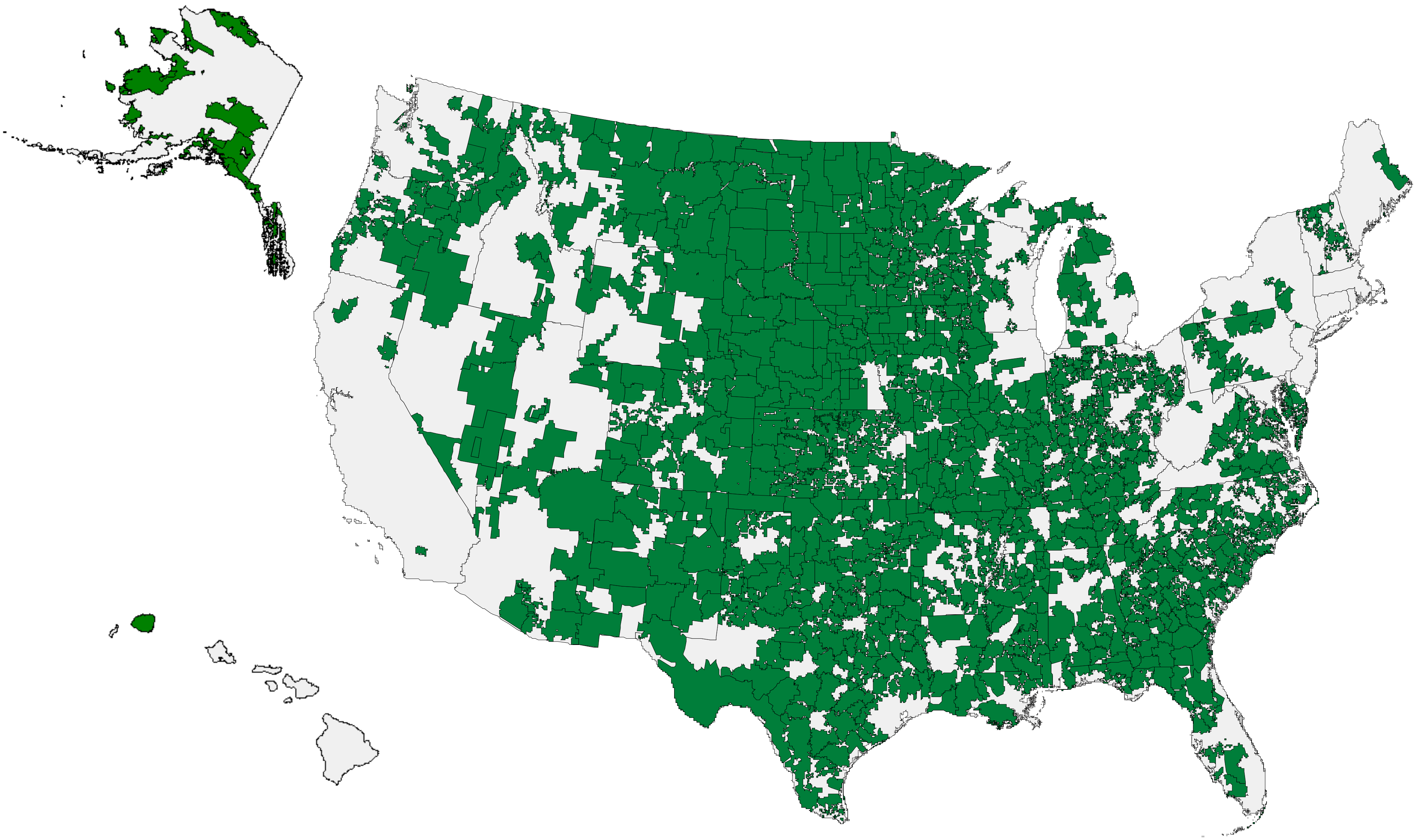
Co-ops do more with less



Cooperative Research Network

- CRN accelerates energy solutions to help co-operatives meet and exceed the expectations of their members

- Original collaborative research by and for the more than 900 electric cooperatives nationwide

Innovation

- CRN advances energy innovation by partnering with cooperatives, national labs, and industry to research technologies of benefit to member consumers

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Demonstration

- CRN's nationwide network of co-ops provides a real-world test bed for demonstrating new technology solutions

Application

- CRN products and tools support electric cooperative application of leading beneficial technologies.

CRN Regional Smart Grid Demonstration Project

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Goal: To demonstrate the technologies that can help co-ops meet the current and future expectations of consumer members nationwide.

Criteria for evaluating the technologies:

- Efficiency
- Reliability
- Affordability

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CRN Regional Smart Grid Demonstration Project

	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	NRECA Smart Grid Demo Project -- Summary Chart													
2			Activity Types											
3			Demand Response				Distribution Automation (DA)				Enabling Technologies			
4		**Participants**	IHD/Web Portal Pilots	DR over AMI	Prepaid Metering	Interac-tive Thermal Storage	Renew-ables	Smart Feeder Switching	Advanced Volt/Var Control	CVR	AMI	MDM	Comm	SCADA
38	Cooperative	Adams Electric Co-op, IL	●	●				●				●	●	●
39		Adams-Columbia Electric Co-op, WI						●	●	●				●
40		Blue Ridge Electric, NC										●		
41		Clarke Electric Co-op, Inc., IA	●	●				●		●	●	●	●	●
42		Corn Belt Power Co-op, IA											●	
43		Calhoun Co. ECA		●							●			
44		Humboldt Co. REC		●							●			
45		Iowa Lakes EC	●	●					●	●				
46		Prairie Energy Co-op		●							●			
47		Delaware County Electric Co-op, NY	●	●							●		●	
48		Delta Montrose EA, CO	●		●							●	●	●
49		EnergyUnited			●			●				●		
50		Flint EMC, GA	●								●			
51		Kaua'i Island Utility Co-op, HI	●	●							●			
52		Kotzebue Electric Assn., AK	●		●		●	●						
53		Menard Electric Co-op, IL	●	●					●					
54		Minnesota Valley EC, MN	●	●			●					●		
55		Great River Energy, MN				●						●		
56		Lake Region Electric Co-op., MN	●									●		
57		Owen Electric Co-op, Inc., KY	●	●				●	●				●	●
58		Salt River Electric Co-op Corp., KY						●					●	
59		Snapping Shoals EMC, GA						●						
60		Washington-St. Tammany EC, LA						●					●	●
61			12	11	3	1	2	9	4	3	7	8	8	6
62												Total Listed		74

Status of the SGDP

- Procurement (90+ percent)
- Guide to Developing a Risk Mitigation and Cyber Security Plan
- Focus Groups and survey on co-op member views and opinions
- Communicators' Guide to a Smart Meter Rollout
- MultiSpeak® extensions

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Initial Findings: Barriers to the Smart Grid

- Costs and benefits of smart technologies difficult to gauge
- Complex communications infrastructure
- Consumers are suspicious
- Immature interoperability standards
- Lack of consensus on cyber security
- Unprepared for rise in the volume of data

COMMUNICATIONS

Increasing complexity of the smart grid will require more sophisticated communications infrastructure

Where we are

- SGDP participants have deployed fiber, point-to-point radios, LAN backhaul, neighborhood area networks

Where we will be

- SGDP will produce guidance on the advantages and disadvantages of each technology, best procurement practices and planning tools
- Develop guidance on how to build a communications infrastructure that can support smart grid functions

COMMUNICATIONS – key findings

- Virtually every smart grid project is also a communications infrastructure project
- The limited bandwidth available when using power line carrier affects both the quality and amount of data available
- Vendors' representation of their products have not all been reliable

PUBLIC ACCEPTANCE

Utilities need to educate their consumers about the benefits of smart technologies or risk backlash

Where we are

- Guide to Communicating About Smart Meters
- Focus groups and surveys

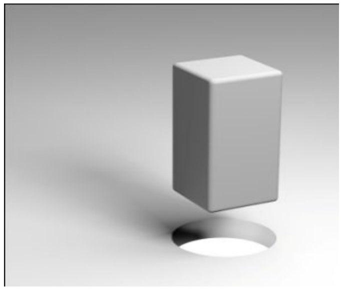
Where we will be

- SGDP study on consumer acceptance of smart-grid enabled programs, including pre-paid metering, accessible meter data and smart appliances

PUBLIC ACCEPTANCE – key findings

- Consumer members have concerns about data privacy and, to a lesser degree, health
- Questions from members must be addressed immediately and in person if possible
- Consumer respond well to reliability benefits of smart grid technologies

INTEROPERABILITY



More interoperability is needed to reduce need for expensive custom integration

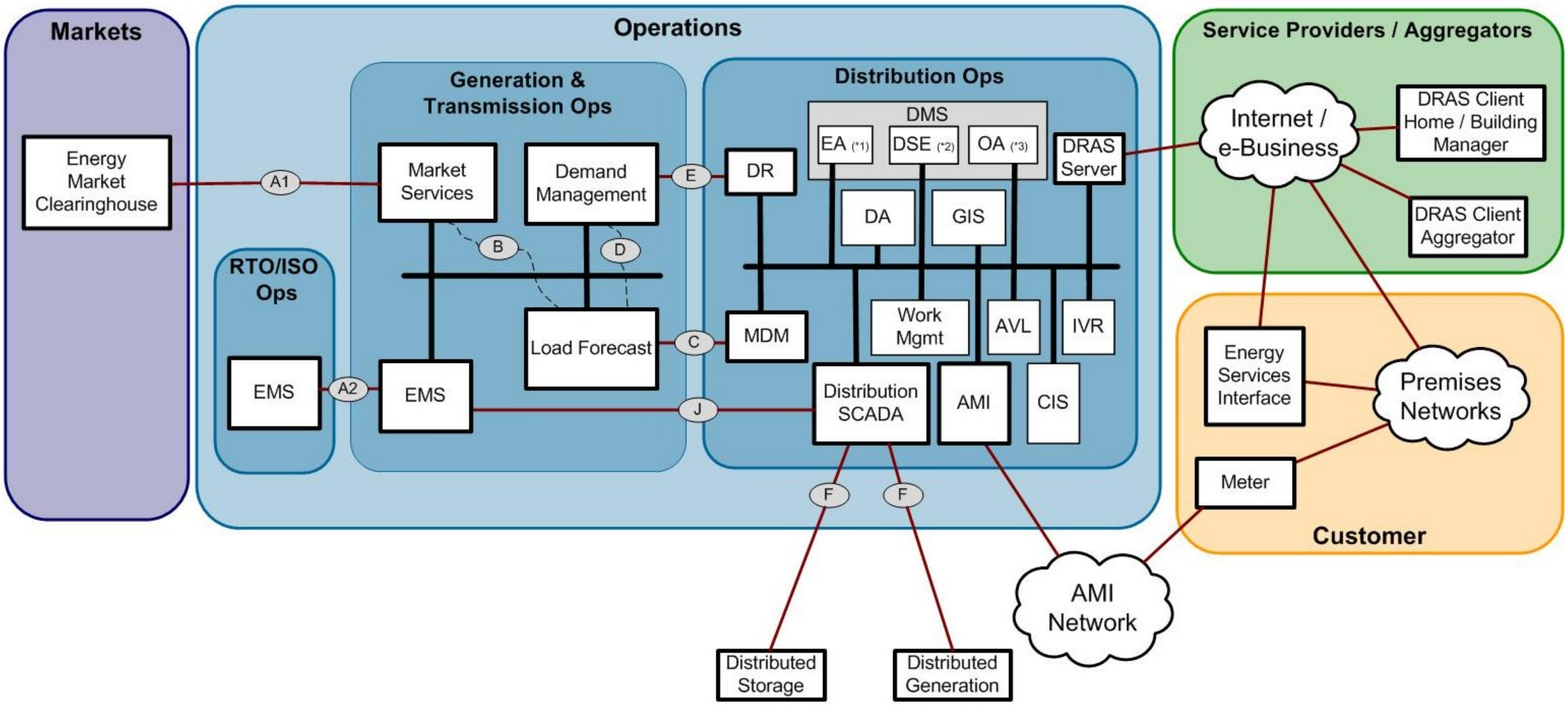
Where we are

- Developed additional MultiSpeak® extensions to meet the needs of the project

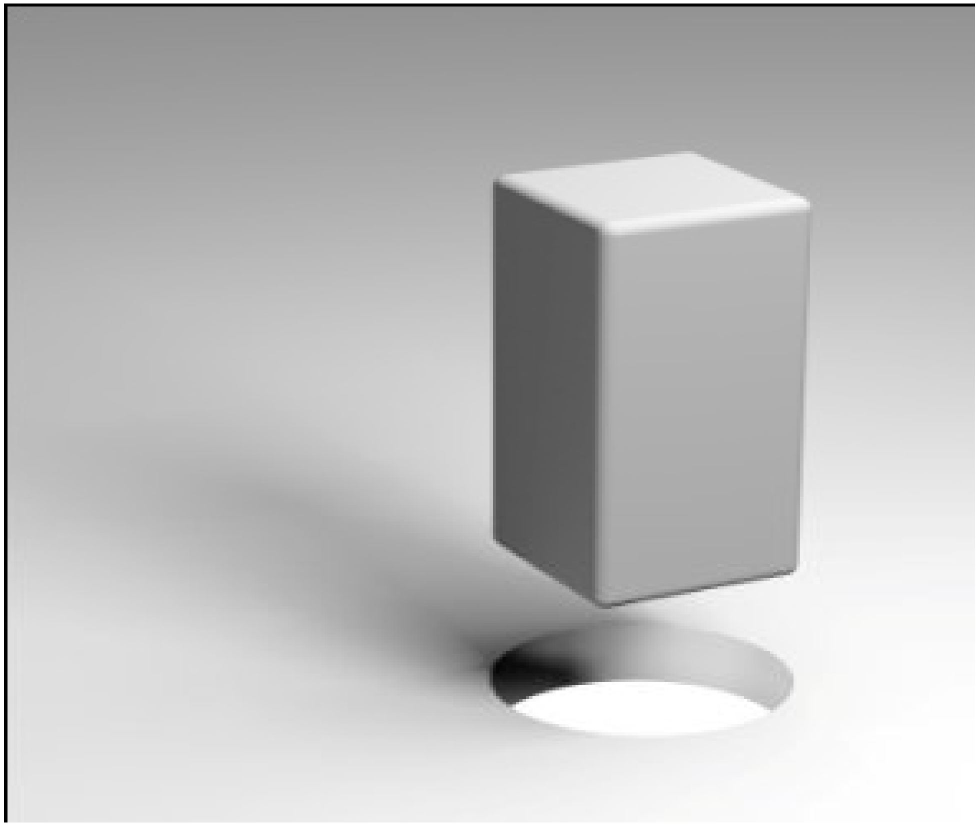
Where we will be

- Improve rigor of documentation around use cases
- Develop case tools
- Develop reference implementation
- Complete roll-out of security extension

Role of MultiSpeak in the CRN Smart Grid Demonstration



INTEROPERABILITY – key findings



- Increasing complexity of utility systems means more interfaces and complex ones
- “Glue code” is ubiquitous and a serious cyber security risk
- Interoperability and cyber security are inextricably connected

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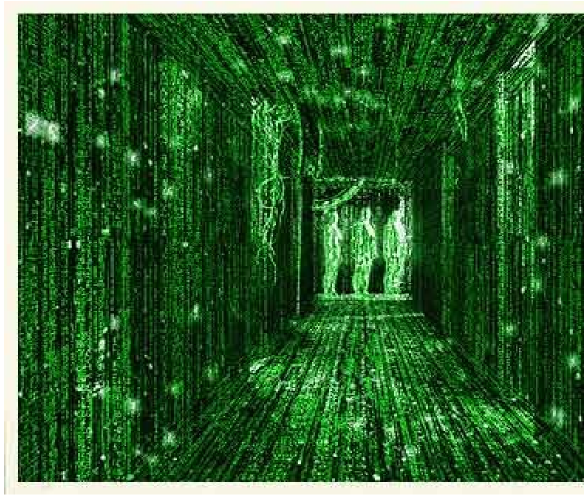
CYBERSECURITY



Strengthening cyber security will be imperative as utilities implement new automation and communications tools and begin moving to the Cloud

Where we are

- Guide and template for developing a cyber security and risk mitigation plan
- Participating co-ops developed plans using the materials

Where we will be

- Educating co-ops nationwide on guide and template
- Template now being aligned with federal maturity models

MultiSpeak® Security Milestones

- Issued draft final release of a standard on how to secure MultiSpeak web services. This draft will go to ballot by the MultiSpeak Technical Committee in December and likely be released to the public by early 2013.
  - Includes four mandatory security profiles that all products must meet.
  - Crafted to support existing V3.0 and V4.1 interfaces in addition to those going forward.
  - Reached 100% consensus among broad-based set of vendors participating in development of the standard.
  - Standard includes clearly testable requirements.
- Have prepared a draft of a guidance document for vendors and utilities on how to implement secure MultiSpeak web services.
- CRN regional demonstration project deliverables:
  - Guidance document on how to implement authentication in utilities.
  - Guidance document for utilities on how to develop security policies. The MultiSpeak security standard is keyed to the options in this guidance document.

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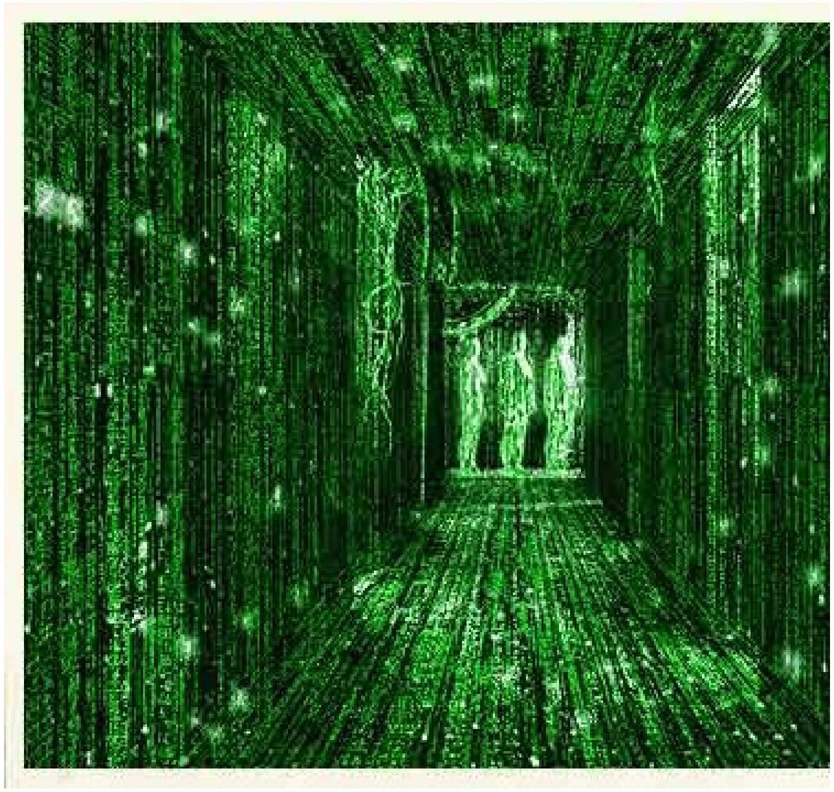
CYBER SECURITY – key findings



- Level of security in the development and manufacture of smart grid components varies widely
- Outsourcing of IT functions changes risk
- Significant vulnerability in commonly used unauthenticated radio links
- Co-ops already moving to the Cloud
- Lack of data authentication

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DATA MANAGEMENT

Utilities need to be prepared to collect, validate and use the volume of data that will be coming from the new systems.

Where we are

- Both G&Ts and distribution co-ops are deploying new data management systems
- Co-ops are connecting systems and breaking down silos

Where we will be

- Advanced architecture
- Cloud computing
- Models for Green Button Connect data

DATA MANAGEMENT– key findings

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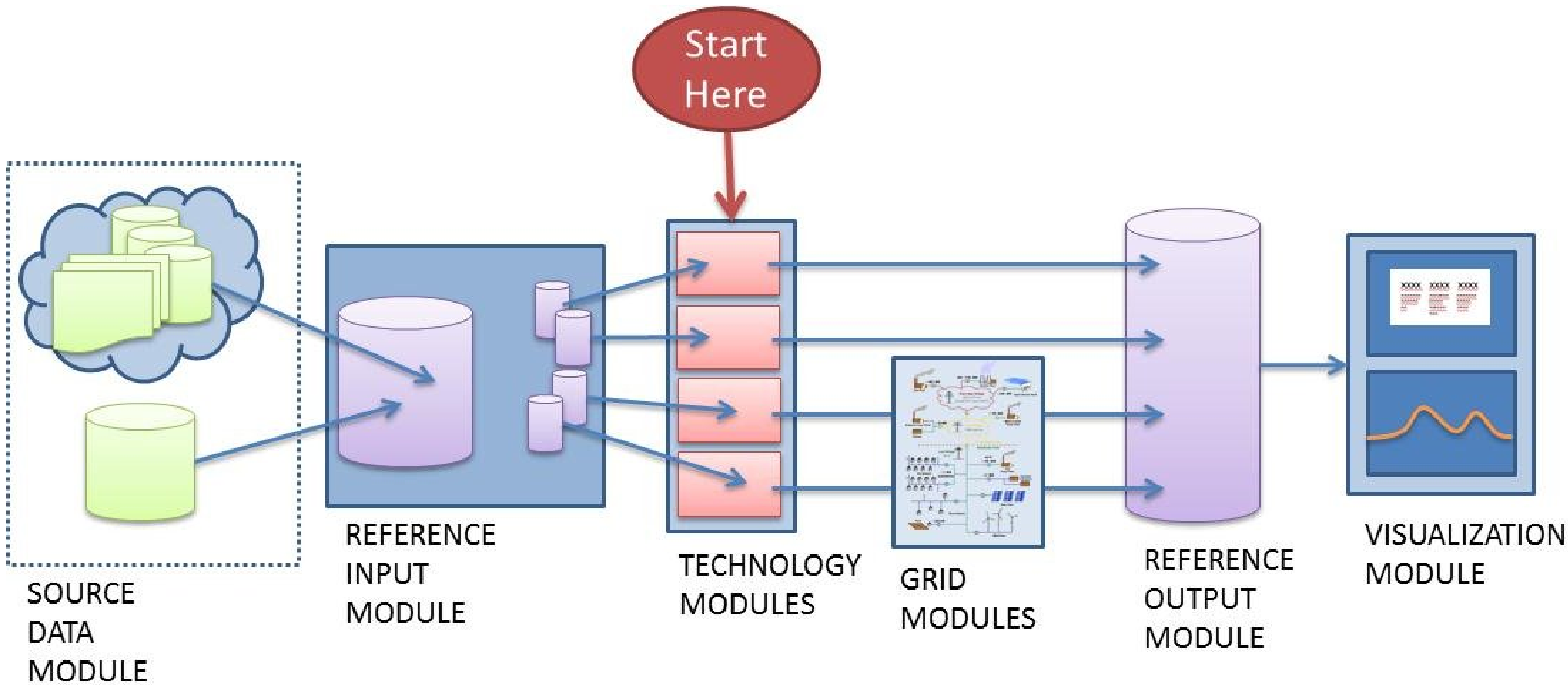
- Co-ops are already moving some data and processes, i.e., outage management and meter data management, to the Cloud
- Co-ops are already using new data in innovative ways – preventing theft, integration of billing data and SCADA, outage management and CVR planning

EVALUATION MODEL– key findings

Grid Lab-D from PNNL is flexible tool for developing cost-benefit models but it requires a framework to make it usable and consistent

A cost-benefit model does not replace commercial engineering and planning tools such as WindMil and Cynedist

OMF: BUILDING THE FRAMEWORK



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STUDIES

- Studies on technologies to improve reliability, efficiency and affordability leading to best practices
- Multi-co-op studies
- Case studies

RELIABILITY Studies

Studies on technologies to improve reliability of operations and power delivery and on the reliability of the technologies themselves

- AMI accuracy
- Advanced communications
- Smart feeder switching

AMI Accuracy over PLC

- Collect errors and malfunctions
- Determine causal factors correlated with AMI errors and malfunctions

Customer acceptance
Computational volume and complexity
Communications
Interoperability
Cyber Security
Assessing costs and benefits

AMI Accuracy Study Approach

- Guidance on planning and deploying AMI over PLC

Cooperatives

- Washington-St. Tammany Electric Cooperative (LA)
- Owen Electric Cooperative (KY)
- Adams Electric Cooperative

Advanced Communications

- Assess the costs, capabilities and limitations associated with advanced communications equipment.
- Develop guidance for comms equipment planning and procurement

- Customer acceptance
- Computational volume and complexity
- Communications
- Interoperability
- Cyber security
- Assessing costs and benefits

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Communications Study Approach

Measure latency, throughput, collisions, dropped data, uptime and costs as a function of weather, solar weather, time-of-year, transmission distance.

Cooperatives

- Washington-St. Tammany Electric Cooperative (LA)
- Owen Electric Cooperative (KY)
- Adams Electric Cooperative

Smart-Feeder Switching

- Assess the impact of smart-feeder switching on outage resiliency, reliability, recovery time.

Customer acceptance
Computational volume and complexity
Communications
Interoperability
Cyber Security
Assessing costs and benefits

SFS Study Approach

Simulate in the Open Modeling Framework, pull results from visualization module.

Cooperatives

- Adams
- Clarke (IA)
- Energy United (NC)
- Kotzebue (AK)
- Owen
- Salt River
- Snapping Shoals
- Washington-St. Tammany

Snapping Shoals – Edge Based Control of Smart-Feeder Switching Case Study

EFFICIENCY Studies

The SGDP deployed technologies to increase efficiency on both sides of the meter

- Prepaid metering
- CVR and Volt/VAR optimization

Prepaid Metering

- Measure the impact of prepaid metering on total energy usage and demand.
- Analyze demographic differences in member satisfaction
- Measure member retention in the programs

- Customer acceptance
- Computational volume and complexity
- Communications
- Interoperability
- Cyber security
- Assessing costs and benefits

Prepaid Metering Study Approach

- Compare demand relative to peers before and after PPM
- Survey and/or focus group studies
- Examine retention rates among different categories of participants

Cooperatives

- EnergyUnited
- Kotzebue EC

Voltage Optimization Study

- Measure the impact on peak demand reduction, loss reduction, power factor and total energy
- Monetize these impacts
- Analyze the interrelationship between Volt/VAR optimization and other smart grid technologies

Customer acceptance

Computational volume and complexity

Communications

Interoperability

Cyber Security

Assessing costs and benefits

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Voltage Optimization Approach

Simulate in the Open Modeling Framework, pull results from data presentation module.

Cooperatives

- Adams EC
- Menard EC
- Owen EC

Blue Ridge EMC – Innovative Uses of MDM Case Study

- Power theft detection
- Error detection
- Voltage control
- Meter accuracy

Customer acceptance

Computational volume and complexity

Communications

Interoperability

Cyber Security

Assessing costs and benefits

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AFFORDABILITY Studies

SGDP deployed an array of technologies to reduce the cost of power and allow members to reduce their use.

- Demand response, consumer information and pricing
- Energy storage and integration of renewables
- Energy storage and demand response

Demand Response, Consumer Information and Pricing

Measure the impact of consumer information, demand response and real-time pricing systems on peak demand and overall energy usage

- Customer acceptance
- Computational volume and complexity
- Communications
- Interoperability
- Cyber Security
- Assessing costs and benefits

Demand Response, Consumer Information, Pricing Study

- Examine relative peak and total demand (using rest of coop as control) year before and after consumer information, demand response and pricing systems are implemented
- Member surveys and/or focus groups

Cooperatives

- Blue Ridge EMC
- Kaua'I
- Adams Electric
- Clarke EC
- Iowa Lakes EC
- Lake Region EC
- Minnesota Valley EC
- Delaware County EC

Kotzebue EC Energy Storage Case Study

Kotzebue EC is testing a large zinc bromide battery to help integrate wind and reduce dependence on diesel

The battery:

- 500kW – 7HR
- 70% Round Trip Efficient

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Great River Energy Storage and DR Case Study

- The G&T is deploying a Multi-Tenant MDM System in order to administer two-way demand response at the G&T level
- Thermal Storage
  - ❑ Energy Arbitrage
  - ❑ Frequency Regulation MISO

Customer acceptance

Computational volume and complexity

Communications

Interoperability

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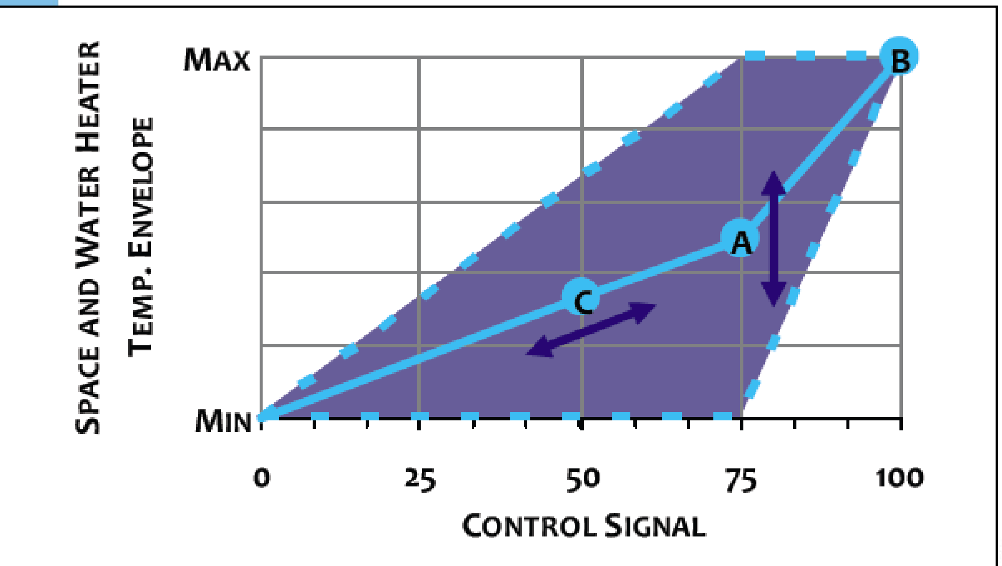
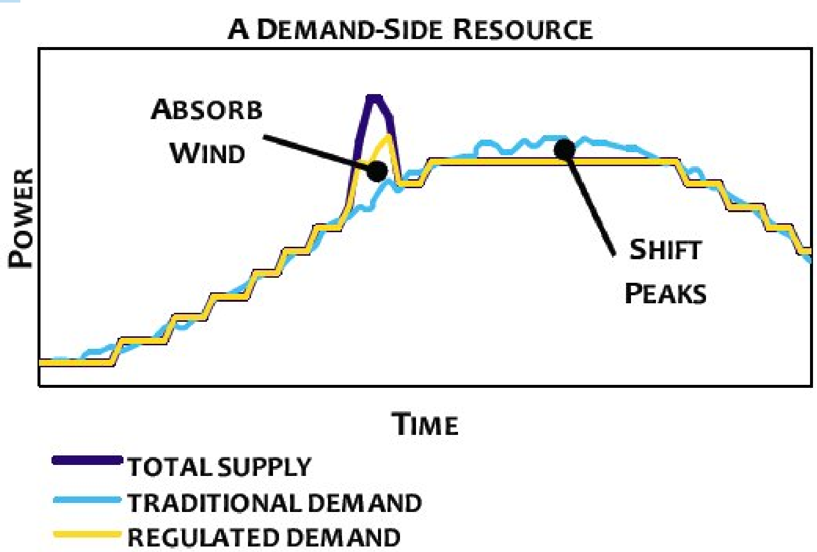
nteractive Thermal Storage



With the receipt of a utility or Smart Grid control signal, the Steffes grid-interactive space and water heater control is also capable of providing utilities and ISOs with powerful methods to shift and shape the load curve.



Minnesota Valley EC Battery Case Study

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- Battery Storage Demonstration
  - ❑ Peak Shaving
  - ❑ Frequency Regulation MISO

Customer acceptance

Computational volume and complexity

Communications

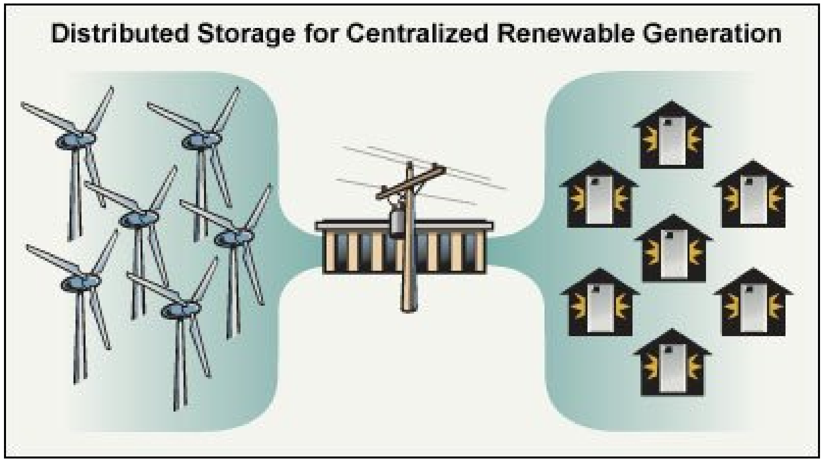
Interoperability

Cyber Security

Assessing costs and benefits

Customer-Sited Distributed Energy Storage

- Silent Power
- Modular units -- 5/10 kW power with 10/20 kW-hr storage (2 hours)
- Sealed Lead Acid
- 5 & 10 kW Unit
- Utility owned behind the meter



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Corn Belt – G&T Managed Demand Response Case Study

- Operating load control switches
  - Calhoun EC
  - Prairie Energy
  - Humboldt EC

- Customer acceptance
- Computational volume and complexity
- Communications
- Interoperability
- Cyber Security
- Assessing costs and benefits

- Sealed Lead Acid
- 5 & 10 kW Units
- Utility Owned/Behind the Meter

Flint Energies Peak-Reduction Incentive Case Study

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Flint Energies

- Peak Reduction Incentives
- Smart Appliances

Customer acceptance

Computational volume and complexity

Communications

Interoperability

Cyber Security

Assessing costs and benefits

Co-ops Innovate at the Pace of Value

- Are these technologies viable
- Are these technologies cost-effective
- How can we accurately assess the benefits