

SEPTEMBER 30, 2014

# Advanced Meters White Paper

Prepared for Seattle City Council

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In City Council Resolution Number: 31529, adopted on June 30, 2014, section 6 requests Seattle City Light to *“report on the cost, health, environmental concerns, and customer data security implications of AMI (smart meters) to the Energy Committee by September 30, 2014. The report should document the costs of AMI implementation, the background information and utility studies that have led City Light to conclude there will be no significant adverse effects from AMI deployment, and plans for customer education. The City Council will establish a public forum prior to September 30, 2014, for the purpose of allowing the public to share community or health concerns regarding the development of AMI. Council intends to consider this information and that brought forward by the public during deliberations for the 2015-2016 Budget.”*

This White Paper responds to the cost, health, environmental, data security and other requests outlined in the resolution.

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## Executive Summary

As part of the Seattle City Light Strategic Plan, the utility will replace approximately 430,000 electric meters with advanced metering infrastructure. The advanced meters will provide two-way communication between the meter and the utility, which will allow customers to view their energy consumption in near real-time, streamline many of the processes that are currently done by hand, and eliminate the need for meter readers to visit homes and businesses. It will also allow the utility to better manage power generation and distribution and to pinpoint areas affected by power outages, helping speed restoration to affected customers.

In 2012, a US Energy Information Administration (EIA) survey showed that 533 US electric utilities have installed 43,165,185 advanced meters. Approximately 89 percent are residential customer installations.

Advanced meters include meters that measure and record electricity usage at a minimum of hourly intervals and provide the data to both the utility and the utility customer at least once daily. They range from basic hourly interval meters to real-time meters with built-in two-way communication capable of recording and transmitting instantaneous data.

Number of AMI Installations by Sector Type				
Residential	Commercial	Industrial	Transportation	Total
38,524,639	4,461,350	179,159	35	43,165,183

*Source: EIA. Data on natural gas or water meters is not available*

## Benefits

Advanced meters will bring new functionality to operations and customers by empowering customers with more frequent and more accurate information about their energy use, enabling them to conserve natural resources, reduce carbon emissions and contribute to long-term cost savings that help keep rates low.

### **Faster Outage Detection and Restoration**

Currently, when the power goes out, City Light depends on telephone calls from customers who have lost power to understand where the outage is. Once the affected addresses are known, City Light staff can start troubleshooting by dispatching crews to patrol the lines and identify a cause. With advanced metering, the affected meters will immediately/automatically send a message to the City Light System Control Center indicating a power disruption. City Light personnel is then able to pinpoint the location of the problem and restore power in a more timely and efficient manner.

### **Greater Consumer Control Over Electricity Use**

Today, customers receive a bill from City Light that shows their consumption for the previous 60 days. Usage is shown in kilowatt hours (kWh), but bills do not indicate how and when the electricity is used. Advanced meters will allow customers to see their energy use in near real-time. Not only will this enable customers to better manage their energy use, it may also help customers to identify problems with their electrical system. For example, they may be able to identify a malfunctioning electric water heater in real time. Currently, customers don't get tipped off to energy wasters in the home until they investigate an unusually high bill, which may come 60 days after the problem started.

### **More Accurate Billing**

Because the approximately 430,000 electrical meters in the City Light service territory are currently being manually read, there is a greater chance for error and estimations. Errors create inconveniences for customers and greater operating costs for making manual bill corrections. Advanced metering eliminates several manual processes and helps ensure that meters get read and billed correctly every time.

### **Reduced Pollution from City Light Vehicles**

In 2013, Seattle City Light meter readers put in approximately 201,312 miles—mostly in their own vehicles—to read the meters. That represents 72.3 tons of CO<sub>2</sub> and more than \$113,741.28 in mileage reimbursements. Mileage for line service trucks will also be saved by the advanced metering outage notification function providing more accurate outage predictions and information on potential trouble spots before problems occur.

## Cost

### Overall Advanced Metering Investment Performance

Key financial results for Seattle City Light investment in advanced metering infrastructure for assumed system lives of 10, 15, and 20 years are presented below.

Investment Life:	10 Years	15 Years	20 Years
Net Present Value (NPV in \$millions)	\$1.6	\$37.4	\$71.8
Internal Rate of Return (IRR)	4.7%	12.3%	14.8%
Cumulative NPV Breakeven Year	2024		
Notes:			
- Deployment begins 2015			
- Deployment interval = 3 years			
- Includes benefits in traditional utility operations only			
- Benefits of new customer programs and distribution management are additional			

### Advanced Metering Cash Flow for City Light

Early capital allocations create a deep negative cash flow at the outset. The large annual benefit recovers that investment to break even in a moderate period (for a utility investment) and continues to produce enduring and substantial benefits for City Light and its customers indefinitely afterward.

### Estimated Advanced Metering Costs

In this business case, the estimated advanced metering costs for City Light are based on recent supplier quotes of other utilities that deployed advanced metering projects. Although those utilities are similar in many ways to City Light, the differences will affect the deployed cost of advanced meters. To that end, the cost parameters were adjusted to correctly reflect the unique aspects of City Light.

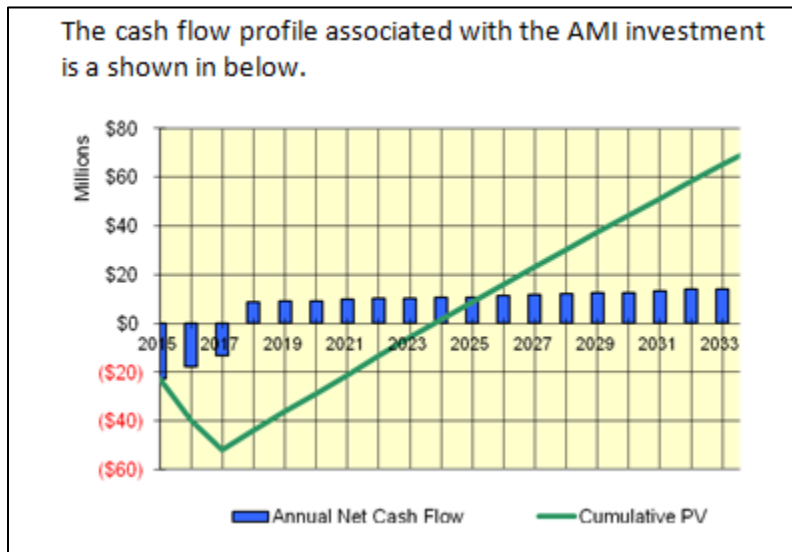
While no one can be certain whether advanced metering costs will rise or fall in the near future, they have fallen steadily for more than 20 years, while capability has expanded. The costs included in this advanced metering business case update are a credible projection of likely costs for City Light as of 2012.

Shown in Figure 1 are the non-recurring acquisition and deployment costs and annual recurring operating and maintenance (O&M) costs used in the business case calculations.

**2012 - Estimated AMI Costs for City Light (\$ thousands)**

Line Item	Acquisition + Deployment Cost	Annual Operation + Maintenance
AMI Meters	\$60,715	\$184
Communication Infrastructure	5,108	549
Master Station & IT Integration	2,739	153
Program Management	1,657	
Operations		1,034
Totals (\$ thousands)	\$70,220	\$1,921
Overall acquisition + deployment cost per meter served = \$171		

**Figure 1 – Non-recurring acquisition, deployment costs, annual O&M costs**



**Figure 2 – Cash flow profile with AMI investment**

The business case assumes that City Light will acquire and deploy advanced meters by contracting with a single entity for a turn-key advanced metering deployment; will accept ownership of the meters as they are deployed; and will own and operate the entire advanced metering system when it is complete. This requires a large capital commitment by City Light at the start of and continuing through the deployment. The contractor will manage IT integration of the new systems with City Light legacy systems. This will be followed by many years of sustained benefit harvesting as City Light manages all advanced metering operations (Figure 2).

In addition to the above costs, Seattle City Light opted to include the Smart Grid Gateway and Meter Data Management System Modules software from Oracle.

## Health

City Light stays current on scientific reports pertaining to possible health effects from radio frequency (RF) emissions and has thoroughly evaluated advanced meters from a health and safety standpoint. Included below are excerpts from scientific studies and measurement reports. This section also describes organizations that have established exposure standards and guidelines, with comment on the composition of these groups and procedural aspects.

### **Scientific Studies Related to Advanced Meter Radio Frequency Electromagnetic Fields (RF-EMF) \***

#### **Overview**

It is well established that health hazards occur from RF exposure when the energy absorbed by a body (or a body area) is sufficient to increase the temperature of the tissue by several degrees Celsius. Changes that result from such heating are collectively called “*thermal effects*.” Among the thermally-induced health effects that have been studied are tissue inflammation, burns, cataracts of the lens of the eye, effects on germ cells of the testis and ovary, and interference with normal physiological functions and behavior.

These thermal effects only occur when, the RF source is of great enough power to increase tissue or brain temperature above normal levels of body temperature. Thermal hazards from RF energy are not present when an external RF source that is not in contact with the body or immediately adjacent to the body cannot produce at least several watts of power. Advanced meters do not produce this level of power.

At the frequencies used for advanced metering, thermal effects – either through direct action or behavioral change – form the basis for current exposure limits in use nationally and internationally. These exposure limits reflect the consensus of most scientists and scientific bodies that temperature increases of more than 1 degree Celsius (1°C) in living tissues are needed to cause potentially adverse health effects. Consequently, exposure limits were set at levels low enough to assure there cannot be a hazardous temperature increase. Advanced meter RF fields are too low to increase temperature by any significant amount and pose no thermal hazard.

The science on RF and health also includes an extensive body of literature concerning biological changes that might occur in the presence of RF energy too weak to increase temperature by 1°C or a significant fraction of 1°C. Biological changes or effects that occur without a significant temperature increase are generally referred to as “*non-thermal effects*.” The reliability of evidence for particular non-thermal effects, and for non-thermal effects in general, continues to be contentious. Importantly, ignoring the controversy about the

existence of non-thermal effects, none has been shown to be the cause of an adverse health effect.

Although the mechanisms for hazardous thermal effects are well-established, there is no established mechanism by which non-thermal effects can change living tissues in a way that results in an adverse health effect. The current science on RF-EMF exposures shows that there are no known adverse health effects for exposures to RF energy at the levels produced by advanced meters.

### **RF-EMF Emissions From Advanced Meters Relative to Exposure Guidelines and Standards**

Advanced meter technology uses RF transmission to communicate data. The metering systems operate at frequencies and power levels that resemble those of cellular phones, wireless networks and local wireless Internet connections (Wi-Fi). Transmission power, the amount of time an advanced meter is transmitting, and the distance and orientation of the meter to a body, combine to determine the energy from the meter's RF field that could be absorbed into a person's body.

In recent years a number of studies have been conducted to document operational levels of advanced meters in relation to standards and guidelines for safe exposure. In the early years of advanced meter deployment there was a limited amount of information on operational performance. A key finding of recent studies is that wireless advanced meters are capable of full operation at a fraction of current exposure limits. This has been found to be true even very close to banks of multiple meters (Tell and Tell, 2013). Following are excerpts from recent studies containing information on this topic.

#### **California Institute of Science and Technology (CCST), "Health Impacts from Smart Meters" (2011)**

"CCST is a non-profit organization established in 1988 at the request of the California State Government and sponsored by the major public and private postsecondary institutions of California and affiliate federal laboratories in conjunction with leading private-sector firms." – from the report title page.

#### Key Report Findings

- 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.
- The current FCC standard provides an adequate factor of safety against **known thermally** induced health impact of existing common household electronic devices and smart meters.
- 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.

- Not enough is currently known about potential non-thermal impacts of radio frequency emissions to identify or recommend additional standards for such impacts.”

**Electric Power Research Institute, “Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model” (Kavet and Mezei, 2011)**

“The Electric Power Research Institute, Inc. (EPRI, www.epri.com) conducts research and development relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, EPRI brings together its scientists and engineers as well as experts from academia and industry to help address challenges in electricity, including reliability, efficiency, health, safety and the environment” (from the report, p 10).

Key Report Findings

- “For the type of smart meter and relatively small sample of meters characterized, the results indicate that in front of the meters, even with 10 meters nominally rated at ¼ watt operating continuously (100% duty cycle) on the same rack, the exposure level a foot from the center of the rack was a small fraction of the FCC exposure limit for the general public and, as expected, diminished with increasing distance from the rack. The power density levels were comparably lower behind the meters” (from the Conclusion, p 9).

**Electric Power Research Institute, “Characterization of Radio Emissions from Advanced Metering Infrastructure Revenue Meters (Smart Meters) in CPS Energy Residential Installations” (EPRI, 2014)**

Key Report Findings

This study, commissioned by CPS Energy, the municipally-owned public utility of San Antonio, Texas found that the meters tested generated RF-EMF emissions that:

- “For any possible exposure conditions produce instantaneous power density levels always less than 30% of the reference levels specified by the International Committee on Non-Ionizing Radio Protection (ICNIRP) safety guideline.
- For typical consumer exposures in residential settings, exposure levels are one order of magnitude less, or lower, than the ICNIRP reference limits. These results are also consistent with previous similar studies.
- Are lower, in terms of combined exposure time and RF power density level, than a variety of common devices that generate RF fields.”  
(from the Executive Summary, p ix)

**“An Evaluation of Radio Frequency Fields Produced by Smart Meters Deployed in Vermont”, Prepared for The Department of Public Service, state of Vermont, by Richard Tell Associates, Inc. (Tell and Tell, 2013)**

Key Report Finding (emphasis in original)



- “The RF emissions produced by the smart meters deployed by [Green Mountain Power] and [Burlington Electric District] were found to comply with the public exposure regulations of the FCC by a wide margin, typically by a factor of approximately 1500 times, even at one foot from the meters. The measurement data show that the RF field emissions decrease sharply with increasing distance from the smart meters. At distances more likely associated with common day-to-day exposures to smart meter emissions, the RF fields become even dramatically less. For example, at a distance of 10 feet in front of a meter, the RF field drops to approximately 76,000 times less than the FCC limit. Relative to the actual biological hazard thresholds, not the MPE [maximum permissible exposure] which contains a safety factor of 50 for the general public, the RF fields at one foot and ten feet from a smart meter are some 75,000 times and 3,800,000 times less respectively.” (from the Conclusions, p 93)

## **RF-EMF Exposure Standards and Guidelines & Development**

This section discusses current exposure standards and guidelines and entities involved in regulation in the US and development worldwide.

### Key Points

- All standards and guidelines now in use are rooted in the same threshold for potential adverse health effects.
- The threshold for potential adverse effects reflected in the standards involves behavioral changes in laboratory animals that occur at a whole body average specific absorption rate (SAR) of 4 watts per kilogram (W/kg). This is an amount of energy absorption sufficient to increase the body temperature of laboratory animals.
- The science underlying standards and guidelines has been conducted over 60 years across many species and organisms, including epidemiology studies of human beings.
- The entire body of scientific studies on possible RF-EMF effects is considered in establishing standards and guidelines, including studies involving exposures that do not result in temperature increases.
- For advanced meters, standards adopted by the Federal Communications Commission applicable to public exposure are more restrictive than are international guidelines.

## **Federal Communications Commission (FCC)**

The FCC’s fundamental task is technical regulation of communications in the US, including responsibilities under federal environmental law (the National Environmental Policy Act of 1969, or “NEPA”). FCC is required to evaluate the effect of emissions from FCC regulated transmitters on the human environment. For this and other reasons it has adopted rules that incorporate health and safety guidelines developed by others. The US government has not itself been author of comprehensive standards or guidelines for RF health and safety, but various federal agencies, such as FCC, have made use of existing standards or guidelines.

The present FCC guidelines (Federal Communications Commission 1996) are derived from the non-governmental standard adopted by the American National Standards Institute (as

ANSI/IEEE C95.1-1992) and features that FCC previously adopted from another set of non-governmental guidelines produced by the National Council on Radiation Protection (1986). The FCC is currently in the process of revising its guidelines to take into account research, new devices, policies, and procedures that have emerged in recent years. In particular, FCC is considering changes made since 1992 in the ANSI/IEEE C95.1 standard and the international guidelines developed after 1996 by the International Commission on Non-Ionizing Radiation Protection, or ICNIRP (see below).

As a federal agency, the FCC process of adopting rules is conducted through a public process in which staff recommendations are published in the Federal Register in order to elicit comments from interested parties. These comments often are addressed in detail, with the process concluding when regulations are adopted by the agency's commissioners. Detailed methods for implementation of regulations are also prepared by FCC and made available to users of the regulations. Details of the FCC guidelines include the following:

- FCC's current guidelines accept a whole body specific absorption rate (SAR) of RF energy of 4 W/kg as the foundation from which whole body and partial body exposure limits were established for members of the general public over the wide range of frequencies used in communications.
- A SAR of 0.4 W/kg is the limit for whole body exposures of workers, and 0.08 W/kg is the limit for members of the public, including exposures to the public from advanced meters.
- Localized exposure, which can be greater than whole body exposure, is limited by the highest SAR averaged over any cubic volume of tissue in the exposed region. The limiting localized SARs averaged over 1 g of tissue are 8 W/kg for workers and 1.6 W/kg for the public, including exposures from advanced meters.
- However, SAR is not readily determined outside a research laboratory. Instead, maximum permissible exposure (MPE) levels are set in terms of RF field strengths that can be more readily measured by technicians in real-world settings. That is, SAR is the research-based quantity underlying FCC and other regulations and MPE levels are derivative, practical measures of exposure.

**Institute of Electrical and Electronic Engineering (IEEE)** This organization (the world's largest professional organization for technology) maintains a Standards Association that establishes committees such as the International Committee on Electromagnetic Safety (ICES). ICES develops, maintains, and revises health and safety standards for electric, magnetic, and electromagnetic fields over the frequency range 0 to 300 GHz, which includes frequencies used in telecommunications, including wireless advanced meter devices.

ICES committee members include scientists, engineers, and medical doctors in academic and research institutions, industry, private consultants, the military, and government. Ninety-nine people located in North America, Europe, Asia and elsewhere were named as contributors to development of the current IEEE Std C95.1-2005 standard. After a rigorous process of technical development through democratic discussions and balloting in a series of

meetings, a draft standard is subjected to review by the Standards Association before approval as an IEEE standard, such as IEEE Std C95.1-2005 (2005), the most recent standard for RF-EMF exposures. After approval by ICES and the IEEE Standards Association, a RF-EMF standard is submitted to ANSI (the American National Standards Institute, an independent non-governmental body) for further review that can lead to designation as an ANSI Standard. ICES provides maintenance of the standard by addressing uncertainties and unforeseen difficulties discovered by users of the standard. That further guidance often appears when attempting to meet the intentions of the standard with available instruments and the software tools used for determining exposures to human beings. Details of the IEEE standard follow.

- The current (2005) IEEE exposure standards for partial body exposures to members of the public are derived from basic restrictions set at an SAR of 2 W/kg averaged over a 10 g cube of tissue for partial body exposure, excepting for the limbs, and 0.08 W/kg for whole body exposure. Exposures to the limbs are limited to 4 W/kg, also averaged over a 10 g cube of tissue.
- The procedure of averaging SAR over a cubic volume is known as “volumetric averaging” or “spatial averaging” that is consistent with the fact that heating is not a point-wise phenomenon but instead is only meaningful over a volume.

### **International Commission on Non-Ionizing Radiation Protection (ICNIRP)**

ICNIRP is distinguished from ICES as a smaller group, consisting of 12 members plus a chair and vice-chair whose affiliations are in academia and government institutes. Members cannot have industry affiliations. Members are drawn from the global community of multi-disciplinary experts on EMF that serve as individuals rather than as representatives of their nations or institutions. The commission provides guidelines (ICNIRP 1998; ICNIRP 2009) for use by regulators, but is not a regulatory body. However, in practice, ICNIRP guidelines have been adopted as regulatory rules with little or no change.

In the past, there have been technical differences among the ICNIRP recommendations and ICES/IEEE, FCC standards, particularly in the size and shape of the volumes specified for spatial averaging, and the manner in which SAR and exposure levels were adjusted with frequency. All standards and guidelines vary the allowable exposure levels with frequency because of the frequency-dependent nature of RF energy absorption. A collaborative effort between ICES and ICNIRP to harmonize recommendations has reduced differences between their exposure rules. Details of the current ICNIRP guidelines follow.

- For members of the public, limits are 0.08 W/kg for whole body exposures and 2 W/kg for localized exposures to the head and body trunk excepting the limbs.
- Localized exposures are averaged over 10 g of tissue.
- These basic restrictions and those of the IEEE standard are nearly identical over the frequency range applicable to advanced meters.

## **Scientific Research on RF-EMF and Health**

Seattle City Light is keenly aware of concerns about RF exposure from advanced meters and health. The utility is committed to staying current on the science and also providing information to customers. This section provides a brief overview of some topics that have been the subject of multiple comments, including highlights from relevant scientific studies and reports as summarized by the authors or others. This is by no means a summary of the scientific literature, but provides an indication of the breadth of research and some of the more recent findings.

Topics introduced are RF-EMF and potential cancer causation, impacts on central nervous system function, reports on human hypersensitivity, and environmental impacts on animals (such as bees).

### **Research on the Carcinogenic Potential of RF-EMF**

Questions about RF exposure and cancer go back to the 1950s when the health of military radar workers was first of interest and continued with interest increasing upon introduction of new uses of RF energy. For example, RF heating in industrial production, microwave ovens for food preparation, high-power television and FM broadcasting, and more recently, numerous communications technologies. Interest and research became especially intense following introduction of mobile telephones and a widely reported case of brain tumor by a phone user. Some of the most prominent deliberations and studies include the following:

- A broad-ranging review of the literature was conducted by an expert group convened by ICNIRP. Epidemiologic studies of people using mobile phones and other epidemiologic research was evaluated. The review had an emphasis on RF-EMF and cancer for a variety of exposures that occurred in the course of work, living at home, and use of personal RF devices (Ahlbom et al. 2009). The group's conclusion follows.

“Results of these studies to date give no consistent or convincing evidence of a causal relation between RF exposure and any adverse health effect. On the other hand, the studies have too many deficiencies to rule out an association. A key concern across all studies is the quality of assessment of RF exposure.”

Additional cautions given by the authors concerned poor exposure information in most studies, and the narrow focus on only a few tumor types, particularly glioma (a brain tumor) and leukemia.

- The International Agency for Research on Cancer (IARC), a well-respected scientific agency of the World Health Organization (WHO), issued a 419-page monograph resulting in classification of RF-EMF as “possibly carcinogenic to humans (“Group 2B”).”

The list of Group 2B agents includes such things as aloe extract, coffee, toothpaste whitener, and shift work. By contrast, “Group 1” agents are known to be “carcinogenic

to humans” and include alcohol, second hand tobacco smoke, sunlight, certain viruses, chemicals, and ionizing radiation.

The IARC conclusion was a majority opinion based on “limited evidence” on cancer. A minority held that there was “inadequate evidence” and thus no justification for the Group 2B classification (IARC 2013 chap 6).

Reviewers noted the classification of RF-EMF in Group 2B should be considered in light of mobile phone epidemiologic research (such as the INTERPHONE study, see below) that was inconclusive yet involved long-term exposures that drove the majority conclusion, the lack of consensus on the committee, and lack of conclusive evidence supporting cancer causation from laboratory studies (IARC 2013 chap 5).

- The INTERPHONE study is a large, multi-national epidemiological study concerned with RF-EMF exposure from mobile phone use and cancer. The study involves data from 13 countries and includes large numbers of cases and controls. For example, 2708 glioma cases and 2972 matched controls. The overall conclusion from the INTERPHONE study (2011) follows:

“This is the largest study of the risk of brain tumors in relation to mobile phone use conducted to date and it included substantial numbers of subjects who had used mobile phones for  $\geq 10$  years. Overall, no increase in risk of either glioma or meningioma was observed in association with use of mobile phones. There were suggestions of an increased risk of glioma, and much less so meningioma, at the highest exposure levels....However, biases and errors limit the strength of the conclusions we can draw from these analyses and prevent a causal interpretation.”

The lack of steadily increasing risk with increasing exposure and reduced risk for most measures of exposure cloud interpretation of the data, reducing scientific reason to interpret the findings as evidence for a cause-and-effect relationship.

Subsidiary analyses from the INTERPHONE study data were conflicting. Some, such as a greater measured risk for users who reported usual exposure to the same side of the head as the tumor, tend to support the possibility of a true risk. But in contrast, there was no increased risk when using number of wireless phone calls, known to be a more accurate measure of exposure than cumulative call duration, the measure that suggested an increased risk of glioma. Internal inconsistencies are not unusual in epidemiology, particularly under circumstances of small excess risk in the presence of possible inherent technical weaknesses such as selection bias. Overall, the INTERPHONE authors found several instances of inconsistency and probable sources of bias and error that raised doubts about a causal relationship between RF-EMF exposures from cell phones and glioma risk.

## **Research Related to Central Nervous System Function, Including Behavior**

A number of health endpoints in cognitive development, function, sleep and mood disorders, and behavior that have been studied in epidemiologic and laboratory research were reviewed in a report by the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR 2014), a European Commission committee on public health issues. Their major findings are:

- “[W]eak evidence” for greater behavioral problems (including ADHD and disruptive behaviors) related to maternal use of mobile phones and for children’s later use, but other studies did not lend support (SCENIHR 2014 sec. 3.5.2.1).
- Recent studies found no increased risk of neurological diseases such as migraine, Parkinsonism, dementia, ALS, and multiple sclerosis (MS) (SCENIHR 2014, sec. 3.5.2).
- A fairly large number of studies on other neurological and neurophysiological studies, including controversial areas such as alterations in the blood-brain barrier, EEG and sleep, Alzheimer disease, learning, and memory had mixed findings that led to the following conclusions on neurophysiological studies,

“Overall there is a lack of evidence that RF affects cognitive functions in humans. Studies looking at possible effects of RF fields on cognitive functions have often included multiple outcome measures. Where effects have been found by individual studies, these have typically only been observed in a small number of these outcomes, with little consistency between studies as to which exact outcomes are affected.

The earlier described evidence for effects on brain activities as reflected by EEG studies during wake and sleep is further substantiated by the more recent studies. The biological significance of the small physiological changes remains unclear” (SCENIHR 2014 p 102). “

## **Studies Concerning Hypersensitivity**

Many individuals have reported sensitivity to EMF, typically reporting adverse neurological symptoms such as headache, insomnia, altered sleep, poor memory, heart palpitations, skin tingling, and other non-specific symptoms. In addition, many persons affected by electromagnetic hypersensitivity (EHS) believe they can detect when a signal, such as from a nearby cell phone, is on or off.

Hypersensitivity to drugs, foods, and allergens in the air and on the skin are well-studied medical conditions involving the immune system and biologically active agents that can be identified with certainty. In contrast, reported hypersensitivity to EMF is non-specific, having been attributed to a wide range of electromagnetic fields ranging in power frequencies from 50- and 60-Hz to frequencies that are higher by a factor of one-hundred million or more. In the overall medical and psychological literature, hypersensitivity has also been evaluated as part of drug side effects, psychiatric disorders, and mass hysteria.

There have been many investigations of EHS, which also is known as Idiopathic Environmental Intolerance attributed to electromagnetic fields (IEI-EMF). Studies have been conducted using the techniques of behavioral science, human physiology, and epidemiology.

- A WHO background paper (2005) concluded,  
“EHS is characterized by a variety of non-specific symptoms that differ from individual to individual. The symptoms are certainly real and can vary widely in their severity. Whatever its cause, EHS can be a disabling problem for the affected individual. EHS has no clear diagnostic criteria and there is no scientific basis to link EHS symptoms to EMF exposure. Further, EHS is not a medical diagnosis, nor is it clear that it represents a single medical problem.”
- One particularly robust study achieved greater statistical power by pooling subjects into what is called a meta-analysis. A systematic review (Roosli 2008) found no evidence for IEI-EMF and an overall subject ability to detect EMF that barely exceeded chance levels and was therefore an indication that human detection of the tested signals was not definitive, contrary to the beliefs of EHS subjects.
- It is important to realize that the inability to demonstrate a true association of RF-EMF exposures with subjective neurological conditions or field perception does not eliminate the fact that some individuals experience a distressing syndrome and some believe they can detect RF-EMF.
- Brain imaging studies of hypersensitive laboratory subjects, compared to controls, showed brain responses consistent with responses to pain even though no EMF exposure occurred (Landgrebe et al. 2008). Other scientific studies of human subjects and laboratory animals also point to causes other than RF\_EMF exposure.
- Based on an review of studies involving approximately 200 IEI-EMF and control subjects, one medical report concluded that clinicians evaluate IEI-EMF by considering a “conventional organic or psychiatric disorder, or in terms of the more subtle psychological processes associated with the nocebo response.” (Rubin et al. 2010 p 9) These authors also advised, “Despite the conviction of IEI-EMF sufferers that their symptoms are triggered by exposure to electromagnetic fields, repeated experiments have been unable to replicate this phenomenon under controlled conditions. A narrow focus by clinicians or policy makers on bioelectromagnetic mechanisms is, therefore, unlikely to help IEI-EMF patients in the long-term.” (Rubin et al. 2010 abstract).

## Environmental Studies

There have been concerns expressed about adverse environmental impacts though there is little research on potential negative environmental impacts on the natural biology of plants and animals from exposures to RF energy at the low levels and brief durations typical of advanced metering systems. Few ecological or environmental studies of RF-EMF have been conducted by adequately funded researchers under the stringent conditions necessary for determining if speculations and observed effects can be confirmed as reliable. Although the lack of rigorous studies of RF-EMF in the natural environment prevents making trustworthy overall conclusions, the following provides a general overview of these concerns and relevant information.\*

- In a review paper, Balmori (2009) cited a number of studies on birds, small mammals, insects, vegetables, and trees to raise questions about potential environmental impacts from environmental sources of RF-EMF such as cell phone base stations, broadcast towers, and the cumulative influences of numerous wireless sources in modern society including advanced metering devices.
- The term “electrosmog” is sometimes used to encompass concern about cumulative emissions from a disparate collection of RF sources that include the above sources as well as radar, personal cell phones, Wi-Fi in homes and public places, Bluetooth, and remotely controlled consumer devices (toys, garage door openers, and some Audio Visual equipment). Many other electronic devices are also sources of low-level, localized, RF-EMF.
- A second line of questioning and concern comes from extrapolation from scattered studies on species such as birds and bees that typically were studied following exposures to RF-EMF near a cell phone handset, cellular base station, radar, or broadcast antenna site.
- The electrosmog concept is severely undermined by the fact that the strength of RF-EMF falls rapidly with distance from a source, resulting in very low RF-EMF levels overall and exceptionally low levels at any one frequency channel, and also by the absence of biological molecules or tissues that amplify or detect either continuous or modulated RF energy, which are the essential features that make modern communication technologies possible.
- Radio, TV, and similar technologies such as cell phones, operate successfully with weak signals by use of tuned antennas, tuned circuits and amplifying circuits. Biological systems of all types, from microbes to large mammals, lack sensory organs that can tune to or amplify an RF-EMF signal.
- “Modulation” generally describes the technical means by which information is encoded in RF-EMF for communications. Modulation can rapidly vary signal strength (“amplitude modulation,” AM), frequency (FM), and other technical parameters utilizing a great many sophisticated techniques of communications engineering; however, fundamental laws of physics and biophysics, supported by experiment, show that, unlike electronic circuits, biological tissue do not detect modulation patterns.



- Colony collapse disorder in cultivated bee colonies has been studied in relation to a number of environmental factors, including viruses, pesticides and suggestions that RF-EMF or emissions from the particular technology of mobile phones may be involved, but there has been no substantiation with research, while in contrast, previous studies at high levels of RF-EMF exposure found no effect on honeybee physiology and behaviors (Westerdahl and Gary 1981; Gary and Westerdahl 1981).

\* The sections on Scientific Studies Related to Advanced Meter Radio Frequency Electromagnetic Fields (RF-EMF) and Environmental Studies were prepared with inputs from Asher Sheppard, PhD.

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## Customer Data and Security

Seattle City Light's disclosure of personally identifiable information, including consumption information, is governed by state law. As a public agency, City Light is obligated to disclose some customer information, including the amount of electricity consumed in a billing cycle, upon request by the media or other members of the public. City Light will disclose that information to law enforcement only when there is a written request stating there is reason to believe the information will help determine whether a crime has been committed. (RCW 42.56.335) If a customer signs up for a service that results in City Light obtaining consumption information for shorter periods than a billing cycle (e.g., hourly consumption information), City Light will not disclose that information to any other parties. (RCW 42.56.330(2))

City Light has developed a set of "Residential Advanced Metering Data Privacy Practices," to inform how the utility will handle the advanced meter data.

### Residential Advanced Metering Data Privacy Practices

- Advanced Metering for residential applications will collect kilowatt-hour consumption only and monitor for abnormal conditions, including voltage or temperature irregularities and full or partial loss of grid power, at the meter base. This monitoring is a value-added service which benefits customers and City Light equally by helping protect property and identify problems before they become major issues. If a City Light customer chooses to participate in a program, such as time-of-use billing or an electric vehicle incentive program, additional information – such as hourly kilowatt-hour consumption or consumption information from Electric Vehicle Service Equipment – will be required; however, the customer will have to sign-up for and give approval for the data use to participate in these programs.
- If City Light chooses to provide an optional web-based Home Energy Management system, City Light may, at the customer's direction, remotely access the Home Energy Management Interface in order to troubleshoot or provide advice on energy efficiency or conservation programs. Access logs, including date, length of access, and name of employee gaining access, will be maintained for a period congruent with City of Seattle Record Retention policies.

### Advanced Metering Data Security

Advanced metering is made up of hardware (meters), communications (RF network), and data (IT). The technology has several layers of security, which is intended to prevent any form of intrusion and allow only City Light to manage and operate the network and its data. This will assure the data for City Light's customers are secured and managed according to City of Seattle codes and Washington state laws on data privacy.

Layers of security include:

- **Reverse Engineering Prevention**
  - Lock the microcontrollers containing the firmware
- **Over the Air Upgrades (OTA)**
  - Encrypt the firmware
  - Encryption using Advanced Encryption Standard (AES) -128 bit
- **Spoof-Proofing Meters**
  - Firmware validated for integrity and authenticated upon installation
- **WAN Security**
  - ANSI C12.21 – Provides WAN access two-way authentication using Data Encryption Standard (DES) encryption of a randomly generated token.
  - ANSI C12.22 – Adds another layer of security by providing WAN access authentication and data encryption using AES-128.
- **Head-End Security**
  - The advanced meter head-end system resides within the utility network.

## Public Meetings

City Light understands that other utilities have experienced customer resistance due to topics such as cost, safety, health and privacy. In response to this information, Seattle City Light held three public forums in 2013 in order to hear from its customers. The meetings were a way to invite customers to voice their comments, concerns and questions about advanced meters and provide more information on advanced meter customer benefits.

### August/September 2013

City Light hosted three community forums primarily fielded topics surrounding health and privacy .

- North – Northgate Community Center
  - August 21, from 5 p.m. to 7:30 p.m.
  - ~60 public attendees
- Downtown – Seattle Center
  - September 10, from 5 p.m. to 7:30 p.m.
  - ~40 public attendees
- South – Seattle Housing Authority New Holly
  - September 26, from 5 p.m. to 7:30 p.m.
  - ~20 public attendees

### Forum Topics

#### *Health*

City Light representatives provided publications on radio frequency (RF) exposure and health, brought in an expert (Dr. Asher Sheppard, consulting scientist) to help address health

questions, and presented existing literature that expresses the minimal amount of exposure caused by these meters.

### *Privacy*

City Light shared its utility privacy policy, which complies with local, state and national guidelines, as well as industry best practices. (City Light staff are currently updating the policy to make it more specific for the advanced metering program. A privacy policy is being compiled to ensure that the privacy of our customers is maintained. City Light is developing safeguards to ensure the utility is held accountable for any issues that may arise.)

### Public Response

Customers expressed concern about the advanced meter program through the community forums, website and other forms of e-correspondence. At forums, they passed out “Say No to Smart Meters” flyers and a DVD movie entitled, “*Take Back Your Power.*” Through City Light’s website, staff collected about 250 customer comments, 131 positive (52.4%), 61 comments of opposition (24.4%) and 58 neutral comments or clarifying questions (23.2%).

The main topics of concern include billing increases, concern that RF exposure could result in adverse health effects, concern for surveillance and security, and safety concerns regarding fire hazards associated with meters.

### **September 2014**

Seattle City Council hosted two public meetings on advanced meters. City Light representatives attended these community forums to present information on health, privacy, cost, safety and benefits as well hear from the public on the topics of concern.

- Downtown – City Hall
  - September 15, from 3 p.m. to 4:15 p.m.
  - ~25 public attendees
- Downtown – City Hall
  - September 18, from 12 p.m. to 1:30 p.m.
  - ~55 public attendees

### Forum Topics

Addressing both the Seattle City Council and public attendees, City Light presented information relating to an overview of advanced meters – what the technology is and how it works; an overview of the benefits; a discussion about technology choices; cost savings; safety concerns and safety features; an opt-out policy still in development; information regarding privacy and security; and information addressing health concerns associated with wireless communication. Dr. Asher Sheppard (RF-EMF expert) and Dr. Robert Olsen (electromagnetic theory expert) both joined the presentation to address specific areas of concern/interest regarding health.

## Public Comments

- Glad to know that Seattle City Light has extra safety measures in place with meters (heat sensors and automatic shutoffs)
- Concerned about spies and hacking to system
- Concerned about health impacts from RF-EMF transmissions
- Concerned about RF effects on bees and birds
- Concerned with safety
- Don't think people will look at consumption habits to inform conservation
- Concerned time-of-use billing will impact low-income households
- Want to see more research done
- Concerned about opt-out in context of apartments
- 418 signed petition to ban smart meters
- Wants Seattle City Council and City Light to be accountable for any potential health impacts from wireless communication by meters
- Concerned about rate hikes

## Addressing Concerns

Following the public forums in September 2014, City Light is revising and clarifying messages and topics related to the AMI project to include feedback and input from the council and the community.

### **Time-of-Use Billing**

City Light would like to clarify apparent misconceptions regarding time-of-use billing. Time-of-use is a proposed voluntary program, which will require approval from Seattle City Council. Advanced meters would enable time-of-use billing; however, City Light has not considered this as a required billing practice. This billing option, if made available and approved by council, would be available to customers by choice.

### **Advanced Meters Opt-Out Policy**

The advanced meters opt-out policy explanation and description will be modified to describe that, currently, all customer bills are factored to cover the operating cost of manual meter reading. If customers chose to opt-out of automated wireless readings, they will continue to pay for the meter reading service. Because the cost to pay for meter reading services will no longer be needed or supported by customers with automated wireless readings, the cost to support manual meter reading will be directed to customers choosing to opt-out. Within the opt-out policy, City Light will work to incorporate low-income customers signed up for the Utility Discount Program (UDP) to address the cost of meter-reading service.

### **Technology Choices**

During the recent public meetings, different communication technologies such as fiber optics and power line communication (PLC) were discussed as potential alternatives to RF-EMF

wireless transmissions. City Light did consider fiber optics, but the costs associated were significantly higher than a wireless technological solution. City Light also considered the PLC technology option; however, due to Seattle City Light's high-density metro distribution system, PLC is not a desirable solution.

In regards to the claims by public attendees that Tacoma Power and Idaho Power are using these communication technologies, City Light research indicates that Tacoma Power has a hybrid fiber-coaxial cable to the meter, however they are in the process of changing it to a Wi-Fi Collector System. Idaho Power uses power line communications.

### **Rate Increases**

As outlined in the Strategic Plan, a proposed rate increase averaging 4.4 percent annually through 2020 will be applied towards several new initiatives, including distribution automation. It is important to note that, due to the current age of meters in use at City Light, there is a need and a cost to replace those meters regardless of whether they are advanced meters or not. In addition to this cost (see page 4), hundreds of utilities have gone with an advanced meter solution because of the cost benefits it provides its customers and the utilities. Operational efficiencies enabled by advanced meters will reduce costs and the need of future rate hikes and will help to keep rates stable and low.

### **Real-Time RF-EMF Measurements**

Comments were made during one public meeting about the measurements showcased in the video produced by City Light and how these measurements were not made in a "real-time environment." To address this concern, City Light would like to clarify that the intent of the measurements made in the video was to compare the RF-EMF field emissions between advanced meters and common devices, not to measure the meters in a real-time environment.

Additionally, during the presentation given by City Light, real-time measurements were addressed by Dr. Sheppard, and reports with those measurements are included in this document referring to the EPRI study (see page 6).

## **Customer Research**

### **Community Energy Forum AMI Survey**

In July 2014, City Light surveyed members of the Community Energy Forum and requested their feedback, thoughts, and perceptions of advanced metering. The Community Energy Forum is a group of self-selected City Light customers that participate in an online survey panel to offer their opinions about a broad range of utility topics. A total of 639 participants responded to the survey. Key findings and survey results were analyzed and incorporated into the communications outreach plan for advanced metering.

- Key Findings

- Despite limited familiarity with advanced meters, when shown a description of the technology, members feel positively towards it.
- Most feel that advanced meters will allow for more customized communications and services, as well as improve service and prevent waste.
- The main benefit of advanced meter technology, according to the respondents, will be allowing members to conserve and better manage their electricity use.
- Members do not feel as if advanced meters will provide any health threats, allow unwanted access by utilities to turn off appliances without their permission, nor are less accurate than analog meters.
- Members show interest in wanting to learn how advanced meter technology will affect their bill and how it will work.
- Customers expressed considerable interest in information on pricing, installation and maintenance costs
- The Seattle City Light website is the first place members will look for more information on the advanced meter rollout, followed by mail inserts.
- Though the majority of respondents currently use a programmable thermostat to manage electric heat usage, nearly half intend to view and monitor their electricity consumption online and/or through an app in the next 12 months.
- More than half of members show intent on changing their energy usage based on their consumption information.

Feedback from the Community Energy Forum Advanced Meter Survey and public meetings will be applied toward Seattle City Light's Advanced Meter Customer Outreach Plan.

## Customer Outreach

City Light has been conducting customer outreach on advanced meters since the initiative became part of the City Light Strategic Plan in 2010. The Strategic Plan was developed with extensive involvement from the City Light Review Panel, other city departments, business groups, neighborhood councils, ethnic communities, business leaders, customers, employees and other key stakeholders and was unanimously adopted by the Seattle City Council in May 2012.

### Advanced Meter Customer Outreach Plan

Seattle City Light is developing an extensive Advanced Meter Customer Outreach Plan and Strategy. The plan will focus on three phases, which align with the project timeline leading up to, during, and after advanced meter deployment. As part of the plan strategy, City Light will also focus on inclusive outreach and public engagement when it comes to customer demographics, languages, ease of access to information, media consumption and the Race and Social Justice Initiative (RSJI).



### Phase I (Present – Spring 2015)

- During the first phase of customer outreach, Seattle City Light will be developing and sharing informative, educational and accessible content relating to advanced meters. According to data/survey results, customers show interest in wanting to learn more about the technology and will look for information on City Light's website.
- In addition to optimizing content, City Light will also build relationships with Community Ambassadors. According to utility best practices, word-of-mouth communication is the most effective way to share information. Currently, City Light has several dozen customers interested in being early adopters.

### Phase II (Spring 2015 – Fall 2016)

- During the second phase of customer outreach, City Light will begin utilizing external communication channels such as its blog, social media, external newsletter, flyers and public meetings/events to share and distribute the content developed in Phase I.
- Additionally, City Light will invite Community Ambassadors to share their experience with advanced meters with their fellow neighbors and community members.

### Phase III (Fall 2016 – Winter 2017)

- During the third and final phase of customer outreach, City Light will prepare customers for advanced meter installation using channels such as bill inserts, door hangers and press releases . Preparation efforts include letting customers know what is happening with advanced meters and why, what to expect, where they can learn more.

## **Customer Service**

Seattle City Light's mission is to set the standard and deliver the best customer service experience of any utility in the nation. In order to uphold this mission, we will make customer service available, accessible and attentive during all phases (and beyond) through the Advanced Meter Customer Outreach Plan.

## **Measuring and Evaluating Success**

We will measure and evaluate success in several ways to ensure effective customer outreach. Some examples include:

- Survey customers to measure how informed and educated they are about advanced meters
- Track effectiveness of website through website analytics
- Ask for public comments/feedback during public events focused on advanced meters
- Track customer service calls about advanced meters
- Track media coverage about advanced meters
- Work with the City Council and Mayor's Office on issues/topics related to advanced meters

## Conclusion

After extensive research on the effects of advanced meters, including consultation with various subject-matter experts and peer-reviewed studies, City Light is confident that advanced meters are safe and that these meters will provide many benefits to both customers and utility operations. City Light will continue to monitor health, privacy, safety, and security research to make sure the utility is well-informed and up-to-date.