Memorandum

From the office of
Commissioner Bob Burns
Arizona Corporation Commission
1200 W. WASHINGTON
PHOENIX, ARIZONA
(602) 542-3682

TO: Docket Control

DATE: May 30, 2014

FROM: Commissioner Bob Burns

SUBJECT: Emerging Technologies in Energy, Docket No. E-00000J-13-0375

The agenda and presentations from the May 28, 2014 Emerging Technologies Workshop have been docketed. If for some reason you cannot access eDocket, please contact my Executive Aide, Jessica Perry, to receive copies of the presentations.

ORIGINAL

Original and thirteen (13) copies of the agenda and presentations filed this 30th day of May, 2014, with:

Docket Control
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Copies of the memo mailed this 30th day of May, 2014, to:

Service List

THIRD REVISED N O T I C E
SPECIAL OPEN MEETING
OF THE ARIZONA CORPORATION COMMISSION

Commission Workshop on Emerging Technologies
Docket No. E-00000J-13-0375

DATE: Wednesday, May 28, 2014 **START TIME: 9:00 a.m.**

Arizona Corporation Commission
Hearing Room One
1200 W. Washington Street
Phoenix, Arizona 85007

This shall serve as notice of a special open meeting of the Arizona Corporation Commission at the above location for consideration, discussion, and possible vote of the items on the following agenda and other matters related thereto. Please be advised that the Commissioners may use this open meeting to ask questions about the matters on the agenda; therefore, the parties to the matters to be discussed or their legal representatives are requested, though not required, to attend. The Commissioners may move to executive session, which will not be open to the public, for the purpose of legal advice pursuant to A.R.S. §§ 38-431.03.A.2, 3 and/or 4 on the matters noticed herein. The Commissioners may also move to executive session, which will not be open to the public, for other purposes specified in A.R.S. §§ 38-431.03, including discussions, consultations or considerations of Commission personnel and salary matters, on matters noticed herein.

The Arizona Corporation Commission does not discriminate on the basis of disability in admission to its public meetings. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, as well as request this document in an alternative format, by contacting Shaylin A. Bernal, phone number (602) 542-3931, E-mail sabernal@azcc.gov. Requests should be made as early as possible to allow time to arrange the accommodations.

Jodi Jerich
Executive Director

Agenda

Morning Session: 9:00 a.m.

Welcome & Opening Remarks

Presentations:

1) Honeywell
    a. Kevin Lauckner , Director of Business Development
       "Thermostat Innovation"
    b. Dave Robinson, Senior Sales Support Consultant
       "Resiliency through Microgrids"

2) TransGrid Consulting
    a. Ken Wilson, Owner and Senior Consultant
    "Distribution Voltage Optimization: Energy Savings for All Customers Through Investment in Grid Technology"

3) Triple Point Energy
    a. Mark Hamilton, Principal
    "An Overview of Strategic Energy Management"

4) First Fuel
    a. Sam Krasnow, Vice President of Regulatory Affairs and Market Development
    "Using Meter Data Analytics to Transform Energy Efficiency"

LUNCH

Afternoon Session: 1:00 p.m.

5) EcoFactor
    a. John Steinberg, Executive Vice President of Business Development
    "Intelligent Residential Energy Automation"

6) Navigant
    a. Peter Asmus, Principal Research Analyst
    "Microgrids: Impacts on Planning and Policy in Arizona"

7) Kroger
    a. Denis George, Energy Manager
    "Alternative Rate Design: a Large Customer Perspective"

8) OPower
    a. Josh Lich, Senior Manager of Solutions Marketing
    "Transforming Your Customers into an Energy Resource"

9) Department of Engineering & Computing Systems, Arizona State University
    a. Nathan Johnson, Assistant Professor
    "Decision Making in Micro-grids from Concept to Construction"

10) Southwest Gas
   a. Joe Varela, Manager of Energy Solutions
      "Emerging Technologies: The Role of Natural Gas"

Add Language →

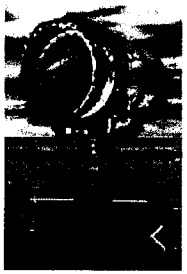
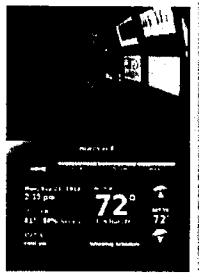
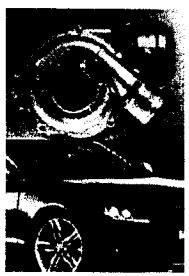
11) EnerNOC
   a. **Mona Tierney-Lloyd, Senior Director of Western Regulatory Affairs**

Wrap-Up & Closing Remarks

Arizona Corporation Commission
Thermostat Innovation and Resiliency through Microgrids - Emerging Technology Workshop
May 28, 2014

Kevin Lauckner
Dave Robinson

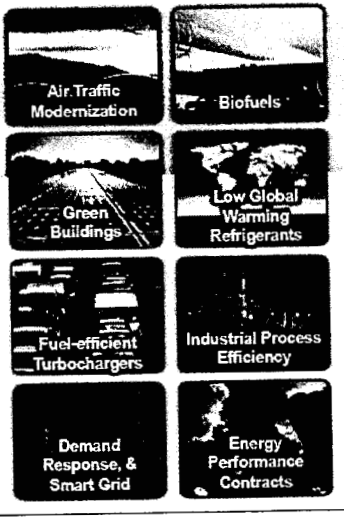
Honeywell's Businesses

Aerospace	Automation and Control Solutions	Performance Materials and Technologies	Transportation Systems
			
Phoenix, AZ headquarters	**Minneapolis, MN headquarters**	**Morristown, NJ headquarters**	**Rolle, Switzerland headquarters**
$12 billion sales	**$16.6 billion sales**	**$6.8 billion sales**	**$3.8 billion sales**

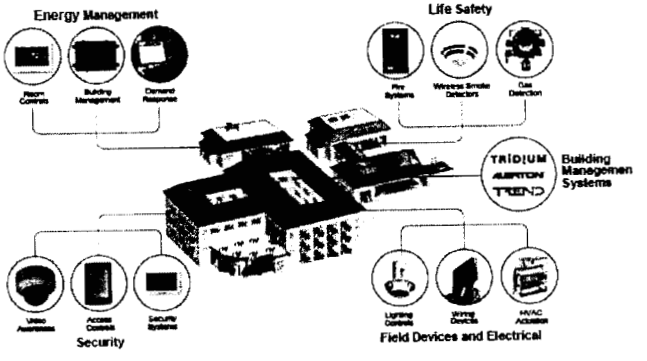
Energy Efficiency and Clean Energy Generation

With nearly 50% of our products linked to energy efficiency, Honeywell is helping the world meet its energy challenges.

By immediately and comprehensively adopting existing Honeywell products, the U.S. could reduce energy consumption 20 to 25%.



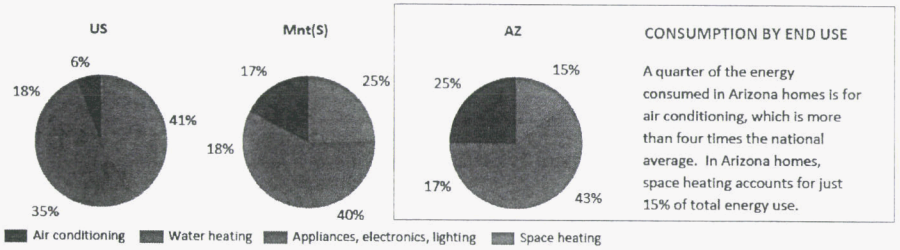
Perspective from a couple of angles



Demand Side Management Experience
- Over 30 years experience
- More than 50 utilities
- Millions of homes and buildings

Original Equipment Manufacturer
- Thermostat
- Building Management System
- Security

Residential- Air Conditioning Key Energy User



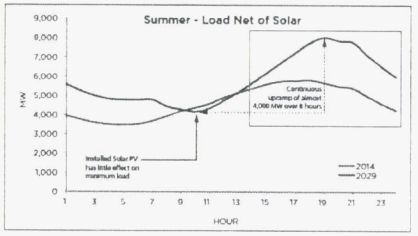
CONSUMPTION BY END USE

A quarter of the energy consumed in Arizona homes is for air conditioning, which is more than four times the national average. In Arizona homes, space heating accounts for just 15% of total energy use.

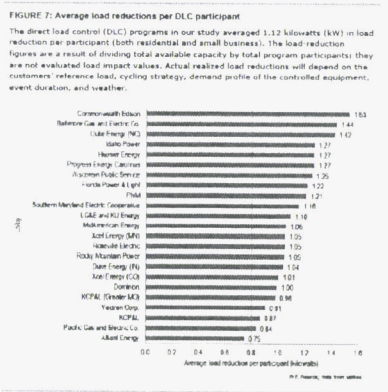
- Peak usage is continuing to grow in Arizona
- Air conditioning is a key energy user
- 86% of Arizona homes have central a/c for cooling

Source: EIA 2009 RECs

and it drives peak demand too



- Residential air conditioning has a high coincidence with the utility peak



- Studies have shown controlling load of residential HVAC can deliver above 1 kW reduction per participant
- Cycling combined with temperature offsets can drive savings even higher while maintaining comfort

Source: eSource and APS IRP

The question becomes

- How do you increase the value proposition for consumers while making energy saving easier?
- How do you help utilities lower peak demand?
- How do you help utilities open up new savings opportunities while getting closer to their customer?

....and capture the nearly ubiquitous energy saving potential

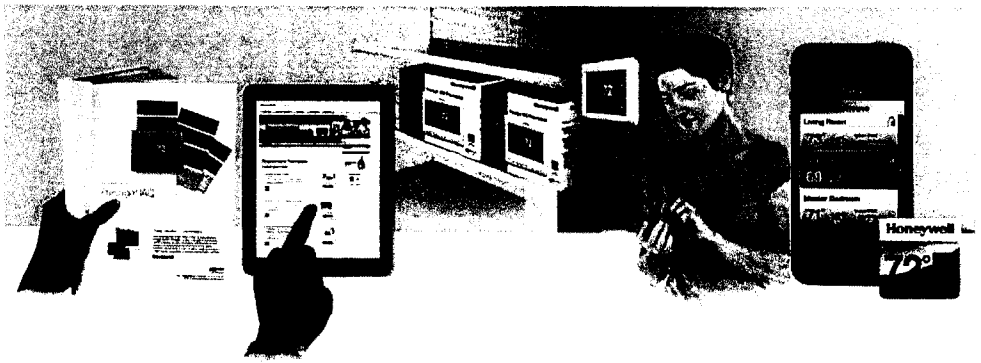
Megatrends changing the way consumers interact with all systems in their home—everything is getting connected

This year, mobile Internet usage will take over desktop Internet usage

~70% of homes already have Wi-Fi

63% of homes have smartphones... and that number grows daily

A great customer experience at all touch points



In Home ***In Store*** ***Out of Box*** ***Install*** ***In Use*** ***Upgrade***

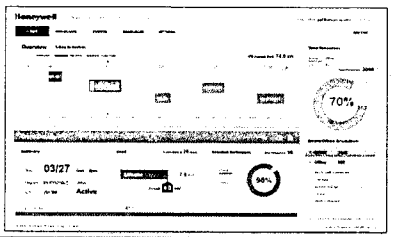
Homeowners want Comfort, Convenience and Control

Consumers rapidly adopting Wi-Fi Thermostats

- ❑ Driven by comfort and control—*NOT* energy
- ❑ 90% of interactions via the mobile app
- ❑ App is the highest and most rated thermostat app on iTunes and Google Play

❑Honeywell Wi-Fi stats TWICE as likely to be in schedule mode
❑ Demand Response enabled out of the box

and Energy Efficiency is coming along for the ride



Make delivery and access easy for consumers

Direct Install

- Almost 2 million DR points delivered
- Full program management

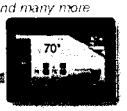
Trade

- Leader in trade channel
- Honeywell's ContractorPRO program includes 23,000 members in North America

Retail

- Honeywell thermostats sold in 29,000 stores in North America
- Retail tie-in

Walmart · sears · LOWE'S · ACE · And many more



What users are saying

- Average rating 4.5 stars
- Over 8,500 ratings on Android & iTunes

Greatest App by Rnnoel Aug 30, 2013
Best app for the home! Never come home to a hot or cold house again.

Disabled Veteran
by VegasTDC Sep 3, 2013
Being in a wheelchair can be very inconvenient. This thermostat and the iPhone App are very convenient for me. I don't have to get out of bed or anything like that.

Great product and Application
by Oberon2u Aug 30, 2013
Very happy with the product and the application to manage it remotely. Works great from my PC, iPad, iPhone and even my iPod.

Love It for Traveling
by AppleLover156 Mar 15, 2013
Not sure why just love seeing the temp etc. for inside and out. Like a web cam

Honeywell 72° *Visit the App Page*

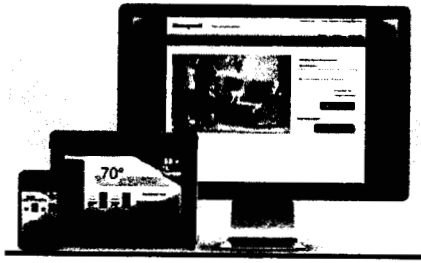
Benefits and Costs

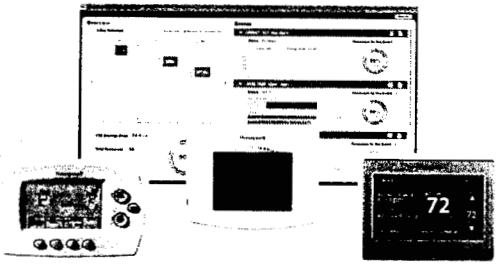
Benefits

- Customer savings on energy
- Customer choice
- Available in Retail, Trade or Direct Install
- Wi-Fi enabled for remote access
- Remotely upgrade capabilities
- Small business offering
- Provides utility with tool for peak demand

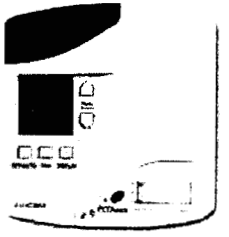
Costs

- Competitive with existing solutions in the market

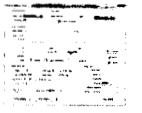




Centrally Networked EMS in Hospitality



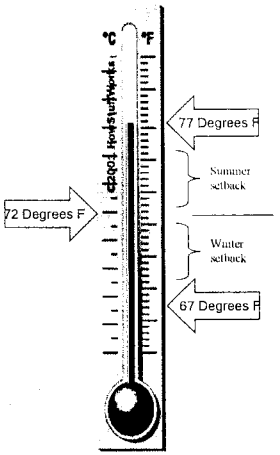
- EMS Integration Sets Room Status
  - Rented vs. Unrented status
  - More control and more savings



- Two Inputs to create occupancy
  - Magnetic door switch or key/door status from lock
  - PIR (passive infrared motion) sensor

- Check Out Room Status Change
  - Guest checks out = room immediately starts energy savings
  - Stand-alone system has delay

Energy Management - Occupancy Sensing



Modes of Operation:

1.) "Rented Occupied"

2.) "Rented Unoccupied"
- Typical Guest Out-of-Room 10 -12 Hours Per Day (8am – 6pm) - Peak demand period
- Room Temperature in all unoccupied rooms maintained within 4 – 5 'F of target.

3.) "Unrented"
- Places Room Into Deeper Setback Upon Guest Check-out (10 – 12 'F)
- Differentiate between guest and staff

- Energy Savings
  - 4-5 Degrees = **12% - 15% Savings**
  - 10 Degrees = **additional 10% - 12% Savings**
  - 10 –12 Hours Per Day

Over 8,000 rooms equipped in Arizona

- **Benefits:** cost reductions, while maintaining comfort and achieving sustainability goals
- **Payback:** typically <3 years
- **Saving** typically over 30% of a room's annual energy use

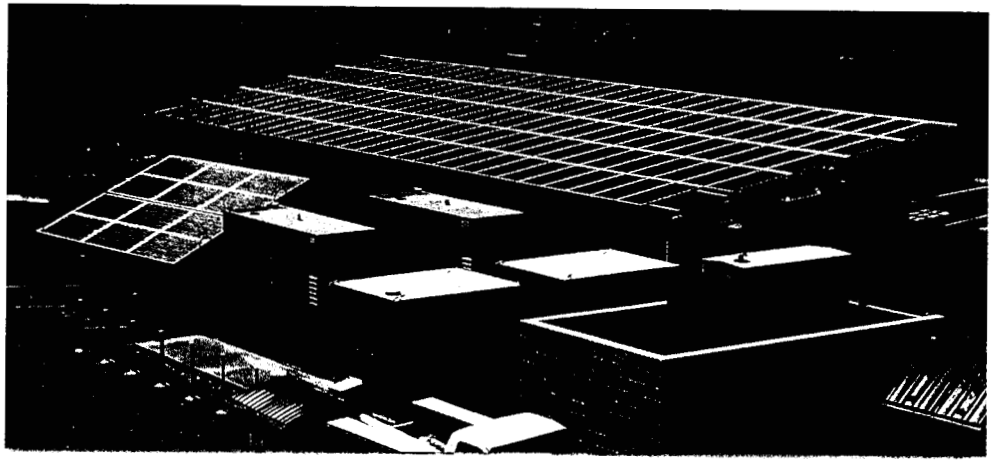
Ability to extend to demand response and other customer types

Regulatory

- Savings potential is real and the technology exists providing a win win for consumer and utility
- Impact is mostly on electricity but savings extend to gas (therms)

- Utilize DSM plan development, approval, and stakeholder collaborative processes to expand offerings to more customers
- Leverage standards such as Open Automated Demand Response
- Include as part of innovation fund or pilot programs
- Utility rebate programs key enabler

Resiliency through Microgrids



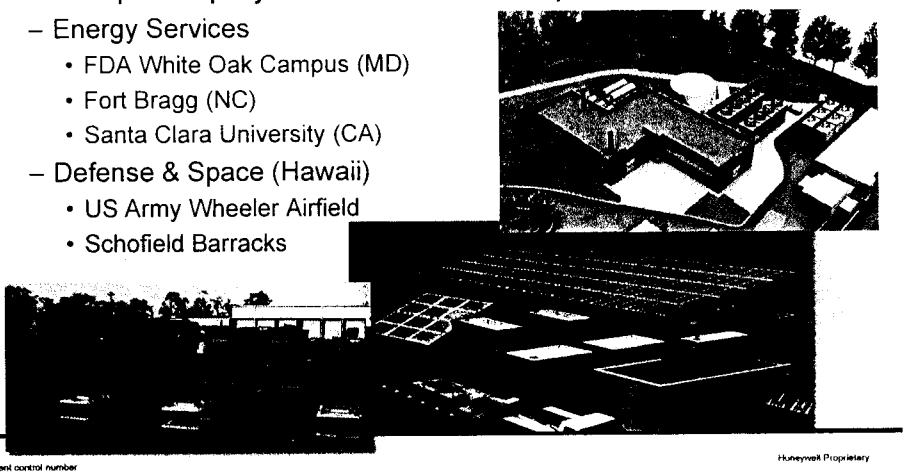
DOE's 'microgrid' definition

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

- NOT just a new way to brand CHP or DG
  - Multiple buildings/ facilities (customers?)
  - Indefinite operation (at least 2 weeks)
  - Control to balance supply with demand while islanded
  - Seamless transition to/ from island mode??

Honeywell and microgrids

- Not a manufacturer of prime movers, switchgear
- Developer of projects with controls expertise
  - Energy Services
    - FDA White Oak Campus (MD)
    - Fort Bragg (NC)
    - Santa Clara University (CA)
  - Defense & Space (Hawaii)
    - US Army Wheeler Airfield
    - Schofield Barracks



Customer classes impacted

- Commercial customers
  - Municipal facilities (and water/ wastewater)
  - Core services – food, pharmacy, fuel
  - Healthcare*
- Industrial customers
  - Large campuses
  - Military installations
- Likely not realistic for primary industries unless DG makes sense

Ideal for critical civic and commercial operations

- Military sites
- Hospitals
- Research-driven universities
- Federal, state and local government facilities
- Data centers

Honeywell

→ Honeywell.com

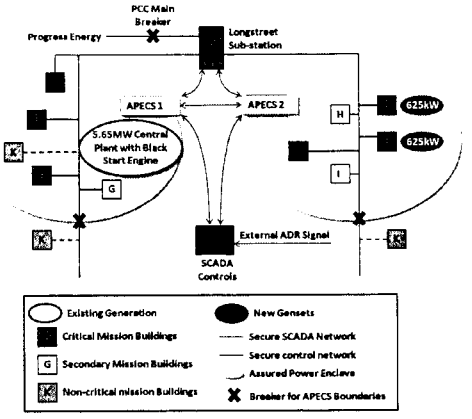
Drivers for adoption

- Initial perception that this will be an economic (cost of electricity) play – not typically the case!
- Corollary to the 'Priceline/ Hotwire' approach – some customers are willing to pay more for the reliability, resiliency that microgrids bring – utilities cannot fully address this
- Borrowing from CT, Alex Kragie:

- Connecticut's first-in-the-nation statewide microgrid program is critical piece of larger resiliency strategy
- Power outages are inevitable, but program provides enhanced safety and quality of life for residents in an outage situation
- Program fits in with Governor's larger vision for cheaper, cleaner, and more reliable energy future for Connecticut
- In line with "portfolio approach" that encourages deployment of distributed generation

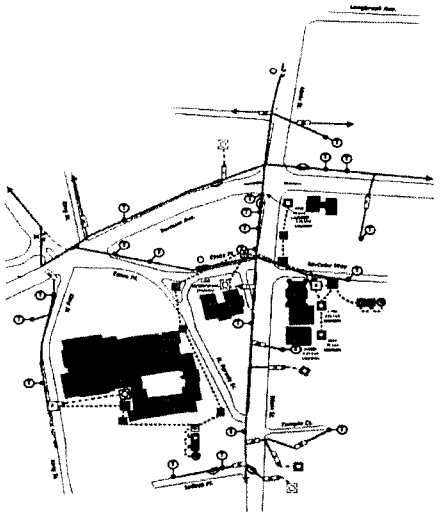
When technology competitive

- Core economics well known
  - Conventional generation costs stable
  - Renewables dropping quickly
  - Storage technology, costs starting to impact market
- Controls and communication making strides
  - Basic systems not problematic
  - Complex systems pose challenges
  - Cyber-security growing concern



Impact on traditional utility systems

- Distribution system
  - Interconnection requirements no less critical
  - Operation and system reconfiguration can be complex
- Metering/ billing
  - Accounting for source of electricity (during outage)
  - Net metering??
  - Virtual net metering (Renewables in CT)??



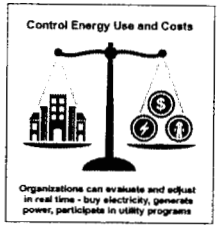
Costs and benefits

Costs: reliability comes at a price!

- System configuration/ interconnection
- Generation/ storage
- Control equipment

Benefits: value over time horizon

- Core cost mitigation
- Interruption minimized
- Mission assurance for critical customers



Maximizing microgrid cost-benefit

1. Energy efficiency

2. Load control/ demand response

3. Generation/ storage

4. Market participation

Business, regulatory changes necessary

- Rate designs: standby charges
  - System outage situations
  - Microgrid equipment outage situations
- Regulatory policies: customer complexities
  - Serving multiple customers
  - Crossing rights of way/ property lines – excerpt from CT

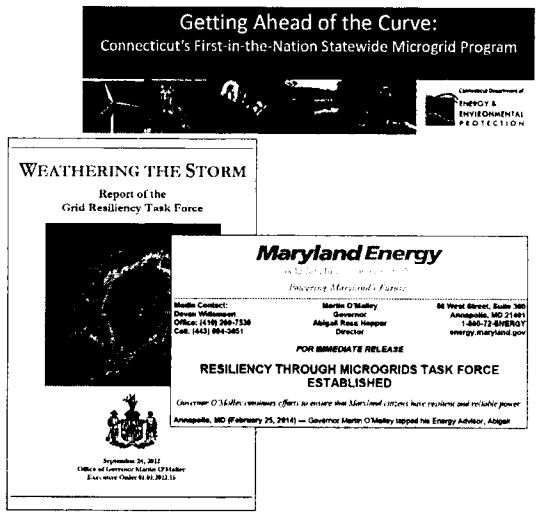
> Q101. Can the dedicated line and other distribution facilities connecting the generator and the Critical Facilities be designed, built owned and maintained by a non-utility party? If so, is licensing required under Conn. Gen. Stat. Section 16-245?
>
> A. The answer to the first question is yes. Provided there is no crossing of a public right-of-way, the host site operator can design, build, and maintain necessary generation and distribution services that meet relevant safety and other standards without licensure under Conn. Gen. Stat. Section 16-245. The microgrid projects envisioned under Public Act 12-148 are intended to connect local, in-state Critical Facilities only "behind the meter" and not in any manner to involve the commercial sale for resale of electricity in interstate commerce. As such, and pursuant to 16 U.S.C. Section 824(b), they are exempt from jurisdiction by the Federal Energy Regulatory Commission. See, CL&P v. Federal Power Commission, 324 U.S. 515 (1945). With regard to

Impact on other regulated industries

- Natural gas
  - Fuel of choice for conventional distributed generation
  - Presumption that supply will not be interrupted during a lengthy outage
  - Flatten annual load duration curve (not impact peak so much)
- Water
  - Minimal water needed for distributed generation systems
  - Larger microgrid projects may consider thermal storage via water tanks that also act as emergency supply

Notable state initiatives

- CT – second round of microgrid grant program underway
- MD –Resiliency Task Force efforts
- MA – initial investigations
- NJ – post-Sandy initiatives



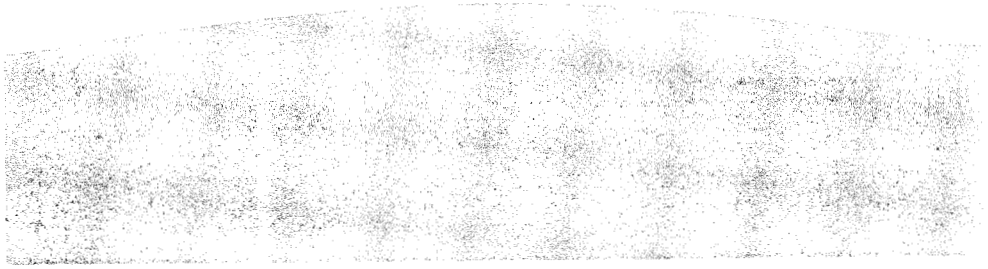
Thank you

Kevin Lauckner, Director Business Development
kevin.lauckner@honeywell.com

Dave Robinson, Sr. Sales Consultant
dave.robinson@honeywell.com

Honeywell

www.honeywell.com



Distribution Voltage Optimization

Energy Savings for All Customers through Investment in Grid technology

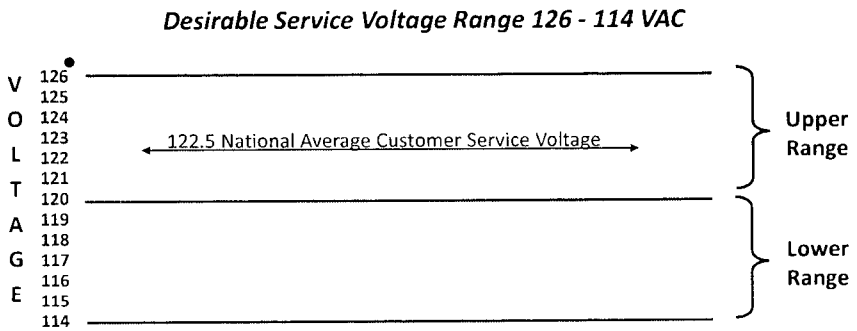
Ken Wilson
Representing
Western Resource Advocates (WRA)
Southwest Energy Efficiency Project (SWEEP)

Problem

- **90%** of homes and businesses receive more voltage than they need.
  - -US Department of Energy

Distribution voltages that are higher than necessary waste energy

Average voltages are higher than necessary



High Voltages Waste Energy

- Power = Voltage x Current (kW)
- Energy = Power x time (kW hours)

so

- Energy = Voltage x Current x time

Why Do Utilities Run Voltages High?

- Lack of real time voltage measurements at customer meter
- Don't want to get low voltage complaints
- Good metering with communication links was expensive
- Lack of vendors

**** Lack of incentives to make the investment in CVR****

The Solution

CVR – Conservation Voltage Reduction

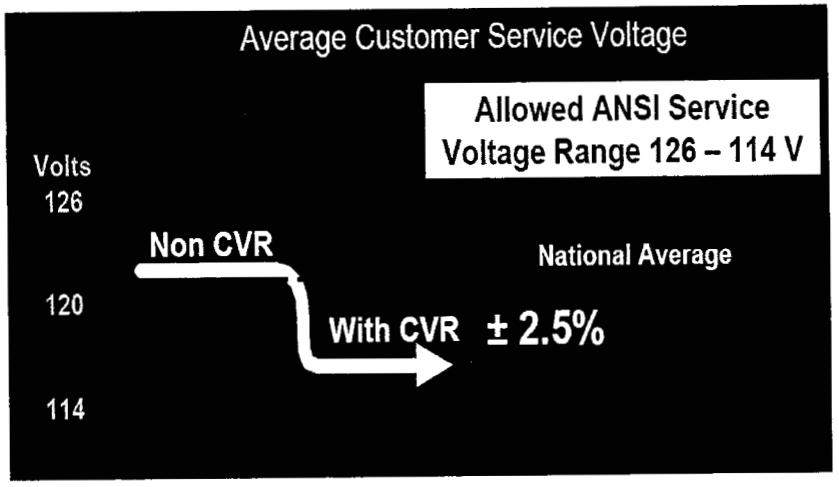
Also called:

VVO – Volt/VAR Optimization

DVO – Distribution Voltage Optimization

Must be done adaptively – not with traditional CVR

What is CVR/DVO?



Use a lower voltage range on each feeder

What is CVR Factor?

- CVR Factor is the % energy reduction for a % voltage reduction
- For example – if CVR reduces voltage 2% and energy reduction is 2%, then the CVR factor would be 1.0
- CVR factor typically ranges from 0.5% to 1.5% with average values around 0.9%.
- CVR factor depends on types of load on feeders and power factor (VAR)

How can voltage ranges be reduced?

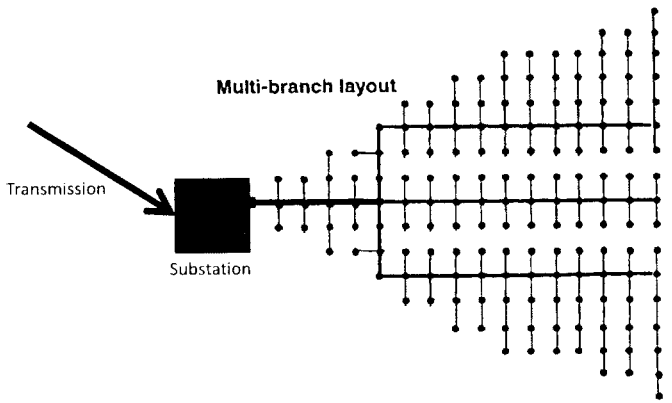
Continuously monitor feeder voltages and use Capacitor Banks (CAP Banks) and Load Tap Changers (LTCs) to adaptively reduce voltages on each feeder at a substation

Equipment		Grid Locations	Grid Functions
Load tap changers		Substation transformers	Adjusts feeder voltages at the substation
Voltage regulators		Distribution feeders or substations	Adjusts voltages at the substation or along the feeder
Capacitor banks		Distribution feeders or substations	Compensates for reactive power and provides voltage support

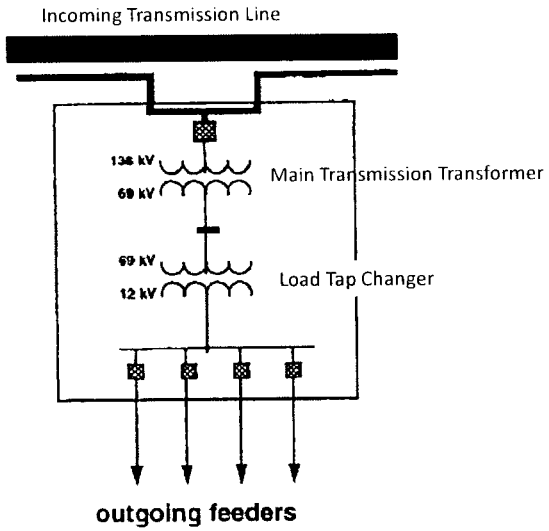
Steps to Construct CVR

- Levelize the voltage along the length of each feeder
- Install voltage meters on each feeder
- Install a communication system for information and control
- Install automated controls at CAP Banks and Load Tap Changers
- Install CVR software to adaptively control voltages on feeders at each substation

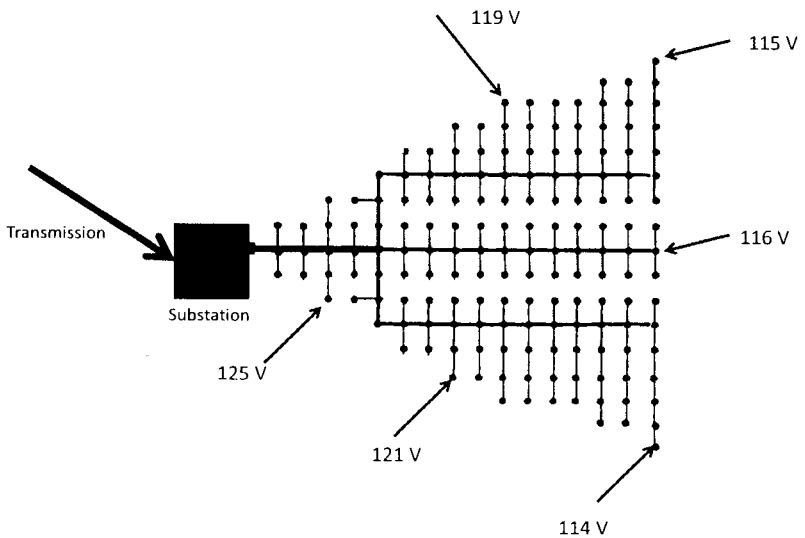
Idealized Grid Layout



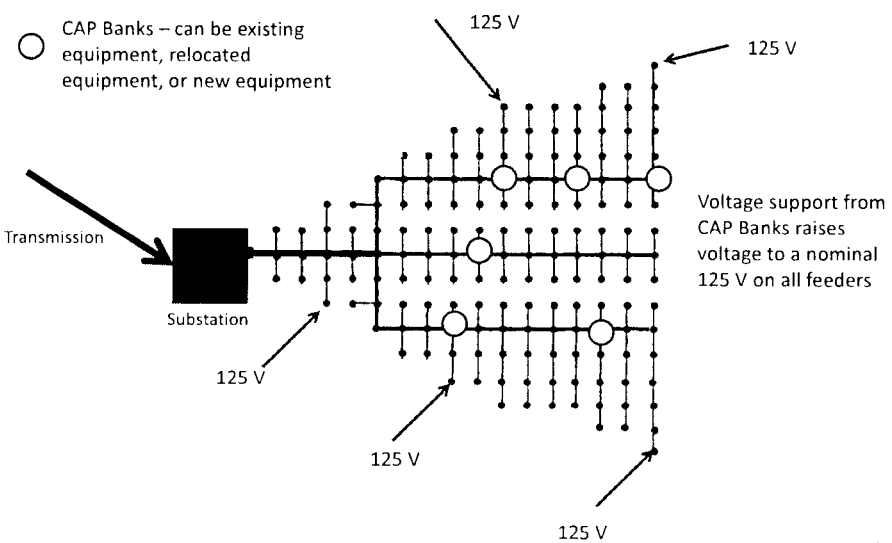
Idealized Substation



Levelizing Feeder Voltages

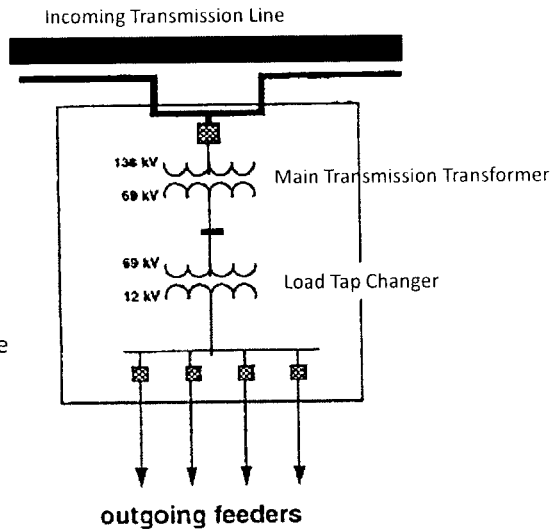


Using CAP Banks to Levelize Voltages

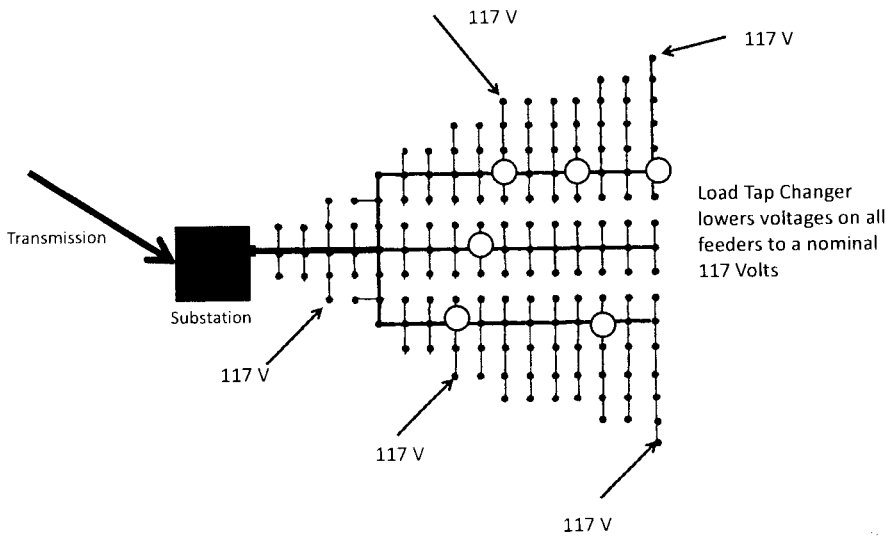


Load Tap Changer is Key

Use Load Tap Changer to lower voltages on all feeders from high range to low range



Load Tap Changer Lowers All Voltages at once



Why Not Stop There?

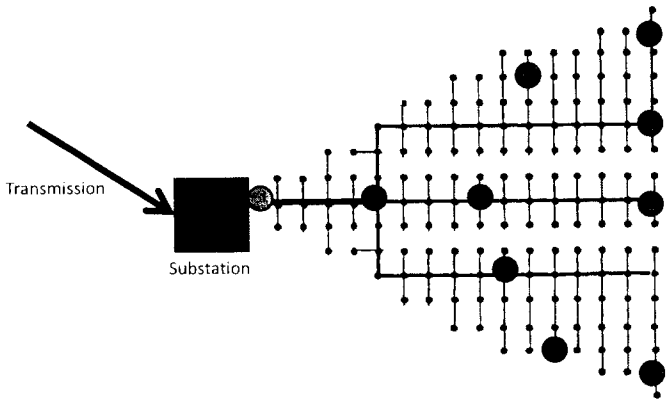
- "Traditional" CVR manually lowered voltages at substations based on infrequent data and statistical analysis
- The resulting energy savings is low – on the order of 0.5%

There is a better way – adaptive, dynamic CVR

Voltages on every feeder change with load

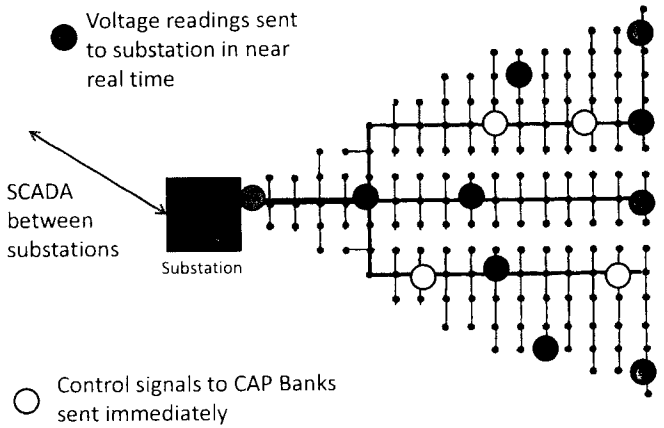
- **Time of day** (morning, afternoon, evening, night)
- **Day of week** (weekday, weekend)
- **Season** (Summer, Winter, Spring/Fall)
- **Changes in usage** (PV systems, EV charging, Large TVs)

Voltage Meters at Strategic Locations

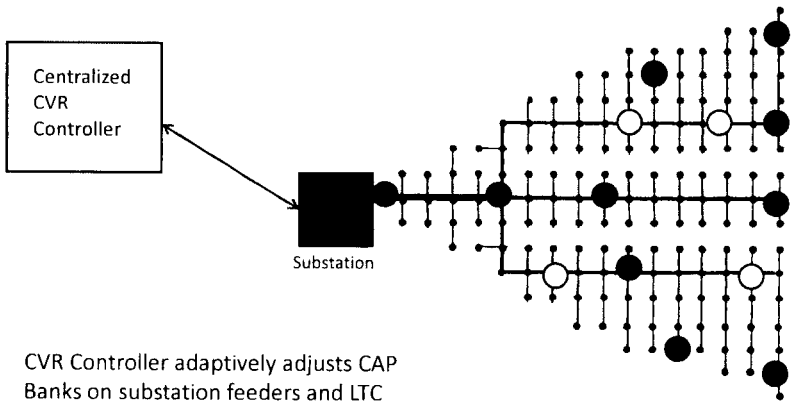


Xcel Energy found that 6 – 8 meters per feeder is adequate. Dominion uses voltage readings from customer AMI meters

Communication System



CVR Software Controller



CVR Controller adaptively adjusts CAP Banks on substation feeders and LTC for optimal energy savings OR capacity savings

Does CVR Actually Save Energy

Yes!

Pacific Northwest National Laboratory (PNNL)

- If CVR is implemented on every feeder in the US, annual energy consumption will be reduced by 3.04%

Pilot projects in multiple utilities have demonstrated energy savings and capacity reduction during peak hours

Energy Savings and/or Capacity Reduction

- CVR can be run in two primary modes:
  - Energy savings, or
  - Capacity Reduction
- Energy savings mode benefits the customer directly by reducing utility bills and also has some capacity reduction for the system and reduction of system losses
- Capacity reduction mode is run on peak days to reduce total capacity need, with little energy savings

Additional Benefits

- Reduces grid losses by a small amount
- Building block for other grid improvements
  - Automated Fault location
  - Automated fault Isolation
  - Increased reliability
- Integration of distributed generation
- Improved reactive power correction

Public Service of Colorado (PSCO)

- Conducted pilots on two substations (2010 – 2012)
- Based on success of pilots PSCO is proposing to implement CVR (DVO) on all feeders
  - $92M investment
  - 5 year roll out
  - Would operate in energy savings mode
  - Projected 2% energy savings for all customers
  - Projected 1% capacity savings for system
  - Decision by PUC is pending

NV Energy in Southern Nevada

- Nevada PUC has encouraged NV Energy to conduct a CVR pilot
- NV Energy was at first reluctant, but has now proposed a robust pilot on their southern system (Las Vegas area)
  - Six substations with associated feeders
  - Collecting data and selecting substations for the remainder of 2014
  - Pilot would run most of 2015

NARUC Recommendation

The National Association of Regulatory Utility Commissioners in EL-2/ERE-3 "Resolution Supporting the Rapid Deployment of Voltage Optimization Technologies" in 2012 States that:

- Volt VAR Optimization is an important component of grid modernization
- Energy efficiency and demand reduction are immediate, predictable and measurable
- Commissions should consider appropriate cost recovery for utilities that implement voltage optimization

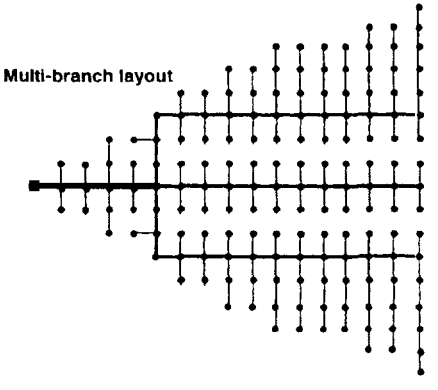
Next Steps for Arizona

The Arizona Corporation Commission and APS should consider a CVR pilot

- At least two substations and all associated feeders
- Carefully select substations with feeders that are representative and could benefit from CVR
- Substations should already have Load Tap Changers

Questions?

Equipment		Grid Locations	Grid Functions
Load tap changers		Substation transformers	Adjusts feeder voltages at the substation
Voltage regulators		Distribution feeders or substations	Adjusts voltages at the substation or along the feeder
Capacitor banks		Distribution feeders or substations	Compensates for reactive power and provides voltage support



EL-2/ERE-3Resolution Supporting the Rapid Deployment of Voltage Optimization Technologies

WHEREAS, Adequate and reliable electric power is critical; *and*

WHEREAS, Each electric utility system is unique and States are in the best position to determine the appropriate activities to be employed in modernizing the distribution of electric power by electric utilities under their jurisdiction; *and*

WHEREAS, Some electric utilities, under State legislative guidance and regulatory oversight, have instituted initiatives designed to modernize the electric power grid to make it more efficient, more responsive and more secure; *and*

WHEREAS, Volt Var Optimization (VVO) technology deployment can be used as an important component of electric power grid modernization; *and*

WHEREAS, VVO technology has been proven through in-field deployments to deliver energy and demand reduction benefits, and these benefits have been independently verified; *and*

WHEREAS, These energy efficiency and demand reduction gains from VVO deployment are immediate, predictable, and measureable; *and*

WHEREAS, Since the VVO technology is typically installed on the utility side of the meter through an investment by the utility, with the possibility for rate base treatment, VVO benefits typically require no change in the consumer's home or business building structures, equipment purchases or uses, or behavior modification; *and*

WHEREAS, VVO technology deployment improves efficient delivery of energy and demand and these improvements are immediately reflected on consumers electric meters and reduce their electric bills; *and*

WHEREAS, The benefit-cost analytical results typically demonstrate that VVO technology investment is cost-effective from a ratepayer perspective; *and*

WHEREAS, Many States have legislative or regulatory Energy Efficiency Resource Standards (EERS) or regulatory expectations for electric utilities to provide for increasing amounts of energy and demand reductions; *and*

WHEREAS, Similar to traditional energy efficiency programs, VVO technology deployment can result in reductions of electric utility revenues, specifically revenues that are relied upon by electric utilities to cover fixed costs of investment and operations; *and*

WHEREAS, The impact of lost electric utility revenues can also be mitigated with the development and application of appropriate cost of service and rate designs, identifying the fixed costs of investment and operations which should not be recovered on the basis of customer consumption, but instead recovered through more appropriate means; *and*

WHEREAS, The energy efficiency impacts of VVO eliminate air emissions associated with the forgone energy production, and therefore provide an important tool to help States and electric utilities in meeting environmental compliance requirements; *and*

WHEREAS, Deployment of VVO technology serves as a platform for potential future grid modernization initiatives that can deliver operational visibility, efficiency, and control of the electric distribution grid, improving reliability and customer service for a relatively small incremental investment; *and*

WHEREAS, Investment in VVO can create new employment opportunities related to the manufacturing of equipment and construction jobs associated with deployment, as well as utility-sector jobs associated with the operation of the VVO technology; *and*

WHEREAS, VVO technology can be deployed incrementally as determined cost effective and as financial conditions and fiscal prudency allow, *now, therefore be it*

RESOLVED, That the National Association of Regulatory Utility Commissioners (NARUC) convened at its 2012 Annual Meeting in Baltimore, Maryland and encourages State public service commissions to evaluate the energy efficiency and demand reduction opportunities that can be achieved with the deployment of Volt-Var Optimization (VVO) technologies and other electric utility grid modernization technologies and activities, and use of appropriate measurement and verification tools to ensure that such technologies provide the projected savings; *and be it further*

RESOLVED, That State evaluation is a preferable course to the establishment of federal standards or guidelines that may not reflect the fact that each utility system is unique and the States are in the best position to determine the appropriate activities to be employed in modernizing the distribution of electric power by electric utilities under their jurisdiction; *and be it further*

RESOLVED, That NARUC encourages State public service commissions to work with State legislatures, State energy offices, governors' offices, other State agencies, and Regional Transmission Organization (RTO'S)/Independent System Operator(ISO's) as needed, to certify energy efficiency and demand reductions associated with utility grid modernization efforts, including, but not limited to, the deployment of VVO technologies, as qualified resources in meeting legislative or regulatory Energy Efficiency Resource Standards (EERS) and/or regulatory expectations and orders to achieve prescribed levels of energy and demand reductions; *and be it further*

RESOLVED, That NARUC encourages State public service commissions to consider appropriate regulatory cost recovery mechanisms as appropriate in their respective States to ensure that electric utilities can reduce the reliance on customers' consumption to recover costs, and so that utilities and customers are not financially burdened as a result of achieving the benefits from the energy and demand reductions while experiencing reduced contributions to

costs associated with the energy sales reductions produced by the VVO technology deployment; *and be it further*

RESOLVED, That NARUC encourages State public service commissions to avoid implementing policies that result in unnecessary barriers to the deployment of VVO technologies.

Sponsored by the Committee on Electricity and the Committee on Energy Resources and the Environment
Adopted by the Board of Directors, November 13, 2012
Adopted by the NARUC Committee of the Whole, November 14, 2012

Overview of Strategic Energy Management

May 28, 2014

triplepointenergy

Workshop Agenda

- About Triple Point Energy
- SEM example project
- Define Strategic Energy Management
- Utility program delivery process
- Benefits and barriers of SEM
- SEM example project

Questions are welcome!

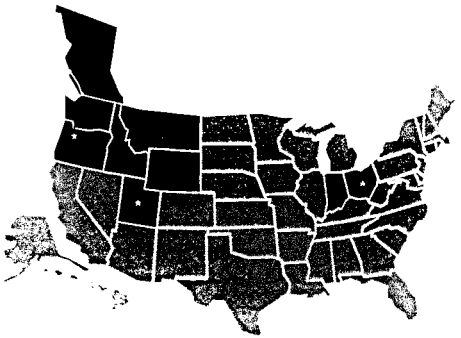
Triple Point Energy by the Numbers

Employees **15**

Number of companies engaged **200**

4.8% total electricity load **saved**

total natural gas load **saved** **5.5%**



131,000,000+ kWh saved

300,000+ therms saved

Example: One Mill's SEM Experience

Before:

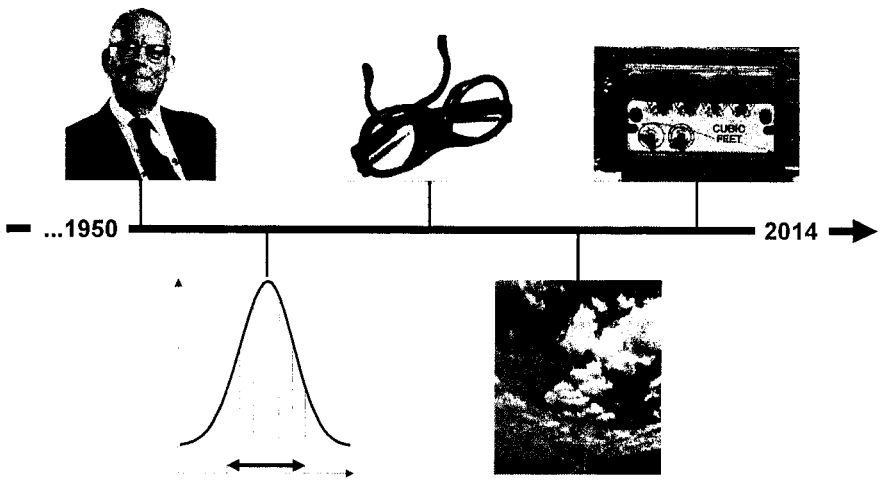
- "Green Team"
- Focus on recycling
- No management focus
  - Goal
  - Policy
  - Employee engagement
- A few capital projects
- Monthly $/board foot

After:

- "Energy Team" - Efficiency
- Management support
- Weekly kWh normalized
- Action!
  - Goal
  - Lunch shut down
  - Off shift audits
  - Batch process
  - Employee engagement
  - Track and report energy

Results: 11% savings first year, 5 years and going strong!

History of Continuous Improvement



"What gets measured gets managed" – *Peter Drucker*

Strategic Energy Management Definition

"... a [illegible] approach to reducing energy intensity over time, characterized by demonstrated

customer ***commitment***,

planning and [illegible],

and systematic measurement."

Consortium for Energy Efficiency

Continuous Improvement & SEM

Commit:
- Policy
- Executive Sponsor
- Resources

Plan:
- Baseline
- Goals
- Identify Team
- Action Plan

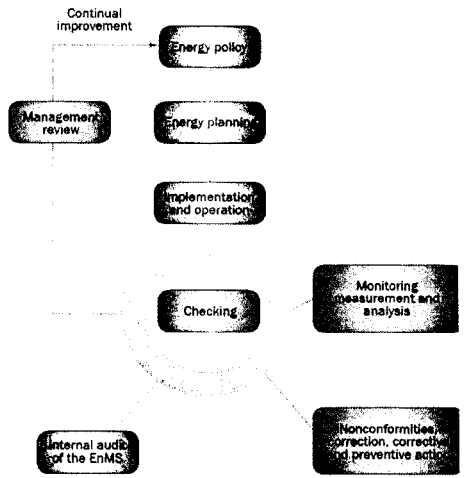
Act:
- Management Review
- Technical Review
- Recognize
- Update the Plan

Check:
- Monitor
- Report
- "Audit"
- Corrective Actions

Do:
- Training
- Employee Engagement
- Operational Control
- Procurement

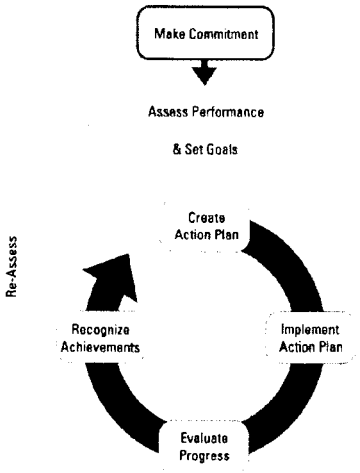
ISO 50001

- ISO 50001, June 2011
- US DOE Superior Energy Performance
  - ISO 50001
  - ANSI/MSE 50021
- Global Superior Energy Performance Partnership (GSEP)
  www.cleanenergyministerial.org



(ISO: International Organization for Standards)

Energy Star Challenge and Partner



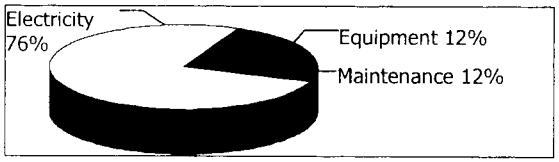
Strategic Energy Management

SEM addresses business processes

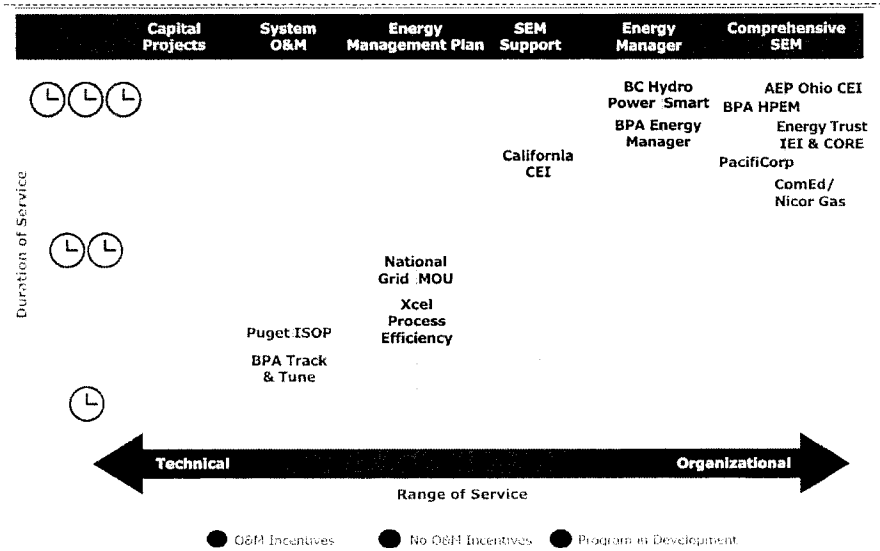
- Employee Engagement
- Operations and maintenance changes
- Training
- Purchasing

...and capital projects

Compressed Air Total Cost of Ownership



How SEM is Delivered



Triple Point Cohort Delivery Process

- 8 – 12 Customers – 1 Year process
- Workshops
- One-On-One Coaching
- Technical Assistance

Workshop Process		
1	Kick Off & Building a Foundation	Group
2	Energy Management, Use & Metering	Individual
3	Monitoring, Targeting & Reporting	Group
4	Identifying Energy Saving - Plan	Group
5	Energy Scan	Individual
6	Employee Engagement - Plan	Group
7	MT&R - Follow up	Individual
8	Technical Forums for Saving Energy	Group
9	Employee Engagement - Event	Individual
10	Sustaining Your Energy Saving Efforts	Group
11	Energy Management Assessment	Individual
12	Report out & Celebration	Group

Comprehensive SEM: Utility Role

- Key Account coordination
- Program structure and facilitation
- Coaching and tools:
  - Policy development process and templates
  - Goal setting – top down / bottom up?
  - Track and report consumption – but how?
  - Employee engagement
  - Energy mapping process
  - Technical training and assistance
  - Opportunity
- Savings measurement
- Incentives

What Do Customers Do?

CEE Minimum Elements:

- Customer Commitment
  - Policy and Goals
  - Resources
- Planning and Implementation
  - Energy Management Assessment
  - Energy Map
  - Metrics and Goals
  - Project Register
  - Employee Engagement
  - Implementation
  - Reassessment

Source: Consortium for Energy Efficiency

What Do Customers Do?

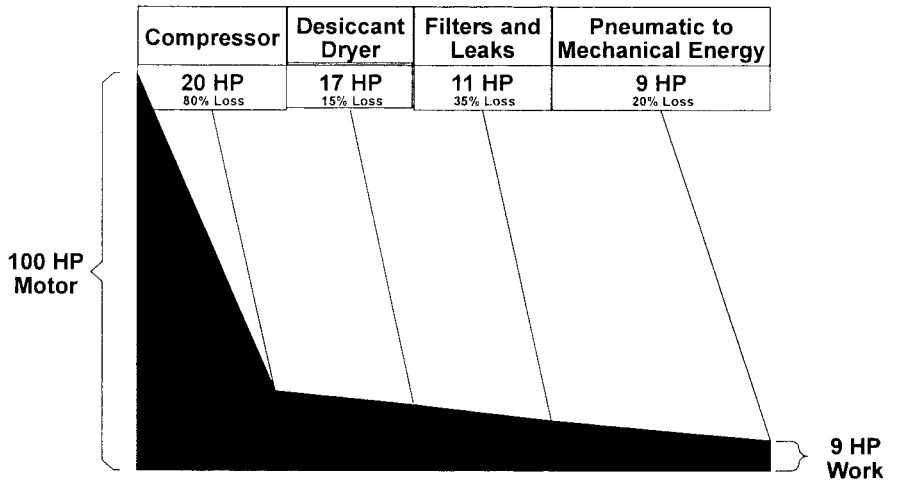
CEE Minimum Elements (cont.):

- System for Measuring and Reporting Performance
  - Measurement
  - Data Collection and Availability
  - Analysis
  - Reporting

Source: Consortium for Energy Efficiency

Engaging Employees

Compressed Air System Efficiency:



Engaging Employees

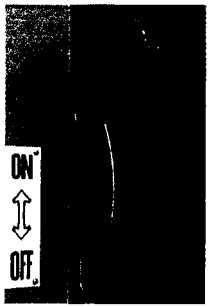
Specific Actions...

- Turn off equipment
- Fix leaks
- Adjust operating procedures
- Purchase on "total" cost
- Help with projects
- Contribute ideas
- Engage others
- Other...

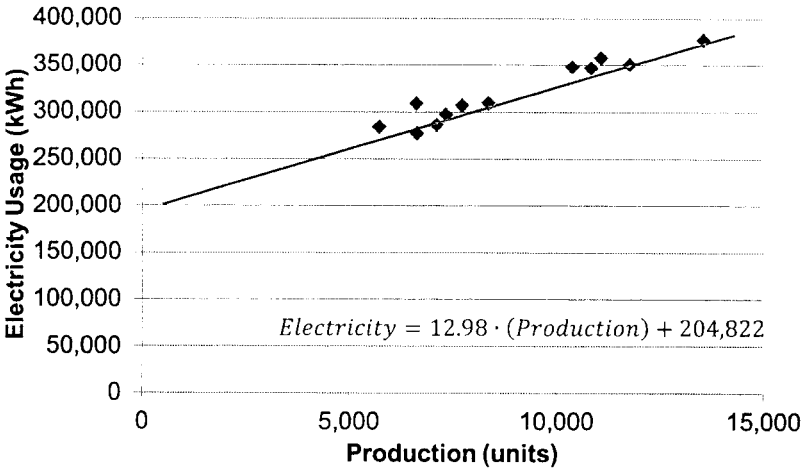
&

Personal Motivation

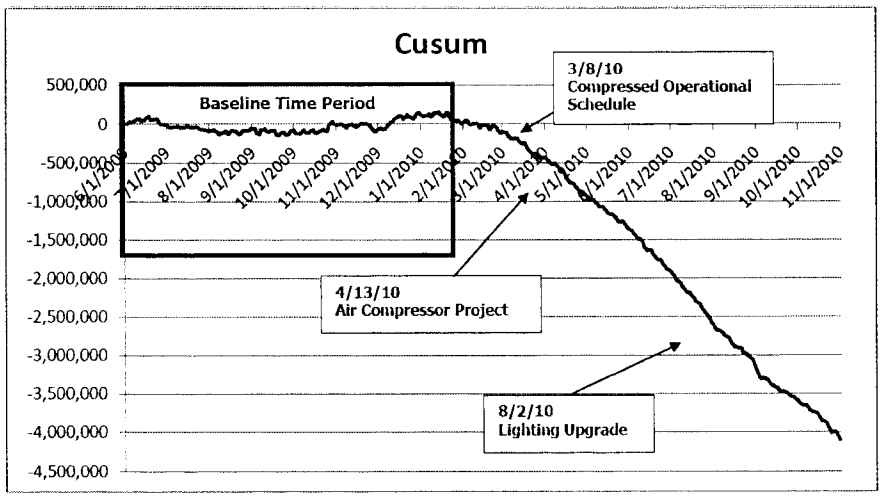
- Safety
- Reliability
- Productivity
- Competitiveness
- Community



Measurement: Linear Regression



Tracking Performance



Utility Program Experience

BONNEVILLE POWER ADMINISTRATION

- 20+ Customers
- SEM is 15% of program savings
- 2x capital projects
- TRC 0.9 – 1.27
- Savings increasing in year 2

EnergyTrust of Oregon, Inc.

- 60+ Customers
- SEM is 20% of program
- More capital projects
- Acquisition cost $0.02/kWh

SEM Benefits

Utility:

Energy Savings

- O&M savings
- More capital projects
- Persistence
- Broader customer objectives
- Long term planning

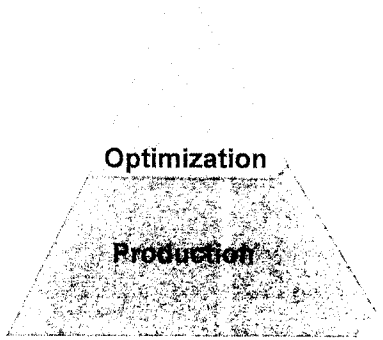
Customer:

Energy Savings

- Safety
- Reliability
- Productivity
- Competitiveness
- Community

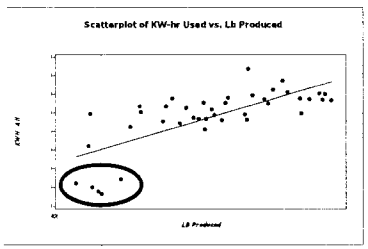
Customer Assistance with SEM

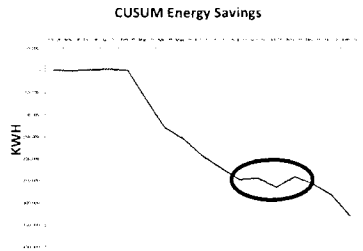
- Structured process
- Reduced staff time
- Facilitation
- Technical assistance
- Tools, templates
- "Fresh eyes"



Metals Manufacturer Success Story

- Energy is 3rd largest cost
- No energy management focus
- Lean Six Sigma experience
- Engaged in SEM
  - Champion, Team, etc.
  - Employee awareness
  - Turned equipment off
  - Improved maintenance
- Achieved 6% Savings





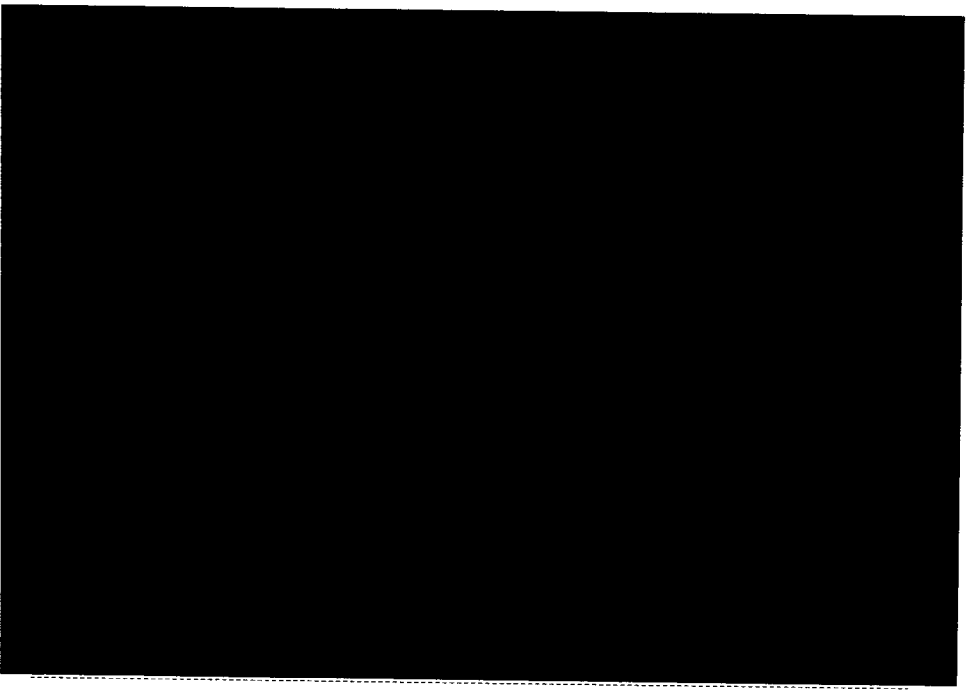
Let's Keep in Touch

For questions or more information, please contact Mark Hamilton

503-914-4171

markh@triplepointenergy.com

Thank you!



□ triplepointenergy □□ □□□□□□□□

FIRSTFUEL
BUILDING ENERGY ANALYTICS

Arizona Corporation Commission

Commission Workshop on Emerging Technologies
Docket No. E-000005-13-0375

Using Meter Data Analytics to Transform Energy Efficiency

Sam Krasnow
VP, Regulatory Affairs & Market Development
401.439.0041
skrasnow@firstfuel.com

May 28, 2014

AGENDA

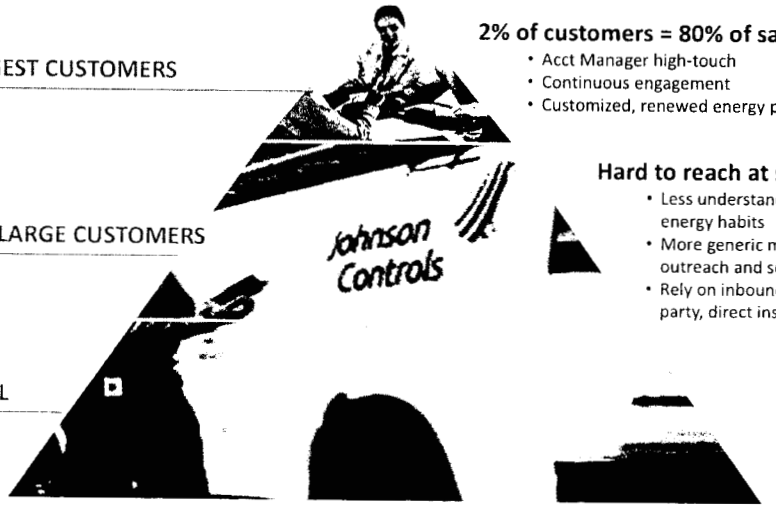
- **Energy Efficiency Challenges**
- FirstFuel Overview
- Market Insights
- Programmatic Innovation
- Benefits for Arizona

THE DEMAND SIDE MANAGEMENT SCALE CHALLENGE

LARGEST CUSTOMERS

MID-LARGE CUSTOMERS

SMALL



2% of customers = 80% of savings

- Acct Manager high-touch
- Continuous engagement
- Customized, renewed energy plans

Hard to reach at scale

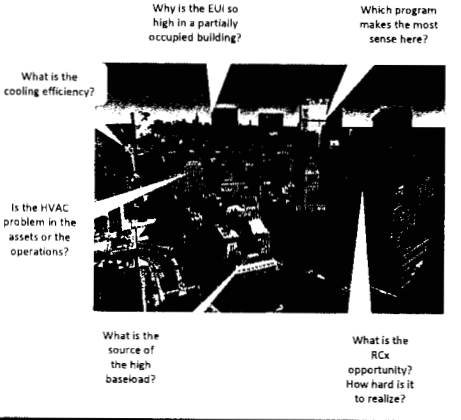
- Less understanding of energy habits
- More generic market outreach and solicitation
- Rely on inbound + 3rd party, direct installs

WHAT THIS MEANS FOR UTILITIES

THE EFFICIENCY PRESSURES ARE MANY...

- Target and engage all customers (ratepayer parity)
- Increasingly aggressive EE goals
- Identify new sources of EE savings
- Deploy a broad array of newly available technologies
- Track and attribute savings over time

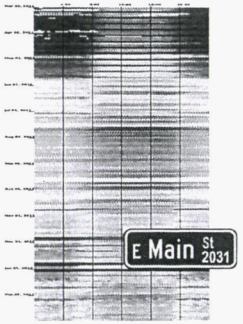
...ALL OF WHICH REQUIRE CONSISTENT, ACTIONABLE ENERGY INFORMATION



KEY TO ACCELERATE KWH/KW SAVINGS:

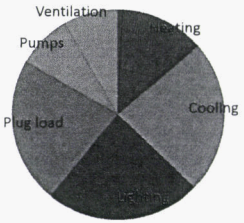
UNDERSTAND THE UNIQUE STORY OF EVERY BUILDING

1



Minimal inputs. No onsite visits or devices.

2



Example: End Use Breakdown

No building simulations or buildings "like" this one.

3

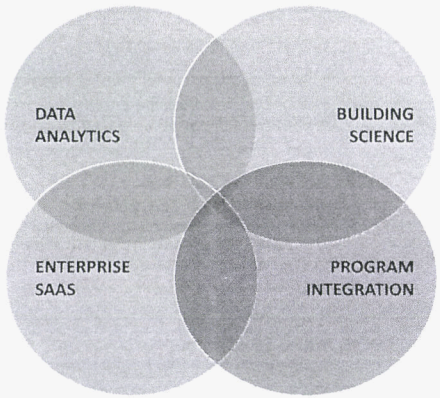
Unique, verified analysis and messages for each building

IMPORTANCE OF TECHNICAL VALIDATION

		Comparison to:	FirstFuel RBA results:
Published reports	PG&E	Onsite audits	• 48 of 49 end-uses within margin of error • Consistent recommendations/savings • Identified opportunities missed by on-sites • Significant speed, cost, and scale advantages
	Fraunhofer USA	End-use sub-metered building	• Within 7% of building end-uses
	BEBHUB	End-use sub-metered building	• Within 1%-5% of building end-uses • Identified opportunities missed by on-sites
Private customer results	US General Services Administration	End-use calculations, Onsite audits	• Within 2% of end-use calculations • Consistent recommendations/savings • Uncovered largest savings opportunity missed by onsite audits
	Johnson Controls	End-use calculations, Onsite audits	• Within 5% of end-uses • Consistent recommendations/savings
	MAJOR US UTILITY	Onsite audits	• Consistent recommendations/savings

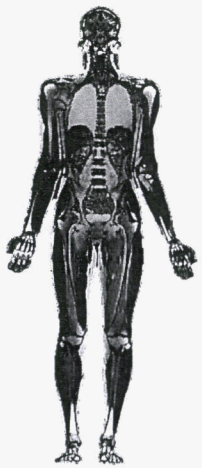
FIRSTFUEL IS AN ENERGY INFORMATION SERVICES COMPANY

Using **customer meter data** to **accelerate and scale** commercial energy efficiency via **'zero-touch' analytics**

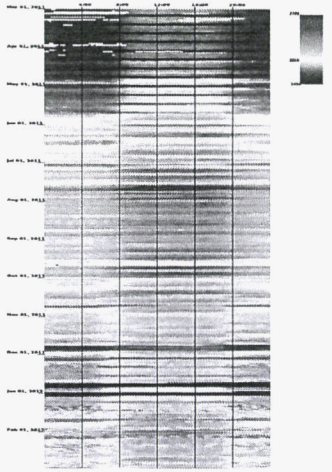


- Deployed at ~20 large utilities and government agencies
- North America and Europe
- Innovative RCx, Whole Building, Led Gen/Cont Engagement programs

A RELEVANT ANALOGY



MRI

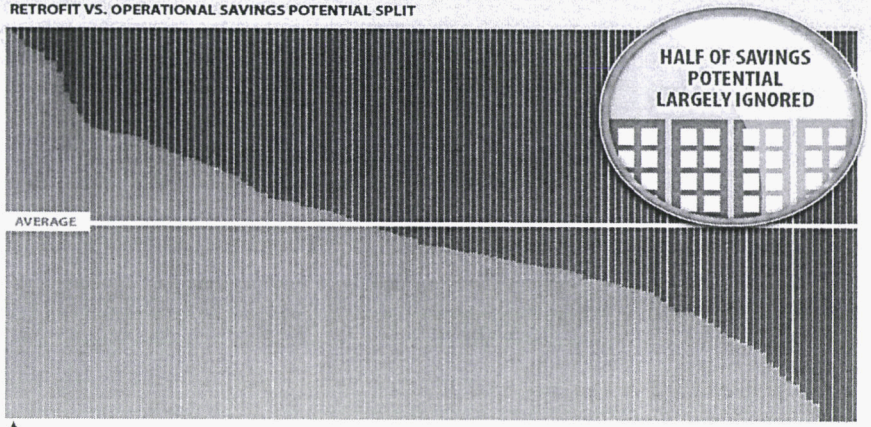


BUILDING MRI

WHAT CAN FIRSTFUEL'S RICH DATABASE TELL US ABOUT THE MOST EFFICIENT PATH TO SAVINGS?

LOW / NO-COST OPERATIONAL CHANGES COULD DOUBLE ENERGY EFFICIENCY IN COMMERCIAL BUILDINGS

RETROFIT VS. OPERATIONAL SAVINGS POTENTIAL SPLIT

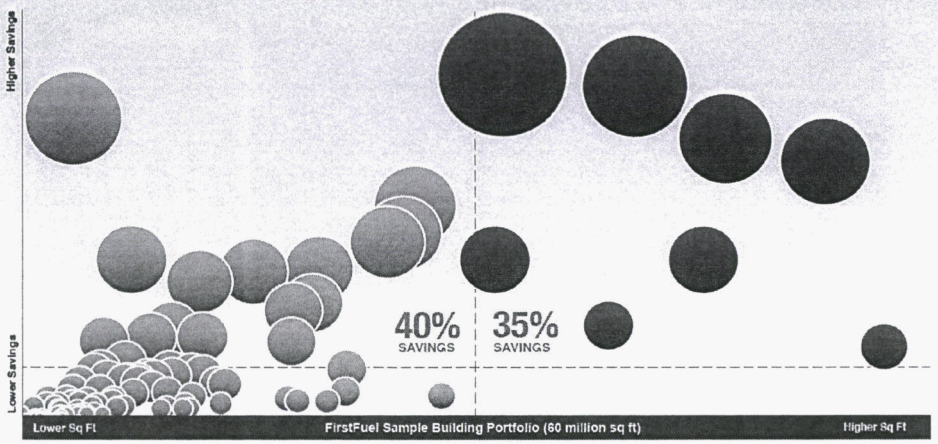


FIRSTFUEL SAMPLE BUILDING PORTFOLIO (60M SQFT)

51 percent of all energy efficiency savings in commercial buildings are achievable through operational improvements–many at little or no cost to building owners. The portfolio above represents a $12M operational savings opportunity.

FIRSTFUEL
BUILDING ENERGY ANALYTICS

DEEP ENERGY SAVINGS HIDDEN IN MID-SIZED COMMERCIAL BUILDINGS



Each bubble represents a building. The size of the bubble is proportional to the size of the savings potential.

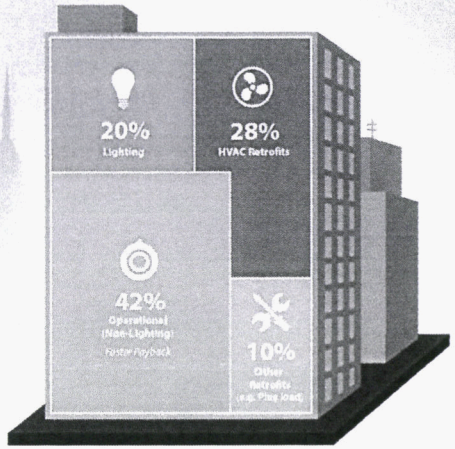
Many mid-sized buildings have limited savings potential.

The top mid-sized buildings represent 40% of total savings potential.

Most large buildings have large savings opportunities... but there are not as many.

FIRSTFUEL
BUILDING ENERGY ANALYTICS

AFTER LIGHTING, WHATS NEXT FOR COMMERCIAL EFFICIENCY?



Lighting Represents Only 20% of the Total Savings Opportunity

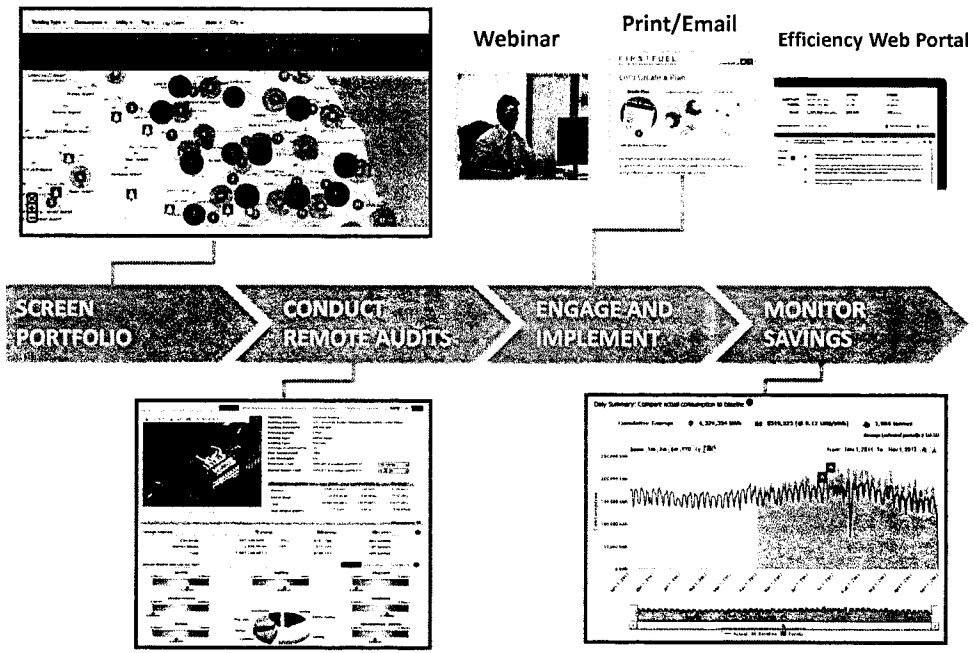
- Operational savings (non-lighting) is the largest, most economical path to next generation savings
- Other retrofit programs have significant potential (38%) and analytics can drive smarter, cost-effective outcomes

Sample based on 60M sq ft. of remote audits conducted by FirstFuel's Remote Building Analytics (RBA) Platform

FIRSTFUEL
BUILDING ENERGY ANALYTICS

HOW CAN ANALYTICS HELP DRIVE MORE IMPACTFUL PROGRAMS?

HOW ANALYTICS CAN TRANSFORM LIFECYCLE OF EFFICIENCY



COST AND BENEFIT IMPACTS ACROSS EE PROGRAMS

Efficiency Program Activities

	Example Opportunities
Marketing & Program Recruiting	• **QUALIFY** more leads faster, better, & cheaper • **TARGET** customers effectively by segment
Auditing & Scoping Studies	• **AUDIT**-level insight at fraction of time & cost • **LOWER** customer engagement costs
Retrofit/Whole Building/RCx Programs	• **TURNKEY** operational savings • **ACCELERATED** retrofit programs
Monitoring & Verification	• **VERIFY** and increase measure persistence • **ENSURE** full attribution for savings

FUEL

ADDITIONAL BENEFITS

SMART METER VALUE	Helps realize the value of smart meter/smart grid investments
CUSTOMER SATISFACTION	Strong linkage to other customer engagement and customer service programs via the portal
CONTINUOUS ENGAGEMENT	Year 2 customers more likely to "stick" and progress to deeper savings
FREE RIDERS	Track Efficiency Actions Taken to Ensure Credit for Savings
COMPLIANCE	With EE plan requirements
RATEPAYER PARITY	Opt-out program available to all C&I ratepayers

FUEL

BENEFITS FOR ARIZONA

Arizona Corporation Commission	Arizona Utilities
• Timely and relevant policy and program decisions • Increased focus on ALL customers regardless of size • Leader for emerging technology • Transparency and persistence of energy savings	• Lower cost to identify and deliver energy savings • Ability to leverage meter investments to achieve additional customer savings • Increase "multi-measure" projects • Real-time monitoring enables faster feedback and program adjustments

THE FUTURE OF ENERGY EFFICIENCY DELIVERY

EE PAST	EE PRESENT + FUTURE
RANDOM. REACTIVE.	STRUCTURED. STRATEGIC.
RETROFITS.	OPERATIONAL + RETROFITS = 2X.
ONE BUILDING. ONE MEASURE.	ALL BUILDINGS. DEEP SAVINGS.
kWh SAVINGS.	kWh + kW + Therms = INTEGRATED.
LOW SCALE. HIGH COST.	HIGH SCALE. LOW COST.

FIRSTFUEL
BUILDING ENERGY ANALYTICS

Q&A

Thank you for your time

Arizona Corporation Commission

Intelligent Residential Energy Automation

@ECO FACTOR

5/28/14
John Steinberg
EcoFactor

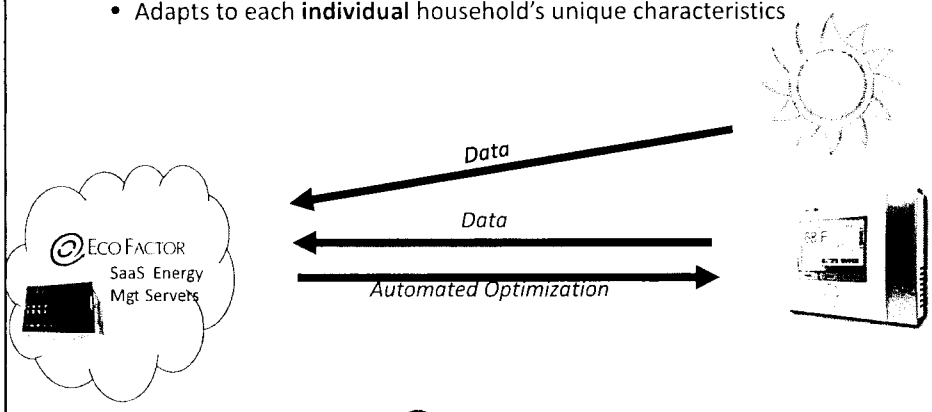
About Us

Founded in 2006
Based in Redwood City, CA
National Grand Prize Winner of 2009 Cleantech Open
18 patents issued, lots more pending

@ECO FACTOR

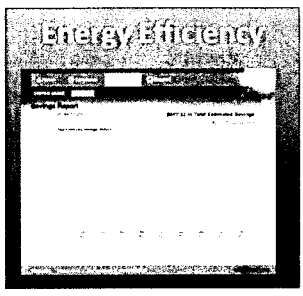
What We Do: Intelligent Residential Energy Automation

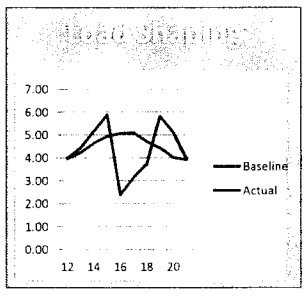
- SaaS-based platform
- Deep analytics
- **Automated** optimization of HVAC usage (NOT just data)
- Adapts to each **individual** household's unique characteristics

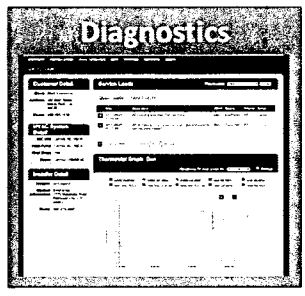


ECO FACTOR

Three Key Services

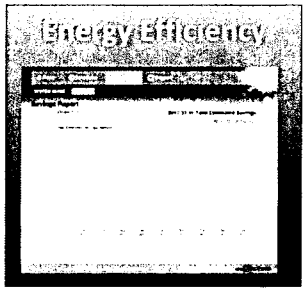




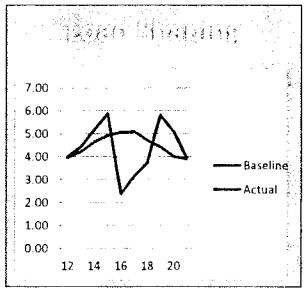


ECO FACTOR

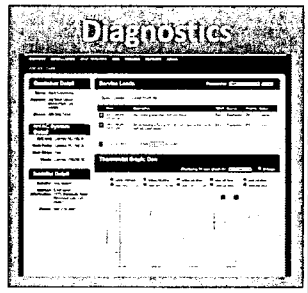
Three Key Services



We save consumers
≈$100/year



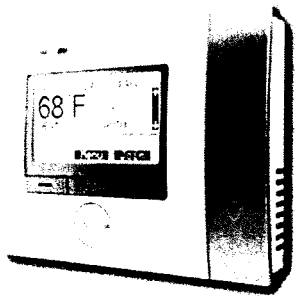
We provide
painless,
cost-effective DR



We find hidden
HVAC problems
(We save consumers
more money)

ECO FACTOR

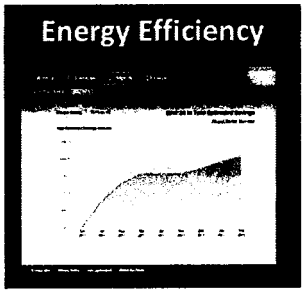
Three Key Services

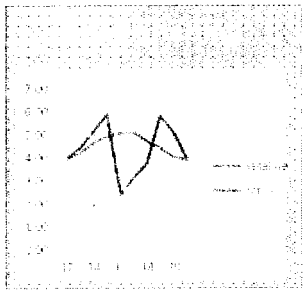


One Managed Device

ECO FACTOR

Three Key Services





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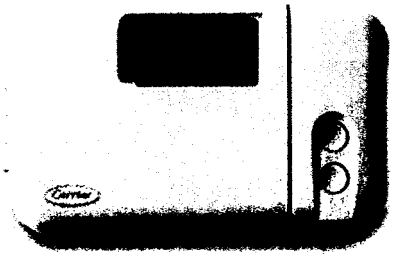
The poster child for INefficiency



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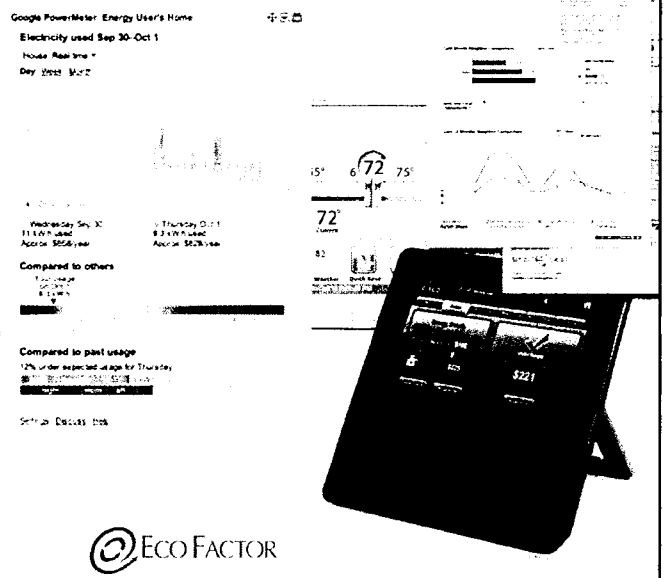
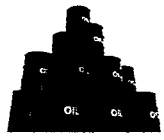
ECO FACTOR

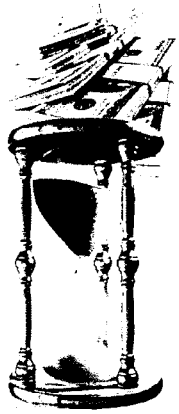
Better?

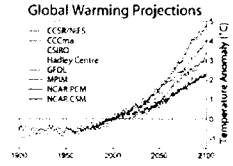


ECO FACTOR

Which resource do YOU care most about?







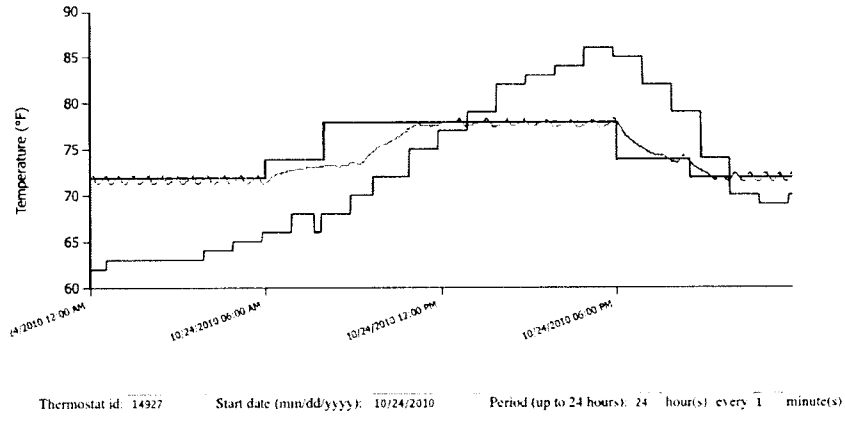
ECO FACTOR

Efficiency = reducing energy costs
without requiring effort,
attention or behavior
modification

Efficiency = Automation

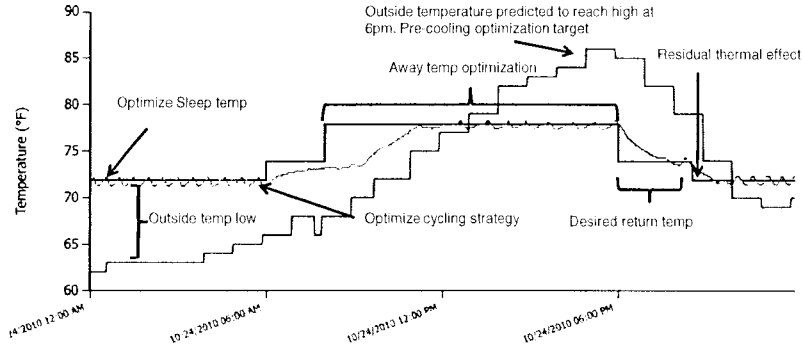
ECO FACTOR

EcoFactor uses [illegible] data...



ECO FACTOR

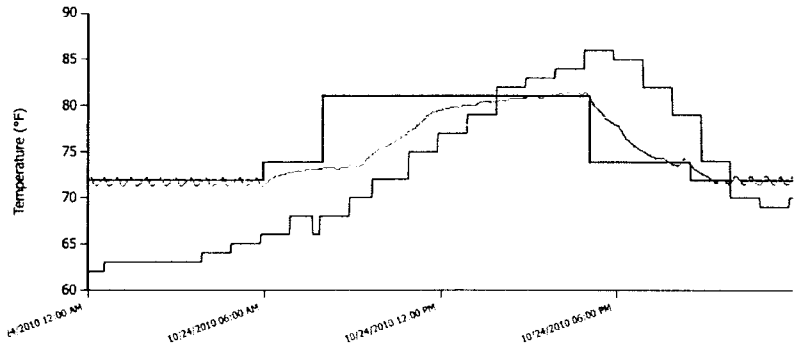
… to understand the thermal behavior of a home



Thermostat id: 14927 Start date (mm/dd/yyyy): 10/24/2010 Period (up to 24 hours): 24 hour(s) every 1 minute(s)

ECO FACTOR

… and optimize each HVAC system 24/7/365



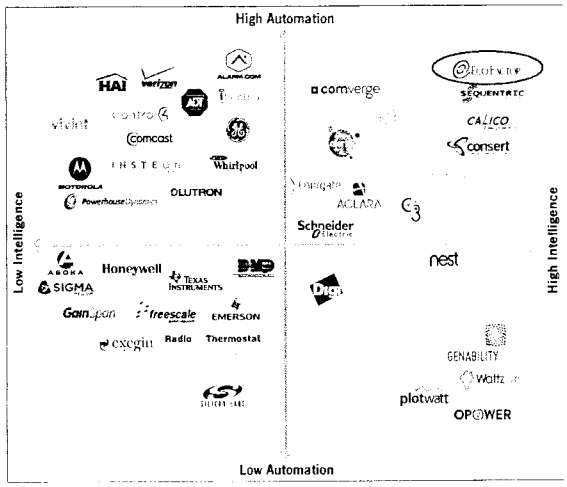
Thermostat id: 14927 Start date (mm/dd/yyyy): 10/24/2010 Period (up to 24 hours): 24 hour(s) every 1 minute(s)

ECO FACTOR

Industry-leading technology

Offers simple programs to follow orders

Uses Intelligence to offer **true automation**



Offers single connected devices

Offers intelligent reports, but requires behavioral changes

Source GTM RESEARCH

ECO FACTOR

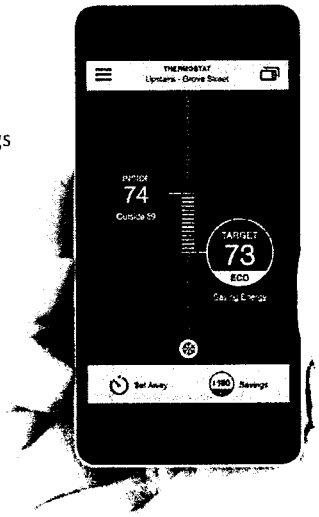
Consumer Value Proposition

Hundreds of small changes/month → big documented savings

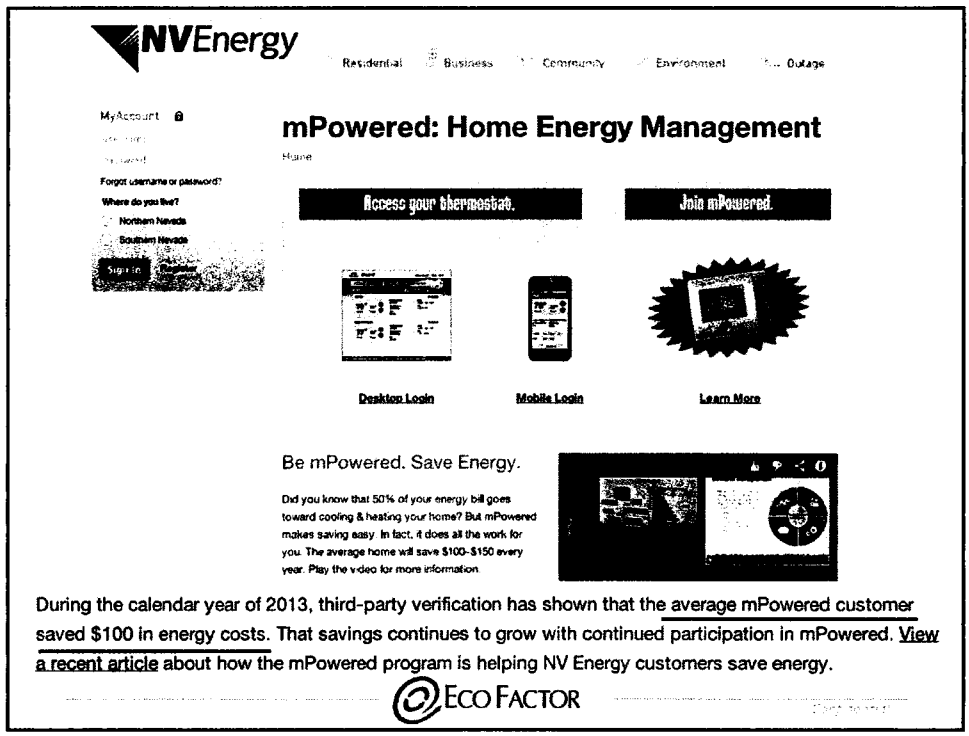
Increased comfort and control

Easy remote access (web, mobile)

... all **without** behavior modification



ECO FACTOR



During the calendar year of 2013, third-party verification has shown that the average mPowered customer saved $100 in energy costs. That savings continues to grow with continued participation in mPowered. View a recent article about how the mPowered program is helping NV Energy customers save energy.

ECO FACTOR

Proven Results: Double-digit Savings

NVEnergy
A MIDAMERICAN ENERGY HOLDINGS COMPANY

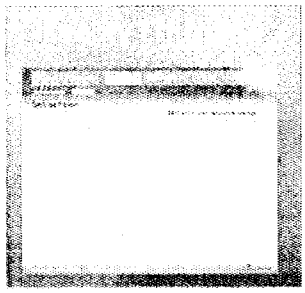
11% A/C savings
585 kWh/year, 18 therms/year per home in Las Vegas confirmed by 3rd party M&V

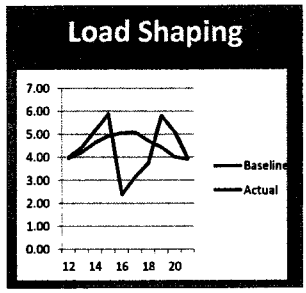
SMUD®

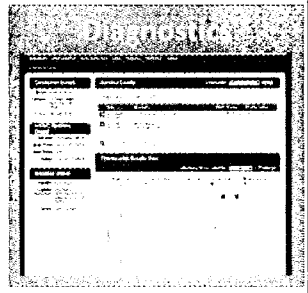
10% HVAC savings
227 kWh/year, 16 therms/year per home (internal EcoFactor M&V)

ECO FACTOR

Three Key Services



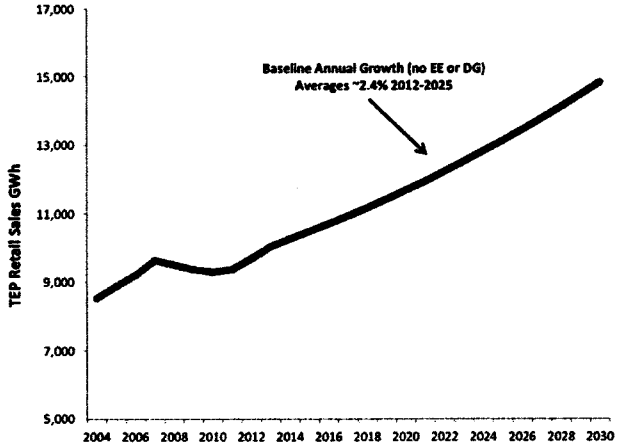




ECO FACTOR

Rising Demand-TEP

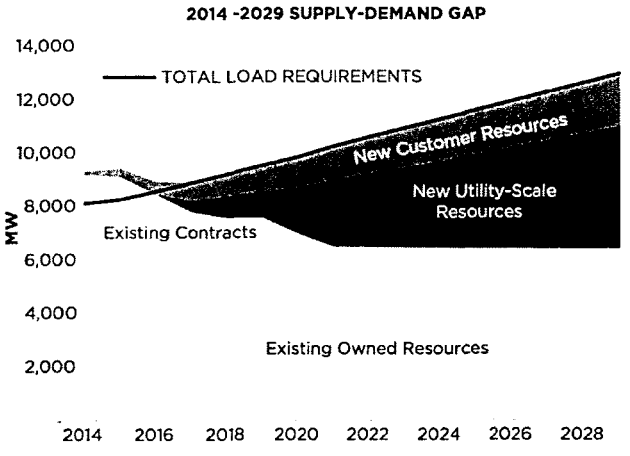
Chart 12 - Reference Case Retail Energy Sales



source

ECO FACTOR

Rising Demand-APS



ECO FACTOR

The Fundamental DR Challenge: The Consumer Perspective

- Peak loads are ***NOT*** a consumer issue
- Residential DR does ***NOT*** make consumers happy
- Ain't enough $ to incent enough misery to make the grid happy

- Key to customer acceptance:
  - Minimizing negative impacts is ***NOT*** enough
  - Need to offer tangible upside

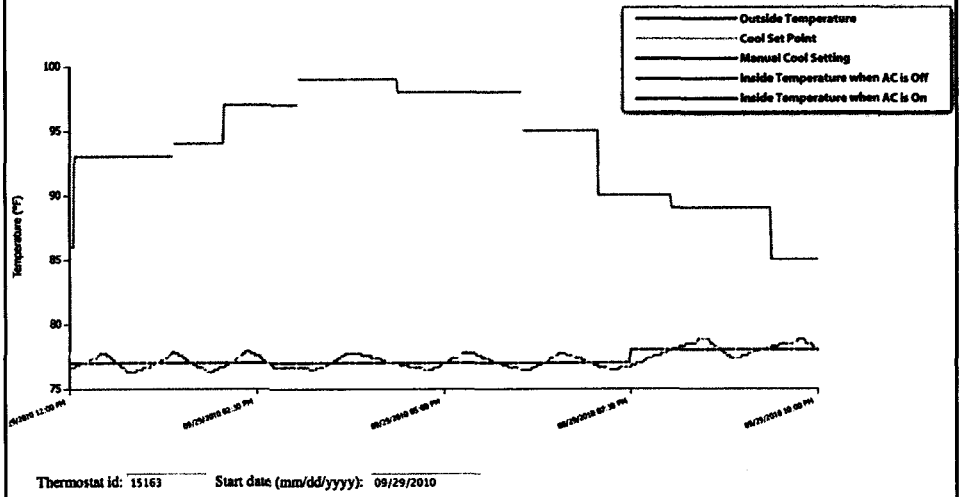
ECO FACTOR

The Answer:

1. **Effortless, Year-round Energy Savings**
2. **Dynamically Optimized Demand Response**

ECO FACTOR

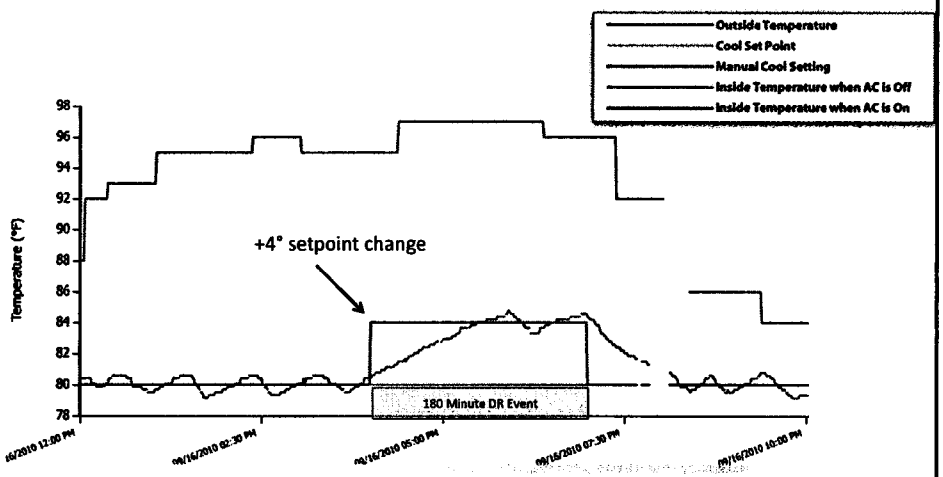
No DR: Focus on Comfort



Thermostat id: 15163 Start date (mm/dd/yyyy): 09/29/2010

ECO FACTOR

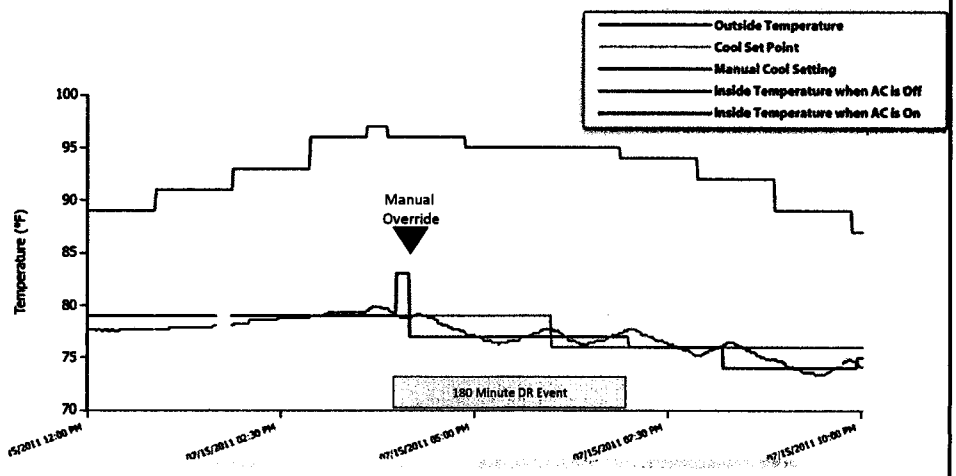
Traditional DR: Load Shed....



Thermostat id: 15115 Start date (mm/dd/yyyy): 09/16/2010

ECO FACTOR

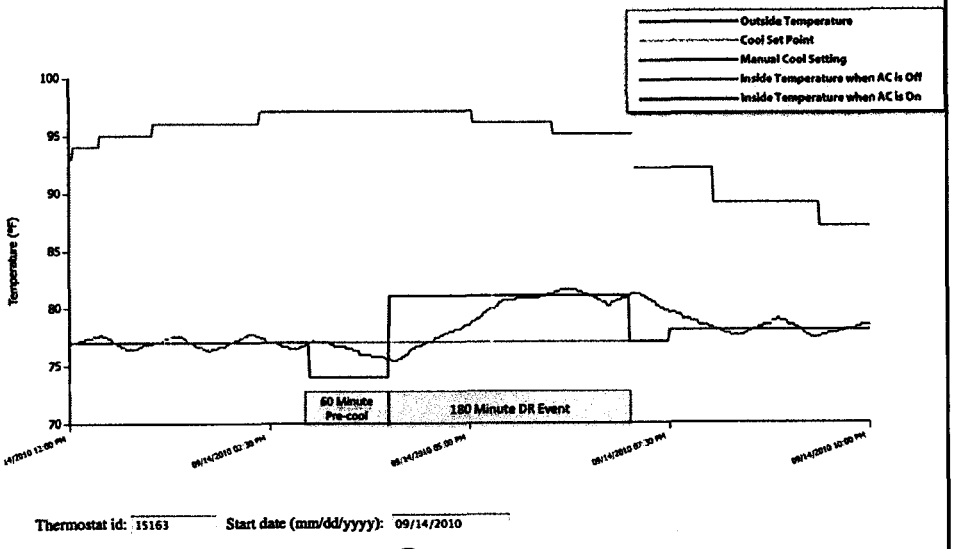
...or Comfort, but Not Both



Thermostat id: 15075 Start date (mm/dd/yyyy): 07/15/2011

ECO FACTOR

Pre-cooling Helps



Thermostat id: 15163 Start date (mm/dd/yyyy): 09/14/2010

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Optimized Pre-cooling

Adapts to:

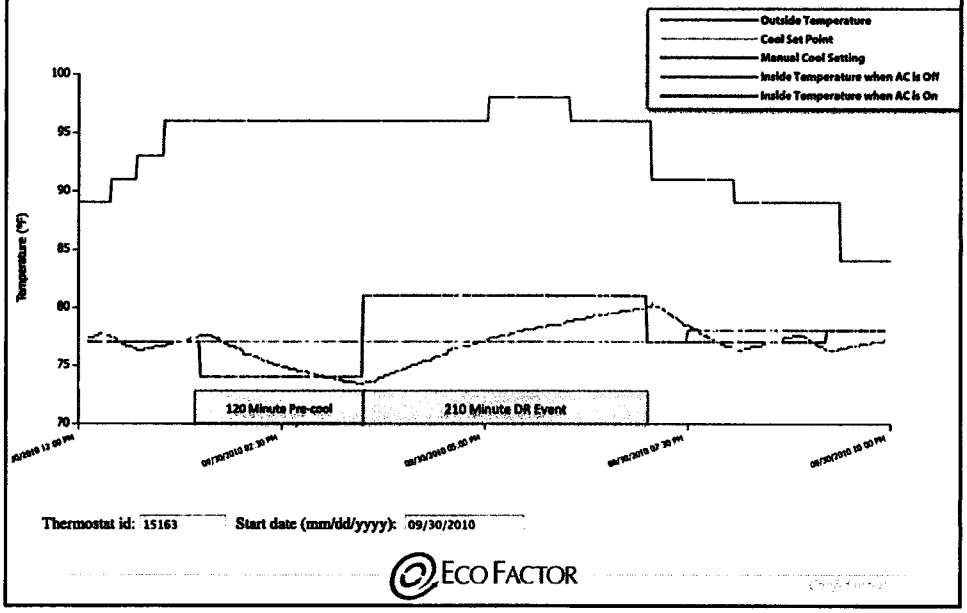
- Changing weather conditions
- The unique characteristics of each home and A/C system
- The preferences of the homeowner

Reduces:

- Opt-outs
- Discomfort

ECO FACTOR

Optimized Pre-cooling Helps More



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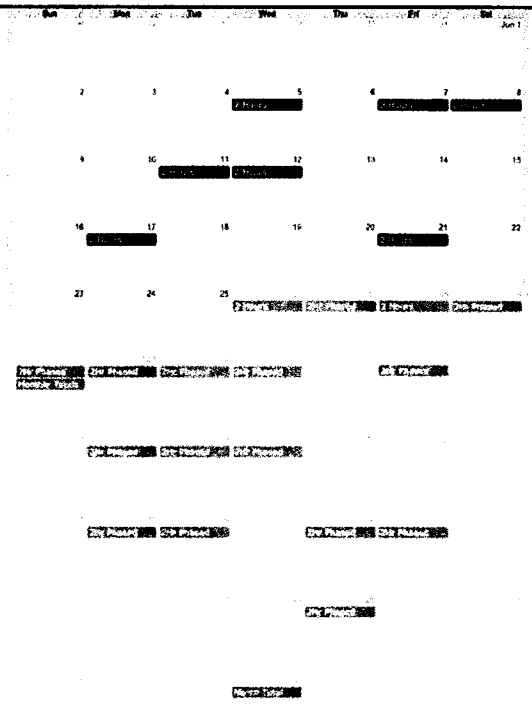
ECO FACTOR



24 DR hours in June

3 events
2 events
2 events
4 events
5 events

24 DR hours In July

3 events
4 events
1 event
0 events

NV Energy's Residential HVAC Optimization Program

SWEEP – 10th Annual Southwest Regional Energy Efficiency Workshop
November 21-22, 2013

Michael O Brown • Manager, Demand Response & Distributed Energy Resources • mbrown@nvenergy.com

ECO FACTOR

NV Energy Overview

Company

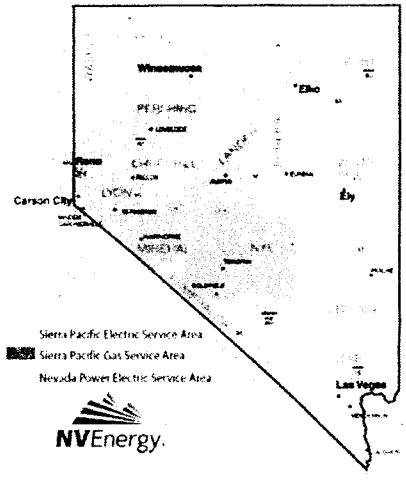
- IOU /Vertically Integrated
- State Commission Regulated
- 1.2 M Electric Customers
- 93% of Nevadans Served
- South: 5,854 MW Peak Demand
- North: 1,720 MW Peak Demand

Smart Grid Efforts

- Statewide AMI Deployment
- Sensus / Smart Meters
- Itron / Meter Data Management
- Aclara / Web Portal
- IBM / SOA

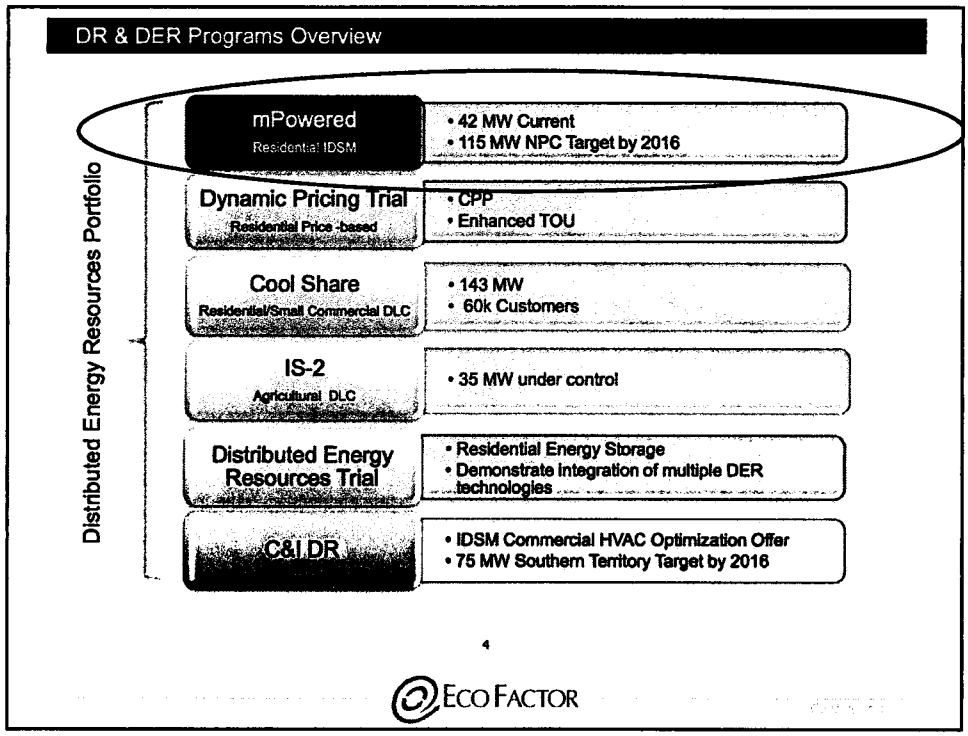
Demand Response Efforts

- 218 MW Statewide
- ~3% of Peak
- ~~Residential, Commercial~~, Agricultural
- Advanced HAN & DRMS technology



3

ECO FACTOR



Proven Results: Optimized DR Works AND Delivers High Customer Satisfaction

NVEnergy
A MIDAMERICAN ENERGY HOLDINGS COMPANY

3.5kW per home
Per 3rd party M&V

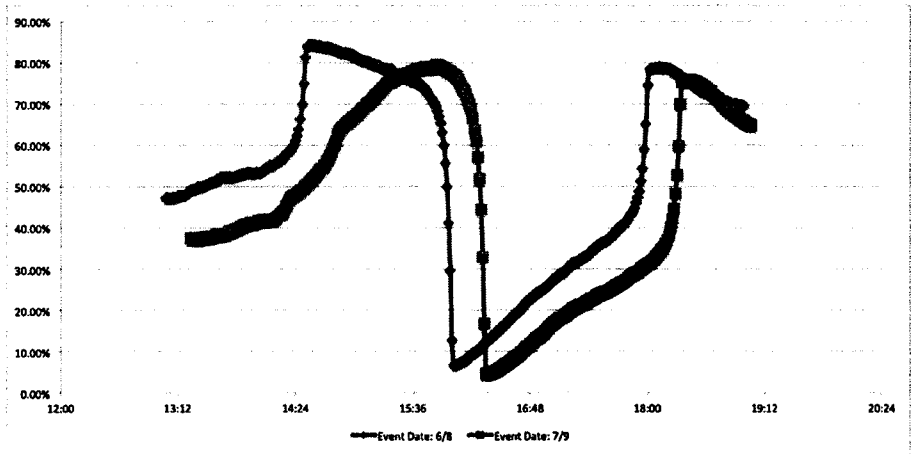
NV Energy survey found that among current users:

86% are satisfied (completely or somewhat)
89% will recommend to others (definitely or probably)

1554 current NVE customers completed surveys, November 2013

ECO FACTOR

Las Vegas 2013: Event #3 and Event #18



ECO FACTOR

What EcoFactor DR Could Do in Arizona

Assume 3kW/home (15% lower than in NV):

50,000 homes = 150MW

100,000 homes = 300MW

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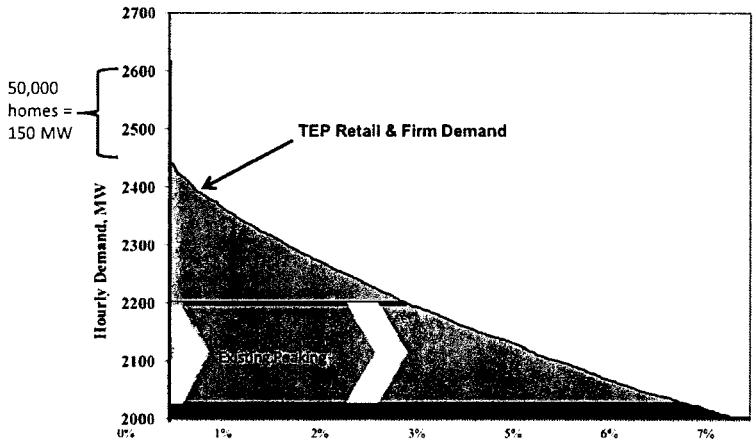
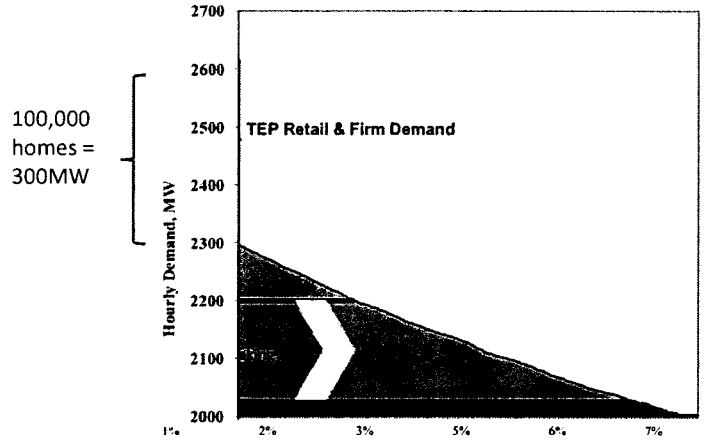
Chart 21 - 2015 TEP Peaking Requirements



ECO FACTOR

Chart 21 - 2015 TEP Peaking Requirements



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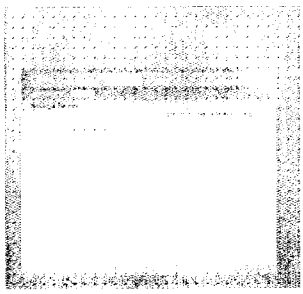
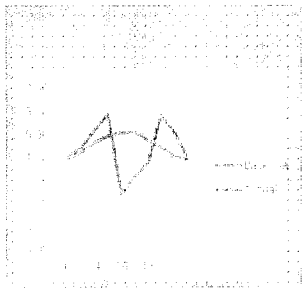
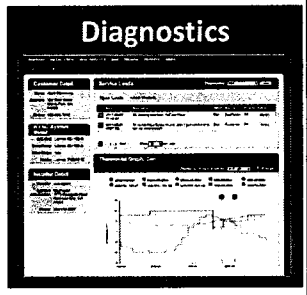
Three Key Services







ECO FACTOR

Finding HVAC Performance Issues

EcoFactor has developed sophisticated diagnostics algorithms

Currently finding significant unrecognized issues in 6% of systems each month

Sampling has strongly validated models (95% accuracy)

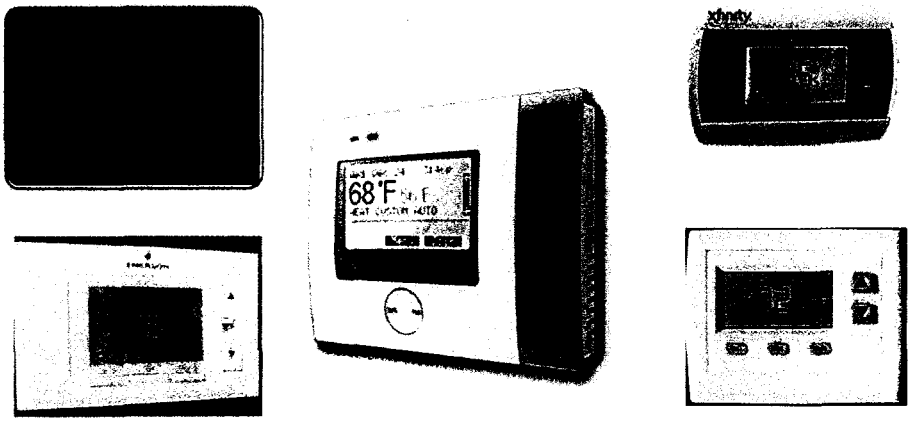
ECO FACTOR

Fixing HVAC Issues Saves Money and Energy

Total number of trucks dispatched: 38
Total number of technician-confirmed issues: 36
Number of issues requiring major AC/Furnace component replacements: 4
Estimated incidence of significant issues fleetwide: 15% annually
Estimated EE benefit of HVAC diagnostics fleetwide: 1.4 - 2%

@ECO FACTOR

Three Key Services



One Managed Device

@ECO FACTOR

What EcoFactor Delivers

Strong consumer value: savings without sacrifice, enhanced convenience and control

Strong utility value: cost-effective integrated demand-side management

ECO FACTOR

Thank-you

John Steinberg
john@ecofactor.com

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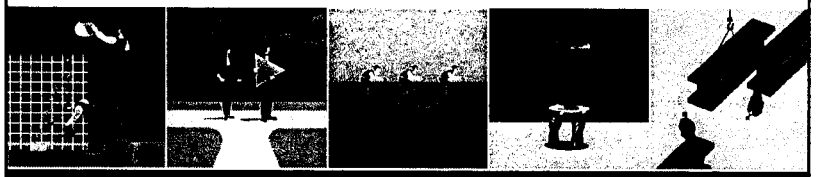

MICROGRIDS

IMPACTS ON ARIZONA UTILITY PLANNING & POLICY

MAY 28, 2014

PETER ASMUS
PRINCIPAL RESEARCH ANALYST

MARKET INTELLIGENCE • ANALYSIS • BENCHMARKING

Introduction

NAVIGANT RESEARCH PROVIDES IN-DEPTH ANALYSIS OF GLOBAL CLEAN TECHNOLOGY MARKETS.

The team's research methodology combines supply-side industry analysis, end-user primary research and demand assessment, and deep examination of technology trends to provide a comprehensive view of the Smart Energy ecosystem.

RESEARCH PROGRAMS:

- Smart Energy
- Smart Utilities
- Smart Transportation
- Smart Buildings

RESEARCH OFFERINGS:

- Research Reports
- Subscription Research Services
- Custom Market Research
  - Custom Market Analysis
  - Market Sizing and Forecasting
  - Primary Research
  - Go-to-Market Services
  - Strategic Advisory Sessions
  - Commercial Due Diligence
  - Technology Evaluation

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MICROGRIDS: DRIVERS AND CHALLENGES

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The What, Why, and How of Microgrids

- Microgrids are smart networks capable of aggregating and optimizing diverse distributed energy resources (DER)
- Key feature: ability to island during utility grid outages
- Latest thinking: capacity and ancillary services for utilities
- Market is global, but United States and Asia Pacific countries lead
  - To date, utilities have NOT been in the driver's seat
  - San Diego Gas & Electric (SDG&E), Sacramento Municipal Utility District (SMUD), American Electric Power (AEP), Duke Energy, and ConEd exceptions in United States
  - Solution for both climate change and ending energy poverty in emerging economies with pay-as-you-go business models

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Global Big Picture Market Drivers

- Declining reliability of incumbent utility electricity grid
  - Arizona Public Service (APS) still ranks in top quartile for reliability in United States
- Demand charges imposed by local distribution utilities
- Mandates and public policies
  - Carbon limits, feed-in tariffs (FITs), net metering, dynamic real-time power pricing, utility revenue decoupling, etc.
- High penetrations of variable solar photovoltaics (PV) and wind
- Organized markets for third-party ancillary services
  - Demand response (DR)
  - Frequency and voltage regulation
- Corresponding need for new business models for electricity

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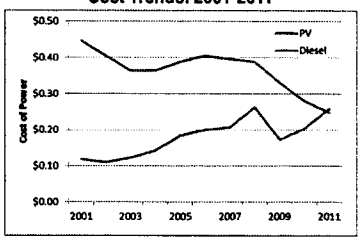
Technology- and Fuel-Specific Microgrid Drivers

- Declining cost of solar PV
  - Grid parity by 2020?
- High cost of diesel fuel
- Natural gas fracking (CHP)
- Diversity of distributed wind
- Advances in direct current technologies
- Declining cost of storage
  - Lithium ion (Li-ion) oversupply
  - Flow batteries
  - Smart lead-acid

Solar PV and Diesel Generation Cost Trends: 2001-2011



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Challenges Still Daunting

- Historic anti-islanding bias of utilities
  - Worker & equipment safety, obligation to serve, and stranded investment concerns
- Existing subsidies for status quo
- Lack of integrated policies for microgrids
- Lack of clear controls technology approach
  - No leading go-to player
- Business models unclear
- How can the reliability, economic, and eco benefits that flow from microgrids be quantified by regulators?

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Why North America?

- Dispersed nature of power grids opens door to microgrids
- Many leading technology providers located in United States
  - General Electric, Johnson Controls, Honeywell, Lockheed Martin, Eaton
- Both grid-tied and remote microgrid opportunities
  - Canada, Alaska, and Hawaii among top markets for remote systems
  - Northeast United States and California are hot spots for grid-tied systems
  - Federal Energy Regulatory Commission (FERC) regulatory actions on DR, energy storage
  - Pushback on utility smart meters by consumers
  - Pushback by utilities on net metering, FITs
  - Deregulation and rise of personalized energy

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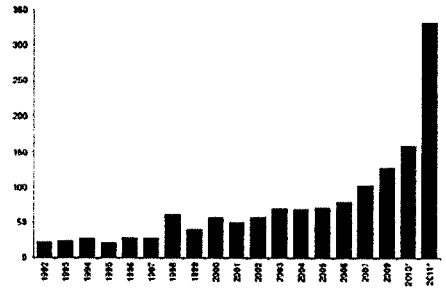
Reliability of North American Power Grid Declining

Major Power Disturbances, North America: 1992-2011

Power outages have risen sharply over the last decade
Major power disturbances in North America



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CAPACITY AND REVENUE MARKET FORECASTS

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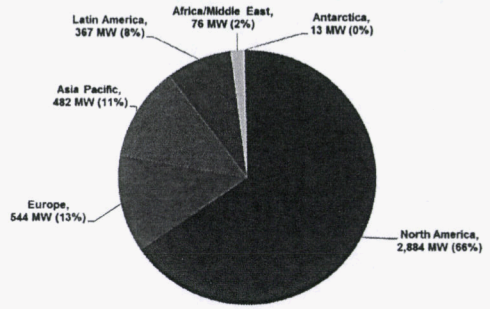
Microgrid Deployment Tracker: A Global Database

Microgrid Capacity by Region, World Markets: 2Q 2014



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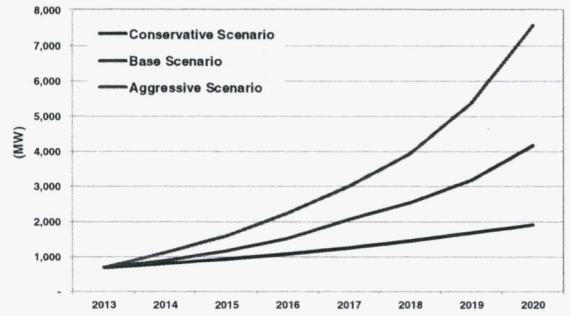
Microgrid Scenarios Reflect Uncertain Future

Annual Total Microgrid Capacity by Scenario, World Markets: 2013-2020



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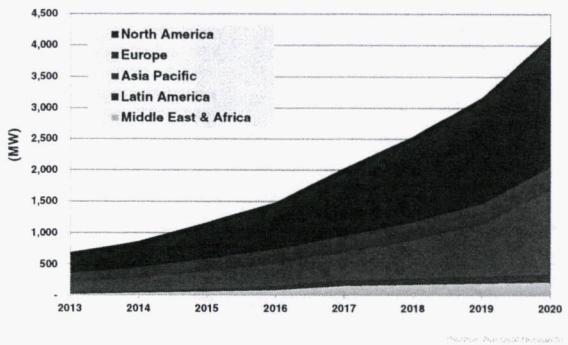
Microgrid Forecast Based on System Capacity

Annual Total Microgrid Capacity by Region, Base Scenario, World Markets: 2013-2020



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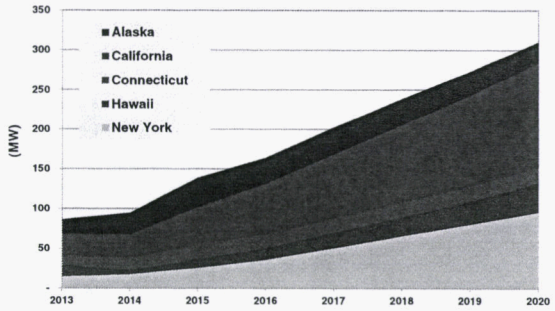
Top Five U.S. State Markets

Top Five U.S. State Microgrid Capacity, Base Scenario: 2013-2020



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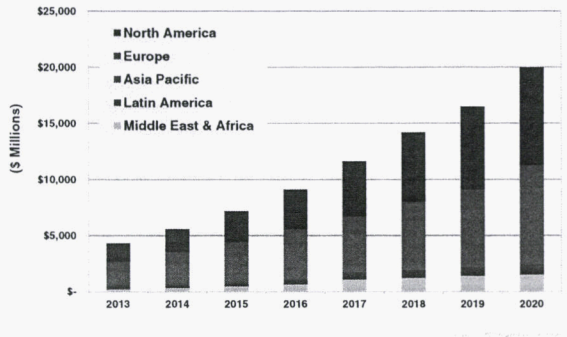
Microgrid Vendor Revenues Differ by Segment and Region

Annual Total Microgrid Vendor Revenue by Region, Base Scenario, World Markets: 2013-2020



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ARIZONA SNAPSHOT

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Snapshot: Arizona's Microgrid Market

- Arizona is not a top tier microgrid market today
  - Arizona has sufficient supply - no immediate need for new supply
  - Retail customer prices are moderate
  - Extreme weather disruptions not a major factor
  - No independent system operator (ISO)/regional transmission organization (RTO) organized markets for ancillary services
- Business case for utilities?
  - Transmission and distribution (T&D) asset deferral
    - Lawrence Berkeley National Laboratory study validates business case
- Primary driver: distributed renewables integration & premium reliability for key customers

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Bottom Line on Arizona Microgrids

- Business case strongest for grid-tied microgrids
  - Islanding only for emergencies
  - What about DR and ancillary services?
- Utility business models still unclear
  - Municipal utilities may lead due to regulatory issues
- Current applications in Arizona
  - Military bases
  - Universities and hospitals
  - Remote communities (a la SDG&E's Borrego Springs)
  - Off-grid Systems
  - T&D asset deferrals

NAVIGANT RESEARCH

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NAVIGANT RESEARCH

Alternative Rate Design: a Large Customer Perspective

Denis George – Corporate Energy Manager
The Kroger Co./Fry's Food Stores
Phoenix, AZ
May 28, 2014

Agenda

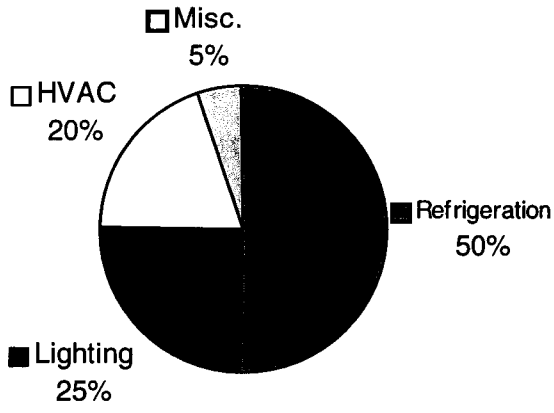
- Introduction
- Energy Efficiency History
- Current Projects and Programs
- Metering Technology and Rates
- Q&A's

Kroger/Fry's

- 2,640 grocery retail stores in 34 states under nearly two dozen banners, and multiple formats.
- 786 convenience stores , 320 fine jewelry stores, 38 food processing or manufacturing facilities, 1,240 supermarket fuel centers, 65 logistics centers, and other facilities.
- 2013 electricity usage of over 6.5 billion kWh.
- In Arizona: 119 Fry's stores w/ nearly 17,000 Associates, two logistics centers, and one manufacturing plant.
- www.thekrogerco.com & www.frysfood.com

- Today's Representative – D. George:
  - 16 years utility experience (wholesale, rates and legal)
  - 15+ years grocery/energy market procurement experience.

Electricity Usage - Typical Kroger



Energy Efficiency Results Since 2000:

Avoided usage: 34.5% of 2001 comparable store usage (thru FY 2013) – approx. 1.2 billion kWh.

Avoided Expense: $180 Million (at today's prices over total SF).

Equivalent stats (for a year):

- Single family homes – 186,719 (Charlotte, NC)
- Annual CO2e reduction: 1.3 million metric tonnes.
  - Acres of trees planted – 364,650
  - Cars off the road – 256,742

ENERGY STAR: Over 575 stores certified since 2010.

Kroger Energy Efficiency – 2000-2010

- Overhead Lighting Upgrades (T-12 to T-8)
- Case Lighting Upgrades
- Skylights and Setback
- Night Setbacks
- Motion Sensors & Timers
- Vending Machine Controllers
- Building & Refrigeration Controls Upgrades
- Singles Room Upgrades
- E-Commissioning & N-Commissioning
- Anti-Sweat Control
- EC Motor Retrofits – glass door cases
- Variable Speed Drives
- LED Exit Signs

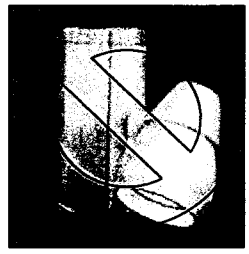
2011-2012 Efficiency Projects:

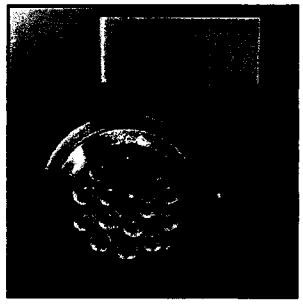
- LED glass door lighting – all remaining stores (w/ horizontal lighting).
- LED lighting retrofits in walk-in's and fresh meat shelves.
- High Efficiency lamp and ballast replacements.
- "Lighting Reinvention."
- Control system upgrades.
- Solar PV systems (5 stores + 1 DC).

LED Track Head Retrofit

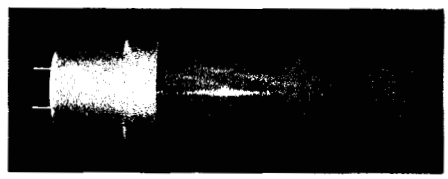
Replacing existing CMH track lighting with LED fixtures in All Departments.

- Reduces both maintenance and energy (75%) expense.
- Less heat and no UL/UV on fresh products = less waste.
- 50,000 hour rated life of product means less burnouts, which means less landfill/recycle items.
- LED products are 100% recyclable.



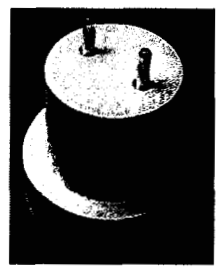


Multi-deck Open Case LED Retrofit



Replacing all T8 & T5 case lighting with LED fixtures.

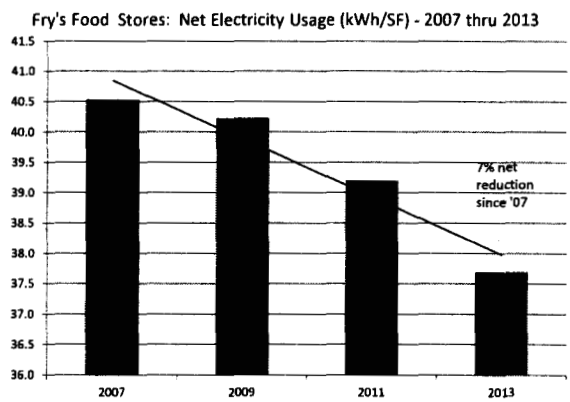
- Rated life is 50,000 hours.
- Will not yellow over time.
- Uses 55% less power than the fluorescent lamps.
- Less maintenance = no lamp replacement.
- No heat & UL/UV light = less waste.
- Gives off less heat, decreasing refrigeration load.



9

Fry's Stores - Arizona:

- 7% net usage reduction since 2007.
- Implementation of Corporate practices, aggressive daylight setbacks & evaporative condensing.
- 107 Certified ENERGYSTAR Stores (Division score 93/100).



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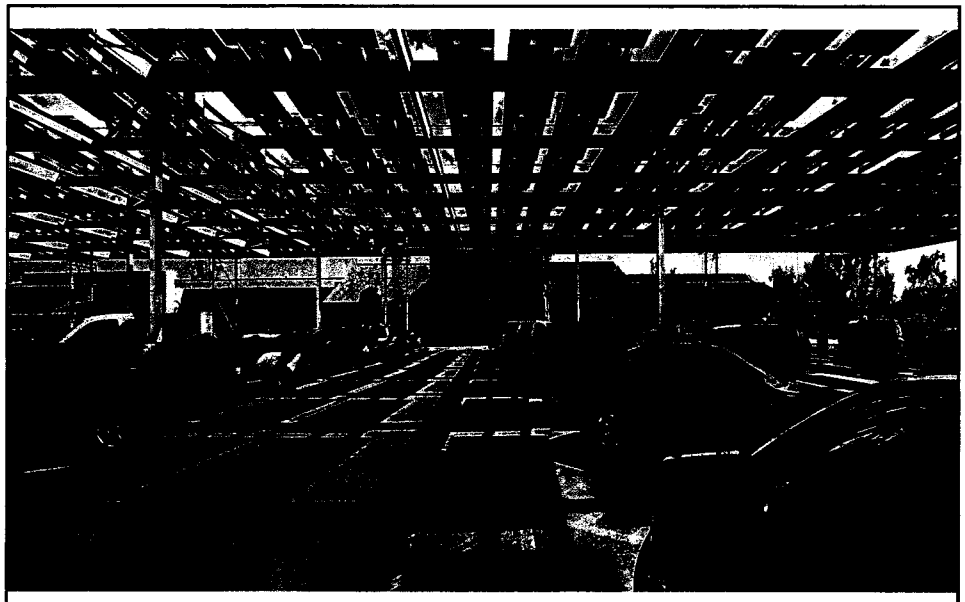


"Power Parasol" Solar Parking Lot - Fry's Store 617 - 2727 West Bell Road.

500th ENERGY STAR Store - over 500,000 kWh produced since November 2013.

Efficiency Lessons Learned

- Energy efficiency is good business – lowers expense (prices) and improves the Customer's shopping experience.
- There are years of efficiency work still ahead – no end in sight.
- Supports the Company's commitment to sustainability & environmental stewardship.
- Higher utility prices, and not necessarily the existence of rebates/incentives, drive efficiency investments.
- Technology and market forces also drives energy efficiency; we now have more products available at lower prices.
- Energy efficiency is affordable w/o incentives, but site renewable energy still requires subsidy.
- Incentives should accelerate future technology, not compensate for existing affordable technology.
- Inherently difficult and contrary to interest for most utilities, particularly investor-owned, to support efficiency programs – so why compel them to act contrary to interest? Program alternatives exist (ex. Oregon Energy Trust).

Advanced Metering & Technology

- Permits a utility to measure and bill customer usage based on hourly basis, and to aggregate multiple site usage.
- Infrastructure and technology forms basis for administering deregulated market structure:
  - Among deregulation benefits for larger commercial consumers is aggregation, separation from class load factor and large-volume price (ex. the "Customer" becomes The Kroger Co, not each individual site).
  - Traditional regulated tariff structures fail to provide these benefits.
- Metering and technology also drives rate innovation at regulated utilities: Georgia Power, Detroit Edison & Consumers Power provide examples of hourly pricing and/or load aggregation for larger commercial consumers.

Potential Rate Structure

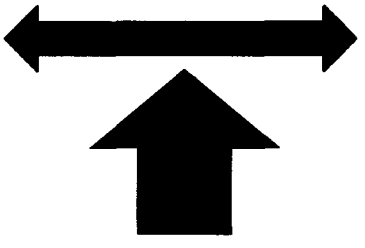
- Hourly Time-of-Use Generation Rates:
  - Day-ahead notice of prices (e-mail & website).
  - Based on hourly incremental cost ("system lambda") – not market based – recovery would be close to same as current design (i.e. not necessarily a profit driver) – eliminates fuel riders - still subject to Commission oversight.
  - Generation only – T&D billed separately.
  - The ultimate "just and reasonable rate" – every user (C & I) pays the same price at all times, and better assigns actual cost to actual usage.
  - Improves price signals for renewable energy, demand reduction and energy efficiency.
  - Help avoid construction of additional peak load facilities.
  - Example: Georgia Power Rate TOU-HLF.

Potential Rate Structure

- Multi-Site (Aggregated) Generation Rates:
  - Based on coincident demand at all customer sites (same "customer" owns all sites).
  - Generation only – T&D determined separately.
  - Recognizes the "Customer" without "geographic discrimination" (i.e. no legitimate generation COS difference between 50MW commercial consumer w/ many meters & a 50MW industrial consumer w/ 1 meter).
  - Sophistication that is not possible except for metering technology.
  - Example: Detroit Edison Rate D-6 Primary (Load Aggregation Option).

The Rate Spectrum: "Deregulation" vs. "Traditional Regulation"

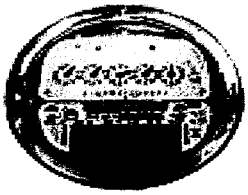
Deregulation:
- Multiple rate options
- Individual contract
- Multi-site aggregation



Traditional Regulation:
- Limited rate options
- Single Tariff for all
- No aggregation

Technology-driven utility rate design can match the best of the new with the best of the old to bridge the "gap" between these market structures to capture the "best of all worlds" for Utilities, Consumers and The State of Arizona.

Many consumers favor deregulation because there are no existing viable utility options that offer modern "technology-driven" cost of service rates. Maintaining the "status quo" on regulated rate design given existing & proven metering and billing technologies appears unreasonable, and will compel interested parties to pursue alternatives. Modern "technology-driven" rates offers more and better price signals and choices versus traditional tariff rates.



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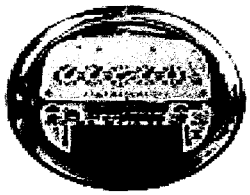


Building a "smart grid" but maintaining "dumb rates" requires additional study and action.

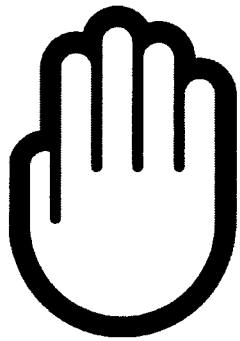
Alternative Rate Design: a Large Customer Perspective

Denis George – Corporate Energy Manager
The Kroger Co./Fry's Food Stores
Phoenix, AZ
May 28, 2014

OPOWER

Transforming your customers into an energy resource

Show of hands



Getting customers to participate isn't always intuitive

Example: California experiment testing signup rates from various tactics

Financial Reward
$25 reward for program enrollment

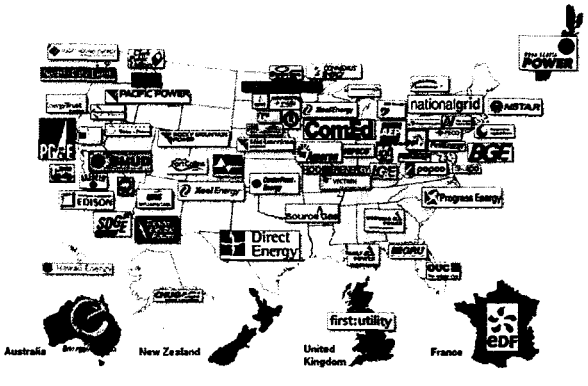
Vs.

4x
more effective

Social Proof
Program signup sheets placed in public areas

OPOWER

Driving Energy Outcomes with Embedded Behavioral Messaging



Opower Today

- Serving **90+** utilities in **8** *countries*
- **22M+ Households** on the platform
- **50%** of US household data under management
- ***500+ employees*** *in* Washington, San Francisco, London, Singapore and Tokyo

Our results

4+ TWh of savings | $460M in bill savings | 5% increase in customer satisfaction

OPOWER

Opower has partnered with Arizona utilities since 2010

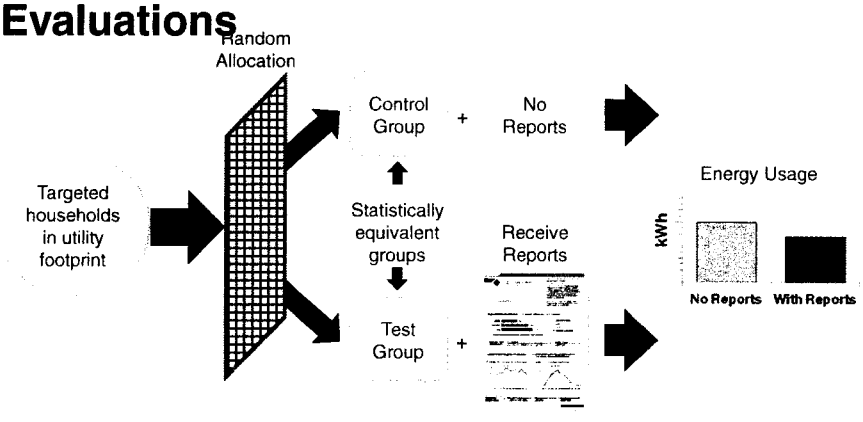
aps

UNS Energy Corp.

Tucson Electric Power

- Close to **600,000** Arizona residents have access to personalized energy tips and information
- Delivered over **80,000 MWhs** in EE savings
- Saved customers over **$8.8M** dollars in bill savings

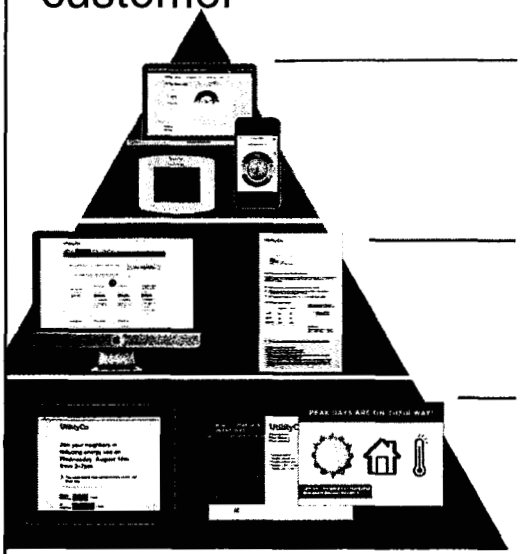
Clearly Defined Measurement & Verification Approach; 34 Independent Evaluations



Methodology endorsed by:

U.S. DEPARTMENT OF ENERGY | EPRI ELECTRIC POWER RESEARCH INSTITUTE | NRDC | neep

Our DR vision for engaging every customer



Automated EE and Demand Response

- » Maximize savings through coaching
- » Hardware from leading providers
- » Accelerate adoption of new technology through utility incentives

Dynamic Rates Engagement

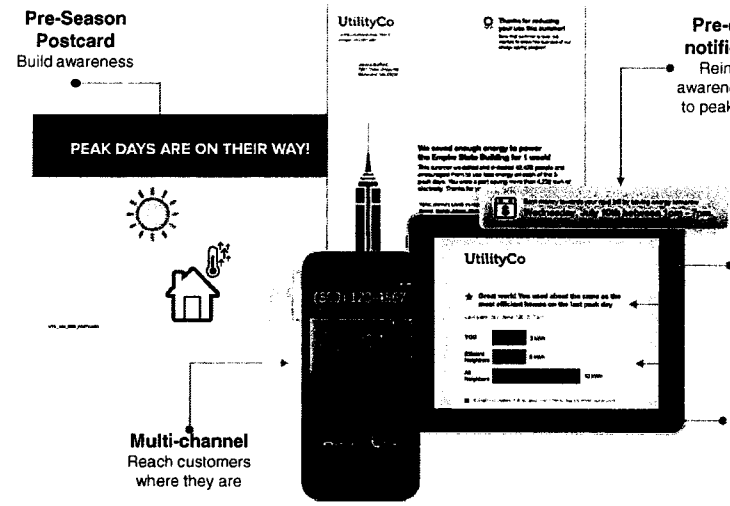
- » Dynamic rate introduction and education
- » Utilize Behavioral Demand Response capabilities to increase impact

Behavioral Demand Response

- » Deploy to **100%** of the customer base
- » Deep analytics and multi-channel messaging
- » Drive customers into other programs

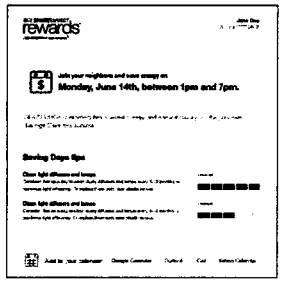
Behavioral Demand Response

Behavioral DR drives large scale peak reduction through multi-channel messaging...



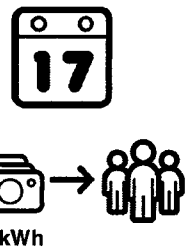
BGE's deployment of Behavioral DR

Before peak day

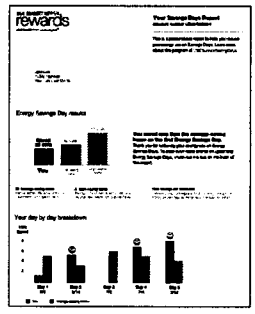


email IVR SMS

Peak day

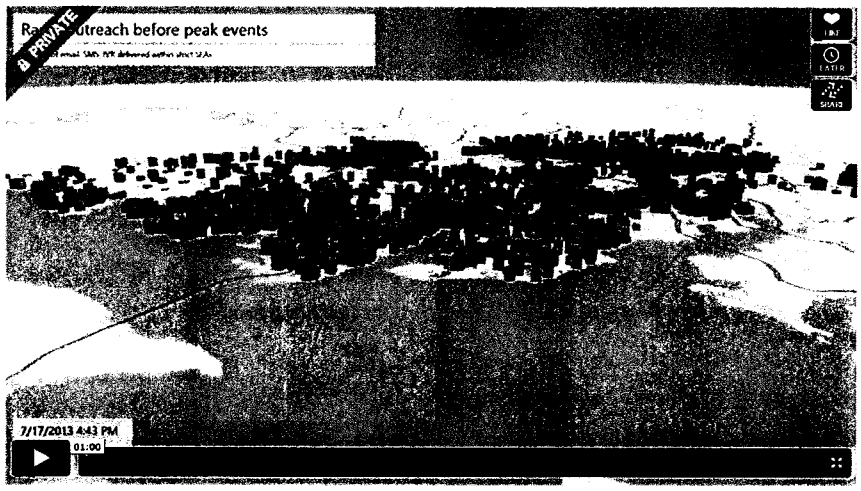


After peak day



email IVR SMS print

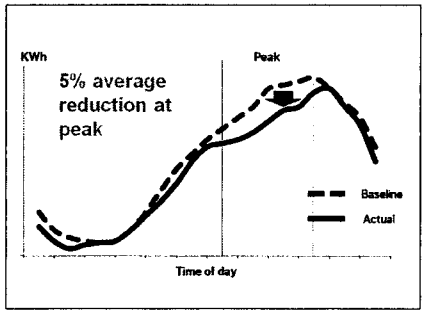
The solution in action



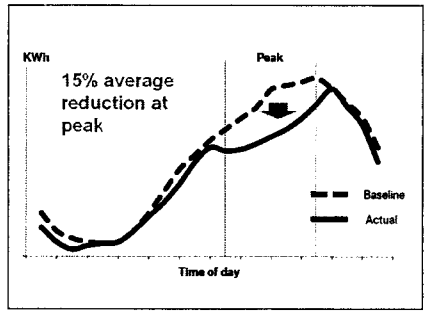
OPOWER

Result: Deep, measurable savings

Passive savers: 5%



Engaged savers: 15%+



OPOWER

Result: Delighted customers

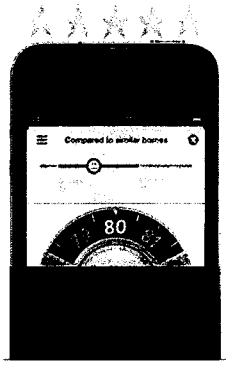
Thermostat Management

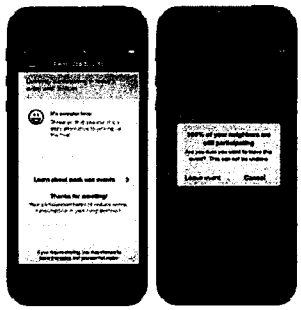
Our approach to thermostat management

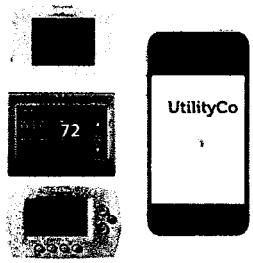
1. Overcome the "behavioral gap" with measurable, effective engagement

2. Deliver more reliable EE and DR energy savings results

3. Empower customers with choice and personal insights from the utility they trust

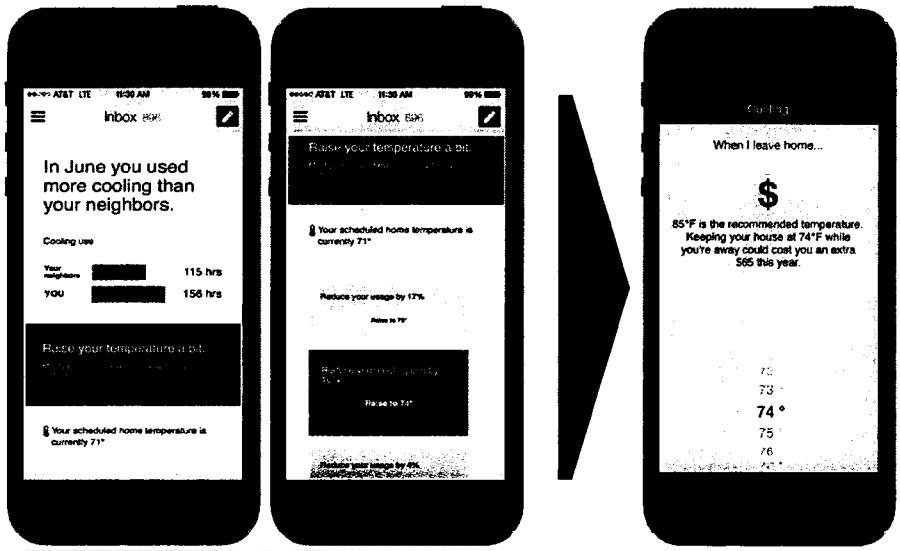






OPOWER

Engaging experience encourages efficient behaviors

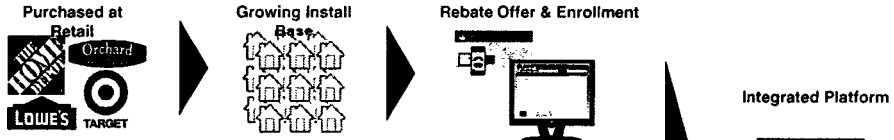


OPOWER

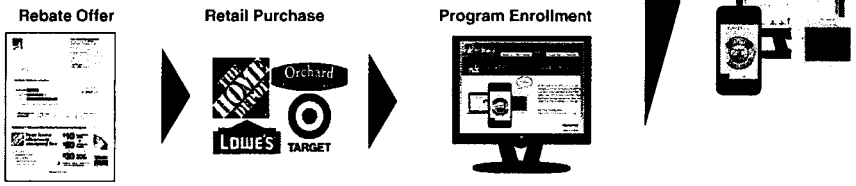
Enable customers to obtain devices through their preferred channels

Leverage existing installed base of WiFi Thermostats to drive program enrollment.

Harvest from Install Base

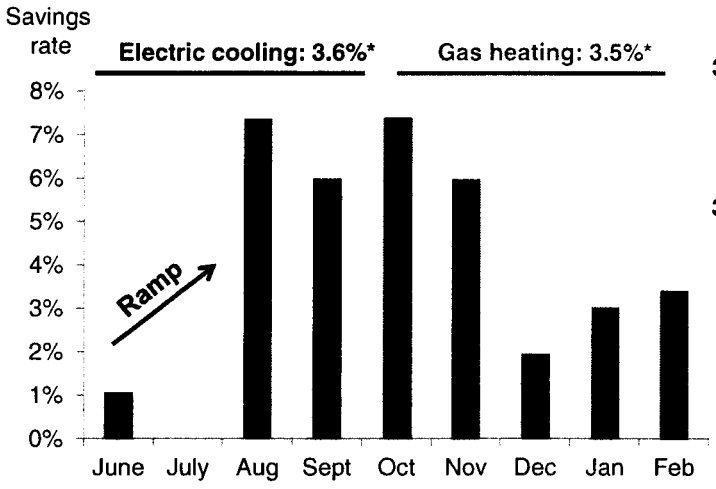


Point of Sale Enrollment



OPOWER

Result: Measurable Energy Efficiency



3.6% saved on **total home electric usage** from June – Sept

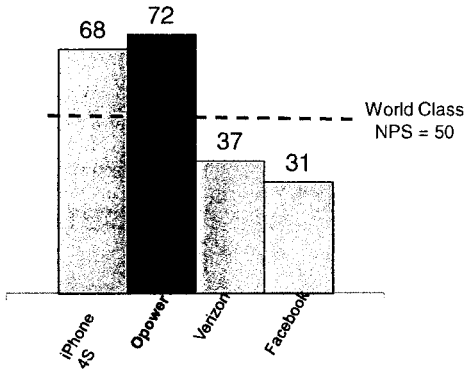
3.5% saved on **total home gas usage** from Oct – Feb

*These savings are rates on overall usage during specified months, and are incremental to home energy report savings

OPOWER

Result: Customers love the program

Product Net Promoter Score



App Store Ratings

OPOWER

Putting it all together: Transforming your customers into an energy resource

Savings	Measurable & cost-effective kW and kWh Savings
Participation	Increased participation across utility programs
Satisfaction	Positive impact on engagement, satisfaction, and bills

OPOWER

Decision Making in Micro-grids from Concept to Construction

Nathan Johnson
Assistant Professor, Department of Engineering & Computing Systems
Arizona State University

Arizona Corporation Commission

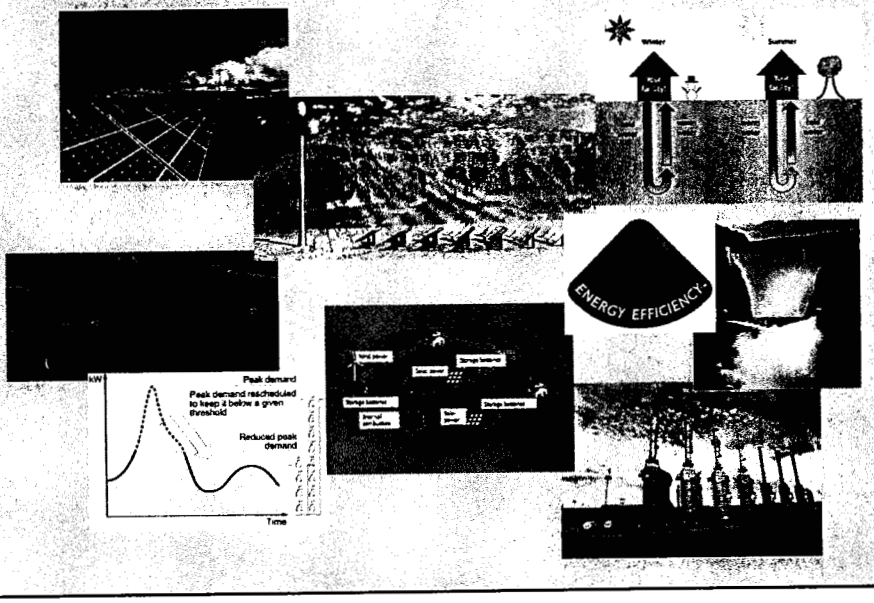
May 28, 2014

Societal goals & trends in the energy industry

CO_2 ▼ cost ▼ reliability ▲

While doubling Arizona's population by 2050 and expanding economic growth

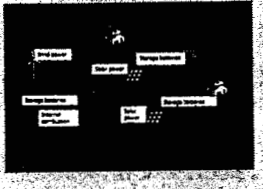
There are many pieces to the solution



The *concept* of a micro-grid

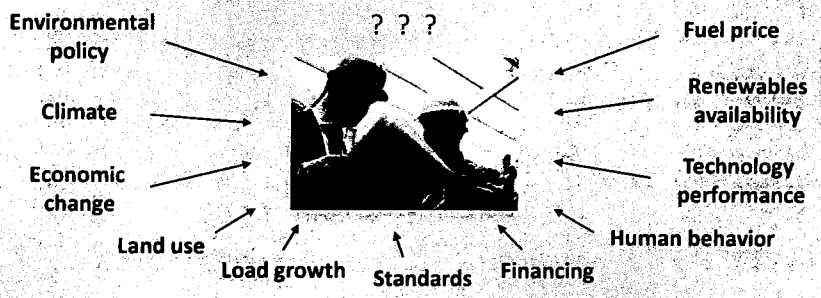
Micro-grid – a group of interconnected loads and distributed energy resources with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid [and can] connect and disconnect from the grid to enable it to operate in both grid-connected or island mode (Dept. of Energy).

- Improve reliability/redundancy (e.g., in event of grid disconnect)
- Allow for localized energy management (supply, storage, demand)
- Facilitate renewables integration
- Provide ancillary services for monetary compensation



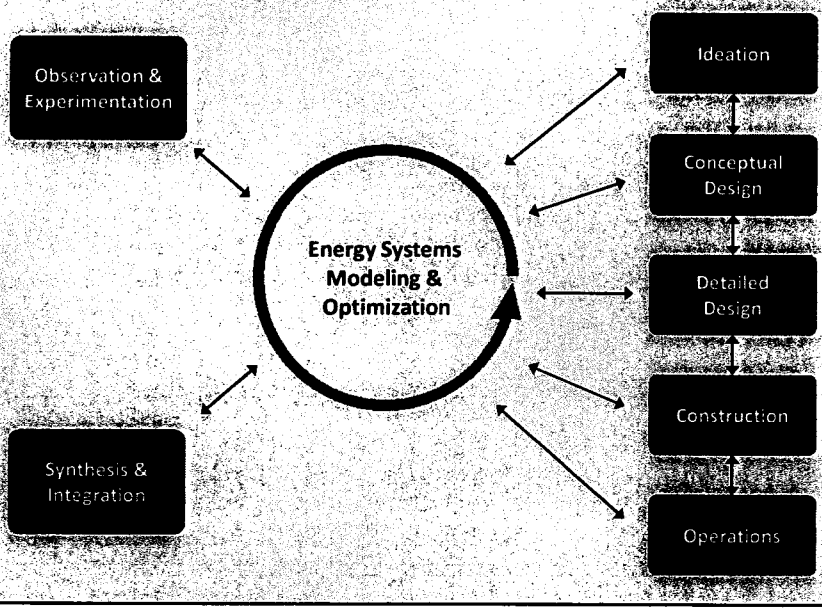
Choosing among options is a complex decision

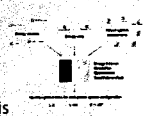
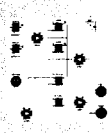
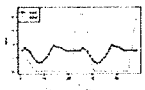
Energy systems are dynamic, and depend upon complex and changing interactions between technical, environmental, and human systems



This is a challenging problem for engineers and policy makers to evaluate

Integrated decision process from concept to construction



Step	Process		Outcome
Ideation	Goal determination Data gathering System identification	 	Prioritized objectives; scope of work
Conceptual Design	Component identification Capacity decisions "What if" scenarios/sensitivity analysis	 	Shortlist energy system architectures
Detailed Design	Power flow analysis Integrated system design Reliability	 	Power electronics, specifications for hardware and controls
Construction	Procurement Installation Integration	 	Integrated systems solutions
Operations	Monitoring & evaluation Control Refinement	 	Projects that meet expectations

Benefits of this approach

Data-driven modeling and analysis

Systems boundaries clearly identified

Synthesizes disparate information and modeling tools

Integrated decision support

Viewers/editors suited to various stakeholders

Human-computer environments fit to purpose

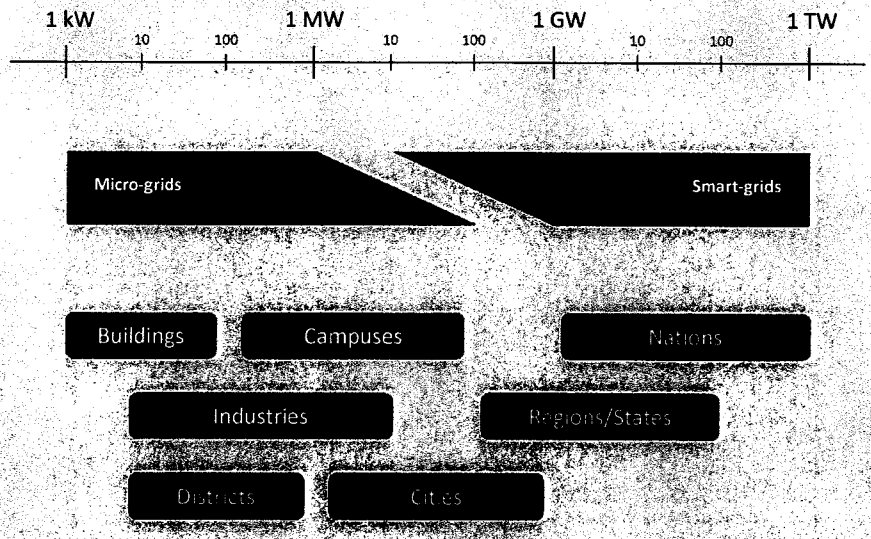
Energy Systems Design Studio

Engineering decisions

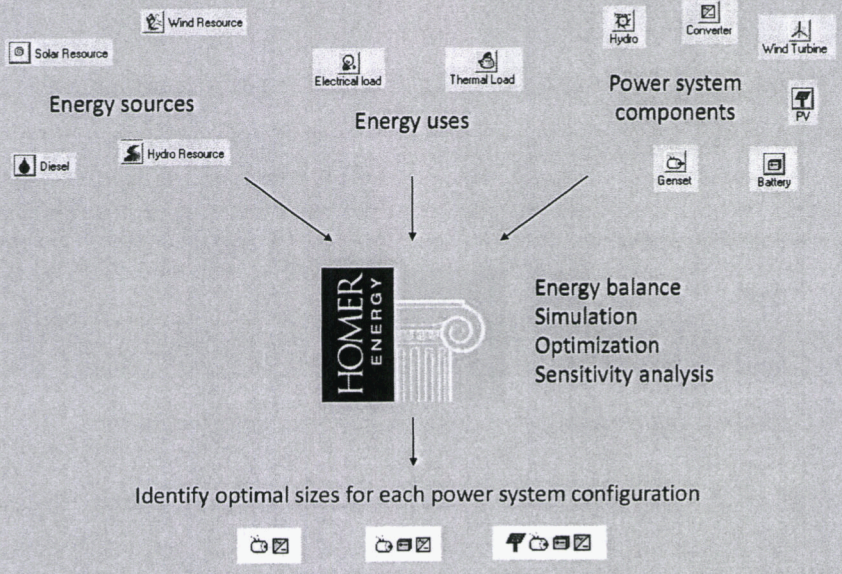
Decision Theater

Policy decisions

Similar process and decision-support tools

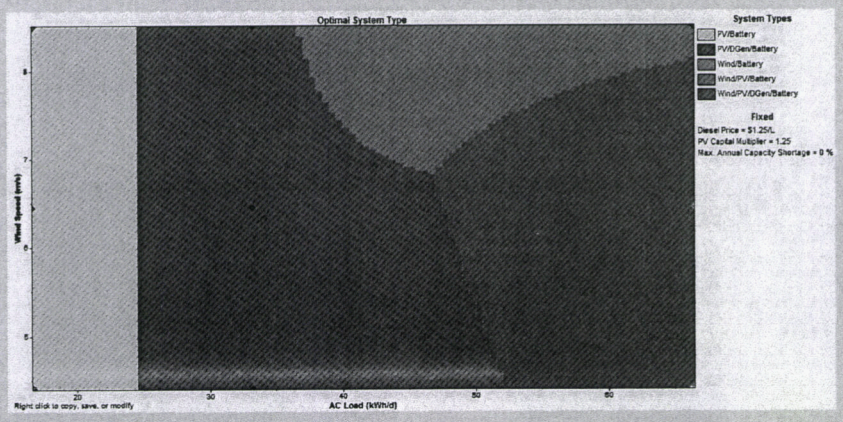


Shortlist energy options

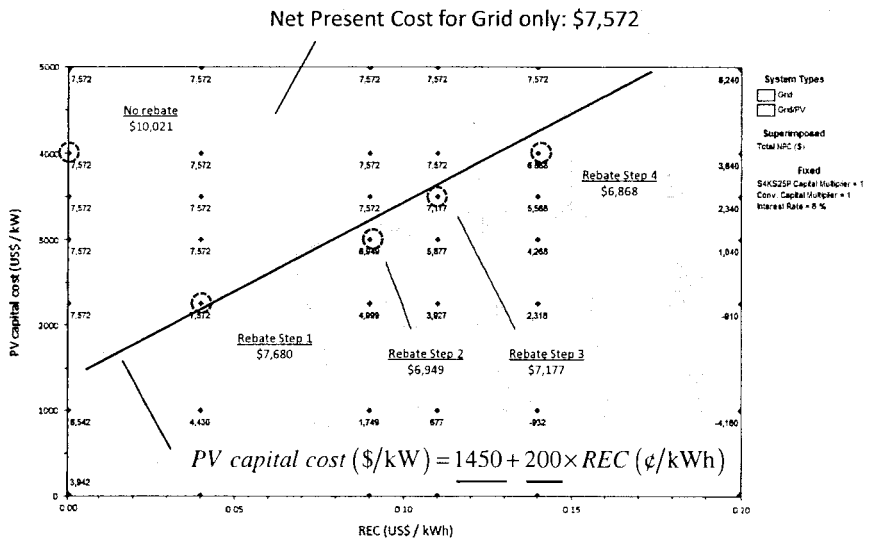


Evaluate energy options against uncertainties

Check power system optimality against uncertainty in fuel costs, load growth, resource availability, equipment performance, etc.



Boulder, CO neighborhood micro-grid with Xcel time-of-use rates and solar rebates (2011)



Boulder, CO neighborhood micro-grid with Xcel time-of-use rates and solar rebates (2011)

Micro-grids not cost-effective at this scale using current rates

Battery cost needs to reduce by 90% to be cost-effective under 2011 time-of-use rate margins

For the rate payer, a one-cent renewable energy credit (kWh) is equivalent to $200 installed capital rebate (kW)

A 10% increase in grid electricity price increases the marginal expense of a grid-only system 9x more than a grid/PV system

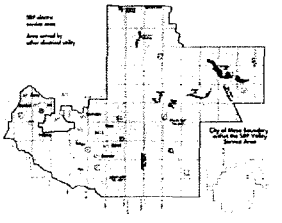
With HOMER Energy, NSF, ASEE

Evaluating effects of the residential energy transition

Goal: Evaluate the system-wide effect of changing consumer behavior, technology, and energy policy/pricing

Market segments are individually represented

Load decisions made by each rate payer



Simulating scenarios

- On-site renewables
- Grid rate structures
- Storage
- Electric vehicles
- Demand response

Optimization criteria

- Load factor
- Energy cost
- Carbon emissions

Next phase: Extend work to include reliability analysis using OpenDSS

With SRP

Solar Brayton cycle micro-grid platforms

Systems analysis: micro-grid architectures, loads, environmental conditions, regular and unplanned events, load control, critical services, infrastructure, etc.

100 kWe + 170 kWt

Exploring technical alternatives

(1) No supplemental heat

(2) Natural gas fired

(3) Biomass fired

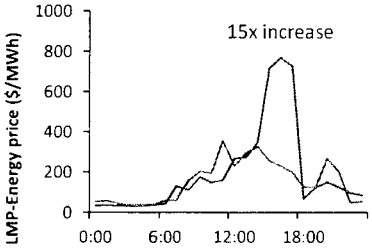
(4) Biogas fired

(5) Thermochemical storage

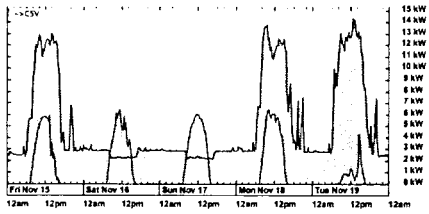
With AORA Solar and US Department of Energy

Dynamic system → adaptive energy management

Manage energy use with respect to continuously changing power price, renewable energy availability, and human behavior

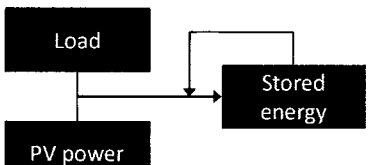


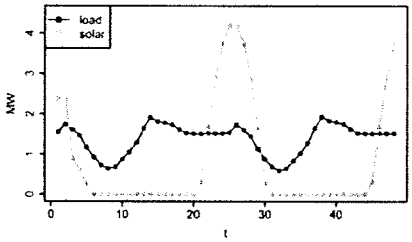
PJM

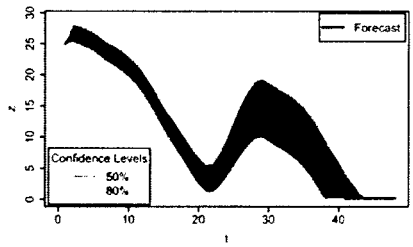


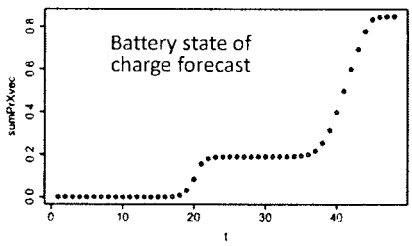
eGauge

Using forecasting to manage critical military loads







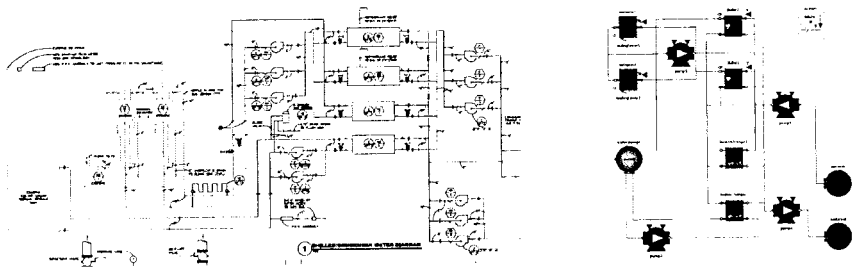


With HOMER Energy and Encorp

Using forecasting to plan cooling schedules

Inputs—inside temps, outside temp, occupancy, historical data, …

Outputs—chiller operation, thermal storage operation, temp set points, …



With SRP and Johnson Controls

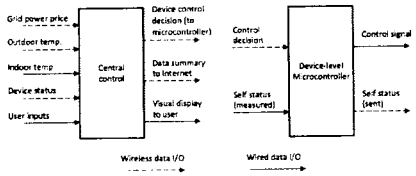
Integrated building energy design and management

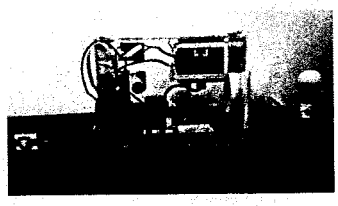
Building design

Thermal system design

Electrical system design

Control system design

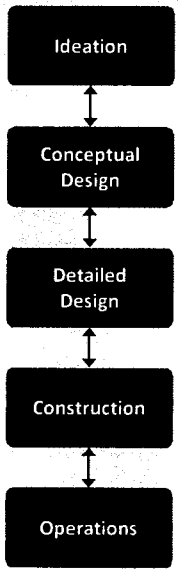




Potential for micro-grid test bed

Foster innovation from circuits to systems

Generation, storage, buildings, micro-grids, conversion technologies, ...



Contact

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Emerging Technologies: The Role of Natural Gas

Workshop on Emerging Technologies

Arizona Corporation Commission

Joe Varela
Manager/Energy Solutions
May 28, 2014

The Role of Natural Gas

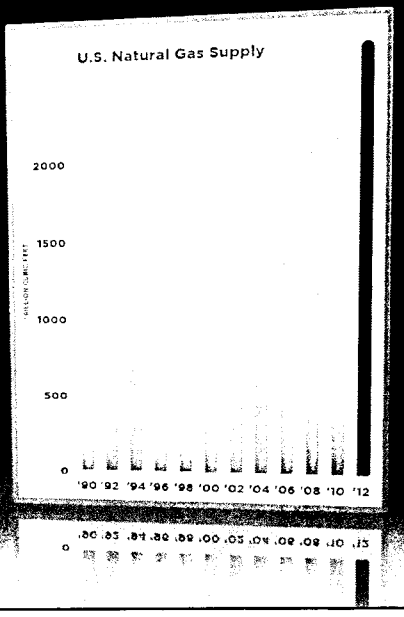
Full Fuel Cycle

Natural Gas Vehicles

Combined Heat & Power

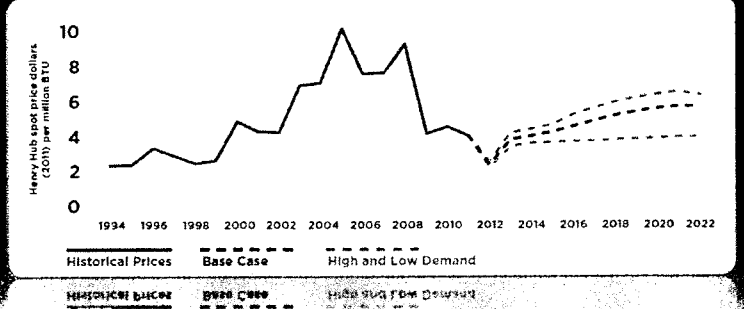
Natural Gas Industry

- US estimated future supply of natural gas stood at 2,718 trillion cubic feet at year end 2012
- Enough natural gas to meet America's diverse energy needs for more than 100 years
- Estimated future supply has more than doubled for the period 1990 - 2012 average

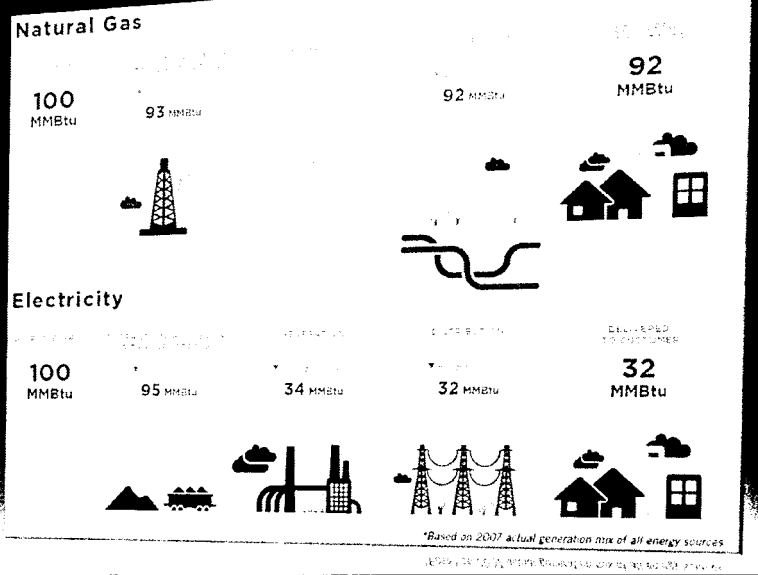


Natural Gas Industry

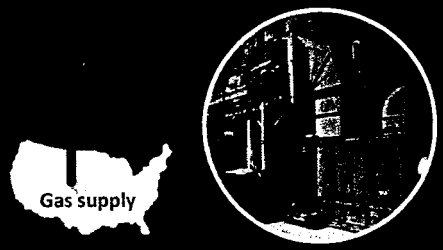
- Production of natural gas has added significantly to North American supplies, resulting in lower and more stable prices for customers
- Estimated prices over the next decade are $4.00 to $6.50 per MMBTu

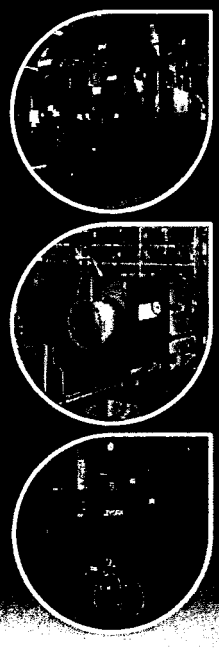


Full Fuel Cycle Efficiency

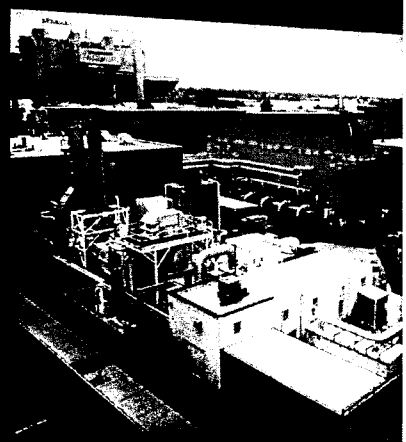


CHP Efficiency





Arizona



University of Arizona	12 MW
Tucson District Energy	1.86 MW
Dunlap Farms	135 KW
Gowan Company	400 KW
Yuma Cogen Associates	55 MW
Clarion Hotel	100 KW
Pima County (pending)	100 KW
Arizona State University	8 MW

Natural Gas Vehicles

Fuel Switching Principles

U.S. Department of Energy

Clean Cities Alternative Fuel Price Report – January 2014

	Nationwide Average Price in Gasoline Gallon Equivalents	*Nationwide Average Price in Diesel Gallon Equivalents*	*Nationwide Average Price in Dollars per Million Btu*
Gasoline	$3.34	$3.73	$28.95
Diesel	$3.49	$3.89	$30.26
CNG	$2.09	$2.33	$18.09
Ethanol (E85)	$4.29	$4.79	$37.22
Propane	$4.31	$4.81	$37.35
Biodiesel (B20)	$3.62	$4.04	$31.40
Biodiesel (B99-B100)	$4.22	$4.70	$36.53

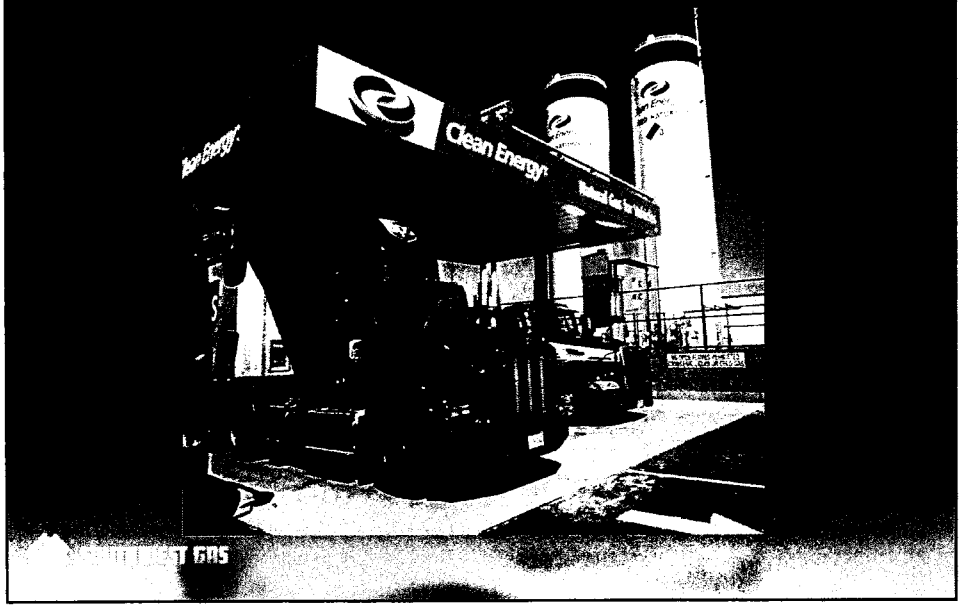
-$1.56

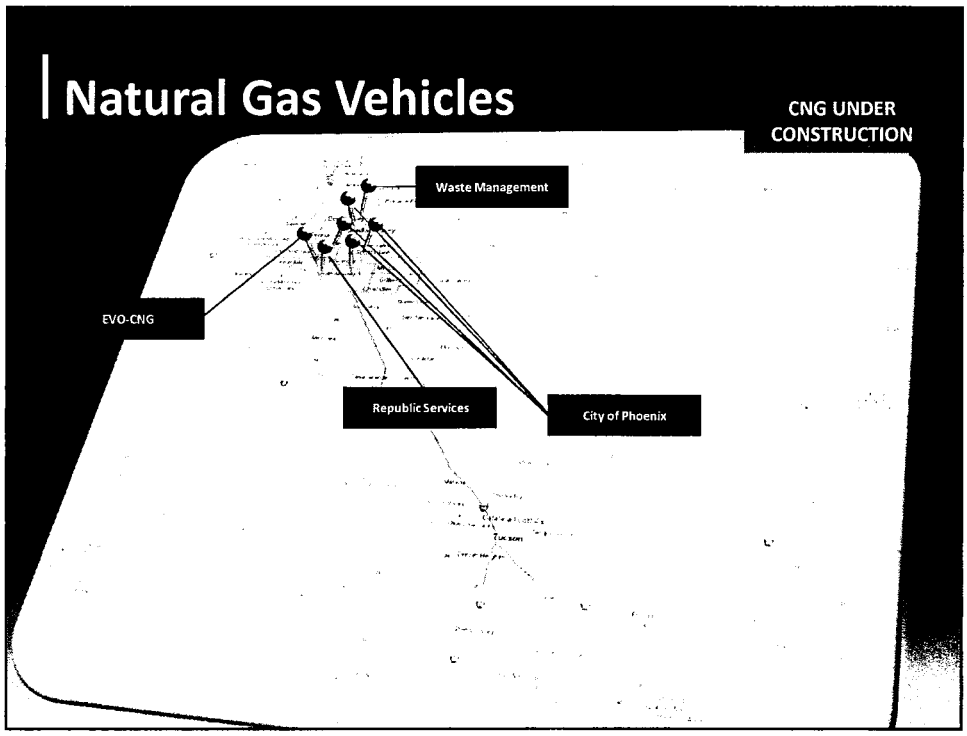
+$0.92

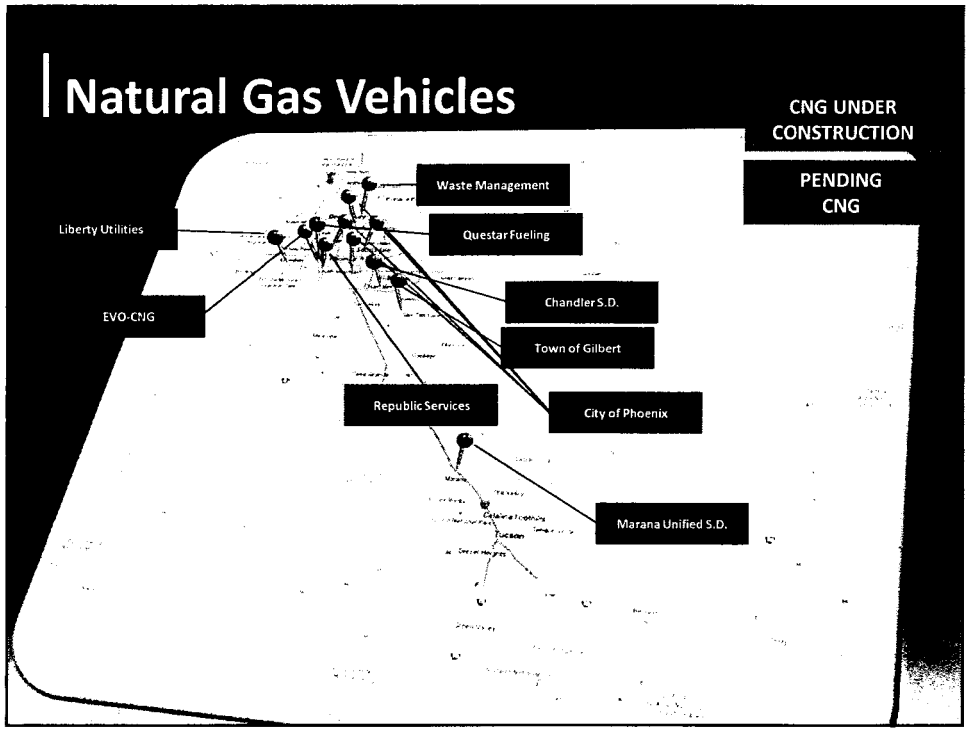
Prices where collected from public and private refueling stations throughout the country between January 1, 2014 and January 15, 2014.

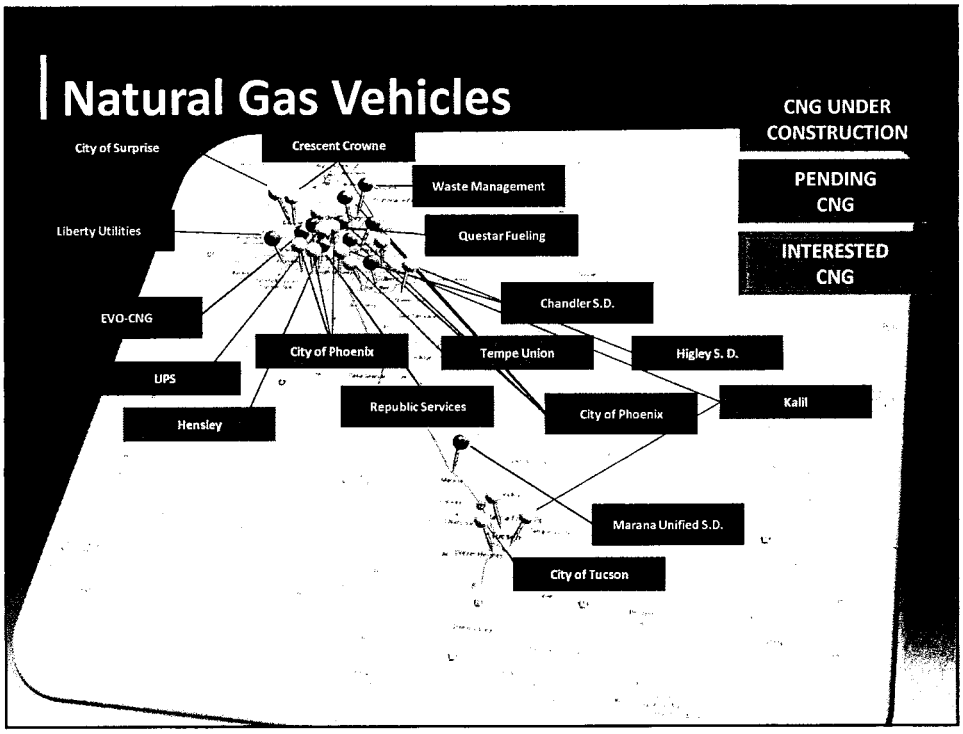
Natural Gas Vehicle Fueling Stations

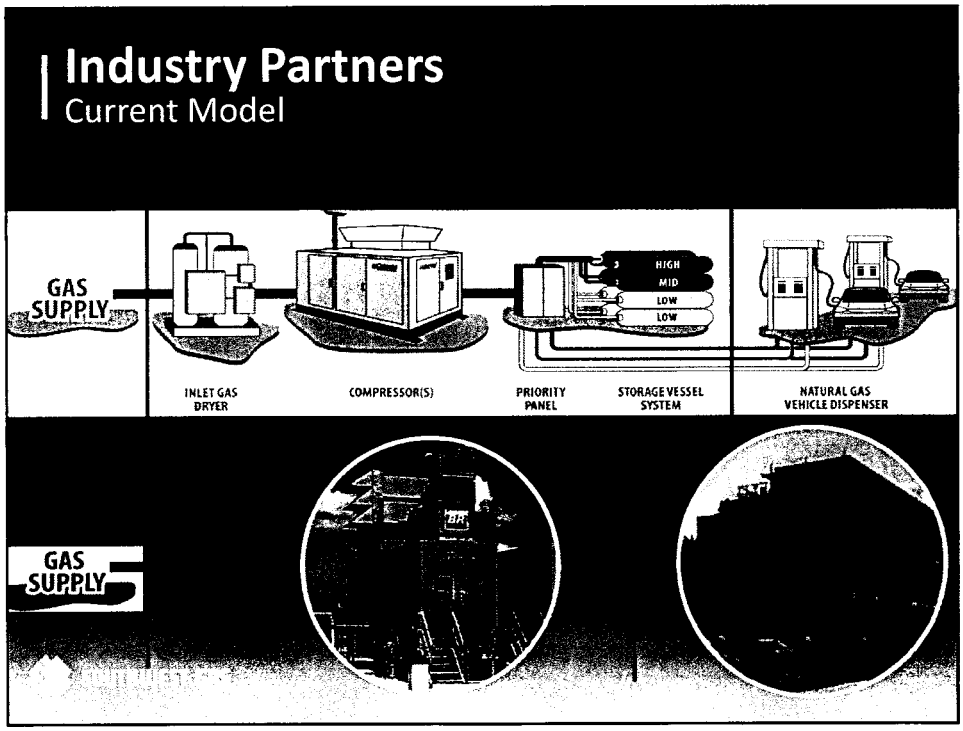
Natural Gas Vehicle Fueling Stations



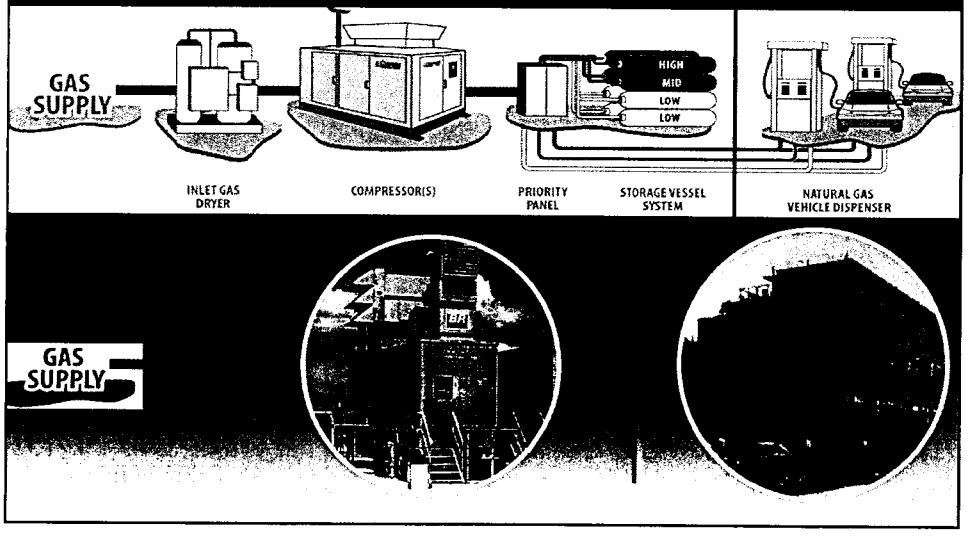

Natural Gas Vehicles
CNG UNDER CONSTRUCTION
Waste Management
EVO-CNG
Republic Services
City of Phoenix


Natural Gas Vehicles
CNG UNDER CONSTRUCTION
PENDING CNG
Waste Management
Liberty Utilities
Questar Fueling
EVO-CNG
Chandler S.D.
Town of Gilbert
Republic Services
City of Phoenix
Marana Unified S.D.


Natural Gas Vehicles
CNG UNDER CONSTRUCTION
PENDING CNG
INTERESTED CNG
City of Surprise
Crescent Crowne
Waste Management
Liberty Utilities
Questar Fueling
Chandler S.D.
EVO-CNG
City of Phoenix
Tempe Union
Higley S. D.
UPS
Republic Services
City of Phoenix
Kalil
Hensley
Marana Unified S.D.
City of Tucson


Industry Partners
Current Model
GAS SUPPLY
HIGH
MID
LOW
LOW
INLET GAS DRYER
COMPRESSOR(S)
PRIORITY PANEL
STORAGE VESSEL SYSTEM
NATURAL GAS VEHICLE DISPENSER
GAS SUPPLY

Industry Partners
Consider



Conclusion

- Southwest Gas has the infrastructure in place to meet the demand from new technologies.
- Natural gas has been and will continue to be an efficient way to meet customer's energy needs.
- Forward thinking policies and the continued development of strategic partnerships between utilities and third parties will benefit customers through the efficient use of energy resulting in a more sustainable community.

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ACC Emerging Technologies Workshop

May 28, 2014

Agenda

- EnerNOC Overview
- Energy Intelligence Software
- Historical DR Applications
- Future DR Applications
- Conclusion and Questions

A Global Demand Response Footprint

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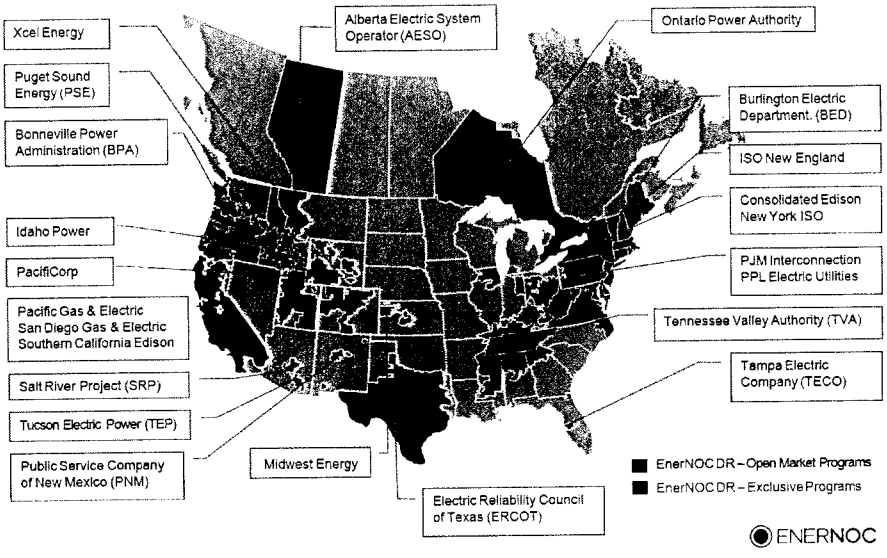
3

EnerNOC Demand Response in North America

We are active in every open DR market with bilateral programs in multiple utility service territories.



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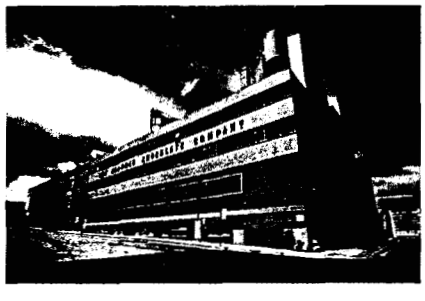
Energy Intelligence Software

Technology is Rapidly Changing How Enterprises Manage Energy

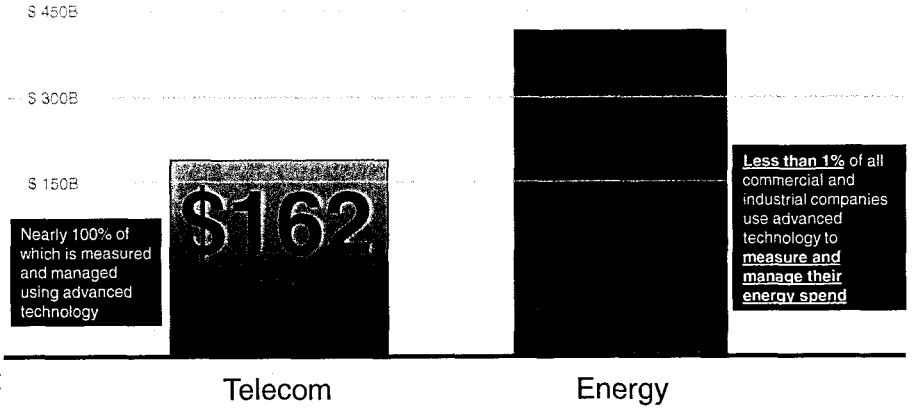


"One thing that I have working for me is people have started to recognize that energy is not rent. It's an actual manageable cost."

-EnerNOC Consumer Products Manufacturing Customer

You can't manage what you can't measure

Advanced technology is in the infancy of being deployed to better manage energy despite the fact that energy represents a significant expense.



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7

Energy Intelligence Software

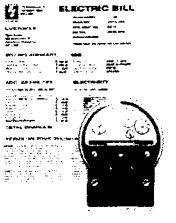
We make organizations better through software that manages the energy cost drivers

1

How you buy it

Buying energy isn't as simple as paying a monthly bill.

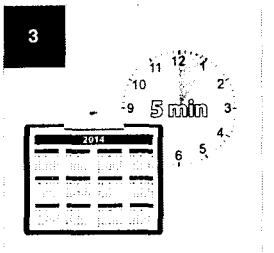
2



How much you use

The cheapest kilowatt hour is the one you don't use.

3



When you use it

Not all kilowatts are created equal.

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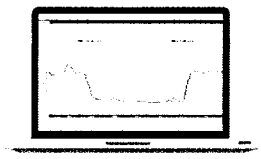
EnerNOC's Approach to Energy Intelligence

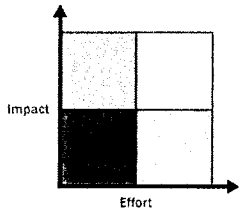
- EnerNOC's approach centers on giving organizations ongoing visibility to make intelligent energy decisions – and drive bottom-line results – because energy intelligence isn't just a one-time project.

GET VISIBILITY



Price data
Usage data
Production data

PRIORITIZE



By ROI
By Ease of Implementation
By Capital Outlay

TAKE ACTION

Start with the quick wins
Build momentum
Reinvest savings

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9

EnerNOC's Energy Intelligence Software

How it is bought	How much is used	When it is used
SupplySMART	EfficiencySMART	DemandSMART
Supply Management Software to help companies procure energy, develop budgets, manage risk and manage their energy positions, supported by advice and purchasing support.	**Visibility and Reporting** Software to track and report to internal and external stakeholders. Includes dashboards, carbon reporting, benchmarking and converting energy to business units.	**Demand Response** Software for reducing real-time demand for electricity by enabling customers to reduce their electricity consumption in response to a market signal.
Utility Bill Management (UBM) Software for tracking, integration with accounts payable software, checking and paying utility bills. Includes basic visibility, error discovery and reporting.	**Facility Optimization** Software for meter analytics and continuous commissioning, supported by a full suite of energy services and implementation support.	**Demand Management** Software to predict and quantify peak demand charges, which make up on average 30% of an organization's energy bill.
	Project Management Software for energy project tracking	

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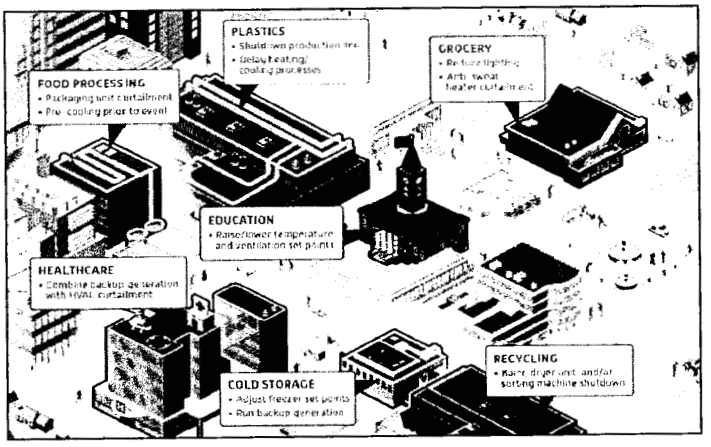
10

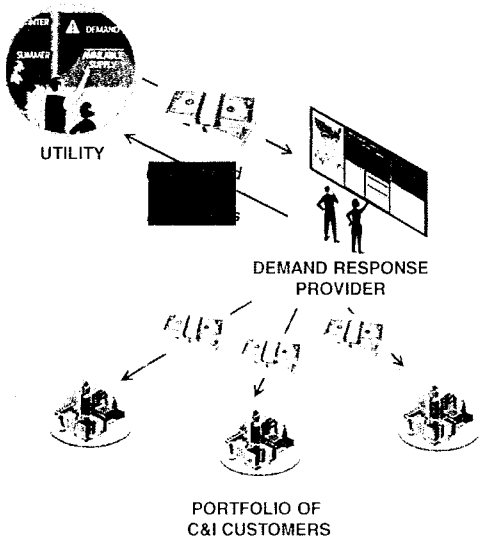
Historical Use of DR

How Demand Response Works

When the electric grid needs resources thousands of facilities across nearly every industry reduce electricity consumption.



The Role of a Demand Response Provider



EnerNOC program features

- **Customized program** designed to **meet utility needs**
- **Guaranteed performance** to utility, while **shielding businesses from penalties** for under-performance.
- Utilities can contribute employee knowledge and customer relationships, while letting EnerNOC staff build and manage the resource
- **Free on-site equipment and customized curtailment plans**
- No new tariff required: One contract with aggregator
- **Utility controls branding and messaging**
- **Dedicated sales and operations staff** in territory

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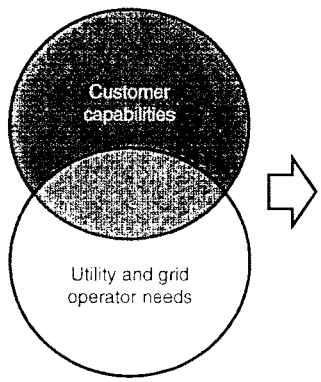
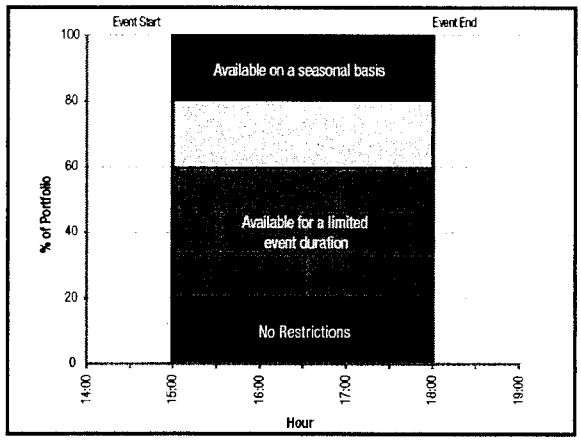
13

DemandSMART: The Value of a Third Party DR Provider

By assembling a portfolio of diverse customers, EnerNOC can provide a firm resource to utilities that has the characteristics of a peaking power plant.





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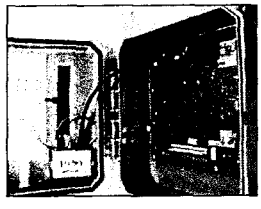
Demand

14

Technology Platform

Demand response technology platforms leverage two-way communication of real-time data, providing a foundation for consistent and reliable resource performance.



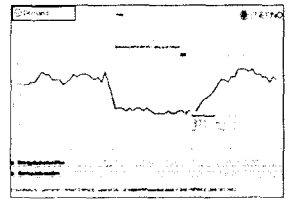
Gateway Device

At customers sites, a gateway device establishes communication with the network and provides near-real time visibility into end-user energy consumption.

The gateway also allows the NOC to remotely curtail loads in order to deliver demand response capacity.

Network Operations Center

The NOC is staffed 24x7x365 and features advanced technology and specialized staff to ensure that load reductions happen quickly, efficiently, and consistently for both the utility and end users.



Energy Management Platform

EnerNOC's web-based energy management platform, DemandSMART, monitors energy consumption and enables end-user load control.

DemandSMART provides end-users and utilities with a web portal for access to near real-time energy usage data and the ability to view load reductions during demand response events.

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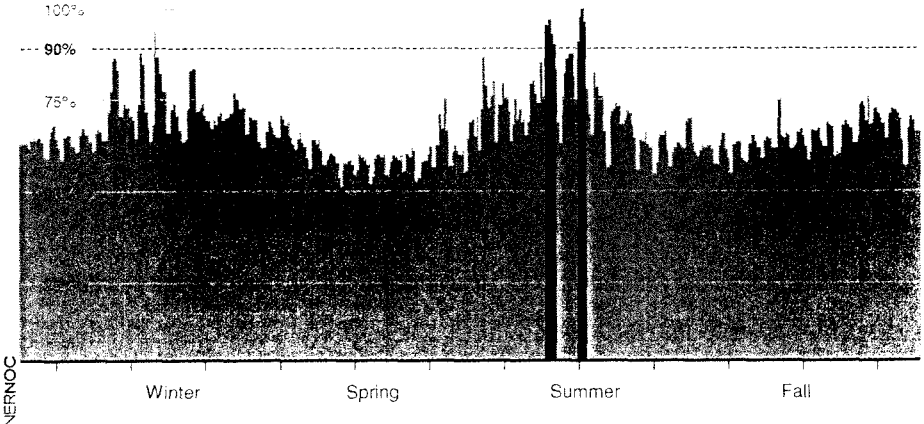
DemandSMART: Comprehensive Demand Response

- Balancing supply and demand on the electricity grid is difficult and expensive. End users that provide a balancing resource are compensated for the service

Annual Electricity Demand As a Percent of Available Capacity



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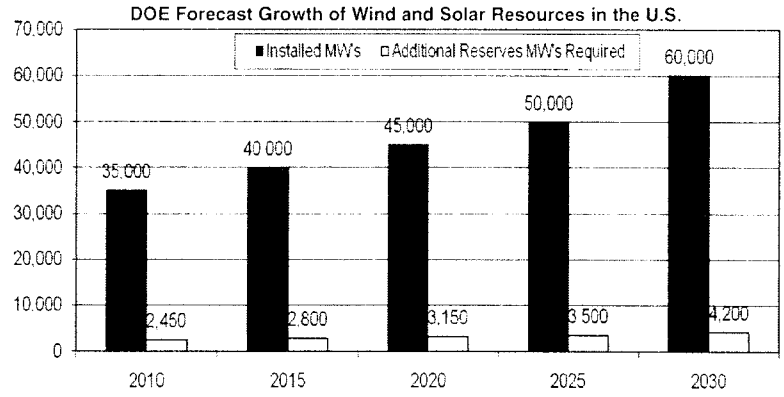
16

Future Uses of DR

Renewable Energy Impact

The growth of renewables requires balancing resources to offset increased intermittency introduced to the system.



Sources: DOE July 2008 - 20% Wind in the US by 2030

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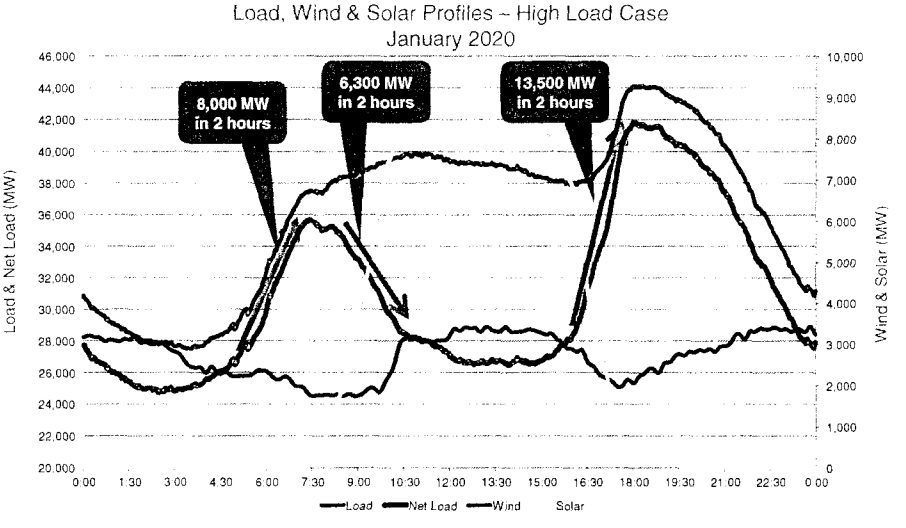
Conventional resources will be dispatched to the net load demand curve – High Load Case



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19

Studies on Operational Impacts of Renewable Integration

Regulatory Assistance Project Study for the Western Governor's Association (June 2012)

- Flexible capacity is one of several operational changes that need to be adopted to efficiently integrate renewable resources
- Expanded balancing area cooperation, including dynamic transfers
- Expand sub-hour dispatch and Intra-hour scheduling
- Improved forecasting of wind and solar
- Commit additional operating reserves
- Build or increase utilization of transmission
- **Target new or existing DR to assist with variability**

- **GE Energy Study for NREL "Western Wind and Solar Integration Study" (May 2010)**

"It is more cost-effective to have demand response address the 89 hours of contingency reserve shortfalls rather than increase spin for 8760 hours of the year. Demand response can save up to $600M/yr ($510M/yr in 2009$) in operating costs versus committing additional spinning reserves."

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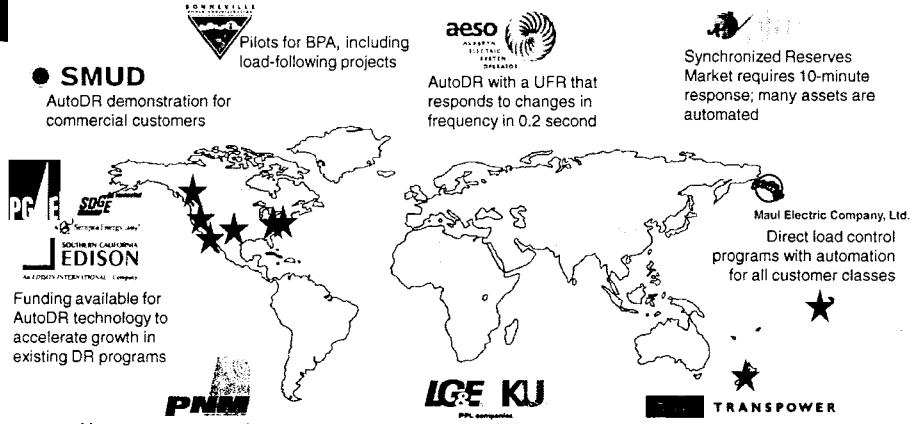
20

LBNL/KEMA June 2012

- AutoDR could provide 180-900 MW of regulation and non-spinning reserves from C&I customers with potential for 420-2,070 MW
  - Require upgrades to ECMS
  - Little research on off-peak and shoulder periods
- 10% of cost of battery storage

"This study suggests that fast automated demand response may help mitigate grid balancing challenges introduced by upcoming increases in intermittent renewable generation resources in an environmentally friendly and cost effective manner." at p. 2.

Examples of Fast Response DR



Pilots for BPA, including load-following projects

SMUD
AutoDR demonstration for commercial customers

AutoDR with a UFR that responds to changes in frequency in 0.2 second

Synchronized Reserves Market requires 10-minute response; many assets are automated

Maui Electric Company, Ltd.
Direct load control programs with automation for all customer classes

Funding available for AutoDR technology to accelerate growth in existing DR programs

Many assets automated to provide 10 min response; qualifies at WECC non-spinning reserves

DR program implemented to accelerate adoption of existing DR tariff

TRANSPOWER
AutoDR resource providing ancillary services with <1 second response time

Balancing Both Spikes *and* Dips in Demand

Case Study: Bonneville Power Administration (BPA) Wind Integration Pilot

EnerNOC is helping BPA use aggregated C&I end use loads to provide a load following resource to mitigate the intermittency of wind power

Pilot Background

- Pace of wind power development in the Pacific Northwest is exceeding BPA's expectations
- BPA has 3,000 MW of wind interconnected today, with 6,000 MW of requests 'in-process' and another 15,000 MW of requests 'in-discussion'
- Given that BPA has a total of 40,500 MW of capacity, this is dramatic penetration for the region

Pilot Parameters

- Direct load control, although customer will have manual override capability, as well as the ability to set specific temperature boundaries
- Loads controlled both up and down
- 24/7/365 resource availability
- Dispatch upon 10 minutes notice
- Maximum 30 minutes per event and 2 events per day
- Minimum 3 hours between events
- Other event limitations may be employed, subject to customer and utility needs

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23

Align Regulatory Policy with Utility and Customer Incentives

Commission:

- In addition to peak management, consider DR for renewable integration purposes
- Consider changes to load shape resulting from energy management services in future IRPs
- Consider incentives for Auto DR

Utilities

- Rules are clear and stable
- Address disincentives to adopt DR and EE
- Recognize efforts

Customers

- Rules are clear and stable
- Make participation easy
- Recognize efforts
- Education and acceptance

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24

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