Smart Meter Fort Collins

Welcome

Big Picture View
   What is a Smart Grid?
     – Dr. Pablo Bauleo (FCL&P)

   A National Perspective
     – Mark Michaels (Enspiria Solutions)

Break
Break continued

The Fort Collins program
Overview of Smart Meter Fort Collins
FortZED: RDSI
  – Dennis Sumner (FCL&P)

What Does it Mean to Me?
  – Gary Schroeder (FCL&P)
Project Vision

High Level aspirations – what does success look like?

“Smart Meter Fort Collins is a key foundation to transform our ability to support, inform, inspire and empower our community.”
Smart Meter Fort Collins

The first step….

a starting point,

a foundation

from which to proceed
Smart Meter Fort Collins

Goals this morning:

Broad overview

Details on Fort Collins

Q&A: Moderated Parking Lot – John Phalen
What is a Smart Grid?

Pablo Bauleo, Ph.D.
Fort Collins Utilities
“On the Origin of the Technologies”

Alexander Graham Bell
1847 - 1922

Thomas Alva Edison
1847 - 1931
Electric Grid

Generation

115 – 230 kV

Transmission

13.2 kV

Distribution

Substation

Customers

← Platte River Power Authority

← Fort Collins Utilities

City of Fort Collins
Outage Impact & Reliability Needs

1960s: Electric clock would be late

1970s: Electronic clock would blink “12:00”

1980-90s: Computers would reboot

2000s: E-Commerce & Stock Markets collapse

Northeast blackout of 2003 ➔ $6 billion loss
Smart Grid

• Smart Grid is a label for a *communication layer* in the electric grid in order to
  
  – Enable **flexibility and automation** of the electric grid
  – Provide real-time feedback to users/utilities
  
  – Capable of reducing energy use by 10% (nationwide)
    • CO₂ reduction equivalent to
      – Remove ~50 millions cars from the roads
      – Plant trees in an area equivalent to Texas

Source: U.S. Department of Energy
Paradigm Shift & New Benefits

Smart Grid Technologies

- Central power generation
- Limited energy storage
- Limited real-time data
- Reactive outage management
- One monthly reading

Customer Benefits

- Distributed generation
- Energy storage devices
- Real-time data
- Proactive outage management
- Detailed billing/usage information

- Improved reliability
- Affordability
- Increased efficiency
- Reduced environmental impact
- Enable customer participation
Smart Grid Vision
Smart Grid Main Areas

The Grid is going from passive to transactive

- **Demand Response**
  - Grid Flexibility (Renewable integration)
  - Residential Energy Management System (HAN)
  - Electric Vehicles
Technologies integrated into Smart Grid

• The communication layer (control) of Smart Grid allows the integration and coordination of
  – Grid Automation
  – Distributed generation (renewables)
  – Energy storage (utility-scale and distributed)
  – Electric Vehicles
  – Real time feedback
  – Smart Home/Smart Business
  – …
Grid Automation

Fault indicator

Remotely operated Pad mounted Switchgear

Power Quality monitoring
Distributed Generation and Storage

“The power industry is like being in an ice-cream business without a refrigerated warehouse”
Utility-size Energy Storage

Flywheel (100 kW – 15 min)

Compressed Air
Alabama,
11,000 houses for 1 day

Sodium Sulfur Battery Bank (1 MW - 6 hs)
Thermal Energy Storage (Distributed)

“Ice-Bear”
Roof-Top Unit A/C
Electric Vehicles

- Tesla Roadster
- Nissan Leaf
- Ford “M”
- Chevy Volt
- GEM e2 Vehicle
Electric Vehicles as Distributed Storage

Electric car has a battery → Vehicle to Grid!
Real Time Feedback

- Empowers customer by providing access to information
- Real time data on energy use and cost of electricity
Smart House

Smart House will be capable of modify power use to adapt to power generation in real time (renewables, cost, etc)

Home Area Network (HAN) enabled via Zigbee, HomePlug or LAN

Integration of
Electric meter
Water meter
Gas meter
In-Home Display
Thermostat
AC/Furnace
Lights
PV/Co-Gen
Electric Vehicles
Washer/Dryer
Dishwasher
...
Smart House for Geeks

“The Big Bang Theory”
CBS TV Show
Season 1 – Episode 9
Smart House for Geeks

“The Big Bang Theory”
CBS TV Show
Season 1 – Episode 9
Smart Grid will benefit from technologies integration but to realize its full potential the users have to embrace it
Smart Meter Fort Collins

Smart Grid: A National Perspective

Mark Michaels – Enspiria Solutions
Why Smart Grid?
Growth of Electronic Device Use

Space Heating & Cooling Use

- Space Heating: 31%
- Space Cooling: 12%
- Water Heating: 12%
- Lighting: 11%
- Computers & Electronics: 9%
- Appliances: 9%
- Refrigeration: 8%
- Other: 9%
Customer Expectations

Why is my bill so high?

How can I reduce my carbon footprint?

How can I lower my energy costs?

WHAT CAN I DO?

Can you show me?

I don’t understand – how many kilo-whats in a dollar?
The Social Context is Changing

- Customer Engagement requires more timely information and knowledge
- Regulators at state and national levels are demanding that utility initiatives support social imperatives
- Social Acceptance, and expectation, of higher utility interaction is forcing new engagement strategies
Regulatory Influences Are Shaping the Future

• US Federal
  – EPAct 2005
  – NARUC, FERC, DOE activities
  – NIST standards
  – ARRA (Stimulus)

State Initiatives:
- California: An early mover that has evolved
- Texas: Additional requirements due to market design
- Pennsylvania & Maryland: Pushing utilities to move forward
American Recovery & Reinvestment Act: 2009

- The Programs:
  - Smart Grid Investment Grants
  - Smart Grid Demonstration Projects

- The Focus: Jobs

- The Deal:
  - Administered by DOE
  - Grants to co-fund projects
  - Detailed metrics monitoring and record keeping
  - Limited time horizon to complete
Smart Grid Projects

represents ARRA-funded smart grid investment grant projects (SGIG)

represents ARRA-funded smart grid demonstration projects (SGDP)

represents non-ARRA funded projects
Selected Smart Grid Grants

Snohomish County PUD  
$16M

SMUD  
$127M

NV Energy  
$138M

Black Hills Energy  
$6M

SRP  
$57M

CoServ  
$17M

City of Fort Collins  
$18M

IPL  
$20M

Exelon  
PECO Energy  
$20M

Pepco Holdings Inc.  
$105M

JEA  
$20M

Westar Energy  
$19M

City of Fort Collins  
$17M

(1) ARRA Awards
Status of AMI Deployments

- A snapshot of North American AMI Projects for utilities with more than 100,000 meters
- Only projects with signed and approved contracts included
- Excludes non-AMI systems
  - Drive-by: tens of millions
  - Fixed Network AMR: 15 million
  - First Generation powerline: 20 million

<table>
<thead>
<tr>
<th>Utility Classification</th>
<th>Available Meters</th>
<th>Meters Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Large (2.5M meters)</td>
<td>42.0M</td>
<td>8.4M</td>
</tr>
<tr>
<td>Large (1M to 2.5M meters)</td>
<td>19.5M</td>
<td>2.9M</td>
</tr>
<tr>
<td>Medium (500K to 1M meters)</td>
<td>6.1M</td>
<td>2.2M</td>
</tr>
<tr>
<td>Small (100K to 500K meters)</td>
<td>2.7M</td>
<td>0.9M</td>
</tr>
<tr>
<td><strong>totals</strong></td>
<td><strong>70.3M</strong></td>
<td><strong>14.4M</strong></td>
</tr>
</tbody>
</table>
Provides the foundation to support

- Smart Appliances
- Plug-in Hybrid Electric Vehicles
- Renewable Energy Sources
- Smart Grid Devices, Theft Detection and Automation
Driving Towards the Smart Grid
Smart Meter Fort Collins

Break!
Smart Meter Fort Collins

Fort Collins Initiatives:

– Smart Meter Fort Collins
– FortZED Jumpstart – RDSI Project

Dennis Sumner  -  Fort Collins L&P
Project Goals

• **Economic**
  – Control operational costs and demand costs

• **Social**
  – Give customers more information so that they can make informed financial decisions.

• **Environmental**
  – Help us meet Energy Policy and Climate Action Plan goals
    • 1.5% energy efficiency
    • Reduce Green House gas emissions
    • Demand reduction 5% by 2015

• **Prepare for the future**
Major Project Areas

1. Advanced Metering Infrastructure and Meter Data Management Systems

2. Distribution Grid Automation

3. Cyber Security

4. Enhanced Demand Response Programs and Customer Engagement
Smart Grid Investment Grant Components

Grant Line Items +++:

- AMI Smart Meters $19.0M #
- Demand Response Systems 5.5M
- Meter Data Mgmt System 2.0M
- CIS Billing System 0.9M
- Cyber Security 0.5M

Subtotal $27.9M

Other Items 3.5M **

Total Grant Proposal $31.4M
## Financial Benefits

### Annual operational savings from AMI

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor and operation expenses for meter reading</td>
<td>$495,755</td>
</tr>
<tr>
<td>Meter accuracy and registration</td>
<td>$347,944</td>
</tr>
<tr>
<td>Theft from manipulation of meters</td>
<td>$268,225</td>
</tr>
<tr>
<td>Load Control (avoided demand during PRPA peaks)</td>
<td>$185,760</td>
</tr>
<tr>
<td>Labor dedicated to move-in / move-out and meter changes</td>
<td>$28,410</td>
</tr>
<tr>
<td>Purchase of Xcel data for rate design</td>
<td>$35,574</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$1,361,668</strong></td>
</tr>
</tbody>
</table>
Financial Benefits

Annual operation savings through SGIG
Enhanced Demand response program $1,074,240

One time benefit
One time savings related to improved cash flow. Reduced lag between meter reads and billing. $1,600,000

Using a 3.5% interest rate the payback is just over 7 years after grant assistance.
Advanced Metering and Meter Data Management

Electromechanical meter

Fort Collins Light & Power currently has 55,000+ in service

New “Smart Meter”
Grid Automation

Fault indicator

Remotely operated Pad mounted Switchgear

Power Quality monitoring
Cyber Security

• Objectives
  • Review Security policies & practices
  • Review standards
  • ID internal and external threats
  • Equipment vulnerabilities
  • Insure customer privacy
  • Comply with Industry Standards
    • National Institute of Standards and Technology (NIST)
    • North American Reliability Corporation (NERC)
    • Critical Infrastructure Protection (CIP)
## Timeline – Administrative

<table>
<thead>
<tr>
<th>Year</th>
<th>Quarter</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Q3</td>
<td>DoE Contract / IGA</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>Appropriation Ordinance</td>
</tr>
<tr>
<td></td>
<td>Q1</td>
<td>Project Execution Plan</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>Cyber Security Plan</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>Customer Response Plan</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>Metrics, Benefits and Risk Plan</td>
</tr>
<tr>
<td>2011</td>
<td>Q1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>Rate Discussion</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Q1</td>
<td></td>
</tr>
</tbody>
</table>
# Timeline – Request for Proposals

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th></th>
<th></th>
<th></th>
<th>2011</th>
<th></th>
<th></th>
<th></th>
<th>2012</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Management/Technical Consultant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AMI/MDMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cyber Security</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*City of Fort Collins*
## Timeline – Major Project components

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **2010**
  - AMI deployment preparation and integration tests
  - MDMS

- **2011**
  - AMI meter deployment
  - Customer Education

- **2012**
  - DRMS
  - Cyber Security

- **2013**
  - Fiber optics installation
  - Distributed Automation
Smart Meters

It isn’t just about the meter! They are important, but…
Beyond Simple Meter Reading Applications

- Advanced billing capabilities:
  - Time of Use,
  - Critical Peak Pricing,
  - Interval Data,
  - Consolidated Billing, etc.
- Customer Engagement (not just data presentment)

- Demand Response
  - Pricing Programs
  - Direct Load Control
- Remote service connect and disconnect
- Outage Information
- Customer Service Enhancement
- Operational Improvements
FortZED – Jumpstart / RDSI

Renewable and Distributed Systems Integration
RDSI

DOE Collaborative Study

• Nine Projects

• Projects are either microgrids or are developing technologies that will advance microgrids

• Objective: To encourage use of distributed resources to provide power during peak load periods and for other functions and services. Minimum 15% reduction in peak load on distribution feeder or substation.

## Project Team

<table>
<thead>
<tr>
<th>Project Lead</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Fort Collins</td>
<td>Thermal Storage, DG, DSM, PHEV-V2G</td>
</tr>
<tr>
<td>Fort Collins Utilities</td>
<td>Utility Company</td>
</tr>
<tr>
<td>Demo Sites</td>
<td>Resource</td>
</tr>
<tr>
<td>City of Fort Collins</td>
<td>Thermal Storage, DG, DSM</td>
</tr>
<tr>
<td>New Belgium Brewing</td>
<td>Solar PV, DG, and DSM</td>
</tr>
<tr>
<td>Colorado State University Facilities</td>
<td>Thermal Storage, DG, and DSM</td>
</tr>
</tbody>
</table>
## Project Team Contd.

<table>
<thead>
<tr>
<th>Tech Partner</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spirae</td>
<td>Smart Grid Platform – DER/Power Management System</td>
</tr>
<tr>
<td>Brendle Group</td>
<td>Demand Management and Program Development</td>
</tr>
<tr>
<td>Colorado State University</td>
<td>Robust Controls and PHEV R&amp;D</td>
</tr>
<tr>
<td>Advanced Energy</td>
<td>Photovoltaic Inverter</td>
</tr>
<tr>
<td>Woodward Governor</td>
<td>Power Management and Mixed Fuel R&amp;D</td>
</tr>
<tr>
<td>Eaton</td>
<td>Switchgear/Power Components and Small Generator Switchgear R&amp;D</td>
</tr>
<tr>
<td>InteGrid</td>
<td>Platform for Controls R&amp;D, DER Integration and Simulation</td>
</tr>
</tbody>
</table>
Project Operational Structure

DOE

City of Fort Collins

DOE Accountability Issues

Executive Committee
Meets Monthly

Partner Issue Resolution

Brendle Group
- Julie Sieving
- Steve Brunner

City of Fort Collins
- Dennis Sumner

Spirae
- Nathan Howard
- Jeff Harrell

Project Management Team
Meets Weekly

Operations Team
Meets Quarterly

Operations Team

R&D Projects

CSU
Eaton
InteGrid
Spirae
Woodward

Larimer County
City of Fort Collins
CSU Facilities
InteGrid
New Belgium Brewery

Brendle Group provides quarterly reports and advice on Demand Side Management (DSM)

City of Fort Collins
RDSI

Project Video

www.FortZED.com

Select: FortZED Jumpstart Project Video
Smart Meter Fort Collins
What does it mean for you and your business?

Gary Schroeder
Energy Services Engineer
Fort Collins Utilities
What’s the landscape?

- Changing electric rate structures?
- Environmental issues
- City policies
  - Climate Action Plan
  - Energy Policy
  - Water Policy
- Lots of information from the smart grid
First - some background

Demand (how fast)
- 1,000 Watts = 1 kilowatt (kW)
- Relates to infrastructure – wires, switches, transformers, etc.

Energy (how much)
- 1 kW x 1 hour = 1 kilowatt hour (kWh)
- Relates to fuel – coal, natural gas, etc. (and therefore Carbon Dioxide & other emissions)
Current Rates

• **Energy**
  – Fixed $/kWh (residential)

• **Facilities Demand** (not time dependent)
  – Energy + $/kW charge (residential & small commercial)

• **Coincident Peak** (time dependent)
  – Energy + Facilities Demand + Coincident Peak charge (large commercial & industrial)

• **Water is Tiered**
New Rates???

- Time-of-Use (TOU)
  - Different prices at different times of the day
- Critical Peak Price (CPP)
  - Very high “critical peak” prices for certain hours on event days
- Peak Time Rebate
  - Like a CPP without TOU, but only one direction – Customer can get credit for load reduction, but no penalty if load increases
- Coincident Peak?
Time-of-Use Rate

Planned electricity rates from Toronto Hydro

The electricity utility will soon charge different rates throughout the day. The following is for weekdays between May 1 and Oct. 31 (based on May 14 rates):

- **Low rate:** 10 p.m. to 7 a.m.
- **Mid rate:** 7 a.m. to 11 a.m./5 p.m. to 10 p.m.
- **High rate:** 11 a.m. to 5 p.m.

<table>
<thead>
<tr>
<th>Time</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>12am</td>
<td>4.2 c/kWh</td>
</tr>
<tr>
<td>7am</td>
<td>7.6 c/kWh</td>
</tr>
<tr>
<td>11am</td>
<td>9.1 c/kWh</td>
</tr>
<tr>
<td>5pm</td>
<td>7.6 c/kWh</td>
</tr>
<tr>
<td>10pm</td>
<td>4.2 c/kWh</td>
</tr>
</tbody>
</table>
Existing “Smart” elements

• Automated meter reading - Electri-Connect
  – 15-minute data – day after
• Voluntary Load Management Program – since 1982
  – Residential ( about 3 MW controlled)
  – Commercial ( about 2 MW controlled)
  – Saved $6 Million in purchase power cost since 1982
ElectriConnect

Customer Information
Name: City FC/281 N.Coll.
Address: 281 N. College Ave.
   Fort Collins, CO
Acct. No: 
Meter No: 

Wed Aug 25 2010 to Fri Sep 24 2010
Total Usage: 27,174.47 KWH
Max Demand: 106.61 KW
Occurred On: Aug 26 2010 14:30
Load Factor: 35.330%
Date Range: Aug 25 To Sep 24

KW (channel: 1  Set: 1)

Daily Peaks

Sat Sep 18 2010 02:45 = 21.12
Load Management Program
Basic customer elements

- Web portal, handheld devices
- In-home/In-business display (IHD)
- Programmable Communicating Thermostat (PCT)
- Gateway/Energy Management System (EMS)
- “Smart” plugs
- “Smart” appliances
- Load switches
Web Portal

What does it do?
- How and when you are using electricity
- Estimate monthly bill
- Look up electricity use history
- Get notifications (web &/or email)
- Understand your rate
- Compare your use to peers
- Advanced – program in-home devices
You are on a time of use rate plan with critical peak pricing.

How it works
The price you pay for energy varies by time of day and from weekday to weekend.
- Heaen fermentum, ut eget locustum coniunctum, eris.
- Pelentesque habitant mortis In quo.
- Lorem ipsum dolor sit amet, consectetur.

$.16 Average price
per kWh used

This bill your total energy costs are $95

Your usage this bill by time period
Costs are based on average usage.
- Critical Peak: $14
- Off Peak: $51
- On Peak: $74

What does this mean?

Description of graph above
Baseline is a measurement of the minimum amount of electricity your house requires to operate. Many devices in your home use energy twenty-four hours a day even when they are left on or are designed to operate that way. Reducing your baseline even small amounts can result in big savings over the course of weeks and months.

Helpful actions, tips or graph here
Cost is reduced. Quisque est odio. Quisque sit amet, erat ac facilisis nec, lobortis sed, accumsan.
This bill your carbon impact is 65 metric tons of CO₂

How do I compare to my neighbors?
You spend 10% more than similar neighbors. Aequan
officiis non, ea iac
temperaturam est et iustitia condimentum, eram ipsum
naturum omn, sagittis tempus lacus enim ac du.

What is ‘carbon impact’
and why should I care?
Sed do eiusmod tempor incididunt ut labore et
dolor in reprehenderit in voluptate velit
esse cillum dolore eu fugiat

Understand your carbon impact

Your total CO₂ use is equal to these activities
These activities result in the same amount of CO₂ generated.

25
Cross-country
36 Projected
Rights

1,206
100W Light bulbs
1,446 Projected

1,478
Miles driven in
1,890 Projected
a mid-size sedan

120
Trees are needed
to offset your CO₂

What does this mean?

Description of graph above
Baseboard is a measurement of the minimum amount of electricity your house requires to operate.
Many devices in your home use energy twenty-four hours a day even when they are turned on or
are in sleep mode. Reducing your baseboard even small amounts can result in big savings over the course of weeks and months.

Helpful actions, tips or graph here
Cras sed ante. Phasellus in massa. Curabitur dolor eros, In
nunc habitasse platea dictumst. Cras eu mauris. Quisque
lacinia. Donec ipsum. Nullam vitae sem at nunc pharetra
ultrices. Vivamus elit eros, ullamcorper a, adipiscing sit.
In-Home (In-Business) Display (IHD)

Sources: Comverge, AzTech, Blueline, Precision Data, HAI, LS Research, Tendril, The Energy Detective, Onzo, Landis+Gyr
Digital Frame Touch Activated

Source: LS Research
Programmable Communicating Thermostat (PCT)
Home Area Network (HAN) / Energy Management System (EMS)
Gateway / Energy Management System
Critical Peak Pricing Event

Due to critical stress on the grid, electricity is currently very expensive. To save you money, your thermostat has been set 4° higher. It will return to normal once this event is over. You may override the energy saving mode immediately by pressing the “Opt Out” button below.

Opt Out  Okay

Power Use Last 24 Hours

Using Now 1385 W
Price Now $0.29/kWh
Peak Estimated
Smart Appliances
Other Opportunities

- Thermal Energy Storage (TES)
- Electric heat storage
- Pumps
- Spas
- Commercial EMS
Thermal Ice Storage
Electric Heat Storage
Load Switch

- Water heaters
- Pumps
- Spas
Commercial EMS

- Receive price signals
- Initiate load shedding routines
Electric vehicles are on the way
Typical PRPA Daily Load Profiles

[Graph showing load profiles for Summer and Winter]
# Charge times and loads

<table>
<thead>
<tr>
<th>Charge Level</th>
<th>Voltage</th>
<th>Power Draw</th>
<th>Charge Time</th>
<th>Equivalent to</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>120 V</td>
<td>1.5 kW</td>
<td>24 hours</td>
<td>Space heater, Hair dryer</td>
</tr>
<tr>
<td>2</td>
<td>240 V</td>
<td>6.5 kW</td>
<td>4 hours</td>
<td>Clothes dryer, Electric Range</td>
</tr>
</tbody>
</table>
Renewables Integration
Conclusion

- Smart meters will facilitate customers having more control over their electricity and water use.
- Baby steps
  - Web portal
  - In-home display, Programmable Communicating Thermostat
  - Energy Management System with load control
  - Electric vehicle charging
  - Commercial applications
Smart Meter Fort Collins

Questions
Smart Meter Fort Collins
Smart Meter Fort Collins

Presentation Reference Materials
Financial Benefits

Annual operational savings from AMI

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor and operation expenses for meter reading</td>
<td>$495,755</td>
</tr>
<tr>
<td>Meter accuracy and registration</td>
<td>$347,944</td>
</tr>
<tr>
<td>Theft from manipulation of meters</td>
<td>$268,225</td>
</tr>
<tr>
<td>Load Control (avoided demand during PRPA peaks)</td>
<td>$185,760</td>
</tr>
<tr>
<td>Labor dedicated to move-in / move-out and meter changes</td>
<td>$28,410</td>
</tr>
<tr>
<td>Purchase of Xcel data for rate design</td>
<td>$35,574</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$1,361,668</strong></td>
</tr>
</tbody>
</table>
Financial Benefits

Annual operation savings through SGIG
Enhanced Demand response program $1,074,240

One time benefit
One time savings related to improved cash flow. Reduced lag between meter reads and billing. $1,600,000

Using a 3.5% interest rate the payback is just over 7 years after grant assistance
Grid Automation

Source 1 breaker opens

Source 1

Switch 1
- Normally Closed

Switch 2
- Normally Closed

Switch 3
- Normally Open

Switch 4
- Normally Closed

Switch 5
- Normally Closed

Feeder Fault Occurs!

Feeder Fault Isolated.

Source 2