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Smart Meters - Smarter Practices

Solving emerging problems.

A review by Dr Isaac Jamieson.

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SMART METERS – SMARTER PRACTICES

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Introduction

This review - *intended for the general public, governments and industries* - is composed of items written by the present author and excerpts of scientific papers, report or articles written by others. It also contains public comments.

To allow rapid review, important items of information are highlighted throughout this briefing document.

“Today, more than ever before, science holds the key to our survival as a planet and our security and prosperity as a nation. It’s time we once again put science at the top of our agenda ... It’s about listening to what our scientists have to say, even when it’s inconvenient, especially when it’s inconvenient.”

US President Barack Obama (2008).

Reference

Obama, B. (2008), The search for knowledge, truth and a greater understanding of the world around us. President-elect Obama’s Weekly Address 20 December 2008, Change. Gov, The Office of the President Elect, http://www.change.gov/newsroom/entry/the_search_for_knowledge_truth_and_a_greater_understanding_of_the_world_aro/%5d

SMART METERS – SMARTER PRACTICES

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EXECUTIVE SUMMARY



Introduction

Problems reported worldwide with Smart Meters and related technology may (without appropriate action) occur in future rollouts and could generate health, legal, security and infrastructure difficulties unless appropriate measures are taken.

The recent classification of RF/microwave radiation as a Class 2B carcinogen by the International Agency for Research on Cancer (IARC)), the Council of Europe's recommendation that electromagnetic emissions should be "as low as reasonably achievable" and calls, such as the Seletun Resolution, to reduce electromagnetic fields (EMF) exposures also create strategic challenges.

Through learning from present successes and mistakes, taking suitable precautions, undertaking best practice and instigating further research and development, Governments and the Energy Sector can undertake appropriate measures to help ensure smooth and efficient Smart Meter rollouts that give positive environmental impact and consumer feedback.

Properly handled, there is a window of opportunity for best practice and innovation to create a better future and new business opportunities where 'everybody wins'. Timing and system development, however, must be right.

Undertaken robustly, the development of bio-friendly 'smart' technology and robust grids can provide the opening for real progressive change and a truly dynamic revolution where both eco-sustainability and bio-sustainability 'kick start' the future.

Public Perception

Existing rollouts

Whilst some Smart Meter rollouts have gone smoothly, others have met with strong resistance from the general public and authorities. In some instances Smart Meters have even had to be removed and replaced with analogue meters. It is necessary to understand why this has occurred.

Among the issues raised are financial viability, safety issues (including risk of fire), human rights issues (including privacy), health matters (primarily related to RF/microwave emissions), their interference with other electrical items (including security devices and baby monitors) and the accuracy of readings provided by some meters. One US utility has stopped Smart Meter rollout due to cost.

The trend of consumers wishing wired Smart Meters units instead of wireless ones may continue to grow as the WHO/IARC now classify RF electromagnetic fields as possibly carcinogenic.

It is now recognised that unless public concerns are addressed *“there is a very great risk that Smart Meter deployment will turn out to be a [very expensive] ... mistake that ratepayers can ill afford”*.

Smart Alternatives

Fibre-optics

Financially viable wired fibre-optic alternatives to wireless Smart Meters are garnering good press, can help ‘future proof’ smart systems and may increase public support.

Power Line Communications (PLC)

PLC using wired Smart Meters is being adopted by some countries and States. The possible biological effects of the radiofrequency waves they create have yet to be assessed. Complaints are being made in some circles that their use can have a serious impact on radio communication.

Suggestions are also being made that their adoption may inadvertently create additional energy usage as broadcasters have to increase the power of their output to get over the interference they cause.

It is proposed, by some, that existing meters should be retained until the issues that have arisen with the present Smart Meter rollouts are resolved, as this will help improve their overall cost effectiveness and improve customer confidence. It will also help ensure that the correct decisions are made.

Human Rights and Smart Meters

The Dutch Government has retreated on its policy of making Smart Meters compulsory. This concession was made after claims that obtaining information from these intelligent monitoring devices would be in breach of Human Rights. Similar claims may be brought worldwide and indicate the benefits of properly anonymising data.

Other Smart Metering Human Rights claims might include: Right to life, Prohibition of torture, Right to liberty and security, Prohibition of discrimination and Protection of property. With proper forethought such claims might be minimised.

Challenges over perceived breaches of Human Rights could prove extremely costly, and stall rollouts, unless issues are addressed and precautions taken to optimise specification and operation.

Health Matters

Considerable concern is already being voiced by some over the alleged detrimental health effects of some (but not all – *present author's comment*) Smart Meter regimes.

Anecdotal evidence suggests that RF/microwave radiation from Smart Meters may cause: stress, difficulty concentrating, dizziness, fatigue, headaches, heart palpitations, irritability, short-term memory loss, nausea, difficulty sleeping and tinnitus.

Exposure to raised field levels may be a contributory factor to other ailments including: cancers, depression, diabetes, infertility and obesity. A pilot study indicates that raised exposures might also be linked with increased risk of autism.

If raised RF/microwave exposures cause the dramatic rise in infertility that some predict, labour forces may decline to a level where countries are unable to adequately support the ill and elderly.

The possible cost to the economy in terms of lost health and productivity from some types wireless Smart Meters and related technologies (in their present form) may be substantial, and could greatly outweigh any cost savings.

The 'biological friendliness' of Smart Metering systems should be rigorously assessed to reduce public concern and ensure the correct systems are used.

Environmental Sustainability

Experts state that Smart Meters may not necessarily bring environmental benefits unless policies relating to them are properly thought through and optimised.

The unintended consequences of some rollouts could add so much to the real costs of the programs to national economies that they may make them financially unviable even if they achieve their stated goals.

It is vital to factor in unforeseen circumstances and concerns as they arise so that strategies can be suitably amended. As noted in the Seletun Resolution, the Burden of Proof for the safety of radiation-emitting technologies should fall on Producers and Providers not Consumers.

The Rio Declaration

Claims may be brought that Principles 1 (health), 4 (environmental protection), 7 (conservation and protection of the ecosystem), 9 (sustainable development through improved scientific understanding), 13 (liability and compensation), 15 (precautionary approach), 16 (the polluter pays principle) and 17 (the need for Environmental Impact Assessment) may be breached through some programs as they currently stand.

The European Commission

The European Commission states that “*Union policy on the environment shall aim at a high level of protection ... It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.*”

It is in the interests of all parties that disproportionate risks be minimised particularly when ‘no risk’/‘low risk’ technologies can be adopted.

Environmental Concerns

Vegetation

Anecdotal evidence indicates that emissions from some wireless Smart Meters can cause severe die off of local vegetation. This concurs with the findings of related RF/microwave research. A brief listing is given:

Amphibians

Environmental RF/microwave emissions have been shown to effect the biological development of amphibians in comparison to shielded controls in the same environment.

In one study 90% mortality was shown for exposed frogs' eggs and tadpoles compared to only 4.2% mortality in shielded controls.

Birds

Fewer male House Sparrows have been found in areas with raised exposures caused by RF/microwaves in the 1 MHz – 3 GHz range (wireless Smart Meters and smart appliances operate within this frequency range).

Insects

Some RF/microwave regimes have been shown to drastically reduce insect numbers, including that of insect pollinators. Such exposures can adversely affect Nature's food chain and may partially explain reduced numbers of some bat and bird species.

Existing technological solutions for Smart Meters and smart grids can be used to avoid at least some of these apparent negative environmental effects. New technologies can also be developed to create more 'ecologically friendly' systems.

Security of Supply

Vulnerability to Solar Flares

According to NASA the Sun is entering a particularly vicious solar maximum, similar to that in which the most powerful solar storm ever recorded took place. Experts state that the effects of such events on smart grids over the next few years could be devastating.

It is predicted that the next storm of similar magnitude could take place in 2012-2014 and may cause widespread devastation due to our increased reliance on sensitive electronics that can be damaged by natural electromagnetic pulse (EMP) events.

One US expert 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 other countries.

As Smart Meters are more vulnerable to stray high-energy electrical fields that can be caused by EMP than the units they replace, a delayed rollout till after 2014 (*when the risk of solar EMP subsides*) may be worth considering. The design of more robust units should also be actively considered.

Practicality, Security, War, Terrorist or Cyber-Attack

Large scale EMP Events

In addition to the risk of natural electromagnetic pulse (EMP) events, there is also the possibility of large-scale manmade EMP events caused by terrorists or rogue nations.

Measures to reduce risk to infrastructures from EMP are already being put in place by governments worldwide. It is important that the design of smart grids addresses this issue.

Source Region EMP

These are caused by nuclear detonation, such as an air-burst EMP cruise missile. A single event could cause irreparable damage to most electronics within a 30 km (18.6 mile) area. Smart Meters (at present) appear more vulnerable to such damage than the units they replace.

Non-Nuclear EMP (NNEMP)

NNEMP can be created by extremely powerful portable radio transmitters (which can be mobile and coordinated). Their effects would be similar to solar threats and HEMP but usually more localised unless a coordinated attack is undertaken. Technical solutions are being developed to address such threats.

If EMP vulnerabilities remain unaddressed they present increased invitations for attacking smart grids.

NNEMP present a comparable risk scenario likelihood to that of Cyber Attack.

Power surges

A recent sustained power surge in the USA, where 80 Smart Meters caught fire, further indicates that Smart Meters may be more susceptible to EMP than the conventional type of meters they replaced which were unaffected by the event.

Measures should be taken to ensure Smart Meters are robust enough to withstand such surges.

Preventing EMP catastrophes

As smart grids create more potential points of failure than traditional grids, cost effective protective measures should be considered early in the brief.

Resolute action is required to prevent smart grid EMP catastrophes and could create numerous opportunities for investment.

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

At present there are no procedures to perform 'black start' (*restoring power stations to operation without requiring use of using the external power grid*) under severe damage scenarios.

Cyber security

Consumers and utilities' infrastructures risk becoming more vulnerable to cyber-attack due to the two-way communication and increased security vulnerabilities of smart grids compared to existing systems.

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 about security shortfalls.

Manipulation of smart grid data

Electricity theft is a cause of great concern to utilities and already there are devices existing that allow Smart Meters to be altered remotely to register less energy consumption than actually used.

There are also risks that some hackers could be virtual traders seeking to benefit financially through intercepting and manipulating smart grid data to place safe bets on manipulated energy demands.

Other foreseen possibilities include attempted attacks to take out sensitive facilities and criminals studying usage patterns to determine when homes can best be burgled.

An additional challenge for present smart technologies is ensuring that their built-in security remains viable throughout their 10-20 year design lifespan.

Blackout attacks

Network security experts state that once hackers gain access to the smart grid they may gain control "*of thousands, even millions, of [smart] meters and shut them off simultaneously.*"

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.*"

The installation of remote off-switches for Smart Meters, as presently advocated by some Governments, would further increase such risks.

The need for 'opt outs' and wired alternatives

Legal rulings

In Maine, USA, a "landmark" legal ruling now permits individuals to fully 'opt out' of the Smart Metering program and retain their existing analogue meters.

The ruling was given as a result of unresolved concerns on health, privacy and cyber-security issues.

Why 'opt outs' don't always work

In situations where individuals are in close proximity to other consumers' wireless Smart Meters, they will still be exposed to the radiation they are seeking to avoid even if they 'opt out'.

PG&E in California offer customers the opportunity to *partially* 'opt out' – with their old meters being replaced with Smart Meters that have their wireless function turned off.

There are claims that allowing individuals to partially 'opt out' may not be enough to address health concerns, as it appears that the units can continue to emit high-frequency radio signals from their Switching-Mode Power Supply (SMPS) units after being disabled.

The apparent effectiveness of wired fibre-optic Smart Meters and technologies to help reduce the likelihood of health concerns has yet to be assessed.

Smart Meters, HAN & smart appliances

Smart Meters

Alternatives to wireless Smart Meters are required for a number of reasons. One of these is that materials used to construct many buildings shield, at least in part, the emissions from such units. The use of wired fibre-optic Smart Meters would avoid such problems.

Home Area Networks (HAN)

Whilst not being universally adopted by utilities – *almost 3/4 of all utilities have either no plans for using HAN or have yet to make a decision* - HAN will form an important part of the Smart Metering system in the UK and some other countries.

At present all current proposals for HAN in the UK are for wireless networks. The wired option is used to create wired HAN networks in several European countries including Germany.

SMART METERS - SMARTER PRACTICES

Public health concerns, the Council of Europe's recommendation that electromagnetic emissions should be "as low as reasonably achievable" and the recent IARC classification of RF/microwaves as being a Class 2B carcinogen should all be considered when deciding which type of system to adopt (WHO/IARC 2011).

It would appear prudent to consider the use of fibre-optics for consumers' HAN and Smart Meters to make them more desirable to end-users.

Smart Appliances

Smart appliances allow communication between consumers' Home Area Networks (HAN) and utility HAN. To date communication has generally been undertaken wirelessly, though potentially safer wired alternatives exist.

At present some manufacturers allow communications solely through RF/microwave connections.

Pushing the adoption of smart appliances at the present time may be a case of too much too soon and could damage the viability of the Smart Metering industry.

"Orders are already being lost with a number of products because some individuals are refusing to have smart appliances and devices (that emit RF/microwaves throughout the day) installed in their homes and workplaces.

Trade Unions may further influence the degree to which such devices are adopted in the workplace.

"... 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,"
UK Trades Union Congress.

Consumer confidence

As noted above, 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.

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

Public health and Human Rights issues also have to be taken into consideration with regard to the design and operation of smart appliances.

Will Smart Meters save money?

As the World faces a prolonged period of austerity, and redundancies increase at an alarming rate, it is necessary to ensure that the correct Smart Metering options are chosen to avoid placing further burden on those facing hardship.

“Very big and complex projects of this sort always cost more than anticipated.”

Whilst real-time displays of usage can be of benefit, there is little evidence that Smart Meters usage results in an overall reduction in energy demand - *savings are not necessarily guaranteed.*

Concerns are being expressed that the cost to end-users may actually exceed the benefits created during the units' lifetimes. Alternative ways to save energy, such as furthering the creation of more efficient building designs and appliances, should also be considered.

Already there are calls that Smart Meters should only be provided to those who request and can pay for them. More consumer-friendly 'opt in' and 'opt out' options are also required.

It appears necessary to robustly re-access the market and the financial viability of different types of Smart Metering regimes in the light of research findings and consumer feedback.

Proper education

There is a real need to educate the general public on ways to reduce their energy usage.

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

Research indicates that manually operating appliances when the price is low is the consumers' favoured way of optimising energy consumption.

Smart Meters and Economic Instruments

'Polluter pays principle'

It has been suggested that 'polluter pays principle' should be applied to electromagnetic pollution.

"National Authorities should endeavour to promote ... 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 ..."

Principle 16 of the Rio Declaration - the 'polluter pays principle.'

The EU's environmental policy incorporates the precautionary principle and that "the polluter should pay".

It is in the interests of all parties that the most environmentally friendly solutions for Smart Metering can be adopted.

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

National Security

The possible unforeseen costs of some Smart Meter regimes to national security and national economies have to be taken into account and contingencies planned.

It is vital that Governments and States make fully informed decisions on the advantages and disadvantages of different Smart Meter options and the need to optimise grid structures.

Cost of securing critical grid infrastructures

There is a very real risk that, unless adequate precautions are taken, smart grids may be more readily damaged by space weather and malicious manmade events than their predecessors.

Governments worldwide are taking space weather and the threat of such manmade events very seriously.

Alongside hardening grids, the option exists of delaying further rollouts of Smart Meters until the main risk period from space weather subsides. This would allow further time for security measures to be better developed.

The security risks to the new systems from hacking are yet to be resolved. Ensuring that Smart Meters cannot be disconnected

remotely would help reduce the risk of blackouts caused by hackers and rogue states.

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 mainly fibre-optic systems. This would reduce health and security issues and make smart grid more attractive for external investors.

Possible costs of Smart Meters on health & productivity

The potential cost and savings of different metering systems have to be transparently balanced against their potential effects on health and productivity.

Anecdotal evidence already indicates that some types of Smart Meter and related technologies may adversely affect these. These matters need to be robustly addressed. It is proposed that ‘biologically friendly’ solutions should be adopted.

Environmental costs

The possible effects of emissions from some smart grid technologies on the environment too have to be considered.

Taking into account the ‘polluter pays principle’, it is vital to ensure that Smart Meters and related technologies are ‘biologically friendly’.

Cost benefits of Human Rights recognition

The possible costs of human rights challenges to various Smart Meter configurations should be addressed before further rollouts are undertaken. Failure to do so has already stalled their installation in the Netherlands (metering.com 2009).

Cost benefit analysis

Independent Cost Benefit Analyses (CBA) should be undertaken which incorporate Life Cycle Costings (LCCs) for the different types of metering system being considered. The CBAs should also take into account health and productivity issues, as determined by multifactoral Environmental Impact Assessments (EIA) and Health Impact Assessments (HIA).

Creating financial opportunities

Once CBAs are taken into consideration, the results obtained may indicate that there are few opportunities to create true financial gains unless radical changes are considered, including creating more purportedly 'biologically friendly' and endorsing other ways to save energy.

One way of achieving financial viability may be through investing in fibre-optic smart grid networks and other novel forms of 'biologically friendly' technology.

The higher initial costs of fibre-optic Smart Meters compared to some other systems could additionally be mitigated through greater national productivity and wellbeing being achieved than might otherwise be the case with widespread use of wireless units (in their present format).

'The introduction of smart grids using fibre-optic technology has already been shown to be financially viable and to improve business investment over other types of system.

It is important to secure a meaningful sustainable growth strategy for the smart grid by opening up its revenue streams. Innovation and increased discourse are key.

Conclusion

It is imperative that national security, human rights issues, public safety and the economic well-being of countries are taken into account with regard to Smart Meters when considering the types of systems to adopt and the timing of their rollout. At present 'future proof' fibre-optic Smart Meter systems appear to be the best option for large-scale rollouts.

For Smart Metering and smart grids to be financially sustainable and excel, 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, the need for beneficial best practice and timely innovation.

Public Perception



Image source: <http://stopsmartmeters.org/>

At present many of the general public are not 'buying in' to the concept of Smart Metering.

Wireless Smart Meters

California, USA

"The [California State Public Utility] Commission has received more than 8,000 complaints about PG&E Smart Meters. Statewide, the Commission has received more than 2,000 complaints in the past two months (August 15 - October 15, 2010). Many of the complaints include health, safety and environmental concerns" (Maurer 2010).

In California several local governments have passed ordinances criminalising new Smart Meter installations. Four of seven counties (Lake County, Marin County, Mendocino County and Santa Cruz County), and eight of the thirty-four cities and towns (Capitola, Fairfax, Lakeport, Rio Dell, Ross, Seaside and Watsonville) have done so to date (SSM.org 2011). The Tribal Community of Pomo Indians in California has also banned their use within its tribal boundaries.

The remaining counties there have also taken steps to address concerns on Smart Meter installations:

- In San Francisco its City Attorney, Dennis J. Herrera, filed a petition against the California Public Utilities Commission (CPUC) in June 2010 to block the installation of more Smart Meters until state regulators conclude their investigation into them. Herrera's prime concern is the accuracy of readings provided by the meters.
- In February 2011, Humboldt County requested that alternative options are identified for customers who decline the installation of Smart Meters by 1st January, 2012.

- In March 2011 The Board of Supervisors of San Luis Obispo County agreed to issue a letter to the CPUC calling for a delay in the installation of wireless Smart Meters in that county until questions about the technology's safety, alleged threat to privacy and cost-effectiveness are answered.

Safety

A number of Californians admit that they have safety concerns over EMF emissions from Smart Meter units. There is presently much confusion and disagreement over the magnitude of the signals created by such units and the appropriateness of safety benchmarks adopted.

As examples of this difference of opinion:

1) There is the official stance from one of the utilities: *"Both the federal government and the international community have deemed the low-level RF on which PG&E's SmartMeters™ rely to be completely safe"* PG&E (2011).

2) Compared with that of others: *"The installation of wireless 'smart meters' in California can produce significantly high levels of radiofrequency radiation (RF) depending on many factors (location of meter(s) in relation to occupied or usable space, duty cycle or frequency of RF transmissions, reflection and re-radiation of RF, multiple meters at one location, collector meters, etc)..."*

Violations of FCC safety limits for uncontrolled public access are identified at distances within 6" [15.2 cm] of the meter. Exposure to the face is possible at this distance, in violation of the time-weighted average safety limits ..." Sage Associates (2011).

The need for further independent testing appears warranted.

Video footage (TIR 2011) additionally indicates that RF/microwave emissions from some Smart Meters may be in excess of what was originally suggested by CCST (2011). Further commentaries on that document are available at SRC (2011).

Some residents state they would be comfortable with a wired Smart Meter, whilst others wish their analogue meters to be retained or reinstated.

In November 2010, the Division of Ratepayer Advocates (DRA) of the CPUC filed documentation arguing that it has a responsibility to ensure wireless Smart Meters do not endanger public health.

The DRA state “*Unless the public's concerns can be put to rest, there is a very great risk that Smart Meter deployment will turn out to be a \$2.2 billion mistake that ratepayers can ill afford*”.

Consumer survey on wireless Smart Meters

An independent survey of 443 individuals evaluated by Survey Design & Analysis (SDA 2011) indicated the following:

- 35% of respondents said they had received increased bills after having the new meters installed.
- 26% of respondents stated they had experienced electronic interference with their radios, mobile phones or cordless phones (15%) and interference with their security systems (11%) since installation of the Smart Meters. 8% said they had experienced burnt out appliances (including TVs, stereos and computers) since the meter installations. Two individuals stated that the meters had caused interference with a medical implant device.
- 49% of respondents claimed they or a member of their household were electrosensitive. The top health issues of 318 respondents since the installation of wireless Smart Meters were: sleep problems (49%), stress, anxiety and irritability (43%), headaches (40%), ringing in the ears (38%) and heart problems (26%).

Statistical testing had revealed the top health symptoms were positively associated with Electrosensitivity and the presence of wireless Smart Meters. The majority of respondents (78%) are from California and share the same utilities provider. Which features of the system might have contributed to the apparent health problems registered remains to be determined. *Refer also to Appendix 1.*

94% of the respondents stated that they wished to retain or have their analogue meters reinstated, with 92% of them stating that they should not have to pay more to do so (SDA 2011).

Optimising public opinion

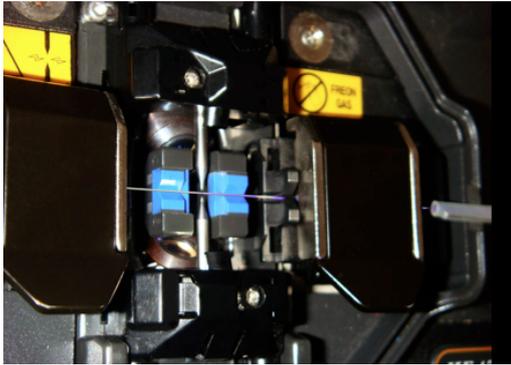
It appears essential to suitably address public concerns for Smart Meters to have a chance of real success in reducing energy usage. *Refer also to Appendix 2.*

Public perception to Smart Meters appears more favourable in Chattanooga, Tennessee, which uses fibreoptics for its Smart Meters (ICF 2011) - *Refer also to section on ‘Smart Alternatives’.*

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Smart Alternatives



<http://www.next-up.org/Newssoftheworld/OpticalFibre.php>

Smart Grids

The classification of RF/microwave radiation as a Class 2B carcinogen (WHO/IARC 2011) taken alongside the recommendation the Parliamentary Assembly of the Council of Europe (PACE 2011) that electromagnetic emissions should be “*as low as reasonably achievable*” (ALARA) – *a call similar to that of the BioInitiative Report (2007)* - create strategic challenges for smart grid infrastructures.

“*Wireless is not necessary - just cheaper and easier to implement*”, Powerwatch (2010).

Not all smart grids are wireless. Some utilities companies have already opted for fibre-optic cabling for their primary communication needs. Others have opted for Power Line Communications (PLC), or use it as a backup channel or for simple installations they consider do not merit the installation costs of fibre-optics.

Practicality of Fibre-optics

The high up-front costs of smart grids present financial challenges (*as do those of broadband projects*). Whilst utility companies use only a small amount of the broadband capacity that they put in to support smart grid applications, a strong case can be given for investing in that capacity to increase revenue potential, particularly if they choose to do so in an environmentally-friendly manner.

As proposed by Kennedy (2011), if utilities were to lease very high bandwidth ‘*future friendly*’ fibre-optic capacity to providers of general broadband services; they, the general broadband providers, and their customers would all benefit. This would allow more broadband projects to become economically viable and lower prices for broadband customers – a true ‘Win/Win’ situation.

Additionally, in situations where fibre-optics have already been put in by broadband providers, they could lease bandwidth to the utilities and avoid the need for wireless Smart Meter connections.

The ruggedness of fibre-optic cables can provide tremendous benefits over their competitors. They are very secure, non-corroding, immune to water damage, electromagnetic and radiofrequency interference, difficult to damage (when in steel armoured cables or in underground conduit), and are more reliable than their competitors during poor weather and catastrophic events. They also have longer service lives – *fifty years plus* - and lower maintenance costs (Kennedy 2011, Fehrenbacher 2009).

With longer service lives, lower maintenance costs, additional potential revenue streams, extra bandwidth for future requirements, and a greater degree of ruggedness than their competitors; fibre-optics can bring tremendous benefits to smart grids and utilities companies over their competitors.

Whilst the costs of fibre-optic and copper cables are similar at present, the price of copper cabling is likely to become more expensive, particularly as networking requires faster speeds and greater bandwidths.

As noted by Fehrenbacher (2009), *“Some cities ... have decided to build out their own [fibre-optic] networks, largely to use it as a way to boost economic prosperity in their regions, delivering jobs and high-speed connections for businesses.”*

Fibre-optics case study

The Electric Power Board (EPB) utility company is presently installing a 100% fibre-optic network for smart grid applications for Chattanooga, Tennessee, USA, using specially designed fibre-connected (and wireless-enabled) Smart Meters (Baker 2011, Fehrenbacher 2009). The network also provides Internet, telephone and video capacity.

According to Fehrenbacher (2009), EPB claim that building out their \$200 million fibre-optic network (*with the help of a DOE ARRA stimulus grant for \$111.5 million to accelerate the project*) will create almost \$850 million in added value from both communications and smart grid services for the city (*including new jobs and energy savings*).

It is predicted that for business, its time-of-use (TOU) rate program will save the 22 manufacturers that have already signed up to it \$2.3 million [£1.44 million] annually (Baker 2011).

The creation of their fibre-optics infrastructure has already led to Chattanooga attracting new business (the new North American manufacturing headquarters for Volkswagen and an Amazon distribution plant).

As a result of its utilisation of fibre-optics Chattanooga is now ranked as one of the World's top seven Intelligent Communities (ICF 2011). No UK communities are presently listed in this ranking.

Chattanooga's ranking was in part achieved as a result of its fully-accessible fibre-optic one gigabit residential Internet service being *"200 times faster than the current [US] national average and ten times faster than the FCC's National Broadband Plan (a decade ahead of schedule),"* (Baker 2011).

"Our 100% fiber-optic network will serve as a platform for accelerated innovation, job creation and deep creativity while serving as the backbone for the next generation of energy efficiency. All in all, with this infrastructure, we can't even imagine today what will be possible in the future – but we will be ready."
David Wade, EPB's Executive Vice President and Chief Operating Officer (Baker 2011).

A fibre-optic network is also being built for Opelika, Alabama, USA. It is planned that the city's public power utility will use the network for smart-grid services and a private company be contracted to deliver triple-play services (Christopher 2010).

The UK seeks to have the best Superfast Broadband Network in Europe by 2015 – *perhaps fibre-optics will contribute to this?*

Investment returns in France

Fibre-optics are additionally being used for the 25 year European Union supported €123 million digital development project by the Syndicat mixte Ardèche Drôme Numérique public body (created by the Conseil général de l'Ardèche, Conseil général de la Drôme and Région Rhône-Alpes in France).

Its fibre-optic network provides ultra-high speed broadband connection (100 Mbps), for a population of about a million people, with neither signal loss over distance nor creation of electromagnetic fields.

Estimated returns on investment (non-binding)

The total cost of the project cost is €123 million. The outlays from different parties are as follows: ADTIM (a subsidiary of Axione / Eiffage / ETDE / ETDE Investment) €73 million; the General Council of Ardèche €10 million; the General Council of the Drôme €10 million; Rhone-Alpes €20 million; and the European Union through the ERDF €10 million.

There are 372,000 homes in the area. If a minimum of 27% of these opt for the 'triple play' service (Internet, telephone and television) offer at €20 per month, the annual turnover will be $100,440 \times 20 \times 12 = €24,105,600$ (\$32,883,900).

As the basic outlay by ADTIM is €73 million (\$99,564,312), the gross return on its investment would be met in approximately 3 years. Going by the minimum estimate, the company should be making a clear profit margin in year 5 or 6 (Next-up 2010).

As the fibre-optic network's extensive installation is indicated as creating a substantial short-term profit for both public and private investors - *even under difficult circumstances* - and is able to do so without creating environmental risks; it is proposed that similar schemes should be undertaken in the UK, and elsewhere, incorporating smart grid connections.

"Considering the developments in technology and in economic matters ... and in view of the fears expressed by some ... concerning the effects of intense radio waves, the committee ... has decided to modify its strategy for providing this service for those areas not yet covered. As a result no new wi-fi or wi-max antennas will be used ..."

Didier Guillaume, President of Conseil Général de la Drôme and Senator of the Upper House of the Parliament of France.

"I am keenly aware of the need to keep in mind the potential health risks linked to radiation, I give my full backing to this decision, which bears out the wish of the General Council to limit the sources of intense radio wave emission," (Guillaume 2009).

Fibre-optics use in other countries

At present fibre-optics have been adopted in part for Smart Metering purposes areas in Canada and the USA (SMPM 2011).

Fibre-optics networks present a more secure, cost-effective, alternative to wireless Smart Meters. They are also more biologically friendly and 'future proofed' than wireless options.

“ ...when you add a demand for reliability and resiliency (as well as a technology that doesn't conduct electricity) to the trends already highlighted, fiber offers a exemplary conduit for the intelligence, two-way communications, and control and monitoring capabilities smart grid applications demand.” (Hardy 2010).

Fibre-optics is the smarter environmentally friendly alternative to adopt for general rollouts to gain public acceptance and attract investment.

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Power Line Communications (PLC)

This is also known as Broadband over Power Line (BPL), Power Line Access (PLA) and Power Line Telecommunication / Technology / Transmission (PLT).

PLC frequencies

- 20-200 kHz frequencies used for home-control PLC devices.
- 100-200 kHz low-frequency carriers on high voltage power lines.
- 15-500 kHz low speed narrow-band. Utility usage including meter reading used for telemetry on high voltage power lines. May be used for meters, domestic appliances and switches.
- 9-500 kHz medium speed narrow-band. Used for home automation. Typically utilise carrier wave in 20-200 kHz range on household wiring. Can be used for automatic meter reading (AMR).
- ≥ 1 MHz high-frequency. HLAN and broadband over power lines (BPL). PLC modems transmit in the 1.6-80 MHz region. System expected to operate in the 10-30 MHz region.
- ≥ 100 MHz ultra-high-frequency (E-Line technology). It can operate anywhere in the 20 MHz – 20 GHz region.

Utility companies use PLC operating in the 24-500 kHz range (Wikipedia 2011).

PLC Effects on shortwave broadcasting

Whilst low speed PLC (below 150 kHz) present no apparent problems - *in terms of causing radiowave interference with broadcasting* - High speed Power Line Communications (HS-PLCs) can and do reduce the effective deployment range of broadcasting to different countries unless transmitter power output levels are substantially increased (Marshall 2010).

“There is strong evidence that the wide deployment of high-speed [PLC] will seriously impact radio communication. If we allow this to happen we sacrifice a proven long-distance universally accessible technology of considerable commercial and social importance for what can only be described as a short-term gain in convenience for local data networks.” Richard Marshall*

*Managing Director and Principal Consultant of the RF and EMC-related electronic design, consultancy & training firm Richard Marshall Limited.

Effects on power usage for broadcasting

The increased use of High speed Power Line Communication (HS-PLC) for Smart Meters may create unforeseen demands in the energy usage of shortwave broadcasters worldwide.

Marshall (2010) predicts that in order to match these additional power requirements worldwide “*Each year this would require the installation of a further electrical generation resource equivalent to some 30,000 wind turbines!*”

Aircraft communications are particularly at risk of receiving interference from PLC (Marshall 2010).

PLC Effects on radio astronomy

In addition to space satellites, radio astronomy laboratories on Earth investigate solar emissions from the Sun and other planets. Their effective operation is vital in predicting possible disturbances that may seriously compromise the integrity of electrical grids and other infrastructures unless sufficient warning is given. The sensitivity of the measurements taken by these laboratories is in large part determined by their ‘radio-noise’ environment in the High Frequency range.

Ohishi et al. (2003) calculated that to protect HF radio astronomy antenna from interference caused by a *single* PLC system, it is necessary to have a separation distance from it of 424 km. Far larger separations will be required if PLC are widely deployed.

PLC Effects on Military Communications and Intelligence

NATO in its report on the effects of HF interference on Communications and Intelligence (COMINT) suggested that (whilst having no authority itself to implement regulatory measures) it would be highly desirable for limits on PLC emissions to be harmonised throughout NATO countries. It stated it would be willing to work with national and international regulatory authorities to do so (NATO 2007).

Deployment of PLC internationally

PLC are being used in whole or part of the following countries: Argentina, Austria, Bosnia & Herzegovina, Brazil, China, Columbia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, India, Mexico, Netherlands, Norway, Portugal, Puerto Rico, Russia, Serbia, Sweden, Spain and the USA. (Echelon 2011, SMPM 2011, ResearchAndMarkets 2010).

PLC in France

Électricité Réseau Distribution France (ERDF) manages the public distribution of electricity to over 95% of the French mainland. It is in charge of the French Smart Meter rollout through its PLC 'Linky' project (ERDF 2011, 2010). Linky is a "slave" system that receives and executes orders, and transmits reports and validated readings to minicomputers in transformer substations, which then inform the distributor's supervision centre.

It uses powerline carrier technology (using a low-voltage electric network) to exchange data and orders between wired Smart Meters and the substations' minicomputers. Its extended communication network allows those minicomputers to talk with the central information system using the telecommunications network.

According to Fontana (2010), ERDF took into account the Canadian and US experience with wireless Smart Meters when deciding to opt for wired units. They are apparently "*very conscious*" of electromagnetic problems. The effectiveness of their proposed measures has yet to be assessed.

Over 35 million wired Smart Meters are to be installed in France.

Unlike Canada and the USA, meters in France are usually located inside homes, as is the general case in the UK.

It appears that PLC will not be used *en masse* for smart grids in the UK. This is primarily due to the present risk of PLC causing significant disruption to communications equipment.

UK perspective on PLC

Resistance to PLC use in the UK has come from the BBC, Civil Aviation Authority, Electromagnetic Compatibility Industry Association and The Radio Society of Great Britain, which are all extremely concerned over the possible damage PLC "would cause" to radio broadcasting and the electromagnetic environment (EMCIA 2011, Ray 2010, RSGB 2011). A report commissioned by Ofcom additionally found that PLC devices tested failed to satisfy essential requirements of the Electromagnetic EMC directive (Smith 2008).

Effects on flora and fauna

The biological and environmental effects of radiofrequencies created by PLC do not appear to have been assessed in detail by those using or seeking to deploy it. This is an important omission that should be rectified at the earliest possible opportunity - Refer to section on '*Environmental Concerns*'.

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Smart Meter Interference



4-60 kHz

Radio frequency interference can be created by the Switched-Mode Power Supply (SMPS) units in Smart Meters even when their wireless transmitters are disabled unless suitable precautions are taken. This interference, or ‘dirty electricity’ as some call it, can be carried indoors from the SMPS onto mains wiring.

“Extensive measurements have demonstrated that all of the meters measured so far, including ABB, GE, and Landis Gyr, emit noise on the customer’s electric wiring in the form of high frequency voltage spikes, typically with an amplitude of 2 volts, but a frequency anywhere from 4,000 Hertz, up to 60,000 Hz. The actual frequency of the phenomena is influenced by the devices that are plugged into the customer’s power. Some houses are much worse than others, and this observation has been confirmed by PG&E installers that have talked to us,” - quote by engineer (Brangan & Heddle 2011a).

Refer also to the section on ‘PLC, Switched-Mode Power Supply and Health’.

900-928 MHz

California, USA

The emissions from PG&E’s wireless electric Smart Meters (which operate in the 902-928 MHz range – *which is unlicensed in North America*) have been implicated as interfering with: baby monitors, remote car starters, cordless phones, DirecTV systems, garage door openers, motion detectors, patio speakers, wireless headphones, wireless microphones and security systems – *even in the middle of the night.*

Such problems were first noted in 2009, and can occur when the Smart Meters transmit information wirelessly back to the utility (OTLB 2011, Rockstroh 2010).

Ontario, Canada

In Ontario, the utility company Chatham-Kent Hydro has installed wireless Smart Meters that operate over the same frequency range (902-928 MHz) used by PG&E.

The choice to use these unlicensed frequencies appears to have been taken as a cost saving measure in an attempt to benefit their customers who had to fund the rollout.

It is, however, now being claimed that the money originally saved by this decision (*the project was coming in at a third of the cost of those by other utilities*) could be lost as a result of severe concerns related to technical aspects of the rollout – namely that the units cause illegal interference on the bandwidths used.

In order for the wireless Smart meters to qualify for licence-exempt use in that frequency range, their transmission power must not exceed 50 mV/m at a distance of (9 feet 10 inches) 3 metres (corresponding to a 0.00075 watts output power). As noted by C-K ARC (2010), as the Smart Meters transmit at significantly higher power levels (0.5 watts of RF/microwave energy), they have to operate using a frequency-hopping scheme under Annex 8 of RSS-210 - which unfortunately causes interference with other devices.

“... it is ILLEGAL to cause this interference in the first place. Industry Canada requires all equipment operating under RSS-210 to cause no interference to other users, including licence-exempt users,” C-K ARC (2010).

Though Industry Canada does not get involved with cases of interference, this is still a matter of law enforceable in Civil Courts and a matter of concern to those in the Smart Meter industry.

Businesses or individuals who have their investment in wireless equipment rendered useless as a result of permanent interference have recourse to legal action, with the likelihood that, due to the large number of parties affected *“a group of cases could be certified for Class Action,”* (C-K ARC 2010).

The EMF Safety Network online survey (SDA 2011) indicated that 8% of respondents had experienced burned out appliances or damaged electronics after installation of Smart Meters.

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The general adoption of fibre-optic systems may provide a simple solution to reduce risk of bandwidth interference and a number of possible legal actions.

Electrical safety and Smart Meters



Image source: Kaskurgichan (2011).

There have been a number of reports of Smart Meters exploding, catching fire, overheating, smoking or smouldering due to poor installation (Admin 2011, Clark 2010, CBS 2010, CPC 2011, Davis 2011, HMH 2011, MrHillDo 2011). It appears vital that properly trained electricians are employed to undertake installations.

“As soon as he pulled the meter we could see what had happened. The receiving clips for the meter were burnt. ... [The utility service worker] then said “... you’re lucky it didn’t start a fire.”

... He then proceeded to tell me that they were having nothing but problems with the contractor who was installing the meters ...

He then went on, telling me that the burnt area was more than likely due to the contractors not being able to fit the new Smartmeter into place, so they widened the receiving clip and shoved it into place. By them widening the clips, they caused an area of no contact which then caused arcing every time we used any appliance with 220v.” Captain Ross, California Fire Department (Admin 2011).

Electrical hazards and fire risks

There have been a number of incidents of electrical hazards and fire risks reported worldwide related to Smart Meter installations both outside and inside buildings. A selection of these is presented.

The above photograph “is the aftermath of one of those new smart meters not being properly installed. The guy who installed it did not know what he was doing and caused the main electric line to the box to become loose and over time it ended up touching the electric meter/box casing causing a fire and a huge firework festival on the side of our house. If I was not home we would have lost the house and our 3 dogs. ...” Kaskurgichan (2011).

Florida, USA

A claim has been made by a Florida woman that a brand new Smart Meter “*caught fire and caused [excess] current to pass thru my house and fry my beautiful new kitchen.*” \$31,993 of damage was caused to appliances and electronic devices in the home which had also recently been rewired.

It is being contested whether the utility company is liable for the damage as “*the Florida legislature has given FPL special protection by declaring that they do not have to pay for damage caused by their negligent mistakes. Only gross negligence and this is done to keep FPL's costs down so they can keep everyone's power bills from going up.*” Howard Finkelstein (HMH 2011).

The following comments were posted online about that incident: (Boater39) “*... we had a fire last week ... Afterwards, I went to investigate and it was the electric meter that burned up. ... I have an electrical background, and from my professional experience, whatever caused the meter to burn up was a dead short carrying a very large amount of current. Based on the damage, the problem was AT THE METER – not at the customer equipment attached to the meter. (like I said, I have professional experience). At the time I found it strange, until I saw this report on TV....*” (HMH 2011).

Texas, USA

There have been a number of complaints about outages and house fires related to Smart Meter installations in Texas (Carey 2011, CPC 2011, CBS 2010). One of these is detailed below:

“*Charles Phillips saw smoke coming from the transformer in his backyard ... When he went out to ... he saw a [utility] contractor at his meter box with a fire extinguisher.*

“*He told me it had caught on fire,” Phillips said. “He had talked to his boss. Evidently, he told him to put it out, which is what he did.” But that was just the beginning. Inside Phillip's home, two TVs were fried, his air conditioner and garage door opener stopped working, and all of the wires and cables hooked up to his electronics were melted from the jolt his electronics took when a fire sparked after the installer removed his old meter. Phillips was left with a total of about \$2,500 in damages.*” (Davis 2011).

“*I felt that they should have some type of liability,”* said Phillips about CenterPoint Energy. But both CenterPoint and the subcontractor installing the smart meters across Houston said the damage is not their fault or their responsibility.’ (Davis 2011).

The utility stated that such *problems exist predominantly in older homes where the wiring is incorrect or a strain has been put on the wiring running into the Smart Meter enclosure.*

Christchurch, New Zealand

A spate of meter fires occurred in Christchurch in 2010 with, in one instance, firefighters being called out to three Smart Meter malfunctions within five days.

In one case a consumer woke up at 4.30 in the morning to find his Smart Meter on fire, the following day a registered electrician who lived in the same area pulled into his driveway to find his meter box on fire and emitting copious amounts of smoke.

Station Officer Murray Jamieson of the NZ Fire Service stated, "*It was very dangerous, ... the whole thing burnt out completely, last night's one was a melt down and it was significantly dangerous,*" (Clark 2010).

Possible causes

Bad fitting - there is not likely to be a significant increase in current indoors from Smart Meters unless they are badly fitted.

There is the possibility that the extra current generated through fitting errors may cause the live/'hot' wires in the building to carry more current than they were designed to, which can cause overheating. This in turn can also overload the 'neutral' wiring (*particularly if it is thinner than the live/'hot' wiring as is often the case in North America*).

This situation may result in damage to appliances and items of electrical equipment and create potential fire hazards - *the greater the current carried the greater the danger, particularly with older wiring.*

The degree of risk of damage to electrical items and fires varies from country to country depending on building codes and also from building to building (depending on how and when it was wired).

In North America, risk of damage from these greater currents can often be exacerbated as a result of neutral wires often being sized smaller than hot/live wires (Spitaels 2011).

Best practice

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. They are required in US building codes for new build construction and renovation work.

Ground Fault Interrupters (GFI) - or *Residual Current Devices (RCD)* as they are known in the UK - are circuit breakers that protect from individuals from electrical shock by interrupting a household circuit when there is a difference in the currents in the hot/live wire and the neutral wire.

Wireless Smart Meters have been shown to trip both AFCI and GFI/RCD (Admin 2011, Rockstroh 2010).

Building wiring

Powercor in Australia acknowledges the safety risks related to wiring stating, “A defect notice is issued when a wiring safety issue is identified. The defect may be identified before or during the smart meter installation or during the testing that we must do before reconnecting the electricity supply. If you are given a defect notice, you will need a registered electrical contractor to rectify the defect and issue a Certificate of Electrical Safety” (SMFE 2011).

As a matter of best practice, neutral wires should never be undersized in buildings where high levels of harmonics and radiofrequencies (as can be caused accidentally by some Smart Meters) are likely to be carried on wiring.

As noted by Spitaels (2011), “In modern facilities the neutral wiring should always be specified to be the same capacity as the power wiring (or larger). This is in contrast the electrical codes which may permit undersizing the neutral wire.” [Emphasis added by present author].

Safety certification

Underwriters Laboratories Inc. (UL) deals with matters of product safety and undertakes certification of Smart Meters worldwide. In February 2011, the Capitola City Council in California discovered that wireless Smart Meters being installed there did not have the UL certification required under the state electrical code for all domestic electrical equipment and appliances (OTLB 2011).

Such matters need to be addressed, as ensuring the safety of ‘smart’ technology is paramount both for reasons of public safety and consumer confidence - certification, such as that already undertaken by Underwriters Laboratories Inc. (UL) appears essential.

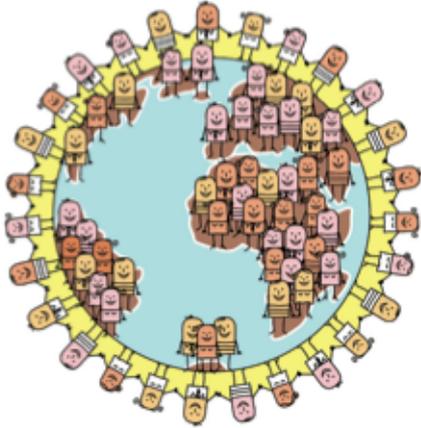
SMART METERS - SMARTER PRACTICES

In addition to UL certification being available for Smart Meters, there is now certification issued under the authority of the US FCC that requires that all persons be kept at least 8 inches (20cm) from wireless Smart Meters (CCS 2011). The more rigorous exposure guidelines of some other countries, such as Russia and China, would require far greater distances.

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Smart Meters and Human Rights



<http://www.dreamstime.com/royalty-free-stock-photo-people-world-image14030255>

Overview

There is increasing talk worldwide of individuals coming together to pursue Human Rights claims related to Smart Meters. Where possible, it is desirable to be aware in advance of the type of claims that may be made so that suitable measures can be taken to reduce the need for such recourse.

The extent to which Smart Metering projects are being embarked on worldwide can be viewed at the following link:

<http://maps.google.co.uk/maps/ms?ie=UTF8&source=embed&oe=UTF8&msa=0&msid=208141621543957618113.0000011362ac6d7d21187>

In order for Smart Metering to have a proper chance of success, it is vital that potential Human Rights issues are properly addressed.

Europe



European Convention of Human Rights

In 2009, the Dutch government retreated on its former position of making Smart Meters compulsory in all homes.

The Dutch Minister of Economic Affairs, Maria van der Hoeven, had intended that refusing installation of a Smart Meter would be punishable by either a €17,000 (\$23,053) fine or six months in prison. She now backs the installation of such units being voluntary (metering.com, 2009).

Their proposed mandatory rollout of Smart Meters was opposed by privacy watchdog groups and consumer organisations, including Consumentenbond (the Netherlands' main consumer organisation) which commissioned a report into the matter by the University of Tilburg (Cuipers & Koops 2008).

That report concluded that Smart Meters could give away sensitive information that might fall into the hands of third parties (including police and insurance companies) on consumers' energy usage habits, including when individuals' leave and return to their homes (which could be particularly useful to burglars).

It also stated that the insights these intelligent monitoring devices would provide into living patterns and relationships could affect individuals' freedom to do as they please within their own homes and therefore be in breach of the European Convention of Human Rights.

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United Kingdom



UK - Human Rights Act 1998

This Act is based on the European Convention of Human Rights. For this reason, many of the pointers that could have been included in the review of the European Convention are covered here instead.

Human rights are required to be part of all UK policy making (DCA 2006). This Act is one of the most important statutes ever passed in the UK (Hoffman & Rowe 2010).

Article 2 - Right to life

1. *“Everyone’s right to life shall be protected by law. No one shall be deprived of his life intentionally save in the execution of a sentence of a court following his conviction of a crime for which this penalty is provided by law.”*

Right to Life: All EU States agree that the human embryo/fetus belongs to the human race (Hoffman & Rowe 2010). As research indicates that some RF/microwave regimes (at levels lower than current limits) may raise risk of infertility, miscarriage, and cause damage to both animal and human offspring (Cherry 2000); claims might be brought that increasing involuntary exposures to such regimes may be against individuals’ right to life.

As shown in the case of LM & R v Switzerland (LMRS 1996), Article 2 is relevant in situations where health may be put at risk, and is not restricted to risk of death or actual death. *Refer also to Appendix 3.*

When authorities are aware (or should be aware) of real risk to life they are under obligation to take appropriate mitigative action to protect those at risk (Hoffman & Rowe 2010).

Taking into account the health effects reported abroad from wireless Smart Meters (KCRA 2011), it appears that some systems may be a cause of real risk to life if installed in the UK.

Environmental Pollution: Incidents of environmental pollution can also be regarded as being in violation of Article 2 (LMRS 1996). The case of *Guerra v Italy* (GI 1998) demonstrates that Article 2 can apply to situations where environmental quality may be at risk.

Anecdotal evidence already exists indicating that RF/microwave emissions from Smart Meters may seriously damage the environment (OTLB 2011). Refer also to section on ‘*Environmental Concerns*’.

Article 3 - Prohibition of torture

“*No one shall be subjected to torture or to inhuman or degrading treatment or punishment*” (HRA 1998).

Article 3 embodies a fundamental human right. “... *the right to freedom from bodily harm is second only to the right to life, and is equally based on the right which all people have a level of basic respect and dignity as human beings,*” (Hoffman & Rowe 2010).

The European Court defines ‘degrading treatment’ as “... *such as to arouse ... feelings of fear, anguish and inferiority, capable of humiliating and debasing... and possibly breaking... physical or moral resistance,*” (IUK 1980). These appear very similar to descriptions provided by some electrohypersensitive (EHS) individuals describing how their condition makes them feel.

It appears from NTSM (2002) that Article 3 also covers living conditions, and that when/if violations are proved, the inconvenience and cost of rectifying matters is placed on the State.

Adverse effects created by exposure to some types of Smart Meters – *if proven true* - may prove very expensive to the UK economy (if such types of unit are widely adopted).

Article 5 - Right to liberty and security

1. “Everyone has the right to liberty and security of person. No one shall be deprived of his liberty save in the following cases and in accordance with a procedure prescribed by law. ...” (HRA 1998).

Under Article 5, the rights of vulnerable individuals may be violated if emissions from Smart Meters and other forms of electronic technology prevent them from being able to go where they wish (even in their own homes and gardens) unhindered by man-made electromagnetic field regimes detrimental to their well-being.

Article 8 - Right to respect for private and family life

1. “Everyone has the right to respect for his private and family life, his home and his correspondence.” (HRA 1998).

- Privacy. The UK government presently wishes access to all UK metering information, with gas and electricity meter readings to be taken from every UK household every half hour. However, this is inconsistent with EU privacy law and, as mentioned previously, has already been successfully contested in the Netherlands (Anderson & Fuloria 2010).

- It is recognised that the enjoyment and quality of domestic life may be damaged by particular types of interference, such as various forms of environmental pollution - *electromagnetic pollution may be in this category.*

It appears that claims that “*economic benefits outweigh the rights of those affected*” could be disputed related to:

- health matters (*as noted elsewhere within this publication*).
- the right for individuals to be able to enjoy their property in the manner to which they have become accustomed. It is already documented that wireless Smart Meters prevent some individuals using parts of their homes in order to avoid/reduce adverse health effects (EMFSN 2011, Havas 2011).

“*Respect for home and home life means more than just providing some form of dwelling or shelter: it extends to maintaining the situation to which a person has become accustomed, and the very permanence of which gives comfort,*” (Hoffman & Rowe 2010).

Some may claim that the installation of wireless Smart Meters and/or wireless smart technology is an actionable nuisance, the radiation from which interferes with their right to peacefully enjoy their possessions (including parts of their homes and their gardens).

They may also claim that the unwarranted introduction of such pollution may reduce the capital value of their homes (*some individuals in the USA are already being forced to relocate in an attempt to escape such exposures*).

With *Guerra v Italy* (1998), the European Court found the state guilty of failing to take ‘positive steps’ to provide essential information pertaining to matters in hand as related to environmental pollution.

The Court also determined that environmental pollution may “*affect individuals’ well-being and prevent them from enjoying their homes in such a way as to affect their private and family life adversely, even without seriously damaging their health,*” (Hoffman & Rowe 2010).

2. “*There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others,*” (HRA 1998).

It may be claimed by some that Article 8 may be violated through the potential weakening of “*national security, public safety or the economic well-being of the country*” unless certain precautions are undertaken – Refer to sections on ‘*Security of Supply*’ and ‘*Health Matters*’ in this present document.

Article 12 - Right to marry

“*Men and women of marriageable age have the right to marry and to found a family, according to the national laws governing the exercise of this right,*” (HRA 1998).

Claims may be brought if the emissions from technology being employed in some Smart Meters and related technology are proven to reduce human fertility and increase risk of miscarriage thereby hindering individuals’ right to found a family.

Article 14 - Prohibition of discrimination

“*The enjoyment of the rights and freedoms set forth in this Convention shall be secured without discrimination on any ground such as sex, race, colour, language, religion, political or other opinion, national or social origin, association with a national minority, property, birth or other status,*” (HRA 1998).

It may be contested by some, particularly those with EHS, that the widespread introduction of some types of RF/microwave emitting Smart Meters (and related wireless emitting technology) may be discriminatory, as it would interfere with their basic rights and freedoms.

It appears important to ensure that the technologies used for the Smart Meter rollouts in the UK, and elsewhere, do not adversely discriminate against those with conditions that may be exacerbated by exposures to inappropriate electromagnetic field regimes.

The First Protocol

Article 1: Protection of property

“Every natural or legal person is entitled to the peaceful enjoyment of his possessions. No one shall be deprived of his possessions except in the public interest and subject to the conditions provided for by law and by the general principles of international law,” (HRA 1998).

“The preceding provisions shall not, however, in any way impair the right of a State to enforce such laws as it deems necessary to control the use of property in accordance with the general interest ...”

The “*peaceful enjoyment of ... possessions*”, and the right for individuals to be able to enjoy their property in the manner they have become accustomed to (*such as having access to rooms in their homes and their gardens without feeling unwell*), may be compromised through some Smart Meter and smart technology regimes.

Refer also to: [Smart Meter Health Impacts Testimonials](#).

There may also be claims that individuals’ “peaceful enjoyment” may be disturbed over privacy issues, including: data hijacking from Smart Meters that may allow thieves to determine the types of electronic equipment they possess (as a result of their unique electronic signatures) and when they are not in occupancy.

Under English Law, the term ‘property’ includes buildings, land and animals owned by individuals (Hoffman & Rowe 2010).

Some Smart Meter regimes may cause individuals to be deprived of other possessions, including plants (through creating inappropriate field regimes that may instigate their die-off) – Refer to section on ‘*Environmental Concerns*’.

The possible effects of exposures on other animals too have to be considered, along with any claims of violation of human rights that may be made as a result of these.

The Council of Europe (CE 2011) draft resolution has already recorded concerns over “*the potentially [emphasis by present author] pathogenic effects observed in livestock – calves, cows, horses, geese, etc. ... [and] unaccountable deformities of new-born calves, cataracts, fertility problems,*” that may be caused by RF/microwave radiation from mobile phone base stations. Possible effects emissions from wireless Smart Meters and powerline communications (PLC) have yet to be undertaken.

The effects on individuals' livelihoods of proposed metering schemes should also be seriously taken into consideration so that optimum solutions can be obtained "*in accordance with the general interest ...*"

**"Human rights must be part of all policy making,"
UK Department for Constitutional Affairs (DCA 2006).**

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Africa



Image source: FreeDigitalPhotos.net staff, <http://www.freedigitalphotos.net>>Image: FreeDigitalPhotos.net</p>

African [Banjul] Charter on Human & Peoples' Rights

The African [Banjul] Charter on Human and Peoples' Rights is an important legal instrument for Africa that was adopted in 1981. It entered into force in 1986 (African Charter 1986).

Part I: Rights and Duties

Chapter I: Human and Peoples' Rights

Article 1

“The Member States of the Organization of African Unity parties to the present Charter shall recognize the rights, duties and freedoms enshrined in this Chapter and shall undertake to adopt legislative or other measures to give effect to them.”

Article 4

“Human beings are inviolable. Every human being shall be entitled to respect for his life and the integrity of his person. No one may be arbitrarily deprived of this right.”

As RF/microwave radiation is categorised as a Class 2B carcinogen (WHO/IARC 2011), respect for life and integrity of person may be infringed by some Smart Meter regimes (*Smart Metering alternatives are available that may avoid this risk – present author's comment*).

In particular, the potential detrimental health effects already noted abroad with Some Smart Meters (EMFSN 2011, KCRA 2011, Milham 2011), right to life issues - as related to the effects of increased RF/microwave exposures (Cherry 2000), and privacy issues that could damage integrity (Quinn 2009, Cuipers & Koops 2008), might be pursued by African citizens unless suitable best practice measures are taken.

Article 5

“Every individual shall have the right to the respect of the dignity inherent in a human being ... All forms of ... degradation of man particularly ... cruel, inhuman or degrading punishment and treatment shall be prohibited.”

The symptoms exhibited by some individuals exposed to RF/microwave regimes from some types of Smart Meters, and related technologies, can make them feel degraded as a human being.

It may be worthwhile for utilities and those developing smart technologies to investigate the use of more potentially ‘biologically-friendly’ options, such as fibre-optics, to prevent potential claims that they may be breaching this right.

Article 6

“Every individual shall have the right to liberty and to the security of his person. No one may be deprived of his freedom except for reasons and conditions previously laid down by law. ...”

The liberty and security of those who are electrohypersensitive (EHS) may be compromised by some Smart metering regimes which can inadvertently inhibit/prevent individuals going where they wish, even within their own homes (EMFSN 2011), in order to avoid electromagnetic exposure from such devices.

Article 12

1. *“Every individual shall have the right to freedom of movement and residence within the borders of a State provided he abides by the law.”*

Freedom of movement and residence may be compromised by emissions from some types of Smart Meters and related smart technologies, as discussed above in the commentary for Article 6.

The threat of exposure to such emissions can, in some instances, prevent vulnerable members of the public from going where they wish within their own country without the risk of becoming unwell as a result of inappropriate EMF exposure.

Article 13

3. *“Every individual shall have the right of access to public property and services in strict equality of all persons before the law.”*

Inappropriate RF/microwave regimes can prohibit EHS individuals from accessing public property. It is important to ensure that Smart Metering, smart appliances and related technologies avoid contributing to this potential problem in Africa.

Article 15

“Every individual shall have the right to work under equitable and satisfactory conditions, ...”

The field regimes created by some Smart Meters and related smart technologies in the workplace may compromise the right to work of vulnerable EHS individuals by creating unsatisfactory work conditions, or conditions where they cannot work without becoming unwell.

Article 16

1. *“Every individual shall have the right to enjoy the best attainable state of physical and mental health.”*
2. *“States parties to the present Charter shall take the necessary measures to protect the health of their people ...”*

As indicated by anecdotal evidence from overseas (EMFSN 2011), the physical and mental health of a number of individuals may become compromised by some Smart Meter regimes.

As it is the duty of African States parties to *“take necessary measures to protect the health of their people,”* it would appear wise to check the scientific validity of the claims made related to health effects, and ensure that options used for smart meter rollouts and related smart technologies are ‘biologically friendly’.

Article 18

1. *“The family shall be the natural unit and basis of society. It shall be protected by the State which shall take care of its physical health and moral.”*
3. *“The State shall ensure the elimination of every discrimination against women and also ensure the protection of the rights of the woman and the child as stipulated in international declarations and conventions.”*
4. *“The aged and the disabled shall also have the right to special measures of protection in keeping with their physical or moral needs.”*

Claims might be brought that as some RF/microwave regimes are linked with increase risk of infertility, miscarriage and damage to human offspring (Cherry 2000); there is a possibility that emissions

from some types of Smart Meters and related devices may cause similar damage, thereby hindering individuals' right to found a family.

Claims might also be brought that if some types of Smart Meter regimes are adopted there may be risk of increased ill health to individuals.

Anecdotal evidence already exists from abroad concerning the risk of Smart Meters to health (EMFSN 2011). It is the State's duty to protect against such risks if proven real, particularly for those considered most vulnerable to such regimes.

Article 20

1. *"All peoples shall have the right to existence. ..."*

Cherry (2000) indicates that some human embryos/fetuses may be (inadvertently – *present author's comment*) deprived of life as a result of inappropriate RF/microwave regimes raising the risk of miscarriage.

There also appears a very real risk that some Smart Meter regimes may shorten individuals' lives (plus reduce the quality of their lives and length of time they are able to work productively).

Article 23

1. *"All peoples shall have the right to national and international peace and security. ..."*

It is predicted by NASA that the Sun is entering a particularly vicious solar maximum over the period 2012-2014 (Moskowitz 2011, NASA 2010). Upcoming solar flares could severely disrupt national grids and infrastructures unless suitable precautions are taken (Birnbach 2011).

"As Smart Meters are more vulnerable to stray high-energy electrical fields that can be caused by EMP than the units they replace. A delayed rollout till after 2014 (when the risk of solar EMP subsides) may be worth considering for this reason alone. The design of more robust units should also be considered." – Dr Isaac Jamieson.

It is already predicted that for the USA, under current states of preparedness, such an event might cause two-thirds of its population to die as a result of starvation and societal collapse (Cogan 2011). It appears that no assessments have been undertaken to date for Africa on the effects of such an event.

Article 24

“All peoples shall have the right to a general satisfactory environment favorable to their development.”

Some installations have been indicated as creating unsatisfactory environmental conditions for individuals’ development both in health terms (EMFSN 2011, Sage Associates 2011), and in terms of the security of their environment, as there may be increased risk of burglary (SGIP 2010) if third parties obtain data on the types of electrical equipment individuals hold and building occupancy patterns.

Article 25

“States parties to the present Charter shall have the duty to promote and ensure through teaching, education and publication, the respect of the rights and freedoms contained in the present Charter and to see to it that these freedoms and rights as well as corresponding obligations and duties are understood.”

It may prove prudent, as part of the promotion of the need to respect the rights and freedoms contained within the Charter being discussed, for the needs of those thought particularly vulnerable and/or likely to be adversely affected by electromagnetic pollution (such pregnant women, young children, the elderly and those with EHS) to become better known.

Article 26

“States parties to the present Charter shall ... allow the establishment and improvement of appropriate national institutions entrusted with the promotion and protection of the rights and freedoms guaranteed by the present Charter.”

It is suggested that in order to further promote and protect the rights and freedoms guaranteed by the present Charter there should be the establishment and improvement of appropriate national institutions to better evaluate the benefits and risks of smart grid employments so that the best choices can be made for the good of all.

Chapter II: Duties

Article 27

“... The rights and freedoms of each individual shall be exercised with due regard to the rights of others, collective security, morality and common interest.”

Smart grid security issues have to be properly addressed – Refer to section on ‘Security of Supply’ in this present document.

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The Nations of the Americas



The American Convention on Human Rights

The American Convention on Human Rights is a legally binding instrument as concluded under international law adopted by the nations of the Americas (OAS 2011).

24 Member States of the Organization of American States (OAS) have ratified the American Convention on Human Rights 'Pact of San José, Costa Rica'. They are: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, and Venezuela. The treaty has not been ratified by the USA, Canada and several Caribbean nations.

Part I: State Obligations and Rights Protected, Chapter 1: General Obligations

Article 1. Obligation to Respect Rights

1. *"The States Parties to this Convention undertake to respect the rights and freedoms recognized herein and to ensure to all persons subject to their jurisdiction the free and full exercise of those rights and freedoms, without any discrimination ..."*

The widespread introduction of RF/microwave emitting Smart Meters (and related wireless emitting technology) may be discriminatory against individuals who may be detrimentally affected by them.

Article 4. Right to Life

1. *"Every person has the right to have his life respected. This right shall be protected by law and, in general, from the moment of conception. No one shall be arbitrarily deprived of his life."*

Since research indicates that some RF/microwave regimes may increase risk of infertility, miscarriage and cause damage to human offspring (Cherry 2000), and RF/microwave radiation is now classified as a Class 2B carcinogen (WHO/IARC 2011), claims might be brought that raising involuntary exposures may be against individuals' right to life. Refer also to section on 'Health Matters'.

Claims might also be brought that individuals may be arbitrarily deprived of their lives through health conditions exacerbated or brought on as a result of the involuntary exposures they receive – refer also to section on 'Health Matters' in present document.

Article 5. Right to Humane Treatment

1. *“Every person has the right to have his physical, mental, and moral integrity respected.”*
2. *“No one shall be subjected to torture or to cruel, inhuman, or degrading punishment or treatment. ... “*
3. *“Punishment shall not be extended to any person other than the criminal.”*

Some Smart Meter regimes are indicated as being potentially inhumane to susceptible individuals (KCRA 2011).

Article 7. Right to Personal Liberty

1. *“Every person has the right to personal liberty and security.”*

Insights into individuals' living patterns and relationships, gained through Smart Meters and related devices (if data is not suitably anonymised), may impinge on their freedom of liberty to do as they please within their own homes and therefore be in breach of their Human Rights (Anderson & Fuloria 2010, metering.com 2009).

2. *“No one shall be deprived of his physical liberty except for the reasons and under the conditions established beforehand by the constitution of the State Party concerned or by a law established pursuant thereto.”*

The physical liberties of some individuals may be violated if EMF emissions from the units prevent them from being able to go where they wish, even within their own homes, without feeling unwell and/or having their health compromised.

6. *“Anyone who is deprived of his liberty shall be entitled to recourse to a competent court, ...”*

It appears highly likely that individuals who consider that they are deprived of their liberty to go where they wish will seek recourse.

Article 11. Right to Privacy

1. *“Everyone has the right to have his honor respected and his dignity recognized.”*

Some individuals may have their dignity severely compromised as a result of some types of Smart Meter exposure making them feel unwell - Refer to section on ‘Smart Meter Health Impacts Testimonials’.

2. *“No one may be the object of arbitrary or abusive interference with his private life, his family, his home, or his correspondence, or of unlawful attacks on his honor or reputation.”*

There are concerns that unless data from Smart Meters is suitably anonymised, it may provide sensitive data to third parties allowing them to cause unwarranted interference.

3. *“Everyone has the right to the protection of the law against such interference or attacks.”*

Protection against interference and the right to privacy may be compromised, unless suitable precautions are undertaken by providers. At present many cyber-security experts have grave reservations over the level of security provided by Smart Meters – Refer to section on ‘Cyber Security’.

Article 17. Rights of the Family

1. *“The family is the natural and fundamental group unit of society and is entitled to protection by society and the state.”*

2. *“The right of men and women of marriageable age to marry and to raise a family shall be recognized, if they meet the conditions required by domestic laws, ...”*

1. Claims of negligence may be brought if the Smart Meter technologies that are adopted are indicated as placing the family at increased risk of ill health, identity theft, etc.
2. The right to raise a family may be compromised if emissions from some Smart Meters and related technology are proven to reduce human fertility and increase risk of miscarriage.

Article 19. Rights of the Child

“Every minor child has the right to the measures of protection required by his condition as a minor on the part of his family, society, and the state.”

The rights of the unborn child may be compromised through increased chance of miscarriage due to exposure to increased levels of RF/microwave radiation from some Smart Meter technologies - increased exposure RF/microwave radiation is linked to incidence of ill health after birth (De Iulius et al. 2009).

Article 21. Right to Property

1. *“Everyone has the right to the use and enjoyment of his property. The law may subordinate such use and enjoyment to the interest of society.”*

EMF emissions from wireless Smart Meters are documented as preventing some individuals using and enjoying parts of their properties on health grounds (EMFSN 2011, Havas 2011, KCRA 2011). Wireless smart appliances and devices may additionally compromise their use and enjoyment. It is suggested that it is not in society’s interest to subordinate such use and enjoyment.

2. *“No one shall be deprived of his property except upon payment of just compensation ... ”*

Compensation claims may be brought by individuals.

Article 22. Freedom of Movement and Residence

1. *“Every person lawfully in the territory of a State Party has the right to move about in it, and to reside in it subject to the provisions of the law.”*

The freedom of movement and residence of some individuals, particularly those who are electrohypersensitive (EHS), may be severely compromised if/where wireless regimes are introduced. (There are already incidences of people being forced to move home and/or sleep elsewhere to try and escape from the emissions of wireless Smart Meters).

Article 24. Right to Equal Protection

“All persons are equal before the law. Consequently, they are entitled, without discrimination, to equal protection of the law.”

Those whose rights may be seen to be compromised by some Smart Meter regimes may seek recourse through law.

It is important to take such matters on board when considering the choice of systems to adopt.

Chapter 3: Economic, Social and Cultural Rights

Article 26. Progressive Development

“The States Parties undertake to adopt measures, both internally and through international cooperation, especially those of an economic and technical nature, with a view to achieving progressively, by legislation or other appropriate means, the full realization of the rights implicit in the economic, social, educational, scientific, and cultural standards set forth in the Charter of the Organization of American States as amended by the Protocol of Buenos Aires.”

Progressive development may be hindered by:

- Smart Meter regimes that hinder economic development through increasing health-related problems and security risks.
- Inappropriate wireless Smart Meter regimes that restrict some individuals' freedom of movement both at home and outdoors.

Article 29. Restrictions Regarding Interpretation

“No provision of this Convention shall be interpreted as:

- 1. permitting any State Party, group, or person to suppress the enjoyment or exercise of the rights and freedoms recognized in this Convention or to restrict them to a greater extent than is provided for herein; ..”*

It appears highly likely that claims will be brought unless suitable action is taken.

Article 32. Relationship between Duties and Rights

- 1. “Every person has responsibilities to his family, his community, and mankind.”*

It is important to ensure that these responsibilities are met with regard to creating appropriate Smart Meter provisions that reduce the likelihood of Human Rights being violated.

Protocol of San Salvador

This is an additional protocol of the American Convention on Human Rights. It was created to bring inter-American Human Rights to a higher level through protecting second-generation rights in economic, social and cultural spheres. It came into effect on 16th November 1999 and has been ratified by 14 nations.

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The countries which have adopted it are: Argentina, Bolivia, Brazil, Columbia, Costa Rica, Ecuador, El Salvador, Guatemala, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname and Uruguay. Some of these countries (Argentina, Brazil, Columbia and Mexico) also have Smart Meter installations.

Under the 'Protocol of San Salvador' (CIDH 2011) the following additional articles might be referred to on matters related to Smart Meters based on the essential rights of humankind:

Article 3: Obligation of nondiscrimination

"The State Parties to this Protocol undertake to guarantee the exercise of the rights set forth herein without discrimination of any kind ..."

Claims may be made that the creation of field regimes inappropriate to those suffering from EHS, or other health ailments, may be a form of discrimination, particularly when practical alternatives that do not create such regimes are available.

Article 6: Right to Work

1. *"Everyone has the right to work, which includes the opportunity to secure the means for living a dignified and decent existence ..."*

The right to work of individuals may be compromised by Smart Meter field regimes that compromise their health.

Article 7: Just, Equitable, and Satisfactory Conditions of Work

"... the States Parties undertake to guarantee in their internal legislation, particularly with respect to:"

a. *"Remuneration which guarantees, as a minimum, to all workers dignified and decent living conditions for them and their families ..."*

"Dignified and decent" living conditions may be compromised by emissions from some Smart Meters and related appliances (EMFSN 2011).

In particular claims may be brought by some that their introduction may result / has resulted in reduced quality of home life and restrictions on which rooms in a dwelling may be used by vulnerable individuals.

e. *“Safety and hygiene at work; ...”*

Claims may be brought that raised field regimes caused by the introduction of Smart Meters and related technologies in the workplace may compromise best practice as related to safety and hygiene at work and compromise health, wellbeing and productivity, particularly as RF/microwave radiation has now been classified as a Class 2B carcinogen (WHO/IARC 2011).

Article 10: Right to Health

1. *“Everyone shall have the right to health, understood to mean the enjoyment of the highest level of physical, mental and social well-being.”*

Some Smart Meter regimes may compromise health. Others may, in comparison, help maintain it. Specifying the right type of system will help reduce likelihood of ill health and claims.

2. *“In order to ensure the exercise of the right to health, the States Parties agree to recognize health as a public good and, particularly, to adopt the following measures to ensure that right:”*

d. *“Prevention and treatment of endemic, occupational and other diseases;”*

e. *“Education of the population on the prevention and treatment of health problems, and”*

f. *“Satisfaction of the health needs of the highest risk groups ...”*

As the right to health is a public good, it may be said that the States Parties have a duty to adopt measures to prevent diseases that may otherwise be exacerbated by some Smart Meter regimes - Refer also to section on ‘*Health Matters*’.

State Parties may also be required to educate the public of the possible health risk of exposure to field regimes from some Smart Meters and related items of technology.

Article 11: Right to a Healthy Environment

1. *“Everyone shall have the right to live in a healthy environment and to have access to basic public services.”*

Claims may be brought that the right to live in a healthy environment is being violated in instances where unhealthy Smart Metering regimes are created.

2. *“The States Parties shall promote the protection, preservation, and improvement of the environment.”*

State Parties might be held liable if they adopt Smart Meter regimes that can be proven to be harmful to the environment.

Article 14: Right to the Benefits of Culture

1. *“The States Parties to this Protocol recognize the right of everyone:”*

a. *“To take part in the cultural and artistic life of the community;”*

Individuals may claim that their Right to the Benefit of Culture is compromised if field regimes prevent them from taking part in the life of the community.

b. *“To enjoy the benefits of scientific and technological progress;”*

Properly undertaken, everyone has the right to enjoy benefits of scientific and technological progress. It is necessary to ensure that the correct Smart Meter systems are specified to help achieve this.

4. *“The States Parties to this Protocol recognize the benefits to be derived from the encouragement and development of international cooperation and relations in the fields of science, arts and culture, and accordingly agree to foster greater international cooperation in these fields.”*

There are many benefits that can be created through international cooperation. One of these is the creation of safe, secure and environmentally friendly smart grids. To achieve this successfully a larger range of stakeholders may be required - *Refer to Appendices 5 and 6.*

Article 15: Right to the Formation and the Protection of Families

1. *“The family is the natural and fundamental element of society and ought to be protected by the State, which should see to the improvement of its ... material conditions.”*

2. *“Everyone has the right to form a family, which shall be exercised in accordance with the provisions of the pertinent domestic legislation.”*

3. *“The States Parties hereby undertake to accord adequate protection to the family unit and in particular.”*

c. *“To adopt special measures for the protection of adolescents in order to ensure the full development of their physical, intellectual and moral capacities; ...”*

Individuals may claim that the State’s duty to protect their ‘Right to the Formation and the Protection of Families’ may be compromised by some Smart Meter regimes that may reduce their ability to form and protect their family.

Article 16: Rights of Children

“Every child, whatever his parentage, has the right to the protection that his status as a minor requires from his family, society and the State. ...”

Some may claim that as the right to protection for children is from the moment of conception, electromagnetic field regimes that compromise this may breach children’s Human Rights.

Article 17: Protection of the Elderly

“Everyone has the right to special protection in old age. With this in view the States Parties agree to take progressively the necessary steps to make this right a reality and, particularly, to:
a. Provide suitable facilities, ...”

States Parties may be required to revise their Smart Meter provisions for the elderly if they wish to avoid potential breaches of Human Rights related to conditions (*including Alzheimer’s Disease and cancers*) that may be aggravated by inappropriate field exposures.

Article 18: Protection of the Handicapped

“Everyone affected by a diminution of ... capacities is entitled to receive special attention designed to help him achieve the greatest possible development of his personality. The States Parties agree to adopt such measures as may be necessary for this purpose and, especially, to:”

- a. “Undertake programs specifically aimed at providing the handicapped with the ... environment needed for attaining this goal ...”*
- c. “Include the consideration of solutions to specific requirements arising from needs of this group as a priority component of their urban development plans; ...”*

Low field Smart Meter regimes might become a priority component of urban development plans, to protect those who are vulnerable by providing them with the specific environment they require to allow the greatest possible development of their personality.

Article 19: Means of Protection

1. *“Pursuant to the provisions of this article ... the States Parties to this Protocol undertake to submit periodic reports on the progressive measures they have taken to ensure due respect for the rights set forth in this Protocol.”*

The creation of secure low field Smart Meter regimes may prove an appropriate progressive protective measure.

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Chile, South America

Political Constitution of the Republic of Chile

Human Rights, as set out within the individual constitutions of South American countries, may also come into play with regard to Smart Meter rollouts.

In December 2009, the Appeal Court in Rancagua, Chile, confirmed by unanimous decision the demolition of Entel PCS' mobile phone mast for the protection of the public in the O'Higgins district of Santa Cruz affected by its radiation (El Mercurio 2009).

That decision was made on the grounds that the structure violated the constitutional rights and obligations of the Political Constitution of the Republic of Chile (PCRC 1980), namely that the State guarantees to all persons:

Article 19:

1. *"The right to life and to the physical and psychological integrity of the individual" - this law also 'protects the life of those about to be born.' ...*

8. *"The right to live in an environment free from contamination. It is the duty of the State to watch over the protection of this right and the preservation of nature."*

"The law may establish specific restrictions on the exercise of certain rights or freedoms in order to protect the environment." ...

9. *'The right to protection of health.'*

"The State protects the free and egalitarian access to actions for the promotion, protection and recovery of the health and rehabilitation of the individual."

"The coordination and control of activities related to health shall likewise rest with the State." ...

One of the specific factors that led to the Appeal Court's decision was a report from the Instituto de Salud Pública de Chile (Institute of Public Health of Chile) acknowledging human health can be damaged by RF/microwave emissions from by mobile phone masts.

As wireless Smart Meters emit similar radiation, their introduction might also be prohibited under such legislation.

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United States of America



United States Constitution

This document was created in 1787 and ratified in 1788 (DPC (1788)). It is the second oldest constitution in the World still in use.

The Fourth Amendment – Search and Seizure

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

There are already numerous concerns about privacy issues related to Smart Metering in the USA – Refer also to section on 'Data provision & privacy/security issues' and Appendix 7.

Below are extracts of transcripts from the Supreme Court of the United States related to the Fourth Amendment and privacy that may be brought into play related to privacy claims brought against Smart Meters:

"The makers of our Constitution undertook ... to protect Americans in their beliefs, their thoughts, their emotions, and their sensations. They conferred, as against the Government, the right to be let alone - the most comprehensive of rights and the right most valued by civilized men. To protect that right, every unjustifiable intrusion by the Government upon the privacy of the individual, whatever the means employed, must be deemed a violation of the Fourth Amendment." O v US (1928).

"[A] Fourth Amendment search occurs when the government violates a subjective expectation of privacy that society recognizes as reasonable," Judge Harlan (K v US 2001).

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"The Fourth Amendment's protection of the home has never been tied to measurement of the quality or quantity of information obtained. ... In the home, our cases show, all details are intimate details, because the entire area is held safe from prying government eyes," (K v US 2001).

"At the very core" of the Fourth Amendment "stands the right of a man to retreat into his own home and there be free from unreasonable governmental intrusion" (S v US 1961).

"The Fourth Amendment is to be construed in the light of what was deemed an unreasonable search and seizure when it was adopted, and in a manner which will conserve public interests as well as the interests and rights of individual citizens" C v US (1925).

"... it is the duty of the courts to be watchful for the constitutional rights of the citizen, and against any stealthy encroachments thereon," B v US (1927).

Right To Privacy

The US Constitution does not expressly state the right to privacy (Walenta 2011). However, US Supreme Court decisions have determined that the right to privacy is a basic Human Right, and as a result of this it is protected by virtue of the 9th Amendment: *"The enumeration in the Constitution of certain rights shall not be construed to deny or disparage others retained by the people."*

"... most justices do believe that the Ninth Amendment has binding authority, and they use it to protect implicit rights hinted at but not explicated elsewhere in the Constitution. Implicit rights include ... the right to privacy ..." Head (2011).

"... In addition, it is said that a right to privacy is inherent in many of the amendments in the Bill of Rights, such as the 3rd, the 4th's search and seizure limits, and the 5th's self-incrimination limit," (Walenta 2011).

"I believe that data mining is inherently dangerous to one's privacy and potentially dangerous to one's liberty on many levels depending on the intentions of the third party obtaining the information.

The smart meter applications and mesh networking systems penetration into one's privacy goes beyond the uses and misuse of data and defiling the sacredness of the home, ... it compromises the exact status of one's life the minute it is turned on and alters the physical destiny of that person forever." Aders (2010).

The Fourteenth Amendment – Citizenship Rights

Section 1.

“... No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.”

a) Life

The IARC now classify RF/microwave radiation as a Class 2B carcinogen (WHO/IARC 2011), indicating to many that increased exposures (as may be caused by some Smart Metering regimes) may risk increasing individuals' chances of dying from cancer, thereby threatening their right to life and length of life.

The detrimental health conditions that may be exacerbated or induced by some types of Smart Metering regimes (EMFSN 2011, KCRA 2011, Milham 2011) might also be claimed to harm individuals' right to life.

Additional claims about individuals' right to life being compromised might be brought as a result of increased exposure to some RF/microwave regimes appearing to increase risk of miscarriage, damage to human offspring and infertility (Cherry 2000).

b) Liberty

The physical liberty of those who react adversely to exposures from some types of Smart metering regimes may be inadvertently compromised if such regimes inhibit/prevent them going where they wish outdoors and indoors, even within their own homes (EMFSN 2011), without the risk of becoming unwell and/or having their health compromised.

Insights into individuals' living patterns and relationships gained by third parties (*if Smart Meter and related technology data are not suitably anonymised*) may impinge on individuals' freedom of liberty to do as they please within their own homes (Aders 2010, Anderson & Fuloria 2010, metering.com 2009).

c) Property

There is the possibility that Individuals may claim that the installation of RF/microwave emitting Smart Meters and/or related smart technology abridges their privileges, as the radiation from them may interfere with their right to peacefully enjoy their possessions.

Individuals may be deprived of their right to enjoy their property (or parts of their property) in the manner to which they have become accustomed, due to RF/microwave emissions from such equipment (EMFSN 2011). It is suggested that it is not in society's interest to subordinate such use and enjoyment.

Additionally, claims may be made that the unwarranted introduction of such pollution from smart grid technologies may reduce the capital value of individuals' homes/property (some individuals are already being forced to relocate in an attempt to escape exposures and others may be less likely to want to move in thereby potentially reducing property value).

Some Smart Meter regimes may cause individuals to be deprived of other property that they own. This may include animals, insects (such as bees) and plants (including plant crops – that may be either directly or indirectly effected such as by loss of insect pollinators) – Refer to section on '*Environmental Concerns*'.

The effects on individuals' livelihoods of proposed metering schemes should also be seriously taken into consideration so that optimum solutions can be obtained for the good of all.

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Constitutions in individual States

The individual states in the USA, and elsewhere, can also have their own constitutional guidelines that may provide further levels of protection.

As an example:

California Constitution

Article 1: Declaration of Rights

Section 1.

“All people are by nature free and independent and have inalienable rights. Among these are enjoying and defending life and liberty, acquiring, possessing, and protecting property, and pursuing and obtaining safety, happiness, and privacy.”

Commentary on this constitution as related to Smart Meters can be found in (Koehle 2010).

References

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The Universal Declaration of Human Rights



Eleanor Roosevelt with the Universal Declaration of Human Rights.
Image source: UN Photo

This declaration was the first international declaration of the human rights and fundamental freedoms to which all human beings are intrinsically entitled. It was initially adopted in 1948.

The General Assembly of the United Nations has proclaimed this Universal Declaration of Human Rights to be “*a common standard of achievement for all peoples and all nations...*” to promote “*social progress and better standards of life in larger freedom.*”

Article 2.

“*Everyone is entitled to all the rights and freedoms set forth in this Declaration, ...*”

Article 3.

“*Everyone has the right to life, liberty and security of person.*”

As previously stated elsewhere in this review, “*As research indicates that some RF/microwave regimes (at levels lower than current limits) may raise risk of infertility, miscarriage, and cause damage to both animal and human offspring (Cherry 2000); claims might be brought that increasing involuntary exposures to such regimes may be against individuals’ right to life.*”

‘Security of person’ is legally defined as “*The legal and uninterrupted enjoyment by a man of his life, his body, his health and his reputation.*” Claims may be brought by some that enjoyment of life and health may be seriously compromised by the RF/microwave regimes created by some Smart Meters and related technologies.

Claims might also be brought that some individuals may have their reputations damaged as a result of how they are forced to behave as a result of exposures, or potential exposures to RF/microwave radiation from such units. Claims might also be brought that they find that having to behave in this way is degrading and damaging to their security of person.

Additionally, with regard to privacy issues, it could be claimed that lifestyle information determined by third parties from analysis of energy usage divulged by Smart Meters (if data is not suitably protected and/or anonymised) may potentially damage individuals' reputations and security of person. *Refer also to Appendix 7 for one opponent's views.*

Article 5.

"No one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment."

As documented earlier when discussing the UK - Human Rights Act 1998, the "... feelings of fear, anguish and inferiority, capable of humiliating and debasing... and possibly breaking... physical or moral resistance" that can be caused by degrading treatment (IUK 1980) appear very similar to descriptions of how EHS individuals can feel when exposed to RF/microwave emissions as created by Smart Meter units (EMFSN 2011). This suggests that deliberately exposing vulnerable individuals to such regimes may be against their basic Human Rights.

Article 7.

"All are equal before the law and are entitled without any discrimination to equal protection of the law. All are entitled to equal protection against any discrimination in violation of this Declaration and against any incitement to such discrimination."

Claims might be brought that if providers ignore the special needs of individuals who are, or believe they are, vulnerable to exposure to the EMF radiation emitted by some Smart Meter and related devices, they may be guilty of discrimination.

Claims might also be brought that those who deliberately ignore and dismiss relevant scientific evidence of potential risks may be guilty of inciting others to unwittingly discriminate against such individuals.

Article 8.

“Everyone has the right to an effective remedy by the competent national tribunals for acts violating the fundamental rights granted him by the constitution or by law.”

As everyone has the right to an effective remedy for acts violating fundamental rights, there appears a very real possibility that those who violate such rights may be required to pay for their rectification.

Article 12.

“No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks.”

There are significant concerns being expressed worldwide that some Smart Metering regimes may compromise this basic Human Right (FIPR 2010, OTLB 2010, Cuipers & Koops 2008).

This policy has already been successfully contested in the Netherlands (Anderson & Fuloria 2010), causing the previously mandatory introduction of Smart Metering there to be replaced by a voluntary ‘opt in’ scheme.

Article 13.

1. *“Everyone has the right to freedom of movement and residence within the borders of each state. ...”*

The freedom of movement of individuals vulnerable to the effects of RF/microwave emissions may be compromised by the presence of some Smart Meter regimes. This has already been documented after some rollouts, and can even restrict some individuals to which rooms within their own homes they can occupy (EMFSN 2011, KCRA 2011).

Article 16.

1. *“Men and women of full age, without any limitation due to race, nationality or religion, have the right to marry and to found a family. ...”*

Scientific research has demonstrated that increased exposures to RF/microwave can reduce human fertility and increase risk of miscarriage, thereby hindering individuals’ rights to found families (Cherry 2000).

Claims of breaches of Human Rights may be brought if similar risks are indicated with particular types of Smart Meters and related technology. (Opting for technologies such as fibre-optics would appear to reduce such risks and likelihood of claims – present author’s comment).

3. *“The family is the natural and fundamental group unit of society and is entitled to protection by society and the State.”*

There is a risk that States (and utility companies) may be declared negligent if they rush through the adoption of Smart Meter technologies that are indicated as potentially placing the family unit at increased risk of ill health, infertility, burglary, identity theft and other privacy violations.

Article 17.

... 2. *“No one shall be arbitrarily deprived of his property.”*

The term ‘property’ can be legally defined as including real estate, land, growing plants and animals. If particular Smart Metering regimes are shown to cause losses to any of these, claims may be made that that this basic Human Right is being denied.

RF/microwaves have already been shown to be capable of causing damage to plants and animals at levels below internationally accepted guidelines and at levels below that which RF/microwave emitting Smart Meters operate.

Anecdotal evidence has also been presented which indicates that some Smart Meter regimes may harm plants and animals – *Refer to section on ‘Environmental Concerns’ in present document.*

Article 21.

... 2. *“Everyone has the right of equal access to public service in his country. ...”*

Inappropriate RF/microwave regimes from certain types of Smart Meters and related technology may prohibit some vulnerable individuals from directly accessing public services if these units are present.

Article 23.

1. *“Everyone has the right to work, to free choice of employment, to just and favourable conditions of work ...”*

It has been suggested that the EMF emissions from some Smart Meters and related smart technologies in the workplace may

compromise the right to work of vulnerable individuals who may react adversely to such exposures. It might therefore be claimed that such conditions are neither just nor favourable to such individuals and may compromise their free choice of employment.

Article 25.

1. *“Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including ... housing ...”*

Anecdotal evidence already indicates that the standard of living of many individuals, as related to health, wellbeing and earning ability, is presently being compromised by a number of Smart Meter rollouts (EMFSN 2011, KCRA 2011).

Standards of living, as related to useable space within individuals' homes, may also become compromised, as vulnerable individuals are no longer able to occupy some areas of their homes (and gardens) for prolonged periods due to emissions from some types of Smart Meters and related technology (EMFSN 2011, KCRA 2011).

2. *“Motherhood and childhood are entitled to special care and assistance. ...”*

As RF/microwave radiation is classified as a Class 2B carcinogen (WHO/IARC 2011), and has been linked with increased incidence of miscarriage and damage to human offspring (Cherry 2000); it would appear wise to limit the exposure of mothers and children to additional sources of such emissions, or at to least prove that the type of emissions created by Smart Meters and related technology cause no such risk.

Article 27.

1. *“Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits. ...”*

Individuals may be prohibited from fully participating in the cultural life of the community if their health is compromised as a result of unwarranted exposures to Smart Meter EMF regimes that damage their health.

In order to help allow vulnerable individuals to share in scientific advancement it is necessary to develop/specify Smart Metering regimes that are scientifically proven, truly beneficial and biologically friendly.

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Additional Human Rights guidelines to those mentioned in this document also exist.

Health Matters



Image source: Bluestone 360°

Health effects and guidance

“Wireless communication is now being implemented in our daily life in a very fast way. At the same time, it is becoming more and more obvious that the exposure to electromagnetic fields not only may induce acute thermal effects to living organisms, but also non-thermal effects, the latter often after longer exposures. This has been demonstrated in a very large number of studies and includes cellular DNA-damage, disruptions and alterations of cellular functions like increases in intracellular stimulatory pathways and calcium handling, disruption of tissue structures like the blood-brain barrier, impact on vessel and immune functions, and loss of fertility,” Johansson (2011). – Refer also to Appendix 8.

It is essential that the possible health effects of electromagnetic fields from Smart Meters, and related technologies, are properly addressed so that appropriate technology is used in rollouts.

The International Agency for Research on Cancer (IARC) has recently reclassified RF/microwave radiation as being possibly carcinogenic to humans (WHO/IARC 2011).

As a result of concerns, some insurers (*including Lloyds of London*) are now withholding coverage for risks linked with such radiation (Ryle 1999).

The Parliamentary Assembly of the Council of Europe now calls for all reasonable measures to be taken to reduce exposure to electromagnetic fields (PACE 2011).

Whilst not all RF/microwave regimes are potentially harmful (*as an example: very low levels of frequency-specific amplitude-modulated EMFs are indicated as beneficial for treating advanced carcinoma (Costa et al. 2011)*); many manufacturers of RF/microwave emitting devices now ensure that their devices carry warnings.

As an example, one mobile phone manual states that studies “*have suggested that low levels of RF could accelerate the development of cancer in laboratory animals. In one study, mice genetically altered to be predisposed to developing one type of cancer developed more than twice as many cancers when they were exposed to RF energy compared to controls,*” (Motorola 2011).

"I want to be very clear. Industry has not said once - once - that ... [RF/microwave radiation is] safe. The federal government and various interagency working groups have said it is safe."

K. Dane Snowden, Vice President, External & State Affairs, CTIA-The Wireless Association®* (Safeschool 2010).

The possible effects that RF/microwave exposures from Smart Meters and related technologies may have on health should be taken very seriously.

Adverse health effects are already being claimed after some Smart Meter rollouts (EMFSN 2011, KCRA 2011). Among conditions that may be exacerbated are: Autism, Alzheimer’s disease, Cancer, Diabetes, DNA damage, Electrohypersensitivity, Fatigue/sleep deprivation, Fertility and Obesity.

The following are excerpts from a letter sent to the CPUC judge overseeing ‘Smart’ Meter proceedings in California:

“Approximately four hours after [the Smart Meter] ... installation ... I developed a band-like headache ... unresponsive to medication. The next morning I awoke with the headache and slight nausea. ... after I was away from my apartment, I noticed that these symptoms resolved — only to return when I was back in my apartment ... I began to have trouble sleeping and difficulty concentrating. I also experienced some transient heart palpitations.

Prior to this I knew nothing about smart meters and had no idea that they could impact human health. ...

I have spent the past 22 days living out of my car, finding shelter at various friends’ homes in the evening. ... I am exhausted, frightened, and do not know where to turn,” Gregory (2011).

UK perspective

In 2011 the UK's Department of Energy and Climate Change (DECC) confirmed it is involved in discussions with the Department of Health (DH) over potential safety concerns related to the proposed mass installation of Smart Meters in the UK.

The DECC states it aims to continue discussions with the DH as concerns escalate over research linking exposure from Smart Meter technologies with adverse health effects, including increased cancer risk, and that it “*will keep under review any evidence related to the effects of radiofrequency signals on the health of individuals,*” (Evans 2011). UK industry is also addressing these concerns:

“The [UK] Smart Metering System shall be installed and maintained in a manner that protects public safety.”
Prospectus requirement - The UK Smart Metering Design Group (SMDG 2011).

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Health Impacts

Possible low cost indicators

Dark Field Microscopy



Image source: Havas (2010), <http://www.youtube/watch?v=L7E36zGHxRw>

Dark field microscopy indicates that some field regimes may cause clumping of red blood cells similar to that found with diabetics, individuals with heart conditions, and cancer patients (Havas 2010).

Rouleaux formation, as shown above (*where blood cells stack together*) is often a precursor to many serious diseases and can occur when blood is exposed to some RF/microwave regimes and intensities.

It may be useful to assess the effects of different Smart Meter regimes on blood parameters using this technique.

Haemograms/Complete Blood Counts

Another way to assist determining the likelihood of any health impacts from exposures to different Smart Meter formats (and their related technologies) may be to undertake low cost Complete Blood Counts (CBCs) of communities (men, women and children) both before and a few months after Smart Meter installations – as has been suggested for determining the possible effects of other similar (but not identical) exposure regimes from mobile phone base stations (NUO 2011, LLRC 2007, Mashevich 2003).

“In people who live close to relay antennas the CBC reveals noticeable changes, especially a significant drop in red corpuscles and/or white cells (leucocytes, cf leukemia, ‘white blood’, cancer of the white cells), an increase in lymphocytes, irregularities in the MCV and levels of hemoglobin below normal, an indicator of anemia and other problems.” – Next-up Organisation (NUO 2011).

It appears likely that the results of such procedures (as documented above), if undertaken for Smart Meters, would provide valid evidence acceptable in court as to their suitability.

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Employing Smart Meter technologies that are proven to be 'biologically friendly' would greatly help allay public fears and further increase their likelihood of their success.

Health symptoms, RF/microwave radiation and dose response

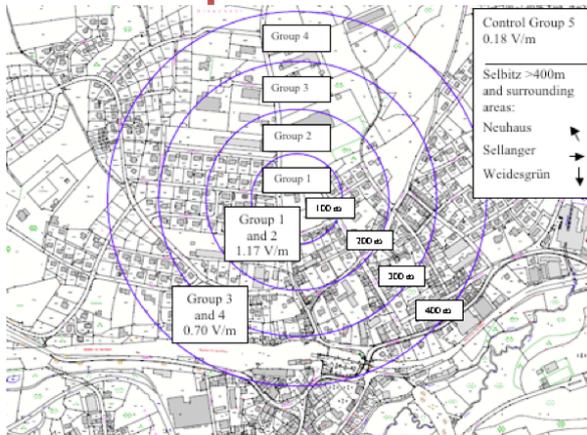


Image source: Eger & Jahn (2010).

The possibility of whether a relationship exists between RF/microwave radiation exposures and health symptoms was investigated by Eger & Jahn (2010) in relation to residential proximity to mobile phone base stations.

In that work, 251 adults in Selbitz, Bavaria took part in a health survey in 2009 before the data collected was assessed (taking into account the levels of RF/microwave radiation they were exposed to from the base station and DECT phones), as determined by measurements at residential location and questionnaire. The residents were then classified into exposure groups.

A significant ($p < 0.01$) dose-response relationship was observed with the four exposure groups for: cardiovascular problems, cerebral symptoms, depression, disorders of the auditory and visual systems and gastrointestinal tract, infections, joint problems, skin problems, sleep problems as related to observed exposure levels and proximity to base station.

Eger & Jahn's results demonstrate that a significant relationship can exist between individuals' mean exposure levels and reported health symptoms. Clear trends were shown for decreasing symptom scores in relation to decreasing mean RF/microwave exposure levels.

Within the framework of the Deutschen Mobilfunkforschungsprogramms (*German Mobile Phone Programme*), the QUEBEB study (Berg et al. 2007) also investigated if health symptoms could be associated with RF/microwave exposure levels. As noted by

Eger & Jahn (2010), it appears that that particular study did not find any significant relationships between exposure and health symptoms because the highest measurement found was 1 V/m, with 99% of the measurements being below 0.34 V/m.

Whilst less than 1% of those in the QUEBEB study were exposed to RF/microwave radiation above 0.34 V/m, 82 out of the 251 participants in Eger & Jahn's study (32.7% of the group) were exposed to fields above 0.7 V/m.

"High exposure groups as found in Selbitz did basically not occur in the samples of the German Mobile Phone Programme. To a certain degree, this has to do with the method of random sampling and leads to a systematic underestimation of the risk for population groups with higher exposures," Eger & Jahn (2010A).

It is proposed that the protocol developed for Eger & Jahn's study might be suitably adapted to assess the possible human health impact of different types of Smart Meter rollouts in comparison with controls.

Many of the symptoms noted as exhibiting a dose-response relationship to RF/microwave exposure are noted in those who have submitted health complaints after some wireless Smart Meter installations.*

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Smart Meter exposures



Image source: <http://stopsmartmeters.org/2011/08/11/smart-meters-not-green-not-safe-not-legal/>

Moldan (2009) noted pulsed microwaves emitted by a single Smart Meter resulted in a power-density of $0.05 \mu\text{W}/\text{cm}^2$ at 1 m (3.28 ft). This increased to $0.2 \mu\text{W}/\text{cm}^2$ 0.5 m (1.64 ft) from the unit and $5.5 \mu\text{W}/\text{cm}^2$ at 30 cm (0.98 ft). Pulsed RF/microwaves can be more biologically active than non-pulsed radiation (Belyaev 2005).

CCST (2011) recorded a power-density of $8.8 \mu\text{W}/\text{cm}^2$ (in the 902-928 MHz range) 30.5 cm (1 ft) from a single wireless Smart Meter for electricity. At a similar distance, they recorded a power-density of $0.00166 \mu\text{W}/\text{cm}^2$ for a single gas Smart Meter operating in the 450-470 MHz range. Units can also operate in the 2.4 GHz range. In that work, power densities of $1.0 \mu\text{W}/\text{cm}^2$ and $0.1 \mu\text{W}/\text{cm}^2$ were measured at distances of 91.4 cm (3 ft) and 304.8 cm (10 ft) from the signal (CCST 2011).

Higher power densities will occur nearer individual wireless Smart Meters and when multiple units (as shown above) and other RF/microwave emitting items are in use. Reflections can also occur, causing potential hotspots and increasing local radiation levels (SA 2011). These will increase the exposure of those spending prolonged periods nearby.

In the assessment of RF/microwave radiation emissions from Smart Meters undertaken by Sage Associates (SA 2011), it is mentioned, [citing Khurana et al. (2010) and Kundi & Hutter (2009)] that chronic exposure of above $0.05\text{-}0.1 \mu\text{W}/\text{cm}^2$ is associated with cardiac problems, increased cancer risk and adverse neurological symptoms.

The exposures that individuals would receive would be determined in part by building construction and distance they were away from the unit(s) and any other pieces of smart technology that are relaying information 24/7. Exposures from other RF/microwave emitting equipment would also contribute to the apparent risk cited.

Studies matrix of power densities similar to those caused by single wireless Smart Meter

| Power Density | Reported Biological Effects | References |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 0.000000001 $\mu\text{W}/\text{cm}^2$ | Altered EEG in humans' brain waves & behaviour | Bise (1978) |
| 0.002 $\mu\text{W}/\text{cm}^2$ | Abnormal blood pressure, digestive problems, fatigue, joint & limb pain, nervousness, sleep disorders & weakness | Altpeter et al., (1995, 1997) |
| 0.06 $\mu\text{W}/\text{cm}^2$ | Altered adrenal hormone levels & enlarged adrenals, disturbed carbohydrate metabolism, altered EEG, structural changes in brain, liver, spleen & testes of animals | Dumanskij & Shandala, (1974) |
| 0.1 $\mu\text{W}/\text{cm}^2$ | EEG brain waves altered under exposure to cell phone signal | von Klitzing (1995) |
| 0.6 $\mu\text{W}/\text{cm}^2$ | Cardiac arrhythmias & sometimes cardiac arrest (frogs) | Frey (1986) |
| 1.0 $\mu\text{W}/\text{cm}^2$ | Headache, dizziness, irritability, fatigue, weakness, insomnia, chest pain, difficulty breathing, indigestion (humans – occupational exposure) | Simonenko et al., (1998) |
| 0.168 - 1.053 $\mu\text{W}/\text{cm}^2$ | Decrease in newborns & irreversible infertility in mice after 5 generations | Magras & Zenos (1997) |
| 5.0 $\mu\text{W}/\text{cm}^2$ | Biochemical and histological changes in brain, heart, kidney & liver tissue | Belokrinitskiy, V.S. (1982) |
| 8 $\mu\text{W}/\text{cm}^2$ | Association between increased incidences of childhood leukaemia & mortality through RF fields | Hocking et al., (1996) |

“... the possibility of harm from exposures [to low levels of radio frequency radiation] insufficient to cause important heating of tissues cannot yet be ruled out with confidence.”
 Sir William Stewart

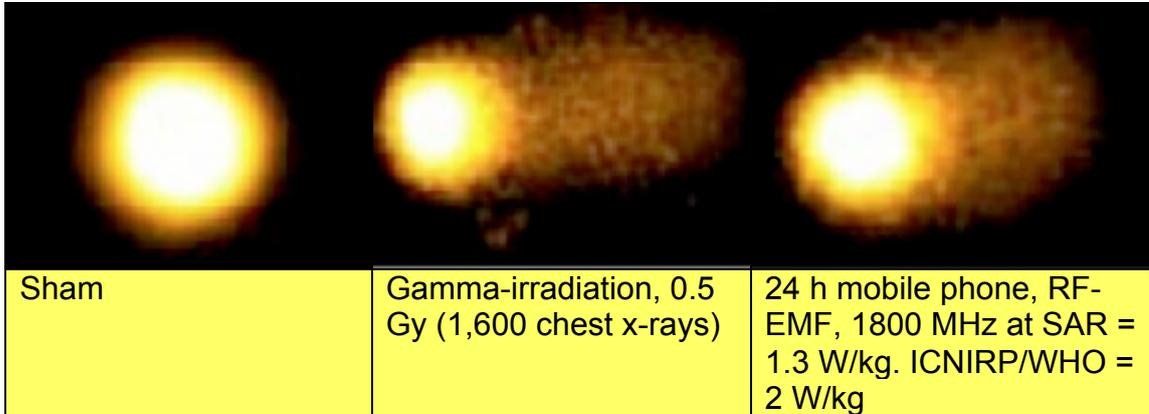
Reducing RF/microwave exposure, particularly at night when the body is sleeping, might greatly reduce risk of serious illness.

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Possible Health Risks

Introduction



Comet Assay - a typical picture after RF-EMF-exposition of HL60 leukaemia cells
Image source: Adlkofer (2004).

“... children, the elderly, and some chronically ill people might have a lower tolerance for one or more forms of [non-ionising radiation] exposure than the rest of the population.”
International Commission on Non-Ionizing Radiation Protection (ICNIRP 2002).

The photos above show the effects of different types of radiation on gene expression of human HL60 cells. **The effects of radiation from the mobile phone, which is below current ICNIRP/WHO standards, creates a similar effect to the high dosage of gamma radiation (Adlkofer 2004).**

It would appear prudent to undertake similar tests with Smart Meters and smart appliances, particularly as RF/microwaves are now regarded as possibly carcinogenic to humans by the WHO/ International Agency for Research on Cancer (WHO/IARC 2011).

As no official data is available on the health effects of exposures to radiation from Smart Meters and related devices; reference is made to research undertaken on other devices emitting RF/microwave radiation at similar intensities.

Some tests which found “no effect” from exposure used methods 10-100 times less sensitive than those shown in the above (Morgan et al. 2009).

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Autism



Image source: <http://www.dreamstime.com/royalty-free-stock-photography-autism-kid-looking-far-away-image20515227>

The lifetime costs for someone with high-functioning autism is £3.1 million and the lifetime costs for someone with low-functioning autism is £4.6 million (Knapp et al. 2007). The number of individuals diagnosed with autism is steadily increasing.

The present annual cost of autism to the UK economy is £27.7 billion (Knapp et al. 2009).

In 1978 it was estimated that approximately 0.04% of individuals exhibited classic autism. Around 1% of the UK population now exhibits autism-spectrum conditions (including classic autism), with approximately 1.57% of school children exhibiting autism-spectrum conditions. This may be due to, amongst other factors, improved detection and recognition (Baron-Cohen et al. 2009).

Kane (2004) suggests that an additional factor may also be at work – electromagnetic pollution. Whilst there are likely to be a number of potential factors that could in part be responsible for any increases that may actually have arisen; his hypothesis is worthy of further study, particularly if lower field regimes are shown to reduce the risk and severity of such conditions and their cost to national economies.

The reasoning behind his suggestion is “... *that human exposures to RF radiation have become pervasive during the past 20 years, whereas such exposures were uncommon prior to that time,*” and that the increased fetal or neo-natal exposures that could have occurred as a result of such variations may be a driver of increased incidence.

Lathe (2010) notes that, in the absence of firm data demonstrating that RF/microwave radiation cannot influence brain tissue, Kane’s hypothesis is plausible.

Presently *anecdotal* evidence as to why such a theory should be taken seriously, at least till it can be disproved or properly verified, is provided by an unpublished pilot study by Dr Dietrich Klinghardt MD, PhD. It intriguingly links higher levels of microwave radiation [0.011-0.171 $\mu\text{W}/\text{cm}^2$], in the bedrooms of pregnant women to increased risk of autism and other neurological impairments in their children compared to low field bedrooms [0.0001-0.004 $\mu\text{W}/\text{cm}^2$] (Klinghardt 2008).

Also of interest is a related study of 13,159 children by Divan et al. (2008), which found a 54% higher chance of children having emotional and social problems at school age if their mothers used mobile phones during pregnancy. Whether there is in fact a link remains open to conjecture.

It appears prudent to determine if raised EMF exposures do increase autism risk, and if so how new generations of 'bio-friendly' technology can mitigate, or even reverse, such risk.

Such precautions are in line with Resolution 1815 of the Council of Europe calls for all reasonable measures to be taken to reduce exposure to electromagnetic fields, particularly RF/microwaves (PACE 2011).

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Alzheimer's disease



Image source: <http://www.dreamstime.com/stock-photo-elderly-woman-with-alzheimer-image21269060>

It has been suggested that the rise in Alzheimer's disease and other dementias may be the "*Most Significant Health Crisis of the 21st Century.*" The number of people with dementia is predicted to double by 2030 and more than triple by 2050 (ADI 2010).

Research in Sweden and the USA have indicated a link between occupational exposures to EMFs and Alzheimer's disease (Davanipour et al. 2007, Feychting et al. 2003, Sobel et al. 1996).

It has also been indicated that there is a dose-response link between environmental exposures to EMFs and senile dementia and Alzheimer's disease (Davanipour & Sobel 2009, Huss et al. 2009).

It appears important to reduce ELF and RF/microwave magnetic field exposures "*through equipment design changes and [proper] environmental placement of electrical equipment ...*"
Davanipour & Sobel (2009).

Very weak microwave radiation can change the shape of cellular proteins in the brain causing them to clump together into formations that resemble pathological fibrils associated with this disease (MWN 2003).

Earlier animal research by Dr Sam Koslov, who was the Director of the Applied Physics Laboratory at John Hopkins University in the US, led him to accidentally discover that exposing chimpanzees to repeated low-level nonthermal microwave exposures produced clinical Alzheimer's disease - lack of funding prevented his findings being followed up at that time (Becker 1990).

Increased risk of Alzheimer's disease and other neurodegenerative disorders is also linked to the increased production of peroxynitrite,

which can damage a wide variety of molecules in cells (including proteins and DNA). Its production can be increased by RF/microwave radiation that causes NADH-oxidase to create extra free electrons in a dose related manner that stimulate its production (Friedman et al. 2007).

Increased peroxynitrite production, as can be caused by exposure to RF/microwave radiation, is a pathogenic contributor to conditions such as: cancer, chronic heart failure, chronic inflammatory diseases, circulatory shock, diabetes, myocardial infarction, stroke, myocardial infarction and stroke (Pacher et al. 2007).

There are other electromagnetic factors that may affect the risk of succumbing to dementia. These, however, are out with the brief of this current document – *present author's comments*.

Interestingly, research by Arendash et al. (2010) indicates that unmodulated microwaves might be able to mitigate the effects of Alzheimer's. However, as the health effects of both these and modulated microwaves (as experienced when using mobile phones) have yet to be adequately researched, caution is required.

The cost of Alzheimer's and other dementias to the UK economy is presently £23 billion per year (ARUK 2011).

The number of individuals in the UK with dementia is presently predicted to rise as the population ages. Reducing RF/microwave exposure may be a novel way to help reduce the number of future sufferers. This may in part be achieved through optimising the design of Smart Meters, and related technologies, to help reduce/optimize individuals' exposures.

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“The worldwide costs of dementia will exceed 1% of global GDP in 2010, at US\$604 billion. ... The costs of caring for people with dementia are likely to rise even faster than the prevalence...” ADI (2010).

Dementia is one of the World’s most costly illnesses. Interventive measures that reduce risk are likely to save Governments substantial outgoings.

Cancer

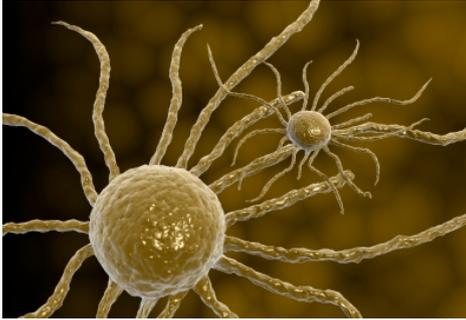


Image source: jscreationzs, http://www.freedigitalphotos.net/images/view_photog.php?photogid=1152

Cancer rates are rising in the UK. The annual cost of cancer to England (not the whole UK – *present author's comment*) in terms of healthcare costs, lost productivity and costs to patients and families is £18.33 billion. These figures are set to rise to £24.72 billion over the next ten years. This figure is 6% higher than the European average (Featherstone & Whitham 2010).

The UK charity Macmillan Cancer Support claims 4 in 10 individuals in the UK may have cancer at some point in their lives (Brimelow 2011). In the USA, it is estimated that around 41 percent of citizens will be diagnosed with cancer at some time in their lives and approximately 21 percent die from it (US DHSS 2010).

“Cancer is the world’s leading cause of death, followed by heart disease and stroke. ... cancer also has the greatest economic impact from premature death and disability of all causes of death worldwide. This data provides compelling evidence that balancing the world’s global health agenda to address cancer will not only save millions of lives, but also billions of dollars,” ACS (2010).

As the International Agency for Research on Cancer (IARC) - which is part of the World Health Organization (WHO) - now classifies RF/microwave radiation as possibly carcinogenic to humans in recognition of growing concern over *“the possibility of adverse health effects resulting from exposure to radiofrequency electromagnetic fields, such as those emitted by wireless communication devices,”* (WHO/IARC 2011); it may be prudent to opt for Smart Meter options that avoid creating EMF regimes that may increase this risk.

Whilst there is growing anecdotal evidence on the effects of RF/microwave emissions from Smart Meters on health, no proper research appears to have been undertaken to date. As this is the case, examples are given of other studies assessing the possible effects of similar types of radiation on animals and individuals as related to cancers.

Whilst a large number of studies (such as those shown below) indicate a link between inappropriate exposures to some EMF regimes and negative health effects; it is important to recognise that not all studies do so, and that beneficial field regimes can also be created (Jamieson et al. 2010).

Eger et al. (2004) found increased risk of malignant tumours in individuals exposed to radiation from mobile phone base stations.

Their work, covering the period 1999-2004, indicated that after 5 years, risk of malignant blastoma for those in the vicinity of the phone mast was 3 times that of individuals living further away (Eger et al. 2004).

(Earlier animal tests by Repacholi et al (1997) found long-term (up to 18 months) intermittent exposure to pulsed 900 MHz fields resulted in significantly enhanced probability of cancer in cancer-prone mice).

Wolf & Wolf (2004) found relative cancer rates for females living adjacent to a base station were significantly higher ($p < 0.0001$) than those living in a low field area and the rest of the city. They recorded 4.15 times more cases in the area adjacent the base station than for the entire population.

Dode et al. (2011) too found a strong association between increased exposures to RF/microwave emissions from base stations (as determined by distance from base stations) and human deaths from cancer in research undertaken in the city of Belo Horizonte in Brazil. Their findings led them to “*strongly suggest the adoption of the Precautionary Principle*” until satisfactory limits of human exposure can be determined.

An association has also been noted between increased incidences of childhood leukaemia & mortality through RF fields at power densities of $8 \mu\text{W}/\text{cm}^2$ (Hocking et al. 1996); a power-density lower than that noted by PG&E (2011) as being created by a single wireless Smart Meter.

Additionally, RF/microwave exposure has been shown to cause DNA damage (De luliis et al. 2009). Changes in DNA can be a precursor of cancer and cause genetic mutations.

The above studies, whilst being in no way definitive, do provide good reason for lowering field emissions wherever practical as a precautionary measure.

The need for additional research particularly under field regimes individuals might receive in standard domestic environments when Smart Meters and smart appliances are installed appears necessary.

“The influence of electrosmog on the human body is a known problem. ... The risk of damage to health through electrosmog has also become better understood as a result of more recent and improved studies. When for example, human blood cells are irradiated with electromagnetic fields, clear damage to hereditary material has been demonstrated and there have been indications of an increased cancer risk. ...” Swisscom AG - major Swiss telecommunications provider (Swisscom AG 2003).

For additional details on studies which indicate that long-term low intensity RF/microwave exposures may provoke cancer growth please refer to the review document by Yakymenko et al. (2011).

“... just as there are many opportunities for harmful environmental exposures, ample opportunities also exist to intervene in, ameliorate, and prevent environmental health hazards. Governments, industry, the academic and medical communities, and individuals all have untapped power to protect the health of current and future generations ... and reduce the national burden of cancer.” US President’s Cancer Panel (US DHSS 2010).

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In 2008 the total economic impact of premature death and disability from cancer worldwide was \$895 billion. This figure is equivalent to 1.5 % of the World's Gross Domestic Product (GDP) and does not incorporate direct medical costs (ACS 2010).

Tests assessing the potential biological effects of exposures to different types of 'smart' technology regimes to prove that they are safe may prove prudent, as this could lead to the development of safer RF/microwave technologies if risks are determined to be real.

Diabetes



Image source: Ambro / FreeDigitalPhotos.net, http://www.freedigitalphotos.net/images/view_photog.php?photogid=1499

Diabetes related care costs the UK upwards of £5 billion annually (Currie et al. 1997).

The cost of diabetes drugs and treatment have risen 40% in the last five years, and since 1996 the number of diagnosed individuals has increased from 1.4 million to 2.6 million.

It is predicted that, unless matters are taken in hand, over four million people will have diabetes by 2025 (Diabetes UK 2010).

'Dirty electricity' - high frequency transients created by a variety of electrical devices (including some Smart Meters) and sometimes carried on mains electricity - may be a contributory factor to diabetes and other health conditions (Milham 2011, Havas 2006).

The switching-mode power supply (SMPS) units in Smart Meters can often create such transients, and it has been suggested may in part be responsible for the detrimental health effects observed with Smart Meter installations even when wireless transmission is disabled (Brangan & Heddle 2011) – Refer also to the section '*PLC, Smart Meters and health*' elsewhere in this review.

The effects of exposure to RF/microwaves regimes from wireless Smart Meters on diabetics have yet to be assessed.

Havas (2006) determined that Type 1 diabetics required less insulin and Type 2 diabetics registered lower blood sugar levels when in electromagnetically clean environments.

Poor sleep is also a contributory factor to diabetes – see *related notes on Fatigue/sleep deprivation*:

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“The prevalence of diabetes has reached epidemic proportions. ... Diabetes is one of the major causes of premature illness and death worldwide. Non-communicable diseases including diabetes account for 60% of all deaths worldwide.” World Diabetes Foundation (2010).

Electrohypersensitivity



Source: <http://en.fotolia.com/id/25156314>

This is known by a variety of terms including 'Electrosensitivity' (ES), 'Electrohypersensitivity' (EHS), 'Electromagnetic Hypersensitivity' (EHS) and 'Idiopathic Environmental Intolerance with Attribution to Electromagnetic Fields' (IEI-EMF). The WHO began investigating it after Dr Gro Harlem Brundtland, their Director General (and former Prime Minister of Norway) announced she had EHS before she retired.

A variety of symptoms are reported by individuals who claim to be EHS. These include: depression, dizziness, fatigue, headaches, irregular heartbeat and palpitations, irritability, memory deficits, nausea, feeling stressed, sleep difficulties (including insomnia), skin rashes, whole-body skin symptoms, feeling of thirst (not quenched by drinking) and tinnitus.

Many of the above symptoms are reported by individuals exposed to radiation from wireless Smart Meters.

Peer-reviewed studies (not directly investigating EHS) indicate increased occurrence of a number of these symptoms in areas where raised exposures to RF/microwaves exist. A partial listing is given below:

Depression: Eger & Jahn (2010) found a highly significant dose-response relationship between the RF/microwave field strengths encountered at residential locations and depression ($p < 0.001$). In their study, the mean radiation exposure level of the highest exposure group (1.2 V/m) was substantially higher than that recorded in other work.

Santini et al. (2002) found an increase in depression for people living within 100 m of a base station, as opposed to in lower field regimes. Women were particularly affected ($p < 0.05$). Increased

incidence of depression also noted under similar circumstances by Bortkiewicz et al. (2004).

The cost to the UK economy of depression in terms of lost earning is now over £9bn a year. This represents an increase of £4bn since 1999, and a rise of half a billion over the last year (RSHCL 2010).

Dizziness: Eger & Jahn (2010) noted a highly significant dose-response relationship between the RF/microwave field strengths measured at residential locations and dizziness when comparing high field and low field exposure groups – *mean exposures levels of 1.17 V/m compared to 0.70 V/m* ($p < 0.001$).

Santini et al. (2002) found an increase in individuals complaining of dizziness when they were living within 100 m of a base station, as opposed to living further away ($p < 0.05$), whilst Simonenko et al., (1998) noted increased incidence of dizziness occurred in individuals at occupational exposures of $1.0 \mu\text{W}/\text{cm}^2$.

Headaches: Eger & Jahn (2010) recorded a highly significant dose-response relationship between residential locations and headaches when comparing high field and low field exposure groups – *mean exposures levels of 1.17 V/m compared to 0.70 V/m* ($p < 0.001$).

Hutter et al. (2006) documented a significant link ($p < 0.017$) between headaches and exposures to power densities $>0.05 \mu\text{W}/\text{cm}^2$ (maximum $0.41 \mu\text{W}/\text{cm}^2$) compared to $\leq 0.01 \mu\text{W}/\text{cm}^2$.

Simonenko et al. (1998) recorded increased incidence of headaches at $1.0 \mu\text{W}/\text{cm}^2$.

Santini et al. (2002) noted an increase in individuals, particularly women, complaining of headaches when living within 200 m of a base station as opposed to further away, or not exposed to radiation from a base station ($p < 0.05$).

Bortkiewicz et al. (2004) also found incidence of headaches related to exposure and distance to base station. This was found for both those who associated their condition with being in proximity to the base station and those who did not.

Headache disorders cost the UK around £7 billion a year in absenteeism and reduced productivity (Thomas 2009).

Irritability: Santini et al. (2002) noted an increase in individuals complaining of irritability when living within 100 m of a base station, as opposed to further away or not exposed to radiation from a base station ($p < 0.05$).

Bortkiewicz et al. (2004) also noted that increased complaints of irritability in individuals close to base stations. Simonenko et al., (1998) found occupational exposures of $1.0 \mu\text{W}/\text{cm}^2$ were associated with increased irritability.

Memory deficits: Increased incidence of concentration difficulties was found in the vicinity of base stations by Bortkiewicz et al.] could also be affected. Poorer memory retention was found by Santini et al. (2002) for individuals living within 100 m of a base station ($p < 0.05$).

Simonenko et al. (1998) reported incidence of difficulty breathing, dizziness, chest pain, fatigue, headache, indigestion, insomnia, irritability & weakness) at occupational exposures of $1.0 \mu\text{W}/\text{cm}^2$.

Incidence of EHS

A 2001 Swiss survey by Rössli et al. (2004), investigating symptoms of ill-health ascribed to EMF exposure, revealed that individuals most often related their symptoms to exposure to RF/microwave radiation from mobile phone base stations (74%), followed by use of mobile phones (36%), cordless phones (29%) and exposure to power lines (27%). **The most common mitigative measure taken by the respondents was to avoid exposures.**

Removing or disconnecting field sources indoors was judged to be particularly effective in reducing/preventing symptoms.

EHS symptoms often only become apparent in many individuals when exposed to higher field regimes. Whilst it is omm. nted that psychosomatic responses can occur, the extent to which biological effects (and differences in autonomic system regulation between individuals – *present author's comment*) may influence results has yet to be fully taken into account.

National variations: Figures on individuals who may be EHS vary greatly between countries. This may be in part due to differences in educational awareness, survey definitions, environmental factors and variations in the field regimes individuals are exposed to.

It is estimated by Schreier et al. (2006) that approximately 5% of the Swiss population may be EHS. If a similar fraction is affected in the UK, this would amount to approximately 3,090,000 individuals.

A German study involving 30,047 participants, found that 10.3% attributed personal adverse health effects they had to exposure to RF/microwave emissions from mobile phone base stations (Blettner et al. 2009).

EHS has become officially fully recognized as a functional impairment in Sweden since 2007. It is not regarded as a disease (Johansson 2010).

Survey studies indicate that around 230,000 – 290,000 Swedish adults (out of a population of 9,000,000) report a variety of symptoms when in contact with manmade sources of EMFs (Miljöhälsorapport 2001). The work of Eger & Jahn (2010) also indicates a highly significant dose-response relationship between the RF/microwave field exposures and symptoms reported by some EHS individuals.

Rea et al. (1991), found that EHS is a real phenomenon in some environmentally sensitive patients (under special test conditions), as they exhibited consistent reactions while none of the controls did.

A similar deduction was recently reached by McCarty et al. (2011) who concluded, “*EMF hypersensitivity can occur as a bona fide environmentally-inducible neurological syndrome.*”

In 2011, the Labour Court in Madrid, Spain declared that hypersensitivity, caused in part by exposure to RF/microwaves, can cause permanent disability. The ruling is unique in this regard and sets a precedent for future conditions related to EHS. The verdict issued on 23rd May awarded the college professor, who has been permanently incapacitated, a permanent disability pension at 100% of his base salary rate.

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Refer also to Appendix 8 – Seletun Resolution

Fatigue/sleep deprivation



Image source: Michal Marcol, http://www.freedigitalphotos.net/images/view_photog.php?photogid=371

Exposure to some RF/microwave radiation regimes are linked with fatigue and insomnia (Eger & Jahn 2010, Hutter et al. 2006, Bortkiewicz et al. 2004).

Simonenko et al. (1998) noted occupational exposures of $0.1 \mu\text{W}/\text{cm}^2$ could cause both fatigue and insomnia in humans, whilst Santini et al. (2002) found a significant increase in individuals complaining of fatigue within 300 m of a base station and sleep disturbances within 200 m of a base station ($p < 0.05$).

Lack of sleep may be a causal factor in premature ageing, high blood pressure, diabetes, obesity, depression and other mental health problems, and can also tax the immune system.

The present annual cost to the UK economy of chronic sleep deprivation is estimated at £1.6 billion (Bupa 2010).

27% of UK workers regularly go to work tired and unrefreshed from sleep. Over 50% arrive at work fatigued more than 20 times a year. Those with sleep debt take on average three days a year more sick leave (at an average cost of £93.50 per employee day lost).

When tired, workers are 23% less satisfied with their jobs. As noted by Dinges et al. (1997), individuals with less than 8 hours sleep exhibit reduced decision making abilities, dramatic attention lapses and distinct physiological and cognitive deficits, (including impaired memory). The effects of these deficits increase as sleep debt continues.

Fatigue/sleep deprivation and accidents: Long-term sleep deprivation increases the likelihood of motor vehicle accidents. At present, driver fatigue is responsible for almost 20% of traffic

accidents on main roads in the UK (DfT 2011).

“The only real cure for sleepiness is proper sleep.”
UK Department for Transport (DfT 2005).

The extent to which EMF emissions by some types of Smart Meters and related technologies may result in increased fatigue and insomnia has yet to be fully determined. One survey indicated that 49.1% of their respondents reported sleep problems in either themselves or members of their household after the installation of wireless Smart Meters (SDA 2011). *Refer also to Appendix 1.*

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Infertility



Animals

Research by Magras & Zenos (1997) recorded irreversible infertility in mice after 3 generations at exposures of $1.053 \mu\text{W}/\text{cm}^2$ from a RF tower – measurements were taken in the 80–900 MHz range. Lower exposures of $0.168 \mu\text{W}/\text{cm}^2$ (further away from the tower) were linked with total infertility in mice after 5 generations.

As mentioned elsewhere in this document, PG&E (2011) have recorded a power-density of $8.8 \mu\text{W}/\text{cm}^2$ (in the 902-928 MHz range) 30.5 cm from a single wireless Smart Meter. Wireless Smart Meters can also operate in the 450-470 MHz and 2.4 GHz range.

Mailankot et al. (2009) reported that exposing male Wistar rats to active mobile phone radiation at frequencies of between 900 MHz to 1.8 GHz for 1 hour per day for 28 days significantly decreased sperm motility. They also suggested that exposure to RF/microwave radiation may impair fertility. The review by Desai et al. (2009) further covers the effects of RF/microwave radiation on animal fertility and also discusses possible mechanisms that might lead to the RF/microwave related infertility in human males.

Humans

Falzone et al. 2011 found that 1 hour exposure to 900 MHz radiation (from mobile phones) caused significant reduction in sperm head areas ($9.2 \pm 0.7 \mu\text{m}^2$ versus controls $18.8 \pm 1.4 \mu\text{m}^2$), and noted a significant decrease in sperm binding compared to controls – *their results indicated that RF/microwaves could have a significant effect on sperm fertilisation potential.*

A pilot study by Agarwal et al. (2009) also revealed a significant reduction in sperm motility and sperm vitality as a result of exposure to such radiation. Additionally, Santini et al. (2002) found a

significant loss in libido for subjects within 100 m of a base station ($p < 0.05$).

Davoudi et al. (2002) tested men who had normal spermiogramms ($n = 13$). They were tested 5 days after not carrying or using mobile phones, then tested 4 weeks later (after carrying mobile phones on their belts and using them 6 hours per day for the 5 days before their final test). Increased exposure to RF/microwaves (through mobile phone use) was indicated as possibly reducing sperm motility by 32.3% ($p = 0.01$).

In research by De luliis et al. (2009), purified human spermatozoa exposed to raised levels of RF/microwave radiation exhibited significantly reduced sperm motility and vitality. Significantly elevated DNA fragmentation and mitochondrial generation of reactive oxygen species were found to occur after exposure ($p < 0.001$).

De luliis et al. (2009) concluded that their own research indicated that there were “*clear implications for the safety of ... [increased RF/microwave exposures to] males of reproductive age, potentially affecting both their fertility and the health and wellbeing of their offspring.*”

Dramatically reduced birth rates would cause a declining labour force, crucially undermining individual countries' economic viability and increasing the burden of supporting the ill and elderly.

At present exposure to many types of Smart Meter and smart appliance would increase RF/microwave radiation indoors 24/7. Research urgently needs to be undertaken to determine suitable solutions so that smart metering regimes do not impact negatively on health.

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It has also been indicated that RF/microwave radiation at levels

encountered in the environment may affect fertility of insects, birds and amphibians – Refer to section on ‘*Environmental Concerns*’.

Learning ability



The hippocampus

The brain’s hippocampus plays a vital role in consolidating information from short-term memory to the long-term memory and in matters related to spatial navigation. Some RF/microwave regimes have been indicated as damaging it and also compromising its development.

Animal research by Odaci et al. (2008) has shown that exposing pregnant rats to 900 MHz RF/microwave radiation (created by a mobile phone in talk mode for 1 hour daily) for the duration of the pregnancy resulted in far fewer nerve cells being present in this part of the brain in offspring ($p < 0.01$). This will have effects on learning and memory.

Some wireless electric Smart Meters operate in the 902-928 MHz range.

Salford et al. (2003) additionally reported that exposing rats to 915 MHz RF/microwave regimes from mobile phones for 2 hours produced highly significant ($p < 0.002$) evidence of neuronal damage in the hippocampus and other parts of the brain.

Memory function

A number of animal tests have been undertaken to help determine the possible effects of RF/microwave exposures on learning abilities. To date none have been undertaken related to emissions from various types of Smart Meters and related technologies.

900 – 1800 MHz exposures

Nittby et al. (2008) investigated the possible effects of exposure to 900 MHz radiation on rats’ cognitive functioning. 32 out of 56 rats

(the rest being either sham exposed or controls) were exposed for 2 hours every week for 55 weeks to RF/microwave mobile phone radiation. After this protracted exposure, they were compared to sham exposed controls.

The RF/microwave exposed rats exhibited impaired memory for objects and temporal order of presentation compared to the sham exposed controls ($p = 0.02$). Their results indicated significantly reduced memory functions in rats after 900 MHz RF/microwave exposures ($p = 0.02$) (Nittby et al. 2008).

Research by Fragopoulou et al. (2009) demonstrated that exposing mice for approximately 2 hours per day to 900 MHz RF/microwave radiation from a mobile for four days caused cognitive deficits in spatial learning and memory. In that study, the exposed mice were shown to be less proficient in transferring learned information to the following day, and exhibited deficits in consolidation and/or retrieval of learned information.

Narayanan et al. (2009), undertaking tests on 10-12 week old male rats, found exposing them to the 900/1800 MHz RF/microwave radiation of 50 missed calls a day from a mobile phone daily for 4 weeks induced behavioural changes though the exact cause of these undetermined.

The rats exposed to RF/microwave radiation took longer to undertake tasks, had poorer spatial navigation and exhibited poorer memory function than those unexposed. (Narayanan et al. (2009).

2.4 GHz exposures

Some wireless Smart Meters operate in the 2.4 GHz range. Again tests have not yet been undertaken to determine the biological effects of their operation 24/7 on leaning ability or other biological functions.

Research undertaken by Wang & Lai & (2000) indicated that exposure to some 2.45 GHz RF/microwave regimes may affect memory.

In that work, the long-term memory and navigational skills of rats appeared negatively influenced by one hour of exposure to 2.45 GHz radiation (pulse width 2ms, 500 pulses/s, average power density of $2,000 \mu\text{W}/\text{cm}^2$) as compared to the unexposed control group. Whilst some studies by others failed to replicate this work (MMF 2005), the need for caution is indicated.

A later study by Li et al. (2008), found exposing rats to a 2.45 GHz pulsed RF/microwave field at an average power density of 1,000 $\mu\text{W}/\text{cm}^2$ for 3 hours daily for up to 30 days resulted in significant deficits in spatial learning and memory performance in the exposed rats.

Concentration, memory or learning problems

Though no official human testing has been undertaken related to Smart Meters, a survey on their impacts found that for 34.6% of recipients (n = 318), either they or individuals in their homes experienced worsened concentration, memory or learning problems since Smart Meter installations (SDA 2011). Refer also to Appendices 3 and 4 related to 'Health promotion' and 'Educational buildings and Smart Meters'.

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Obesity



Image source: Michelle Meiklejohn, http://www.freedigitalphotos.net/images/view_photog.php?photogid=901

Obesity is on the rise worldwide. It is estimated that the annual cost of obesity in the USA may be over \$75 billion (Finkelstein et al. 2004).

In 1980, 36% of the UK population was comm. nted as being overweight or obese. By 2004 this figure had risen to 63%, with a third being comm. nted as obese. Almost two of every three individuals in the UK are overweight or obese (WHO 2005). If this is not addressed, 60% of men, 50% of women and 25% of children in the UK could be obese by 2050 (DH 2011).

Obesity increases risk of many serious ailments:
Cardiovascular disease, Cancer, Diabetes, High blood pressure, Osteoarthritis, Psychological problems / Mental Disorders, Urinary incontinence & Sleep disorders (NIH 2011).

Obesity places a significant burden on health services worldwide. At present it is estimated that the UK's National Health Service (NHS) has direct costs of £4.2 billion annually caused by obesity, and that this figure is likely to double by 2050. Reducing obesity is a priority of the UK Government (DH 2011).

Poor quality sleep, as can be created by exposure to inappropriate RF/microwave regimes – Refer to related item on 'Fatigue/sleep deprivation' in current document – is a contributory factor to obesity.

Sleep debt can increase fatigue levels making individuals less prone to exercise. It can also increase levels of the hormone grehlin thereby stimulating appetite (Taheri et al. 2004).

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The EMF Safety Network Smart Meter survey (SDA 2011) indicated 49.1% of respondents (n = 318) experienced sleep problems after Smart meter installations. The need to replicate that study appears evident.

Smart Meter Health Impacts Testimonials



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

Smart Meter Health Impacts – comments

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

Excerpts

The following comments about how the new wireless utility Smart Meters have [apparently – *present author's comment*] affected people's health were sent to the EMF Safety Network, or publicly posted. Most are posted anonymously. ...

“My name is Diane Nagby and I and my pets are also a victim of the Smart Meter. Dizziness, ringing in my ears, insomnia, nausea, rapid heart beat. I had none of these problems prior to the installation of the Smart Meter. I came home from work and they had just finished installing the Smart Meter. That very night my animals started acting agitated. There is a constant feeling of uneasiness in my household now and at night a loud buzzing/humming noise takes place, which was never present prior to the installation of the Smart Meter. It is just plain old common sense that should tell us any amount of radiation in our household is NOT going to be good for us. A friend of mine that lives in Upland, California experienced a stroke just days after her Smart Meter was installed. How many people have to die, have their homes burned down (because the Smart Meter has been proven to be a fire hazard in some houses), get sick, watch their animals suffer, as I have, before we stand up and say ENOUGH is ENOUGH.”

“... My patients, Shivani Arjuna and her husband Dan Small, have asked me to write to you with regard to how Shivani is affected by exposure ... I share their concern.

People who are aware of experiencing symptoms as soon as they are exposed to radio (RF) and microwave (MW) frequencies are currently termed “electrically hypersensitive,” or EHS.

... However, these individuals are by no means the only people actually being affected by such exposure, ... chronic [RF/MW] exposure causes health damage to people who note no immediate symptoms.

Please see, for example, the bibliography of reported biological phenomena associated with radio-frequency and microwave radiation compiled by the US Navy Medical Research Institute in 1971, with over 2,000 references, at:

www.dtic.mil/cgibin/GetTRDoc?AD=AD750271&Location=U2&doc=GetTRDoc.pdf

Also, please see the summary of EMF effects at:

www.icswebsite.com/emf/emfissues.html with 62 more recent references.

... here is brief information regarding a few known mechanisms:

- It is established from multiple, independent studies that EMR from ELF to RF/MW reduces melatonin in animals and human beings.

Melatonin is not only vital for healthy sleep, it is the most potent, naturally produced antioxidant that helps to protect cells from genetic damage that leads to cancer, neurological, cardiac and reproductive damage, illness and death.

- Exposure to intensities and field strengths that are extremely low cause a biological effect called calcium ion efflux. Calcium ion alteration of cells by EMR is linked to neurological degeneration, to cancer and many other health effects. The heart is also an electromagnetic organ, with an electric pulse initiating a cascade of calcium ions that cause the cells in the heart to contract and produce a heartbeat. Exogenous electromagnetic signals can interfere with this regular, electrical pulse leading to heart disease and heart attack of the arrhythmic kind.

The most commonly reported symptoms from exposure to wireless Smart Meters are: difficulty concentrating, dizziness, fatigue, headaches, heart palpitations, irritability, short-term memory loss, nausea, difficulty sleeping and tinnitus.

- Physiological changes that are bedrock indicators of allergic response and inflammatory conditions that are stimulated by EMF exposures include: overreaction of the immune system;

morphological alterations of immune cells; profound increases in mast cells in the upper skin layers, increased degranulation of mast cells and larger size of mast cells in EHS individuals; presence of biological markers for inflammation that are sensitive to EMF exposure at non-thermal levels; changes in lymphocyte viability; decreased count of NK cells; decreased count of T-lymphocytes; negative effects on pregnancy (uteroplacental circulatory disturbances and placental dysfunction); suppressed or impaired immune function; and inflammatory responses that can result in cellular, tissue and organ damage if exposure occurs on a continuing basis over time.

Mast cells are also found in the brain and heart, and this might account for some of the other symptoms commonly reported: headache, sensitivity to light, arrhythmias and other cardiac symptoms.

- Many studies have shown that RF/MW radiation and ELF fields cause increased DNA strand breakage and chromosome aberrations. ...” Roy D. Ozanne, MD, HMD

“... Five people have reported symptoms in my home: My father has experienced headaches and visual migraines. My mother reported having pressure on the upper part of her chest and palpitations. One neighbor exposed to these 16 cluster meters is experiencing headaches and chest tightness. Another neighbor has difficulty opening her eyes in the mornings after 8 hours by the meters. Her ophthalmologist could find no explanation. She said she uses her fingers to open her lids. All of the above symptoms have occurred since the smart meter installations. The symptoms are worsening for everyone. ...” R.H., San Diego CA

The following letter is from a prominent doctor in Napa:

“I have a patient who is being injured from the SmartMeter. She has a history of Cardiomyopathy from infection and was doing well until the SmartMeter went in last fall. She is now back in Atrial Fibrillation and needs meds she does not tolerate well. It is all a result of the extra EMF. I will send you copies of articles about how EMF affects patient’s heart rate. Is there are special complaint form I could send off to the SmartMeter company that you use? I was going to dictate something for my patient and reference the EMF and heart rate issue”.

“I have been in the ER overnight three times this week, with unexplained sickness. I have had a CT Scan of the brain, Stress

Test, CTA, EKGs, Ultra Sounds, Blood work and still no definite answer. We recently had a Smart Meter installed and these symptoms began about a week after: Extreme Stress, diagnosed TIAs, dizziness, headaches, nausea and fainting. I mentioned this to a doctor and he suggested that the Smart Meters may have something to do with it because the hospital has had quite a rise in illness of this kind reporting to the ER. "J.W. (anon). ...

"Smart Meters were installed in my neighborhood on April 15, 2011. Since then I have had constant ringing in my ears. Smart Meters violate my constitutional right to be safe and secure in my home, 4th Amendment. Smart Meters violate my privacy and my health. This is a KILLER and you know it. S.B. Orange County CA"

"I am (was) a very healthy individual, and have all the past medical information to prove it. In the last year I have been suffering illness that I feel is *omm. nt* related to the Smart Meter on my home. ... I have no alternative but to move to a house outside of the PG &E territory. Removing my meter alone won't solve the problem. My house is at the hub, the terminal, for the neighborhood distribution and the adjacent neighbor's meters are on my side of their houses, putting me in direct line of currect for three homes. I want these things removed so I can resume my life, which is on hold. C.L. Yolo County."

"Like many with the symptoms, I am on my last and giving up... exhausted from trying to get help, afraid of my health, depressed, crying all the time, difficult to work, cannot get the proper sleep... I Don't know how much more I can tolerate w/o major support. All I want is my life back." ZEENA QUINN, Marin

"Though I never was electrically sensitive before, an extreme exposure to Electro Magnetic Frequencies (EMFs) from just one of PG&E's digital SmartMeters, (from 10/31/09 to 3/3/10), left me as an electrically sensitive person. ... Now, a year after the SmartMeter was removed, 30% of the symptoms still rule my life. ..."

There are numerous other comments posted about the suggested health impacts of wireless Smart Meters at the above site (EMFSN 2011) – *present author's comment.*

Reference

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

Health Impacts from Smart Meters – the CCST report

The California Council on Science and Technology (CCST 2011) agreed to gather and assess the evidence available on the impacts of RF/microwaves from Smart Meters on health.

The CCST assessed two particular questions:

1. “Whether FCC [US Federal Communications Commission] standards for Smart Meters are sufficiently protective of public health taking into account current exposure levels to radiofrequency and electromagnetic fields.”
2. “Whether additional technology specific standards are needed for Smart Meters and other devices that are commonly found in and around homes, to ensure adequate protection from adverse health effects.”

For the first question the CCST found that *“The FCC standard provides an adequate factor of safety against thermally induced health impacts of smart meters and other electronic devices in the same range of RF emissions.”*

The CCST also noted that *“in some of the studies reviewed, contributors have raised emerging questions from some in the medical and biological fields about the potential for biological impacts other than the thermal impact that the FCC guidelines address.”*

“Non-thermal effects ..., including cumulative or prolonged exposure to lower levels of RF emissions, are not well understood. Some studies have suggested non-thermal effects may include fatigue, headache, irritability, or even cancer,...” (CCST 2011).

The CCST suggests additional research and monitoring are required to help better estimate and understand non-thermal effects.

Comments

United States Environmental Protection Agency

In 2002 the United States Environmental Protection Agency (US EPA), in correspondence with the President of the EMR Network stated that the FCC guidelines had been *“recommended by the EPA with certain reservations.”*

The US EPA stated that since its comments were submitted to the

FCC in 1993:

- the amount of scientific research documenting effects associated with both acute and chronic low-level exposure to RF/microwave radiation had risen.
- health and safety agencies have still to develop policies relating to risk from long-term, *non-thermal* exposures.

The US EPA also declared that:

- exposures complying with the FCC's guidelines are usually presented as "safe" by many RF/microwave operators and service providers in spite of uncertainties over possible risks from intermittent non-thermal exposures.

- The FCC guidelines are considered to protective against effects arising from thermal mechanisms but not all possible mechanisms.

- the omm. nted eti by many that FCC guidelines protect humans from harm by any or all mechanisms is unjustified. US EPA (2002).

Maret (2011), commenting on the CCST Report, mentions that the biological effects of low-level, non-thermal EMFs have been investigated for over 30 years.

He provides the following quote from Professor Arthur Pilla, PhD (*Professor of Biomedical Engineering, Columbia University and Director of the Bioelectrochemistry Laboratory, Mount Sinai School Of Medicine, New York*) taken from the Handbook of Biological and Medical Aspects of Electromagnetic Fields (Third Edition):

"The biophysical lore ... and lingering to this day is that, unless the amplitude and frequencies of an applied electric field were sufficient to trigger an excitable membrane (e.g. heart pacemaker), produce tissue heating or move an ion along a field gradient, there could be no effect. However, this position had to be changed as the evidence for weak (non-thermal) EMF bioeffects became overwhelming," (Pilla, 2006).

This latter point is in agreement with the thoughts of Associate Professor Magda Havas, as documented in the written report CCST asked her to submit to it on Smart Meters (Havas 2011). With regard to the 'Thermal vs. Non-thermal Debate', citing Inglis (1970), she also notes that (non-thermal) biological effects can take place

at levels far below the FCC thermal guidelines.

Maret (2011) goes further on this topic, stating that there is a large body of scientific literature describing several key mechanisms for non-thermal effects. He cites early reports by Frey (1993), Hyland (2000) and Lai (2000) on the potential health effects on non-thermal EMFs, then mentions that many relevant scientific findings are covered in the Bioinitiative Report (2007), and that last year the European Journal of Oncology published an entire monograph outlining non-thermal effects of EMFs (Giuliani & Soffritti 2010).

Key mechanisms that he mentions for the action of weak EMFs are:

- changes in the blood-brain barrier of test-animals after microwave exposure
- change of calcium ion leading to changes in cells' metabolic processes
- removal of calcium ions bound to cellular membranes, leading to their weakened structure and changed cellular functioning
- leakage of calcium ions into neurons creating spurious action potentials
- defined cellular stress response, including production of heat shock proteins (HSP), which are triggered electromagnetically at non-thermal levels (that need far less energy than when triggered by heat)
- fragmentation of DNA in cells as shown through Comet assay
- activation of specific genes through exposure to non-thermal EMFs leading to gene transcription to form RNA, the first stage in the synthesis of proteins.

All the biological effects Dr Maret lists are found to exist at far lower levels than the current FCC standards which wireless Smart Meters are designed to comply with.

Havas (2011) notes that the FCC standard was originally based “on the amount of radiation that would heat an adult male in the US military exposed to radar,” and that other countries, such as China, Poland, Russia and Switzerland, have substantially lower ‘biologically-based’ guidelines (i.e. 10 $\mu\text{W}/\text{cm}^2$ instead of 1,000 $\mu\text{W}/\text{cm}^2$ as advocated by the FCC).

Unlike the FCC standard, those guidelines take into account children, pregnant women, the elderly, and those with debilitating conditions.

For the second question, “Whether additional technology specific standards are needed for Smart Meters and other devices that are

commonly found in and around homes, to ensure adequate protection from adverse health effects,” the CCST found the following:

“At this time there is no clear evidence that additional standards are needed to protect the public from smart meters or other common household electronic devices.” (CCST 2011).

The CCST notes, however, that there is a need to further identify gaps in research and research priorities relating to potential biological or adverse health effects from RF/microwave emissions, particularly as related to non-thermal mechanisms not presently covered by FCC guidelines (NRC 2008) – *a point with which the present author agrees.*

Comments

In answer to the second question, Havas (2011) wrote that she considered additional standards are required for Smart Meters (in addition to DECT baby monitors, cordless phones, wireless routers *“and all of the other devices that emit radio frequency radiation”*).

She further commented that she has received correspondence from individuals who have experienced ill health after wireless Smart Meters were installed, *“... many are unable to use the room closest to the smart meter. ... Sickness contributes to time off work and away from school, growing medical costs and a general poorer quality of life.”* Such responses from the general public indicate a need for the precautionary principle to be applied.

“... Children are particularly vulnerable as are pregnant women and those with compromised immune systems.” Havas (2011).

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“...there is no federally developed national standard for safe levels of exposure to radiofrequency (RF) energy, ...”

US Federal Communications Commission (FCC 2011).

Commentary on Safety Guidelines

Council of Europe / Conseil de L'Europe

The potential dangers of electromagnetic fields and their effect on the environment

Resolution 1815 adopted by the Council of Europe's parliamentary assembly on 27 May 2011.

Excerpts

... While electrical and electromagnetic fields in certain frequency bands have fully beneficial effects which are applied in medicine, other non-ionising frequencies ... appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects and animals, as well as the human body when exposed to levels that are below the official threshold values.

Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco.

The Parliamentary Assembly has repeatedly stressed the importance of states' commitment to preserving the environment and environmental health, ... [including] Recommendation 1885 (2009) on drafting an additional protocol to the European Convention on Human Rights concerning the right to a healthy environment and Recommendation 1430 (1999) on access to information, public participation in environmental decision-making and access to justice – implementation of the Aarhus Convention [which amongst other things acknowledges that we owe an obligation to future generations – *present author's comment*]...

... As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly recommends that the ALARA or "as low as reasonably achievable" principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation.

Present author's note: The following text is from the draft resolution earlier adopted unanimously by the CE committee on the Environment, Agriculture and Local and Regional Affairs. It is missing from the final document (shown on previous page), as there was a wish to gain the widest possible support in the assembly (BMJ 2011). It appears highly valid.

Excerpts excluded from final version

... According to the [European Environment Agency] EEA, there are sufficient signs or levels of scientific evidence of harmful biological effects to invoke the application of the precautionary principle and of effective, urgent preventive measures.

... In connection with the proven or potential risks of electromagnetic fields, it should also be noted that after a Lloyd's report, insurance companies tended to withhold coverage for risks linked with electromagnetic fields under civil liability policies, in the same way as, for example, genetically modified organisms or asbestos, which is hardly reassuring ...

... the rapporteur wonders whether it might not be expedient and innovative to try and develop new wireless communication technologies ... but more energy-efficient and above all less problematic in terms of the environment and health than the present microwave-based wireless communication.

Such systems ... are reportedly being developed in the United States and Japan and could largely replace the present technologies. Should such changes in transmission and communication systems [or others – *present author's comment*] prove realistic, it would then be a case of technological and economic innovations not to be missed or obstructed.

The precautionary principle and the right to a healthy environment, particularly on behalf of children and future generations, must be key factors in all economic, technological and social development of society.

Refer also to the Seletun Resolution in Appendix 8.

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PLC, Smart Meters and health



Power Line Communications (PLCs) transform electric grids into smart grids through turning them into communications networks by placing RF-modulated carrier signals onto the grid wiring. A variety of PLC systems use different frequency bands depending on the characteristics of the wiring they operate on – Refer to section on ‘*Power Line Communications (PLC)*’.

The effects of PLC on health have yet to be properly assessed. Some electrohypersensitive (EHS) individuals appear to react adversely to PLC signals as indicated by the following anonymous testimonial:

“Jack (not his real name) has been sensitive to wireless transmitters for well over a decade. ...

In the spring of 2011, [he and his girlfriend] moved into their rented house ... When he arrived, he could immediately feel something had changed. It was as if a cell tower had been erected nearby, but he could not find one. It was unlikely to be the neighbors, since they lived on a large lot and he could still feel it when he drove some distance away. It seemed to be everywhere.

...

After asking around, they found out that the local utility had swapped out all of the electrical meters over the winter. The new smart meters communicate with the utility’s computers by [PLC]. ... The signal is not very powerful, but the antennas are huge and everywhere. ... The pulses bother him even fifty feet (15 meters) from the house, with the power line 150 feet (50 meters) on the other side of the house.” Anon (2011).

Radio-frequency emissions can also be created by the Switched-Mode Power Supply (SMPS) of Smart Meters.

Tests have indicated that some Smart Meters, even when their transmitters are disabled, can create radio-frequency voltage spikes on consumers' indoor electric wiring due to their SMPS. This occurs over the frequency range of 4-60 kHz, typically with a 2 volts amplitude (Brangan & Heddle 2011).

It has been suggested by some, including (Milham 2011), that the detrimental health effects which have been noted with some wireless Smart Meters – even *before* their wireless function is enabled – may be because of the addition of this 'dirty electricity' onto mains wiring [placebo effects too can come into play – *present author's comment*]. Further research is required to determine the possible extent of any such problems, if they do indeed exist, and if they do, how they may be remedied.

As little work has been undertaken on the possible biological effects of PLC and Smart Meter emissions in the radiofrequency range, reference is made to past research cover similar frequencies to those they can create.

Whilst the SMPS of some Smart Meters can create frequencies of 4-60 kHz on indoor wiring (Brangan & Heddle 2011), PLC typically operate at frequencies between 9-500 kHz and at frequencies of ≥ 1 MHz (Wikipedia 2011).

Literature review covering different frequencies

4-500 kHz frequencies

“Acute biological effects have been established for exposure to ELF electric and magnetic fields in the frequency range up to 100 kHz that may have adverse consequences on health,” WHO (2007).

1-100 kHz (natural atmospheric/sferics)

These are naturally occurring electromagnetic impulses of short duration (500 μ s) normally in the 1-100 kHz range, with a frequency maximum normally around 10 kHz. They are of low-intensity (<0.1 μ T).

Reiter's work revealed significant positive correlations between sferics impulse rates and humans' pain levels from brain injuries, operation scars and wounds, plus incidences of asthma, angina pectoris and migraine. Increased reaction times, accident-rates, incidents of crime and suicides were also noted during natural enhanced sferics activity (Reiter 1974, 1954).

Research by Fischer & Grossmann (1990) revealed the following probabilities for increased 10 kHz activity: general troubles, insomnia, increased accident frequency or muscular spasms ($p < 0.001$), hypertension, suicide or thrombosis ($p < 0.05$). Biases towards positive correlations were found with migraine, colic, depression and heart attacks.

Natural sferics activity can also influence platelet adhesiveness and risk of thrombosis (whilst increased adhesiveness is not a risk issue for thrombosis by itself, when there is reduced blood flow, heart failure, or blood vessel walls are already damaged, increased adhesiveness may greatly increase its risk of occurring).

Ranscht-Froemsdorf & Rinck (1972) revealed that variations in susceptibility to thrombosis (and haemorrhage) could occur under simulated natural electro-climates, whilst Jacobi et al. (1973) demonstrated that a rapid transformation in weather accompanied by sferics with field-strengths of 0.02-0.4 V/m, could significantly alter the degree of platelet adhesiveness that was measured ($p < 0.001$).

Ruhenstroth-Bauer et al. (1984), found a significant positive correlation between incidence of increased 28 kHz sferics and the epileptic seizures of human sufferers (Spearman's rank correlation-coefficient for entire group of 0.30, $p < 0.0001$), and a negative correlation with incidence of 10 kHz sferics and seizures (negative correlation = -0.20, $p < 0.0032$).

A significant positive association between sferics activity in the 28 kHz range and onset of myocardial infarction in humans ($r = 0.15$) was made by Ruhenstroth-Bauer et al. (1985). Cheng (1985) commenting on that work, and additionally citing GMCCG (1984), stated that similar findings had been made in China indicating that this was a universal phenomenon.

4-100 kHz (manmade)

The controversial work of Havas (2006), Milham (2010) and Milham & Morgan (2008) is also of interest with regard to the possible health effects of PLC and Smart Meter SMPS emissions, as the 'dirty electricity' (*electromagnetic energy that deviates from a pure mains-frequency sine wave and contains both harmonic and transient components*) they document in their research carries similar radio frequency radiation transients.

The RF filters used to reduce exposure to 'dirty electricity' in the research by Havas (2006) do so over the 4-100 kHz range, and have been claimed to reduce the risk and occurrence of a number of health and behavioural problems.

They have no effect in reducing exposure to frequencies below that frequency range which can also be biologically active.

≥1 MHz high-frequency (manmade)

A pilot study instituted by Commander Russell M. Jaffe in 1978 (who was Senior Staff Physician at the US National Institutes of Health at that time) indicated that whilst exposures to frequencies in the 0.1-100 MHz range appeared to weaken human muscle strength, proper shielding restored both tone and strength (Ott 1982). As PLC and the SMPS Smart Meters can create interference in this range it may prove wise to undertake similar experimentation.

≥100 MHz ultra-high-frequency (manmade)

Von Klitzing (1993) demonstrated that 15min exposure to 150 MHz signals of low amplitude ($1 \mu\text{W}/\text{cm}^2$) pulsed with frequencies corresponding to 8-10 Hz human brainwaves increased human alpha-rhythms.

Future research

Independent research, using properly validated research methods, is urgently required to determine to what, if any, effects PLC and Smart Meter SMPS may have on national health, wellbeing and prosperity.

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Environmental Concerns



The Environment and Sustainable Development

“Smart Meters do not necessarily bring environmental benefits. Like many new technologies, their rollout requires replacing an entire, fully functional, existing system. Their lifespan is expected to be short, at only 15 to 20 years (rather than over 30 years for traditional meters) and they use electricity to run – which requires extra generation to supply. The overreaching conclusion of the study is that the policies governing smart meters, are decisive in limiting or maximizing the positive impacts of this technology.”
VaasaETT Global Energy Think Tank (Stromback & Dromacque 2010).

Unintended consequences and sustainable development

The law of unintended consequences is amongst the most powerful in creation. It has yet to be adequately addressed with regard to the effects that Smart Meters, smart grids and related technologies may have on sustainable development.

“The law of unintended consequences provides the basis for many criticisms of government programs. As the critics see it, unintended consequences can add so much to the costs of some programs that they make the programs unwise even if they achieve their stated goals. The law of unintended consequences is at work always and everywhere,” Norton (2008).

The more that is known of the possible knock-on effects of Smart Meters and related technologies being rolled out across the world, and measures that can be taken to mitigate potential problems the smoother such rollouts are likely to be.

In-depth official Environmental Impact Assessments (EIA) that cover all of the areas discussed in this document have yet to be undertaken.

The Rio Declaration – as related to smart grids

There are many factors that need to be assessed for the development of the new electricity age to be commensurate to be in accord with the spirit of the 1992 United Nations Rio Declaration on Environment and Development (UNEP 1992). As examples:

Principle 1

“Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.”

As documented in the section on Human Rights, for some human beings at least, this principle may be compromised through the creation of inappropriate Smart Meter regimes that impact negatively on their health and potential productivity.

Principle 4

“In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.”

It appears that some, though not all, Smart Meter systems may *in their present form* damage have the potential to damage flora and fauna. This matter needs to be urgently addressed.

Additionally, environmental protection should extend to ensuring smart grids are adequately protected against natural and manmade EMP, as failure to do so could have huge negative repercussions.

Principle 7

“States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth’s ecosystem. ...”

Transparent, properly funded, *unbiased* research is urgently required on the possible effects of Smart Meters and related technologies on the health and integrity of the Earth’s ecosystem.

Principle 9

“States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.”

If a true spirit of cooperation and global partnership can be achieved, *that takes onboard the advice of relevant specialists often excluded from such developments*, this goal can be comm. nt with smart technologies to an even greater extent.

‘Open innovation’ approaches based on collaboration and co-creation may prove particularly worthwhile in creating environmentally cost effective solutions.

Principle 13

“States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage. States shall also cooperate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.”

Unless suitable mitigative and low-cost best practice measures are developed/undertaken related to Smart Meters and related technologies; there may be numerous liability and compensation claims lodged by victims related to ‘electromagnetic pollution’ and other environmental damage claims related to the rollouts.

Principle 15

“In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

It appears that there may be a number of benefits in applying cost-effective precautionary measures in the design and operation of Smart Meters and related technology to reduce the likelihood of serious or irreversible environmental damage. Full EIAs which take into account the comments of those who could address such matters, appear warranted.

Low cost low risk alternatives and strategies should be applied wherever practical.

Principle 16

“National authorities should endeavour to promote the internalization 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.”

This ‘polluter pays’ principle – which Marshall (2010) suggests should be applied to electromagnetic pollution – is very important as it may be one of the key deciding factors related to which formats of smart technologies are adopted and how existing smart systems should be implemented.

It is in everyone’s interest that the most environmentally friendly cost-effective smart technologies and infrastructures are chosen.

Principle 17

“Environmental impact assessment [EIA], as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority.”

It appears that some Smart Meter and smart grid EMF regimes may in their present forms risk causing serious or irreversible damage to the environment. It is suggested that comprehensive EIA on Smart Meters and related technology (covering the matters raised in this present document) should be carried out by States at the earliest possible opportunity to address these issues.

Terrific inroads are being made with regard to the development of intelligent grids – *there is much still to be achieved*. Smart Meters do not benefit the environment without proper regulation (Stromback & Dromacque 2010).

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The European Commission

The European Commission Communication on the Precautionary Principle (EC 2000) states:

“The precautionary principle applies where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU.”

For Europe there is also ‘The Consolidated Version of The Treaty on the Functioning of the European Union’ (CVTFEU 2010), which states in Article 191 (ex Article 174 TEC) that:

“Union policy on the environment shall aim at a high level of protection ... It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.”

It has already been indicated that some RF/microwave regimes may cause environmental damage. Refer to section on ‘Possible environmental effects’.

Risk assessment

Proper risk assessment plays a key contributor to the precautionary principle. The Council of Europe / Conseil de L’Europe (2011) suggest:

“Risk assessment [should be] more prevention oriented.

- improve risk-assessment standards and quality by ... making the indication of the risk level mandatory, commissioning several risk hypotheses and considering compatibility with real life conditions;
- pay heed to and protect “early warning” scientists; formulate a human rights oriented definition of the precautionary and ALARA principles; increase public funding of independent research, *inter alia* through grants from industry and taxation of products which are the subject of public research studies to evaluate health risks; ...”

“... the issue of independence and credibility of scientific expertise is crucial to accomplish a transparent and balanced assessment of potential negative impacts on the environment and human health.”
CE (2011).

Ensuring that Smart Meters, and other types of electronic technology, are 'environmentally sound' can create direct beneficial financial impact whilst also helping to future proof such systems. Such 'best practice' measures can be directly recouped by the UK through savings on overall healthcare expenditure and increased workforce productivity.

The responsibility for environmental impact lies with the provider – providing impetus for proper development and the creation of World-class clean-technology products and services.

Responsibly undertaking risk assessment and investment may greatly benefit corporations and countries, and could lead to numerous innovative solutions and technological breakthroughs that may benefit the worldwide Smart Meter rollout and the next generations of electronic technology.

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Many countries are committed to enhancing their 'green infrastructure'. One such way of doing so is ensuring Smart Meters and related technologies are biologically and 'environmentally friendly' and that their development and operation adhere to the