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Impact of Information and Communications Technologies on Residential Customer Energy Services

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Acronyms and Abbreviations

AEP	American Electric Power
AMR	Automated meter reading
BECO	Boston Edison
BG&E	Baltimore Gas & Electric
CSW	Central & South West
CCLM	Customer-controlled load management
CCU	Cell control unit
C/I	Commercial/industrial
DISCO	Distribution company
DLC	Direct Load control
DSM	Demand-side management
EIA	Energy Information Administration
EIS	Energy information services
ESCO	Energy service company
FERC	Federal Energy Regulatory Commission
Fiber-coax cable	Fiber-optic and coaxial cable network
FPN	First Pacific Network
HVAC	Heating, ventilation, and air-conditioning
IBUS	Integrated Broadband Utility Solution
ICS	Integrated Communications Systems
LAN	Local-area network
LEOS	Low-Earth Orbiting Satellites
KCP&L	Kansas City Power & Light
NII	National Information Infrastructure
PBR	Performance-based regulation
PCS	Personal Communications Services
PG&E	Pacific Gas & Electric
PLC	Power line carrier
PSC	Public Service of Colorado
PSE&G	Public Service Gas & Electric
PUC	Public utilities commission
RF	Wireless radio frequency
RTP	Real-time pricing
SDIG	Southern Development Investment Group
TECO	Tampa Electric
TOU	Time-of-use pricing
TVA	Tennessee Valley Authority
UBI	Universal Bi-directional Integration

Executive Summary

This study analyzes the potential impact of information and communications technologies on utility delivery of residential customer energy services. Scores of U.S. utilities are conducting trials which test energy-related and non-energy services using advanced communications systems (e.g., hybrid fiber-coax cable or wireless radio networks). The cumulative investment by utility ratepayers and shareholders (and other equity partners) may soon approach recent funding levels for ratepayer-funded demand-side management (DSM) activities targeted at residential customers. Key drivers for these initiatives include the rapid innovation in and declining costs of information and communication technologies and utilities' desire to reduce operating costs and to provide enhanced services in order to retain and attract customers in emerging retail services markets.

Survey of Electric Utility Projects

We identified about 40 projects initially based on a literature review of recent publications and the trade press and interviews with vendors. Projects were eliminated that were outside of the study's scope (e.g., focused on commercial/industrial customers) or because utility staff were unwilling to provide the minimum information requested in our survey. Telephone interviews were conducted with utility staff and equipment vendors involved in 21 projects between August and October 1995. Table ES-1 provides an overview of each project including the primary communications system, the project's status and stage of development, the number of participating households, and location.

Market Entry Strategies

Electric utility-sponsored projects that offer communications-enabled services to residential customers can be distinguished along three important dimensions: (1) types of services provided, (2) the communications system used to deliver services (e.g., cable, twisted pair telephone wires, wireless radio), and (3) the utility's strategic approach to accessing telecommunications networks (e.g., own vs. lease) and partnering with telecommunications providers and product vendors.

- The diversity of market entry strategies reflects the early stage of market development. Today, no single communications system is capable of serving all residential market niches economically, in part because choosing the most attractive system (i.e., superior economics and technical features) depends to some extent on the characteristics of the utility (e.g., density, geographical terrain), the utility's exist-

Table ES-1. Overview of Utility-Customer Telecommunications Projects

Communications System	Utility	Project Name	Status	Location	Number of Customers
Cable	Central & South West	Customer Choice & Control	Pilot	Laredo, TX	600
	Entergy	Customer-Controlled Load Management	Pilot	Chenal Valley, AR	50
	Glasgow Electric Board	TVA Water Heater Project	Pilot	Glasgow, KY	100
	Hydro Quebec	Universal Bidirectional Integration	Pilot (P)	Chicotimi, QU	440
	Pacific Gas & Electric	Energy Information Services	Pilot	Walnut Creek & Sunnyvale, CA	100
	Public Service Electric & Gas	Integrated Broadband Utility Solution	Pilot	Moorestown, NJ	1,000
	Southern Dev. Inv. Group	Dominion Project	Pilot	Duluth, GA	303
	Virginia Power	Cable-Based Energy Management System	Pilot	Norfolk & Virginia Beach, VA	< 48
Telephone	American Electric Power	TranstexT	Pilot (C)	Dublin, OH; Muncie, IN; Roanoke, VA	460
	Gulf Power	Advanced Energy Management System	Pilot	Gulf Breeze, FL	240
	Wisconsin Energy	Energy Oasys	Concept	Milwaukee, WI	15
	Wright-Hennepin Cooperative	Meter Minder	Roll-out	MN, OK	5,000
Fixed Wireless Radio	Baltimore Gas & Electric	IRIS Fixed Network	Pilot	Timonium, MD	100
	Boston Edison	UtiliNet Automatic On/Off	Pilot (C)	Brighton, MA	15,000
	Kansas City Power & Light	CellNet Pilot	Pilot	Johnson Cty, KS	5,000
	PacifiCorp	UtiliNet	Pilot	Canon Beach, OR	100
	Pacific Gas & Electric	CellNet	Pilot (C)	North Bay, CA	1,700
	TECO Energy	TeCom Inc.	Pilot	Tampa, FL	140
Mobile Wireless Radio	Baltimore Gas & Electric	Itron AMR	Roll-out	MD	<500,000
	Boston Edison	Itron AMR	Roll-out	Boston, MA	40,000
	Public Service of Colorado	Itron AMR	Roll-out	Denver, CO	300,000

Note: C = Completed, P = Planned

ing communications infrastructure, and the desired applications and services. Ultimately, we expect that a small number of big "winners" -- probably four to seven leading firms that act as system integrators for teams of product vendors, meter companies, communications and software firms -- will emerge from the many utility-sponsored trials that are currently underway.

- Wireless radio technologies are farther along in terms of large-scale deployment compared to competing communications systems. Several utilities (Kansas City Power & Light, Public Service of Colorado, Baltimore Gas & Electric) are deploying wireless radio systems, either mobile or fixed network systems, on a systemwide basis. These projects typically involve less complex partnering arrangements than broadband projects.

- Electric utilities involved in hybrid-fiber coax cable (or broadband) projects appear eager to get involved in the burgeoning home-based information, entertainment, and communications market. A few utilities (e.g., Entergy and Central & South West) have decided to build and own their communications infrastructure between utility and customer, while most others have decided to partner with cable and/or telecommunications companies by arranging to lease capacity on the provider's network. These projects involve complex teaming arrangements. The success of these partnering arrangements is one key factor that distinguishes broadband projects that are moving forward to the next stage of development from those that appear to be floundering.

- A utility's long-term strategic vision and/or near-term corporate objectives influence and help explain its choices with respect to communications-enabled services. For example, utilities involved in wireless projects focus on near-term improvements in utility operations to reduce rates. In some cases, these utilities are relatively low-cost providers in their region and believe that competitive advantage can be maintained by reducing costs in their traditional core business (e.g., widespread application of automatic meter reading). In contrast, many utilities involved in broadband projects seek to become full-service retail providers of energy and non-energy services and view both as potential sources of new revenue. In some cases, their approach appears driven by a strategic assessment that industry restructuring is proceeding relatively quickly and that utilities should focus on marketing value-added services because electricity is becoming a commodity. These utilities are betting that residential customers will ultimately want "one-stop shopping" (e.g., a critical mass of compelling applications that can hopefully be provided at reasonable cost) and that customers will want interactive services provided over familiar and easy-to-use interfaces (e.g., computer or TV).

Range of Services Offered or Planned

- The range and type of services varies among utilities, driven in part by communication system capabilities. Utilities that are utilizing broadband cable networks offer a broader array of energy and non-energy services compared to wireless radio and telephone-based projects. A few utilities package services, which include automated meter reading, time-differentiated pricing, customer-controlled load management, energy information, various types of billing options, long-distance telephone and cable service, home security and alarm services, and personal communication services, together in novel ways. Wireless radio projects currently focus on improving operational efficiency of utility distribution services (e.g., automating meter reading functions). Wireless radio technologies that utilize a fixed network with in-home display units also enable the utility to offer energy information services and pricing options.

- In many cases, we found that utility's current service offerings are much more limited than the capabilities claimed for their system or services that may or could be offered in the future. For example, while many utilities report that they are considering offering a variety of non-energy services, at the time of our survey, only three utilities (Glasgow, Wright-Hennepin, and Entergy) are currently incorporating non-energy services in their pilots.

- Our sample of projects highlights the recent surge in interest among electric utilities in automated meter reading (AMR): every utility offered AMR. Because utilities typically spend only about $0.50 to $0.80/month on the direct costs for manual reads, the cost of an AMR system must be fairly low (<$75 per meter installed) in order to pay for itself in a reasonable time frame. On a stand-alone basis, AMR systems may be cost-justified only in certain niche markets (e.g., difficult-to-read meters, high-density urban areas). However, vendors of fixed network radio systems claim that, in addition to AMR, their systems provide other quantifiable benefits and a gateway for offering innovative, new energy services. These benefits include reduced losses from tampering and theft, reduced service turn-on and turn-off costs, outage monitoring, improvements in billing reliability (e.g., fewer errors than manual reads leading to fewer customer complaints). Moreover, these systems enable utilities to offer innovative pricing and billing services.

- About half of the utilities in our sample offer time-of-use pricing for residential customers, which typically includes posted prices for up to four periods (e.g., low, medium, high, and critical) that were signaled to customers through an interactive, "smart" thermostat or an in-home display device. Only one utility (Public Service Electric & Gas) is testing real-time pricing with a small subset of residential customers participating in its 1,000-home Integrated Broadband Utility Solution trial.

- About half of the utilities in our sample offer various energy information services to residential customers, although a rather limited set of options were being tested compared to services that potentially could be offered (see Chapter 4). For example, a few utilities (e.g., PG&E and Central & South West) plan to offer itemized bills that show usage for major appliances or end uses under each price tier. Several utilities display information on price currently in effect, temperature in the home, electric bill to date (in dollars and kWh), comparisons of current usage with historical energy use, programmed response of appliances to price signals, and scheduling options.

Market Trends: Project Costs

For this study, utilities were asked to provide information on estimated project costs and savings. This information is reported in Table ES-2, with projects grouped into six categories based on communications system and ownership. We present cost ranges for each group as well as the utility's cost target. Project costs are self-reported and typically include the costs of communications link between utility distribution network and customer's home network (the so-called "last mile"), customer premise equipment, program administration, and marketing expenses. Because of the inherent difficulty in estimating per unit costs in small-scale R&D projects, we regard project costs as order of magnitude estimates for the "last mile" connection to the customer premise, while cost targets are indicative of utility goals for system roll-out.

- Utilities testing one-way, *mobile* wireless radio systems report the lowest installation costs ($100-150/house). Mobile wireless systems typically involve radio-equipped vans that drive by and collect meter readings from electric meters that have been retrofitted with radio modules. These systems have more limited functionality and service offerings compared to other types of communications networks. Project costs for wireless radio systems using *fixed* networks ranged between $180-$600 per house. These systems typically have two-way networks from the local poletop collector back to the utility's central location, rather than all the way to the customer premise. In the projects that reported lower costs, a limited number of services are currently being offered. However, vendors claim that additional services can be provided at low incremental costs on a systemwide basis, particularly if these services are not made available or desired by all customers. Projects at the high end of this range either included additional customer premise equipment (e.g., in-home display equipment) or had low customer density levels, which meant that fewer customers were served by each

Table ES-2. Market Features: Project Costs and Savings

Strategy	Utility	Key Partners/ Vendors	Installed Cost (Current)[a]	Installed Cost (Target)[b]	Peak Demand and/or Energy Savings
Cable, Utility-Owned	Central & South West	FPN	1,000-3,000	1,000	Avg. bill savings of 7-10%; 2 kW peak demand reduction
	Entergy Southern Dev. Invest. Group	FPN formerly FPN			
	Glasgow Electric Board	CableBus	240[c]	NA	$14/mo
Cable, Leased	Hydro Quebec Pacific Gas & Electric Public Service Electric & Gas Virginia Power	Domosys TCI, Microsoft AT&T Cox, Nortel	2,000-3,000	300-500	$60-80/yr
Telephone, Leased	American Electric Power Gulf Power Wisconsin Energy	ICS ICS Ameritech	1,000- 1,500	750	Avg. bill savings of 12-15% (~$175/yr) 2-4 kW peak demand reduction
	Wright-Hennepin Cooperative	ITI	240[d]		
Fixed Wireless, Utility-Owned	Baltimore Gas & Electric Boston Edison PacifiCorp TECO Energy Mgmt Services	IRIS Metricom Metricom IBM	240-600	NA	
Fixed Wireless, Leased	Kansas City Power & Light Pacific Gas & Electric	CellNet CellNet	180-240	NA	
Mobile Wireless, Utility-Owned	Baltimore Gas & Electric Boston Edison Public Service of Colorado	Itron Itron Itron	100-200	NA	

Note: First Pacific Networks (FPN), Integrated Communications Systems (ICS), Interactive Technologies Inc. (IT); NA = Not Available

a, b: Costs and savings in $ per residence; cost ranges for pilot projects in each group; excludes costs of installing backbone network

c: Cost estimates are for incremental costs of pilot (i.e., CableBus switch, AMR meter, and water heating wiring); and do not reflect total cost of linking Glasgow's cable network to the residence

d: Costs are lower because Wright Hennepin project does not include in-home display unit and cost of CPU is excluded from installation cost.

radio transformer. The installed costs of hybrid fiber-coax cable (i.e., broadband) projects is currently quite expensive in residential markets (e.g., $1,000-3,000/house). Factors that may explain the large range in reported costs include: (1) extent to which an existing backbone network can be utilized vs. the costs of constructing a new backbone network, (2) differences in customer premise equipment costs which depend on the range of services offered (e.g., telephony, cable TV) and their saturation (e.g., every house vs. sub-group among total population), and (3) differences in system design (e.g., coax cable to the customer premise vs. coax cable to secondary transformer and powerline carrier or wireless radio to the customer premise).

- Large-scale deployment of cable systems to residential customers may well hinge on the ability of utilities to meet aggressive cost targets quickly ($300-500/house) and develop attractive applications for which customers are willing to pay. Developers of broadband projects face a formidable competitive challenge if fixed wireless radio networks are deployed on a large-scale and capture most of the potential energy-related benefits (e.g., reduce costs of utility operations, provide energy information services). These investments in a competing communications network infrastructure may foreclose or seriously limit deployment of broadband networks by electric utilities because project economics may hinge on realizing benefits to the utility system (i.e., cost reductions and peak demand savings) as well as revenues derived from a broad array of energy and non-energy applications.

Benefits to Utilities and Customers

- With respect to benefits to utilities, several utilities located in the South (Gulf Power and CS&W) report summer peak demand reductions of about 2 to 2.2 kW per home as customers shifted or reduced loads in response to time-of-use prices. A few utilities provided anecdotal information on savings in system operation, productivity impacts, or customer satisfaction. Only a few utilities (e.g., Glasgow Electric Board, Wright-Hennepin) have achieved reasonably high market penetration rates in promoting non-energy services that generate substantial revenue streams from residential customers. Most other utility projects are either still at the proof-of-concept stage, pilot market research, or large-scale technical trial.

- With respect to benefits to customers, several utilities reported annual bill savings from TOU prices and customer-controlled load management that ranged from 7 to 15% of current bills. These savings were worth between $60 and $175 per year to residential customers at current rates. With one exception (Gulf Power), these savings estimates are self-reported. In the future, some utilities envision that participating customers may pay a portion of the costs of pricing and load management programs if they are offered as energy services. However, several utilities reported that, based on their market research, participating customers were only willing to pay a small monthly fee ($5-10 per month or less), which translates into less than 25% of the bill savings achieved in most houses. Thus, overall, the amount of savings, customer's willingness to pay a portion of the value of these savings to the utility for these services (e.g., 10-25%), and customer's payback criterion (e.g., 2-3 years) establish an upper limit on the annual contribution that could be expected from customers for these energy-related services.

Participation Rates and Market Response

Some utilities report high participation rates in their pilot projects (20-70% of eligible customers), although customers were typically not asked to pay for services. Not surprisingly, market response is lower in those few projects where customers actually pay for services. Several small publicly-owned and rural electric cooperatives (Glasgow Electric Board and Wright-Hennepin Cooperative Electric Association) have the most experience in providing communications-enabled services that are paid for by customers. However, significant uncertainties still exist regarding services desired by residential customers and their willingness to pay for them—a situation which motivated our exploratory market research effort.

Exploratory Market Research

We also conducted a small market research effort that assessed services which might be of interest to residential customers. Utilities routinely conduct market research, although typically results are not publicly available. To begin to address this information gap, we conducted a focus group and individual interviews with ten residential customers in Newark, Delaware between December 1995 and January 1996. These interviews explored customer reactions to a set of fourteen proposed services. Respondents were also asked to fill out a short questionnaire at the end of the focus group discussion or interview in order to gauge customers' perceived economic value of the services.

Key findings from our exploratory market research include:

- Many respondents were interested in specific energy information services, although most wanted the service only if it were free or were only willing to pay a small amount ($0.50-1.00 per month or $1-2 per use). Compared to previous studies, participants were asked for their reactions to a more extensive set of energy information services—neighborhood comparisons of energy use, energy use breakdowns by individual appliances or major end uses, time-of-day pricing, information on energy efficiency products, and on-line "do-it-yourself" or informational videos on home energy use.

- About 10 to 40% of the respondents did not want specific energy information services even if offered free of charge. They regarded the proposed services as unnecessary either because they could access the information with greater ease using existing media (e.g., their utility bill) or questioned the validity of the information. Given these responses, utilities may wish to bundle a set of energy information services as part of a more comprehensive package of communications-enabled services that could command a reasonable monthly fee.

- Not surprisingly, our focus group and interviews revealed several well-known barriers to marketing energy-efficiency services. Some respondents had limited interest in energy efficiency and reducing their bill, partly due to their perception that potential energy savings were low or would negatively impact their lifestyle. To overcome consumer information barriers, effective consumer education will be a necessary component of any large-scale utility effort to deploy communications-enabled energy services.

- We also found that customers' receptiveness to new, communications-enabled services was affected by concerns regarding privacy, intrusive marketing, and network security. Some respondents were wary that utilities would provide disaggregated data on their household energy use or a customers' specific product and equipment needs to other private firms. In their view, this unauthorized disclosure could result in an increase in unwanted marketing pitches. Those customers that had previous negative experiences with telecommunications services providers (e.g., intrusive marketing) tended to be more dubious and suspicious of new service offerings.

- Customers viewed customer-controlled load management and time-of-day pricing as particularly useful energy information services; these services had the most favorable responses overall.

- A majority of participants were willing to pay for security services and entertainment videos on demand, respectively. The average amounts offered by those customers willing to pay ($11/month for security services and $3 per view for entertainment videos on demand) provide a calibration that these measures are at or below market value, thus lending some credence to responses for energy-related services that are not currently offered in the market. Based on reactions of some respondents, we believe that customer concerns about unfair competition and utility entry into new business areas may represent a barrier among some segments of the residential customer base.

Future Directions

We are convinced that the utility pilot projects described in this study foreshadow the future direction of residential customer energy services. Today, the market is in the early stages of development. Only a handful of utilities have demonstrated significant operational savings or generated significant revenue streams through successful marketing of energy and non-energy services to residential customers. Given market and regulatory uncertainties and the technological risks, utilities and their partners must overcome significant hurdles before large-scale deployment of a comprehensive set of communications-enabled services in the residential sector becomes a robust business activity.

We plan to continue monitoring emerging trends in communications-enabled services for residential customers, focusing on developments in the following areas.

Market experience - Over the next year or two, we will be better able to assess “winners” and “losers” based on actual field performance from utility trials. System integrators that can successfully target and sell bundles of energy and non-energy services in various residential market niches utilizing a reliable, low-cost, two-way communication connection between service provider and home are more likely to thrive. Important indicators to evaluate include whether early, and in many cases, successful, entry by companies and teams utilizing wireless radio networks creates a sustainable competitive advantage and whether broadband projects in the proof-of-concept or pilot phase successfully are rolled-out on system-wide basis.

Customer response - Customer willingness to pay for these services is still unproven and it will be important to analyze utilities’ success in moving from technical trials to market-based programs. The search for the “killer” customer service application will be an important indicator to monitor. We believe that, overall, the industry would benefit if additional market research and field evaluations on customer response to these services were publicly available. We expect that utilities and others will devote increasing efforts towards home security, alarm, monitoring and notification services, and personal communication services (e.g., Internet access). A growing number of utilities may offer both general and interactive energy information services (EIS) over the Internet in addition to specific EIS services enabled by communications networks to the customer premise (e.g., real-time pricing, customer-controlled load management, customized bills). It is unclear to what extent there will be convergence on communication medium (e.g., computer, TV, or “smart” thermostat).

Technical innovation & risk - We expect the rapid pace of innovation in information and communication technologies to continue, and thus it will be important to keep abreast of these developments, particularly as they affect the relative economics of competing systems. It will also be important to monitor progress towards development of “open” standards and protocols and the trend towards “hybrid” communications networks (e.g., fiber backbone networks plus fixed wireless radio systems).

Regulatory - Unless there is federal legislation that mandates retail competition, we believe that the pace of electric industry restructuring will vary significantly by state and region. Decisions of state regulators in three key areas could have a major impact on the deployment of communications-enabled residential customer services: (1) performance-based regulation (PBR), (2) policies that require distribution utilities to unbundle metering & billing services, and (3) regulatory oversight and monitoring of the activities of unregulated subsidiaries. Adoption of PBR for distribution utilities that allows shareholders to increase earnings if the utility achieves significant operational cost savings may spur deployment of AMR systems. However, limitations on the scope of services to be provided by distribution utilities may adversely affect the deployment of certain types of communications networks. For example, if billing and metering services are unbundled and provided by competitive suppliers rather than DISCOs, it may be more difficult to justify system-wide deployment of fixed wireless radio networks because low per unit costs of these systems are achieved by including all homes within a defined geographic area (e.g., portion of utility service territory). Regulatory policies in such areas as potential cross-subsidies between regulated and unregulated services or constraints on the activities of unregulated retail energy service affiliates or subsidiaries that take equity positions in product vendors who supply regulated DISCOs may also impact the deployment of communications-enabled services by utilities.

CHAPTER 1

Introduction

Many U.S. electric utilities are currently testing innovative energy-related and non-energy services for residential customers that are delivered via modern telecommunications systems (e.g., fiber-optic and coaxial cable networks, fixed and mobile wireless radio equipment, dedicated telephone lines). Key drivers for these initiatives include rapid innovation and declining costs in information and communication technologies and utilities' desire to enhance customer service in an increasingly competitive environment and develop business strategies that enable utilities to thrive in emerging retail services markets.

This study explores several important questions which are of interest to electric and gas utilities and their regulators, service providers, and the U.S. Department of Energy. These questions include:

What are the potential impacts of information and advanced communications technologies on utility delivery of energy services to residential customers?

Utilities have relied on communications technologies to support load management programs since the 1970s. For example, in direct load control programs, utilities utilized powerline carrier or wireline radio technologies to remotely control the on-off duty cycles of home appliances. However, in designing these programs, utilities often regarded residential load management and innovative rates as mutually exclusive. Moreover, communications were typically one-way, from the utility to the customer, and required relatively little telecommunications system capability (Hanser et al. 1993). By contrast, a number of the utility projects surveyed for this report bundle load management, pricing, distribution automation, and energy information services. Utilities are packaging a variety of services together in novel ways including automated meter reading, time-differentiated pricing, customer-controlled load management, smart thermostats, energy information, various billing options, home security, video, long-distance telephone, and personal communication services (e.g., Internet access). As part of this study, we requested that utilities (and vendors) estimate project costs, savings, and capabilities of their systems. This information is used to assess the relative merits of alternative communications delivery systems and costs of providing various services.

What role will electric utilities play in the delivery of energy services, particularly energy efficiency services and load management, as the electric power industry moves into a more competitive era?

In response to increasing competition and the prospect of industry restructuring, many utilities have reduced the size and scope of their demand-side management programs, particularly in the residential sector (EIA 1995). Increasingly, the emphasis of remaining utility DSM programs focuses on retaining large customers and their loads. Utilities have adopted varying strategies with regard to providing services to smaller commercial and residential customers. Some utilities appear ready to compete primarily on the basis of price with limited service offerings, while other utilities attempt to build loyalty and satisfaction by improving existing services in anticipation of retail choice or providing new value-added services that differentiate them from potential competitors (Rufo 1996). Utilities in this latter group are forming strategic alliances and/or joint ventures with telecommunications companies, product vendors, and information technology vendors.

In order to gain regulatory and political support for these projects, utilities have cited the reduction in electrical system peak demand, reduction in market barriers to energy efficiency through provision of accurate, real-time prices and energy information, and operational cost savings in the distribution utility business. These benefits potentially distinguish electric utilities from other providers that propose to offer communications-enabled non-energy services to residential customers. Some utilities are conducting their projects as a traditional regulated activity, especially those that focus on load management or reduced operating costs through automated meter reading (AMR). Over time, we expect that these activities, particularly if they include energy efficiency services as part of a broader package of non-energy services, will increasingly be developed by unregulated utility affiliates. We are also likely to see "convergence" among fuel forms and energy suppliers as customers are offered comprehensive services, including electricity, gas and fuel oil commodity purchases along with other value-added services. As utilities and other new entrants move to horizontally re-integrate retail energy services, regulators will have to decide to what extent to unbundle various retail services (e.g., merchant, marketing, billing, and metering functions) which are potentially competitive from those portions of the electricity distribution or "wires" business that should be subject to economic regulation because of their natural monopoly characteristics.

What types of energy-related and non-energy services are of most interest to residential customers, and how much would they be willing to pay for them?

Ultimately, utilities (and other providers) hope to recoup their investment in information and advanced communications networks through revenues derived from customers' willingness to pay for energy and non-energy services as well as savings in system operation. Many utilities have conducted market research exploring customers' interest in these services, although with one or two exceptions, the results of those studies have not been released into the public domain. Thus, to partially address this information gap, we conducted a focus group and a small number of customer interviews in order to explore customer reactions to these new service packages.

1.1 Scope

This study focuses on the impact of information and communications technologies on residential customer energy services. Projects and technologies aimed at commercial and industrial customers are not included. Our focus on small customers derives in part from a public policy perspective that, even in a competitive electricity industry, the market barriers to the use of energy efficient products and services may be most significant among these consumers. Moreover, the current Administration, through the U.S. Department of Energy, in their National Information Infrastructure initiative, have expressed concerns that residential customers, particularly low-income and rural customers, are the ones most likely to need governmental assistance in gaining access to

Table 1-1. Overview of Electric Utility Services Using Communications Systems

Category	Service/Program	Primary Business Objective
I. Corporate Activities	- Power system monitoring and control - Control center operations - Internal communications and message handling - Supervisory control and data acquisition	Improving system operations and increasing administrative efficiencies
II. Wholesale Power Market Activities	- Reliability exchanges and bulk power transfers - Brokering and spot market transactions - Wholesale pricing	Improving the efficiency and reducing the cost of whole-sale market transactions
III. Retail Electricity Market Activities	- Automated meter reading - Automated billing - Remote connect/disconnect - Theft/tamper detection - Outage detection and handling	Reducing utility cost of service to customers
	- Energy information and education - Bill feedback - Energy and demand management - Energy and customer monitoring - Power quality monitoring - Real-time pricing	Increasing the value of service to customers
IV. Non-Energy Retail Activities	- Telephone - Data and information services (e.g., Internet access) - Educational programming - Home and business security and fire protection - Entertainment	Improving financial performance and expanding business base through diversification

Source: Adapted from EPRI 1994; Andersen 1994.

the broad array of services envisioned through the deployment of information resources and modern telecommunications networks (NIST 1994).

Potential utility services that can be enhanced by the use of information and telecommunications systems can be grouped into four general categories (EPRI 1994; Andersen Consulting 1994):

- **Corporate Activities** are those aimed at improving utility system operations or internal administrative efficiencies and in most cases rely on phone, radio, or fiber-optic cable networks that are currently in place.

- **Bulk Power Market Activities** are those aimed at enhancing communications between utilities bilaterally, facilitating pooling arrangements, and enabling access by new market entrants such as marketers, brokers, and independent generators. This category also includes growing interest in the use of electronic bulletin boards for broadcasting information on transmission access and pricing policies to market participants on a non-discriminatory basis as outlined in the recent Federal Energy Regulatory Commission Order 889 (FERC 1996).[1]

- **Retail Electricity Market Activities** are aimed at strengthening the business relationship between utilities and their customers not only for providing new energy-related products and services but also to build loyalty and enhance service value.

- **Non-Energy Retail Activities** involve products and services that some utilities wish to provide on a competitive basis with other vendors such as cable, wireless, and telephone companies.

The focus of our study is limited to retail electricity market and non-energy retail activities. Retail electricity market activities involving residential customers are the primary focus of this report. In Table 1-2, we classify these retail market activities in terms of their communications system functionality requirements: system capacity (e.g., narrowband vs broadband) and necessity for customer feedback and interactivity (i.e., one-way vs. two-way).[2] Understanding functionality requirements is important because

[1] FERC required utilities to establish an open access information system (OASIS) to encourage the development of more competitive bulk power markets.

[2] There are not universally accepted definitions of the break points between narrowband, wideband, and broadband systems. According to EPRI (1994), narrowband systems operate at rates of up to 64,000 bits per second, wideband systems operate at rates between 64,000 and several million bits per second, and broadband systems operate at rates of about 10 million bits per second. However, many practitioners prefer not to differentiate between wideband and broadband and label systems as broadband if they operate at greater than 1 million bits/second.

it impacts the selection of communications systems, which affects costs and profitability of providing certain services. In general, the greater the functionality, the greater the bandwidth and cost. Hybrid fiber-optic and coaxial cable (i.e., broadband) networks offer the greatest capability for two-way exchange of large volumes of information between utilities and customers and hence greater functionality. However, these systems are the most expensive to install at this time.[3]

Table 1-2. Retail Electricity Market Opportunities Enabled by Technology Choices

Communications Technology/ Customer Requirements	Broadband	Narrowband
One-Way	- Energy information and education (energy broadcasts on television)	- Demand management (direct load control)
Two-Way	- Power quality monitoring - Energy information and education (interactive) - Bill feedback - Energy management (interactive)	- Remote connect/disconnect - Outage detection and handling - Remote/automated meter reading - Automated billing - Energy and customer monitoring - Real-time pricing

Table 1-3 provides an overview of telecommunications systems currently used by utilities to support various types of DSM programs. One hallmark of the traditional use of telecommunications in DSM programs is that the majority of communications were one-way, from the utility to the customer and required little telecommunications system bandwidth capacity (i.e., narrowband). As noted earlier, residential direct load control programs have targeted air conditioning and water heating loads of residential customers since the 1970s. Utilities have also experimented with time-of-use pricing and various types of energy information programs (e.g., innovative customer bills, energy education, audits) to elicit response from residential customers. Real-time pricing and interruptible rates are often directed at larger commercial and industrial customers.

3 Broadband includes hybrid fiber-coax cable systems while standard twisted-pair telephone line, radio, and powerline carrier systems are narrowband.

Table 1-3. Demand-Side Management Programs and Communications Systems

Program Type	Load-Shape Objective	Telecommunica-tions System	Target Market (Activity Level in U.S.)
Direct Load Control	Peak Clipping	Radio, Powerline Carrier	Residential and small commercial air conditioning and water heating (over 450 programs)
Real-Time Pricing	Peak Clipping, Valley Filling	Telephone Lines	Large commercial/industrial customers (small number of pilot programs)
Interruptible Rates	Peak Clipping, Valley Filling	Telephone Lines	Large C/I customers (hundreds of programs)
End-Use Metering	Not applicable (used to measure DSM program performance)	Telephone Lines	Residential and commercial customers (over 90 utilities have conducted 500 programs)
Energy Management Cooperatives	Peak Clipping, Valley Filling	Telephone Lines	Large C/I (small number of pilot programs)

1.2 Approach

In this study, we collected and analyzed market data from three primary sources: (1) vendors of telecommunications equipment, software, and metering technologies, (2) utilities conducting pilot projects, and (3) focus group and interviews conducted directly with a small number of residential customers.

We reviewed product literature from vendors and conducted a series of telephone interviews with technical representatives. Descriptions of various products were compiled and are summarized in Appendix A. We also conducted telephone interviews with project managers at utilities, using an interview protocol and data collection instrument to gather consistent information on the size, scope, team members, equipment, services, status, and stage of development of projects. Project summaries were prepared (see Appendix B) and as a quality control check were sent to utility project managers to verify and validate their responses. A caution to the reader: while every effort was made to collect accurate information, the rapid pace of developments in these projects means that some of the reported information could be out-of-date.

We also conducted a focus group and interviews with a small number of customers that explored their interest in and willingness to pay for a set of fourteen proposed services. While the results obtained from the focus group and customer interviews provide are evocative and insightful, the sample size is too small for statistical analyses, thus limiting the extent that generalizations can be made.

1.3 Organization of the Report

In Chapter 2, we report on results from our survey of 21 utility projects, including services offered. In Chapter 3, we identify and analyze key market trends, including market entry strategies employed by utilities, strategic alliances and teaming arrangements, and a preliminary assessment of costs and benefits. In Chapter 4, we present results from our customer interviews and focus group and discuss reactions to specific energy information and other services. Key findings from our exploratory market research are summarized in Chapter 5.

Survey of Electric Utility Projects

2.1 Overview

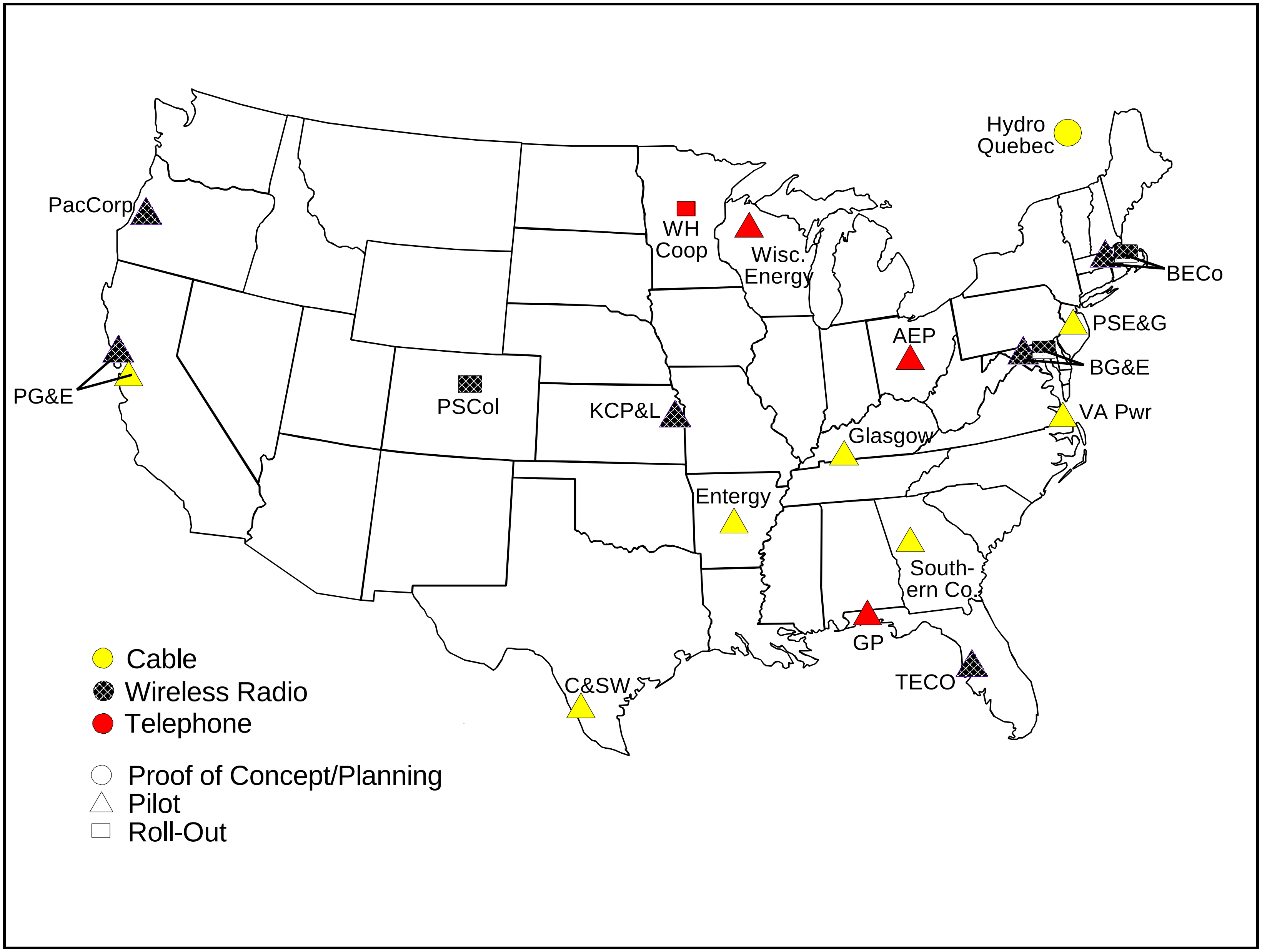
This chapter presents results from our survey of 21 utility-customer telecommunications projects at 18 utilities. We provide summary descriptions of pilot projects, which are classified based on their primary communications modes (e.g., telephone lines, wireless radio networks, and hybrid fiber-coax cable). We discuss the types of services offered in these pilots as well as utility experiences implementing specific services.

Every utility in our sample offered automated meter reading (AMR). Projects that use wireless radio communications systems are farthest along in terms of large-scale system deployment compared to fiber-coax cable projects. However, wireless radio projects typically offer only energy-related services. We found that there is a significant gap between services that utilities currently offer and their planned offerings in the future, particularly with respect to non-energy services. Cable-based projects currently include or plan to offer a broader array of energy and non-energy services, although almost all projects are still in the pilot or proof-of-concept stage.

2.2 Approach

We identified about 40 projects initially based on interviews with 11 telecommunications equipment and software vendors and a literature review of the trade press, conference proceedings, and recent publications (Chartwell 1995; Andersen Consulting 1995). We focused on projects that targeted residential customers and offered energy information services in conjunction with other services. Projects were eliminated either because they were outside of the study's scope or because utility representatives were unwilling to provide the minimum information requested in our survey. We conducted telephone interviews with utility staff involved in 21 projects between August-October 1995. Written summaries of the interviews were then sent to utility contacts and vendors who had an opportunity to verify the accuracy of the information. Appendix A provides detailed description of vendor products, including technology characterization and current projects with utilities. Appendix B provides a detailed summary of each utility project, including key team members, target market, services offered, and status.

Figure 2-1. Selected Utility Telecommunications Projects



2.3 Project Descriptions

Table 2-1 provides background information on the utilities in our survey. With two exceptions (Glasgow Electric Board and Wright-Hennepin Cooperative), utilities in our sample are investor-owned and cumulatively account for about 15% of U.S. residential electricity sales. The sample is geographically diverse and includes utilities of varying sizes (see Figure 2-1). A number of these utilities (e.g., Boston Edison, Pacific Gas & Electric, Baltimore Gas & Electric, and Public Service Electric & Gas) are currently implementing relatively large residential DSM programs. However, previous experience with large-scale residential DSM programs does not appear to be a decisive factor in explaining utility interest in communications-based energy services.

Table 2-2 provides background information on each project including the primary communications media between the utility and customer (e.g., hybrid fiber-coax cable, telephone, fixed or mobile wireless radio frequency), the project's status and stage of development (e.g., proof-of-concept, pilot, market roll-out), the number of participating households and location of the project. For discussion purposes, we describe the projects in terms of primary data communications mode or network.[4]

2.3.1 Hybrid Fiber-Coax Cable Network Projects

Eight projects utilize hybrid fiber-coax cable networks to establish the communication link between the electric utility and customers; projects are typically in the pilot or proof-of-concept stage and are limited in scope to a few hundred customers. Several projects that utilize First Pacific Network (FPN) products have substantial field experience. In 1989, Glasgow Electric Board constructed a 120-mile coaxial cable network and was a beta test site for FPN's first generation product (FPN 1000), which features non-energy services (cable TV to over 3,000 subscribers and telephone and LAN services to several hundred customers). Currently, Glasgow Electric Board is involved in a pilot project that focuses on the customer's willingness to heat water off-peak in response to a favorable tariff offered by Tennessee Valley Authority (2.7 ¢/kWh after midnight for water heating).

As of December 1995, Central & South West's Customer Choice and Control has completed installations in over 600 homes in Laredo, Texas. This project focuses on energy management, testing customer's interest in and ability to shift load, given their control over scheduling and usage of major appliances. Participants can control use of

[4] Other technical alternatives that are currently available or under development , which are not represented in our sample of utilities, include: power-line carrier technology, Low-Earth Orbiting Satellites (LEOS), and Personal Communications Services (PCS) and Cellular networks. There are numerous ways to combine technologies in a system (e.g., power line carrier technology within customer premises or from meter to local collector combined with radio or broadband from local collector to utility head-end).

Table 2-1. Electric Sales/Revenues and DSM Program Impacts for Sample Utilities

Utility	Class	Total Sales (GWh)	Residential Sales (GWh)	DSM Savings (GWh)	Electric Revenues ($Million)	DSM Program Costs ($Million)
American Electric Power	Parent	93,534	28,876	100	4,524	9
Baltimore Gas & Electric	IOU	26,772	10,614	190	2,001	66
Boston Edison	IOU	12,516	3,487	382	1,287	57
Central & South West	Parent	41,363	13,426	270	2,431	9
Entergy	Parent	59,144	18,945	NA	4,005	NA
Glasgow Electric Board	Municipal	274	54	NA	15	NA
Gulf Power	Subsidiary	8,193	3,713	418	472	52
Hydro Quebec	Gov't.	NA	NA	NA	NA	NA
Kansas City Power & Light	IOU	11,303	3,582	NA	784	2
Pacific Gas & Electric	IOU	75,807	24,111	1,610	7,542	147
PacifiCorp	Parent	57,362	12,054	678	1,968	41
Public Service of Colorado	IOU	19,523	5,776	97	1,169	8
Public Service Electric & Gas	IOU	38,154	10,631	56	3,628	50
Southern Development Invest. Group	Subsidiary	NA	NA	NA	NA	NA
TECO Energy	Subsidiary	13,446	5,706	162	942	16
Virginia Power	IOU	68,184	21,846	160	3,784	36
Wisconsin Energy	Subsidiary	20,291	6,405	1,286	1,153	58
Wright-Hennepin Cooperative	Cooperative	398	274	NA	28	NA
Utilities in Our Sample		546,264	169,500	5,409	35,733	551
All U.S. Electric Utilities		2,763,365	935,939	44,349	198,220	2,769

Source: Energy Information Administration (EIA). Form 861 and Annual Electric Utility Report 1993.

Table 2-2. Overview of Utility-Customer Telecommunications Projects

Communications System	Utility	Project Name	Status	Location	Number of Customers
Cable	Central & South West	Customer Choice & Control	Pilot	Laredo, TX	600
	Entergy	Customer-Controlled Load Management	Pilot	Chenal Valley, AR	50
	Glasgow Electric Board	TVA Water Heater Project	Pilot	Glasgow, KY	100
	Hydro Quebec	Universal Bidirectional Integration	Pilot (P)	Chicotimi, QU	440
	Pacific Gas & Electric	Energy Information Services	Pilot	Walnut Creek & Sunnyvale, CA	100
	Public Service Electric & Gas	Integrated Broadband Utility Solution	Pilot	Moorestown, NJ	1,000
	Southern Dev. Inv. Group	Dominion Project	Pilot	Duluth, GA	303
	Virginia Power	Cable-Based Energy Management System	Pilot	Norfolk & Virginia Beach, VA	< 48
Telephone	American Electric Power	TranstexT	Pilot (C)	Dublin, OH; Muncie, IN; Roanoke, VA	460
	Gulf Power	Advanced Energy Management System	Pilot	Gulf Breeze, FL	240
	Wisconsin Energy	Energy Oasys	Concept	Milwaukee, WI	15
	Wright-Hennepin Cooperative	Meter Minder	Roll-out	MN, OK	5,000
Fixed Wireless Radio	Baltimore Gas & Electric	IRIS Fixed Network	Pilot	Timonium, MD	100
	Boston Edison	UtiliNet Automatic On/Off	Pilot (C)	Brighton, MA	15,000
	Kansas City Power & Light	CellNet Pilot	Pilot	Johnson Cty, KS	5,000
	PacifiCorp	UtiliNet	Pilot	Canon Beach, OR	100
	Pacific Gas & Electric	CellNet	Pilot (C)	North Bay, CA	1,700
	TECO Energy	TeCom Inc.	Pilot	Tampa, FL	140
Mobile Wireless Radio	Baltimore Gas & Electric	Itron AMR	Roll-out	MD	<500,000
	Boston Edison	Itron AMR	Roll-out	Boston, MA	40,000
	Public Service of Colorado	Itron AMR	Roll-out	Denver, CO	300,000

Note: C = Completed, P = Planned

their air conditioner, water heater, and clothes dryer in response to pre-specified time-of-use rates that range between 5.5 and 50 ¢/kWh.

Entergy has substantially downsized its highly-publicized Customer-Controlled Load Management pilot compared to its initial pronouncements. The company has completed installations in about 40-50 homes in the Chenal Valley of Arkansas compared to its original goal of several thousand homes.[5] Entergy is testing a broad set of energy and non-energy services including customer-controlled load management of up to four major appliances (e.g., HVAC, hot water, and two additional appliances), automated meter reading, 22 cable TV stations, and long-distance telephone service. The project was initially co-developed by Entergy and FPN, although FPN is no longer actively involved in the project. Entergy now plans to continue the program, testing a new time-of-use tariff through January 1997, but does not expect a roll-out after the pilot.

Several other cable-based projects are being developed jointly by electric utilities, software companies, and telecommunications or cable TV service providers. Examples include the Energy Information Services trial in which TCI, Microsoft, and Pacific Gas & Electric are taking leading roles. In New Jersey, Public Service Electric & Gas (PSE&G) and Lucent Technologies (formerly AT&T) completed a ten-home proof-of concept in 1995 and have completed equipment installation in a 1,000 customer technical trial of their Integrated Broadband Utility Solution (IBUS) project. PSE&G/Lucent are currently field testing various devices and services among sub-groups of customers. One sub-group of customers is receiving real-time prices over the utility's communication system via a "smart" thermostat, which can be programmed to control HVAC system in response to these time-varying prices. Virginia Power has teamed with Cox Cable to conduct a small pilot program (~50 homes) in two neighborhoods (Virginia Beach and Norfolk) where the backbone hybrid coax cable network is already in place.

Projects sponsored by two utilities, Hydro Quebec and Southern Company, have not yet begun installations. Hydro Quebec's project, called Universal Bi-directional Integration (UBI), is still in the planning stages, with testing slated to begin in September 1996. The energy services portion of this project is limited to a town in northern Quebec, Chicotimi, that is noteworthy because of its relatively high saturation and use of electric appliances and equipment. As a result, the town is a target for Hydro Quebec's load management and efficiency programs. Southern Development Investment Group (SDIG), an unregulated subsidiary of the Southern Company, is testing an extensive set of energy and non-energy services (e.g., home security, cable TV, video on demand) in a new, all-electric apartment complex in Georgia Power's service territory. Dominion, the developer of the complex, has aggregated the load under a master metering contract with Georgia Power.

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5 In January 1994, Entergy announced its intent to deploy a 10,000-home pilot throughout the Entergy system at shareholder expense to demonstrate functionality and potential of its Customer-Controlled Load Management pilot, with the option to request cost recovery later for the program (Vince et al. 1994).

Electric utilities offered various reasons for their participation in these projects including a desire to develop new products and services (3), reduce summer peak demand (2), and test innovative rates (1) (see Table 2-3). Among the eight projects, there is substantial diversity in the types of customers and residential market segments targeted by utilities.

Table 2-3. Hybrid Fiber-Coax Cable Projects

Utility	Test Start	Test End	Homes	Reason	Target Market
Central & South West	Mar. 1994	Dec. 1995	500	Reduce summer peak in Laredo	Single family homes
Entergy	Jan. 1996	Jan. 1997	40	High electricity prices	Wealthy, sophisticated substation
Glasgow Electric Board	Dec. 1995	June 1997	50	Test variable rate	Electric water heaters
Hydro Quebec	Sept. 1996	Mar. 1997	330**	Join information highway	Wealthy, all-electric homes
Pacific Gas & Electric	June 1995	Mid-1996	100	Sell product to other utilities	Temperate/coastal climates
Public Service Electric & Gas	Dec. 1995	Dec. 1996	1000	Develop new product	Demographic mix
Southern Development Invest. Group	Apr. 1996	June 1998	303	Reduce summer peak in Atlanta	All-electric wealthy apartments
Virginia Power	May 1995	May 1997	48	Develop new product	VEPCO/Cox employees' homes

** In addition, 110 homes were metered as control group.

For example, several utilities (Public Service Electric & Gas and Central & South West) are consciously seeking a broad demographic mix among residential customers. Several pilots target wealthy owners of single-family houses (e.g., Entergy, Hydro Quebec) or upscale tenants in multi-family complexes (Southern Company) because there may be greater interest in and ability to pay for non-energy services (e.g., home security, video on demand). Customers that live in all-electric homes are often targeted, especially residences with electric heating and air-conditioning, because there may be greater opportunities to either shift or reduce electricity demand. One utility is targeting knowledgeable customers who have already participated in other DSM programs because they may be more receptive to and familiar with customer-controlled load management. In some cases, the utility’s choice of location for its pilot is heavily influenced by its desire to make use of an existing hybrid fiber/coax cable network (e.g., Virginia Power).

2.3.2 Telephone-Based Projects

Projects sponsored by four utilities employ telephone communications between utility and the home and powerline carrier within the home. The most novel is the Energy Oasys project, co-developed by Wisconsin Energy Corp. and Ameritech, which combines wireless paging to the customer with telephone from the customer. A large suite of energy and non-energy services is envisioned after proof-of-concept testing is completed. Energy Oasys participants use a plug-in device to receive energy information and control appliances in response to time-of-use rates.

American Electric Power (AEP) and Gulf Power (a subsidiary of Southern Company) are using TranstexT products in their pilots. In fact, both holding companies are investors in Integrated Communications Systems (ICS), developer of the TranstexT product line. Customers have the ability to choose automatic settings for heating and air conditioning at four price tiers; electricity price data is received from the utility via telephone line modem. An interesting aspect of the AEP project is their ability to monitor the performance of 460 participating residences in three distinct geographic areas (and operating subsidiaries) from a single computer in the holding company's headquarters in Columbus, Ohio. AEP recently requested that the Public Utilities Commission of Ohio approve a permanent “variable spot price rate” which would enable AEP to roll-out the project in Ohio by 1997. Ultimately, AEP plans to roll out the project to 25,000 homes across six states by the end of 1998. Gulf Power’s project, called Advanced Energy Management System targeted large electricity-intensive single-family homes in Gulf Breeze, Florida and was completed in 1994. Gulf Power equipped 240 homes with a smart thermostat and meter for time-of-use rates, and a control group of 200 homes with meters only. Gulf Power is not convinced that telephone is the appropriate technology to communicate TOU prices and plans to test fixed wireless radios to broadcast price information.

Wright Hennepin Cooperative Electric Association offers a telephone-based home security system, known as Meter Minder, with automated meter reading and power outage reporting, discounted cellular phones and long-distance telephone service, and an appliance warranty program. The utility has achieved relatively high market penetration as 3,000 of its 29,000 members have installed the Meter Minder; customers pay a $17.50 monthly fee for the home security add-on.

2.3.3 Wireless Radio Network Projects

Projects sponsored by seven utilities involve wireless radio communications in a *fixed* network. These radio networks typically consist of transmitter modules in residential electric meters, a local neighborhood collection unit (e.g., poletop communications node) with an integral radio that reads meters within its range, and a wide area radio infrastructure that brings meter reading and other information back to a central location. These systems typically have two-way networks from the local poletop collector back to the utility's central location, rather than all the way to the customer premise. (CPUC DAWG 1996).

A number of vendors have developed or are developing products using this technology including CellNet Data Systems, Itron, Metricom, IRIS and Schlumberger.[6] With one exception (TECO Energy), these projects offer only energy-related services. Fixed radio networks are most cost-effective when deployed in areas of medium to high density in relatively flat terrain because the cost per household depends to some extent on the number of meters that are within the range of the neighborhood collection unit.

Most projects are still in the pilot stages, although several utilities have recently signed contracts for system-wide roll-out. For example, Kansas City Power & Light, Union Electric, and Northern States Power have signed long-term contracts with CellNet, who will deploy an extensive wireless radio network in each utility's service territory that will ultimately provide over 2.5 million urban customers with various service options (Energy Services and Telecom Report 1996d).[7] CellNet basically offers a turnkey approach: utilities sign a long-term performance contract with the company for installation, operation, and maintenance of the system, paying a fee of about $1.00 per meter per month for the basic service of a daily meter read.

PacifiCorp and Boston Edison are deploying fixed network radio systems developed by Metricom; in these projects, the utility owns and operates the system outright. Baltimore Gas & Electric and TECO are testing load control options under time-of-use pricing while PacifiCorp is testing time-of-use pricing by providing customers with energy information through an in-home display unit. Some vendors of these systems claim that they can provide additional enhanced services beyond meter reading and other operational benefits

[6] Recently, Itron has purchased Iris and it appears that Metricom is focusing on utility applications rather than large-scale deployments to customers.

[7] As of June 1996, CellNet reports that 250,000 meters have been installed for Kansas City Power & Light and 30,000 meters are in place at Union Electric (Energy Services & Telecom Report 1996c).

once the communications system has been deployed over a significant portion of the utilities distribution network (see Table 2-4).[8]

Table 2-4. Potential Benefits of Fixed Radio Network Communications Systems

Meter Reading *Direct Benefits*	• Reduced manual meter reading costs • Reduced service turn-on and turn-off costs • Reduced accident and injury costs associated with meter reading activities • Fewer missed and inaccurate reads (and customer complaints) because of automated data collection
Meter Reading *Indirect Benefits*	• Reduced interest expenses associated with accounts receivable because meter read to collection time is shortened • More flexible billing options (e.g., summary billing and selectable bill date) • Ability to continuously monitor customers with recurring payment problems
Other Benefits	• Alarms for meter tampering • Deliver real-time outage alarms and restoration notification
Up-Side Revenue Opportunities	• Gas & Water Meter reading • Vending data and security alarm

Source: "Vendor Carries Investment in AMR." 1995. *Electrical World.* April; "Design and Implementation of Direct Access Programs." 1996. CPUC Direct Access Working Group (DAWG). August 30.

We surveyed three utilities (Baltimore Gas & Electric, Boston Edison, Public Service of Colorado) that are currently involved in large scale system roll-outs of *mobile* wireless radio projects to several hundred thousand customers. In these systems, utilities have installed radio modules in electric meters, both new and existing, and then use radio-equipped vans that drive by slowly to collect meter readings. As currently configured at most utilities, these systems typically utilize only one-way communication.[9] This technology is attractive to utilities with many difficult- or dangerous-to-read meters.

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8 Fixed radio networks are especially suited for handling short bursts of information (like meter reads) and are currently unable to handle long, large information streams (e.g., voice and video). (CPUC DAWG 1996).

9 Itron is currently developing a fixed radio network system with local controllers (cell control units or CCUs) on power poles called Genesis, which will allow for two-way communication (see Appendix A).

2.4 Customer Energy Services

In this section, we discuss overall trends in the types of services offered and describe utility experiences implementing specific services.

2.4.1 Range of Service Offerings

Table 2-5 shows the energy and non-energy services that utilities are currently offering in their project or planning to offer in the future. The range and type of services varies somewhat by communications system. For example, utilities involved in hybrid fiber-coax cable projects offer a broader array of energy and non-energy services compared to radio and telephone-based projects. Non-energy services include home security, telephone service, medical alert, cable television, video-on-demand, and internet access. In contrast, wireless radio projects currently offer only energy information services. Mobile radio projects focus on energy-related services that provide operational savings to the utility (e.g., AMR, remote connect/disconnect, outage detection), while fixed network radio projects have also utilized
in-home display devices to facilitate load control, TOU pricing, and energy information services.

There is also a significant gap between services that utilities currently offer and their planned offerings in the future, particularly with respect to non-energy services (see Table 2-5). For cable projects where utilities have not completed installations or have not yet implemented a particular service, we indicate energy services that are planned (shown as P in Table 2-5). In some wireless projects, utilities are planning to expand their current services to customers to include load control and TOU pricing. Only three utilities (Glasgow, Wright-Hennepin, and Entergy) currently offer non-energy services in their pilots; other utilities are planning to offer these services in the near future.

2.4.2 Automated Meter Reading

Every utility in our sample offered automated meter reading (AMR) in their project. The potential market for AMR is huge as a relatively small fraction (2-3%) of the nation's 150 million electric, and 75 to 100 million gas and water meters are automated thus far. Industry analysts are predicting rapid growth in the AMR market for electric meters: a seven-fold increase by 2000 from current levels (~1.1 million). Over 30 vendors offer AMR systems, although a few companies are quite dominant in terms of market share (Electrical World 1996).

It appears that utilities use AMR to "test the water" for more extensive telecommunications-based services. Currently, utilities typically spend only about 0.50-$0.80/month on the direct costs for manual and appointment meter reads. This means that the overall cost of an AMR system must be fairly low (<$75 per meter installed) to pay

Table 2-5. Services Offered in Utility Telecommunications Projects

Communications System	Utility	Automated Meter Reading	Outage Detection	Remote On/Off	Load Control	TOU Pricing	Energy Information	Planned Non-Energy Services[a]
Cable	Central & South West	x	P		x	x	x	
	Entergy	x			x	P	x	C, T*
	Glasgow Electric Board	P				x		H, C, I, O*
	Hydro Quebec	P			P	P	P	C, V, I, O
	Pacific Gas & Electric	x			P	x	x	H, O
	Public Service Electric & Gas	x	x	x	x	x	x	H, M, O
	Southern Dev. Invest. Group	P	P			P	P	H, M, C, V, I, O
	Virginia Power	x	x		x	P	P	C, V, T, I
Telephone	American Electric Power	x				x	x	
	Gulf Power	x	P			x		
	Wisconsin Energy	x	x	x	x	x	x	H, M, O
	Wright-Hennepin Cooperative	x	x				x	H, T, O*
Fixed Wireless Radio	Baltimore Gas & Electric	x	x		P	P		
	Boston Edison	x		x				
	Kansas City Power & Light	x	x			P		
	PacifiCorp	x				x	x	
	Pacific Gas & Electric	x						
	TECO Energy	x			x	x	x	H, M, I, O
Mobile Wireless Radio	Baltimore Gas & Electric	x		x				
	Boston Edison	x		x				
	Public Service of Colorado	x	P			P		M,O

Notes: X= energy service is currently offered; P = planning to offer service in the future

[a] Non-energy services are currently offered in only Entergy, Glasgow, and Wright Hennepin pilots; other utilities are planning to offer these services in future; H = Home Security, M = Medical Alert, C = Cable TV, V = Video on Demand, T = Telephone Services, I = Internet Access, O = Other

for itself in a reasonable time. On a stand-alone basis, AMR may be cost-justified only in certain niche markets (e.g., difficult-to-read meters, high-density urban areas). However, vendors claim that these systems also reduce losses from tampering and theft, and costs associated with disconnections (Jennings 1996).[10] In addition, these systems may improve billing reliability (e.g., usage on inactive accounts) and customer service (e.g., fewer errors than manual reads leading to fewer customer complaints), which may reduce the utility's exposure to bad debt or uncollectibles. Finally, the information collected by an AMR service (e.g., hourly data stored for 40 days of usage) provides increased functionality to the utility which can be used to create new energy information services and products.

One utility in our sample reported that meter reading costs had dropped from about $1.00/month (fully loaded with benefits) to about $0.20 per meter per month. Another utility reported that its mobile wireless system paid for itself in less than seven years. In contrast, another utility thought that the project economics for its wireless radio pilot were relatively poor because the customer to transformer ratio was low throughout its service territory; thus system costs were high (because radio was installed on transformers). In evaluating the economics of a network-based AMR system for an individual utility, a number of factors affect the benefits, including (1) current costs for meter reading and related customer services, (2) age and type of existing meters (e.g., number of meters that can not be retrofitted; number of indoor vs. outdoor meters), and (3) population density, geographic distribution, and customer mix of the utility.

2.4.3 Outage Detection

We received divergent opinions on the usefulness of automatic reporting to utilities of unscheduled outages by relays on customer meters. Product vendors touted the benefits of outage reporting. Based on their experiences, some utility representatives thought that it was more effective to have a distribution substation or transformer report its outage status to headquarters rather than customer meters served by that station calling in outage reports.

10 Vendors claim average savings of about $0.25 per meter per month from reduced energy theft and tampering. Utilities can also set threshold alarms for unauthorized usage which can eliminate about 75% of the disconnection visits, which cost about $7.80. Connects and disconnects affect about 30% of customers annually; thus vendors claim average savings of about $0.20 per month per meter (Jennings 1996).

2.4.4 Remote Connect/Disconnect

Several utilities (Boston Edison and Baltimore Gas & Electric) indicated that inaccessible meters or problems and costs associated with high turnover among customers was a major contributing factor in their decision to test automated services. For example, BG&E indicated that the utility has about 15,000 physical turn-ons/turn-offs each month due to high turnover among students and apartment dwellers. Because of the large number of universities in the Boston area, Boston Edison's residential customer base includes a disproportionately high number of relatively transient students. The utility incurs additional costs to serve this population (e.g., students move without closing out their bill or notifying the utility, utility staff must verify status of use and payment). Thus, these utilities installed a meter that can be triggered by the utility to shut off when payment is not received or reactivated when payments begin anew. These meters can also disconnect when tampering or theft is detected.

2.4.5 Load Management

As discussed in Chapter 1, many utilities have traditionally offered direct load control programs in which they controlled specific appliances, such as air conditioners or water heaters, during peak demand periods to reduce system loads. Typically, in exchange for allowing the utility to control certain appliances, customers receive a bill credit in the range of $5 to $10 per month, during the load control season.[11] Based on our sample, we found that utility control of customer appliances is giving way to customer-controlled load management (CCLM) in which customers can preprogram response of individual appliances to time or price signals.

2.4.6 Time-of-Use Pricing

About half of the projects in our sample included time-of-use prices. Some utilities obtained approval for their tariff from the local city government (e.g., Central & South West) or state regulatory authority. Other utilities (e.g., TEMS and Virginia Power) indicated that the TOU pricing schemes were experimental and would not be formally filed with the state PUC.[12] Utilities typically post prices for up to four periods (i.e., low, medium, high, and critical), which are signaled to customers through an interactive

[11] For example, PSE&G has a direct control program in which customers are paid $8 for four months of permitting the utility to control central air conditioners no more than 15 times a year.

[12] In TECO Energy's project, participation is limited to TECO employees. In the event that participating customers do not succeed in saving energy and reducing expenses in response to the TOU rate, employees are permitted to submit expense reports to cover the difference between the old billing and the experimental billing.

thermostat or an in-home display device. Prices in the four tiers ranged between about 5 and 50 ¢/kWh in CS&W's Laredo pilot. TOU rates ranged between 1 and 28 ¢/kWh in AEP's pilot project with its TranstexT system. The customer may chose to reduce heating and cooling equipment, pool heaters, water heaters, dishwashers, or other appliances during a high or critical price period or shift use to a lower price period. In our sample of projects, no more than eight appliances could be controlled, although one utility (TECO Energy) claims that it plans to control up to 17 devices through CEBus-adapted plugs and thermostats.

2.4.7 Energy Information

About half of the utilities in our sample offer various energy information services. We found that utilities in our sample are currently testing a rather limited set of energy information services compared to those that potentially could be offered to residential customers (see Chapter 4).

For example, in its Customer Choice and Control pilot, Central & South West presents the following information to customers in its in-home display unit: temperature in the home,
time and date, price currently in effect, programmed response of appliance to price signals, vacation schedule programming, and electric bill to date (in dollars and kWh). In Pacificorp's pilot, the in-home display provides energy information through a sequenced menu display which includes four functions: energy usage in kWh and $ (i.e., last week, last month), historical energy usage in kWh and $ to compare this month with last year, a pre-set energy budget for customer based on recent and historical usage, and rate structure in effect. The customer is alerted by an LED on the front of the in-home device if actual usage exceeds budgeted consumption.

CSW and PG&E plan to offer itemized bills, with usage quantities under each price tier (see Figure 2-2). TECO Energy plans to track energy use by appliance load with sub-metered information available on four to eight appliances. PSE&G plans to offer customer messaging

Figure 2-2. Sample Itemized Bill

ELECTRIC BILL

Customer Name and Address

Total Due: $99.61

Account Number 000-001

Billing Summary from 6/15/96 to 7/14/96

APPLIANCES	Total	Low Tier 1	Medium Tier 2	High Tier 3	Average Daily Rate
Air Conditioning	$44.38	$7.76	$15.64	$9.23	$1.53
Water Heater	$23.92	$12.43	$15.38	$0	$0.82
Dryer	$8.54	$2.87	$5.67	$0	$0.29
Other	$22.77	$3.62	$12.23	$4.58	$0.79
MONTHLY TOTAL	$99.61	$26.68	$48.92	$13.81	$3.43

Source: CSW, Customer Choice and Control through one-liners on in-home displays, e.g., notifying customers when gas pressure gets low and request that gas heat use be restricted voluntarily until notified otherwise. PSE&G is also interested in customer load shape information: the utility will be able to generate customer load profiles for electric and gas consumption, graphing out use in five- to 15-minute intervals.

2.4.8 Other Energy Services

One of the more unique services is the Energy Saver Module offered by Wright-Hennepin Cooperative. Customers with weekend cabins can remotely turn on the heating system and selected appliances and lights from a touch-tone telephone which accesses a setback thermostat.

2.4.9 Home Security

Wright-Hennepin is the first electric utility to offer home security monitoring through its Meter Minder project and its program extends into three service territories in Minnesota and Oklahoma. Customers pay a monthly charge of $17.50 for the security monitoring service, which generates annual revenues of about one million dollars for the utility. The window and door sensors are wireless and are controlled by a touch pad device or a touch-tone telephone. The alarm system communicates with central monitoring through the Meter Minder's telephone connection.

About one-third of the utilities in our sample are considering offering home security services in the future. For example, SDIG has wired the common areas (e.g., pool, garage, lobby) of the large apartment complex, which is the site for its pilot; apartment dwellers will be able to access and view activity in common spaces through their cable television sets.

2.4.10 Medical Alert

Several utilities indicated that they are planning to offer some type of medical alert feature. For example, TeCom Inc., an unregulated subsidiary of TECO Energy, is considering offering in-home medical monitoring through relationships with hospital in South Florida, although implementation details have yet to be worked out.

2.4.11 Cable Television

Cable-based projects with set-top box controllers plan to offer cable television services.[13] A few utilities already compete with cable providers, most notably Glasgow Electric Board serving 3,000 subscribers. Entergy offers 22 stations and Virginia Power plans to offer cable TV through its Cox Communications partner.

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[13] Several utilities testing hybrid fiber-coax cable systems, but not the TV as the device, do not plan to compete with existing cable providers in their service territory.

CHAPTER 3

Market Trends

3.1 Overview

In this chapter, we draw upon our survey of utility projects, discussions with product vendors, and review of the literature to summarize major market trends. We describe alternative strategies used by utilities to enter the market to provide communications-based services, strategic alliances and teaming arrangements between utilities and telecommunications providers, and the characteristics and costs of competing communications systems.

The battle for competitive advantage involves choice of communications technologies, vendor products, and service offerings as utilities have formed strategic alliances with telecommunications providers and product vendors. Scores of utilities are conducting technical and market trials, although, thus far, only a handful of utilities appear to have either demonstrated significant operational savings or successfully marketed energy and non-energy services that generate significant revenue streams from residential customers. Given differences in population density and existing utility systems infrastructure, no single communications delivery system is capable of serving all residential market niches economically. At present, the installed costs per household for wireless radio projects are substantially lower than for hybrid fiber-coax cable projects ($100-300 vs. $1,000-3,000); several utilities have opted for full-scale, system-wide deployment of wireless radio systems. Broadband cable projects offer increased functionality and upside revenue potential from non-energy services, but face a formidable competitive challenge if wireless radio projects foreclose or limit their deployment by capturing most of the potential energy-related benefits (e.g., operational savings, energy information services). Large-scale deployment of cable systems to residential customers may well hinge on the abilities of utilities to meet aggressive cost targets ($300-500/house) and develop attractive applications that customers are willing to pay for.

Scores of utilities are conducting trials—only a handful have demonstrated significant operational savings or successfully marketed energy and non-energy services to residential customers that generate significant revenue streams.

We are convinced that these utility pilot projects for communications-enabled services foreshadow the future of residential customer energy services and DSM. This is one of the few growth areas in utility DSM: in aggregate, the cumulative financial investment of utility shareholders and other equity partners may soon approach recent funding levels for ratepayer-funded DSM activities targeted at residential customers ($700-900 million/year in 1994). However, given the market and regulatory uncertainties and technological risks, utilities and their partners must overcome significant hurdles before large-scale deployment of a comprehensive set of communications-enabled services in the residential sector becomes a robust and profitable business activity.

3.2 Market Entry Strategies

The diversity of market entry strategies reflects the early stage of market development and the fact that the choice of communications system (i.e., superior economics and technical features) depends on density, geography, existing communications infrastructure, and desired services.

Utilities must consider several key parameters in providing energy information services to residential customers: communications delivery system ownership issues (e.g., utility-owned or lease from telecommunications service provider), and communications capability (e.g., one- or two-way). Until recently, utilities have traditionally owned and utilized one-way, wireless or powerline carrier communications systems to provide direct load control and energy information services. Projects in our sample highlight five other emerging market entry strategies that utilities are pursuing: (1) utility owns cable network, (2) utility leases capacity on cable network from telecommunications services provider, (3) utility owns wireless radio system, (4) utility leases wireless system from vendor, and (5) utility leases telephone-based communications system (see Table 3-1).[14]

The diversity of approaches reflects the early stages of market development for communications-enabled services as well as the likelihood that no single communications delivery system will be capable of serving all residential market niches economically, given differences in population density, building stock, and existing utility system communications infrastructure. Some utilities are conducting multiple pilots that test alternative communications delivery systems. For example, both Boston Edison and Baltimore Gas & Electric are trying two different types of wireless radio technologies, while PG&E is conducting pilot projects using cable and wireless radio systems.

[14] Within the home, powerline carrier (PLC) technology is typically used to integrate smart thermostats or energy management systems with these communications systems that connect the utility to the residence.

Table 3-1. Market Entry Strategy

Strategy	Utilities Interviewed	Vendors Interviewed
Utility-owned, two-way cable network	Central & South West (CSW) Entergy Glasgow Electric Board Southern Development Invest. Group	First Pacific Networks
Leased, two-way cable network	Hydro Quebec Pacific Gas & Electric (PG&E) Public Service Electric & Gas (PSE&G) Virginia Power	Cox Communications Intellon Lucent Technology TeleCommunications Inc.
Leased, two-way telephone network	American Electric Power Gulf Power Wright-Hennepin Cooperative	Integrated Communications Systems Interactive Technologies Inc.
Utility-owned, two-way wireless network	Baltimore Gas & Electric Boston Edison PacifiCorp TECO Energy	CIC Systems IBM Metricom
Leased, two-way wireless network	Kansas City Power & Light Pacific Gas & Electric	CellNet Data Systems
Utility-owned, one-way wireless network	Baltimore Gas & Electric Boston Edison Public Service of Colorado	Integrated Systems Solutions Corp.

3.2.1 Virtues of "Early" Entry

Utilities and product vendors believe that early, successful entry, defined as significant market share, will create a sustainable competitive advantage in this emerging business area. This view follows the "conventional wisdom" in marketing literature on new product and service development. We also believe that a case can be made that significant investments in a particular type of technology infrastructure may foreclose, or seriously limit, competing alternatives. For example, assume that utilities deploy fixed wireless radio networks in system roll-outs and that this enables them to capture most of the potential energy-related benefits (e.g., operations-related savings, energy information services). If this occurs, will utilities be less likely to develop and deploy competing communications systems, such as broadband cable networks. The economics of a broadband network to the customer premise may hinge on realizing benefits to the electric utility system (i.e., cost reductions and peak demand savings) as well as revenues derived from a broad array of energy and non-energy applications.

Knowledge-based products such as computers, telecommunications equipment, and fiber optics are largely subject to increasing returns to scale. Although these products (or systems) require large initial R&D investments, unit costs fall as more systems are built.

Moreover, the benefits of using these systems increase as the technology gains market share, particularly if they operate in networks that require compatibility. Economists describe this phenomenon as "path dependence:" a situation in which a technology or system's edge quickly snowballs into clear economic advantage because production costs fall as volumes and manufacturing experience increases and because consumer acceptance (or development of supporting products by suppliers) grows with greater familiarity (Arthur 1994; Passell 1996).[15]

3.2.2 Wireless vs. Broadband Projects

Thus far, wireless radio projects are farther along than competing communications delivery systems in terms of large-scale deployment. Recent contracts signed between utilities and various vendors for system-wide rollouts of fixed or mobile radio networks highlight this trend (e.g., Kansas City Power & Light, Union Electric). Wireless radio projects typically involve less complex teaming arrangements and fewer partners than broadband projects. Utility staff often are more familiar with wireless radio systems and have more experience integrating these systems into business operations (e.g., metering) or customer services (e.g., direct load control programs).

A fixed network radio system is most attractive in metropolitan areas with medium to high population density levels. Key factors that affect the large-scale deployment of these systems include: (1) demonstrating that a fixed radio network reduces operational and administrative costs of the utility or facilitates additional customer service offerings besides automated meter reading, and (2) maintaining their current cost advantage over competing technologies as they add functionality and services (e.g., security, home alarm). The economics of fixed network radio systems currently depend on widespread deployment over a geographic area and long-term contracts assuring recovery of the capital investment in infrastructure. Thus, a supportive regulatory environment and/or favorable regulatory treatment may also facilitate large-scale deployment. Examples include performance-based regulation, high probability of cost recovery under traditional cost-of-service regulation, or little pressure to unbundle the utility's distribution "wires" business from provision of various retail services (e.g., billing, information).

Over the last three to four years, a number of electric utilities have launched broadband projects with significant fanfare in the trade press. A few of the utilities, such as Entergy and Central & South West, have decided to build and own their communications

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15 A societal implication of the "path dependence" phenomenon is that "a technology that improves slowly at first but has enormous long-term potential could easily be shut out, locking an economy (industry) into a path that is both inferior and difficult to escape." Standards that are established early can be hard for later ones to dislodge, no matter how superior would-be successors may be (Arthur 1994). This argument has been raised by some broadband proponents (Rivkin 1996).

infrastructure between utility and customer. However, most other utilities (e.g., PG&E, PSE&G, Virginia Power, and Hydro Quebec) have decided to partner with cable and/or telecommunications companies and lease capacity on the provider's network. Electric utilities involved in broadband projects appear eager to get involved in the burgeoning home-based information, entertainment, and communications market. These utilities expect that residential customers will ultimately want a critical mass of compelling applications ("one-stop shopping") and that customers will want interactive services provided over familiar and easy-to-use interfaces (e.g., computer or TV). These utilities are also betting that, in the long run, they can improve the efficiency of utility operations by selecting a base communications system (i.e., two-way broadband) that can handle the greatest number of utility applications (Andersen Consulting 1995).

3.2.3 Corporate Strategy: Near-Term Cost Reduction vs. Long-Term Positioning

The approach taken by electric utilities to providing communications-enabled services is often linked to their near-term strategic response to increasing competition or long-term "vision" of their role in evolving residential electricity markets. We sketch out two scenarios, describe the utility's strategic response, and its possible relationship to different types of utility-telecommunications projects. In the first situation, the utility faces minor threats to its market share or core business either because it is a low-cost provider or because restructuring and retail competition do not appear imminent. The utility's strategy is to focus on near-term cost reductions and develop enhanced services in its core utility business. This strategy appears to underlie many wireless radio projects, which often focus on near-term improvements in utility operations to reduce rates and provision of energy information services to a small number of selected customers (e.g., real-time pricing or innovative billing to large commercial customers). In some cases, these utilities are relatively low-cost providers in their region and believe that competitive advantage can be maintained by reducing costs in their core distribution (wires) business. Kansas City Power & Light and Baltimore Gas & Electric are two examples of utilities in our sample who are aggressively moving forward with large-scale wireless projects focused on cost reduction, automation of customer service and distribution, and testing of value-added energy information services.

In contrast, other utilities seek to become full-service providers of energy and other retail services in order to maintain their competitive position. These utilities regard energy and non-energy services as an important new source of potential revenues. In some instances, the utility's strategy may be driven by their current position as a high-cost producer or their desire to focus on value-added services in an industry that is becoming more commoditized. In our sample, a number of the utilities that are testing a broad array of energy and non-energy services in cable projects tend to be located in states where industry restructuring is proceeding relatively quickly (e.g., California) or are higher-cost providers in their region. It appears that these utilities are hoping that communications-enabled services will provide a competitive weapon to retain existing customers and/or offer important new sources of future revenue growth to offset potential revenue losses in commodity sales.

Project objectives and design are often linked to the utility's assessment of the pace of industry restructuring or the future regulatory regime under which it will operate (see Table 3-2). For example:

- Public Service Electric & Gas and Lucent Technologies (formed as a result of the AT&T trivesture) are conducting a technical trial of 1,000 residences and businesses. The project focuses on demonstrating the operational savings from AMR and outage detection and peak demand reductions from load control and energy information services. System-wide rollout is contingent on operational and peak load savings because PSE&G believes that state regulation will move towards performance-based ratemaking (e.g., price cap), which would mean that shareholders would be able to capture these benefits in increased earnings. Based on its assessment of the unbundling of services that were likely to occur as a result of industry restructuring, PSE&G also concluded that its system must have the capability to provide real-time pricing and usage information (i.e., 30-minute intervals) which influenced its choice of a fiber-coax cable system.

- Central & South West's (CSW) strategy is quite explicit: expertise in fiber-optic energy management is key to gaining a competitive advantage in the future. Thus, they have followed an aggressive "learn-by-doing" approach: a large-scale, fast-track, market demonstration (~2,500 homes). CSW concluded that only a large-scale demonstration would provide sufficient experience to assess customer interest in energy information services, develop alliances with strategic partners, reap economies of scale to reduce costs, and demonstrate their capability compared to other potential competitors.

- PG&E, in conjunction with TCI and Microsoft, is currently undertaking a much smaller (~50 homes) market research-oriented pilot with the following objectives: (1) assess customer willingness to pay, (2) assess different ways to bundle services, and (3) develop business plan for PG&E Enterprises (PG&E's unregulated subsidiary). PG&E's cautious approach is driven by their assessment that the consumer services market is highly-demanding, that market demand for the proposed services has not been demonstrated, and, we believe, by the regulatory and market uncertainties created by the electricity industry restructuring process in California.

Table 3-2. Link Between Utility's Strategic Vision and Project Objectives

Utility	Project Objectives	Industry Future/Market Strategy
PSE&G	• 1,000-home "technical" trial underway	• Utility roll-out contingent on operational & peak load savings • Link to performance-based regulation (PBR); requirements of real-time pricing
Central & South West (CSW)	• Large-scale pilot required to assess customer interest and demonstrate technical and market capability	• Fiber-optic energy management key to competitive advantage
PG&E	• Market research-oriented pilot	• Demands of consumer market & CA regulatory uncertainty shape pilot

3.3 Strategic Alliances and Teaming Arrangements

Utilities have typically forged strategic alliances and teaming arrangements in order to manage the technical and financial risks associated with developing communications-based services. Table 3-3 shows the team members and their roles in each utility project; projects are grouped by communications system (e.g., cable, telephone, and wireless radio). In many wireless radio projects, arrangements are less complex because one key vendor is often responsible for obtaining all necessary equipment (e.g., Cellnet, Itron). In some cases, as more services are offered, additional team members are added to wireless projects. For example, in PacifiCorp wireless radio pilot which uses Metricom's UtiliNet product, CIC Systems developed an in-home energy management system that displays current usage, a 12-month usage history, rate schedules, and budget settings, and Landis & Gyr supplied electronic meters for remote disconnect applications.

It is also common for utilities to make an equity investment in companies that are key technology partners. For example, both AEP and Southern Company are investors in Integrated Communications Systems (ICS), the developer of TranstexT and Advanced Energy Management Systems products. Entergy invested about $15 million when it purchased its 10% share of First Pacific Network.

Table 3-3. Team Members and Roles in Utility Telecommunications Projects

Communi-cations System	Utility	Lead	Thermostat	Display	Controller	Meter	Engineering
Cable	Central & South West	Utility		Raytheon	FPN	American Innovation	FPN, Raytheon
	Entergy	Utility	Honeywell		Echelon	American Innovation	Honeywell, Utility
	Glasgow Electric Board	Utility		CableBus	CableBus		CableBus
	Hydro Quebec	Utility	C-Mac	Zenith	Domosys		Domosys
	Pacific Gas & Electric	Utility, TCI, Microsoft		TCI	Utility	Landis & Gyr	Microsoft, Utility
	Public Service Electric & Gas	Utility, AT&T	Honeywell		Honeywell, Intellon	General Electric	AT&T, Utility
	Southern Development Invest. Group	Utility		Raytheon	FPN	Landis & Gyr	FPN, Raytheon
	Virginia Power	Cox		Nortel	Nortel		Utility, Cox
Telephone	American Electric Power	Utility	Johnson Controls		Southern	ABB	Southern, ICS
	Gulf Power	Utility	Johnson Controls		Southern	ABB	Southern, ICS
	Wisconsin Energy	Utility, Ameritech	Johnson Controls	Pensar			
	Wright-Hennepin Cooperative	Utility				ITI	ITI, Utility
Fixed Wireless Radio	Baltimore Gas & Electric	Utility	TBD		IRIS		IRIS
	Boston Edison	Utility	CIC Systems		Metricom	Landis & Gyr	Metricom
	Kansas City Power & Light	CellNet			CellNet		CellNet
	PacifiCorp	Utility	CIC Systems		Metricom		Metricom
	Pacific Gas & Electric	Utility			CellNet		CellNet
	TECO Energy	Utility		IBM	M-TEL		Utility
Mobile Wireless Radio	Baltimore Gas & Electric	Utility			Itron	Various	Itron
	Boston Edison	Utility			Itron		
	Public Service of Colorado	Utility			Itron	Various	

Fiber-coax projects typically involve more complex teaming arrangements: the utility, along with a telecommunications service provider, often assumes the project integrator or lead role while other companies provide various types of equipment (HVAC controls, thermostat, in-home display), software, or specialized expertise. The success of these partnering arrangements (e.g., successful integration of disparate corporate cultures and balancing of expertise) is one key factor that distinguishes projects that are moving forward to the next stage of development from pilots that appear to be floundering.[16] These strategic alliances are critical in part because the project team leaders (e.g., utility and telecommunications provider) often hope to profit from their venture by marketing their product to other utilities. For example, CSW Communications was recently awarded a large contract to deploy a cable-based system to serve several hundred thousand customers in Austin, Texas, which builds on its Customer Choice and Control pilot in Laredo, Texas (Energy Services & Telecom 1996a). Similarly, PG&E/TCI/Microsoft recently announced that seven utilities agreed to pay an up-front fee for use of the energy information services technology, with access to PG&E's market research for its pilot and assistance to conduct their own market research trials (Energy Services & Telecom 1996b). Finally, Lucent Technologies announced that Consolidated Edison and Louisville Gas & Electric have agreed to participate in its Integrated Broadband Utility Solution.

3.4 Participation Rates and Market Response

Some utilities report relatively high participation rates in pilot projects, although customers were typically not asked to pay for services. For example, one utility was able to get 50% of the customers on a feeder line to participate in a wireless R&D project without offering incentives. Gulf Power reports that >20% of targeted single-family customers responded favorably to participating in its pilot program which offered TOU pricing with its TranstexT system. CSW reports that they have signed up about 70% of the customers in neighborhoods that were physically able to participate in their 2,500-home cable pilot in Laredo, Texas. In discussions with utility staff, it appears that they regard these high participation rates as proxies for customer interest in innovative services. Not surprisingly, market response is lower in those few projects where customers actually pay for services. Several small publicly-owned utilities and rural electric cooperatives appear to have the most experience in terms of customers'

Some utilities have achieved high participation rates in their market trials and aroused customer interest in innovative, new services, although willingness to pay is unclear.

16 Projects that are "floundering" include those that have been dramatically scaled back in size (e.g., number of households), experienced significant delays due to technical problems, or decided to not proceed to next stage of development (e.g., discontinue after small-scale pilot).

actual willingness to pay. For example, about 10% of the 29,000 residential customers of Wright-Hennepin Cooperative Electric Association have installed Meter Minders; many customers lease the security equipment, paying monthly charges of $17.50. Over 50% of Glasgow's 5,500 residential customers subscribe to cable TV, while 5 to 10% subscribe to telephone and local area network services.

3.5 Project Costs and Savings

For this study, utilities were asked to provide information on project costs, estimated savings to the utility and customer, and other benefits or revenues that derived from their projects. This information is reported in Table 3-4, with projects grouped into six general categories based on communications system and ownership. We present cost ranges for each group as well as utility cost targets. Several caveats are worth noting: (1) project costs are self-reported, and (2) it is inherently difficult to estimate per-unit costs in small-scale R&D projects.[17] Project costs typically include the costs of communications link between utility distribution network and customer's home network (the so-called "last mile"), customer premise equipment, program administration, and marketing expenses. The cost of the communications backbone network is typically not included; in some cases, utilities rely heavily on existing cable networks in their pilot programs.[18] Given these caveats, we regard reported costs as order-of-magnitude estimates for the "last-mile" connection, while cost targets are indicative of utility goals for large-scale pilots or system roll-out.

Utilities testing one-way *mobile* wireless networks report the lowest installation costs per household ($100-150/house). These systems have more limited functionality and service offerings compared to other communication systems. Project costs for wireless radio systems using *fixed* networks typically ranged between $180-$600 per house. In the projects that reported lower costs, a limited number of services are currently being offered. However, vendors claim that additional services can be provided at low incremental costs on a systemwide basis, particularly if these services are not made available or desired by all customers. Projects at the high end of this range either included additional customer premise

17 Some utilities were quite reluctant to divulge or include start-up or development costs in their estimates. For example, one utility indicated that the start-up and development costs for its small pilot (<100 homes) would exceed its estimated costs for the "last mile" connection to the household, while others indicated that start-up costs were "substantial."

18 One utility indicated that the cost of the fiber backbone network in its pilot was "very expensive," but would not divulge costs. Anderson Consulting (1994) estimates that utilities have spent between $50,000-$65,000 per mile to build a backbone fiber network. In several cases, utilities noted that estimated costs excluded the sunk costs of software development

Table 3-4. Market Features: Project Costs and Savings

Strategy	Utility	Key Partners/ Vendors	Installed Cost (Current)[a]	Installed Cost (Target)[b]	Peak Demand and/or Energy Savings
Cable, Utility-Owned	Central & South West	FPN	1,000-3,000	1,000	Avg. bill savings of 7-10%; 2 kW peak demand reduction
	Entergy	FPN formerly			
	Southern Dev. Invest. Group	FPN			
	Glasgow Electric Board	CableBus	240[c]	NA	$14/mo
Cable, Leased	Hydro Quebec	Domosys	2,000-3,000	300-500	$60-80/yr
	Pacific Gas & Electric	TCI, Microsoft			
	Public Service Electric & Gas	AT&T			
	Virginia Power	Cox, Nortel			
Telephone, Leased	American Electric Power	ICS	1,000- 1,500	750	Avg. bill savings of 12-15% (~$175/yr) 2-4 kW peak demand reduction
	Gulf Power	ICS			
	Wisconsin Energy	Ameritech			
	Wright-Hennepin Cooperative	ITI	240[d]		
Fixed Wireless, Utility-Owned	Baltimore Gas & Electric	IRIS	240-600	NA	
	Boston Edison	Metricom			
	PacifiCorp	Metricom			
	TECO Energy Mgmt Services	IBM			
Fixed Wireless, Leased	Kansas City Power & Light	CellNet	180-240	NA	
	Pacific Gas & Electric	CellNet			
Mobile Wireless, Utility-Owned	Baltimore Gas & Electric	Itron	100-200	NA	
	Boston Edison	Itron			
	Public Service of Colorado	Itron			

Note: First Pacific Networks (FPN), Integrated Communications Systems (ICS), Interactive Technologies Inc. (IT); NA = Not Available

[a, b] Costs and savings in $ per residence; cost ranges for pilot projects in each group; excludes costs of installing backbone network

[c] Cost estimates are for incremental costs of pilot (i.e., CableBus switch, AMR meter, and water heating wiring); and do not reflect total cost of linking Glasgow's cable network to the residence

[d] Costs are lower because Wright Hennepin project does not include in-home display unit and cost of CPU is excluded from installation cost.

equipment (e.g., in-home display equipment) or had low customer density levels, which meant that fewer customers were served by each radio transformer (e.g., ratio of customers to transformer was 3:1 vs. 20 or 35:1 in dense urban areas).

Installed costs of cable-based projects in residential markets is currently quite expensive (e.g., $1,000-3,000/house). Factors that may explain the large range in reported costs include: (1) extent to which an existing backbone network can be utilized vs. the costs of constructing a new backbone network, (2) differences in customer premise equipment costs, which depend on the range of services offered (e.g., telephony, cable TV) and their saturation (e.g., every house vs. sub-group among total population), and (3) differences in system design (e.g., coax cable to the customer premise vs. coax to secondary transformer and powerline carrier to customer premise). Some utilities report that installed costs per household have declined significantly as they have ramped up their pilot programs and it appears likely that some utilities will be able to reach their near-term cost targets (e.g., $500-1,000/house).

We also collected information on utility estimates of either peak demand savings or customer bill reductions (see Table 3-4). Savings estimates are also self-reported with one exception (Gulf Power) where there is an evaluation of the project by a third-party consultant. Gulf Power reported summer peak demand reductions of about 2.25 kW/home from TOU prices in its Advanced Energy Management System pilot. American Electric Power reported that it was able to obtain a significant load shift of 4 kW per house among its all-electric customers when it posted a critical price during an extremely cold winter day (-30° F). Bill savings for customers averaged about 12 to 15% (Energy Services and Telecom Report 1996c). CSW claims that customers in its Customer Control and Choice pilot are reducing their energy bills by about 7 to 10% on average with a summer peak demand reduction of 2 kW per household. Annual bill savings for residential customers reported by several utilities ranged between $60-$175 per year.

Peak demand reductions reported by these utilities for customer-controlled load management (CCLM) are in the same range (i.e., ~2 kW/house) as that reported by utilities in their evaluations of traditional direct load control programs. However, given the limited experience with residential CCLM, utilities will need to conduct independent evaluations with large samples in order to establish reasonable forecasts of aggregate peak demand reductions that can be used for system planning purposes.

3.6 Technological Risks and Market Uncertainties

These pilot programs allow utilities to assess some of the technological risks associated with providing communications-enabled services. For example, utilities have experienced first-hand the challenges of system integration (e.g., integrating home network and customer premise equipment with the utility distribution network) and problems that arise because of the lack of standardized communications protocols. More fundamentally, utilities are increasingly aware that large-scale investments in communications infrastructure may become obsolete quickly, a concern driven in part by the rapid pace of technical innovation in information, computing, and communications technologies. Thus, in addition to evaluating the field performance of specific systems, utilities are also assessing technology risk in terms of flexibility and obsolescence. Issues here include: (1) reliance on "open" vs. proprietary standards or protocols, (2) ease with which technology or the system can migrate to new or next generation technologies, and (3) integration with other products and strategic alliance opportunities.

Utilities continue to search for the "killer application"-- Internet access, home security & alarm services - that will open up the residential market for large-scale deployment of two-way, communications-enabled services.

Proponents of broadband (Arthur Anderson 1994) argue that fiber-coax cable communications infrastructure offer significant advantages to electric utilities because of their flexibility and functionality to meet current and future needs (e.g., two-way communications with easy customer interface, ability to deliver voice, video and data). These capabilities mean that a cable communications infrastructure potentially has "strategic value" to electric utilities because it enhances their ability to address competitive threats or provides flexibility to take advantage of opportunities in the future. In contrast, Komor (1996) argues that the low-risk strategy for utilities is to pilot new services, relying where possible on existing or low-cost narrowband communications networks, which can handle most energy services.[19] Given the lack of demonstrated market demand, it is riskier to rely on higher capacity (and higher cost) links such as fiber-coax cable, which cannot be justified for energy services alone.

Ultimately, utilities hope to recoup their investment in communications systems and service applications from savings in the cost of utility operation and from revenues from customers that are willing to pay for energy-related and non-energy services. At present, utilities typically receive cost recovery from all ratepayers for load management programs based on a determination that these activities provide overall net benefits to the system. However, in the future, some utilities envision that participating customers may pay a portion of the costs of pricing and load management programs if they are offered as energy services. Most utilities either refused to divulge results of their market research or were in the midst of large-scale trials. However, we did uncover one or two studies of utility-sponsored market research that asks customers whether they would be willing to pay for these types of services. For example, Gulf Power found that most customers

[19] Komor includes several examples of services that can be offered to commercial customers using existing networks: use phone lines to test remote equipment monitoring, simulating real-time pricing through electronic bulletin board that can be accessed via modem, and send daily faxes that summarize real-time consumption using phone lines.

would be willing to pay $5 to $10 per month or less for the TranstexT system, which translates into less than 25% of the bill savings in most houses. Thus, the amount of savings, customers' willingness to pay a portion of the value of these savings to the utility (e.g., 10-20%), and customers' payback criterion (e.g., 2-3 years) establish an upper limit on the annual contribution that could be expected from customers for these energy-related services.

Other potential benefits include savings in operating costs and improved productivity (e.g., fewer meter readers), increased revenues from non-energy services, and increased customer satisfaction leading to customer retention or growth. Few utility contacts provided data or studies quantifying these benefits, although some managers offered anecdotal information on productivity impacts or customer satisfaction. Based on our survey, only a few utilities (e.g., Glasgow Electric Board, Wright-Hennepin) have achieved reasonably high market penetration rates in promoting non-energy services that generate substantial revenue streams from residential customers. Most other utility projects are either still at the technical proof-of-concept stage, pilot market research, or large-scale technical trial. Utilities and others continue to search for the "killer application" such as Internet access, video-on-demand, or home security services that will open up the residential market for large-scale deployment of two-way, communications-enabled services. However, at this time, significant uncertainties exist regarding services desired by residential customers and their willingness to pay for them. This situation motivated our exploratory market research effort, which we discuss in Chapter 4.

Exploratory Market Research on Energy-Related and Non-Energy Services

4.1 Overview

In this chapter, we discuss results from a focus group and ten individual interviews which sought customer reactions to 14 energy and non-energy services. These customers' local utility is not currently conducting a DSM pilot program that uses advanced telecommunications technologies. Our main objective was to understand consumer perceptions of and explore their interest in and willingness to pay for communications-enabled energy services. A secondary objective was to develop a survey protocol for an extensive set of energy information services that could be used by other groups. To provide a context for our work, we describe briefly the publicly available research on this topic. We then present an overview of our research and sampling methodology and discuss customer reactions to specific services. A summary of key findings from our exploratory market research is presented in Chapter 5.

4.2 Market Research on Communications-Enabled Services

Many utilities have conducted market research exploring customers' interest in communications-enabled services, although, with one or two exceptions, results of such studies are proprietary (Frauenheim 1995). The American Information Users Survey involved eight focus groups and structured telephone surveys with 2,000 households. Frauenheim reports that a fairly high proportion of the population is interested in various energy information and other services (see Table 4-1). However, the publicly-available summaries of Frauenheim's proprietary studies are not very detailed, although we assume that more in-depth results are available to clients. Find/SVP and Texas Systems have undertaken another survey, The American Home Energy Management Survey: Consumer Energy Management and Use, to assess how consumers perceive, value, and will use home energy management products and services. As best we could determine, summary results of this second survey are not yet publicly available.

Table 4-1. American Home Energy Management Survey Results

Service	Very Interested	Interested	Not Interested
Dial up to switch light or thermostat	38%	41%	21%
Monitor/Control energy usage	33%	45%	22%
Educational programs	47%	41%	12%
Movies and TV on demand	69%	25%	6%
Electronic shopping	25%	50%	25%

Source: Frauenheim (1995)

4.3 Research Methodology and Sampling

We utilized qualitative techniques (e.g., focus group and personal, semi-structured interviews) to elicit in-depth responses of perceptions and opinions from a diverse sample of utility bill payers (Bernard 1994). To preserve anonymity, when quoting individual statements by focus group participants or interviewees, only the first name of the participants is used. Individuals were drawn from Newark, Delaware. The focus group was conducted on December 12, 1995 and the ten in-person interviews were conducted during January 1996. Because of Newark's particular demographic profile, our sample did not adequately represent minority or low-income populations. Because both the focus group and interview solicitations yielded high refusal rates, some sampling bias may have been introduced.

For the focus group, we employed a systematic random sample. Individuals were selected from the Newark telephone directory, using a random number table to select page numbers as well as a name from every column from the selected page numbers. We developed screening questions to select the bill payer of the household and to minimize inclusion of University of Delaware faculty and students.[20] A total of 235 calls were placed, of which 125 yielded answers and 110 yielded answering machines or no answer. Seven of the 12 who agreed to participate when first solicited actually attended the focus group. The group included three women and four men; participant profiles are included in Table 4-2.

[20] Newark is a college town, and we thought university students and faculty might be more receptive to new technologies, so our sampling method and screening questions excluded most faculty and students.

Table 4-2. Profiles of Respondents

Name	Age	Sex	Occupation
Focus Group:			
Colin	30s	F	Office Manager, construction company
Chuck	30s	M	Carpenter, self-employed
Wayne	30s	M	Engineer
Susan	20s	F	University Administrative Assistant
Pat	40s	M	Chemical Technician
Shirley	50s	F	Not known
Bruce	60s	M	Retired, formerly utility employee
Face-to-Face Interviews:			
Aaron	30s	M	Buyer (self-employed)
Mike	40s	M	Stock Broker
Carl	60s	M	Professor
Becky	30s	F	Graduate Student
Gilles	50s	M	Businessman
Patchy	50s	F	Schoolteacher
Neel	50s	M	Engineer
Paul	50s	M	Professor, Business School
Dave	30s	M	Fitness Instructor
Sherry	30s	F	Collection Officer, major credit card company

Several participants had home computers which they used to access on-line services or indicated that they used software packages, such as Quicken, for personal financial management and record keeping purposes. One group participant (Shirley) had previously participated in a time-of-day pricing program and made regular use of bank-by-phone services.

We also conducted ten personal interviews in order to complement the focus group results, specifically to capture elements that could be clouded by group dynamics. Due to a very low response rate, six interviewees were recruited through colleagues' and friends' contacts.[21] The interviews typically lasted 30 to 40 minutes. In order to gauge the perceived economic value of the services, respondents were asked to fill out a short questionnaire at the end of the focus group discussion and individual interviews (see Appendix D).

4.4 Overall Reactions to Communications-Enabled Services

In this section, we highlight several themes that emerged from the focus group and individual interviews that are not specifically related to the proposed services, but rather to respondents' views on advanced information, computing, and telecommunications technologies, concerns as consumers, or the appropriate role for utilities.

4.4.1 Necessity and Usefulness of Services and Information

The predominant direction of the focus group discussion was that many of the services described were viewed as not required or particularly useful because the information either was already available or would not be used. The fact that these services were offered via advanced telecommunications technologies made them even less desirable. In contrast, the personal interviews brought out a fairly positive overall response to the services described. Most of the services were viewed as information—"the more the better"—and considered essential in order to track and become aware of consumption changes.

4.4.2 Medium

The appropriate choice of communication medium also emerged as an issue in both the focus group discussions and individual interviews. Among vocal focus group participants, there was a general perception that establishing a separate "high tech" system to provide energy information was unnecessary. For example, participants commented that various energy information services could easily be included in paper-bills, could be offered through telephone services and various printed media, or otherwise be made available on public domain web pages on the Internet.

Participants' views on the relative merits of different communications mediums (e.g., television or computer) also emerged during the discussion of individual services,

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21 We believe the poor response rate may be attributable in part to the timing of our surveys (i.e., Christmas holiday season) and the severe winter weather. Relying on colleagues' and friends' contacts was expected to minimize a bias based on interviewees' interest since they agreed to participate (at nearly 100 percen t acceptance) in order to do a favor, not because they had any interest in the topic.

although we did not ask participants to indicate their preferences on this issue. For example, some focus group members raised concerns that the television was not the ‘best’ medium for distribution of these services. Several people questioned the ease of use of the TV set and “smart box” or commented that the TV would likely be in use at the time when bill-related activities occurred or was not located near where they processed their bills. In response, other focus group members suggested the computer as an alternative medium of display. To computer users, computers seemed a more logical and easier medium than a separate system on the TV, as one said, “Why not just put all this on the Internet?” During the discussion, several participants voiced concerns that if computers were the preferred medium, sections of the population, particularly the poor, would be excluded from taking advantage of these services, which would tend to further widen the gap between the haves and the have-nots. Although less convenient to use, the television set was seen as a more equitable medium that would reach a broader section of society.

In the individual interviews, most people seemed to be neutral regarding medium, although several commented that television might facilitate broader access to these services because “everybody has televisions” Three participants indicated a strong preference that they did not want the information on a computer, mainly because they did not like high technology devices (they ranged in age from 40s to early 60s).

4.4.3 Control and Choice

Comments of many participants indicate a strong preference for them to be in charge of controlling and monitoring their own energy consumption and make personal choices about the need to engage in energy conservation through the implementation of specific measures, both technical and behavioral. Load management and building automation controlled by the occupants of the house, as opposed to the utility, was the preferred solution for all except one of the respondents.

4.4.4 Privacy

Privacy issues were raised as a significant concern by participants in discussions of several services, particularly ‘Appliance Energy Consumption Breakdown’, ‘Energy Efficiency and Conservation Programs’, ‘Energy Efficiency Product Information’, and ‘Load Management and Automation.’ For example, several participants questioned whether the utility should have access to information on the energy usage patterns associated with different household activities. In some cases, it appears that their objections stem from concerns that the utility would pass this information on to third parties, which would lead to an increase in unwanted marketing calls and letters. Several participants commented that marketing of long distance telephone services was very annoying and that they did not want the type of service offerings described in our materials to become an occasion, and a vehicle, for more marketing calls and letters. In contrast, the individual interviews yielded very different reactions: most people did not have problems with utilities keeping this type of information. Several focus group members also felt that computer network security issues have not been adequately addressed, specifically that they did not trust that the information could be adequately protected. Overall, our sense is that for focus group participants, privacy and security concerns, coupled with general distrust in the utility, detracted from the perceived desirability of communications-enabled services.

4.4.5 Interest in Energy Efficiency and Bill Reductions

Based on the discussion of various energy information services, we believe that the lack of interest in energy services that could reduce bills may be due in part to participants' perception of low potential for energy conservation, relative to the efforts required to achieve the savings. This finding is consistent with previous studies (Kempton and Montgomery 1982). For example, Aaron said "time consumption does not compensate for the possible savings", and Carl asked, "how much would it save him as opposed to the cost that he would have to incur in order to use the services". Another major issue was the perception that load management or time-of-day pricing would imply significant lifestyle changes.

4.5 Reactions to Specific Services

In this section, we discuss customers' reactions to fourteen proposed services, which are described briefly in Table 4-3. The services can be grouped into five general areas: (1) billing-related services, (2) pricing, (3) other energy information services, (4) energy management, and (5) non-energy services. Readers who want a complete description of the text describing the services and accompanying visual illustration should refer to Appendix C. Table 4-4 summarizes the questionnaire responses of the seven focus group participants and ten interviewees regarding interest level and willingness to pay for our 14 proposed services. Appendix D includes the survey questionnaire form and customer's individual responses on willingness-to pay for services. Because our sample is small, we interpret the quantitative results as providing a consistency check on the qualitative discussion and possibly an indication of some customers' willingness to pay for various services.

Table 4-3. Summary of Proposed Services

No.	Name of Service	Description
1	Historic Consumption	Gives customers a graphical display of monthly energy usage for an entire year.
2	Neighborhood Comparison of Energy Use	Allows customers to compare their electric or gas bills with households in their neighborhood.
3	Appliance Energy Consumption Breakdown	Gives information on how much energy is consumed by each major appliance in the house.
4	Billing and Payment Plans	Allows customer to review and pay the bill directly via an interactive system.
5	Instantaneous Consumption and Time-of-Day Pricing	Provides the amount of energy being used and the price at which it is being sold, allowing the customer to decide how to reduce energy bills by shifting energy demanding activities.
6	Energy Services Agreements and Rate Options	Offers detailed descriptions of energy services, agreements, and rate options aimed to increase customers awareness of these utility offerings.
7	Energy Efficiency and Conservation Programs	Information about the energy savings programs that could be offered via the system.
8	Energy Efficiency Product Information	Up-to-date energy efficient appliance information offered as a service to customers as part of overall energy efficiency goals.
9	"Do-it-yourself" Videos and Booklets on Energy Information	Enables orders for "Do-it-yourself" Videos and Energy Information booklets.
10	Scheduling of Installation, Field Services and Repairs.	An interactive scheduling service that would allow customers to plan ahead and suggest preferred time for service installation or repair.
11	Specific Customer Queries	An interactive customer service center that would work almost like an electronic mail-box.
12	Load Management and Automation	Services to reduce utility peak load demand, and customer control and operation of appliances based on customized time schedule.
13	Entertainment Videos on Demand	Allows customers to order movies of their choice on a pay-per-view basis.
14	Security Services	Security services that would allow remote monitoring and control of residences through light switches or locks, when home is unoccupied.

Table 4-4. Customer Interest in Energy and Non-Energy Services

No.	Service	Does Not Want	Want If Free	Want and Will Pay[b]	Pay-per-Month[c] ($)	Pay-per-Month[d] ($)	Pay-per-Use[d] ($)
1	Historic Consumption	2	8	5	0.16	0.62	
2	Neighborhood Comparison	6	3	7	0.34	0.91	
3	Appliance Energy Breakdown	4	7	6	0.16	0.50	
4	Billing and Payment Plans	6	7	3	0.06	0.50	
5	Instantaneous Consumption and Time-of-day Pricing	1	10	4	0.13	0.50	
6	Automated Sign-up for Rate Options and Utility Services	2	11	3	0.13	2.0	
7	Conservation Pgm. Information	3	9	4	0.28	1.50	
8	Energy Efficient Product Information	4	5	8	0.13	2.0	1.17
9	Do-it-Yourself Videos and Booklets on Energy Efficiency	3	10	4			2.17
10	Scheduling Repairs and Services	5	10	1	0.12	2.0	
11	Customer Queries	4	11	2	0.12	2.0	2.0
12	Load Management and Automation[e]	0	12	3	0.63	5.0	
13	Entertainment Videos on Demand	3	3	11	3.53	8.57	3.13
14	Security Services	6	4	6	3.82	10.83	

[a] One interviewee was willing to pay $2 per month to have all the services available plus a $5 for Pay-per-Use of each service.
[b] One interviewee would prefer an annual maintenance fee of not more than $60 for Services 1 through 8.
[c] Average over all respondents
[d] Average of those who would pay
[e] One respondent was willing to pay a “one-time” set-up fee of $15, subsequent willingness to pay depending on cost/savings ratio

Note: Number of responses may not add up to 17 since not all respondents answered the question for each service.

Billing-Related Services

4.5.1 Historic Monthly Energy Consumption

Initially, most focus group participants felt that providing information on historic energy usage using advanced communications technologies was redundant and non-essential, because the information was already available from old utility bills. Several respondents said they would not want to go to the effort of a separate 'log-on' for an energy-specific services link to access this type of information. Then, Neel mentioned a situation where a high utility bill caused him to go through several files looking for old bills. He said this was very painstaking and, thus, would find it useful if such a service was available at the push of several buttons. He indicated that such information would also be useful in educating his family members about their "wasteful" habits. Several participants said that this type of information would be easier to keep track of it using a financial software package, such as Quicken.

Focus-group participant, Chuck, expressed doubts about the usefulness of this information in the context of energy management. He felt that more detailed, disaggregated information would be necessary to help utility customers fine tune their energy usage because only dramatic changes in consumption would alert a customer to a problem. Other participants seemed to agree that because of changes in individual behavior and/or weather, historic consumption data would not enable customers to determine whether conservation measures which were implemented during a previous billing period actually had a significant impact. In response, several people indicated that it would be useful to give the average temperatures along with monthly consumption figures.

When considering this service as part of a whole package, five of seven participants in the focus group said they would like it, although they would not want to pay for it.

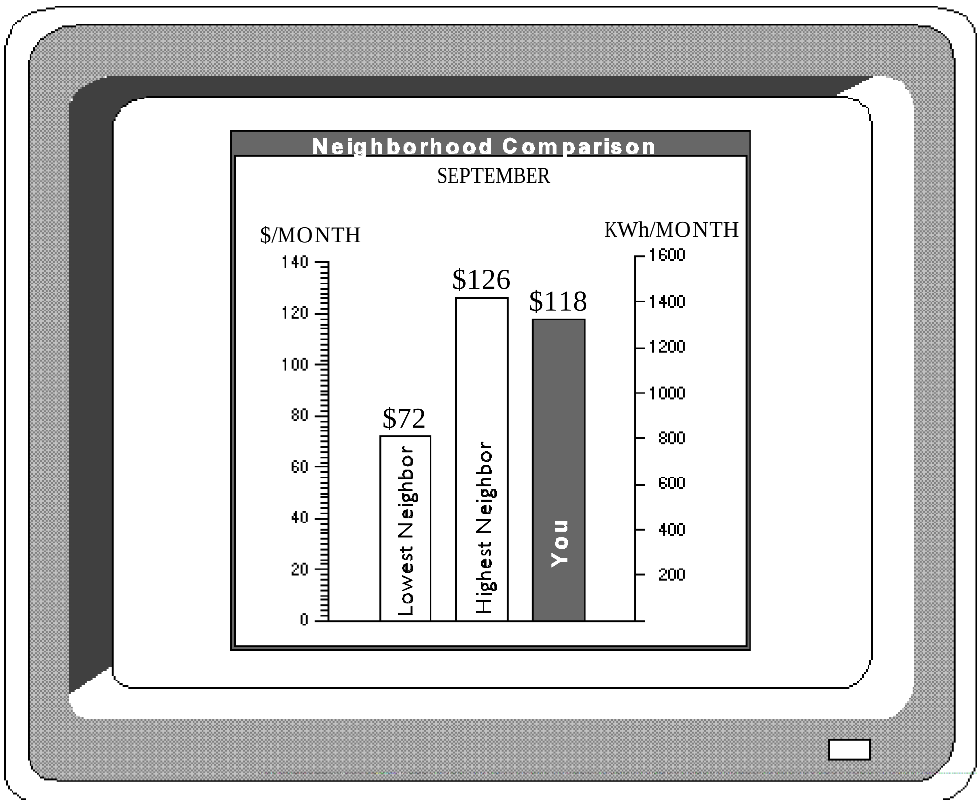
4.5.2 Neighborhood Comparison of Energy Use

Validity of neighborhood comparisons of energy use was the main concern that arose during the discussion of this service (see Figure 4-1). There were two rather distinct schools of thought among focus group participants. One group maintained that this information was useless due to problems inherent in the data used for comparison: "Unless you know how many kids and how many people live in the household, [it] is useless information." Differences in values, lifestyles and habits were other factors thought to complicate and render the comparisons meaningless. The second group commented that this information could be used as a diagnostic tool and would generate some additional inquiries. Pat said that "If you're scrimping and saving, or conserving and you look on the graph and see you're the second highest consumer, you know you have

Value of neighborhood comparisons of energy use depends on customer perceptions of validity.

a problem." These participants considered the data less problematic because they perceived houses in their neighborhood to be approximately the same. For example, Pat stated: "Even with a range of houses in your neighborhood, you would have an idea of where in the range you fall."

Figure 4-1. Example of a Graphic Display for Neighborhood Comparison of Energy Use



In the personal interviews, the majority of respondents reacted more favorably to this service: first, because they would become aware of their own consumption relative to others; and, second, they could initiate changes. Paul mentioned that such a comparison made a lot of sense and was easy to do since most neighborhoods in Delaware were similar in type and were identifiable. Gilles said he would be interested in knowing "whether it's my sloppy habits that is causing higher consumption, or if there is a problem."

It appears that several respondents tend to correlate the level of comfort with the amount of energy that they consume. This partially explains their reluctance to make use of information which compares their usage with that of others. For example, Mike seemed to think that maintaining a certain quality of life required him to maintain his current consumption level ("If I can afford to pay for a certain level of comfort, then why not …

I work hard, and would like to enjoy the things that I work for" … "I'd much rather wear a T-shirt and a pair of shorts rather than turn the heat down").

The 'willingness-to-pay' questionnaire indicates a split between the focus group and the interviewees. Among focus group participants, six out of seven participants said they would not be interested in this service even if it was free. Eight of ten interviewees liked the service; five were willing to pay a monthly fee ranging from $0.50 to $2.00, while three others preferred an annual fee (see Appendix D, Table D-1).

4.5.3 Appliance Energy Consumption Breakdown

A service that provided energy usage information on each major appliance evoked strong negative responses from several focus group participants because of its potential threat to privacy. Two aspects of privacy seemed to be of concern:

- the potential consequences of allowing the utility to collect and make use of disaggregated energy data; and
- the potentially invasive nature of setting up and installing the disaggregated metering technology, or 'smart box' system, which meant that it also would be expensive.

We did not dispel these false assumptions underlying the latter aspect, due to the exploratory nature of the study. The underlying assumption among most focus group participants seemed to be that someone would have to come into the house and the installation would result in additional wiring, possibly going through ceiling and walls, which would be quite expensive.

The focus group moderator asked the group to reconsider the service disregarding the issue of cost, whether low or high, and to disregard issues concerning the nature of the technology itself, whether physically invasive or not. The respondents stated that this would not change the way they felt about the service, because it still did not address the issue of privacy. For example, there was general concern about utilities making this information available to other companies, which would result in unwanted marketing pitches. In the focus group, the general mood was suspicion about the utility's use of information on individual appliance use.

Breakdowns of appliance energy usage may be attractive to customers; but privacy concerns must be addressed.

In contrast, in the personal interviews, this service was viewed quite positively. For example, Gilles said that he had already tried to get this type of information by observing the meter every time he turned on or off a particular appliance, but it did not help since it gave him only a rough idea. He indicated a preference for better information, if possible. Becky noted that this service would help her take preventative action, instead of waiting for an appliance to die before replacing it or repairing it, and avoid wasted energy caused by a malfunctioning appliance. She also suggested that if the display had a comparison showing consumption of a similar efficient model, it would make more sense.

Nine of ten interviewees were interested in and six were willing to pay a monthly fee for the services ranging from $0.50 to $1.00, indicative of the positive response to this service. In contrast, in the focus group, four of seven focus group participants indicated that they liked this service but would not want to pay for it, whereas three would not want it even if it was free. The discussion of privacy issues, which was dominated by a few individuals, may have affected the questionnaire responses of other focus group members.

4.5.4 Billing and Payment Plans

The focus group was generally not very enthusiastic about a service in which they could review and automatically pay their bill using an interactive TV or computer system. They perceived that electronic payment and transactions involved some security risks along with a loss of customer control. “Making my checking account open to the utility makes me feel very uncomfortable,” Colin said. The group indicated that they like to have control over payment, and wanted a “hard” copy of the bill for record-keeping purposes, which was perceived as impossible given the way this service was described. In their questionnaire, six of seven focus group participants indicated that they would not want this service, even if it were free.

Most respondents in the individual interviews, however, liked the idea of making payments in this way. Several people indicated that this was how transactions were going to take place in the future. Nevertheless, most people did not want to pay for such a service. To them it was more a matter of convenience, than a service to be paid for (see Table 4-4).

Pricing

4.5.5 Instantaneous Consumption and Time-of-Day Pricing

Overall, focus group participants reacted quite positively to a service in which they were provided with feedback on their hourly energy consumption in conjunction with time-of-use prices that would be posted one day in advance. Participants indicated that it would give them an idea of how to change or shift consumption to take advantage of the bill saving potential embedded in the low rate periods and that it puts the consumer more in control of the bill. One focus group participant, Shirley, recounted her positive experiences with an experimental time-of-day pricing program that her family participated in 12 years ago: “You feel more in charge of your bill, you had more control over how the bill was going to be like when it came in the mail, but you gave up some convenience.” The group expressed considerable astonishment when they learned that Shirley had been able to reduce her monthly household energy bills by at least 30% by implementing behavioral changes under time-of-use pricing. Shirley noted that her utility had provided helpful information during the first several months on appliance energy consumption and tips on how best to take advantage of the program by shifting certain activities to low peak periods. Several participants thought that it was unnecessary to provide time-of-day pricing information on a daily basis and suggested that it would be easier, cheaper and more convenient to include the time-of-day prices on the bill once a month.

In contrast to the focus group, most respondents in the personal interviews were less interested in this service. Most people indicated that they were reluctant to make any changes in lifestyle, which included using certain appliances at specific times of the day or week. However, several people were willing to make changes if it resulted in reduced bills. Gilles, for instance, remarked, “if it is costing me money, yes, I would change my habits”.

Fourteen of 15 respondents liked this service to be offered by the utility, although only four participants indicated some willingness to pay (see Table 4-4).

4.5.6 Automated Sign-up for Rate Options and Utility Services

Five of the seven focus group participants said they liked the idea of a service in which they could sign up for utility services or rate options through an interactive computer interface, although they would not want to pay for it. However, several vocal focus group participants looked at this service simply as an attempt by the utility to position itself in the event of deregulation and increased competition in the utility industry. They viewed the utility as trying to sell services rather than improve consumer choice, which negatively influenced their perception of the desirability of the service (e.g., they would not want this service even if it were free). This service did not seem to evoke the same suspicion among interviewees regarding the utilities’ intentions for offering such services. Most interviewees said they liked this service if it were provided free of charge, and four people were willing to pay a monthly fee ranging from $0.50 to $3.00.

Other Energy Information Services

4.5.7 Energy-Efficiency Programs and Energy-Efficiency Product Information

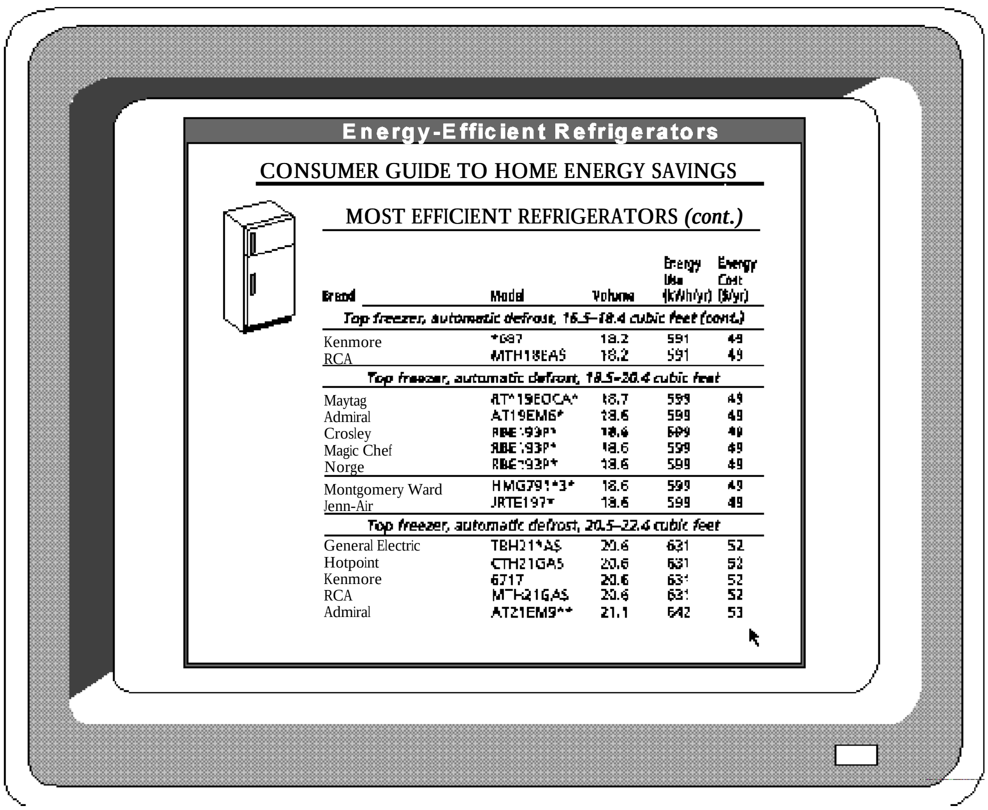
We discuss services in which the utility would provide information on energy-efficiency programs and products together because participants viewed them as very similar (Items 7 and 8 in Table 4-3). Neither service was viewed as particularly useful by focus group participants. They indicated that it would provide yet another channel for marketing messages to come into the house. The group also felt that this type of information was available elsewhere or could be provided more easily in other ways: consumer reports, retailers and energy guide labels were viewed as good alternative information sources.

Some focus group members and interviewees were skeptical about the quality and reliability of product information provided by the utility (see Figure 4-2).

Utilities may be able to provide information on energy-efficiency products, possibly on a fee-per-use basis.

Four of seven focus group participants liked the 'Efficiency and Conservation Programs' but would not want to pay for them, whereas three out of seven liked the Product Information service and two of them would be willing to pay for it on a per-use basis, with fees ranging from $1 to $1.50. Most interviewees suggested that a pay-per-use option was preferred, since this type of information would be needed very infrequently.

Figure 4-2. Information on Energy-Efficient Products



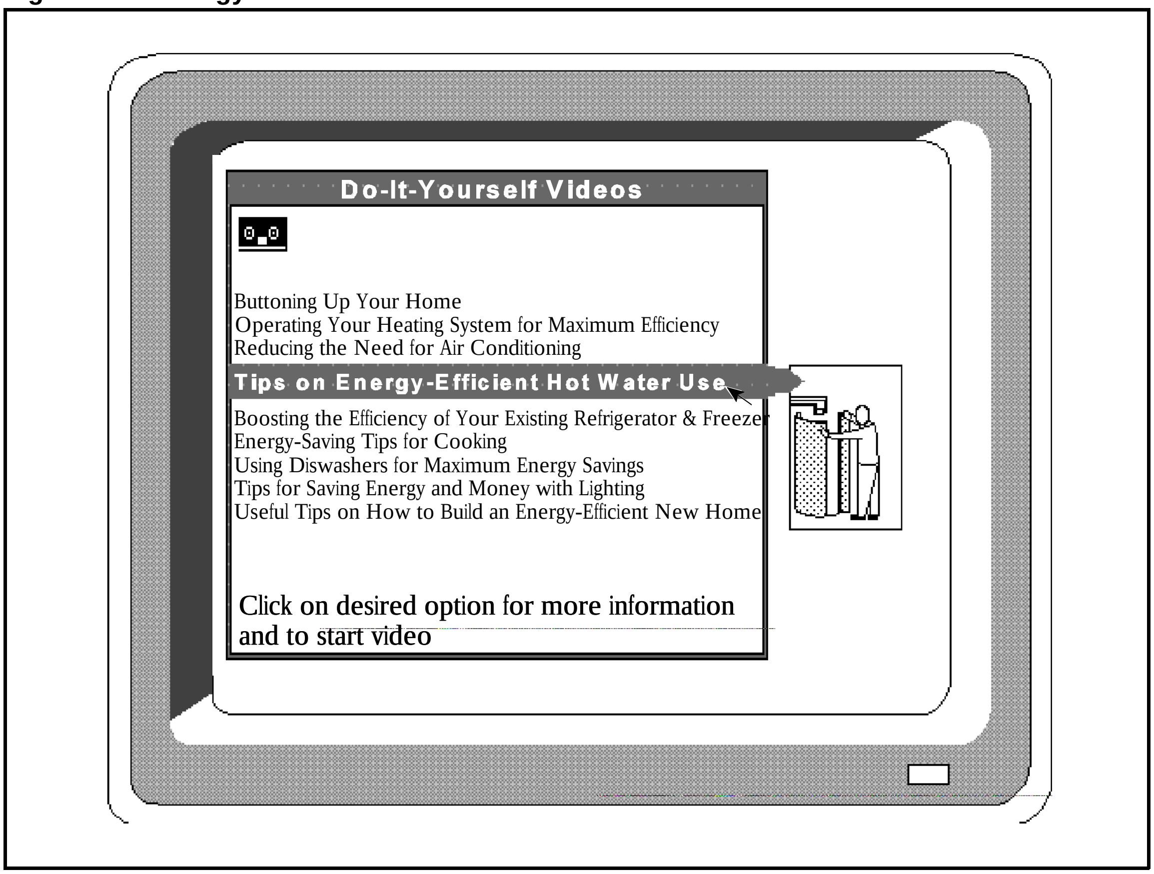
4.5.8 "Do-It-Yourself" Videos and Ordering Energy Information Booklets

A service in which the utility provided "do-it-yourself" videos that provided information on how customers could improve the comfort in their home and save money was perceived as useful by all members of the focus group (see Figure 4-3).

Participants commented that this service was unique among the set of proposed services in that it filled a need that was not already being met. The cost of providing this service would influence whether some would prefer receiving this information using advanced telecommunications technologies or opt for other lower technology options for service delivery. Calling the utility to order was suggested as an alternative, equally convenient method.

In contrast, respondents in individual interviews did not express much interest in this type of service. Some suggested that the service should be 'pay-per-use' because it was not something you would require frequently. Five of seven focus group participants said they liked this service but would not want to pay for it (Table 4-4). The convenience of access to videos at all times was seen as a plus by several people.

Figure 4-3. Energy Information Videos



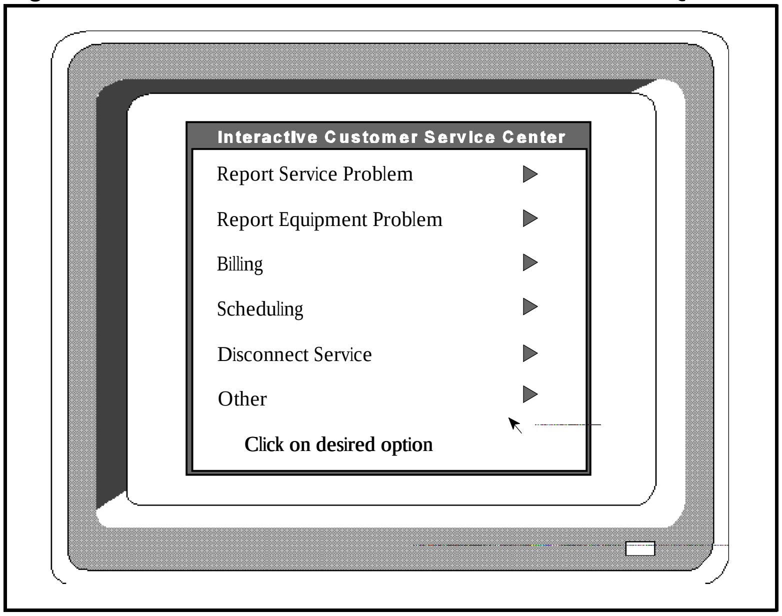
4.5.9 Scheduling of Installation, Field Services and Repairs

Several focus group participants initially thought this service would be useful, in part because it is currently not offered. It seemed to be viewed favorable mainly because it would enable the customer to pin the utility down to a more precise time schedule (e.g., two-hour time block), which in turn would give more time flexibility to customers awaiting service personnel. Colin remarked that "It would be a real advantage to get the service scheduled within a two-hour window." [22] If this service were to be offered using an advanced information/communications system, most focus group members wanted some confirmation of the appointment time. Most interviewees also found this service useful. However, several respondents stated that an emergency service option was necessary as well, in which case, they would not want to go through a regular appointment scheduling service.

Ten respondents liked this service but were unwilling to pay for it. Five focus group participants did not want the service even if it was free.

4.5.10 Specific Customer Queries

Figure 4-4. Interactive Service Center for Customer Queries



Focus group participants and interviewees generally thought that an interactive customer service center where they could report service problems, make requests, or obtain answers for common questions would be a useful service. However, some respondents had misgivings about the service being too inflexible and impersonal. For example, one person commented that one problem with, "the point and click method is that your question may not always fall within the parameters defined by the utility." Accountability was

[22] We think this view was expressed because the 'screen' in the display for this service shows the time slots in one-hour intervals, whereas phone and energy utilities often limit themselves to time frames stretching four to five hours.

another issue. One participant commented that when you phone the utility you can obtain the person's name and hold this individual responsible if a problem should occur at a later stage. Personalized service was seen as an additional advantage of the phone over this system.

Eleven of 17 respondents were interested in this service, provided it was offered at no charge, while two others were willing to pay a nominal monthly fee ($2.00). Three respondents indicated that they would not want this service even if it were free (see Table 4-4).

Energy Management

4.5.11 Direct Load Control and Customer-Controlled Load Management

These two services were combined in our interview materials because of the technical similarity between utility-controlled load management and customer-controlled building automation. However, we found that the distinction in control was critical to both focus group participants and interviewees. Specifically, participants indicated that it was very important for them to determine control over energy use by having the ability to switch appliances on and off at will. With this proviso, focus group members saw these services as very useful, particularly in conjunction with time-of-day pricing as a means of programming and fine tuning household energy management activities.

Respondents stated that the direct load control program should be voluntary and, if controlled by the utility, the consumer should have the ability to override utility peak load settings. In part, objections seemed to be raised based on lack of familiarity with the concept of direct load control (DLC). Thus, in promoting DLC programs, utilities typically would have to respond to these concerns in their marketing materials (e.g., customer ability to override settings and minimal change in comfort levels). [23]

If offered free of charge, more respondents wanted this service (12) than any other of our proposed services. Only three respondents were willing to pay for this service (about $5 per month). One person indicated that they would be willing to pay a $15 one-time set-up fee for building automation (see Table 4-4).

[23] We did not offer any explanations that would reduce or counter the objections that were raised, since our objective was to establish how the respondents perceived and understood each service as we presented it, and not to explain it to receive more favorable responses.

Non-Energy Services

4.5.12 Entertainment Videos on Demand

Reactions of focus group participants to a service offering entertainment videos on demand were somewhat mixed, with differing views on the usefulness of this service as well as whether the utility should get involved in the entertainment business. A few participants commented on problems that are perceived to be a negative by-product of an increasingly technological society (e.g., social alienation and isolation, excessive consumerism). For example, several participants noted that this service would “keep people in front of the TV sets” where they would just have to “point and click,” and “buy, buy, buy.” However, Susan liked the simplicity of having one company providing all utilities, even including entertainment; other participants were more concerned about this concentration of control. This may explain why three focus group participants indicated that they would not want this service even if it was free.

Interviewee reactions to this service were somewhat more positive. Most interviewees liked the flexibility and possibly the lower cost. Patchy believed that such a service could lower the cost of providing entertainment because it would eliminate the intermediate business link from the system, although she was concerned that this would “put somebody (small businesses) out of business.”

More customers were willing to pay for this service than any other (see Table 4-4). Two focus group participants said they would be willing to pay a $10 monthly fee, while four others would be willing to pay on a per-use basis, with fees ranging from $2 to $3 per use. Nine of ten interviewees were willing to pay for a service offering entertainment videos on demand ranging from $1 to $25 per month or $2 to $5 per use (see Appendix D, Table D-1).

4.5.13 Security Services

Focus group members reacted more negatively to the utility offering security services than interviewees. Six of seven focus group participants did not like this service. Participants did not perceive security services as falling within the ‘core’ business of electric utilities and could not see any advantage to getting this service from the electric utility.

In contrast, most interviewees reacted positively to this service. Five of ten interviewees were willing to pay monthly fees ranging from $1 to $30 for the service, assuming cost and quality were competitive with other security firms. One respondent, Neel thought that utility involvement might improve service quality in the home security field. According to him, commonly available home security systems are useful “only to keep school kids away, when it comes to professional robberies, these are no good.”

4.5.14 Additional Service Suggestions

We also asked respondents for their suggestions on other services that would be useful and they offered the following ideas:

- weather reports;
- educational videos for children;
- a bulletin of cultural program offerings in the area;
- food ordering services;
- screening of incoming commercial calls;
- catalog shopping, as a means of saving paper; and
- health monitoring for elderly residents.

Exploratory Market Research: Summary and Key Findings

5.1 Overview

In this chapter, we summarize results and key findings from our focus group and individual interviews with ten residential customers. We found that between 25 and 60% of the 17 respondents had some interest in new billing-related or other energy information services. However, some respondents commented that these services could also be provided quite satisfactorily by current information mechanisms (e.g., utility bills, libraries) and that they were concerned about “technological overkill” and “information overload” because these services would be used on an infrequent basis. Based on survey responses, most customers only wanted billing-related and energy information services if they were free or were only willing to pay a small amount. Our analysis suggests that utilities will need to bundle billing-related and energy information services as part of a comprehensive service package. Customer-controlled load management (CCLM) and time-of-day pricing yielded the most favorable overall responses among energy-related services. We also found that privacy and network security issues and concerns regarding potential for intrusive marketing were a significant issue for many respondents. With respect to utilities offering non-energy services (e.g., security services, entertainment videos on demand), some respondents had concerns regarding the appropriateness of this new business role for electric utilities.

5.2 Communications Display Medium: TV, Computer or ‘Smart’ Thermostat

Many respondents viewed the computer as a more convenient medium for display of energy information and other services than TV. However, respondents also commented that TV was universally available and therefore allowed services to be provided to all customers, not just those who owned computers (see Section 4.4.2). Some respondents said they prefer current information mechanisms, such as paper bills, the telephone, consumer reports, and libraries. Our small sample suggests significant differences among residential customers in their attitude toward and familiarity with various media (e.g., TV vs. computer) which when combined with differing availability and usage patterns, affects their receptivity to more sophisticated communications systems.

5.3 Bill-Related and Energy Information Services

Most respondents were interested in specific energy information services, although average willingness to pay was quite low; thus we recommend bundling of these services as part of a comprehensive package.

Compared to previous studies, we developed a more extensive set of bill-related and energy information services which included historic data on monthly consumption, neighborhood comparisons of energy use, breakdown of individual appliance and end use consumption, information on energy efficiency programs and products, and "do-it-yourself" videos. Some respondents indicated that these services may have some practical value and application (e.g., increase awareness of their own energy consumption and alert them to energy savings opportunities and potentials). However, depending on the proposed service, about 10-40% did not want the service even if it was offered free of charge. Some people regarded the services as unnecessary either because they could access the information with greater ease using other media (e.g., paper bills) or because they would not use the information or questioned its validity.[24] Overall, most respondents wanted the service only if it was free or were only willing to pay a nominal amount ($0.50-$1.00 per month or $1-2 per use).

These initial results suggest several possible strategies: (1) bundle a set of energy information services as part of a more comprehensive package of communications-enabled services that could command a reasonable monthly fee; (2) offer energy information services which can easily be unbundled and marketed on a per-use basis (e.g., "do-it-yourself videos, product information), and (3) conduct additional market segmentation analysis in order to determine if some energy information services can be offered profitably on a stand-alone basis to certain targeted customer groups. Based on our small sample, we are not overly optimistic that the third strategy– providing individual stand-alone energy information services– would prove successful. Our focus group discussion also provides utilities with some insights on customer concerns (e.g., privacy, technological overkill, relevancy) that must be addressed so that energy information services add value to their product offering (see Section 4.4).

[24] For example, several respondents questioned the validity of neighborhood comparisons of energy use because of the difficulty in normalizing for differences in lifestyle, demographics, and building type.

5.4 Barriers to Marketing Energy-Efficiency Services

Some respondents limited interest in energy information services arises in part because they do not consider the potential for energy savings worth pursuing.[25] The basis for this conclusion often rests on two significant discrepancies: (1) the perceived potential for energy savings vs. the actual potential, and (2) the perceived impacts on lifestyle which are thought to be significant vs. minimal lifestyle changes that are typically required to reduce bills. The willingness to engage in behavior to save energy seems to be correlated with knowledge about technical and behavioral potential for energy efficiency and conservation as well as the size of the economic reward relative to changes that have to be made. Thus, in order to overcome consumer information barriers, effective consumer education will be a necessary component of any large-scale utility effort to deploy communications-enabled services. For example, utility marketing materials could highlight the fact that high-efficiency products do not necessarily compromise lifestyle or provide realistic estimates of energy and dollar savings potential that homeowners could expect from various activities.

Respondents' limited interest in energy efficiency and bill reduction is partly due to their perception that energy savings potential is low or would negatively impact their lifestyle.

5.5 Customer-Controlled Load Management and Time-of-Day Pricing

Customers viewed customer-controlled load management (CCLM) and time-of-day pricing as particularly useful services; these services had the fewest negative responses. During the focus group discussion, several participants made the connection that CCLM could work particularly well in conjunction with time-of-day pricing. This may be another indication of the benefit of service bundling: a more accurate price signal on electricity service costs may be perceived more favorably in tandem with a service that puts the customer in a position to improve their home energy management and reduce bills. We believe these service options were popular because customers clearly saw that they would enable them take control of and responsibility for their energy management.

Customer-controlled load management and time-of-day pricing were the two energy-related services that yielded the most favorable overall responses

[25] One focus group member stated that the savings potential was not perceived as high enough to care. Despite Shirley's earlier testimonial to her significant DSM savings, this comment did not generate remarks or corrections of any kind.

5.6 Non-Energy Services

More respondents indicated some willingness to pay for security services and entertainment videos on demand compared to other services which were offered by an electric utility as part of an advanced communications system. The average amounts offered by those customers willing to pay (e.g., $11 per month for security services and $3 per view for entertainment videos on demand) appear to be reasonable compared to similar services that are well-established in the market. Again, while we do not expect precise values from this small sample, security services and video-on-demand do provide a calibration that our measures are close to market value, thus lending some credence to the responses for energy-related services that are not currently offered in the market.

Some customers appear willing to pay for non-energy services such as entertainment videos on demand and security services, although customer concerns about unfair competition and utilities entering new business areas may represent a barrier among some segments of the residential customer base

Focus group participants and several interviewees raised concerns regarding the appropriateness of utility entry into these new businesses or the advantages of purchasing these services from a utility vs. a firm that specialized in this business. The utilities current status as a regulated monopoly entity is both a curse and a blessing in the residential market. Some respondents indicated that they tend to trust utilities or value their technical capabilities more than other types of businesses (e.g., security firms) and thus may be receptive to utilities offering non-energy services. On the other hand, because they are often perceived as a large monopoly, utilities are vulnerable to arguments that their entry into new markets will negatively impact small businesses, that they may be unfair competitors, or that they could become too powerful. These sentiments were expressed in one form or another by some respondents.

5.7 Intrusive Marketing and Privacy Concerns

Based on the focus group discussion, we found a direct link between customers' receptiveness to new services, their attitude towards electric utilities, and their experiences with telephone utilities and cable companies. For example, several focus group partici-

Customer reactions to energy information and other services are influenced by their perception of electric utilities, marketing experiences with providers in other recently deregulated industries, and privacy and network security concerns.

pants appeared to distrust their investor-owned utility. This distrust appeared to amplify their concerns regarding privacy issues for some services (e.g., services that involved the utility collecting disaggregated data on personal energy use or customers' product and equipment needs), specifically whether the utility would provide information on their usage patterns or energy services needs to other private firms. In their view, this could result in an increase in unwanted marketing pitches from other commercial product and service providers.

Privacy issues and the annoyance factor associated with unwanted marketing pitches were a significant concern for several focus group participants because of their prior experiences with deregulation in the telecommunications industry and the prospect of increased competition in the electricity industry. Not surprisingly, those customers that had negative experiences with providers of telecommunications services tended to be more dubious and suspicious of new service offerings. These concerns were reinforced when the framework for discussion was a deregulated competitive environment in which utilities also offered a range of non-energy services. Several focus group participants' misgivings about a single entity providing bundling of energy and other services (e.g., telecommunications, cable network, security services) were less pronounced if the utility was a locally-controlled, publicly-owned municipal entity. If our small sample is reflective of the population of residential customers, then it is clear that utility marketing and advertising materials will have to address the image of the electric utility as well as differentiate these service offerings from customers' negative perceptions of telecommunications providers' marketing of services.

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