

# **HEALTH AND SAFETY ASPECTS OF ELECTRICITY SMART METERS**

## ***A STUDY INTO THE POTENTIAL HEALTH EFFECTS OF RADIO FREQUENCY EMISSIONS FROM SMART METERS***

Commissioned by Arc Innovations Limited on behalf of New Zealand's energy consumers

Carried out by the Electric Power Engineering Centre, College of Engineering, University of Canterbury, Christchurch

Reviewed by the Wireless Research Centre, College of Engineering, University of Canterbury, Christchurch

N.B. This is the brief summary, with minimum technical content. The full study, which necessarily involves scientific and engineering terms, is also available.



New Zealand's Centre of Excellence for Power Engineering

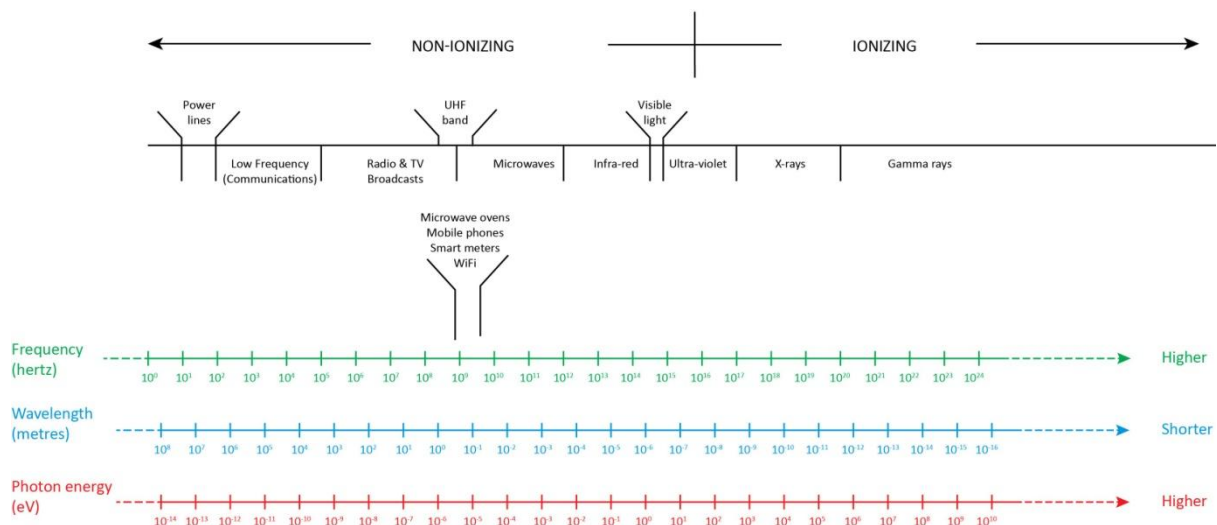
# HEALTH AND SAFETY ASPECTS OF ELECTRICITY SMART METERS - BRIEF



**Figure 1. A typical Smart Meter and the traditional electromechanical meter it replaces**

A lot of activity has been taking place in New Zealand over the last few years where old electromechanical meters are being replaced with "Smart Meters" in the meter boxes of our homes and businesses (figure 1). A Smart Meter needs to communicate information between the meter and your electricity retailer and in some cases the network lines companies. In order to do so it uses radio communication, much like that of your mobile phone. Some people are concerned about the health and safety aspects of Smart Meters, because they use radio communications. This brief summarizes an investigation by the Electric Power Engineering Centre (EPECentre) of the University of Canterbury into smart meters. The full investigation paper that this brief is based upon is also available.

Smart Meters are able to quickly communicate important information between electricity companies and consumers regarding amount, time and cost of energy use. This is of benefit to all New Zealanders, allowing more efficient use of power stations, lines and sub-stations and reducing the need to build new infrastructure. To do this, Smart Meters use radio communication in what is called the ultra high frequency (UHF) band – the same band that is used for mobile and cordless phones. When Smart Meters send information to your electricity company, they give out radio frequency (RF) waves. These waves are known as RF radiation, because waves always radiate from a source, just like the waves from a pebble dropped into a pond, or the light waves from the sun. There is nothing sinister about the word "radiation"!

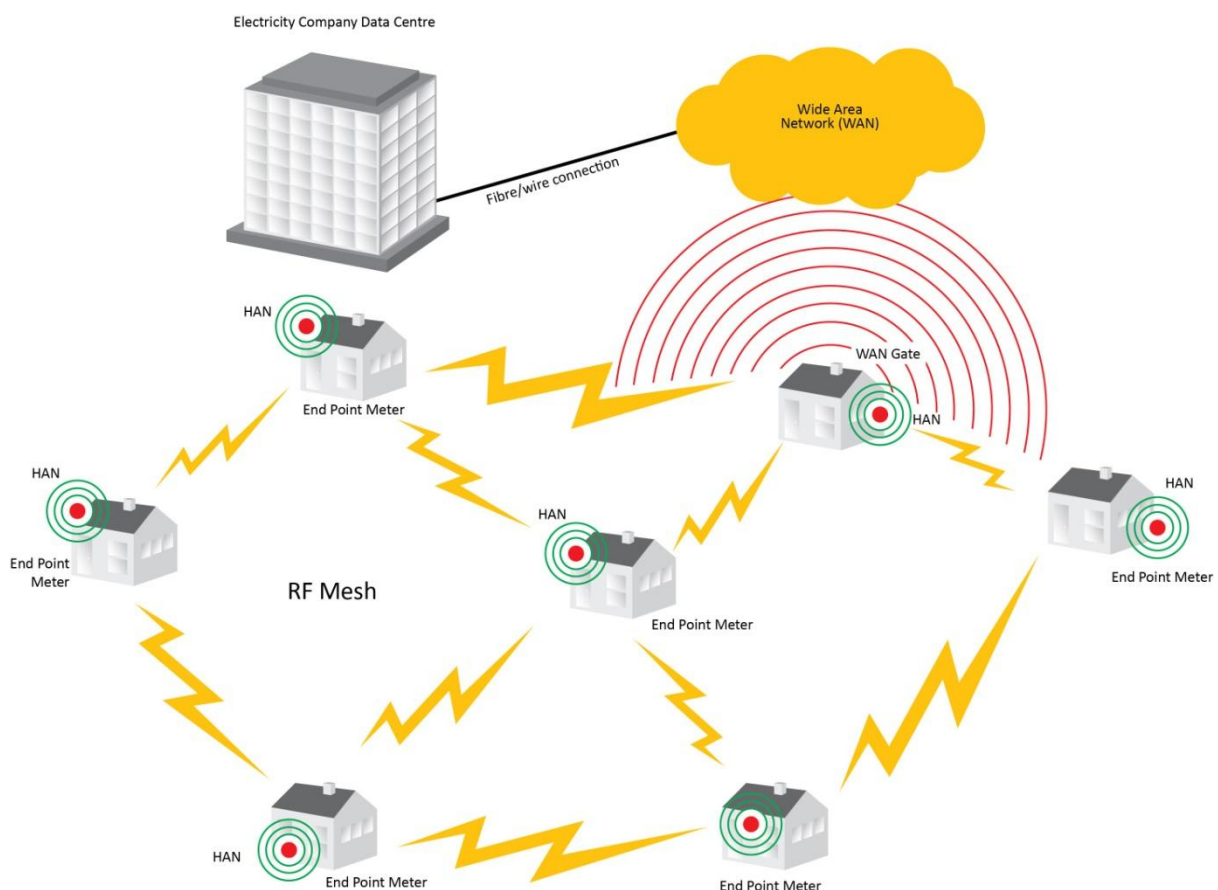


**Figure 2. The electromagnetic spectrum**

As shown in figure 2, RF waves form part of the electromagnetic spectrum, which covers all radiation frequencies. These frequencies stretch from the earth's roughly constant magnetic field (frequency is zero), up to theoretically infinitely high frequency. (This is why figure 2 has no start and no finish, across the page). In practice radiation is classified into low frequencies, such as power lines, RF (stretching from low frequency communications, through radio and TV broadcasts, right up to microwaves), infra-red, visible light, ultra-violet, X-rays and Gamma rays.

RF radiation is non-ionizing, unlike higher frequency radiation types such as hard ultra-violet (UV), X-ray and Gamma radiation [2]. This means that it does not cause changes to living cells, such as can occur with sunburn from UV exposure. However RF radiation does cause heating of body tissue (an effect used deliberately in microwave ovens). Studies over a long period of time have shown that this heating can cause noticeable effects in the behaviour of people and animals. International standards for Maximum Permissible Exposure (MPE) for members of the general public, based on reducing this heating effect to 1/50<sup>th</sup> of the amount shown to cause these noticeable effects, are in force and must be complied with. In NZ the current standard is NZS2772: Part 1: 1999 [3], which is virtually identical to other national and international standards.

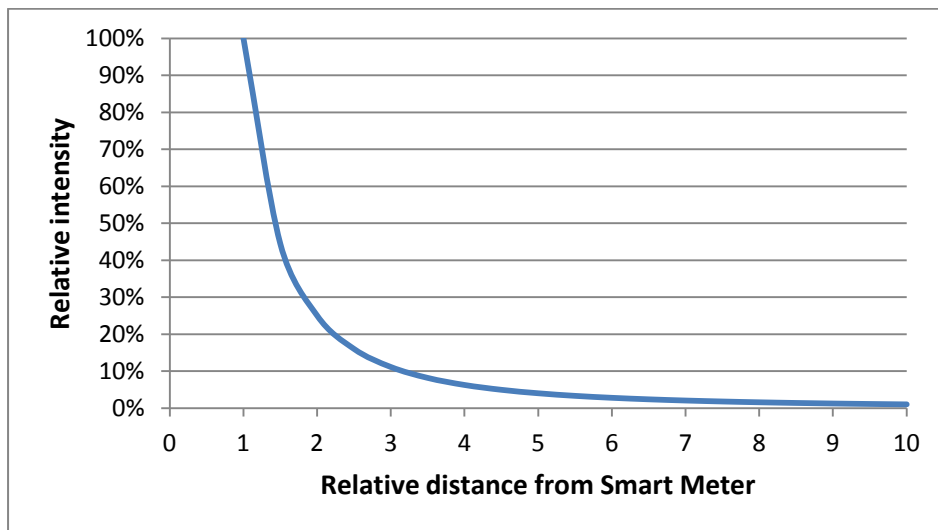
It is therefore important to be sure that even the worst case Smart Meter installation complies with the requirements of NZS2772:Part 1: 1999.



**Figure 3. Network of Smart Meters using RF Mesh and Home Area Network (HAN)**

One type of Smart Meter deployment, shown in figure 3, involves a network of meters (called an RF Mesh), which interconnects each meter to its neighbours, to route data between each meter and a data centre. It may also (in the future), have a Home Area Network (HAN), which interconnects each meter to individual smart appliances in each house. This HAN is another RF network, also at a similar frequency to that of your mobile phone, cordless phone and wireless router.

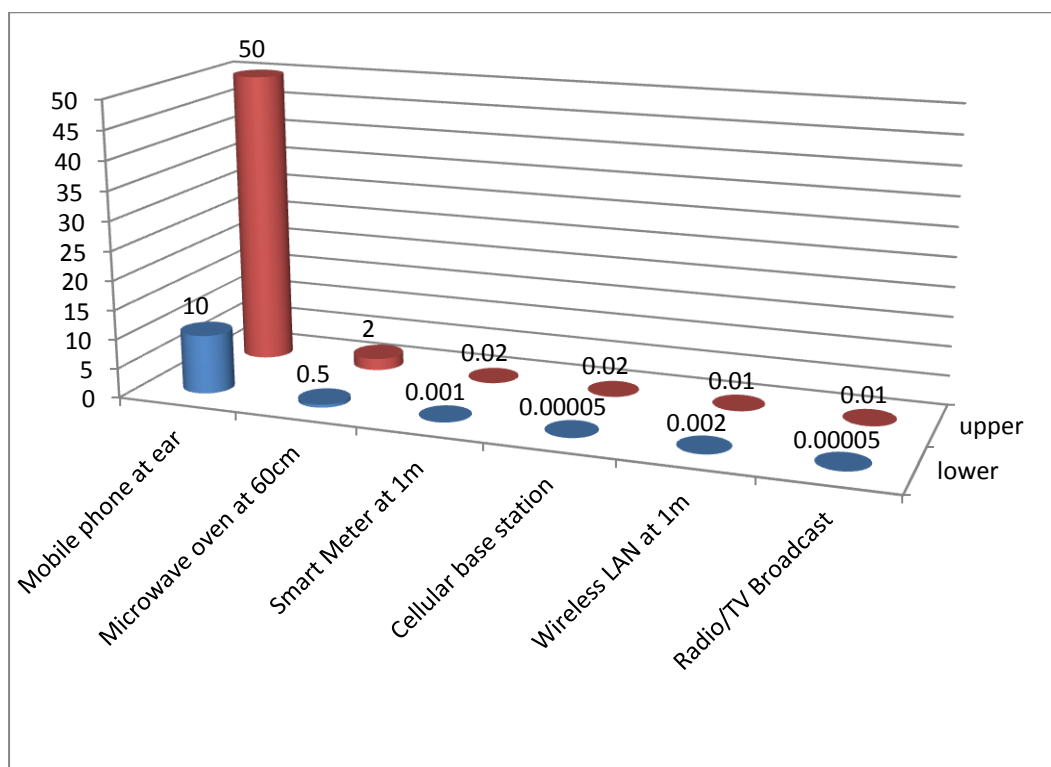
The Smart Meters in the network of figure 3 use two different Industrial, Scientific and Medical (ISM) bands located within the UHF band of the spectrum – one for the RF Mesh and another for the HAN (if used). Smart Meters using the ISM bands must comply with the RF radiation power limits of the NZ General User Radio Licence for Short Range Devices [4]. **In practice they radiate much less power than this allowance and then for only a small fraction of the time [5]. Calculations, backed up by real measurements, show that even if they radiate the maximum allowable amount, on both bands simultaneously, all the time, at any distance greater than 1m from the Smart Meter the exposure is less than 35% of the allowable limit [1].** This leaves at least 65% of the Maximum Personal Exposure (MPE) limit for radiation from all other sources, such as microwave ovens, mobile and cordless phones, wireless routers (WiFi) and so on. Since the intensity of radiation falls off rapidly with distance, according to the “inverse square law” shown in figure 4 (just like the light from a lamp or torch), in practice the exposure levels are much lower than this.



**Figure 4. Relative intensity of RF radiation versus distance from Smart Meter (inverse square law)**

Another type of Smart Meter uses the cellular bands (also located within the UHF band of the spectrum) to transmit over the General Packet Radio Service (GPRS) network used by mobile phones. These Smart Meters transmit data similar to Short Message Service (SMS) texts, at the same RF radiation levels as a mobile phone. Because under normal conditions they are much further away from the body than a mobile phone, they result in much lower exposure. **Calculations, backed up by real measurements, show that even if the meter spends half its time transmitting data, in a marginal coverage area, at full power, at any distance greater than 1m from the meter the exposure is less than 28% of the allowable limit [1].** This leaves at least 72% of the MPE limit for radiation from all other sources.

Modern householders are typically exposed to a wide range of RF radiation. Sources include mobile phones (predominantly when talking), microwave ovens (only when cooking), signals from radio and TV broadcast transmitters and cellular base stations (substantially all the time) and wireless routers (dependent on usage). The intensity of the exposure will be determined by many factors, such as how close to the nearest cellular base station or broadcast transmitter the house is situated, or how close to the microwave oven you are standing when cooking. Figure 5 shows the typical range of likely exposure from different sources and puts the exposure from the Smart Meter into context. It is much more likely that we would spend an hour or so a day talking on the mobile phone or working within 1 metre of our wireless router or laptop than standing within 1 metre of our Smart Meter!



**Figure 5. Range of likely exposure levels (in  $W/m^2$ ) in the home from various RF sources [6]**

However, taking the advice from NZS2772: Part 1: 1999 to “minimize unnecessary or incidental RF exposure”, a sensible approach is to locate Smart Meters in positions where the general public will be at least 1m away from them for all but a few minutes per day. This will ensure that mobile phone use remains, by far, the most significant RF source to which any member of the public is likely to be exposed.

For much more detailed information on this subject, please read the full EPECentre report [1].

[1] EPECentre, “Health and Safety Aspects of Electricity Smart Meters”,

[http://www.epecentre.ac.nz/docs/media/Arc\\_Full\\_Final\\_01.pdf](http://www.epecentre.ac.nz/docs/media/Arc_Full_Final_01.pdf)

[2] [http://en.wikipedia.org/wiki/Non-ionizing\\_radiation](http://en.wikipedia.org/wiki/Non-ionizing_radiation)

[3] Standards New Zealand, “NZS 2772:Part 1:1999, Radiofrequency Fields, Part 1 – Maximum Exposure Levels – 3kHz to 300GHz”, NZ Standards Council, 1999, <http://www.standards.co.nz/web-shop/?action=viewSearchProduct&pid=2772.1%3A1999%28NZS%29&mod=catalog>

[4] Radio spectrum division, NZ Ministry of Economic Development, “General User Radio Licence for Short Range Devices (SRDs)”, 7<sup>th</sup> April 2011, <http://www.rsm.govt.nz/cms/licensees/types-of-licence/general-user-licences/short-range-devices>

[5] EPRI, “Characterization of Radio Frequency Emissions From Two Models of Wireless Smart Meters”, Report no. 1021829, December 2011, [http://my.epri.com/portal/server.pt?Abstract\\_id=00000000001021829](http://my.epri.com/portal/server.pt?Abstract_id=00000000001021829)

[6] EPRI, “Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model”, Report no. 1022270, February 2011, [http://my.epri.com/portal/server.pt?Abstract\\_id=00000000001022270](http://my.epri.com/portal/server.pt?Abstract_id=00000000001022270)