Benefit Definitions.

Due to space limitations, these definitions are being provided on the web site.

Metering – These are services traditionally done either with the existing meter or with the data that is retrieved from the meter during analysis.

Meter reading

This is the traditional service that is preformed via a human today. It is taking the current index reading from the meter and recording it for billing and other purposes.

Non-technical losses

Theft of power by another name, in a traditional meter, when the meter reader arrives, they can look for visual signs of tampering. During the analysis of the data, tampering that is not visually obvious may be detected. In smart meters tampering alarms are set off by a number of different sensors and routines in the meter.

Net metering

When you have the ability to generate or store power as well as consume power, the ability to measure the movement of power in both directions becomes important. Today large commercial and industrial customers and some smaller customers have net metering installed. As plug-in hybrids become the norm, net metering will increasingly be implemented in homes and small businesses, even parking lots.

Real-time customer information

Today the majority of real time information about a customer, comes from the customer, they pick up the phone and call about issues they have, such as an outage, and provide information to the utility. In the future, the smart meter will be able to provide up to date information about the customer and the status of their service.

Operations – These services have not traditionally been part of the metering requirement and most older AMR systems (drive by and one-way) are not capable of providing the services in the period of time that the utility would need the data for operational purposes.

Connectivity Validation

Determination that the customer is connected to the grid and even with the right signally which phase and circuit they are on. In several reviews of customer connectivity today for utilities the phase information is missing from many single phase connections and in some cases the circuit information is missing or wrong. Validation helps with making sure the data analysis is correct for engineering studies and other purposes.

Closing Verification

In completing work orders, it is useful to know that all of the customers that were affected by the work order have power and that there are no outstanding issues that need to be corrected, prior to the crew leaving the area. The ability to “ping” every meter in the area that was affected by the work order and determine if there are any customers who are not communicating that they have power is useful to minimize return trips to the work area to restore single customers.

Geo-Location

In asset data bases today many meters are literally miles (kilometers) from their physical location in the real world. During the installation of the meters GPS or other geo-location techniques can be used to provide accurate information on the meter’s location. If the location of the meter accidently is changed in the database it is possible to flag the problem. This is possible since the location of the circuit is known, helping to eliminate problems that creep in over the long life of electric (gas and water) networks.

Power Quality Monitoring

Today for some larger customers and at select locations on the grid we are able to monitor harmonics, wave form, phase angles and other power quality indicators. The need continues to grow as large screen televisions and other consumer electronics devices are increasingly adding harmonics

to the system. With the newest metering technology some power quality monitoring is built into the meter and more is on the way. While not every house needs to monitor power quality, a percentage of the meters deployed should probably have this advanced capability.

Asset Load Monitoring

With Connectivity Verification and Geo-Location information it is possible to group the devices in a tree structure that correctly shows connection points in the grid. With the ability to read intervals from the meters it is then possible to build a picture of the load that each asset (e.g. transformers, conductors, etc.) are subjected to. This allows an operator to monitor heavily loaded assets and look for ways to off load some of the demand from that asset. It also allows a maintenance planner to prioritize what maintenance should be done to maximize the reliability of the grid, as part of a reliability centered maintenance program.

Phase Balancing

One of the least talked about issues with losses in the distribution grid today is single phase load and the imbalance it can cause between the phases. These losses have seldom been measured in the grid and little study has been done of the amount of phase imbalance on the grid today. In early studies the chronic phase imbalance in several circuits that were monitored averaged over 10 percent. While correction is hard when the circuit is run as single phase laterals, in many cases there is enough load on the feeder portion of the circuit to allow rebalancing of the circuit to eliminate more than half of the chronic phase imbalance.

Load Balancing

Where there is an option to move a portion of the load from one circuit to another, the instrumentation is not always available to make good choices or to be able to forecast the load in a way that makes the movement pro-active instead of reactive. Automated feeder switches, and segmentation devices are becoming more and more common in the grid. The ability to use metering data to support the operation of these devices will only increase their value to the grid operator. Today with information only at the substation end of the circuit, it is tough to determine where on the circuit the load really is and where to position segmentation and when to activate a segmentation device when more than one is available. Operators today typically learn the right way by trial and error on the system.

Work Dispatch Improvement

Today we use manufacturers' recommendations, models, estimates and visual inspection to determine when a lot of maintenance work should be done. While it works, in some utilities it means more maintenance than others think is required and in others it means less. In almost every case, some maintenance is performed that is not really required for reliability centered maintenance strategies. When smart metering information is available and used to do asset loading analysis and other data analysis, work can be more accurately dispatched to the crews in the field improving reliability in the system for the same number of jobs completed.

Order Completion Automation

Some utilities have the field crew log the completion of their job prior to packing up; others want the crew ready to roll prior to completion of the order. Some want the crews to look around before leaving, some want the crew to leave and let the customers call if there is still an issue in the area. With smart metering, as restoration alerts come in, it is possible to automate the time the job was completed and some of the closing paperwork, allowing the crew to stay in the field longer each day and to do less paperwork overall.

Site/Line Status

Tag out procedures are supposed to render a segment of the network dead and safe to work on, unfortunately with the addition of true distributed generation, it is possible to have an islanding failure and to have a line that the crew expects to be ready for work, to actually still be live. With the correct smart metering system and the right connectivity mapping, it is possible to use the smart meters to determine if any power is still flowing through the lines. With the potential for the sales of plug-in hybrids to ramp up quickly in the next decade and the lack of protection schemes currently this may become an even larger issue.

Automation of Emergency Response

Today in a fire, the fire department normally handles the disconnection of the power and other utilities from the involved structures. Often with a fire axe! With the advent of remote disconnects in the

meters it will be possible to cut the power to the structure, as well as gas and other utilities. This makes it easier to restore service after small problems and to more rapidly remove a possible source of problems from the structure.

Call Center Unloading

Today we rely on customers to call in when there is an outage; this normally is one of the factors in sizing call centers and staffing them. When smart metering is deployed in the right way, it is possible for the system to determine where the outages are and to let the utility call the customer with an outage message and an estimated time to repair. In the long run this will reduce the loading on the call center during periods of high outage levels.

Restoration Verification

Like closing verification, restoration verification has the metering system report in as the power it returned to the meters. This alert function is built into many meters that are being deployed as smart meters today and includes a timestamp for the restoration time. For some utilities this is improving their IEEE indices, since their crews may take several minutes to complete other actions before reporting the power back on. It can also be used to help isolate nested outages and help the field crews get to the root cause of those nested outages before they leave the scene.

Vegetation Management

Momentary outages normally increase as vegetation grows back in an area and starts to become potential issue for overhead lines. Smart metering allows the return of momentary outage information and allows the outage counts to be overlaid on a GIS system. This allows the planners to better target vegetation management people to the right locations. In the underground world, cable failures and splice failures can be found early, prior to a complete failure.

Distribution SCADA

If more sensors were available in the distribution network, it would be possible to do distribution SCADA, with the deployment of smart meters and a near real-time communications network, it is possible to pick a sub-set of the smart meters and use them as bell weather devices in the grid to provide a distribution SCADA like capability. In addition some utilities are installing smart meters in place of RTUs for extending their current SCADA system further into the grid.

System Security

As interference with the operation of the distribution grid becomes more common, it becomes more and more important to monitor the integrity of the grid at all times. Smart meters offer a way to get a “heart beat” from the whole of the distribution system on a regular basis thus providing assurance that the grid is intact. That it has not been attacked by a mad man in a backhoe or a copper thief with a chainsaw.

System Protection

Overloads on the system once were not a big issue devices could operate at two or even three times their rated capacity for several hours on a peak day. Today devices have been engineered to run at loads much closer to their ratings, and overloads of several hours can cause degradation in the devices. By being able to monitor the load on the device and with the deployment of direct load control or disconnect switches, the load on the device can be managed until it can be replaced or upgraded, the same goes for other physical assets that may be de-rated, allowing at least some of the lights to stay on.

Selective Load Management

With the deployment of disconnects and home area networks the utility can choose to manage the load on the grid, to manage peak, to manage customer bills, to allow for a generation or transmission issue to be corrected or other reasons. This can permit, with the right equipment the reduction in the need for reserve margin in generation and for rolling reserve, the selective load management becoming a virtual power plant that is a callable and schedulable asset.

Outage Notification

For either scheduled outages for maintenance or for notification of a customer that the power is out in their home when they are at work or away from home, smart metering provides a needed piece. For scheduled outages, if there are in home displays deployed the metering system can provide the outage times and durations to the customers directly impacted and no others. This minimizes possible

security issues of the information getting into the wrong hands as security systems that require power stop functioning, etc. It also helps with the number of phone calls that have to be placed to customers to let them know that maintenance is happening. With the connectivity verification, it is possible to really know who is on a specific path and to accurately manage the outage. For unscheduled outages, it possible to use the information coming from the meters to let customers know that they will be returning to a location with no power (water, gas) and that will let them make alternate plans, rather than walking into a surprise.

IEEE Outage Indices

Today the IEEE indices are manually calculated in most utilities and they are not up to date, since the information needed to track them comes from field reports and other documents that do not feed into a central location. Additionally since not every single point is tracked in any system for outages, it is impossible to accurately determine the indices. Most utilities have gotten very good at the development of indices that are very close to the reality that their customers are seeing and to the limits of the information available.

Islanding Verification for Distributed Generation (DG)

Each time an outage occurs DG should island itself from the rest of the grid and only feed the single location that is directly attached to. In many cases the islanding equipment in smaller installations is poorly installed or poorly maintained. This leads to leakage of the power into the rest of the grid and potential problems for the field crews. Each time an outage occurs, meters that are designed to monitor net power can tell if the islanding occurred correctly, if they are installed at the right point in the system. This reporting can minimize crew safety and allow the utility to let the customer know that maintenance is required on their DG system. In most cases when the islanding fails, other problems also exist that reduce the efficiency of the DG system, costing the customer the power that they expected to get from the system.

Reliability Centered Maintenance (RCM) Planning

Today we guess at the loading on devices using models, and use that information to develop a reliability centered maintenance plan. Based on that information we do our best to perform the maintenance that the system requires to make sure that people have power. With the ability to do load monitoring and load forecasting more accurately, preseason maintenance can be scheduled based on the facts that the system generates. While it will never prevent all failures in the system, use of this information and a well designed RCM plan can result in significantly less outage for non-natural disaster causes.

Distributed Capacitor Bank Management

When and where are capacitor banks required? The answer today is that they are traditionally installed in substations and that is the best answer available today. Also the hours of operation are typically pre-defined based on historical information or rules of thumb about what is needed. As the characteristics of the load change in the field, and home owners install more and more equipment that is sensitive to the power quality delivered by the grid, the old rules may not work any more. Use of power quality data from smart meters may allow better deployment of smaller capacitor banks and also allow the utility to re-define when they need to operate, thus providing higher quality power to the customers for potentially less investment.

Field Worker Data Access

Today if a line worker wants to know the status of an area of the grid, she can measure power flow, she can look at meters or he can call dispatch. Access to near real time information on the status of the customers close to the worker's location is limited today. With the deployment of smart metering, depending on how the software is configured and the security setup, it may be possible for a field worker to get access to the a near real-time map of the status of the customers in their working area, minimizing the need for dispatch to tell the worker where to go next and what to do. With experience, field workers have proven to be very good at determining where in their work area a likely root cause is, based on outage information, reducing the time it takes to find the cause and start the repair work.

Regulatory – There are a number of issues the regulators like to look at around the performance of a utility and the fairness of a utility to its customers. Smart metering has a role to play in providing facts to the regulator to help them manage these issues.

Tariff Design

Today a sample of the customers is used to determine what the customer profile should be and how that profile should be priced. In many cases the classification of the customers is very broad and does not really take into account the different ways that customers actually consume power. For example a young educated single male living in an apartment may have a lower usage than the young family across the hallway and they may both pay the same per kilowatt hour of power. But the young male many actually cost the utility more to serve, since the load factor for that single male may be much lower than the load factor for the young family. By being able to provide accurate data, better tariffs can be designed and better segmentation done to support a fair power price.

Rate Case Support

Today to get almost any change in what can be charged to the customers or what is placed in the rate base, it requires a rate case. In some rate cases the documents filed fill rooms and rooms in a building, mostly because the issues can be handled in a black and white manner. Experts are required to testify on many aspects of the rate case using data from other locations, since the complete data set to answer the question does not exist at the utility. While experts will not go away, and there will still be a lot of estimating, it is important to realize that smart meters provide a large data set to assist with the rate cases.

Critical & Complex Tariff Design

Do critical peak tariffs create the response expected, does it do it for all segments of customers, and does it impact some customer segments more harshly than others. Use of smart meter data allows a better review of how the customers are responding to the tariffs and how to re-work them to better fit the needs of the society.

Cross Subsidization

An issue that is raised over and over again is cross subsidization of customers, one group of customers paying part of the cost of another group of customers. With our example in Tariff Design, more than likely the young family is subsidizing the young male. Regulators want to know what the cross subsidization is, they do not always want to eliminate it (e.g. the long distance rates for the telephone companies for decades financed the ability of everyone to have a phone). By having complete data on each and every customer, subsidization arguments no longer fall on “I think” arguments, but fall into the “I know” allowing the regulator to only have intended subsidies.

Investment Decision Support

When a utility goes to the regulator for a major capital expense there is a need for proof that the expense is required. Today like other regulator interactions, the data is typically made up of sampled data and expert opinions. With smart metering the complete data set is available to support the decisions.

Customer Segmentation

Customer segmentation has traditionally been done by industry or by business segment or by customer type, not by the actual needs or profile of the customers. Regulators have never had enough data to make segmentation decisions that really classify customers together by the way they consume power and their needs for power quality or their creation of power quality issues that the utility needs to fix. Smart metering can provide the data to make meaningful segmentation decisions.

Customer Operations – Customers today call the call center and receive bills. They have little interaction with their utilities, less than 40% of the customer base interacts with the utility annually. The majority of the call volume is related to outage or other power quality issues. The second highest interaction reason is billing issues. If the industry is to be successful in changing people’s habits and helping to reduce consumption, then there will need to be more interaction with customers, some on billing issues, some on power quality, but more on the way they consume power and what they have for appliances.

Prepayment

Customers who either want a lower rate or have a history of slow payment can benefit from prepayment of power. Smart metering makes it easier to deploy new types of prepayment to customers and provide them with better visibility on the remaining hours of power, as well as extending time of use rates to prepayment customers.

Real Time Pricing

Use of real time pricing for electricity is common for very large customers affording them an ability to determine when to use power and minimize the costs of energy for their business, one aluminum company cut the cost of power by more than 70% with real time pricing and flexible scheduling. The extension of real time pricing to smaller customers and even residential customers is possible with smart metering and in home displays. Most residential customers will probably decline to participate because of the complexity of managing power consumption.

Time of Use Pricing

Time of use pricing creates blocks of time and seasonal differences that allow smaller customers with less time to manage power consumption to gain some of the benefits of real time pricing. This is the favored regulatory method in most of the world for dealing with global warming

Critical Peak Pricing

Critical Peak Pricing builds on Time of Use Pricing by selecting a small number of days each year where the electric delivery system will be heavily stressed and increasing the peak (and sometime shoulder peak) prices by up to 10 times the normal peak price. This is intended to reduce the stress on the system during these days. California is the largest proponent of this tariff program. Most of the California utilities would prefer an incentive program instead to encourage the same behavior. There is some question as to whether retailers in unregulated markets would have to pass thru the Critical Peak Pricing to customers or if they could offer a flat price and hedge the risk of the critical peak pricing.

Bill - Paycheck Matching

Today, depending on the utility bills arrive monthly, quarterly or yearly and not on a schedule selected by the customer, rather they are based on a schedule that matches the meter reading schedules. Small scale trials have proven that for customers who are living on the margin and miss occasional payments, that matching the date and frequency of the customer's paycheck reduces the number of late or missing payments significantly, cutting collection costs and reducing the cost to all customers.

Remote Disconnect

The cost of collections is high, typically higher yet is the cost of disconnecting a customer – not only the lost revenue, but the cost of two special trips to the location, one to turn the power off and eventually another to turn it back on again. While remote disconnects are still pricy today, they offer a much lower cost for turning the power off and once customers understand that a disconnect can be done immediately, collections costs also seem to decline.

Customer Price Display

To make a realistic decision about using or not using energy and water, customers need to know how much it will cost. As we have seen with Gasoline the global consumption decreased very little (in reality only the projection of growth in consumption declined, not the actual usage) when the price tripled at the pump in many countries. Electricity, gas and water today are in the noise of running a household for most families and for many businesses the cost does not enter the top five costs for the business. To this end, making a decision to consume energy and water is easy. For a few businesses and a small percentage of residential customers this is not true and they have strong motivation to conserve power. With critical peak pricing or time of use pricing and rising prices for energy and water, the percentage of the average family income consumed by these utilities will no longer be noise and having information about pricing, will drive some conservation. Expect that customers will need to know the price to wash a load of clothes, not the price of a kilowatt hour.

Remote Issue Validation

When a customer calls today with a problem, other than twenty questions on the phone or rolling a truck to the location, there is no way to understand if the customer really knows what the problem is or if they do not understand the problem. Use of near real time information from smart meters can allow the customer service representative (CSR) to provide better information to the customer and to provide better advice on what to do with the current situation. It can also reduce the dispatch of trucks for customer complaints. In general it reduces both call volume and call handling times.

Customer Dispute Management

The most frequent customer dispute is a high bill. They complain about the meter reading being wrong. In truth there are enough meter reading errors that high bills are a fact of life. But the ability to check the current meter reading directly from the meter while the customer is on the phone and re-

calculate the bill if the bill was high, and to end the post call investigation, by being able to directly validate the customer dispute reduces the time to clear a complaint that is non-phone time and it reduces the call handling time of the life of the dispute. It is not unusual that the initial call time goes up, since the CSR has to explain how they are getting the information and may have to have the customer walk to the meter while on the phone and verify the numbers that show on the meter. This has reduced monthly disputes with chronic callers over a period of 3 to 6 months in most utilities that have this ability.

Outbound Customer Issue Notification

Not only can customers be called at work for problems with outage, but other problems can be determined and customers notified, in one case, a meter looked like it had been tampered with, but the customer had a complaint about low voltage on file. A review of the situation determined that one of the wires was probably loose in the customer's breaker panel. That call resulted in the customer hiring an electrician and fixing a number of electrical problems in their home that the electrician uncovered while fixing the loose wire in the panel. This is one example of a number of proactive actions that can be taken with the customer to help them be safe and know what is going on with their energy consumption. Similar work was undertaken on behalf of a water company and a number of beyond the meter leaks were identified with night time readings on homes with high water bill complaints.

Customer Energy Advisory

Salt River Project undertook to provide a customer energy consumption advisory that allowed customers to indicate to SRP what they had for energy consuming devices and information about their home, in return SRP would rank their consumption against similar homes and provide feed back on the equipment and appliances that were consuming significant energy. This advisory went so far as to suggest what should be replaced and the payback period on the replacement based on energy usage. The comparison allowed customers to see how they did against similar customers and where they ranked in energy consumption. This has been useful in getting customers to pay more attention to their consumption.

Forecasting & Scheduling – Most of the forecasting and scheduling today is done top down. Take a similar day in history, adjust for overall load growth and use that as a starting point for how much energy to plan to provide or how much water to provide for the day. Top down was easier when there was a true monopoly in the market and no one else was generating power or selling power into the market. In today's world as DG and unregulated retail eat away at the ability of a top down forecast to provide accurate information, most system operators are reducing risk by increasing their rolling reserve and other ancillary services.

Demand Side Management

Management of the use of energy is important in a number of ways. Demand Side Management is a step beyond just tariff based load reduction. It assumes that customer will setup or allow to be set up equipment to reduce load when signals are sent to the customer's location. The customer is in charge of making demand side management decisions.

Load Forecasting

Given the ability to draw a full data set from the field, it is now possible to do real bottom up forecasting for demand and supply. It is possible to forecast even DG contributions from the data set, allowing a net load plan to be created.

Simulation

As time goes by and the dataset gets larger, it will be possible to have real information about what occurs when the price of power increases or demand side management is requested or direct load control run. This ability to simulate the market a day or more in advance should allow for better planning and for the system to run with smaller amounts of rolling reserve and ancillary services.

Asset Load Analysis

With the ability to have a real load history on a specific asset and to be able to do bottom up forecasting, the same can be done for assets in the connection tree. This should allow planners and others to see potential problem areas before they really exist.

Load Scheduling

Given the ability to get customers to shift load when requested, and to do bottom up simulation it becomes possible to work with customers who have the ability to shift load to different times of the day

or week. This ability to do load scheduling could have an impact on transmission and other capital expenses.

Curtailment Planning

To do proper load reduction, for either de-rated equipment or for planned outage or even to deal with load growth that has gotten ahead of system upgrades takes having data on what the loads are and what can be curtailed. In California, load curtailment has been called rolling blackouts, the best that can be done without an ability to control the demand on the system in a more granular fashion. By using curtailment planning, notice can be given in advance to the impacted customers and they have enough time to respond if they have an option in their contract to keep the power on.

Planned Outage Scheduling

Ideally planned outages should be done at a time when they have the least impact on the customers. Today we use rules of thumb about when to take a planned outage, in the future with a complete data set it is possible to adjust the time of the outage to correspond with the lowest number of customers demanding power. This minimizes the impact to the customers.

Direct Load Control

Florida Power and Light runs the most successful direct load control program in the world, their customers have allowed them, for an incentive, to take control of over 3 million devices that are installed in their homes and manage the time that the device is on and the time the device is off. Direct Load Control provides positive control for the utility making it a callable and schedulable resource, if you will a virtual power plant. Customer like it (if it is invisible), because they do not have to think about it, they sign up, allow the installation and forget it.

Construction and Standards – Standards are the rules for doing things and construction determines what a market has for assets to support their customers and what they need.

Design Standards

Many of today's standards assume that complete data is not available so there are factors of safety built into the calculations at each step of the design process for the transmission and distribution grid to make sure that the design is useful for its full design life. The improvement in load and demand data from the smart meters will make it possible to remove many of the rules of thumb and design to the real needs of the customers.

Maintenance Standards

Maintenance is done with incomplete information. So the maintenance standards allow for this, in some cases too much maintenance is done and some times too little is done, standards call for the best possible maintenance planning that incomplete information can provide. The good news is that the reliability of the system is very high, better than any other service (including telecommunications and cable TV) that is available to a customer. The bad news is with all the retirements in the industry, the experienced technicians that are required to make the judgment calls in the field will all be replaced in a few years. Improving the standards for maintenance with better information will mean that the new field workers will be routed to the highest priority work almost every time.

Feeder Ratings

When you visit Energy Australia you will see the operators dynamically rating feeders and other conductors in their system, in some cases running them below the rated capacity and at other time pushing them well beyond the ratings. They do this with excellent data about the conductors and their environment. The next step in the Energy Australia quest is to have the data on load to determine if they will be able to meet the demand based on the dynamic feeder ratings.

Rebuild Cycle

When is the right time to rebuild a circuit and how much of it really needs to be upgraded? Today with the information we have, we hang some recorders and use a few weeks or months of data from a few locations to determine what to rebuild, with the improved data set and the improved standards it is possible to actually determine the sections of the grid to rebuild and how much to reinforce them.

Replacement Planning

Equipment replacement is based on the estimated load or a load study that is normally conducted with less than perfect information. This has resulted in the engineering team being conservative and

over sizing many of the replacement equipment. Smart metering offers better information to make better sizing decisions.

Distributed Resources Integration – In the future more and more of the resources on the grid will be connected to the distribution network and will complicate the operation of the grid for the future. Failure to integrate these resources into the grid and understand their impact will only degrade the operation of the grid and its reliability. It is no longer an option to deal with distributed resources, the time for refusing to allow them has passed. The only choice is to either embrace them and manage their impact or ignore them and suffer the consequences.

Net and Gross Generation Monitoring

There are two different generation results from distributed generation, the gross output of the device and the net input into the grid, after the owner takes their needed energy. The two can be very different at times when the DG is creating most power the owner may also be drawing so heavily that the net result to the grid is still negative. At other times, the demand from the owner may be less than the output, even though the output may be well under the design output of the device. Ontario decided to reward renewable generation owners on the gross output others have decided to reward them on the net. But to manage a utility and the reliability of the grid it is important to know both the net and the gross output of the device for simulation, load forecasting and for engineering design. Smart metering, done correctly can provide both results and assist in islanding the DG, should the DG fail to island on its own.

Storage Fill/Draw Management

If someone has installed distributed storage, when should it be topped off, and when should the storage discharge? Today's answer is to use a timer in most cases or a phone based trigger. For one utility the use of electric thermal storage for winter heat and time of use tariffs that encouraged topping up at a specific time of the day resulted in the destruction of a number of pieces of equipment on the grid as demand exceeded the local ability to supply that demand. The attempt to improve the load factor on the grid with this storage system resulted instead with demand that exceeded all expectations. Smart metering with a home area network capability can trigger each storage device based on the total load in the area, leveling out the peaks in the system and providing better use of generation resources that may be variable in nature.

Plug-in Hybrid Management

Depending on how plug-in hybrids are sold and how the consumers take to them, they may either become one of the largest new uses of power or they may not have an impact. A major problem is that planners are now assuming that they will be mobile generation plants, that the drivers will burn fuel and store power in the battery to be drawn during the peak times while parked in the company garage. Others have assumed that the cars will become the largest new consumer of power in the downtown grid, an overstressed part of the grid already. How plug-ins are managed and how consumers will use them is a social experiment. What is not is that they will draw a large amount of power from somewhere and have the potential to store a lot of power for later use. How the power company measures which car provides or takes how many megawatt hours and proves it and bills for it, will be an interesting change. Smart meters can help with this if the right standards are place to deal with communication from the car to the meter.

Supply Following Tariffs

DG has a strong probability of having a large percentage of renewable generation which has a strong variable component. Since the supply will be variable and highly variable on short notice, it may be that to avoid either a large component of rolling reserve that uses fossil fuels, it may be that a supply following tariff could be possible. It would require a very high speed forecasting system, excellent weather information and near real time communications to devices in the homes and in businesses with almost instant response. This is a tall order in today's world, but the cable companies have proven that millions of devices are possible to broadcast to in near real-time, so it is possible. Smart meters on the right communications network and with the right in home gateway could provide a piece of this supply following tariff system.

Small Fossil Source Management

There is a large amount of diesel generation that is installed on customer sites to deal with outages on the grid. Some companies are now forming to manage these resources, not for outage, but for peak power production, bidding into the market a few megawatts at a time. While the use of these resources is a good thing, the penetration of private companies will never be as complete as if the

utility were to work with their customers to equip most of this generation with controls and monitoring equipment. Whether the utility operates and maintains these resources or allows third parties to take responsibility is not important. What is important is that smart metering can reduce the cost and complexity of making these resources available. In California more than 2,000 Megawatts of generation are already installed, more than enough to end most rolling blackouts (if the resources are in the right areas).

Gas and Water – Some benefits are specific to gas and water, this is not an exhaustive list, but to better balance the article they have been included. Note that the value chain boxes have not been filled in, since the value chain part of the table is specific to the electric power industry.

Leak Detection
In the world of gas and water, non-revenue water and leaking gas pipes are important to track down. In the water industry, use of pressure transducers on smart meters has proven useful when doing minimum night flows to find unexpected pressure drops in the system. Normally the need is one pressure transducer meter per 500 to 1000 customers in an urban environment.

Battery Management
If there were no smart meters, there would be no need to do battery management, so the benefit only works for smart meter equipped networks. In an operational world the meters communicate more, running the battery down faster. It is important to have good battery management or the cost of maintaining the system will skyrocket. Remote battery monitoring (as part of the regular communications) can help deal with battery replacement planning and battery life extension.

Flood Prevention
With a disconnect in the meter, it is possible if there is a sudden increase in flow and a drop in pressure that is sustained and unusual, that the disconnect can be activated and prevent flooding. Much work will have to be done in the control software algorithms to make this a useful benefit and not one the shuts off the water when the sprinkler system and the shower are both running.

Gas Leak Isolation
Similar to flood prevention, again the software needs to get much better or their needs to be a gas leak sensor in the structure that communicates with the meter.

Pressure Management
If there is a home area network, then shut off devices or throttling devices can be attached to specific water taps and the gas meter can communicate to thermostats and water heater controls to manage the rate of consumption in the location and help with pressure management on critical days.

Other – These are the leftovers, all things that the utility does not do today, and would be very hard to do without the infrastructure that smart metering provides. While home security is a going business, the rest are not. They offer either new revenue opportunities or the ability to create new third party industries.

Appliance Monitoring
Appliances seldom last as long in the home as they do in the lab, part of this is that home owners do not do maintenance when they should, and part of it is that when small problems occur that are not handled, so they become big and expensive problems. Smart meters are a key part of an appliance monitoring solution, even for appliances that were installed long ago.

Home Security Monitoring
Today's security monitoring industry uses phone lines and other communications methods to monitor homes. The ability to hook security monitoring devices into a home area network and provide alerts and alarms over the smart metering network could lower the cost of home security monitoring making it more affordable to the people who live in areas most likely to need it.

Home Control Gateway
Home owners may want to control their home devices themselves or they may want a third party to do so, in either case, the smart metering system can be a method of providing that home area network gateway and allowing that control to be done.

Medical Equipment Monitoring

More and more medical equipment is being installed in homes as nursing homes and hospitals are getting too expensive to live in and more life support equipment is required for people who still can live at home unassisted most of the time. Today that equipment is only monitored by specialized companies and this seldom happens. It is a growing need especially for the elderly customers of the utility. While utilities may not wish to step into this role, the smart metering infrastructure can provide a way for authorized third parties to do so.