An incomplete Benefit-Cost analysis and the urgent need for research

Comments on the Commonwealth of Massachusetts' document no. D.P.U. 12-76-A. Investigation by the Department of Public Utilities on its own Motion into Modernization of the Electric Grid, December 23, 2013

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Executive Summary

This submission examines the report of the Department of Public Utilities on its Motion to modernize the electric grid in Massachusetts and raises the possibility that unforeseen risks that currently are not addressed in the report may adversely impact on the benefit-cost analysis (risk assessment) recommended in the report.

My qualifications for this opinion are that I have been involved in telecommunications standard setting since 1992 and from 1998 to 2000 I was a member of the Standards Australia TE/7 Committee (Human Exposure to Electromagnetic (radiofrequency) Fields. From 2004 to 2009 I was enrolled in a PhD research program at the University of Wollongong, New South Wales, Australia. In 2010 my thesis passed external review and was accepted by the university.

This submission raises three questions. They are:

1) **Do the relevant telecommunications standards, IEEE C95.1 and ICNIRP's RF guidelines assure safety from smart meter emissions?**

Answer: While the standard limits do provide protection against the known thermal effects (tissue heating from acute exposures) they are not relevant to the type of exposure people may receive from advanced metering infrastructure (AMI), hereafter referred to as smart meters. A possibility exists that in situations where people are sleeping in close proximity to an active smart meter, the combination of the frequent smart meter transmission bursts at around 900 Mhz constitutes a new and unique human exposure situation that may have unintended biological effects. Reasons for this are given.

2) **Are the widespread reported adverse health impacts after the installation of a smart meter in homes a real biological effect or a Nocebo phenomenon?**

Answer: While the nocebo effect is a real effect and cannot be discounted, evidence is given which strongly indicates claims that all health effects from exposure to electromagnetic fields (power-frequency and radiofrequency) are just a nocebo effect are unjustified. Given the large numbers of consistent health complaints coming from countries where smart meters have been rolled out this represents a potential risk (cost) to the Massachusetts' grid proposal, which currently is not being addressed.

3) **What avenue of research is needed in order to clarify the above question 2**?

Answer: The suggestive evidence that smart meter RF emissions may be having an adverse health impact calls for a research effort in order to quantify that risk. Even if the number of affected people is small, the sheer number of people exposed represents a potentially significant public health risk. One way to proceed with this research is to take the "worst-case scenario"—when a bedhead is next to a smart meter located on the outside of the wall—and design a study to determine if smart meter emissions affect the sleep cycle. This should be done as a double-blind study through an independent sleep center with the testing facility and investigators having no present or former financial or employment ties with an industry sector that might be affected by the findings of the study. Taking a strictly benefit-cost analysis viewpoint, the cost of the public opposition to AMI (smart metering) technology, based on health concerns, is a factor that needs to be included in any such analysis. Whether or not that factor is real of imagined is not the issue in this regard. It does exist and can only be resolved by independent research as outlined above. It is therefore recommended that the Massachusetts state government err on the side of caution and halt the deployment of AMI smart metering until the above-mentioned research has been conducted and the controversial health effects issue clarified.

Scope of comments

My comments on D.P.U. 12-76-A primarily deal with the scope of the D.P.U.'s Benefit-Cost Analysis recommendations, as outlined in Section 4: *Elements of a Comprehensive Advanced Metering Proposal*, page 20. In this section the Working Group directs that the electric distribution companies include a benefit-cost analysis which "assesses all costs and benefits including those that are difficult to quantify, and provides its underlying assumptions".

To this I suggest there is a need to address the risk of possible adverse health effects (actual and perceived) that may occur as a result of the modernization of the electricity grid, specifically the use of advanced metering infrastructure (AMI), hereafter referred to as smart meters. If such a risk is real, there would be a significant cost to the companies. To continue to ignore that risk because of misplaced "underlying assumptions" is a risk in itself.

My qualifications and interest

My name is Donald R Maisch. I reside in Hobart, Tasmania, Australia and I am a citizen of Australia. I have been directly involved in telecommunications standard setting since 1992. From 1998 to 2001 I was a member of the Standards Australia TE/7 Committee: Human Exposure to Electromagnetic Fields (Radiofrequency standards) which concluded in 2001.

From 2004 to 2009 I was enrolled in a PhD research program at the University of Wollongong, New South Wales, Australia. My area of research was examining the risk assessment process as it applied to the development and maintenance of Western telecommunications standard exposure settings. In 2010 my thesis, *The Procrustean Approach: Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation*, passed external review and was accepted by the university.[1] As my thesis addresses the inadequacy of RF exposure standards, which are often referred to in the smart meter literature, the abstract and overall conclusions are reproduced in **Appendix A**.

I have focused my PhD research, and current writings on the controversy over the level of health protection that is provided by the internationally recognized radiofrequency exposure standards/guidelines. These are the RF standards developed under the auspices of the Institute of Electrical and Electronic Engineers (IEEE C95.1) and the RF guidelines promoted by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Although not covered in my thesis, the FCC RF exposure limits are largely based on the ANSI/IEEE C95.1 recommendations, such as using specific absorption rate (SAR) limits as a primary metric for compliance. My understanding is that the FCC still uses the old C95.1 thermal limit of 1.6 W/Kg averaged over 1g while the current IEEE standard has increased its limit to 2.0 W/Kg averaged over 10g to 'harmonize' with ICNIRP's RF guidelines. Thus, my criticisms of IEEE C95.1's limitations would also apply to the FCC RF limits, although they are somewhat more cautious than the IEEE standard.

The assurances of safety for smart meters are largely based on the above-mentioned standards, depending on the country. The reasoning for an absence of health issues from smart meter RF exposure is that as smart meter emissions fall significantly below the standard limit restrictions, there is an assumption that there can be no health effects whatsoever. Section 6 on page 31 of the DRI document does mention concerns about

[1] Available online at: http://www.emfacts.com/download/The_Procrustean_Approach.pdf

potential health effects but dismisses the reality of actual effects because *"a number of published reports on potential health effects of AMI* (advanced metering infrastructure) *suggest that RF from this technology is unlikely to harm health.* Three references are given for this conclusion and I briefly comment upon them in **Appendix B**

After reviewing the proposal, in my opinion the rollout as currently planned in Massachusetts stands the risk of repeating the fiasco in Victoria, Australia where public opposition to the mandated rollout has resulted in significant consumer opposition with thousands of Victorians rejecting the electricity monitoring systems being imposed statewide. The mandated roll-out of smart meters in Victoria was originally estimated to cost around $800 million but by the end of 2011 had blown out to cost the government approximately $2.3 billion. Continuing consumer opposition can only add to the blowout.[2] Much of the initial opposition in Victoria was sparked by the forced mandating of smart meters on homes resulting in a level of public outrage. As a result of the Victorian experience the federal government's Standing Council on Energy and Resources (SCER) has backed away from a mandated rollout and instead opted for a market driven rollout (the customer can opt out). According to Tasmanian Minister for Energy and Resources and member of SCER, Bryan Green: *"These proposed regulatory changes effectively mean that Victoria may be the only state in Australia where there will ever be a mass deployment of a smart metering infrastructure"*.[3]

I restrict my comments to areas where I have had direct involvement. It must be noted that I am writing from an Australian perspective. However, as the planning for a global smart grid requires that the same grid network be used ubiquitously, my comments will equally apply to other areas where wireless smart grids are being introduced.

Questions covered

1) Do the relevant telecommunications standards, IEEE C95.1, ICNIRP's RF guidelines and the FCC limits assure safety from smart meter emissions?

2) Are the widespread reported adverse health impacts after the installation of a smart meter in homes a real biological effect or a Nocebo phenomenon?

3) What avenue of research is needed in order to clarify the above question 2?

Question 1: Do the relevant telecommunications standards, IEEE C95.1, ICNIRP's RF guidelines and the FCC limits assure safety from smart meter emissions?

In my opinion there is no argument in the claim that smart meters emissions fall far below the RF standard/guideline limits. This is a frequent claim made and I doubt that there could ever be a situation where a smart meter's emissions could ever reach even a small fraction of the above limits. However, such a statement is usually not followed up with a disclaimer that the limits are restricted to providing protection against well-known thermal effects (tissue heating at high-level (acute) exposure situations). Consideration of other possible biological effects not related to heating has not been taken into account in the setting of maximum exposure limits in these standards. The vast bulk of the historical research effort that serves as the basis of these standards has focused on thermoregulatory studies (how the body handles excessive heat from RF exposure – a thermal effect) and the establishment of maximum exposure levels to eliminate excessive temperature increases.

[2] *The Australian*, Smart meters fuel blowout cost fears, Dec. 15, 2011, http://www.theaustralian.com.au/national-affairs/state-politics/smart-meters-fuel-blowout-cost-fears/story-e6frgczx-1226222383024

[3] Letter from Energy and Resources Minister Bryan Green to Don Maisch, May 24, 2013

Much of this research consisted of exposing small laboratory animals to acute short term RF/MW to determine at what level of exposure their body's ability to dissipate heat (thermoregulatory) was breached. The results of these studies were then extrapolated to what was thought would happen to a human. Adair and Black (2003) have pointed out, however, that, *"these small animals are poor models for human beings because their physiological heat loss mechanisms are limited"*.[4] This was referring to thermal research (thermal effects) but in this admission the authors were effectively implying that the 'weight-of-evidence' for Western RF thermally based standards is based on a poor and inadequate data-base for human exposure.

Established adverse health effects

The definition of an "established adverse health effect" in IEEE C95.1 is restricted to heating effects only for telecommunications frequencies. They are defined as (1) "adverse or painful electrostimulation due to excessive RF internal electric fields, (2) RF shocks and burns due to contact with excessively high RF voltages, (3), heating pain or tissue burns due to excessive localized RF exposure, and (4) behavioral disruption, heat exhaustion or heat stroke due to excessive whole body RF exposures. The standard states (in part) that, in their definition, adverse effects do not include: "biological effects without a harmful health effect [the above mentioned 4 effects]" and "changes in subjective feelings of well-being that are a result of anxiety about RF-effects or impacts." [5] Thus, as there are no thermal effects (acute exposure) associated with smart meter exposures, the assumption is made that all reported effects from smart meters must be the result of anxiety (the Nocebo Effect). This is the viewpoint now being taken globally by authorities and other vested interests pushing for the introduction of the smart grid.

However, if one takes into consideration the body of available peer reviewed and published research, there has long been evidence that RF exposures well below that which causes tissue heating may cause non-thermal biological effects[6]. For example, this was a concern in 1999 by the U.S. Radiofrequency Interagency Work Group (RFIAWG), a governmental interagency committee working under the House of Representatives' Committee on Commerce.

Work group membership included the Food and Drug Administration (FDA), the Center for Device and Radiological Health (CDRH), the National Institute for Occupational Safety and Health (NIOSH), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC)[7]. This work group expressed a significant difference of opinion over the adequacy of the thermally based proposed IEEE C95.1 standard revisions, compared with that of the (industry make-up) IEEE standard setting committee, the SCC-28 subcommittee. These differing expert opinions illustrated that differing scientific interpretations of the same scientific literature base varied considerably according to one's affiliations.

In June 1999 Gregory Lotz, representing NIOSH on the RFIAWG, presented the Chairman of the SCC-28 subcommittee IV a list of issues that RFIAWG considered needed to be addressed in the IEEE RF Standard. The list was in response to previous requests from the

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[4] E. Adair, D. Black, 'Thermoregulatory Responses to RF Energy Absorption', Bioelectromagnetics, Supplement 6 , 2003, pp. S17 – S38.
http://journals2.scholarsportal.info/details.xqy?uri=/01978462/v24is6/s17_trtrea.xml

[5] D. Maisch, The Procrustean Approach, p. 143, http://www.emfacts.com/download/The_Procrustean_Approach.pdf

[6] **"**Non-Thermal Effects and Mechanisms of Interaction Between Electromagnetic Fields and Living Matter**",** eds.L Giuliani, M. Soffritti**,** *European Journal of Oncology*, Vol.5, 2010.

[7] E. Jacobson, Deputy Director, Center for Devices and Radiological Health, FDA Letter Regarding Cellular Phones, May 5, 1997, http://www.osha.gov/SLTC/radiofrequencyradiation/fda.html

work group for greater participation in SCC-28 discussions on RF standards. In particular, RFIAWG criticized the biological rationale of the Standard on a number of fronts. A fundamental issue was the Standard's failure to address chronic (low intensity/prolonged) as opposed to acute (high intensity/short term) exposures. This was seen in the proposed Standard limiting the definition of an "adverse effect level" to only acute exposure situations and the use of time-averaged calculations that were not suitable for prolonged exposure situations, and therefore may not adequately protect the public. RFIAWG recommended that a clear rationale needed to be developed to also include chronic exposures. There was also a concern expressed about failure to include consideration of the body of research on the biological effects of exposure to ELF-modulated and pulse-modulated RF that was relevant to public exposures. To address these concerns the working group recommended a comprehensive review of long-term, low-level exposure studies that had relevance to environmental chronic occupational RF exposures and neurological-behavioral effects to better define the adverse effect level for RF, and micronucleus assay studies with relevance to carcinogenesis.[8]

These concerns raised by the RFIAWG in 1999 are still valid and are directly relevant to smart meter emissions which, rather than being a continuous wave, pulse thousands of times over a 24-hour period of time. This is clearly seen in **Table 1**, taken from a document from Pacific Gas and Electric Co. where over a 24-hour period up to 190,000 transmission pulses can occur.[9] These are very brief but frequent transmissions, as seen in **Table 2**.

Table 1

Electric System Message Type [a]	Transmission Frequency Per 24-Hour Period: Average [b]	Transmission Frequency Per 24-Hour Period: Maximum (99.9th Percentile) [c]
Meter Read Data	6	6
Network Management	15	30
Time Synch	360	360
Mesh Network Message Management	9,600	190,000
Weighted Average Duty Cycle	45.3 Seconds[4]	875.0 Seconds

> **Table 1** presents scheduled smart meter system messages and their durations. This is only for the 900Mhz smart meter transmitter radio and represents data for all scheduled messages that are required to sustain the mesh network communications.

As for the reason for all this activity, a 2013 report by Richard Tell Associates, states the following:

> Smart meters emit short duration pulses of RF energy in their communication with other meters and data collection points. These emissions generally happen all through the day. Besides the normal three (in the case of BED) or four (in the case of GMP) times a day that electric energy consumption data are reported back to a data collection point for subsequent transmission to the company, smart meters must maintain their organization within the RF LAN to which they belong and this necessitates the transmission of beacon signals from time to time. Additionally, each meter can, when required by the mesh network, assist neighboring smart meters by

[8] G. Lotz, RFIAWG, RF Guideline Issues: Identified by members of the Federal RF Interagency Work Group, June 1999, letter from Gregory Lotz to Richard Tell, Chair of IEEE SCC28 IV, www.emrpolicy.org/litigation/case_law/docs/exhibit_a.pdf

[9] Ref: Pacific Gas and Electric Co., http://emfsafetynetwork.org/wp-content/uploads/2011/11/PGERFDataOpt-outalternatives_11-1-11-3pm.pdf

transmitting the neighbor's data on to another meter or data collection point. Further, the HAN radio can produce pulsed fields in its search for and communication with IHDs. All of this means that most smart meters remain relatively active in terms of brief signals being transmitted.[10]

As for what this might look like in a 'real world' situation, **Table 2** shows measurements taken outside, 1 metre from a smart meter on a suburban house in Melbourne, Victoria Australia.[11]

Table 2

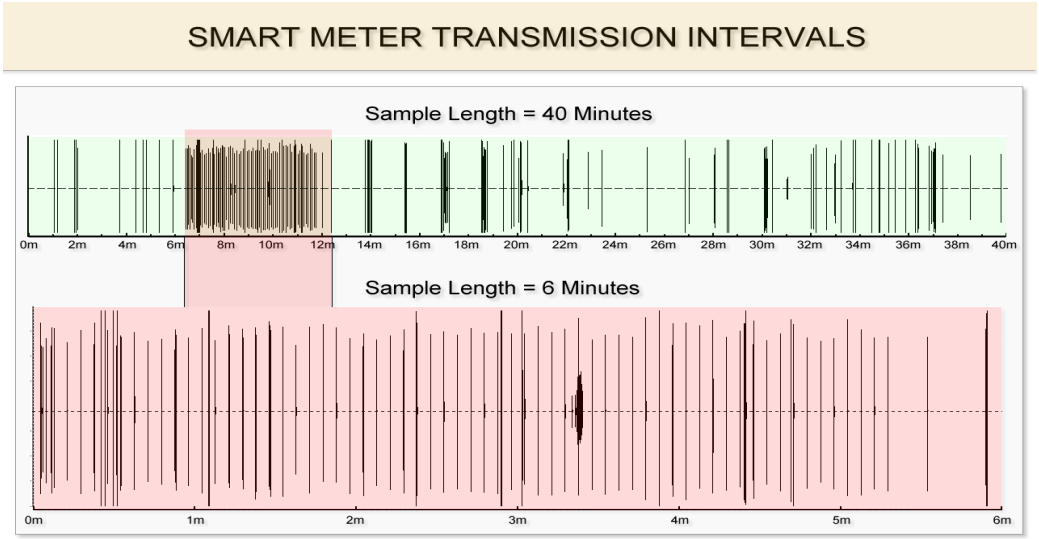

Table 3

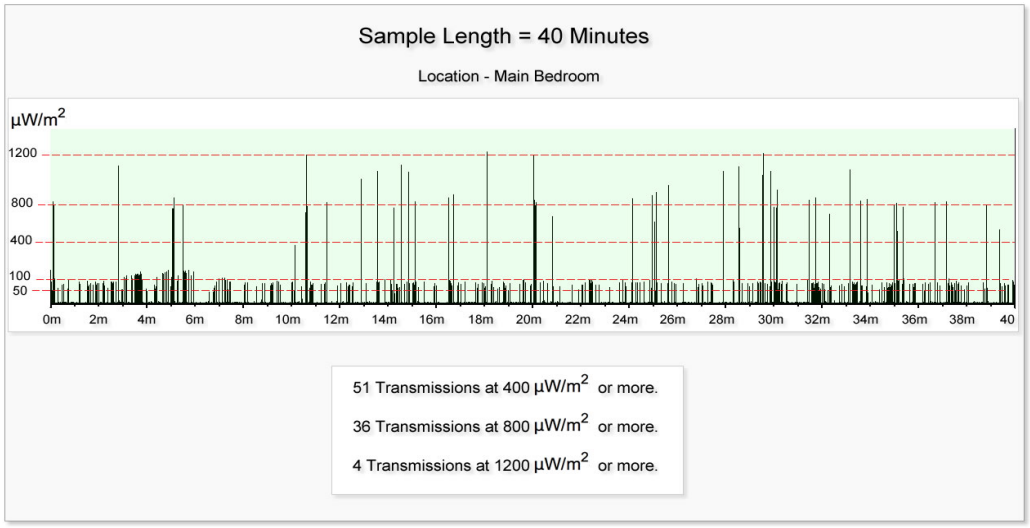

Table 3 shows the same house, this time with measurements taken by the bedhead in a bedroom adjacent to the smart meter.

[10] Richard Tell Associates, An Evaluation of Radio Frequency Fields Produced by Smart Meters Deployed in Vermont,: http://publicservice.vermont.gov/sites/psd/files/Topics/Electric/Smart_Grid/Vermont%20DPS%20Smart%20Meter%20Measurement%20Report%20-%20Final.pdf

[11] Using a Gigahertz Solutions HF 35C RF meter, January 2013. They are only meant to illustrate the frequent transmission intervals of the smart meter measured

The frequency used may also be an issue

Besides the constant pulsing of smart meter emissions there is the issue of the frequency range used. In 1976, Lin concluded that 918 MHz energy constitutes a greater health hazard to the human brain than does 2450 MHz energy for a similar incident power density. In addition studies of diathermy applications consistently show that electromagnetic energy at frequencies near and below 900 MHz is best suited for deep penetration into brain tissue.[12] So a possibility exists that in situations where people are sleeping in close proximity to an active smart meter, the combination of the frequent transmission bursts at around 900 Mhz constitutes is a new and unique human exposure situation that may have unintended biological effects, especially on sleep.

Possible implications to ponder

In Australia many homes are constructed with the old analogue electricity meter placed on an easily accessible external wall for the meter reader. This frequently turns out to be on a bedroom wall. In my examination of many of the anecdotally reported adverse health effects from people in Victoria, a common occurrence is that the affected person had his or her bed in close proximity to a smart meter placed externally on the bedroom wall. In many cases the person was not aware that their old meter had been replaced, with symptoms, primarily insomnia, preceding awareness of the smart meter installation.[13] At the present time all this is anecdotal and would need to be verified with sleep research using an accredited sleep laboratory. Considering that very similar complaints are coming from many areas after smart meters have been rolled out in the US and Canada, from a public health perspective an independent investigation is imperative.

The above information clearly suggests that with the widespread rollout of smart meters we have a significant and new public exposure situation that lies outside the thermally protective parameters of the RF standards referred to previously. In my opinion it is unjustified to refer to thermally restricted RF exposure standards as somehow inferring safety for exposure to smart meter emissions.

Question 2: Are the widespread reported adverse health impacts after the installation of a smart meter in homes a real biological effect or a Nocebo phenomenon?

Central to the nocebo claim with the reported smart meter health complaints is the proposition that without a conscious pre-existing worry there would be no symptoms at all; it's all in the mind. With this viewpoint all the adverse smart meter health reports are simply the result of individuals from the uninformed public hearing or reading about the alleged health effects and then, when smart meters are rolled out in their neighborhood, they worry themselves sick. This would be in agreement with the IEEE's view that it's all just "changes in subjective feelings of well-being that are a result of anxiety about RF-effects or impacts." Professor Andrew Wood from the Brain and Psychological Sciences Research Centre at Swinburne University of Technology, in his report on smart meters, suggests that the nocebo effect may play a role in symptoms being reported.[14]

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[12] Marko Markov, Research International, Williamsville, NY, USA & Yuri G. Grigoriev, Russian National Committee of Non-Ionizing Radiation Protection, Moscow, Russia
http://www.viewdocsonline.com/document/6kn1ey

[13] Smart meter cases, http://www.emfacts.com/download/SM_case_studies.pdf

[14] A Wood, Comparison of the Preliminary Victorian Study To Other Overseas Studies, in AMI Meter Electromagnetic Field Survey. Prepared for the Department of Primary Industries, App. A, pp. 87-94,

It must be acknowledged that the nocebo effect (and its opposite, the placebo effect) are well recognized as real conditions[15]. For example, in tribal Australian aborigines the act of "pointing the bone" by a tribal shaman (a form of voodoo curse) at an accused wrongdoer has been known to cause death of the wrongdoer. The necessary element being that the accused person must believe in the power of the curse. Paul Martin's book, *The Sickening Mind: Brain, Behaviour, Immunity and Disease,* is replete with examples of the complex interplay between a person's state of mind and its effect on the immune system, and vice versa.[16] Considering the evidence, it is entirely possible that, with the widespread internet information available about possible smart meter health hazards, some psychologically vulnerable people who have had a smart meter installed on their home will succumb to worry and exhibit symptoms that are not related to exposure.

However, to then assume that all reports of health effects from smart meter exposure are a nocebo effect is not good science, especially when the assumption is coming from individuals and organizations with a vested financial interest in promoting the technology. Dare we say it's 'like throwing the baby out with the bathwater'?

In conducting population-based research on electrohypersensitivity (EHS), it's important to consider both the placebo and the nocebo effects. For this reason, in an Australian study on EMF exposure which examined residential exposures to mains-power magnetic fields (not RF) in a group of chronic fatigue patients, a decision was made at the onset not to include subjects who had any preconception that their illness might be caused by electromagnetic field exposure. In other words, none of the participants were worried about EMF, thus a nocebo effect was ruled out as far as possible. It was found that reducing "excessive" night-time ELF magnetic fields significantly improved fatigue symptoms and quality of sleep. Interestingly, one of the symptoms reported, tinnitus, especially at night, disappeared after removal of the source of exposure.[17, 18]

The absence of any nocebo effect was also seen in a WorkCare compensation case that took place in Melbourne in 1991–1992. In this case, a number of women who had worked in an office directly over an electrical substation had remarkably similar symptoms that ceased when they no longer worked in the area. None of the women had any idea that there were high power-frequency magnetic fields (not RF) in the office. Common symptoms were chronic tiredness/fatigue, insomnia, stress, prone to viral infections, inability to concentrate, depression, facial rashes and headaches. One woman summed it up as "a permanent severe case of jet lag". [19]

The absence of a nocebo effect was suggested in a study of population effects of a short-wave RF transmitter facility at Schwarzenburg, near Berne, Switzerland. In the early 1990s, a study was conducted because of persistent health complaints in the population near the transmitters. The findings were "highly suggestive of a direct effect of the radio shortwave transmitter on sleep quality" (disturbances in falling asleep and maintaining sleep). Other

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[15] J Stromberg, What Is the Nocebo Effect? smithsonianmag.com, July 23, 2012, http://www.smithsonianmag.com/science-nature/what-is-the-nocebo-effect-5451823/

[16] P Martin, *The Sickening Mind: Brain, Behaviour, Immunity and Disease*, Flamingo , 1998

[17] D. Maisch, B. Rapley, J. Podd, Changes in Health Status in a Group of CFS and CF Patients Following Removal of Excessive 50 Hz Magnetic Field Exposure, *JACNEM*, Vol. 21 No. 1; April 2002: pages 15-19 http://www.emfacts.com/download/cfs_changes.pdf

[18] J. Podd, D. Maisch, Reducing EMF exposure improves sleep and reduces CFS symptoms, Poster presentation at the 2nd International Workshop on "Biological effects of Electromagnetic fields", 7-11 October 2002 , Rhodes, Greece. http://www.emfacts.com/download/Reducing50.pdf

[19] D. Maisch, D., (compiled) The Ross House Substation: Chronic Fatigue Syndrome (CFS) symptoms attributed to exposure to electromagnetic fields (EMF) due to proximity to an electrical substation, Workcare compensation case, Melbourne Victoria, 1991-1992, February 1999. Full report available upon request, Summary: http://www.emfacts.com/download/The_Ross_House_Electrical_Substation.pdf

effects found were restlessness, joint pain, disturbances in concentration, general weakness and tiredness. The researchers specifically looked for a nocebo effect, which they called "health-worry personality", but found no evidence of it. This was highlighted when the transmitter was turned off unexpectedly, unknown to the residents, in the middle of the study. Normal sleep patterns re-established until the transmitter was turned on again, at which point deterioration set in once more.[20]

The authors concluded that "our findings support a relationship between operation of the radio transmitter under investigation and sleep disturbances in the exposed population…From a public health perspective, our findings call for caution in exposing populations to EMF from short-wave radio transmitters."[21] Such advice would be a good public health policy when dealing with mass public exposure to smart meter emissions.

In my opinion the nocebo effect may be a factor in some smart meter health complaints but that this a distraction from the possibility that we are facing a significant public health risk that has not yet been investigated because of entrenched preconceptions.

Provocation studies

Another reason for dismissing possible smart meter health effects from RF exposure has been the reliance on the findings of provocation studies to evaluate the reality of electromagnetic hypersensitivity (EHS). This type of study simply consists of exposing subjects who have identified themselves as electrosensitive to electromagnetic radiation (EMR) to see if they can feel when the field is turned on or off. These tests have generally found that the subjects failed to distinguish whether the field was present or not - leading to a conclusion by the researchers that the fields were not the cause of their reported symptoms and therefore the problem may be psychosomatic.

Central to EMR provocation studies is the hypothesis that if a person is sensitive to EMR they should be able to feel when the exposure is taking place. If not, it must then be a psychological problem. For example, Rubin and colleagues from Kings College, London reviewed over 40 provocation studies on EHS volunteers and concluded that, overall, people with EHS did not react to EMR exposure any differently from the way subjects react to a sham exposure. Thus, the authors suggested that EMR was not the cause of their condition. [22]

A significant weakness of provocation studies when applied to possible adverse health effects of EMR exposure, however, is that by their very design, they limit the definition of electrosensitive persons to those who claim that they can feel when they are being exposed. This definition excludes the possibility that there may be people who are adversely being affected by EMR exposure but cannot feel when they are being exposed. In both the CFS study and Ross House cases, mentioned previously, there was no indication that any of the affected people could feel when they were being exposed to EMF.

Question 3: What avenue of research is needed in order to clarify the above point 2? A Research Proposal

From a public health perspective, the suggestive evidence that smart meter RF emissions may be having an adverse health impact calls for an urgent research effort. Even if the

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[20] N. Cherry, Swiss shortwave transmitter study sounds warning, *Electromagnetics Forum*, Vol. 1, No. 2, Article 10, http://www.emfacts.com/forum/issue2/mag_9.html

[21] http://www.ideaireland.org/2006.00%20Altpeter%20et%20al.pdf

[22] Rubin, GJ, Electrosensitivity: A Case for Caution with Precaution, http://archive.radiationresearch.org/conference/downloads/011555_rubin_extra.pdf

number of affected people is small, the sheer number of people exposed represents a potentially significant public health risk. To dismiss this possibility simply as just a nocebo effect without undertaking a serious research effort is inexcusable. Even if it were eventually found that the reported adverse effects from smart meter exposure were simply the effects of worry (nocebo) the size of the numbers affected by worry should call for research specifically to address the reality, or otherwise, of their concerns. If it could be shown by specific sleep research that there was no effect on sleep patterns (the primary reported effect) that would go a long way to resolving public concerns. If, on the other hand, an effect on sleep was found and replicated, that would be another matter. For those with a vested interest in the technology this is a Pandora's Box. However, from a public health perspective this is a box that should be opened as a matter of urgency.

One way to proceed with this research is to take the "worst-case scenario"—when a bedhead is next to a smart meter on the outside of the wall—and design a study to determine if smart meter emissions affect sleep patterns. This should be done as a double-blind study through an independent sleep center with the testing facility and investigators having no present or former financial or employment ties with an industry sector that might be affected by the findings of the study. The importance of this is highlighted by the International Committee of Medical Journal Editors in their "uniform requirements" statement (in part):

> Financial relationships (such as employment, consultancies, stock ownership, honoraria, and paid expert testimony) are the most easily identifiable conflicts of interest and the most likely to undermine the credibility of the journal, the authors, and of science itself.[23]

The researchers could set up a sleeping room with a functioning smart meter close to the bedhead on the other side of the wall so that it is not seen by the participants. As it might be difficult to set up an operating smart meter in a laboratory situation, it may be easier to use an existing residence with a bed placed by an existing smart meter that has been modified to be able to be switched on and off at random times. Smart meter emissions would be confidentially recorded throughout the study, using suitable equipment to determine if there is a correlation between sleep patterns and emissions. Recruit healthy volunteers (equal numbers of males and females) to spend a few nights sleeping in the room, while collecting electroencephalogram (EEG) data to gauge sleep and brain wave patterns, etc. The smart meter source would be switched on and off for some of the volunteers, but neither the volunteers nor the people overseeing the experiment would know whether or not the smart meter was active or not. A questionnaire would also be used to assess subjective feelings such as depression, stress, anxiety levels and tinnitus, for example. A second part of the study would be to call for volunteers who claim to be affected adversely by smart meter emissions to see if their symptoms correlate with the times when the meter is emitting. A provocation study could be included here to see if these subjects can sense whether or not the meter is active while they are awake.

Most importantly, an independent oversight committee would be created and would include members from concerned community organizations, public interest groups and the medical fraternity. This would ensure that the eventual findings have been obtained without the influence of vested interests.

If at the end of the first part of the study the volunteers show no differences in sleep patterns, even when sleeping next to an active smart meter, that would go a long way in assuring the public that smart meters are safe. If, on the other hand, clear differences in

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[23] The International Committee of Medical Journal Editors "uniform requirements" statement. http://www.icmje.org/ethical_4conflicts.html

sleep patterns are seen, that would call for a re-evaluation of the current mass deployment of smart meter technology. It is inexcusable that to date, absolutely no research focusing specifically on possible smart meter health hazards has been conducted.

It is a sad state of affairs if this research is avoided simply because the findings may constitute a risk to the deployment of AMI technology.

I understand that approximately $100 million has been set aside nationally for four smart meter pilot roll-outs. It would only require a small fraction of this money to conduct the above-suggested study and hopefully resolve the controversial health effects issue.

Taking a strictly benefit-cost analysis viewpoint, the cost of the public opposition to AMI (smart metering) technology, based on health concerns, is a factor that needs to be included in any such analysis. Whether or not that factor is real of imagined is not the issue in this regard. It exists and can only be resolved by independent research as outlined above.

It is therefore recommended that the Massachusetts state government err on the side of caution and halt the deployment of AMI smart metering until the above-mentioned research has been conducted and the issue clarified. Only then can steps be taken to eliminate or mitigate the risk once the extent of it is known.

Don Maisch PhD

Appendix A

Extracts from *The Procrustean Approach: Setting Exposure Standards for telecommunications frequency Electromagnetic Radiation*

Abstract: Since the 1950s there has been an ongoing controversy regarding the possibility of health hazards from exposure to non-ionizing radiation emissions from radiofrequency and microwave (RF/MW) sources ranging from military radar to telecommunications. In response to these concerns, and with support from the World Health Organization's International EMF Project (IEMFP) human exposure limits have been developed by the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). These limits, although differing in detail, are founded on the same scientific literature base and deem that the primary hazard to be considered in setting human exposure limits is thermal. This is defined as an excessive and harmful rise in body temperature as a consequence of exposure to high-level RF/MW emissions. This viewpoint has come to dominate the debate at an international level and is justified by these organizations as a product of expert risk assessments of peer reviewed data. The thesis challenges the validity of this viewpoint by critiquing regulatory risk assessment and the peer review and advisory processes that have shaped RF/MW regulation. It is shown that these processes have been prone to political manipulation and conflicts of interests leading to various scientific perspectives being marginalized with reluctance on the part of regulators to make decisions that might inconvenience industry interests. To substantiate these claims the thesis provides an assessment of the development of the American RF/MW standard from the 1950s and its later revisions under the IEEE, the ongoing development of guidelines and standards by ICNIRP and IEMFP and RF/MW standard development in Australia. The thesis concludes with the argument that, given the sheer number of people exposed to RF/MW from telecommunications devices, there is an urgent need to reform the standard setting process and to conduct an international re-assessment of the biological limits placed on current RF/MW standards.

Conclusions: The marginalization of criticisms of the validity of the thermal approach to RF standard setting has been an important issue raised in this thesis and is what I call the Procrustean Approach, where all scientific evidence not in conformity with the thermal bed of knowledge is simply cut off from consideration. Such a state of affairs has been maintained by the creation of restricted risk assessment methodologies, conflicted peer review and expert committees constituted primarily by individuals who have a vested interest in maintaining the status quo. This has been illustrated in this thesis by the analysis of the IEEE's peer review processes for accepting research papers for consideration in RF standard setting, the IEGMP/ICNIRP's risk assessment committees and the case study of the Australian RF standard setting process. In all three cases the problem of conflict of interest can be more accurately described as a majority shared interest in maintaining the status quo in standard setting for vested interest considerations… It is important to note that the concerns raised in this thesis also apply to other broader environmental debates where industry and other vested interests, following revisionist principles, have been able to influence the parameters for regulation of their activities. In this context, this thesis contributes to the debate over the role played by peer review and expert advisory committees by illustrating that these processes, far from being a source of unproblematic and objective expert advice, can be prone to conflict of interest and a biased interpretation of scientific information, as exampled herein by the RF controversy.

Appendix B (A brief examination of the three references given for Section 7, page 31)

1) The referenced WHO report, titled **Systematic review on the health effects of exposure to radiofrequency electromagnetic fields from mobile phone base stations,** does not deal with smart meter exposures. It concludes that no relationship exists between mobile phone base stations and acute symptom development (thermal effects). However, for long-term effects it concludes "data are scarce and the evidence for the absence of long-term effects is limited. Moreover, very little information on effects in children and adolescents is available and the question of potential risk for these age groups remains unresolved. Where data are scarce, the absence of evidence of harm should not necessarily be interpreted as evidence that no harm exists. Further research should focus on long-term effects and should include children and adolescents…. such studies should include an assessment of exposure to other sources of radiofrequency electromagnetic fields in daily life, such as mobile and cordless phones and wireless local area networks".

2) The report by Richard Tell Associates, titled **An Evaluation of Radio Frequency Fields Produced by Smart Meters Deployed in Vermont**, is a very informative report on actual smart meter measurements and is useful in that regard. It concludes that any potential exposure to the investigated smart meters will comply with the FCC exposure rules by a wide margin.

3) The report, written for the Public Utilities Commission of Texas (PUCT), was prepared by Alan Rivaldo, a Cyber Security Analyst at PUCT. Titled **Health and RF EMF from Advanced Meters** the report takes the extreme view that a scientific consensus has been reached within the body of scientific evidence for RF, and people who do not understand this are suffering from misconceptions based on faulty assumptions. This supposed consensus according to Rivaldo is that there are no known non-thermal effects from exposure to RF. He asserts that reports of EHS are unrelated to RF exposure but may be due to psychiatric conditions or stress from worry, going on to say that "scientific studies show that people who are ill are highly receptive to negative suggestions and may demonstrate a 'nocebo response' as a result of these suggestions". The overall impression given by the report is that the "weight of scientific evidence", as presented by organizations such as the IEEE, ICNIRP, the FCC and others, is a body of credible research which is above serious reproach. Any claims otherwise come from notorious, biased researchers who lack scientific rigor. In what is unusual for a supposedly scientific document, the report resorts to making personal attacks on a number of people. While serving up a diatribe against anyone claiming that non-thermal effects exist, especially about smart meters, the author althogether overlooks the significant industry biases and level of scientific uncertainty that exists in the RF controversy, relying exclusively on industry sources for his claims. As such, the PUCT report reads more like the writings of a product defence PR company than a scientific review, which it is not. The best that I can say about the PUCT report is that it is a suitable example of what I call the Procrustean Approach as mentioned in Appendix A.

   While the first two references given in the Massachusetts DPU report (1 and 2 above) do have scientific merit in their area of expertise, the PUCT report does not, and, in my opinion, it should not have been included as a reference in the Massachusetts DPU electricity grid modernization report.