

Advanced Metering Infrastructure (AMI)

Overview of System Features and Capabilities

Chris King
Co-Chair
DRAM Coalition

January 6, 2005


DRAM Coalition Members

- ❖ Alliance to Save Energy
- ❖ Capgemini
- ❖ DSCI
- ❖ Echelon
- ❖ Elster Electricity
- ❖ eMeter
- ❖ EMON/MeterSmart
- ❖ Hunt Technologies
- ❖ Landis+Gyr
- ❖ Northeast Energy Efficiency Council
- ❖ Silver Spring Networks
- ❖ SmartSynch
- ❖ Tantalus Systems

Today's Presentation

- 1. Overview of metering technologies**
- 2. Benefits and costs**
- 3. Status of deployment**
- 4. Closing comments**

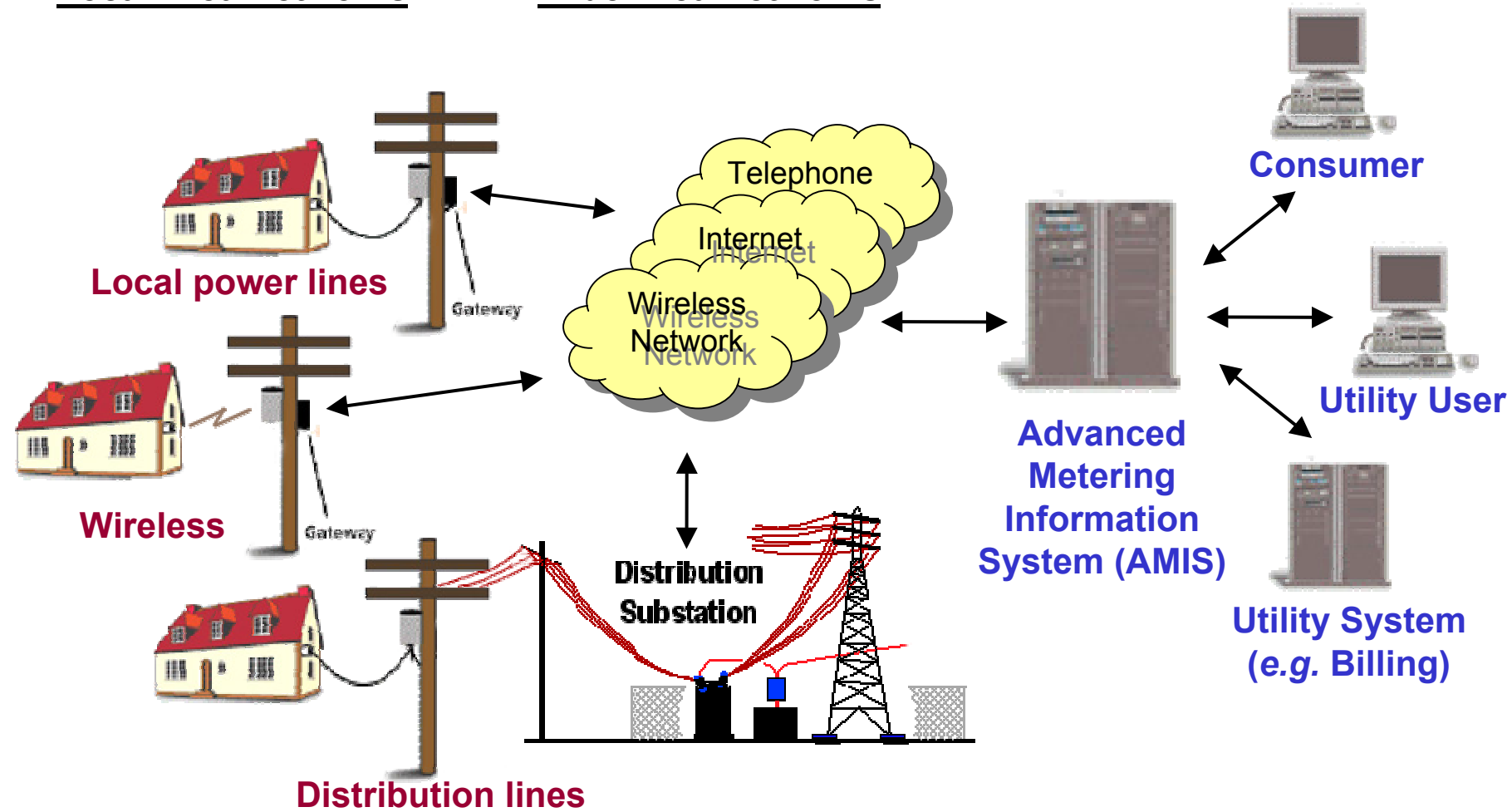
Metering Technologies

System Element/Feature	Manual	Automatic Meter Reading (AMR)	Advanced Metering Infrastructure
Meters	Electromechanical	Hybrid 	Hybrid or solid-state
Data collection	Manual, monthly	Drive-by, monthly	Remote via communications network, daily or more often
Data recording	Total consumption	Total consumption	Time-based (usage each hour or more often)
Primary applications	Total consumption billing	Total consumption billing	Pricing options Customer options Utility operations Emergency demand response
Key software interfaces	Billing and customer information system	Billing and customer information system	Billing and customer information system Customer data display Outage management Emergency demand response
Additional devices enabled (but not included in base infrastructure)	None	None	Smart thermostats In-home displays Appliance controllers

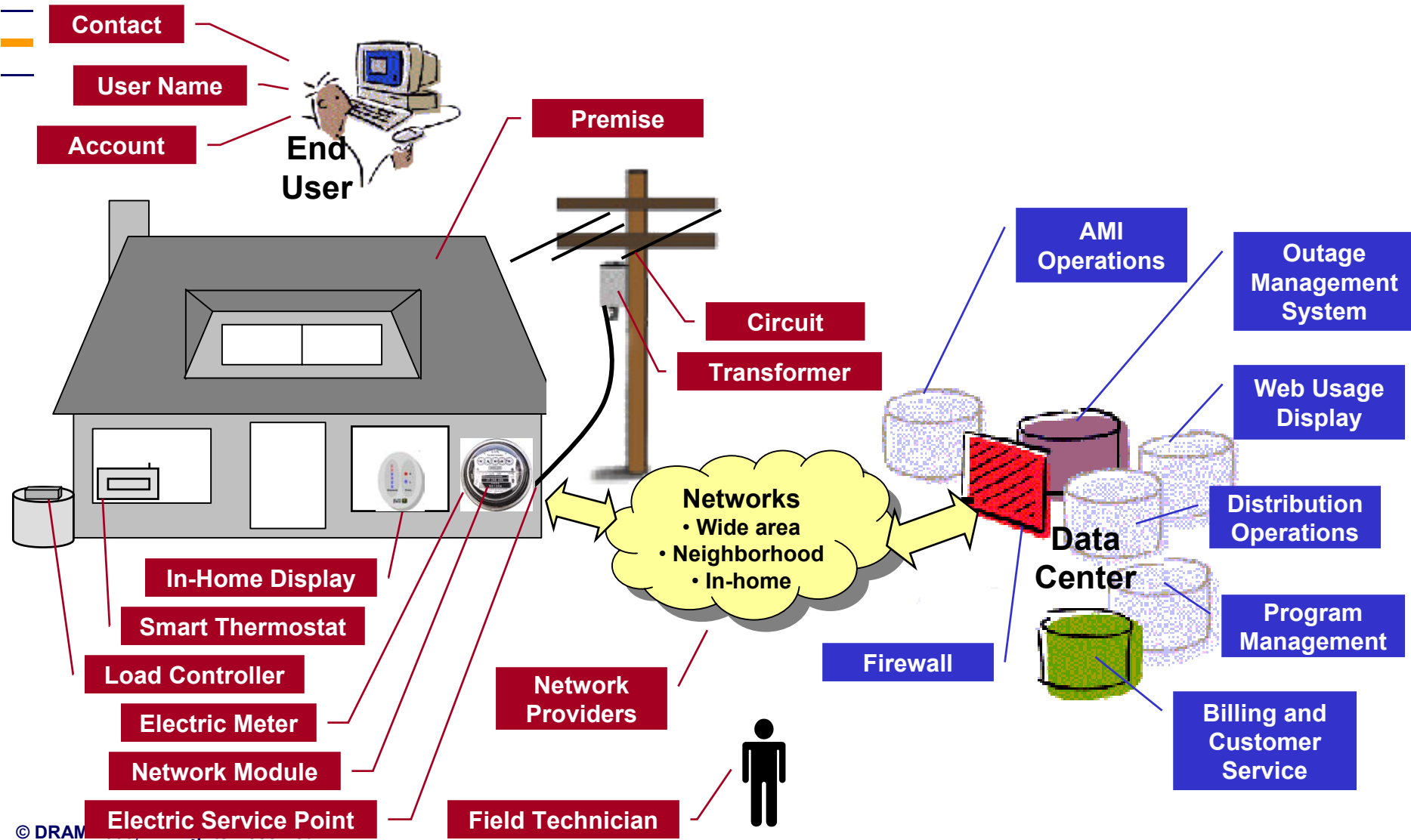
AMI Communication Networks

Local Area Networks

Wide Area Networks

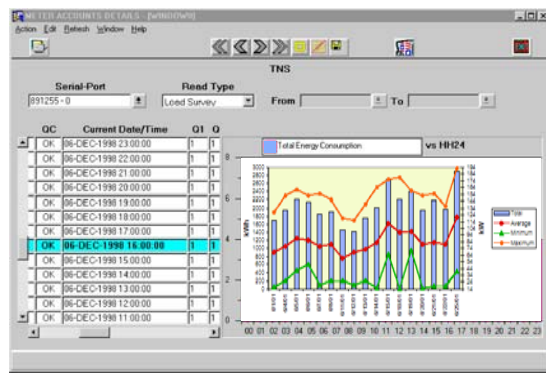
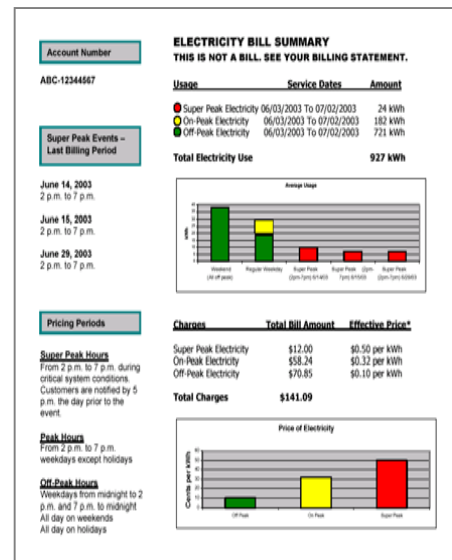


AMI Data and Software Relationships



Metering System Applications

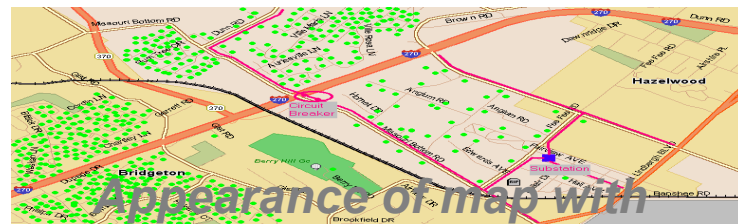
	Manual/AMR	AMI
Pricing	Total consumption only	Total consumption Time-of-use Critical peak pricing Real-time pricing
Other demand response	None	Load control Demand bidding Demand reserves Critical peak rebates
Customer feedback	Monthly bill	Monthly bill Monthly detailed report Web display In-home display
Customer bill savings	Turn off appliances manually	Turn off appliances Shift appliances off peak Manual or automatic control
Outages	Customer phone calls	Automatic detection Verification of restoration at individual home level
Distribution operations	Use engineering models	Dynamic, real-time operations



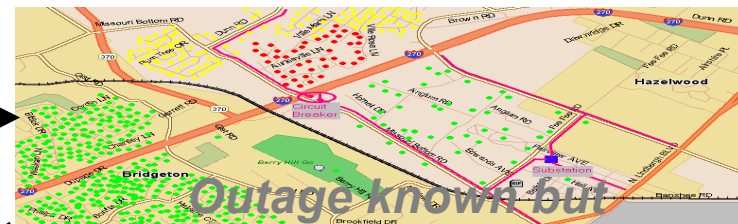
New Utility Capabilities Enabled by AMI

Service	New Capabilities Enabled
Power Quality	Meter-level voltage monitoring
Distribution Automation	Load balancing Capacitor bank switching* Regulator and tap changer monitoring* Transformer load management Automated outage management

* - requires additional devices

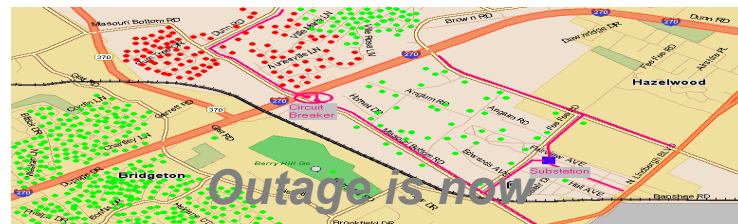


Appearance of map with normal power status

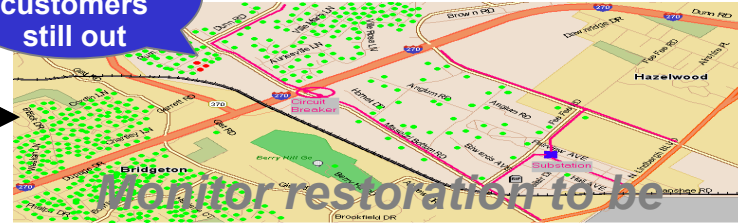


Outage known but not yet fully mapped

Individual customers still out



Outage is now fully mapped

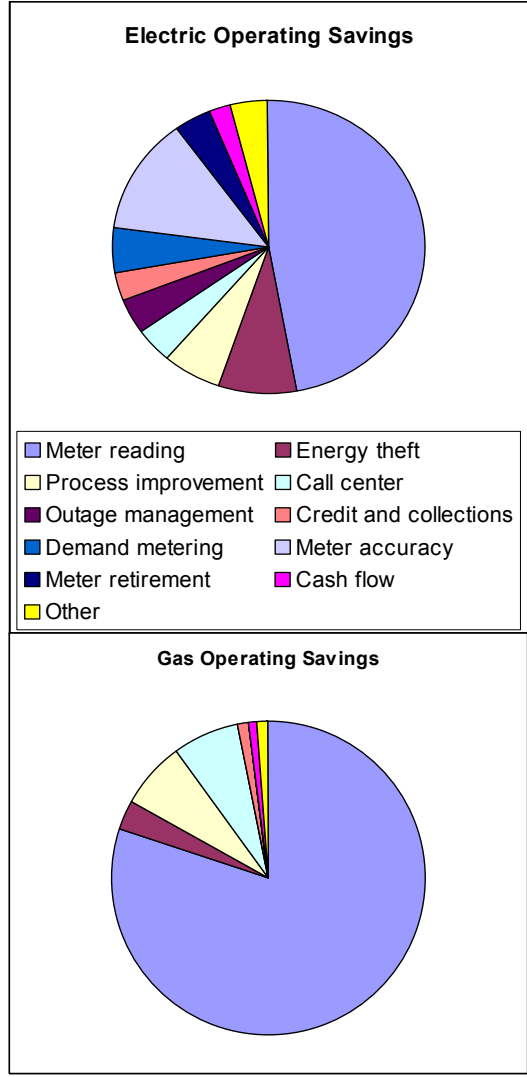


Monitor restoration to be sure power is fully restored

Benefits – Utility Operations

Puget Sound Energy Example

Source	Share of benefits	
	Electric	Gas
Meter reading	47%	80%
Energy theft	8%	3%
Process improvement	6%	7%
Call center	4%	7%
Outage management	4%	0%
Credit and collections	3%	1%
Demand metering	5%	0%
Meter accuracy	13%	0%
Meter retirement	4%	0%
Cash flow	2%	1%
Other	4%	1%
TOTAL	100%	100%

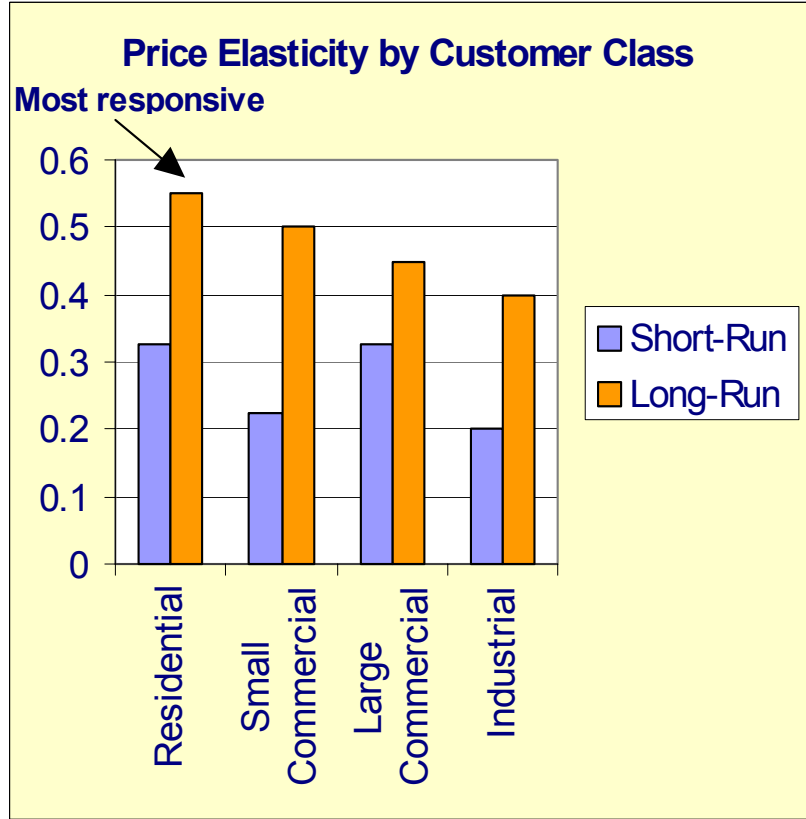


PSE Payback: **Operations Only = 9 years**
 Operations w/TOU = 5 years

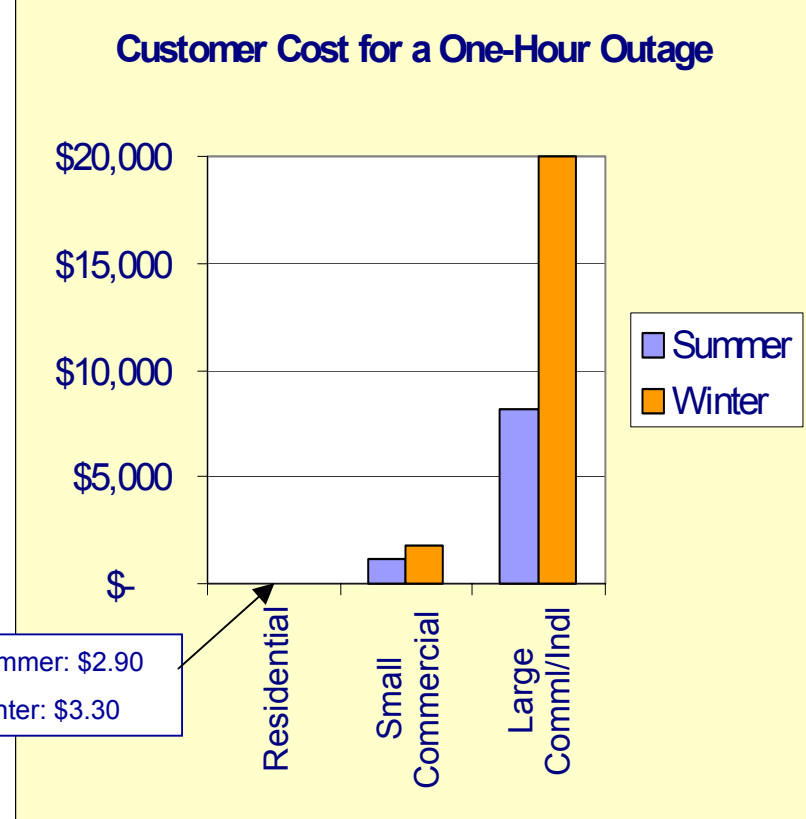
Customer Service Benefits of AMI (Basic)

Service	New Options Supported
Billing	<ul style="list-style-type: none"> <input type="checkbox"/> Choice of billing date <input type="checkbox"/> No estimated bills <input type="checkbox"/> Month-to-date bill <input type="checkbox"/> Projected month-end bill
Pricing	Choice of flat rates or dynamic pricing
Outage handling	Automatic response and restoration verification by utilities
Usage information	<ul style="list-style-type: none"> <input type="checkbox"/> Real-time meter read <input type="checkbox"/> First call problem resolution <input type="checkbox"/> Web data access <input type="checkbox"/> Monthly detailed usage reports <input type="checkbox"/> Baseline threshold alarms <input type="checkbox"/> Month-to-date usage <input type="checkbox"/> Daily or hourly data for customer education

Electricity Consumers



Source: California Energy Commission, 2003



Source: Department of Energy, 2003

AMI Costs in Volume

- 1. Meter with Communications Module: \$50-400**
 - New vs. retrofit
 - Residential/small commercial vs. large commercial
- 2. Meter installation: \$10-200**
 - Residential/small commercial vs. large commercial
 - Primary variable is "drive time" (universal vs. scattered deployment)
- 3. Local Area Network Node: \$2-50 per meter**
 - At premise vs. pole top vs. substation
 - Primary variables are network type and number of meters connected
- 4. Wide Area Network: \$10 per LAN node per month**
 - Public vs. private network
- 5. Data Center: \$0.25 to \$5 per meter per month**
 - Advanced Meter Information System (AMIS) software
 - Staffing, facilities, servers, and other operations & maintenance
 - Startup and base monthly cost
- 6. Field Equipment Operations & Maintenance: \$1 per meter-mo**
 - Meters
 - Local Area Network nodes
- 7. Overheads: 10-20%**
 - Administrative & general
 - Financing costs for capital investments



AMI Costs Case Study

- ❖ Summary of data collected in several U.S. utility procurements
- ❖ Independent consultant compared total capital cost and operating benefits of automating meters
- ❖ Technologies
 - ❑ Vendors with proven installations
 - ❑ Multiple technologies considered
- ❖ Average all-in capital cost: **\$107**

Major AMI Installations

Utility	Type	Technology	Quantity	Install Completed
U.S.				
Kansas City Power & Light (MO)	Electric	Wireless	400,000	1996
Duquesne Light (PA)	Electric	Wireless	580,000	1998
Ameren (MO)	Electric & Gas	Wireless	1,400,000	1999
Xcel Energy (MN)	Electric & Gas	Wireless	1,400,000	1999
Puget Sound Energy (WA)	Electric & Gas	Wireless	1,500,000	2000
United Illuminating (CT)	Electric	Wireless	320,000	2000
Indianapolis Power & Light (IN)	Electric	Wireless	470,000	2000
Exelon (PA)	Electric & Gas	Wireless	2,100,000	2002
Wisconsin Public Service (WI)	Gas	Wireless	200,000	2003
Wisconsin Public Service (WI)	Electric	Distribution line carrier	650,000	2004
PPL (PA)	Electric	Distribution line carrier	1,300,000	2004
JEA (FL)	Electric & Water	Wireless	600,000	2005
WE Energies (WI)	Electric & Gas	Wireless	1,000,000	2005
Hundreds of Small Utilities	Electric & Gas	Various	5,000,000	2004
International				
ENEL (Italy)	Electric	Power line carrier	30,000,000	2005
PREPA (Puerto Rico)	Electric	Distribution line carrier	1,400,000	2006
Sweden	Electric	Wireless & power line carrier	5,200,000	2009
Ontario (Canada)	Electric	To be determined	5,000,000	2010
Victoria (Australia)	Electric	To be determined	2,500,000	2013

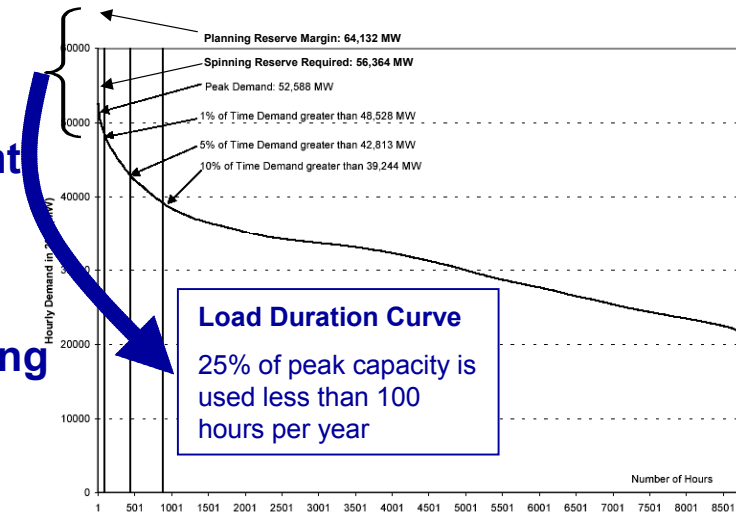
Regulatory Policy Activity

❖ U.S.

- ❑ California utilities filing 100% deployment plans with CPUC on March 15, 2005
- ❑ Commissions have explicitly approved utility cost recovery for advanced metering in several states

❖ International

- ❑ Italy is 2/3 complete with 100% deployment to 30 million customers
- ❑ Sweden has begun 100% deployment, to be completed in 2009
- ❑ Ontario, Canada has mandated 100% “smart meter” deployment to begin in 2006 and be completed in 2010
- ❑ Victoria, Australia has mandated 100% deployment to large businesses by 2008 and all customers by 2013



Cost Recovery Options

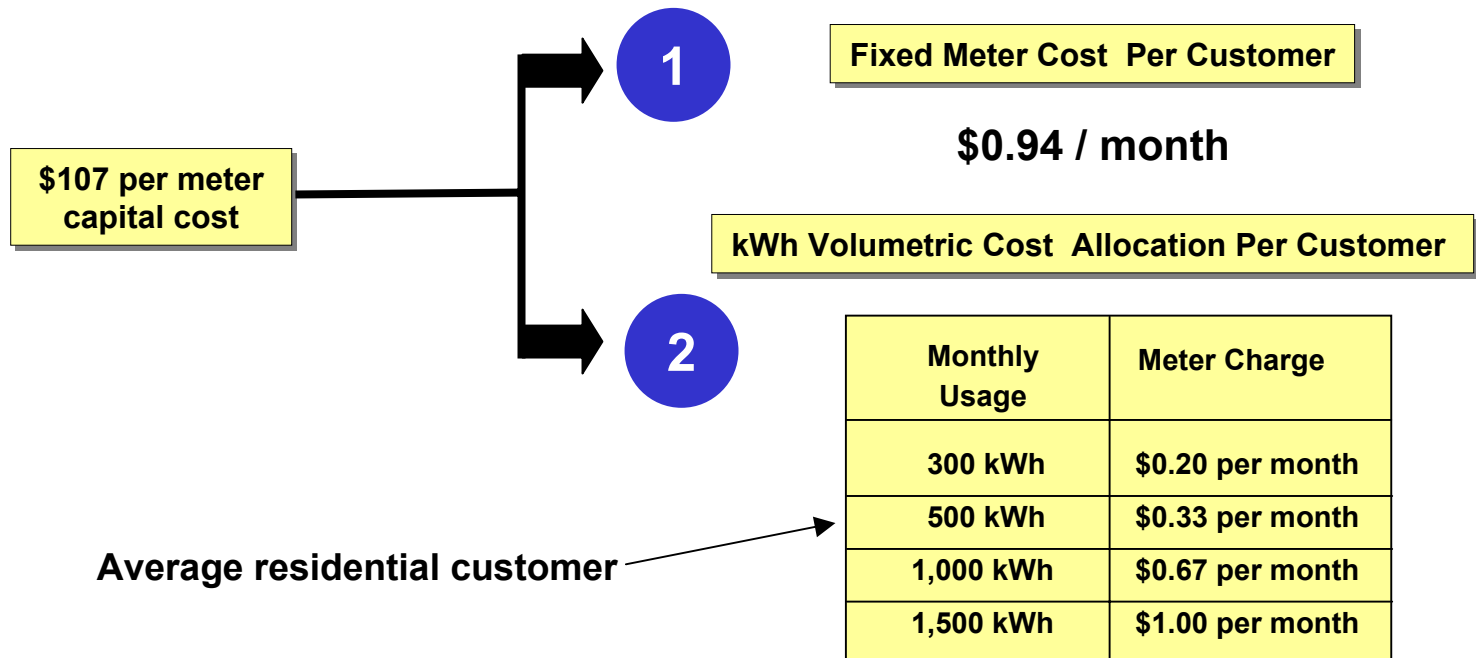
PROBLEM

Fixed charges disproportionately impact low use customer bills.

SOLUTION

Consider a 'volumetric' kWh based cost allocation method.

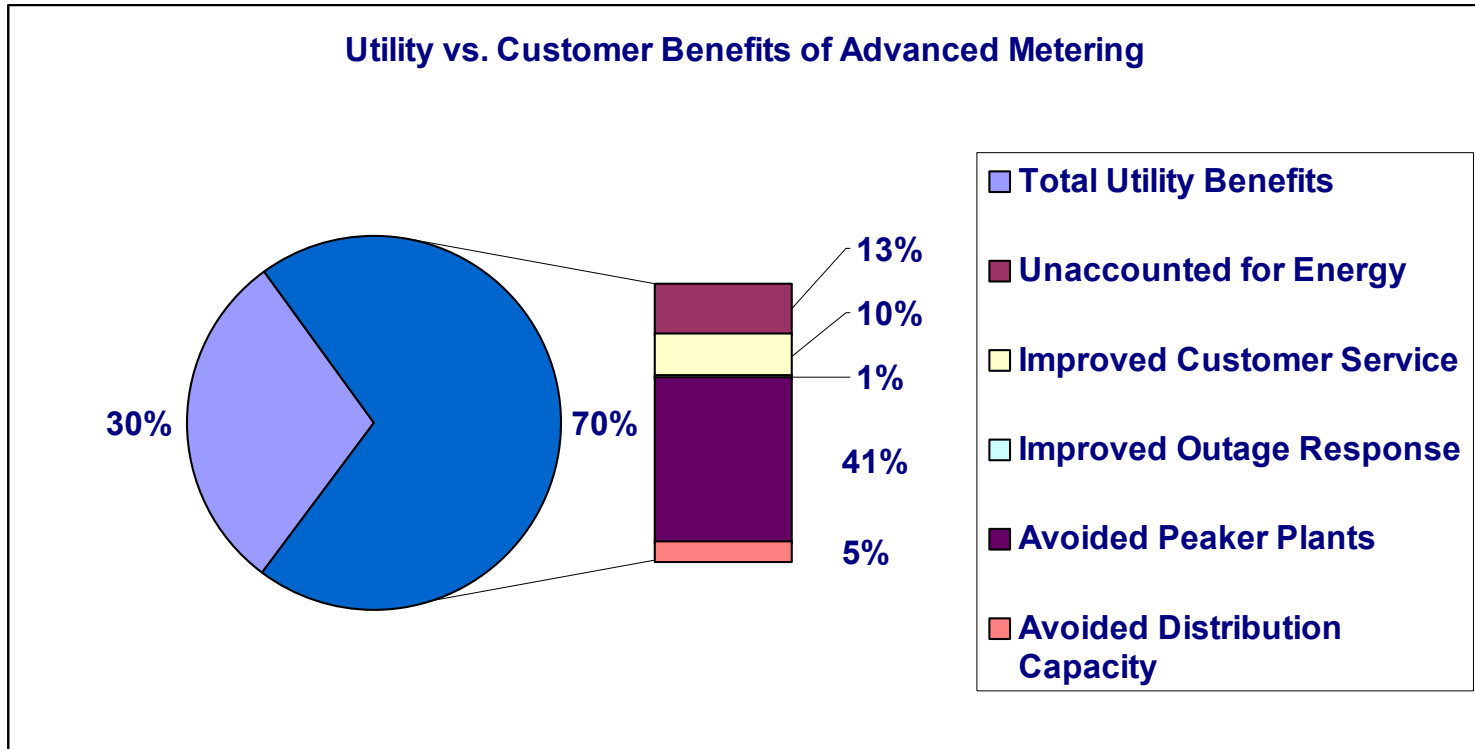
- Preferred in general as it promotes conservation



Regulators' Challenge

- ❖ **Utility takes risk**
 - ❑ **Operating benefits roughly equal to costs**

- ❖ **Ratepayers receive 70% of benefits**



Source: Frost & Sullivan, 2003

Summary

- ❖ **Multiple technologies available**
- ❖ **Benefits exceed costs**
 - ❑ **Especially when consumer benefits are included**
- ❖ **Many jurisdictions have adopted or are evaluating advanced metering policies**
 - ❑ **Finding that consumers benefit from advanced metering regardless of whether the retail market is deregulated**
- ❖ **Regulators have a crucial role**
 - ❑ **Include consumers in the business case**
 - ❑ **Enable utilities to benefit from doing the right thing**