

Municipal Utilities 2030

Strategies for Planning and Sustainability

Planning for the Smart Grid and Implementing Dynamic Pricing

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Observations, Predictions and Opinions

- * We will not achieve the full potential of “demand response”¹ and energy efficiency if the end-use consumer cannot see the “price signal.”²
- * End-use consumers can participate actively, but unless we can make it look like a video game, it’s not likely to happen consistently or to the extent possible through automatic intervention.

1. FERC: Demand response means a reduction in the consumption of electric energy by customers from their expected consumption in response to an increase in the price of electric energy or to incentive payments designed to induce lower consumption of electric energy. 18 CFR § 35.28 (b)(4).

2. Wikipedia: A price signal is a message sent to consumers and producers in the form of a price charged for a commodity; this is seen as indicating a signal for producers to increase supplies and/or consumers to reduce demand.

Observations, Predictions and Opinions

- * Demand response programs are more likely to be successful if they are automatic, that is, if they facilitate passive participation by consumers.
- * “Dynamic pricing” of electricity to end-use electric consumers has been shown to be successful in numerous pilot studies.
- * Performance of dynamic pricing for demand response is enhanced when integrated with “enabling technologies” at the consumer level.

Observations, Predictions and Opinions

- * In order for dynamic pricing of electricity to function efficiently and automatically,
 - ❖ Utilities will need to invest in “smart grid” infrastructure to get the price signal to consumers and
 - ❖ End-use consumers will need to invest in smart thermostats and smart appliances to enable automatic response to dynamic price signals.

Observations, Predictions and Opinions

- * The development of dynamic pricing, integrated with smart-grid investments will require
 - ❖ bold and forwarding thinking strategies on the part of the governing boards of municipal electric systems
 - ❖ Consumer education on the changes and system benefits of such an integrated approach to demand response and energy efficiency
 - ❖ Phased implementation

Observations, Predictions and Opinions

- * The ability of municipal electric systems to take full advantage of such programs may depend on the structure of their power supply arrangements:
 - ❖ Municipal systems that self-generate and/or participate directly in regional energy markets can more readily implement dynamic pricing strategies.
 - ❖ Municipal systems that buy power under current regulated rate structures are less likely to pass on regional market prices and achieve the level of demand response possible for municipal systems participating directly in regional markets.
 - ❖ It is possible, perhaps even probable, that power suppliers selling power and energy to municipal systems under purchased power contracts will modify their rate structures to send timely market price signals to their wholesale customers.
 - ❖ Indeed, it is certainly plausible that they may be required to do so in the future by legislative or regulatory fiat.

Observations, Predictions and Opinions

- * Implementation of smart grid technologies and dynamic pricing will have an important place in preparing for plug-in electric vehicles and plug-in hybrids.
- * It is a good thing we are looking toward 2030 and not 2015 for this workshop.

Demand Response Initiatives Using Dynamic Pricing

* Will require integration of:

- ❖ “Smart Grid” technologies at the utility end
- ❖ Enabling technologies at the consumer end
- ❖ Appropriate “price signals” at the wholesale level
- ❖ Retail rates based on “dynamic pricing” mechanisms
 - Dynamic priced rates as default rate schedule
 - Opt-out required (rather than option to opt in)
- ❖ Consumer education
- ❖ Phased implementation
- ❖ Program assessment
- ❖ Adjustment/modification as needed

What is the Smart Grid?

* FERC's Smart Grid Policy Smart Grid Policy⁴:

“The Smart Grid concept envisions a power system architecture that permits two-way communication between the grid and essentially all devices that connect to it, ultimately all the way down to large consumer appliances. . . . Once that is achieved, a significant proportion of electric load could become an important resource to the electric system, able to respond automatically to customer-selected price or dispatch signals delivered over the Smart Grid infrastructure without significant degradation of service quality.”

⁴Smart Grid Policy, 126 FERC ¶ 61,253, at P 19 and n.23 (2009)

What is the Smart Grid?

* Characteristics of a Smart Grid³:

1. digital information and controls to improve reliability, security, and efficiency of the electric grid;
2. dynamic optimization of grid operations and resources, with full cyber-security;
3. deployment and integration of distributed resources and generation, including renewable resources;
4. development and incorporation of demand response, demand-side resources, and energy efficiency resources;
5. deployment of "smart" technologies for metering, communications concerning grid operations and status, and distribution automation;
6. integration of "smart" appliances and consumer devices;

³Title XIII of the Energy Independence and Security Act of 2007

What is the Smart Grid?

* Characteristics of a Smart Grid Continued:

7. deployment and integration of advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal storage air conditioning;
8. provision to consumers of timely information and control options;
9. development of standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid; and
10. identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.

Smart Grid Applied to Demand Response

* Advanced Metering Infrastructure (AMI)⁵

- ❖ A system including measurement devices and a communication network, public and/or private, that records customer consumption, and possibly other parameters, hourly or more frequently and that provides for daily or more frequent transmittal of measurements to a central collection point. AMI has the capability to provide customers with price information, allowing them to respond to dynamic or changing prices.
- ❖ AMI includes “smart meters” that have the capability to measure customer usage over short intervals of time (often 15 minutes), as opposed to many conventional meters that are read manually on a monthly basis.

⁵ A National Assessment of Demand Response Potential, Federal Energy Regulatory Commission, June 2009

Smart Grid Applied to Demand Response

* AMI Continued:

- ❖ having advanced meters is a necessary but not sufficient condition to support price-responsive demand response—a utility also needs a meter data management system and billing system that will support price-responsive demand response options.
- ❖ Quite often, utilities install meters that qualify as advanced meters in that they gather hourly or sub-hourly data daily, but use them as an automated meter reading system to produce monthly meter reads—they do not install the meter data management system and billing systems needed to support wide scale price-responsive demand response.

Smart Grid Applied to Demand Response

* AMI Continued:

- ❖ The AMI deployment scenarios recognize that more than just metering is needed to support price-responsive demand response. The deployment time lines for each scenario are based on the understanding that only systems that have MDMS and billing systems are considered AMI for purposes of supporting demand response potential.
- ❖ Examples of enabling technologies include in-home displays, programmable communicating thermostats, or home area networks.

Example Smart Grid Implementation⁶

* Advanced solid state meters and meter modules:

- ❖ provide the ability to record interval usage and demand data
- ❖ support on-demand reads, allow remote programming
- ❖ provide outage and tamper notification
- ❖ replace all electric meters with new meters

* A two-way hybrid communication network:

- ❖ supports the meters and AMI applications
- ❖ near real-time communications capability
- ❖ power line carrier (PLC) technology will be used

* A meter data management (MDM) system:

- ❖ collect, organize, and manage the data captured using AMI
- ❖ make information available to other Company and web applications

⁶ Advanced Metering Infrastructure Overview and Plan, Rochester Gas and Electric Corporation and New York State Electric and Gas Company, February 1, 2007

Example Smart Grid Implementation⁶

* RG&E/NYSEG Plan Continued:

- ❖ 1,800,000 new meters
- ❖ \$270 million, \$2007
- ❖ Average installed per-unit cost: \$206 per meter
- ❖ Continuing annual costs: \$9 per meter per year

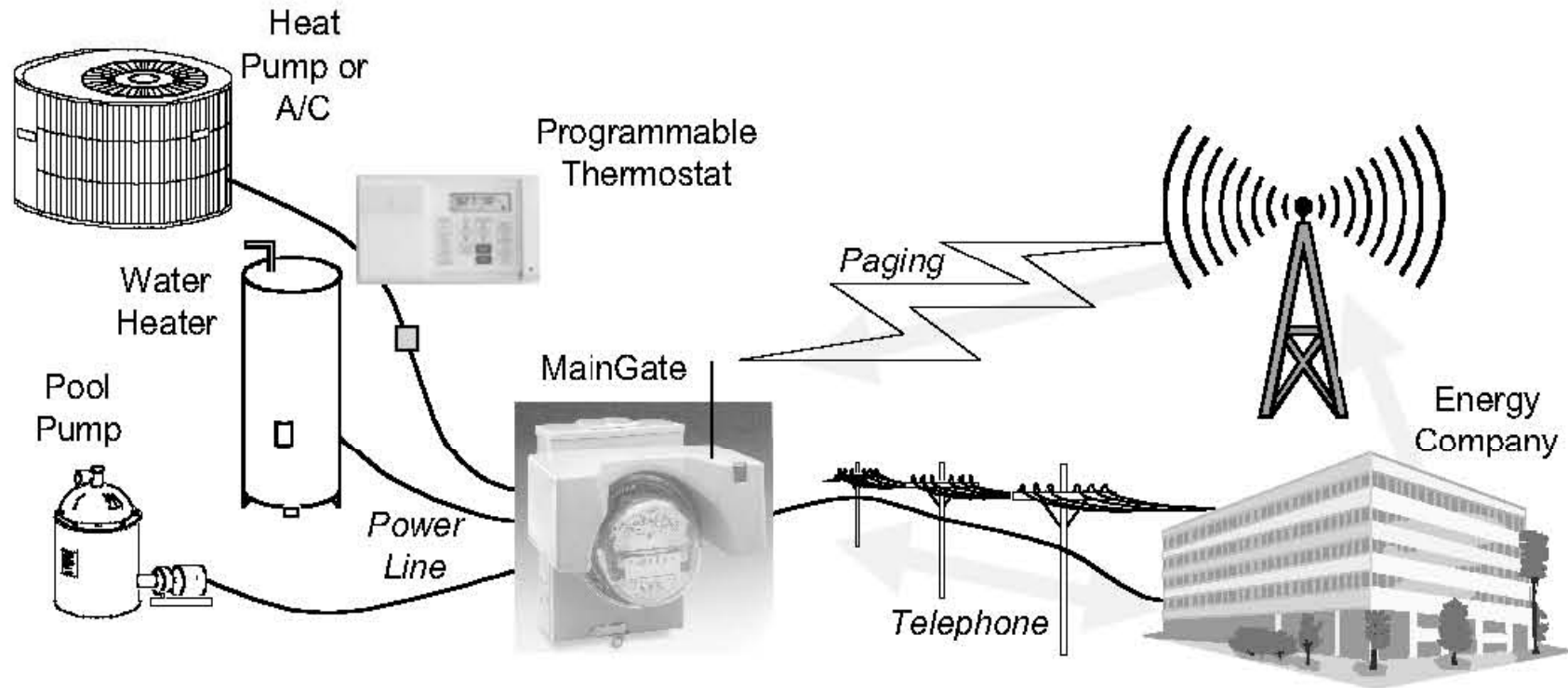
* Another AMI implementation – City of Naperville, IL

- ❖ 57,000 meters
- ❖ \$22 million (\$11 mm from DOE grant, \$11 mm from City)
- ❖ \$386 per meter?

* Commonwealth Edison:

- ❖ 130,000 meters
- ❖ \$69 million
- ❖ \$530 per meter?
- ❖ Add \$5 per year increase to participating customers

Example Smart Grid Implementation⁷



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Gulf Power Company, GoodCents Select Advanced Energy Management Program

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Enabling Technologies at Consumer End

- * Smart thermostats
 - ❖ remotely programmable
 - ❖ two-way communications
- * Communications gateway
- * Cycling control of Air Conditioning
- * Smart appliances
- * Lighting controls (e.g., dimmable ballasts)

Current Pricing Models

- * Fixed prices by rate block, e.g.⁸, :
 - ❖ Customer Charge
 - For bills of 0-325 KWH per month \$ 6.70 per month
 - For bills over 325 KWH per month \$11.00 per month
 - ❖ Energy Charge
 - Any part of the first 500 KWH per month 6.70¢ net per KWH
 - Over 500 KWH per month 4.40¢ net per KWH
 - With electric heating and/or water heating over 1000 KWH per month 3.18¢ net per KWH
 - ❖ Plus Fuel Adjustment Charge and other Riders
- * No variation in price by hour, day or season
- * No linkage to marginal production cost or MISO day-ahead or real-time market prices

⁸ Indianapolis Power & Light Company, Rate RS, eff. 8/29/2007

Current Pricing Models

* As a consumer:

- ❖ I have no idea what the true cost of electric service is
- ❖ I have no incentive to modify my consuming behavior
- ❖ In short, I am a disinterested bystander
- ❖ Current direct load control options are limited and inconsistently applied
- ❖ I cannot even get a summary of my monthly consumption or find out how I compare to other residential customer

* Even Time-of-Day rates have been shown to have limited impact on consumer behavior

* Many retail suppliers don't even have TOD rates, even for industrial customers

Dynamic Pricing

- * Generally defined as pricing that reflects the variation in wholesale market or generation costs over time (hourly, daily, seasonally)
- * Prices are “dynamic” in that they change in parallel with real-time market prices or prices change depending on system operating conditions
- * Examples:
 - ❖ Real-Time Pricing
 - ❖ Peak-Time Rebate
 - ❖ Critical-Peak Pricing

Real-Time Pricing

- * In its simplest form, customer pays the real-time price on an hourly basis

- * Two-Part RTP:

- ❖ customer pays fixed, base rates for usage up to a baseline amount,
- ❖ plus real-time price above the baseline,
- ❖ less rebate for usage below the baseline.

- * Example:

- ❖ Georgia Power tariff for large commercial and industrials
 - Day-ahead price option
 - Hour-ahead price option

Peak-Time Rebate

* Customer receives a rebate for reducing usage during declared peak-time periods

* Examples:

❖ SDG&E Peak-Time Rebate⁹

- Customer pays regular residential tariff rate for customer specific reference level of usage,
- less rebate of \$0.75 per kWh.
- Rebate increases to \$1.25 per kWh if customer has enabling technology -- technology which can be initiated via a signal from the Utility that will reduce electric energy end-use for specific electric equipment or appliances.

❖ Wisconsin Electric Power Company¹⁰

- \$0.47 per kWh Rebate for Energy Adjustment from Baseline Usage

⁹ San Diego Gas & Electric Company, Rate Schedule PTR, eff. 1/1/2010

¹⁰ Wisconsin Electric Power Company, Rate Schedule PTR, eff. 6/7/2009

Critical Peak Pricing

- * Objective – dramatically reduce consumption during certain critical periods when the cost of purchasing or generating is very expensive
- * Typically based on Time-of-Use rate structure with additional rate steps to price service during critical load periods
- * Prices on certain days are known ahead of time, but the days on which those prices will occur are not known until the day before or day of consumption.

Comparison of CPP tariff structures

Company/ program name	Gulf Power Good Cents Select	WPS Thermostat Pilot	Ameren
Target population	Single family w/ central AC and heat, phone service	With central AC and in specific geographic area so could receive paging signal	St. Louis city and county; ≥ 1500 kWh use per summer month; high AMR reliability
# event days	Not to exceed 88 hours per year (1% of hours)	Up to 101 hours	10 event days
CPP period	Summer: 1-6 pm weekdays Winter: 6-10 am weekdays	Summer: 2-7 pm weekdays	Summer 3-7 pm
Price during CPP hours (cents/kWh)	Summer = 32.6 Winter = 32.6	Summer = 35	Summer = 30

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Critical Peak Pricing

* Examples:

❖ Gulf Power Company (RSVP Residential Service Variable Pricing)

- Customer Charge: \$10.00
- Program Participation Charge: \$4.95
- Energy Demand Charge:
 - ✓ Low Cost Hours (P1): 1.785¢ per KWH
 - ✓ Medium Cost Hours (P2): 3.021¢ per KWH
 - ✓ High Cost Hours (P3): 7.598¢ per KWH
 - ✓ Critical Cost Hours (P4): 28.500¢ per KWH
- Each customer notified by electronic signal at least one half hour prior to the start of price level P4.
- Customer pays \$179 installation cost
- GPC pilot results
 - ✓ 96% customer satisfaction
 - ✓ 2 kW reduction per customer per critical event
 - ✓ 100 hours of critical events per year is OK

Critical Peak Pricing

- * Results of numerous pilot studies show that:
 - ❖ residential customers respond to higher prices by lowering usage
 - ❖ The magnitude of results depend on several factors, including availability of enabling technologies
 - ❖ TOU rates show reductions in peak demand of 3 to 6%
 - ❖ CPP without enabling technologies induce peak demand reductions of 13 to 20%
 - ❖ CPP with enabling technologies show peak demand drops of 27% to 44%.¹¹

¹¹ Household Response To Dynamic Pricing Of Electricity—a Survey Of The Experimental Evidence; Ahmad Faruqui and Sanem Sergici; January 10, 2009