

GE Energy
Digital Energy

Grid IQ™

Demand Optimization Solution



imagination at work

Precisely fine-tune demand to deliver all the power you can

There's nothing new about wanting to manage demand. Utility, regulators and industry groups see the need. The challenge is figuring out how to do it better. Through Grid IQ – GE's companywide commitment to modernizing the world's electrical infrastructure – we've figured out a solution.

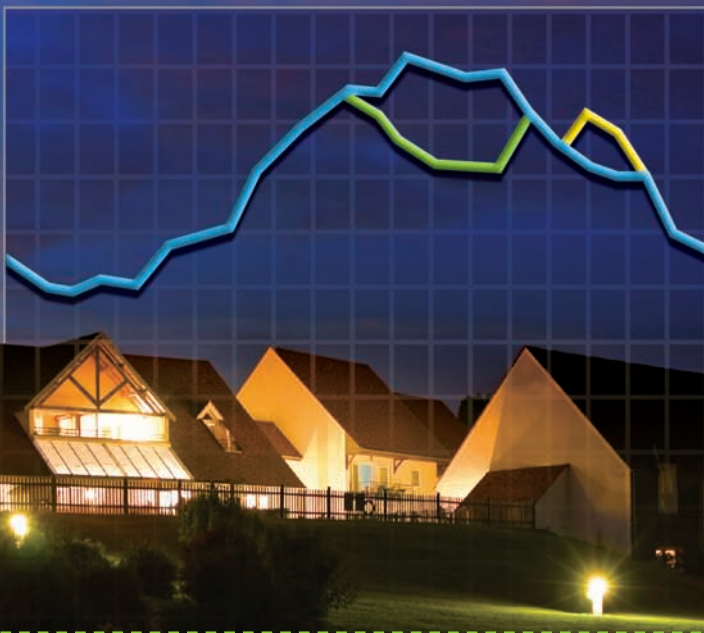
GE's Demand Response Management System (DRMS) is a smarter, integrated approach to managing demand. It uses GE software and continuous-learning algorithms as part of a complete system of two-way communications, smart devices and dynamic pricing incentives to deliver a new level of precision and control to demand-side management. It's like moving from a sledgehammer to a laser for cutting away at demand.

Control, Choice, Cooperation and Insight

Key to the success of GE's DRMS is its fresh objective. In addition to suppressing or shifting peak loads, this holistic solution enables an optimal balance between supply and predictable consumer demand, with smart load technologies like Programmable Communicating Thermostats (PCT), smart appliances, electric vehicle charging stations, in-home energy portals and home automation devices. It will also help to optimize the future integration of distributed renewables, like solar, wind and storage.

Now, instead of shutting down a large pool of load resources, utilities precisely turn down only the load they need to meet their objectives –without over-compensating and missing potential revenue.

Better yet, GE's DRMS gets smarter with every day of experience and data collection. So the mastery of demand becomes a more powerful tool for maximizing revenue while minimizing risk.

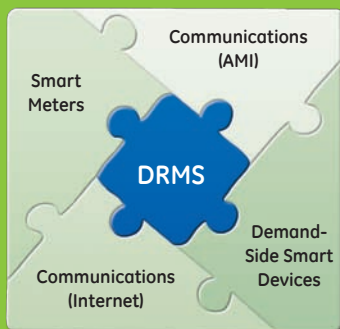


Demand Optimization Delivers Results:

Studies show that utilities can experience peak demand reduction between 10% and 15%.¹ GE estimates this could save up to \$18 million per year in avoided capital expenditure for a utility with one million customers.

¹The Brattle Group

Demand Optimization at work



A holistic view to your complete solution

GE's DRMS integrates leading-edge software, communications tools, smart meters and our energy experience. This big-picture thinking maximizes the flexibility and accuracy for each event.

The core of a multi-faceted, energy management resource

GE's DRMS delivers comprehensive demand-side management support. We've designed an application with open standards and a modular format that increases the functionality, flexibility, and ease of integrating future technologies into the system.

Three foundational software components power GE's DRMS functionality: Operations, Configurations and the Consumer Web Portal. The dynamic functionality integrated within these three components makes a practical tool for understanding and managing demand.

A New Balance of Power

Knowledge to smooth the peaks and fill the valleys

Today's demand response systems lack a vital component for optimal success: feedback. Without a feedback loop, you're driving blind. You send a load-reducing signal to shut down devices or alter thermostat operation, but there's no response to confirm the results. Who received the signal? If they received the signal, did the consumer allow the event occurrence or override it? How much total demand did you shift?

With the GE's DRMS, you get the feedback you need. It lets you know, and also learns from, the results of each peak-reducing event you initiate.

Feedback builds precision

As the system gains experience, it can forecast results from different scenarios with pinpoint accuracy. For example, you will know, with a high level of confidence, what reduction you can expect and what the participation will be from adjusting thermostats in the north end of town by five degrees. It's an aggregated load knowledge-based on the historical understanding of each individual consumer.

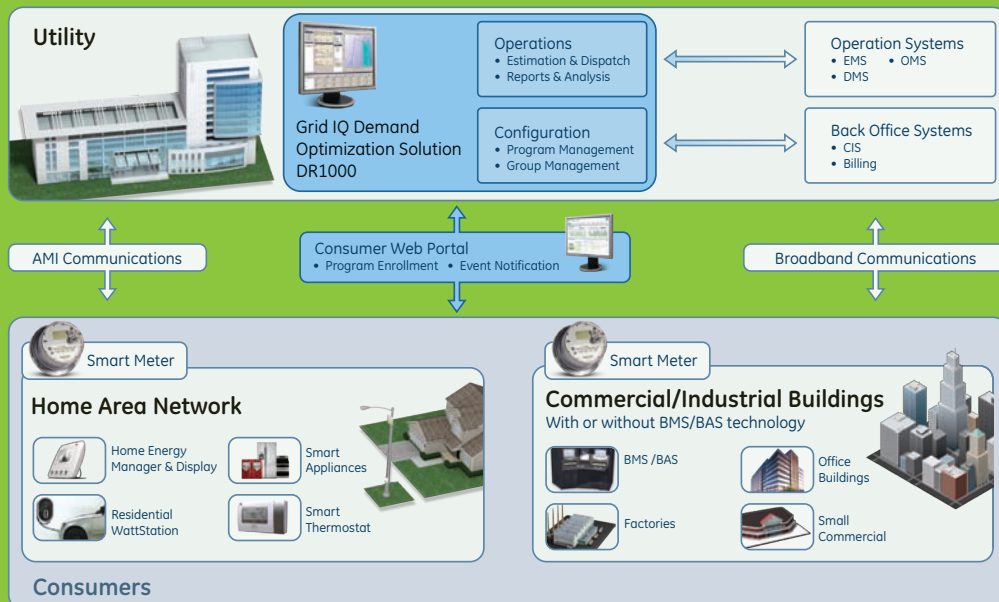
Comparisons lead to informed choices and effective action

With precise knowledge of the impact of each scenario, you can determine the ideal configuration to shift peak loads.

For example, if you're expecting demand to be "X" Megawatts above where you would like it during the afternoon of a heat wave, you can determine the optimal time window and number of participants to lower demand to precisely where you want it. You meet your business objectives while optimizing your balance sheet and minimizing impact on consumers.



Demand Optimization System Architecture



Operations Core Module

Current demand response programs have inherent challenges that limit their ability to scale up – as the number of participating consumers increases, several problems emerge. GE's DRMS is smart enough to overcome these issues by managing the rebound, timing the event window, and ramping up the response, thereby maximizing benefits of every peak-shifting event.

Managing the rebound

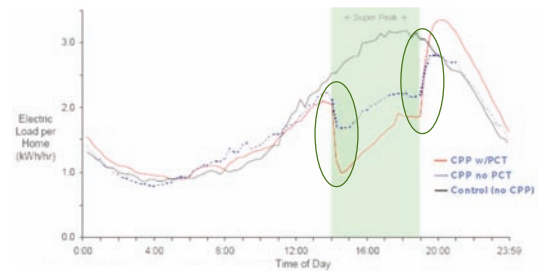
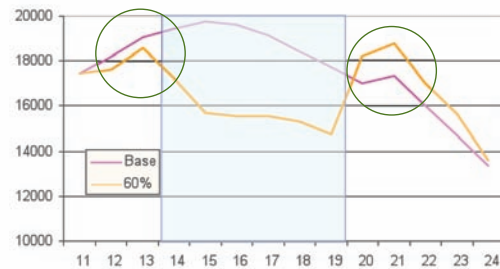
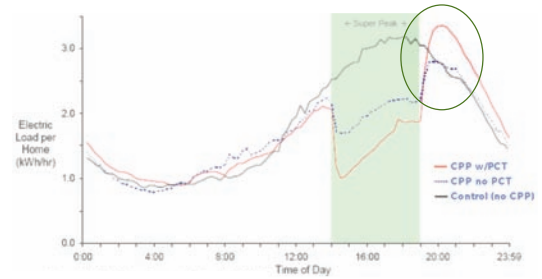
A majority of demand response potential comes from shifting loads from one time to another. With a large number of participating customers, you may have a post event phenomenon known as the "rebound effect" – large increases in demand as appliances kick on and thermostats return to normal. We help you anticipate the size of the rebound and plan accordingly.

Timing the event window action

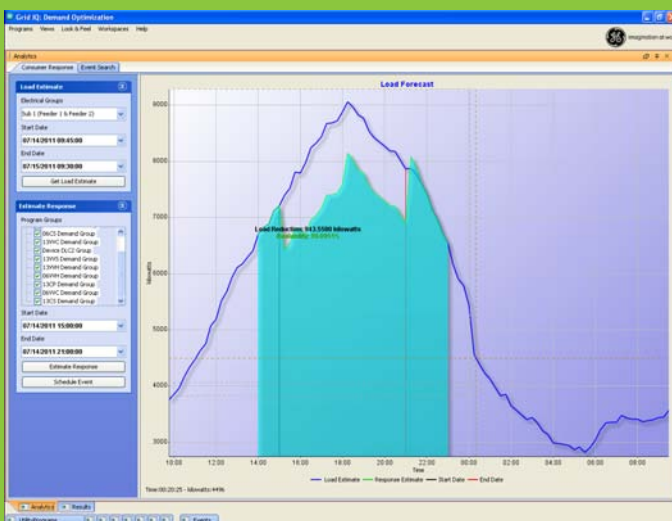
Consumers are smart. In response to increased pricing periods, they'll manage consumption by adjusting thermostats, washing laundry, etc. – either just prior to or immediately following an event. GE's DRMS learning algorithms can help choose event schedules to minimize the effect of coinciding events and associated consumer behavior.

Ramping up the response

A large number of smart home devices operating in unison can result in quick load ramp ups and ramp downs, impacting utility operations. GE's DRMS helps you choose the right event configuration, the ideal duration and optimal ramp-up and recovery scenarios. So you phase in the event and restoration, spreading the effect out over time and smoothing the post-event demand profile.



Forecast program results and implement your ideal course of action



Once you determine your demand-shifting objective, GE's DRMS system lets you select from a variety of options based on combinations of consumption demand groups and the remaining level of utility load resources. By knowing the potential results with such a high level of certainty, you can consider a whole host of variables in your decision process, including the cost of power, the effect on available customer-event limits and the potential benefit of lengthening or shortening the duration.

Doing more with less.

Now utilities have a smart tool to manage the demand side of their business. With precise planning and accurate results, you can make smarter grid decisions every day. And power a more productive energy future.

The operations component in GE's DRMS contains the critical applications to manage and maximize resources for demand response events. These applications include estimation, dispatch, aggregation/disaggregation, measurement and verification, and reports and analyses.

Response Estimator

The response estimator uses heuristics to determine load resources available for demand response over a given timeframe:

- Utilizes current load forecast, historical load, price and weather data to develop accurate estimates
- Evaluates the likely response from participating homes, and their probabilities of participation
- Improves its accuracy as customer behavior and response knowledge is gathered over time

Demand Dispatch

Most utilities rely on manual processes, spreadsheets and independent software applications to decide if, when, and how many resources are needed to support forecasted demand. The system's demand dispatch decision support tool provides recommendations to the user for optimal results. The underlying algorithm executes based on the following:

- Estimated load forecast
- Demand resources available
- Economic impact

Aggregation/Disaggregation

Aggregation and Disaggregation are necessary components of the response estimator and demand dispatch applications that:

- Determines the total demand response available based on customer participation and availability

- Enables summation of all premises connected based on pre-configured groups
- Collects up-to-date metering data from each of the applicable premises to assess current load state and potential for demand optimization
- Performs disaggregation, identifying participating customers for each pricing event

Measurement and Verification

This function calculates baseline customer load profiles according to contractual terms and verifies reductions/changes in load for billing purposes. This information can be tied into a utility's Customer Information System (CIS) to facilitate billing and customer-rewards calculations for demand program participation.

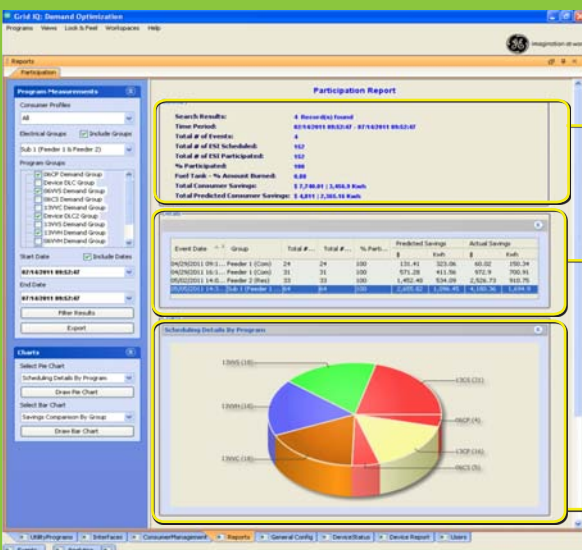
Reports and Analyses

The reports and analyses function provides summarized information on either a program or time basis:

- Statistically validates the economic effectiveness of demand response offerings
- Takes into account the opportunity costs of contractually limited events (i.e., only 10 events per year) to set a savings threshold for initiating events
- Ensures event opportunities are used judiciously



Validate program performance



After each event, you can see the results in demand reduction over time, geography and a whole host of additional reporting parameters. So you'll know how you met your objectives.

GE's DRMS system can also take advantage of dynamic pricing for purchased power. By scheduling events to alter demand, you can hit the sweet spot that delivers the greatest profit margin and avoid penalties for missing targets.

View a participation report summary displaying filtered search results

More detailed statistics displaying event dates, participation details, and projected cost and energy savings

Graphs displaying specific group participation, overrides, and a comparison of results of different groups.

Configuration Core Module

Residential demand response programs provide significant economic value with scale. However, managing large numbers of consumers in demand response programs can be a daunting challenge:

- Tracking customer registration and installation and provisioning of Home Area Network (HAN) devices
- Customers continuing to enroll or withdraw during the life of the demand program
- Events must be tied to participation rates and the availability of active customers
- Program limits, including policy tariff restrictions

GE's DRMS is designed to manage demand response programs by establishing policy rules based on tariff specifications. It has the flexibility to establish program groups and sub-groups, and track information at the consumer level to ensure your success.

GE's DRMS provides a straightforward mechanism to import large amounts of data into the system (e.g. system commissioning).

Program Management

Create, customize and manage demand optimization programs to meet business and operating objectives. The program administrator can assign each user rights and privileges, and creates an audit trail.

Inventory Management

The inventory management function oversees multiple demand optimization programs, including grouping customers by meters, hierarchy, devices, or other categorizing methods.



Policy Database

- Tracks participation and enforces program policies, such as limits to the number of events that can be dispatched
- Enhances the estimation functions

Customer Enrollment

As customers enroll in utility-defined programs through a web portal, customer enrollment:

- Assigns the customer to the program selected
- Collects household information to enable customer segmentation and support load estimation
- Allows disenrollment after the program administrator confirms contractual obligations

Device Provisioning

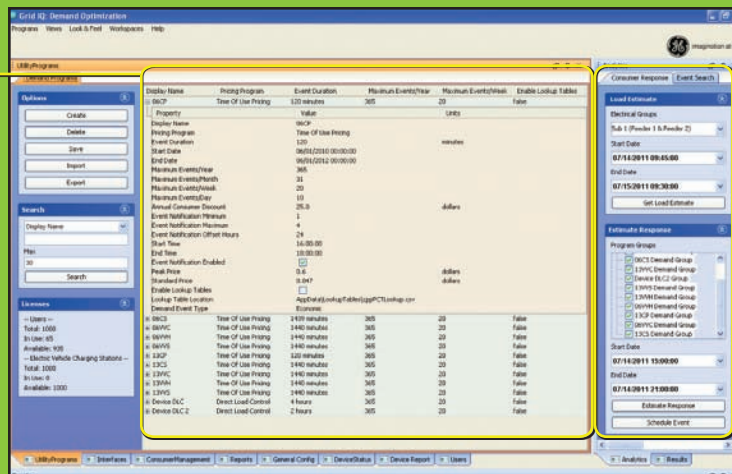
As consumers add smart devices to their home, GE's DRMS:

- Facilitates device tracking and changes in energy profiles
- Updates information in the load estimation application as customer segmentation increases

Setup consumer demand response programs

View Program Details

Specific program configuration and status details are easily available for viewing to assist in determining demand response options, and forecasting results.



Schedule Events & Estimate Responses

Accurately determine demand reductions by using participation data to project plan results based on specific demand groups.

Consumer Web Portal Core Module

Consumers can understand and appreciate results.

Communication builds value: the DR1000 system makes it easy for you to format and report savings to consumers. As they see results, plan participation grows and your options multiply.

Understanding the program's effectiveness is the key to success. As such, we've developed the functionality to pull high-level reports to assist answering:

- What types of customers are participating?
- How often are customers participating?
- What are my estimated savings in energy and cost?
- Which demand response programs are most effective?

The System's Consumer Web Portal is a convenient way for households to enroll in utility demand response programs and register their smart appliances.

The web portal allows consumers to be a part of response programs, when demand response events are initiated and provides:

- Event participation history
- Registered devices
- Real-time & historical pricing

The Consumer Web Portal in the DRMS allows participating households to access easy to understand graphical reports that track their overall energy savings, utility bill cost reductions, and how actively they have participated in utility programs.



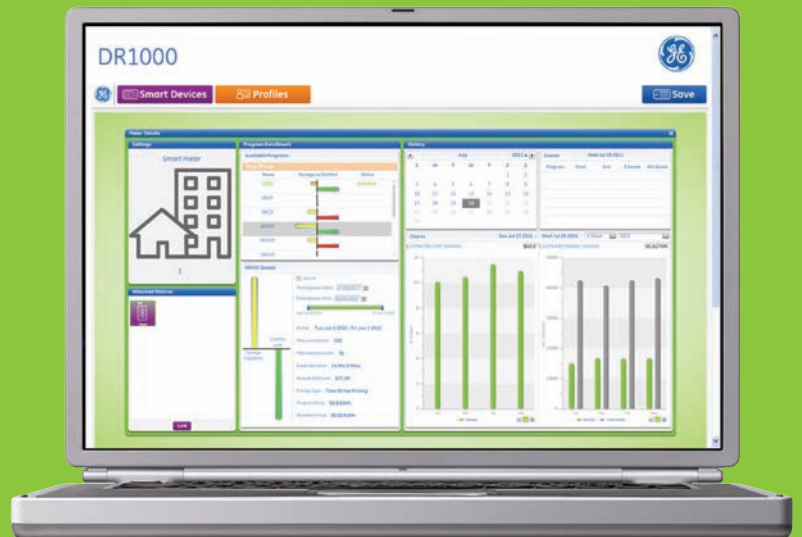
Understanding the Need and Saving Money

Choice and opportunity leads to success

Research shows that most consumers know very little about the power grid, electricity demand concerns, and how it can affect them. In today's smart grid, consumers play an important role in the success of a demand response program. GE's DRMS provides consumers with the tools and techniques to maximize consumer participation and educate them on the results.

Consumers can understand and appreciate results

The Consumer Web Portal makes it easy for utilities to format and report savings to consumers. As consumers see results, plan participation grows and utility options for demand response will multiply.



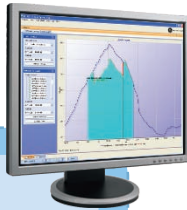
Home Area Network

Utility Monitoring & Control Center



Grid IQ Demand Optimization Solution DRMS

- Estimation & Dispatch
- Reports & Analysis
- Program Management
- Group Management



Smart Home

AMI



GE GeoSpring™ hybrid water heater
Efficient operation along with low energy setting for use during peak hours



Smart Thermostat
Automatically adjust temperatures to lower energy and costs during peak hours



Smart Appliances
Delay cycle starts, low energy settings, & adjusted consumption levels during peak hours



Home Energy Manager
Communicates directly with AMI meter and energy saving appliance for seamless integration with the Utility



WattStation™ Electric Vehicle Charging Station
Available with time-of-use pricing and the ability to receive utility load control messages



DR1000 - Functional Details

Functionality	
DR Forecast Estimation	
DR Dispatch (Economic)	
Aggregation/Disaggregation	
Measurement and Verification	
Reporting	
Web Portal	- Enrollment - Notification - Energy Usage
Program Management	- Direct Load Control - Critical Peak Pricing - Time of Use
Matrix Group Configuration	
Residential and Small Commercial	
Semi-Automated Provisioning	
Scalable to over 1 Million Consumers	

Interoperability Options
Energy Management System
Meter Data Management System
Customer Information System
Advanced Meter Infrastructure
Internet Service
Custom Interfaces

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