Section 6
DR Technologies

SECTION 6: DR TECHNOLOGIES

I. INTRODUCTION

We all use tools to simplify our daily lives. Things such as the hammer, coffee maker, and computer are used to reduce the time it takes to complete a life's daily chores. The demand response industry has also developed technologies that simplify the implementation and utilization of DR resources in the energy marketplace. In order for a DR resource to be useful in the energy market it must have the ability to react when needed and its response must be measurable. Tools and systems have been developed that help activate a DR asset (e.g. direct load control) and manage a DR asset portfolio (e.g. DR software products). These and other DR related technologies help the DR resource react to load reduction request and opportunities and they help provide the business process mechanisms that connect the resource to the energy marketplace.

This chapter will explore how technology is being used in the demand response industry today. The objective of this section is to help the DR market participant identify technologies and systems that are used to make DR more effective in the energy marketplace from the perspective of the participating customer, the energy provider and the system operator.

Improvement in communication and metering technologies has helped the demand response industry grow in recent years. In fact, some people have suggested that the demand response industry was made possible by the improvement and wide scale deployment of Internet communications in the late 1990s. The Internet instantly made "one-to-many" and "many-to-one" communication capabilities less expensive and more reliable. For example, prior to the development of the Internet, traditional utility load curtailment programs were dispatched manually, usually by telephone or fax machine. This served the purpose and utilized state of art technology at the time, but it was labor intensive and prone to human error. Internet communications opened a whole new world of possibilities.

Today, systems can be set up to monitor energy markets and automatically convert load consumption according to user preferences. This can be an automatic response that requires no human intervention. In addition, with the right configuration, and contractual agreements, a control room operator can surgically target a grid problem by activating demand response resources near a specific substation. The difference between the two types of deployment solutions can be equated to the power and speed of computers that were the size of large rooms in the 1950s to the laptop computers used today. They both got the job done, but the current tools do it faster, cheaper, and more effectively. The balance of this chapter is organized as follows:

Section II: Purpose of DR Technology
This section introduces what DR technology means and how they are being used.

Section III: DR Technology Functionality
This section discusses some basic elements of DR technologies.

Section IV: DR Technology Case Studies
This section categorizes and summarizes the technology case studies provided by the Country Experts. The actual case studies are located in the technology database section of the project portal.

Section V: Identify Where to Use DR Technologies
This section offers suggestions for identifying where DR technologies can be used at consumer sites.

Appendix A: DR Technologies in the U.S.
In addition to the case studies located in Section IV, the United States provided a list of firms that market a variety of DR technologies.

II. PURPOSE OF DR TECHNOLOGY

The demand response marketplace is rapidly evolving and new ways for using DR resources are being invented on a regular basis. For example, after the 2003 blackout in the northeastern region of the United States, DR resources were called upon to help bring the power grid back to life. The availability of these resources allowed grid engineers to bring the grid back more slowly and methodically. The New York Independent System Operator (NYISO) estimated that the utilization of these DR resources for these few days provided enough benefit to the marketplace to pay for having them sit idle for the next seven years[1].

The primary reason for using any DR technology is to improve the speed and ease at which DR resources are available as additional energy and capacity in the energy market. As it is with most technology, the tasks that DR technology performs can usually be performed manually. However, many of the DR technologies being used today help improve speed and accuracy which allow DR to be used in ways that was not practical 10 years ago.

For example, interval meter reads are usually used to verify that a consumer provided the DR benefit in the amount and time period that was expected or contracted. A meter read can most certainly be performed manually. However, this limits the speed in which the read can be acquired as well as the number of entities that can view the read at a time. On the other hand, there are automated meter reading (AMR) technologies available that can acquire the meter read monthly, weekly, daily and almost instantaneously. In addition, there are Internet based software solutions that can present this meter data to multiple market actors at the same time and in a format that is useful to them (e.g. a TSO may

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[1] Update: Due to a cool summer and adequate capacity levels, the resources were not needed in 2004. However, a strong heat wave in the summer of 2005 caused the market to call upon the DR resources multiple times.

wish to see information presented differently from the end use consumer). The benefit of the automated system is that it expands the range of DR products that can be developed. With the improvement of communication speed and the use of appropriate information technology tools, DR resources can demonstrate that they can be reliably used in reserves markets.

There are a wide variety of DR technologies available for DR product managers and energy consumers to consider. Technologies such as building automation, near real time meter reading, and access to real time pricing data can create better energy consumers. This information can be used to correlate energy consumption with energy costs. By doing this, consumers are able to assess whether it is best to reduce consumption or continue using power as they normally would. Similar systems can be used by the demand response service provider to alert their customers to cost saving or revenue earning opportunities.

However, a key issue to remember is that demand response technologies and products must be relatively easy for the end customer. That means in many cases, limited or little cost to the customer at the start of a program, as well as, low risk and minimal resource needs to manage the program. End use customers have a core business or lifestyle (in case of residential customers) that is not typically involved with selling energy. If the demand response technology or product disproportionately affects customer core business or lifestyle, or requires substantial management oversight in the case of businesses, it is the product is unlikely to be successful.

Demand response is one of the least expensive and fastest ways to add capacity to a given market - with initial deployments measured in months not years. The key is to start a demand response strategy early enough to allow for adequate product design and marketing of the program to end-use customers. More specifically, you can't start designing and marketing a program in April when you need it operational in June. Products must be designed, operating and control technologies must be evaluated and installed, and consumer marketing must be clearly designed and communicated to consumers. A well rationalized strategy that is easy for consumers to understand will be more successful than one that is hastily developed and deployed.

There are a variety of DR technologies that can be used to make DR operations easier, faster, and more efficient. Though, it is generally best to identify the type of DR products that will best serve the local market and correlate that with the available DR market potential consumer mix. For example, most people believe that interval meter data is a critical enabling infrastructure for DR services. It's possible that this belief can cause people to immediately conclude that wide scale deployment of an Automatic Metering Reading (AMR) system will lead to an effective DR deployment. However, it is possible that the installed AMR system will not have the right functional specifications to implement the DR solution needed by the local market. In other words, an economic forecast can indicate that the market would benefit most from real-time "spinning" reserve type DR products. Unfortunately, it is possible that an AMR system designed to

provide monthly meter reads may not provide data needed to make proper operational decisions in the control room.

The following chart provides an example of the level of AMR functionality that may be desired with various types DR applications. On the other hand, this is not the only possible scenario. Any number of permutations can be developed between the extremes of load profiling all DR resources (aka estimated measurement) to real time metering with real time data communications. It generally comes down to a benefit-cost analysis between the value of the information for a given DR product and the cost of providing the information when and where it is required.

DR Application	AMR Time Latency
Support Spinning Reserves	Minutes
Backup Capacity	Hours
Economic Dispatch	Daily
Residential DR	Monthly or Profiled

The point here is that, if possible, DR products must be designed based on the needs and abilities of the local market. Once that is done, then consideration can be given to functional specifications needed from potential technology solutions to achieve those goals. If technologies are chosen first, potential functional limitations with those technologies may be constraining factors in DR product design. Therefore, it is possible that the deployed DR products will not be the best solutions for the local market.

It should be noted that the use of the metering example above does not imply that AMR is needed for a successful DR solution. In fact, the example shows that a load profiled solution may be appropriate for residential DR. Interval metering is a technology that many use to measure and settle DR, and therefore it is an important DR technology. But, it is not an absolute requirement.

IV. DR TECHNOLOGY FUNCTIONALITY

As noted above, DR technology can be used to help simplify the implementation of DR events. As a general rule, technologies are designed and utilized to replace manual operations. The theory is that the technology can replace the manual operation and thereby improve efficiency and reduce long term costs. Most of the DR technology used today adheres to this theory.

In order for a DR product to be successful, it must have ways to trigger DR opportunities, measure the consumer performance, and properly settle the event (potentially with both the consumer and the wholesale marketplace). From these needs, it can be inferred that the following basic functionality will need to be incorporated into the DR product:

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1. Notification
2. Measurement
3. Compliance
4. Settlement

It is also possible that the following fifth functional requirement will be needed (or at least desired) depending on the DR product design.

5. Automated controls

Let's explore each of these functions in more detail.

Notification:

In order for a DR event to be activated, there needs to be a way to notify the consumer. Notifications can be direct, such as telephone calls or electronic messaging, or they can be passive, such as a including a signal on a residential thermostat. The important things to consider here are the speed in which notifications are required, the volume of notifications that must be produced, and whether actions are required by the consumer.

For example, if the DR product incorporates automated HVAC controls, then a simple notification on the thermostat informing the consumer that they are in a DR event may be sufficient. However, if an industrial consumer is required to shut down a production process within a specific amount of time, then direct communication with a transaction validation process may be more appropriate.

It is also important to consider the number of notices and the speed in which they must be distributed. If a DR product only has a few participants, a manual solution may be best. However, if there are dozens, hundreds, or even thousands of participants, it may be best to utilize an automated system. An automated solution can send out automated phone calls to hundreds or thousands of individuals almost instantaneously via today's Internet telephony communications. These services also provide the ability to track when the notice was sent, the person that received the notice, and provide them with the option of accepting or rejecting event participation (subject to product rules).

The record keeping and event tracking function of some automated notification systems can provide useful documentation when a DR product requires mandatory compliance. This information removes the "we didn't know we were supposed to reduce consumption" argument because the records will indicate who was informed and when it occurred. This back up could be very helpful when significant amounts of money are on the line.

Measurement:

Engineers regularly profess that to control something it must be measurable. This adage holds true in the DR business as well. By definition, DR energy and/or capacity is provided by end use consumers. In order to harness this capability, there needs to be a way of measuring the energy that the consumer uses and when they use it.

There are a variety of ways in which to measure consumer loads. There are low tech ways to do it that utilize load profiling, a statistical sampling methodology used to extrapolate consumer class usage patters. There are also extremely sophisticated SCADA Remote Terminal Units (RTU) that provide usage data to a remote control room almost instantly.

Assuming that load profiling and RTUs are the extremes, there are a plethora of solutions that fall in between them. Recent improvements in communication technologies make some other solutions fast, reliable, and cost effective. Usage data can now be transmitted via powerline carrier, radio frequency signals, telephone, and/or Internet. There are certainly pluses and minuses to each of these options, but fact that the variety of communication mediums exist allows the DR product designer to utilize the right solution(s) for their DR product portfolio.

It is also likely that the type of DR product used will help establish the speed in which the data needs to be communicated. For example, in the when DR is used for spinning reserves, the control room may desire to have near-real time data transfers. On the other hand, if it is a residential demand response product, monthly data acquisition may be sufficient. The point here is that it is important to make sure the technology's functional capabilities are able to support the data needs.

It is also important to ensure that the right data is being collected. As a general rule, the electric industry tends to operate in hourly intervals (e.g. wholesale price per MWh, retail cost per kWh). This indicates that the usage data should at least provide hourly intervals as well, but 15-minute intervals are more of an industry standard. Some DR products may require 5-minute intervals, so it is important to make sure the communication mechanism and the metering devices are able to support it when needed.

Compliance:

Compliance is closely related to measurement, but the concept is so important that it warrants its own category. As previously noted, DR assets come from the energy consumer. Therefore, it is necessary to determine the methodology for calculating the consumer's compliance (aka DR event performance level).

There are three basic ways this is done today:

   a. <u>Baseline:</u> The baseline methodology is used to pay consumers for load reductions they achieve below their expected level of consumption. In other words, consumption forecast algorithm is used to estimate what the consumer would use

for each hour of the day based on normal operation. This is then compared to the actual meter read for that hour. The facilities DR performance would then be the delta of the two numbers. It is common today for this methodology to be based on the usage of the 10 previous business days sans weekends and holidays. However, since this methodology is based on expected consumption levels it is open to calculation error and/or "gaming". Those using this methodology have developed business rules and monitoring techniques to mitigate and discourage such activity.

b. <u>Direct resource metering:</u> It is also possible to directly meter the asset responsible for lowering usage at the facility meter. For example, a consumer may have an onsite generator for emergency backup purposes. With deference to the local environmental rules, this asset could be activated when the DR event is triggered. If the asset was directly metered, then the genset's actual output could be used to establish its compliance level. This strategy is generally reserved for onsite generation assets, but it can be used in a variety of other scenarios as well.

c. <u>Real time pricing:</u> The purest form of consumer response may be real-time-pricing tariffs. This strategy basically matches the hourly market price to the consumer's actual consumption for that hour.

In the previous two cases, the consumer is basically selling their load reduction or onsite generation production to the market. They are compensated based on the baseline delta or the metered output. In this case, the consumer is simply charged the hourly energy price based on their hourly consumption.

This strategy is an excellent way to directly match consumer demand with market supply. However, it may also be difficult for some regulators to endorse for all classes. Electric tariffs are derived from complex calculations. Often times the tariffs are used to protect some classes (e.g. low income) and encourage others (e.g. industry). They also help to normalize costs over a 12 month period. Absent this, many electric customers would see significantly higher bills in the summer months and lower bills in the winter months. This could cause some public discontent.

Nonetheless, real time pricing is an excellent way to match actual demand with actual supply.

Settlement:

While it's a bit of an over simplification, settlement is basically a cash management system. There must be a process for managing cash receipts and properly crediting the consumer, either via a check or bill credit. The system should maintain meter usage, market pricing, event compliance levels, and individual contract terms.

Unless the consumer is directly connected with the wholesale market, which is usually reserved to the very large consumers, there are two primary settlement categories: a) wholesale market to the DR service provider (e.g. aggregator, distribution company, energy supplier, etc.); and, b) DR service provider to consumer. The settlement function should be able to delineate between these two levels.

Automated Controls:

Some consider this last category optional, while others consider it mandatory. There are a number of technologies available today that can remotely and automatically control predetermined loads. For example, residential load control technologies exist that modulate HVAC, electric water heaters, pool pumps, etc. These technologies allow a DR service provider to instantly load shed many loads one time.

The concept has also been expanded into many commercial facilities in recent years. For example, several firms market remote lighting dimmers. These devices will either lower light levels or turn off predetermined light banks. In addition, a number of building automation control contractors work with facility managers to program the system to respond to market prices instead of just demand levels. By doing this, they are able to make the building operate based on predetermined comfort vs. cost strategies.

V. DR TECHNOLOGY CASE STUDIES

One of the best ways to learn about technologies is to see how others are using them. In this regard, IEA's Task XIII collected demand response technology case studies from the participating Country Experts. Task XIII requested case studies from all class of users: consumers, DR service providers, and system operators.

A total of fifty (50) technology case studies were received from Australia (AU), Canada (CN), Denmark (DK), Finland (FI), Italy (IT), Korea (KO), Netherlands (NL), Norway (NO), Spain (SP) and the United States of America (US). Each of the technology case studies are summarized below by country.

The types of technologies vary from new meters and AMR equipment, to advanced load control equipments and new systems which aggregate and manage distributed generation resources. The technology applications cover all customer class types (i.e. residential, commercial and industrial). In certain of the cases, the technology applications are currently being studied/tested in pilot programs -- if so, the key pilot program parameters are noted (if they were provided).

In addition to the case studies, Norway and the United States provided a list of AMR and DR technology service providers. Norway's list is listed as NO-3 in the case study summary section. The US list is listed as US-12. A chart from their report is incorporated in the case study summary and the full report is attached as Appendix A. These lists

provide brief descriptions of the firm and its products as well as instruction locating additional information. Combined, these lists provide information on over 40 firms that service the DR industry.

The information provided has been categorized in the Master Technology Case Summary Chart below. However, because a given technology can serve multiple purposes and be used by more than one type of market actor, many technologies are listed in multiple locations.

The case studies will show the following general utilization of DR technology by the class of users:

Consumers:

Consumers tend to use technologies that help monitor their facility(s) load levels and control specific energy using equipment. Monitoring technologies tend to focus on metering equipment and software systems to analyze the usage data provided by the meters. Control technologies span the spectrum from dedicated controls (e.g. lighting controls) to sophisticated building automation systems. In addition, some consumers are connecting the monitoring systems to their building automation systems. They are then programming those systems to operate the building based on predetermined cost versus comfort decisions. These systems are also sometimes able to accept a signal from the DR service provider (or using a wholesale price trigger) to cause the system to make automated DR decisions.

A few Case Study References: AU-1,4; DK1; NO-,2; US-3,4

DR Service Providers:

These firms are in the business to connect consumers to DR opportunities. In order to do this effectively, many of these firms are using technologies that give them remote control capabilities over specific consumer loads (e.g. HVAC systems, ability to send signals to consumer building automation systems, water heater control signals, etc.). They tend to use these systems to aggregate many consumer DR resource loads and then market it to the wholesale power market – either via bilateral agreements or at a structured power exchange.

However, this group of users also has two other key needs. First, they need to be able to rapidly communicate with dozens and sometimes thousands of consumers simultaneously in order to alert them to DR events. In order to do this, many of these users have found benefit in some of the new Internet communication systems. These systems have the ability to send out many signals (i.e. email, automated telephone service, fax, etc). Many of these systems have an added benefit of being able to track who received the notification and when they received it. This audit trail can prove useful during any dispute resolution process.

Secondly, they need to be able to properly settle transactions with both the wholesale market and with the consumer. Depending on the DR product in question, some DR service providers are utilizing metering devices that can communicate via the Internet in virtually real time with limited communication expenses. On the other hand, if the situation does not require that level of data speed, they can acquire the information via the normal meter reading cycle. Regardless of how and when they acquire the data, they will need some type of system to manage the data they receive, help correlate it with the DR event compliance level of each consumer, and reconcile it with the wholesale market transaction. There are some Internet based software packages available that specifically focus on simplifying these needs.

A few Case Study References: AU-10,14; IT-1; KO-1; NL-2

System Operators:

The system operator tends to have similar needs as the DR service provider in that they need to notify external parities (which could be the service providers or individual consumers depending on the market rules); they need to manage large volume of usage data, they need to validate DR event compliance (sometimes at the consumer level); and they need to properly settle accounts with their customers (which tends to be the DR service provider and not the actual consumer).

However, one of the biggest challenges that these users have is that a DR service provider may not have is that depending on the market (i.e. liberalized or non-liberalized) they may have multiple customers in a specific zone and each DR service provider will likely have DR resource customers in many zones. Given that system operators generally manage the power grid on a zonal basis, they may to need the ability to surgically request DR operation in a specific zone in order to deal with things like transmission congestion. Therefore, their communication system may benefit from having this feature. There are some packages available in the market today that can support this ability.

A few Case Study References: AU-11,14; US-12

This element of Task XIII is intended to inform readers about DR technology that are being used in the market. The project is not designed to endorse any particular technology or solution. The goal is simple to make the information available. However, it may be helpful to highlight a few intriguing solutions.

Demand response runs on information. Consumers need to know when to reduce consumption and the market needs to know that that it happened. A few general trends are:

- There are technologies that make it easier for the consumer to understand their consumption patterns and energy costs.
    - AU-1: Cent-A-Meter
    - CN-2: Blueline PowerCost Monitor

- There are also technologies that help the DR Aggregator and/or System Operator better manage the DR product. These systems operate like a control room energy management system for DR.
    - DK-1: EFFLOCOM
    - FI-1: ENERMET
    - US12: RETX Energy Service ; eLutions

- Immediately after DR market actors are able to get the information they need (i.e. connect consumer loads to proper price signals), they start to look for ways to activate the DR more efficiently. There are a number of solutions related to building automation and direct load control systems that may be helpful in this endeavor.
    - AU-12: Bryln
    - NL-1: Assimilation Lighting and Heating in the Horticultural Sector
    - US-2: Doubltree Hotel, Sacramento CA remote facility monitoring and control

This is not an exhaustive list, but it does highlight that (a) DR is driven by making the right information available to the right people at the right time; and, (b) automation can improve consumer ease and responsiveness.

A summery of each technology case study collected is immediately below.

Master Technology Case Study Summary				
DR Technology (Note: AU-1, 2, 3….etc are cross referenced in the Case Study Indexes which follows this table)	**Residential Energy Management**	**Commercial Peak-load Reduction (typ. min. 100 MW)**	**Load Curtailment & Shifting**	
			Energy Suppliers	**TSO**
METERING AND COMMUNICATION				
Advanced meters, including Sub-meters	AU-1,4,5,7 DK-1,2,3 NL-3	AU-7 DK-3 FI-2	AU-5,7 DK-1,2,3 FI-2 NL-3	AU-7 DK-1,3 FI-2 NL-3
Energy information systems – involving meters, sub-meters	AU-1,4,5, 10 DK-2,3	AU-7,10 DK-2,3 FI-3,4,5,6 US-1,2,3,4	AU-5,7,10 CN-1,2 DK-2,3 FI-3,4,5,6 KO- 1 SP-1,2,3,4	AU-7,10 CN-1,2 DK-3 SP-1,2,3,4
Automated Meter Reading (AMR)	AU-8 CN-1,2,3 DK-2,3 NL-3	AU-8 DK-2,3 FI-1,3,4 NL-3	AU-7,8 CN-1,2,3 DK-2,3 FI-1,3,4 NL-3	AU-7,8
Highly integrated approaches for event notification	AU-3 DK-1,3	AU-3 DK-3	AU-3 DK-1,3 KO-1 SP-4	AU-3 DK-1,3 KO-1 SP-4
Expanded use of broadband technologies for automated load control.	AU-3 CN-3 NO-1,2	AU-3 FI-3 NO-1	AU-3 CN-3 FI-3 NO-1,2	AU-3 NO-1,2
ENERGY MANAGEMENT				
Whole house energy systems	AU-3			
Energy management systems	AU-3,5,12,14 DK-1,2,3 NO-1	AU-3,5, 12,14 DK-3 NL-1 NO-1 US-1,2,3,4,7,8	AU-3,5,12,14 DK-1,2,3 IT-1 NO-1	AU-3,5 DK-1,2,3 IT-1 NO-1
Smart thermostats	NO-2		NO-2	NO-2
GENERATION OF ELECTRICITY				
Dispatchable emergency generators		AU-6	AU-6	AU-6 DK-4,5
Combined heat and power generation applications (CHP)	AU-9 NL-1	AU-9 NL-1		

LOAD CONTROL				
Direct load control of air conditioners and water Heaters	AU-12,13 DK-3 KO-2 NO-2 US-10	AU-12,13 DK-3	AU-12,13 DK-3 KO-2 US-10	DK-3 US-10
Cycling of commercial air conditioners			KO-2	
Load curtailment –shifting	AU-2 DK-1,2,3 KO-1,2 NO-1	AU-2 DK-2,3 NL-1 NO-1	AU-2 DK-1,2,3 KO-1,2 NO-1	AU-2 DK-1,2,3 NO-1
Systems implementation and control strategies via new systems	AU-3 DK-1,2,3 KO-1	AU-3 DK-2,3	AU-3 DK-1,2,3 KO-1	AU-3 DK-1,2,3
VERIFICATION OF LOAD CONTROL				
Load control and load reduction verification	AU-3, 12, 3, 14 DK-1,2,3 FI-1 NO-1 KO-1,2 US-10	AU-3,12,13,14 DK-2,3 FI-1 NO-1	AU-3,12,13,14 DK-1,2,3 FI-1 IT-1 KO-1,2 NO-1 US-10	AU-3 DK-1,2,3 IT-1 NO-1 US-10
Verification through load profiling and sample-based spot metering applications	AU-3 US-10	AU-3	AU-3 US-10	AU-3 US-10

AU Technology Case Study Index:

AU-1 Wireless Monitors Australia Pty Ltd (CENT-A-METER)

AU-2 Energy Response Pty Ltd (DSR Facility)

AU-3 Arrow Australia Electronics Pty Ltd (LonWorks (Echelon Corp))

AU-4 Computer Control Instrumentation (PowerMate™)

AU-5 AMPY Email Metering (Home Energy Monitor)

AU-6 CSIRO Distributed Energy Management & Control Project

AU-7 EDMI Pty Ltd

AU-8 Intermoco (Utiligy)

AU-9 GridX

AU-10 deSide® Software

AU-11 EcoVision Solution

AU-12 Brylyn

AU-13 Comverge Load Control Unit

AU-14 SAAB Systems Direct Load Management System

CN Tech Case Study Index :

CN-1 OZZ Corporation

CN-2 Blueline PowerCost Monitor

CN-3 Trilliant Mesh Underglass Meter Reading

DK Technology Case Study Index:

DK-1 EFFLOCOM pilot: DR offered by households with direct electric heating

DK-2 NESA's Smart Read metering system

DK-3 AMR system at Sydvest Energi

DK-4 RCOM – Use of Back-up Generation as Regulatory Power

DK-5 Aggregation offering back-up generation as Regulatory Power

FI Technology Case Study Index:

FI-1 Enermet

FI-2 MX Electrix

FI-3 Comsel

FI-4 ista Suomi Oy

FI-5 Empower Oy

FI-6 Aidon Oy

IT Technology Case Study Index:
IT-1 Load Shedding System for Interruptible Loads

KO Technology Case Study Index:
KO-1 Direct Load Control in KEMCO

KO-2 Remotely Controlled Air-Conditioners

NL Technology Case Study Index:
NL-1 Assimilation Lighting and Heating in the Horticultural Sector

NL-2 Example Application intelligent metering and smart power system

NO Technology Case Study Index:
NO-1 Technology for Direct Communication (EFFLOCOM Partners)

NO-2 Lekey load controller

NO-3 List of AMR Technology used in Norway

SP Technology Case Study Index:
SP-1 GECO Consumers Management Tool

SP-2 Research and development of a new methodology about demand management capacity of large consumers of electricity

SP-3 Indel Project (Spanish Electric Demand Atlas)

SP-4 Interruption Flexible Management Program (IFMP) Tech

US Technology Case Study Index:
US-1 Almeda County California Government remote facility monitoring and control

US-2 Doubletree Hotel, Sacramento CA remote facility monitoring and control

US-3 Staples Office Supply remote facility monitoring and control

US-4 Wesleyan University remote facility monitoring and control

US-5 Case Study of Niagara Mohawk's Large Customer RTP Tariff

US-6 Real Time Pricing for C&I Customers: Eight Case Studies

US-7 Advanced Control and Communication for Demand Response and Energy Efficiency

US-8 2004 Fully Automated Demand Response Tests in Large Facilities

US-9 Update on Automated Demand Response Research

US-10 Estimated Load Reductions for PJM's Small Customer Load Response Pilot Project

US-11 Survey of Utility Experience with Real Time Pricing

US-12 List of US DR and AMR Technology Providers

AU Tech Case #1: Wireless Monitors Australia Pty Ltd (CENT-A-METER™)
The cent-a-meter™ is an easy-to-use wireless home monitoring system that measures electricity being used in homes and small businesses and shows the cost per hour on a portable display, perfect for those serious about reducing energy consumption and environmental conservation. The cent-a-meter™ display features include: power consumption, cost per hour of electricity, equivalent greenhouse gas generated, and indoor ambient temperature and humidity comfort levels.

AU Tech Case #2: Energy Response Pty Ltd (DSR Facility)
Energy Response is the only Demand Side Response (DSR) aggregator in the Australian National Electricity Market (NEM). Energy Response has developed a national DSR facility. By registering a range of DSR from a wide range of electricity consumers across the market Energy Response is able to form high quality and reliable 'aggregated' DSR products which are valuable to electricity retailers, network operators, NEMMCO (the market operator) and ultimately a number of other market participants. The use of these DSR products will address the major inefficiencies in the market and result in lower electricity costs.

AU Tech Case #3: Arrow Australia Electronics Pty Ltd (LonWorks (Echelon Corp))
Echelon is at/near the forefront of the technological revolution because of the LonWorks platform, a universal, open standard for networking everyday devices to each other and the Internet. At the heart of Echelon's LonWorks technology are networks of low-cost, intelligent devices like switches, thermostats, elevators, washing machines, and utility meters that communicate with each other to provide distributed monitoring and control.

AU Tech Case #4: Computer Control Instrumentation (PowerMate™)
The *PowerMate* can show figures on greenhouse gas emissions and the running costs of particular appliances. The PowerMate has the ability to set greenhouse gas emissions and electricity tariffs as emissions from electricity generation and prices change over time. PowerMate measures the watts drawn and kilowatt-hours consumed by an electrical appliance and can estimate hourly, quarterly and yearly running costs and greenhouse gas emissions. It's easy to use – one simply plugs the *PowerMate* into a power point and then in turn plugs an appliance into the *PowerMate*.

AU Tech Case #5: AMPY Email Metering (Home Energy Monitor)
The AMPY Email Metering AMI demand response system provides home owners real information on applicable energy tariffs and usage information, such as the energy consumed over the past hour and how much energy the home is currently using. Displayed in engineering units and Dollars and Cents on the home energy monitor,

customers may respond to the easy to understand information and utility generated price signals to vary demand in peak periods.

AU Tech Case #6: CSIRO Distributed Energy Management & Control Project
The Distributed Energy Management and Control (DEM&C) project is primarily concerned with the management and control of distributed energy resources. Considering large-scale uptake of distributed energy resources below the 5MW level, the operation and scheduling of these resources in a timely and coordinated fashion is a difficult challenge. Generally, traditional electricity network SCADA systems are not designed to operate at the required granularity at such a low level in the network, and the extension of traditional SCADA systems to this level is considered uneconomical.

The DEM&C project is focused on applying cutting-edge computer science, communications and electrical engineering technology to solving this problem. The general approach is to use *decentralized* control methods for managing the system- no single controlling entity manages the system. Rather, the system shows *emergent behavior*, in trying to solve a variety of possible issues, such as reducing expenditure, minimizing greenhouse gas contribution, or maximizing profit. This decentralized approach has many advantages, including scalability, no single points of failure, great flexibility, and increased granularity of control.

AU Tech Case #7: EDMI Pty Ltd
EDMI manufactures a range of electronic smart meters to suit all sectors of the energy utility industry – consumer, commercial and industrial. EDMI meters are also widely used in energy management and sub-metering applications. EDMI meters are powered by the latest microprocessor and digital signal processing technology and have application for AMR, etc. EDMI meters feature a range of communication capabilities.

AU Tech Case #8: Intermoco (Utiligy)
Intermoco's utility AMR solutions is an end-to-end web-based AMR Solution, which provides real-time meter data recording and presentation of a customer's energy profile. Utiligy empowers electrical utilities to record and control energy consumption and demand patterns to maximize the effective use of system capacity and to more closely match system capacity to demand.

AU Tech Case #9: GridX
The GridX Combined Chilling Heating and Power CCHP units produce energy at an 85% level of efficiency, compared to a coal burning power station producing the same amount of electricity at an overall efficiency of less than 30%. The primary reason for the significant difference in efficiency levels is that any by-products produced during the generation process of a coal power station are released to the atmosphere.

Whereas the GridX Power System utilizes its by-products such as heat to provide heating in winter and heat for appliances in addition to air conditioning in summer. The CCHP are linked via an underground delivery network which is also connected to the main

electricity grid. The GridX Power System is controlled and managed remotely, utilizing leading edge software to monitor the efficient operation of the system.

AU Tech Case #10: deSide® Software

deSide facilitates real-time data updates over any internet connection to a central MS SQL server database installed on the energy user's network (obviating the need for the energy user to have a expensive, dedicated link to NEMMCO set up). Various client tools (for display and analysis etc) have been incorporated into the product offering.

AU Tech Case #11: EcoVision Solutions

A programmable controller that receives input from meters, sensors, timers and other detectors and manages the operation of resource consuming equipment.

AU Tech Case #12: Brylyn

The Brylyn system uses wireless technology to provide a discrete and uniform control across all air conditioners controlled by the management system. This is achieved by dividing the loads into groups; the controller program will cycle through each group on a continuous closed loop basis. The control system is designed to switch off and on the load of air conditioning refrigeration's systems linked to the control system. This ensures that all of the air conditioner compressors do not start at the same time therefore avoiding excessive demand on the electrical system.

AU Tech Case #13: Comverge Load Control Unit

Product offerings cover a broad range of load control and AMR technologies, including direct load control devices and systems for residential, retail, commercial and industrial segments, including "smart" thermostats to under-glass cellular gateways and now to BPL enabled technology.

AU Tech Case #14: SAAB Systems Load Management System

The system calculates and presents the various demand side options available to bring demand in line with the available supply. On instruction, the system turns off the requested electrical loads at the targeted properties which can occur on a variable cycling basis with infinite possibilities, (e.g. all at once, section by section, individually, by load factor, etc.). Alternatively, the system can distribute the power shed on a rotational basis, (e.g. 25% of participating loads every 15 minutes etc.).

CN Tech Case #1a & 1b: OZZ Corporation

OZZ Corporation designs and operates two way AMR systems. They have been providing service for 20 years and serve 1.5 M utility customer accounts in Canada. Their metering devices have multiple communication capabilities (e.g. drive by & internet).

There are two documents that describe their services. Document "1a" provides a detailed look at how the AMR network works and potential solutions it can provide. And, document "1b" provides a more general overview.

CN Tech Case #2: Blueline PowerCost Monitor
PowerCost Monitor delivers real-time feedback about electricity usage to consumers, giving them the information they need to make smarter choices and reduce energy consumption. The device is the size of a small alarm clock. It lets consumers see exactly what they are using in real-time in terms of total and current cost as well as kWh usage.

The document provides a detailed overview that describes how the system works. It also highlights a few projects currently in place.

CN Tech Case #3: Trilliant Mesh Under glass Meter Reading
Trilliant provides a low cost AMR metering device. The unit is designed to serve the residential market. It uses wireless networks, so it is "always on". The enclosed document provides technical specs for the device as well as suggested applications and uses.

DK Tech Case #1: EFFLOCOM Pilot - DR Offered by Households with Electric Heating

The pilot project was established in 2003 including 25 domestic homes with direct electrical heating with a consumption of more than 16,000 kWh/year in order to reach a successful economy (the average consumption for houses with electric heating is 11.000 kWh/year). The communication system might control groups of loads and include remote meter reading at different voltage levels in order to follow the influence of the demand response control and avoid return load higher than the grid and/or system can supply.

DK Tech Case #2: NESA's Smart Read metering system
 The Danish Electric Utility NESA (550,000 customers) has developed a metering system called Smart Read, built on the dual band mobile phone technologies SMS/GPRS. The metering system is able to perform hourly or daily reading of electricity consumption and is the platform for development of new and better customer service.

Two hundred Smart Read meters are currently deployed for field test. During 2005 will be installed 20,000 units: 14,000 units for commercial customers, 5,000 residential customers with integrated alarm, and 1,000 selected customers. From 2006 and five years ahead, the plan is to install 110,000 metering systems annually, leading to a total of 550,000 installations during the next 5-6 years.

The vision for the direct improved service is to send a bill every month to every customer based on actual reading and thus avoiding future consumption estimation, automatic metering when the owner of a house is changing, visualizing energy consumption for the customers and increased pay rate in order to increase the long-term income.

The Smart Read system will be able to provide other attractive services to the customers such as alarm systems, buying of electricity at spot prices, reduction of stand-by loads and load control for demand response. NESA sees the possibility of using the system for DR by installation of automatic DR at the 30,000 homes with direct electric heating in NESA's grid area.

The goal is to include the following added services to the customers: Silent and simple alarms, remote control, wireless local meters operated via customer cell phones, and DR cut off of load when the price is high.

DK Tech Case #3: AMR system at Sydvest Energi

The Danish Electric Utility Sydvest Net A/S Energi (156.000 customers) is using a metering system called AIM from the manufacturer Enermet. The metering system is able to perform 15 min., hourly or daily reading of electricity consumption and is the platform for development of new and better customer service.

At present 13.500 meters are installed including 3.500 units for commercial customers and 10.000 residential customers. From 2005 and 3 years ahead, 50.000 metering systems are installed annually, leading to a total of 156.000 installations by the year 2008 including all customers served by Sydvest Energi.

The metering system will be able to provide other attractive services to the customers such as alarm systems, buying of electricity at spot prices, reduction of stand-by loads and load control for demand response.

Sydvest Energi sees the possibility of using the system for DR by installation of automatic DR in homes with direct electric heating in their grid area. Some commercial customers might also offer DR.

Control of loads (direct electric heating zones or radiator, water heater, dishwasher) might be done by units in front of each appliance including a relay or by applications directly included in the appliance – the later might be necessary for small appliances in order to get a good cost-benefit ratio.

A web site gives the customers access to follow their consumption. The vision is to developed DR features for individual control of maximum duration of interruptions and an override option.

DK Tech Case #4: RCOM - Use of Back-up Generation as Regulating Power

In Denmark the use of backup generation (BUG) has been introduced as a part of a major DR activity. Elkraft System has signed 18 contracts covering 40 units and 32 MW including 29.7 MW back-up power (13 contracts) and 2.3 MW interruptible power (5 contracts). The typical owners of BUGs are hospitals, airports, computer centres, medical factories, phone companies and electric utilities. The typical size of the BUG is 0.5 MW. The preliminary results show that the use of BUGs as regulation power has advantages for both the owners of the units and the TSO. The owner experiences that the local security system can be maintained or even improved. At the same time the owner get an income payment of generally 27,000€per MW per year in reservation costs and 0.15 €/kWh produced.

For the TSO, new capacity is introduced to the market - thus improving competition and security of supply. It is expected that the typical operation time is 10 to 30 hours per year. The project revealed high introduction costs up to 27,000 €per unit because of the need of extra meters and synchronization units.

DK Tech Case #5: Aggregator offering back-up generation as Regulating Power

In June 2004, the Western Danish TSO, Eltra entered a contract with the Norwegian company EffektPartner who offered to make contracts with customers with backup generation power to be used as operating reserve. Effektpartner offer through to Eltra's monthly tender for regulatory power.

In 2005 Elkraft System and Eltra will merge to be one national TSO covering all Denmark.

EffektPartner enter an agreement with the owners of the backup generation units and establish the communication infrastructure and offer the backup generation units into the market for regulatory power, where the resource through/via Eltra will be available to all the Nordic TSOs. The backup generation units will be activated, when the energy price in the market for regulatory power exceeds their operating costs (bids). The system will be automatic.

FI Tech Case #1: Enermet
Enermet AIM is Enermet's Advanced AMR (automatic meter reading) solution. Enermet AIM measures the energy consumption, collects and manages metering data as well as transfers it in right format to other systems. Enermet Advanced AIM includes also world-class devices to complete and fully support metering value chain.

Enermet Advanced AMI includes a unique two-way integration platform (AIMIA) for error-free, timely and seamless data flow between other systems and AIM. Enermet cooperates actively with global system suppliers in order to find the optimal integration solution for every customer.

FI Tech Case #2: MX Electrix
MX Electrix has manufactured power measuring equipment for over 15 years. Electrix provides solutions for today's needs and at the same time predicts future development. They offer wide variety of products for measuring power consumption and for monitoring power quality. Our total solution includes measurement technique solutions, analysis of measured data, start-up training and strong technical support.

The case study highlights two power measurement meters.

FI Tech Case #3: Comsel
Comsel System develops, markets and delivers solutions for remote data acquisition. Our solutions use wideband nets for remote data acquisition and control. Main areas of use are automatic meter reading (AMR), real estate automation and M2M communication. By automating various kinds of routine tasks, our customers will be able to increase efficiency and thereby have opportunities to increase profitability.

ComselAMR is their solution for automatic meter reading. With AMR, power net owners can easily and safely collect data on electricity, water, heating and gas. AMR will save both time and money of our customers. As new regulations on frequent meter reading are taken into use, ComselAMR is the easy and safe solution especially if there is access to broadband.

ComselAMR is used directly with the existing database for measuring values and with the existing customer information system. This is to make it easy for the user to handle collected data. Data is transferred over fixed IP-connection, GSM, GPRS or a traditional modem. Focus is on safety, flexibility and the smallest possible margin of error.

FI Tech Case #4: ista Suomi Oy
ista is a world leader service corporation in measuring consumption of energy, water, and gas, and in billing based on actual consumption. We have a wide experience in system delivery and in out-sourcing of services

Experience has shown that 100 % AMR coverage cannot be achieved by using one single technology only. The slow progress in standardization and lack of open systems have been obstacles when one wishes to combine the various AMR technologies in one system. Data communication technologies that can be used include PSTN, PLC, LON, GSM, GPRS, radio, and TCP/IP.

One of the most important technological starting points in our services is the freedom for the customer to choose for each application the most cost-effective data collection technology. ista Suomi Oy can read terminals and meters that are based on technologies from Enermet, ADD Group, Turtle, Comsel, IskraEmeco, Aidon, and Landis+Gyr.

FI Tech Case #5: Empower Oy
Empower offers services to customers in the energy and telecommunications industries and the manufacturing sector. Customers receive comprehensive solutions for energy data management, production, and transmission and delivery of energy and data.

Their system support data management functions for control room operations, energy trading and distribution sales.

FI Tech Case #6: Aidon Oy
The starting point of Aidon is a new, open way of thinking based on industrial standards. Our new way of thinking makes it possible to more freely combine the various AMR-technologies of energy companies. This will make the most cost-efficient solution always available, which allows attaching new devices and services to it. An open way of thinking builds a secure future.

They offer a variety of open communication power meters and data management systems. For example, the Aidon 5530 meter has a modular integrated system module, producing time-stamped register values and offers various services such as load control, etc. It registers power cuts, quality of supply and fault messages and reads the status of external device. The meter's functions can be used in real time (controlled by the energy company's own system) or by an independently-operated integrated timer.

IT Tech Case #1: "A New Load Shedding System for Ind'l Loads in Italian Power System"
Interruptible Customers must satisfy the following requirements:

- Be a final user, so that the responsibility of the consequences of the load shedding can be directly attributed to the customer;
- Be users supplied by the high voltage network;
- Have a shedding power above a certain limit;
- To select and describe loads relating to the assigned bands, as an Interruptible Customer can shed loads both in *real time* (without notice) and *upon notice* (15 minutes);
- To guarantee a continuous service of the LSPU (*Load Shedding Peripheral Unit*) apparatus, and of the router connected to it;
- To guarantee there are no timers, by-pass circuits, relays, programmable logic controllers between the LSPU apparatus and the interruptible circuit;
- To create a blocking circuit upon re-closure by GRTN, and to present suitable pre-settings to assure the   Redundancy of the opening commands received;
- To guarantee security for people, equipment and productive processes, releasing GRTN from any civil   and criminal responsibility as regards damages to things or people due to the load shedding.

The system also includes LSPU devices installed in the plants of the Interruptible Customers. Their function is to measure, in real time, the power load, as well as other auxiliary information and to activate the shedding command following an order proceeding from the responsible ACC or from the GRTN NCC.

KO Tech Case #1: Direct Load Control in KEMCO
DLC can be divided into two parts, upper system and lower system, according to characteristics and functions of each layer. The upper system is designed to exchange information with the wholesale power market (load and pricing). The lower system is designed to give KEMCO the ability to monitor consumer usage and remotely shed specific loads based on tariff and/or contractual agreements with the consumer

KO Tech Case #2: Remotely Controlled Air Conditioners
The Korea Electric Power Corporation (KEPCO) offers incentives to customers who install remotely controlled air-conditioners to effectively manage the cooling load when needed during summer peak periods. The remotely controlled air-conditioners are installed with the remotely controlled cycling device which permits KEPCO to periodically turn them off and on during the height of the summer season. KEPCO operates the control system within the extent of giving no discomfort to the affected customers.

NL Tech Case#1: Assimilation Lighting and Heating in the Horticultural Sector
In the Netherlands, a number of companies throughout the country are active in the horticultural market which is very competitive and innovative. In this market, electricity is consumed in massive quantities for assimilation lighting of crops and flowers. Assimilation lighting is combined with carbon dioxide treatment for manuring.

Combined heat power installations with storage of heat in a heat tank are used throughout. Due to the increase in fuel prices (gas price) the technique no longer is used

for peak-shaving but for direct operation on the power markets. The technologies are focused on getting the most out of the flexible demand and supply from a market perspective. Markets include the day-ahead market and the imbalance and control power markets.

A three-year payback of these systems is achieved; investment costs are in the order of 3000 Euro including network connectivity. In order to conserve energy apart from market optimization, heat balance control of neighboring installations is also served by these systems, as well as having the potential to transport the excess CO_2 to other greenhouses.

NL Tech Case#2: Example Application intelligent metering and smart power system

In the Netherlands an overall business case study has been done for intelligent metering covering benefits and expenditures for all stakeholders. It appears, that there is a 1.4 billion Euro to be gained, if all meters are replaced instantaneously and 0.4 billion Euro if meters are replaced gradually. The benefits come from more accurate factoring, a decreased number of people involved in customer help desks (a considerable amount of client-contacts currently has to do with the yearly advance payment for energy) and an increase in energy efficiency by frequent feedback via WEB-like interfaces. For Continuon, providing information services to retailers, TSO and service companies is the major goal; for Oxxio, more intense client contacts are the cornerstone of the business models.

NO Tech Case #1: EFFLOCOM – Technology for Direct Communication
This report gives a description of benefits of direct communications for different actors in a deregulated power market. The main content is an overview of technology for direct communication between the end-use consumer and the "utility".

NO Tech Case #2: Lekey load controller
The LeKey software can manage and coordinate energy loads to minimize the energy cost for the end user based on price signals. Grid operators and energy providers can use LeKey to optimize the use of network capacity. LeKey measures energy consumption in real time. Internet based software for real time monitoring and measuring of energy consumption, energy management and messaging system to reach personnel needing information regarding shut down and start up of energy loads. The loads are controlled via the LeKeyBox, which is an affordable solution without any installation costs, minimal communication costs and low hardware costs. Standard Internet browsers are used to communicate with LeKeyBox. With the built-in thermostat and timer, LeKeyBox handles energy management based on time and/or temperature. With the push of a button energy providers and grid operators can send a signal to thousands of LeKeyBoxes that are connected to electric devices. No batteries are necessary, and the flash memory ensures that settings are saved in case of power failure. The LeKeyBox is approved by Norwegian and European approval bodies.

The concept is used in the Norwegian DRR demonstrator, described in the SINTEF report "Automatic demand Response referred to electricity spot price.

NO Tech Case # 3: **List of AMR Technology used in Norway**

Company	Functionality	Time resolution meter readings	Means of communication
Enermet (http://www.enermet.com)	AMR/LC	From 1 min.	PLC/GSM/GPRS/PSTN
Intelli (http://www.intelli.no)	AMR/ Smarthouse	Every 60 min	PLC/ISDN
IT&Process (ITP)	AMR/ Smarthouse	Every 60 min	PLC/Different alternatives
Policom (http://www.policom.no)	AMR/ LC	Configurable, less than 60 min	PLC/Different alternatives
Senea	AMR/LC	From 1 min	Low power radio/Different alternatives
Aidon (http://www.aidon.se/)	AMR/LC	From 1 min	SMS, GSM, GPRS
Telenor Cinclus (http://www.telenorcinclus.com/uk/)	AMR/LC	From 1 min	SMS, GSM, GPRS

SP Tech Case #1: **GECO Consumers Management Tool**
GECO is a combination of many applications. All these applications use data provided by GECO/CORE tool, this tool organize and store the static and dynamic information about Spanish interruptible tariff consumers. The information is frequently updated through Consumer's Load Profile with new data every 15 minutes.

GECO has three applications:
- OPCO: Forecast Model of consumer response during the operation period. It is a prototype for assisting the interruption system operation.
- CODIR. Consumer Directory, Negotiation and Planning Tool
- ATLAS. It offers demand Characteristics. Planning and Valuation Tool.

SP Tech Case #2: **Research and development of a new methodology about demand management capacity of large consumers of electricity**

The aim of the study is the development of a new methodology based on surveys that will help to determine the potential of demand management for large consumers of electricity.

Based on the results, the study identifies mechanisms that would permit to increase the energy and economic efficiency of electrical systems.

The study focused on identifying technologies located at the consumer location that can be used to participate in demand response. Review the case study and reference documentation for detailed information.

General conclusions:
- The weight of manageable power in relation to the contracted power is frequently high.
- Consumers could interrupt consumption and give power from their generation capability. This can be done simultaneously or not.

SP Tech Case #3: Indel Project (Spanish Electric Demand Atlas)
This is a research study designed to gain a better understanding of how electric demand behaves in Spain. The project was initiated in 1988. It included all electric market actors and the government partially financed the project cost.

The general objectives were:
- Understand the evolution of the electric use in Spain.
- Energy uses identification.
- Create reliable statistically information.
- Determine the needs and technical solution to produce demand data.

The study helped the system operator improve it grid demand load management/forecasting models.

For example,
- Currently it is possible to estimate the system demand in any hour by the consumption of 8 large segments of consumers. They represent the 51% of maximum power system demanded.

SP Tech Case #4: Interruption Flexible Management Program (IFMP)
IFMP system increases the technical relation Consumers-System Operator. The system allows the collaboration between consumers and REE in the knowledge and development of Demand Response about its potential, prediction and certainty.

The participating consumers will communicate to the System Operator and its Distribution Utility, an hourly energy demand program for the following two months. Besides it will communicate the dates predicted of maintenance and/or stop of their installations although they be out of the time limit of two months before mentioned.

The hardware used by Customers and the System Operator should be provided with surveillance and supervision communications elements, in order to generate and to transmit the corresponding alarm signals to the facility with proper interruption instructions.

US Tech Case #1: Almeda County (CA) Government

http://www.energy.ca.gov/enhancedautomation/case_studies/CS01_Alameda.pdf

To make their BAS more flexible in the face of energy shortages and to "do their part" to mitigate the chance of rolling blackouts, the County upgraded the existing BAS in five of their largest facilities using CMS Viron's Curtailment Vision™, an Internet-based load curtailment program. The upgrades, funded mostly through the California Energy Commission, involved (1) enabling the County to set controls to incrementally power down its chillers and (2) connecting the affected facilities' utility meters to the Internet so that the effect of the chiller load reductions on facility-wide loads could be verified in near-real time from any computer with an Internet connection and standard Web browser.

US Tech Case #2: Doubletree Hotel, Sacramento, CA

http://www.energy.ca.gov/enhancedautomation/case_studies/CS06_Doubletree.pdf

The Doubletree Hotel Sacramento is meeting this challenge with an aggressive energy management strategy that utilizes enhanced automation technologies. Their effort began six years ago, when the hotel installed its energy management system (EMS) and partnered with the local utility, the Sacramento Municipal Utility District (SMUD), to participate in a demand curtailment program. Since then, the hotel has been an annual partner in this program, installed a real-time energy information system (EIS), and made concerted efforts to reduce loads and improve the efficiency of energy-using equipment. For example, the Doubletree can now monitor real-time energy use through EnerLink, a software interface that is linked to the hotel's interval meter. From a PC, facility operators watch the hotel's overall demand level throughout the day. As demand reaches peak levels, they can start shedding load and avoid excessive demand charges. The Doubletree uses their EMS to target numerous HVAC systems from a central location, and their EIS to immediately see the effects on overall demand.

US Tech Case #3: Staples Office Supply Superstores, CA

http://www.energy.ca.gov/enhancedautomation/case_studies/CS05_Staples.pdf

Almost one-tenth of Staples' 1,300 office supply superstores were located in the territories of the three California investor-owned utilities, which were paying record-high wholesale electricity prices. In Southern California, the high cost of energy was being passed on to the utility's customers—including Staples. Energy Logic, Inc., an energy-consulting firm in Massachusetts, devised and implemented an energy management plan for Staples that would help insulate several California stores from surging demand charges and rolling blackouts. The plan involved the installation of wireless control technology that allows Staples personnel to send electronic pages from the Internet to automatically reduce the lighting and HVAC loads at selected California stores. To verify the load reductions, Staples also installed modem-enabled utility meters at each of the stores. Energy Logic, Inc. secured funding for the project from the California Energy Commission. Action Electric and Novar Controls undertook the electrical and programming aspects of the work, respectively.

US Tech Case #4: Wesleyan University, CT

http://www.iso-ne.com/genrtion_resrcs/dr/broch_tools/Wesleyan_University_Real-Time_Price_Response_Case_Study.pdf

When the University was approached by Connecticut Light & Power to consider enrolling in ISO New England's Demand Response Program, the operations group seized upon the opportunity. ISO New England activated the Real-Time Price Response Program on ten weekdays from March 3, 2003 to March 14, 2003 when wholesale electricity prices were forecasted to exceed 10 cents per kWh. The University responded by reducing their electricity consumption by an average of 206 kW. They performed at more than twice the level they originally enrolled at. In several hours their reduction exceeded 350 kW. By responding to wholesale prices the University earned over $1,400 in incentive payments.

US Tech Case #5:   Does Real-Time Pricing Deliver Demand Response? A Case Study of Niagara Mohawk's Large Customer RTP Tariff
Goldman, C., N. Hopper, O. Sezgen, M. Moezzi and R. Bharvirkar (LBNL) and B. Neenan, D. Pratt, P. Cappers, and R. Boisvert (Neenan Associates). LBNL-54974. August 2004
http://drrc.lbl.gov/pubs/54974.pdf
Real-time pricing (RTP) is advocated as the most economically efficient way to invoke demand response (DR) benefits, yet actual customer experience is limited and thinly documented. This study examines the experience of 130 large (over 2 MW) industrial, commercial and institutional customers at Niagara Mohawk Power Corporation that have faced day-ahead electricity market prices as their default tariff since 1998. It is the first study of large customer response to RTP in the context of retail competition.

US Tech Case #6:   Real Time Pricing as a Default or Optional Service for C&I Customers: A Comparative Analysis of Eight Case Studies
Barbose, G., C. Goldman, R. Bharvirkar, N. Hopper, and M. Ting, Lawrence Berkeley National Laboratory; and B. Neenan, Neenan Associates. LBNL-57661. August 2005
http://drrc.lbl.gov/pubs/57661.pdf
Demand response (DR) is broadly recognized to be an integral component of well-functioning electricity markets, but currently underdeveloped in most regions. In recent years, there has been renewed interest among a number of public utility commissions (PUC) and utilities in implementing real-time pricing (RTP), typically for large commercial and industrial (C&I) customers, as a strategy for developing greater levels of DR. A key question for policymakers is how much DR can ultimately be expected from RTP, which requires analyzing customers' willingness to be exposed to dynamic hourly prices over a sustained time period and their actual price responsiveness.

US Tech Case #7: Advanced Controls and Communications for Demand Response and Energy Efficiency in Commercial Buildings
Kiliccote S., Piette M.A. and Hansen D., *Proceedings of Second Carnegie Mellon Conference in Electric Power Systems: Monitoring, Sensing, Software and Its Valuation for the Changing Electric Power Industry, Pittsburgh, PA*. LBNL Report 59337. January 2006.
http://drrc.lbl.gov/pubs/59337.pdf

This paper discusses recent research results and new opportunities for advanced building control systems to provide demand response (DR) to improve electricity markets and reduce electric grid problems. The main focus of this paper is the role of new and existing control systems for HVAC and lighting in commercial buildings.

A demand-side management framework from building operations perspective with three main features: daily energy efficiency, daily peak load management and event driven, dynamic demand response is presented. Case studies involving energy management and control systems and DR savings opportunities are presented. The paper also describes results from three years of research in California to automate DR in buildings. Case study results and research on advanced buildings systems in New York are also presented.

US Tech Case #8: Findings from the 2004 Fully Automated Demand Response Tests in Large Facilities
Piette, M.A., D.S. Watson, N. Motegi, and N. Bourassa, Lawrence Berkeley National Laboratory. LBNL-58178. September 2005.
http://drrc.lbl.gov/pubs/58178.pdf
This report describes the results of of research to develop and evaluate the performance of new Automated Demand Response (Auto-DR) hardware and software technology in large facilities. Demand Response (DR) is a set of time dependant activities that reduce or shift electricity use to improve electric grid reliability, manage electricity costs, and provide systems that encourage load shifting or shedding during times when the electric grid is near its capacity or electric prices are high. Demand Response is a subset of demand side management, which also includes energy efficiency and conservation. The overall goal of this research project was to support increased penetration of DR in large facilities through the use of automation and better understanding of DR technologies and strategies in large facilities. To achieve this goal, a set of field tests were designed and conducted. These tests examined the performance of Auto-DR systems that covered a diverse set of building systems, ownership and management structures, climate zones, weather patterns, and control and communication configurations.

US Tech Case #9: Update on Automated Demand Response Research, Mary Ann Piette, LBNL, February 2006
http://ciee.ucop.edu/dretd/Auto-DR%20Update.pdf
This presentation to the DR Enabling Technologies Development Program provides an update on research efforts by Lawrence Berkley National Laboratory, focusing on findings from specific projects.

US Tech Case #10: Independent Review of Estimated Load Reductions for PJM's Small Customer Load Response Pilot Project, Heffner, G., M. Moezzi and C. Goldman. LBNL-54835. June 2004
http://eetd.lbl.gov/EA/EMP/reports/54835.pdf
This study describes the results of a low-cost approach used to measure reported load reductions from a residential electric water heater (EWH) load control program operated as part of PJM Interconnection's Demand Response small customer pilot program.

Lawrence Berkeley National Laboratory (LBNL) conducted this independent review of the engineering estimates for EWH load control reported by a Curtailment Service Provider (CSP) at PJM's request. LBNL found that the observed load reductions for the premise-level data aggregated over all households in the two participating electric cooperatives were, respectively, 40%-60% less and 3 % less-10% higher than the estimated diversified demand reduction values assumed by the CSP, depending on whether observed or normalized results are considered.

US Tech Case #11: A Survey of Utility Experience with Real Time Pricing,
Barbose, G. and C. Goldman (LBNL) and B. Neenan (Neenan Associates). LBNL-54238. December 2004
http://eetd.lbl.gov/EA/EMP/reports/54238.pdf
While other mechanisms can be used to induce price responsive demand and/or reduce peak demand, many economists argue that RTP represents the most direct and efficient approach, and therefore it should be the primary focus of policymakers' efforts to improve the performance of wholesale and retail electricity markets (Borenstein et al. 2002). While clearly appealing from a theoretical perspective, questions remain about the extent to which RTP can ultimately affect wholesale market performance and utility resource planning. First, assuming that RTP is offered on a voluntary basis, how many customers would choose to enroll in RTP, given the additional risks and transaction costs compared to traditional, fixed price retail supply service? Second, even if a sizable number of customers did choose to enroll, to what extent, and how consistently, would a diverse population of participants respond to the prices they face?

DEMAND RESPONSE & ADVANCED METERING TECHNOLOGIES AND PROVIDERS	Advanced Metering	Advanced Submetering	Communications	Automated Controls	Information Display	Building Optimization	Smart Thermostat	Direct Load Control	Thermal Storage	Energy Management Systems	Demand Bidding	Distributed Generation	Customer Aggregation and Control	Asset Optimization and Coordination	System Integration and Information/Data Coordination	Market Coordination and Communication
Advantage Energy, Inc.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ames Goldsmith Corp.												x				
ArKion Systems	x	x	x	x	x		x	x					x			
Automated Energy, Inc.	x	x	x		x									x	x	x
Cannon Technologies, Inc.	x		x	x	x		x	x					x	x	x	x
Cellnet	x		x													
Comverge, Inc.	x	x	x		x		x	x				x		x		x
Consolidated Edison Company							x	x				x		x	x	x
ConsumerPowerline	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Control Technologies, Inc.	x	x	x	x	x	x	x	x			x		x	x	x	
Elster Electricity	x		x												x	
eLutions, Inc.	x	x	x	x	x	x				x			x	x	x	
eMeter Corporation	x		x	x	x		x	x						x	x	x
Energy Analytics	x	x	x	x		x	x	x			x	x	x	x	x	x
Energy Curtailment Specialists, Inc.		x			x							x		x		
Energy Enterprises, Inc.																
Energy Spectrum	x	x		x		x	x	x			x	x	x	x	x	
EnerNOC, Inc.	x	x	x	x	x					x		x	x	x	x	x
GoodCents Solutions							x	x								
Hunt Power, L.P.	x	x						x								
iES/Specified Air, Inc.	x		x	x	x	x		x		x		x	x	x	x	x
Mount Sinai Medical Center				x		x										
NES Energy, Inc.																
Nexus Energy Software	x		x		x			x				x			x	x
NYSEG & RG&E	x	x	x		x											x
Optimal Technologies (USA), Inc.	x	x	x	x	x	x	x	x		x		x	x	x	x	x
Powerit Solutions, LLC		x	x	x	x					x		x				
RETX Energy Services	x	x	x		x	x	x	x		x	x	x	x	x	x	x
RS Energy Solutions, Inc.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Sensus Metering Systems	x		x		x		x	x							x	
Siemens Building Technologies, Inc.	x		x	x		x	x	x		x			x		x	x
The Trane Company	x	x	x	x	x	x	x	x	x	x			x		x	x
UCS, Inc.			x	x		x	x	x		x	x	x				
Ziphany, LLC	x	x	x		x					x						

VI. IDENTIFYING WHERE TO USE DR TECHNOLOGIES

As a general rule, electricity end-use is almost equally distributed between the three major customer sectors (Residential, Commercial & Industrial).   As such, it is important to carefully look at all three of the sectors when considering energy efficiency and load shedding opportunities and related program strategies.

While the industrial sector is the least sensitive end-use sector with respect to <u>weather</u>, it is the most sensitive to <u>price</u>. It is also the easiest to reach in terms of making contact with customers and in terms of the relative costs associated with marketing and advertising (i.e. Largely due to the industrial sector having significantly fewer customers than either the residential or commercial sectors). Commodity suppliers and ISOs also tend to have better ongoing account relationships with their industrial accounts. Therefore, the industrial sector has been the primary target of most commodity supplier as well as energy efficiency and load shedding project to date. However, it is important that strategies for targeting residential loads be developed. Not only do they represent 1/3 of the system load, they are also willing to participate if they understand what they are being asked to do.

Below are discussions regarding potential load shedding opportunities for each of the three sectors: (A). <u>Residential</u>, (B). <u>Commercial</u> and (C). <u>Industrial</u>. The individual sector discussions describe both "low cost" load shedding measures as well as measures which require some level of "investment" in new and/or upgraded equipment, additional controls and metering, etc.

A. Residential Load Shedding Opportunities

Traditionally, utilities/commodity suppliers have attempted to accurately predict residential demand for energy and then ensure they have sufficient generation and grid resources to meet that demand.

Numerous studies over the past decade have shown that commodity suppliers could eliminate the need for a substantial amount of new generation and grid assets if they could shift some of the residential demand from "peak" to "off peak" times. Residential loads (Especially, electric space and water heating and swimming pool pumps) lend themselves well to being shifted to off peak periods; or to having their time(s) of operation limited or staggered in some fashion.

Current utility programs offer various demand reduction incentives to residential customers via rate designs, demand side management (DSM) programs and more recently, utility controlled home load management systems (Home LMS). All three programs are discussed below – including their respective pros and cons and their overall levels of acceptance and effectiveness.

Load Shedding Action Plan for Residential Consumers

1. **Low-cost** load shedding measures:

   Actual load shedding amount/energy savings will depend on the degree to which the actions or measures are implemented and schedules adhered to.

Energy Item	Action	Load Shedding / Energy Savings
Electric water heaters & pool pumps	Use of utility owned time clocks and separate meters or combination electric & time clock meters to limit hours of operation to off peak periods.	The load shedding is effective; however, because the load shift occurs typically on a daily basis – customers are often inconvenienced unnecessarily and customer participation rates tend to be low.
Lighting, Water heaters, pool pumps and space heating and cooling (HVAC)	Utility tariffs – **Time of Day (TOD)** Rates (Requires a TOD meter)	TOD rates use a "carrot and stick" approach by providing a financial incentive for consumers to move loads to a time when it is less expensive for the commodity supplier to produce or obtain power. TOD rates in general, tend to be difficult for customers to understand and tend to not yield predictable and certain results for utilities. As a result TOD rates tend to have very low customer participation rates.
Space heating & cooling (HVAC)	Programmable thermostats	Utility supplied thermostats have been tried particularly in the U.S. by Rural Cooperatives without significant success due to customer's comfort being adversely affected and/or through customer's frequently exercising their override option during peak load times.

2. **Investment** in load shedding equipment control equipment and retrofits/upgrades:

Energy Item	Action	Load Shedding / Energy Savings
Electric water heaters, pool pumps and space heating & cooling (HVAC)	**Demand Side Management (DSM) Programs**	These programs use a "carrot" approach because the customer typically receives a credit for each month of participation. In DSM programs, the customer allows the utility to "shed load" in the home, by curtailing power typically to electric water heaters, pool pumps and HVAC equipment. However, these curtailments are seldom exercised by the utility. When the utility does exercise a curtailment, especially on the customer's HVAC equipment, the resulting interruptions often affect customer's comfort. The complaint and drop out rates also tend to be high.
Electric water heaters, pool pumps and space heating & cooling (HVAC)	**Utility Home Load Management Systems (Home LMS)**	Home LMS provide "soft" load control of HVAC systems by using temperature ramping capabilities of the specially designed thermostats. The thermostats manage the comfort range in the home by varying the set points over a range in tenths of a degree. Because of the precise control, the system is able to deliver energy/load reductions while eliminating the adverse thermal gain or loss characteristics of traditional DSM systems. The special thermostats also provide the homeowner with an easy to use interface. The thermostats have the ability to display the energy price at any time and to indicate whether

		the price is considered low, medium, or high, etc. It is believed that providing pricing information will sensitize the homeowner/renter to the real cost of energy and promote additional discretionary load reductions. A Home LMS also can control other major loads in a way that the customer's needs are met while allowing the utility to control/specify the hours of operation. A particular attribute is the ability to "stage" the load shedding – e.g. the utility can shed water heaters and pool pumps first, followed by HVAC adjustments, etc. Other unique features of a Home LMS are its ability to report tampering or disconnect conditions. An "always on" broadband network connection allows the utility to know exactly how much load has been shed at each residence and how much load is still available to be shed. This allows the utility to aggregate the load shed (or load available to be shed) up to a circuit, sub station, or transmission line level. Home LMS use is particularly attractive for working families wherein their homes are normally unoccupied during the workday and early evening peak utility load periods. By treating Home LMS as "micro generation" facilities, some utilities may also

		recover the installation and operation costs like other rate based assets.

B. Commercial Load Shedding Opportunities

Energy Characteristics of Commercial Space

- According to the U.S. Dept. of Energy, more that 4.7 million commercial and government buildings, representing over 67 billion sq. ft., currently account for about 25% of the nation's energy bill, spending over $26 billion annually.
- Utility costs, represent approximately 30% of the average commercial building's operating expenses.
- Energy metering and monitoring programs are seen as being among the least expensive and fastest ways to reduce an owner's utility costs. The Commercial and Industrial Branch of the EnergyStar Program at the U.S. Environmental Protection Agency (EPA) indicates that while metering and related monitoring systems alone do not save money, the information from such systems, when acted upon, can result in significant reductions – typically 5 to 15%.
- U.S. Commercial Sector electricity expenditures:

Lighting	28%
Other	23%
Air conditioning*	22%
Space heating*	14%
Ventilation	10%
Hot water	3%
Total	100%

  * Note: Percentages are dependent on U.S. location and the number of cooling/heating degree days at each location.

- The results of an April 2004 survey of energy and facilities managers across the U.S. by Energy and Power Solutions (EPS) indicated that 75% of the managers recognize that they could be more effective in identifying and recovering rebates and incentives offered via incentive programs by local utilities, PUCs, and governmental agencies. The average payback for all energy reduction activities implemented was less than two (2) years.

Load Shedding Action Plan for Commercial Customers

1. **Low-cost** load shedding measures:

   Actual load shedding amount/energy savings will depend on the degree to which the actions or measures are implemented and a mall's actual load

profile.

Energy Item	Action	Load Shedding / Energy Savings
Lighting	Adjust lighting controllers (time clocks, etc) to turn off various lighting during ISO/utility peak -emergency conditions. Reduce lighting in ancillary areas – for example, turn off 25%, 50% or 75% of lights.	Up to 3% of energy use is typical load reduction.
Heating, Ventilation and Air Conditioning	Install Energy Star labeled Programmable thermostats in leased spaces and lock covers to prevent tampering. Raise or lower thermostat Set points of mall temperature during ISO/utility peak - emergency conditions.	For each degree, the temperature is raised in cooling season (air conditioning) or the temperature is lowered in heating season, up to 5% of energy use is typical load reduction for the adjusted temperature time period.
On-site Emergency/Standby generation	Run generator(s) during ISO/utility grid peak – emergency conditions	Dependent on equipment / amount of lighting and motors load (escalators, etc) removed from utility grid supply.
Other	• Reduce use of multiple elevators and escalators; stagger use. • Delay use of battery chargers • Pre-cool/heat facilities by a few degrees by early p.m. and then increase set points. • Turn off decorative fountains, outside pond fountains and other flowing-water displays.	Load shedding/savings is dependent on the extent and timing of the various initiatives.

2. **Investment** in load shedding equipment control equipment and retrofits/upgrades:

Energy Item	Action	Load Shedding / Energy Savings
Lighting	Of all building upgrades, lighting is generally considered the easiest and most lucrative. Under DR tariff agreements, a typical scenario might be to reduce customer load by 15% in 15 minutes and maintain the reduction for the full duration of each declared emergency period. Effective technology applications include: (1.) Integration of the lighting automation system with the building management system; (2.) Fluorescent dimming technologies (electronic dimming ballasts, etc.); (3.) Installation of building automation systems (BASs).	The load shedding possibilities are determined by the mall's current lighting and control system characteristics and degree of upgrade/level of equipment sophistication and extent of reach (e.g. building automation commands are accessible throughout the entire mall. State-of-the-art dimmers are electronic and use semi conductors to vary the fixture input voltage, and hence light output. A programmable lighting controller interfaced with a building automation system (BAS) provides an excellent means for shedding load. Each lighting circuit in the mall can be controlled by a relay that responds to the programmed directions. In a fully developed system, each fluorescent ballast can be accessed for on/off control or dimming through a standard computer network interface. A complete lighting upgrade, including new lamps, ballasts and advanced controls, can typically quality for various types of energy efficiency rebate incentives, including custom measures. Light controls can also be used to qualify for on-going incentives through demand response (DR) programs.
Heating, Ventilation and Air Conditioning	A number of manufactures offer sophisticated building/mall equipments to monitor, control and manage intricate control and load	Degree of load shedding / savings is dependent largely on chosen temperature set points.

|		
	reduction strategies. Such systems tend to be "pricey" and installation can be challenging (to work around existing systems).	Some facilities will gradually shift the temperature set points one degree per day as electric grid loadings approach peak conditions.
On-site Generation / Cogeneration Facilities	On-site and Cogeneration plants are usually of the order of size of a few tenths to one megawatt. Cogeneration is only economically viable where the heat profile vs. the electric profile is a good match. To install a Cogeneration system inside an already existing structure is also often difficult – for brand-new facilities, the design is much easier. The economics of On-site generation are significantly improving with some utilities actively promoting it with their larger customers	On-site generation is an attractive way for commercial establishments to benefit from the significant DR incentives available in the national electric marketplace.
Custom solutions	Example: Rescheduling power intensive operations to non-peak times.	Most custom solutions require the assignment of an "energy czar" who can spearhead the response when called upon to do so.

C. Industrial Load Shedding Opportunities

USA Electricity Usage by Major Manufacturing Sectors (Ranked highest to Lowest) – Source AeA, Annual Survey of Manufacturers

1. Chemical Mfg.
2. Primary Metal Mfg.
3. Paper Mfg.
4. Food Mfg.

5. Plastics & Rubber Products Mfg.
6. Transportation Equipment Mfg.
7. Fabricated Metal Product Mfg.
8. High Technology Mfg.
9. Textile Mills
10. Machinery Mfg.
11. Wood Product Mfg.
12. Furniture & Related Product Mfg.
13. Apparel Mfg.
14. Textile Product Mills

USA Manufacturing Energy End-Use Breakdown
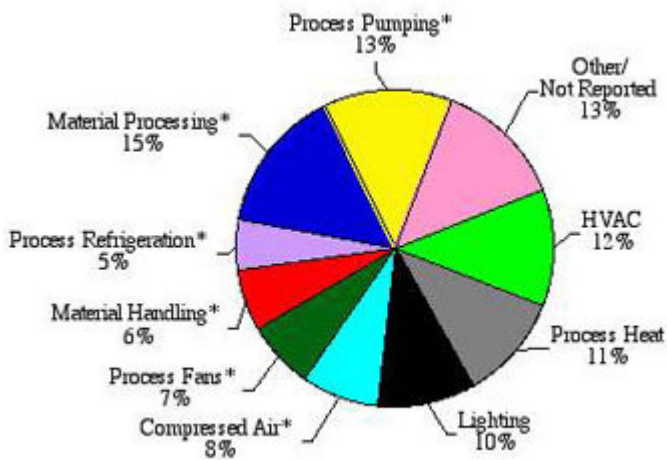
* Motor-driven equipment
California Energy Commission,
"California Energy Demand 2003-2013 Forecast"
February 11, 2003, #100-03-002SD and Xenergy analysis.

Load Shedding Action Plan for Manufacturing Facilities

1. **Low-cost** load shedding measures:

Actual load shedding amount/energy savings will depend on the degree to which the actions or measures are implemented and a facilities actual load profile.

Energy Item	Action	Load Shedding / Energy Savings
Lighting	Adjust lighting controllers (time clocks, etc) to turn off various lighting during ISO/utility peak -emergency conditions. (Example: Turn off every second or third lighting fixture) Reduce lighting in ancillary areas – for example, turn off 25%, 50% or 75% of lights.	Up to 3% of energy use is typical load reduction.
Water Pumping & Storage	If have large storage tanks and/or towers on-site, fill them before peak electric demand periods.	Allows for maintaining sufficient water pressure in the event of a call for load shedding.
On-site Emergency/Standby generation	Run generator(s) during ISO/utility grid peak – emergency conditions	Load shedding/savings depends on the amount of equipment, lighting and motor loads removed from the utility grid supply.
Other	- Pre-cool/heat facilities by a few degrees by early p.m. and then increase set points. - Raise thermostat settings for air conditioning systems by a few degrees during p.m. working hours. - Offer flexible work hours in the summer where practical to allow employees to come in earlier and leave work earlier. - Schedule planned facility shutdowns during the hottest months (July & August). - Allow sumps at sewerage pumping stations to remain as full as safely possible	Load shedding/savings is dependent on the extent and timing of the various initiatives.

| | before pumping. | |
| | • To degree possible, reschedule power-intensive processes to non-peak times. | |

2. **Investment** in load shedding equipment, control equipment, onsite generation and various equipment retrofits/upgrades. Taking advantage of various commodity supplier and ISO incentive peak shaving rates helps justify the capital, operating, and maintenance costs of such equipment investments.

   Typically manufacturers will look for an overall payback of less than three years. However, often times retrofits/upgrades and improvements in sub-metering and monitoring equipments offer significant savings due to increased operating times, resolving issues quicker, seeing problems before they turn into disasters and having the ability to recognize the subtleties of operating large production machinery in high demand applications – thereby providing both substantial savings as well as a competitive operating edge:

Energy Item	Action	Load Shedding / Energy Savings
Lighting	Of all building upgrades, lighting is generally considered the easiest and most lucrative. Under DR tariff agreements, a typical scenario might be to reduce customer load within 15 minutes and maintain the reduction for the full duration of each declared emergency period. Effective technology applications include: (1.) Integration of the lighting automation system with the building management system; (2.) Dimming technologies (electronic dimming ballasts, etc.); (3.) Installation of building automation systems (BASs).	The load shedding possibilities are determined by the facilities' current lighting and control system characteristics and degree of upgrade/level of equipment sophistication and extent of reach (e.g. building automation commands are accessible throughout the entire mall. State-of-the-art dimmers are electronic and use semi conductors to vary the fixture input voltage, and hence light output. A programmable lighting controller interfaced with a building automation system (BAS) provides an excellent means for shedding load. Each lighting circuit in the mall can be controlled by a relay that responds to the programmed directions. In a

		fully developed system, each ballast can be accessed for on/off control or dimming through a standard computer network interface. A complete lighting upgrade, including new lamps, ballasts and advanced controls, can typically quality for various types of energy efficiency rebate incentives, including custom measures. Light controls can also be used to qualify for on-going incentives through demand response (DR) programs.
Heating, Ventilation and Air Conditioning	A number of manufactures offer sophisticated building equipments to monitor, control and manage intricate control and load reduction strategies. Such systems tend to be "pricey" and installation can be challenging (to work around existing systems).	Degree of load shedding / savings is dependent largely on chosen temperature set points and or operating schemes.
On-site Generation / Cogeneration Facilities	On-site and Cogeneration plants are usually of the order of size of a few tenths to one megawatt. Cogeneration is only economically viable where the heat profile vs. the electric profile is a good match. To install a Cogeneration system inside an already existing structure is also often difficult – for brand-new facilities, the design is much easier. The economics of On-site generation are significantly improving with some utilities actively promoting it with their larger customers.	With proper interconnection to an industrial-facility power system, onsite generation can be used for both standby and peak shaving purposes. Owners should be aware, however, that standby and peak shaving requirements are usually quite different – e.g. loads requiring emergency/standby power are usually small and might not be running continuously whereas "ideal peak shaving loads" for transfer to generator power will be relatively large and will operate continuously or nearly so.

Custom Solutions to Allocate & Manage Energy Costs as well as Identify Load Shedding Opportunities	• **Manage Energy Costs**	• By monitoring usage and demand, facility managers can shrink their electricity bill by identifying ways to reduce peak demand, increase load factor and reduce usage.
	• **Allocate Energy Costs**	• By assigning energy costs based on square footage of floor space, number of occupants or capacity of electric circuits, or by sub-metering and allocating electricity costs based on actual usage, previously unmanageable fixed costs become controllable variable costs. Also, allocating electricity costs based on actual usage provides an incentive for departments within a facility to reduce their own energy use.
	• **Establish "Tenant" Billing**	• Sub-metering can be applied to industrial facilities with multiple manufacturing processes taking place, enabling management to provide each department/"tenant" with an electricity bill and thereby achieving better accountability.
		• By allocating energy costs, the energy efficiency of manufacturing

	• **Determine Equipment Efficiency**	equipment can be measured. By strategically positioning electric sub-meters on circuits that feed key pieces of equipment or processes, very useful metrics can be developed to help evaluate the performance of existing equipment and systems, as well as determining their being involved in peak shaving strategies.

APPENDIX A

DR Technology in the U.S. - Providers and Resources

Developed for Subtask V (Technology)

International Energy Agency (IEA)
Task XIII (Demand Response Resources)

Produced by
U.S. Demand Response Coordinating Committee (DRCC)[2]

I.   Introduction

In August 2005, the U.S. Demand Response Coordinating Committee (DRCC), with the assistance of the New York State Research and Development Authority (NYSERDA) implemented a survey of U.S. companies providing demand response products, services, and technologies so as to obtain information about their offerings.

In its work the DRCC has defined demand response as:

Providing electricity customers in both retail and wholesale electricity markets with a choice whereby they can respond to dynamic or time-based prices or other types of incentives by reducing and/or shifting usage, particularly during peak periods, such that these demand modifications can address issues such as pricing, reliability, emergency response, and infrastructure planning, operation, and deferral.

The DRCC requested information about companies and their offerings related to both wholesale and retail markets and to both competitive markets and traditional, vertically regulated structures. It also sought information about technologies and services that are used directly with end-use customers, as well as technologies and services that are provided to companies that in turn help them provide a demand response service or product.

This report summarizes the responses of companies to the survey.

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[2] The United States Demand Response Coordinating Committee (DRCC) is the U.S. stakeholder/funder group for IEA Task XIII. Members of the DRCC include Ameren, American Electric Power, Demand Response Research Center, ISO-New England, MidAmerican Energy, MidWest ISO, National Grid, New York State Research and Development Authority (NYSERDA), Pacific Gas & Electric, PJM Interconnection, Salt River Project, San Diego Gas & Electric, Southern California Edison, Southern Company, Tennessee Valley Authority.   DRCC Member NYSERDA contributed time and resources and assisted DRCC Staff in the development of this document.

- Section II includes three tables identifying Provider Companies by the Technologies they provide, the Markets that they operate in, and the Users they serve with their products, services, etc.

- Section III offers a summary of each of the firms that responded to the DRCC survey with a brief description provided by the respondent, contact information and, where available, a link to one more case studies of the companies offerings.

- Section IV offers a listing of additional companies that did not respond to the survey, but which are involved in the demand response arena. A link to the websites of these companies is provided for those who wish to learn more.

II.   Responses to the Survey

Table A indicates the type of Product and Service Offering that each respondent provides.

Table B indicates the type of market that they provide their offerings into.

Table C delineates the type of user of the respondent's products and/or services.

III.   Survey Respondents

Advanced AMR Technologies LLC
285 Newbury Street
Peabody, Massachusetts 01960 USA
(978) 826-7660 or (866) 826-7660
www.advancedamr.com

Advanced AMR Technologies is a subsidiary of Peabody, MA based AES Corp. AES developed a new family of products in 2000 specifically to serve the energy information and control needs of the Energy Management industry. These products monitor, report and control energy usage in situations that require real time, wide area, low cost energy management solutions. Advanced AMR solves the problem of slow or outdated meter reading data and provides an architecture that allows energy consuming devices to be managed and controlled from a single system to reduce energy usage. Advanced AMR provides real-time energy information and control capabilities from the same system that delivers automated meter reading. Benefits include:

- AMR without the infrastructure cost of alternative AMR.
- Demand Response programs are easily deployed.
- Load Control for energy savings is possible for customer or via ESCOs.
- Load Profiling information provides more informed purchasing decisions
- SCADA monitoring and control can improve utility network management.
- Measurement & Verification provided by accurate reliable data

Case Studies/Marketing Materials –
www.advancedamr.com/documents/AES_AS_ClayUnion.pdf
www.advancedamr.com/documents/AES_ANlambcounty.pdf
www.advancedamr.com/documents/CaseStudy-Richards1.pdf

Table A

DEMAND RESPONSE & ADVANCED METERING TECHNOLOGIES AND PROVIDERS	Advanced Metering	Advanced Submetering	Communications	Automated Controls	Information Display	Building Optimization	Smart Thermostat	Direct Load Control	Thermal Storage	Energy Management Systems	Demand Bidding	Distributed Generation	Customer Aggregation and Control	Asset Optimization and Coordination	System Integration and Information/Data	Market Coordination and Communication
Advantage Energy, Inc.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ames Goldsmith Corp.												x				
ArKion Systems	x	x	x	x			x	x				x		x		
Automated Energy, Inc.	x	x	x		x									x	x	x
Cannon Technologies, Inc.	x		x	x	x		x	x				x		x	x		x	x
Cellnet	x		x													
Comverge, Inc.	x	x	x	x			x	x				x		x		x
Consolidated Edison Company							x	x		x		x	x		x	x	x
ConsumerPowerline	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Control Technologies, Inc.	x	x	x	x	x	x	x	x				x		x	x	x
Elster Electricity	x		x												x	
eLutions, Inc.	x	x	x	x	x	x		x						x	x	x
eMeter Corporation	x		x	x	x		x	x							x	x	x
Energy Analytics	x	x	x	x			x	x	x			x	x	x	x	x	x
Energy Curtailment Specialists, Inc.		x		x								x		x		
Energy Enterprises, Inc.																
Energy Spectrum	x	x		x			x	x	x			x	x	x	x	
EnerNOC, Inc.	x	x	x	x	x				x			x	x	x	x	x	x
GoodCents Solutions								x	x							
Hunt Power, L.P.	x	x						x								
iES/Specified Air, Inc.	x		x	x	x	x		x				x	x	x	x	x	x	x
Mount Sinai Medical Center				x		x										
NES Energy, Inc.																
Nexus Energy Software	x		x		x			x				x				x	x
NYSEG & RG&E	x	x	x		x											x
Optimal Technologies (USA), Inc.	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x
Powerit Solutions, LLC		x	x	x	x			x				x		x		
RETX Energy Services	x	x	x		x	x	x	x				x	x	x	x	x	x
RS Energy Solutions, Inc.	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x
Sensus Metering Systems	x		x		x		x	x							x	
Siemens Building Technologies, Inc.	x		x	x		x	x	x				x		x		x	x
The Trane Company	x	x	x	x	x	x	x	x	x	x		x		x	x	x
UCS, Inc.			x	x			x	x	x			x	x	x		
Ziphany, LLC	x	x	x		x				x							

PROVIDERS AND MARKETS SERVED	Residential	Small Commercial	Large Commercial	Industrial	Governmental	Utility	System Operator	International
Advantage Energy, Inc.		x	x	x	x			
Ames Goldsmith Corp.		x	x	x				x
ArKion Systems	x	x	x	x	x	x		
Automated Energy, Inc.	x	x	x	x	x	x		x
Cannon Technologies, Inc.	x	x	x	x	x	x	x	x
Cellnet						x		
Comverge, Inc.	x	x	x	x	x	x	x	x
Consolidated Edison Company	x	x	x	x	x			
ConsumerPowerline	x	x	x	x	x	x	x	x
Control Technologies, Inc.		x	x	x	x			
Elster Electricity	x	x	x	x			x	x	x
eLutions, Inc.		x	x	x		x	x	x
eMeter Corporation	x	x	x	x	x	x	x	
Energy Analytics	x	x	x	x	x			
Energy Curtailment Specialists, Inc.			x	x	x			
Energy Enterprises, Inc.		x						
Energy Spectrum		x	x	x				
EnerNOC, Inc.		x	x	x	x	x	x	x
GoodCents Solutions	x	x						
Hunt Power, L.P.		x	x	x	x	x		
iES/Specified Air, Inc.			x	x	x			
NES Energy, Inc.		x	x	x	x			
Nexus Energy Software	x	x				x	x	x	x
NYSEG & RG&E		x	x	x	x	x		
Optimal Technologies (USA), Inc.	x	x	x	x	x	x	x	x
Powerit Solutions, LLC			x	x	x			x
RETX Energy Services	x	x	x	x	x	x	x	x
RS Energy Solutions, Inc.		x	x	x	x			
Select Energy New York, Inc.		x	x	x	x			
Sensus Metering Systems	x	x	x	x	x	x		
Siemens Building Technologies, Inc.			x	x	x			
The Trane Company	x	x	x	x	x	x		x
UCS, Inc.	x	x	x					
Ziphany, LLC		x	x	x	x	x		x

USERS OF PROVIDER OFFERINGS	End-Use Customers	Mass Market	Large Customer	Utilities	Competitive Suppliers	System Operators	Demand Response Providers
Advantage Energy, Inc.	x	x	x				
Ames Goldsmith Corp.	x		x				x
ArKion Systems	x	x	x	x	x		x
Automated Energy, Inc.	x	x	x	x	x		x
Cannon Technologies, Inc.	x	x	x	x	x	x	x
Cellnet				x			
Comverge, Inc.				x		x	
Consolidated Edison Company	x	x	x		x		x
ConsumerPowerline	x	x	x	x	x	x	
Control Technologies, Inc.	x		x				x
Elster Electricity				x	x		
eLutions, Inc.	x		x	x	x	x	x
eMeter Corporation				x			
Energy Analytics	x	x	x				
Energy Curtailment Specialists, Inc.	x		x				
Energy Enterprises, Inc.							
EnerNOC, Inc.	x		x	x	x	x	x
GoodCents Solutions				x			
Hunt Power, L.P.	x		x	x	x		
iES/Specified Air, Inc.	x	x	x				
NES Energy, Inc.	x		x	x		x	x
Nexus Energy Software	x	x		x	x	x	x
NYSEG & RG&E	x		x				
Optimal Technologies (USA), Inc.	x	x	x	x	x	x	x
Powerit Solutions, LLC	x	x	x				x
RETX Energy Services	x	x	x	x	x	x	x
RS Energy Solutions, Inc.	x	x	x			x	x
Select Energy New York, Inc.	x						
Sensus Metering Systems				x			
Siemens Building Technologies, Inc.	x		x				x
The Trane Company	x	x	x	x			x
UCS, Inc.	x	x	x			x	
Ziphany, LLC	x	x	x	x	x	x	x

III.   Survey Respondents (Continued)

Advantage Energy, Inc. (ID #20)
3556 Lake Shore Road, Suite 420
Buffalo, NY 14219-
(716) 826-9778
www.advantageenergyusa.com
Jody M. Spaeth   (716) 826-9778   jmspaeth@advantageenergyusa.com

Advantage Energy is a curtailment service provider that offers financial incentives to New York State companies/facilities for voluntarily reducing their electricity usage during periods of unusually high market demand. Working together with the NYISO during last summer's state emergencies, Advantage was able to reduce over 250 MW of poer from the grid through voluntary load reductions. Advantage's curtailment program is ideal for customers who can commit to a significant load reduction through the use of back-up generation or temporary equipment and production process shut-downs.

Case Studies/Marketing Materials –
www.advantageenergyusa.com/advantage/programs_load.aspx

ArKion Systems (ID #35)
230 Union Street
New Bedford, MA 02738-
(508) 993-5100
www.arkionsystems.com
Jennifer Diglaw   (508) 993-5100   diglaw@arkiosystems.com

ArKion Systems provdes an end-to-end two-way remote monitoring solution that provides advanced AMR features as well as connecting automated meter reading with other remote monitoring solutions such as checking and controlling thermostats, water heaters, etc. and other electricity control devices. ArKion real time Demand Side Management System enables rapid development of connectivity solutions for existing building climate control system to reduce and shift energy usage for any industry.

Cannon Technologies, Inc. (ID #4)
8301 Golden Valley Road
Golden Valley, MN 55427-
(763) 595-7777
www.cannontech.com
Charles Parsons   (763) 253-5549   cparsons@cannontech.com

Cannon Technologies offers a complete portfolio of demand response technologies and applications, along with integrated solutions for AMR and distribution automation as part of out Yukon Advanced Energy Services Platform. DR technologies include intelligent load management receivers and thermostats using a variety of communication paths, and applications include on-site generation monitoring & dispathc, meter data collection, demand bidding and buy-back, automated notification, Web-based interactive display, meter data aggregation, critical peak pricing, TOU, virtual energy management, power quality and more.

Cellnet
30000 Mill Creek Avenue
Suite 100
Alpharetta GA 30022-
(678) 258-1500
www.cellnet.com
Derek Booth   (678) 258-1506   derek.booth@cellnet.com

Cellnet is the leading provider of real-time automated meter reading (AMR) and automation solutions to the utility industry. Based in Atlanta, Georgia, Cellnet supplies gas, water, and electric utilities with highly reliable, field-proven products that enable them to communicate with residential and commercial and industrial (C&I) meters and ancillary devices, such as demand control and monitoring, using wireless and IP network communications. The Cellnet InfiNet system combines the fixed network AMR Technology with the wireless mesh technology to bring the most comprehensive offering-merging scalability, flexibility, and cost-effectiveness available in the market today. Cellnet is dedicated to combining its leading technology and vast industry experience to continue to provide the industry with the most reliable and proven AMR solutions available.

Comverge, Inc. (ID #26)
120 Eagle Rock Avenue, Suite 190
East Hanover, NJ 07936-
(973) 884-5970
www.comverge.com
Dawn Peterson   (973) 884-5970   sales@comverge.com

Comverge, Inc. provides end-to-end energy intelligence solutions. Comverge's suite of solutions encompasses AMR, peak load control, and grid management products and services, including the company's unique and innovative Virtual Peaking Capacity (VPC) business model, which allows utilities to purchase peak capacity as if they were signing a supply-style agreement.

ConsumerPowerline (ID #15)
17 State Street, 19th Floor
New York, NY 10004-
(212) 361-6300
www.consumerpowerline.com
Deborah Stern   (212) 361-6300   dstern@consumerpowerline.com

Founded in 2000, ConsumerPowerline (CPLN) is a full service strategic energy asset management firm with a proven track record of generating electricity savings and energy market revenues for our clients. CPLN's basic offering is demand response management. We bring clients a means of financing improved energy management by first generating revenues through demand response - which requires no up-front investment from the client, no financial penalty risk, and a limited time commitment from management. CPLN is the largest demand response service provider in New York City, which is the

most profitable DR market nationwide. The company also represents clients in the CA, New England, PJM markets, and is actively tracking opportunities in all demand response markets nationwide on behalf of our clients. CPLN currently delivers nearly 100 MW of demand response capacity to the NYISO representing 340 MW of electric load in summer 2005; 68 million square feet of commercial, industrial and institutional property, 85,000 residential units, 285 buildings, leading property managers and owners across all sectors, e.g., Starwood Hotels, Forest City Ratner Companies, New York Presbyterian Hospital, and the country's largest commercial property manager - CB Richard Ellis.

Elster Electricity (ID #21)
208 S. Rogers Lane
Raleigh, NC 27610-
(919) 250-5425
www.elsterelectricity.com
Sharon Allan   (919) 250-5425   sharon.s.allan@us.elster.com

Elster is a leading technology company that supplies AMI (automatic metering infrastructure) solutions to utilities around the world. Located in Raleigh, NC, Elster Electricity provides a broad range of electro-mechanical and "SMART" electronic meters for both North American ANSI and international IEC standards. In addition, Elster provides software systems and communication networks to facilitate business process usage of metering data. Elster's EnergyAxis Systems enables utilities or energy service providers the ability to remotely enable collection of metering data during critical peak pricing times as well as change what information is collected and how oftem.

eMeter Corporation (ID #27)
1 Twin Dolphin Drive
Redwood City, CA 94065-
(650) 631-7230
www.emeter.com
Chris King   (650) 631-7230   chris@emeter.com

eMeter provides software and services to support implementation of demand response and advanced metering programs, primarily by utilities. Our software manages meter data and supports the planning, marketing, operation, maintenance, and evaluation of demand response programs.

E-mon/ MeterSmart
c/o Hunt Power East Coast
One Oxford Valley, Suite 418
Langhorne, PA 19047
(800) 334-3666 or (215) 752-0601
www.emon.com and www.metersmart.com

E-Mon's comprehensive portfolio of sub-metering products tracks energy use in buildings, industrial plants, government facilities and campus environments. Sub-metering allows monitoring of the energy consumption by individual tenants or equipment, such as air conditioning units. It also can track energy use by production line

or manufacturing process, and by department or major facility, such as an arena or stadium. MeterSmart, a subsidiary of Hunt Power, L.P., through it's operating division markets E-MON utility grade meters and sub-meters with Utility Data Resources, Inc. data collection, processing and web-enabled data applications.

Case Studies/Marketing Materials
www.emon.com/html/articles.html

Energy Curtailment Specialists, Inc. (ID #25)
3735 Genesee Street
Buffalo, NY 14225-
(877) 711-5453
www.ecsny.com
Glen E. Smith   (877) 711-5453   gesmith@ecsny.com

Energy Curtailment Specialists, Inc. (ECS) has become one of the largest demand response providers in the country. Our primary concentration is in New York City and Long Island, though we have many larger manufacturing plants in Western New York (particularly Niagara Falls) also in our program. ECS does demand response exclusive to all other services. We currently have more than 1,000 MW of load, of which ~300 MW is curtailed during emergency events declared by the New York Independent System Operator (NYISO). .

Energy Spectrum (ID #31)
1114 Avenue J
Brooklyn, NY 11230-
(718) 677-9077
www.energyspec.com
David Ahrens   (718) 677-9077   dahrens@energyspec.com

Energy Spectrum is an energy management firm specialized in providing a range of energy services in the NY region. Our engineers, financial analysts and energy consultants team up with building operators and managers to optimize demand response. We are certified with the NYISO as an Responsible Interface Provider and a Curtailment Service Provider. Our services include: load management, facility monitoring, installation, government interaction, utility facilitation, economic analysis and energy optimization. Energy Spectrum works with clients to install the monitoring equipment necessary to participate in the NYISO program. Clients can receive 24/7 monitoring of their electricload, usage and profiles including options for real-time web-based data and graphics. Energy Spectrum has worked with its clients to curtail over 20MW of demand reduction in 2005.

Enerwise Global Technologies, Inc.
511 Schoolhouse Road, Suite 200
Kennett Square, PA 19348
800-307-3395 or (610) 444-1100
www.enerwise.com
George Hunt   (610) 444-1100 x301   george.hunt@enerwise.com

Enerwise provides enterprise energy management solutions (EEM) as a hosted software suite accessed via the Internet and purchased on a stand-alone basis or as part of a larger integration solution. Enerwise's enabling technology and solutions help customers to reduce energy costs, improve reliability, and improve efficiency. Enerwise supports its products with professional design, integration and analysis services to provide customers with a flexible one-stop solution for energy management. Solutions provided by Enerwise include:

- Demand Response Services
- Energy Consumption Analysis
- Energy Related Notification and Alarms
- Management of Peak Loads
- Tools to Manage Utility Contracts
- Validation of Utility Bills
- Allocation of Utility Costs
- Creation of Tenant Utility Billings
- Optimization, Oversight, and Control of Energy Assets
- Enterprise Performance Improvement Planning
- Electrical Distribution Engineering and Maintenance
- Metering Systems Integration Services
- Generation Asset Maintenance

Case Studies/Marketing Materials –
http://www.enerwise.com/successoverview.php

Excel Energy Technologies, Ltd.
8282 S. Memorial Drive, Suite 300
Tulsa, OK 74133
(918) 585-5000
www.excel-energy.com

Excel actively manages energy solutions for over 30 million square feet of property with hundreds of clients across the nation. Energy costs, energy use, comfort, HVAC equipment performance, and monitoring of over 20,000 devices are continually reviewed for action by our around the clock 24/7 support center.

Excel has invested approximately $10 million in the development of patented technology ideally suited for energy management solutions in targeted commercial class buildings. The result is mass deployable energy management systems providing customers with compelling value and industry standard setting reliability.

Excel's fully automated systems can typically generate 10-30% annual energy savings in targeted commercial class buildings, and the real time control capabilities enable participation in curtailment/demand reduction programs without onsite actions by the building operations team.

Case Studies/Marketing Materials –
http://www.excel-energy.com/case_study1.htm

GoodCents Solutions (ID #11)
1899 Parker Court

Stone Mountain, GA 30087-
(770) 982-4962
www.goodcents.com
Roger Gray   (770) 982-4962   roger.gray@goodcents.com

GoodCents provides residential and small commercial demand response and energy efficiency programs to electric utilities across the U.S.   GoodCents develops and manages utility-sponsored turnkey programs, from program design through long-term customer care, in which it installs direct load control, home automation, automated energy management, surge suppression, and other metering devices. In addition to equipment installation, GoodCents provides a full range of professional program services, including marketing, marketing services, pricing and rates, load research, information systems, and economic evaluation. Our staff has been directly involved with the installation and management of over 1 million direct load control devices.

iES/Specified Air, Inc. (ID #3)
1390 Valley Road
Stirling, NJ 07980-
(908) 903-9277
www.iescorp.us
Brock Nigg   (908) 903-9277   bnigg@iescorp.us

Electric Curtailment, Steam Curtailment, Gas and Water Curtailment services and products related to reducing electric, steam, gas/oil and water consumption. iES/Specified Air develops programs with facilities staff to upgrade to higher facility related equipment such as HVAC, chillers, VFDs, Pumps, Steam monitoring and measures the performance on our web-based platform (Axon Energy subsidiary). iES/Specified Air delivers permanent demand load reduction and curtailment upon demand programs for our customers. We are focused in the New York City Metropolitan market place.

Case Studies/Marketing Materials –
www.iescorp.us and go to enerlogic link and attachment

NES Energy, Inc. (ID #10)
2221-7 Fifth Avenue
Ronkonkoma, NY 11779-
(631) 588-6698
www.nesenergy.com
Philip Bonsignore   (631) 588-6698   philipbonsignore@nesenergy.com

NES Energy, Inc. is in the business of design, development and implementation of energy conservation projects. Between our associates and staff we have experience in the Lighting, Controls, Electrical, Manufacturing and Finance Industries. NES brings to the industry a wellspring of expertise, with the ability to offer a "Turnkey" source for energy conservation projects (including financing the project). NES has the ability to design and manufacture unique products that can solve difficult problems. NES' proposals are the result of a field engineering survey of the premises, and the use of various products and technologies. All of our recommendations are specifically designed to provide a pleasant

and comfortable environment for the occupants of the building, while simultaneously significantly reducing operating and maintenance expenses.

Case Studies/Marketing Materials –
www.nesenergy.com

Nexus Energy Software (ID #18)
16 Laurel Avenue, Suite 100
Wellesley, MA 02481-
(781) 694-3300
www.nexusenergy.com
Richard Huntley   (781) 694-3308   rhuntley@nexusenergy.com

Nexus Energy Software provides the utility industry with Interval Meter Data Management and Analytics, including the ENERGYprism Interactive Web Bill and Meter Analysis system, which helps customers respond to Time-Based Pricing. With Nexus' Web, call center, and mail-based products, 50 utilities now educate and support customers with actionable bill analysis including benchmarks and personalized bill reducing strategies. For utilities with AMI, ENERGYprism amplifies the effectiveness of time-based rates. Industry research indicates that, by adding web-based bill analysis support to a critical peak rate program: 1) substantial impacts occur and can be measured with hard statistical accuracy; 2) customer interest levels are high; and 3) Bill Analysis produces substantial savings by reducing bill inquiries, while raising customer satisfaction.

Case Studies/Marketing Materials –
www.energy.ca.gov/demandresponse/documents/group3_final_reports/   or
www.nexusenergy.com or attached

Optimal Technologies (USA), Inc. (ID #22)
283 East H Street
P.O. Box 639
Benicia, CA 94510-
(707) 557-1788
www.otii.com
Lynette McInnes   (707) 557-1788   lynettem@otii.com

Optimal Technologies provides the "SUREFAST" Energy Management and Demand Response system consisting of "no new wires" communications, hardware, software, and Web services. SUREFAST provides an Advanced Metering, Infrastructire (AMI) platform that allows remote, real-time, customer-suthorized, device- room-, building-, and system-level monitoring, automation, control, metering, and submetering. SUREFAST allows energy providers the ability to immediately maximize the potential of energy reduction via DR programs while maintaining an engaged customer base through multiple customer benefits and empowerment -- for long term DR program benefits and sustainability. By utilizing existing demand-side resources more intelligently through SUREFAST, on-peak supply-side risk can be significantly mitigated: SUREFAST's intelligent energy management and building automation system has the "smarts" to allow

the demand-side to reduce price and delivery risks when supply-side delivery risks are high.

RETX Energy Services (ID #37)
230 Scientific Drive, Suite 150
Norcross, GA 30092-
(770) 390-8500
www.retx.com
Phil Davis, SVP   (770) 972-0611   pdavis@retx.com

RETX provides professional development, consultation, IT services and support software and systems that allow organizations to design, build, implement, and manage a side variety of demand side program resources in widely varied environments. The signature product, ePath®, supports demand response programs by offering notifications, response monitoring, aggregation and analysis of responding and non responding DR resources, meter data management and health monitoring, financial settlement, and more. Professional services include rate design, market survey and potential calculations, DR potential studies and valuation, RFP generation and response analysis, physical site surveys and technical analysis, distributed generation siting, provisioning, installation, and management, Clean Energy resources, market promotion, advertising, call center support, billing, remittance processing, settlement and more. RETX also provides specific expertise on certain types of clean energy initiatives.

Case Studies/Marketing Materials –
attachment and www.retx.com ; www.demandresponseresources.com ; www.alliedutility.com ; and www.alliedenergyservices.com

Select Energy New York, Inc. (ID #14)
507 Plum Street
Syracuse, NY 13204-
(888) 758-6888   www.selectenergy.com
Annette Durnack   (315) 460-3361   durnaam@selectenergy.com

Select participates in all NYISO demand response programs - SCR, EDRP, DADRP

Siemens Building Technologies, Inc. (ID #13)
85 Northpointe Parkway, Suite 8
Amherst, NY 14228-
(716) 568-0983
www.sbt.siemens.com
Bert Spaeth   (716) 568-0983   bert.spaeth@siemens.com

Siemens Building Technologies offers a complete range of products and services including Building Automation, HVAC Controls, Open Systems, Security, Fire Alarm & Life Safety, Systems Integration, Mechanical Systems Service, Performance Contracting, Facility Management Services, Critical Environments, Utility Cost Management, Energy Services & Solutions, and Indoor Air Quality Solutions.

Case Studies/Marketing Materials –
www.sbt.siemens.com/bau/solutions

SmartSynch
P.O. Box 12250
Jackson, MS 39236
(601) 362-1780
http://www.smartsynch.com

> SmartSynch provides the connectivity needed to thrive in the ever-changing energy market. Utilizing its robust software architecture, SmartMeters and advanced communication network, SmartSynch delivers a smart metering solution that empowers you and your customer with valuable data. In a world where customer satisfaction and profitability are critical to the success of your company, SmartSynch offers you the smart way to harness the power of information.
>
> **Case Studies/Marketing Materials –**
> http://www.smartsynch.com/PDF/casestudy_FPL.pdf
> http://www.smartsynch.com/PDF/casestudy_PEPCO.pdf

Telemetric
9941 West Emerald Street
Boise, ID 83704
(208) 658-1292
www.telemetric.net

> Telemetric is a leader in wireless communication and information solutions for the utility industry. Our solutions help customers make the most of their electric distribution assets – enhancing system reliability and reducing costs – by delivering secure, reliable communications over the existing cellular infrastructure. A suite of communications hardware, network services, and software allow Telemetric to deliver end-to-end communication solutions tailored to the customer's needs.
>
> **Case Studies/Marketing Materials –**
> www.telemetric.net/info/techinfo_cs.htm

UCS, Inc. (ID #33)
8 Woodland Drive
Oak Ridge, NJ 07438-
(973) 697-6007
John Flood   (973) 697-6007   ucs_2@msn.com

> UCS Is an energy-consulting firm that provides a variety of energy related services to primarily large commercial customers. We specialize in the area of automated energy control and are currently involved in two separate efforts relating to fleet control of window unit air conditioners and also with respect to automated control through the use of unique software designed to work in concert with a building management system. In addition, we work with a number of large commercial customers in assisting them in their energy purchase decision-making process for both gas and electric. We are also involved in the installation of several distributed generation efforts.

IV.   ADDITIONAL DEMAND RESPONSE TECHNOLOGY FIRMS

APOGEE Interactive, Inc.
2100 East Exchange Place, Suite 100
Tucker, Georgia 30084
www.apogee.net

Brayden Automation Corp.
1807 East Mulberry
Fort Collins, CO 80524
www.brayden.com

Connected Energy Corp.
Four Commercial St.
Rochester, NY 14614
www.connectedenergy.com

Conservation Resource Solutions
www.crsolutions.us

Distribution Control Systems, Inc.
945 Hornet Drive
Hazelwood, MO 63042
www.twacs.com

Enflex Corp.
1040 Whipple St. #225
Prescott, AZ 86305
www.enflex.net

FMC Technologies, Inc.
24 Westech Drive
Tyngsboro, Ma 01879
www.fmc-technologies.com

Infotility
7136 Petursdale Ct
Boulder, CO 80301
www.infotility.com

Intech 21
50 Glen St.
Glen Cove, NY 11542
www.intech21.com

Itron
2818 N. Sullivan Road
Spokane, WA 99216
www.itron.com

Landis+Gyr Inc.
2800 Duncan Road
Lafayette, Ind. 47904-5012
www.landisgyr.com

Lightstat
22 W West Hill Road
Barkhamsted, CT 06063
www.lightstat.com

Mach Energy
1801 N. California Blvd. Suite 103
Walnut Creek, CA 94596
www.machenergy.com

Power Measurement
2195 Keating Cross Rd.
Saanichton, BC Canada V8M 2A5
www.pwrm.com

Powerweb Technologies
415 East Baltimore Pike
Media, PA 19065
www.2powerweb.com

Residential Control Systems Inc.
11460 Sunrise Gold Circle Suite A
Rancho Cordova, CA 95742
www.resconsys.com

Square D (Eaton)
c/o Schneider Electric
Palatine, IL
www.squared.com

Silver Spring Networks
2755 Campus Drive
Suite 205
San Mateo, CA 94403
www.silverspringnetworks.com

Solidyne
4215 Kirchoff Road
Rolling Meadows, IL 60008
www.solidyne.com

StatSignal
2859 Paces Ferry Road, Suite 700
Atlanta, GA 30339

www.statsignal.com

Tantalus Systems Corp.
2410 Flints Pond Circle
Apex, NC 27523
www.tantalus.com

Trilliant Networks
www.trilliantnetworks.com

USCL Corporation
2737 Eastern Avenue
Sacramento, California
www.usclcorp.com

WebGen Systems, Inc.
41 William Linskey Way
Cambridge, MA 02142
www.webgensystems.com