'precautionary principle'.

Possible environmental effects Vegetation

OTLB (2011), http://stopsmartmeters.org/2011/04/08/shrubs-I-lie/

In the photos above, taken 20 days apart in the USA, severe die off of the bush is noted after the installation of wireless Smart Meters. It was reported that none of the other plants or trees in the area (further away from the units) were affected.

Similar was found in Canada after installation of a wireless Smart Meter. The meter was in place less than two months at the time the photo was taken. Prior to installation, leaves in the area where it was to be housed were green and healthy indicating that radiation from Smart Meters may cause adverse effects on vegetation.

Image sources: http://www.youtube.com/watch?v=IsuP_WBBr2c, Weatherall(2011).

The possible validity of such conjecture is indicated in research by Roux et al. (2007), Sandu et al. (2005), Balmori (2004), Selga & Selga (1996), Magone (1996), Balodis et al (1996), Brauer (1950) – and that discussed by Firth (2010) – some of which indicates that RF/microwave radiation may damage vegetation, even at levels below those typically emitted by wireless Smart Meters.

The earliest research proving that microwaves could affect plant growth appears to have been undertaken in 1905 (Bose 1919).

The use of wired Smart Meters, or retention of existing meters until such problems as appear to exist are solved, would appear prudent. *Smart Meters need not be wireless and can be safe and smart.*

References

Balmori, A. (2004), ¿Pueden afectar las microondas pulsadas emitidas por las 138tratfor de telefonía a los árboles y otros vegetales? Ecosistemas, www.hese-project.org/de/emf/WissenschaftForschung/Balmori_Dr_Alfonso/Ecosistemas_(Alfonso).pdf

Balodis, V., et al (1996), Does the Skrunda Radio Location Station diminish the radial growth of pine trees? The Science of the Total Environment 180:57-64.

Brauer, I. (1950), Experimental studies on the effect of meter waves of various field intensities on the growth of plants by division. Chromosoma 3, pp. 483-509.

Bose, J.C. (1919), The Response of Plants to Wireless Stimulation, Letters to Editor, Nature 104, pp. 172-174.

Firth, N. (2010), Is Wi-Fi killing trees? Dutch study shows leaves dying after exposure, http://www.dailymail.co.uk/sciencetech/article-1332310/Is-Wi-Fi-killing-trees-Dutch-study-shows-leaves-dying-exposure-Wi-Fi-radiation.html#ixzz1Ll541Xrk

Magone, I. (1996), The effect of electromagnetic radiation from the Skrunda Radio Location Station on *Spirodela polyrhiza* (L.) Schleiden cultures. The Science of the Total Environment 180, pp. 75-80.

OTLB (2011), Shrubs Don't Lie- We Should Listen When They Die, http://stopsmartmeters.org/2011/04/08/shrubs-dont-lie/

Roux, D., Vian, A., Girard, S., Bonnet, P., Paladian, F., Davies, E. & Ledoigt, G.(2007), High frequency (900 MHz) low amplitude (5 V m^{-1}) electromagnetic field: a genuine environmental stimulus that affects transcription, translation, calcium and energy charge in tomato, Planta, 227, pp. 883–891.

Sandu, D.D., Goiceanu, C., Ispas, A., Creanga, I., Miclaus, S., Creanga, D.E. (2005), A preliminary study on ultra high frequency electromagnetic fields effect on black locust chlorophylls, Acta Biologica Hungarica, 56, pp. 109–117.

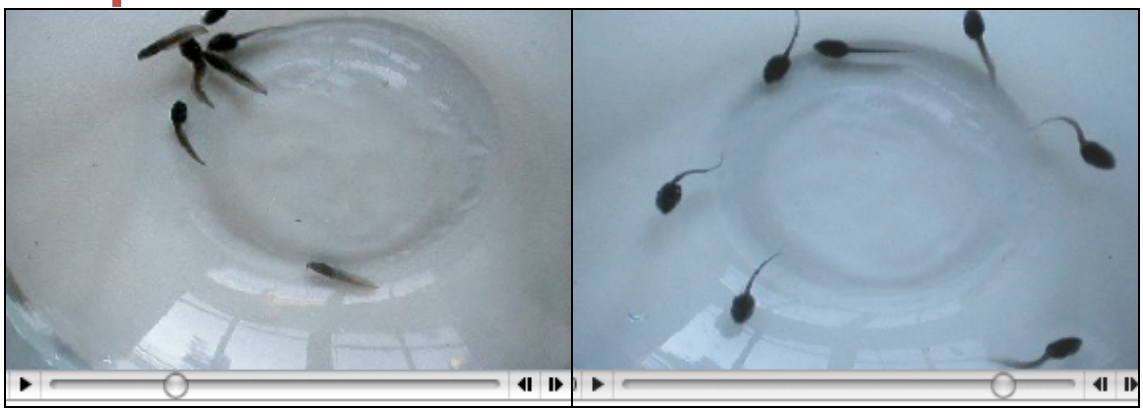
Selga, T. & Selga, M. (1996), Response of Pinus sylvestris L. needles to electromagnetic fields. Cytological and ultrastructural aspects. The Science of the Total Environment 180:65-73, Elsevier Science BV.

Tkalec, M., Malarik, K., Pevalek-Kozlina, B. (2007), Exposure to radiofrequency radiation induces oxidative stress in duckweed Lemna minor L., Sci. Total Environ. 388, pp. 78–89.

Weatherall, M. (2010), Stratford – Death by Smart Meter and Wi Fi, http://weepnews.blogspot.com/2010/09/138tratford-death-by-smart-meter-cbc.html

Weatherall, M. (2010), Stratford Smart Meter Killing Shrub, http://www.youtube.com/watch?v=lsuP_WBBr2c

Amphibians



Videos of tadpoles exposed to antenna radiation (left) & shielded controls (right). http://bemri.org/component/content/article/43-heseuk/100-amphibians-eggs-and-tadpoles-of-common-frog.html (© Balmori, A. 2008).

There is presently a drastic decline in wild amphibian populations, and an increase in the number of deformed amphibians being found (Blaustein & Johnson 2003). Balmori (2006) suggested electromagnetic pollution may have a role to play in this.

Balmori (2010) investigated whether RF/microwave emissions, at levels that could be found in the everyday environment, could affect frogs' biological development. In this study he exposed frogs' eggs and tadpoles to radiation from several mobile phone base stations at a distance of 140 m over a 2-month period.

The group exposed to environmental RF/microwave fields of 1.8-3.5 V/m (n = 70) had poor coordination of movements, exhibited asynchronous growth (resulting in big and small tadpoles) and had high mortality (90%).

In comparison, the control group (n = 70) under the same conditions (with the exception of being protected from those fields by a Faraday cage), exhibited normal coordination of movements, synchronous development and only 4.2% mortality.
Refer also to the video link.

These results indicate that RF/microwave radiation levels, even within current safety guidelines, may be harmful to wildlife, and that measures should be taken to reduce such emissions.

There is also the possibility (as yet apparently uninvestigated) that the drastic decline may in part be due to RF/microwave regimes suppressing immune system functioning, thereby allowing viruses to multiply more readily inside the body.

References

Balmori, A. (2010), Mobile Phone Mast Effects on Common Frog (*Rana temporaria*) Tadpoles: The City Turned into a Laboratory. Electromagnetic Biology and Medicine, 29(1–2), pp. 31-35.

Balmori, A. (2006), The incidence of electromagnetic pollution on the amphibian decline: is this an important piece of the puzzle? Toxicological and Environmental Chemistry, 88, pp. 287–299.

Blaustein, A.R. & Johnson, P.T.J. (2003), Explaining frog deformities, Scientific American 288, pp. 60–65.

Research indicates that both natural and artificial electromagnetic phenomena can cause positive and negative effects on the environment. One of the key challenges in Smart Meter development will be to ensure that they are biologically friendly.

Birds

Image source: Arvind Balaraman, http://www.freedigitalphotos.net/images/view_photog.php?photogid=1058

Everaert & Bauwens (2007) recorded fewer male House Sparrows in areas with relatively high electric field strengths caused by RF/microwave field emitters (mobile phone base stations) than in lower field areas. Spatial variation was negatively and highly significantly related to the field strengths from such units ($p < 0.001$).

Similar findings were made by Balmori & Hallberg (2007) with regard to House Sparrows exposed to fields in the 1 MHz – 3 GHz range (that UK wireless Smart Meters and appliances will operate within).

They noted reduced bird density in areas of increased field strength ($p = 0.0001$).

Balmori (2005) had previously indicated that increased exposure to microwave radiation (as indicated by electric field intensity) may hinder the reproduction and productivity of white stork. Increased aggression was also noted under the higher field regimes.

Whilst the need for caution is apparent, further research, particularly as related to the increased field levels that the presence of wireless Smart Meters, or powerline communications (PLC), might cause (unless systems are upgraded) would appear warranted.

References

Balmori, A. & Hallberg, Ö. (2007), The Urban Decline of the House Sparrow (Passer domesticus): A Possible Link with Electromagnetic Radiation. Electromagnetic Biology and Medicine, 26, pp. 141–151.

Balmori, A. (2005), Possible effects of electromagnetic fields from phone masts on a population of white stork (*Ciconia ciconia),* Electromagnetic Biology and Medicine, 24, pp. 109–119.

Everaert, J. & Bauwens, D. (2007), A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding House Sparrows (*Passer domesticus*), Electromagnetic Biology and Medicine, 26, pp. 63-72.

Insects

A growing body of scientific literature indicates that inappropriate electromagnetic field (EMF) regimes may adversely affect insects, including bees and other insect pollinators.

Greatly reduced numbers of insects would adversely affect Nature's food chain, and may partially explain reduced numbers of some bat and bird species.

Common fruit fly (*Drosophila melanogaster*)

Panagopoulos et al. (2004) found exposing common fruit fly to modulated nearfield 900 MHz GSM radiation for 6 minutes daily for the first 2-5 days of their adult lives decreased their reproductive capacity by 50%-60%.

Similar exposures with unmodulated waves were shown to cause a 15%-20% reduction. The effects of long-term exposures were not investigated. Panagopoulos et al. (2010) further noted that bioactivity was greatest for intensities down to less than 10 μW/cm^2 and was still evident until 1 μW/cm^2.

Honey bees (*Apis mellifera*)

These and other insect pollinators are vital for many agricultural crops. Gallia et al. (2009), estimated that the total economic value of insect pollination worldwide is €153 billion (£135 billion).

It has been recognised for several decades that electromagnetic fields can influence bees' behaviour (Korall et al. 1988, Warnke 1976, Lindauer & Martin 1968). How such fields may be made more biologically friendly has been alluded to.

Korall et al. (1988) noted that bursts of magnetic fields could induce jumps of misdirection in bees - they also noted ways that such problems might be avoided. Whether the pulsed emissions from

Smart Meters may induce jumps of misdirection, or adverse health effects in bees (and if so how these may be remedied), have yet to be assessed.

Sharma & Kumar (2010) compared the performance of honey bee colonies either exposed or unexposed to RF/microwave radiation from mobile phones. Exposures were for 15 minutes twice a day, twice a week from February to April. They found a significant ($p < 0.05$) decline in colony strength and queen's egg-laying rate in those exposed. Forager bees were negatively influenced by exposure, and neither honey nor pollen was found in the exposed colony at the end of the experiment. According to the authors, the average power density experienced 8.5 $\mu W/cm^2$.

Neelima et al. (2011), investigating the effect of short-term mobile phone radiation on adult worker honey bees found that exposure to RF/microwave radiation for up to 40 minutes altered worker bees' behaviour and physiology. Favre (2011), additionally found RF/microwave radiation from active mobile phone handsets had a dramatic effect on worker bee behaviour, principally by inducing a piping signal that announces either that a colony is disturbed or that it is going to swarm. Negative control runs using a radio did not induce changes in behaviour.

RF/microwave radiation, alongside other contenders such as immunodeficiencies, mites and pesticides may be contributing to the dramatic decline of insect pollinators worldwide.
Until such time as this might be disproved it would appear prudent to limit such emissions.

References

Favre, D. (2011), Mobile phone-induced honey bee worker piping. Apidologie, DOI: 10.1007/s13592-011-0016-x
http://www.springerlink.com/content/bx23551862212177/fulltext.pdf

Gallia et al. (2009), Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecological Economics, 68(3), pp. 810-821.

Korall et al. (1988), Bursts of magnetic fields induce jumps of misdirection in bees by a mechanism of magnetic resonance, Journal of Comparative Physiology A, 162, 279-284.

Lindauer, M. & Martin, H. (1968), Die Schwereorientierung der Bienen unter dem Einfluss der Erdmagnetfelds. Z. vergl. Physiol. 60, pp. 219-243.

Neelima, R.K. et al. (2011), Exposure to cell phone radiations produces biochemical changes in worker honey bees, Toxicology International, 18(1), pp. 70–72.

Panagopoulos, D.J. et al. (2010), Bioeffects of mobile telephony radiation in relation to its intensity or distance from the antenna. International Journal of Radiation Biology, 86(5), pp. 345-357.

Panagopoulos, D.J. et al. (2004), Effect of GSM 900-MHz Mobile Phone Radiation on the Reproductive Capacity of Drosophila melanogaster, Electromagnetic Biology and Medicine, 23(1), pp. 29-43.

Sharma, V.P. & Kumar, N.R. (2010), Changes in honeybee behaviour and biology under the influence of cellphone radiations. Current Science, 98(10), pp. 1376-1378.

Warnke, U. (1976) Effects of Electric Charges on Honeybees. Bee World, 57(2), 50-56. http://bemri.org/archive/hese-uk/en/papers/warnke_bee_world_76.pdf

WHO (1986), Ottawa Charter for Health Promotion, First International Conference on Health Promotion Ottawa, 21 November 1986 - WHO/HPR/HEP/95.1, http://www.who.int/hpr/NPH/docs/ottawa_charter_hp.pdf

"Systematic assessment of the health impact of a rapidly changing environment - particularly in areas of technology, work, energy production and urbanization - is essential." WHO (1986). *Refer also to Appendix 3 'Health Promotion'.*

SmartReach, the UK consortium created to address the UK Government mandate on Smart Meter installation is "*committed to helping protect the environment and to making a meaningful contribution to the development of a thriving low–carbon economy*." It is comprised of three companies: BT, Arqiva and Detica. http://smartreach.com/

Security of Supply

Image source: smokedsalmon / FreeDigitalPhotos.net,
http://www.freedigitalphotos.net/images/view_photog.php?photogid=2038

"*In a world of startling change, the first duty of the Government remains: the security of our country."* UK Prime Minister David Cameron and UK Deputy Prime Minister Nick Clegg (HMG 2010).

Both natural and malicious manmade events can affect security of supply as can the design of smart grids, Smart Meters and smart appliances.

Reference

HMG (2010), A Strong Britain in an Age of Uncertainty: The National Security Strategy, HM Government, Presented to Parliament by the Prime Minister by Command of Her Majesty October 2010, The Stationery Office Limited.

Vulnerability to Space Weather

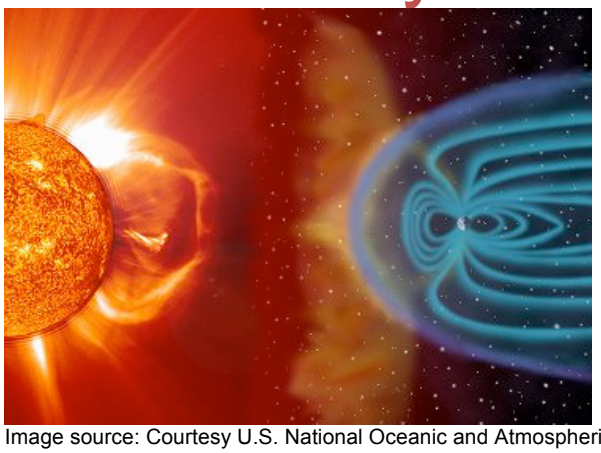


Image source: Courtesy U.S. National Oceanic and Atmospheric Administration (NOAA).

Solar super storms

According to NASA, the US National Oceanic and Atmospheric Administration (NOAA), the Sun may be entering a particularly vicious solar maximum in 2013, similar to that in which the Solar Super Storm of 1859 (*the most powerful solar storm ever recorded*) occurred (Moskowitz 2011, NASA 2010, US NRC 2008).

Solar storms can greatly compromise the integrity of electrical grids and damage electrical equipment and satellites.

The effects that the electromagnetic pulses (EMP) of a solar super storm would have on Smart Meters, smart grids and smart technologies have yet to be fully assessed. Such storms are already a major threat to less vulnerable grid systems (Birnbach 2011).

The US and UK are now planning to undertake “controlled” power cuts to their national electricity supplies to protect them against potential damage from large solar storms that might otherwise take months or even years to repair (Connor 2011).

1859 & likelihood of similar events

During the 1859 event, the most powerful solar storm ever recorded, caused the telegraph systems in North America and Europe to short out creating electric shocks and numerous fires (Odenwald 2000). Nowadays the effects would be far more damaging and widespread due to the increased use of electricity and more complex technology that is more easily damaged.

Marusek (2007) claims that such a storm could cause long-term blackouts in the USA, Canada, Europe, China, Central Asia, Russia, Argentina, Chile and New Zealand.

According to Dr Richard Fischer (Hough 2010), director of NASA's Heliophysics Division, the next solar storm of such a magnitude hitting Earth "*will disrupt communication devices such as satellites [as used for some smart grid communications – present author's comment] and car navigations, air travel, the banking system, our computers, everything that is electronic. It will cause major problems for the world.*"

On 7th June 2011 the largest ever observed coronal mass ejection from the Sun took place (Mosher 2011).

According to Antti Pulkkinen, head of NASA's "Solar Shield" satellite-based detection system, such events could cause a "*major space weather event*" if they were orientated towards the Earth (Behr & ClimateWire 2011).

It is predicted by some scientists that the Sun's 11-year cycle will now hit its maximum in late 2013 or early 2014. Phillip Chamberlin of NASA's Solar Dynamics Observatory said that there could be very energetic solar storms "*every couple of months instead of years*," at that time (Mosher 2011). It appears imperative to have smart grids protected against such events.

Such an event would cause individuals to be without electricity for hours or days. In the worse case scenario, large areas of the Earth would be without electricity for longer periods, possibly several months. Countries with "*fragile*" grid infrastructures are likely to be affected most.

It is predicted that upcoming solar flares could greatly endanger national security and take down key services such as electricity grids, electronics and communications for prolonged periods.

It is predicted that the next solar super storm could occur in 2012-2014. The 1859 super solar storm took place during a solar cycle of about the same size that NASA is predicting for 2013 (NASA 2009).

The present design of many high-tech devices (including Smart Meters) makes them more vulnerable to the effects of space weather than the units and technologies they replace. Transformer designs could also be improved (Birnbach 2011, EMPrimus 2011).

Solar storm of 1989

Generator step-up transformer damaged by March 1989 solar storm.
Images: Kappenman (2011). Images originally provided courtesy of Public Service Electric and Gas and Peter Balma.

The geomagnetically induced currents (GICs) that the solar storm of 1989 created caused the overloading of circuits, tripping of breakers, and (in severe cases) even melted the windings on heavy-duty transformers (NASA 2010). Transformers were damaged in the USA, Canada and the UK. Satellites were also damaged – *this latter fact is mentioned as some smart grids use satellites for communication which might get damaged in future solar storms.*

The March 1989 event was of considerably lesser strength than the 1859 event (a Disturbance storm time (Dst) value of -589 nT was registered in 1989 compared to a Dst of -1760 nT for the 1859 event (Lakhina et al. 2005). [The Dst index is a measure of geomagnetic activity used to assess the severity of magnetic storms. It is expressed in nanoteslas and based on the average value of the horizontal component of the Earth's magnetic field measured hourly at four near-equatorial geomagnetic observatories. *A negative value is shown when the Earth's magnetic field is weakened*].

Fortuitously, that solar storm hit in the middle of the night: if it had hit during peak load conditions, grid closure may have cascaded into the USA (Riswadkar & Dobbins 2010).

It caused over 200 power anomalies in North America. These included: the blackout of the province of Québec in Canada (*due to a voltage depression over a 90-second period that could not be mitigated by automated compensation equipment*); melting of power transformers in New Jersey (*including the failure of a transformer at a Nuclear Power Plant*); voltage swings at major substations; and generators tripping and going out of service (US NRC 2008).

A utility firm placing a top priority order for the replacement of a damaged generator step-up transformer as a result of the 1989 event was told it would take almost 2 years to fulfill. Luckily, a spare was available which was installed within 6 weeks (Marusek 2007). Within 25 months of the March 1989 storm, 12 Nuclear Plants had transformer incidents that were suspected as being delayed failures caused by that storm (Kappenman 2011).

The direct cost of the March 1989 solar storm was over $2 billion [£1.245 billion]. The cost of protecting key areas of the US grid against EMP would be $150 million [£94 million] (Riswadkar & Dobbins 2010). The costs would be greater for smart grids as present grid designs have unknowingly increased GIC risks and their potential impacts (Kappenman 2011). Measures to reduce risk are already being put in place by governments to secure their "*critical electric infrastructures*" (EIS 2011, 2010).

Solar storms of equal, or greater, magnitude to that of the 1989 solar storm have occurred in 1859, 1872, 1882, 1903, 1909, 1921, 1928, 1938, 1958, 1989 (Gonzalez et al. 2011). It appears more cost-effective to create robust smart grids now than to have to do so in retrospect. Solar events are not particularly rare.

Smart Meters are more vulnerable to solar storms than the meters they replace, as the chips for their integrated circuits are easily damaged by solar EMPs/geomagnetically induced currents (GICs).

Research indicates that large GICs are also possible at low-latitudes, as well as at high latitudes (Kappenman 2011).

It appears that smart grids will need to be protected against solar EMP to comply with the International Infrastructure Security Roadmap.

References

Behr, P. & ClimateWire (2011), Solar Flare This Week Illuminated Power Grid's Vulnerability, Scientific American, 9 June 2011.

Birnbach, C. (2011), Understanding the problem: Nuclear and Non-Nuclear EMP. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

EIS (2011), EIS Summit: International Infrastructure Security Roadmap, Electric Infrastructure Security Summit - The Capitol Building, US Congress, Washington D.C., 11 April 2011.

EMPrimus 2011, Grid and transformer protection, http://www.emprimus.com

EIS (2010), EIS Summit Summary Report, Report: The First World

Infrastructure Security Summit, Electric Infrastructure Security Summit - London, 20 September 2010, Westminster Hall, Parliament, UK.

Gonzalez, W.D. et al. (2011), Extreme geomagnetic storms, recent Gleissberg cycles and space era-superintense storms, Journal of Atmospheric and Solar-Terrestrial Physics, 73, pp. 1447-1453.

Hough, A. (2010), NASA warns solar flares from 'huge space storm' will cause devastation, The Telegraph, 14 June 2010, http://www.telegraph.co.uk/science/space/7819201/Nasa-warns-solar-flares-from-huge-space-storm-will-cause-devastation.html)

Kappenman, J.G. (2011), Severe Solar Activity/Space Weather and the Global Threat to Electric Grids. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

Lakhina, G.S. et al. (2005), Research on Historical Records of Geomagnetic Storms. In: Proceedings IAU Symposium No. 226, International Astronomical Union, Dere, K.P. et al. (Eds).

Marusek, J.A. (2007) Solar Storm Threat Analysis, Impact. 29pp.

Mosher, D. (2011), Solar Flare Sparks Biggest Eruption Ever Seen on Sun: Enormous ejection of particles into space shocks scientists. Daily News, National Geographic, 8 June 2011, http://news.nationalgeographic.com/news/2011/06/110608-solar-flare-sun-science-space/

Moskowitz, C. (2011), U.S. Must Take Space Storm Threat Seriously, Experts Warn, http://www.sott.net/articles/show/224561-U-S-Must-Take-Space-Storm-Threat-Seriously-Experts-Warn

NASA (2010), Solar Shield – Protecting the North American Power Grid, http://science.nasa.gov/science-news/science-at-nasa/2010/26oct_solarshield/

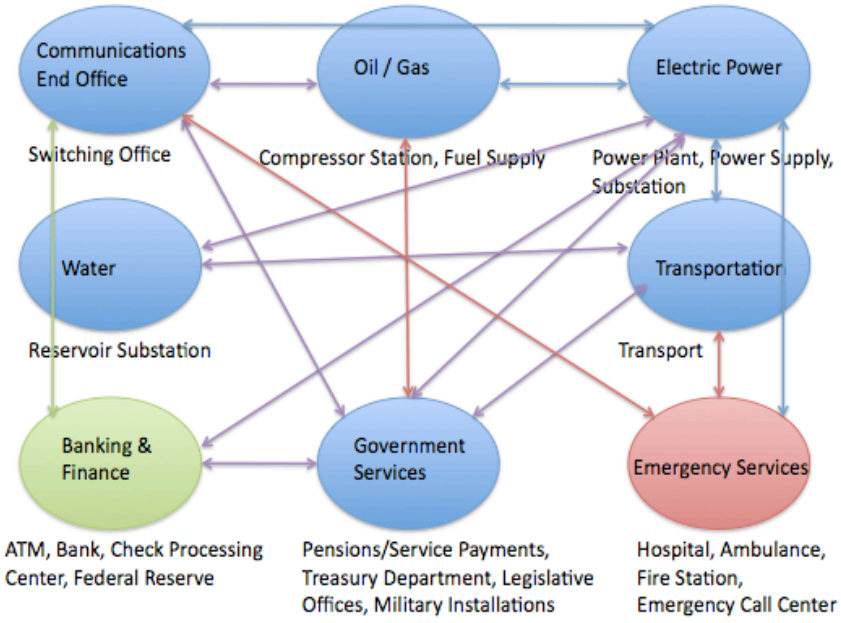
Riswadkar, A.V. & Dobbins B. (2010), Solar Storms: Protecting Your Operations Against the Sun's 'Dark Side', Zurich Services Corporation, 12 pp.

NASA (2009), New Solar Cycle Prediction, Science News, NASA Science, http://science.nasa.gov/science-news/science-at-nasa/2009/29may_noaaprediction/

NOAA/SEC (1999), NOAA/SEC Satellite Working Group, April 1999, http://www.swpc.noaa.gov/sww/sww99/WGReports.html

Odenwald, S. (2000), The 23rd Cycle: Learning to live with a stormy star, Columbia University Press, http://www.solarstorms.org/S23rdCycle.html

Sensitivity to geomagnetic storms



The economy is sensitive to geomagnetic storms due to a network of interdependencies. [Adapted from original graphic by US Department of Homeland Security].

The US National Research Council (NRC 2008) states, "*Because of the interconnectedness of critical infrastructures in modern society, the impacts of severe space weather events can go beyond disruption of existing technical systems and lead to short-term as well as to long-term collateral socioeconomic disruptions*."

"*There is limited time to upgrade national electric grids to avoid solar flare-induced, global scale burn out*." Arbuthnot et al. (2010).

The consequences of such an event could be very high, as its effects could cascade through other systems dependent, either directly or indirectly on electricity. It is therefore vital that smart grids and Smart Meters are robust and able to withstand such threats.

Distribution of drinkable water could be compromised, as could cooking and food refrigeration facilities, fuel supply, heating, lighting, Internet and telephone communications, sewage disposal and transport (fuel pumps require electricity to work). Banking, government, medical treatments and emergency services could also be affected to various degrees.

The effects of a solar super storm, as predicted for 2012/2013, could take many years to correct and severely damage national economies unless appropriate measures are taken in time.

UK Government Expert Opinion

The UK Government is aware of the threat of solar storms and has already taken various contingency measures, including allowing some transformers to be switched off if necessary (Connor 2011).

The UK's National Risk Register (NRR 2010) has contingency plans to cope with a complete national outage and regional outage of electrical supplies. It states that "*In the event of a national outage (which has never occurred), and provided there had been no damage to the system, the objective would be to restore supplies throughout Great Britain within three days*." Some question whether such measures are adequate.

The UK Government's chief scientific adviser when speaking at the annual meeting of the American Association for the Advancement of Science (AAAS) in Washington DC earlier this year noted that solar storms could cause catastrophic damage to the world's economy.

"*The potential vulnerability of our systems* [to space weather] *has increased dramatically. Whether it's the smart grid in our electricity systems or the ubiquitous use of GPS*."
Professor Sir John Beddington, UK Government's chief scientific adviser (Brewster 2011).

Similar concerns were raised by UK Defence Secretary, The Right Honourable Liam Fox MP, in 2010 when he warned that with our heavier reliance on technology our way of life is now more at threat from such solar events than ever before (EIS 2010).

It is estimated that the cost of what Professor Sir John Beddington call a potential "*global Katrina*", caused by the increased solar storm activity could be up to $2 trillion (£1.2 trillion) as a result of various technologies being knocked out unless suitable precautionary measures are undertaken.

Whilst severe solar storms occur infrequently, they have the potential to create catastrophic long duration impacts on electricity supply and end users (US NRC 2008). Less severe storms can also cause significant damage.

As Smart Meters are more vulnerable to stray high-energy electrical fields than the units they replace, a delayed rollout till after 2014 might be worth considering for this reason alone.

Erinmez et al., (2002) noted that whilst the power transmission systems of UK's National Grid are "*generally designed to operate reliably under challenges mainly related to terrestrial weather conditions … the measures* [used to increase their] *robustness have also made transmission systems more vulnerable to the risk of space weather through geomagnetic storm activity*."

US Expert Opinion

In similar vein, Jane Lubchenco, head of the National Oceanic and Atmospheric Administration (NOAA), is on record as having said at the AAAS 2011 meeting that the US also needs to be better prepared than at present to avoid loss of electrical power and communications as a result of solar flares.

She stated that "*This is not a matter of if, it's simply a matter of when and how big. We have every reason to expect we're going to be seeing more* [potentially harmful] *space weather in the coming years, and it behooves us to be smart and to be prepared*."

"*Many things we take for granted today are so much more prone to the effects of space weather than was the case during the last maximum*," Lubchenco declared (Moskowitz 2011a). The challenge faced may increase as the World is likely to become more 'technologically dependent' as it edges towards 2013 and other periods of solar maxima – *it appears wise to start 'future proofing' technology now and industry needs help from governments to do so*.

"*What's at stake are the advanced technologies that underlie virtually every aspect of our lives*." Tom Bogdan, Director of the US Space Weather Prediction Center. He also mentioned that forthcoming individual solar events could be particularly powerful (Lovett 2011).

These echo the earlier thoughts of John Kappenman at the 2008 US National Research Council workshop on the societal and economic impacts of severe space weather events (US NRC, 2008). He additionally noted that lack of preparedness could result in "*significant societal impacts and with economic costs that could be measurable in the several-trillion-dollars-per-year range*."

Seven months after that meeting, NASA found a giant breach in the Earth's protective shield (Phillips 2008) that will increase the impact of solar storms above those discussed in the report above – *present author's comments.*

Need for robust smart grid solutions to space weather

Since 1989, development of open access on transmission systems has encouraged the transport of large amounts of energy across grid infrastructures to benefit economic returns by delivering less expensive energy to areas on demand.

That rationalisation, however, taken alongside the increased likelihood of multiple equipment failures from solar events has increased the risk of collateral damage – *sophisticated items, such as Smart Meters (and satellites used for smart grids), are more likely to be damaged by such events than the equipment they replace. Smart appliances too might be more easily damaged than their conventional counterparts?*

The vulnerabilities of electric grids to EMP events are now being addressed in the USA by the US National Security Working Group (NSWG 2011). Also in February 2011, US Congressman Trent Franks proposed for federal legislation the H.R. 668 SHIELD Act, "*to amend the Federal Power Act to protect the bulk-power system and electric infrastructure … against natural and manmade electromagnetic pulse (`EMP') threats and vulnerabilities,"* (Franks 2011).

Further support for increasing the robustness of smart grid systems worldwide – *as related to space weather* – beyond what is already being achieved might prove appropriate?

Riswadkar & Dobbins (2010) propose the hardening of system and critical assets through installing circuits or passive devices to prevent, or reduce, geomagnetically induced currents (GICs) flowing into electrical grids. Both aging transformers & grid infrastructure and smart grids create mitigation challenges.

The risk of solar flares to the low orbiting satellites that can be used for smart grid data transference too has to be taken into consideration – *these too should be hardened*. X-class flares, which are on the increase till 2013 (Moskowitz 2011a), can cause their orbital decay.

Some locations where Smart Meters will be installed are more vulnerable than others. In particular, electrical grids are at greater risk from the effects of geomagnetic activity in areas where igneous rock (such as granite) is present (Odenwald, 2009). [The high resistance of such rock encourages geomagnetically induced

currents (GICs) to course through powerlines situated above them raising risk of damage].

At the very least, as a precautionary measure, it is suggested that consideration should be given to retaining existing electromechanical rotating-disk meters (which are more resilient to space weather than present Smart Meters) till after the solar maxima of 2012/2014 when risk begins to subside. Grids should be appropriately upgraded as finances allow and ideally hardened to increase their resilience.

"*[The risk we face from solar events] is slightly scary, and I think properly so. …We've got to be scared by these events otherwise we will not take them seriously*."
Professor Sir John Beddington, the UK Government's chief scientific adviser (Moskowitz 2011a).

Shielding just 10% of critical infrastructure could reduce anticipated damage from EMP events considerably (The Sage Policy Group, 2007). The present author suggests that as a basic minimum at least 20% should be protected before the main risk periods in 2012-2013 - ideally protection levels should be 'As High As Reasonably Achievable' (AHARA).

Precautions taken to protect smart grids and technology from natural EMP events will also help protect them from EMP events by terrorists/rogue nations.

References

Brewster, T. (2011), Professor Sir John Beddington says governments need to get ready for some serious solar storms. ITPro News, http://www.itpro.co.uk/631306/government-advisor-warns-of-solar-storm-disaster

Connor, S. (2011), 'Controlled' power cuts likely as Sun storm threatens national grid. The Independent, 13 June 2011, http://www.independent.co.uk/news/science/controlled-power-cuts-likely-as-sun-storm-threatens-national-grid-2296748.html

EIS (2010), EIS Summit Summary Report, Report: The First World Infrastructure Security Summit, Electric Infrastructure Security Summit - London, 20 September 2010, Westminster Hall, Parliament, UK.

Erinmez, I.A. et al. (2002), "Management of the Geomagnetically Induced Current Risks on the National Grid Company's Electric Power Transmission System", Journal of Atmospheric and Solar Terrestrial Physics, 64, pp. 743–756. Special Addition for NATO Space Weather Hazards Conference, 2000.

Franks, T. (2011), Secure High-voltage Infrastructure for Electricity from Lethal

Damage Act' or the SHIELD Act', H.R. 668, http://www.empactamerica.org/HR668_SHIELD_Act.pdf

Lovett, R.A. (2011), What If the Biggest Solar Storm on Record Happened Today?: Repeat of 1859 Carrington Event would devastate modern world, experts say. National Geographic News, 2 March 2011, http://news.nationalgeographic.com/news/2011/03/110302-solar-flares-sun-storms-earth-danger-carrington-event-science/

Moskowitz, C. (2011), Sun erupts with mightiest solar flare in 4 years: Explosion hurls massive wave of charged particles into space, toward Earth, http://www.msnbc.msn.com/id/41604785/ns/technology_and_science-space/t/sun-erupts-mightiest-solar-flare-years/

Moskowitz, C. (2011a), U.S. Must Take Space Storm Threat Seriously, Experts Warn, http://www.sott.net/articles/show/224561-U-S-Must-Take-Space-Storm-Threat-Seriously-Experts-Warn

NRC (2008), Severe Space Weather Events - Understanding Societal and Economic Impacts: A Workshop Report, National Research Council of the National Academies, The National Academies Press, 144 pp.

NRR (2010), National Risk Register 2010, http://interim.cabinetoffice.gov.uk/media/349003/nrr2010-chapter2.pdf

NSWG (2011), National Security Working Group, Weekly National Security Working Group Update, Republican Study Committee http://rsc.jordan.house.gov/UploadedFiles/NSGW_041311_Update.pdf

Odenwald, S. (2009), The Day the Sun Brought Darkness. NASA News & Features, http://www.nasa.gov/topics/earth/features/sun_darkness.html

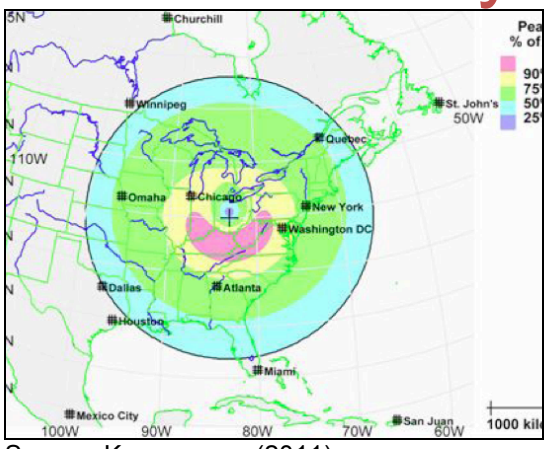
Phillips, T. (2008), Giant breach in Earth's magnetic field discovered, NASA Science, Science News, http://science.nasa.gov/science-news/science-at-nasa/2008/16dec_giantbreach/

Riswadkar, A.V. & Dobbins B. (2010), Solar Storms: Protecting your operations against the Sun's 'dark side', Zurich Services Corporation, 12 pp.

The Sage Policy Group (2007), Initial Economic Assessment of Electromagnetic Pulse (EMP) Impact upon the Baltimore-Washington-Richmond Region, The Sage Policy Group, http://www.pti.org/docs-safety/EMPecon_9-07.pdf

US NRC (2008), Severe Space Weather Events - Understanding Societal and Economic Impacts, http://books.nap.edu/catalog.php?record_id=12507

Practicality, Security, War, Terrorist or Cyber-Attack



Source: Kappenman (2011).

High-Altitude Electromagnetic Pulse (HEMP)

This term is often used for EM signals created from a nuclear detonation interacting with the Earth's upper atmosphere.

EMP can cause "*temporary upset and even catastrophic failure to modern electronics and electrical systems over considerable geographic areas of the Earth*" (NATO 2011).

It is often seen as impracticable to protect wireless systems (such as used in Smart Meter systems? – *present author's comment*) against EMP attack. The US National Security Working Group (NSWG 2011), notes "… *vintage type electronic systems are much more robust and tolerant to EMP effects. The bad news is that these systems are growing old and must be replaced, and they will be replaced with modern versions that are inherently more vulnerable to EMP."*

In the USA, Dr Peter Vincent Pry, former Director of the US Nuclear Strategy Forum and President of EMPact America states "… *given our current state of unpreparedness, within 12 months of an EMP event, about two-thirds of the U.S. total population… would perish from starvation, disease and societal collapse*."
No figures appear available for the UK or Europe.

"*A serious national commitment to address the threat of an EMP … can lead to a national posture that would significantly reduce the payoff for such an attack …*"
William R. Graham, Chairman of the US Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack.

It appears sensible to at least delay the rollout of Smart Meter technology till after the passing of the forthcoming solar maxima. This might also allow time for additional system improvements to be undertaken.

Source Region Electromagnetic Pulse (SREMP)

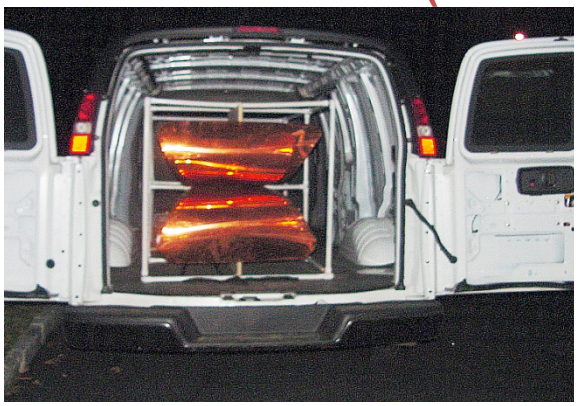
These are caused as a result of nuclear detonation, such as can be created by an air-burst EMP cruise missile, interacting with the Earth's and its adjacent atmosphere.

A single SREMP event could cause irreparable damage to most electronics within a 30 km (18.6 mile) area (Powerwatch 2010). Power supplies for large areas of a smart grid could be easily disabled by such devices unless suitable precautions are taken.

The vulnerability of electronic Smart Meters to such events appears far greater than that of the electromechanical rotating-disk meters they are designed to replace which are unlikely to be damaged.

UK Smart Meters are also being designed so they can be disconnected remotely (Anderson & Fuloria 2010). This may be a major design flaw. As a matter of best practice such meters should be designed to fail in a "supply on" mode (Powerwatch 2010).

Non-Nuclear EMP (NNEMP)



NNEMP Level EMP Source. Source: Kappenman (2011).

Non-Nuclear EMP (NNEMP) is also known as Intentional ElectroMagnetic Interference (IEMI) and is labeled as the "*Intentional malicious generation of electromagnetic energy introducing noise or signals into electric and electronic systems, … disrupting, confusing or damaging these systems for terrorist or criminal purposes*," (IEC 2005).

Extremely powerful portable radio transmitters (*which can be mobile and coordinated*) can be built to create NNEMP. The effects of

NNEMP/IEMI are similar to solar threats and HEMP but are usually more localised, unless a coordinated attack is undertaken (where they could create effects far larger than those achievable by large nuclear EMP pulses).

They pose a serious threat to medium and high voltage transformers and smart grids. Technical solutions are being created to address such threats (Birnbach 2011, Radasky & Savage 2010).

If EMP vulnerabilities remain unaddressed they present increased invitations for attack (Graham et al. 2011).

NNEMP/IEMI present a comparable risk scenario likelihood to that of Cyber Attack (Kappenman 2011).

Power surges

A recent sustained power surge in California appears to further indicate the increased susceptibility of Smart Meters to EMP over the conventional analogue meters they replace (Dremann 2011).

In that incident 80 PG&E SmartMeters caught fire and burned out after the power surge, causing some residents and utilities officials to question their safety. The surge, which lasted 80 minutes, affected 200 homes and businesses. None of the analog meters were affected.

"*The idea with SmartMeters is to make the customers' and the utility's life better, but this is a good example of how sometimes the old way is the good way*."
Debbie Katz, spokesperson for Palo Alto utilities.

Katz further commented that the advantage of the analog meter over its intended 'smart' replacement is that it does not have internal electronics which can be shut down or disrupted by power surges (Dremann 2011).

It is now intended that Paolo Alto city officials will undertake additional research and investigative work to ensure Smart Meter shortfalls and glitches are resolved before investing further in them.

Measures should be taken to ensure that Smart Meters are robust enough to withstand such events. In the meantime, till such matters are addressed, delaying their rollout till after solar maxima subside in 2014 may prove beneficial – *present author's comment.*

References

Anderson, R. & Fuloria, S. (2010), On the security economics of electricity metering, 9th Workshop on the Economics of Information Security, Harvard University, George Mason University in Arlington, VA, June 2010, 18 pp.

Birnbach, C. (2011), Understanding the problem: Nuclear and Non-Nuclear EMP. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

Dremann, S. (2011), Power surge raises questions about SmartMeters: East Palo Alto electricity surge burnt out digital meters, Palo Alto Online News, http://www.paloaltoonline.com/news/show_story.php?id=22378

EIS (2010), EIS Summit Summary Report, Electric Infrastructure Security Summit, 20 September 2010, Westminster Hall, Parliament, UK.

Graham, W.R. et al. (2011), Commission to Assess the Threat from High Altitude Electromagnetic Pulse (EMP): Overview. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

IEC (2005), International Standard IEC 61000-2-13 ed1.0, Electromagnetic compatibility (EMC) - Part 2-13: Environment - High Power Electromagnetic (HPEM) Environments - Radiated and Conducted, International Electrotechnical Commission, Switzerland. Quoted by Koepke (2010).

Kappenman, J.G. (2011), An Overview of ElectroMagnetic Threats to Electric Grids – Space Weather, EMP & IEMI. Round Table presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

Koepke, G. (2010), Highlights of Connectivity Week 2010: EMC and Smart Grid, http://www.emcs.org/acstrial/newsletters/summer10/EMCStandards.html

NATO (2011), Electrical and Electromagnetic Environmental Conditions: AECTP-250 Edition 2, Allied Environmental Conditions and Test Publication, NATO International Staff, Defence Investment Division.

Powerwatch (2010), Smart Meters - smart idea - not so smart implementation http://www.powerwatch.org.uk/news/20101018_smart_meter.asp

Pry, P.V. (2011), Dr. Peter Vincent Pry President, EMPact America Statement Before The Congressional Caucus On EMP The Capitol Room HVC 200 February 15, 2011, http://www.empactamerica.org/pry-statement-to-emp-caucus.pdf

Foster, J.S. Jr. (2008), Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack: Critical National Infrastructures. Commission to Assess the Threat to the United States from Electromagnetic Pulse Attack, http://www.bibliotecapleyades.net/archivos_pdf/empc02.pdf

NSWG (2011), National Security Working Group, Weekly National Security Working Group Update, Republican Study Committee http://rsc.jordan.house.gov/UploadedFiles/NSGW_041311_Update.pdf

Radasky, W. & Savage, E. (2010), Intentional Electromagnetic Interference (IEMI) and Its Impact on the U.S. Power Grid. Report prepared by Metatech Corporation for Oak Ridge National Laboratory. 53 pp.

Preventing EMP catastrophes

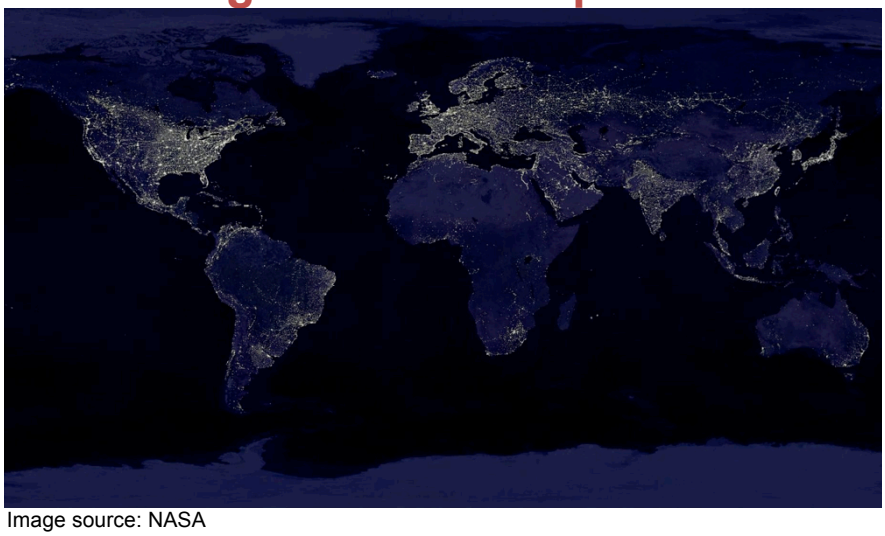


Image source: NASA

Smart grids create more potential points of failure than traditional grids. Ideally, protection should be considered early in the brief. Cost effectiveness is essential (EMPrimus 2011, Koepke 2010).

It is possible with robust planning to prevent EMP catastrophes. Action is required sooner rather than later for smart grids and smart devices, and could create numerous opportunities for investment and the development of new sustainable technologies.

At present there are no procedures to "perform *"black start" [restoring a power station to operation without requiring use of using the external power grid] under severe damage scenario,"* as these require energy and telecom transport that are power dependent (Graham et al. 2011).

Smart grids, Smart Meter systems and related technology should be hardened where practical to prevent adverse effects from EMP.

"*The technology to protect critical infrastructures from natural or malicious electromagnetic threats now exists.*

Implementation costs are estimated at less than 0.01% of GNP. For example, costs for protection of the U.K. electric grid are estimated at approximately £ 0.1B.

The corresponding estimate for the U.S. would be approximately $1B," EIS (2010). … "*Since much of this cost would in any case be incurred for normal periodic upgrade and modernization, the net costs are even lower*," Arbuthnot et al. (2010).

The UK National Security Council recognises cyber-attacks as a Tier One threat – *the highest priority for UK national security* (HMG 2010).

Recommendations (partial listing) – *various authors*

- Adhere to the Electric Infrastructure Security Council (EIS) International Infrastructure Security Roadmap (EIS 2011).
- Determine grid and network level vulnerabilities & prioritise actions.
- Improved forecasting required for EMP events.
- Protect important infrastructures and "high value" assets through appropriate design measures - *including hardening*.* "High value" assets include essential government operations and those of other national institutions.
- Grid-level protection systems should be installed to protect against EMP threats to transformers.
- Harden Smart Meters, smart grids and related technologies against EMP risk.* *(This creates a new level of safety – much like fitting seat belts in automobiles).*
- Delay rollout of additional Smart Meters till after main period of solar risk if unhardened.
- Develop regional and national smart grid restoration plans.
- Provide Government endorsement & tax incentives for required work.
- Undertake "controlled" power cuts when necessary to protect grid.
- Identify & address regulatory gaps that preclude effective mitigation.

*If budget does not stretch to automatically protecting Smart Meters in this way, allow individuals to purchase upgrades that allow them to be hardened.

Recovery periods are shortened as level of grid protection increases (Birnbach 2011). Significant, affordable improvements can be made to prevent, prepare, protect and recover from EMP events (Graham et al. 2011).

It is anticipated that the costs of EMP Protection may in part be compensated by reduced insurance costs (Birnbach 2011).

"*If addressed, our reduced vulnerability helps deter attack, enhances infrastructure resilience and confers added protection against cyber threats and damaging geosolar storms*." Commission to Assess the Threat from High Altitude EMP (Graham et al. 2011).

Certain measures, such as a widespread changeover to fibre-optic data and signal cabling, may greatly increase system robustness to EMP threats (Cikotas & Kappenman 2011), and also open up other streams of revenue (Fehrenbacher 2009) – *the hardening of such systems will further increase their attractiveness to investors*.

References

Arbuthnot, J. et al. (2010), EIS Summit: Electric Infrastructure Security Summit. The First World Infrastructure Security Summit, - London, 20 September 2010, Westminster Hall, Parliament, UK.

Birnbach, C. (2011), Understanding the problem: Nuclear and Non-Nuclear EMP. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

Cikotas, B. & Kappenman, J. (2011), Options for Protection: Protecting National Electric Grids and Critical Infrastructures. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

Connor, S. (2011), 'Controlled' power cuts likely as Sun storm threatens national grid. The Independent, 13 June 2011, http://www.independent.co.uk/news/science/controlled-power-cuts-likely-as-sun-storm-threatens-national-grid-2296748.html

EIS (2011), EIS Summit: International Infrastructure Security Roadmap, Electric Infrastructure Security Summit - The Capitol Building, US Congress, Washington D.C., 11 April 2011.

EMPrimus 2011, Grid and transformer protection, http://www.emprimus.com

Fehrenbacher, K. (2009), Fiber Have a Role in the Smart Grid? A Tennessee Utility Thinks Sohttp://gigaom.com/cleantech/does-fiber-have-a-role-in-the-smart-grid-a-tennessee-utility

Foster, J.S. Jr. et al. (2008), Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack: Critical National Infrastructures.

Graham, W.R. et al. (2011), Commission to Assess the Threat from High Altitude Electromagnetic Pulse (EMP): Overview. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington D.C.

HMG (2010), A Strong Britain in an Age of Uncertainty: The National Security Strategy, HM Government, Presented to Parliament by the Prime Minister by Command of Her Majesty October 2010, The Stationery Office Limited.

Koepke, G. (2010), Highlights of Connectivity Week 2010: EMC and Smart Grid, http://www.emcs.org/acstrial/newsletters/summer10/EMCStandards.html

McClelland, J.H. (2011), Protecting our Critical Infrastructures. Presentation given at The 2nd Annual World Summit on Infrastructure Security, Washington DC

US Homeland Security (2009), Securing the Modern Electric Grid from Physical and Cyber Attacks. Hearing before the Subcommittee on Emerging Threats,. First Session 21 July 2009, Serial No. 111-30, 147pp.

Cyber security

"Just as securing and managing the physical defence of the country is a unique challenge, so is protecting the UK's critical infrastructure from threats of cyber terrorism. … Traditional security technologies are in no way up to the challenge."
Mark Darvill, Director of security firm AEP Networks (AEPN 2010).

Similar concerns are being voiced abroad. Experts at the IEEE Smart Grid Comm 2010 conference warned that consumers and utilities' infrastructures are becoming more vulnerable to cyber-attack due to increased security vulnerabilities and the two-way communication of smart grids as compared to existing systems. They predict that the smart grid will present up to 440 million possible points to be hacked by 2015 (Schwartz 2010).

It is recognised by the US Government Accountability Office (US GAO) and the US Department of Energy (US DOE) that the present transition to smart grids is leaving electric grids open to increased cybersecurity weaknesses that risk damaging their efficient operation (Mills & LaMonica 2010, US GAO 2011).

Built in security

The US GAO states that "*increasing the use of new system and network technologies can introduce new, unknown vulnerabilities. … our experts stated that smart grid home area networks … do not have adequate security built in, thus increasing their vulnerability to attack.*" To counter such risks, over $30 million *(£18.62 million*) has been awarded to address these cyber-security and reliability issues. (Schwartz 2010).

Even with such massive funding, some experts still express grave concerns (Mills & LaMonica 2010). Smart Meters being hacked could result in local and widespread disruptions, sensitive facilities being 'taken out', loss of data privacy (*including information on the types of equipment individuals own, building occupancy patterns and identity theft*).

Manipulation of smart grid data

Electricity theft is a cause of great concern to utility companies, and already there are devices existing that allow Smart Meters to be altered remotely to register less energy consumption than actually used (Mills & LaMonica 2010).

Assistant Professor Le Xie of Texas A&M University notes that it is likely that some attackers could be virtual traders seeking to benefit financially through intercepting and manipulating smart grid data to place safe bets on energy demands (Schwartz 2010).

Blackout attacks

Network security experts state that once a hacker gains access to the smart grid he/she may gain control "*of thousands, even millions, of [smart] meters and shut them off simultaneously*." Individual hackers may also be able to substantially raise or lower power demand, disturbing the local power grid's load balance and creating a blackout.

They also state that such outages would "*cascade to other parts of the grid, expanding the blackout,*" with no-one being able to predict the possible scale of such damage (Meserve 2009).

As a result of the remote off-switches currently specified for some countries' Smart Meters, 'blackout attacks' could be carried out by rogue nations, terrorists or criminals unless appropriate countermeasures are taken. One of these is the option that Smart Meters are designed to fail in the 'on' mode - *human rights laws in Europe stop defaulters simply being disconnected* (Anderson & Fuloria 2010).

There is a high cost to blackouts, the Northeast Blackout of 2003 in North America cost $3 billion (£1.86 billion). A coordinated attack on the grid "could lead to even more significant economic damages" (ICFC 2003).

"*As the nature of our technology becomes more complex, so the threat becomes more widespread. … However advanced we become, the chain of our security is only as strong as its weakest link*."
UK Defence Secretary, the Rt. Hon. Dr. Liam Fox MP (Fox 2010).

The development of appropriate solutions to realistic threats to security of supply should be carried out before large-scale UK smart grid rollouts are undertaken.

"Without securely designed smart grid systems, utilities will be at risk of not having the capacity to detect and analyze attacks, which increases the risk that attacks will succeed and utilities will be unable to prevent them from recurring," (US GAO 2011).

The installation of remote off-switches for Smart Meters would further increase risk to the consumer.

References

AEPN (2010), Cyber Terrorism Escalated To Tier One Risk In The UK, AEP Networks, http://www.prosecurityzone.com/News/It_security/Network_security__routers_and_data_centres/Cyber_terrorism_escalated_to_tier_one_risk_in_the_uk_15519.asp#axzz1QjuniAJI

Anderson, R. & Fuloria, S. (2010), On the security economics of electricity metering, 9th Workshop on the Economics of Information Security, Harvard University, George Mason University in Arlington, VA, June 2010, 18 pp.

Fox, L. (2010), Keynote presentation at The First World Infrastructure Security Summit, Electric Infrastructure Security Summit, Westminster Hall, Parliament, UK, 2010.

HMG (2010), A Strong Britain in an Age of Uncertainty: The National Security Strategy, HM Government, Presented to Parliament by the Prime Minister by Command of Her Majesty October 2010, The Stationery Office Limited.

ICFC (2003), The Economic Cost of the Blackout An issue paper on the Northeastern Blackout, August 14, 2003, ICF Consulting, 3pp.

Meserve, J. (2009), 'Smart Grid' may be vulnerable to hackers. CNN.com, http://edition.cnn.com/2009/TECH/03/20/smartgrid.vulnerability/#cnnSTCText)

Mills, E. & LaMonica, M. (2010), Money trumps security in smart-meter rollouts, experts say. InSecurity Complex, cnet NEWS, http://news.cnet.com/8301-27080_3-20007672-245.html?tag=mncol;txt

Powerwatch (2010), Smart Meters - smart idea - not so smart implementation, http://www.powerwatch.org.uk/news/20101018_smart_meter.asp

Schwartz, M.J.(2010), Smart Grids Offer Cyber Attack Opportunities Hackers are likely to exploit the 440 million potential targets researchers predict smart grids will offer by 2015. InformationWeek, http://www.informationweek.com/news/security/vulnerabilities/showArticle.jhtml? articleID=227701134

US GAO (2011), Electricity Grid Modernization: progress being made on Cybersecurity Guidelines, but key challenges remain to be addressed. United States Government Accountability Office, Report to Congressional Requesters.

Smart Meter Data

Every electrical appliance has its own energy fingerprint readable by Smart Meters. Those accessing such information have indications of the appliances individuals have and how often they use them.

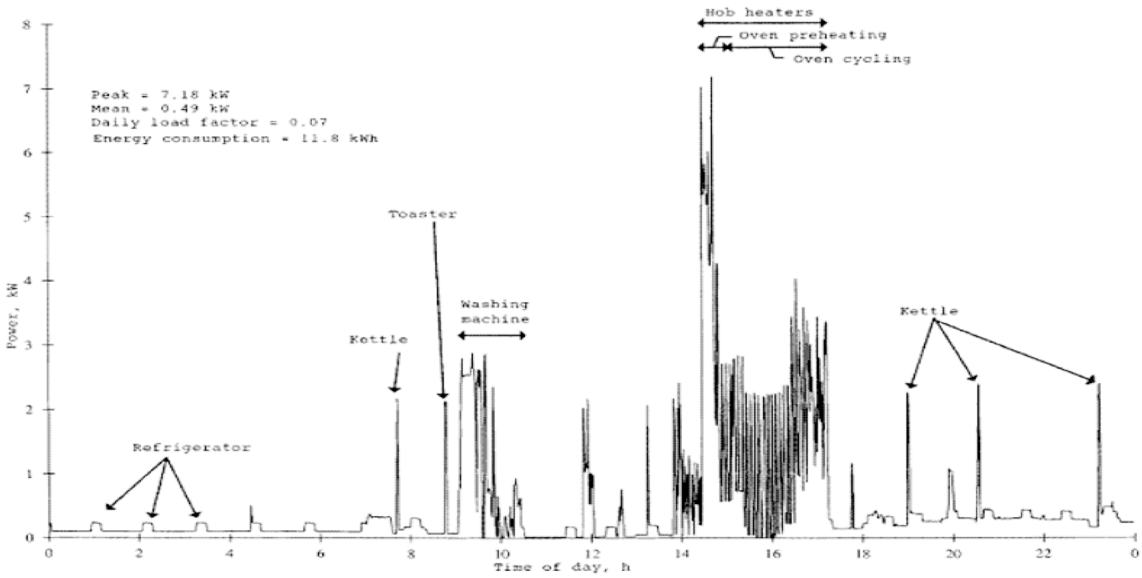


Image source: Newborough & Augood (1999).

Parties wishing Smart Meter data?	Potential use (partial listing)
Utilities	Efficiency analysis, monitoring of electricity usage & load for forecasting & bills
Electricity usage advisory companies	To promote energy conservation & awareness measures
Insurance companies	Determining health care premiums based on unusual behaviours (such as sleep problems*), that might indicate illness
Marketers	Profiling for targeted advertisements
Law enforcers	Identifying suspicious or illegal activities
Civil litigators	Determining when home occupied, by how many parties & activities undertaken
Landlords	To verify lease compliance
Private investigators	Monitoring for specific events
The Press	Information on famous individuals' movements & lifestyle
Creditors	Determination of behaviour that might indicate creditworthiness
Criminals	To identify the best times for burglary or to identify high-priced appliances to steal

Original source: SGIP (2010)

*Emissions from some wireless Smart Meters have been reported to be linked to health and sleep problems (EMF SN 2011) – *present author's comment*.

Data provision & privacy/security issues

"*Digital information and communication technology offers the possibility of a new world of freedom. It also offers possibilities of surveillance and control which dictatorships of the past could only struggle to establish. The battle to decide between these possibilities is being fought now*," Stallman (2010).*

**Refer also to Appendix 7*.

We … have the technology to record … (energy consumption) every minute, second, microsecond, more or less live... From that we can infer how many people are in the house, what they do, whether they're upstairs, downstairs, do you have a dog, when do you habitually get up, when did you get up this morning, when do you have a shower: masses of private data. …
Martin Pollock of Siemens Energy, quoted by Wynn (2010).

We think the regulator needs to send a strong signal to say that the data belongs to consumers and consumers alone. We believe that's a blocker to people adopting the technology,"
Martin Pollock of Siemens Energy, quoted by Wynn (2010).

Unlike conventional meters that measure total energy use through day and night tariffs (and are normally read four times every year), Smart Meters allow energy use to be read with far finer granularity (typically every half-hour). There is much debate as to what level of information should be provided by Smart Meters and to whom it should be provided.

" *high resolution electricity usage information can be used to reconstruct many intimate details of a consumer's daily life … [there are many ways], that information could be used in ways potentially invasive of an individual's privacy*." Quinn (2009).

A court in the Netherlands (Cuipers & Koops 2008) has already determined that the mandatory collection of non-essential fine-grained Smart Meter data is against Article 8(1) of the European Convention of Human Rights (which the UK is signed up to).

That ruling has led to mandatory Smart Meter installation being halted in the Netherlands (metering.com 2009). It is important to address such potential legal issues as early as possible and ensure that necessary safeguards are put in place.

"it [is] imperative that proper consideration is given to individuals' fundamental rights to privacy," EC (2011).

Under EU Data Protection Law, consumers' rights to privacy "*may not be overridden*", as it is their degree of positive acceptance, support and involvement with Smart Meters and related technology that will determine the level of success smart metering achieves.

"*Data protection issues play a very important and even decisive role in the successful implementation of smart metering*," Knyrim & Trieb (2011).

As noted by Berliri & Maxwell (2010):

- 'Privacy by Design' creates opportunities rather than threats for smart grids – *it instills consumer confidence.*
- Consumers concepts of privacy are altering; soon statutory provisions may be inadequate. Privacy should be embedded into the technology.
- There may be competitive advantages for those able to offer the highest levels of privacy protection.

Robust privacy measures and policies are required to cover data usage and distribution if consumers are to be brought onboard and potential security shortfalls addressed.

Smart grid privacy measures			
Privacy threat		Service required	Existing protection mechanisms
Network threats	Shallow packet inspection	Anonymity	Anonymity networks
	Deep packet inspection	Confidentiality	Encryption
Data usage threats	Unauthorised usage/access	Access control	Policies, legislation, secure storage
	Customer privacy	Customer control of customer data	

Source: Sooriyabandara & Kalogridis (2011).

Undertaking robust measures to anonymise Smart Metering data and remove recognisable appliance load signatures can help to address privacy concerns (Efthymiou & Kalogridis 2010, Kalogridis et al. 2010). Such measures may include: Privacy Enhanced Home Energy Management using Elec Privacy algorithms (*to disguise the signatures of electronic equipment*) and Escrow: Data Anonymisation.

Privacy Initiatives

Ontario, Canada

The province of Ontario in Canada is a world leader in embedded privacy protections for smart grids (PBD 2010). Adopting its guidelines may help prevent many claims on Human Rights privacy issues that might otherwise stall or halt rollouts.

1. Proactive not Reactive; Preventative not Remedial

"*Smart Grid systems should feature privacy principles in their overall project governance framework and proactively embed privacy requirements into their designs …*"

2. Privacy as the Default

"*Smart Grid systems must ensure that privacy is the default — the "no action required" mode of protecting one's privacy — its presence is ensured*."

3. Privacy Embedded into Design

"*Smart Grid systems must make privacy a core functionality in the design and architecture of Smart Grid systems and practices — an essential design feature*."

4. Full Functionality — Positive-Sum, not Zero-Sum

"*Smart Grid systems must avoid any unnecessary trade-offs between privacy and legitimate objectives of Smart Grid projects*."

5. End-to-End Lifecycle Protection

"*Smart Grid systems must build in privacy end-to-end, throughout the entire life cycle of any personal information collected*."

6. Visibility and Transparency

"Smart Grid systems must be visible and transparent to consumers - engaging in accountable business practices - to ensure that new Smart Grid systems operate according to stated objectives."

7. Respect for User Privacy

"Smart Grid systems must be designed with respect for consumer privacy, as a core foundational requirement."

That document states that the above principles should be applied to: accountable business practices; Information Technology (IT) systems; and physical design and networked infrastructure for smart grids (PBD 2010).

"… if the data protection rights of consumers are not sufficiently taken into account, then their acceptance of the new technology will be lacking, which could lead to its unsuccessful implementation," Knyrim & Trieb (2011).

Another concern related to 'Privacy by Design' is that present smart grid systems have a life expectancy of 10-20 years, during which time any in-built security they may have risks becoming compromised or outdated.

United Kingdom

The UK is adopting an approach to privacy drawn on international best practice measures and the advice of privacy experts (DECC 2011).

In September 2011, it was announced that the UK Government has established a central data and communications company to administer access to smart grid data to help allay consumer privacy concerns over Smart Metering. The UK Government will also oversee its security (smartmeters 2011).

California, USA

In July 2011, California voted to adopt it's own comprehensive set of privacy and security rules for the three utility companies that provide the majority of Californians with electricity (King 2011).

If consumers wish, they will be able to allow third parties to receive their backhauled Smart Meter data directly from the utilities, as opposed to directly from the Smart Meters in order to support services including demand response, energy advice and energy efficiency. It is important to note that the CPUC declared that "*The utilities … will bear no new liability for the actions of third parties which acquire information via this [mechanism]*."

The CPUC also stated that they will not exercise jurisdiction over third parties who directly receive energy usage data from installed devices that receive data via the HAN interface (King 2011).

It is likely that the Californian and UK initiatives will be a success if they fully take into account Human Rights' privacy issues and the need to anonymise electrical metering data to gain public trust.

Texas, USA

In Texas all meter data on electricity shall belong to the customer (BSM (2011). Texas Utilities Code 39.107(b) states:

"*All meter data, including all data generated, provided, or otherwise made available, by advanced meters and meter information networks, shall belong to a customer, including data used to calculate charges for service, historical load data, and any other proprietary customer information*. …"

References

Berliri, M. & Maxwell, W. (2010) Smart metering, smart grid and privacy by design, Project E-Cube, 21 September 2010.

BSM (2011), Smart Meter Data Belongs to the Customer, http://www.bansmartmeters.com/blog/2011/03/smart-meter-data-belongs-to-the-customer/

Cuipers, C. & Koops, B.J. (2008), Het wetsvoorstel 'slimme meters': een privacytoets op basis van art. 8 EVRM, Universiteit van Tilburg.

DECC (2011), Smart Metering Implementation Programme: Response to Prospectus Consultatiion. Supporting Document 1 of 5 Data Access and Privacy. Department of Energy and Climate Change and the Office of Gas and Electricity Markets, 56 pp.

EC (2011), Article 29, Data Protection Working Party Opinion 12/2011 on smart metering Adopted on 4 April 2011, 00671/11/EN WP 183, The Working Party on the Protection of Individuals with Regard to the Processing of Personal Data, http://ec.europa.eu/justice/policies/privacy/index_en.htm

Efthymiou C. & Kalogridis, G. (2010), Smart Grid Privacy via Anonymization of Smart Metering Data, First IEEE Int. Conference on Smart Grid Communications, Oct. 2010

Kalogridis, G. et al. (2010), Privacy for Smart Meters: Towards Undetectable Appliance Load Signatures, First IEEE Int. Conference on Smart Grid Communications, Oct. 2010.

King, C. (2011), California PUC adopts consumer data access and privacy rules for smart meters. Smart Grid Watch, eMeter, http://www.emeter.com/smart-grid-watch/2011/california-puc-adopts-consumer-data-access-and-privacy-rules-for-smart-meters/

Knyrim, R. & Trieb, G. (2011), Smart metering under EU Data Protection Law, International Data Privacy Law, 1(2), pp. 121-128.

Newborough, M. & Augood, P. (1999), Demand-side management opportunities for the UK domestic sector, IEE Proceedings of Generation Transmission and Distribution 146(3), pp. 283–293.

PBD (2010), Privacy by Design: Achieving the Gold Standard in Data Protection for the Smart Grid. Information and Privacy Commissioner, Ontario, Canada, Hydro One Inc. and Toronto Hydro Electric. 37 pp. http://www.ipc.on.ca/images/Resources/achieve-goldstnd.pdf

Quinn, E.L. (2009), Privacy and the New Energy Infrastructure, Social Science Research Network, 09, pp. 1995-2008.

SGIP (2010) NISTIR 7628, Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and the Smart Grid, The Smart Grid Interoperability Panel - Cyber Security Working Group, National Institute of Standards and Technology, Vol. 2, pp. 30–32, http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol2.pdf, pp. 30-32.

Smartmeters (2011), Britain Remains Smart Grid leader. smartmeters, http://www.smartmeters.com/the-news/2584-britain-remains-smart-grid-leader-

.html

Sooriyabandara, M. & Kalogridis, G. (2011), Smart Grid Privacy by Design, ETSI 6th Security Workshop, Sophia Antipolis, France, 19th Jan 2011, PowerPoint presentation, http://docbox.etsi.org/Workshop/2011/201101_SECURITYWORKSHOP/S5_SECURITYinSMARTGRIDS/SOORIYABANDARA_TOSHIBA_SmartGridsPrivacybyDesign.pdf

Stallman, R. (2010), Is digital inclusion a good thing? How can we make sure it is?, IEEE Communications Magazine, 48, pp. 112-118.

TUC (2011), [Texas] Utilities Code, Title 2. Public Utility Regulatory Act, Subtitle B. Electric Utilities, Chapter 39. Restructuring of Electric Utility Industry, Subchapter A. General Provisions, http://www.statutes.legis.state.tx.us/Docs/UT/htm/UT.39.htm

Wynn, G. (2010), Privacy concerns challenge smart grid rollout, http://www.reuters.com/article/2010/06/25/us-energy-smart-idUSTRE65O1RQ20100625

The need for ‘opt outs’ and wired alternatives

Image source: http://2.bp.blogspot.com/-k7RtVOx5FmY/Tki0ChvyW9I/AAAAAAAADV4/4QCQUmzWY5Y/s1600/smart-meter-free-zone-signs-on-meters.jpg

Legal rulings

In Maine, USA, a “landmark” legal ruling has been made to allow individuals to ‘opt out’ of the Smart Metering program and retain their existing analogue meters (SKT&A 2011). This was the first time a US state had demanded that an electric utility must allow utility customers the choice to opt out. It is claimed that the decision “*will benefit utility customers throughout the country*.”

Alan Stone of law firm Skelton, Taintor & Abbott successfully proved in the “landmark” ruling that as a result of unresolved concerns on health, privacy and cyber-security issues related to the installation of wireless meters on their homes, customers should be allowed a choice over whether such meters are installed.

The Central Maine Power Company had “*argued vigorously that customers should not be allowed to opt out*”, which the Maine Public Utilities Commission found unreasonable and unjust (SKT&A 2011).

Energy users in Maine have two ‘opt out’ options: they either retain their existing analogue meter or receive a Smart Meter and have its transmitter turned off. They pay extra for either option (SOP 2011).

PG&E in California presently offer customers the opportunity to partially ‘opt out’, with a charge being made by PG&E to deactivate individuals’ Smart Meters along with an additional monthly charge (LaMonica 2011). The California Public Utilities Commission President Michael Peevey has additionally now told members of the public that the utility “*will provide for you to go back to the analog meter if that’s your choice*,” (OTLB 2011a).

Milham (2011) suggests allowing individuals to only partially 'opt out' may not be enough to address health concerns, as the switching-mode power supply (SMPS) of some Smart Meters can continue to emit high-frequency radio signals (which have been indicated in some studies as being potentially injurious to health) 24/7. Further action is urgently required. Measures can be taken to avoid such problems.

"*I have had a number of cases where symptoms continued after the [smart] meter's transmitters were disabled, but disappeared when an analog meter was reinstalled. I think it prudent to offer customers the option of retaining their old utility meter or to have another reinstalled*." Milham (2011).

Additional legal claims may be following the 'victory' by Alan Stone, as a US attorney has provided guidelines available online detailing how individuals can file small claims suits over Smart Meters (Koehle 2010). There is a need to resolve such problems.

The cost of 'opt outs' - United States

Consumers in Maine, USA, are to be charged a one-time fee of $40.00 fee and a monthly charge of $12.00 for retaining their existing meter. If they opt for choosing to have a non-transmitting Smart Meter they will be liable for an initial fee of $20.00 and a monthly charge of $10.50 (SOP 2011).

The above charges are markedly lower than those that PG&E wishes to charge its customers who wish to 'opt out'. They propose that consumers pay $270 up front and a $14 monthly fee, or $135 up front and a $20 monthly charge for the option of having Smart Meters that have had their wireless transmission deactivated (Chediak 2011, LaMonica 2011). PG&E does not presently wish to let consumers keep their old meters.

At present, PG&E estimates that approximately 145,800 customers may chose to have their Smart Meters disabled at a potential cost of $84.4 million (Chediak 2011).

Consumer reaction to PG&E: "… *a smart meter costs between 3 and 10 times as much as a traditional meter depending on options and communications choices; installation costs 2-3 times the cost of a traditional meter; traditional meter reading fees are around $1 per month. … IF PG&E wanted to be fair they would let you opt out ahead of the meter installation, lower your rate to the pre-program level and then charge a monthly meter reading fee equal to the actual costs of the read*," Damianio (2011).

Why ‘opt outs’ don’t always work

112 Smart Meters in apartment complex

Source: OTLB (2011).

112 wireless Smart Meters have been installed in the large apartment complex shown above. If the individual who lives immediately above them opts out she is still exposed to microwaves from the remaining 111 units (OTLB 2011).

“*In the US, if too many people opt out, the utility companies have vowed to put a repeater in neighborhoods, possibly on utility poles right outside some people’s windows, to boost the signal. REPEATERS emit even more intense radio frequency radiation, so these are also unacceptable*,” CST (2011). The use of fibre-optics for smart grids as championed in Chattanooga (Baker 2011) would avoid such logistical problems.

Additional claims (Milham 2011, Brangan & Heddle 2011, Wilner 2011), with regard to possible health effects from RF emitted by the switching-mode power supply (SMPS) also have to be taken into account.

If SMPS and RF/microwave issues are not properly addressed, ‘opt outs’ linked to health concerns may prove at least partially ineffective, as individuals may still be being exposed to unwanted radiation, which may be in violation of WHO health promotion initiatives – *Refer to Appendix 3*.

As noted by Wilner (2011), if concerned customers pay more for an ‘opt out’ installation yet derive no material benefit, it “*would be a violation of CPUC Code Section 451 which describes any utility rate that is unjust and/or unreasonable as unlawfu*l.”

If consumer concerns are addressed, ‘opt outs’ and the risks they cause to the credibility of the rollouts, may be dramatically reduced, particularly if the technology can be made more attractive.

References

Baker, L. (2011), EPB Deploys America's Fastest Fiber-optic Smart Grid, http://www.electricenergyonline.com/?page=show_article&mag=68&article=550

Brangan, M.B. & Heddle, J. (2011), Ecological Options Protest. Application 11-03-014 filed before the Public Utilities commission of the State of California on 24 March 2011, 17 pp.

Chediak, M. (2011), PG&E to Charge Up to $20/Month to Turn Off Wireless Meters, http://www.bloomberg.com/news/2011-03-24/pg-e-to-charge-up-to-20-month-to-turn-off-wireless-meters-1-.html

CST (2011), Immediate Opt-Out and Ban on Smart Meters, http://www.citizensforsafetechnology.com/Immediate-OptOut-and-Ban-on-Smart-Meters,5,1082

Damiano, R. (2011), Opt Out and be Punished. Online comment given to SmartGridNews.com article: PG&E files game-changing smart meter opt out plan. But will it work?, http://www.smartgridnews.com/artman/publish/news/PG-E-to-anti-smart-meter-customers-Sure-we-ll-shut-em-off-for-a-price-3577.html

Koehle, O. (2010), Chapter Seven, Law Suits Concerning Smart Meters, In: Just Say No to Big Brother's Smart Meters, pp. 95-99, http://www.refusesmartmeter.com/smart%20meter%20aug%2026.pdf

LaMonica, M. (2011), PG&E offers opt-out for smart meters at a cost. Green Tech, http://news.cnet.com/8301-11128_3-20047091-54.html#ixzz1WPL7HJcP

Milham, S. (2011), Smart meter illness. E-mail sent to Judge DeBerry by Physician Dr Sam Milham on 12th May 2011, https://www.pge.com/regulation/GRC2011-Ph-II/Pleadings/WilnerAssoc/2011/GRC2011-Ph-II_Plea_WilnerAssoc_20110525_211252Atch01_211253.pdf

OTLB (2011), Why Opt Out is a Cop Out, Posted on March 23, 2011 by onthelevelblog http://stopsmartmeters.org/2011/03/23/why-opt-out-is-a-cop-out/

OTLB (2011a), PG&E Begins Removing 'Smart' Meters Due to Health Effects, http://stopsmartmeters.org/2011/11/01/pge-begins-removing-smart-meters-due-to-health-effects/

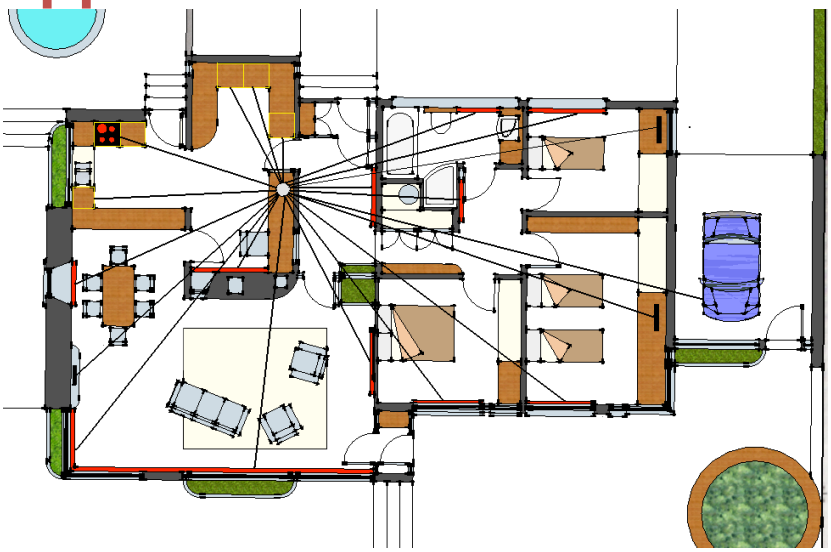
SGN (2011), Smart Meters: PG&E files game-changing smart meter opt out plan. But will it work?, SmartGridNews.com, http://www.smartgridnews.com/artman/publish/news/PG-E-to-anti-smart-meter-customers-Sure-we-ll-shut-em-off-for-a-price-3577.html

SKT&A (2011), Skelton, Taintor & Abbott Wins Landmark Smart Meter Case, http://www.skeltontaintorabbott.net/news/85/77/Skelton-Taintor-Abbott-Wins-Landmark-Smart-Meter-Case.html

SOP (2011), Maine Utilities Must Offer Consumer a Smart Meter Opt Out, Spencer Ogden Power, http://www.sopower.co.uk/news/maine-utilities-must-offer-consumer-a-smart-meter-opt-out-news-11402015193.

Wilner, D.L. (2011), Selection of e-mails by individuals sent to The Honorable Administrative Law Judge Bruce DeBerry California Public Utilities Commission, https://www.pge.com/regulation/GRC2011-Ph-II/Pleadings/WilnerAssoc/2011/GRC2011-Ph-II_Plea_WilnerAssoc_20110525_211252Atch01_211253.pdf

Smart Meters, HAN & smart appliances



Smart Meters

Alternatives to wireless Smart Meters and related technologies may be required for a number of reasons.

One of these is that, as many individuals who claim to be electrohypersensitive (EHS) - *or simply do not wish to be exposed to raised levels of manmade electromagnetic fields* - have shielded their homes against RF/microwave signals; wireless Smart Meters located within such dwellings (as most meters are in the UK) would be unable to connect to utility Home Area Networks (HAN) outdoors.

Another reason alternatives are required is that many materials used to construct standard dwellings (and many commercial buildings) shield, at least in part, emissions from such units.

Powerwatch (2010) proposes that this might be addressed by utilities offering to locate such meters outside the house. However, individuals could still be exposed to RF/microwave emissions from such units when directly outside their own property and could still result in them being able to use parts of their property as they used to. The use of wired Smart Meters (*such as used by EPB in Chattanooga (Baker 2011*)), would avoid such problems. Refer also to section on '*Human Rights and Smart Meters'*.

As a matter of best practice, filters should used to reduce high frequency transients and harmonics from Smart meters that may otherwise create 'dirty electricity' which have been indicated in some studies as negatively impacting on health (Milham 2010, Havas 2006). Refer also to section on '*Smart Meter Interference'.*

Home Area Networks (HAN)

"*The Home Area Network (HAN) is a critical part of the [UK] smart metering programme. As these HAN devices are to be connected into every home in Great Britain, the HAN must be both reliable and secure in order to provide the consumer with a top class user experience…*" SmartReach (2011).

According to 'The Worldwide Smart Grid Market in 2011: A Reality Check and Five Year Outlook Through 2015', "*Nearly 3/4 of all utilities either have no plans for home area networking, or have not yet made a decision. Only 2% have already committed to a business venture, with another 12% considering such a move*," (Berst 2011). It is proposed that the use of fibre-optics and RF/microwave regimes that are proven to be 'bio-friendly' could reverse this trend.

Public health concerns, the recent classification of RF/microwave radiation as a Class 2B carcinogen (WHO/IARC 2011), the BioInitiative Report (2007) recommending drastically lower RF/microwave exposure levels, and the recommendation by the Parliamentary Assembly of the Council of Europe (PACE 2011) that electromagnetic emissions should be "*as low as reasonably achievable*" (ALARA), provide further incentive to develop and adhere to best practice measures when developing HAN systems.

HAN design and specification

The Smart Meter HAN interface can be activated to both receive or transmit signals to smart appliances by either the utility company or the smart appliances themselves transmitting data. This can only take place, however, after the utility permits HAN communication by issuing a security password that only it controls.

Wireless HAN

At present all the current proposals for HAN in the UK are for wireless networks - though one of these systems, M-Bus, can be used wirelessly and was originally conceived as a simple wired network especially for Smart Meters. The wired option of M-Bus is used to create wired HAN networks in several European countries including Germany and is likely to cause fewer problems for those who are electrohypersensitive (EHS).

Signals from wireless HAN can be blocked or degraded by the presence of some types of building materials.

In particular signals can often be blocked by foil-backed plasterboard (used in many buildings) and some types of foil-backed high thermal insulation. Wire mesh used in some old buildings for plaster and lath work also blocks signals. Concrete and some dense building materials too can compromise signals.

Signals can also be deliberately blocked by the use of particular materials and finishes by electrosensitives who attempt to screen themselves and their homes from RF/microwaves which they say can often make them feel unwell.

The result of such factors is that reliable signals cannot be received in some areas, whilst increased signals can be encountered in others thereby raising occupancy exposure to RF/microwave radiation).

Ideally wired options should be available to reduce risk to those who are considered particularly vulnerable to RF/microwave radiation, those who for personal reasons do not wish to be exposed to such regimes, and those who wish to optimally use smart appliances without signal degradation.

Wired HAN

Powerwatch (2010) suggest that it may be appropriate for the UK to consider supplying Smart Meters that can have their wireless function disabled and allow for wired M-Bus port to be used as single screened wire connections instead of wireless. They further suggest that as the UK forbids there being any directly wired connections to gas meters, either opto-isolated couplings (at the outside of gas meter enclosures) or short lengths of fibre-optic cables are used as the final connection.

Fibre-optic HAN

HAN are now considered essential by many consumers, with growing numbers of people wishing them to be preinstalled in new homes. This can now be achieved in every room using plastic optical fibre (POF) instead of wireless or copper cabling.

POF is easy to install (without the need for an electrician) and can be used for distances of up to 100 m (328 feet) - *industrial glass fibre optic cables send digital signals far further but are more expensive and should only be installed by professionals*. A POF system is also available which has a low voltage DC distribution system allowing digital products to be run more energy efficiently (FL 2011).

The use of fibre-optic cabling, in contrast to other alternatives, allows built-in systems to be 'future proofed' against increasing needs for bandwidths whilst helping to create 'electromagnetically clean' environments and good transmission. It would appear prudent to consider its use for consumers' HAN and Smart Meters to make them more desirable to end-users.

References

Baker, D.R. (2010), PUC division pushes for SmartMeter health probe, Business Report. San Francisco Chronicle, The Chronicle with Bloomberg. http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2010/11/17/BU8S1GDJ2F.DTL

Berst, J. (2011), Smart grid market research exclusive: Smart grid winners and losers revealed. SmartGridNews.com, http://www.smartgridnews.com/artman/publish/Business_Markets_Pricing/Smart-grid-market-research-exclusive-Smart-grid-winners-and-losers-revealed-3912.html

BioInitiative Report (2007), BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF), http://www.bioinitiative.org/freeaccess/report/index.htm

FL (2011), New Homes – Digital Networks as Standard!, Fibrepoint Ltd http://www.fibrepoint.co.uk/articles

Havas, M. (2006), Electromagnetic Hypersensitivity: Biological Effects of Dirty Electricity with Emphasis on Diabetes and Multiple Sclerosis. Electromagnetic Biology and Medicine, 25, pp. 259–268.

Milham, S. (2010), Dirty Electricity: Electrification and the Diseases of Civilization, 120pp.

PACE (2011), The potential dangers of electromagnetic fields and their effect on the environment, Parliamentary Assembly Assemblée parlementaire, Resolution 1815, Council of Europe / Conseil de L'Europe.

Powerwatch (2010), Smart Meters - smart idea - not so smart implementation http://www.powerwatch.org.uk/news/20101018_smart_meter.asp

SmartReach (2011), SmartReach for a greener Future. http://smartreach.com/down/SmartReach_HAN.pdf

WHO/IARC (2011), IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans, Press Release No. 208, World Health Organization, 31st May 2011.

Smart Appliances

The range of smart appliances and devices includes: coffee makers, cooker, dishwashers, microwave ovens, standard ovens, thermostats, toasters, tumble dryers, washing machines, water heaters, freezers and refrigerators. Smart electric sockets also exist for offices and home use.

Zypryme (2010) predicts that the global market for smart appliances will be as follows in 2015*:

Clothes washers - $3,542,000,000 (€2,608,000,000)
Refrigerators - $2,693,000,000 (€1,983,000,000)
Clothes dryers - $2,236,000,000 (€1,646,000,000)
Dishwashers – $1,354,000,000 (€997,000,000)
Freezers - $1,166,000,000 (€858,500,000)
Other smart appliances - $4,184,000,000 (€3,080,000,000)
* Projected figures given in US dollars.

A number of commentators and consumers take issue with the 'need' for some appliances to be smart. As an example, one US pilot study has shown that consumers do not want utilities to tell them when to do the laundry or use the dishwasher (Ansell 2010).

It is important to assess the market accurately for appliance manufacturers who may wish to invest in it and not create unnecessary risks by 'talking up' the market or specifying the wrong type of systems.

It is presently predicted that in 2015 there will be a combined global market for 'smart' clothes washers, clothes dryers and dishwashers of $7,132,000,000. (€5,251,000,000)

The predicted combined global market for 'smart' refrigerators and freezers in 2015 will be $3,859,000,000. (€2,841,000,000)

Hunn (2011) suggests that as refrigerators and freezers are operational throughout the day, they are less suited to be smart than the appliances just discussed. Whilst this is debatable, the point he makes about the need for appliances to decrease their energy consumption still further through innovative design is highly valid. As he notes, the cheaper appliances of a number of companies advocating the use of smart technology presently have poor energy performance.

"*Consumer agreements may focus on utilities controlling only particular appliances such as freezers, air conditioners or luxury items such as swimming pools*," Wynn (2010).

Health and communication issues

Smart appliances allow communication between consumers' Home Area Networks (HAN) and utility HAN.

At present some manufacturers allow communications solely through RF/microwave connections, with no provisions being made for wired connections, or for their 24/7 signals to be disabled.

When such appliances are used, the pulsed RF/microwave signals they emit are supposed to be transmitted very infrequently. Milham (2011), however, has reported measuring [almost] "*continuously radiating RF from internal power transmitters*" from a smart oven and smart dishwasher designed to transmit their energy usage to wireless Smart Meters. Emissions only ceased when the power to them was switched off.

As mentioned at the start of this section, smart electric socket extension leads are also now available. One brand offers units that emit RF/microwave radiation at 2.4 GHz during their operation at a typical time interval of 10 seconds down to 1 second if required. Slower configurations can also be created.

That socket extension lead is being sold as being "*ideally suited for use within an office environment as a simple replacement for traditional 4 way extensions typically found under desks*." Possible health risks and potential liability claims resultant through increased RF/microwave exposures appear not to have been considered.

Orders are already being lost with a number of items because some individuals are refusing to have smart appliances and devices (that emit RF/microwaves throughout the day) installed in their homes and workplaces. Exposures to such radiation can make some individuals quite ill.

As mentioned in an earlier section, Schreier et al. (2006) noted that approximately 5% of the Swiss population may be electrohypersensitive (EHS) - the percentage of EHS individuals may be roughly similar in other countries. This is a large sector of the customer base to risk alienating. Creating wired options would help reduce such risk.

Trade Unions may also influence the degree to which particular smart formats are adopted, especially as a result of the recent WHO/IARC (2011) classification of RF/microwave radiation as a Class 2B carcinogen.

The Trades Union Congress in the UK (TUC 2008) states: "… *trade unions believe the aim should be to remove all exposure to any known or suspected carcinogen in the workplace*," and "*Caution should be used to prevent exposure to substances in Group 2B*," there may be the call for the removal of such devices in the workplace where 'safer' practical alternatives are available.

Consumer confidence

"*With growth like this it is easy to overlook the needs of the consumer."* Jason S. Rodrigues, CEO & Director of Research, Zpryme Research & Consulting, LLC (Zypryme 2010).

Some consumers have started to question how many smart appliances actually benefit them by being 'smart', and are stating that they are unhappy with the idea of having a large number of RF/microwave emitters within their homes, particularly when they will often have to be in close proximity to them (Sage 2011).

Increased exposure to RF/microwave emissions 24/7 may prove a particular problem in bedsits and studio flats due to the high concentrations of equipment often within very limited space.

These matters need to be addressed, especially as related to the possible effects of their RF/microwave emissions on potentially vulnerable individuals, such as children, pregnant women, the elderly, and those with debilitating conditions.

Ideally, wireless transmissions from such systems should be able to be disabled and wired smart interfaces built in as standard.

For the success of smart appliances and devices to be optimised, it is necessary to assess the science robustly and understand the consumer psyche.

Improving consumer response

"*Rather than let the smart metering industry have a period of relative stability to confirm their technical specifications, complete trials and educate users, this new mania around [smart] appliances adds a level of unnecessary technical uncertainty*," Hunn (2011).

Hunn (2011) adds a valid point to the debate about smart appliances with his comments shown above. He further notes that the wholesale introduction of such technology at this time could provide "*a very dangerous distraction to the core requirements of smart energy. … It adds technical uncertainty at a point when the*

industry is trying to coalesce on standards for smart meters and it distracts appliance vendors from concentrating on core improvements to the technology of their devices."

"*The industry needs to consider whether the prospect of a smart appliance is worth pursuing in the short term, as it has the potential to do more harm than good*," Hunn (2011).

If appliance manufacturers take such matters into consideration, they can greatly reduce their risks in a volatile financial climate.

By delaying the rollout of a number of smart appliances at the present time to help ensure the success of smart grids, appliance manufacturers could allow themselves a 'window of opportunity' to better develop more ecologically and environmentally friendly technologies and launch them when the public is ready to receive them – a true 'Win/Win' situation.

References

Ansell, M. (2010), quoted by Wynn (2010). Martin Ansell is General Manager of the Smallworld Geospatial Asset Management and Mobile Software Applications business within GE Energy Transmission & Distribution.

Hunn, N. (2011), Smart Appliances – a Dangerous Distraction for Smart Energy, http://www.nickhunn.com/index.php/archives/844

metering.com (2009), Smart meters not to be compulsory in Netherlands, http://www.metering.com/node/15062

Milham, S. (2011), Personal communication with C. Sage, cited by OTLB (2011).

OTLB (2011), Appliances Introducing Stealth EMF Into Our Homes, onthelevelblog, http://stopsmartmeters.org/2011/05/27/appliances-introducing-stealth-emf-into-our-homes/

Sage, C. (2011), quoted by OTLB (2011).

Schreier, N. et al. (2006), The prevalence of symptoms attributed to electromagnetic field exposure: a cross-sectional representative survey in Switzerland. Sozial- und Präventivmedizin, 51(4), pp. 202-209.

TUC (2008), Occupational Cancer: A workplace guide, http://www.tuc.org.uk/extras/occupationalcancer.pdf

WHO/IARC (2011), IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans, Press Release No. 208, World Health Organization, 31st May 2011.

Wynn, G. (2010), Privacy concerns challenge smart grid rollout, http://www.reuters.com/article/2010/06/25/us-energy-smart-idUSTRE65O1RQ20100625

Zpryme (2010), Smart Grid Insights: Smart Appliances, Zpryme Research & Consulting, http://www.zpryme.com/SmartGridInsights/2010_Smart_Appliance_Report_Zpryme_Smart_Grid_Insights.pdf

Financial implications of Smart Meters

Will Smart Meters save money?

The International Monetary Fund states that there is the possibility of a double-dip recession in many advanced economies and advocates the need to reduce risk in investments (IMF 2011). Smart Metering risks should be reduced wherever possible to increase their viability. Strategic rollouts could reduce such risk.

The rules of investment

"*Investors should start with a view of skepticism. They should become intellectual investors rather than emotional investors. They should be careful, and they should be skeptical*."
Arthur Levitt, Jr.
Senior adviser at the Carlyle Group and former Chairman of the US Securities and Exchange Commission.

Cost impact

For indications on the cost impact in the UK of a number of different Smart Meter options, including that of a dumb meter/smart box option, refer to MMDB (2007).

Consumer Impact with four roll-out options and Hybrid 2		
Roll-out option/ Technology	Consumer Net Present Value	Average Annual Impact per meter
New, Replacement and Voluntary		
ERA Spec	- £8,287,000,000	- £8.29
BEAMA Spec	- £4,276,000,00	- £4.3
Dumb+Smart	+ £343,000,000	+ £0.48
Meter Retrofit	+ £982,000,000	+ £0.85
Clip-On	+ £617,000,00	+ £1.05

Source: MMDB (2007) – other options such as fibre-optic Smart Metering should additionally be appraised.

At present Smart Metering is listed as the least financially attractive investment of all smart grid initiatives (N-ERC 2011).

World market

As the World faces a prolonged period of austerity (IMF 2011), and the possibility of redundancy increases at an alarming rate, it is necessary to show that Smart Metering does not place further burden on those facing hardship. In such troubled times, people need robust proof of the benefits to themselves of 'opting in' to such programs. Alternative ways of reducing energy consumption, such as through optimised building design and the creation of more energy efficient appliances, too need to be championed.

The possible costs and benefits of different Smart Metering systems in terms of health, productivity and the environment should also be factored into the equation, so that optimum solutions are developed. Human Rights issues too have to be factored in.

Another matter to be taken into consideration is the cost to nations of upgrading utilities' IT infrastructures - *which often currently run on a mix of old computing systems that often do not properly communicate with each other* - for the huge onslaught of data information they will be receiving from Smart Meters (Antow 2011).

There is also the question of whether some of the money currently earmarked for Smart Metering should be diverted to the creation of grids that are more secure against the harsh solar storms NASA predict for 2012-2014 which could severely damage infrastructures and national economies – *Refer to the section on 'Vulnerability to Space Weather'.*

UK installations

The UK deployment of Smart Meters is already set to become the most expensive in the world (Datamonitor 2010). It has been rumoured that at present Smart Meters will cost around £350 to install per household (Anderson & Fuloria 2010).

In March 2011, UK energy customers were told they would have to pick up the £11.3 billion rollout cost through their bills (uSwitch.com 2011). This may cause some resentment, as a survey of consumers in 2010 revealed 83% were not prepared to pay additional costs for their installation (Which 2010). *Before* that press release, only 15% of the public had welcomed their introduction (uSwitch 2010) - *it is vital to have the public's support for Smart Meters to succeed.*

At present consumers appear more concerned with the financial costs of using them than the environmental cost of inefficient energy use.

The DECC estimates that Smart Metering will "*result in an increase in annual domestic energy and gas bills for the average dual fuel customer of £6 by 2015 but by 2020 it will deliver a net annual saving of £23*," NAO (2011).

At present smart grid systems have a life expectancy of 10-20 years (Mills & LaMonica 2010). If consumers have to meet the full installation cost, it might take them 15 years worth of savings (*at the returns predicted for 2020*) to pay for a Smart Meter that may require replacing within that period or have already been replaced.

This figure does not take into account loss of earnings from having to stay at home on the day of meter installation – *the average daily wage in the UK at present is just under £100* (ONS 2010) - or the potential costs that inappropriate Smart Meter specifications and rollout timings might have on the national economy.

There are also additional consumer costs that have to be taken into account. To obtain the major benefits of Smart Metering consumers will have to spend further money on communications devices, programmable communicating thermostats, appliance chips and other automated equipment (in addition to paying directly or indirectly for the Smart Meter units). Computers and high-speed Internet connections also appear essential to optimise operation (TURN 2011).

"If consumers don't reduce usage then the [Smart Meter] system becomes an expensive white elephant."
Jon Lane, Energy Director at The Datamonitor Group*

*Datamonitor is a world-leading provider of premium global business information, delivering independent data, analysis and opinion.

There are also concerns that the project could be as technologically challenging as NHS National Project for IT (Flinders 2011), which further indicates the need for the UK to increase its knowledge base to better address matters and allay public concerns. Initiatives such as SmartGrid GB (SG GB 2010) may prove very timely.

USA

In some instances huge rises in bills have been reported primarily due to faulty Smart Meter units, inappropriate billing systems, shortcomings in consumer education and unusual extremes in weather conditions prompting extra energy usage (Burbank ACTION 2011, CBS 5, Zeller 2010). It seems these matters can be remedied. Some overcharging was additionally caused by units mistakenly charging customers for the units of electricity they generated (via green technologies such as solar panels) and fed back into the grid (Wolff 2010). This fault too now appears to be corrected.

The actual costs to some consumers as related to apparent health issues from some types of Smart Metering regimes and from faulty Smart Meter installations that have caused fire damage to their properties remains to be addressed – Refer to sections on '*Health Matters'* and *'Electrical safety and Smart Meters'*.

California

The annual report PG&E submitted to the California Public Utilities Commission (CPUC) on their Smart Meter program shows that to date no energy savings have been made as a result of their large scale Smart Meter rollout (PG&E 2011).

Table I PG&E SmartMeter™ Program Enabled Demand Response Programs Subscription Statistics December 31, 2010

		Demand reduction (MW)		Energy savings (MWh)		
Program	Service accounts	Aggregrate Load Impact	Financial benefits (thousands)	Energy savings	Financial benefits (thousands)	Total financial benefits (thousands)
Demand response						
Programmable Communicating Thermostat	0	0	$0	0	$0	$0
Peak Time Rebate	0	0	$0	0	$0	$0
SmartRate™/ PDP	24,535	6.5	$546	0	$0	$0
Real Time Pricing (RTP)	0	0	$0	0	$0	$0
Time of Use	0	0	$0	0	$0	$0
Total	24,535	6.5	$546	0	$0	$0

Source: PG&E (2011).

The Division of Ratepayer Advocates of the CPUC believes that the $1 billion Smart Meter program for the Southern California Gas Company (SoCalGas) "*will cost ratepayers $185 million more than the benefits to be produced over the project's lifetime*" (DRA 2010).

"*There is no compelling reason to move ahead with this expensive project, especially at a time when Southern Californians are already struggling to pay their bills and with unemployment so high*."
Dana Appling, Director of DRA (DRA 2010).

As noted by TURN Consumer Advocates, "*The cost of retrofitting or replacing existing appliances alone will be astronomical. Without the expenditures, consumers will not see any difference from the new meters except higher electric bills. … The meters have failed to provide customer benefits commensurate with their costs,*" (TURN 2011).

The Helix Water Board has decided to reject Smart Meter technology on the grounds of cost. With Helix undergoing budgetary restrictions they decided it was not appropriate to introduce Smart Meters.

Additionally, there was a lack of public interest shown in the web portal set up for their Smart Meters in a pilot study. Of the 28 registered users, 9% of pilot customer accounts, only three visits per week were registered after an initial 20 visits per week (Suzuki 2011). Health concerns and Human Rights issues had also been raised. Such matters must be addressed and solutions recognised.

Connecticut

In Connecticut, Attorney General George Jepsen stated that the utility's plan to replace existing electric meters with advanced technology "*would be very expensive and would not save enough electricity for its 1.2 million customers to justify the expense*."

Jepsen urged regulators to "*continue to evaluate emerging meter system technologies as well as other conservation programs*" and only sanction installation of advanced meters when they are proven to be cost effective.

"*The pilot results showed no beneficial impact on total energy usage, … the savings that were seen in the pilot were limited to certain types of customers and would be far outweighed by the cost of installing the new meter systems*." Attorney General George Jepsen.

Jepsen calls for a "*surgical*" approach in the brief where Smart Meters are only provided to those who request, and can pay, for them (Tweed 2011). The creation of more energy efficient devices would also be of benefit.

Developing Countries

In Chile, it has been claimed that the costs of installing Smart Meters are "*greatly surpassing the benefits, principally because of the initial capital investment costs*." Ramila & Rudnick (2010) further claimed that installed Smart Meters benefitted "*society as a whole, but not … customers within the area of installation, who originate the benefits and pay for the meters.*"

Stromback & Dromacque (2010), talking of Brazil, noted that those on very low incomes may need to be exempt from paying for Smart Meters, indicating once more the benefits of finding other ways to finance such projects if they are to be a success with all consumers.

The VaasaETT Global Energy Think Tank suggests that Smart Meters are "*not necessarily appropriate … for developing nations, or those were household consumption is low*." Concerns were also raised about how resilient the technology may be to climates such as Brazil's (Stromback & Dromacque 2010).

References

Antow, M. (2011), Smart Grid: The Challenges of Big Data http://cloudtimes.org/smart-grid-the-challenges-of-big-data/

Berst, J. (2011), Smart grid market research exclusive: Smart grid winners and losers revealed. SmartGridNews.com, http://www.smartgridnews.com/artman/publish/Business_Markets_Pricing/Smart-grid-market-research-exclusive-Smart-grid-winners-and-losers-revealed-3912.html

DRA (2010), DRA Says Approval of SoCalGas Smart Meters Will Increase Rates, Lead to Job Losses, http://www.dra.ca.gov/DRA/News/News+Releases/100408_scg.htm

Flinders, K. (2011), The UK smart metering project: a failed NHS project in the making? Continued. Inside Outsourcing, http://www.computerweekly.com/blogs/inside-outsourcing/2011/07/the-uk-smart-metering-project-a-failed-nhs-project-in-the-making-continued.html

IMF (2011), World Economic Outlook: Slowing Growth, Rising Risks, Sep 11. World Economic and Financial Surveys. World International Monetary Fund, 241 pp.

Jepsen, G. (2011), Jepsen urges State Regulators to reject CL&P'S plan to replace electric meters. Press release State of Connecticut - Office of the Attorney General 8th February 2011. http://www.ct.gov/ag/lib/ag/press_releases/2011/020811clpmeters.pdf

MMDB (2007), Appraisal of Costs & Benefits of Smart Meter Roll Out Options - Final Report. Mott MacDonald / BERR, http://www.bis.gov.uk/files/file45997.pdf

NAO (2011), Report by the Comptroller and Auditor General HC 1091,

Department of Energy and Climate Change - Preparations for the roll-out of smart Meters, National Audit Office, http://www.official-documents.gov.uk/document/hc1012/hc10/1091/1091.pdf

N-ERC (2011), The Worldwide Smart Grid Market in 2011: A Reality Check and Five Year Outlook Through 2015. Newton-Evans Research Company.

PG&E (2011), PG&E 2010 Program Year SmartMeter™ Program Enabled Demand Response and Energy Conservation Annual Report, Pacific Gas and Electric Company, 59 pp. http://docs.cpuc.ca.gov/EFILE/CF/134539.pdf

Ramila, P. & Rudnick, H. (2010) Smart metering in Santiago de Chile, Metering International, 1, pp. 48-51.

SG GB (2011), SmartGrid GB, http://www.energyandutilities.org.uk/representative_organisations/company/smartgrid_gb

Stromback, J. & Dromacque, C. (2010), Evaluation of residential smart meter policies: WEC-ADEME Case studies on Energy Efficiency Measures and Policies, VaasaETT Global Energy Think Tank, 77pp.

Suzuki, G. (2011), http://mounthelix.patch.com/articles/helix-water-decides-new-meters-not-smart-for-now

TURN (2011), Smart Meters: Dumb Idea, Turn Consumer Advocates, http://www.turn.org/article.php?id=875

Tweed, K. (2011), Attorney Generals Lash Out Against Utilities: Some AGs aren't looking to haggle over smart grid details—they just want to put up a roadblock. Greentechgrid, http://www.greentechmedia.com/articles/read/attorney-generals-lash-out-against-utilities/

It appears imperative that Governments, States and individuals make fully informed decisions on Smart Metering issues as related to their true costs, as determined by Cost Benefit Analyses (CBAs) which take into account issues noted in this present review document.

Smart Meters and Economic Instruments

'Polluter pays principle'

Marshall (2010) suggests that this principle, adopted for atmospheric pollution by CO_2, should also be applied to electromagnetic pollution; with possibly a tax being placed on all products that do not conform to the internationally adopted EMC Standards.

Introducing the 'polluter pays principle' would provide welcome incentives for industries to create more 'environmentally friendly' technologies (*particularly if extended to be more in line with existing WHO policies on Health Promotion*) and would provide further incentive for improved science-based stakeholder processes and technological innovation – a true 'Win/Win' situation. Refer also to Appendices 5 and 6.

Other EMF researchers suggest that such measures should also apply with regard to the more rigorous national standards that already exist in some countries and environmental and public health safeguards.

"*National Authorities should endeavour to promote the internalisation of environmental costs and the use of economic instruments, taking into account the approach that the polluter, should in principle, bear the cost of pollution with due regard to the public interest and without distorting international trade and investment*."
Principle 16 of the Rio Declaration - the 'polluter pays principle.' (UNEP 1992).

The EU's environmental policy is based on the precautionary principle and that "the polluter should pay" (CVTFEU 2010).

Infrastructure design

The infrastructure chosen to support Smart Meters, and the design of the units themselves, may have marked effects on the environment and the economy.

Creating 'eco-sustainable' and 'bio-sustainable' environments

Economic instruments can be used as a means of better considering 'external costs' to provide increased understanding of signals in trends for Smart Metering and possible 'knock on' effects.

It is important to ensure that comprehensive cost benefit analyses are undertaken so that correct and informed decisions can be taken by authorities and individuals.

Economic Instruments influence activities and/or effect change from their impact on market signals. They take on board a variety of policy tools including deposit-refund systems, marketable permits, performance bonds and pollution taxes.

Possible 'external costs' to consider for different Smart Meter regimes may include:

- health impacts to the public
- wellbeing impacts
- indirect impacts on work efficiency
- costs to other industries
- disability discrimination
- natural resource depletion
- environmental degradation
- biodiversity issues
- human rights claims
- security of supply
- timings of rollouts
- cyber security, etc.

Economic Instruments can be devised in a number of ways to encourage end objectives: Increasing the cost of goods and services which harm health and the environment, in addition to increasing financial returns for those adopting more sustainable approaches which promote more environmentally-friendly results (WHO 2011).

Relevance of Economic Instruments to policy-makers

Economic instruments assist the implementation of the 'polluter pays principle'. They are frequently compared to 'command and control' policy approaches which define allowable control technologies (via regulations or laws) and determine pollution reduction targets.

Subsidies

"*Subsidies, usually provided by government … often create perverse economic incentives; they can encourage producers to generate higher levels of environmental pollution -- and higher levels of associated health impacts*." WHO (2011).

"*Such subsidies conflict with the polluter and user pays principles by sending false price signals. They also … distort competition and inhibit the development of substitutes that are more environmentally-friendly*," WHO (2011).

Providing incentives for investments in innovation and improved environmental technology for smart grids and related technologies allow both environmental and financial benefits to be created.

There is a need to investigate ways environmentally harmful subsidies to smart grid related industries or enterprises can be reduced.

As noted by the WHO (2011), "*Tax breaks or other financial incentives might be offered to groups, individuals or industries investing in cleaner technologies*." It appears appropriate that these are applied to the development of Smart Meters and related technologies to help optimise returns.

References

CVTFEU (2010), The Consolidated Version of The Treaty on the Functioning of the European Union, Official Journal of the European Union, C 83/47, 154pp.

Marshall, R. (2010), Environmental Effects of the widespread deployment of high speed Power Line Communication Cumulative Effects on Signal/Noise ratio for Radio Systems, The EMC Journal, 87, pp. 33-41.

UNEP (2004), The Use of Economic Instruments in Environmental Policy – UNEP, http:www.unep.ch/etb/publications/EconInst/econInstruOppChnaFin.pdf 121 pp.

UNEP (1992), Rio Declaration on Environment and Development, United Nations Environment Programme, http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163

WHO (2011), Economic instruments as a lever for policy, http://www.who.int/heli/economics/econinstruments/en/index.html

Optimising energy usage

The real need is for consumers to reduce their energy usage. This can be encouraged by a number of different measures in addition to Smart Metering – *Refer to Appendix 2*. Darby (2010) notes that whilst real-time displays of usage can be of benefit, there is little evidence that the rollout of Smart Meters will result in an overall reduction in energy demand.

The UK already charges 50% more for daytime electricity use than at night (Anderson & Fuloria 2010) - so savings are not guaranteed by the change in system. Experts already voice concerns over this.

Research by van Dam et al., (2010), indicates that initial savings created through the use of home displays may lessen over time as their novelty wears off. Their 15-month study found that initial electricity savings of 7.8% after four months were not sustained medium to long-term.

There is also debate over how many people will actually use in-home displays (IHD). Ogi Kavazovic Vice President of Marketing and Strategy at OPOWER (a customer engagement platform for the utility industry) appears highly sceptical about IHDs being a success (Berst 2011).

Jesse Berst, chief analyst of Smart Grid News, agrees stating: "*[IHDs] will never catch on. If the average electricity bill is, let's say, $100 and the average savings is, let's say, 10%, then we are talking $10 per month [In the UK it is reckoned that on average £1.92 will be saved per month (approximately £0.06 per day) by households (DECC 2011) – present author's comment]. For that amount, most homeowners will scan a report every month or three and then make tweaks to pre-programmed settings. That's it*," (Berst 2011a).

In apparent response to this suggested consumer apathy Google recently axed its PowerMeter electricity monitoring tool due to poor sales (LaMonica 2011).

As noted by Berst (2011a), companies that are unrealistic about future trends, or belief overly optimistic forecasting "*could literally put themselves out of business*."

It is vital that the energy market is better understood so that products and services can be properly developed and specified for the end consumer.

Consumer Focus, the statutory consumer champion for the UK, is particularly concerned that poorer households could bear increased hardship under time-of-use Smart Meter tariffs, as they may be less able to change their patterns of use or determine how to save money from altering their usage. It states "*Consumers must not be forced on to time-of-use tariffs and must have the option to switch back to standard tariffs if they find themselves worse off,"* (Webster 2011).

The effectiveness of consumer monitoring versus advising customers to simply "*turn off electrical items when not in use*", more energy efficient building design, having simple tarrif schemes, and industry creating more energy efficient (and biologically and environmentally friendly) devices appear not to have been fully assessed. *Additionally, research indicates that manually operating appliances when the price is low is the consumers' favoured way of optimising energy consumption* (Paetz et al. 2011).

References

Anderson, S. & Hokfelt, M. (2011), Do Energy Displays Work? Insights into customer response and behaviour to In Home Displays. Green Energy Options Ltd, Smart Metering Scandinavia, 15th March 2011, http://www.greenenergyoptions.co.uk/assets/media/SM%20Scandinavia%202011.pdf

Anderson, R. & Fuloria, S. (2010), On the security economics of electricity metering, 9th Workshop on the Economics of Information Security, Harvard University, George Mason University in Arlington, VA, June 2010, 18 pp.

Berst (2011), How OPOWER is crushing its competition http://www.smartgridnews.com/artman/publish/End_Use_Efficiency/How-OPOWER-is-crushing-its-competition-3613.html

Berst (2011a), CNET story bungles smart grid predictions. Smart Grid Technology, SmartGridNews.com, http://www.smartgridnews.com/artman/publish/Technologies_Home_Area_Networks/New-Pike-Research-report-bungles-smart-grid-predictions-3632.html

Darby, S. (2010), Smart metering: what potential for householder engagement? Building Research & Information, 38(5), pp. 442-457.

Hawiger, M. (2010), Energy savings can be achieved without PG&E's disasterous SmartMeter devices, http://turn.org/article.php?id=918

LaMonica, M. (2011), Google axes PowerMeter--a bad sign for others?, Green Tech, http://news.cnet.com/8301-11128_3-20074160-54/google-axes-powermeter-a-bad-sign-for-others/?tag=topTechContentWrap;editorPicks

Paetz, A.-G. et al. (2011), Tomorrow's households: How do consumers react to a smart-home environment? Presentation given at the 6th International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL), Copenhagen, 25 April 2011.

van Dam, S.S. et al. (2010), Home energy monitors: impact over the medium-term, Building Research & Information, 38(5), pp. 458-469.

Webster, B. (2011), Smart Meters. Smart meters and time-of-use tariffs could help reduce power demand but will change how we live – Save money: shower later. New Statesman, Supplement, 4 July 2011, pp. 9-10.

Cost of securing critical electric infrastructures

There is a very real risk that, unless adequate precautions are taken, many Smart Meters, in their present formats, may be more readily damaged by space weather and malicious manmade events than their predecessors. Governments worldwide are taking such threats very seriously (EIS 2011, 2010). Industry is now starting to address this matter.

Smart grids (and Smart Meters) may need to be protected against electromagnetic pulse (EMP) damage to comply with the International Infrastructure Security Roadmap developed to secure power supplies. It seems the costs of such measures for different metering systems have yet to be obtained. Additionally ensuring that Smart Meters cannot be disconnected remotely would greatly help reduce risk of blackouts caused by hackers and rogue states.

Where/if appropriate, it is proposed that customers should be allowed the option of paying for upgrades for hardening their Smart Meters. Whether this could be recouped in the long term through reduced insurance premiums remains to be seen.

The option also exists of delaying further rollouts of Smart Meters until the main risk period from solar EMP subsides, whilst undertaking appraisals as to the best ways to proceed to optimise their performance and address consumer concerns (whilst also educating the public on energy saving measures and asking them to reduce their energy usage).

Future proofing investments

For Smart Meters to meet the international Electric Infrastructure Security Council (EIS) requirements and be a financial success, they need to be “future proofed’ and made more desirable to the end user. One way to help achieve this may be through providing a mainly fibre-optic system. This reduces health and security issues and makes smart grid more attractive for investors.

Anderson & Fuloria (2010)’s suggestion of bringing on board additional highly qualified IT professionals and systems engineering

staff (at the earliest possible opportunity) to help further recognise and address potential IT problems and optimise Smart Meter solutions to could be of great benefit.

Possible cost effects of Smart Meters on health and productivity

Rigorous research has to be undertaken to investigate claims on the effects of different types of Smart Meters and Smart Metering regimes on health and the environment – *ideally before they are installed – Refer also to 'Healh Matters' and Appendix … .*

The alleged change in Indoor Environmental Quality (IEQ) created by some wireless Smart Meter emissions, as demonstrated by some existing rollouts, may adversely affect individuals' productivity and wellbeing (EMFSN 2011, Schreier et al. 2006). These matters need to be appropriately addressed and solutions applied.

It is recognised that poor indoor environmental quality (IEQ) alone can greatly impact health and productivity, possibly at a cost of up to hundreds of billions of dollars per year (Kats et al. 2003).

It is vital to ensure that Smart Meters and related technologies are biologically friendly and do not harm IEQ.

The possible damage that health problems allegedly related to some types of Smart Meters might have on national productivity, and the level of burden these may place on already overstretched health services, have yet to be properly assessed.

The possible effects of emissions on Nature - *if proven true* - too have to be considered. Ideally empirical or theoretical studies should be undertaken on the potential economic effects on the environment of the rollout of different types of Smart Meter system.

Cost benefits of ensuring human rights are recognised

The possible costs of human rights challenges to various Smart Meter configurations should be addressed before further large scale rollouts are undertaken so that the likelihood of challenges are reduced through the specification/development of appropriate units.

Failure to adequately address human rights issues has already stalled Smart Meter installation in the Netherlands (metering.com 2009).

Cost benefit analysis

The UK's Department of Energy and Climate Change (DECC) have estimated in the past that Smart Meters may deliver "*a net benefit to consumers of around £5.98 billion over 20 years,*" (Ofcom 2009).

This works out to around an average of £299 million annually.

The above sum appears significantly less than the damage that might be inflicted on human health, productivity, national security and the environment if the wrong types of Smart Metering system and infrastructures are specified.

Transparent and detailed cost benefit analyses are urgently required taking into account the potential effects (beneficial or detrimental) of different Smart Meter regimes, as related to the billions countries spend on health, the environment and security of their supply and data - *all of which may be effected by Smart Metering decisions*.

As an example: as RF/microwaves are now recognised as being a potential human carcinogen (WHO/IARC 2011), the possible effects of RF/microwave emissions emitted from some types of unit should also be factored into such analysis. The annual cost to England alone (not the UK) from cancer is £18.33 billion - *with figures set to rise to £24.72 billion over the next ten years* (Featherstone & Whitham 2010). *Refer also to 'Health Matters' and Appendix 1.*

References

EMFSN (2011), Smart Meter Health Impacts-comments, EMF Safety Network, http://emfsafetynetwork.org/?page_id=2292

Featherstone, H. & Whitham, L. (2010), The cost of cancer, Policy Exchange research note February 2010. Policy Exchange, 20 pp.

Kats, G. et al. (2003), The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force, http://www.ciwmb.ca.gov/greenbuilding/Design/CostBenefit/Report.pdf.

metering.com (2009), Smart meters not to be compulsory in Netherlands, http://www.metering.com/node/15062

Ofcom (2009), Delivering Smart Meters Factsheet 84, http://ofgem.gov.uk

Schreier, N. et al. (2006), The prevalence of symptoms attributed to electromagnetic field exposure: a cross-sectional representative survey in Switzerland. Sozial- und Präventivmedizin, 51(4), pp. 202-209.

WHO/IARC (2011), IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans, Press Release No. 208, World Health Organization, 31st May 2011.

Life Cycle Costing

Life Cycle Costing (LCC)*, taking into account health and productivity, as determined by multifactoral Environmental Impact Assessments (EIA) and Health Impact Assessments (HIA), should be used to help determine which types of Smart Meter systems are best for optimising overall investments and financial returns.

*[LCC is a methodology used to identify the most financially viable solution to save money through estimating the total cost of ownership of a product, structure or system over its useful life based on a variety of factors].

Creating financial opportunities

In 2009, Ernst & Young warned that the UK Government at that time that it had underestimated the cost of a nationwide Smart Meter rollout and stated that the end cost could be £13.4 billion.

"*Very big and complex projects of this sort always cost more than anticipated," … [the Government's figures appeared to rely] on an assumption of absolute efficiency*."
Tony Ward, Power and Utilities Partner in Ernst & Young (Pagnamenta 2009).

As indicated earlier in this document, once Health Impact Assessments (HIA), Environmental Impact Assessments (EIA) and Life Cycle Costings (LCC) factors are taken into consideration (alongside potential customer savings over time and security issues); *there is very little opportunity for countries such as the UK to make financial gains from installing Smart Meters, unless radical changes are undertaken.*

One such way of achieving financial viability and addressing potential public health concerns appears to be through investing in innovative fibre-optic smart grid networks similar to those used in Chattanooga, Tennesee – *Refer to section on 'Smart Alternatives'*.

The higher initial costs of fibre-optic Smart Meters might be mitigated through countries achieving greater national productivity and wellbeing over their lifespan than might be the case with widespread use of wireless units (in their present format). Their infrastructure is also less vulnerable than wireless alternatives and can provide additional sources of income from broadband providers.

Challenging financial perceptions

"*There is only one difference between a bad economist and a good one: the bad economist confines himself to the visible effect; the good economist takes into account both the effect that can be seen and those effects that must be foreseen*."
Frédéric Bastiat (1801-1850) political economist and leading advocate of free markets and free trade in the 19th century.

In the past wishful thinking, over simplification and incomplete understanding of the matters at hand have often prevented optimum solutions being achieved.

Such approaches can be tremendously counterproductive to all concerned, particularly where risks are high, and appropriate stakeholders and technological solutions that could be brought in are virtually ignored or dismissed out of hand.

It is already evident that billions of dollars have been misspent worldwide in the rush to implement smart metering. It is time to address this issue properly with robust interdisciplinary research and the ability to "*think outside the box*" and also take onboard other measures can also help reduce energy usage.

Benefits of investing in innovation

By investing properly in the smart grid infrastructure, it can be made far safer and used in highly innovative ways, including Internet provision (through leasing fibre-optic capacity to providers of general broadband services).

"*The internet is a tremendous opportunity for innovative UK companies. The UK internet economy was worth £100 billion in 2009 … That's roughly 7.2% of gross domestic product, making the internet a larger factor in the UK economy than construction, mining, tourism, agriculture and a number of other industries. And the internet is expected to be worth 10% of UK GDP in 2015*."
Eric Schmidt, Executive Chairman of Google.

As the introduction of smart grids using fibre-optic technology has already been shown to improve business investment over other types of system and optimise/'future-proof' Internet connections; it is proposed that their adoption should be seriously considered.

No-one has yet fully assessed the potential benefits of introducing a fibre-optic smart grid and broadband network for a whole country. The bringing onboard of other energy saving measures too should be considered - *Refer also to Appendix 2*.

Improving revenue streams

It is important to secure a meaningful sustainable growth strategy for the smart grid by opening up its revenue streams. As noted by Lord Green, UK Minister of State for Trade and Investment (when discussing infrastructures) growth can be provided from investment by external sources seeking business opportunities (Parsley 2011).

There is a window of opportunity for increased investment by external sources in the UK's smart grids; possibly through creating new Electric Market Reforms (EMR), as a first step towards creating a robust 'future-proof' national infrastructure of smart grids – *present author's comments*. Other energy saving concepts and technological innovations could provide further opportunities for sound investment.

"… *we have to all think more proactively about where opportunities are*."
Lord Green, UK Minister of State for Trade and Investment (Parsley 2011).

References

Anderson, R. & Fuloria, S. (2010), On the security economics of electricity metering, 9th Workshop on the Economics of Information Security, Harvard University, George Mason University in Arlington, VA, June 2010, 18 pp.

Bastiat, F. (1848), Selected Essays on Political Economy. Translated by S. Cain, G.B. de Huszar (Ed). Chapter: 1: What Is Seen and What Is Not Seen 1, http://oll.libertyfund.org/title/956/35425/1409294 on 2011-08-25

Burbank ACTION (2011), Smart Meter Consumers Anger Grows Over Higher Utility Bills, Burbank ACTION (Against Cell Towers In Our Neighborhood), http://sites.google.com/site/nocelltowerinourneighborhood/home/wireless-smart-meter-concerns/smart-meter-consumers-anger-grows-over-higher-utility-bills

CBS 5 Investigates Smart Meter Complaints, http://www.youtube.com/watch?v=csvmw2frBws

Datamonitor (2010), Me-too mindset drives smart metering to $5.7 billion, http://about.datamonitor.com/media/archives/5095

DECC Smart Metering Implementation Prospectus (2011). http://www.decc.gov.uk/en/content/cms/consultations/smart_mtr_imp/smart_mtr_imp.aspx: see 1.5 and 1.6 on pp. 5.

EIS (2011), EIS Summit: International Infrastructure Security Roadmap, Electric Infrastructure Security Summit - The Capitol Building, US Congress, Washington D.C., 11 April 2011.

EIS (2010), EIS Summit Summary Report, Report: The First World Infrastructure Security Summit, Electric Infrastructure Security Summit - London, 20 September 2010, Westminster Hall, Parliament, UK.

Mills, E. & LaMonica, M. (2010), Money trumps security in smart-meter rollouts, experts say. InSecurity Complex, cnet NEWS, http://news.cnet.com/8301-27080_3-20007672-245.html?tag=mncol;txt

ONS (2010), Annual Survey of Hours and Earnings, 2010 Statistical Bulletin, Office for National Statistics.

Pagnamenta, R. (2009), Government's smart-meter estimate falls short by £6bn, expert claims. The Times, 18 May 2009.

Parsley, D. (2011), The UK advantage: Minister of State for Trade and Investment, Lord Green discusses the task ahead with David Parsley. Springboard, Spring 2011, pp. 16-20.

Schmidt, E. (2011), Google says it wants to keep the London technology ball rolling, The London Evening Standard, 29 June 2011, pp. 36.

uSwitch.com 2011) £11.3 Billion smart meter cost to be met through customer bills – uSwitch.com comments.

uSwitch (2010), uSwitch.com research - survey conducted by YouGov online between 10th – 13th August, 2010. A total of 5,070 UK energy customers took part in the survey. The figures have been weighted.

Which, (2010), Consumers not prepared to pay for smart meters, http://www.which.co.uk/about-which/press/press-releases/campaign-press-releases/energy/2010/07/consumers-not-prepared-to-pay-for-smart-meters/

Wolff, E. (2010), EXCLUSIVE: Smart meters and solar panels don't mix: Software, systems won't be ready until 2011, utilities say. North County Times, http://www.nctimes.com/business/article_560be00e-f979-5516-bf44-873527a9ea96.html

Zeller, T (2010) ‘Smart’ Meters Draw Complaints of Inaccuracy, Business Day, New York Times. http://www.nytimes.com/2010/11/13/business/13meter.html

Conclusion

Image source: posterize, http://www.freedigitalphotos.net/images/view_photog.php?photogid=1665

Optimising opportunities for success

Looking to the future

For Smart Metering and smart grids to stand a chance of real success, there is a need for the adoption of 'open innovation' approaches based on collaboration and co-creation that respect security issues, human rights, public health, the environment and the need for beneficial best practice and timely innovation.

"*Companies face tough dilemmas every day for which there is a uniquely prepared mind somewhere in the world who possesses the right combination of expertise and experience to solve that problem*," Tapscott & Williams (2008).

History has continually proven that, when more facts are known, properly thought out strategies can often provide cheap and simple solutions for seemingly unsolvable problems.

The 'Win/Win' approach

There are already experts available worldwide who can provide creative, technical, legal and scientific insights into how Smart Metering and smart grids can be improved and optimised.

If larger interdisciplinary teams are created, numerous problems (both those that have been seen and are unforeseen) can be solved far more rapidly, whilst creating more resilient 'biologically friendly' technology, legal frameworks and 'win/win' scenarios for all concerned.

Whilst some Smart Meters - *in their present form* - may adversely affect health, and there are concerns about system security and the timing of rollouts; more suitable alternatives are available - or can be created.

"This is a once in a lifetime opportunity and if … [we get] it right it will genuinely be the case that 'everybody wins' …

It will be those … who look to be part of the 'smart scene' by seeing these challenges as a means of opening up new business opportunities who will benefit. …

This is a unique opportunity for those professionals associated with developing the 'intelligent' buildings of tomorrow, and who themselves are smart enough to help make the 'smart revolution' happen."
Terry Rowbury, Director-Energy Sector, BEAMA*

***BEAMA is the independent expert knowledge base & forum for the electrotechnical industry in the UK & Europe.**

The need for strong vision

It is imperative that the precautionary principle is employed and that national security, public health, public safety and the economic well-being of countries are taken into consideration when considering the types of Smart Meter systems to adopt and the timing of their rollouts – *Refer also to the Appendices*.

The adoption of other measures that can further reduce energy usage should be actively encouraged.

"*Coming together for maximum mutual benefit requires strong vision, openness, responsibility, commitment, accountability, fairness, mutual respect, and the wisdom to know how to act appropriately on the findings discovered so that maximum long-term gains are made by all parties*," Isaac Jamieson (2010).

Those who positively address the matters raised in this review document may be more likely to create successful Smart Metering systems – they may also be more likely to be the leaders in the forthcoming 'bio-electromagnetically friendly' technological revolution. Adopting pioneering (*instead of closed*) mindsets has already been proven to generate superior results and innovation in the electronics industry (Hiltzik 1999). Which countries will choose to adopt this path remains to be seen.

Those who fail to address such issues may leave themselves at increased risk of economic destabilisation, public distrust and ever increasing lawsuits. Cost effective 'Win/Win' solutions that benefit the individual, national economies and the environment should be sought wherever practical.

References

Hiltzik, M.A. (1999), Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age. Harper Business, HarperCollins Publishers, New York.

Jamieson, I.A. (2010), Intelligent Communication: The Future of EMF Discourse and Risk Governance?, IOP Conference Series: Earth and Environmental Sciences, http://iopscience.iop.org/1755-1315/10/1/012009

Rowbury, T. (2011), Terry Rowbury discusses the challenges and opportunities of the 'smarter future', http://www.wholebuild.co.uk/building-product/energy-and-utility-provision/news/terry-rowbury-discusses-the-challenges-and-opportunities-of-the-smarter-future.

Tapscott, D. & Williams, A.D. (2008), Wikinomics: How mass collaboration changes everything (Expanded Edition), Atlantic Books, London, 351 pp.

Appendix 1 – Health & Smart Meter safety survey

High number of health complaints reported after installation of wireless Smart Meters (SDA 2011).

Excerpts from online survey* are given below:
The figures reflect whether individuals or members of their homes experienced health impacts (n = 318).

Sleep problems	49.1%
Stress, anxiety, irritability	43.1%
Headaches	40.9%
Ringing in the ears	38.1%
Concentration, memory or learning problems	34.6%
Fatigue, muscle or physical weakness	34.3%
Disorientation, dizziness, or balance problems	25.8%
Eye problems, including eye pain, pressure in the eyes, blurred vision	33.0%
Cardiac symptoms, heart palpitations, heart arrhythmias, chest pain	25.8%
Leg cramps, or neuropathy	19.2%
Arthritis, body pain, sharp, stabbing pains	18.2%
Nausea, flu-like symptoms	17.3%
Sinus problems, nose bleeds	14.5%
Respiratory problems, cough, asthma	13.8%
Skin rashes, facial flushing	12.6%
Urinary problems	8.8%
Endocrine disorders, thyroid problems, diabetes	8.8%
High blood pressure	7.2%
None of the above	8.8%
Other	30.5%
I don't know	24.8%

Meter type preferred

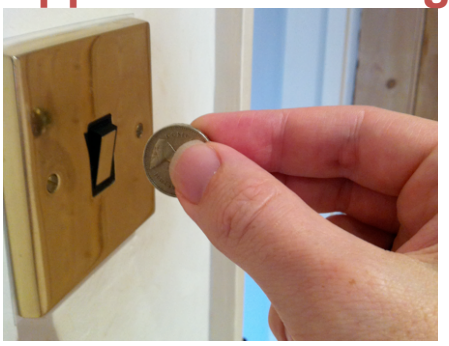
94.1% of respondents (n = 387) stated that they would prefer to retain or restore their original analogue meters, and 91.7% (n = 374) stated that they did not wish to pay more for such meters.

*The EMF Safety Network initiated that survey from 13th July to 2nd September 2011 to investigate to what extent there may be health and safety complaints related to wireless Smart Meters. The majority of respondents (78%) were from California and the survey results were analysed by consultant Dr. Ed Halteman from the firm Survey Design & Analysis (SDA 2011).

Reference

SDA (2011), Wireless Utility Meter Safety Impacts Survey, Survey Design & Analysis, http://emfsafetynetwork.org/wp-content/uploads/2011/09/Wireless-Utility-Meter-Safety-Impacts-Survey-Results-Final.pdf

Appendix 2 – Energy use & financial implications



Governments, States and individuals should be able to make fully informed decisions on Smart Metering issues related to their true costs, as determined by Cost Benefit Analyses (CBAs) that take into account issues raised in this present review document. 'Willful blindness' (or access to incomplete facts) is not a sustainable option.

The type of Smart Metering system proposed may greatly determine its likelihood of success or failure. Safeguards also have to be put in place to address public and scientific concerns.

It is already contested by some researchers whether consumers and nations will make worthwhile savings with the Smart Metering systems *presently* proposed by many utilities.

A 12-month study by Hargreaves (2011), undertaken in dwellings where monitors displaying electricity use had previously been installed demonstrated that the initial enthusiasm towards energy saving measures with the monitors soon wore off. In some homes their use was abandoned, whilst in others they caused rows over energy consumption between partners or parents and teenagers.

"*Rather than feeling motivated to save more energy and money householders were left feeling frustrated and despondent that the changes they could make were very small and they were receiving little or no meaningful support from anywhere else, such as government and local authorities.'* Hargreaves (2010).

Dr Hargreaves claims the current UK decision to rollout Smart Meters has been hastily arrived at, without sufficient evidence on their likely impact, and that key opportunities may be being missed by the process being rushed.

"*SmartMeters represent a high-cost, high-tech approach where a less expensive and more expansive one will do. The best way to address global warming 'and higher electric bills' is already available, and it is called conservation*" (Hawiger 2010).

Conservation

Many measures do not require the benefits of Smart Meters and smart technology only Common Sense. Among the simple measures that can be adopted are:

- Proper insulation of homes and offices.
- Switching off lights* and equipment in empty rooms and corridors.
- Creating ways to bring natural light deeper into buildings reducing daytime need for artificial lighting and energy use.
- Getting up earlier when it is light reducing need for artificial light.
- Avoiding having appliances on standby.
- Ensuring heaters, air-conditioning and boilers are energy efficient.
- Energy efficient appliances.
- Use of appliances powered manually or from free energy.
- Keep heating thermostats at 19 °C (66.2 °F) or less.
- Wearing more clothes indoors when cold so less heating required.
- Opening windows and doors for increased ventilation on hot days instead of using air-conditioning or electric fans.
- Switching off equipment when not in use and avoiding using standby mode when not in use (as this still consumes energy).
- Boiling only the water required when using kettles.
- Using less bathwater when bathing, or ideally, having short showers.
- Line drying clothes instead of using a tumble drier.

Through proper education of the general public, *substantial* energy savings can be achieved even *without* the introduction of smart grids - *and at far lower risk than is being created by many rollouts.*

It is necessary to optimise smart grid design whilst promoting such measures and taking into account the true needs of the consumer.

*The replacement of traditional incandescent lighting with compact fluorescent bulbs (CFLs) is frowned upon in some circles because of potential health and environmental risks (Oliver 2008).

References

Hargreaves, T. (2011), When practices strike back...: a longitudinal study of the impact of smart energy monitors on domestic energy-use practices. Presentation at the Royal Geographical Society (with IBG) annual International Conference, London. 2nd September 2011. Media release.

Hawiger, M. (2010), Energy savings can be achieved without PG&E's disasterous SmartMeter devices, http://turn.org/article.php?id=918

Oliver, R. (2008), Understanding flourescent light bulbs, EcoSolutions, http://edition.cnn.com/2008/TECH/07/27/eco.flourescent/

Appendix 3 - Health Promotion

Image source: Kookkai_nak, http://www.freedigitalphotos.net/images/view_photog.php?photogid=2354

There is a need for 'biologically friendly' meter regimes that enhance health and wellbeing.

There are a number of health promotion initiatives that have been instigated by the World Health Organization (WHO), which provide incentive for Governments, international organisations, international industries, technological companies, schools and local communities to achieve the target of '*Health For All*' through improved health promotion and the creation of healthier technologies and environments.

"Systematic assessment of the health impact of a rapidly changing environment - particularly in areas of technology, work, energy production and urbanization - is essential." WHO (1986).

It is important to ensure that health impacts are undertaken for the technologies used for Smart Meters, smart grids and related equipment, and that they are made as 'biologically friendly' as possible to enable people to lead healthy lives.

Ottawa Charter for Health Promotion

First International Conference on Health Promotion Ottawa, 21 November 1986 - WHO/HPR/HEP/95.1

This Charter is an international agreement signed in 1986 at the First International Conference on Health Promotion in Ottawa, Canada, which was organised by the World Health Organization (WHO 1986). It has acted, and continues to act, as a catalyst for a wide range of beneficial actions which encourage improved health promotion measures worldwide.

Extracts from the Ottawa Charter are given below:

Health Promotion

"*Health promotion is the process of enabling people to increase control over, and to improve, their health. To reach a state of complete physical, mental and social well-being, an individual or group must be able to identify and to realize aspirations, to satisfy needs, and to change or cope with the environment. …* "

Advocate

"*Good health is a major resource for social, economic and personal development and an important dimension of quality of life. Political, economic, social, cultural, environmental, behavioural and biological factors can all favour health or be harmful to it. Health promotion action aims at making these conditions favourable through advocacy for health*."

Enable

"Health promotion focuses on achieving equity in health. Health promotion action aims at reducing differences in current health status and ensuring equal opportunities and resources to enable all people to achieve their fullest health potential. This includes a secure foundation in a supportive environment, access to information, life skills and opportunities for making healthy choices."

"People cannot achieve their fullest health potential unless they are able to take control of those things which determine their health. …"

Health Promotion Action Means:
Build Healthy Public Policy

"*Health promotion goes beyond health care. It puts health on the agenda of policy makers in all sectors and at all levels, directing them to be aware of the health consequences of their decisions and to accept their responsibilities for health*."

"… It is coordinated action that leads to health, income and social policies that foster greater equity. Joint action contributes to ensuring safer and healthier goods and services, healthier public services, and cleaner, more enjoyable environments."

"Health promotion policy requires the identification of obstacles to the adoption of healthy public policies in non-health sectors, and ways of removing them. The aim must be to make the healthier choice the easier choice for policy makers as well."

Create Supportive Environments

"Our societies are complex and interrelated. Health cannot be separated from other goals."

"Systematic assessment of the health impact of a rapidly changing environment - particularly in areas of technology, work, energy production and urbanization - is essential and must be followed by action to ensure positive benefit to the health of the public. The protection of the natural and built environments and the conservation of natural resources must be addressed in any health promotion strategy."

Strengthen Community Actions

"*Health promotion works through concrete and effective community action in setting priorities, making decisions, planning strategies and implementing them to achieve better health."*

"At the heart of this process is the empowerment of communities - their ownership and control of their own endeavours and destinies."

"… This requires full and continuous access to information, learning opportunities for health, as well as funding support."

Moving into the Future

"*Health is created and lived by people within the settings of their everyday life; … Health is created by caring for oneself and others, by being able to take decisions and have control over one's life circumstances, and by ensuring that the society one lives in creates conditions that allow the attainment of health by all its members*."

Commitment to Health Promotion

"*The participants in this Conference pledge:*

- *to move into the arena of healthy public policy, and to advocate a clear political commitment to health and equity in all sectors;*

- *to counteract the pressures towards harmful products, resource depletion, unhealthy living conditions and environments …; and to focus attention on public health issues such as pollution, occupational hazards, housing and settlements;*

- *"to acknowledge people as the main health resource; to support and enable them to keep themselves, their families and friends healthy … and to accept the community as the essential voice in matters of its health, living conditions and well-being;"*

• *"to recognize health and its maintenance as a major social investment and challenge; and to address the overall ecological issue of our ways of living."*

Adelaide Recommendations on Healthy Public Policy

Second International Conference on Health Promotion, Adelaide, South Australia, 5-9 April 1988

Excerpts:

Healthy Public Policy

"*Healthy public policy is characterized by an explicit concern for health and equity in all areas of policy and by an accountability for health impact. The main aim of health public policy is to create a supportive environment to enable people to lead healthy lives.*"

"*Such a policy makes … social and physical environments health-enhancing. In the pursuit of healthy public policy, government sectors concerned with agriculture, trade, education, industry, and communications need to take into account health as an essential factor when formulating policy.*"

"*These sectors should be accountable for the health consequences of their policy decisions. They should pay as much attention to health as to economic considerations.*"

The value of health

"*Health is both a fundamental human right and a sound social investment. Governments need to invest resources in healthy public policy and health promotion in order to raise the health status of all their citizens. A basic principle of social justice is to ensure that people have access to the essentials for a healthy and satisfying life.*"

"… this raises overall societal productivity in both social and economic terms. Healthy public policy in the short term will lead to long-term economic benefits as shown by the case studies …"

"*New efforts must be made to link economic, social, and health policies into integrated action.*"

Accountability for Health

"*Public accountability for health is an essential nutrient for the growth of healthy public policy. Governments and all other controllers of resources are ultimately accountable to their people*

for the health consequences of their policies, or lack of policies."

"*A commitment to healthy public policy means that governments must measure and report the health impact of their policies in language that all groups in society readily understand. …*"

Partners in the policy process

"*Government plays an important role in health, but health is also influenced greatly by corporate and business interests, nongovernmental bodies and community organizations. Their potential for preserving and promoting people's health should be encouraged*."

Future Challenges

"Health for All will be achieved only if the creation and preservation of healthy living and working conditions become a central concern in all public policy decisions."

"*The most fundamental challenge for individual nations and international agencies in achieving healthy public policy is to encourage collaboration (or developing partnerships) in peace, human rights and social justice, ecology, and sustainable development around the globe*."

Jakarta Declaration on Leading Health Promotion into the 21st Century

"*… The Fourth International Conference on Health Promotion is the first to be held in a developing country, and the first to involve the private sector in supporting health promotion. It has provided an opportunity to reflect on what has been learned about effective health promotion, to re-examine the determinants of health, and to identify the directions and strategies that must be adopted to address the challenges of promoting health in the 21st century. The participants in the Jakarta Conference hereby present this Declaration on action for health promotion into the next century*."

Health promotion is a key investment

"Health is a basic human right and is essential for social and economic development. Increasingly, health promotion is being recognized as an essential element of health development. It is a process of enabling people to increase control over, and to improve, their health. …"

Health promotion makes a difference

"*Research and case studies from around the world provide convincing evidence that health promotion is effective. Health promotion strategies can develop and change lifestyles, and have an impact on the social, economic and environmental conditions that determine health. Health promotion is a practical approach to achieving greater equity in health. …*"

New responses are needed

"To address emerging threats to health, new forms of action are needed. … There is a clear need to break through traditional boundaries within government sectors, between governmental and nongovernmental organizations, and between the public and private sectors."

"Cooperation is essential; this requires the creation of new partnerships for health, on an equal footing, between the different sectors at all levels of governance in societies."

Priorities for health promotion in the 21st Century

1. Promote social responsibility for health

"Decision-makers must be firmly committed to social responsibility. Both the public and private sectors should promote health by pursuing policies and practices that:

- *avoid harming the health of individuals*
- *protect the environment …*
- *include equity-focused health impact assessments as an integral part of policy development*."

2. Increase investments for health development

"*In many countries, current investment in health is inadequate and often ineffective. Increasing investment for health development requires a truly multisectoral approach … Greater investment for health and reorientation of existing investments … has the potential to achieve significant advances in human development, health and quality of life*."

"*Investments for health should reflect the needs of particular groups such as women, children, older people, and indigenous, poor and marginalized populations*."

3. Consolidate and expand partnerships for health

"*Health promotion requires partnerships for health and social development between the different sectors at all levels of governance and society. Existing partnerships need to be*

strengthened and the potential for new partnerships must be explored."

"*Partnerships offer mutual benefit for health through the sharing of expertise, skills and resources. Each partnership must be transparent and accountable and be based on agreed ethical principles, mutual understanding and respect*. …"

4. Increase community capacity and empower the individual

"Health promotion is carried out by and with people, not on or to people. It improves both the ability of individuals to take action, and the capacity of groups, organizations or communities to influence the determinants of health."

5. Secure an infrastructure for health promotion

"… *All countries should develop the appropriate political, legal, educational, social and economic environments required to support health promotion*."

Call for action

"…In order to speed progress towards global health promotion, the participants endorse the formation of a global health promotion alliance … to advance the priorities for action in health promotion set out in this Declaration.

Priorities for the alliance include:

- *raising awareness of the changing determinants of health*
- *supporting the development of collaboration and networks for health development*
- *mobilizing resources for health promotion*
- *accumulating knowledge on best practice …*
- *fostering t*ransparency and public accountability in health promotion"

"*National governments are called on to take the initiative in fostering and sponsoring networks for health promotion both within and among their countries*."

"*The participants call on WHO to take the lead in building such a global health promotion alliance and enabling its Member States to implement the outcomes of the Conference. A key part of this role is for WHO to engage governments, nongovernmental organizations, development banks, organizations of the United Nations system, interregional bodies, bilateral agencies, the labour movement and cooperatives, as well as the private sector, in advancing the priorities for action in health promotion*."

Mexico Ministerial Statement for the Promotion of Health: from Ideas to Action

Excerpts:

"*Gathered in Mexico City on the occasion of the Fifth Global Conference on Health Promotion, the Ministers of Health who sign this Statement:*

- *Recognize that the attainment of the highest possible standard of health is a positive asset for the enjoyment of life and necessary for social and economic development and equity. …*
- *Conclude that health promotion must be a fundamental component of public policies and programmes in all countries in the pursuit of equity and better health for all.*
- *Realize that there is ample evidence that good health promotion strategies of promoting health are effective*."

"Considering the above, we subscribe to the following:

Actions

To position the promotion of health as a fundamental priority in local, regional, national and international policies and programmes."

"… To take the leading role in ensuring the active participation of all sectors and civil society, in the implementation of health promoting actions which strengthen and expand partnerships for health. …"

"The support of research which advances knowledge on selected priorities. … To establish or strengthen national and international networks which promote health."

"*To advocate that UN agencies be accountable for the health impact of their development agenda. …*"

This Ministerial Statement was signed by the following countries:
Algeria, Angola, Argentina, Australia, Austria, Bangladesh, Belize, Bhutan, Bolivia, Brazil, Bulgaria, Cameroon, Canada, China, Colombia, Costa Rica, Cuba, Czech Republic, Denmark, Dominica, Dominican Republic, Ecuador, El Salvador, Finland, France, Gabon, Germany, Guatemala, Hungary, India, Indonesia, Iran, Israel, Jamaica, Korea, Kuwait, Lao PDR, Lebanon, Madagascar, Malaysia, Maldives, Malta, Morocco, Myanmar, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Pakistan, Panama, Paraguay, Poland, Portugal, Puerto Rico, Russian Federation, Saint Kitts and Nevis, Saint Lucia, Samoa, Slovakia, Slovenia, Spain, Swaziland, Sweden, Switzerland, Turkey, United Kingdom, United States, Uruguay, Vanuatu, Venezuela, Yugoslavia, Zambia.

The Bangkok Charter for Health Promotion in a Globalized World (WHO 2005).

Excerpts:

"*The Bangkok Charter identifies actions, commitments and pledges required to address the determinants of health in a globalized world through health promotion. … [It] affirms that policies and partnerships … to improve health and health equality, should be at the centre of global and national development*."

"The Bangkok Charter complements and builds upon the values, principles and action strategies of health promotion established by the 'Ottawa Charter for Health Promotion' and the recommendations of the subsequent global health promotion conferences which have been confirmed by Member States through the World Health Assembly."

"The Bangkok Charter reaches out to people, groups and organizations that are critical to the achievement of health, including:

- *governments and politicians at all levels*
- *civil society*
- *the private sector*
- *international organizations, and*
- *the public health community."*

"The United Nations recognizes that the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without discrimination."

"Health promotion is based on this critical human right and offers a positive and inclusive concept of health as a determinant of the quality of life and encompassing mental and spiritual well-being."

"Health promotion is the process of enabling people to increase control over their health and its determinants, and thereby improve their health. It is a core function of public health and contributes to the work of tackling communicable and noncommunicable diseases and other threats to health. …"

Strategies for health promotion in a globalized world

Effective interventions

"Progress towards a healthier world requires strong political action, broad participation and sustained advocacy.

Health promotion has an established repertoire of proven effective strategies which need to be fully utilized."

Required actions

"To make further advances in implementing these strategies, all sectors and settings must act to:
• *advocate for health based on human rights and solidarity*
• *invest in sustainable policies, actions and infrastructure to address the determinants of health*
• *build capacity for policy development, leadership, health promotion practice, knowledge transfer and research, and health literacy*
• *regulate and legislate to ensure a high level of protection from harm and enable equal opportunity for health and well-being for all people*
• *partner and build alliances with public, private, nongovernmental and international organizations and civil society to create sustainable actions."*

Key commitments

1. Make the promotion of health central to the global development agenda

"*Health promotion must become an integral part of domestic and foreign policy and international relations, …*
This requires actions to promote dialogue and cooperation among nation states, civil society, and the private sector. …"

2. Make the promotion of health a core responsibility for all of government

"… health is a major determinant of socioeconomic and political development.
Local, regional and national governments must:
• *give priority to investments in health, within and outside the health sector*
• *provide sustainable financing for health promotion."*

"To ensure this, all levels of government should make the health consequences of policies and legislation explicit, using tools such as equity-focused health impact assessment."

3. Make the promotion of health a key focus of communities and civil society

"*Communities and civil society often lead in initiating, shaping and undertaking health promotion. They need to have the rights,*

resources and opportunities to enable their contributions to be amplified and sustained. …"

"Civil society needs to exercise its power in the marketplace by giving preference to the goods, services and shares of companies that exemplify corporate social responsibility."

"Health professional associations have a special contribution to make."

4. Make the promotion of health a requirement for good corporate practice

"*The corporate sector has a direct impact on the health of people and on the determinants of health …"*

"*The private sector, like other employers and the informal sector, has a responsibility to ensure health and safety …".*

"The private sector can also contribute to lessening wider global health impacts, ... by complying with local national and international regulations and agreements that promote and protect health. …"

A global pledge to make it happen

All for health

"Meeting these commitments requires better application of proven strategies, as well as the use of new entry points and innovative responses."

"Partnerships, alliances, networks and collaborations provide exciting and rewarding ways of bringing people and organizations together around common goals and joint actions to improve the health of populations."

"Each sector – intergovernmental, government, civil society and private – has a unique role and responsibility."

Closing the implementation gap

"*Since the adoption of the Ottawa Charter, a significant number of resolutions at national and global level have been signed in support of health promotion, but these have not always been followed by action. The participants of this Bangkok Conference forcefully call on Member States of the World Health Organization to close this implementation gap and move to policies and partnerships for action."*

Worldwide partnership

"*This Bangkok Charter urges all stakeholders to join in a worldwide partnership to promote health, with both global and local engagement and action*."

Commitment to improve health

"Conference participants request the World Health Organization and its Member States, in collaboration with others, to allocate resources for health promotion, initiate plans of action and monitor performance through appropriate indicators and targets, and to report on progress at regular intervals. United Nations organizations are asked to explore the benefits of developing a Global Treaty for Health."

The Bangkok Charter contains the collective views of international experts and does not necessarily represent WHO decisions or stated policies – *comment by present author*.

References

HPI (1986), A discussion document on the concept and principles of health promotion, Health Promotion International, 1 (1), pp. 73-76.

WHO (1986), Ottawa Charter for Health Promotion, First International Conference on Health Promotion Ottawa, 21 November 1986 - WHO/HPR/HEP/95.1, http://www.who.int/hpr/NPH/docs/ottawa_charter_hp.pdf

WHO (1988), Adelaide Recommendations on Healthy Public Policy, Second International Conference on Health Promotion, Adelaide, South Australia, 5-9 April 1988, http://www.who.int/healthpromotion/milestones_adelaide.pdf

WHO (1997), Jakarta Declaration on Leading Health Promotion into the 21st Century, http://www.who.int/hpr/NPH/docs/jakarta_declaration_en.pdf

WHO (2000), Mexico Ministerial Statement for the Promotion of Health, http://www.who.int/healthpromotion/conferences/previous/mexico/statement/en/index.html

WHO (2005), The Bangkok Charter for Health Promotion in a Globalized World, 6th Global Conference on Health Promotion, Bangkok, Thailand, August 2005, http://www.who.int/healthpromotion/conferences/6gchp/hpr_050829_BCHP.pdf

HO (2009) Milestones in Health Promotion: Statements from Global Conferences. World Health Organization, Switzerland, http://www.who.int/healthpromotion/milestones.pdf

"*The concept of health promotion is positive, dynamic and empowering which makes it rhetorically useful and politically attractive. … Further developmental work is clearly required …*" WHO (2009) / HPI (1986).

Appendix 4 - Educational buildings and Smart Meters

Image source: Grant Cochrane, http://www.freedigitalphotos.net/images/view_photog.php?photogid=2365

"*Pupil's education, health and wellbeing should be at the centre of any initiatives to introduce new technologies into schools. The technologies need to be adding value and need to be safe*."
WFIS (2011).

Anecdotal evidence and peer-reviewed studies, investigating radiation similar to that emitted by specific types of Smart Meters and related devices, indicate that exposures to some EMF regimes may be linked to reduced learning abilities and a number of health ailments – *Refer to section on 'Health Matters'.*

It appears prudent to adopt the 'Precautionary Principle' with regard to Smart Meter rollouts in kindergartens, schools and colleges, and use wired alternatives to standard RF/microwave emitting technologies where feasible.

United Kingdom

"*Everyone in the education system must do what is sensible to keep pupils safe and healthy. This includes making the school environment as safe as possible*. …"
Directgov (2011).

At present the UK Government is having Smart Meters installed in all schools (SM.com 2010).

As a result of the UK Government's resolve on making learning environments "*as safe as possible*", and its adherence to the 'Jakarta Declaration on Leading Health Promotion into the 21st Century' (WHO 1997) – it appears crucial to ensure that Smart Meters (and other items of electrical equipment) are specified, or retrofitted, with this in mind.

Europe

The Parliamentary Assembly of the Council of Europe (PACE) recommends that the member states of the Council of Europe take "*all reasonable measures*" to reduce the exposure of children and young people to manmade electromagnetic fields to those that are 'As Low As Reasonably Achievable' (ALARA).

Whilst not discussing Smart Meters specifically, PACE suggests that for schools preference should be given to adopting wired as opposed to wireless connections to reduce potential exposures (PACE 2011).

United States

The American Public Health Association (APHA) - in recognition of the Rio Declaration on Environment - states the 'Precautionary Principle' should be the foundation of US public health policy to protection children's health. It also "*calls for explicit inclusion of the precautionary approach in all federal, state, and local legislation, rules, or policies… that may impact the health of children* …" (APHA 2001).

International

"*Studies confirm the importance of a school's physical and psychosocial environment to the health of the students and staff and the success or failure of school health programmes* …" WHO ECCSH (1997).

"*Schools can make a substantial contribution to a student's health and well-being. This has been increasingly recognised by many international initiatives including those from the World Health Organization (WHO), UNICEF, UNESCO, the U.S. Centers for Disease Control and Prevention (CDC), the International Union for Health Promotion and Education (IUHPE) and others*." IUHPE (2009).

Health Promoting Schools (HPS)

The presence or absence of environmental pollutants, such as electromagnetic pollution, may significantly impact on the learning and wellbeing of some individuals.

"*Healthy students learn better. The core business of a school is maximising learning outcomes. Effective Health Promoting Schools (HPS) make a major contribution to schools achieving their educational and social goals*." IUHPE (2010).

The essential elements required in HPS, based on the WHO's Ottawa Charter for Health Promotion (WHO 1986), include having 'Healthy school policies' that are clearly defined in documents or accepted best practices which promote health and well-being; and that the school's physical environment (buildings, grounds and equipment) help promote health.

Another of the essential elements required in HPS is that potential environmental contaminants detrimental to health are addressed (IUHPE 2009).

It is proposed that Health Promoting Schools should ideally seek to adopt metering (and ICT) regimes that are indicated as being the most 'biologically friendly'.

References

APHA (2001), The Precautionary Principle and Children's Health. American Journal of Public Health, 91 (3), pp. 495-496.

Directgov (2011), Pupil health and safety, http://www.direct.gov.uk/en/Parents/Schoolslearninganddevelopment/YourChildsWelfareAtSchool/DG_4016097

IUHPE (2010), Promoting health in schools: from evidence to action, http://www.iuhpe.org/uploaded/Activities/Scientific_Affairs/CDC/School%20Health/PHiS_EtA_EN_WEB.pdf

IUHPE (2009), Achieving Health Promoting Schools: Guidelines for Promoting Health in Schools. Version 2 of the document formerly known as 'Protocols and Guidelines for Health Promoting Schools'. International Union for Health Promotion and Education, http://www.iuhpe.org/uploaded/Publications/Books_Reports/HPS_GuidelinesII_2009_English.pdf

PACE (2011), The potential dangers of electromagnetic fields and their effect on the environment, Parliamentary Assembly Assemblée parlementaire, Resolution 1815, Council of Europe / Conseil de L'Europe.

SM.com (2010), Smart Meters, Smart Schools, http://www.smartmeters.com/the-news/792-smart-meters-smart-schools.html.

WFIS (2011), BECTA, WiFiinschools.org.uk, http://wifiinschools.org.uk/17.html

WHO (1997), Jakarta Declaration on Leading Health Promotion into the 21st Century, http://www.who.int/hpr/NPH/docs/jakarta_declaration_en.pdf

WHO ECCSH (1997), Promoting Health Through Schools, WHO Technical Report Series 870, Report of a WHO Expert Committee on Comprehensive School Health Education and Promotion, World Health Organization, Geneva, 99 pp.

WHO (1986), Ottawa Charter for Health Promotion, First International Conference on Health Promotion Ottawa, 21 November 1986 - WHO/HPR/HEP/95.1, http://www.who.int/hpr/NPH/docs/ottawa_charter_hp.pdf

Appendix 5 - Need for additional stakeholders

Image source: Master isolated images: http://www.freedigitalphotos.net/images/view_photog.php?photogid=1962

Input from additional stakeholders may be required for Smart Meter rollouts to be a true success. An example is given of the present situation in the UK.

To date official meetings undertaken to develop the specifications for the UK's Smart Meters "*have excluded not just potentially critical academics, but also the technical staff of the meter suppliers*" (Anderson & Fuloria 2010). This situation needs to be addressed.

To optimise opportunities for success - *and soundly address its critics* - it appears prudent to robustly expand the UK's Ofgem Smart Metering Implementation Programme Consumer Advisory Group. At present the group consists of representatives of: Age UK, Consumer Focus, the Fuel Poverty Advisory Group (FPAG), Which?, the Public Utilities Access Forum (PUAF), plus DECC and Ofgem representatives (Ofgem 2010).

As noted by Jamieson et al (2010), Robbins (2008) suggests that the optimum number of stakeholder representatives could be between five to twelve, whilst Corder/Thompson & Associates (CTA 2002) suggests this number could be as high as twenty. The present author suggests that due to the complexity of the subject a figure towards twenty may prove more appropriate.

An expanded group could include academics, technical staff and experts on: human rights issues, electromagnetic pulse (EMP) and electromagnetic compatibility (EMC) issues, cyber-security, health (*as related to the biological effects of possible emissions from Smart Meters & related technology*) and environmental matters.

Amongst those who could be considered for inclusion as stakeholders are groups involved with electrohypersensitivity and

chronic RF/microwave exposure issues. In the UK these include: bemri.org, Cavisoc, Electrosensitivity UK, the EM Radiation Research Trust, ES-UK, Mast Action UK, Mast Sanity, Powerwatch, WiFiinschools.org.uk and WiredChild.

It is recognised by the WHO (1986) that it is vital to take into consideration the health impact of technology on the environment.

An efficient restructuring is required to optimise the chances of Smart Meter success. A more collaborative approach could also prove of great benefit in determining what is realistic, practical and achievable.

This restructuring might now be achievable as a result of initiatives such as SmartGrid GB which was launched by Charles Hendry MP, UK Minister of State for Climate Change in June 2011(SG GB 2011).

References

Anderson, R. & Fuloria, S. (2010), On the security economics of electricity metering, 9th Workshop on the Economics of Information Security, Harvard University, George Mason University in Arlington, VA, June 2010, 18 pp.

CTA (2002), Choosing Stakeholders: A Key Step in a Collaborative Process, Corder/Thompson & Associates, http://www.corderthompson.com/documents/Choosing%20Stakeholders%20for%20Public%20Processes.pdf

Jamieson, I. (2010), Intelligent Communication: The Future of EMF Discourse and Risk Governance?, IOP Conference Series: Earth and Environmental Sciences, http://iopscience.iop.org/1755-1315/10/1/012009

Ofgem (2010), Smart Metering Implementation Programme – Consumer Advisory Group, 16 December 2010 at Ofgem, 9 Millbank, London, http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?file=SmartmeterCAGMEETINGNOTE1612.pdf&refer=e-serve/sm/Stakeholder/CAG

Robbins, S.P. (2008), The Truth about Managing People (Second Edition). Pearson Prentice Hall Business, London, 232 pp.

SG GB (2011), SmartGrid GB, http://www.energyandutilities.org.uk/representative_organisations/company/smartgrid_gb

WHO (1986), Ottawa Charter for Health Promotion, First International Conference on Health Promotion Ottawa, 21 November 1986 - WHO/HPR/HEP/95.1, http://www.who.int/hpr/NPH/docs/ottawa_charter_hp.pdf

Appendix 6 - Improving science-based stakeholder processes

Extracts from the EPA's findings on 'Improving Science-Based Environmental Stakeholder Processes' (US EPA 2001):

Finding 1

"An adequate treatment of science is possible in stakeholder processes, but typically only if substantial financial resources, adequate time, and high-quality staff are available from the outset to allow the necessary deliberation and provide the necessary support on an iterative basis through ongoing interaction with the stakeholders."

"Absent such resources, stakeholder decision processes, of the types considered in this commentary, frequently do not do an adequate job of addressing and dealing with relevant science."

Finding 3

"If group stakeholder processes, … are to result in environmental decisions that are adequately informed by science, participants … must share a commitment to explore the implications of all relevant science, and a willingness to reframe the problems they address when scientific evidence leads in unanticipated directions."

Finding 5

Using stakeholder process … should be undertaken with great care. … it can appropriately be applied to only a modest subset of environmental regulatory decisions in which:

a) adequate staff, generous financial resources, and sufficient time are available to provide expert support on an iterative basis;

b) parties are willing to adapt their thinking and the problem formulation to the scientific evidence as it becomes understood;

c) the problem being addressed involves a small number of well identified affected parties who can all be made party to the decision process; …

Finding 6

"If and when a stakeholder process is to be used as the vehicle for decision-making, great care must be taken to assure that all relevant interests are represented in a full and balanced manner. Only then can modest ambiguities involving fact-value tradeoffs be allowed to persist without risking serious errors in outcome. …"

Reference

US EPA (2001), Improved Science-Based Stakeholder Processes, EPA Science Advisory Board (1400A), United States Environmental Protection Agency, Washington DC, 216 pp.

Appendix 7 - Privacy matters – *thoughts from a Smart Meter opponent*

SMART METERS - A little too smart?

Jerry Day (2011), http://www.youtube.com/watch?v=8JNFr_j6kdI

"*We are now entering the brave new world of Smart Meters. That means your electric meter will do so much more than just show how much electricity you use. New Smart Meters are watching you. They sense all kinds of goings on. They see when you turn something on or off. They see how many watts your electric toothbrush pulls.*

They send a record of that little event over wireless networks, bouncing through your neighbors' Smart Meters all the way to the power company where they keep a record of all your power consumption, volumes and patterns, every minute of every day and store that data forever on computers that you will never get to see.

That data shows when you are at home, shows when you are sleeping, shows when you are on vacation, when you have visitors, when you use a lamp, a power tool, some extra computers and when you look like you are running a business out of your home. It even senses when you bootleg energy off the grid.

Your Smart Meter data shows a vivid pattern of your personal living patterns and whether or not you were at home on the night of the murder. This is not electrical metering. This is personal surveillance. This is a search without a warrant every day.

This is your personal private life going straight out through your electric meter to the power company, to the government, to the police, to the insurance company, to anyone who cuts a deal with your power company to look at your life under a microscope. Sorry, it's actually worse than that. People who don't cut a deal can get your information too by simply intercepting the wireless signal spewing from the side of your house.

Yes Smart Meters are radio-transmitters. Here's how you tell, this one is a 1-watt radio station licensed by the FCC. On this all news radio station, every detail of your electrical life is shooting off to some institutional data centre somewhere. [*Look at the data strip on the face of the meter which gives its specification].*

Already the police in Ohio, Texas, British Columbia and places I don't know about are regularly using Smart Meter data to pinpoint marijuana grow houses, enforce business licenses and punish

people for doing things in the privacy of their own homes, that you were not supposed to do, but they would not even know you were doing if they weren't spying on you.

Your power company apparently gets to sell your life story to whomever it wants. Any unusual power consumption pattern is considered probable cause to raid you for growing marijuana or running a computer server without a business license.

This is about as Big Brother as it gets. Those friendly men with their truckload of Smart Meters are going door to door with something a little different than a Christmas carol. My personal opinion is that you and I need to demand that these things be taken off our homes.

It is not possible for your power company to claim that they have the right to install a surveillance device on your house. Smart Meters are no different from wire-tapping devices. And, in case you didn't know, wire-tapping is illegal in all 50 of the states and the federal territories.

If you let your power company put a Smart Meter on your house, you may as well walk around all day with a Facebook helmet webcam pointed at yourself. They have convinced themselves installing Smart Meter is lawful by some reaching to the moon jive called implied consent. If you say they can change your meter, they pretend you consent, even when you don't know really what they are doing.

Here's a tip. Tell them they can't change your meter; they had no trouble billing you with the old meter. If you send them a notice by certified mail that they may not install a Smart Meter or any other surveillance device on your house, your implied consent goes out the window. I would do that if I were you. In fact I did that and I'm not even you. You can see a copy of my letter in the drop down next to this video. You can copy and paste that into your word processor. Make sure and change the info into your own info. The post office will give you the certified mail slip.

Those friendly guys on the sidewalk told me that they plan to put a Smart Meter on every house in America. If they do that it will no longer be America."

Comment by present author - Privacy guidelines have now been created for California in the USA, Ontario in Canada and the UK. Refer to the section on '*Privacy Initiatives*'.

Appendix 8 – Seletun Resolution

Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales.

Fragopoulou et al. (2010).

Abstract

In November, 2009, a scientific panel met in Seletun, Norway, for three days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields (EMF). EMF exposures (static to 300 GHz) result from the use of electric power and from wireless telecommunications technologies for voice and data transmission, energy, security, military and radar use in weather and transportation. The Scientific Panel recognizes that the body of evidence on EMF requires a new approach to protection of public health; the growth and development of the fetus, and of children; and argues for strong preventative actions.

10 Key Points:

1. Global populations are insufficiently protected, thus currently at risk;
2. Sensitive Populations are extra vulnerable;
3. Government actions are urgently warranted now, based on evidence of serious disruption to biological systems;
4. The Burden of Proof for the safety of radiation-emitting technologies should fall on Producers and Providers not Consumers;
5. EMF Exposures should be reduced in advance of complete understanding of mechanisms of action;
6. The current operative measure of Radiation Risk is inadequate, and misguides on safety and health risks;
7. An international Disease Registry is needed to track Time Trends of the incidence of Illnesses to correlate illnesses with exposures;
8. Pre-market health testing and safety demonstration is needed for all radiation-emitting technologies;
9. Parity is needed for occupational exposure standards, compared to those for the general public;
10. Persons with Electrohypersensitivity need the classification Functionally Impaired.

Reference

Fragopoulou et al. (2010). Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales. Reviews on Environmental Health, 25(4), pp. 307-317.

Appendix 9 – Website listings

Utility news and smart grid related information (*partial listing*)

Detect Energy - http://detectenergy.com/
eMeter - http://www.emeter.com/Green Tech - http://news.cnet.com/
Metering.com - http://www.metering.com/
SmartGridOpinions, http://www.smartgridopinions.com
smartmeters - http://www.smartmeters.com
VaasaETT Global Energy Think Tank –
http://www.vaasaett.com/?s=smart+meters

Smart Metering and Advanced Metering Infrastructure (AMI)

Aclara® - http://www.aclaratech.com
ADD GRUP - http://www.addgrup.com
ANDREA Informatique - http://www.andrea.fr
Applied Precision Ltd - http://www.appliedp.com
Avnet Memec - http://www.avnet.com
Cewe Instrument - http://www.ceweinstrument.se
Connect Group Consulting Limited - http://www.connectgroupltd.com
DIEHL Metering Group - http://www.diehl.de
Digi International - http://www.digi.com
Echelon Corporation - http://www.echelon.com
El Sewedy Industries Group - http://sewedy-eg.com
Elster - http://www.elster.com
eMeter - http://www.emeter.com
Ferranti computer systems - http://www.ferranti.be
Freescale Semiconductor - http://www.freescale.com
Holley Metering Limited - http://www.holleymeter.com
Inhemeter - http://www.inhemeter.com
International Electrotechnical Commission – http://www.iec.ch
ISKRAEMECO - http://www.iskraemeco.si
Itron - http://www.itron.com
IUSA - http://www.grupo-iusa.com
Kamstrup - http://www.kamstrup.com
Landis+Gyr - http://www.landisgyr.com
Microchip Technology Inc. - http://www.microchip.com
ON Semiconductor - http://www.onsemi.com
Pacific Trading & Recycling LLC - http://www.pacifictradingandrecycling.com
Panasonic - industrial.panasonic.com
Paradox Engineering - http://www.pdxeng.ch
Process Vision Oy - http://www.processvision.fi
PROLAN - http://www.prolan.com
Radiocrafts - http://www.radiocrafts.com
Renesas - http://am.renesas.com
RF Micro Devices, Inc. (RFMD®) - http://www.rfmd.com
Sanxing Electric - http://www.sanxing.net.cn
Secure - http://www.securetogether.com
Shenzhen Kaifa Technology Co., Ltd - http://www.kaifa.cn
Londian Electrics - http://www.londian.com.cn

Sierra Wireless - http://www.sierrawireless.com
Silicon Laboratories - http://www.silabs.com
Sinoware Technology - http://www.sinowaretech.com
Shenzhen Star Instrument Co. Ltd. - http://www.szstar.com
Telit Wireless Solutions - http://www.telit.com
Telvent - http://www.telvent.com

Utilities that have participated to date in creating the Smart Grid Maturity Model

North America	Rest of World
Excelon/PECO	Tokyo Electric
Manitoba Hydro	Shanghai Municipal Electric Power Co.
BC Hydro	Alliander
Bonneville Power	EDF (UK)
Portland Gen.	DONG Energy
Salt River Proj.	ERDF (France)
Sempra	Union Fenosa
Austin Energy	NDPL (India)
Co Serv	Zhejiang Energy
Centerpoint	CLP (Hong Kong)
Entergy	Energy Australia
Glendale W & P	Country Energy
Detroit Edison	CPFL (Brazil)
EPCOR	EDP (Brazil)
Hydro Ottawa	
Excelon/ComEd	
VELCO	
Allegheny Power	
Dominion Vir.	
First Energy	
AEP	
PHI	
Progress Energy	
Duke Energy	
SCANA Corp	
East Miss EPA	

Global Intelligent Utility Network Coalition

This is a group of select utilities that collaborates to accelerate, shape, and share in the development of smart grid. Its members are:

Australia

Queenbeyan: Country Energy - http://www.countryenergy.com.au/

Brazil

Sao Paulo: CPFL - http://www.cpfl.com.br/

Denmark

Copenhagen: DONG Energy – http://www.dongenergy.com

France

Paris: ERDF - http://www.erdfdistribution.fr/Accueil

India

Delhi: NDPL - http://www.ndpl.com/

Netherlands
Arnhem: Alliander - http://www.alliander.com/nl/alliander/
United States of America:
Dallas, Texas: Oncor Electric Delivery - http://www.oncor.com/
Houston, Texas: CenterPoint Energy - http://www.centerpointenergy.com/home
New York, NY: IBM - http://www.ibm.com/us/en/
Raleigh, North Carolina: Progress Energy - https://www.progress-energy.com/
San Diego, California: Sempra Energy – http://www.sempra.com/
Washington, D.C.: PHI - http://www.pepcoholdings.com/services/outreach/

Energy Companies for Smart Metering (*partial listing*)
CISCO - http://www.cisco.com/web/strategy/energy/external_utilities.html
Spencer Ogden Smart - http://www.sosmartenergy.com/
Europäischen Funk-Rundsteuerung GmbH (EFR) - http://www.efr.de/CMS/

United Kingdom
Department of Energy & Cllimate Change (DECC) - http://www.decc.gov.uk/en/content/cms/tackling/smart_meters/smart_meters.aspx
SmartReach: consortium created to address UK Government mandate on Smart Metering - http://smartreach.com/
npower.com – http://www.npower.com/SmartMetering
British Gas Smart Meters – http://www.britishgas.co.uk/Smart_Meters
Southern Electric – http://www.southern-electric.co.uk/smart_meter
Energy Retail Association – http://www.energy-retail.org.uk/smartmeters.html

Russia
ENERGOAUDITCONTROL - http://www.ackye.ru/

South Africa
Eskom - http://www.eskom.co.za/live/index.php

United States of America:
SGIC Smart Grid Information Clearinghouse - http://www.sgiclearinghouse.org/
Smartgrid.gov - http://www.smartgrid.gov/

References

Ferro, E. (2009), Global Intelligent Utility Network Coalition – The Power of Partnerships, IBM, 11 pp. http://www.asiapacificpartnership.org/pdf/PGTTF/ddsm/presentations/The_Power_of_Partnerships_Erica_Ferro.pdf
Smart Grid Maturity Model (2010), Software Engineering Institute, Carnegie Mellon, 12pp. http://www.sei.cmu.edu/library/assets/brochures/SGMM-1010.pdf

Appendix 10
Smart Metering projects worldwide

Argentina
Cooperativa de Obras y Servicios Públicos de Brinkmann

Australia
Alice Springs Solar City
Adelaide Solar City
Blacktown Solar City
Country Energy
MidCoast Water
SP Ausnet
Synergy Trial
Townsville Solar City
Wide Bay Water

Austria
Energie AG
Linz Strom

Azerbaijan
Azerigaz

Belgium
Belgium

Bosnia and Herzogovinia
Elektroprivreda HZ HB Mostar

Brazil
Ampla Energia
Foz do Iguaçu
Government Sponsored Project in Campinas

Canada
Berwick Electric Commission
BC Hydro
Chatham-Kent Hydro
Enersource Hydro Mississauga
Halton Hills Hydro
Horizon Utilities
Manitoba Hydro
Norfolk County
Ontario IESO Overview
Peterborough Distribution
Powerstream
Toronto Hydro-Electric System Limited
Toronto Water
Thunder Bay Hydro

China
China
Guizhou Province

Colombia
EMCALI - UENE

Croatia
ODS Croatia

Czech Republic
CEZ
E.ON Czech Republic

Denmark
EnergyMidt
Elro Net
NRGi
Odense Energi
SEAS NVE
Syd Energi

Dominica
Dominica Electricity Services

Dominican Republic
Corporación Dominicana De Electricidad

Estonia
VKG Elektrivõrgud OÜ

Finland
Fortum
Fortum Espoo Oy
Haukiputaa Electricity Cooperative
Kainuun Energia
Kemin Energia
Satapirkan Sähkö Oy
Tornion Energia
Vattenfall Verkko Oy

France
Electricitie De France

Smart Metering projects worldwide (*continued*)

Germany
EnBW
EWE
Mainova
RWE Pilot in Mülheim an der Ruhr
Stadtwerke Bochum & EVB
Stadtwerke Dusseldorf
Stadtwerk Haßfurt
Stadtwerke Neu-Isenburg & EVB
Stadtwerke Schwerte & EVB Energie
STW Setec & EVB
SVO Energie & EVB
TWK Kaiserslautern & EVB
Yello Strom

Italy
Acea Distribuzione
ENEL
Italian Gas Developments

India
Grinpal Energy Management
City of Mumbai

Iran
IGMC Project

Ireland
Ireland

Jamaica
Jamaica Public Service

Japan
Kansai Electric Power

Jerusalem
Marmilla, Jerusalem

Malaysia
Tenaga Nasional Berhad

Malta
Enermalta

Mexico
Federal Commission of Electricity

Netherlands
Oxxio/Nuon
Smart City Project in Amsterdam

New Zealand
Contact Energy
Genesis Energy
Mercury Energy
Meridien Energy

Norway
Kragero Energi
Skagerak Nett AS

Pakistan
KESC - Karachi Electricity Supply Company
GEPCO - Pakistan Electric Power Company
LESCO - Pakistan Electricity Company

Philippines
Meralco

Portugal
EDP Distribuciao
Quinta De La Portela

Puerto Rico
Puerto Rico Electric Power Authority

Romania
Distrigaz Sud

Russia
Energoauditcontrol

Serbia
Elektrovojvodina D.O.O.

Singapore
Singapore SP Services

Spain
Endesa
Iberdrola

Sweden
E.ON Sverige
Gothenburg Energy
Halmstad Energi och Miljo
PiteEnergi
Staffanstop Energi AB
Utsikt Nät AB
Vattenfall

Smart Metering projects worldwide (*continued*)

Switzerland
Stadtwerke Feldkirche

Thailand
Provincial Electricity Authority

Trinidad and Tobago
Trinidad and Tobago Electricity Commission

Turkey
Elektromed

United Arab Emirates
United Arab Emirates

United Kingdom
GB Smart Metering
Guernsey Electric
Northern Ireland Electricity

United States of America
Alabama
Alabama Power
Alabama Power Smart Meter of Southern Co
City of Andalusia
Arizona
Arizona Public Service
Salt River Project
Sulphur Springs Valley Electric
California
Burbank Water and Power
Discovery Bay
Glendale Power & Water
Modesto Irrigation District
Pacific Gas & Electric
Sacramento Municipal Utility District
San Diego Gas and Electric
SFPUC
Silicon Valley Power
Southern California Edison
Colorado
Boulder - Smart City
Xcel Energy
Connecticut
Connecticut Light and Power
Metropolitan District (MDC)
Delaware
Delmarva Power - a PHI Company
Florida
City of Tallahassee
Florida Power & Light
Tampa Electric Co.
Georgia
Georgia Power
Jackson EMC
Suwanee EMC
Hawaii
Hawaiian Electric Company
Kauai Department of Water
Idaho
Idaho Power
Illinois
ComEd Trial in Chicago
Indiana
Duke Energy Indiana
Whitewater, IN
Iowa
Alliant Energy
Des Moines Water Works
Kentucky
Duke Energy - Kentucky
Kentucky Power
Louisville Gas and Electric
Louisiana
Cleco Power
Maine
Central Maine Power
Maryland
Baltimore Gas and Electric
Cumberland, Maryland
Potomac Electric Power Co
Massachusetts
Boston Water and Sewer Commission
National Grid US
Pittsfield Township
Western Massachusetts Electric Company
Minnesota
City of Duluth
Missouri
Laclede Electric CoOperative
Mississippi
Gulfport

Smart Metering projects worldwide (*continued*)

New Hampshire Central Vermont Public Service Portsmouth, NH Vermont Electric Coop New Jersey Atlantic City Electric PECO Smart Meter Plans New York Amenia NY Horseheads Ithaca, NY Long Island Power Authority National Grid PSE&G Smart Grid Trial in Queens North Carolina Piedmont Electric Membership Southern Company Ohio AEP Ohio City of Cuyahoga Falls Mansfield Oklahoma Oklahoma Gas And Electric Pennyslyvannia Cumberland, Maryland Dubois, PA PECO AMI Trial PECO Smart Meter Plans PPL Pilot in Harrisburg PSE&G West View Water Authority Rhode Island National Grid Tennessee Clarksville Department of Electricity EPB Pulaski Electric Service	Texas AEP Texas Arlington & Grand Prairie Austin Energy Bluebonnet Electric Centerpoint Energy City of Corpus Christi City of Denton OnCor Post, Texas San Marcos City Council Stamford, Texas Utah Heber Light and Power Spanish Fork Vermont Central Vermont Public Service Vermont Electric Coop Virginia Appalachian Power City of Danville Dominion Power of Virginia Dominion Virginia Power Wythe County Washington Gridwise Trial Okanogan County PUD Portland General Electric Co. Seattle City Light Tacoma Power Wisconsin Alliant Energy Corporation

Refer also to:
Google Maps (2011), Smart Metering Projects Map, http://maps.google.com/maps/ms?ie=UTF8&oe=UTF8&msa=0&msid=115519311058367534348.0000011362ac6d7d21187

Appendix 11 - EMF & related web sites (*partial listing*)

International

AAAS – The American Association for the Advancement of Science - http://www.aaas.org/aboutaaas/
BioInitiative Report - http://www.bioinitiative.org/
Council of Europe - http://www.coe.int/lportal/web/coe-portal
The Collaborative on Health and the Environment CHE EMF - http://www.healthandenvironment.org/working_groups/emf
CTIA The Wireless Association® - http://www.ctia.org/
Europeans on Smart meters - http://www.facebook.com/pages/Europeans-on-smart-meters/122384431183034
The Foundation for Information Policy Research (FIPR) http://www.fipr.org/
International Agency for Research on Cancer (IARC) - http://www.iarc.fr/
International Electro-Magnetic Fields Alliance (IEMFA) - http://international-emf-alliance.org/
REFLEX - Risk Evaluation of Potential Environmental Hazards From Low http://ec.europa.eu/research/environment/pdf/env_health_projects/electromagnetic_fields/e-reflex.pdf
Stop Smart Meters NOW, http://www.facebook.com/pages/Stop-Smart-Meters-Now/
Smart Meter Site in Spanish *(under construction)* http://www.concienciaradio.com/nosmartmeters/
Underwriters Laboratories Inc. (UL) - http://www.ul.com/
VaasaETT Global Energy Think Tank - http://www.vaasaett.com/
World Health Organization (WHO) - http://www.who.int/en/

Australia

Australian Centre for RF Bioeffects Research - http://acrbr.org.au/
EMF Facts Consultancy - http://www.emfacts.com
EMR Australia - http://www.emraustralia.com.au/

Austria

Mobilefunk-Initiative - http://www.plattform-mobilfunk-initiativen.at

Belgium

Etudes & Vie - http://www.etudesetvie.be/
Lasante.be - http://www.lasante.be/
Teslabel Coordination - http://www.teslabel.be/

Canada

Canadians for A Safe Learning Environment (CASLE) - http://www.casle.ca/Home/tabid/36/Default.aspx
Citizens for Safe Technology Canada - http://www.citizensforsafetechnology.org/
Clean Energy Foundation Canada - http://www.cleanenergycanada.com/
EM Radiation Health Alliance of BC - http://emrabc.ca/
EMR Heath Alliance of BC, http://emrabc.ca/
Gulf Islanders for Safe Technology - http://www.gifst.ca/
La Maison du 21^{e} siècle - http://www.21esiecle.qc.ca/
RF.com Canada - http://www.rfcom.ca/welcome/index.shtml
Rule of Law Defenders - http://www.hosnyinfo.com/home

Safe Living Technologies Inc. Canada - http://www.safelivingtechnologies.ca/
WEEP Initiative Canada - http://www.weepinitiative.org/index.html

Denmark

Danish Association of Electrosensitives - http://www.el-allergi.dk/

Éire/Ireland

Alliance for Irish Radiation Protection - http://www.eirewaves.com/

France

Accuel – France Nature Environment - http://www.fne.asso.fr/
Agence Nationale des Fréquences (ANFR) – http://www.anfr.fr/
Association pour la Recherche Thérapeutique Anti-Cancéreuse (ARTAC) - http://www.artac.info
Association Agir pour l'Environnement - http://www.agirpourlenvironnement.org/
Association Santé–Environnement en Rhône-Alpes - http://www.sera.asso.fr/
Association Santé–Environnement France - http://www.asef-asso.fr/
Autorité de régulation des communications électroniques et des postes (ARCEP) - http://www.arcep.fr/
Agence Nationale de sécurité sanitaire - http://www.anses.fr/
Ecoforum – http://www.ecoforum.fr
Centre de Recherche et d'Information Indépendantes sur les Rayonnements ElectroMagnétiques (Criirem) - http://www.criirem.org
Collectif SEMO - http://www.dangersemo.com/Site_SEMO/WEB_SEMO_page_1.html
electrosensible.org – http://www.electrosensible.org
Europe Ecologie - http://www.europe-ecologie.fr/
EuroTinnitus a,s.b.l. - www.eurotinnitus.com
Fédération Française des Telecoms – http://www.afom.fr/
Fondation pour une Tere Humaine – http://www.terrehumaine.org
Fondation Santé et Radiofréquences – http://www.sante-radiofrequences.org
International Radiation Protection Association – www.irpa.net
Liberterre - http://www.liberterre.fr/
Mobilou.info – http://www.mobilou.info
Next-Up News of the World France - http://www.next-up.org
Pour une Réglementation des Implantations d'Antennes Relais de Téléphonie Mobile (PRIARTéM) - http://www.priartem.fr/
Pratiques - http://www.pratiques.fr/
Robin Des Toits France - http://www.robindestoits.org/
SantéPublique éditions - http://www.santepublique-editions.fr
Science… & pseudo-sciences - http://www.pseudo-sciences.org/
www.contaminations-chimiques.info - http://www.contaminations-chimiques.info/
Sciences Citoyennes fondation – http://www.sciencescitoyennes.org
TcherMobile.org - http://www.tchermobile.org/
Zone Blanche – White Zone - http://www.zoneblanche.fr/

Germany

Bürgerwelle, http://www.buergerwelle.de/
Der Mast muss weg! - http://www.der-mast-muss-weg.de/
diagnose FUNK – http://www.diagnose-funk.org/

ECOLOG-Institut - http://www.ecolog-institut.de
www.elektrosmog.com - http://www.elektrosmog.com/
ElektroSMOG NEWS - http://www.elektrosmognews.de/
Forschungsgemeinschaft Funk e.V. - http://www.fgf.de/
Gigahertz Solutions – http://www.gigahertz-solutions.com/
human ecological social economical project (h.e.s.e.) - http://www.hese-project.org/
Informationszentrum Mobilfunk - http://www.izmf.de/
Initiative der direkten Demokratie – http://www.iddd.de
International Commission on Non-Ionizing Radiation Protection - http://www.icnirp.de/
Die Kompetenzinitiative zum Schutz von Mensch, Umwelt und Demokratie e.V.- http://www.kompetenzinitiative.de/
Mobilfunk Bürgerforum.de - http://www.mobilfunk-buergerforum.de
Puls-Schlag – http://www.puls-schlag.org/
Risiken des Mobilfunks – http://www.mobilfunkrisiken.de
www.risiko-elektrosmog.de - http://www.risiko-elektrosmog.de
Strahlung-gratis … nein danke! - /http://www.strahlung-gratis.de/
Verband Baubiologie- http://www.verband-baubiologie.de/

Iceland

Nordic Society for Radiation Protection - http://www.nsfs.org/

Italy

Associazione Italiana Elettro Sensibili / Italian Association for the Electrosensitive - http://www.elettrosensibili.it/
CO.NA.CEM - http://www.conacem.it/
International Commission for Electromagnetic Safety – http://www.icems.eu

Korea

Korean EMF Pages - http://emf.or.kr/

Luxembourg

Biirgerfrequenz a.s.b.l. - http://www.biirgerfrequenz.lu/

Netherlands

Beperk de Straling – http://www.beperkdestraling.org
Stichting EHS / Dutch EHS Foundation - http://www.stichtingehs.nl/
Nationaal Platform Stralingsrisico's / Dutch National Platform on Radiation Risks - http://www.stralingsrisicos.nl/
Stop UMTS! - http://www.stopumts.nl/
www.milieuziektes.nl - http://www.milieuziektes.nl/
Stralings gevoeligheid - http://www.straling.org/

New Zealand

Ban the Tower: New Zealand - http://www.banthetower.co.nz/
Dr. Neil Cherry (1946-2003) - http://www.neilcherry.com/
EMR - http://www.emr.co.nz
Wi-Fi in Primary Schools-New Zealand - http://www.webshack.co.nz/wifiinschools.htm

Norway

Norwegian Association for the Electro-Hypersensitive - http://www.felo.no/

Portugal

Antenas Agui NAO Portugal - http://antenasaquinao.blogspot.com/

South Africa

Electromagnetic Radiation Research Foundation of South Africa - http://www.emrrfsa.org/smart-meters/

Spain

Asociación Independiente para Defender la Salud - http://www.asides.es/
Asociación Vallisoletana de Afectad@s por las Antenas de Telefonía (AVAATE) - http://www.avaate.org

Sweden

FEB Sweden Electrosensitivity - http://www.feb.se/

Switzerland

Association Romande Alerte (ARA) – http://www.alerte.ch/
Bürgerwelle Schweiz – http://www.buergerwelle-schweiz.org
Femme-medicine.ch - http://www.femme-medecine.ch/
gigaherz.ch - http://www.gigaherz.ch/
MCS-SOS - http://www.mcs-sos.ch/
Strahlungfreies Kreuzlingen, http://www.strahlungsfrei.ch

United Kingdom

Age UK – http://www.ageuk.org.uk/
The British Electrotechnical & Allied Manufacturers Association (BEAMA) - http://www.beama.org.uk/en/about-us/
Bioelectromagnetic Research Initiative - http://bemri.org/
Consumer Focus – http://www.consumerfocus.org.uk/
Department of Energy and Climate Change (DECC) – http://www.decc.gov.uk/
Department of Health (DH) - http://www.dh.gov.uk/
ElectroSensitivity.org – http://www.electrosensitivity.org
Electrosensitivity UK(ES-UK) - http://www.es-uk.info/
EM Radiation Research Trust - http://www.radiationresearch.org/
Fuel Poverty Advisory Group (FPAG) - http://www.decc.gov.uk/en/content/cms/about/partners/public_bodies/fpag/fpag.aspx
Independent Expert Group on Mobile phones (IEGMP) – http://www.iegmp.org.uk
Mast Action - http://www.mastaction.co.uk/
Mast Sanity - http://www.mastsanity.org/
Mast-Victims.org - http://www.mast-victims.org/
Office of Gas and Electricity Markets (Ofgem) - http://www.ofgem.gov.uk/
Powerwatch - http://www.powerwatch.org.uk/
Public Utilities Access Forum (PUAF) – http://www.puaf.org.uk/
scram.uk.com – http://www.scram.uk.com
SmartReach – http://smartreach.com/
TETRAWATCH - http://www.tetrawatch.net/
Which? – http://www.which.co.uk/
Wi-Fi in Schools - http://wifiinschools.org.uk/index.html
WiredChild - http://wiredchild.org/

United States of America

American Coalition Against Smart Meters - http://www.causes.com/causes/594297-american-coalition-against-smart-meters?recruiter_id=66515572
The Bioelectromagnetics Society - https://www.bems.org/
Center for Safer Wireless - http://www.centerforsaferwireless.org/index.php
Condo Residents Against SmartMeters - http://smartmeters.webbery.net/
ElectromagneticHealth.org - http://www.electromagnetichealth.org
The EMR Network – http://www.emrnetwork.org
The EMR Policy Institute - http://www.emrpolicy.org/
Government Accountability Office (GAO) - http://www.gao.gov/
Microwave News – http://www.microwavenews.com
SAFEWIRELESS.ORG - http://www.safewireless.org/
US National Research Council - http://www.nationalacademies.org/nrc/

Arizona:

Ban Smart Meters Arizona.com - http://www.bansmartmetersarizona.com/index.html

California:

Alliance for Human and Environmental Health – http://www.allianceheh.org
Burbank Action - https://sites.google.com/site/nocelltowerinourneighborhood/home
California Public Utilities Commission (CPUC) - http://www.cpuc.ca.gov/puc/
Council on Wireless Technology Impacts - http://www.wirelessimpacts.org/
Division of Ratepayer Advocates in California (DRA) - http://www.dra.ca.gov/dra/
EMF Safety Network - http://www.emfsafetynetwork.org
Eon3 EMF Blog - http://eon3emfblog.net/
No Smart Meters SF - http://nosmartmeters.blogspot.com/
People's Initiative Foundation: Santa Monica CA - http://www.thepeoplesinitiative.org/
Refuse Smart Meters Mendocino - http://www.refusesmartmetersmendo.blogspot.com/
San Francisco Neighborhood Antenna-Free Union, - http://www.antennafreeunion.org
Smart Meter Action Group - http://smartmeters.transbay.net/doku.php?id=dnc
Smart Meter Dangers - http://www.smartmeterdangers.org/
SNAFU: San Francisco California USA - http://www.antennafreeunion.org/
Stop OC Smart Meters – http://www.stopocsmartmeters.com/
Stop Smart Meters - http://stopsmartmeters.org/
TURN The Utility Reform Network – http://www.turn.org

Florida:

smart / meter / matrix - http://smartmetermatrix.org/

Illinois:

Naperville Smart Meter Awareness - http://www.napervillesmartmeterawareness.org/

Maine:

Smart Meter Safety - http://smartmetersafety.com/

Maryland:
Maryland Residents Against Smart Meters - http://www.marylandresidentsagainstsmartmeters.org/index.html
Michigan:
Smart Meters - Stop the Invasion! – http://www.w4ar.com/Smart-Meters.html
Minneapolis:
Guinea Pigs “R” Us – http://www.guineapigsrus.org
New Jersey:
Mobile Impact: Brandon New Jersey - http://brandonfarmswatertower.com/wordpress/
New Mexico:
Why Fry? Smart Meters – http://whyfry.org/tag/smartmeters
Tennessee:
Stop Smart Meters Now.com - http://www.stopsmartmetersnow.com/?page_id=33
Texas:
Ban Smart Meters - http://www.bansmartmeters.com/blog/

Human Rights organisations (*partial listing*)

International
Amnesty International - http://www.amnesty.org.uk/
Asian Human Rights Commission – http://www.humanrights.asia/
Asia-Pacific Human Rights Information Center - http://www.hurights.or.jp/english/
Derechos Human Rights – http:www.derechos.org/ - *in Spanish*
Human Rights Watch - http://www.hrw.org/about
Inter-American Court & Commission of Human Rights (OAS) - http://www.cidh.oas.org/
Directorate General of Human Rights and Legal Affairs of the Council of Europe - http://www.coe.int/t/dghl/default_en.asp
United Nations Human Rights - http://www2.ohchr.org/

Africa
African Commission on Human and Peoples’ Rights - http://www.achpr.org/
Australia
Australian Human Rights Commission – http://www.hreoc.gov.au/
Canada
The Canadian Human Rights Commission - http://www.chrc-ccdp.ca/
China
Human Rights in China - http://www.hrichina.org/what-we-do
Denmark
The Danish Institute for Human Rights - http://www.humanrights.dk/
International Society for Human Rights (ISHR) - http://www.ishr.org/
Éire/Ireland
Irish Human Rights Commission – http://www.ihrc.ie/
France
Commission nationale consultative des droits de l’homme / French National Consultative Commission on Human Rights (NCCHR) (France) - http://www.cncdh.fr/

Germany
German Institute for Human Rights - http://www.institut-fuer-menschenrechte.de/en/home.html
Iceland
Icelandic Human Rights Centre - http://www.unhcr.org/48fdec2c2.html
Netherlands
Netherlands Institute of Human Rights - http://sim.law.uu.nl/
New Zealand
Human Rights Foundation of New Zealand - http://www.humanrights.co.nz/
Norway
Norwegian Centre for Human Rights - http://www.jus.uio.no/smr/
Russia
Moscow Research Center for Human Rights (Russia) - http://www.ishr.org/
South Africa
South African Human Rights Commission - http://www.sahrc.org.za/home/
Sweden
The Swedish Government's Human Rights Website - http://www.humanrights.gov.se/
United Kingdom
Directgov – Human Rights - http://www.direct.gov.uk/en/governmentcitizensandrights/yourrightsandresponsibilities/dg_4002951
United States of America
U.S. Department of State – Human Rights - http://www.state.gov/g/drl/hr/

Space weather and manmade EMP (*partial listing*)
Committee on Space Research (COSPAR) - http://cosparhq.cnes.fr/Meetings/Cosponsor.htm
DTIC® Online, Information for the Defense Community - http://www.dtic.mil/dtic/
The Electric Infrastructure Security Summit – http://www.eissummit.com/
EMPact America – http://www.empactamerica.org/about.php
EMPrimus – http://emprimus.com
Federation of American Scientists - http://www.fas.org/
Institute of Electrical and Electronics Engineers (IEEE) - http://ieeexplore.ieee.org/
Institute for Space Applications and Remote Sensing - http://www.space.noa.gr/
International Astronomical Union - http://www.iau.org/
International Electrotechnical Commission (IEC) - http://www.iec.ch/
National Aeronautics and Space Administration (NASA) - http://www.nasa.gov/
National Geographic - http://www.nationalgeographic.com/
NASA – http://www.nasa.gov
NATO – http://www.nato.int/
Ofcom - www.ofcm.gov/swef/2011/
Powerwatch - http://www.powerwatch.org.uk/
physicstoday – http://www.physicstoday.org/
Public Technology Group - http://www.pti.org/
US National Research Council - http://www.nationalacademies.org/nrc/
US National Security Working Group - http://rsc.jordan.house.gov/

US National Academy of Sciences - http://www.nationalacademies.org/nrc/
US National Oceanic and Atmospheric Administration. (NOAA) - http://www.swpc.noaa.gov/
Sage Policy Group, Inc. – http://www.sagepolicy.com/
SPACE.COM - http://www.space.com/
Space Weather Enterprise Forum - http://www.nswp.gov/swef/
Zurich Services Corporation - http://www.zurichservices.com/

Privacy and Security (*partial listing*)
The Electronic Frontier Foundation (EFF) – http://www.eff.org/
eMeter® - http://www.emeter.com/
European Telecommunications Standards Institute (ETSI) - http://www.etsi.org/WebSite/AboutETSI/AboutEtsi.aspx
The Foundation for Information Policy Research (FIPR) - http://www.fipr.org/
Information and Privacy Commissioner, Ontario Canada - http://www.ipc.on.ca/
Institute of Electrical and Electronics Engineers (IEEE) - http://ieeexplore.ieee.org/
International Data Privacy Law - http://idpl.oxfordjournals.org/
US National Institute of Standards and Technology - http://csrc.nist.gov/
PROsecurity zone - http://www.prosecurityzone.com/

Appendix 12 - Glossary and abbreviations

AAAS – The American Association for the Advancement of Science. This is an international non-profit organization dedicated to advancing science around the world by serving as an educator, leader, spokesperson and professional association.

Age UK – This UK charity seeks to help create a world in which older people flourish. It believes that everyone should be able to enjoy good health in later life, free from the diseases and disabilities associated with growing older. It funds research into, amongst other things, dementia and strokes.

AFCI – Arc-fault circuit interrupters (AFCI) are circuit breakers designed to prevent fires by detecting non-intentional electrical arcs and disconnecting the power supply before the arcing starts a fire.

Anonymisation – The process of removing the ability for Smart Meter data to be traced to an individual.

APHA – The American Public Health Association. This is a professional organisation for public health professionals based in the United States. Its mission is "… *to protect all Americans and their communities from preventable, serious health threats* …"

Autism – This is a lifelong developmental disability characterised by restricted and repetitive behavior, impaired communication and impaired social interaction. It affects how individuals relate and communicate with others.

BEAMA – The British Electrotechnical & Allied Manufacturers Association. This is the independent expert knowledge base & forum for the electrotechnical industry in the UK & Europe.

BECTA – The British Educational Communications and Technology Agency. This was the UK Government's partner for the use of ICT in education. It closed on 31st March 2011.

bemri.org – The Bio-Electromagnetic Research Initiative, a cooperative formed to provide an EMF research portal for the scientific community and interested members of the lay public showing the latest scientific information and hypotheses regarding EMFs.

BERR – [UK Department for] Business Enterprise and Regulatory Reform.

Bio-sustainability – a core concept for purposefully creating beneficial environments to enhance the health and wellbeing of humans, animals and Nature's eco-systems both now and for the future.

Blastoma – A type of cancer caused by malignancies in precursor cells (*often called blasts cells*).

CASLE – Canadians for a Safe Learning Environment. Website with practical resources for parents to work within the educational system to improve the condition of school buildings and products and practices used within so children and school staff occupy safe and healthy environments.

CCST – The California Council on Science and Technology. This offers expert advice to the State government and recommends solutions to policy issues that are science and technology-related.

Consumer Focus – This is presently the statutory consumer champion for the UK, though it is being disbanded with some of its functions being likely to transfer to Citizens Advice. It is involved in ensuring a fair deal for energy consumers and vulnerable consumers.

Council of Europe – This organisation works to develop common and democratic principles based on the European Convention on Human Rights and other reference texts on the protection of individuals throughout Europe.

CPUC – California Public Utilities Commission. This regulates amongst other things privately owned electric, gas, telecommunications and water companies. Its mandate is to serve the public interest through protecting consumers and ensuring the provision of safe, reliable utility services and infrastructures at reasonable rates whilst being committed to environmental enhancement and a healthy Californian economy.

CTIA - The Wireless Association® - an International Association for the Wireless Telecommunications Industry.

DCA – The former UK Department for Constitutional Affairs. All its affairs were taken over by the Ministry of Justice in 2007.

DECC – the UK's Department of Energy and Climate Change. Its brief includes supporting vulnerable customers, delivering secure energy and enabling a low carbon energy economy.

DH – The UK's Department of Health. It is the government department responsible for public health issues, adult social care and the UK's National Health Service. The UK's Health Improvement & Protection Directorate is part of this department.

Diabetes – A group of metabolic diseases where individuals have high blood sugar; either because cells are unresponsive to insulin the body produces, or because the body produces too little insulin.

Directgov – The UK Government's digital single point of access to UK public sector information and services. The information shown is developed by government departments.

DRA – Division of Ratepayer Advocates in California, USA. Its statutory mandate is to obtain the lowest feasible rate for service that is consistent with safe and dependable service levels. As part of this mandate it also advocates for customer and environmental protections.

Eco-sustainability – a means to create beneficial environments for living things and the world both now and for the future.

EFF – The Electronic Frontier Foundation is a US based organisation is involved in matters related to consumer rights, innovation, privacy and free speech.

EHS – Electrohypersensitivity. This condition is also known by a variety of other names including 'Electrosensitivity' (ES), 'Electromagnetic Hypersensitivity' (EHS) and 'Idiopathic Environmental Intolerance with Attribution to Electromagnetic Fields' (IEI-EMF).

EIA – Environmental Impact Assessment. This is an assessment of the possible beneficial or detrimental impact a proposed scheme may have on the environment taking into account natural, social and economic aspects.

EIS – The Electric Infrastructure Security Council. The EIS helps coordinate US and international infrastructure protection against electromagnetic threats. "*Working together to protect our nations' vital infrastructures against severe geomagnetic storms and EMP risks.*"

EMF – Electromagnetic field.

EMPact America – This is a bipartisan, non-profit organisation concerned with protecting Americans from natural or nuclear EMP catastrophes.

EM Radiation Research Trust – a UK registered charity involved in raising public awareness of the health effects of electromagnetic radiation worldwide. It also works with cross party members of the UK and European parliaments to help provide advice and information for parliamentary questions and reports, and is supported by Independent Scientific, Public Health and Technical advisors.

The EMR Policy Institute – This organisation was formed to advance sound electromagnetic radiation (EMR) public policy for the USA.

ERA – Energy Retail Association. This organisation represents the six main electricity and gas suppliers in the domestic market in Great Britain. It works closely with the Government, NGOs, charities and other organisations to ensure a coordinated approach related to energy.

ERDF – Électricité Réseau Distribution France. This subsidiary company of Électricité de France (EDF) manages 95% of the public electricity network in the French territories.

ES-UK – ElectroSensitivity UK is charity whose aim is to provide unbiased and balanced information to help those who have become EHS.

FCC – The Federal Communications Commission. This is an independent US Government agency. It works towards goals in the areas of broadband, competition, homeland security, the media, public safety, the spectrum and modernising itself. It provides varied degrees of cooperation, leadership and oversight for communications bodies in other American countries.

Fibre-optics – Optical fibres that act as waveguides, or 'light pipes' to transmit light between the two ends of a fibre. They are used in for communications purposes and allow transmission over longer distances and at higher data rates than other types of communication.

FIPR – The Foundation for Information Policy Research is an independent body that undertakes study on the interaction between information technology and society.

Fuel poor households – Households which spend at least 10% of their annual disposable income on home energy use.

FPAG – The UK Fuel Poverty Advisory Group. This advisory Non-Departmental Public Body for England is sponsored by DECC. The role of the

Group is amongst other things to consider and report on the effectiveness of current policies aiming at reducing fuel poverty.

GAO – The US Government Accountability Office is also sometimes referred to as the “congressional watchdog" and has a brief to investigate how the US federal government spends taxpayers’ dollars.

Geomagnetic storms – These are temporary disturbances of the Earth's magnetosphere caused by disturbances in the matter occurring between the starts in our Galaxy.

GFI – Ground Fault Interrupters, also known as Residual Current Devices (RCDs), are circuit breakers that protect from individuals from electrical shock.

GNP – Gross national product. This the market value of all services and products produced annually by labour and property supplied by a country’s residents.

HAN – Home area network. These can be used to enable communication between Smart Meters, In-Home Displays (IHDs) and other devices in consumers' premises.

HIA – Health Impact Assessment. This is a combination of procedures, methods and tools by which a policy, program or project may be assessed for its potential effects on public health and the distribution of those effects.

IARC – International Agency for Research on Cancer. Its mission is to coordinate and undertake research on the causes of human cancer, mechanisms of carcinogenesis, and to develop scientific strategies for cancer control and prevention.

ICNIRP – International Commission on Non-Ionizing Radiation Protection. It is an international commission that specialises in radiation protection issues, including determining exposure standards for RF/microwave emissions.

ICT - Information and Communication Technology.

IEEE – The Institute of Electrical and Electronics Engineers. This is the World’s largest professional association that is committed to advancing technological innovation and excellence for the benefit of humanity.

IEQ – Indoor Environmental Quality. The overall quality of a building’s interior as related to the comfort and health of its occupants.

IHD – In-Home Display. These are electronic devices linked to Smart Meters for providing information on individual customer’s energy consumption.

IUHPE – The International Union for Health Promotion and Education. A worldwide, independent and professional association committed to improving the health and wellbeing through education, community action and the development of appropriate public health policy.

The International Electro-Magnetic Fields Alliance (IEMFA) - This is an independent global body of scientific experts on living processes, with a multilevel, multidisciplinary health focus. Its principal aim is to disseminate coherent, health-oriented information and advice.

LCC – Life Cycle Costing. The investigation and valuation of environmental impacts of scheme caused by its existence.

Mast Action UK – Mast Action UK (MAUK) is a voluntary national organisation set up to help communities and individuals with mast siting problems.

Mast Sanity – National organisation in the UK opposing the inappropriate siting of mobile phone and Tetra masts and the installation of wireless Smart Meters.

Microwaves (MW) – These are electromagnetic waves between 1 m and 1 mm in length that occur over the frequency range of 300 MHz (0.3 GHz) to 300 GHz. Sometimes frequencies in this range are (*incorrectly in the present author's opinion*) referred to as radiowaves.

MLA – Member of the Legislative Assembly. A representative elected by the constituency's voters to the legislature or legislative assembly of a sub-national jurisdiction.

NASA – The US's National Aeronautics and Space Administration is an executive branch agency of the US government, responsible for the US civilian space program, aeronautics and aerospace research and the prediction of space weather.

NHS – The UK's National Health Service. This is the shared name for 3 of the 4 four publicly funded healthcare systems in the UK.

National Security Council (NSC) – This is the UK's chief forum for collective discussion of the UK Government's objectives for national security and how they can be best achieved in the current financial climate.

NK cells – Natural killer cells. These are a type of cytotoxic lymphocyte which are a major component of the innate immune system. They cells play a major role in the rejection of tumors and cells infected by viruses.

NRR – The UK's National Risk Register of Civil Emergencies.

NOAA – US National Oceanic and Atmospheric Administration. The brief of this agency is to enrich life through science. Its reach extends from the surface of the Sun to the depths of the oceans.

Ofgem – Office of Gas and Electricity Markets, the UK's regulator for electricity and gas markets. It is responsible for protecting gas and electricity consumers in the UK.

PACE - The Parliamentary Assembly of the Council of Europe. This deals with Human Rights issues, Democracy and Rule of Law for 47 Member States. It is committed to preserving the environment and environmental health, whilst also improving prevention of environment-related health hazards. Observer States for the Council of Europe include the United States and Canada.

PLC – Power Line Communications. These are systems developed to carry data on a conductor that is also used for electric power transmission.

Power density – This is the usual unit of measurement above 30 MHz, though electric and magnetic fields can also be measured. It is usually expressed in milli- or microwatts per square centimetre (mW/cm^2 or $\mu W/cm^2$), and is defined as the amount of power per unit area in a radiated microwave field or other type of electromagnetic field.

Powerwatch – A small independent non-profit UK organisation involved in the EMF and microwave health debate. It works closely with decision-makers in

government and business, and other like-minded groups, promoting policies for a safer environment.

Privacy by design – this is a design philosophy whereby privacy issues are considered before and during system is designed, rather than afterwards.

Psychosomatic responses – These are reactions created by the mind in response to a physical change just from the belief something has occurred. In medicine it is also known as the 'placebo effect'.

PUAF – The Public Utilities Access Forum – This is an informal association of organisations that helps develop policy on public utilities' regulation in England and Wales.

RCD – Residual Current Device, also known as Ground Fault Interrupters (GFIs), are circuit breakers that protect from individuals from electrical shock.

RF – Radiofrequency waves. These are in the frequency range of between 3 kHz to 300 MHz. Some authorities state that RF waves cover the frequency range of 3 kHz to 300 GHz that also encompasses all microwave frequencies.

RF/microwaves – This term covers wavelengths in both the radio frequency and microwave frequency areas, i.e. of 3 kHz to 300 GHz.

REFLEX – Risk Evaluation of Potential Environmental Hazards From Low Energy Electromagnetic Field Exposure Using Sensitive *in vitro* Methods. This EU funded project ran from 2000 to 2004.

Safe School Committee – Organisation set up in Canada to fully support equal access to technology for all children in schools through the use of wired internet connections. It seeks to help create the healthiest learning environment for children.

SHE – Schools for Health in Europe. The SHE Network is open for any organisation or professional with an interest in schools and health. It aims to support organisations and professionals to further develop and sustain school health promotion by providing the European platform for school health promotion.

Security by Design – This is a design philosophy aimed to ensure the security of a system is designed from conception to be secure. With this concept security risks and issues are identified early in the system's development.

Smart grids – These can intelligently and efficiently integrate the actions of all users connected to them for the economic and sustainable use of energy supplies. They are created through the integration of a globe-spanning network of thousands of companies.

SmartGrid GB – This initiative has been set up to provide an open forum for a wide range of concerned organisations to come together, share ideas and information and develop thinking on how the smart grid can be optimised to create consumer, economic and environmental benefits.

Smart Meter – This is a utility meter that records energy consumption in intervals of an hour or less and communicates that information at least daily back to the utility for billing and monitoring. They enable two-way communication between the meter and the utility.

SmartReach – This UK consortium was created to address the UK Government mandate on Smart Meter installation and is comprised of three UK companies: BT, Arqiva and Detica. It is "*committed to helping protect the environment and to making a meaningful contribution to the development of a thriving low–carbon economy*."

SMPS – Switching-Mode Power Supply. These can induce electromagnetic interference and high-frequency transients in the wiring systems they are attached to.

Solar flares – These are large energy releases on the surface of the Sun. They eject clouds of atoms, electrons and ions through the corona into space. The clouds they create often reach Earth a day or two after each event.

Solar maxima – This is the period of greatest solar activity in the solar cycle of the Sun.

SSITA - Safe Schools Information Technology Alliance. A UK alliance of partner organisations, parents, teachers, scientists, lawyers and other experts working to identify issues and concerns regarding wireless technologies in schools, nurseries, day care environments and colleges.

UL – Underwriters Laboratories Inc. (UL) is a global independent safety science company. It develops standards and test procedures for assemblies, components, equipment, materials, products and tools, predominantly dealing with product safety.

UN – United Nations. This is an international organisation whose stated aims are facilitating cooperation in economic development, Human Rights, international law, international security, social progress and achievement of World peace.

US NRC – The US National Research Council. Its mission is to improve government decision making and public policy, increase public understanding, and promote the acquisition and dissemination of knowledge in matters involving science, engineering, technology, and health.

VaasaETT Global Energy Think Tank – This provides global reach for best practice and knowledge in the energy industry. Its own expertise is combined with a network of thousands of specialists and partners in five continents to provide high quality independent work.

Verband Baubiologie – An international professional association for building biologists and adjacent vocational fields.

WAN - Wide Area Network – Smart Metering WAN can be used for two-way communication between Smart Meters and DCC (via the WAN module in the customer's premises).

Which? – This is an independent UK based campaigning and product-testing charity that undertakes advocacy campaigns on consumer protection issues, and also promotes informed consumer choice and increased awareness of consumer rights.

WHO – The World Health Organization. Coordinating and directing authority for health matters within the UN system. It provides leadership on global health matters, shapes health research agenda, communicates evidence-based policy

options, sets standards and norms, assesses and monitors health trends and provides technical support to countries.

WiFiinschools.org.uk – An organisation created by a small group of scientists concerned about the rapid spread of wireless technologies in schools and its potential risks to health. It fully supports the use of technology in ways that protect health.

WiredChild – A registered UK charity, run by a group of concerned parents, seeking to raise awareness of the potential risks to children of exposure to radiation from wireless technology.

Zurich Services Corporation: Risk Engineering – Risk management arm of insurance firm.

Dr Isaac Jamieson Email: isaac.jamieson AT live.co.uk

Author biography:

Dr Isaac Jamieson is a scientist, architect and built environment consultant specialising in the design and enhancement of bio-sustainable environments and technologies. He was Honorary Secretary and Treasurer of the Electrostatics Group of the Institute of Physics from 2008 to 2011, and is presently a scientific advisor on stakeholder groups in the EU and UK involved in policy decisions for the creation of healthy environments at national and international level. In addition to this he has in the past undertaken work for the Lifelong Health Project at Imperial College London, related to the development of environmental design factors and preventive interventions aimed to encourage healthy ageing and enhance wellbeing. He undertakes freelance consultancy work, private commissions and international research collaborations.

He organised the International one-day conference 'Electromagnetic Phenomena and Health – a Continuing Controversy?' at the Institute of Physics in London in 2008.

His recent research papers and reviews include:

Jamieson (2011), Underground Living and Health. Presentation given at 'Designing for Intelligent Underground Buildings' seminar held by the CIBSE Intelligent Buildings Group, CIBSE HQ, London on 6 July 2011.

Jamieson (2010) Visible Light Communication (VLC) Systems, bemri.org/visible-light-communication.html

Jamieson, Holdstock, ApSimon & Bell (2010), Building Health: The Need for Electromagnetic Hygiene?, IOP Conference Series: Earth and Environmental Sciences – http://iopscience.iop.org/1755-1315/10/1/012007

Jamieson (2010), Intelligent Communication: The Future of EMF Discourse and Risk Governance?, IOP Conference Series: Earth and Environmental Sciences – http://iopscience.iop.org/1755-1315/10/1/012009

Jamieson & Briggs (2009), Towards Effective Risk Discourse: the Role of Stakeholder Partnerships. International Journal of Risk Assessment and Management, 13, (3-4), pp. 276-293.

Disclaimer

EM Radiation Research Trust – UK registered charity No. 1106304. It is involved in raising public awareness of the health effects of electromagnetic radiation worldwide. It also works with cross party members of the UK and European parliaments to help provide advice and information for parliamentary questions and reports, and is supported by Independent Scientific, Public Health and Technical advisors. **It relies entirely on donations from the general public for the work that it does. http://www.radiationresearch.org/**

EM-RADIATION
RESEARCH TRUST

www.radiationresearch.org

Reg. Charity No: 1106304