DATE: July 12, 2011 STAFF: Brian Janonis, Steve Catanach, Kraig Bader *Pre-taped staff presentation: available at fcgov.com/clerk/agendas.php*	**WORK SESSION ITEM** **FORT COLLINS CITY COUNCIL**

SUBJECT FOR DISCUSSION

Modernizing Water and Electric Infrastructure.

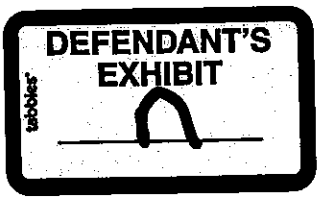
EXECUTIVE SUMMARY

The objective of this work session item is to provide City Council with an update on the Advanced Meter Fort Collins project. The project involves the upgrade of all of the electrical and water meters within the City utilities service territories. The project will improve current operations within Utilities, help meet the goals established in the Energy Policy, enhance our ability to serve customers, and ensure that Utilities is well positioned to support the current evolution of the traditional electric utility.

The opportunities available to customers surrounding involve their energy choices are growing. Looking towards the future, industry predictions suggest that the life-cycle cost of installing solar panels will be the same as, or less than, electrical prices from the utility within the decade. In addition, consumers have expressed a strong interest in the adoption of electric vehicles. In response, manufacturers are investing heavily in the development of electric vehicles; there are currently 34 all-electric vehicle manufacturers in the United States. A recent report from the Department of Energy addressing the progress toward the President's goal of "One Million Electric Vehicles By 2015" indicates that the manufacturing capability already exists and the next necessary step is educating and supporting the consumer.

The installation of advanced metering technology provides a foundation that will enable Fort Collins Light & Power to support, inform and empower our community by providing energy choices while maintaining the same level of quality service and high reliability provided to customers today. The key benefits defined include:

- use information and technology to maintain high system reliability
- make utility operations even more cost-effective
- provide more timely customer service
- prepare the utility and the community for emerging technologies.



GENERAL DIRECTION SOUGHT AND SPECIFIC QUESTIONS TO BE ANSWERED

Utilities is providing several options for customers.

- Option 1: Standard mode with full functionality
- Option 2: Limited mode collects data only once per day
- Option 3: Manual mode: meter read manually once per month (added monthly cost)

The table below summarizes the features.

Considerations	Option 1: Standard	Option 2: Limited	Option 3: Manual
Functionality and ability to take advantage of new technology; allows full customer benefits	High	Limited	Minimal
Data collected in 15-minute to one-hour intervals	✓		Optional
Data collected once per day		✓	
Data collected once per month via manual read			✓
Data transmitted 4 to 6 times per day via a 1.5 second signal	✓	✓	
Additional customer cost		✓	✓
Additional system cost			✓
Requires monthly service call			✓
Ability to support Energy Policy	High	Limited	Minimal

1. Is Council comfortable with the options?

2. The technology that has been selected for the AMI communication system is expandable. It will provide an opportunity to support current, future and new applications within Utilities, the City and the community. Should staff pursue opportunities within the City and community and bring back to Council?

BACKGROUND / DISCUSSION

In 2008, the City adopted the Climate Action Plan. One of the strategies identified in the Plan included the installation of Advanced Meters to provide customers with information on their energy usage. Starting in January 2009, Utilities staff worked in cooperation with R.W. Beck to develop a business case for the installation of an Advanced Metering Infrastructure (AMI) system for both the water and electrical systems. The business case analysis supported the decision to move forward with installation of the system. As Utilities moved the budget offer through the Budgeting For Outcomes (BFO) process, the availability of American Recovery and Reinvestment Act (ARRA) funding for grid modernization projects was announced. In addition to the AMI system, Utilities reviewed the Utilities Long Range Information Technology Plan for projects that would be applicable to the ARRA grants funded by the Department of Energy (DOE). The grant application requested funding for the electrical AMI system infrastructure improvements to support the system such as installation of additional fiber optics, cyber security improvements, grid modernization equipment and, in support of the Climate Action Plan goals, a greatly enhanced demand response program. The total program proposed for funding the Smart Grid Investment Grant program for the electrical system was approximately $32 million. In October 2009, Utilities was notified it had been awarded a matching grant of $15.7 million.

In April and May of 2010, Council approved both the appropriation and the sale of bonds in order to providing matching funds for the Smart Grid Investment Grant (SGIG) awarded to the City from the Department of Energy and for the installation of the AMI system. In July 2010, Council approved the appropriation of funds for water meters. The Advanced Meter Fort Collins program (AMFC) includes citywide deployment of advanced metering infrastructure (AMI), which will provide two-way communication between the Utility and the electrical and water meters and from the meters to customers. The information collected can then be shared with the customers by a web portal or other device, allowing them to make more informed decisions on how they use energy and water.

As noted, the AMFC program also includes:

- The installation of approximately 5 remotely operated high voltage switches. This gives Light & Power the opportunity to gain experience in developing the appropriate safety regulations, standards, process and procedures related to the automation of the distribution system.

- Installation of additional fiber optic cable in order to connect the new Portner and Timberline Substations.

- The development of Cyber Security guidelines consistent with the National Institute of Standards (NIST), standard 800-53. The NIST standards provide a roadmap for the development of policies and procedures that are best practices in the management of computer systems.

- The expansion of the existing demand response and energy efficiency programs.

The City's current Energy Policy and the Climate Action Plan establish goals that are directly served by the AMFC project – high reliability and reduction of carbon footprint, as detailed below.

Goal #1: Provide highly reliable electric service.

The bullets below are a truncated list of the Objective and Metrics defined in the Energy Policy for Goal #1 that are supported by the AMFC program.

- Demonstrate and communicate the high reliability of the Fort Collins electric system by maintaining annual reliability metrics of:
  - Average System Availability Index (ASAI) greater than 99.9886%;
  - Customer Average Interruption Index (CAIDI) less than 60 minutes; and
  - System Average Interruption Frequency Index (SAIFI) less than 1.0.

- Manage peak loads to reduce demands on the distribution system, optimize infrastructure investment and reduce purchased power costs.
  - Maintain energy efficiency and demand side management programs targeting peak loads.
  - Increase the power managed by load management, smart grid and distributed generation to at least 5% of 2005 system peak demand by 2015 and at least 10% by

2020. Develop a methodology for tracking load management as a percentage of peak demand, considering utility programs, customer response and weather normalization.

- Support customer efforts to reduce electric costs through managing peak loads.

Goal #2: Support the community's carbon emissions goal of reducing the City's carbon footprint 20% below 2005 levels by 2020 and 80% by 2050.

The bullets below are a truncated list of the Objective and Metrics defined in the policy for Goal #2 that are supported by the AMFC program.

- Continuously reduce energy use through verifiable energy efficiency programs, independent of population growth and economic trends.
  - Achieve annual energy efficiency and conservation program savings of at least 1.5% of annual energy use (based on a three year average history).

- For renewable energy resource investments, balance the interrelated factors of carbon reduction, cost-effectiveness, impact on power plant operations, and local economic benefits.
  - Maintain a minimum fraction of renewable energy in compliance with State of Colorado requirements. In coordination with Platte River Power Authority, develop generation resources and the delivery of renewable energy to meet minimum requirements.
  - Offer voluntary renewable energy programs whereby customers can support renewable energy and local renewable energy projects through opt-in premium pricing.
  - Increase the contribution of renewable energy to reach the 20% by 2020 carbon reduction goal, after accounting for the contributions of resource mix, energy efficiency, conservation, minimum renewable energy requirements and voluntary renewable energy programs.
  - Include renewable energy sources that can be scheduled to maintain system stability and reliability.

The AMFC program provides support for the cited goals in several ways as described below.

Background on the AMI System and Operation

The AMI system that will be installed is fundamentally similar to the network communication systems that are installed in homes and businesses across the community. The network provides and exchanges information through local area networks (LAN) which are analogous to the wireless networks in most of our homes. The LAN then connects to a service provider through a Wide Area Network (WAN), which is the high capacity, high-speed collector. The WAN is typically a high-speed broadband connection provided to homes through the cable, phone or other providers. In the case of the AMI system, the LAN is a Neighborhood Local Area Network (NLAN), providing communications with the meter. The WAN is a Distribution Wide Area Network (DWAN) that carries the information to the Utilities' "back-office" systems, such as the Meter Data Management System (MDMS), Customer Information System (CIS), Billing System, Outage Management System (OMS), etc.

How does this relate to achieving the City's energy policy goals and how it currently operates?

Today, the information we have relative to the operation of our electrical system is mathematically modeled. We have very detailed information about electrical demand at our electrical substations. Unfortunately, with today's technology, that is where it stops. Both the design and operation of our electric distribution system are based on a worse-case scenario.

The integration of the communications and metering system provides detailed information about the operation of the utility. Looking forward towards the evolution of the electrical system, the installation of large amounts of solar panels on homes and businesses, the purchases of more and more electric vehicles, and the information and communication desires of our customers, the information provided by the AMI meters becomes critical in the service to our customers and the operation of the electrical system.

As with the electrical system, the information provided to both the Utilities and customer relative to water usage will be valuable. The system will provide an opportunity to better model the water system operations by providing a clearer picture related to system losses through leaks. Today there is no clear data that supports how much water might be lost on the system. The measurement of water delivered takes approximately 30 days for all the meters to be read. This does not provide a way to balance production with delivery. AMI will provide an opportunity to compare the output of the plant to the water being consumed at a relative window in time. In other words, the amount of water leaving the plant at midnight can be compared to the amount of water being delivered at midnight. The additional data can then be used to model the system better and identify losses.

The customer benefit is more timely information on water use over the course of the billing period which allows them to make informed decisions on their use.

Meeting the Reliability Goal

The electric delivery system has been designed as a one-way delivery system. Historically, power is generated at a central plant, such as Platte River Power Authority's Rawhide Plant. That energy is then transmitted over high voltage power lines to local distribution utilities. Voltage can be thought of as pressure in a water line. In order to move the energy greater distances the pressure, or voltage, is increased. The distribution utility transforms the high voltage power to a medium voltage more suitable for delivery through a community. The distribution utility then reduces the voltage again for delivery into the home. Using the pressure analogy, the pressure is again reduced to a more suitable level for the home or business.

Note, the generation and transmission systems across the western U.S. are interconnected, which supports highly reliable delivery from the transmission system. In similar fashion to the transmission system, circuits in our electric distribution system are designed to be interconnected to reduce the impact of outages on our customers. This interconnected system is typically referred to as the grid. Today, when there is a problem on the distribution system the utility relies on customers to call in to report that they have no power. The integration of a communications system on top of the delivery system will provide immediate information that an outage has occurred and will give us information on where the problem may be. The new electric meters have a function called a "last-gasp". This "last-gasp" is sent as a high priority message to the utility indicating power is out. Rather than waiting on a phone call, the utility will immediately know there is a problem.

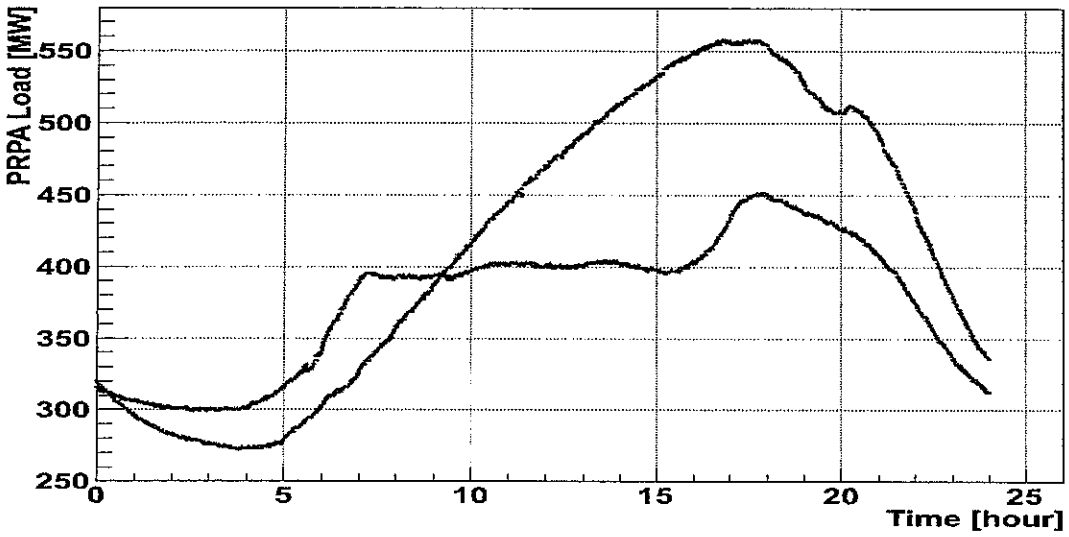
In addition to the automated notification system, Light & Power will be installing devices called fault indicators. Using the water analogy, a fault is like "a break in the line". A fault indicator is a device which provides a visual or remote indication that a fault has passed a particular point in the electric power system. Fault indicators help reduce the outage duration because they help to "narrow down" the possible locations of a fault. By using fault indicators, the line crews no longer have to "guess" where the fault may be. Today we have fault indicators throughout the system, but they do not communicate back to the utility. Line crews must drive to strategically selected points along the circuit and open vaults containing fault indicators to see if the fault has passed through that vault. The fault indicators proposed for this project will communicate via the enhanced communications network to report to the utility. The AMFC project will strategically place additional devices on the system allowing communications from the fault indicators to our System Control and Operations (SCO) center helping them dispatch crews to the suspected problem site more quickly.

The network communications system being installed as part of the AMI system provides a foundation technology that will help achieve the goals of the energy policy. The enhanced communication system will help us maintain the high level of reliability and lower the length of outage time.

Managing Peak Loads to Reduce System Peak

A significant component of the AMFC program is the adoption of technologies to help reduce system peak demands. Electric power demand is measured in watts and is more commonly discussed using the terms kilowatt (1000 watts = 1 kilowatt, or 1kW) or megawatt (1,000,000 watts = 1 megawatt, or 1 MW). A peak demand is the maximum level of power required over a given period. An analogy for electrical demand and its relationship to the electric distribution system is the maximum speed a driver achieves while driving across town. Although the car is traveling below the peak speed the majority of the time, it must be capable of reaching that maximum speed for driver safety and satisfaction. Similarly, an electrical system must be designed to meet the peak demand, although the majority of the time the system operates well below the peak demand. The Fort Collins electrical system typically operates at about 60% of the maximum peak on an annual basis. There are daily peaks, monthly peaks and annual peaks. Customers and the City are billed monthly for peak demand. The graph below is a typical peak day curve for both summer and winter for the Platte River system. The summer peak is the higher of the two. The peak value may change but the load shape over the course of the day is very typical for each season.

Peak Load Winter and Summer Graph



The Energy Policy goal of reducing the peak demand, translates to a reduction of approximately 15,000 kilowatts (kW). Fort Collins' maximum peak demand has been 292,000 kW. In relative terms, a house typically uses between 3 – 6 kilowatts, a small business such as a retail shop has a peak demand of 15 – 25 kW, a retail space such as a grocery store is between 500 and 750 kW.

Since 1982, the Light and Power utility has offered demand reduction programs which include customer incentives. Customers volunteer to have a device installed on their electric water heater unit and then, during peak periods, Light and Power will cycle the unit off and on for 15 minutes at a time throughout the peak period, thereby reducing the overall system peak. In return, the utility applies a customer credit of $4.00 per month to their account. In 2005, the program was expanded to include air-conditioning units. During the four-month period surrounding summer, the customer is paid an incentive of $4.00 per month for their participation in the program. It is currently estimated the program reduces peak by approximately 1,800 kW. The AMFC program will provide an upgrade of the existing demand response programs. This upgrade, along with the communication system and the advanced meters, will allow customers to utilize in-home displays, smart thermostats, and other emerging technologies, such as Home Energy Management Systems. Customers are not required to participate in these programs. The programs will be voluntary as they have always been.

One of the identified risks in the project is associated with the implementation of the demand reduction and efficiency related technologies. The standards by which these technologies integrate with AMI systems are still under development and are more in the domain of the consumer electronics arena. Historically, utilities have invested in equipment with an expectation that it will last for decades. In the consumer electronics arena, the equipment becomes obsolete every three to five years. Additional risks exist due to lack of a clear perspective on what the types of programs and equipment the consumer wants.

As part of AMFC program, the Utility is working with the Department of Energy (DOE) on a Customer Behavior Study (CBS), which includes up-front work to determine what technologies and

information customers desire and will be most responsive to. This study may include focus groups, surveys, interviews, and pilot programs of the technologies that are currently evolving in the demand response and energy management area. Programs will then be developed to support the customer's needs and to help the Utilities achieve the maximum level of demand reduction, energy efficiency, and conservation.

As part of AMFC program, the communications system will provide valuable information allowing us to integrate higher levels of distributed generation onto the distribution system, allowing the system to be designed and operated more efficiently. The system knowledge gained will help us maintain the high reliability our customers expect.

Goal #2: Support the community's carbon emissions goal of reducing the City's carbon footprint 20% below 2005 levels by 2020 and 80% by 2050.

AMFC program will achieve some direct carbon reduction. It is estimated that the AMI system will eliminate approximately 198,000 vehicle miles per year with a net carbon reduction of, 147,559 lbs of CO2, 241.6 lbs of Nitrogen Oxide (NOx), 11.5 lbs of Particulate Matter (PM-10), and 2.6 lbs of Sulfur Oxide (Sox) per year because of reduced meter reads, special reads and service calls.

The Energy Policy set a goal of achieving a 1.5% reduction in annual energy use (based on a three-year average history). The AMFC program will allow customers who are interested to view their usage data on-line or via an in-home display. It is anticipated that this feature will be available to customers late in phase 2, approximately the 3rd quarter of 2012.

Today, residential customers receive their energy usage for the previous month about nine days after the end of their billing cycle. It is difficult for customers to be actively engaged and informed about their energy and water usage, their cost, and what choices they may make differently, when the information they receive is 9 days or further in the past. The information that the AMFC system will provide via the internet will be about one day old. Once, the meter information is transmitted through the mesh network, it goes through a Validation, Estimation and Editing (VEE) process, and is then posted to a web portal. Those customers who choose to use an in-home display, smart thermostat, or a home energy management system will have data that is much closer to instantaneous. The information will be updated as often as the meter records data, which currently is planned for fifteen minutes or one-hour.

The provision of more timely data, along with customer education and outreach on how this information can be used by customers to help them save, is part of the program. One example, of how a customer might benefit from the information might be that they receive a notification, via an email, text, page, or however they wish, when they have used 4000 gallons of water in a given billing cycle, and that they will soon enter the higher cost second-tier water rate at 5000 gallons. This is an example of a system that can provide the customer with information that allows them to make an informed decision about their water use. The same is true for electrical usage, whether it is a tiered demand rate, inclining block rate or Time-of-Use (TOU) rate. Customers can be informed as they reach higher-priced periods. The desired outcome is that the information provided through the AMI systems can be leveraged by customers to control their usage and costs and, in turn, help the Utilities reach their conservation and efficiency goals.

Goal #2 - Objectives and metrics speak to the need to meet the State Renewable Energy Standards, provide voluntary programs to help customers meet their renewable energy goals, increase the contribution of renewable energy to help meet our carbon reduction goals and include renewable energy sources that can be scheduled to maintain system stability and reliability.

Utilities are working towards meeting all the goals summarized above. As we anticipate the many changes that the future will bring, we know the installation of solar panels (PV) will continue to come down in cost; within the decade, the cost of PV energy is expected to be the same or lower than utility prices; new technology and applications for existing distributed generation are becoming more attractive and affordable. Information about how the electrical system is operating becomes critical. As noted above, the current electrical grid is designed as a one-way delivery system. In order to manage multiple sources of energy on the complex mesh of electrical circuits, and to ensure the safe, reliable and efficient operation of the system, the information provided by the AMI system becomes critical.

Council recently received a letter recommending that we establish new standards for the electrical system's construction, in anticipation and support of future distributed generation. The challenge is that the distribution system is designed and operated using mathematical models that view the design requirements from a 50,000-foot perspective. This methodology has worked well in the development of a robust and reliable system that serves customers today. However, when we start to consider changing construction practices, we cannot clearly define how the system should be designed and operated without detailed information in the portions of the distribution system where the greatest changes will be occurring. The implementation of the AMFC technology will provide us with the system operational information that will help us understand the time-of-day cyclic nature of the different elements of the system. AMFC helps us prepare for the future that our customers are already building.

Project Update - Technology Selected

The Advanced Metering Infrastructure (AMI) and the Meter Data Management System (MDMS) vendor have both been selected. Contract negotiations with both vendors are currently underway.

The AMI system has several specific components. Specifically, the system includes the meters, the communication systems, the Information Technology (IT) components and the collection software, which is referred to as the Head End System (HES). The AMI system vendor that we have selected is Elster Inc. Elster is a well-established and experienced vendor in both the metering and AMI space. Elster has been providing metering to utilities for over 170 years. They currently have approximately 5 million AMI meters deployed and operating in the field and have completed over 90 installation projects.

The AMI meters are a solid-state meter with a two way radio communication card, a remote connect / disconnect device, and a Home Area Network (HAN) communication card within the meter. The Home Area Network device is what communicates with in-home displays, smart thermostats or other consumer devices. All communications with the in-home device will be initiated by the customer and will be the customer's choice. Figure 1, (Attachment 3), shows both residential and commercial Elster meters.

In order to bring information back to the utility, the meters communicate with a device called a Gatekeeper. The Gatekeeper serves as the conductor for the Neighborhood Local Area Network (NLAN) by controlling the network interconnection efficiency and collecting the metering data from the individual meters. A Gatekeeper can communicate with over 2000 meters. Typically, the Gatekeepers will be mounted on existing street light poles. A typical Gatekeeper is shown in attached Figure 2 (Attachment 3).

The Gatekeeper communicates with the Distribution Wide Area Network (DWAN) router. The DWAN router will then pass the information to centralized routers that will send the information back to the utility via our existing fiber optic network. The DWAN routers will be mounted on the arms of existing streetlight and intersection light poles. Pictures of a DWAN router on a street light and being mounted are shown in Figure 3 (see Attachment 3).

Attached Figure 4 (see Attachment 3) provides a graphic illustration of the communication system.

The Utility has selected Siemens to supply of the Meter Data Management System (MDMS). Siemens has collaborated with E-meter to supply and configure the system. With the installation of the AMI system, the volume of data that the utility will be receiving will increase significantly. Currently, we receive one data point, once a month from each of our residential customer accounts and our small commercial General Service Accounts. In contrast, we currently receive 15-minute data from approximately 500 of our largest customers. With the installation of AMI meters, we expect to have the capability to get this level of resolution from all customers in the future. The MDMS is designed to help manage the information the AMI meters will provide. The system will:

- Effectively manage the AMI provisioning/commissioning process
- Reduce revenue loss through use of real-time validation algorithms and reporting that:
  - Detect unauthorized consumption
  - Detect leaks/tamper events
  - Identify failed meters and registers
  - Detect dead or dying meters
- Track key infrastructure assets: meters, communication modules, pumps, valves, including compound meters
- Systematically monitor events and issue work orders i.e. on pressure when maximum limits are exceeded/potential revenue protection issue, etc.
- Support a systematic repair and replace program that extends infrastructure life and optimizes leak control programs through precise tracking
- VEE (Validation – Error checking – and Editing) real-time the 15 minute, hourly and/or daily usage allowing for variable pricing options (TOU, CPP, CPR)
- Manage events generated by the AMI system

A general outline of the current project schedule is provided below.

Project timeline

Completed

- Nov. 22, 2010 – Jan 11, 2011: Prepare and Release Request for Proposal (RFP) for AMI and MDMS
- January 2011 Through March 23, 2011: Evaluate Vendor RFP Responses, Conduct Vendor Interviews, Recommend Vendor Selection

To Be Completed

- March through June 2011: Contract negotiations with AMI & MDMS vendors
- July 2011 through September 2011: Develop deployment contractor (RFP), release RFP select vendor
- July 2011 through September 2011: Define requirements with AMI and MDMS vendors
- September 2011 through December 2011: IT infrastructure installation, MDMS system installation and testing
- September 2011 through November 2011: Contract negotiations with installation vendor
- November 2011 through January 31, 2012: Deployment Planning and staging
- February 1, 2012 through April 2012: **Phase 1** - Installation of 4000 Electric meters, 2000 Water meters (end-to-end, or meter-to-bill test)
- April through May 2012: System Functional test (prior to release to move to Phase 2)
- May 24 through November 8, 2012: **Phase 2** - Installation; ('Interval' Billing Tests, Mass Deployment)
- November. 9, 2012 through June 7, 2013: **Phase 3** - Installation; ('Advanced' Rates , Continued Mass Deployment)

There are currently three primary concerns that have been voiced nationally related to AMI or smart meters. There are over 18 million AMI meters installed in the US and approaching 100 million worldwide. The upgrade of existing utility meters has raised concerns for some customers about the costs, health effects and privacy and security of the information broadcast by the meters.

Health effects

- National concerns related to health effects have included:
  - The meters cause cancer
  - People suffering from electromagnetic sensitivity are being adversely affected by the meters.

The meters selected operate in a frequency range between 902 megahertz (MHZ) and 928 MHZ. Other devices that operate in this spectrum are cell phones, cordless phones, wireless routers, TV and radio broadcasts, and other common devices. Figure 5 (Attachment 3) is a graphical representation of the electromagnetic spectrum.

Health effects from Radio Frequency electromagnetic fields are a topic that has been raised across the country. A recent report released by the World Health Organization (WHO) International Agency for Research on Cancer (IARC) recently classified Cell phones as a Group 2B carcinogen. Group 2B elements are classified as possibly carcinogenic to humans. As noted above, the Elster AMI meters operate in the same frequency range as cell phones and other devices.

Other studies specifically related to AMI technology such as a meta-study performed by the California Council on Science and Technology found the following:

KEY REPORT FINDINGS
1. Wireless smart meters, when installed and properly maintained, result in much smaller levels of radio frequency (RF) exposure than many existing common household electronic devices, particularly cell phones and microwave ovens.
2. The current FCC standard provides an adequate factor of safety against *known thermally* induced health impacts of existing common household electronic devices and smart meters.
3. To date, scientific studies have not identified or confirmed negative health effects from *potential non-thermal* impacts of RF emissions such as those produced by existing common household electronic devices and smart meters.
4. Not enough is currently known about potential non-thermal impacts of radio frequency emissions to identify or recommend additional standards for such impacts

OTHER CONSIDERATIONS
Smart electricity meters are a key enabling technology for a "smart grid" that is expected to become increasingly clean, efficient, reliable, and safe at a potentially lower cost to the consumer. The CCST Smart Meter Project Team offers the following for further consideration by policy makers, regulators and the utilities. We appreciate that each of these considerations would likely require a cost/benefit analysis. However, we feel they should be considered as the overall cumulative exposure to RF emissions in our environment continues to expand.
1. As wireless technologies of all types increase in usage, it will be important to: (a) continue to quantitatively assess the levels of RF emissions from common household devices and smart meters to which the public may be exposed; and (b) continue to investigate potential thermal and non-thermal impacts of such RF emissions on human health.
2. Consumers should be provided with clearly understood information about the radiofrequency emissions of all devices that emit RF including smart meters. Such information should include intensity of output, duration and frequency of output, and, in the cases of the smart meter, pattern of sending and receiving transmissions to and from all sources.
3. The California Public Utilities Commission should consider doing an independent review of the deployment of smart meters to determine if they are installed and operating consistent with the information provided to the consumer.
4. Consideration could be given to alternative smart meter configurations (such as wired) in those cases where wireless meters continue to be concern to consumers.

The table below is from the Electric Power Research Institute (EPRI). EPRI is an independent, non-profit company that performs research, development and demonstrations in the electricity sector for the benefit of the public. The table represents the relative strengths associated with different devices that operate within the microwave frequency range. The EPRI information is also attached in graphical form as Figure 6 (Attachment 3). As shown the meters exposure levels are significantly less than those of a cell phone or other common devices.

Table 1 – Radio-Frequency Levels from Various Sources

Source	Frequency	Exposure Level (mW/cm²)	Distance	Time	Spatial Characteristic
Cell phone[1]	900 MHz, 1800 MHz	1–5	At ear	During call	Highly localized
Cell phone base station[2]	900 MHz, 1800 MHz	0.000005–0.002	10s to a few thousand feet	Constant	Relatively uniform
Microwave oven[3]	2450 MHz	~5 0.05-0.2	2 inches 2 feet	During use	Localized, non-uniform
Local area networks[4]	2.4–5 GHz	0.0002–0.001[a] 0.000005–0.0002 [b]	3 feet	Constant when nearby	Localized, non-uniform
Radio/TV broadcast[5]	Wide spectrum	0.001 (highest 1% of population) 0.000005 (50% of population)	Far from source (in most cases)	Constant	Relatively uniform
Smart meter[6]	900 MHz, 2400 MHz	0.0001 (250 mW, 1% duty cycle) 0.002 (1 W, 5% duty cycle)	3 feet	When in proximity during transmission	Localized, non-uniform
		0.000009 (250 mW, 1% duty cycle) 0.0002 (1 W, 5% duty cycle)	10 feet		

[a] wireless router

[b] client card

FCC rule: From 300 MHz to 1,500 MHz, $MPE = 0.2 \times f/300$ mW/cm² (f is frequency in MHz); for 1,500 MHz and greater, $MPE = 1$ mW/cm². For example, at 900 MHz $MPE = 0.2 \times (900/300)$ mW/cm² = 0.6 mW/cm². Note: Compliance for cell phones is provided by manufacturers, and expressed in terms of SAR, which cannot exceed 1.6 W/kg for any single gram of tissue.

(1) Based on a 3-inch, 250 mW antenna emitting in a cylindrical wavefront.

(2) Elliott P, Toledano MB, Bennett J, Beale L, de Hoogh K, Best N, Briggs DJ. 2010. Mobile phone base stations and early childhood cancers: case-control study. BMJ 340:c3077.

ICNIRP. 2009. "Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)." International Commission on Non-Ionizing Radiation Protection, Oberschleißheim, Germany, page 14.

Ramsdale PA, Wiener A. 1999. Cellular Phone Base Stations: Technology and Exposures. Radiat Prot Dos 83:125-130.

(3) ICNIRP. 2009. "Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz)." International Commission on Non-Ionizing Radiation Protection, Oberschleißheim, Germany, page 21.

Tell RA. 1978. Field-strength measurements of microwave-oven leakage at 915 MHz. IEEE Trans Electromagnetic Compatibility 20:341-346.

R.A. Tell, personal communication.

(4) Wireless router based on 50–100 mW isotropic emitter.

Client card based on: Foster KR. 2007. Radiofrequency exposure from wireless LANs utilizing Wi-Fi technology. Health Phys 92:280-9.

(5) Tell RA, Mantiply ED. 1980. Population Exposure to VHF and UHF Broadcast Radiation in the United States. Proc IEEE 68:6-12.

(6) Based on spatial peak power density with 6 dB (x4) antenna gain. For instantaneous power density during transmission, multiply the value for 1% duty cycle by 100, and the value for 5% duty cycle by 20.

In order to support our community, Utilities is working with Dr. Bruce Cooper, Executive Director of the Health District of Northern Colorado, to provide an independent and informed risk analysis to the community. Dr. Cooper will be in attendance at the upcoming work session. Additionally, Dr. Cooper has provided the following statement:

> "I was asked by Patty Bigner, Customer and Employee Relations Manager of the City of Fort Collins, to help the City interpret information on the potential adverse health effects of the radio-frequency electromagnetic fields emitted by "smart meters" after some concerns were expressed by several residents.
>
> I have focused my review on recent assessments of radiofrequency radiation and health effects conducted by major public health authorities and other government

agencies—the World Health Organization, the U.S. Food and Drug Administration (FDA), Federal Communications Commission (FCC) and National Toxicology Program, the University of Ottawa McLaughlin Center for Population Health Risk Assessment in Canada, the Health Protection Agency of the United Kingdom, and the comprehensive 2009 review by the International Commission on Non-Ionizing Radiation. I have also examined technical documents on smart meters published by the Electrical Power Research Institute, and very recent reviews on smart meter health effects produced by the California Council on Science and Technology, April 2011, and State of Maine Center for Disease Control, November, 2010.

Brief Summary of my Findings:

Smart meters are a new technology but they use the same radio frequency (RF) fields as cell phones, cordless phones, WiFi equipment, and other communication devices used around the home. Emissions of RF from these sources are regulated by the Federal Communications Commission (FCC), with advisory support from the Food and Drug Administration (FDA) and Environmental Protection Agency. The RF exposure limits adopted by the FCC were established by the Institute of Electrical and Electronics Engineers (IEEE) with a wide margin of safety, and according to the FDA, are based on detailed and continuously updated assessments of the available scientific evidence. Published research indicates that exposure to RFs from smart meters is very low—1000 times or more below the exposure guidelines established by the FCC.

There is a large body of evidence that has accumulated over the past 20 years examining the potential adverse health effects of exposure to low level RF emissions below the established exposure guidelines, much of it focused on RF from mobile phones. Mobile phone RF exposures are qualitatively similar to smart meters and wireless local area networks, but because typical use of cell phones results in exposures much closer to the body, the resulting exposures are of much higher intensity. Many public health authorities, agencies and expert panels in the US and other countries are periodically reviewing this research and from the documents I have reviewed, they have all concluded that the weight of evidence indicates that there are no adverse health effects from RF emissions below current guidelines. However, all have noted that the published research has limitations, particularly in addressing long-term exposures to low-level RF.

Just a few weeks ago, the World Health Organization's International Agency for Research on Cancer (IARC) announced that they were classifying the electromagnetic fields produced by mobile phones as "possibly carcinogenic". Although this could be seen as a departure from previous assessments, it is important to interpret it in perspective. The classification is consistent with previous reviews that have found no clear scientific evidence of cancer risk, but it acknowledges that the possibility exists based on "limited evidence" of a small increase in risk of a rare form of brain cancer among heavy users of cell phones. According to IARC, the classification indicates that "there could be some risk" and therefore "it is important that additional research be conducted into the long-term, heavy use of mobile phones." (IARC press release, May 31, 2011).

The Federal Drug Administration is the U.S. agency charged with monitoring the research on health effects of EMF. The FDA web site (accessed 7/1/2011) calls attention to the fact that other agents that are currently classified as "possibly carcinogenic to humans" by IARC include coffee, talcum powder and electromagnetic fields around power lines and states, "According to current data, the FDA believes that the weight of scientific evidence does not show an association between radiofrequency from cell phones and adverse health outcomes". Likewise, the World Health Organization's updated fact sheet on mobile phones acknowledges the recent IARC determination, but states, "To date, no adverse health effects have been established as being caused by mobile phone use". While no adverse health effects have been established from exposure to low-level RF, these authorities have echoed those of previous reviews and called for more research to reduce the uncertainty about the impacts of long-term exposure to RF on health, and this research is on-going.

Conclusion

Based on the City of Fort Collins Utilities smart grid implementation plan it appears that residential smart meters and the connecting network to the utility in Fort Collins will contribute a relatively small amount to the total RF emissions from broadcast sources, cell phone base stations, WiFi routers and other devices now in common usage in households and much less than typical use of cell phones. Because of the very low exposure to RFs associated with the planned use of smart meters in Fort Collins, it is not likely to lead to health effects in residents of homes with these devises. There appears to be no health reason to avoid the use of smart meters. Nevertheless, given the uncertainty that still exists regarding the potential long-term health effects of cumulative exposure to RF fields, residents who remain concerned about potential risks may appreciate alternatives to installing smart meters with wireless transmitters.

Limitations

My assessment of the potential health effects of smart meters has several limitations: First, I am not an expert in non-ionizing radiation health effects. I am trained and board certified in public health/general preventive medicine and family medicine. Preventive medicine specialists have core competencies in biostatistics, epidemiology, environmental medicine, and research into causes of disease and injury in population groups. Second, I have not examined the extensive body of literature on this topic, but instead relied on recent summaries of reviews produced by expert panels, agencies and public health authorities we normally rely on to sort out complicated science."

Privacy and Security

- National concerns related to privacy have included:
  - Placing customer information at risk
  - "The Utility will know what I'm doing when"
  - The meters can be hacked

The City of Fort Collins Utilities takes customer privacy very seriously and has for many years. We recognize that emerging technologies open new avenues of risk. We are undertaking an extensive program to make sure that customer data is secure, confidential, and accurate in accordance with our existing policy that details how customer's information is managed. Other than through a formal request from law enforcement customer information is not shared with anyone, unless formally released by the customer.

The Utilities complies with all local, state and federal regulations to protect personal data and information. All customer information – including personal information, bill payment type or status, utility use - are strictly protected. Specifically:

- Fort Collins Utilities is subject to the Colorado Open Records Act & Fort Collins Municipal Code 26-26, which govern the accessibility of public records

- Fort Collins Utilities is subject to the FACT Act (Fair and Accurate Credit Transactions Act of 2003), which requires federal agencies, including the Federal Trade Commission (FTC), to establish guidelines for use by creditors to prevent identity theft. In 2007, the FTC published the "Red Flags Rules" requiring that creditors create and implement a program to address the detection, prevention and mitigation of identity theft. As a creditor, Fort Collins Utilities implemented an identity theft prevention program under the Red Flag Rules, effective December 31, 2011.

The City has already met generally accepted best practices for cyber security. Through this project, the City is taking additional measures to secure its network and data by fully implementing the Cyber Security Plan submitted to, and approved by, the federal government. The City is also enforcing the same stringent standards on all project/utility vendors. Additionally, the City will be audited by the federal government to ensure all necessary precautions have been implemented.

Utilities have conducted a risk assessment related to the AMFC communications system. The system was deemed as a low risk, low value cyber system. The data that will be communicated by the meters will be encrypted by the meter and then again, with a different encryption key at the gatekeeper and then again, as it moves thought the wide area network back to Utilities. The information that will be broadcasted will not have any customer information in it. The data will have to do with the operational health of the meter, energy and demand information, and a premise identifier. Even if intercepted, and decrypted there is little value to the data.

Although Utilities is implementing best practices in relation to protecting privacy, we will also offer those concerned with privacy the option of having their meter information measured and recorded only once per day.

As shown in Figure 7 (Attachment 3), the data received via the advanced meters does not provide information at a level of detail that would provide insight into specific activities. In addition, the data received is representing activity that occurred in the past. It does confirm what utilities across the country have known for years; that is, at certain times of the day households use more utility services than other times.

The benefit of the higher resolution data is that it offers customers precisely the kind of information that will allow them to make choices that impact their energy consumption.

Lastly, Utilities is offering options to customers that would receive daily usage data transmitted from the meter or to have a meter manually read once per month; this would address the needs of those customers who still have continued privacy concerns. Note there is a cost associated with manually reading a meter once per month. Utilities estimate that it will cost approximately an additional $10 per month to read the meter. There may also be a one time up-front cost of $60 if the meter is replaced after initial deployment.

Business Case and Project Cost

- National concerns related to cost have included:
    - The meters are just another added expense to customers
    - The meters are inaccurate and bills will increase.

The Utilities started researching the business case for an advanced metering project approximately three years ago to explore its viability from an economic, environmental and social standpoint. At that time, R.W. Beck a nationally recognized utility consulting firm worked closely with Utility staff to understand the benefits, risks and return on investment. Using best practices in business case analysis, that results showed a payback period of approximately 10-11 years.

Although several project aspects have changed since this early analysis, it showed a positive return and a viable project on its own merits. Then, the federal government announced American Recovery and Reinvestment Act (ARRA) funding to upgrade the electric grid throughout the nation. Due to the early work that Fort Collins Utilities had done, we successfully competed for a matching grant.

Black & Veatch / Enspiria, another nationally recognized firm, recently vetted the original business case at a high level and validated the conclusions. Although the scope of the project has increased and the grant money is part of the equation and other factors have changed in the years since the initial business case was developed, the payback period was modified only slightly to an 11-12 year payback.

As noted above, the cost of the electric portion of the AMFC project is $31.4 million. A three-year, $15.7 million matching grant through the 2009 American Recovery and Reinvestment Act (ARRA) is helping to finance the project. The balance of the electric project expense is being covered by project savings. Bonds were issued to spread the costs over a longer time period.

The water meter project is budgeted for $4 million. Grant funds are not available for the water portion of the project, but including them in the project is critical to the return on investment identified in the business case analysis.

The financial savings realized through advanced meter systems are derived primarily from four sources, as follows:

- Meter reading labor and expenses

- Detection of service diversion

- Engineering and system benefits
- Meter accuracy and registration

It is worth commenting on the savings derived from the labor and operational expense of manual meter reading. Initially, investing in advanced meters will save the labor and operational expenses of reading meters. Fort Collins Utilities is working with meter readers to provide training and skill development for other jobs; several have already found new positions.

In addition, there is information from national sources that speak to the business merits of advanced metering. For example, the Department of Energy finds that although the electricity system is 99.97 percent reliable, it still allows for power outages and interruptions that cost Americans at least $150 billion each year – about $500 for every man, woman and child in the country. This fact underscores the broader need to maintain the high level of reliability our system enjoys.

System efficiency is very important to maximize the most efficient use of resources. The Department of Energy estimates that 25% of distribution infrastructure and 10% of all generation assets are required less than 400 hours per year or roughly 5% of the time. Platte River's peaking units typically run less than this average. While advanced metering projects cannot eliminate the need for all new infrastructure, such systems will help defer or avoid some of it.

After the development of a thorough business case, we are confident that this clearly shows a positive economic return and represents a solid investment for the community's future. As such, it is a sound financial decision that will continue to support the needs of Fort Collins Utilities customers for many years beyond the payback horizon.

ATTACHMENTS

1. "One Million Electric Vehicles By 2015" Report
2. Health Impacts of Radio Frequency from Smart Meters by the California Council on Science and Technology
3. Figures 1 thru 7. Pictures and color graphics
4. Powerpoint presentation