Brown, Audley

From: *Spunaugle, Shirley A*
Sent: Thursday, July 16, 2020 1:49 PM
To: Myers, Benjamin; Brown, Audley
Subject: RE: Bolte v Met Ed 3011287

Thank you very much for the detailed explanation. This definitely clarifies the process and what all took place.

Have a fabulous rests of your day!

Shirley

From: Myers, Benjamin <benmyers@pa.gov>
Sent: Thursday, July 16, 2020 1:25 PM
To: Brown, Audley <audbrown@pa.gov>; Spunaugle, Shirley A <sspunaugle@pa.gov>
Subject: Bolte v Met Ed 3011287

As a follow up to our conversation about the exhibits I dropped off this morning in the above docket.

This case was done entirely through pre-served testimony which is already a part of the record. In addition to written statements, the parties provided exhibits.

The exhibits I dropped off today were sent to me prior to the March 16 lockdown. It was in anticipation of the hearing that was scheduled at that time.

After the lockdown, the parties agreed to skip a hearing and simply submit any remaining testimony or exhibits electronically. The exhibits you got today were mailed to me back before March 16 when we were still operating normally. They were the only exhibits and pre-served testimony that weren't part of the record yet.

The record closed on May 8.

I hope that clears things up. I will be issuing a decision which will say that the testimony and exhibits were admitted to the record by agreement of the parties. The decision will tie everything up.

Anything else just let me know.....thank you!!!!

Charles and Sylvia Bolte
108 Pinebrook Road
Milford, PA 18337
forestnyc@hotmail.com

January 14, 2020

Administrative Law Judge Benjamin Myers
Pennsylvania Public Utility Commission
Office of Administrative Law Judge
400 North Street
Harrisburg, PA 17120

Dear Judge Myers,

I am enclosing 3 copies of the exhibits for my January 21, 2020 hearing, according to your December 17, 2019 order which says, "If you have any hearing exhibits to which you will refer during the hearing, three (3) copies must be sent to the Administrative Law Judge and one (1) copy each must be sent to every other party. All copies **must be received** at least five (5) business days **before** the hearing."

I have also sent one copy to Attorney Giesler at Met-Ed and I am enclosing a certificate of service to show that too.

I am hoping my Amended Formal Complaint, which was mailed on January 8th and was supposed to be delivered on January 10th, has been received by now. As of Saturday evening, the tracking number on the certified mail receipt showed it had not yet been delivered, which has me very concerned.

Sincerely,

Sylvia Bolte

Sylvia Bolte

Exhibit 1

ENVIRONMENTAL HEALTH TRUST (/)

tZS0VsYS4aPeVUDDykOurVBFwi75EMH4sN4N2p-b2yLv-kiK0gdX86jE8SQn5VS0bkLnSeDAXGqy6IY%3D)

Electromagnetic Sensitivity

Electromagnetic Sensitivity

Also *Referred To As* Microwave Sickness

The human body normally functions by using natural electromagnetic energy and humans are electromagnetic beings. Thus we are affected by electromagnetic fields in our environment. People worldwide are reporting health issues and symptoms after exposures to electromagnetic fields.

"Common EHS symptoms include headaches, concentration difficulties, sleep problems, depression, a lack of energy, fatigue, and flu-like symptoms...The primary method of treatment should mainly focus on the prevention or reduction of EMF exposure, that is, reducing or eliminating all sources of high EMF exposure at home and at the workplace. The reduction of EMF exposure should also be extended to public spaces such as schools, hospitals, public

Exhibit 1

transport, and libraries to enable persons with EHS an unhindered use (accessibility measure)." – EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses (https://www.researchgate.net/publication/305689940_EUROPAEM_EMF_Guideline_2016_for_the_prevention_diagnosis_and_treatment_of_EMF-related_health_problems_and_illnesses) (Belyaev 2016) (https://www.researchgate.net/publication/305689940_EUROPAEM_EMF_Guideline_2016_for_the_prevention_diagnosis_and_treatment_of_EMF-related_health_problems_and_illnesses)

SYMPTOMS OF ELECTROMAGNETIC SENSITIVITY

Headaches, Sleeping Problems, Concentration and Memory problems, Nosebleeds, Extreme thirst, Bad allergies, Unexplained skin rashes, Digestive Problems, including stomach pains, constipation, diarrhea, Neurological problems including anxiety and unexplained feelings of stress, Heart Palpitations, Strong fatigue, Appetite Loss

DIAGNOSIS and TREATMENT

Clinicians have developed assessment tools and clinical protocols to assess and treat patients.

Please see the Patient Questionnaire on Electrical Sensitivity (https://ehtrust.org/wp-content/uploads/patient-questionnaire-electrohypersensitivity-print-pdf-2.pdf) provided by Physicians for Safe Technology for an assessment tool to understand EMF exposures.

***The Austrian Medical Association Guidelines for Diagnosis and Treatment of EMF related* Health Problems**

The Austrian Medical Association has developed a guideline for differential diagnosis and treatment of health problems associated with outdoor and indoor electrosmog. **Guidelines of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses (EMF syndrome)** (https://ehtrust.org/wp-content/uploads/The-Austrian-Medical-Association-Guidelines-for-Diagnosis-and-Treatment-of-EMF-related-Health-Problems.pdf)

How to File an ADA Accommodations Request for Electrosensitivity to Avoid Small Cells and Wifi (http://www.electrosmogprevention.org/ada-accommodations-for-rf-exposures/ada-for-es-to-avoid-small-cells-and-wifi/)*Copyright Center for Electrosmog Prevention, 2019.

- This packet is freely available for use only under Fair Use (non-commercial) terms and agreement with the CEP & Packet Disclaimers. *It does not substitute for legal advice and there is no guarantee of successful outcome.*
- The following ADA Accommodations Request Packet may be used by ES (electrosensitivity) sufferers to apply for reasonable accommodations to help avoid rf radiation from "small cells" and wifi *in public government areas*, related to accessibility or any other Title II (https://www.ada.gov/taman2.html)application. "Title II of the Americans with Disabilities Act (https://www.ada.gov/ada_title_II.htm) applies to State and Local Governments.

COURT CASE & LEGAL ISSUES

Australia, 2013, Court Case Won: McDonald and Comcare: (http://www.austlii.edu.au/au/cases/cth/aat/2013/105.html) The AAT ruling means McDonald will continue to be paid 75 per cent of

Exhibit 1

Go to top

PUBLISHED SCIENTIFIC RESEARCH ON EHS

Heuser, G. and S.A. Heuser. "Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields." Rev Environ Health (2017). doi: 10.1515/reveh-2017-0014. (https://doi.org/10.1515/reveh-2017-0014)

- Ten adult patients with electromagnetic hypersensitivity underwent functional magnetic resonance imaging (fMRI) brain scans.
- All ten patients had abnormal functional MRI brain scans. The abnormality was often described as hyper connectivity of the anterior component of the default mode in the medial orbitofrontal area. Other abnormalities were usually found. Regular MRI studies of the brain were mostly unremarkable in these patients.
- "We propose that functional MRI studies should become a diagnostic aid when evaluating a patient who claims electrohypersensitivity (EHS) and has otherwise normal studies. Interestingly, the differential diagnosis for the abnormalities seen on the fMRI includes head injury. It turns out that many of our patients indeed had a history of head injury which was then followed sometime later by the development of EHS. Many of our patients also had a history of exposure to potentially neurotoxic chemicals, especially mold. Head injury and neurotoxic chemical exposure may make a patient more vulnerable to develop EHS."

Marino AA, Kim PY, Frilot Ii C. Trigeminal neurons detect cellphone radiation: Thermal or nonthermal is not the question. (https://www.ncbi.nlm.nih.gov/pubmed/27419655?dopt=Abstract) Electromagn Biol Med. 2016 Jul 15:1-9.

- Cellphone electromagnetic radiation produces temperature alterations in facial skin. We hypothesized that the radiation-induced heat was transduced by warmth-sensing trigeminal neurons, as evidenced by changes in cognitive processing of the afferent signals. Ten human volunteers were exposed on the right side of the face to 1 GHz radiation in the absence of acoustic, tactile, and low-frequency electromagnetic stimuli produced by cellphones.

Exhibit 1

- Results: Trigeminal neurons were capable of detecting temperature changes far below skin temperature increases caused by cellphone radiation. Simulated cellphone radiation affected brain electrical activity associated with nonlinear cognitive processing of radiation-induced thermal afferent signals. Radiation standards for cellphones based on a thermal/nonthermal binary distinction do not prevent neurophysiological consequences of cellphone radiation.
- The public-health significance of chronic and subacute exposure to cellphone radiation is under scrutiny (Chu et al., 2011; Coureau et al., 2014; Hardell et al., 2013; Szykjowska et al., 2014), and marked disagreements exist among the stakeholders as regards the public-health risks. Our work is directly pertinent to one aspect of the contentiousness, the assumption that there exists a binary distinction between so-called thermal and nonthermal biological effects associated with cellphone radiation. In that perspective, cellphone radiation is regarded as inherently nonthermal and consequently unable to cause any biological effects, health related or otherwise. The results reported here indicated that a standard cellphone radiating at a level well within approved emission limits will necessarily produce a physiological thermal effect triggered by heat deposited in the user's facial skin. Consequently, cellphone safety cannot validly be predicated on the absence of thermal effects because they are never absent.

Belpomme D, Campagnac C, Irigaray P., Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. (http://www.ehs-mcs.org/fichiers/1454070991_Reliable_biomarkers.pdf) *Rev Environ Health*, vol. 30, no. 4, 2015, pp. 251-71.

Igor Belyaev, Amy Dean, Horst Eger, Gerhard Hubmann, Reinhold Jandrisovits, Markus Kern, Michael Kundi, Hanns Moshammer, Piero Lercher, Kurt Müller, Gerd Oberfeld*, Peter Ohnsorge, Peter Pelzmann, Claus Scheingraber and Roby Thill, EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses, (https://www.ncbi.nlm.nih.gov/pubmed/27454111) **Rev Environ Health 2016. Read the full PDF** (https://ecfsapi.fcc.gov/file/10910251701394/EUROPAEM%20EMF%20Guideline%202016%20for%20the%20prevention%20and%20treatment%20of%20EMF-related%20health%20problems.pdf)

- "On the one hand, there is strong evidence that long-term exposure to certain EMFs is a risk factor for diseases such as certain cancers, Alzheimer's disease, and male infertility. On the other hand, the emerging electromagnetic hypersensitivity (EHS) is more and more recognized by health authorities, disability administrators and case workers, politicians, as well as courts of law."
- "We recommend treating EHS clinically as part of the group of chronic multisystem illnesses (CMI), but still recognizing that the underlying cause remains the environment. In the beginning, EHS symptoms occur only occasionally, but over time they may increase in frequency and severity. Common EHS symptoms include headaches, concentration difficulties, sleep problems, depression, a lack of energy, fatigue, and flu-like symptoms. A comprehensive medical history, which should include all symptoms and their occurrences in spatial and temporal terms and in the context of EMF exposures, is the key to making the diagnosis."
- "The primary method of treatment should mainly focus on the prevention or reduction of EMF exposure, that is, reducing or eliminating all sources of high EMF exposure at home and at the workplace. The reduction of EMF exposure should also be extended to public

Exhibit 1

spaces such as schools, hospitals, public transport, and libraries to enable persons with EHS an unhindered use (accessibility measure). If a detrimental EMF exposure is reduced sufficiently, the body has a chance to recover and EHS symptoms will be reduced or even *disappear.*

- "There is increasing evidence that EMF exposure has a major impact on the oxidative and nitrosative regulation capacity in affected individuals. This concept also may explain why the level of susceptibility to EMF can change and why the range of symptoms reported in the context of EMF exposures is so large. Based on our current understanding, a treatment approach that minimizes the adverse effects of peroxynitrite – as has been increasingly used in the treatment of multisystem illnesses – works best. This EMF Guideline gives an overview of the current knowledge regarding EMF-related health risks and provides recommendations for the diagnosis, treatment and accessibility measures of EHS to improve and restore individual health outcomes as well as for the development of strategies for prevention."

Belpomme D, Campagnac C, Irigaray P., Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. (https://www.ncbi.nlm.nih.gov/pubmed/26613326) Rev Environ Health. 2015 Dec 1;30(4):251-71. doi: 10.1515/reveh-2015-0027.

- Much of the controversy over the causes of electro-hypersensitivity (EHS) and multiple chemical sensitivity (MCS) lies in the absence of both recognized clinical criteria and objective biomarkers for widely accepted diagnosis. Since 2009, we have prospectively investigated, clinically and biologically, 1216 consecutive EHS and/or MCS-self reporting cases, in an attempt to answer both questions. We report here our preliminary data, based on 727 evaluable of 839 enrolled cases: 521 (71.6%) were diagnosed with EHS, 52 (7.2%) with MCS, and 154 (21.2%) with both EHS and MCS. Two out of three patients with EHS and/or MCS were female; mean age (years) was 47. As inflammation appears to be a key process resulting from electromagnetic field (EMF) and/or chemical effects on tissues, and histamine release is potentially a major mediator of inflammation, we systematically measured histamine in the blood of patients. Near 40% had a increase in histaminemia (especially when both conditions were present), indicating a chronic inflammatory response can be detected in these patients. Oxidative stress is part of inflammation and is a key contributor to damage and response. Nitrotyrosin, a marker of both peroxynitrite (ONOO°-) production and opening of the blood-brain barrier (BBB), was increased in 28% the cases. Protein S100B, another marker of BBB opening was increased in 15%. Circulating autoantibodies against O-myelin were detected in 23%, indicating EHS and MCS may be associated with autoimmune response. Confirming animal experiments showing the increase of Hsp27 and/or Hsp70 chaperone proteins under the influence of EMF, we found increased Hsp27 and/or Hsp70 in 33% of the patients. As most patients reported chronic insomnia and fatigue, we determined the 24 h urine 6-hydroxymelatonin sulfate (6-OHMS)/creatinin ratio and found it was decreased (<0.8) in all investigated cases. Finally, considering the self-reported symptoms of EHS and MCS, we serially measured the brain blood flow (BBF) in the temporal lobes of each case with pulsed cerebral ultrasound computed tomosphygmography. Both disorders were associated with hypoperfusion in the capsulothalamic area, suggesting that the inflammatory process involve the limbic system and the thalamus. Our data strongly suggest that EHS and MCS can be objectively characterized and routinely diagnosed by commercially available simple tests. Both

Exhibit 1

disorders appear to involve inflammation-related hyper-histaminemia, oxidative stress, autoimmune response, capsulothalamic hypoperfusion and BBB opening, and a deficit in melatonin metabolic availability; suggesting a risk of chronic neurodegenerative disease. *Finally the common co-occurrence of EHS and MCS strongly suggests a common* pathological mechanism.

Electromagnetic hypersensitivity – an increasing challenge to the medical profession. (https://www.ncbi.nlm.nih.gov/pubmed/26372109) Reviews on Environ Health. 2015 Sep 15.

- CONCLUSION: It seems necessary to give an International Classification of Diseases to EHS to get it accepted as EMF-related health problems. The increasing exposure to RF-EMF in schools is of great concern and needs better attention. Longer-term health effects are unknown. Parents, teachers, and school boards have the responsibility to protect children from unnecessary exposure.

Sage C. The implications of non-linear biological oscillations on human electrophysiology for electrohypersensitivity (EHS) and multiple chemical sensitivity (MCS). (https://www.ncbi.nlm.nih.gov/pubmed/26368042) Rev Environ Health. 2015 Sep 12.

- Electrohypersensitivity (EHS) can be a precursor to, or linked with, multiple chemical sensitivity (MCS) . Similarity of chemical biomarkers is seen in both conditions [histamines, markers of oxidative stress, auto-antibodies, heat shock protein (HSP), melatonin markers and leakage of the blood-brain barrier]. Low intensity pulsed microwave activation of voltage-gated calcium channels (VGCCs) is postulated as a mechanism of action for non-thermal health effects.

Mortazavi G, Mortazavi SM. Increased mercury release from dental amalgam restorations after exposure to electromagnetic fields as a potential hazard for hypersensitive people and pregnant women. (https://www.ncbi.nlm.nih.gov/pubmed/26544100) Rev Environ Health. 2015 Dec 1;30(4):287-92. doi: 10.1515/reveh-2015-0017.

- Over the past decades, the use of common sources of electromagnetic fields such as Wi-Fi routers and mobile phones has been increased enormously all over the world. There is ongoing concern that exposure to electromagnetic fields can lead to adverse health effects. It has recently been shown that even low doses of mercury are capable of causing toxicity. Therefore, efforts are initiated to phase down or eliminate the use of mercury amalgam in dental restorations. Increased release of mercury from dental amalgam restorations after exposure to electromagnetic fields such as those generated by MRI and mobile phones has been reported by our team and other researchers. We have recently shown that some of the papers which reported no increased release of mercury after MRI, may have some methodological errors. Although it was previously believed that the amount of mercury released from dental amalgam cannot be hazardous, new findings indicate that mercury, even at low doses, may cause toxicity. Based on recent epidemiological findings, it can be claimed that the safety of mercury released from dental amalgam fillings is questionable. Therefore, as some individuals tend to be hypersensitive to the toxic effects of mercury, *regulatory authorities should re-assess the safety of exposure to electromagnetic fields in* individuals with amalgam restorations. On the other hand, we have reported that increased mercury release after exposure to electromagnetic fields may be risky for the pregnant women. It is worth mentioning that as a strong positive correlation between maternal and cord blood mercury levels has been found in some studies, our findings regarding the effect of exposure to electromagnetic fields on the release of mercury from dental amalgam

Exhibit 1

fillings lead us to this conclusion that pregnant women with dental amalgam fillings should limit their exposure to electromagnetic fields to prevent toxic effects of mercury in their fetuses. Based on these findings, as infants and children are more vulnerable to mercury exposures, and as some individuals are routinely exposed to different sources of electromagnetic fields, we possibly need a paradigm shift in evaluating the health effects of amalgam fillings.

De Luca et al., Metabolic and Genetic Screening of Electromagnetic Hypersensitive Subjects as a Feasible Tool for Diagnostics and Intervention (http://www.hindawi.com/journals/mi/2014/924184/), *Mediators of Inflammation*, vol. 2014, no. 924184, 2014.

- Growing numbers of "electromagnetic hypersensitive" (EHS) people worldwide self-report severely disabling, multiorgan, non-specific symptoms when exposed to low-dose electromagnetic radiations, often associated with symptoms of multiple chemical sensitivity (MCS) and/or other environmental "sensitivity-related illnesses" (SRI). This cluster of chronic inflammatory disorders still lacks validated pathogenetic mechanism, diagnostic biomarkers, and management guidelines. We hypothesized that SRI, not being merely psychogenic, may share organic determinants of impaired detoxification of common physic-chemical stressors. Based on our previous MCS studies, we tested a panel of 12 metabolic blood redox-related parameters and of selected drug-metabolizing-enzyme gene polymorphisms, on 153 EHS, 147 MCS, and 132 control Italians, confirming MCS altered −0.0001) glutathione-(GSH), GSH-peroxidase/S-transferase, and catalase erythrocyte activities. We first described comparable—though milder—metabolic pro-oxidant/proinflammatory alterations in EHS with distinctively increased plasma coenzyme-Q10 oxidation ratio. Severe depletion of erythrocyte membrane polyunsaturated fatty acids with increased ω6/ω3 ratio was confirmed in MCS, but not in EHS. We also identified significantly altered distribution-versus-control of the CYP2C19*1/*2 SNP variants in EHS, and a 9.7-fold increased risk (OR: 95% C.−74.5) of developing EHS for the haplotype (null)GSTT1 + (null)GSTM1 variants. Altogether, results on MCS and EHS strengthen our proposal to adopt this blood metabolic/genetic biomarkers' panel as suitable diagnostic tool for SRI.

Redmayne, M. and O. Johansson. "Radiofrequency exposure in young and old: different sensitivities in light of age-relevant natural differences. (https://www.ncbi.nlm.nih.gov/pubmed/26613328)" *Rev Environ Health*, vol. 30, no. 4, 2015, pp. 323-35.

- Our environment is now permeated by anthropogenic radiofrequency electromagnetic radiation, and individuals of all ages are exposed for most of each 24 h period from transmitting devices. Despite claims that children are more likely to be vulnerable than healthy adults to unwanted effects of this exposure, there has been no recent examination of this, nor of comparative risk to the elderly or ill. We sought to clarify whether research supports the claim of increased risk in specific age-groups. First, we identified the literature which has explored age-specific pathophysiological impacts of RF-EMR. Natural life-span changes relevant to these different impacts provides context for our review of the selected literature, followed by discussion of health and well-being implications. We conclude that age-dependent RF-EMR study results, when considered in the context of developmental stage, indicate increased specific vulnerabilities in the young (fetus to adolescent), the elderly, and those with cancer. There appears to be at least one mechanism other than the known thermal mechanism causing different responses to RF-EMR depending upon the exposure parameters, the cell/physiological process involved, and according to age and

Exhibit 1

health status. As well as personal health and quality-of-life impacts, an ageing population means there are economic implications for public health and policy.

Tuengler A, von Klitzing L., Hypothesis on how to measure electromagnetic hypersensitivity. (https://www.ncbi.nlm.nih.gov/pubmed/23301924) *Electromagnetic Biology and Medicine*, vol. 32, no. 3, 3013, pp. 281-90.

- Electromagnetic hypersensitivity (EHS) is an ill-defined term to describe the fact that people who experience health symptoms in the vicinity of electromagnetic fields (EMFs) regard them as causal for their complaints. Up to now most scientists assume a psychological cause for the suffering of electromagnetic hypersensitive individuals. This paper addresses reasons why most provocation studies could not find any association between EMF exposure and EHS and presents a hypothesis on diagnosis and differentiation of this condition. Simultaneous recordings of heart rate variability, microcirculation and electric skin potentials are used for classification of EHS. Thus, it could be possible to distinguish "genuine" electromagnetic hypersensitive individuals from those who suffer from other conditions.

Juutilainen, Jukka, Timo Kumlin, and Jonne Naarala. "Do extremely low frequency magnetic fields enhance the effects of environmental carcinogens? A meta-analysis of experimental studies." (http://www.tandfonline.com/doi/abs/10.1080/09553000600577839) *International Journal of Radiation Biology*, vol. 82, no. 1, 2006, pp. 1-12.

- "This paper is a meta-analysis of data from *in vitro* studies and short-term animal studies that have combined extremely low frequency magnetic fields with known carcinogens or other toxic physical or chemical agents."
- "The majority of the studies reviewed were positive, suggesting that magnetic fields do interact with other chemical and physical exposures. Publication bias is unlikely to explain the findings. Interestingly, a nonlinear 'dose-response' was found, showing a minimum percentage of positive studies at fields between 1 and 3 mT."
- "Confirmed adverse effects even at 100 μT would have implications for risk assessment and management, including the need to reconsider the exposure limits for magnetic fields. There is an obvious need for further studies on combined effects with magnetic fields."

Rea, William J., et al. "Electromagnetic field sensitivity." (http://www.next-up.org /pdf/JournalOfBioelectricityElectromagneticFieldSensitivityCaseStudyEvaluationDrReaEHC1991.pdf) *Journal of Bioelectricity* 10.1-2 (1991): 241-256.

- A double-blind study showing that **EHS is a repeatable, physiological response of the autonomic nervous system to EMFs** when provocation studies are done in a controlled, shielded environment and subjects are exposed to the frequencies that they are sensitive to. 16 EHS subjects exposed to frequencies they were sensitive to showed a 100% response rate during two rechallenges.
- ***"The principal signs and symptoms produced were neurological (tingling, sleepiness, headache, dizziness, unconsciousness), musculoskeletal (pain, tightness, spasm, fibrillation), cardiovascular (palpitation, flushing, tachycardia, edema), oral/respiratory (pressure in earss tooth pains, tightness in chest, dyspnea), gastrointestinal (nausea, belching), ocular (burning), and dermal (itching, burning prickling pain) (Table 4). Most reactions were neurological."***

Dr. Marino's Research (http://andrewamarino.com/journalarticles.html) summaries that looks at

Exhibit 1

alloworigin=1) it here.

Proclamations in the USA: State of Colorado Proclamation on Electrical Hypersensitivity (http://www.emfrf.com/wp-content/uploads/2014/03/State_Colorado_Proclamation.pdf), State of Connecticut Proclamation (http://www.emfrf.com/wp-content/uploads/2014/03/State%20_Connecticut_Proclamation.pdf), Broward County Florida Proclamation (http://www.emfrf.com/wp-content/uploads/2014/03/Broward_County_Florida_Proclamation.pdf), Portland City Council Proclamation (http://www.emfrf.com/wp-content/uploads/2014/03/Portland_City_Council_Proclamation.pdf)

Recognition of the Electromagnetic Sensitivity as a Disability Under the ADA

The Architectural and Transportation Barriers Compliance Board (Access Board) is the Federal agency devoted to the accessibility for people with disabilities. The Access Board is responsible for developing and maintaining accessibility guidelines to ensure that newly constructed and altered buildings and facilities covered by the Americans with Disabilities Act and the Architectural Barriers Act are accessible to and usable by people with disabilities. In November 1999, the Access Board issued a proposed rule to revise and update its accessibility guidelines. During the public comment period on the proposed rule, the Access Board received approximately 600 comments from individuals with multiple chemical sensitivities (MCS) and electromagnetic sensitivities (EMS).

The Board has taken the commentary very seriously and acted upon it. As stated in the Background for its Final Rule Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Recreation Facilities that was published in September 2002:

"The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or other functions of an individual that it substantially limits one or more of the individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals".

Following its recognition of electro sensitivity and its declaration of commitment to attend to the needs of the electromagnetic sensitive, the Access Board contracted the National Institute of Building Sciences (NIBS) to examine how to accommodate the needs of the electro sensitive in federally funded buildings. In 2005 the NIBS issued a report.

View the report here

(https://web.archive.org/web/20060714175343/ieq.nibs.org/ieq_project.pdf)

Go to top

DOCUMENT ON ACCOMODATIONS IN USA

MEMORANDUM OF THE UNITED STATES DEPARTMENT OF EDUCATION OFFICE OF SPECIAL EDUCATION AND REHABILITATION SERVICES ADMINISTRATION REHABILITATION SERVICES ADMINISTRATION WASHINGTON (*https://ehtrust.org/wp-content/uploads* /DOE_EHStriggersMCS.pdf) on page 8 it states suggested ways to accommodate which include "minimizing exposure to electromagnetic fields from computers, fluorescent light ballasts, and other equipment."

Job Accommodations for People with Electrical Sensitivity (https://ehtrust.org/wp-content /uploads/JAN-EHS-1.pdf) Job Accommodation Network (JAN). Preparation of this item was

Exhibit 1

expected course of a particular disorder absent mitigating measures (such as a student with a peanut allergy could stop breathing after contact with peanuts.) This is why it is also beneficial to involve parents in the evaluation process, to access such information that parents may have.

A student is not required to stop taking needed medication or using another mitigating measure in order to receive an evaluation.

Therefore, when determining whether a student with a health concern has a disability, the school district must evaluate whether the health concern (for example, a tree nut allergy or diabetes) would be substantially limiting without considering the beneficial effects (amelioration) of medication or other measures.

The federal Access Board contracted the National Institute of Building Sciences (NIBS) to examine how to accommodate the needs of the electro sensitive in federally funded buildings. The 2005 NIBS Report Indoor Environmental Quality (IEQ) report is here . (https://web.archive.org/web/20060714175343/ieq.nibs.org/ieq_project.pdf)

On p. 51-52:

" **Cell Phones Turned Off**: *Protect those with electromagnetic sensitivities and others who may be adversely affected by electrical equipment.*"

"Ability to turn off or unplug computers and other electrical equipment by occupant or staff: Protect those with electromagnetic sensitivities."

"People with electromagnetic sensitivities can experience debilitating reactions... from electromagnetic fields emitted by computers, cell phones, and other electrical equipment. The severity of sensitivities varies among people with electromagnetic sensitivities...According to the Americans with Disabilities Act (ADA) and other disability laws, public and commercial buildings are required to provide reasonable accommodations for those disabled by electromagnetic sensitivities. These accommodations are best achieved on a case-by-case basis"

Go to top

PRESS

Electro-sensitivity caused by chronic nervous system arousal – Dr Roy Fox (https://maisonsaine.ca/sante-et-securite/electrosmog/ehs-royfo.html)

Is Wi-Fi making your child ill?: As France bans Wi-Fi in nursery and (https://www.telegraph.co.uk/lifestyle/wellbeing/11589857/Is-Wi-Fi-making-your-child-ill.html?fb_ref=Default) primary schools, a British expert who has given up using wireless gadgets says we should do the same. (https://www.telegraph.co.uk/lifestyle/wellbeing/11589857/Is-Wi-Fi-making-your-child-ill.html?fb_ref=Default) The Telegraph

What It's Like to Be Allergic to Wi-Fi NY Magazine (https://nymag.com/scienceofus/2015/03/what-its-like-to-be-allergic-to-wi-fi.html) By Alexa Tsoulis-Reay

The Town without WiFi (http://www.washingtonian.com/articles/people/the-town-without-wi-fi/), Washingtonian Magazine

Notre Dame Magazine I Am an EMF Refugee (http://magazine.nd.edu/news/67946-i-am-an-emf-refugee/)

Allergic to Wifi? Meet a group of people who say they absolutely are – Fox 8, 8th May 2017

Exhibit 2

Journal of Chemical Neuroanatomy

Volume 75, Part B, September 2016, Pages 43-51

Review

Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression

Martin L. Pall

Show more

https://doi.org/10.1016/j.jchemneu.2015.08.001

Journal of Chemical Neuroanatomy 75 (2016) 43–51

Contents lists available at ScienceDirect

Journal of Chemical Neuroanatomy

journal homepage: www.elsevier.com/locate/jchemneu

Review

Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression

Martin L. Pall

Professor Emeritus of Biochemistry and Basic Medical Sciences, Washington State University, 638 NE 41st Avenue, Portland, OR 97232-3312, USA

ARTICLE INFO

Article history:
Received 13 April 2015
Received in revised form 1 August 2015
Accepted 9 August 2015
Available online 21 August 2015

Keywords:
Excessive calcium effects
Oxidative/nitrosative stress
Low-intensity microwave electromagnetic fields

ABSTRACT

Non-thermal microwave/lower frequency electromagnetic fields (EMFs) act via voltage-gated calcium channel (VGCC) activation. Calcium channel blockers block EMF effects and several types of additional evidence confirm this mechanism. Low intensity microwave EMFs have been proposed to produce neuropsychiatric effects, sometimes called microwave syndrome, and the focus of this review is whether these are indeed well documented and consistent with the known mechanism(s) of action of such EMFs. VGCCs occur in very high densities throughout the nervous system and have near universal roles in release of neurotransmitters and neuroendocrine hormones. Soviet and Western literature shows that much of the impact of non-thermal microwave exposures in experimental animals occurs in the brain and peripheral nervous system, such that nervous system histology and function show diverse and substantial changes. These may be generated through roles of VGCC activation, producing excessive neurotransmitter/neuroendocrine release as well as oxidative/nitrosative stress and other responses. Excessive VGCC activity has been shown from genetic polymorphism studies to have roles in producing neuropsychiatric changes in humans. Two U.S. government reports from the 1970s to 1980s provide evidence for many neuropsychiatric effects of non-thermal microwave EMFs, based on occupational exposure studies. 18 more recent epidemiological studies, provide substantial evidence that microwave EMFs from cell/mobile phone base stations, excessive cell/mobile phone usage and from wireless smart meters can each produce similar patterns of neuropsychiatric effects, with several of these studies showing clear dose–response relationships. Lesser evidence from 6 additional studies suggests that short wave, radio station, occupational and digital TV antenna exposures may produce similar neuropsychiatric effects. Among the more commonly reported changes are sleep disturbance/insomnia, headache, depression/depressive symptoms, fatigue/tiredness, dysesthesia, concentration/attention dysfunction, memory changes, dizziness, irritability, loss of appetite/body weight, restlessness/anxiety, nausea, skin burning/tingling/dermographism and EEG changes. In summary, then, the mechanism of action of microwave EMFs, the role of the VGCCs in the brain, the impact of non-thermal EMFs on the brain, extensive epidemiological studies performed over the past 50 years, and five criteria testing for causality, all collectively show that various non-thermal microwave EMF exposures produce diverse neuropsychiatric effects.

Contents

E-mail address: martin_pall@wsu.edu.

http://dx.doi.org/10.1016/j.jchemneu.2015.08.001

Exhibit 2

Chemicals having roles:

Calcium(2+)
Nitric oxide (NO)
Oxido nitrite (peroxynitrite)

1. Introduction

Microwave syndrome (Hocking, 2001; Johnson Liakouris, 1998), a combination of various neuropsychiatric symptoms originally described in persons with occupational exposures to microwave frequency EMFs, has been disputed largely because of the lack of an apparent mechanism for generating these symptoms. It is reported to often include such symptoms as fatigue, headache, insomnia, dysesthesia (impaired sensation), irritability, lack of concentration and other symptoms (Hocking, 2001; Johnson Liakouris, 1998). Similar but more extensive combinations of symptoms have been reported following occupational exposures in two U.S. government reports from the 1970s/1980s (Naval Medical Research Institute Research Report, 1971; Raines, 1981) and following environmental exposures as described in two more recent reviews (Khurana et al., 2010; Levitt and Lai, 2010).

The goal here is not just to review the epidemiology, however, but more importantly to consider the issue of possible physiological mechanism(s). Hennekens and Buring (1989), on p. 40 in their textbook Epidemiology in Medicine state "The belief in the existence of a cause and effect relationship is enhanced if there is a known or postulated biologic mechanism by which the exposure might reasonably alter risk of developing disease." It is of critical importance therefore to assess possible biological mechanism before considering the epidemiological evidence.

Accordingly, this paper considers the mechanism by which low intensity microwave EMFs impact the cells of our bodies, how that mechanism may be predicted to impact the nervous system, evidence for such impact from experimental animal studies, genetic polymorphism evidence for that mechanism acting in humans to produce neuropsychiatric effects and finally, the epidemiological evidence for such effects in human populations with repeated low level microwave EMF exposure. Consideration of each of these types of evidence influences the overall interpretation presented in this paper.

2. Microwave/lower frequency EMFs act to activate voltage-gated calcium channels

In 24 different studies reviewed earlier (Pall, 2013) and two additional studies (Li et al., 2014; Lisi et al., 2006), microwave and lower frequency low intensity EMF effects were blocked or greatly lowered by calcium channel blockers, agents thought to be specific for blocking voltage-gated calcium channels (VGCCs). In these 26 studies, a total of 5 distinct types of channel blockers were used, with each type having a distinct structure and binding to a distinct site, such that it is essentially certain that these must be acting by blocking VGCCs, which is their only known common property. In each of these 26 studies, each of the responses studied, were blocked or greatly lowered by calcium channel blockers, showing that VGCC activation has roles in producing a wide variety of EMF effects. There is a large literature on changes in calcium fluxes and in calcium signaling following microwave EMF exposure (partially reviewed in Walleczek, 1992; Adey, 1993); each of these, including calcium efflux changes, can be explained as being due to VGCC activation, again suggesting a widespread role of VGCC activation in producing biological responses to EMFs. Pilla (2012) showed that pulsed microwave field exposure, produced an almost instantaneous increase in calcium/calmodulin-dependent nitric oxide (NO) signaling, providing strong evidence that these fields can produce an almost instantaneous VGCC activation. It is likely, that these EMFs act directly on the voltage sensor of the VGCCs to produce VGCC activation (Pall, 2015) with the voltage sensor being exquisitely sensitive to these EMFs because of its physical properties and location in the plasma membrane.

EMFs have been proposed to act to produce a wide variety of responses in the cell, via downstream effects of VGCC activation (Pall, 2013, 2014, 2015), including elevated intracellular calcium [Ca2+]i, excessive calcium and nitric oxide signaling and also excessive peroxynitrite, free radicals and oxidative stress.

VGCC activation has been shown to have a universal or near-universal role in the release of neurotransmitters in the brain and also in the release of hormones by neuroendocrine cells (Berridge, 1998; Dunlap et al., 1995; Wheeler et al., 1994), with such release being produced by calcium signaling. There are high densities of diverse VGCCs occurring in neurons throughout the nervous system. Both the high VGCC density and their function in neurotransmitter and neuroendocrine release throughout the nervous system suggests that the nervous system is likely to be highly sensitive to low intensity EMFs.

3. Genetic polymorphism studies

Genetic polymorphism studies are powerful tools for looking at the roles of specific proteins in human populations. In Table 1, a series of genetic polymorphism studies have been performed that show that an allele producing increased expression of the gene encoding the channel of the main L-type VGCC in the brain, produces diverse neuropsychiatric effects. These studies clearly show that excess L-type VGCC activity can cause neuropsychiatric effects. They also predict, therefore, that increased VGCC activity produced by microwave EMFs may be able to also produce widespread neuropsychiatric effects.

4. Histological and functional changes in central nervous system (CNS) and peripheral nervous system (PNS) in animals exposed to microwave EMFs

The most extensive literature on histological and functional changes in animals is from the Soviet literature from the 1950s/1960s with additional Western literature from the same time period. Both Soviet and non-Soviet literature were reviewed in an English language Publication by Tolgskaya and Gordon (1973). This publication is, therefore, the main focus of this section. That publication was divided into thermal and non-thermal exposure studies, with the non-thermal studies which occupy the majority of the text (pp. 53–137) being of sole interest here.

Exhibit 2

Table 1
Influence of genetic polymorphism of the CACNA1C in producing diverse neuropsychiatric effects.

Citation	Genetic polymorphism	Changes produced by allele of gene
Bhat et al. (2012)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Review: The polymorphism is associated with increased susceptibility to bipolar disorder, "depression, schizophrenia, autism spectrum disorders, as well as changes in brain function and structure in control subjects who have no diagnosable psychiatric illness."
Bigos et al. (2010)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Associated with increases in both bipolar disorder and schizophrenia
Krug et al. (2010)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Negatively influences language production on a semantic level
Krug et al. (2014)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Influences episodic memory and retrieval
Soeiro-de-Souza et al. (2012)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Produces impaired facial emotion recognition
Tesli et al. (2013)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Produces increased activation of the amygdala during emotional processing
Thimm et al. (2011)	Polymorphism producing increased expression of CACNA1C L-type VGCC subunit	Associated with attention deficits including alerting, orienting and executive control of attention

These were all derived from the Tolgskaya and Gordon (1973) review and page numbers listed are page numbers from that document. All refer to changes produced by non-thermal exposures in the nervous system of experimental animals, with most being in rats.

This discussion scrolls down through Table 2.

The majority of the histological changes seen in these mostly rodent studies, are seen in the nervous system, despite its being less than 2% of the rodent cell mass. There are statements made that the nervous system, both central and peripheral, is the most highly sensitive tissue to these non-thermal microwave and lower frequency EMFs. Following the nervous system in sensitivity are the myocardium and the testis; myocardial cells are known to have very high densities of VGCCs with especially high densities in the pacemaker cells and the testis is known to have high densities specifically of the T-type VGCCs. Pulsed EMFs are more active in producing histological changes in the brain than are non-pulsed fields, in two studies reviewed; there is a much larger literature showing that in most cases pulsed fields are more biologically active (Pall, 2015; Pangopoulos et al., 2013; Belyaev, 2015).

A wide variety of brain and peripheral nervous system tissues show histological changes following non-thermal exposures. Among the important tissues impacted are the hypothalamus and pituitary gland, where both show similar patterns of changes in neuroendocrine activities. There is an initial increase in neuroendocrine activity (this may be produced directly by VGCC stimulation of secretion), followed over time by "exhaustion" of neuroendocrine activity (this may be produced by tissue damage produced from long term intracellular calcium [Ca2+]i elevation).

There are widespread histological changes produced in neuronal and neuroendocrine tissues. These were repeatedly reported to be largely reversible on cessation of EMF exposure. They become, however, irreversible when exposure is extended in time. There are changes in EEG activity, which may be an easily measurable monitor of neurological damage.

In a summary statement, Tolgskaya and Gordon (1973) state, "This does not confirm the view, so widely held in the past among Soviet investigators and still maintained to a large extent even at the present time in the West, that the action of microwaves is entirely thermal."

While there were many studies of brain impact of non-thermal EMFs performed in the 1950s/60s that make the information content of Tolgskaya and Gordon (1973) quite high, there is also a substantial recent literature on brain effects of non-thermal microwave EMF exposures (see, for example: Ammari et al., 2008a,b; Bas et al., 2009; Brillaud et al., 2007; Carballo-Quintás et al., 2011; Eberhardt et al., 2008; Dasdag et al., 2009, 2012; Grafström et al., 2008; Kumlin et al., 2007; López-Martín et al., 2006; Mausset-Bonnefont et al., 2004; Odaci et al., 2008; Rağbetli et al., 2010; Salford et al., 2003; Sonmez et al., 2010).

5. Older epidemiological reviews and other related studies

Two U.S. Government reports each listed many apparent neuropsychiatric effects of microwave/radiofrequency EMFs and a third recognized the role of non-thermal effects on our bodies, but had only a little consideration of neuropsychiatric effects.

The earliest to these was a Naval Medical Research Institute (NMRI) Research Report (1971) which listed 40 apparent neuropsychiatric changes produced by non-thermal exposures including: 5 central/peripheral nervous system (NS) changes, 9 CNS effects, 4 autonomic system effects, 17 psychological disorders, 4 behavioral changes and 2 misc. effects. This NMRI report also provided a supplementary document listing over 2300 citations documenting these and other effects of microwave exposures in humans and in animals.

The Raines (1981) NASA report reviewed extensive literature based on occupational exposures to non-thermal microwave EMFs, with that literature coming from U.S., Western European and Eastern European studies. There are no obvious differences in the literature coming from these different regions. Based on multiple studies, Raines (1981) reports 19 neuropsychiatric effects to be associated with occupational microwave/radiofrequency EMFs.

The Bolen (1994) report put out by the Rome Laboratory of the U.S. Air Force, acknowledged the role of non-thermal effects of microwave EMFs on humans. This report states in the Conclusion section that "Experimental evidence has shown that exposure to low intensity radiation can have a profound effect on biological processes. The nonthermal effects of RF/MW radiation exposure are becoming important measures of biological interaction of EM fields." Clearly Bolen (1994) rejects the claim that only thermal effects occur. Bolen (1994) discusses a specific non-thermal neuropsychiatric effect, where anesthetized animals are awakened when the head is irradiated with microwave EMFs. This suggests a similar mechanism to that acting in humans where such EMFs produce insomnia (see below).

6. Specific epidemiological studies on neuropsychiatric effects of microwave EMFs

There are 26 different epidemiological studies described in Table 3. Although 4 of these only studied a single neuropsychiatric effect, 22 of these each provide substantial evidence for the pattern described in the earlier U.S. reports, that a wide range of

Exhibit 2

Table 2
Histological and functional changes in brain function in animals following exposure to non-thermal microwave EMFs.

Observations including page numbers	Comment from Author
The majority of the histological changes seen following non-thermal exposures, occurred in the nervous system, despite its being only about 2% of the tissue mass in rodents; this suggests that the nervous system is highly sensitive to such exposures. Elsewhere (pp. 129, 136), it is suggested that the nervous system is the most sensitive tissue, followed by the heart and the testis, among all of the tissues of the body. The most severe histological changes produced by these non-thermal EMF exposures occur in the nervous system (pp. 136).	High CNS sensitivity to EMFs is predicted by the high density of VGCCs that occur in neurons throughout the nervous system, plus the VGCC role in neurotransmitter and neuroendocrine release.
Pulsed fields were more active than non-pulsed fields in producing histological changes (pp. 71, 97).	Pulsed fields have often been found to be more biologically active than are non-pulsed fields in many different studies from many countries (Pall, 2015; Pangopoulos et al., 2013; Belyaev, 2015).
Nervous system regions impacted by non-thermal microwave and lower frequency fields include: cortex, diencephalon including the hypothalamus and thalamus, hippocampus, autonomic ganglia, sensory fibers, pituitary gland including neurohypophysis.	
Neuroendocrine changes seem to undergo change over increased time of exposure. Neurosecretion in the hypothalamus and in the pituitary each go through a complex sequence over time, where EMF exposure initially produces increased hormone secretion but where over time, the neurosecretory cells become "exhausted", leading to lowered secretion and in some cases cell death (pp. 77–96).	Elevated [Ca2+]i stimulates hormone secretion. However when such elevated [Ca2+]i occurs over extended time periods it is highly damaging to the cell, leading in some cases to apoptosis; thus this time course of action should not be surprising.
Histological changes include boutons/argyrophilia, smaller neurons, vacuole formation in neuroendocrine cells, bead-like thickening along dendrites (pp. 66, 70, 71, 73, 97, 98, 100, 111, 115–117, 121–125). Spines near the ends of dendrites become deformed and with still more sessions of irradiation, disappeared entirely (p. 70). Sensory neurons, following exposures, developed changes characteristic of irritation, with "marked tortuosity of the nerve fibers." Many histological changes are seen in the hypothalamic cells (pp. 87–92) as their neuroendocrine function becomes impacted. Histological changes were found even with exposures that produced no apparent functional changes.	
Many histological and functional changes are reported to initially be reversible, following cessation of exposure, but progressively become irreversible with longer exposure. (pp. 64, 72, 74). Paralleling the development of irreversibility, it is found that "Repeated exposure leads to gradual increase in severity of observed changes." . . including "increasingly severe disturbance of conditioned reflex activity in the animals, changes in responses of animals particularly sensitive to acoustic stimulation. . .." (p. 104).	If this is also true in humans, then claims that there cannot be non-thermal effects, claims which act to prolong exposures, may be causing irreversible damage to many humans.
EEG changes (pp. 55, 60, 102), including seizure activity following sensory provocation.	Lai (1997) has an extensive review of EEG changes in animals following non-thermal microwave EMF exposures
Neurodegeneration is reported in a number of places in this review (pp. 72, 83, 117).	
Synaptic connections in regions of the brain are disrupted (pp. 65–74, 97, 113, 121, 136), and at the extreme, some neurons are completely asynaptic (p. 73).	Synaptic connections are known to be disrupted in autism; could this suggest that autism may be generated by EMF exposure? No doubt, we need much more evidence on this. One wonders whether almost 60 years ago, the Soviet literature may have already described a possible animal model for EHS. None is known to exist today, and because of that, EHS studies are severely constrained. Clearly one needs to be skeptical about this interpretation, but it is of great importance that this be further studied.
"after prolonged and repeated irradiation with low-intensity centimeter waves, with no elevation of the body temperature and when the animal's condition remained satisfactory, changes were nevertheless found in the sensory fibers of the skin and viscera in the form of irritation phenomena. These findings concur with the view in the literature that the receptor system as a whole and, in particular its preterminal portions are highly sensitive." p. 76. This description is similar to what is reported to occur in electromagnetic hypersensitivity (EHS). Other such studies are described and include cumulative changes over time, that may also explain changes reported in EHS (pp. 75, 99, 100, 104).	

neuropsychiatric effects are produced by exposure to various non-thermal microwave frequency EMFs. Perhaps the most important of these 26 is the Santini et al. (2003) study of people living near cell phone base stations.

There are three recent studies on the generation of headache during or shortly following long mobile phone calls (listed under Chu et al., 2011 in Table 3). The timing of development of these headaches and the finding that they occur on the ipsilateral side of the head, the side receiving much higher EMF exposure during the call, both argue strongly that these headaches are caused by the long mobile phone calls. Such causality was concluded earlier by Frey (1998) based on earlier studies and is now still more strongly documented.

7. Criteria for assessing causality in epidemiological studies

It is important to consider the different criteria that allow one to judge whether a cause and effect relationship is justified by the studies listed in Table 3 and the individual studies cited in Raines (1981). There are five such criteria that should be considered in making that judgment (see pp. 39–43 in Hennekens and Buring, 1989):

Strength of Association: Is there a strong correlation between exposure and the neuropsychiatric symptoms? There clearly is for several studies cited in Raines (1981). One example is the Dwyer and Leeper (1978) study (see Table 3) where there is a large increase in symptoms and where that increase is greater with longer occupational exposure. Another example is the Lerner (1980) study of 1300 microwave workers, where workers with relatively low exposure levels had an approximate doubling of neurological complaints and where those with substantially higher exposure levels had an approximate tripling of neurological complaints over controls. Sadcikova (1974) found that 7 of 8 neuropsychiatric symptoms studied, showed a statistically significant rise in prevalence with longer occupational exposure (see Table 3). Sadcikova (1974), also found that microwave workers had increases of 3 to over 10-fold in: feeling of heaviness in the head; tiredness; irritability; sleepiness; partial loss of memory; and skin sensitivity. There is also a strong association where important new exposures occur – this is clearly the case with all of the studies of people living near cell/mobile phone base

Exhibit 2

Table 3
Neuropsychiatric symptoms apparently produced by exposure to various electromagnetic fields.

Citation	EMF exposure	Apparent neuropsychiatric symptoms
Abdel-Rassoul et al. (2007)	Living near mobile phone base station	Significant increases in neuropsychiatric complaints included: headache, memory changes, dizziness, tremors, depressive symptoms, sleep disturbance; attributed to effects of EMFs on the human nervous system.
Al-Khlaiwi and Meo (2004)	Mobile phone use	Higher prevalence of fatigue, headache, dizziness, tension and sleep disturbance; the authors conclude that mobile phone use is a risk factor for developing these symptoms.
Altpeter et al. (2000)	Short-wave broadcasting tower, ranging from 6.1 to 21.8 MHz	Sleep disruption shown to occur, correlated with exposures and apparent increase over time; short term suppression of melatonin shown, based on melatonin increases during a 3 day period when the tower was turned off.
Bortkiewicz et al. (2004)	Living near cell phone base station EMFs	Sleep disturbance, irritability, depression, blurred vision, concentration difficulties, nausea, lack of appetite, headache, vertigo.
Bortkiewicz et al. (2012)	Living near mobile phone base stations	Dose response relationships for sleep disturbance, irritability, depression, blurred vision, concentration difficulties, nausea, lack of appetite.
Chu et al. (2011), also Chia et al. (2000), Oftedal et al. (2000)	Mobile phone use	Headache during prolonged mobile phone use or within an hour following such use, with pain occurring on the ipsilateral side of the head; similar observations obtained in each of the 3 studies in column 1; see also Frey (1998).
Conrad (2013)	Smart meter EMF exposure	14 common new symptoms (both severe and moderate) among those exposed and symptomatic, 13 apparent neuropsychiatric: Insomnia, tinnitus, pressure in the head, concentration difficulty, headaches, memory problems, agitation, dizziness, fatigue, skin tingling/burning, involuntary muscle contractions, eye/vision problems, numbness; These ranged in prevalence from 63% to 19% of those experiencing symptoms, such that most symptomatic people experienced multiple symptoms.
Dasdag et al. (1992)	People working in MW broadcasting or at a television transmitter station	These groups suffered from headache, fatigue, irritability, stress, sleepiness, loss of appetite, loss of hearing.
Dwyer and Leeper (1978)	People working in radiofrequency EMFs	Headache, eyestrain, dizziness, disturbed sleep, daytime sleepiness, moodiness, mental depression, memory impairment, muscle and/or cardiac pain, breathing difficulties, increased perspiration, difficulty with sex life.
Eger and Jahn (2010)	Living near mobile phone base station	Neuropsychiatric symptoms, with most showing dose-response relationships: depression; headache; cerebral symptoms; dizziness; disorders of optical and acoustic sensory systems; sleep disturbance; skin changes; with the exception of dizziness, all of these had $p < 0.001$.
Johnson Liakouris (1998)	Study of personnel in U.S. embassy in Moscow exposed to microwave EMFs	Statistically significant increases in neurological (peripheral nerves and ganglia), dermographism (skin responses), irritability, depression, loss of appetite, concentration difficulties, peripheral ganglia and nerve dysfunction.
Khan (2008)	Excessive mobile phone use	Complaints of headache, fatigue, impaired concentration, memory disturbance, sleeplessness, hearing problems.
Kolodynskii and Kolodinska (1996)	Children living near a Radio Location Station, Latvia	Memory dysfunction, attention dysfunction, lowered motor function, slowed reaction time, lowered neuromuscular endurance.
Lamech (2014)	Exposure to wireless smart meter radiation in Victoria, Australia	The most frequent symptoms to develop after smart meter radiation exposure were insomnia, headache, tinnitus, fatigue, cognitive disturbances, dysesthesias (abnormal sensation), dizziness.
Navarro et al. (2003)	Living near cell phone base station	Statistically significant dose response relationships for fatigue, irritability, headache, nausea, loss of appetite, sleep disorder, depressive tendency, feeling of discomfort, difficulty of concentration, loss of memory, visual disorder & dizziness.
Oberfeld et al. (2004)	Living near cell phone base station	Statistically significant dose-response relationships for headache, fatigue, irritability, loss of appetite, visual disorder, nausea, sleeping disorders, dizziness, poor concentration, memory loss.
Oto et al. (1994)	Occupational exposure of 25 workers to either UHF television broadcasting (10) or to 1062 kHz medium wave broadcasting (15)	10 neuropsychiatric changes were assessed, all showing statistically significant changes compared with controls: Somatization*, obsessive compulsivity*, interpersonal sensitivity, depression, anxiety*, hostility*, phobic anxiety*, paranoid ideation, psychoticism*, sleeping disturbance. *$p < 0.001$.
Sadcikova (1974)	Occupational exposure to microwave radiation, including at <.07 mW/cm^2	Heaviness in head*, fatigue*, irritability*, sleepiness, memory loss*, cardiac pain*, dermographism (skin sensitivity)*, hyperhidrosis* * significant increase with time of exposure.
Salama and Abou El Naga (2004)	High cell (mobile) phone use	Most common effects were headache, ear ache, sense of fatigue, sleep disturbance, concentration difficulty, face burning sensation. The first three of these had very high statistical significance for correlation with extent of cell phone use.
Santini et al. (2003)	Living near cell phone base stations	Each of the following neuropsychiatric symptoms showed statistical significant dose-response relationships: nausea, loss of appetite, visual disturbance, irritability, depressive tendencies, lowered libido, headache, sleep disturbance, feeling of discomfort, fatigue.
Schüz et al. (2009)	Mobile phone use	Found a small, statistically significant increase in migraine and vertigo. Also found an apparent lowered occurrence of Alzheimer's, other dementia, Parkinson's and epilepsy – these latter were interpreted as being due to perhaps early symptoms of the developing diseases lowering probability of acquiring a mobile phone.
Söderqvist et al. (2008)	Use of mobile phone among adolescents	Increased mobile phone use was associated with increases in tiredness, stress, headache, anxiety, concentration difficulties and sleep disturbances.
Thomée et al. (2011)	High mobile phone use	High mobile phone use was associated with statistically significant rises in stress and sleep disturbance, with somewhat weaker association with depression.
Waldmann-Selsam et al. (2009)	Digital TV signaling	Constant headaches, pressure in head, drowsiness, sleep problems, tightness in chest, shortness of breadth, depressive mood, total apathy, loss of empathy, burning skin, inner burning, leg weakness, pain in limbs, stabbing pain in various organs, weight increase.

Exhibit 2

stations, listed in Table 3 and also with the two studies of people who become exposed to radiation from smart meters. The studies listed in Table 3 under Chu et al. (2011) (see also Chia et al., 2000; Oftedal et al., 2000) are of a special type. Here people making very long (over 1 h) cell/mobile phone calls develop headaches an hour or more following the initiation of the long call. So these occur within a specific time range following initiation of these long calls, such that headache would only occur very infrequently in that time frame by chance. So here again, there is a strong association. While there is no question that many of these studies show high strength of association, it is also clear that it is becoming progressively more difficult to do these studies. As exposures become almost universal in countries around the world, it is getting difficult if not impossible to find good negative controls. There may be a similar problem in doing animal studies, such that it may be necessary to raise animals in Faraday cages in order to avoid exposures that would otherwise occur as a consequence of our near ubiquitous EMFs.

Biological credibility is extremely strong here, with three aspects of the biology predicting that these low intensity fields cause widespread neuropsychiatric effects. This was discussed above and is reconsidered in the following section.

Consistency within the different epidemiological studies and with other types of studies. The epidemiological studies listed in Table 3 and also those showing neuropsychiatric effects that were cited in Raines (1981) have been performed in many different countries with different cultures. They have been performed in multiple countries in Western Europe, Eastern Europe, the Middle East and in East Asia, as well as in the U.S. and Australia. They are, therefore, not limited to one or two cultural contexts. This is deemed, therefore, an important indicator of causality. We also have a surprising consistency of apparent neuropsychiatric effects of different fields, including various occupational exposures and exposures to cell/mobile phone base stations, exposure to the phones themselves, exposure to smart meter pulses, and other EMFs (see Table 3). Pulsation patterns, frequencies and exact intensities may produce various biological responses (Pall, 2015; Pangopoulos et al., 2013; Belyaev, 2015) so it is a bit surprising that we have as much consistency as we do have across different types of exposures. We also have consistency with the biology discussed in the previous section. Because elevated VGCC activity produced by genetic polymorphism (Table 1) produces diverse neuropsychiatric effects, it is not surprising that elevation of VGCC activity produced by microwave EMF exposure apparently also produces diverse neuropsychiatric effects. Similarly because non-thermal EMF exposures produce widespread changes in brain structure and function in animals (Tolgskaya and Gordon, 1973), it is not surprising that the neuropsychiatric symptoms, which are produced as a consequence of brain dysfunction are produced by such EMFs.

Time sequence: It is clear that the all of these effects follow exposure in the various studies that have been published. In some studies, it is also clear that longer occupational exposure times produce increased symptom prevalence. These include Dwyer and Leeper (1978) and Baranski and Edelwejn (1975). These observations all support a causal relationship between exposure to EMF and the development of neuropsychiatric symptoms.

Dose–response relationship: It is assumed, here, that biological effects have a positive correlation with the intensity of the apparent causal stressor. This is not necessarily true of EMF effects, because it has been shown that there are "window effects" where specific intensities have larger biological effects, than *do either lower or higher intensities* (Pall, 2015; Pangopoulos et al., 2013; Belyaev, 2015). Nevertheless, where different intensities were studied in these epidemiological studies, they do show the dose–response relationship assumed here including Altpeter et al. (2000), Dwyer and Leeper (1978), Eger and Jahn (2010), Lerner (1980), Navarro et al. (2003), Oberfeld et al. (2004), Salama and Abou El Naga (2004), Santini et al. (2003) and Thomée et al. (2011). Thus these data do fit well to the assumed dose–response relationship, found in most causal roles. The Altpeter et al. (2000) study showed a special type of evidence for causality: during a 3-day period when the broadcasting tower was turned off, the melatonin levels recovered to near-normal levels. The studies of headache occurrence on prolonged cell/mobile phone calls (typically well over one hour) listed under Chu et al. (2011) in Table 3 also suggest the assumed dose–response relationship (see also Chia et al., 2000; Oftedal et al., 2000 and earlier citations listed in Frey, 1998). Because such headaches only occur with prolonged cell/mobile phone calls, these studies also provide evidence for a dose–response relationship because low doses are ineffective. Furthermore these same studies provide evidence for such a dose–response relationship from another type of observation. Because the headaches occur predominantly on the ipsilateral side of the head which receives much higher EMF exposure intensity, rather than on the contralateral side of the head, which receives much lower intensities, this provides an additional type of evidence for the predicted dose–response relationship.

While the evidence is convincing that the various neuropsychiatric apparent consequences of microwave EMF exposure are in fact caused by such exposures, there may be somewhat more controversy about another EMF-neuropsychiatric linkage. Havas et al. (2010) have reported a similar list of neuropsychiatric symptoms in electromagnetic hypersensitivity (EHS) patients. They found that each of the following symptoms were common in EHS: poor short term memory; difficulty of concentration; eye problems; sleep disorder; feeling unwell; headache; dizziness; tinnitus; chronic fatigue; tremors; body pain; difficulty speaking; tingling sensation in feet or hands; difficulty writing; difficulty walking; migraine. The similarity of these symptoms to the most commonly found symptoms following non-thermal microwave EMF exposures (Table 3), suggests that EHS is a genuine sensitivity to EMFs. In the bottom row in Table 2, sensitivities were found in rodent studies following non-thermal exposure that suggest a possible animal model for the study of EHS. Each of these EHS-related issues needs to be followed up experimentally.

8. Discussion and conclusions

In the previous section, each of the five criteria for assessing whether an epidemiological association is causal, were considered. Those five are (Hennekens and Buring, 1989): (1) strength of association; (2) biological credibility; (3) consistency; (4) time sequence; (5) dose–response relationship. Each of these five provide strong support for causality such that the combination of all five provides compelling evidence for causality. Low-intensity microwave frequency EMFs do cause diverse neuropsychiatric symptoms. While each of these five is important here, the one that is most important is the criterion of biological credibility.

Three related sets of biological observations each predict that low-intensity microwave EMFs produce widespread neuropsychiatric effects:

1. Such EMFs act via activation of VGCCs, acting through the VGCC voltage sensor which is predicted to be exquisitely sensitive to these EMFs (Pall, 2015). VGCCs occur in high densities throughout the nervous system and have essential roles throughout the nervous system in releasing neurotransmitters and neuroendocrine hormones. These properties predict, therefore, that these low intensity non-thermal microwave EMFs cause widespread changes in the nervous system, causing, in turn, diverse neuropsychiatric effects.

Exhibit 2

2. Elevated VGCC activity, produced by an allele of the CACNA1C gene which encodes the channel of the main L-type VGCC in the brain, produces various neuropsychiatric effects (Table 1). This predicts, that low intensity non-thermal microwave frequency EMFs which also produce elevated L-type and other VGCC activity, therefore produce widespread neuropsychiatric effects.
3. Studies reviewed in the Tolgskaya and Gordon, 1973 publication (Table 2) have shown that the cells of the mammalian nervous system show high sensitivity to various non-thermal microwave and lower frequency EMFs, being apparently more sensitive than any other organ in the body of rodents. These studies predict that the human nervous system is likely to be similarly sensitive to these EMFs, predicting, therefore, widespread neuropsychiatric effects in humans.

We not only have biological credibility but also more importantly, each of these distinct but interrelated biological considerations predicts that low-intensity, non-thermal microwave EMFs produce widespread neuropsychiatric effects. That common prediction is verified by extensive data summarized in citations provided by the Naval Medical Research Institute Research Report (June 1971), data provided by The Raines (1981) NASA report, and by 26 epidemiological studies summarized in Table 3.

The most commonly reported neuropsychiatric symptoms from these studies are summarized in Table 4.

A total of 22 different studies described in Table 3 were used for data for this table, but not 4 others that only assessed a single neuropsychiatric end point. The Altpeter study which only assessed sleep disturbance/melatonin depletion and the three studies listed under Chu et al. which only assessed headache occurrence following long cell phone calls, listed in Table 3 were not included. Because many of the studies only assessed from 3 to 7 specific symptoms, it is not surprising that the numbers of studies reporting a specific symptom fall far below 22. Where several symptom descriptions were included under one heading, such as dysesthesia, if a study had more than one of these symptom descriptions, it was only counted once.

All the symptoms listed in Table 4 should be considered established parts of microwave syndrome (Hocking, 2001; Johnson Liakouris, 1998). Even if the statistical significance in each study was of the lowest statistical significance ($p < .05$) one would expect only 1 positive study to occur at random out of the 22 studies included here. Because many individual symptoms were not surveyed in many individual studies, the expectation is substantially lower than that. Each of these, having shown positive results in 5 or more studies are highly unlikely, therefore, to have occurred by chance. Stong statistical significance is also seen for individual neuropsychiatric effects reported to have $p < 0.001$ in the Eger and Jahn (2010) and Oto et al. (1994) studies (see Table 3).

Table 4
Commonly reported neuropsychiatric symptoms following microwave EMF exposure.

Symptom(s)	Numbers of studies reporting
Sleep disturbance/insomnia	17
Headache	14
Fatigue/tiredness	11
Depression/depressive symptoms	10
Dysesthesia (vision/hearing/olfactory dysfunction)	10
Concentration/attention/cognitive dysfunction	10
Dizziness/vertigo	9
Memory changes	8
Restlessness/tension/anxiety/stress/agitation/feeling of discomfort	8
Irritability	7
Loss of appetite/body weight	6
Skin tingling/burning/inflammation/dermographism	6
Nausea	5

EEG changes may well be part of microwave syndrome, as well. While none of the studies described in Table 3 measured EEGs, six studies of human occupational exposure cited in the Raines (1981) showed EEG changes (Baranski and Edelwejn, 1975; Bise, 1978; Dumanskij and Shandala, 1974; Lerner, 1980; Sheppard and Eisenbud, 1977). Murbach et al. (2014) cited 10 human studies in support of their statement that "the most consistently reported effects (of mobile phone use) in various studies conducted by different laboratories are changes in the electroencephalogram (EEG) power spectrum." Three recent studies (Lustenberger et al., 2013; Schmid et al., 2012a,b) and several earlier studies cited in Wagner et al. (1998) have each shown EEG changes in sleeping humans exposed to non-thermal pulsed microwave fields. Two recent studies showed EEG changes in persons exposed to Wi-Fi fields (Maganioti et al., 2010; Papageorgiou et al., 2011). Lai (1997) described 8 animal studies showing changes in EEG patterns in animals exposed to non-thermal EMFs and three additional animal studies were described in Tolgskaya and Gordon (1973). With the exception of the 6 studies cited in the second sentence in this paragraph, all of these are direct experimental studies which are not, therefore, susceptible to the questions of causality that can be raised about epidemiological studies. It is the author's view that future studies should consider studying EEG changes as an objectively measurable assessment of brain physiology and that before and after increased exposure studies should be considered when a new EMF source is to be introduced into human populations. While such studies must be done carefully, given the complexity of EEGs, even very small numbers of individuals may produce highly statistically significant results in well designed studies analyzed with paired *t*-tests.

One of the citations from the previous paragraph, Bise (1978) reviewed earlier studies of low level microwave frequency exposures in humans and concluded that such EMFs produced the following neuropsychiatric effects: headache, fatigue, irritability, dizziness, loss of appetite, sleepiness, sweating, difficulty of concentration, memory loss, depression, emotional instability, dermographism, tremor, hallucinations and insomnia. The strong similarity of this list from 37 years ago and the list in Table 4 should be noted. The Bise (1978) list is based on occupational exposure studies whereas the current list in Table 4 is based primarily on EMF exposures from cell/mobile phone base stations, from heavy cell phone usage and from smart meters, three types of exposures that did not exist in 1978. The strong similarity between the Bise (1978) list and the current one 37 years later alone produces a compelling argument that the 11 neuropsychiatric effects found on both lists are caused by exposure to multiple types of low-intensity microwave EMFs.

The pattern of evidence is compelling in support of the earlier statement of Levitt and Lai (2010) that "the primary questions now involve specific exposure parameters, not the reality of complaints or attempts to attribute such complaints to psychosomatic causes, malingering or beliefs in paranormal phenomena."

We can barely imagine how the combinations of neuropsychiatric effects, including those in Table 4, will influence human behavior and social interactions, now that the majority of the human populations on earth are exposed to ever increasing intensities and diversity of microwave frequency EMFs. You may recall that three of the occupational exposure studies cited in (Raines, 1981 showed increasing prevalence of neuropsychiatric symptoms with years of exposure to consistent patterns of EMF exposure intensities (Dwyer and Leeper, 1978; Sadcikova, 1974;

Exhibit 2

Baranski and Edelwejn, 1975). With ever increasing exposures in human populations, we have no idea what the consequences of these ever increasing exposures will be.

Conflict of interest

The author declares no conflict of interest.

References

Abdel-Rassoul, G., El-Fateh, O.A., Salem, M.A., Michael, A., Farahat, F., El-Batanouny, M.A., Salem, E., 2007. Neurobehavioral effects among inhabitants around mobile phone stations. Neurotoxicology 28, 434–440.

Adey, W.R., 1993. Biological effects of electromagnetic fields. J. Cell. Biochem. 51, 410–416.

Al-Khlaiwi, T., Meo, S.A., 2004. Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population. Saudi Med. J. 25, 732–736.

Altpeter, E., Battaglia, M., Bader, A., Pluger, D., Minder, C.E., Abelin, T., 2000. Ten Years Experience with Epidemiological Research in the Vicinity of the Short-Wave Broadcasting Area Schwarzenburg: What does the Story Tell Us? , http://www.salzburg.gv.at/Proceedings_%2819%29_Altpeter.pdf.

Ammari, M., Brillaud, E., Gamez, C., Lecomte, A., Sakly, M., Abdelmelek, H., de Seze, R., 2008a. *Effect of a chronic GSM 900 MHz exposure on glia in the* rat brain. Biomed. Pharmacother. 62, 273–281.

Ammari, M., Lecomte, A., Sakly, M., Abdelmelek, H., de-Seze, R., 2008b. Exposure to GSM 900 MHz electromagnetic fields affects cerebral cytochrome c oxidase activity. Toxicology 250, 70–74.

Baranski, S., Edelwejn, Z., 1975. Experimental morphologic and electroencephalographic studies of microwave effects on the nervous system. Ann. N. Y. Acad. Sci. 47, 109–116.

Bas, O., Odaci, E., Kaplan, S., Acer, N., Ucok, K., Colakoglu, S., 2009. 900 MHz electromagnetic field exposure affects qualitative and quantitative features of hippocampal pyramidal cells in the adult female rat. Brain Res. 1265, 178–185.

Belyaev, I., 2015. Biophysical mechanisms for nonthermal microwave effects. In: Markov, Marko S. (Ed.), Electromagnetic Fields in Biology and Medicine. CRC Press, New York, pp. 49–67.

Berridge, M.J., 1998. Neuronal calcium signaling. Neuron 21, 13–26.

Bhat, S., Dao, D.T., Terrillion, C.E., Arad, M., Smith, R.J., Soldatov, N.M., Gould, T.D., 2012. CACNA1C (Cav1.2) in the pathophysiology of psychiatric disease. Prog. Neurobiol. 99, 1–14.

Bigos, K.L., Mattay, V.S., Callicott, J.H., Straub, R.E., Vakkalanka, R., Kolachana, B., Hyde, T.M., Lipska, B.K., Kleinman, J.E., Weinberger, D.R., 2010. Genetic variation in CACNA1C affects brain circuitries related to mental illness. Arch. Gen. Psychiatry 67, 939–945.

Bise, W., 1978. Low power radio-frequency and microwave effects on human *electroencephalogram and behavior. Physiol. Chem. Phys. 10, 387–398.*

Bolen, S.M., 1994. Radiofrequency/Microwave Radiation Biological Effects and Safety Standards: A Review. AD-A282 886, Rome Laboratory, U.S. Air Force Material Command, Griffiss Air Force Base, New York.

Bortkiewicz, A., Zmyslony, M., Szyjkowska, A., Gadzicka, E., 2004. Subjective *symptoms reported by people living in the vicinity of cellular phone base* stations: review. Med. Pr. 55, 345–351.

Bortkiewicz, A., Gadzicka, E., Szyjkowska, A., Politański, P., Mamrot, P., Szymczak, W., Zmyślony, M., 2012. Subjective complaints of people living near mobile phone base stations in Poland. Int. J. Occup. Med. Environ. Health 25, 31–40.

Brillaud, E., Piotrowski, A., de Seze, R., 2007. Effect of an acute 900 MHz GSM exposure on glia in the rat brain: a time-dependent study. Toxicology 238, 23–33.

Carballo-Quintás, M.I., Martínez-Silva, I., Cadarso-Suárez, C., Alvarez-Figueiras, M., Ares-Pena, F.J., López-Martín, E., 2011. A study of neurotoxic biomarkers, c-fos and GFAP after acute exposure to GSM radiation at 900 MHz in the picrotoxin model of rat brains. Neurotoxicology 32, 478–494.

Chia, S.E., Chia, H.P., Tan, J.S., 2000. Prevalence of headache among handheld cellular telephone users in Singapore: a community study. Environ. Health Perspect. 108, 1059–1062.

Chu, M.K., Song, H.G., Kim, C., Lee, B.C., 2011, September. Clinical features of headache associated with mobile phone use: a cross-sectional study in university students. BMC Neurol. 11, 115. http://dx.doi.org/10.1186/1471-2377-11-115.

Conrad, R.H., 2013. Smart Meter Health Effects Survey and Report, http://www.mainecoalitiontostopsmartmeters.org/wp-content/uploads/2013/02/Exhibit-D-Smart-Meter-Health-Effects-Report-w-AppendicesV3-1-9Reduced-Appendices.pdf.

Dasdag, S., Akdag, M.Z., Ulukaya, E., Uzunlar, A.K., Ocak, A.R., 2009. Effect of *mobile phone exposure on apoptotic glial cells and status of oxidative stress* in rat brain. Electromagn. Biol. Med. 28, 342–354.

Dasdag, S., Akdag, M.Z., Kizil, G., Kizil, M., Cakir, D.U., Yokus, B., 2012. Effect of 900 MHz radio frequency radiation on beta amyloid protein, protein carbonyl, and malondialdehyde in the brain. Electromagn. Biol. Med. 31, 67–74.

Dasdag, S., Balci, K., Celik, M.S., Batun, S., Kaplan, A., Bolaman, Z., Tekes, S., Akdag, Z., 1992. Neurologic and biochemical findings and CD4/CD8 ratio in people occupationally exposed to RF and microwave. Biotechnol. Biotechnol. Equip. 6 (4), 37–39.

Dumanskij, J.D., Shandala, M.G., 1974. The biologic action and hygienic significance of electromagnetic fields of super-high and ultrahigh frequencies in densely populated areas. In: Czerski, P., et al. (Eds.), Effects and Health Hazards of Microwave Radiation, Proceedings of an International Symposium, Warsaw15–18 October 1973.

Dunlap, K., Luebke, J.L., Turner, T.J., 1995. Exocytic Ca^{++} channels in the mammalian central nervous system. Neuroscience 18, 89–98.

Dwyer, M.J., Leeper, D.B., 1978. A Current Literature Report on the Carcinogenic Properties of Ionizing and Nonionizing Radiation. DHEW Publication (NIOSH), , pp. 78–134.

Eberhardt, J.L., Persson, B.R., Brun, A.E., Salford, L.G., Malmgren, L.O., 2008. Blood-brain barrier permeability and nerve cell damage in rat brain 14 and 28 days after exposure to microwaves from GSM mobile phones. Electromagn. Biol. Med. 27, 215–229.

Eger, H., Jahn, M., 2010. Specific symptoms and radiation from mobile basis *stations in Selbitz, Bavaria, Germany: evidence for dose-effect relationship.* Umw. - Med. Ges. 23, 130–139.

Frey, A.H., 1998. Headaches from cellular telephones: are they real and what are the implications? Environ. Health Perspect. 106, 101–103.

Grafström, G., Nittby, H., Brun, A., Malmgren, L., Persson, B.R., Salford, L.G., *Eberhardt, J., 2008. Histopathological examinations of rat brains after long-*term exposure to GSM-900 mobile phone radiation. Brain Res. Bull. 77, 257–263.

Havas, M., Marrongelle, J., Pollner, B., Kelley, E., Rees, C.R.G., Tully, L., 2010. Provocation study using heart rate variability shows microwave radiation from 2.4 GHz phone affects autonomic nervous system. Eur. J. Oncol. Libr. 5, 273–300.

Hennekens, C.H., Buring, J.E., 1989. Epidemiology in Medicine. Little Brown and Co., Boston.

Hocking, B., 2001. Microwave sickness: a reappraisal. Occup. Med. 51, 66–69.

Johnson Liakouris, A.G., 1998. Radiofrequency (RF) sickness in the Lilienfeld study: an effect of modulated microwaves? Arch. Environ. Health 53, 226–228.

Khan, M.M., 2008. Adverse effects of excessive mobile phone use. Int. J. Occup. Med. Environ. Health 21, 289–293.

Khurana, V.G., Hardell, L., Everaert, J., Bortkiewicz, A., Carlberg, M., Ahonen, M., 2010. Epidemiological evidence for a health risk from mobile phone base stations. Int. J. Occup. Environ. Health 16, 263–267.

Kolodynskii, A.A., Kolodinska, V.V., 1996. Motor and psychological functions of *school children living in the area of the Skrunda Radio Location Station in* Latvia. Sci. Total Environ. 180, 87–93.

Krug, A., Nieratschker, V., Markov, V., Krach, S., Jansen, A., Zerres, K., Eggermann, T., Stöcker, T., Shah, N.J., Treutlein, J., Mühleisen, T.W., Kircher, T., 2010. Neuroimage 49, 1831–1836.

Krug, A., Witt, S.H., Backes, H., Dietsche, B., Nieratschker, V., Shah, N.J., Nöthen, M.M., Rietschel, M., Kircher, T., 2014. A genome-wide supported variant in CACNA1C influences hippocampal activation during episodic memory encoding and retrieval. Eur. Arch. Psychiatry Clin. Neurosci. 264, 103–110.

Kumlin, T., Iivonen, H., Miettinen, P., Juvonen, A., van Groen, T., Puranen, L., Pitkäaho, R., Juutilainen, J., Tanila, H., 2007. Mobile phone radiation and the developing brain: behavioral and morphological effects in juvenile rats. Radiat. Res. 168, 471–479.

Lai, H., 1997. Neurological effects of radiofrequency electromagnetic radiation relating to wireless communication technology. In: Paper presented at the IBC-UK Conference: "Mobile Phones – Is There a Health Risk?". , http://www.papcruzin.com/radiofrequency/henry_lai1.htm.

Lamech, F., 2014. Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: a case series. Altern. Ther. Health Med. 20, 28–39.

Lerner, E.J., 1980. RF radiation: biological effects. IEEE Spectr. 17 (December), 51–59.

Levitt, B.B., Lai, H., 2010. Biological effects from exposure to electromagnetic radiation emitted by cell towers base stations and other antenna arrays. Environ. Rev. 18, 369–395.

Li, Y., Yan, X., Liu, J., Li, L., Hu, X., Sun, H., Tian, J., 2014. Pulsed electromagnetic field enhances brain-derived neurotrophic factor expression through L-type voltage-gated calcium channel- and Erk-dependent signaling pathways in *neonatal rat dorsal root ganglion neurons. Neurochem. Int. 75, 96–104.*

Lisi, A., Ledda, M., Rosola, E., Pozzi, D., D'Emilia, E., Giuliani, L., Foletti, A., Modesti, A., Morris, S.J., Grimaldi, S., 2006. Extremely low frequency electromagnetic field exposure promotes differentiation of pituitary corticotrope-derived AtT20 D16V cells. Bioelectromagnetics 27, 641–651.

López-Martín, E., Relova-Quinteiro, J.L., Gallego-Gómez, R., Peleteiro-Fernández, M., Jorge-Barreiro, F.J., Ares-Pena, F.J., 2006. GSM radiation triggers seizures and increases cerebral c-Fos positivity in rats pretreated with subconvulsive doses of picrotoxin. Neurosci. Lett. 398, 139–144.

Lustenberger, C., Murbach, M., Dürr, R., Schmid, M.R., Kuster, N., Achermann, P., Huber, R., 2013. Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent performance improvement. Brain Stimul. 6, 805–811.

Maganioti, A.E., Papageorgiou, C.C., Hountala, C.D., Kyprianou, M.A., Rabavilas, A.D., Papadimitriou, G.N., Capsalis, C.N., 2010. Wi-Fi electromagnetic fields exert gender related alterations of EEG. In: 6th International Workshop on

Exhibit 2

Biological Effects of Electromagnetic Fields, Bodrun, Turkey, October, http://www.istanbul.edu.tr/6internatwshopbioeffemf/.
Mausset-Bonnefont, A.L., Hirbec, H., Bonnefont, X., Privat, A., Vignon, J., de Seze, R., 2004. Acute exposure to GSM 900 MHz electromagnetic fields induces glial reactivity and biochemical modifications in the rat brain. Neurobiol. Dis. 17, 445–454.
Murbach, M., Neufeld, E., Christopoulou, M., Achermann, P., Kuster, N., 2014. Modeling of EEG electrode artifacts and thermal ripples in human radiofrequency exposure studies. Bioelectromagnetics 35, 273–283.
Naval Medical Research Institute Research Report, 1971, June. Biobliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation. Report No. 2 Revised.
Navarro, G., Segure, J., Porteles, M., Perretta, Gomez, 2003. The microwave syndrome: study in Spain. Electromag. Biol. Med. 22, 161–169.
Oberfeld, G., Navarro, A.E., Portoles, M., Maestu, C., Gomez-Perretta, C., 2004. The microwave syndrome: further aspects of a Spanish study, http://www.apdr.info/electrocontaminacion/Documentos/Investigacion/ESTUDOS%20EPIDEMIOLOXIDOS%20E%20ANTENAS/The%20Microwave%20Syndrome%20-%20Further%20Aspects%20of%20a%20Spanish%20Study.pdf.
Odaci, E., Bas, O., Kaplan, S., 2008. Effects of prenatal exposure to a 900 MHz electromagnetic field on the dentate gyrus of rats: a stereological and histopathological study. Brain Res. 1238, 224–249.
Oftedal, G., Wilén, J., Sandström, M., Mild, K.H., 2000. Symptoms experienced in connection with mobile phone use. Occup. Med. (Lond.) 50, 237–245.
Oto, R., Akdag, Z., Dasdag, S., Celik, Y., 1994. Evaluation of psychologic parameters in people occupationally exposed to radiofrequencies and microwave. Biotechnol. Biotechnol. Equip. 8 (4), 71–74.
Pall, M.L., 2013. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. J. Cell. Mol. Med. 17, 958–965.
Pall, M.L., 2014. Electromagnetic field activation of voltage-gated calcium channels: role in therapeutic effects. Electromagn. Biol. Med. 33, 251.
Pall, M.L., 2015. Review: scientific evidence contradicts findings and assumptions of Canadian safety panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts a non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. Rev. Environ. Health 30, 99–116.
Pangopoulos, D.J., Johansson, O., Carlo, G.L., 2013. Evaluation of specific absorption rate as a dosimetric quantity for electromagnetic fields bioeffects. PLOS ONE 8 (6), e62663.
Papageorgiou, C.C., Hountala, C.D., Maganioti, A.E., Kyprianou, M.A., Rabavilas, A.D., Papadimitriou, G.N., Capsalis, C.N., 2011. Effects of wi-fi signals on the p300 component of event-related potentials during an auditory hayling task. J. Integr. Neurosci. 10, 189–202.
Pilla, A.A., 2012. Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems. Biochem. Biophys. Res. Commun. 426, 330–333.
Rağbetli, MC1, Aydinlioğlu, A., Koyun, N., Rağbetli, C., Bektas, S., Ozdemir, S., 2010. The effect of mobile phone on the number of Purkinje cells: a stereological study. Int. J. Radiat. Biol. 86, 548–554.
Raines, J.K., 1981, April. Electromagnetic Field Interactions with the Human Body: Observed Effects and Theories. National Aeronautics and Space *Adminstration, NASA CR 166661, Greenbelt, Maryland.*
Sadcikova, M.N., 1974. Clinical manifestations of reactions to microwave radiation in various occupational groups. In: Czerski, P. (Ed.), Biological Effects and Health Hazards of Microwave Radiation. Proceedings of the International Symposium, Warsaw 13–18 October 1973. Polish Med Publishers, Warsaw, pp. 261–267.
Salama, O.E., Abou El Naga, R.M., 2004. Cellular phones: are they detrimental? J. Egypt. Public Health Assoc. 79, 197–223.
Salford, L.G., Brun, A.E., Eberhardt, J.L., Malmgren, L., Persson, B.R., 2003. Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. Environ. Health Perspect. 111, 881–883.
Santini, R., Santini, P., Le Ruz, P., Danze, J.M., Seigne, M., 2003. Survey of people living in the vicinity of cellular phone base stations. Electromagn. Biol. Med. 22, 41–49.
Schmid, M.R., Loughran, S.P., Regel, S.J., Murbach, M., Bratic Grunauer, A., Rusterholz, T., Bersagliere, A., Kuster, N., Achermann, P., 2012a. Sleep EEG alterations: effects of different pulse-modulated radio frequency electromagnetic fields. J. Sleep Res. 21, 50–58.
Schmid, M.R., Murbach, M., Lustenberger, C., Maire, M., Kuster, N., Achermann, P., Loughran, S.P., 2012b. Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequency electromagnetic fields. J. Sleep Res. 21, 620–629.
Schüz, J., Waldemar, G., Olsen, J.H., Johansen, C., 2009. Risks for central nervous system diseases among mobile phone subscribers: a Danish retrospective cohort study. PLoS ONE 4 (2), e4389, http://dx.doi.org/10.1371/journal.pone.0004389.
Sheppard, A.R., Eisenbud, M., 1977. Biological Effects of Electric and Magnetic Fields of Extremely Low Frequency. New York University Press, New York.
Söderqvist, F., Carlberg, M., Hardell, L., 2008. Use of wireless telephones and self-reported health symptoms: a population-based study among Swedish adolescents aged 15–19 years. Environ. Health 7 (May), 18, http://dx.doi.org/10.1186/1476-069X-7-18.
Soeiro-de-Souza, M.G., Otaduy, M.C., Dias, C.Z., Bio, D.S., Machado-Vieira, R., Moreno, R.A., 2012. The impact of the CACNA1C risk allele on limbic structures and facial emotions recognition in bipolar disorder subjects and healthy controls. J. Affect. Disord. 141, 94–101.
Sonmez, O.F., Odaci, E., Bas, O., Kaplan, S., 2010. Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field. Brain Res. 1356, 95–101.
Tesli, M., Skatun, K.C., Ousdal, O.T., Brown, A.A., Thoresen, C., Agartz, I., Melle, I., Djurovic, S., Jensen, J., Andreassen, O.A., 2013. CACNA1C risk variant and amygdala activity in bipolar disorder, schizophrenia and healthy controls. PLOS ONE 8 (2), e56970, http://dx.doi.org/10.1371/journal.pone.0056970.
Thimm, M., Kircher, T., Kellermann, T., Markov, V., Krach, S., Jansen, A., Zerres, K., Eggermann, T., Stöcker, T., Shah, N.J., Nöthen, M.M., Rietschel, M., Witt, S.H., Mathiak, K., Krug, A., 2011. Effects of a CACNA1C genotype on attention networks in healthy individuals. Psychol. Med. 41, 1551–1561.
Thomée, S., Härenstam, A., Hagberg, M., 2011. Mobile phone use and stress, *sleep disturbances, and symptoms of depression among young adults – a* prospective cohort study. BMC Public Health 11 (January), 66, http://dx.doi.org/10.1186/1471-2458-11-66.
Tolgskaya, M.S., Gordon, Z.V., 1973. Pathological Effects of Radio Waves. (B. Haigh, Trans.)Consultants Bureau, New York/London, pp. 146.
Wagner, P., Röschke, J., Mann, K., Hiller, W., Frank, C., 1998. Human sleep under the influence of pulsed radiofrequency electromagnetic fields: a polysomnographic study using standardized conditions. Bioelectromagnetics 19, 199–202.
Waldmann-Selsam, C., Aschermann, C., Kern, M., 2009. Warning against adverse health effects from the operation of digital broadcast television stations (DVB-T): letter from 3 German physicians to the U.S. President and *Congress, http://www.stayontruth.com/*warning-against-adverse-health-effects-digital/TV.php.
Walleczek, J., 1992. Electromagnetic field effects on cells of the immune system: the role of calcium signaling. FASEB J. 6, 3177–3185.
Wheeler, D.B., Randall, A., Tsien, R.W., 1994. Roles of N-type and Q-type channels in supporting hippocampal synaptic transmission. Science 264, 107–111.

Exhibit 3

Mediators of Inflammation
Volume 2014, Article ID 924184, 14 pages
http://dx.doi.org/10.1155/2014/924184

Clinical Study

Metabolic and Genetic Screening of Electromagnetic Hypersensitive Subjects as a Feasible Tool for Diagnostics and Intervention

Chiara De Luca,[1,2] Jeffrey Chung Sheun Thai,[3] Desanka Raskovic,[4] Eleonora Cesareo,[4] Daniela Caccamo,[5] Arseny Trukhanov,[2] and Liudmila Korkina[1,2]

[1]Centre of Innovative Biotechnological Investigations (Cibi-Nanolab), Novoslobodskaya Street 36/1, Moscow 127055, Russia
[2]Active Longevity Clinic "Institut Krasoty na Arbate", 8 Maly Nikolopeskovsky lane, Moscow 119002, Russia
[3]Natural Health Farm, 39 Jln Pengacara U1/48, Seksyen U1, Temasya Industrial Park, 40150 Shah Alam, Selangor, Malaysia
[4]2nd Dermatology Division, Dermatology Institute (IDI IRCCS), Via Monti di Creta 104, 00167 Rome, Italy
[5]Department of Biomedical Sciences and Morpho-Functional Imaging, Polyclinic University of Messina, 98125 Messina, Italy

Received 28 November 2013; Accepted 26 February 2014; Published 9 April 2014

Academic Editor: Beatriz De las Heras

Abstract

Growing numbers of "electromagnetic hypersensitive" (EHS) people worldwide self-report severely disabling, multiorgan, non-specific symptoms when exposed to low-dose electromagnetic radiations, often associated with symptoms of multiple chemical sensitivity (MCS) and/or other environmental "sensitivity-related illnesses" (SRI). This cluster of chronic inflammatory disorders still lacks validated pathogenetic mechanism, diagnostic biomarkers, and management guidelines. We hypothesized that SRI, not being merely psychogenic, may share organic determinants of impaired detoxification of common physic-chemical stressors. Based on our previous MCS studies, we tested a panel of 12 metabolic blood redox-related parameters and of selected drug-metabolizing-enzyme gene polymorphisms, on 153 EHS, 147 MCS, and 132 control Italians, confirming MCS altered ($P < 0.05$–0.0001) glutathione-(GSH), GSH-peroxidase/S-transferase, and catalase erythrocyte activities. We first described comparable—though milder—metabolic pro-oxidant/proinflammatory alterations in EHS with distinctively increased plasma coenzyme-Q_{10} oxidation ratio. Severe depletion of erythrocyte membrane polyunsaturated fatty acids with increased $\omega 6/\omega 3$ ratio was confirmed in MCS, but not in EHS. We also identified significantly ($P = 0.003$) altered distribution-versus-control of the CYP2C19*1/*2 SNP variants in EHS, and a 9.7-fold increased risk (OR: 95% C.I. = 1.3–74.5) of developing EHS for the haplotype (null)GSTT1 + (null)GSTM1 variants. Altogether, results on MCS and EHS strengthen our proposal to adopt this blood metabolic/genetic biomarkers' panel as suitable diagnostic tool for SRI.

1. Introduction

The term *electromagnetic hypersensitivity* or *electrosensitivity* (EHS) referred to a clinical condition characterized by a complex array of symptoms typically occurring following exposure to electromagnetic fields (EMFs) even below recommended reference levels and is followed by remission through the complete isolation [1, 2]. The most frequently claimed trigger factors include video display units, radio, televisions, electrical installations, extremely low-frequency ranges of electromagnetic fields or radio-frequencies—including the so-called dirty electricity due to poor isolation of electric wires and telephonic lines, wireless devices, and wi-fi—fluorescent lamps and low-energy lights, appliances with motors, photocopiers, microwave transmitters, and high tension power lines (reviewed in [3, 4]). EHS is characterized by a broad range of nonspecific multiple-organ symptoms implying both acute and chronic inflammatory processes, involving mainly skin and nervous, respiratory, cardiovascular, musculoskeletal, and gastrointestinal systems, in most cases self-reported in absence of organic pathological signs except skin manifestations (reviewed in [2, 5]).

Many efforts have been made to determine if a causal relationship between exposure to EMFs and claimed health symptoms does exist and to identify biologically plausible mechanisms underlying this syndrome (for review, see [2, 6, 7]). Despite the growing wealth of evidences gathered

Exhibit 3

Hindawi Publishing Corporation
Mediators of Inflammation
Volume 2014, Article ID 924184, 14 pages
http://dx.doi.org/10.1155/2014/924184

Hindawi

Clinical Study

Metabolic and Genetic Screening of Electromagnetic Hypersensitive Subjects as a Feasible Tool for Diagnostics and Intervention

Chiara De Luca,[1,2] Jeffrey Chung Sheun Thai,[3] Desanka Raskovic,[4] Eleonora Cesareo,[4] Daniela Caccamo,[5] Arseny Trukhanov,[2] and Liudmila Korkina[1,2]

[1] *Centre of Innovative Biotechnological Investigations (Cibi-Nanolab), Novoslobodskaya Street 36/1, Moscow 127055, Russia*
[2] *Active Longevity Clinic "Institut Krasoty na Arbate", 8 Maly Nikolopeskovsky lane, Moscow 119002, Russia*
[3] *Natural Health Farm, 39 Jln Pengacara U1/48, Seksyen U1, Temasya Industrial Park, 40150 Shah Alam, Selangor, Malaysia*
[4] *2nd Dermatology Division, Dermatology Institute (IDI IRCCS), Via Monti di Creta 104, 00167 Rome, Italy*
[5] *Department of Biomedical Sciences and Morpho-Functional Imaging, Polyclinic University of Messina, 98125 Messina, Italy*

Correspondence should be addressed to Chiara De Luca; deluca@cibi-nanolab.com

Received 28 November 2013; Accepted 26 February 2014; Published 9 April 2014

Academic Editor: Beatriz De las Heras

Growing numbers of "electromagnetic hypersensitive" (EHS) people worldwide self-report severely disabling, multiorgan, nonspecific symptoms when exposed to low-dose electromagnetic radiations, often associated with symptoms of multiple chemical sensitivity (MCS) and/or other environmental "sensitivity-related illnesses" (SRI). This cluster of chronic inflammatory disorders still lacks validated pathogenetic mechanism, diagnostic biomarkers, and management guidelines. We hypothesized that SRI, not being merely psychogenic, may share organic determinants of impaired detoxification of common physic-chemical stressors. Based on our previous MCS studies, we tested a panel of 12 metabolic blood redox-related parameters and of selected drug-metabolizing-enzyme gene polymorphisms, on 153 EHS, 147 MCS, and 132 control Italians, confirming MCS altered ($P < 0.05$–0.0001) glutathione-(GSH), GSH-peroxidase/S-transferase, and catalase erythrocyte activities. We first described comparable—though milder—metabolic pro-oxidant/proinflammatory alterations in EHS with distinctively increased plasma coenzyme-Q_{10} oxidation ratio. Severe depletion of erythrocyte membrane polyunsaturated fatty acids with increased $\omega 6/\omega 3$ ratio was confirmed in MCS, but not in EHS. We also identified significantly ($P = 0.003$) altered distribution-versus-control of the CYP2CI9*1/*2 SNP variants in EHS, and a 9.7-fold increased risk (OR: 95% C.I. = 1.3–74.5) of developing EHS for the haplotype (null)GSTT1 + (null)GSTM1 variants. Altogether, results on MCS and EHS strengthen our proposal to adopt this blood metabolic/genetic biomarkers' panel as suitable diagnostic tool for SRI.

1. Introduction

The term *electromagnetic hypersensitivity* or *electrosensitivity* (EHS) referred to a clinical condition characterized by a complex array of symptoms typically occurring following exposure to electromagnetic fields (EMFs) even below recommended reference levels and is followed by remission through the complete isolation [1, 2]. The most frequently claimed trigger factors include video display units, radio, televisions, electrical installations, extremely low-frequency ranges of electromagnetic fields or radio-frequencies—including the so-called dirty electricity due to poor isolation of electric wires and telephonic lines, wireless devices, and wi-fi—fluorescent lamps and low-energy lights, appliances with motors, photocopiers, microwave transmitters, and high tension power lines (reviewed in [3, 4]). EHS is characterized by a broad range of nonspecific multiple-organ symptoms implying both acute and chronic inflammatory processes, involving mainly skin and nervous, respiratory, cardiovascular, musculoskeletal, and gastrointestinal systems, in most cases self-reported in absence of organic pathological signs except skin manifestations (reviewed in [2, 5]).

Exhibit 3

Many efforts have been made to determine if a causal relationship between exposure to EMFs and claimed health symptoms does exist and to identify biologically plausible mechanisms underlying this syndrome (for review, see [2, 6, 7]). Despite the growing wealth of evidences gathered both *in vitro* and *in vivo* on animal models, data from human case-control and double-blind trials attempting to correlate EMFs exposure and claimed symptoms, resulted so far controversial [8–10]. Nowadays, wide gaps still exist in understanding EHS, which most often remains neglected by the medical community or confined within the frame of mere psychogenic etiology [11, 12]. In the persistent lack of a proven pathogenetic mechanism for electromagnetic hypersensitivity and of clinical consensus on the few proposed diagnostic and therapeutic approaches hypothesized, no guideline for safe and efficient validated treatments has been made available until now to the patients worldwide [13, 14].

Nevertheless, the number of subjects self-reporting EHS is progressively increasing, especially in European countries [15–17], with symptoms that are often strongly disabling both professionally and socially, motivating patients to leave home and job to find rescue in "electromagnetic pollution-free" environmental settings. Because of the huge socioeconomic impact anticipated for EHS syndrome worldwide, the World Health Organization has devoted considerable attention to EHS, acknowledging this condition and recommending that people self-reporting sensitivities receive a comprehensive health evaluation [18].

Clinical similarities and frequent comorbidity between EHS and the other medically unexplained multisystem conditions of environmental origin, like *multiple chemical sensitivity* (MCS), *fibromyalgia* (FM), *chronic fatigue syndrome* (CFS), *sick building syndrome, Persian Gulf War veteran syndrome*, and *amalgam disease*, to which EHS is often associated [19, 20], have induced many authors to hypothesize that these so-called *idiopathic environmental intolerances* (IEI), more extensively also defined as *sensitivity-related illnesses* (SRI) [21], may share common genetic and/or metabolic molecular determinants connected with an impaired capability to detoxify xenobiotics (for review, see [19, 22]). Our group has evidenced for the first time a set of altered metabolic blood parameters—comprising selected redox-active and detoxifying enzymes, low-molecular weight antioxidants and oxidation markers, membrane polyunsaturated fatty acid, and proinflammatory cytokine patterns—specifically and selectively compatible with the MCS condition [23]. Recently, we contributed to the still open issue of possible genetic polymorphic patterns associated with MCS proneness, proposing a pattern of genotypic alterations of the cytochrome P450 isoenzymes CYP2C9, CYP2C19, and CYP2D6, as candidate risk factors for this specific condition, also being potentially able to discriminate different environmental-borne hypersensitivities (MCS, FM, and CFS), depending on specific combinations of their mutated alleles [24].

In this study, the working hypothesis was that EHS, as previously proposed for MCS and other environmental SRI [19, 22], may as well be based on aberrant responses to physic or chemical xenobiotic stressors through airborne or other routes of exposure, due to inherited or/and acquired dysfunction of the chemical defensive system, that is the interrelated network of phase I and II xenobiotic-metabolizing and antioxidant enzymes [19]. Based on the results of our past clinical studies on MCS, FM, and CFS, we sought to assess if similar profiles of metabolic or genetic dysfunctions could be found in those subjects self-reporting EHS phenotype. To this purpose, we measured possible alterations of a previously identified panel of twelve blood redox and lipid parameters and frequencies of selected genetic mutated variants of a set of drug-metabolizing enzymes and transcription factors with first-line roles in the detoxification of physical and chemical xenobiotics, in a group of 153 patients self-reporting EHS symptoms, co-morbid in most cases with different degrees of MCS symptoms. Results were compared to those obtained on 147 MCS patients without EHS symptoms and on a healthy control group of 132 age- and sex-matched subjects, all groups enrolled within the Italian population.

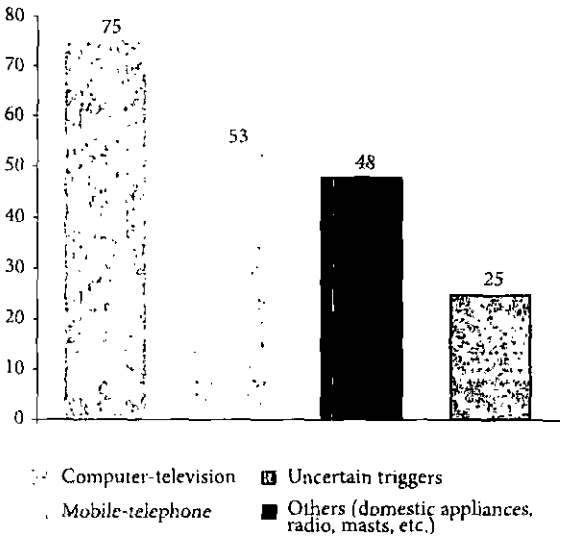


FIGURE 1: Electromagnetic field sources reported as symptom triggers in the group of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 153$). Data are expressed as percent of patients affected on the total number of patients.

2. Materials and Methods

2.1. Patients. A group of 153 Italian Caucasian consecutive subjects self-reporting hypersensitivity to electro-magnetic fields (EHS group) as described in Figure 1 were enrolled in the study at a specialized Diagnostic Unit for Redox Balance of Istituto Dermopatico dell'Immacolata, IDI IRCCS, Rome, Italy. Age ranged from 16 to 75 years of age (mean ± SD: 46.8 ± 11.7) and female sex represented 85.6% (131 subjects). This group was compared with a size-matched group of 147 patients (age range 19–72 y, mean ± SD: 49.6 ± 12.8, 129F (87.8%)/18M), diagnosed with MCS, but not reporting any symptom of EHS (MCS group). MCS diagnosis was set in both groups according to Cullen's criteria [25] and modified Quick environmental Exposure and Sensitivity Inventory

Exhibit 3

(QEESI) questionnaire scoring [26, 27]. Cullen's criteria refer to a disorder characterized by symptoms that involve more than one organ system and are regularly elicited by chemically unrelated compounds at doses far below those known to cause adverse effects in the general population. Symptoms typically improve considerable or heal completely after trigger withdrawal [25]. QEESI is a validated self-administered questionnaire developed as a screening tool for patients with multiple chemical sensitivity. It is based on five different scales of assessment: symptoms severity, chemical triggers, other triggers, life impact, and finally a masking index to ongoing exposures [26, 27]. A modified QEESI score of 10 common environmental exposures and 10 major symptoms enabled the diagnosis of MCS: full diagnosis ($20 \leq$ Score ≤ 30) or strongly suspected diagnosis (sMCS, suspected MCS), that is subjects fulfilling diagnostic criteria only partially ($10 \leq$ Score ≤ 20), or subjects excluded from enrollment ($0 \leq$ Score ≤ 10) [23]. As commonly seen by our group occurring in the Italian patient population, the large majority (94.7%) of the EHS group was also affected with multiple chemical sensitivity (fully diagnosed or suspected MCS).

A cohort of 132 healthy age- and sex-matched subjects was enrolled as the control group (CTR group), (age range 18–74 y, mean ± SD: 45.3 ± 12.4, 109F (82.6%)/23M), according to the established criteria of (i) absence of any clinically diagnosed disease, in particular allergic or immunologic disturbances, (ii) no drug or nutraceutical supplement since at least six weeks, at the time of blood sampling, and (iii) whole blood total production of reactive oxygen and nitrogen species (ROS/RNS) below 650 cps/μL, as determined by luminol-dependent chemiluminescent response to phorbol 12-myristate 13-acetate (PMA) [28] (Study protocol approval by Istituto Dermopatico dell'Immacolata—IDI IRCCS, Rome, Italy—Ethical Committee, n.52/CE/2010).

All patients and controls entering the study had taken no drugs or nutraceutical supplements known to interfere with metabolizing/antioxidant enzymes activity since at least six weeks, at the time of blood sampling. Nonsmokers in the patient groups were, respectively, 89.3% in EHS and 81.8% in MCS, and 85.2% in the CTR group; undetermined smoking habits were registered in 2% of EHS and 7% of MCS patients, and in 5% of controls. Patients and controls were selected from different Italian regions in the attempt to minimize the historical genetic variability in this country [29]. Demographic information (age, race, weight, and height) and a detailed medical history were recorded in a standardized questionnaire-assisted interview, by trained medical personnel. In particular, subjects were asked to report age at onset of symptoms, agents or events likely to initiate EHS and MCS condition, if recognized, and those capable of triggering symptoms once the condition was established. No alcohol or drug abusers were present in any of the three cohorts studied.

The study protocol was reviewed and approved by the Hospital Ethical Committee Board (IDI IRCCS n.121/CE/2008). All subjects gave informed consent to personal and anamnestic data collection, blood sampling for the specific sets of analyses, and blood fraction's banking.

2.2. Reagents and Assay Kits. Majority of chemical reagents, HPLC standards, mediums, fluorogenic probes, and reverse transcription polymerase chain reaction (RT PCR) primers for gene polymorphism analyses were from Sigma Chemical Co. (St. Louis, MO, USA); kits were from Cayman Chem. Co. (Ann Arbor, MI, USA)—enzyme activities are from Qiagen (Hilden, Germany)—DNA extraction is from Applied Biosystems Inc. (Foster City, CA, USA)—polymerase chain reaction is from PCR Kit for CYPs.

2.3. Redox Studies. Complete differential blood cell counts and metabolic/genetic analyses were performed on fresh EDTA-anticoagulated venous blood of 12-hour fasting subjects. Biochemical assays were performed on plasma or erythrocytes (RBC) either immediately (coenzyme Q_{10}—CoQ_{10}) or within 72 hr. on sample aliquots stored at −80°C under argon. Whole blood luminol-dependent chemiluminescence (CL) response to phorbol 12-myristate 13-acetate (PMA) was quantified by chemiluminescence according to [28], levels of (nitrites/nitrates) by Griess reagent [30]. Plasmatic total antioxidant capacity (TAC) was determined as described previously [31]. Reduced and oxidised glutathione (GSH and GSSG) levels in erythrocytes [32], reduced and oxidized CoQ_{10}, and alpha-tocopherol levels in plasma [33] were quantified by HPLC equipped with array photodiode and electrochemical detection. Activities of CuZn superoxide dismutase (CuZn-SOD) [34], catalase [35], glutathione S-transferase (GST) [36], and glutathione peroxidase (GPX) [37] in erythrocytes were measured spectrophotometrically.

2.4. Erythrocyte Membrane Fatty Acid Profiling. The fatty acid (FA) pattern of erythrocyte membrane phospholipids was analyzed by gas-chromatography coupled with mass spectrometry with the selected ion monitoring technique, set to identify C16:0, C16:1, C18:0, C18:1*cis*, C18:1*trans*, C18:2ω6, C18:3ω6, C20:4ω6, C20:5ω3, C22:4ω3, C22:5ω3, and C22:6ω3 peaks [38]. Results were expressed as percent of the total fatty acid content of membrane phospholipids for saturated + monounsaturated FA (SFA), polyunsaturated FA (PUFA), and single representative FA of the ω3 and ω6 series.

2.5. Genotyping of Drug Metabolism-Related Enzymes. Targeted genotype analysis was performed on subgroups of EHS ($n = 127$) and MCS patients ($n = 85$) and of controls ($n = 68$), with reduced due to financial limitations—but yet representative—group sizes for single genotype. Genomic DNA was purified from 400 μL of human whole blood using the QIAamp DNA Blood Mini Kit (Qiagen, Hilden, Germany) according to the manufacturer's instructions. DNA was quantified spectrophotometrically at 260 nm, aliquoted, and stored at −20°C until being assayed. Genotyping and controls for eight single nucleotide polymorphisms in drug metabolism- and inflammation-related genes were carried out by real-time PCR allelic discrimination using predesigned TaqMan single nucleotide polymorphism (SNP) genotyping assays available from Applied Biosystems (Applera Italia, Monza, Italy). The polymorphisms analyzed were those of genes coding for the following:

Exhibit 3

cytochrome P450 (CYP), family 2, subfamily C, polypeptides 9 and 19, namely, CYP2C9*2 (C>T, rs1799853; assay ID: C_25625805_10), CYP2C9*3 (A>C, rs1057910; assay ID: C_27104892_10), and CYP2C19*2 (G>A, rs4244285; assay ID: C_25986767_70); CYP2 subfamily D, polypeptide 6, namely, CYP2D6*4 (1846G>A, rs3892097; assay ID: C_27102431_D0) and CYP2D6*41 (C>T, rs28371725; assay ID: C_34816116_20); aryl hydrocarbon receptor (AHR) Arg554Lys variant (G>A, rs2066853; assay ID: C_11170747_20). Genotyping reactions were set up in a 96-well plate on a 7900HT fast real-time PCR System (Applied Biosystems, Foster City, CA) and were carried out in a final volume of 20 μL containing 1× TaqMan Genotyping Master Mix, 1× TaqMan-specific assay, and 10 ng genomic DNA, using thermal cycling conditions suggested by manufacturer's protocols.

The GSTP1 polymorphisms resulting in an Ile (wild type) to Val (mutant) substitution at residue 104 in exon 5 and Ala (Wild Type) to Val (mutant) substitution at residue 113 in exon 6 were determined by real time PCR using two different fluorogenic probes for the wild type and the mutant. By combining the results of the analysis of exon 5 and exon 6, the allelic setup was determined (GSTP1*A = Ile104/Ala113; GSTP1*B = Val104/Ala113; GSTP1*C = Val 104/Val113). The deletion polymorphisms for the GSTM1 and the GSTT1 genes were determined simultaneously in a single assay using a multiplex PCR approach with the amplification of the GSTM1 and the GSTT1 genes from genomic DNA and using β-globin as internal control [39].

2.6. Statistical Analysis. Statistic significance of redox and fatty acid parameters was evaluated using STATISTICA 6.0 program (StatSoft Inc., Tulsa, OK, USA). Normality of data was checked using the Shapiro-Wilk test. Since the distribution of the data in the three groups was significantly different from normal, nonparametric statistics was used. Values were presented as mean, standard error of the mean, and 1.96× standard error. Mann-Whitney U-test for independent samples was employed for comparison between case groups and controls. All reported P values are from two-tailed tests, and P values of less than 0.05 were considered to indicate statistical significance. If necessary, P values were adjusted for multiple comparisons using the Bonferroni adjustment.

The comparison of allele and genotype frequencies between patients and controls, or in-between patient cohorts, was performed using the GraphPad Prism 4 software (San Diego, CA, USA). Genotypes frequencies of patients' and control groups were compared with Fisher's exact test. A P value ≤ 0.05 or lower was regarded as statistically significant. Odds ratio (OR) and 95% confidence interval (CI) were used to analyze the frequency of genotypes since they provide a measure of the strength of association, compared to the control population.

3. Results

3.1. Anamnestic and Lifestyle Data. Among EMFs emissions recognized as trigger factors in the group of 153 patients self-reporting electromagnetic hypersensitivity-EHS, video display units and television were the most frequently reported sources (75% of patients), followed by mobile and landline phones (53%) and by domestic appliances (48%), while 25% of the electrosensitive population studied could not indicate a specific triggering factor (Figure 1). Potential exposure patterns to indoor EMFs can be inferred from the analysis of the percent distribution of occupational features in the EHS group, described in Figure 2.

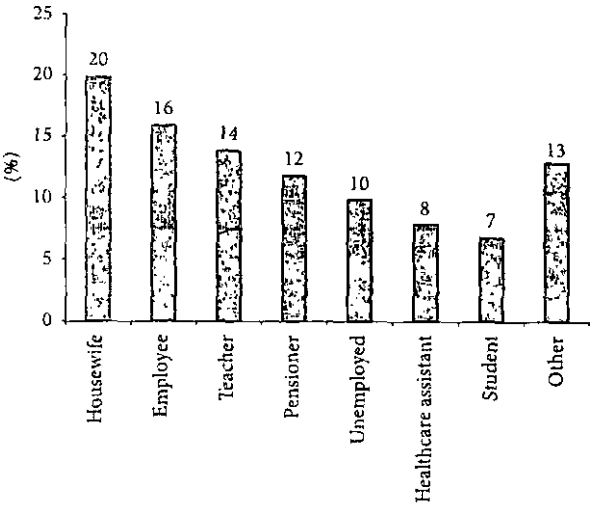


FIGURE 2: Occupational features in the group of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 153$). Data are expressed as percentage of the total number of patients.

The percent distribution of concomitant organ diseases (comorbidities) in the EHS patient cohort, as obtained by clinical anamnestic evaluation, is presented in Figure 3(a). Body mass index (BMI) in the EHS subjects ranged between 15 and 37 (mean ± SD: 23.3 ± 5.06), while in the group of MCS without electro-hypersensitivity there were 20% overweight patients (BMI: 25.00–29.99), 11% obese (BMI: 30.00–34.99), 2% severely obese (BMI: 35.00–39.99), 11% underweight (BMI: 18.49–16.00), and only 56% normal-weight patients (BMI: 18.50–24.99). Figure 3(b) shows the percent distribution of the other sensitivity-related illness-SRI coexisting with electromagnetic hypersensitivity in the EHS study cohort, where the 52.7% of MCS cases and the 42% of suspected MCS cases sum up clearly predominant 94.7% of multiple chemical sensitivity symptomatic subjects, within the patients self-reporting EHS symptoms.

In Figure 4, the main classes of cutaneous symptoms or specific diseases recorded by the clinical operators through questionnaire-assisted anamnestic interview are represented, evidencing remarkable prevalence of acute dermatitis or chronic eczema conditions (both symptoms referable to different etiologies) among EHS subjects, whilst in the MCS group without electro-hypersensitivity urticaria and itching referable to (different etiologies) represented the most common findings.

3.2. Blood Metabolic Parameters. Candidate metabolic biomarkers of electrhypersensitivity, as compared to multiple

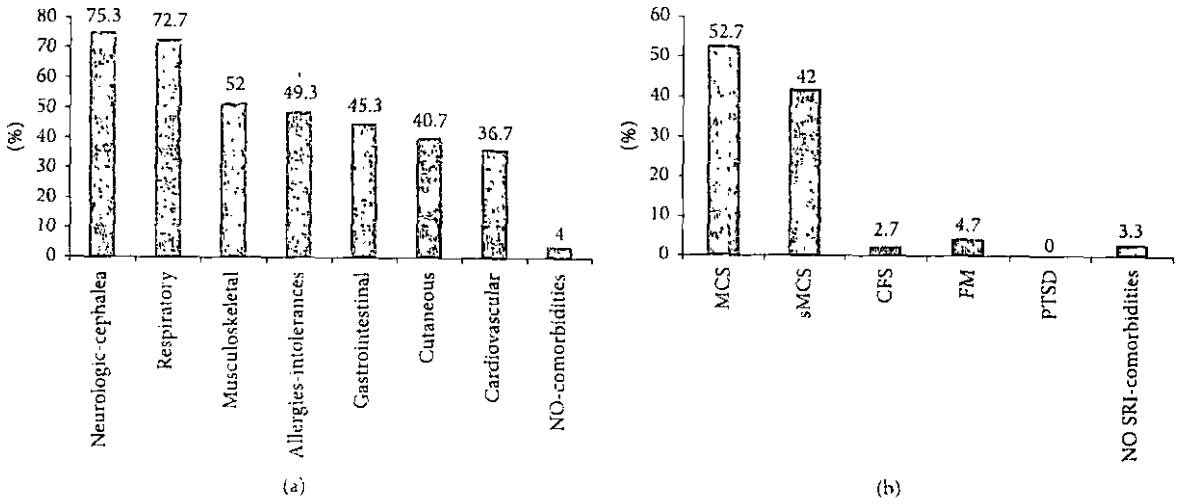


FIGURE 3: Distribution of specific organ comorbidities (a) and sensitivity-related illness-SRI comorbidities (b) registered in the case history of the group of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 153$). Data are expressed as percentage of the total patient group, for patients affected by each single category of organ pathologies (a), and by each SRI (b), specifically multiple chemical sensitivity (MCS) or suspected MCS (sMCS), chronic fatigue syndrome (CFS), fibromyalgia (FM), and posttraumatic stress disorders (PTSD).

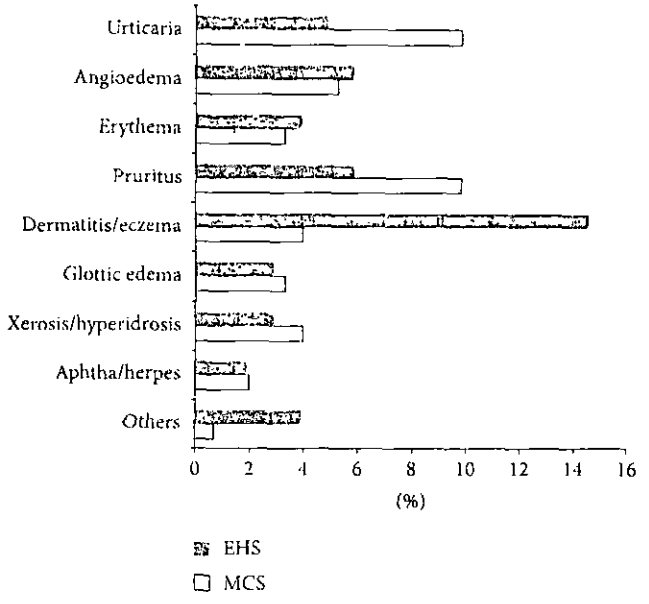


FIGURE 4: Skin manifestations (common symptoms and specific diseases) registered in the case histories of the groups of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 153$) and of patients affected by multiple chemical sensitivity without EHS symptoms (MCS, $n = 147$). Data are expressed as percentage of patients affected by each specific class of cutaneous manifestations.

chemical sensitivity without EHS manifestations and to the corresponding values of the same blood parameters in the group of healthy controls, are shown in Figures 5–8.

A set of 12 metabolic enzymatic and nonenzymatic redox parameters were measured in the blood of the 153 EHS patients, 147 patients with MCS reporting no EHS, and in the 132 healthy age- and sex-matched CTR subjects. Figure 5 shows the respective alterations of all four enzymatic activities studied in the EHS group, compared to MCS and to control values. More specifically, GST activity in erythrocytes was severely decreased in both EHS and MCS groups, compared to the CTR group ($P < 0.0001$), with no significant difference between the patients' subgroups (Figure 5(a)). A clearly uprisen erythrocyte GPX activity was registered in the EHS and more markedly in the MCS groups versus controls ($P < 0.05$ and $P < 0.001$ resp.) (Figure 5(b)), and the same was true for RBC CuZnSOD activity of MCS group versus CTR ($P < 0.0001$), while EHS patients showed only a trend towards increased activity ($P < 0.05$ versus MCS) (Figure 5(c)). Finally, Figure 5(d) shows how catalase activity rate in RBC was found decreased in both EHS and MCS patients as compared to healthy CTR, though reaching a clear-cut and elevated statistical significance only in the MCS group ($P < 0.0001$), as previously already reported [23].

Figure 6 describes the alteration of the blood levels of four redox-active low-molecular weight parameters investigated as suitable biomarkers of EHS condition, in comparison to the uncomplicated MCS and the healthy control study cohorts. The levels of both reduced (GSH) and oxidized (GSSG) glutathione forms (data shown in the figure only for GSH (Figure 6(a))) were strongly decreased in the RBC of EHS and MCS environmentally sensitive groups as compared to CTR subjects (GSH: $P < 0.0001$ for both groups; GSSG: $P < 0.001$ and $P < 0.0001$, resp., for EHS and MCS), although decrease scores for both glutathione forms were inferior in the EHS than in the MCS subgroup (GSH: $P < 0.05$; GSSG: $P < 0.001$ in EHS versus MCS). Also the ratio of GSSG/GSH (Figure 6(b)), indicating the relative oxidation grade of the erythrocyte glutathione marker, displayed a trend to elevation in the two patient subgroups versus control, although data were too scattered to reach any statistical value.

The plasmatic levels of coenzyme Q_{10} and alpha-tocopherol displayed a similar trend-to-depletion in both

Exhibit 3

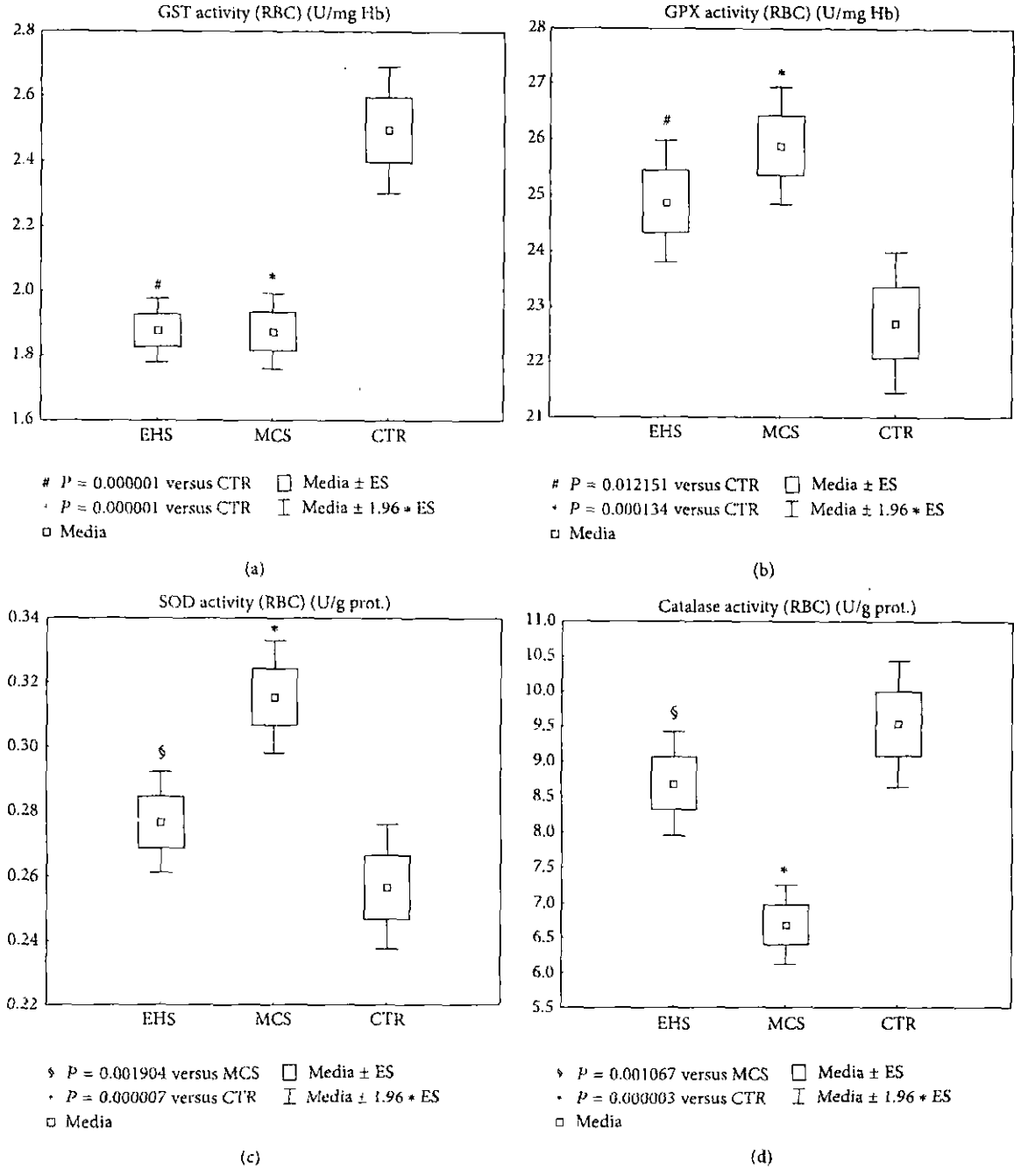


FIGURE 5: Metabolic redox parameters: the antioxidant/detoxification enzymatic activities of erythrocyte GST (a), GPX (b), CuZnSOD, (c) and catalase (d), in the groups of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 153$), of patients affected by multiple chemical sensitivity without EHS symptoms (MCS, $n = 147$), and of control healthy subjects (CTR, $n = 132$). Values are represented as mean (□), standard error of the mean (upper and lower limits of the box), 1.96× standard error (upper and lower whiskers). Intergroup significant differences (P) are reported under each panel. RBC: red blood cells; SOD (CuZn superoxide dismutase); GST: glutathione S-transferase; GPX: glutathione peroxidase; prot.: proteins; Hb: haemoglobin.

patient subgroups versus controls. Figure 6(c) reports results of ubiquinol ($CoQ_{10}H_2$, the reduced form of coenzyme Q_{10}) analysis which, together with levels of total CoQ_{10} (reduced + oxidized forms) and of alpha-tocopherol (both groups of data not shown)—showed similar trend of reduction for EHS as well as MCS subgroups, as compared to CTR group, though lacking statistical significance. Indeed, we found a higher percent coenzyme Q_{10} oxidation (ratio oxidized-CoQ_{10}/total-CoQ_{10}), significant versus CTR at $P < 0.001$ in EHS patients, not confirmed for MCS patients, as reported in Figure 6(d).

Although a trend-to-increase in the values of whole blood chemiluminescence (CL) and to decreased levels of plasmatic total antioxidant capacity (TAC) were recorded for both

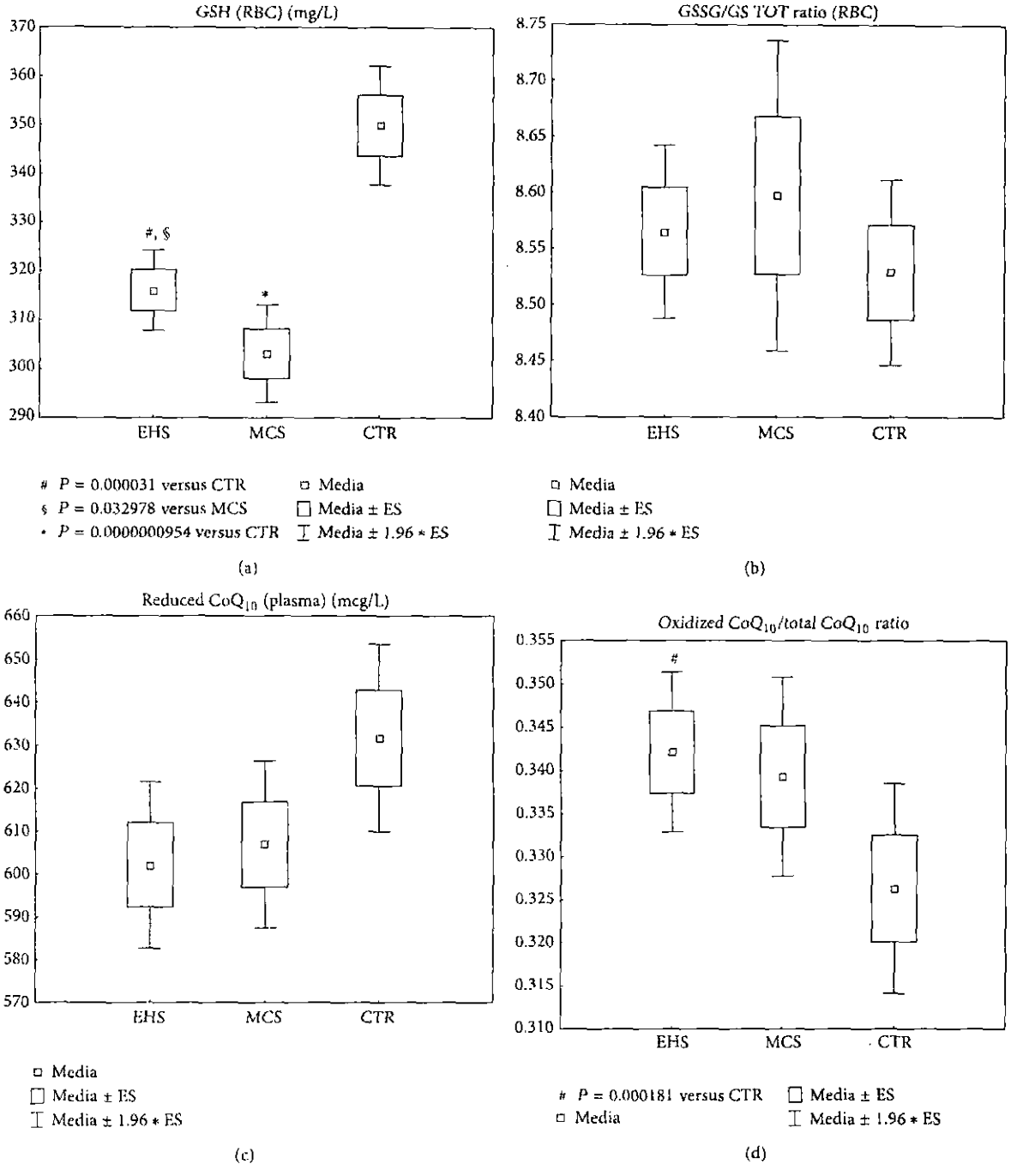


FIGURE 6: Metabolic redox parameters: levels of the low-molecular weight antioxidants/cofactors, erythrocyte glutathione ((a) and (b)), and plasma coenzyme Q_{10} ((c) and (d)), in the groups of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 153$), of patients affected by multiple chemical sensitivity without EHS symptoms (MCS, $n = 147$), and of control healthy subjects (CTR, $n = 132$). Values are represented as mean (□), standard error of the mean (upper and lower limits of the box), and 1.96× standard error (upper and lower whiskers). Intergroup significant differences (P) are reported under each panel. RBC: red blood cells: GSH: glutathione reduced form; GSSG: glutathione oxidized form; GS TOT: total glutathione; CoQ_{10}: coenzyme Q_{10}.

patient subgroups compared to controls, differences were unable to reach any statistical significance (data not shown). The increase of NO_2^-/NO_3^- plasma levels of MCS patients obtained in our previous study [23] was not confirmed in this new MCS subgroup, as well as in the EHS group of the present study, respectively, averaging or being inferior to control values (data not shown).

Since the majority of the above metabolic data were similar for EHS and MCS subgroups, the costly and time-consuming analyses of fatty acid profiles were carried out on

Exhibit 3

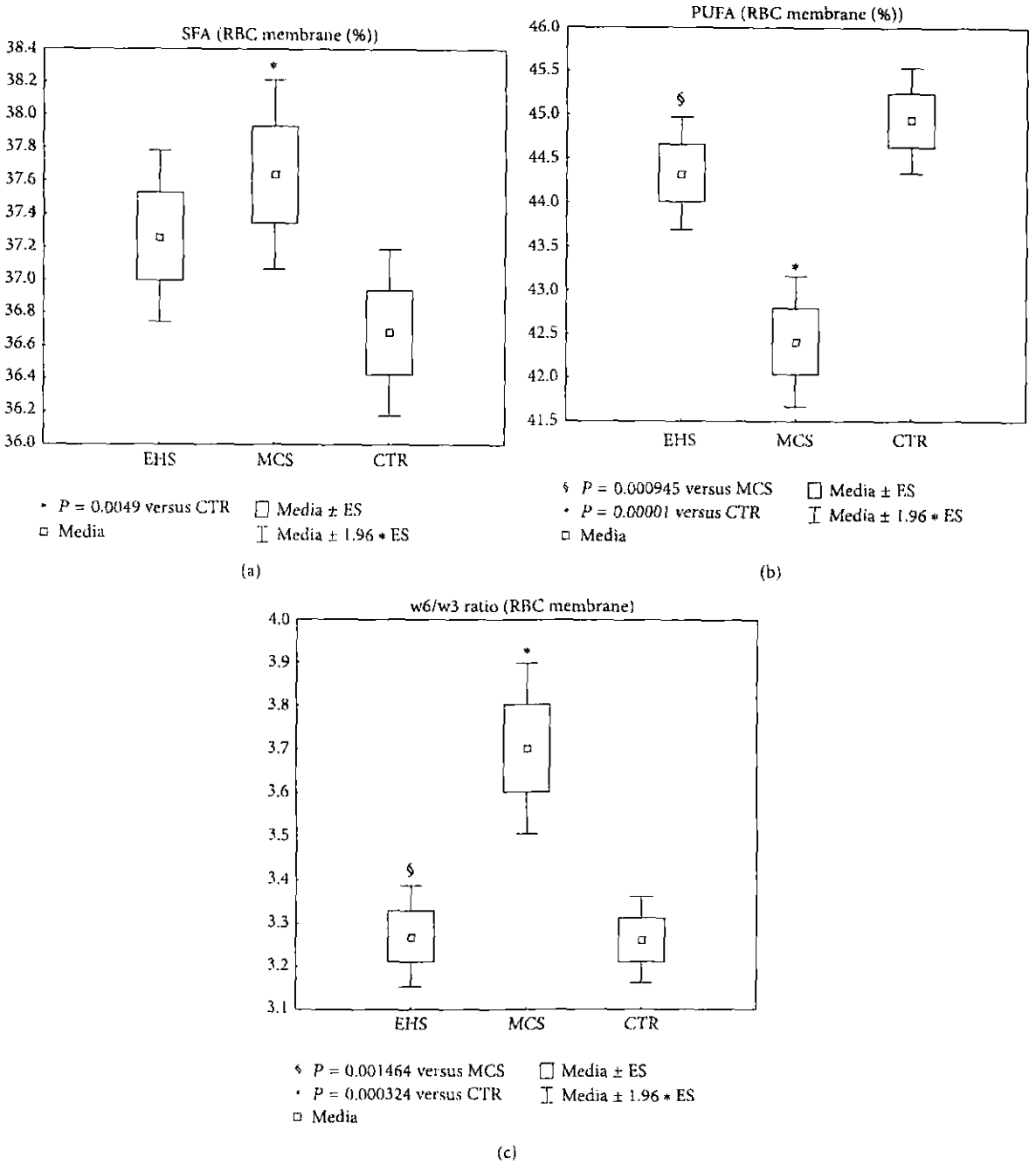


FIGURE 7: Selected representative parameters describing fatty acid (FA) patterns of erythrocyte membrane phospholipids, in the groups of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 58$), of patients affected by multiple chemical sensitivity without EHS symptoms (MCS, $n = 54$), and of control healthy subjects (CTR, $n = 70$). (a) % saturated and monounsaturated acid (SFA) on total FA content of phospholipids, (b) % polyunsaturated fatty acids (PUFA) on total FA content of phospholipids, and (c) ratio omega-6/omega3 PUFA. Values are represented as mean (□), standard error of the mean (upper and lower limits of the box), and 1.96× standard error (upper and lower whiskers). Intergroup significant differences (P) are reported under each panel. RBC: red blood cells.

a more limited subgroup of patients who fully corresponded to all diagnostic criteria. Representative fatty acid profiles in the phosholipid fraction of the erythrocyte membranes of EHS ($n = 58$), MCS ($n = 54$) and CTR ($n = 70$) patients are shown in Figures 7 and 8. The comparative analysis of the fatty acid (FA) profiles in the erythrocyte membranes of the 3 studied groups showed elevated levels of the saturated and monounsaturated fatty acid fraction (SFA) for both environmental-sensitive patients (Figure 7(a)) and correspondingly depleted levels of the polyunsaturated fatty acid fraction (PUFA) (Figure 7(b)), with both parameters statistically significant at $P < 0.05$ for MCS patients versus

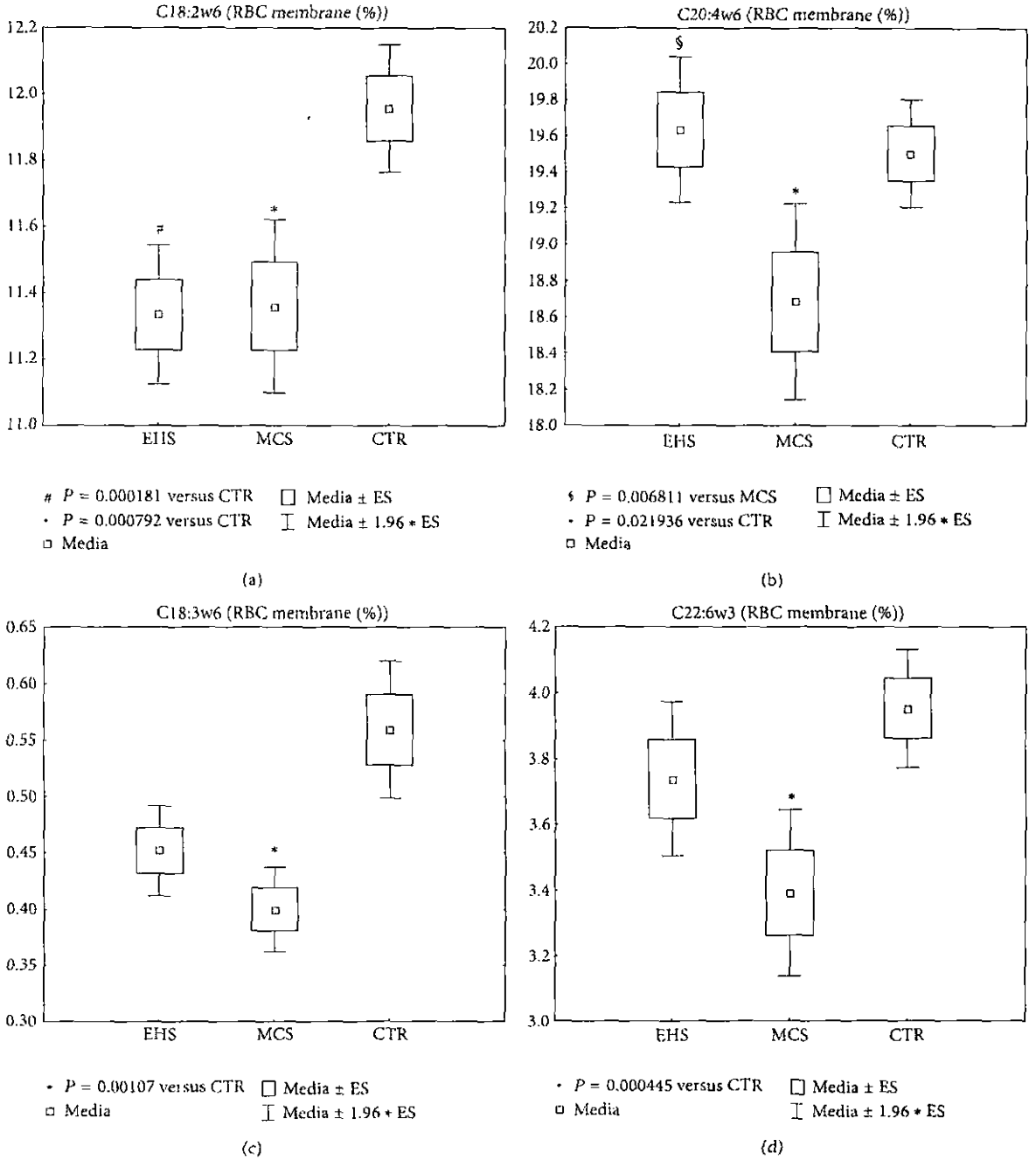


FIGURE 8: Selected representative omega-6 and omega-3 polyunsaturated fatty acids (PUFA) of erythrocytes membrane phospholipid fatty acids (FA), in the groups of patients self-reporting electromagnetic hypersensitivity (EHS, $n = 58$), of patients affected by multiple chemical sensitivity without EHS symptoms (MCS, $n = 54$), and of control healthy subjects (CTR, $n = 70$). (a) % C18:2ω6; (b) C20:4ω6; (c) C18:3ω6; (d) C22:6ω3 FAs, on total FA content of phospholipids. Values are represented as mean (□), standard error of the mean (upper and lower limits of the box), and 1.96× standard error (upper and lower whiskers). Intergroup significant differences (P) are reported under each panel. RBC: red blood cells. 18:2ω6 (linoleic acid), 18:3ω6 (alpha linolenic acid), 20:4ω6 (arachidonic acid), and 22:6ω3 (docosahexaenoic acid).

controls, whilst the EHS group differed sensibly from MCS in displaying only a mild trend-to-alteration of fatty acid patterns versus control group. In detail, the percent levels of the omega-6 FA linoleic (18:2ω6), alpha linolenic (18:3ω6), arachidonic (C20:4ω6), and the omega-3 FA docosahexaenoic (C22:6ω3) (Figures 8(a)–8(d)) were lower than control values in both EHS and MCS cohorts, although the clear-cut statistical significance registered for the MCS group ($P < 0.05$–0.001 for all 4 parameters) was confirmed in EHS patients only for linoleic acid fraction ($P < 0.001$) (Figure 8(a)). Finally, the range of the ω6/ω3 PUFA ratio in electrosensitive subjects practically equalled that of controls,

Exhibit 3

whilst MCS patients showed significantly increased values versus both CTR ($P < 0.001$) and EHS group ($P < 0.05$), as reported in Figure 7(c).

3.3. Genetic Parameters. The main results of genotype analysis for a selected panel of detoxifying enzymes, obtained on limited subgroups of EHS, MCS, and controls, are illustrated in Table 1. Having previously demonstrated in the MCS population a significantly higher-versus-CTR frequency of the homozygous mutated *1 allele and a CYP2C19*2 heterozygous genotype *1/*2, with a lower frequency of the *2 allele in the homozygous and heterozygous forms [24], we here confronted the panel of previously investigated CYP isozymes in the EHS versus the already studied MCS cohort previously studied. Genotype frequencies for cytochrome P450 CYP2C19 SNP variants in EHS and MCS patients' groups showed that the CYP2C19*1/*1 and the CYP2C19*1/*2, *2/*2 genotypes differed with statistical significance at $P = 0.003$ between EHS ($n = 29$) and MCS ($n = 85$) groups. The other gene polymorphisms of CYPs studied (CYP2C9 and CYP2D6), as well as the aryl hydrocarbon receptor (AHR) variant Arg554Lys, displayed similar frequency distributions for EHS and MCS patients (data not shown).

Genotype frequencies of the glutathione S-transferase (GST) isoenzymes GSTP1, GSTM1, and GSTT1, previously found not significantly differing in MCS versus healthy control populations [23], were compared in 127 EHS patients versus 68 CTR subjects. No statistically significant differences were observed for GSTP1 in the frequency of the GSTP1*A, GSTP1*B, or GSTP1*C homozygous and heterozygous variants between the EHS patient and control groups (Table 1).

The statistical analysis of the distribution of GSTM1 and GSTT1 isoenzymes showed no statistical difference in homozygous + heterozygous and null genotype variants neither in GSTM1 nor in GSTT1, when analyzed independently. Conversely, the combined GSTM1 (*0/*0) + GSTT1 (*0/*0) null genotypes differed significantly (13% versus 1.5%, resp.), with $P = 0.007$, in EHS patients versus CTR subjects, conferring to this association of gene variants 9.7 times higher risk (OR: 95% C.I. = 1.3–74.5) of developing EHS compared to other GSTM1 and GSTT1 combinations of genotypes examined (Table 1).

4. Discussion

Till now, no causal relationship between electromagnetic fields exposure and onset of clinical symptoms has been clearly proven. Nevertheless, the term electric hypersensitivity is currently used both by patients who claim health effects of environmental electromagnetic pollution and doctors to define patient clusters of symptoms [40]. Most of the evidences about altered organic parameters due to EMF exposure have been so far obtained on cell or animal models. Very few human studies investigated possible organic parameters distinctive of the hypersensitivity to electromagnetic stressors ([41, 42]; for review, see [2]).

Main difficulties for clinical studies' implementation arise from the necessity to deal with patients in a protected environment, sheltered from EMF sources and also free of chemical barriers, since the majority of electrosensitive patients are also intolerant to a multiple array of chemical triggers [43]. Indeed, in the group of 153 EHS subjects enrolled for this study, 145 were also affected at different degrees by MCS symptoms (Figure 3(b)). The experimental group of EHS patients was exposed by lifestyle to the most common electromagnetic sources deriving mainly from indoor or outdoor urban electromagnetic pollution and no heavy professional exposure in industrial settings was recorded in the group (Figure 2). In addition, EHS patients shared with MCS patients the sensitivity to the most frequent organic chemical triggers initiating and sustaining MCS.

Another relevant issue complicating human studies is connected with the difficulties encountered in provocation studies, aimed at connecting the electromagnetic trigger with electrohypersensitivity symptoms' onset. These difficulties arise generally from the necessity to standardize types and dosages of EMF sources, from the broad qualitative and quantitative range of individual multiorgan responses to trigger, difficult to measure objectively, and also from heavy psychoemotional bias factors affecting experimental protocols and their repeatability [44, 45]. Notably, provocation studies commonly proposed as the main milestone for EHS assessment and validation are based on the questionable assumption that the individual capability to directly perceive EMFs at low or very low intensities below established toxicological thresholds, claimed by EHS subjects in analogy with MCS odor perception, may be *conditio sine qua non* for EHS symptom manifestation [40, 46]. Waiting for a consensus on a standardized methodology for an objective clinical assessment of electro-sensitivity, our present work referred to self-reported EHS as registered in the course of the anamnestic evaluation performed by trained medical personnel.

Data concerning the involvement of organic causes connected with chronic oxidative damage as a key factor in the induction and perpetuating of symptoms in functional SRI syndromes has been growing in the last decade (reviewed in: [22]). Our previous studies provided evidence of a specific and peculiar metabolic disease-marker profile in multiple chemical sensitivity, the prototype of all medically unexplained environmental illnesses so far described. In fact, moving from published data accounting for the altered redox balance in favor of a prooxidative and proinflammatory state in patients with fibromyalgia or chronic fatigue symptoms [7, 22], we identified a profile of 12 specifically altered blood parameters connected with systemic oxidative stress and impaired detoxification, in a representative sample of the Italian population fully or partially complying with MCS diagnosis [23]. In the same line, the present study was conceived to verify if analogous alterations of this pattern of MCS reliable organic biomarkers may also apply to EHS condition, in order to seek evidences of the organic etiology of this group of environmental sensitivity disorders and provide the clinicians with suitable tools for laboratory diagnosis and treatment follow-up.

The profiles of metabolic parameters' alteration observed in EHS subjects were comparable to those of the "pure

Exhibit 3

TABLE 1: Statistical analysis of genotype distribution of cytochrome P450 (CYP) isoenzymes in EHS-patients self-reporting electromagnetic hypersensitivity ($n = 29$) versus MCS-multiple chemical sensitivity patients without EHS ($n = 85$) and of glutathione S-transferase P1 (GSTP1), glutathione S-transferase M1 (GSTM1), and glutathione S-transferase T1 (GSTT1) isoenzymes in CTR-healthy control subjects ($n = 68$) versus EHS-patients ($n = 127$).

Genotype	CTR	EHS	MCS	P	Odds Ratio	C.I. 95%
CYP2C19 (*1/*1)		26 (89.7%)	51 (60.0%)	0.003		
CYP2C19 (*1/*2, *2/*2)		3 (6.9%)	34 (38.8%)			
GSTP1 (*A/*A, *A/*B)	62 (91%)	104 (82%)		0.09		
GSTP1 (*B/*B, *B/*C, *C/*C, *A/*C)	6 (9%)	23 (18%)		n.s.		
GSTM1 (*1/*1, *1/*0)	36 (53%)	64 (50%)		n.s.		
GSTM1 (*0/*0)	32 (47%)	63 (50%)				
GSTT1 (*1/*1, *1/*0)	58 (85%)	101 (80%)		n.s.		
GSTT1 (*0/*0)	10 (15%)	26 (20%)				
GSTM1 (*1/*1, *1/*0) + GSTT1 (*1/*1, *1/*0)	67 (98.5%)	111 (87%)		0.007	9.7	(1.3–74.5)
GSTM1 (*0/*0) + GSTT1 (*0/*0)	1 (1.5%)	16 (13%)				

MCS" group, though generally less pronounced (Figures 5–8). Similarly to those MCS patients self-reportedly nonelectrosensitive, the EHS cohort showed a highly significant-versus-control decrease in the erythrocyte GST activity and an increase in GPX activity levels (Figure 5), coupled with a marked decrease of GSH levels (Figure 6). Again in line with MCS, EHS group showed a trend to the increase in erythrocyte CuZnSOD activity and to the depletion of the main lipophilic antioxidants in plasma-reduced coenzyme Q_{10} and alpha-tocopherol (vitamin E) (Figures 5 and 6). The most striking difference between the two patient subgroups was recorded, instead, for erythrocyte catalase. Enzymatic activity was in fact only slightly and not significantly, reduced in EHS as compared to control values, while the highly significant ($P < 0.0001$) reduction recorded in the MCS group (Figure 5) confirmed our previous reports, validating the relevance and selectivity of this blood metabolic marker specifically for the MCS condition [23], being previously confirmed also in those patients only partially complying with MCS criteria (suspected MCS group).

We also calculated the ratios between oxidized and reduced forms of glutathione and coenzyme Q_{10} as suitable indicators of a systemic oxidative and proinflammatory *status* [47]. Relative oxidation of the two redox molecules was increased, though not significantly, in both EHS and MCS groups versus CTR (Figure 6). Interestingly, only in electrosensitive subjects, the oxidized/total CoQ_{10} ratio reached statistical significance ($P < 0.001$) versus normal values. Due to its marked lipophilicity, coenzyme Q_{10} is essential, along with alpha-tocopherol and squalene, for skin protection against oxidizing environmental physicochemical stressors, and it is able to efficiently reach the skin from the blood compartment [48, 49]. The elevated oxidation of plasma coenzyme Q_{10} observed in EHS appears to be consistent with the higher frequency of cutaneous involvement in EHS (40.7%) symptoms self-reported by our experimental group (Figure 3(a)), as compared to the minor relative clinical relevance assessed in the classical MCS condition, previously described [23]. Accordingly, Figure 4 shows how the prevalent skin symptom, in the EHS but not in the MCS cohort, resulted in being acute or chronic dermatitis (eczema), a group of inflammatory skin diseases where systemic and local lipophilic antioxidant depletion is strongly implicated [48].

A second parameter proved to be significantly different ($P < 0.05$) between EHS and MCS groups that is the ratio omega-6/omega-3 polyunsaturated fatty acids in the erythrocyte membrane phospholipid fraction (Figure 7(c)). The ratio showed a remarkable elevation versus CTR in favor of the more proinflammatory $\omega 6$ PUFA in the MCS group ($P < 0.001$), while EHS values were instead nearly overlapping CTR values, data that appears consistent with the overall less pronounced prooxidative and proinflammatory state evidenced in EHS versus MCS, from the whole pattern of redox parameters investigated in this study. Again, this molecular marker difference between the two environmental hypersensitivities can possibly be connected with the clinical setting, where, for example, a higher frequency of pathological obesity with metabolic syndrome is observed in MCS [50], whereas EHS condition features a milder chronic inflammatory *status* [51].

As a whole, MCS values of all metabolic parameters studied confirmed our previous results obtained in a larger cohort of 226 MCS + sMCS patients [23], highlighting the reliability of the selected redox-marker panel on this additional study cohort. With two exceptions, (a) erythrocyte CuZnSOD activity, now found significantly increased ($P < 0.0001$) in MCS versus CTR (Figure 5(c)) whilst nonsignificant in the first study, and (b) plasma nitrites/nitrates values, significantly elevated in the previous study MCS cohort [23], a finding not confirmed in the present study (data not shown). These differences may possibly be related to the extreme individual genetic and metabolic variability characterizing MCS populations, even within the same ethnic, geographic, lifestyle, and cultural setting, which represented one of the difficulties facing SRI human studies [52].

The question as to whether genetic background may determine a proneness to environmental hypersensitive syndromes remains still unanswered, from the time of the first pioneer studies on multiple chemical sensitivity [53, 54], followed by a wealth of extensive investigations on MCS,

Exhibit 3

FM, and CFS western populations worldwide [19, 23, 55]. We attempted to contribute to this unresolved issue of utmost relevance for diagnostic purposes in these poorly defined clinical settings. In previous works, we had investigated gene and allele frequencies of selected polymorphisms of a wide array of phase I and II xeno- and endobiotic metabolizing enzymes, GST (M1, T1 and P1), UDP-glucuronosyl transferase (UGT), and cytochrome P450 (CYP) variants belonging to the CYP2C9, CYP2C19, CYP2D6, and CYP3A5*3 isoenzymes. After a first study not showing any significant prevalence of the studied CYP, UGT, and GST gene polymorphisms in a group of 110 MCS patients [23], we proceeded to a second investigation on a clinically better characterized MCS group of 156 patients and of 113 matched controls, where we identified significantly ($P < 0.05$–0.0001) higher frequencies versus CTR for the polymorphisms CYP2C9*2, CYP2C9*3, CYP2C19*2, CYP2D6*4, and CYP2D6*41, confirming other studies indicating these genetic variants as a risk factor for SRI [24]. Starting from these results, in the present study, genotyping for the CYP2C19 single nucleotide variants showed that the frequency of the homozygous mutated *1 allele was significantly higher in EHS, than in MCS cases, whilst the *2 allele in the homozygous and heterozygous forms was less frequent in EHS than in MCS ($P = 0.003$) (Table 1). Moreover, our previous work had shown that the CYP2C19*2 heterozygous genotype *1/*2 was significantly more frequent ($P = 0.05$) in MCS cases, not only versus controls but also versus FM + CFS cases [24]. The same study showed for the first time that the Arg554Lys mutated variant of the aryl hydrocarbon receptor-AHR gene did not reach significant differences in distribution between SRIs and controls when analyzed alone but showed in specific haplotype combinations with CYP variants promising implications for in-between group discrimination within SRI comorbidities, namely, MCS versus sMCS and FC + FM versus controls [24]. In the present work, we were able to confirm the absence of significant differences for AHR genotype between EHS and CTR groups (data not shown).

Having previously found no significant difference between MCS patients and controls, in the distribution of GST isoenzyme genotypes [23], in the GST study we now compared EHS and healthy controls. Differently from our previous results on MCS, we here identified a mutated (null) allele combination of *GSTT1* and *GSTM1* variants able to predict risk of developing EHS by a 9.7 fold versus CTR (Table 1).

Taken together, our genetic results obtained on a number of cases due to be enlarged in the studies to come, although being far to be conclusive on such a controversial matter, can at least contribute additional indications to the complex mosaic of genetic risk factors in environmental hypersensitivities, still waiting to be correlated with individual metabolic phenotypes.

The outcomes of this work confirmed, in the whole, our previous results on MCS and provided additional evidences for the validity of the selected panel of metabolic blood parameters also in the self-reported EHS condition. Further developments must necessarily include a more objective and standardized classification of individual electromagnetic sensitivity scores, to conclusively assess the proposed parameters as a distinctive and specific panel of disease biomarkers for EHS. Our findings will hopefully contribute, in combination with the so-far putative genetic-risk factors, a better molecular definition of environmental-borne sensitivity-related illnesses and a tool to discriminate single SRI comorbidities, based on sufficiently proven molecular evidences able to gain clinical consensus.

Conflict of Interests

The authors declare that they have no conflict of interests.

Acknowledgments

The authors acknowledge the generous participations of Dr. M. Grazia Bruccheri, MD, from IRMA-Istituto Ricerca Medica e Ambientale, Acireale (CT), Italy, for patient diagnosis and enrolment in Sicily, Francesca Romana Orlando, from the Patient Association A.M.I.C.A.—Associazione per le Malattie da Intossicazione Cronica e/o Ambientale, Rome, Italy, for excellent documental support, and Andrea Stancato, from IDI IRCCS for skilled technical assistance.

References

[1] P. Levallois, "Hypersensitivity of human subjects to environmental electric and magnetic field exposure: a review of the literature," *Environmental Health Perspectives*, vol. 110, supplement 4, pp. 613–618, 2002.

[2] S. J. Genuis and C. T. Lipp, "Electromagnetic hypersensitivity: fact or fiction?" *Science of the Total Environment*, vol. 414, pp. 103–112, 2012.

[3] R. Richman, A. J. Munroe, and Y. Siddiqui, "A pilot neighbourhood study towards establishing a benchmark for reducing electromagnetic field levels within single family residential dwellings," *Science of the Total Environment*, vol. 466-467, pp. 625–634, 2014.

[4] World Health Organization, "Electromagnetic Fields," 2011, http://www.who.int/peh-emf/en/.

[5] H. Seitz, D. Stinner, T. Eikmann, C. Herr, and M. Röösli, "Electromagnetic hypersensitivity (EHS) and subjective health complaints associated with electromagnetic fields of mobile phone communication-a literature review published between 2000 and 2004," *Science of the Total Environment*, vol. 349, no. 1–3, pp. 45–55, 2005.

[6] M. Röösli and K. Hug, "Wireless communication fields and non-specific symptoms of ill health: a literature review," *Wiener Medizinische Wochenschrift*, vol. 161, no. 9-10, pp. 240–250, 2011.

[7] C. de Luca, D. Raskovic, V. Pacifico, J. C. S. Thai, and L. Korkina, "The search for reliable biomarkers of disease in multiple chemical sensitivity and other environmental intolerances," *International Journal of Environmental Research and Public Health*, vol. 8, no. 7, pp. 2770–2797, 2011.

[8] S. Gangi and O. Johansson, "A theoretical model based upon mast cells and histamine to explain the recently proclaimed sensitivity to electric and/or magnetic fields in humans," *Medical Hypotheses*, vol. 54, no. 4, pp. 663–671, 2000.

[9] O. Johansson, "Disturbance of the immune system by electromagnetic fields—a potentially underlying cause for cellular

Exhibit 3

damage and tissue repair reduction which could lead to disease and impairment," *Pathophysiology*, vol. 16, no. 2-3, pp. 157–177, 2009.

[10] M. Röösli, "Radiofrequency electromagnetic field exposure and non-specific symptoms of ill health: a systematic review," *Environmental Research*, vol. 107, no. 2, pp. 277–287, 2008.

[11] G. J. Rubin, R. Nieto-Hernandez, and S. Wessely, "Idiopathic environmental intolerance attributed to electromagnetic fields (formerly "electromagnetic hypersensitivity"): an updated systematic review of provocation studies," *Bioelectromagnetics*, vol. 31, no. 1, pp. 1–11, 2010.

[12] F. Köteles, R. Szemerszky, M. Gubányi et al., "Idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF) and electrosensibility (ES)—are they connected?" *International Journal of Hygiene and Environmental Health*, vol. 216, no. 3, pp. 362–370, 2013.

[13] L. Hillert, B. Kolmodin-Hedman, P. Eneroth, and B. B. Arnetz, "The effect of supplementary antioxidant therapy in patients who report hypersensitivity to electricity: a randomized controlled trial," *Medscape General Medicine*, vol. 3, no. 2, p. 11, 2001.

[14] G. J. Rubin, J. Das Munshi, and S. Wessely, "A systematic review of treatments for electromagnetic hypersensitivity," *Psychotherapy and Psychosomatics*, vol. 75, no. 1, pp. 12–18, 2006.

[15] J. Schröttner and N. Leitgeb, "Sensitivity to electricity—temporal changes in Austria," *BMC Public Health*, vol. 8, article 310, 7 pages, 2008.

[16] M. Hagström, J. Auranen, and R. Ekman, "Electromagnetic hypersensitive Finns: symptoms, perceived sources and treatments, a questionnaire study," *Pathophysiology*, vol. 20, no. 2, pp. 117–122, 2013.

[17] M. Witthöft and G. J. Rubin, "Are media warnings about the adverse health effects of modern life self-fulfilling? An experimental study on idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF)," *Journal of Psychosomatic Research*, vol. 74, no. 3, pp. 206–212, 2013.

[18] World Health Organization, *Establishing a Dialogue on Risks from Electromagnetic Fields*, Radiation and Environmental Health Deparment of Protection of the Human Environment, Who Library, Geneva, Switzerland, 2002.

[19] L. Korkina, M. G. Scordo, I. Deeva, E. Cesareo, and C. de Luca, "The chemical defensive system in the pathobiology of idiopathic environment-associated diseases," *Current Drug Metabolism*, vol. 10, no. 8, pp. 914–931, 2009.

[20] E. Palmquist, A. S. Claeson, G. Neely, B. Stenberg, and S. Nordin, "Overlap in prevalence between various types of environmental intolerance," *International Journal of Hygiene and Environmental Health*, 2013.

[21] S. J. Genuis, "Sensitivity-related illness: the escalating pandemic of allergy, food intolerance and chemical sensitivity," *Science of the Total Environment*, vol. 408, no. 24, pp. 6047–6061, 2010.

[22] C. de Luca, G. Scordo, E. Cesareo, D. Raskovic, G. Genovesi, and L. Korkina, "Idiopathic environmental intolerances (IEI): from molecular epidemiology to molecular medicine," *Indian Journal of Experimental Biology*, vol. 48, no. 7, pp. 625–635, 2010.

[23] C. de Luca, M. G. Scordo, E. Cesareo et al., "Biological definition of multiple chemical sensitivity from redox state and cytokine profiling and not from polymorphisms of xenobiotic-metabolizing enzymes," *Toxicology and Applied Pharmacology*, vol. 248, no. 3, pp. 285–292, 2010.

[24] D. Caccamo, E. Cesareo, S. Mariani et al., "Xenobiotic sensor- and metabolism-related gene variants in environmental sensitivity-related illnesses: a survey on the Italian population," *Oxidative Medicine and Cellular Longevity*, vol. 2013, Article ID 831969, 9 pages, 2013.

[25] M. R. Cullen, "Multiple chemical sensitivities: summary and directions for future investigators," *Occupational Medicine*, vol. 2, no. 4, pp. 801–804, 1987.

[26] C. S. Miller and T. J. Prihoda, "The environmental exposure and sensitivity inventory (EESI): a standardized approach for measuring chemical intolerances for research and clinical applications," *Toxicology and Industrial Health*, vol. 15, no. 3-4, pp. 370–385, 1999.

[27] K. R. Fabig, "Das multiple chemikalien-sensitivität-syndrom (MCS). Können fragebögen, IgE und SPECT zur Diagnostik beitragen?" *Hamburger Ärzteblatt*, vol. 12, pp. 600–603, 2000.

[28] G. E. Brown, G. M. Silver, J. Reiff, R. C. Allen, and M. P. Fink, "Polymorphonuclear neutrophil chemiluminescence in whole blood from blunt trauma patients with multiple injuries," *Journal of Trauma*, vol. 46, no. 2, pp. 297–305, 1999.

[29] T. Esko, M. Mezzavilla, M. Nelis et al., "Genetic characterization of northeastern Italian population isolates in the context of broader European genetic diversity," *European Journal of Human Genetics*, vol. 21, no. 6, pp. 659–665, 2013.

[30] G. Giovannoni, J. M. Land, G. Keir, E. J. Thompson, and S. J. Heales, "Adaptation of the nitrate reductase and Griess reaction methods for the measurement of serum nitrate plus nitrite levels," *Annals of Clinical Biochemistry*, vol. 34, no. 2, pp. 193–198, 1997.

[31] N. J. Miller, C. Rice-Evans, and M. J. Davies, "A new method for measuring antioxidant activity," *Biochemical Society Transactions*, vol. 21, no. 2, p. 95S, 1993.

[32] D. J. Reed, J. R. Babson, P. W. Beatty, A. E. Brodie, W. W. Ellis, and D. W. Potter, "High-performance liquid chromatography analysis of nanomole levels of glutathione, glutathione disulfide, and related thiol and disulfides," *Analytical Biochemistry*, vol. 106, no. 1, pp. 55–62, 1980.

[33] C. de Luca, I. Deeva, S. Mariani, G. Maiani, A. Stancato, and L. Korkina, "Monitoring antioxidant defenses and free radical production in space-flight, aviation and railway engine operators, for the prevention and treatment of oxidative stress, immunological impairment, and pre-mature cell aging," *Toxicology and Industrial Health*, vol. 25, no. 4-5, pp. 259–267, 2009.

[34] Y. Sun, L. W. Oberley, and Y. Li, "A simple method for clinical assay of superoxide dismutase," *Clinical Chemistry*, vol. 34, no. 3, pp. 497–500, 1988.

[35] H. Aebi, "Catalase *in vitro*," *Methods in Enzymology*, vol. 105, pp. 121–126, 1984.

[36] W. H. Habig, M. J. Pabst, and W. B. Jakoby, "Glutathione S-transferases. The first enzymatic step in mercapturic acid formation," *The Journal of Biological Chemistry*, vol. 249, no. 22, pp. 7130–7139, 1974.

[37] D. E. Paglia and W. N. Valentine, "Studies on the quantitative and qualitative characterization of erythrocyte glutathione peroxidase," *The Journal of Laboratory and Clinical Medicine*, vol. 70, no. 1, pp. 158–169, 1967.

[38] C. de Luca, A. Filosa, M. Grandinetti, F. Maggio, M. Lamba, and S. Passi, "Blood antioxidant status and urinary levels of catecholamine metabolites in β-thalassemia," *Free Radical Research*, vol. 30, no. 6, pp. 453–462, 1999.

[39] A. Primavera, S. Fustinoni, A. Biroccio et al., "Glutathione transferases and glutathionylated hemoglobin in workers exposed to low doses of 1,3-butadiene," *Cancer Epidemiology Biomarkers & Prevention*, vol. 17, no. 11, pp. 3004–3012, 2008.

Exhibit 3

[40] N. Leitgeb and J. Schröttner, "Electrosensibility and electromagnetic hypersensitivity," *Bioelectromagnetics*, vol. 24, no. 6, pp. 387–394, 2003.

[41] O. Elmas, "Effects of electromagnetic field exposure on the heart: a systematic review," *Toxicology and Industrial Health*, 2013.

[42] A. Costa, V. Branca, C. Minoia, P. D. Pigatto, and G. Guzzi, "Heavy metals exposure and electromagnetic hypersensitivity," *Science of the Total Environment*, vol. 408, no. 20, pp. 4919–4920, 2010.

[43] K. Österberg, R. Persson, B. Karlson, F. C. Eek, and P. Ørbæk, "Personality, mental distress, and subjective health complaints among persons with environmental annoyance," *Human & Experimental Toxicology*, vol. 26, no. 3, pp. 231–241, 2007.

[44] A. Tuengler and L. von Klitzing, "Hypothesis on how to measure electromagnetic hypersensitivity," *Electromagnetic Biology and Medicine*, vol. 32, no. 3, pp. 281–290, 2013.

[45] S. Eltiti, D. Wallace, K. Zougkou et al., "Development and evaluation of the electromagnetic hypersensitivity questionnaire," *Bioelectromagnetics*, vol. 28, no. 2, pp. 137–151, 2007.

[46] C. H. Mueller, H. Krueger, and C. Schlerz, "Project NEMESIS: perception of a 50 Hz electric and magnetic field at low intensities (laboratory experiment)," *Bioelectromagnetics*, vol. 23, no. 1, pp. 26–36, 2002.

[47] L. Korkina, I. Deeva, G. Ibragimova, A. Shakula, A. Luci, and C. de Luca, "Coenzyme Q_{10}-containing composition (Immugen) protects against occupational and environmental stress in workers of the gas and oil industry," *BioFactors*, vol. 18, no. 1–4, pp. 245–254, 2003.

[48] C. de Luca and G. Valacchi, "Surface lipids as multifunctional mediators of skin responses to environmental stimuli," *Mediators of Inflammation*, vol. 2010, Article ID 321494, 11 pages, 2010.

[49] V. Kostyuk, A. Potapovich, A. Stancato et al., "Photo-oxidation products of skin surface squalene mediate metabolic and inflammatory responses to solar UV in human keratinocytes," *PLoS ONE*, vol. 7, no. 8, article e44472, 2012.

[50] C. Lubrano, G. Genovesi, P. Specchia et al., "Obesity and metabolic comorbidities: environmental diseases?" *Oxidative Medicine and Cell Longevity*, vol. 2013, Article ID 640673, 9 pages, 2013.

[51] N. Dahmen, D. Ghezel-Ahmadi, and A. Engel, "Blood laboratory findingsin patients suffering from self-perceived electromagnetic hypersensitivity (EHS)," *Bioelectromagnetics*, vol. 30, no. 4, pp. 299–306, 2009.

[52] International Programme on Chemical Safety/World Health Organization (IPCS/WHO), "Conclusion and recommendations of a wokshop on multiple chemical sensitivities (MCS)," *Regulatory Toxicology and Pharmacology*, vol. 24, pp. S79–S86, 1996.

[53] G. McKeown-Eyssen, C. Baines, D. E. Cole et al., "Case-control study of genotypes in multiple chemical sensitivity: CYP2D6, NAT1, NAT2, PON1, PON2 and MTHFR," *International Journal of Epidemiology*, vol. 33, no. 5, pp. 971–978, 2004.

[54] E. Schnakenberg, K.-R. Fabig, M. Stanulla et al., "A cross-sectional study of self-reported chemical-related sensitivity is associated with gene variants of drug-metabolizing enzymes," *Environmental Health: A Global Access Science Source*, vol. 6, article 6, 2007.

[55] N. D. Berg, H. B. Rasmussen, A. Linneberg et al., "Genetic susceptibility factors for multiple chemical sensitivity revisited," *International Journal of Hygiene and Environmental Health*, vol. 213, no. 2, pp. 131–139, 2010.

Exhibit 4

HONESDALE NEUROLOGY
600 MAPLE AVE HONESDALE, PA 18431
PHONE: (570) 253-8635
FAX: (570) 253-8646

December 23, 2019

To Whom It May Concern:

This letter is in regards to patient Sylvia Bolte. The pt is concerned because of the planned installation of smart meters around her residence. The patient thinks that she is affected by electromagnetic radiation, and potentially this is possible. Nervous system problems which theoretically may occur from electromagnetic radiation includes headaches, numbness, weakness, difficulty concentrating, and dizziness. She does already report some of these symptoms.

Thank you for your attention to this matter. If you have any questions please contact our office for additional information.

Sincerely,

Julianne J. O'Boyle MD

Julianne J O'Boyle, MD.

Exhibit 5

CHAPTER 15
SERVICE AND FACILITIES

Subchapter
A. General Provisions
B. Discontinuance of Service to Leased Premises

Enactment. Chapter 15 was added July 1, 1978, P.L.598, No.116, effective in 60 days.
Cross References. Chapter 15 is referred to in section 2603 of this title.

SUBCHAPTER A
GENERAL PROVISIONS

Sec.

Subchapter Heading. The heading of Subchapter A was added November 26, 1978, P.L.1245, No.297, effective in 60 days.

§ 1501. Character of service and facilities.

Every public utility shall furnish and maintain adequate, efficient, safe, and reasonable service and facilities, and shall make all such repairs, changes, alterations, substitutions, extensions, and improvements in or to such service and facilities as shall be necessary or proper for the accommodation, convenience, and safety of its patrons, employees, and the public. Such service also shall be reasonably continuous and without unreasonable interruptions or delay. Such service and facilities shall be in conformity with the regulations and orders of the commission. Subject to the provisions of this part and the regulations or orders of the commission, every public utility may have reasonable rules and regulations governing the conditions under which it shall be required to render service. Any public utility service being furnished or rendered by a municipal corporation beyond its corporate limits shall be subject to regulation and control by the commission as to service and extensions, with the same force and in like manner as if such service were rendered by a public utility. The commission shall have sole and exclusive jurisdiction to promulgate rules and regulations for the allocation of natural or artificial gas supply

Exhibit 5

by a public utility.

Cross References. Section 1501 is referred to in sections 102, 1353, 2205, 2207, 2807, 3205 of this title.

Exhibit 6

Shawn E. Abrell, WSB No. 41054, *Pro Hac Vice*
4614 SW Kelly Avenue, Suite 200, Portland, Oregon 97239
Tel.: 971.258.0333; Fax: 503.222.0693
E-Mail: shawn.e.abrell@gmail.com
Lead Counsel for Plaintiffs

Tyl W. Bakker, OSB No. 90200
621 SW Alder, Suite 621, Portland, Oregon 97205
Tel.: 503.244.4157; Fax: 503.220.1913
E-Mail: tylbakker@gmail.com
Local Counsel for Plaintiffs

United States District Court

District of Oregon

Portland Division

AHM, by and through
her Guardian *ad litem* and father,
David Mark Morrison, and
David Mark Morrison, individually,

v.

Portland Public Schools,

Defendant.

Civil Action No. 3:11-cv-00739-MO

Amended Declaration of Barrie Trower

I, Barrie Trower, under penalty of perjury pursuant to 28 U.S.C. § 1746, hereby make the following declaration in support of a preliminary and permanent injunction enjoining Portland Public Schools' use of WI-FI:

Exhibit 6

Background

1. I trained at the Government (Ministry of Defense) microwave warfare establishment(s) early in the 1960s covering all aspects of microwave (MW) radiation technology, uses and health dangers. Later works included underwater bomb-disposal, which incorporated MW technology.

2. In the late 1960's and 1970's a part of my task was to extract confidential (hitherto secret) information from master criminals, terrorists, and spies. This included Cold War MW technology.

3. My first degree is in Physics with a specialization in microwaves. My second degree is a research degree. I have a teaching diploma in human physiology. Before retiring, I taught advanced physics and mathematics at South Dartmoor College.

4. I am Scientific Advisor to the Radiation Research Trust and the H.E.S.E. (Human Ecological Social Economical) Project.

5. I am the author of both Tetra Reports for the Police Federation of England and Wales and the Public and Commercial Service Union.

6. In April 2010, I gave a speech for the King of Botswana. http://www.magdahavas.com/wordpress/wp-content/uploads/2010/08/Barrie_Trower_SA.pdf. I hereby adopt and incorporate by reference my opinions and findings therein.

7. My work is done entirely free of charge and I have never accepted money from any person or organization in the years I have been doing this research. I consider myself absolutely independent.

8. I reserve the right to amend to add new studies as they may become available through the time of trial.

Origins

9. To my knowledge, 'microwave' or 'radiowave sickness' was first reported in August 1932 with the symptoms of severe tiredness, fatigue, fitful sleep, headaches, intolerability and high susceptibility to infection. Hecht, K *et al.*, *Overloading of Towns and Cities with Radio*

Exhibit 6

Transmitters (Cellular Transmitter): A hazard for the human health and a disturbance of ecoethics, International Research Centre of Healthy Ecological Technology (IRCHET), Berlin-Germany, at l ¶ 3 (2007). These symptoms were reported to be from athermal (which are sometimes also called subthermal or microthermal) effects.

10. By 1971, the US Naval Medical Research Institute (NMRI) referenced 2300 research articles listing in excess of 120 impairments and illnesses attributed to radiofrequency and microwave radiation. Biography of Reported Biological Phenomena (Effect) and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation, Research Report. MF12.524.015-0004B, Report No. 2. NMRI, National Naval Medical Centre (1971). Under the Freedom of Information Act, extracts from published US Defence Intelligence Agency (DIA) Documents confirmed the NMRI research and stated: 'If the more advanced nations of the West are strict in enforcement of stringent exposure standards, there could be unfavourable effects on industrial output and military functions,' in order to protect industrial profit and military function, and to avoid litigation from military employees. It was suggested that governments in the West chose a safety level compatible to industrial output and military function. The governments that adopted the thermal level only denied and still to this day deny any adverse effect from subthermal levels. DIA Documents: DST - 1810S - 076-76, ST-c5-01-169-72, DST-18105-074-76 (1972-1983).

11. In 1975, after an extensive study, the United States DIA warned all of its personnel of the risk from low-level microwaves including illnesses ranging from microwave sickness (flu like symptoms, depression, suicidal tendencies) to cancers and leukaemia. *Biological effects of electromagnetic radiation (radiowaves and microwaves) – Eurasian Communist Countries*, Defence Intelligence Agency: DST-1810S-074-76, March (1976).

Exhibit 6

12. During the Cold War, the Russian Embassy microwaved the United States Embassy in Moscow with low-level microwaves for many years from across the road; why and how is outside the scope of this Declaration. After changes of staff for serious neurologic impairments, miscarriages, multiple cancers / leukaemias and other illnesses to both male and female employees and their children, the late John R. Goldsmith, M.D., was invited to investigate this matter. His investigative report on this incident showed that continuous, long-term low-level microwaves were responsible for those illnesses. Goldsmith, J. R., *Radiofrequency Epidemiology*, Environmental Health Perspectives, Vol 105, at 1585, Supp 6, Table 8, Dec (1997). Dr. Goldsmith held 11 Professorships and was the World Health Organization (WHO) representative for Europe. Interestingly, the power of the microwaves used by the Russians in some cases was less that the power used by modern-day transmitters, with the average ranging <0.02 – 0.05 $\mu W/cm^2$and the maximum ranging 5 – 18 $\mu W/cm^2$. Goldsworthy JR. Epidemiological evidence of radiofrequency radiation (microwave) effects on health in military, broadcasting, and occupational studies, Intl J Occ and Env Health, 1:47-57, 1995. http://www.radiationresearch.org/goldsworthy_bio_weak_em_07.pdf. Dr. Goldsmith's warning on health and fertility: http://omega.twoday.net/stories/1755556/.

13. Debriefing spies during The Cold War extended my military education into the full diversity of stealth microwave warfare and communication systems. In so doing, I learned a list of approximately 30 pulse frequencies that could induce some 50 physical and mental ailments by entrainment.

14. As soon as ordinary MW transmitters became commonplace, residents started to complain of neurologic impairments, illnesses and later of cancer clusters. Independent researcher Sue Webster took data from just 19 transmitters and found approx 92 cancers (breast, thyroid, bowel, leukaemia), where the average age of those affected was roughly only 39. Health

Exhibit 6

Dangers from Wireless Laptops, Sue Webster was quoted in Canceractive's ICON magazine in January 2003 article, http://www.canceractive.com/shop/product.php?productid=16157&cat=255&page=1.

15. Microwave sickness was well documented by 1997, when over 100 further research documents pertaining to it were referenced. Grant, L., *Microwave Sickness*, Electrical Sensitivity News, Vol I No 6, Vol 2 Nos 1-4 (1997).

16. Portland Public Schools are transmitting electromagnetic, specifically MW, frequencies at low exposure levels compared to thermal levels. However, these exposure levels are very high compared to natural background levels at the frequencies deployed: 2.45 GHz and 5 GHz frequency, which means between 2.45 and 5 billion cycles per second. When I realized that power densities and frequencies similar to those used as weapons during the Cold War were being used as WI-FI in schools, I decided to come out of retirement and travel around the world free of charge and explain exactly what the problem is going to be in the future.

17. HAARP – High Frequency Active Auroral Research Program – was originally researched by Sister Dr. Rosalie Bertell, who investigated its electromagnetic interference to our atmosphere. HAARP reflects electromagnetic waves off the ionosphere and can influence any part of the air or land on this Planet. This has the potential to cause physiologic and neurologic effects on humans, animals and plants.

18. The paradox of course is how microwave radiation can be used as a weapon to cause impairment, illness and death and at the same time be used as a communications instrument. Therefore, WI-FI cannot be safe for the schoolchildren and teachers exposed to it. Also, there still exists an ongoing stealth microwave warfare industry, continuing from the 1950's.

Exhibit 6

Technology

19. The International Commission for Non-Ionizing Radiation (ICNIRP) classifies microwaves as electromagnetic waves from 300 MHz to 300 GHz. ICNIRP Guidelines, Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz), Health Physics April 1998, Vol 74, No 4, 522, www.icnirp.de/documents/emfgdl.pdf. Therefore, everything discussed in this report is in the microwave 'band.'

20. Microwaves react very differently in our water-based bodies than do radio waves. The term 'Radio Frequency' is often used to describe MW-based communications systems. It is important that the term 'Radio Frequency' is not associated solely with Radio Waves, but rather primarily with Microwaves. Microwaves are the preferred medium for communication, over radiowaves, due to their *superior penetrative properties*. Penetration occurs in living tissues in particular, with more absorption due to water content; and microwaves will also penetrate most dwellings and other buildings.

21. What is all this really about? Imagine the field around a magnet and imagine ordinary everyday static electricity. If you put the force field from the magnet with the force field from the static electricity, you make a wave. This is called an electromagnetic wave. There are lots of different types of electromagnetic waves, but they are all made of the same two things, magnetic and static fields. The main difference between these waves is their wavelength or the length of the wave, hence the number of waves that can be produced per second, i.e. the frequency. All electromagnetic waves are included in a table called the electromagnetic spectrum.

22. At one end of this electromagnetic spectrum you have the very shortest lengths, namely cosmic, gamma rays and x-rays, and at the other end of the spectrum you have the very long ways, namely TV and radio. Physicists sometimes take the radiofrequency spectrum further yet, all the way to extreme low frequency (ELF), such as the electrical power frequency. All

waves have the same basic properties: they can be reflected, diffracted, and they all travel at the same speed, which is the speed of light. For interest, if you were one wave of light you would be able to travel around the world nearly seven times every second; that is the speed of light. The electromagnetic spectrum is ordered; starting with the shortest wave end you have cosmic and gamma rays, x-rays, ultra-violet, visible light, infra-red, microwaves, TV and radio being the longest, in that order. The ultra-violet and higher frequencies are known as ionizing waves; and they are damaging to the body. Longer than ultraviolet and visible light is the radiofrequency side of the spectrum, which is also damaging. The microwaves deployed for the WI-FI system are on this radiofrequency side of the electromagnetic spectrum. I will be discussing microwaves and health herein.

Adverse Health Effects

23. There is a plethora of extensive, well-researched documents from around the world highlighting impairments and illnesses caused by MW radiation. These papers (in their thousands) discuss adverse health outcomes caused by low-level (below thermal) microwaves as: arrhythmia, heart attack, cell death, diseases of the blood, interference to bone marrow, brain tumours, DNA damage, altered calcium level in cells, reduction in night-time melatonin, suppression of the immune system, arthritis, rheumatism, skin problems, lymphatic diseases, vaginal discharge, vascular system disease, tinnitus, leukaemia, childhood cancer, sleep problems, mental problems involving depression, irritability, memory loss, difficulty in concentrating, headache, dizziness and fatigue, suicidal tendencies, miscarriage and infertility.

24. Some have asserted that such symptoms and illnesses are psychogenic. For example, when a neighbourhood sees the erection of a transmitter, subsequent health problems are often attributed to that transmitter. Psychologically the mast is deemed to have caused the illnesses. However, an argument against this is the many cases where disguised, stealth, or concealed transmitters have been erected without local knowledge and similar illnesses still occur.

Moreover, when similar conditions arise in animals near new transmitters, and in laboratory trials under controlled circumstances, the animals do not have such a psychologic component, yet still respond similarly in the ways that humans do.

25. Advancement in microwave technology since the Cold War necessitated concurrent experimentation. Thousands of research studies exist concerning ill effects from low-level, below thermal irradiation levels, involving almost every organ in the body. Possibly the most comprehensive explanation for this phenomenon is written by Dr. A. Goldsworthy of Imperial College London: *The biological effects of weak electromagnetic fields* (2007), http:tinyurl.com/2nfujj; also: a.goldsworthy@imperial.acuk.

26. Before I go further, I wish to comment on the telecommunication industry's own research. In February 2007, I was invited to give a short presentation concerning low-level microwave irradiation and cancer at London's Great Ormond Street Hospital for Children. One of the other speakers present was Dr. George Carlo. Sharing the same hotel afforded me the opportunity to engage in several conversations with Dr. Carlo during the two days we were in London. Dr. Carlo explained how he was commissioned by the mobile industry to conduct research on its products. His study (www.health/concerns.org) involved 200 research doctors and 15 epidemiological studies (1993-1999), at a cost of 28.5 million US dollars. 'Our data showed *increased risk to children*, concerning tumours, genetic damage and other problems,' explained Dr Carlo. He continued, 'my results were suppressed by the telecommunications industry.'

27. Further discussion of industry influence is warranted as The University of Berne, Switzerland, published a data synthesis of 59 research studies involving ill health from low-level MW irradiation. The Department of Social and Preventive Medicine concluded: 'Studies funded exclusively by industry reported the largest number of outcomes, but were least likely to report a

Exhibit 6

statistically significant result. The interpretation of results * * * should take sponsorship into account.' Huss, A. *et al.*, Source of Funding and Results of Studies of Health effects of Mobile Phone Use: Systematic Review of experimental Studies, (2006), University of Berne, Finkenhubelweg II, Switzerland (egger@ispm.unibe.ch).

28. Moreover, the 'Journal of Industrial Medicine' published the fact that industrial affiliation was being concealed by research scientists, suggesting that biases from conflicting interests in risk assessments cannot be evaluated properly. Hardell, L., *et al.*, *Secret Ties to Industry and Conflicting Interests in Cancer Research,* American Journal of Industrial Medicine, at I, May (2006), [Wiley-Liss Inc.]; www.interscience.wiley.com; Dept of Oncology, University Hospital, Orebro University, Sweden. Examples of these problems from Sweden, the United Kingdom and the United States are presented.

29. Notwithstanding industry's attempts to influence research, even their own studies continued to find adverse health effects. One example is a worldwide epidemiological study (commissioned by T-Mobile, on its own product) that concluded, 'On the cellular level, a *multitude of studies* found the type of damage from high frequency electromagnetic fields which is important for cancer initiation and cancer promotion.' Mobile Telecommunications and Health, ECOLOG Institute, Sec 7, April (2000) (mailbox@ecolog-institut.de). This document also describes DNA damage on the same page.

30. The US Environmental Protection Agency (EPA) recommended that electromagnetic radiation (which includes WI-FI radiation) be classified as a 'probable human carcinogen.' United States Environmental Protection Agency, Evaluation of the Potential Carcinogenicity of Electromagnetic Fields, External Review Draft, No. EPA1600/6-901005B, October 1990. With many new studies since 1990, there is certainty that microwave radiation in particular is carcinogenic.

Exhibit 6

31. Following a spate of illnesses in their practices, on October 9, 2002, a group of doctors produced the Freiburger Appeal. http://omega.twoday.net/stories/555926/, scroll down for cluster listing. Initially signed by 270 medical consultants, scientists, GPs, MPs and physicians, it now has many thousands of signatories worldwide. It is a warning to decision-makers concerning illnesses from low-level microwaves. This appeal lists 13 severe, chronic illnesses and various disorders involving: behaviour, blood, heart, cancers, migraines, tinnitus, susceptibility to infections and sleeplessness, all of them ascribed to 'pulsed microwaves from mobile communications technology.' *Interdisziplina re Gesellschaft fur Umweltmedizin e. V.* http://www.e-smognrw.denews/skandal/wewelsburg/HESEProject!FreiburgerAppell/Liv elistenderunterschriftensammlungfurdenFreiburgerAppellArztelists.htm.

32. During September 2002 at the University of Vienna, 19 of the world's top scientists met to discuss electromagnetic waves. This was known as the Catania Resolution. They stated 'we take exception to arguments suggesting that weak, low-intensity EMF cannot interact with tissue. There are plausible mechanistic explanations for EMF-induced effects that occur below present ICNRP guidelines and exposure recommendations by the EU.'

33. An international study of schools near cell towers or with a cell tower on school premises published a list of impairments and illnesses amongst staff and students, finding with large numbers of cancer clusters and other illnesses. There were 47 cancer clusters. Schools and Cell Tower Antennaes, 2003, http://members.aol.com/gotemf/emf/schools.htm; www.omega.tw oday.net/stories/55592.

34. Another report, *School References (school and cell tower antennas)* from 138 schools, dated November 2003, lists miscarriages, brain tumours, cancers, breast cancers and teachers ill within this report. One single school had transmitters on its roof in the Saint-Cyr-l'Ecole quarter of France, where eight cases of cancer were confirmed amongst children in the district.

Exhibit 6

35. The Stewart Report 2004 asks that anecdotal evidence be taken seriously in the absence of long-term epidemiological studies, regarding illnesses around the area of mobile phone transmitters. Such anecdotal evidence produced July 2002 refers to 92 cases of cancer around just 19 mobile phone transmitters. Other illnesses in the same paper refer to breast cancers, thyroid, bowel and blood problems. Now, of course, there are many epidemiological studies, and they are consistent in showing such illnesses and other harmful effects.

36. In 2007, an international group of scientists studied 2000 peer-reviewed and published research papers. They recommended an acceptable level of radiation of not more than 0.6 V/m = ~1μW/cm^2 outdoors, and 0.2 V/m = ~0.1 μW/cm^2 indoors, based on the interaction between low-level microwaves and the cellular processes. This became known as the Bioinitiative Level, which has since been lowered by a factor of 10, to 0.01 μW/cm^2.

37. A project called EU-Reflex or European Union Risk Evaluation of Potential Environmental Hazards from Low Frequency Electromagnetic Field Exposure using sensitive in Vitro Methods shows that cells exposed to cell phone radiation exhibit chromosomal damage well below the exposure guidelines of the WHO.

38. The following studies: Naila, Hutter, Santini, Oberfeld, Bamberg, Wolf, etc. all show increased neurologic impairments and/or cancers and/or other illnesses from low-level microwave irradiation. A good summary of these studies, with details, can be found on the Radiation Research Trust's website: www.radiationresearch.org.

39. The International Association of Fire Fighters opposes the use of fire stations as transmitter sites, because of the health problems of its members. International Association of Fire Fighters, www.iaff.org/safe/content/celltower/celltowerfinal.htm.

40. The world-renowned Irish Doctors' Association listed 70 research papers showing the dangers from low-level microwaves. Dr. Santini listed 20 similar studies; the

EM Radiation Research Trust listed 9 studies; Dr. Blackwell listed 6 similar studies in his report, and finally 4 international universities completed the Spanish Study, which verified all of these known illnesses. The authors of the Spanish study (The Microwave Syndrome-Further Aspects of a Spanish Study, 2004) recommended a level 10 million times below ICNIRP guidelines (discussed below), or 0.1 $\mu W/cm^2$. Dr. Gerd Oberfeld, one of the authors of the study, is the Director of the Public Health Office in Salzburg, Austria, which lowered its precautionary value for indoor exposures to GSM frequencies to comply with the recommendation made by the study. See: http://www.ideaireland.org/emrresearch.htm; Santini paper (2006): http://next-up.org/pdf/Roger_SANTINI_Scientific_arguments_to_prove_application_of_precaution_principle_mobil_phone.pdf, Dr. Grahame - Six studies showing ill effect: http://www.starweave.com/masts/; The Microwave Syndrome Further Aspects of a Spanish Study: http://www.hese-project.org/hese-uk/en/papers/navarro_n%20045%20_p353%20-%20p358_.pdf.

41. Listing and referencing all such epidemiological studies would be too extensive and repetitive for this article; suffice to say, by 2006, it was reported that 80 percent of the extant epidemiological studies on the WHO database list symptoms from microwave sickness, including up to fourfold increase in cancers from low-level microwaves. Guilmot, Jean-luc, *WHO EMF Database*, Watch - Understand - Act 26, Sept (2006), www.001be.cx. I was curious to investigate the remaining 20 percent that showed no symptoms. However, this had already been looked at by Swiss scientists who said 'the interpretation of results * * * should take sponsorship into account.' By that time, Michael Meacher, Minister for the Environment 1997-2003 (United Kingdom), had published a report blaming some universities for accepting lucrative contracts in reporting favourable results from scientific research. In the same month, United States Congressman Henry Waxman published a similar report in Scientific American stating that science was being corrupted by industry. http://www.next-up.org/pdf/Ope

Exhibit 6

nLetterWHODrvanDeventer.pdf; Swiss Study on funding sources; http://www.ehponline.org/docs/2006/9149/abstract.html; Michael Meacher quote, http://www.epolitix.com/EN/MPWebsites/Michael+Meacher/c8afdecc-b15e-41ad-b9cf-25354790d2dc.htm, also published in The Times, May (2004); Henry Waxman in The Scientific American, http://www.sciam.com/article.cfm?articleID=0000FF81-A7DD-1084-A73E83414B7F0000 (May 2004).

42. In April 2011, the Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP) found:

> Preventing childhood and juvenile diseases from exposure to EMF sources is of paramount social and economic importance. * * * This problem has been already recognized by the international community: in May 2011, the World Health Organization (WHO) will be organizing the Second International Conference: 'Non-ionizing Radiation and Children's Health' dedicated to health protection of children exposed to EMF sources of various frequency ranges. It is the WHO's opinion that a 'child is more vulnerable to environmental factors.' * * *
>
> Human brain and the nervous system tissues directly perceive EMF *and react irrespective of its intensity*, and in certain cases it depends on EMF modulation. * * * Analysis of scientific peer-reviewed national and international publications as well as analysis of actual population exposure to EMF have allowed the RNCNIRP to formulate 10 postulates. * * * *(Note: here and following, 'EMF' includes RF/MW radiation).*
>
> 1. For the first time in human evolution, the brain is daily exposed to modulated EMF at all developmental stages.
>
> 2. Absorption of EMF in a child's brain is greater than in adult phone users; larger brain areas including those responsible for intellectual development are exposed in a child's brain.
>
> 3. A child's brain is undergoing development * * *
>
> 8. Better safety criteria for children and teenagers are required *in the nearest term*. Features of the developing organism should be taken into account, as well as the significance of bioelectric process for human life and activities, present and future conditions of EMF, prospects of technological and technical development should be addressed in a document of legal status. (Italics added). RNCNIRP, *Electromagnetic Fields From Mobile Phones: Health Effects on Children and Teenagers*, (Italics added) April 2011, www.scribd.com/doc/55420788/Electromagnetic-Fields-from-Mobile-Phones-Health-Effect-on-Children-and-Teenagers.

Exhibit 6

43. On May 6, 2011, the European Parliament was presented with a report recommending that wireless networks and mobile phones be totally banned from schools on health grounds. Council of Europe, *The potential dangers of electromagnetic fields and their effect on the environment*, Parliamentary Assembly, Committee on the Environment, Agriculture and Local and Regional Affairs, assembly.coe.int/documents/workingdocs/doc11/edoc12608.pdf. This document notes that young people are most susceptible. *Id* at 2. The Assembly recommends that we take all reasonable measures to reduce exposure to electromagnetic fields on 'as low as reasonably achievable' (ALARA) (*Id.*) The Parliamentary Assembly asked education and health authorities to develop information campaigns 'aimed at teachers, parents and children to alert them to the specific risks of early, ill-considered and prolonged use of mobiles and other devices emitting microwaves.' *Id* at 3. The Assembly also asked that Governments '*ban all mobile phones, DECT phones or WI-FI or WLAN systems from classrooms and schools*, as advocated by some regional authorities, medical associations and civil society organizations.' (Italics added) *Id.*

44. In conclusion, ***even so-called 'low' levels of microwave radiation are very serious***! Emphasis supplied. It is impossible to MW-irradiate the body without an effect. Low-level MW radiation is as dangerous or even more dangerous than high-level radiation.

45. I reserve the reserve the right to amend to add new relevant studies as they may arise and pending analysis, additional testing, and recently received voluminous discovery.

Current Regulations and Thermal Heating

46. The guidelines set by ICNIRP and the National Radiological Protection Board (NRPB), and which are followed by the United States' FCC, are amongst the least protective in the world. Being thermally based – no account whatsoever is given to the effect of the electric and magnetic of the wave interacting with the physiology of the body – it is very unlikely, if not impossible, for any person to receive warming of the body with exposure exceeding the guidelines, if this person

is not sitting right on top of the transmitter. Guidelines in units of microwatts per cm2, the maximum level for 1,800 MHz transmitters, 1,000 of these units. By contrast, Russia and China have a total maximum of 10 of these units, $\mu W/cm^2$, Toronto has a maximum of 6 $\mu W/cm^2$ and in Salzburg, the limit is 0.1 $\mu W/cm^2$. The June 2000 International Conference at Salzburg, consisting of 19 of the world's top scientists in this field, set the level at 0.1 units.

47. The EU Parliament on September 4, 2008, by 522 votes to 16, stated that the 'ICNIRP guidelines were obsolete and out of date.' Mast Action UK - Legal Services (2010).

48. By way of example, Russia has recommended the banning of children under 16 from using cell phones when possible.

49. As a result of research that documents the harmful effects of MW radiation on fetuses, the British government warned in the cell phone handbook under 'safety,' that pregnant women should not have a cell hone near the abdomen, children under 16 should avoid carrying phones near their abdomen, like boys in their trouser pockets, and children should text rather than phone. The handbook recommends that if they do phone, they use hands-free, so the phone is away from the head; that, if one is going to make a long call, one should use a landline telephone; and that the phone should never be closer than 0.98 inch from the body. The government advice for children is 'essential calls only' to avoid exposure to MW radiation. See Statz, P., The Cell Phone Handbook: Everything You Wanted to Know About Wireless Telephony (But Didn't Know Whom or What to Ask) (1999) http://www.amazon.com/Cell-Phone-Handbook-Everything-Telephony/dp/1890154121.

50. These international bodies', NRPB's and ICNIRP's, guidelines are based purely on thermal effects. Looking at scientific papers, most of the rest of the world disagrees with this assessment. Dr. Cletus Kanavy, Chief of the Biological Effects Group of the Phillips Laboratory's Electromagnetic Effects Division at Kirkfield Air Force Base in New Mexico, says there is a 'Large amount of data, both animal, experimental and human clinical to support the existence of

chronic, non-thermal effects * * * these include behavioural, neural, fetal, blood, metabolic, endocrine and immune problems.'

51. Professor Adey, a Fellow of the US American Academy of Scientists and a distinguished visitor of the Royal Society of Medicine said of his own research, in parallel with similar studies in Russia in the early 1980s, that they showed that radio frequency and microwave radiation affected enzyme systems that regulate growth and the division of white blood cells.

52. Clearly there are experts worldwide, both in military-intelligence and from Universities, from the long before Cold War to the present, who have shown that microwave radiation below thermal effects can impinge on human and other living organisms' physiologic functions.

Pulse and Modulation

53. Carrier waves may be used to carry information (video or audio data) that can be superimposed on them by modulation.

54. Sometimes academic arguments arise where the word 'pulsing' is not used and a word like 'modulated' substituted. Theoretically, there can be very little difference between a modulated wave and a pulsed wave.

55. Scientists argue over what constitutes a modulation or pulse. A modulation is a superimposition of data upon a carrier wave; modulations are usually connected with an infinitesimally thin thread of 'energy.' A pulse has no such attachment to the following pulse. A reader may wonder why this distinction is relevant. Scientists specializing in this field blame pulsed microwaves for various biological reactions within our cellular structures, which may then cause illness and impairment.

56. Further arguments suggest that there is no biological difference between a frequency modulated transmission or pulse when it comes to resonance with our cyclotronic and circadian rhythms.

Exhibit 6

57. Transmissions may be directional or isotropic (equal in all directions), may be analogue (with continuously variable quantity e.g. spatial position) or digital (sometimes called 'frequency-modulated'). However, all transmissions are electromagnetically propagated. In the world of nuclear and atomic physics, electronic switches can make tens of millions of decisions a second; and all transmissions travel at the speed of light.

58. Transmissions can be increased by possibly up to 40 percent, with side lobe technology. Vector mathematics can demonstrate whether any of these transmissions are incident upon another transmitted wave, such as a low-frequency radio wave, as there can be a piggy-back effect (constructive interference).

59. The Health Council of the Netherlands Radio Frequency Radiation Committee says in its 200 page 1997 report, concerning frequencies of 300 Hz to 300 GHz: 'The experimental data indicate that the effects of EM fields occur at lower power densities when the object is exposed to pulsed electromagnetic fields.' In other words, you will get impairments and illnesses quicker if the microwaves are pulsed. Health Council of the Netherlands: Radiofrequency Radiation Committee, *Radiofrequente elektromagnetische velden (300 Hz – 300 GHz)*, at 134 (1997).

60. Professor Salford at Lund University in Sweden has shown in his work in the year 2000 that pulsing can alter the permeability of the blood/brain barrier in rats. This would reasonably occur in human brains as well, and could have profound effects on brain function.

61. The Freiburger Appeal (2002), as previous mentioned, says, 'One can no longer evade these pulsed microwaves. They heighten the risk of already present chemical/physical influences, stress the body's immune system and can bring the body's still functioning regulatory mechanisms to a halt. Pregnant women, children, adolescents, elderly and sick people are especially at risk.'

62. Assimilating knowledge from the Cold War and other sources, I accumulated a plethora of data describing how pulsed / modulated microwaves interfere with our cellular biochemistry.

Exhibit 6

Believing the communications industry to be spiralling out of control with its new innovations, I published my list on the Internet in the hope that the industry and policymakers would take note. (*The Communications Industry is in the position where it is spiralling out of any person's ability to control it*, An open letter from Barrie Trower (undated); http://omega.twoday.net/search?qBarry+Trower; http://www.mastsani ty.org),

Transduction

63. I will try to summarise the thousand or so research papers written over the last 20 or so years and explain or summarise what happens when the electric and magnetic part of the wave goes into our bodies. We, being water-based animals, act like aerials to these waves. As the waves penetrate our bodies, an electric current is generated inside our bodies, which is how aerials work. Waves come in and electricity is generated. The electricity generated in our bodies, like all electric currents, goes to ground through our bodies; and like all electric currents, it takes the path of least resistance. Unfortunately, the path of least resistance through our bodies, although only representing 10 percent of our pathways, carries 90 percent of our traffic rather like the M1 motorway. The traffic in our bodies, namely hormones, antibodies and neurotransmitters, know where they are going because they also carry an electric charge. The hormones, antibodies and neurotransmitters know where to 'get off' the pathway, because there is a corresponding opposite charge at the site of delivery – rather like the positive and negative ends of a battery. The problem is, if you have an electric current passing through the body it can change this charge, either on the hormones, antibodies or neurotransmitters, or at the site of delivery.

64. A similar effect is that the destination for some of these hormones, neurotransmitters, and antibodies is a surface of a cell where chemicals will pass through a membrane into a cell. If you think of a cell in our body, be it a brain cell, bone cell, etc., as having a positive and negative charge on the outside and the inside similar to a battery the difference in these charges will draw

the chemical into the cell or draw poisonous substances out of the cell. If the charge is changed on the outside of the cell, then necessary chemicals may not go in or poisonous chemicals may not go out.

Children

65. WI-FI in a classroom is more powerful energy than having a cell tower 300m away. It makes no sense to have WI-FI in the class, especially where cell masts are disallowed.

66. My position as scientific advisor requires that I read and translate papers from all around the world, and, I have never, ever, no matter which country I lecture in, which paper I have read, I have never seen a single scientist brave enough to submit for peer review a safety level of microwave radiation for a child or embryo. There is not one that exists. Last year I lectured in six countries. When I'm in a country I challenge on TV the industry and the government to produce a scientist who will come on air with me and cite a safe level for children. In 12 years, no one has ever come forward.

67. Children act like antennas and absorb more radiation than adults because they are smaller, and their very dimensions approximate the deployment's wavelength. See example of humans acting as antennae: Cohn G, Morris D, Patel S, Tan D, *Your Noise is My Command: Sensing Gestures Using the Body as an Antennae*, http://research.microsoft.com/en-us/um/redmond/groups/cue/publications/chi2011_rfgestures_cohn.pdf:

> A basic receiving antenna can be thought of as an apparatus that converts electromagnetic waves into electrical current * * * It turns out that the human body is also a very effective antenna over a broad frequency range. As an electrical conductor, when exposed to electromagnetic fields, it behaves as an antenna with a frequency resonance determined by various factors including height, posture, etc.

68. Children are not merely small adults. They are physiologically and neurologically immature; their systems have not yet formed. Microwave radiation alters the blood-brain barrier

so that toxins leak into the brain. This can cause neurologic and psychologic amongst many other problems more easily in children. A child's immune system, which fights off infection, takes 18 years to develop. Additionally, 122 layers of protein – myelin – insulate the electrically generated signals used by the nervous system to control muscles and organs. These layers of protein take 22 years to develop. MW radiation has been shown to affect protein synthesis. This could lead to muscular dystrophy-like symptoms in later life.

69. I have always predicted that any school that allows itself to be 'bathed' in microwaves from whatever source will see its sicknesses rise and behaviour fall. I have received many phone calls to confirm this. In all of the schools I have visited around the world with WI-FI, every one has reported the same symptoms in students: fatigue, headaches, nausea, chest pain, vision problems. I argue that one could experience from microwave radiation psychologic problems, with increase in aggression and other bad behaviour, as well as reduced immune symptoms, leading to more and longer colds and coughs, depression, anxiety, bad behaviour and suicidal tendencies from sleep deprivation and finally – leukaemia.

70. The effects of microwaves will continue long after the children are exposed at school. A study has been carried out on children using an ordinary microwave transmitter, a cell phone. What it found was that after just two minutes' use of a cell phone, the children had their natural brain waves disrupted for up to two hours thereafter. This is called long-term potentiation, and it can last up to six weeks.

71. Research suggests children and women (females have more complex hormone-based systems to be disrupted than males) exhibit more vulnerability to illnesses from MW irradiation than do adult males.

72. The problem with young girls is that microwave irradiation has been shown to damage the genetic structure in their ovaries. Girls are born with all of the eggs they need in their ovaries at

birth. They are immature eggs, hence susceptible to damage during growth. ***Microwaves are genotoxic*** (experiments can be linked to children showing low-level mobile telephony radiation disrupts the biochemistry of follicle cells in a mammalian egg chamber), hence the microwaves irradiation could affect the genetic structure within the eggs. The problem here is that the mitochondrial DNA, the genes inside the ovaries, is irreparable.[1][2][3] If you have a little girl in whom there is damage through this mechanism to the genetic structure in one of her eggs, and she has a daughter, that daughter will carry that genetic problem. It is irreparable. And her daughter in turn will carry that genetic problem, because it is irreparable. And every female *forever*, in that line, will carry that problem in perpetuity, because it is irreparable. Attached as Addendum 'A' is a diagram further explaining this process.

73. I believe the most important research I have read is from Dr. Goldsworthy, *The biological effects of weak electromagnetic fields* (2007), http:tinyurl.com/2nfuj; also, a.goldsworthy@imperial.ac.uk. Dr. Goldsworthy not only shows the mechanism by which microwaves disrupt cells, but also predicts that a genetically damaged sperm and egg can lead to mutant offspring. If you think of children with these transmitters near their laps, the question must be, 'Why do this for the sake of a piece of cable and a plug, which could replace WI-FI with no loss of performance, and in fact improved performance?'

---

[1] Acharya, PVN; The Effect of Ionizing Radiation on the Formation of Age-Correlated Oligo Deoxyribo Nucleo Phospheryl Peptides in Mammalian Cells; 10th International Congress of Gerontology, Jerusalem. Abstract No. 1; January 1975. Work done while employed by Dept. of Pathology, University of Wisconsin, Madison.

[2] Acharya, PVN; Implicatons of The Action of Low-Level Ionizing Radiation on the Inducement of Irreparable DNA Damage Leading to Mammalian Aging and Chemical Carcinogenesis.; 10th International Congress of Biochemistry, Hamburg, Germany. Abstract No. 01-1-079; July 1976. Work done while employed by Dept. of Pathology, University of Wisconsin, Madison.

[3] Acharya, PV Narasimh; Irreparable DNA-Damage by Industrial Pollutants in Pre-mature Aging, Chemical Carcinogenesis and Cardiac Hypertrophy: Experiments and Theory; 1st International Meeting of Heads of Clinical Biochemistry Laboratories, Jerusalem, Israel. April 1977. Work conducted at Industrial Safety Institute and Behavioral Cybernetics Laboratory, University of Wisconsin, Madison.

Exhibit 6

74. This represents permanent, low-level microwave damage, and it also involves the induction of chronic nitrosative and oxidative stress.

Warnke, http://www.hese-project.org/de/emf/WissenschaftForschung/Warnke_Dr.%20rer.%20nat._Ulrich/20050219_VortragDrWarnke.pdf (2005) (in German, English translation in progress). It is known that chronic nitrosative/oxidative stress damages the mitochondria, the 'powerhouses' of each cell in the body. Mitochondropathy is at the root of many of today's chronic illnesses, such as MS, Alzheimers, Parkinsons, Fibromyalgia Diabetes, Artherosclerosis and Obesity. Kuklinsli, http://www.kpu-berlin.de/For_Neu_Kuklinski_1_en.html (2004). Even more disturbingly, when chronic nitrosative and oxidative stress is present, irreversible mitochondrial DNA damage will occur sooner or later (see also Kuklinski, http://www.kpu-berlin.de/For_Neu_Kuklinski_1_en.html (2004)). The mitochondrial DNA is ten times more susceptible to nitrosative / oxidative stress than is the DNA in the cell nucleus. Whilst regular cell DNA has built-in repair mechanisms, mitochondrial DNA is irreparable, due to its low histone protein content. The mitochondropathy is therefore irreversibly transmitted to the children by the maternal egg cell, causing cumulative irreparable damage to future generations.

75. There is no known safe level of MW irradiation for an embryo, a fetus, a child or a pregnant woman.

Electro-hyper-sensitivity

76. The World Health Organization (WHO) recognizes and describes electro-hyper-sensitivity. Electro-hyper-sensitivity can be compared to a food allergy that exposes the person to great harm on each occasion that the food is absorbed. If a food received this much adverse publicity from research all over the world, it would be immediately taken off the shelf.

77. In Sweden, it is published that 3.15 percent of its population is medically recognized and registered as being handicapped from electro-hyper-sensitivity. This number is comparable in California and it is believed to be similar in Australia. The Irish Doctors' Association believes this figure may actually be as high as 15 percent.

Experimentation

78. In 2008, the European Parliament wrote to its 27 countries urging them to ignore WHO guidelines and set exposure limits at lower levels. Ries, *European Parliament 2004-2009 Commission on the Environment. Public Health and Food Safety*, 2008/2211/INI (translation by www.nexyt-up.org) Editor: Frederique Ries (2008). In response, the WHO (which only began studying microwave radiation effects on children in 2009) stated it will not comment on microwave radiation effects on people until 2015, when it will be able to establish effects on human beings. Their researchers are watching people to see how many will become sick. We are being experimented upon.

The Cumulative Dose

79. Professors Sosskind, Provsnitz, Lai, and Cherry and a Russian International Medical Commission have all warned about the cumulative effect of these microwaves. See, Effects of chronic microwave irradiation on mice, S Prausnitz & C Susskind, 1962.

80. Professor Sosskind and Provsnitz write, 'An accumulated cellular level damage mechanism is not necessarily related to the intensity but can relate to total dose.' This is not surprising; a property of electromagnetic radiation exposure is that the effects are cumulative. By way of example, if we go out on a cloudy day we can still get sunburned, it just takes longer.

81. In the report *Mobile telephones, their base stations and health,* from the French Health General Directorate, January (2001), they warn of the cumulative exposure over the lifetime of a child. This body concluded with an interesting sentence stating, 'Biological

Exhibit 6

effects occur at energy levels that do not cause any rise in local temperature.' As it may be argued that biological effects may not be hazardous, ***the responsibility for this decision concerning children should lay with the parents***, guardians or those in loco-parentis and not the school.

82. Based upon a review of the Mount Tabor School WI-FI Floor Plan, schoolchildren will be exposed to as much as 30-40 hours per week of constant, digitally encoded pulsed WI-FI signals from each wireless device in the child's vicinity, in addition to the infrastructure, making the cumulative exposure over a child's lifetime successively higher.

83. When reviewing this case, it occurred to me to compare the relative cumulative dose of WI-FI in the classrooms with a commonly known device that emits the same frequencies. That device is a microwave oven. Both WI-FI and microwave ovens operate at a frequency of ~2.4 GHz. An average WI-FI transmitter operates on 0.2 J/s [0.2 Watts] power. Therefore, if using only 20 computer/laptop transmitters in a classroom, there is a combined 4 J/s [4 Watts]. A typical microwave oven (output) is 800 J/s [800 Watts] (magnetron input equals 1,200 J/s [1,200 Watts]). A classroom equals 4 J/s [4 Watts]; a microwave oven 800 J/s [800 Watts]. A ratio of 1:200. Thus, if WI-FI is used in morning and afternoon sessions, and if 200 seconds in a classroom (at 4 J/s [4 Watts]) equals 1 second inside a microwave oven (at 800 J/s [800 Watts]), then over a school day a child or adult receives the equivalent of 2 minutes in a microwave oven, 10 minutes per week.[4]

---

[4] *It should be noted these calculations will vary according to the following factors:*

i. There can be approximately 13 mathematical variations to wave formulae;
ii. The $1/d^2$ rule will apply to distance;
iii. The wall transmitter and main transmitter are not included/calculated;
iv. Constructive interference patterns are not calculated;
v. WI-FI sets and transmitters in nearby classrooms are not included/calculated; and
vi. Reflective materials are unknown: i.e. wall insulation.

To understand fully the actual exposures, a reading will be taken in a classroom with 20 or more fully operational

84. As a final word about cumulative dose, it must be stressed that a long-low exposure can be more dangerous than a short-high exposure. By way of example, as I wrote in my published paper (co-written with Scientist Andrea Klein), *Wireless Laptops and Their Transmitters Using Microwaves in Schools*, http://www.mastsanity.org/wifi/17/154-wireless-laptops-and-their-transmitters-using-microwaves-in-schools-a-report-by-barrie-trower.html, Permanent low-level microwave exposure can induce chronic nitrosative/oxidative stress; hence damage to mitochondrial DNA.

Conclusion

85. There is a simple solution, use a cable and a plug or fibre optic cable to deliver the Internet.

86. With all of this evidence pointing to physical, mental and long-term disorders even long into the future (including cancers and mutant newborns), is this honestly worth the risk to our next generations for the sake of just a few metres of wire and a plug. As shown, the dangers of low-level, below-thermal microwaves, have been known to governments for >50 years. I was educated in microwave technology by the Military (United Kingdom) in the early 1960's, and even then we were instructed of these dangers. Nothing has changed to suddenly make microwaves safe.

87. The evidence for adverse effects of low-level microwave irradiation is currently strong and grows stronger with each new study. Using a cabled Internet system does not increase exposure.

88. I ask you, if a drink were reported in the 1950's to cause cancer and other ill effects, and if countless reports and epidemiologic and toxicologic studies and expert associations since showed these reports to be correct, would you give this to your children to drink, knowing they have their whole lives ahead of them? So what is the difference? It is simple. This product, pulse-modulated microwave radiation from WI-FI, is backed and financed by the most powerful

---

computers and WI-FI transmission devices next to other classrooms (below, above, adjacent, etc.) with 20 or more fully operational transmission devices in each of those rooms.

Exhibit 6

industry on the planet. This is an industry that apparently does not have to prove its product is safe (unlike a drug company). Incredibly, the public is rather told to prove it is not! Thence take this industry to court with your list of impairments, illnesses, cancers, leukaemias, early deaths, etc.

89. Within the relevant scientific community, it is generally accepted that that many bioeffects and adverse health effects occur at far lower levels of radio wave and MW exposure where no measurable heating occurs; some effects are shown to occur at several hundred thousand times below the existing public guidelines.

90. In my opinion, Portland Public Schools' use of WI-FI is causing and will continue to cause AHM, other students, and school staff and faculty adverse health effects, and should be discontinued immediately.

Dated this 21st day of December 2011.

/s/ Barrie Trower

BARRIE TROWER

Exhibit 7

FOURTH AMENDMENT

SEARCH AND SEIZURE

CONTENTS

SEARCH AND SEIZURE

FOURTH AMENDMENT

The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated; and no Warrants shall issue but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

SEARCH AND SEIZURE

History and Scope of the Amendment

History.—Few provisions of the Bill of Rights grew so directly out of the experience of the colonials as the Fourth Amendment, embodying as it did the protection against the utilization of the "writs of assistance." But while the insistence on freedom from unreasonable searches and seizures as a fundamental right gained expression in the Colonies late and as a result of experience,[1] there was also a rich English experience to draw on. "Every man's house is his castle" was a maxim much celebrated in England, as was demonstrated in *Semayne's Case*, decided in 1603.[2] A civil case of execution of process, *Semayne's Case* nonetheless recognized the right of the homeowner to defend his house against unlawful entry even by the King's agents, but at the same time recognized the authority of the appropriate officers to break and enter upon notice in order to arrest or to execute the King's process. Most famous of the English cases was *Entick v. Carrington*,[3] one of a series of civil actions against state officers who, pursuant to general warrants, had raided many homes and other places in search of materials

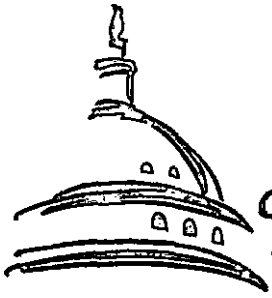
[1] Apparently the first statement of freedom from unreasonable searches and seizures appeared in The Rights of the Colonists and a List of Infringements and Violations of Rights, 1772, in the drafting of which Samuel Adams took the lead. 1 B. SCHWARTZ, THE BILL OF RIGHTS: A DOCUMENTARY HISTORY 199, 205–06 (1971).

[2] 5 Coke's Rep. 91a, 77 Eng. Rep. 194 (K.B. 1604). One of the most forceful expressions of the maxim was that of William Pitt in Parliament in 1763: "The poorest man may in his cottage bid defiance to all the force of the crown. It may be frail—its roof may shake—the wind may blow through it—the storm may enter, the rain may enter—but the King of England cannot enter—all his force dares not cross the threshold of the ruined tenement."

[3] 19 Howell's State Trials 1029, 95 Eng. 807 (1705).

https://fas.org/sgp/crs/misc/R42338.pdf

Exhibit 8



Smart Meter Data: Privacy and Cybersecurity

Brandon J. Murrill
Legislative Attorney

Edward C. Liu
Legislative Attorney

Richard M. Thompson II
Legislative Attorney

February 3, 2012

Congressional Research Service
7-5700
www.crs.gov
R42338

CRS Report for Congress
Prepared for Members and Committees of Congress

Exhibit 8

Summary

Fueled by stimulus funding in the American Recovery and Reinvestment Act of 2009 (ARRA), electric utilities have accelerated their deployment of smart meters to millions of homes across the United States with help from the Department of Energy's Smart Grid Investment Grant program. As the meters multiply, so do issues concerning the privacy and security of the data collected by the new technology. This Advanced Metering Infrastructure (AMI) promises to increase energy efficiency, bolster electric power grid reliability, and facilitate demand response, among other benefits. However, to fulfill these ends, smart meters must record near-real time data on consumer electricity usage and transmit the data to utilities over great distances via communications networks that serve the smart grid. Detailed electricity usage data offers a window into the lives of people inside of a home by revealing what individual appliances they are using, and the transmission of the data potentially subjects this information to interception or theft by unauthorized third parties or hackers.

Unforeseen consequences under federal law may result from the installation of smart meters and the communications technologies that accompany them. This report examines federal privacy and cybersecurity laws that may apply to consumer data collected by residential smart meters. It begins with an examination of the constitutional provisions in the Fourth Amendment that may apply to the data. As we progress into the 21st century, access to personal data, including information generated from smart meters, is a new frontier for police investigations. The Fourth Amendment generally requires police to have probable cause to search an area in which a person has a reasonable expectation of privacy. However, courts have used the third-party doctrine to deny protection to information a customer gives to a business as part of their commercial relationship. This rule is used by police to access bank records, telephone records, and traditional utility records. Nevertheless, there are several core differences between smart meters and the general third-party cases that may cause concerns about its application. These include concerns expressed by the courts and Congress about the ability of technology to potentially erode individuals' privacy.

If smart meter data and transmissions fall outside of the protection of the Fourth Amendment, they may still be protected from unauthorized disclosure or access under the Stored Communications Act (SCA), the Computer Fraud and Abuse Act (CFAA), and the Electronic Communications Privacy Act (ECPA). These statutes, however, would appear to permit law enforcement to access smart meter data for investigative purposes under procedures provided in the SCA, ECPA, and the Foreign Intelligence Surveillance Act (FISA), subject to certain conditions. Additionally, an electric utility's privacy and security practices with regard to consumer data may be subject to Section 5 of the Federal Trade Commission Act (FTC Act). The Federal Trade Commission (FTC) has recently focused its consumer protection enforcement on entities that violate their privacy policies or fail to protect data from unauthorized access. This authority could apply to electric utilities in possession of smart meter data, provided that the FTC has statutory jurisdiction over them. General federal privacy safeguards provided under the Federal Privacy Act of 1974 (FPA) protect smart meter data maintained by federal agencies, including data held by federally owned electric utilities.

A companion report from CRS focusing on policy issues associated with smart grid cybersecurity, CRS Report R41886, *The Smart Grid and Cybersecurity—Regulatory Policy and Issues*, by Richard J. Campbell, is also available.

Exhibit 8

Contents

Figures

Contacts

Exhibit 8

Overview

Smart meter technology is a key component of the Advanced Metering Infrastructure (AMI)[1] that will help the smart grid[2] link the "two-way flow of electricity with the two-way flow of information."[3] Privacy and security concerns surrounding smart meter technology arise from the meters' essential functions, which include (1) recording near-real time data on consumer electricity usage; (2) transmitting this data to the smart grid using a variety of communications technologies;[4] and (3) receiving communications from the smart grid, such as real-time energy prices or remote commands that can alter a consumer's electricity usage to facilitate demand response.[5]

Beneficial uses of AMI are developing rapidly, and like the early Internet, many applications remain unforeseen.[6] At a basic level, smart meters will permit utilities to "collect, measure, and analyze energy consumption data for grid management, outage notification, and billing purposes."[7] The meters may increase energy efficiency by giving consumers greater control over their use of electricity,[8] as well as permitting better integration of plug-in electric vehicles and renewable energy sources.[9] They may also aid in the development of a more reliable electricity grid that is better equipped to withstand cyber attacks and natural disasters, and help to decrease peak demand for electricity.[10] To be useful for these purposes, and many others, data recorded by

[1] AMI includes the meters at the consumer's residence or business, the communications networks that send data between the consumer and utility, and the data management systems that store and process data for the utility. ELECTRIC POWER RESEARCH INST., ADVANCED METERING INFRASTRUCTURE (AMI) (2007), *available at* http://www.ferc.gov/eventcalendar/Files/20070423091846-EPRI%20-%20Advanced%20Metering.pdf. The primary function of AMI is to "combine interval data measurement with continuously available remote communications" to increase energy efficiency and grid reliability, and decrease expenses borne by the utility and consumer. *Id.*

[2] The Energy Independence and Security Act of 2007 (EISA) lists ten characteristics of a smart grid. These include "[i]ncreased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid"; "[d]evelopment and incorporation of demand response, demand-side resources, and energy-efficiency resources"; and "[d]eployment of 'smart' technologies (real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices) for metering, communications concerning grid operations and status, and distribution automation." EISA, P.L. 110-140, §1301, 121 Stat. 1492, 1783-84 (2007) (to be codified at 42 U.S.C. §17381).

[3] DEP'T OF ENERGY, COMMUNICATIONS REQUIREMENTS OF SMART GRID TECHNOLOGIES 1 (2010) [hereinafter DEP'T OF ENERGY COMMUNICATIONS REPORT], *available at* http://energy.gov/sites/prod/files/gcprod/documents/Smart_Grid_Communications_Requirements_Report_10-05-2010.pdf.

[4] *Id.* at 3, 5. These technologies include fiber optics, wireless networks, satellite, and broadband over power line. *Id.*

[5] *Id.* at 20. "Demand response is the reduction of the consumption of electric energy by customers in response to an increase in the price of electricity or heavy burdens on the system." *Id.*

[6] DEP'T OF ENERGY, DATA ACCESS AND PRIVACY ISSUES RELATED TO SMART GRID TECHNOLOGIES 5, 9 (2010) [hereinafter DEP'T OF ENERGY PRIVACY REPORT], *available at* http://energy.gov/sites/prod/files/gcprod/documents/Broadband_Report_Data_Privacy_10_5.pdf; *see also* ELIAS LEAKE QUINN, SMART METERING & PRIVACY: EXISTING LAW AND COMPETING POLICIES: A REPORT FOR THE COLORADO PUBLIC UTILITIES COMMISSION 1, 12 (2009) [hereinafter COLORADO PRIVACY REPORT], *available at* http://www.dora.state.co.us/puc/docketsdecisions/DocketFilings/09I-593EG/09I-593EG_Spring2009Report-SmartGridPrivacy.pdf.

[7] DEP'T OF ENERGY COMMUNICATIONS REPORT, *supra* note 3, at 12.

[8] Companies are developing several new applications that use smart meter data to offer consumers and utilities better control over energy usage, for example by determining the energy efficiency of specific appliances within the household. DEP'T OF ENERGY PRIVACY REPORT, *supra* note 6, at 5, 9; *see also* COLORADO PRIVACY REPORT, *supra* note 6, at 1, 12.

[9] DEP'T OF ENERGY COMMUNICATIONS REPORT, *supra* note 3, at 1.

[10] *Id.* at 3.

Exhibit 8

smart meters must be highly detailed, and, consequently, it may show what individual appliances a consumer is using.[11] The data must also be transmitted to electric utilities—and possibly to third parties outside of the smart grid—subjecting it to potential interception or theft as it travels over communications networks and is stored in a variety of physical locations.[12]

These characteristics of smart meter data present privacy and security concerns that are likely to become more prevalent as government-backed initiatives expand deployment of the meters to millions of homes across the country. In the American Recovery and Reinvestment Act of 2009 (ARRA), Congress appropriated funds for the implementation of the Smart Grid Investment Grant (SGIG) program administered by the Department of Energy.[13] This program now permits the federal government to reimburse up to 50% of eligible smart grid investments, which include the cost to electric utilities of buying and installing smart meters.[14] In its annual report on smart meter deployment, the Federal Energy Regulatory Commission cited statistics showing that the SGIG program has helped fund the deployment of about 7.2 million meters as of September 2011.[15] At completion, the program will have partially funded the installation of 15.5 million meters.[16] By 2015, the Institute for Electric Efficiency expects that a total of 65 million smart meters will be in operation throughout the United States.[17]

Installation of smart meters and the communications technologies that accompany them may have unforeseen legal consequences for those who generate, seek, or use the data recorded by the meters. These consequences may arise under existing federal laws or constitutional provisions governing the privacy of electronic communications, data retention, computer misuse, foreign surveillance, and consumer protection. This report examines federal privacy and cybersecurity laws that may apply to consumer data collected by residential smart meters. It examines the legal implications of smart meter technology for consumers who generate the data, law enforcement officers who seek smart meter data from utilities, utilities that store the data, and hackers who access smart grid technology to steal consumer data or interfere with it. This report looks at federal laws that may pertain to the data when it is (1) stored in a utility-owned smart meter at a consumer's residence; (2) in transit between the meter and the smart grid by way of various communications technologies; and (3) stored on computers in the grid. This report does not address state or local laws, such as regulations by state Public Utilities Commissions, that may establish additional responsibilities for some electric utilities with regard to smart meter data. It also does not discuss the mandatory cybersecurity and reliability standards enforced by the North

---

[11] *See* NAT'L INST. OF STANDARDS AND TECH., GUIDELINES FOR SMART GRID CYBER SECURITY: VOL. 2, PRIVACY AND THE SMART GRID 14 (2010) [hereinafter NIST PRIVACY REPORT], *available at* http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol2.pdf.

[12] *Id.* at 3-4, 23-24, 29.

[13] The act provides $4.5 billion for "electricity delivery and energy reliability," which includes "activities to modernize the electric grid, to include demand responsive equipment," as well as "programs authorized under title XIII of the Energy Independence and Security Act of 2007." ARRA, P.L. 111-5, 123 Stat. 115, 138-39.

[14] ARRA §405(5), (8), 123 Stat. 115, 143-44 (amendment to be codified at 42 U.S.C. §17386) (amending the Energy Independence and Security Act of 2007 (EISA) to allow for the reimbursement of up to 50% of qualifying smart grid investments instead of only 20%); *see also* EISA, P.L. 110-140, §1306, 121 Stat. 1492, 1789-91 (to be codified as amended at 42 U.S.C. §17386) (initially establishing the SGIG program).

[15] FED. ENERGY REGULATORY COMM'N, ASSESSMENT OF DEMAND RESPONSE & ADVANCED METERING 3 (2011), *available at* http://www.ferc.gov/legal/staff-reports/11-07-11-demand-response.pdf.

[16] *Id.*

[17] INST. FOR ELECTRIC EFFICIENCY, UTILITY-SCALE SMART METER DEPLOYMENTS, PLANS & PROPOSALS 1 (2011), *available at* http://www.edisonfoundation.net/iee/issuebriefs/SmartMeter_Rollouts_0911.pdf.

Exhibit 8

American Electric Reliability Corporation, which impose obligations on utilities that participate in the generation or transmission of electricity.[18]

General federal privacy safeguards provided under the Federal Privacy Act of 1974 (FPA) protect smart meter data maintained by federal agencies, including data held by federally owned electric utilities. Section 5 of the Federal Trade Commission Act (FTC Act) allows the Federal Trade Commission (FTC) to bring enforcement proceedings against electric utilities that violate their privacy policies or fail to protect meter data from unauthorized access, provided that the FTC has statutory jurisdiction over the utilities.

It is unclear how Fourth Amendment protection from unreasonable search and seizures would apply to smart meter data, due to the lack of cases on this issue. However, depending upon the manner in which smart meter services are presented to consumers, smart meter data may be protected from unauthorized disclosure or unauthorized access under the Stored Communications Act (SCA), the Computer Fraud and Abuse Act (CFAA), and the Electronic Communications Privacy Act (ECPA). If smart meter data is protected by these statutes, law enforcement would still appear to have the ability to access it for investigative purposes under procedures provided in the SCA, ECPA, and the Foreign Intelligence Surveillance Act (FISA).

Smart Meter Data: Privacy and Security Concerns

Residential smart meters present privacy and cybersecurity issues[19] that are likely to evolve with the technology.[20] In 2010, the National Institute of Standards and Technology (NIST) published a report identifying some of these issues, which fall into two main categories: (1) privacy concerns that smart meters will reveal the activities of people inside of a home by measuring their electricity usage frequently over time;[21] and (2) fears that inadequate cybersecurity measures surrounding the digital transmission of smart meter data will expose it to misuse by authorized and unauthorized users of the data.[22]

Detailed Information on Household Activities

Smart meters offer a significantly more detailed illustration of a consumer's energy usage than regular meters. Traditional meters display data on a consumer's *total* electricity usage and are typically read manually once per month.[23] In contrast, smart meters can provide *near real-time* usage data by measuring usage electronically at a much greater frequency, such as once every 15

[18] For additional information on the development of mandatory national smart grid privacy and cybersecurity standards by federal agencies, see MASS. INST. OF TECH., THE FUTURE OF THE ELECTRIC GRID 197-234 (2011) [hereinafter MIT GRID STUDY]; *see also* CRS Report R41886, *The Smart Grid and Cybersecurity—Regulatory Policy and Issues*, by Richard J. Campbell.

[19] According to the authors of the MIT study, cybersecurity "refers to all the approaches taken to protect data, systems, and networks from deliberate attack as well as accidental compromise, ranging from preparedness to recovery." MIT GRID STUDY, *supra* note 18, at 208. Closely related is the concept of "information privacy," which "deals with policy issues ranging from identification and collection to storage, access, and use of information." *Id.* at 219 n.viii.

[20] *See* NIST PRIVACY REPORT, *supra* note 11, at 1.

[21] *Id.* at 4, 11. Data that offers a high degree of detail is said to be "granular." *Id.*

[22] *See id.* at 4, 23-24, 29.

[23] *Id.* at 2, 9.

Exhibit 8

minutes.[24] Current smart meter technology allows utilities to measure usage as frequently as once every minute.[25] By examining smart meter data, it is possible to identify which appliances a consumer is using and at what times of the day, because each type of appliance generates a unique electric load "signature."[26] NIST wrote in 2010 that "research shows that analyzing 15-minute interval aggregate household energy consumption data can by itself pinpoint the use of most major home appliances."[27] A report for the Colorado Public Utilities Commission discussed an Italian study that used "artificial neural networks" to identify individual "heavy-load appliance uses" with 90% accuracy using 15-minute interval data from a smart meter.[28] Similarly, software-based algorithms would likely allow a person to extract the unique signatures of individual appliances from meter data that has been collected less frequently and is therefore less detailed.[29]

By combining appliance usage patterns, an observer could discern the behavior of occupants in a home over a period of time.[30] For example, the data could show whether a residence is occupied, how many people live in it, and whether it is "occupied by more people than usual."[31] According to the Department of Energy, smart meters may be able to reveal occupants' "daily schedules (including times when they are at or away from home or asleep), whether their homes are equipped with alarm systems, whether they own expensive electronic equipment such as plasma TVs, and whether they use certain types of medical equipment."[32] **Figure 1**, which appears in NIST's report on smart grid cybersecurity, shows how smart meter data could be used to decipher the activities of a home's occupants by matching data on their electricity usage with known appliance load signatures.

[24] *Id.* at 13.

[25] COLORADO PRIVACY REPORT, *supra* note 6, at 2. Some utilities may elect to receive data at less frequent intervals because "backhauling real-time or near real-time data from the billions of devices that may eventually be connected to the Smart Grid would require not only tremendous bandwidth" but also greater data storage capacities that could make the effort "economically infeasible." DEP'T OF ENERGY COMMUNICATIONS REPORT, *supra* note 3, at 20. However, the "trend" is for utilities to collect data more frequently. *See* COLORADO PRIVACY REPORT, *supra* note 6, at A-1 n.111.

[26] NIST PRIVACY REPORT, *supra* note 11, at 2, 14.

[27] *Id.* at 14. *But see* DEP'T OF ENERGY PRIVACY REPORT, *supra* note 6, at 9 (claiming, in 2010, that smart meter technology "cannot yet identify individual appliances and devices in the home in detail, but this will certainly be within the capabilities of subsequent generations of Smart Grid technologies").

[28] COLORADO PRIVACY REPORT, *supra* note 6, at 3 n.7, A-8.

[29] *Id.* at A-9.

[30] NIST PRIVACY REPORT, *supra* note 11, at 6 & n.9.

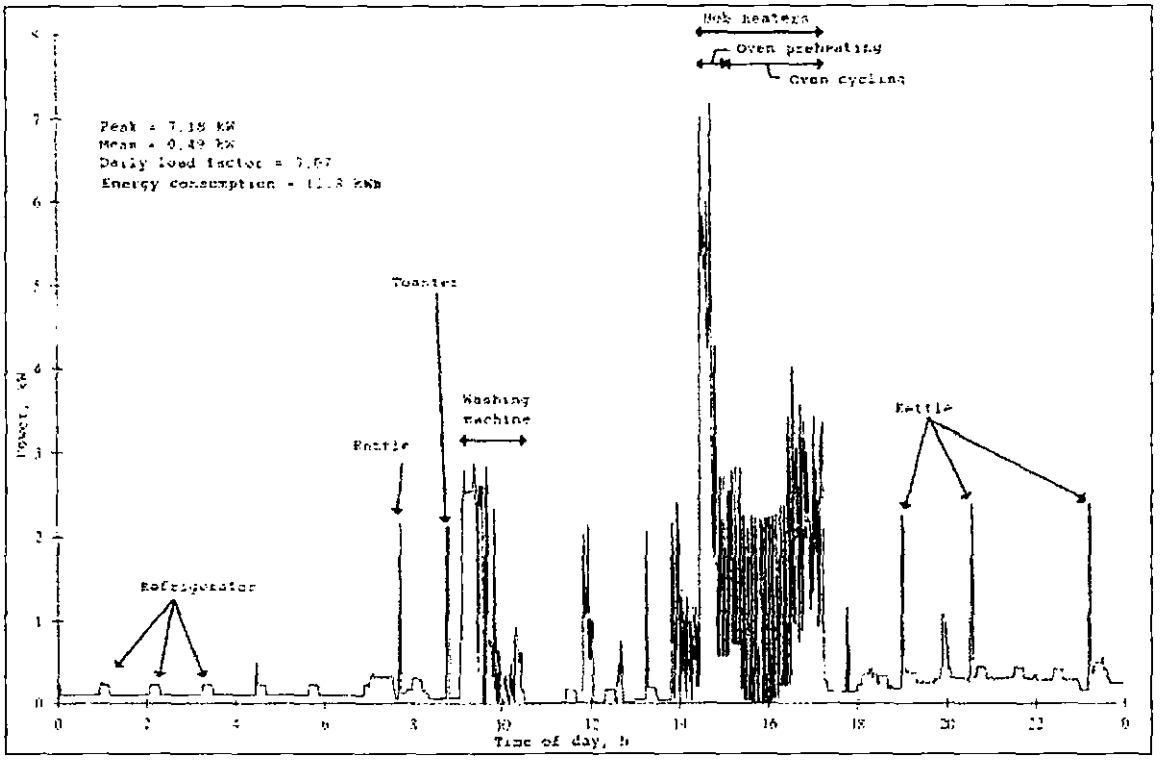
[31] *Id.* at 11.

[32] DEP'T OF ENERGY PRIVACY REPORT, *supra* note 6, at 2.

Exhibit 8

Figure 1. Identification of Household Activities from Electricity Usage Data

Unique Electric Load Signatures of Common Household Appliances



Source: NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST), GUIDELINES FOR SMART GRID CYBER SECURITY: VOL. 2, PRIVACY AND THE SMART GRID 13 (2010), *available at* http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol2.pdf.

Note: Researchers constructed this picture from electricity usage data collected at one-minute intervals using a nonintrusive appliance load monitoring (NALM) device, which is similar to a smart meter in the way that it records usage data. For a comparison of the technologies, see COLORADO PRIVACY REPORT, *supra* note 6, at A-1 to A-9.

Smart meter data that reveals which appliances a consumer is using has potential value for third parties, including the government. In the past, law enforcement agents have examined *monthly* electricity usage data from *traditional* meters in investigations of people they suspected of illegally growing marijuana.[33] For example, in *United States v. Kyllo*, a federal agent subpoenaed the suspect's electricity usage records from the utility and "compared the records to a spreadsheet for estimating average electrical use and concluded that Kyllo's electrical usage was abnormally high, indicating a possible indoor marijuana grow operation."[34] If law enforcement officers obtained near-real time data on a consumer's electricity usage from the utility company, their ability to monitor household activities would be amplified significantly.[35] For example, by observing when occupants use the most electricity, it may be possible to discern their daily schedules.[36]

[33] NIST PRIVACY REPORT, *supra* note 11, at 11, 29; *see also* United States v. Kyllo, 190 F.3d 1041, 1043 (9th Cir. 1999), *rev'd on other grounds*, 533 U.S. 27 (2001).

[34] *Kyllo*, 190 F.3d at 1043.

[35] *See supra* notes 26-32 and accompanying text.

[36] *See supra* note 32 and accompanying text.

Exhibit 8

As smart meter technology develops and usage data grows more detailed, it could also become more valuable to private third parties outside of the grid.[37] Data that reveals which appliances a person is using could permit health insurance companies to determine whether a household uses certain medical devices, and appliance manufacturers to establish whether a warranty has been violated.[38] Marketers could use it to make targeted advertisements.[39] Criminals could use it to time a burglary and figure out which appliances they would like to steal.[40] If a consumer owned a plug-in electric vehicle, data about where the vehicle has been charged could permit someone to identify a person's location and travel history.[41]

Even privacy safeguards, such as "anonymizing" data so that it does not reflect identity, are not foolproof.[42] By comparing anonymous data with information available in the public domain, it is sometimes possible to identify an individual—or, in the context of smart meter data, a particular household.[43] Moreover, a smart grid will collect more than just electricity usage data. It will also store data on the account holder's name, service address, billing information, networked appliances in the home, and meter IP address, among other information.[44] Many smart meters will also provide transactional records as they send data to the grid, which would show the time that the meter transmitted the data and the location or identity of the transmitter.[45]

Increased Potential for Theft or Breach of Data

Smart grid technology relies heavily on two-way communication to increase energy efficiency and reliability, including communication between smart meters and the utility (or other entity) that stores data for the grid.[46] Many different technologies will transmit data to the grid, including "traditional twisted-copper phone lines, cable lines, fiber optic cable, cellular, satellite, microwave, WiMAX, power line carrier, and broadband over power line."[47] Of these communications platforms, wireless technologies are likely to play a "prominent role" because they present fewer safety concerns and cost less to implement than wireline technologies.[48] According to the Department of Energy, a typical utility network has four "tiers" that collect and transmit data from the consumer to the utility.[49] These include "(1) the core backbone—the primary path to the utility data center; (2) backhaul distribution—the aggregation point for

---

[37] NIST PRIVACY REPORT, *supra* note 11, at 14, 35-36.

[38] *Id.* at 27-28.

[39] *Id.* at 28.

[40] *Id.* at 31.

[41] *Id.*

[42] *Id.* at 13.

[43] *See id.* at 13, 25.

[44] *Id.* at 26-27.

[45] *Id.* at 12 (drawing a comparison to telecommunications providers' "call detail records").

[46] *Id.* at 3; DEP'T OF ENERGY COMMUNICATIONS REPORT, *supra* note 3, at 3 (stating that "integrated two-way communications ... allows for dynamic monitoring of electricity use as well as the potential for automated electricity use scheduling."). As more consumers become generators of electricity through the use of "fuel cells, wind turbines, solar roofs, and the like," the importance of two-way communication will increase. MIT GRID STUDY, *supra* note 18, at 201.

[47] DEP'T OF ENERGY COMMUNICATIONS REPORT, *supra* note 3, at 3.

[48] *Id.* at 5, 51 n.215.

[49] *Id.* at 16.

Exhibit 8

neighborhood data; (3) the access point—typically the smart meter; and, (4) the HAN—the home network."[50] Energy usage data moves from the smart meter,[51] and then to an "aggregation point" outside of the residence such as "a substation, a utility pole-mounted device, or a communications tower."[52] The aggregation points gather data from multiple meters and "backhaul" it to the utility using fiber, T1, microwave, or wireless technology.[53] Utilities typically rely on their own private networks to communicate with smart meters because they have found these networks to be more reliable and less expensive than commercial networks.[54]

As NIST explains, consumer data moving through a smart grid becomes stored in many locations both within the grid and within the physical world.[55] Thus, because it is widely dispersed, it becomes more vulnerable to interception by unauthorized parties[56] and to accidental breach.[57] The movement of data also increases the potential for it to be stolen by unauthorized third parties while it is in transit, particularly when it travels over a wireless network[58]—or through communications components that may be incompatible with one another or possess outdated security protections.[59]

Smart Meters and the Fourth Amendment

The use of smart meters presents the recurring conflict between law enforcement's need to effectively investigate and combat crime and our desire for privacy while in our homes. With smart meters, police will have access to data that might be used to track residents' daily lives and routines while in their homes, including their eating, sleeping, and showering habits, what appliances they use and when, and whether they prefer the television to the treadmill, among a host of other details.[60] Though a potential boon to police, access to this data is not limitless. The Fourth Amendment, which establishes the constitutional parameters for government investigations, may restrict access to smart meter data or establish rules by which it can be obtained.[61] The Fourth Amendment ensures that the "right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated...."[62] This section discusses whether the collection and use of smart meter data may

---

[50] *Id.*

[51] The home network will be used to provide *consumers* with near real-time data on their energy usage. *Id.* at 13-15.

[52] *Id.* Many urban installations use wireless mesh networks to carry data from the meters to the aggregation point. These networks are more reliable because each smart meter can serve as a router in the network, providing redundant network coverage. *Id.* at 18.

[53] *Id.* at 16, 19.

[54] *Id.* at 4, 19, 44.

[55] NIST PRIVACY REPORT, *supra* note 11, at 23.

[56] *Id.* at 23-24.

[57] *Id.* at 29.

[58] *See id.* at 9, 12, 33, and 36.

[59] MIT GRID STUDY, *supra* note 18, at 209, 213-16.

[60] Jack I. Lerner & Deirdre K. Mulligan, *Taking the "Long View" on the Fourth Amendment: Stored Records and the Sanctity of the Home*, 2008 STAN. TECH. L. REV. 3, ¶ 3 (2008).

[61] Additionally, as described below, there are federal statutory protections that may pertain to this data. State constitutional and statutory safeguards may also apply, but these are beyond the scope of this report.

[62] U.S. CONST. amend IV.

Exhibit 9

AUGUST 21, 2018

eff.org

Win! Landmark Seventh Circuit Decision Says Fourth Amendment Applies to Smart Meter Data

The Seventh Circuit just handed down a landmark opinion, ruling 3-0 that the Fourth Amendment protects energy-consumption data collected by smart meters. Smart meters collect energy usage data at high frequencies—typically every 5, 15, or 30 minutes—and therefore know exactly how much electricity is being used, *and when*, in any given household. The court recognized that data from these devices reveals intimate details about what's going on inside the home that would otherwise be unavailable to the government without a physical search. The court held that residents have a reasonable expectation of privacy in this data and that the government's access of it constitutes a "search."

This case, *Naperville Smart Meter Awareness v. City of Naperville*, is the first case addressing whether the Fourth Amendment protects smart meter data. Courts have in the past held that the Fourth Amendment *does not* protect monthly energy usage readings from traditional, analog energy meters, the predecessors to smart meters. The lower court in this case applied that precedent to conclude that smart meter data, too, was unprotected as a matter of law. On appeal, EFF and Privacy International filed an amicus brief urging the Seventh Circuit to reconsider this dangerous ruling. And in its decision, released last week, the Seventh Circuit wisely recognized that smart meters and analog meters are different:

> "Using traditional energy meters, utilities typically collect monthly energy consumption in a single lump figure once per month. By contrast, smart meters record consumption much more frequently, often collecting thousands of readings every month. Due to this frequency, smart meters show both the amount of

Exhibit 9

> electricity being used inside a home and when that energy is used."

The Seventh Circuit recognized that this energy usage data "reveals information about the happenings inside a home." Individual appliances, the court explained, have distinct energy-consumption patterns or "load signatures." These load signatures allow you to tell not only *when* people are home, but *what* they are doing. The court held that the "ever-accelerating pace of technological development carries serious privacy implications" and that smart meters "are no exception."

This is critical precedent. Last year, roughly 65 million smart meters had been installed in the United States in recent years, with 88% of them—over 57 million—in homes of American consumers; more than 40% of American households had a smart meter. Experts predict that number will reach about 80% by 2020. And law enforcement agencies are already trying to get access to data from energy companies without a warrant.

In this case, a group of citizens called Naperville Smart Meter Awareness challenged Naperville's policy of requiring every home to have a smart meter, objecting on Fourth Amendment and other grounds. The district court held that smart meter data—despite being collected directly a city utility, not any non-governmental third party—was subject to the so-called "third party doctrine." In other words, the lower court reasoned that simply because the utility company held the data, it was automatically devoid of constitutional protection.

The Seventh Circuit reversed the district court's decision, holding that the third party doctrine did not apply. The court first noted that application of the third party doctrine would make no sense in this case. The city itself collected the data; there was no third party. The court then cited the Supreme Court's recent decision in *Carpenter v. United States*, which rejected the third party doctrine in a case involving cell site location information. In *Carpenter*, the Supreme Court held that this antiquated doctrine does not apply to the exhaustive stores of personal information information collected today by wireless carriers, which can be used "detailed chronicle of a person's physical presence compiled every day, every moment over years." The Court reasoned that people do not "voluntarily 'assume the risk' of turning over a comprehensive dossier of physical movements" just by choosing to use a cell phone. The Seventh Circuit held that the same goes for smart meter data: "a

Exhibit 9

home occupant does not assume the risk of near constant monitoring by choosing to have electricity in her home." As the court explained, the third-party doctrine rests on "the notion that an individual has a reduced expectation of privacy in information knowingly shared with another" and "in this context, a choice to share data imposed by fiat is no choice at all."

After concluding that smart meter data is protected by the Fourth Amendment, the Seventh Circuit next assessed whether the municipal utility's "search" was reasonable. The court, after weighing the city's interest in collecting the data with the residents' privacy interest, concluded that the city's collection of smart meter data *in this context* was reasonable. The court explained that smart meters play a crucial role in the modernization of the energy grid, allow utilities to restore service more quickly when power goes, permit utilities to offer time-based pricing to reduce the strain on the grid by encouraging consumers to shift usage away from peak demand periods, and reduce utilities' labor costs because home visits are needed less frequently.

Critically, the court noted that its analysis would be different if Naperville conducted the search with "prosecutorial intent," if the search was conducted by law enforcement instead of the city's public utility, or if the data was more easily accessible to law enforcement or other city officials outside the utility. The court cited the city's policy of not providing customer data to third parties—including law enforcement—without a warrant or court order. The court also noted that its conclusion might also change if the city were to collect data at intervals shorter than every 15 minutes.

The court did, however, chide the city for failing to give residents the option of keeping traditional meters: "Naperville could have avoided this controversy—and may still avoid future uncertainty—by giving its residents a genuine opportunity to consent to the installation of smart meters, as many other utilities have."

We applaud the Seventh Circuit for recognizing that smart meters pose serious risks to the privacy of all of our homes, and that rotely applying analog-era case law to the digital age simply doesn't work. We hope that courts around the country follow the Seventh Circuit in concluding that the Fourth Amendment protects smart meter data.

Exhibit 9

Special thanks to David Gulbransen, pro bono counsel for the plaintiff, for his hard work on this landmark victory.

JOIN EFF LISTS

Join Our Newsletter!

Email updates on news, actions, events in your area, and more.

Email Address

Postal Code (optional)

Anti-spam question: Enter the three-letter abbreviation for Electronic Frontier Foundation:

SUBMIT

Exhibit 10

PUBLIC UTILITY CODE (66 PA.C.S.) - OMNIBUS AMENDMENTS
Act of Oct. 15, 2008, P.L. 1592, No. 129 **Cl. 66**
Session of 2008
No. 2008-129

HB 2200

AN ACT

Amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, further providing for director of operations, secretary, employees and consultants; repealing provisions relating to office of trial staff; further providing for bureaus and offices; providing for other bureaus, offices and positions; further providing for electric utility definitions; providing for energy efficiency and conservation program and for energy efficiency and conservation; further providing for duties of electric distribution companies and for market power remediation; and providing for procurement, for additional alternative energy sources and for carbon dioxide sequestration network.

The General Assembly recognizes the following public policy findings and declares that the following objectives of the Commonwealth are served by this act:

(1) The health, safety and prosperity of all citizens of this Commonwealth are inherently dependent upon the availability of adequate, reliable, affordable, efficient and environmentally sustainable electric service at the least cost, taking into account any benefits of price stability over time and the impact on the environment.

(2) It is in the public interest to adopt energy efficiency and conservation measures and to implement energy procurement requirements designed to ensure that electricity obtained reduces the possibility of electric price instability, promotes economic growth and ensures affordable and available electric service to all residents.

(3) It is in the public interest to expand the use of alternative energy and to explore the feasibility of new sources of alternative energy to provide electric generation in this Commonwealth.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1. Section 305(a) of Title 66 of the Pennsylvania Consolidated Statutes is amended to read:

§ 305. Director of operations, secretary, employees and consultants.

(a) Director of operations.--The commission may appoint a director of operations who shall serve at the pleasure of the commission and shall be responsible for the day-to-day administration and operation of the bureaus and offices of the commission, except that the director of operations shall have responsibility for the [Office of Trial Staff] **prosecutorial function** only with regard to administrative matters.

* * *

Section 1.1. Section 306 of Title 66 is repealed:

[§ 306. Office of Trial Staff.

(a) General rule.--The Office of Trial Staff to the Pennsylvania Public Utility Commission is hereby created. The Director of Trial Staff, who shall be the chief prosecutor of

Exhibit 10

section is amended by adding subsections to read:

§ 2807. Duties of electric distribution companies.

* * *

(e) Obligation to serve.--[An electric distribution company's] **A default service provider's** obligation to provide electric **generation supply** service following [implementation of restructuring and the choice of alternative generation by a customer] **the expiration of a generation rate cap specified under section 2804(4) (relating to standards for restructuring of electric industry) or a restructuring plan under section 2806(f) (relating to implementation, pilot programs and performance-based rates)** is revised as follows:

(1) While an electric distribution company collects either a competitive transition charge or an intangible transition charge or until 100% of its customers have choice, whichever is longer, the electric distribution company shall continue to have the full obligation to serve, including the connection of customers, the delivery of electric energy and the production or acquisition of electric energy for customers.

[(2) At the end of the transition period, the commission shall promulgate regulations to define the electric distribution company's obligation to connect and deliver and acquire electricity under paragraph (3) that will exist at the end of the phase-in period.

(3) If a customer contracts for electric energy and it is not delivered or if a customer does not choose an alternative electric generation supplier, the electric distribution company or commission-approved alternative supplier shall acquire electric energy at prevailing market prices to serve that customer and shall recover fully all reasonable costs.]

(3.1) Following the expiration of an electric distribution company's obligation to provide electric generation supply service to retail customers at capped rates, if a customer contracts for electric generation supply service and the chosen electric generation supplier does not provide the service or if a customer does not choose an alternative electric generation supplier, the default service provider shall provide electric generation supply service to that customer pursuant to a commission-approved competitive procurement plan. The electric power acquired shall be procured through competitive procurement processes and shall include one or more of the following:

(i) Auctions.

(ii) Requests for proposal.

(iii) Bilateral agreements entered into at the sole discretion of the default service provider which shall be at prices which are:

(A) no greater than the cost of obtaining generation under comparable terms in the wholesale market, as determined by the commission at the time of execution of the contract; or

(B) consistent with a commission-approved competition procurement process. Any agreement between affiliated parties shall be subject to review and approval of the commission under Chapter 21 (relating to relations with affiliated interests). In no case shall the cost of obtaining generation from any affiliated interest be greater than the cost of obtaining generation under comparable terms in the wholesale market at the time of execution of the contract.

Exhibit 10

(3.2) The electric power procured pursuant to paragraph (3.1) shall include a prudent mix of the following:

(i) Spot market purchases.

(ii) Short-term contracts.

(iii) Long-term purchase contracts, entered into as a result of an auction, request for proposal or bilateral contract that is free of undue influence, duress or favoritism, of more than four and not more than 20 years. The default service provider shall have sole discretion to determine the source and fuel type. Long-term purchase contracts under this subparagraph may not constitute more than 25% of the default service provider's projected default service load unless the commission, after a hearing, determines for good cause that a greater portion of load is necessary to achieve least cost procurement. This subparagraph shall not apply to contracts executed under paragraph (5).

(3.3) The commission may determine that a contract is required to be extended for a longer term of up to 20 years, if the extension is necessary to ensure adequate and reliable service at least cost to customers over time.

(3.4) The prudent mix of contracts entered into pursuant to paragraphs (3.2) and (3.3) shall be designed to ensure:

(i) Adequate and reliable service.

(ii) The least cost to customers over time.

(iii) Compliance with the requirements of paragraph (3.1).

(3.5) Except as set forth in paragraph (5)(ii), the provisions of this section shall apply to any type of energy purchased by a default service provider to provide electric generation supply service, including energy or alternative energy portfolio standards credits required to be purchased under the act of November 30, 2004 (P.L.1672, No.213), known as the Alternative Energy Portfolio Standards Act. The commission shall apply paragraph (3.4) to comparable types of energy sources.

(3.6) The default service provider shall file a plan for competitive procurement with the commission and obtain commission approval of the plan considering the standards in paragraphs (3.1), (3.2), (3.3) and (3.4) before the competitive process is implemented. The commission shall hold hearings as necessary on the proposed plan. If the commission fails to issue a final order on the plan within nine months of the date that the plan is filed, the plan shall be deemed to be approved and the default service provider may implement the plan as filed. Costs incurred through an approved competitive procurement plan shall be deemed to be the least cost over time as required under paragraph (3.4)(ii).

(3.7) At the time the commission evaluates the plan and prior to approval, in determining if the default electric service provider's plan obtains generation supply at the least cost, the commission shall consider the default service provider's obligation to provide adequate and reliable service to customers and that the default service provider has obtained a prudent mix of contracts to obtain least cost on a long-term, short-term and spot market basis and shall make specific findings which shall include the following:

(i) The default service provider's plan includes prudent steps necessary to negotiate favorable generation supply contracts.

(ii) The default service provider's plan includes prudent steps necessary to obtain least cost generation supply contracts on a long-term, short-term and spot

Exhibit 10

market basis.

(iii) Neither the default service provider nor its affiliated interest has withheld from the market any generation supply in a manner that violates Federal law.

(3.8) Notwithstanding sections 508 (relating to power of the commission to vary, reform and revise contracts) and 2102 (relating to approval of contracts with affiliated interests), the commission may modify contracts or disallow costs only when the party seeking recovery of the costs of a procurement plan is, after hearing, found to be at fault for the following:

(i) not complying with the commission-approved procurement plan; or

(ii) the commission of fraud, collusion or market manipulation with regard to these contracts.

(3.9) The default service provider shall have the right to recover on a full and current basis, pursuant to a reconcilable automatic adjustment clause under section 1307 (relating to sliding scale of rates; adjustments), all reasonable costs incurred under this section and a commission-approved competitive procurement plan.

(4) If a customer that chooses an alternative supplier and subsequently desires to return to the local distribution company for generation service, the local distribution company shall treat that customer exactly as it would any new applicant for energy service.

(5) (i) Notwithstanding paragraph [(3)] (3.1), the electric distribution company or commission-approved alternative supplier may, in its sole discretion, offer large customers with a peak demand of 15 megawatts or greater at one meter at a location in its service territory any negotiated rate for service at all of the customers' locations within the service territory for any duration agreed upon by the electric distribution company or commission-approved alternative supplier and the large customer. The commission shall permit, but shall not require, an electric distribution company or commission-approved alternative supplier to provide service to large customers under this paragraph. Contract rates entered into under this paragraph shall be subject to review by the commission in order to ensure that all costs related to the rates are borne by the parties to the contract and that no costs related to the rates are borne by other customers or customer classes. If no costs related to the rates are borne by other customers or customer classes, the commission shall approve the contract within 90 days of its filing, or it shall be deemed approved by operation of law upon expiration of the 90 days. Information submitted under this paragraph shall be subject to the commission's procedures for the filing of confidential and proprietary information.

(ii) For purposes of providing service under this paragraph to customers with a peak demand of 20 megawatts or greater at one meter at a location within that distribution company's service territory, an electric distribution company that has completed its restructuring transition period as of the effective date of this paragraph may, in its sole discretion, acquire an interest in a generation facility or construct a generation facility specifically to meet the energy requirements of the customers, including the electric requirements of the customers' other billing locations within its service territory. The electric distribution

Exhibit 10

company must commence construction of the generation facility or contract to acquire the generation interest within three years after the effective date of this paragraph, except that the electric distribution company may add to the generation facilities it commenced construction or contracted to acquire after this three-year period to serve additional load of customers for whom it commenced construction or contracted to acquire generation within three years. Nothing in this paragraph requires or authorizes the commission to require an electric distribution company to commence construction or acquire an interest in a generation facility. The electric distribution company's interest in the generation facility it built or contracted to acquire shall be no larger than necessary to meet peak demand of customers served under this subparagraph. During times when the customer's demand is less than the electric distribution company's generation interest, the electric distribution company may sell excess power on the wholesale market. At no time shall the costs associated with the generating facility interests be included in rate base or otherwise reflected in rates. The generation facility interests shall not be commission-regulated assets.

(6) A default service plan approved by the commission prior to the effective date of this section shall remain in effect through its approved term. At its sole discretion, the default service provider may propose amendments to its approved plan that are consistent with this section, and the commission shall issue a decision whether to approve or disapprove the proposed amendments within nine months of the date that the amendments are filed. If the commission fails to issue a final order within nine months, the amendments shall be deemed to be approved and the default service provider may implement the amendments as filed.

(7) The default service provider shall offer residential and small business customers a generation supply service rate that shall change no more frequently than on a quarterly basis. All default service rates shall be reviewed by the commission to ensure that the costs of providing service to each customer class are not subsidized by any other class.

(f) Smart meter technology and time of use rates.--

(1) Within nine months after the effective date of this paragraph, electric distribution companies shall file a smart meter technology procurement and installation plan with the commission for approval. The plan shall describe the smart meter technologies the electric distribution company proposes to install in accordance with paragraph (2).

(2) Electric distribution companies shall furnish smart meter technology as follows:

(i) Upon request from a customer that agrees to pay the cost of the smart meter at the time of the request.

(ii) In new building construction.

(iii) In accordance with a depreciation schedule not to exceed 15 years.

(3) Electric distribution companies shall, with customer consent, make available direct meter access and electronic access to customer meter data to third parties, including electric generation suppliers and providers of conservation and load management services.

(4) In no event shall lost or decreased revenues by an electric distribution company due to reduced electricity consumption or shifting energy demand be considered any of

Exhibit 10

the following:

(i) A cost of smart meter technology recoverable under a reconcilable automatic adjustment clause under section 1307(b), except that decreased revenues and reduced energy consumption may be reflected in the revenue and sales data used to calculate rates in a distribution rate base rate proceeding filed under section 1308 (relating to voluntary changes in rates).

(ii) A recoverable cost.

(5) By January 1, 2010, or at the end of the applicable generation rate cap period, whichever is later, a default service provider shall submit to the commission one or more proposed time-of-use rates and real-time price plans. The commission shall approve or modify the time-of-use rates and real-time price plan within six months of submittal. The default service provider shall offer the time-of-use rates and real-time price plan to all customers that have been provided with smart meter technology under paragraph (2)(iii). Residential or commercial customers may elect to participate in time-of-use rates or real-time pricing. The default service provider shall submit an annual report to the price programs and the efficacy of the programs in affecting energy demand and consumption and the effect on wholesale market prices.

(6) The provisions of this subsection shall not apply to an electric distribution company with 100,000 or fewer customers.

(7) An electric distribution company may recover reasonable and prudent costs of providing smart meter technology under paragraph (2)(ii) and (iii), as determined by the commission. This paragraph includes annual depreciation and capital costs over the life of the smart meter technology and the cost of any system upgrades that the electric distribution company may require to enable the use of the smart meter technology which are incurred after the effective date of this paragraph, less operating and capital cost savings realized by the electric distribution company from the installation and use of the smart meter technology. Smart meter technology shall be deemed to be a new service offered for the first time under section 2804(4)(vi). An electric distribution company may recover smart meter technology costs:

(i) through base rates, including a deferral for future base rate recovery of current basis with carrying charge as determined by the commission; or

(ii) on a full and current basis through a reconcilable automatic adjustment clause under section 1307.

(g) Definition.--As used in this section, the term "smart meter technology" means technology, including metering technology and network communications technology capable of bidirectional communication, that records electricity usage on at least an hourly basis, including related electric distribution system upgrades to enable the technology. The technology shall provide customers with direct access to and use of price and consumption information. The technology shall also:

(1) Directly provide customers with information on their hourly consumption.

(2) Enable time-of-use rates and real-time price programs.

(3) Effectively support the automatic control of the customer's electricity consumption by one or more of the following as selected by the customer:

Exhibit 10

(i) the customer;
(ii) the customer's utility; or
(iii) a third party engaged by the customer or the customer's utility.

Section 4. Section 2811 of Title 66 is amended by adding a subsection to read:

§ 2811. Market power remediation.

* * *

(e.1) Market misconduct.--

(1) If an electric distribution company or any of its affiliated companies or any company that an electric distribution company has purchased generation from is found guilty of market manipulation, exercising market power or collusion by the Federal Energy Regulatory Commission or any Federal or State court or, if an electric distribution company or any one of its affiliated companies or any company that an electric distribution company has purchased generation from settles a claim of market manipulation, exercising market power or collusion that is brought by a regional transmission operator's market monitoring unit, the Federal Energy Regulatory Commission or another entity, the commission:

(i) Shall direct the electric distribution company to take any and all reasonable action to quantify the effect of the market misconduct upon Pennsylvania ratepayers.

(ii) Following public hearing on the matter and a finding of public interest, may direct the electric distribution company to take any and all reasonable legal action, including the filing of a lawsuit as may be necessary, to recover the quantified damages which shall be used to recompense Pennsylvania ratepayers affected by the market misconduct.

(2) If the electric distribution company fails to pursue reasonable action to quantify or seek recovery of damages for Pennsylvania ratepayers affected by market manipulation, the exercise of market power or collusion, the commission is authorized, following notice and an opportunity of the electric distribution company to comply or contest, to assess a civil penalty, which shall not be recovered in rates, of not more than $10,000 per day for failure or neglect to obey an order of the commission, the continuance of the failure or neglect being a separate offense.

(3) Any monetary damages recovered by the electric distribution company shall be paid to affected Pennsylvania ratepayers in the form of a credit to their electric bills or as refunds.

(4) The provisions of this subsection shall be held to be in addition to and not in substitution for or limitation of any other provision of this title.

* * *

Section 5. Title 66 is amended by adding sections to read:

§ 2813. Procurement of power.

Except as provided under the act of November 30, 2004 (P.L.1672, No.213), known as the Alternative Energy Portfolio Standards Act, the commission may not order a default service provider to procure power from a specific generation supplier, from a specific generation fuel type or from new generation only.

§ 2814. Additional alternative energy sources.

(a) Alternative energy sources.--The term "alternative energy sources" as defined under section 2 of the act of November 30, 2004 (P.L.1672, No.213), known as the Alternative

Exhibit 11

PRIOR PRINTER'S NOS. 3089, 3176 PRINTER'S NO. 3218

THE GENERAL ASSEMBLY OF PENNSYLVANIA

HOUSE BILL

No. 2200 Session of 2008

INTRODUCED BY GEORGE, McCALL, BELFANTI, CALTAGIRONE, CONKLIN, DALEY, GOODMAN, HARHAI, HARKINS, KULA, MANDERINO, McGEEHAN, VITALI, J. WHITE, WALKO, SURRA, DeLUCA, DERMODY, GRUCELA, JOSEPHS, JAMES, GINGRICH, FREEMAN, K. SMITH, McILVAINE SMITH, YOUNGBLOOD AND FRANKEL, JANUARY 15, 2008

AS AMENDED ON SECOND CONSIDERATION, HOUSE OF REPRESENTATIVES, FEBRUARY 11, 2008

AN ACT

Amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, PROVIDING FOR RECOVERY OF CERTAIN LABOR RELATIONS EXPENSES; further providing for definitions; and providing for adoption of energy efficiency and demand-side response; AND FURTHER PROVIDING FOR DUTIES OF ELECTRIC DISTRIBUTION COMPANIES. <--

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1. Section 2803 of Title 66 of the Pennsylvania Consolidated Statutes is amended by adding definitions to read: <--

SECTION 1. TITLE 66 OF THE PENNSYLVANIA CONSOLIDATED STATUTES IS AMENDED BY ADDING A SECTION TO READ: <--

§ 1329. RECOVERY OF CERTAIN LABOR RELATIONS EXPENSES.

NO PUBLIC UTILITY MAY CHARGE ITS CUSTOMERS AS A PERMISSIBLE OPERATING EXPENSE FOR RATEMAKING PURPOSES ANY PORTION OF THE DIRECT OR INDIRECT COST OF MEETINGS, PUBLICATIONS, CONSULTANTS, ATTORNEYS OR OTHER PROFESSIONAL SERVICES AND EXPENSES ASSOCIATED WITH THE UTILITY'S EFFORTS TO DISSUADE THE EMPLOYEES OF THE UTILITY, OR THE EMPLOYEES OF ANY AFFILIATED INTEREST OF THE UTILITY AS DEFINED IN SECTION 2101 (RELATING TO DEFINITION OF AFFILIATED INTEREST), FROM BECOMING OR REMAINING A MEMBER IN, OR OTHERWISE BEING REPRESENTED BY, ANY LABOR UNION.

SECTION 2. SECTION 2803 OF TITLE 66 IS AMENDED BY ADDING DEFINITIONS TO READ:

§ 2803. Definitions.

The following words and phrases when used in this chapter shall have the meanings given to them in this section unless the context clearly indicates otherwise:

"Affiliated interest." As defined in section 2101 (relating to definition of affiliated interest).

Exhibit 11

REQUIREMENTS OF THIS PARAGRAPH AND HOW THE SMART METER TECHNOLOGY SHALL BE INSTALLED ACCORDING TO THIS PARAGRAPH. IN ADDITION, THE PLAN SHALL ENSURE THAT ALL SMART METER TECHNOLOGY INSTALLATION AND MAINTENANCE WORK SHALL BE PERFORMED BY ADEQUATELY TRAINED AND QUALIFIED PERSONNEL AND THAT, TO THE EXTENT PRACTICAL, SUCH WORK SHALL BE OFFERED INITIALLY TO EMPLOYEES OF THE ELECTRIC DISTRIBUTION COMPANY.

(II) ELECTRIC DISTRIBUTION COMPANIES SHALL FURNISH SMART METER TECHNOLOGY TO:

(A) CUSTOMERS RESPONSIBLE FOR 40% OF THE DISTRIBUTION COMPANY'S ANNUAL PEAK DEMAND WITHIN FOUR YEARS AFTER THE EFFECTIVE DATE OF THIS PARAGRAPH.

(B) CUSTOMERS RESPONSIBLE FOR 75% OF THE DISTRIBUTION COMPANY'S ANNUAL PEAK DEMAND WITHIN SIX YEARS AFTER THE EFFECTIVE DATE OF THIS PARAGRAPH.

(C) ONE HUNDRED PERCENT OF ITS CUSTOMERS WITHIN TEN YEARS AFTER THE EFFECTIVE DATE OF THIS PARAGRAPH.

ELECTRIC DISTRIBUTION COMPANIES SHALL, WITH CUSTOMER CONSENT, MAKE AVAILABLE ELECTRONIC ACCESS TO CUSTOMER METER DATA TO THIRD PARTIES, INCLUDING ELECTRIC GENERATION SUPPLIERS AND PROVIDERS OF CONSERVATION AND LOAD MANAGEMENT SERVICES.

(III) ELECTRIC DISTRIBUTION COMPANIES SHALL BE PERMITTED TO RECOVER ALL REASONABLE AND PRUDENT COSTS, AS DETERMINED BY THE COMMISSION, OF PROVIDING SMART METER TECHNOLOGY, INCLUDING ANNUAL DEPRECATION AND CAPITAL COSTS OVER THE LIFE OF THE SMART METER TECHNOLOGY, THAT ARE INCURRED AFTER THE EFFECTIVE DATE OF THIS PARAGRAPH, LESS ALL OPERATING AND CAPITAL COSTS SAVINGS REALIZED BY

THE ELECTRIC DISTRIBUTION COMPANY FROM THE INTRODUCTION AND USE OF THE SMART METER TECHNOLOGY. AN ELECTRIC DISTRIBUTION COMPANY MAY, AT ITS OPTION, RECOVER SUCH SMART METER TECHNOLOGY COSTS:

(A) THROUGH BASE RATES, INCLUDING A DEFERRAL FOR FUTURE BASE RATE RECOVERY OF CURRENT COSTS, WITH CARRYING CHARGES EQUAL TO 6%; OR

(B) ON A FULL AND CURRENT BASIS THROUGH A RECONCILABLE AUTOMATIC ADJUSTMENT CLAUSE UNDER SECTION 1307 (RELATING TO SLIDING SCALE OF RATES; ADJUSTMENTS).

IN NO EVENT SHALL LOST OR DECREASED REVENUES BY AN ELECTRIC DISTRIBUTION COMPANY DUE TO REDUCED ELECTRICITY CONSUMPTION OR SHIFTING ENERGY DEMAND BE CONSIDERED A COST OF SMART METER TECHNOLOGY. SMART METER TECHNOLOGY SHALL BE DEEMED TO BE A NEW SERVICE OFFERED FOR THE FIRST TIME UNDER SECTION 2804(4)(VI) (RELATING TO STANDARDS FOR RESTRUCTURING OF ELECTRIC INDUSTRY).

(IV) BY JANUARY 1, 2010, OR AT THE END OF THE APPLICABLE GENERATION RATE CAP PERIOD, WHICHEVER IS LATER, A DEFAULT SERVICE PROVIDER SHALL SUBMIT TO THE COMMISSION ONE OR MORE PROPOSED TIME-OF-USE RATES AND A REAL-TIME PRICE PLAN. THE COMMISSION SHALL APPROVE OR MODIFY THE TIME-OF-USE RATES AND REAL-TIME PRICE PLAN WITHIN SIX MONTHS OF SUBMITTAL. THE DEFAULT SERVICE PROVIDER SHALL OFFER COMMISSION-APPROVED TIME-OF-USE RATES AND A REAL-TIME PRICE PLAN TO ALL RESIDENTIAL AND COMMERCIAL CUSTOMERS THAT HAVE BEEN PROVIDED WITH SMART METER TECHNOLOGY WITHIN 60 DAYS OF INSTALLATION OF THE SMART METER TECHNOLOGY OR COMMISSION APPROVAL OF THE

Exhibit 11

TIME-OF-USE RATES AND A REAL-TIME PRICE PLAN, WHICHEVER IS LATER. CUSTOMER PARTICIPATION IN TIME-OF-USE RATES OR REAL-TIME PRICING SHALL BE VOLUNTARY AND SHALL ONLY BE PROVIDED WITH THE AFFIRMATIVE CONSENT OF THE CUSTOMER. THE DEFAULT SERVICE PROVIDER SHALL SUBMIT AN ANNUAL REPORT TO THE COMMISSION ON THE PARTICIPATION IN THE TIME-OF-USE AND REAL-TIME PRICE PROGRAMS AND THE EFFICACY OF THE PROGRAMS IN AFFECTING ENERGY DEMAND AND CONSUMPTION AND THE EFFECT ON WHOLESALE MARKET PRICES.

(V) FOR PURPOSES OF THIS PARAGRAPH, THE TERM "ELECTRIC DISTRIBUTION COMPANY" SHALL MEAN A PUBLIC UTILITY PROVIDING FACILITIES FOR THE JURISDICTIONAL TRANSMISSION AND DISTRIBUTION OF ELECTRICITY TO 100,000 OR MORE RETAIL CUSTOMERS IN THIS COMMONWEALTH.

Section 3 5. This act shall take effect immediately. <--

Exhibit 12

PRIOR PRINTER'S NOS. 3089, 3176, 3218 PRINTER'S NO. 3233

THE GENERAL ASSEMBLY OF PENNSYLVANIA

HOUSE BILL

No. 2200 Session of 2008

INTRODUCED BY GEORGE, McCALL, BELFANTI, CALTAGIRONE, CONKLIN, DALEY, GOODMAN, HARHAI, HARKINS, KULA, MANDERINO, McGEEHAN, VITALI, J. WHITE, WALKO, SURRA, DeLUCA, DERMODY, GRUCELA, JOSEPHS, JAMES, GINGRICH, FREEMAN, K. SMITH, McILVAINE SMITH, YOUNGBLOOD AND FRANKEL, JANUARY 15, 2008

AS AMENDED ON THIRD CONSIDERATION, HOUSE OF REPRESENTATIVES, FEBRUARY 12, 2008

AN ACT

Amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, providing for recovery of certain labor relations expenses; further providing for definitions; providing for adoption of energy efficiency and demand-side response; and further providing for duties of electric distribution companies.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

Section 1. Title 66 of the Pennsylvania Consolidated Statutes is amended by adding a section to read:

§ 1329. Recovery of certain labor relations expenses.

No public utility may charge its customers as a permissible operating expense for ratemaking purposes any portion of the direct or indirect cost of meetings, publications, consultants, attorneys or other professional services and expenses associated with the utility's efforts to dissuade the employees of the utility, or the employees of any affiliated interest of the utility as defined in section 2101 (relating to definition of

---

affiliated interest), from becoming or remaining a member in, or otherwise being represented by, any labor union.

Section 2. Section 2803 of Title 66 is amended by adding definitions to read:

§ 2803. Definitions.

The following words and phrases when used in this chapter shall have the meanings given to them in this section unless the context clearly indicates otherwise:

"Affiliated interest." As defined in section 2101 (relating to definition of affiliated interest).

* * *

"Cost effective." In relation to a program being evaluated,

Exhibit 12

distribution company.

(ii) Electric distribution companies shall furnish smart meter technology to:

(A) Customers responsible for 40% of the distribution company's annual peak demand within four years after the effective date of this paragraph.

(B) Customers responsible for 75% of the distribution company's annual peak demand within six years after the effective date of this paragraph.

(C) One hundred percent of its customers within ten years after the effective date of this paragraph.

Electric distribution companies shall, with customer consent, make available electronic access to customer meter data to third parties, including electric generation suppliers and providers of conservation and load management services.

(iii) Electric distribution companies shall be permitted to recover all reasonable and prudent costs, as determined by the commission, of providing smart meter technology, including annual deprecation and capital costs over the life of the smart meter technology, that are incurred after the effective date of this paragraph, less all operating and capital costs savings realized by the electric distribution company from the introduction and use of the smart meter technology. An electric distribution company may, at its option, recover such smart meter technology costs:

(A) through base rates, including a deferral for future base rate recovery of current costs, with carrying charges equal to 6%; or

(B) on a full and current basis through a reconcilable automatic adjustment clause under section 1307 (relating to sliding scale of rates; adjustments).

In no event shall lost or decreased revenues by an electric distribution company due to reduced electricity consumption or shifting energy demand be considered a cost of smart meter technology. Smart meter technology shall be deemed to be a new service offered for the first time under section 2804(4)(vi) (relating to standards for restructuring of electric industry).

(iv) By January 1, 2010, or at the end of the applicable generation rate cap period, whichever is later, a default service provider shall submit to the commission one or more proposed time-of-use rates and a real-time price plan. The commission shall approve or modify the time-of-use rates and real-time price plan within six months of submittal. The default service provider shall offer commission-approved time-of-use rates and a real-time price plan to all residential and commercial customers that have been provided with smart meter technology within 60 days of installation of the smart meter technology or commission approval of the time-of-use rates and a real-time price plan, whichever is later. Customer participation in time-of-use rates or real-time pricing shall be voluntary and shall only be provided with the affirmative consent of the customer. The default service provider shall submit an annual report to the commission on the participation in the time-of-use and real-time price programs and the efficacy

Exhibit 12

of the programs in affecting energy demand and consumption and the effect on wholesale market prices.

(v) For purposes of this paragraph, the term "electric distribution company" shall mean a public utility providing facilities for the jurisdictional transmission and distribution of electricity to 100,000 or more retail customers in this Commonwealth.

Section 5. This act shall take effect immediately.

Exhibit 13

SENATE AMENDED

PRIOR PRINTER'S NOS. 3089, 3176, 3218, 3233 PRINTER'S NO. **4429**

THE GENERAL ASSEMBLY OF PENNSYLVANIA

HOUSE BILL

No. 2200 Session of 2008

INTRODUCED BY GEORGE, McCALL, BELFANTI, CALTAGIRONE, CONKLIN, DALEY, GOODMAN, HARHAI, HARKINS, KULA, MANDERINO, McGEEHAN, VITALI, J. WHITE, WALKO, SURRA, DeLUCA, DERMODY, GRUCELA, JOSEPHS, JAMES, GINGRICH, FREEMAN, K. SMITH, McILVAINE SMITH, YOUNGBLOOD AND FRANKEL, JANUARY 15, 2008

SENATOR TOMLINSON, CONSUMER PROTECTION AND PROFESSIONAL LICENSURE, IN SENATE, AS AMENDED, SEPTEMBER 23, 2008

AN ACT

Amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, ~~providing for recovery of certain labor relations expenses; further providing for definitions; providing for adoption of energy efficiency and demand-side response; and further providing for duties of electric distribution companies.~~ FURTHER PROVIDING FOR DEFINITIONS; PROVIDING FOR ENERGY EFFICIENCY AND CONSERVATION; FURTHER PROVIDING FOR DUTIES OF ELECTRIC DISTRIBUTION COMPANIES; AND PROVIDING FOR PROCUREMENT.

The General Assembly of the Commonwealth of Pennsylvania hereby enacts as follows:

~~Section 1. Title 66 of the Pennsylvania Consolidated Statutes is amended by adding a section to read:~~

~~§ 1329. Recovery of certain labor relations expenses.~~

~~No public utility may charge its customers as a permissible operating expense for ratemaking purposes any portion of the direct or indirect cost of meetings, publications, consultants, attorneys or other professional services and expenses associated~~

Exhibit 13

MEASURES APPROVED BY THE COMMISSION.

"PEAK DEMAND." THE HIGHEST ELECTRICAL REQUIREMENT OCCURRING DURING A SPECIFIED PERIOD. FOR AN ELECTRIC DISTRIBUTION COMPANY, THE TERM SHALL MEAN THE SUM OF THE METERED CONSUMPTION FOR ALL RETAIL CUSTOMERS OVER THAT PERIOD.

"QUALITY ASSURANCE." ALL OF THE FOLLOWING:

(1) THE AUDITING OF BUILDINGS, EQUIPMENT AND PROCESSES TO DETERMINE THE COST-EFFECTIVENESS OF ENERGY EFFICIENCY AND CONSERVATION MEASURES USING NATIONALLY RECOGNIZED TOOLS AND CERTIFICATION PROGRAMS.

(2) INDEPENDENT INSPECTION OF COMPLETED ENERGY EFFICIENCY AND CONSERVATION MEASURES COMPLETED BY THIRD-PARTY ENTITIES TO EVALUATE THE QUALITY OF THE COMPLETED MEASURE.

"REAL-TIME PRICE." A RATE THAT DIRECTLY REFLECTS THE DIFFERENT COST OF ENERGY DURING EACH HOUR.

"THIRD-PARTY ENTITY." AN ENTITY WITH NO DIRECT OR INDIRECT OWNERSHIP, PARTNERSHIP OR OTHER AFFILIATED INTEREST WITH AN ELECTRIC DISTRIBUTION COMPANY.

"TIME-OF-USE RATE." A RATE THAT REFLECTS THE COSTS OF SERVING CUSTOMERS DURING DIFFERENT TIME PERIODS, INCLUDING OFF-PEAK AND ON-PEAK PERIODS, BUT NOT AS FREQUENTLY AS EACH HOUR.

"TOTAL RESOURCE COST TEST." A STANDARD TEST THAT IS MET IF, OVER THE EFFECTIVE LIFE OF EACH PLAN NOT TO EXCEED FIVE YEARS, THE AVOIDED MONETARY COSTS OF SUPPLYING ELECTRICITY ARE GREATER THAN THE MONETARY COSTS OF ENERGY EFFICIENCY MEASURES AND CONSERVATION OF CONSUMPTION.

SECTION 3. SECTION 2807(E) OF TITLE 66 IS AMENDED AND THE SECTION IS AMENDED BY ADDING SUBSECTIONS TO READ:

§ 2807. DUTIES OF ELECTRIC DISTRIBUTION COMPANIES.

* * *

Exhibit 13

FACILITY INTERESTS SHALL NOT BE COMMISSION-REGULATED ASSETS.

(6) A DEFAULT SERVICE PLAN APPROVED BY THE COMMISSION PRIOR TO THE EFFECTIVE DATE OF THIS SECTION SHALL REMAIN IN EFFECT THROUGH ITS APPROVED TERM. AT ITS SOLE DISCRETION, THE DEFAULT SERVICE PROVIDER MAY PROPOSE AMENDMENTS TO ITS APPROVED PLAN THAT ARE CONSISTENT WITH THIS SECTION, AND THE COMMISSION SHALL ISSUE A DECISION WHETHER TO APPROVE OR DISAPPROVE THE PROPOSED AMENDMENTS WITHIN NINE MONTHS OF THE DATE THAT THE AMENDMENTS ARE FILED. IF THE COMMISSION FAILS TO ISSUE A FINAL ORDER WITHIN NINE MONTHS, THE AMENDMENTS SHALL BE DEEMED TO BE APPROVED AND THE DEFAULT SERVICE PROVIDER MAY IMPLEMENT THE AMENDMENTS AS FILED.

(7) THE DEFAULT SERVICE PROVIDER SHALL OFFER RESIDENTIAL AND SMALL BUSINESS CUSTOMERS A GENERATION SUPPLY SERVICE RATE THAT SHALL CHANGE NO MORE FREQUENTLY THAN ON A QUARTERLY BASIS. ALL DEFAULT SERVICE RATES SHALL BE REVIEWED BY THE COMMISSION TO ENSURE THAT THE COSTS OF PROVIDING SERVICE TO EACH CUSTOMER CLASS ARE NOT SUBSIDIZED BY ANY OTHER CLASS.

(F) SMART METER TECHNOLOGY AND TIME OF USE RATES.--

(1) WITHIN NINE MONTHS AFTER THE EFFECTIVE DATE OF THIS PARAGRAPH, ELECTRIC DISTRIBUTION COMPANIES SHALL FILE A SMART METER TECHNOLOGY PROCUREMENT AND INSTALLATION PLAN WITH THE COMMISSION FOR APPROVAL. THE PLAN SHALL DESCRIBE THE SMART METER TECHNOLOGIES THE ELECTRIC DISTRIBUTION COMPANY PROPOSES TO INSTALL IN ACCORDANCE WITH PARAGRAPH (2).

(2) ELECTRIC DISTRIBUTION COMPANIES SHALL FURNISH SMART METER TECHNOLOGY AS FOLLOWS:

(I) UPON REQUEST TO A CUSTOMER THAT AGREES TO PAY THE COST OF THE SMART METER.

Exhibit 13

(II) IN THE CONSTRUCTION OF A NEW RESIDENCE OR NEW BUILDING TO BE USED BY A COMMERCIAL CUSTOMER.

(III) IN ACCORDANCE WITH A SCHEDULE OF REPLACEMENT OF FULL DEPRECIATION OF EXISTING METERS.

(3) ELECTRIC DISTRIBUTION COMPANIES SHALL, WITH CUSTOMER CONSENT, MAKE AVAILABLE ELECTRONIC ACCESS TO CUSTOMER METER DATA TO THIRD PARTIES, INCLUDING ELECTRIC GENERATION SUPPLIERS AND PROVIDERS OF CONSERVATION AND LOAN MANAGEMENT SERVICES.

(4) AN ELECTRIC DISTRIBUTION COMPANY SHALL NOT BE PERMITTED TO RECOVER THE COSTS, AS DETERMINED BY THE COMMISSION, OF PROVIDING SMART METER TECHNOLOGY UNDER PARAGRAPH (2).

(5) IN NO EVENT SHALL LOST OR DECREASED REVENUES BY AN ELECTRIC DISTRIBUTION COMPANY DUE TO REDUCED ELECTRICITY CONSUMPTION OR SHIFTING ENERGY DEMAND BE CONSIDERED A COST OF SMART METER TECHNOLOGY.

(6) BY JANUARY 1, 2010, OR AT THE END OF THE APPLICABLE GENERATION RATE CAP PERIOD, WHICHEVER IS LATER, A DEFAULT SERVICE PROVIDER SHALL SUBMIT TO THE COMMISSION ONE OR MORE PROPOSED TIME-OF-USE RATES AND REAL-TIME PRICE PLANS. THE COMMISSION SHALL APPROVE OR MODIFY THE TIME-OF-USE RATES AND REAL-TIME PRICE PLAN WITHIN SIX MONTHS OF SUBMITTAL. THE DEFAULT SERVICE PROVIDER SHALL OFFER THE RATES AND REAL-TIME PRICE PLAN TO ALL RESIDENTIAL AND COMMERCIAL CUSTOMERS THAT HAVE BEEN PROVIDED WITH SMART METER TECHNOLOGY WITHIN 60 DAYS OF INSTALLATION OF THE SMART METER TECHNOLOGY OR COMMISSION APPROVAL OF THE TIME-OF-USE RATES AND REAL-TIME PRICE PLAN, WHICHEVER IS LATER. RESIDENTIAL OR COMMERCIAL CUSTOMERS MAY ELECT TO PARTICIPATE IN TIME-OF-USE RATES OR REAL-TIME

Exhibit 14

SENATE AMENDED

PRIOR PRINTER'S NOS. 3089, 3176, 3218, 3233, 4429

PRINTER'S NO. 4526

THE GENERAL ASSEMBLY OF PENNSYLVANIA

HOUSE BILL

No. 2200 Session of 2008

INTRODUCED BY GEORGE, McCALL, BELFANTI, CALTAGIRONE, CONKLIN, DALEY, N. P. GOODMAN, HARHAI, HARKINS, KULA, MANDERINO, McGEEHAN, VITALI, J. WHITE, WALKO, SURRA, DeLUCA, DERMODY, GRUCELA, JOSEPHS, JAMES, GINGRICH, FREEMAN, K. SMITH, McILVAINE SMITH, YOUNGBLOOD AND FRANKEL, JANUARY 15, 2008

SENATOR TOMLINSON, CONSUMER PROTECTION AND PROFESSIONAL LICENSURE, IN SENATE, RE-REPORTED AS AMENDED, OCTOBER 7, 2008

AN ACT

Amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, ~~providing for recovery of certain labor relations expenses; further providing for definitions; providing for adoption of energy efficiency and demand-side response; and further providing for duties of electric distribution companies. FURTHER PROVIDING FOR DEFINITIONS; PROVIDING FOR ENERGY EFFICIENCY AND CONSERVATION; FURTHER PROVIDING FOR DUTIES OF ELECTRIC DISTRIBUTION COMPANIES; AND PROVIDING FOR PROCUREMENT.~~ FURTHER PROVIDING FOR DIRECTOR OF OPERATIONS, SECRETARY, EMPLOYEES AND CONSULTANTS; REPEALING PROVISIONS RELATING TO OFFICE OF TRIAL STAFF; FURTHER PROVIDING FOR BUREAUS AND OFFICES; PROVIDING FOR OTHER BUREAUS, OFFICES AND POSITIONS; FURTHER PROVIDING FOR ELECTRIC UTILITY DEFINITIONS; PROVIDING FOR ENERGY EFFICIENCY AND CONSERVATION PROGRAM AND FOR ENERGY EFFICIENCY AND CONSERVATION; FURTHER PROVIDING FOR DUTIES OF ELECTRIC DISTRIBUTION COMPANIES AND FOR MARKET POWER REMEDIATION; AND PROVIDING FOR PROCUREMENT, FOR ADDITIONAL ALTERNATIVE ENERGY SOURCES AND FOR CARBON DIOXIDE SEQUESTRATION NETWORK.

THE GENERAL ASSEMBLY RECOGNIZES THE FOLLOWING PUBLIC POLICY FINDINGS AND DECLARES THAT THE FOLLOWING OBJECTIVES OF THE COMMONWEALTH ARE SERVED BY THIS ACT:

(1) THE HEALTH, SAFETY AND PROSPERITY OF ALL CITIZENS OF

Exhibit 14

(2) INDEPENDENT INSPECTION OF COMPLETED ENERGY EFFICIENCY AND CONSERVATION MEASURES COMPLETED BY THIRD-PARTY ENTITIES TO EVALUATE THE QUALITY OF THE COMPLETED MEASURE.

"REAL-TIME PRICE." A RATE THAT DIRECTLY REFLECTS THE DIFFERENT COST OF ENERGY DURING EACH HOUR.

"TIME-OF-USE RATE." A RATE THAT REFLECTS THE COSTS OF SERVING CUSTOMERS DURING DIFFERENT TIME PERIODS, INCLUDING OFF-PEAK AND ON-PEAK PERIODS, BUT NOT AS FREQUENTLY AS EACH HOUR.

"TOTAL RESOURCE COST TEST." A STANDARD TEST THAT IS MET IF, OVER THE EFFECTIVE LIFE OF EACH PLAN NOT TO EXCEED 15 YEARS, THE NET PRESENT VALUE OF THE AVOIDED MONETARY COST OF SUPPLYING ELECTRICITY IS GREATER THAN THE NET PRESENT VALUE OF THE MONETARY COST OF ENERGY EFFICIENCY CONSERVATION MEASURES.

§ 2806.2. ENERGY EFFICIENCY AND CONSERVATION.

(A) REGISTRY.--THE COMMISSION SHALL, BY MARCH 1, 2009, ESTABLISH A REGISTRY OF APPROVED PERSONS QUALIFIED TO PROVIDE CONSERVATION SERVICES TO ALL CLASSES OF CUSTOMERS. IN ORDER TO BE INCLUDED IN THE REGISTRY, A CONSERVATION SERVICE PROVIDER MUST MEET EXPERIENCE AND OTHER QUALIFICATIONS DETERMINED BY THE COMMISSION.

(B) APPLICATION.--THE COMMISSION SHALL DEVELOP AN APPLICATION FOR REGISTRATION UNDER SUBSECTION (A) AND MAY CHARGE A REASONABLE REGISTRATION FEE.

SECTION 3. SECTION 2807(E) OF TITLE 66 IS AMENDED AND THE SECTION IS AMENDED BY ADDING SUBSECTIONS TO READ:

§ 2807. DUTIES OF ELECTRIC DISTRIBUTION COMPANIES.

* * *

(E) OBLIGATION TO SERVE.--[AN ELECTRIC DISTRIBUTION COMPANY'S] A DEFAULT SERVICE PROVIDER'S OBLIGATION TO PROVIDE ELECTRIC GENERATION SUPPLY SERVICE FOLLOWING [IMPLEMENTATION OF

Exhibit 14

DEFAULT SERVICE PROVIDER MAY PROPOSE AMENDMENTS TO ITS APPROVED PLAN THAT ARE CONSISTENT WITH THIS SECTION, AND THE COMMISSION SHALL ISSUE A DECISION WHETHER TO APPROVE OR DISAPPROVE THE PROPOSED AMENDMENTS WITHIN NINE MONTHS OF THE DATE THAT THE AMENDMENTS ARE FILED. IF THE COMMISSION FAILS TO ISSUE A FINAL ORDER WITHIN NINE MONTHS, THE AMENDMENTS SHALL BE DEEMED TO BE APPROVED AND THE DEFAULT SERVICE PROVIDER MAY IMPLEMENT THE AMENDMENTS AS FILED.

(7) THE DEFAULT SERVICE PROVIDER SHALL OFFER RESIDENTIAL AND SMALL BUSINESS CUSTOMERS A GENERATION SUPPLY SERVICE RATE THAT SHALL CHANGE NO MORE FREQUENTLY THAN ON A QUARTERLY BASIS. ALL DEFAULT SERVICE RATES SHALL BE REVIEWED BY THE COMMISSION TO ENSURE THAT THE COSTS OF PROVIDING SERVICE TO EACH CUSTOMER CLASS ARE NOT SUBSIDIZED BY ANY OTHER CLASS.

(F) SMART METER TECHNOLOGY AND TIME OF USE RATES.--

(1) WITHIN NINE MONTHS AFTER THE EFFECTIVE DATE OF THIS PARAGRAPH, ELECTRIC DISTRIBUTION COMPANIES SHALL FILE A SMART METER TECHNOLOGY PROCUREMENT AND INSTALLATION PLAN WITH THE COMMISSION FOR APPROVAL. THE PLAN SHALL DESCRIBE THE SMART METER TECHNOLOGIES THE ELECTRIC DISTRIBUTION COMPANY PROPOSES TO INSTALL IN ACCORDANCE WITH PARAGRAPH (2).

(2) ELECTRIC DISTRIBUTION COMPANIES SHALL FURNISH SMART METER TECHNOLOGY AS FOLLOWS:

(I) UPON REQUEST FROM A CUSTOMER THAT AGREES TO PAY THE COST OF THE SMART METER AT THE TIME OF THE REQUEST.

(II) IN NEW BUILDING CONSTRUCTION.

(III) IN ACCORDANCE WITH A DEPRECIATION SCHEDULE NOT TO EXCEED 15 YEARS.

(3) ELECTRIC DISTRIBUTION COMPANIES SHALL, WITH CUSTOMER CONSENT, MAKE AVAILABLE DIRECT METER ACCESS AND ELECTRONIC

Exhibit 14

ACCESS TO CUSTOMER METER DATA TO THIRD PARTIES, INCLUDING ELECTRIC GENERATION SUPPLIERS AND PROVIDERS OF CONSERVATION AND LOAD MANAGEMENT SERVICES.

(4) IN NO EVENT SHALL LOST OR DECREASED REVENUES BY AN ELECTRIC DISTRIBUTION COMPANY DUE TO REDUCED ELECTRICITY CONSUMPTION OR SHIFTING ENERGY DEMAND BE CONSIDERED ANY OF THE FOLLOWING:

(I) A COST OF SMART METER TECHNOLOGY RECOVERABLE UNDER A RECONCILABLE AUTOMATIC ADJUSTMENT CLAUSE UNDER SECTION 1307(B), EXCEPT THAT DECREASED REVENUES AND REDUCED ENERGY CONSUMPTION MAY BE REFLECTED IN THE REVENUE AND SALES DATA USED TO CALCULATE RATES IN A DISTRIBUTION RATE BASE RATE PROCEEDING FILED UNDER SECTION 1308 (RELATING TO VOLUNTARY CHANGE IN RATES).

(II) A RECOVERABLE COST.

(5) BY JANUARY 1, 2010, OR AT THE END OF THE APPLICABLE GENERATION RATE CAP PERIOD, WHICHEVER IS LATER, A DEFAULT SERVICE PROVIDER SHALL SUBMIT TO THE COMMISSION ONE OR MORE PROPOSED TIME-OF-USE RATES AND REAL-TIME PRICE PLANS. THE COMMISSION SHALL APPROVE OR MODIFY THE TIME-OF-USE RATES AND REAL-TIME PRICE PLAN WITHIN SIX MONTHS OF SUBMITTAL. THE DEFAULT SERVICE PROVIDER SHALL OFFER THE TIME-OF-USE RATES AND REAL-TIME PRICE PLAN TO ALL CUSTOMERS THAT HAVE BEEN PROVIDED WITH SMART METER TECHNOLOGY UNDER PARAGRAPH (2)(III). RESIDENTIAL OR COMMERCIAL CUSTOMERS MAY ELECT TO PARTICIPATE IN TIME-OF-USE RATES OR REAL-TIME PRICING. THE DEFAULT SERVICE PROVIDER SHALL SUBMIT AN ANNUAL REPORT TO THE PRICE PROGRAMS AND THE EFFICACY OF THE PROGRAMS IN AFFECTING ENERGY DEMAND AND CONSUMPTION AND THE EFFECT ON WHOLESALE MARKET PRICES.

Exhibit 15

Pennsylvania General Assembly

https://www.legis.state.pa.us/cfdocs/billinfo/bill_history.cfm?syear=2007&sind=0&body=H&type=B&bn=2200

01/12/2020 08:00 PM

Bill Information - History

House Bill 2200; Regular Session 2007-2008

Sponsors: GEORGE, McCALL, BELFANTI, CALTAGIRONE, CONKLIN, DALEY, N. P. GOODMAN, HARHAI, HARKINS, KULA, MANDERINO, McGEEHAN, VITALI, J. WHITE, WALKO, SURRA, DeLUCA, DERMODY, GRUCELA, JOSEPHS, JAMES, GINGRICH, FREEMAN, K. SMITH, McILVAINE SMITH, YOUNGBLOOD and FRANKEL

Printer's No.(PN): 4526* , 4429, 3233, 3218, 3176, 3089

Short Title: An Act amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, further providing for director of operations, secretary, employees and consultants; repealing provisions relating to office of trial staff; further providing for bureaus and offices; providing for other bureaus, offices and positions; further providing for electric utility definitions; providing for energy efficiency and conservation program and for energy efficiency and conservation; further providing for duties of electric distribution companies and for market power remediation; and providing for procurement, for additional alternative energy sources and for carbon dioxide sequestration network.

Actions:

PN 3089	Referred to CONSUMER AFFAIRS, Jan. 15, 2008
PN 3176	Reported as amended, Feb. 5, 2008
	First consideration, Feb. 5, 2008
	Laid on the table, Feb. 5, 2008
	Removed from table, Feb. 5, 2008
	Re-committed to APPROPRIATIONS, Feb. 5, 2008
	Re-reported as committed, Feb. 11, 2008
PN 3218	Second consideration, with amendments, Feb. 11, 2008
	(Remarks see House Journal Page 386-403), Feb. 11, 2008
PN 3233	Third consideration, with amendments, Feb. 12, 2008
	Final passage, Feb. 12, 2008 (152-45)
	(Remarks see House Journal Page 430-432), Feb. 12, 2008
	In the Senate
	Referred to CONSUMER PROTECTION AND PROFESSIONAL LICENSURE, Feb. 20, 2008
PN 4429	Reported as amended, Sept. 23, 2008
	First consideration, Sept. 23, 2008
	Second consideration, Sept. 24, 2008
	Re-committed to CONSUMER PROTECTION AND PROFESSIONAL LICENSURE, Sept. 24, 2008
PN 4526	Re-reported as amended, Oct. 7, 2008
	Re-referred to APPROPRIATIONS, Oct. 7, 2008
	Re-reported as committed, Oct. 7, 2008
	Third consideration and final passage, Oct. 8, 2008 (47-3)
	(Remarks see Senate Journal Page 2626-2631), Oct. 8, 2008
	In the House

Exhibit 15

Referred to RULES, Oct. 8, 2008

Reported as committed, Oct. 8, 2008

House concurred in Senate amendments, Oct. 8, 2008 (186-4)

(Remarks see House Journal Page 2323-2328), Oct. 8, 2008

Signed in House, Oct. 8, 2008

Signed in Senate, Oct. 8, 2008

Presented to the Governor, Oct. 9, 2008

Approved by the Governor, Oct. 15, 2008

Act No. 129

* *denotes current Printer's Number*

How to Read a Bill About PDF Documents

https://www.legis.state.pa.us/WU001/LI/HJ/2008/0/20080211.pdf#page=[illegible] Exhibit 1

Cohen	Hickernell	Oliver	Swanger
Conklin	Hornaman	Pallone	Tangretti
Costa	Hutchinson	Parker	Taylor, J.
Cox	*James*	*Pashinski*	*Taylor, R.*
Creighton	Josephs	Payne	Thomas
Cruz	Kauffman	Payton	True
Curry	Keller, M.	Peifer	Turzai
Cutler	Keller, W.	Perry	Vereb
Daley	Kenney	Petrarca	Vitali
Dally	Kessler	Petri	Vulakovich
DeLuca	Killion	Petrone	Wagner
Denlinger	King	Phillips	Walko
DePasquale	Kirkland	Pickett	Wansacz
Dermody	Kortz	Preston	Waters
DeWeese	Kotik	Pyle	Watson
DiGirolamo	Kula	Quigley	Wheatley
Donatucci	Leach	Quinn	White
Eachus	Lentz	Ramaley	Williams
Ellis	Levdansky	Rapp	Wojnaroski
Evans, D.	Longietti	Raymond	Yewcic
Evans, J.	*Mackereth*	*Readshaw*	*Youngblood*
Everett	Maher	Reed	Yudichak
Fabrizio	Mahoney	Reichley	
Fairchild	Major	Roae	O'Brien, D.,
Fleck	Manderino	Rock	Speaker
Frankel	Mann	Roebuck	

NAYS–0

NOT VOTING–0

EXCUSED–2

Perzel	Shimkus

The majority having voted in the affirmative, the question was determined in the affirmative and the resolution was adopted.

SUPPLEMENTAL CALENDAR B

BILL ON SECOND CONSIDERATION

The House proceeded to second consideration of **HB 2200, PN 3176,** entitled:

An Act amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, further providing for definitions; and providing for adoption of energy efficiency and demand-side response.

On the question,
Will the House agree to the bill on second consideration?

Mr. **FREEMAN** offered the following amendment No. **A05751:**

Amend Sec. 2 (Sec. 2806.1), page 4, lines 7 and 8, by striking out "in whose service territory the programs are implemented," and inserting

from all sources, including default service generation revenues as of January 1, 2007.

Amend Sec. 2 (Sec. 2806.1), page 9, by inserting between lines 3 and 4

(i) By May 31, 2011, total annual deliveries to retail customers of electric distribution companies shall be reduced by a minimum of 1%. This load reduction shall be measured against the expected load forecasted by the commission for June 1, 2010, through May 31, 2011, based on load for the period June 1, 2007, through May 31, 2008, with provision made for weather adjustments and extraordinary load that the electric distribution company must serve. The commission shall determine and make public the forecasts to be used for each electric distribution company no later than August 31, 2008. The program administrator shall ensure that a third-party entity meets the goals contained in this section through the implementation of a program of energy efficiency measures throughout the service territory of the electric distribution company.

Amend Sec. 2 (Sec. 2806.1), page 9, line 4, by striking out "(i)" and inserting

(ii)

Amend Sec. 2 (Sec. 2806.1), page 9, line 6, by inserting a period after "2.5%"

Amend Sec. 2 (Sec. 2806.1), page 9, lines 6 through 8, by striking out ", WITH PROVISIONS MADE FOR" in line 6, all of line 7 and "ELECTRIC DISTRIBUTION COMPANY MUST SERVE." in line 8

Amend Sec. 2 (Sec. 2806.1), page 9, line 12, by inserting after "2008"

, with provision made for weather adjustments and extraordinary load that the electric distribution company must serve

Amend Sec. 2 (Sec. 2806.1), page 9, line 20, by striking out "(ii)" and inserting

(iii)

Amend Sec. 2 (Sec. 2806.1), page 9, line 28, by striking out "*(iii)*" *and inserting*

(iv)

On the question,
Will the House agree to the amendment?

The SPEAKER. The Chair recognizes Representative Freeman on the amendment.

Mr. FREEMAN. Thank you, Mr. Speaker.

Mr. Speaker, this amendment does a number of things. First, it adds clarifying language dealing with the 2-percent cost cap that is currently contained in the legislation. It would add generation to the list of items that go into calculating the final figure. Currently it only deals with transmission and distribution, but we add generation, and generation makes up roughly 60 percent of the revenues of a public utility. So it is important to put generation in to make sure that we have a higher figure to work off of.

Second, we add an incremental figure of 1 percent. Currently in the bill the goal, or target goal, is going to be 2.5 percent, in terms of target, of making demand go down by 2013, and we have an interim goal of 1 percent that would kick in in 2011, and that is important to provide for in this legislation as a means of expediting the efforts on the part of the electric utility companies to put in place their efforts to reduce demand and to make conservation a real priority.

And third, we provide language in this amendment to deal with the issue of adjusting the figure, the load figure, based on weather conditions and the like, those kinds of extraordinary factors that are beyond the control of the utility company, in order to take that into consideration.

I would urge a "yes" vote on this amendment.

The SPEAKER. Representative Ross, on the amendment.

Mr. ROSS. Thank you, Mr. Speaker.

I believe this is a good amendment, and I intend to support it.

EXHIBIT 16

Mr. PYLE. Thank you, Mr. Speaker.

The SPEAKER. Representative Hutchinson, on the amendment.

Mr. HUTCHINSON. Thank you, Mr. Speaker.

I rise in opposition to this amendment.

Mr. Speaker, I think that this amendment makes absolutely no common sense at this time. The consumers of Pennsylvania are about to experience an increase in the electricity costs over the next couple of years because rate caps will be phasing out in various areas over the next 2 or 3 years, and with that, consumers are going to see their electric rates increased. By passing this amendment, we are going to be piling on the consumers because they will be mandated, although in an indirect way, they will be mandated to pay for these new meters to be installed in their home whether they save on their electric costs or not.

It only makes sense to say smart meters should go to consumers who can save money by installing them. Those who can save by having a smart meter, it would make sense for them to have smart meters in their home. Mandating it across the board mandates that everybody pays whether they save or not, and that just does not make sense.

I am very concerned that we continue to ignore the consumers by making more mandates and increasing their costs, whether it is through mandating the meters, through trying to have some kind of a surcharge, all these things at a time when their electric costs are going up anyways.

So although on a case-by-case basis, smart meters might be a good thing to do, making a 100-percent mandate does not make sense. So I am opposing this amendment.

Thank you, Mr. Speaker.

The SPEAKER. Representative Godshall, on the amendment.

Mr. GODSHALL. I would like to interrogate the maker of the amendment, please.

The SPEAKER. Representative Freeman indicates he will stand for interrogation. Representative Godshall is in order and may proceed.

Mr. GODSHALL. Thank you, Mr. Speaker.

On these smart meters, I understand that PPL has smart meters installed already in their service area. Is that correct?

Mr. FREEMAN. That is correct, Mr. Speaker.

Mr. GODSHALL. Is that in their full service area?

Mr. FREEMAN. To the best of my knowledge, it is.

Mr. GODSHALL. I questioned in our caucus this morning. I am in a PPL service area. If I have a smart meter installed, I do not know it. I have not been told that, nor do I have any idea what it is doing to save me energy. I do not know.

Mr. FREEMAN. I should note that PPL did install smart meters. They would need to upgrade that technology that they installed to make it bidirectional. The benefits being realized by smart meters in the PPL service area really are to the utility at this point, because it allows them to better track theft, to track blackouts, to track out shortages, anything that they could respond to more quickly, which also helps them in terms of their cost savings and cutting down on consumer complaints. At this point in time, they do not offer the optional requirement that we are putting in with this amendment, which would allow the consumer to be able to pick and choose their off-peak periods, if they so choose, in order to run their dishwasher or their laundry to save in terms of their electric utility costs.

So the technology is there in the PPL territory. It needs a slight upgrade to be able to be bidirectional, but the benefits from the utility standpoint of being able to be better on top of blackouts, thefts, shortages is already being accrued to the utility. What we would be able to do with this is to ensure that the customer will now have the option of buying their electricity at off-peak periods and thereby saving considerable dollars.

Mr. GODSHALL. So at this point the benefit of the smart meter supposedly that is on my home is benefiting the company, and I am still not sure how that— I have no knowledge as far as turning this appliance off or buying my electric at whatever. If it is there, it is of little use, and if there is going to be any conservation, it would be on my part, not on the company's part.

Mr. FREEMAN. Keep in mind again, Mr. Speaker, that when PPL—

Mr. GODSHALL. Mr. Speaker, I am having trouble hearing. Just one second.

I am sorry.

Mr. FREEMAN. That is okay.

Mr. Speaker, the meters as installed by the PPL utility really are for the benefit of the company in their current configuration. With this amendment, we would be able to realize the benefits for the consumer as well.

The company understood that this technology was a cost savings for them, because again, they could capture blackouts, they could capture shortages, they could capture cases of theft through this technology. It will require on the part of PPL somewhat of an upgrade in order to be able to realize a bidirectional reporting system, but in doing so, we then afford to the consumer the option of saving money by being able to purchase their electricity at cheaper off-peak periods as opposed to the current system where they are stuck with the averaging out, which is a much higher rate than an off-peak period.

Mr. GODSHALL. As of right now, I believe, in going to PJM (Pennsylvania-Jersey-Maryland Interconnection), you know, they look at the peak demand, and everybody is really charged the same rate when PPL or PECO or whoever is buying electric. It is based on the last amount of energy needed coming in to PJM before it goes out. I still do not understand how that is going to relate to each individual household, you know, when you are talking about millions of households in the system.

And the costs, we had a cost, I believe, from the PUC of $1.2 billion or $1.3 billion to install these around in the State of Pennsylvania, and I do not know if that has taken off because PPL has them already, and you know, if they are in place or not, I have no idea. But I am not sure how each individual home is going to be able to purchase based on the way our electric is being distributed today and the various companies charge, the distribution companies charge for that electric by the PJM, who distributes the electric.

Mr. FREEMAN. Just for the members' information, Mr. Speaker, I would point to the fact that PPL, by their own estimates, has stated that they believe that the cost of installation has paid for itself in terms of the savings that the company has realized, which is good news for the consumer if this becomes a statewide program.

The other factor to be kept in mind, too, is that even if only 1 percent, only 1 percent of all utility customers, all consumers, utilize smart meter technology by purchasing their power at off-peak hours, that reduces dramatically the amount of demand on peak-hour periods of generation. Bringing that number down can result in a 10-percent savings for all utility customers,

whether they use the smart meter technology or not, and the reason for that is the fact that if you can reduce the peak-hour demand, you reduce the period of time when any utility company is forced to buy the most expensive amount of energy. It is at peak periods that energy costs the most. You bring that demand down in those peak periods and you have a cost savings for both the utility company and the consumer. So even just 1 percent of utility customers utilizing smart meter technology, purchasing their electricity at off-peak hours, will result in a 10-percent savings for everyone.

Mr. GODSHALL. Do you have any idea how many people – are there any projections based on how many people would actually use this? Have there been any kind of test markets done showing how many people are going to use this technology and how many people are going to be sitting up there watching this meter on their computer or whatever?

Mr. FREEMAN. Well, there are a couple of factors to be kept in mind, Mr. Speaker, in that regard. One is the fact that a statewide poll that was conducted last year showed that 67 percent of registered Democrats and 62 percent of registered Republicans support smart meter technology and have expressed their support for the concept.

In terms of usage, obviously there has got to become a greater awareness on the part of the consumer that they have this option, and that will become part of the process as the utilities move forward with their procurement plans.

I do recall an article I came across – I do not have it with me on the floor today – but an article that I came across where smart meter technology was utilized in the Province of Ontario in Canada, and it has met with a great response on the part of customers. They have voluntarily bought into the optional plan. They are saving money and energy demand at peak periods is dropping. So at least in the case of Ontario, there shows a real response to it, and I think given the nature of our consumer-oriented society where in the last 10 to 15 years in particular, we have given more and more options of choice to consumers in an array of different utility service areas, it only makes common sense to be able to give them this choice, to give the consumer the opportunity to be able to purchase their power at a cheaper rate. In particular, when you are dealing with those very mundane household chores like doing laundry or washing the dishes in a dishwasher, why run those activities during a period of peak hour when you can save money in an off-peak period?

I would also note, and you will see this in the amendment, there is the option to the consumer of getting the services of a third party so that that third party can guarantee, through the consumer's consent, the ability of purchasing the power through a computer-programmed period. There is no need for the consumer to have to keep watching when the peak hour and off-peak hour is. They could actually purchase that service and have that third party make sure that the purchase of electricity occurs in an off-peak period for whatever the consumer wants that electricity purchased for.

So there are a lot of options that we lay out with this amendment that will benefit the consumer, reduce their utility bill, and save money for both the utility company and definitely for the customer themselves.

Mr. GODSHALL. In this case are we not taking the choice away from the consumer by saying you have to put this in service in your district rather than you may or you have a choice? Are we not saying that you must do it? We are taking that choice away from the consumer, I believe, and I would have no problem with this if we do it on a choice basis, as you used the word "choice" before. We are taking that choice away.

Mr. FREEMAN. Well, I would only point out, Mr. Speaker, that we are requiring the utility company to install the meter, not the customer, and it is the utility company. If we are going to see the kind of cost savings that will reduce the price of electricity for consumers throughout the State, it has got to be done on a statewide basis by the utility companies. To do it piecemeal really would not result in a lot of savings to the individual customer, but if we do it statewide, the economies of scale begin to kick in and you see a savings statewide to all customers.

And as I mentioned before, a very important statistic, if just 1 percent, just 1 percent of utility customers decide that they want to utilize this technology, everyone saves a minimum of 10 percent because peak-hour demand goes down, and that is the most expensive time to purchase electricity both for a utility company and for a customer. So there is a savings for everyone, and they have the choice to either opt in to those smart meters or to not opt in, but at least through this process, we can guarantee that through the economies of scale, that will be there and the savings can be realized by all customers across the Commonwealth.

Mr. GODSHALL. Thank you, Mr. Speaker.

That concludes my interrogation. I would like to make a few comments.

The SPEAKER. The gentleman is in order and may proceed.

Mr. GODSHALL. In looking at this, I totally agree with the gentleman that we need to conserve energy, we need to save energy. I totally agree that smart meters are a big step in doing this. What I am not in full agreement on in any way is that everyone is mandated to, whether they intend to use it or not, whether they know how to use it or not, everyone is mandated, under this legislation, to go ahead with the smart meter technology.

And again, the gentleman mentioned there were polls taken. If there is a poll taken and said, do you believe in the use of smart meters, my answer to that would be yes. I would have absolutely no problem in answering yes, but then if there was a question at the bottom that says you are going to be paying $300 for the installation through your utility bill for this meter and the software that goes with it, I am not sure what the answer would be.

And the other thing I am not quite certain of is why we are addressing this in HB 2200 when the smart meter technology part of it is in HB 2201, which remains in committee. We did not move that out of committee as of 2 weeks ago, I believe it was. It is still there, and the smart meter part of the discussion that we are doing today on the smart meters is in HB 2201, which remains in the Consumer Affairs Committee.

As I said, I agree with the bulk of what the gentleman says. I agree we have got to conserve. I agree on everything else he said, but I am just totally not in agreement that somebody who has no intention of using this technology should be assessed by the utility companies approximately, until it is finished, at least $300 to get this in place in his residence and he is going to be paying for it. It is going to be paid for by the consumer whether they use it or not.

So anyway, those are my feelings on the bill, and you have to vote accordingly.

EXHIBIT 16

The SPEAKER. Representative Ross.

Mr. ROSS. Thank you, Mr. Speaker.

I think that we have gotten engaged in a very technical discussion about the particular technology here, but underneath this, there is a larger issue, and that is that regardless of what we do here today, the Public Utility Commission is moving us toward real-time pricing, real-time pricing basically reflecting the actual demands and costs at any particular time in the day. In order to be able to react to that, we will need technology sufficient to help customers understand and save money on their usage.

It is inherent in the discussion that we ultimately get this technology one way or another. We can dispute about whether this is the best way to go at getting that technology deployed, whether a voluntary or incentive-based program might be better, but ultimately we will need, in order to save money for our customers and reduce peak demand and achieve our goals in that regard, we will need some form of technology that will enable communications with devices within the house and enable us to manage our electric usage in real time in a better way.

So although I recognize some valid points by some of my colleagues here, Mr. Speaker, I will personally be voting in favor of this amendment.

The SPEAKER. Representative McCall.

Mr. McCALL. Thank you, Mr. Speaker.

Mr. Speaker, I would ask the members to support the Freeman amendment, and I would submit to the members that this is one of the most important tools that we will have at our disposal for us to achieve the energy conservation and demand-side management that we need. And there is no question with this technology that if it is implemented and implemented properly, that we will save both the consumers money and we will save the utilities money. The bottom line is that if we give people the tools and the ability to reduce peak demand, that reduction in peak demand reduces everybody's energy bill, not just one-sided. Everybody gets a reduction in their energy bill when we start managing peak demand in this Commonwealth.

And the other thing that it does, when you reduce that peak demand, you reduce the probability that we are going to have to build more generation in this Commonwealth. The reason why we are here today is because of the growth and demand on the energy front, and if we continue to rely on the energy or consume the energy that we are consuming today, 10 years down the road we are going to have to build at least five new generating facilities at exorbitant costs, at costs of like $25 to $30 billion, and they are costs that our consumers are going to have to pay unless we start giving them the tools to manage, and the Freeman amendment does precisely that. It gives people the ability to, voluntarily, by the way – and I think that is the key to this whole debate, is voluntarily – we are going to allow them to decide whether they want time-of-use pricing.

Just like we do with cell phones today – you get free calls on the weekend or cheaper rates in the evening – you could choose on your electric utility bill with smart meter technology time-of-day pricing, because maybe you are not home during the day, but at nighttime or weekends you want to run the dryer and you know it is going to be a cheaper price, so time-of-use pricing is the way for you to go. Or if you are more savvy, and I know a lot of us in this chamber do not have the time, but you could go for real-time pricing. You will have the ability as the consumer – voluntarily, by the way; understand this is a voluntary program – voluntarily you will have the ability to use real-time pricing that will allow you as a consumer to look at your electric meter on an hour-to-hour, minute-to-minute basis to see where energy consumption is and where peak demand is, and you could make that decision as a consumer, looking at what that kilowatt average is on that meter and decide whether or not you want to run the oven, an iron, or whatever else. If you are savvy enough, you will have that ability under this legislation. Or you could be just like me right now. I will just use same-day pricing. That is what most of us use right now. If you do not want to worry about where the peak demand is, just give me a bill with real-time pricing. You have that ability, under this amendment, to just keep your electric bill the way it is.

But I think we need to give our consumers the ability and the tools to make those kinds of decisions to help reduce peak demand. If we reduce peak demand, we can reduce that certain probability that we are going to have to build more generation. And when you consider peak demand, the demand side of this equation, where we are telling the utility companies that the 100 highest hours of any peak demand in a utility's year, which is generally July or August, the hottest, hottest days of the week where air conditioners are running constantly, that we want you to have the ability to reduce that demand and understand what the consequences of that are.

It is not just all of this money that we are spending on those peak-demand prices, but we can actually help air pollution in this State because utilities have to buy energy on the spot market, which is very expensive. They have to turn on facilities that burn maybe not as efficiently as we would all like. There are increased mercury emissions, increased carbon dioxide emissions by virtue of these 100 highest peak hours that utilities have to turn up extra generation.

Mr. Speaker, I think it is extremely important that we give our consumers this necessary tool, help utilities with the issue of reliability because it will help with reliability when you reduce that peak demand. This is a very, very strong component of the overall energy conservation and demand-side management program, and I would certainly urge each and every one of you to look at this hard and vote affirmatively on the Freeman amendment.

The SPEAKER. Representative Bud George.

Mr. GEORGE. Mr. Speaker, we sit here not only as legislators but also as consumers, and there are none of us that do not understand the concept of supply and demand.

Now, for someone to engage in an argument about why nonpeak hours cost more is simply because the utility had to procure, unassured of what was going to be delivered. And when it is not delivered, the truth of the matter is, it is not cliché, that it is literal and it is factual that you are basically paying more for those hours at nonpeak. So the truth is, you are paying more for power you do not use than for power you do use.

Where there are many, many ways, I am sure, that we can get around to where we are going, the most positive way for the utilities and mostly for the consumer is what we are trying to do with this amendment. So in all fact, if you want to eliminate what is now pressing us very hard, this matter of deregulation and rate cap, the best way to do this is to work with one and all and to give these individuals who pay for power they do not use

Exhibit 16

an opportunity to look at a meter and make a decision of when they should turn off this or turn off that.

So really and truly, what better way is it for us to understand supply and demand and the concept of needing to pay for something you do not use than it is to look at your bill every month and understand that now there will be an opportunity for the bill to be somewhat less because you are not going to pay for something you did not use.

I would urge that we would support this amendment.

The SPEAKER. The Chair recognizes the minority leader, Representative Smith.

Mr. S. SMITH. Thank you, Mr. Speaker.

Mr. Speaker, when I first started looking into this issue of the smart meters, there was certainly a component of it that makes a lot of sense, and I think one of the previous speakers touched on that, meaning that it would give individual homeowners or businesses the opportunity to adjust their usage based on that actual time-of-day pricing.

What I think is inconsistent with how this amendment has been put forth, though, and what we are saying here on the floor of the House is that members are saying that this is entirely voluntary. That is not completely accurate, Mr. Speaker, because what this amendment would require is for the electric distribution company to put the cost of a smart meter, distribute it to every user in that service territory, into your rate base, and to install those, whatever is involved in the smart meter, on every meter.

What is voluntary is whether you actually use it or not. What I think the difference is in the way we should be approaching this is to allow the individuals who want to take advantage of smart meter technology, allow them to sign up for it to have it installed, then they engage in the program, as opposed to many of the people who might have the availability of the technology, the cost of the technology, but not the desire to use it.

So, Mr. Speaker, while I certainly support the voluntary utilization of smart meters, what I think is going to be a costly measure that many people will not reap the benefits of is the fact that the smart meters will be put onto your bill. The overall cost of distributing, installing, and setting up that smart meter technology will be put onto every consumer of the Commonwealth whether or not they use it.

If we really want to encourage people to use it, I think we ought to allow them to engage it themselves as opposed to forcing them to pay for something they may not use, and that is really the difference, Mr. Speaker, in what I think is right or wrong with this amendment. While I certainly appreciate the direction it is trying to go, I think the fact that it forces the cost of the meters onto every consumer of electricity in Pennsylvania, I think that is the wrong direction to go and would ask for a vote against the amendment.

Thank you, Mr. Speaker.

The SPEAKER. Representative Saylor, on the amendment.

Mr. SAYLOR. Mr. Speaker, I want to make it clear to everybody, this is a mandate. This is not voluntary; it is a mandate required to use smart meters in Pennsylvania. And while I agree, again, with my colleague on the other side of the aisle that this is all great, the Adams Electric, the Rural Cooperatives of Pennsylvania, have been very effective in using smart meter technology to help lower consumers' bills, the choice is up to the consumer to use that technology and whether they want that smart meter installed on their house. The key is, should we in the General Assembly mandate something on consumers that is going to cost them more dollars in their electric bill?

Every year we hear from people who need more money to pay their electric bills throughout this Commonwealth through LIHEAP (Low-Income Home Energy Assistance Program) and their fuel bills, and we constantly are asking the Federal government to put more money into LIHEAP and other programs similar to that, installation programs and so on and so forth, to help consumers.

This issue in particular should be a choice by consumers, not a mandate by the General Assembly onto an additional cost to electric bills in Pennsylvania. So remember, voting for this amendment, while I think it has great goals and where the gentleman wants to get to is very admirable and where we need to get to at some point in time, it still needs to be a consumer choice, not a General Assembly mandate onto consumers that is going to cost them more in their electric bill.

Thank you, Mr. Speaker.

The SPEAKER. Representative Vitali, on the amendment.

Mr. VITALI. Thank you, Mr. Speaker.

I rise in support of the Freeman amendment. This is truly a voluntary measure for consumers, and I think the interesting thing is, going to the gentleman from Jefferson County's point about increased costs with regard to smart metering, it should be noted that PPL installed smart metering in every one of its customers' homes or businesses while they were under a rate cap. In other words, PPL put smart metering in because it benefited them and saved them money, even when they were in a rate-cap situation, so they could not recover the costs. I think that is an important point to make here, because smart meters do save money. They do save the utilities money, because when there is a power outage, they can get the power up faster. They have less problems with customers' bills. It is a money savings.

Another point, Mr. Speaker, is I sat in on the Consumer Affairs Committee meeting on this issue last week, and one thing I was surprised about is many of the major utility companies in Pennsylvania support smart metering. I thought it would be just the opposite. But utility company after utility company testified they supported this.

Mr. Speaker, listen to this; this is from Reliant Energy: "HB 2201 also directs deployment of smart meters, an initiative Reliant fully supports. In fact, Reliant urges the committee to speed up the implementation of advanced metering...." So you have utility companies supporting smart metering.

Listen to this; this is from PECO: "PECO supports the section of H.B. 2201 that provides for a phased-in deployment of smart-meter technology and the availability of time-of-use rates for all customers. Such offerings will provide customers with tools to help enable them to manage their energy consumption...." The same with EPGA (Electric Power Generation Association). Mr. Speaker, this is something, quite surprisingly, that is also supported by utilities.

The next point. Mr. Speaker, I know some of us are hunters. We respect game land. We are fans of our parks and forests. The problem is, if we do not enact things like smart metering, we put them in jeopardy, and here is the connection. There is a national transmission corridor. Huge swaths of Pennsylvania have been designated by the Federal government to be part of this corridor because of the country's need for power lines, and these power lines, if we increase and increase and increase our demand for electricity, will go through Pennsylvania's wooded areas near the view scapes of our national parks. Smart metering

helps us protect our parks and forests and historical places by preventing the need for additional transmission lines.

The next point. Mr. Speaker, consumers need to be aware that rate hikes are coming. In the PECO service area, for example, PECO experts predicted that rates could go as high as 26 percent between 2010 and 2011. Utility rates could increase as high as 26 percent. We need to do something about that. The Freeman amendment does something about that by dealing with reducing demand. It is a very basic economic principle that price is a function of supply and demand, and one thing Freeman does is keep down the lid on the demand for electricity, so when these rate caps come off in 2011, our constituents are not going to be paying these big predicted rate increases because we have helped reduce demand. That is why we are saving consumers money if we can enact measures that will reduce demand.

Mr. Speaker, finally, smart metering helps consumers who do not opt for the time-of-use rates in a number of ways. One, even if you do not opt in, the power goes out, if you have a smart meter in your home, even though you did not opt in to the time-of-use rates, your utility company knows that; it can get your power up much more quickly. So even if you do not use the time-of-use rating, having a smart meter in your home will help you.

Also, Mr. Speaker, another reason why it is necessary to do this in a comprehensive way, as the Freeman bill does, is you can capture the economies of scale if all these meters are installed in a systematic program instead of having an installer go out one by one as people volunteer for this.

Mr. Speaker, for all these reasons I urge the adoption of the Freeman amendment. Thank you.

The SPEAKER. Representative Benninghoff, on the amendment.

Mr. BENNINGHOFF. Thank you, Mr. Speaker.

I wish to see if the maker of the amendment would stand for a couple of questions, please?

The SPEAKER. The gentleman, Representative Freeman, indicates he will stand for interrogation. Representative Benninghoff is in order and may proceed.

Mr. BENNINGHOFF. Thank you.

I was just curious if the maker could tell me how many other States have done this and whether their program was a mandate.

Mr. FREEMAN. I cannot say how many States have done it. I know that the Province of Ontario in Canada has done this.

Mr. BENNINGHOFF. All right. Well, my follow-up question was going to be, obviously, from an economic perspective. I am curious if we know of any savings, but if no other State in the Commonwealth has done that, then I will assume that there are no savings to those States.

My second question concerns, if people in the Commonwealth are mandated to put a meter in their home and prices fluctuate from time to time, is the potential there for a company or a supplier to absorb or inherit a windfall of money or revenue or proceeds? I just cannot imagine that the company is going to be adjusting cost every time that it is adjusted for them back to the consumer. So therefore, I would think that they could inherently see a windfall of profits, as we see oftentimes when the gas pump prices are going up every other day and we know the fuel in the ground has already been paid for a week in advance. Will that not be the same case in this scenario?

Mr. FREEMAN. No, it really will not, and I will tell you why, Mr. Speaker. Keep in mind that the utility company has to purchase energy at various times of the day to meet demand. If that demand is being purchased during peak hour, when you are at the maximum of the system, it is going to be more expensive energy. So we realize two savings with this legislation with my amendment. One is for the consumer – for the customer. They have the opportunity, if they want to opt in to this optional program, to be able to choose their electricity at an off-peak time when it is cheaper than what it is at peak times.

Currently what we get is an averaging of the expensive and the less expensive. So when you pay your electric bill, even if you were to be someone today who runs their electricity at off-peak periods – you are doing it at a time when the actual cost of electricity is cheaper – you are not realizing a savings. You might be doing the utility company a favor, you might be doing the environment a favor, but you are not realizing a savings, because the average cost, or the cost, rather, that you will pay is going to be an averaged-out cost of high peak and low peak.

So even though you are someone who is being conservation-minded, thinking about the environment, thinking about the purchase of electricity, under the current system, you will not realize a savings. Under this amendment, you have the option of entering into that program to realize a savings by buying your electricity at off-peak periods. That reduces the cost for everyone. Again, I go back to the statistic that if just 1 percent of all utility customers were to buy into the optional purchasing proposal, it would be a cost savings for everyone of 10 percent, because it reduces peak-hour demand.

Now, obviously that also helps the utility company, because they do not have to purchase as much energy during a high-peak period, but it is not going to be a windfall situation because they have to justify their rates, obviously. If they do not, it causes the possibility of going to a different utility company. So there is not going to be a windfall of savings in that regard.

Mr. BENNINGHOFF. I appreciate your thorough answer. I think you and I share some obviously common ground where we want to see energy efficiency and energy savings.

Again, under your answer, I am still having difficulty understanding why a company would not try to purchase the bulk of their energy at the lowest cost and know what time period that is, how that subsequently is not going to be sold to me at a higher peak time, and thus I pay a higher rate than what they may have purchased at a lower peak time. And as a customer, how am I going to know that on my bill?

Mr. FREEMAN. Well, once you have the smart meter technology, you will be able to either choose by yourself or by contracting with a third party who can monitor it for you as to when the off-peak periods are. You will know that information, and as such, you will be able to make an informed decision as to when to purchase your electricity.

Maybe you want to run your laundry in the middle of the night when the cost of electricity is down considerably because of it being an off-peak period. Maybe you will set your dishwasher to kick in in the middle of the night, again, when electricity is cheaper. So you will have that information through the smart meter technology, and that will enable you to be able to make smart choices and to reduce your electric bill.

Mr. BENNINGHOFF. And the last question, if you would.

I as a consumer, if this is voluntary, do I have the ability to acquire one of those meters right now? If this is the best thing to come down the road for me and it is going to have the

opportunity for me to save money, can I go and get a meter right now and have it installed in my house?

Mr. FREEMAN. Because of the simple reason that without this amendment, there is no requirement for the utility company to recognize your personal smart meter. You might be able to know when you are purchasing, but keep in mind, under current procedures, utility companies do not give you rates at a cheaper time of day or a more expensive time of day. The only way they bill you is on an average of the overall cost of the electricity.

So unless we can put into place my amendment which will require them to have the optional buy-in program where you can purchase your electricity at a cheaper rate, you will never be able to realize that savings on your own by going out and purchasing a smart meter. You might be able to monitor it, you might be able to see when your rates are higher or lower, but there is nothing that is going to require the utility company to charge you based upon your usage. It requires this amendment to achieve that and to, in essence, require the utility company to give you the savings that they are realizing by you using it at an off-peak period.

Mr. BENNINGHOFF. Thank you. And if I may clarify one last question on that.

Mr. FREEMAN. Sure.

Mr. BENNINGHOFF. So I understand, the part that is actually voluntary is not the installation of the meter statewide by your amendment; it is the billing process by the companies—

Mr. FREEMAN. Well, I would say that—

Mr. BENNINGHOFF. —how I am going to be billed. If this passes, I am going to get a meter whether I want it or not. The only option is going to be on the rates of energy that I would be paying for. So it is the billing that is the optional part?

Mr. FREEMAN. Yeah. I would say that in order for everyone to realize the savings of smart meter technology, it has to be done as a requirement statewide because of economies of scale. But you are right, what we are requiring here is the installation of those meters.

And keep in mind, utility companies change their meters, roughly 5 or 10 percent of their meters, every year. So in a 10-year period of time, whether you want it or not, you as the customer are going to have to pay for the installation currently of a new meter. The difference is, the current meters they install every 10-year cycle is a dumb meter. We are requiring a smart meter. So you will have the opportunity to then buy into that optional plan in which you can purchase your electricity at a cheaper period of time and realize the savings in your electric bill.

Mr. BENNINGHOFF. Thank you.

Mr. Speaker, a quick comment on the amendment itself.

The SPEAKER. The gentleman is in order and may proceed.

Mr. BENNINGHOFF. Thank you, Mr. Speaker.

And again I thank the maker of the amendment for his time in answering those questions. I guess my reservation, obviously, is do we want a statewide mandate? Do we want the government telling you that you have to have a meter put in your property? I think the majority of us appreciate the fact that we want to be more energy conscious, have more efficient appliances, and I think a lot of us are moving that way.

I just struggle with the fact that there is no other State in the Commonwealth that has done this in the past, although I would like to see Pennsylvania obviously be a leader. It gives me some reservations that if this technology is so accurate and so helpful and such a cost reduction savings for the consumer, why is it not being used unilaterally across this great nation? I would ask the members to keep that in mind.

I think it is important that we are smart about our energy use, but I also think we have to think about what government's role is in mandating such a thing.

Mr. Speaker, thank you very much for your time.

The SPEAKER. Representative Bennington, on the amendment.

Ms. BENNINGTON. Thank you, Mr. Speaker.

If Pennsylvania does nothing to reduce its electricity consumption, our State will need to make room for at least 12 new power plants.

Opponents of this amendment talk about the cost to the consumer. All told, not passing Representative Freeman's amendment and HB 2200 will cost $17 billion in capital, fuel, and other costs associated with meeting increases in electricity demand. Smart meters and Representative Freeman's amendment will help reduce this demand.

Again, in response to the queries regarding the cost of this technology, I ask, what is the cost of clean air to our children? What is the cost of clean water to our children? When they ask us, should we tell them that it costs too much? Please vote "yes" on the Freeman amendment.

Thank you, Mr. Speaker.

The SPEAKER. Representative Gabig, on the amendment.

Mr. GABIG. Thank you, Mr. Speaker.

Would the maker of the amendment stand for brief interrogation?

The SPEAKER. The gentleman, Representative Freeman, indicates he will stand for interrogation. Representative Gabig is in order and may proceed.

Mr. GABIG. Thank you, Mr. Speaker.

I have been listening to the debate, and I need to get a few answers that I have not heard yet.

How much would it cost a customer to have a smart meter installed? What would be the cost of that?

Mr. FREEMAN. Excuse me, Mr. Speaker. Are you referring to the actual price of a smart meter? Is that what the question is?

Mr. GABIG. Well, I think there is a cost— As I understand it, there is a cost of the meter and a cost of installation, and so I was trying to find out what that cost would be to an electric customer.

Mr. FREEMAN. Now, this question came up in the Environmental Resources and Energy Committee when we discussed this issue previously. It is difficult to ascertain an actual cost for a variety of reasons. Let me explain, if I may.

If you are looking at the actual cost of a meter, it could be as high as $240, or it could be $175, as was the case with PPL. But what you have to figure in to the actual costs, what will be realized, is the fact that the utility company makes considerable savings with smart meter technology. By installing the smart meters, they will realize savings which will bring the actual cost down dramatically for the actual customer. So in fact, in the case of PPL, they felt that the cost of the meters paid for themselves simply by being able to use this technology to be able to get a hold of outages, blackouts, theft of electricity, to be able to lower the amount of customer complaints, because with this technology, they know how to respond quickly before the complaints overload the system. All of that brings the cost down dramatically.

And one final point, if I may, to answer the gentleman's question, and that is the fact that the cost itself is not going to be

that significant when you think of the overall savings, and we have to think long term. If you are thinking about trying to reduce the amount of electricity that is consumed in this Commonwealth, that is used in this Commonwealth, if you are thinking about saving energy and saving money for the consumer, you need conservation technology like smart meters to bring it down. The actual cost of the meter will be considerably less because of economies of scale, because of the savings that will be realized by the consumer, and because of the simple fact that the utility will only be able to recoup that percentage of the cost that is an actual cost for them. Whatever savings they realize they will not be able to charge the customer for, and the savings to them is considerable.

Mr. GABIG. Wow, what an answer. Now, if I understood the answer, I think the gentleman said between $175 and $240 for a smart meter, for the cost of the meter. Did that include per customer? Does that cost of the meter, the installation, does that include installation or just the cost of the physical meter?

Mr. FREEMAN. Again, with all due respect to the gentleman, Mr. Speaker, it is mixing apples and oranges. That is not the actual cost under this amendment for the simple reason that you have economies of scale which bring that price down, and you have cost savings by the utility which are not borne by the customer. Since the utility actually realizes cost savings under this amendment, it is nowhere near $175 for the meter. When you stop and realize the exact cost savings that occur to the company as well as to the consumer, it is far less.

It is difficult to give the gentleman a precise figure, but I can guarantee the fact that it is considerably less based on the fact that there are cost savings for the utility and obvious savings for those customers who wish to participate in the optional program as well as all utility ratepayers who will realize the benefit from even a small percentage of those customers opting to purchase their electricity at off-peak periods.

Mr. GABIG. All right. I understood that from the gentleman's first response to the question, but if I understood the earlier advocacy of this amendment, it said that the big corporations, the utility companies, are not going to be paying for this installation. It is going to be borne by the customer. So the gentleman keeps bringing up in his responses matters dealing with the utility – it may be savings down the road or not. I am just talking about how much it is going to cost the electric customer to have this installed, and I do not know why it is such a State secret. It is going to cost so much money to go on an electric bill, and I think, to respond to the gentleman's answer, I think we have a duty as the House to tell the people in Pennsylvania how much it is going to cost them. This might be the greatest thing since sliced bread, as the gentleman seems to think. I am not debating that right now. All I want to know is how much we are going to be charging? How much does it cost to do this? And you said it has been done in Ottawa or someplace in Canada—

Mr. FREEMAN. Ontario.

Mr. GABIG. Ontario; I am sorry, and it has also been done by other utilities. We heard that Adams Electric has done it. So how much is it going to cost them to put these meters in? That is the simple question. There should be a dollar figure. If it is not $175 to do it, we should have at least a range that we can tell people. Does the gentleman have that information, after all these hearings he has been to, all this research that he has done, all the investment that he has looked at? I just want to know how much it is initially costing a customer in Pennsylvania to put one of these in their house or in their business. That is a simple question. I hope I can get a simple response from the gentleman.

Mr. FREEMAN. Unfortunately, Mr. Speaker, not all complex issues can be boiled down to a simple answer. That is why they are complex issues.

However, to give the gentleman greater clarity, there is a reasonable and prudent standard within the legislation, within the amendment, rather, and the PUC will determine how much the utility can recoup their costs for on a reasonable and prudent basis. They can only recoup the net costs. Any savings they realize they cannot charge the consumer for.

And I think there is a bit of a misunderstanding on the part of the gentleman, Mr. Speaker, when the gentleman said that this is a cost to the—

Mr. GABIG. Well, Mr. Speaker, if I could rephrase the question since it was—

Mr. FREEMAN. Just let me answer—

Mr. GABIG. —complicated.

The SPEAKER. The gentlemen will suspend.

The Chair will remind the gentleman to ask a question and wait for the responder to give his answer and request that the gentlemen not speak over each other in interrogation.

Mr. FREEMAN. Thank you, Mr. Speaker.

Just to finish my—

Mr. GABIG. Thank you, Mr. Speaker.

If I could just—

The SPEAKER. The Chair will ask the gentlemen to suspend.

The Chair will ask the gentleman, Mr. Gabig, to ask his question and then ask Representative Freeman to respond.

Mr. GABIG. Thank you, Mr. Speaker.

I am going to ask it one more time. Three times can be good, and three times you can be out. Is it fair to say that the gentleman cannot tell the people of Pennsylvania how much it is going to cost them to put these meters in their homes and businesses? Is that fair to say? You just do not know?

Mr. FREEMAN. In answer to your question, it is the PUC which determines the cost based upon a reasonable and prudent decision, and it is wrong for the gentleman to insist that somehow this is a cost that gets directly put at the door of the consumer. It is the utility that has to pay for it. They then have to go to the PUC, as they do for the installation of current meters.

Any expense by a utility in terms of equipment has to go before the PUC to recover the costs. If you expend money as a utility, that gets passed on to the consumer, but under this amendment, there is a savings to the utility company which dramatically brings down the cost of installation, and on top of that, there is a savings to the customer by having the option of purchasing cheaper electricity.

These meters more than pay for themselves. That is the bottom line, and any customer will have to pay for the installation of a dumb meter or a smart meter. If you pay for the installation of a smart meter, you save money. That is the bottom line.

Mr. GABIG. All right. I appreciate the gentleman's candid response to those questions.

Mr. Speaker, I have another question that I do not know if I am going to get any more of a response to or not. But in my district, there are apartment buildings, apartment buildings, where people live in apartment buildings, and there are senior

Exhibit 16

centers where people live in individual, sort of apartment-style units. And so what I am wondering, is each person that lives in an apartment going to be mandated under this Freeman amendment to get a meter or not? Or if there is an apartment building or a townhouse that has many different units in it that has one meter currently, will each individual apartment dweller in such a situation be required to get one of these meters?

Mr. FREEMAN. With all due respect to the gentleman, Mr. Speaker, we are making the mandate on the utility company to install smart meters. The individual customer does not have to go out and purchase a smart meter. That requirement is being borne by the utility. They have to replace their meters every 10 years anyway. They can either replace it with a dumb meter that does little to save energy and save dollars for the consumer, or we can, through this amendment, require them to purchase and install smart meters that save money for the consumer and the utility company by cutting down on the amount of energy that is consumed.

Mr. GABIG. So if I understand the gentleman's response, it will be in the power of the utility company to decide whether or not they are going to require each person in an apartment building or not to have a meter or not. It will be in their power to decide whether to do that and whether to pass that cost on to their customers. Is that correct?

Mr. FREEMAN. No, Mr. Speaker. It is not the power—

Mr. GABIG. There is no protection in this legislation—

Mr. FREEMAN. Mr. Speaker, can I please answer the question?

The SPEAKER. The Chair will again remind the gentlemen not to speak over each other.

Mr. FREEMAN. I would like to be able to—

Mr. GABIG. I thought he was done when he said no, Mr. Speaker.

The SPEAKER. The gentleman will suspend. The gentleman is not in order. Representative Freeman will respond.

Mr. FREEMAN. Thank you, Mr. Speaker.

It is not the power of the utility company; it is a requirement in our conservation efforts here in this Commonwealth with this amendment that they install smart meters.

A utility company has the requirement to have meters for all of its customers. They have to replace those meters every 10 years because they wear out. Now, they can either put in a dumb meter that does not allow the customer to choose what time of day they wish to purchase their electricity, either at a cheaper off-peak period or at a more expensive high-demand period, or through this amendment, we can require those utility companies to utilize smart meter technology to save money in terms of the purchase of electricity for them and, most importantly, for the customer. If we wish to save money for the customer, you need smart meter technology, and it has to be done on a statewide basis if you are to realize economies of scale. It is a basic point of economics.

Mr. GABIG. Thank you, Mr. Speaker.

That concludes my attempts to question the maker of the amendment. If I might speak on the amendment.

The SPEAKER. The gentleman is in order and may proceed.

Mr. GABIG. The problem I am having with the amendment is I think if I were called on the telephone and asked, are you for a smart legislator or a dumb legislator, are you for a smart card or a dumb card, are you for a smart meter or a dumb meter, I would probably answer, I am for the smart legislator, the smart card, the smart meter. But if they start saying, well, for the smart legislator you are going to pay five times more money and for the dumb legislator you are going to pay five times less money, for the smart card you are going to pay five times more money and for the dumb card you are going to pay five times less money, for the smart meter you are going to pay we do not know how much more money because we will not tell you, but it is not going to be the utilities that pay for it because we took care of them in our amendment; they are taken care of in this Freeman amendment. The big utility companies and corporations, they are all right with it; they support this, but the customer, well, you are going to pay the freight for this mandate, this State mandate.

You know, I think some of you know I was in the Navy before I came here to the House, and we were under orders. I was overseas, I can remember, and the command said, hey, we are running out of water. I was stationed in Guantanamo Bay, Cuba – there has been a lot in the news about it – and they did not have fresh water down there. They had to desalinate the water, and the Army would come with their big desalination things and they would have to take the salt out of the water so that we could use it. And we would start running out of water, and they would come down and say, you cannot wash your clothes between such and such a time and such and such a time; you can only do it, you know, midnight to 2 o'clock in the morning. You can only wash your clothes on Tuesdays and Thursdays; you cannot do it Wednesdays. And there were other regulation and command and control items that we had to abide by. And I was in the Navy; I said "yes, sir" and saluted. Some people got in trouble for washing their clothes on the wrong day. That is what this is. This is a mandate to people saying you have to buy this whether this is good for you or not good for you; we are telling them what to do.

And it is going to cost them money. The average apartment person, their electric bill is, I do not know, when I used to live in an apartment it was $30, maybe, a month or something like that. It was not that much money. The gentleman would not answer the question. I do not know what the answer is. I heard different figures. I heard it could be up to $300 to install one of these smart meters, for the cost of the meter and to install it. So somebody is paying $30 a month, or a senior citizen that is on a fixed income, to have that passed on by the big utility company to pay for this because somehow it is going to, in the long run, be a cost benefit to us. Now, maybe it is, and maybe these things are great, but it should not be forced upon people to have to do it who live on fixed incomes. It should be something that is voluntary and that the market drives.

I think that the gentleman from York, Stan Saylor, mentioned that Adams Electric Co-op has a similar program, but it is not forced on people; it is a voluntary program, and they can use the market to decide whether they want to do it or not.

We also have heard that you have to have Internet capability to do this, and in rural areas – I know in the big cities and other areas I am told that there is Internet capability. I do not know if that is true in all cities across Pennsylvania. But in some of the areas that I represent, they do not have that out there yet, so they are going to be forced to buy this $300, this cost will be passed on to them, and they will not get the benefit of it. They will not get the benefit of it.

So I appreciate the intent of this amendment. I think there are some serious questions, unresolved questions, that have not been satisfactorily dealt with, and that is why the gentleman, who is a very good friend of mine, by the way, was unable to

CALENDAR CONTINUED

BILLS ON THIRD CONSIDERATION

The House proceeded to third consideration of **HB 2200, PN 3218**, entitled:

An Act amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, providing for recovery of certain labor relations expenses; further providing for definitions; providing for adoption of energy efficiency and demand-side response; and further providing for duties of electric distribution companies.

On the question,
Will the House agree to the bill on third consideration?

Mr. **GEORGE** offered the following amendment No. **A05845:**

Amend Sec. 3 (Sec. 2806.1), page 9, line 19, by striking out "(c)(6)(iv)" and inserting
(c)(6)(iii)

On the question,
Will the House agree to the amendment?

The SPEAKER. The Chair recognizes Representative George on the amendment.

Mr. GEORGE. Mr. Speaker, this is a technical amendment that just makes a technical change. It does not change the bill in any way. I ask that we put that in the bill.

The SPEAKER. Will the House agree to the amendment? Representative Ross.

Mr. ROSS. Thank you, Mr. Speaker.

Although I think this is an excellent amendment, because it exactly mirrors a provision that I suggested, is it not true that we need to suspend the rules in order to do this on third?

The SPEAKER. This is a technical amendment. It does not require a suspension of the rules.

Mr. ROSS. In that case, I urge a positive vote on this excellent amendment.

The SPEAKER. The Chair thanks the gentleman.

On the question recurring,
Will the House agree to the amendment?

The following roll call was recorded:

YEAS–198

Adolph	Gabig	Marshall	Ross
Argall	Galloway	Marsico	Rubley
Baker	Geist	McCall	Sabatina
Barrar	George	McGeehan	Sainato
Bear	Gerber	McI. Smith	Samuelson
Belfanti	Gergely	McIlhattan	Santoni
Benninghoff	Gibbons	Melio	Saylor
Bennington	Gillespie	Mensch	Scavello
Beyer	Gingrich	Metcalfe	Schroder
Biancucci	Godshall	Micozzie	Seip
Bishop	Goodman	Millard	Shapiro
Blackwell	Grell	Miller	Shimkus
Boback	Grucela	Milne	Siptroth
Boyd	Haluska	Moul	Smith, K.
Brennan	Harhai	Moyer	Smith, M.
Brooks	Harhart	Mundy	Smith, S.
Buxton	Harkins	Murt	Solobay
Caltagirone	Harper	Mustio	Sonney
Cappelli	Harris	Myers	Staback
Carroll	Helm	Nailor	Stairs
Casorio	Hennessey	Nickol	Steil
Causer	Hershey	O'Brien, M.	Stern
Civera	Hess	O'Neill	Stevenson
Clymer	Hickernell	Oliver	Sturla
Cohen	Hornaman	Pallone	Surra
Conklin	Hutchinson	Parker	Swanger
Costa	James	Pashinski	Tangretti
Cox	Josephs	Payne	Taylor, J.
Creighton	Kauffman	Payton	Taylor, R.
Cruz	Keller, W.	Peifer	Thomas
Curry	Kenney	Perry	True
Cutler	Kessler	Petrarca	Turzai
Daley	Killion	Petri	Vereb
Dally	King	Petrone	Vitali
DeLuca	Kirkland	Phillips	Vulakovich
Denlinger	Kortz	Pickett	Wagner
DePasquale	Kotik	Preston	Walko
Dermody	Kula	Pyle	Wansacz
DeWeese	Leach	Quigley	Waters
DiGirolamo	Lentz	Quinn	Watson
Eachus	Levdansky	Ramaley	Wheatley
Ellis	Longietti	Rapp	White
Evans, D.	Mackereth	Raymond	Williams
Evans, J.	Maher	Readshaw	Wojnaroski
Everett	Mahoney	Reed	Yewcic
Fabrizio	Major	Reichley	Youngblood
Fairchild	Manderino	Rose	Yudichak
Fleck	Mann	Rock	
Frankel	Mantz	Roebuck	O'Brien, D.,
Freeman	Markosek	Rohrer	Speaker

NAYS–0

NOT VOTING–0

EXCUSED–5

Bastian	Hanna	Keller, M.	Perzel
Donatucci			

The majority having voted in the affirmative, the question was determined in the affirmative and the amendment was agreed to.

On the question,
Will the House agree to the bill on third consideration as amended?

The SPEAKER. The House will be at ease.

The House will come to order.

On the question recurring,
Will the House agree to the bill on third consideration as amended?
Bill as amended was agreed to.

The SPEAKER. This bill has been considered on three different days and agreed to and is now on final passage.

(Bill analysis was read.)

The SPEAKER. The question is, shall the bill pass finally?

Exhibit 17

The Chair recognizes Representative Ross.

Mr. ROSS. Thank you, Mr. Speaker.

Back in 2004 when we passed the Alternative Energy Portfolio Standards, many of us were concerned about the effect that that would have in the long run on electricity pricing when the price caps came off. And over the next couple of years, I and others worked very hard on an idea to try and bring conservation and demand-side management forward as an alternative to reduce the cost of electricity when the price caps came off. A good deal of us worked on that and we made some significant progress on that over the last year or so, and I am pleased to see that much of what I was looking for in my legislation is contained in this bill as it currently is before us.

I am, of course, also disappointed, because it could be better. I am disappointed that we did not have more conversation, despite my efforts to reach across the aisle. And I would say that we have many speeches about bipartisanship, and I think they are important. But we have to also, in addition to having speeches about bipartisanship, we actually have to have conversations. We have to talk to each other, and I am disappointed that we did not have those conversations until after the voting was taken yesterday.

After the voting is taken, it is really too late. The conversations need to be had previous to that, when the language can be improved. It does not matter whose name is on this bill. When it goes to the Governor's desk, the names come off the bill and the language is left, and that is why it is important to improve the language, not with just one-half of the body but with the whole body, with every intelligent member participating fully and involved in the discussions.

I am hoping we are going to change. I am hoping we are going to start talking to each other in a useful way so that we can improve the quality of the legislation that we give to the public. It is important for the public, and I think that this is a good time to start making that change.

I urge a positive vote on this, and I urge all the members, Republicans, Democrats, Mr. Speaker, to work together more effectively in the future.

The SPEAKER. Representative Hutchinson.

Mr. HUTCHINSON. Thank you, Mr. Speaker.

Mr. Speaker, I rise in opposition to passage of HB 2200, and let me tell you why.

I believe that in its original, unamended form, before it came to the House floor, there were a lot of redeeming qualities in the bill. It did promote conservation, and that is a laudable goal for Pennsylvania, to try to conserve energy use. However, by the amendments passed yesterday, which mandated universal smart meters across Pennsylvania, that is a fatal flaw that makes this bill a bad idea for Pennsylvania. It is bad for the consumers of Pennsylvania who will have to pay for those smart meters, whether they save on their electric bills or not. It makes no sense whatsoever to force people to pay for those smart meters and then, in addition, still pay higher and higher utility bills.

It was said yesterday that if only 1 percent of the people used smart meters, we would have huge savings in energy use in Pennsylvania, and, Mr. Speaker, I agree with that statement. But my idea is, let us get the smart meters only to those 1 percent of the people and get this same savings in energy use. That is the smart way to move forward to promote energy conservation, to use technology like smart meters in a targeted and commonsense way instead of a mandated, across-the-board consumer tax – that is what it is, a couple hundred dollars per person – that will have to be paid to pay for these smart meters.

So after adding that fatal flaw to this bill, I think it is incumbent upon everyone in this chamber to vote against HB 2200, and I ask them to join me in that vote. Thank you, Mr. Speaker.

LEAVE OF ABSENCE

The SPEAKER. The Chair recognizes the minority whip, who requests that Representative Sam ROHRER be placed on leave for the remainder of the day. The Chair sees no objection. Leave will be granted.

CONSIDERATION OF HB 2200 CONTINUED

The SPEAKER. The Chair recognizes Representative George.

Mr. GEORGE. Mr. Speaker, again, I echo the gentleman, Mr. Ross—

The SPEAKER. If the gentleman will suspend.

The Chair will ask the members to please take their seats and quiet their conversations. Conferences will break up. Conferences will break up. The House will come to order.

Representative George is in order and may proceed.

Mr. GEORGE. Mr. Speaker, do you think there is a possibility they do not want to hear what I have to say?

The SPEAKER. I do not think that is a possibility, Representative.

Mr. GEORGE. Well, as I said at the start, I admire Representative Ross's courage to do the best thing for all whom we serve, regardless of principle or party, and I commend him for his positive approach to what we should do for our constituents in that HB 2200 gives utilities and consumers the framework that they must have to counter the looming increases in generation charges.

In a nutshell, HB 2200 institutes rewards rather than penalties for conserving energy. Under HB 2200, utilities would be required to reduce overall output by 2 1/2 percent and peak demand, when energy prices are at their highest, by 4 percent.

HB 2200 would direct the State Public Utility Commission to establish the criteria for implementing conservation and efficiency programs and to select a program administrator to oversee the program's implementation within each utility. Under HB 2200, programs would be designed to benefit all classes of ratepayers – all classes – from the homeowners and the renters to the largest of industrial users. For the utilities, HB 2200 would establish a clearly defined process for financial compensation for meeting performance benchmarks.

Other States have realized – hear this – other States have realized a $2 savings for constituents for every dollar invested by the utilities in efficiency measures. Currently, however, Pennsylvania ranks 44th among States in per capita spending on energy efficiency for utilities.

My colleagues, we thank you for your consideration of HB 2200. Thank you, Mr. Speaker.

The SPEAKER. Representative Preston.

Mr. PRESTON. Thank you, Mr. Speaker.

HB 2200 really takes us into the term of 2000. Last year when I had a hearing, I had a person who was involved in marketing and advertising and had talked to me about that she

SB 1107 (Pr. No. 2472) (Rereported) *(Concurrence)*

An Act amending Titles 23 (Domestic Relations) and 51 (Military Affairs) of the Pennsylvania Consolidated Statutes, further providing for modification of existing custody orders; and providing for protection of deployed members of the Pennsylvania National Guard and reserve components in child custody arrangements.

SB 1504 (Pr. No. 2454) (Rereported) *(Concurrence)*

An Act providing for the highway capital budget project itemization for the fiscal year 2008-2009 to be financed from current revenue or by the incurring of debt.

CONSIDERATION OF CALENDAR RESUMED

BILL ON CONCURRENCE IN HOUSE AMENDMENTS TO SENATE AMENDMENTS AS AMENDED

SENATE CONCURS IN HOUSE AMENDMENTS TO SENATE AMENDMENTS AS AMENDED

HB 1096 (Pr. No. 4527) – The Senate proceeded to consideration of the bill, entitled:

An Act amending the act of November 10, 1999 (P.L.491, No.45), known as the Pennsylvania Construction Code Act, further providing for definitions; establishing the Uniform Construction Code Review and Advisory Council; and further providing for revised or successor codes and for training of inspectors.

On the question,
Will the Senate concur in the amendments made by the House to Senate amendments, as further amended by the Senate, to House Bill No. 1096?

Senator PILEGGI. Mr. President, I move that the Senate do concur in the amendments made by the House to Senate amendments, as further amended by the Senate, to House Bill No. 1096.

On the question,
Will the Senate agree to the motion?

The yeas and nays were required by Senator PILEGGI and were as follows, viz:

YEA-50

Armstrong	Fontana	O'Pake	Tartaglione
Baker	Fumo	Orie	Tomlinson
Boscola	Gordner	Piccola	Vance
Browne	Greenleaf	Pileggi	Washington
Brubaker	Hughes	Pippy	Waugh
Corman	Kasunic	Punt	White, Donald
Costa	Kitchen	Rafferty	White, Mary Jo
Dinniman	LaValle	Regola	Williams, Anthony H.
Earll	Logan	Rhoades	Williams, Constance
Eichelberger	Madigan	Robbins	Wonderling
Erickson	Mellhinney	Scarnati	Wozniak
Ferlo	Mellow	Stack	
Folmer	Musto	Stout	

NAY-0

A constitutional majority of all the Senators having voted "aye," the question was determined in the affirmative.

Ordered, That the Secretary of the Senate inform the House of Representatives accordingly.

THIRD CONSIDERATION CALENDAR RESUMED

BILLS ON THIRD CONSIDERATION AND FINAL PASSAGE

HB 2200 (Pr. No. 4526) – The Senate proceeded to consideration of the bill, entitled:

An Act amending Title 66 (Public Utilities) of the Pennsylvania Consolidated Statutes, further providing for director of operations, secretary, employees and consultants; repealing provisions relating to office of trial staff; further providing for bureaus and offices; providing for other bureaus, offices and positions; further providing for electric utility definitions; providing for energy efficiency and conservation program and for energy efficiency and conservation; further providing for duties of electric distribution companies and for market power remediation; and providing for procurement, for additional alternative energy sources and for carbon dioxide sequestration network.

Considered the third time and agreed to,
And the amendments made thereto having been printed as required by the Constitution,

On the question,
Shall the bill pass finally?

The PRESIDENT pro tempore. The Chair recognizes the gentleman from Bucks, Senator Tomlinson.

Senator TOMLINSON. Mr. President, I rise to ask for support for House Bill No. 2200 as amended by the Senate. I think this is very, very important legislation for our consumers today who consume power and energy in Pennsylvania. House Bill No. 2200 is, I think, a large step forward. The Governor of the State of Pennsylvania, Ed Rendell, has been a leader in a new energy policy, and this legislation contains many of those items in there.

It includes demand-side reduction, conservation, that I think is going to help the consumer, in the long run, to reduce the demand on power. We are requiring a reduction of 3 percent by the year 2013 and 4 1/2 percent for peak power, and I think that is extremely important as we go forward with an energy policy, Mr. President. It also contains language in there that we will have smart meters. It is not mandated, but it allows for the deployment of smart meters through a depreciation process, through new home construction process, and through the depreciation of 15 years, and for anyone who wants to purchase a smart meter which they feel will help them manage their electric load better.

I think probably the most important reason that we do this is the procurement language. As many of you know, we fought, in the last few months, trying to get mitigation for rate caps coming off. So that is a year or 2 away in some instances, and I think we have more time to fight that battle, but something that I think will help the consumer immediately will be the fact that we have new procurement standards. We no longer are going to use market pricing. We are going to use best pricing or least price for the consumer, and I think that helps the consumer in the end, when utilities are able to go out and compete for power as they purchase it for the distribution company.

I think that by offering these different tools and giving some latitude, people are not locked into buying power in 1 day for the rest of their contracts. Many of you are aware of the Pike County

Exhibit 18

situation, where after the episode of Katrina, Pike County and that utility up there were forced to buy their power the day after the hurricane, and of course, the rates were extremely high. Under our provisions here for procurement, we would be able to prevent that. And so for that reason, I think that would be a huge step forward in trying to bring electric rates down for the consumers in Pennsylvania.

I am disappointed. I fought hard to try to get mitigation. I do not think that is possible now, but I do not think that chapter is closed. I think that we are going to stand here and fight hard in these next 2 years and fight for mitigation or fight to make sure that any rate increases when the caps come off are not onerous for our consumers. But I think it is important today that we step forward and take these steps when it comes to demand-side reduction, to energy conservation, and to procurement, to make sure that we are moving forward with a very sensible energy policy in Pennsylvania.

I want to thank several people here. I want to thank Senator Boscola, my counterpart on the committee, for her hard fight and her cooperation. I want to thank my counterparts in the House, Representative McCall and Representative Preston. I want to thank our staffs. Fran Cleaver and Kathy Eakin have worked extremely hard, along with Bernie Kieklak and Christopher Craig, who have done an outstanding job, particularly, I think, in representing the interests of the consumer in this.

We are very, very fortunate in Pennsylvania to have some very strong utility companies, and we are, in fact, an exporter of power. We are, in fact, very energy-independent. We export probably 40 percent of the power we produce. Thirty-five percent of our power is produced by nuclear, and we are, of course, very, very rich in coal resources in Pennsylvania. So I think we have a great base in our energy policies and in our energy companies here to be able to go on and move into some of our alternative energies, to move into a better energy policy, as the Governor has asked for.

So I think this is a great compromise bill. It has been hard-fought. There are very, very strong and passionate positions on both sides of this issue. But I think it is time now to move forward, help the consumer, move forward with a forward-thinking energy policy that the Governor has put forward, and pass this bill today. So for that reason, Mr. President, I ask for a favorable vote on House Bill No. 2200 as amended by the Senate.

The PRESIDENT pro tempore. The Chair recognizes the gentlewoman from Northampton, Senator Boscola.

Senator BOSCOLA. Mr. President, as we all know, electric rate caps are scheduled to expire in Pennsylvania's five largest electric companies in 2010. And if we do nothing, if we do nothing to protect millions of electric customers from rate shock, the people we represent will see their bills go up by 30, 40, 50, and up to 70 percent in some areas, and that will be overnight.

Today, in House Bill No. 2200, we can finally do something to help millions of ratepayers hold on to more of their money instead of having to send it to their electric company. The procurement provisions contained in this bill will force power companies to purchase least-cost fuel instead of purchasing coal or natural gas or uranium at prevailing market rates, which is more expensive. It also gives Pennsylvania's Consumer Advocate the tools he needs to keep electric prices as low as possible in the future. That is why our Consumer Advocate endorses this bill today, and personally assured me late last night that passing House Bill No. 2200 today is the right thing to do.

The other major provision of this bill deals with energy conservation and some very important steps that we all need to take for electric use. So-called smart meters by themselves are not magically -- anyone's monthly electric bill is not going to go down just because you are getting a smart meter. That will not happen. But this new technology will reward customers who are smart enough to realize that they can use electricity when it is cheapest during off-peak hours and pay a lower rate. We also made sure that smart meters would not be mandated for every single ratepayer. Not only is that a smarter approach to smart meter deployment, but it will also save electric customers hundreds of millions of dollars paying for something that will not provide a real benefit in their own households.

There is also strong market manipulation language in House Bill No. 2200, and that is what Senator Mellow insisted on being part of this bill. He should be commended for that, and we should not overlook that critical provision, because it will insure that real competition will not be undermined by existing power companies manipulating the wholesale market or the retail market to their own advantage.

What is not contained in this bill, unfortunately, is a real rate relief mitigation plan that I think the Senate needs to pass eventually. As everyone in this Chamber knows, that is what I have been fighting for for the past 2 years, and I do not doubt anybody knows that I am passionate about it, and this is just the beginning of this fight. Now, have we reached an agreement on mitigation yet? No. Despite our best efforts and ongoing negotiations that lasted into early morning, we have not. But I believe we are getting there.

And I know for a fact that we are closer to real rate mitigation now than we were 2 weeks ago or 2 months ago or 2 years ago. If there is anyone who wants to dispute that, you just have to take my word for it. And you can ask Senator Pileggi and Senator Tomlinson. They both sat in marathon sessions, negotiating sessions, and they want what we all want. We want Pennsylvania power companies to put up their own money to make it easier for customers to afford the new deregulated electric rates in 2010 and 2011. To do that will cost billions of dollars, billions, billions, that the companies would have given to their shareholders or slickly added to their profits.

So real rate relief, not just some Christmas card program or a plan to add some coupons, stuff some coupons in your pocket and save $10 off your next purchase of a $30,000 solar panel, that is not real rate relief. Just because it did not all come together at the eleventh hour like it does in the movies does not mean that we are done and that mitigation is dead. I have too much respect for Senator Pileggi, Chairman Tomlinson, Senator Fumo, and Senator Mellow to doubt that we will have a mitigation plan in place before rate caps come off. I also know that Governor Rendell will not rest until we have a mitigation plan in place that helps the ratepayers, small businesses, and our most vulnerable industries from this rate shock.

Together, we have put a tremendous amount of time into making this bill good for ratepayers and good for Pennsylvania. I

Exhibit 18

want to thank Senator Pileggi and Kathy Eakin and Dave Woods on his staff, Senator Tomlinson for going above and beyond the call of duty on this very, very complicated issue, and of course, my shopping partner, Fran Cleaver on his staff. I want to also thank Senator Mellow and Senator Fumo for their faith in me during these times when the obstacles seemed almost insurmountable, and both Gladys Brown and Christopher "Wing Man" Craig, who distinguished themselves in the heat of so many battles here and so many late, late nights and early mornings of hard, hard work.

Our job is not finished. There is still a lot of work to do. As of today, we have 449 days left to get it done before the rate caps come off, and get it done right. And as of today, after talking to Governor Rendell, he had indicated that he will take the bus that he goes around in across the State, and we are going to talk rate mitigation come January and February and take that bus to every corner of the State until we get a rate mitigation plan in effect before 2010.

Thank you, Mr. President. I thank everybody for all their hard work, and let us try to move forward. Thank you.

The PRESIDENT pro tempore. The Chair recognizes the gentleman from Schuylkill, Senator Rhoades.

Senator RHOADES. Mr. President, first, I want to applaud everyone who has worked so hard on this particular issue - Senator Tomlinson and his staff, Senator Pileggi, and everyone who has been involved and committed to this. I really do think we have a good piece of legislation, but I am going to agree with the gentlewoman from Northampton, because I will tell you what, 10 years ago may have been--and I say may have been--the first and the only time I voted for deregulation.

But the decision I made then was based on what I perceived to be the statements made to me, and as I saw it, that this would result in lower or at least the same level playing field rates for consumers. There was no talk then of a cost increase. There was no talk of a projection increase. There was no talk of a 35- or 40-percent increase at the end. And we still allowed the stranded costs. Then I look over that 10-year period, and the local company I have has made billions of dollars of profit, has been able to distribute very fine dividends to its stockholders. That is fine. That is excellent. That is good.

We have gone from a regulated monopoly to an unregulated monopoly, and I have problems with that. I do not want to move on any piece of legislation until I see the mitigation piece and how it is going to affect the consumers. Then I will say we should do the whole thing. I want to see how it affects the consumers, what it is going to mean to them, and how we are going to put it in place. I know, I hear, well, we will give them a 75-percent break, then a 50-percent break, then a 25-percent break, but as a company borrows that money, you know who is going to end up paying the interest on it. Or I will tell you what, you put your deposit in, and I will give you 6 percent now. Why do I have to go through that gyration when I should have had an understanding, at least it was projected to me, that all things will remain basically the same, except now, you will be able to go out and be at least more competitive. I have not seen that.

Another grave concern I have, too, is I want to make sure that PPL retirees, and those are the people I am talking about, have their pension system put in a separate account. I do not want to end up like Bethlehem Steel, where it ended up that they closed down, and then I had people looking for pensions. I want these kinds of things to be understood, and I want to know what the consumer is really going to have to pay before I can pass on anything. So for that reason, I will be voting "no."

The PRESIDENT pro tempore. The Chair recognizes the gentleman from Allegheny, Senator Ferlo.

Senator FERLO. Mr. President, with all due respect to all the self-congratulatory accolades being expressed, I am very disappointed in the final outcome represented in this bill, House Bill No. 2200, and it quite honestly represents a sucker punch in the face of electric ratepayers, both individual homeowners and ratepayers at a residential level, as well as those in the small business community, and even larger businesses that are going to have to continue to bear exorbitant rate hikes and rate increases when it comes to electricity.

I am disappointed mostly because as a benchmark piece of legislation, this legislation does not admit or declare in some type of form the horrendous failure that so-called electric choice has been. The State legislature should be held accountable for a bad decision made over 10 years ago in creating so-called electric choice. The only electric choice we have, basically, is to continue to pay exorbitant electric rates.

There is no true competition. There is basically an almost fraudulent methodology by which electricity is purchased on the PJM marketplace. We have companies going to Wall Street, blatantly and with very clear annual statements and reports, even documenting the amount of profiteering that they are going to make off the backs of ratepayers. And as one of my most brilliant colleagues reported at a press conference in June, the rate hikes will basically represent probably the largest tax increase on the backs of Pennsylvania residents and businesses, although it will not be in the form of taxes. It will come through the back door in the form of higher electric rates.

Needless to say, I am less than pleased. I have three amendments here. Two deal, actually, with the issue that everybody seems to say they want, and that is rate mitigation. Well, I have two amendments right here. One is to extend the rate caps to 2013. Another one is to implement a more modified rate cap over a 5-year period at 9 percent per year, which would at least create less pain for residents and small businesses. I am also concerned, at a third level, about the fact that this legislature, just 2 1/2 years ago, removed the so-called Chapter 14 provisions, which at least provided some consumer protections under the Public Utility Commission code.

We have had over 60 house fires in this State in the last 2 years since the removal of the Chapter 14 consumer rights provisions, where people have actually died in their houses, people trying to keep gas and light on either illegally or inappropriately, or during the winter months, trying to use kerosene heaters, lighting wood and fuel. That is a horrendous situation, and given the harsh reality of the economics of this country right now, today, and what everybody admits is going to be hard times for the next several years, I find it reprehensible that we are not able to proceed with some level of rate cap mitigation in this bill and, as well, some restoration of consumer rights to provide opportunities to ban winter shutoffs, to allow a more rational and reasonable reconnect policy as to how much people have to pay to get

Exhibit 18

their gas and light put back on by the utility company, to allow the Public Utility Commission to reenter as the mediator between the utility companies' narrow self-interests and the ratepayer. Right now, say you are on the phone with some operator, you do not even know if the operator works in China or India or Asia, and you are trying to argue about some consumer right that you feel you have to try to get a more reasonable reconnection. You have no rights whatsoever. We should restore that. And I have amendments that do that.

It is clear, however, that there are important elements in this bill that I certainly would not want to oppose or argue with, because I have fought hard. I have fought hard for some of the provisions that are in this bill, including the provision for the least-cost purchase price, and that is very important. And there are other elements of this bill that none of us would want to argue about, because, in fact, they are moving forward in trying to create a more level playing field between outright profiteering and the ability of small businesses and residences to survive in our Commonwealth with a needed, basic right to electricity.

So I am betwixt and between. There is not majority support to support these amendments, so I am not going to go forward in a Don Quixote fashion and offer amendments on the mitigation side of the equation, and I believe that come January, when people will be freezing to death, maybe there will be an ability for both sides of the aisle, in a nonpartisan way, to come together to talk about restoring some of the consumer protections.

So at this eleventh hour, as my colleague reported, I think it is important that we move forward on the bill, but I do think it is inappropriate that we were not able--and we keep saying we are rushed, it is the eleventh hour. I mean, we do not set the agenda on this side of the aisle. You all do on the aisle opposite. I do not know what says that we have to leave today. I know there is an election coming up in a few weeks. I do not know what says that we cannot reconvene to really deal with the rate cap mitigation. It is not rocket science.

So I am very disappointed, but I think it is important that we try to move forward on this bill, and accordingly, Mr. President, I will not be offering the amendments. Thank you.

The PRESIDENT pro tempore. The Chair recognizes the gentleman from Beaver, Senator LaValle.

Senator LaVALLE. Mr. President, as most people probably know, up until about an hour ago, I was prepared to vote "no" on this bill simply because I really wanted to see rate cap mitigation included. I thought that was the direction we were going. Since that time, and I want to be on record, the Governor has assured us that beginning in January, he will do all that he can to address that issue. Senator Boscola has been committed to addressing the issue and working as hard as she can possibly work to get the rate cap mitigation included, or at least address that issue next year. So although I am not very happy with not having it in now, I am prepared to vote "yes."

As Senator Ferlo said, there are some good things in the bill. However, you know, I am not going to be here next year, so the guy who takes my place when the rates go sky high, he can take all the complaining, and I will be one of the complainers. So, hopefully, we will do something to relieve him of that pain.

Thank you, Mr. President.

The PRESIDENT pro tempore. The Chair recognizes the gentleman from Philadelphia, Senator Fumo.

Senator FUMO. Mr. President, I want to thank Senator Ferlo for not offering his amendments today, because I think that would have ultimately denied us the opportunity of voting on House Bill No. 2200. I want to thank Senator LaValle and the other Members of my Caucus who were negative and are now positive. But I also want to echo some of the comments, in two particular areas.

This is not a bad bill. This is not a vote against mitigation, which we all seem to want, in one form or another, but this is a step in the right direction. The procurement portions of this bill will result in immediate ratepayer savings. As was mentioned earlier, and I just want to reemphasize, this legislation will change the current law and force utilities to purchase their electricity at the least possible rate, the lowest-cost rate, not the phony market rate that the current law allows them to do.

Secondly, it will require them to have a mix in their portfolio of long-term, short-term, and middle-term contracts, which will ultimately also benefit the consumer. It will require them, in that portfolio, to have at least some long-term contracts, more than 4 years, but not less than 20. And as was also said, the amendment will impose significant safeguards intended to prevent market manipulation and self-dealing.

In addition to that, the bill has been amended to say that the maximum fine will not be $5 million, which to some of these large utilities is just merely the cost of operation, but rather $20 million, which is some pain.

Then, on the demand side, we do have long-term goals and positions that will save us energy in the long run. But like everything else, no one wants to hear about that, because it is not going to really kick in for 8 to 10 years. But it is there, and future generations will be the beneficiaries of that. In addition, we did not mandate smart meters, but we made them optional. We did say in new construction, where they really are practical, they will be put in.

So this is not a bad vote for anybody. What has been explained to me in the main argument that I have heard is that, gee, we blew an opportunity. We had some leverage. We had no leverage with utility companies on this bill. This was similar to the guy who stands there with a gun to his head and says to the other guy, if you move, I will shoot. There was no leverage against utility companies in this bill.

Next, I want to address, because I, too, will not be here, but I was here in 1996 when I not only voted against deregulation, I predicted that there would not be any competition, and regrettably, my prediction has come true. But then I sued PECO, and I was the one who got the 8-percent reduction and the current caps that we have. Now I am beginning to think it was the right thing to do. We saved people billions of dollars, but when it comes off, they are going to be upset.

In addition to that, the people have not yet gotten the message. That is why I think the utility companies have made a major strategic mistake by not attempting to resolve mitigation at this stage. What is going to happen is every day they delay in coming to the table, and every day we do not do anything about mitigation in the next Session, more and more pressure is going to be built up

Exhibit 19

dividuals are not required to have a lawyer to file Formal Complaint or to participate in the PUC omplaint process. But, the utility or company is :quired by law to be represented by a lawyer.

Formal Complaint may take six months or more om the time you file it with the PUC's Secretary's ureau until the time the PUC decides your case or etermines whether it can address your problem or oncern.

Proposed Rate Increases

Consumers may file comments about a utility's roposed rate increase by mailing a form to the UC's Secretary's Bureau. (*See Forms below*)

Consumers may file Formal Complaints to a ıtility's proposed rate increase with the PUC. *See Formal Complaint Process*)

Forms

- To access forms for an Informal/Formal Complaint, Informal Transportation Complaint, or Comments, visit **www.puc.pa.gov** or call 1-800-692-7380 *to request a hard copy.*

- Informal Complaints can be mailed to the PUC at:

PA PUC - Bureau of Consumer Services
400 North Street
Harrisburg, PA 17120

• *Formal Complaints and Comments should be* addressed to the PUC's Secretary's Bureau.

• Informal Transportation Complaints should be addressed to PA PUC - Bureau of Investigation & Enforcement.

Helpful Resources Guide Available

For more information:

PA PUC Consumer Complaint Procedures Guide
available at **www.puc.pa.gov**
or call **1-800-692-7380** to request a copy

or write:

PA PUC Bureau of Consumer Services
400 North Street
Harrisburg, PA 17120

@PA_PUC
Pennsylvania Public Utility Commission

Helpful Agencies and Resources

PA Public Utility Commission
www.puc.pa.gov

Public Utility Code
www.legis.state.pa.us

PUC Regulations
www.pacode.com

Office of Consumer Advocate
www.oca.state.pa.us
1-800-684-6560

7/17

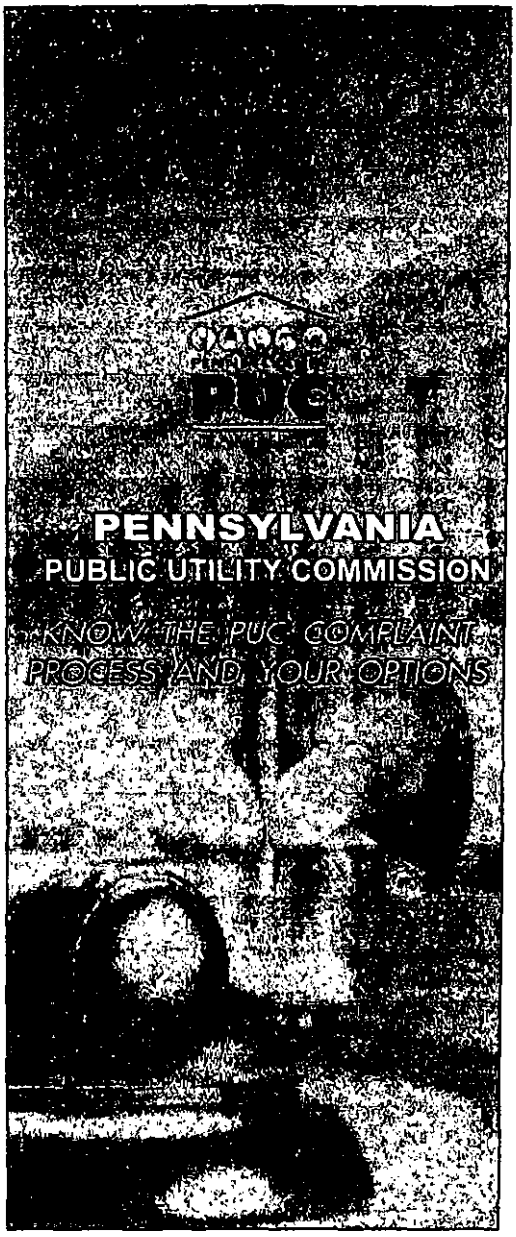


Exhibit 19

What Does the PUC Regulate?

The PUC regulates nearly 8,000 public utility providers that deliver the following services in Pennsylvania: electricity, natural gas, telephone, water and wastewater collection and disposal, steam heat, and transportation of passengers and property by motor coach, truck and taxi.

How Can the PUC Help?

If you provide information to prove that there has been a problem with your utility or PUC-regulated entity in violation of the law, we can hold the company accountable by ordering the company to pay a fine, usually payable to the state; ordering the company to give you a refund or a credit if you have been overcharged; or setting up a payment arrangement if you are behind on your utility bill.

Two types of public utility complaints can be filed with the PUC - an **Informal Complaint** and a **Formal Complaint**. Before filing any complaint with the PUC, consumers should always contact the utility company first to allow an opportunity to resolve the issue.

PUC Complaint Options

- ✓ Contacting Your Utility or Company
- ✓ Filing Informal Complaint with the PUC
- ✓ Filing Formal Complaint with the PUC
- ✓ Filing Comment on Proposed Rate Increase with the PUC
- ✓ Filing Formal Complaint to Proposed Rate Increase with the PUC
- ✓ Contacting Other Agencies for Assistance

PUC Complaint Checklist

- Did you call your utility first to discuss your complaint?
- Are you the utility customer?
- Are the service and the home with service in your name?
- Do you have legal authority to act on behalf of the customer of record or applicant? (Example: Power of Attorney or Legal Guardian)
- Are you prepared to indicate whether you have a Protection from Abuse (PFA) Order when filing the complaint?
- Are you aware that, by filing a complaint, you are giving the PUC permission to contact the utility and review your account information?
- Do you know that you still must pay all of your current bills with the utility while your complaint is under review by the PUC?

What Information Do I Need to File a Complaint?

You must complete and file a Complaint Form and include the following information:

- Your name (account holder)
- Customer account number
- Billing and service address
- Telephone number and fax number (if available)
- The name of the utility company or transportation service provider you have a complaint against
- Clear description of the facts leading to the complaint (you may attach supporting documents)

Note: The same information must be provided by any person representing you.

Informal Complaint Process

Consumers may file Informal Complaints with the **PUC's Bureau of Consumer Services (BCS)** against PUC-regulated electric, natural gas, telephone and water/wastewater companies, and transportation services, for example, taxicabs, limousines, household moving companies, trucking companies, transportation network companies or paratransit companies. BCS will investigate the complaint, work with the parties to resolve the complaint, and provide the outcome of the investigation to the customer and utility.

The PUC recommends that you use the Informal Complaint process first because many complaints are resolved sooner, are simpler, and take less time to solve compared to Formal Complaints. You also avoid the need for a legal proceeding. Informal Complaints are confidential and not available for public inspection.

Note: If you have a concern with a Philadelphia taxicab or limousine company you must contact the Philadelphia Parking Authority (PPA) at www.philapark.org or call 1-888-591-3636.

Formal Complaint Process

Consumers may file Formal Complaints about problems with a utility, for example, billing or quality of service issues. Filing a Formal Complaint begins a legal proceeding before a **PUC Administrative Law Judge (ALJ)** who holds hearings, if necessary, to gather evidence and issue a decision. You must participate in this proceeding and present evidence if needed to prove facts and issues related to your Formal Complaint. Telephonic options also are available.