

# Smart meters and remote reading meters

*(for a short RF exposure summary see page 7)*

## What is it all about?

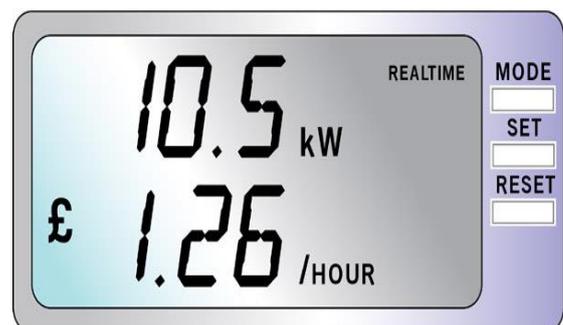
We almost certainly will be forced to have more 'intelligent' metering and control in the future for electricity use and sustainability. As European demand continues to grow and UK nuclear power stations are decommissioned due to their old age we are going to be short of both electricity and gas. Renewable energy systems will help but often are unable to deliver the power at times of high demand.

By 2020 all 27 million households in the UK are expected to have their old gas and electricity meters taken out and replaced with intelligent metering. The cost is expected to run to between £11 billion and £13 billion. This will initially be swallowed by the energy companies (and tax concessions to them), who over time will be allowed to pass it on to consumers by an overall rise in the price of energy.

British Gas customers who receive the upgrade will have separate smart meters for electricity and gas.

The average installation cost will be approximately £400, but the government believe that customers will save this (and more) in the long term, and reduce carbon emissions, by seeing their costs and usage on a daily basis, and therefore be encouraged to cut back to reduce bills. This has been hailed as a forward-looking 'green' initiative, which appeals to those who do not want the production of electricity using nuclear power, or a reduction in need for power.

You will not get a direct bill from your energy company for installing the meter but, instead, you will pay about an extra £2 per month for electricity use so that you will pay for it over the next 20 years. Taking into account the energy you will be saving by having the meter, official analysis has predicted that we will be better off overall by about £40 a year, although this figure is controversial, with other estimates far lower. This is mainly the consumer using less electricity due to an increased awareness of how much money is being spent.



Most of the 'savings' will be made by the utility companies as they will not be employing meter readers, but they have to pass these savings back to their customers. In 2012 most of the UK electricity suppliers did not see a profitable business case in the current Smart Meter project. National Grid is probably an exception as it has to balance UK national supplies and full Smart technology should enable them to smooth out the main peaks in demand that cause them problems and cost them money in having to have extra power stations on running standby at

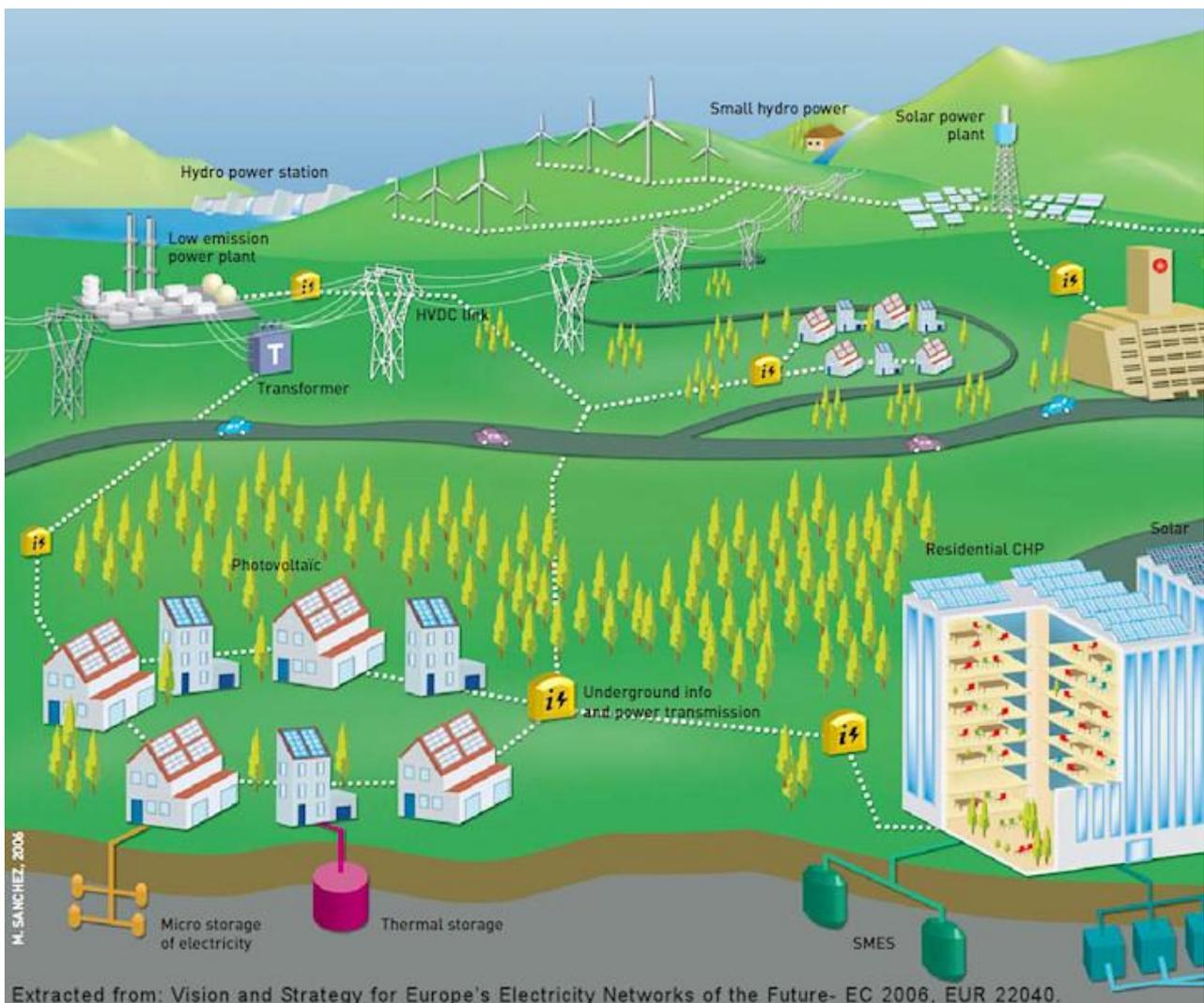
certain times of the day. These power stations are paid a fee for running in standby even though they are not supplying electrical power to the National Grid.

At one point in the summer of 2011, National Grid were having to pay up to £2,000,000 per night to some northern wind farms “not to generate” as they had no way of actually using the power. Smart electrical technology, properly applied, should be able to help with this sort of problem.

The smart meter rollout in Victoria, Australia, was originally estimated at \$1 billion, in September 2012, it had reached \$2 billion. However, the power industry will save billions of dollars by cutting demand during peak usage times, but for most households, the savings will be very limited, indeed.

## Smart Grid

Here is an European Commission 'smart grid vision' diagram from 2006. Note that they show



smart meter data transmission is by underground methods and not by wireless.

The full report is available here:

[ftp://ftp.cordis.europa.eu/pub/fp7/energy/docs/smartgrids\\_en.pdf](ftp://ftp.cordis.europa.eu/pub/fp7/energy/docs/smartgrids_en.pdf)

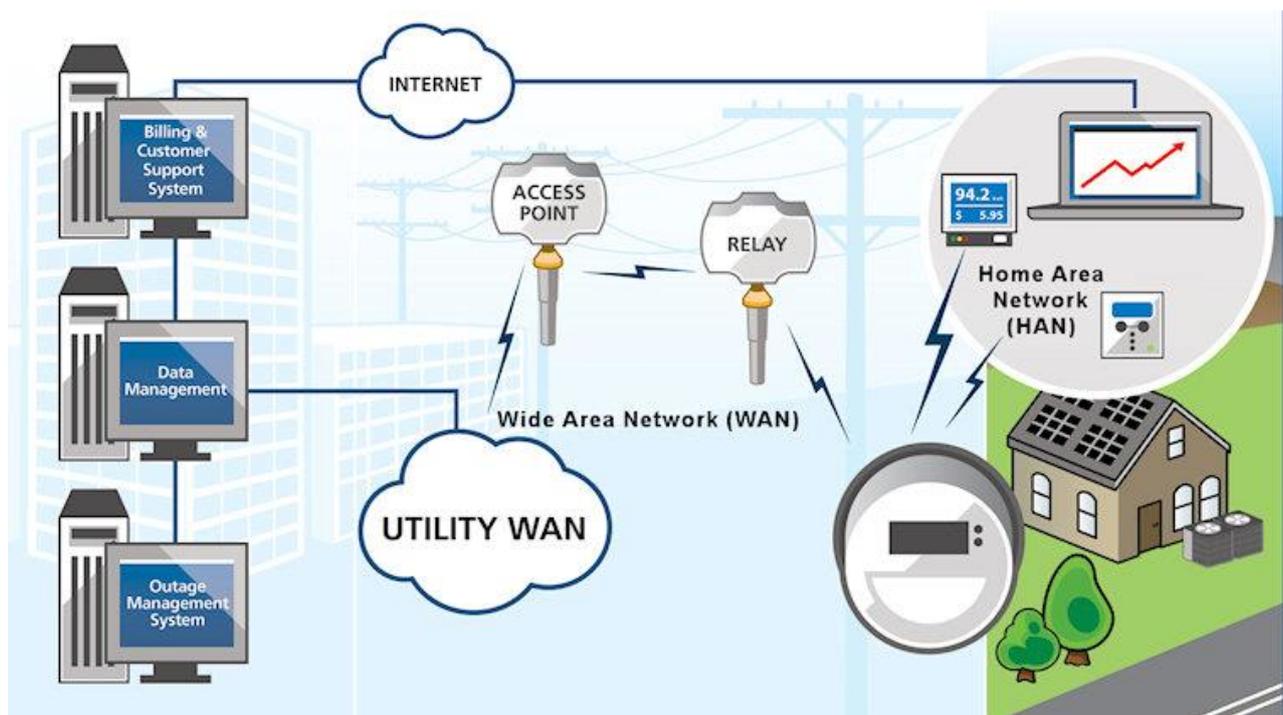
## Remote reading meters

Remote reading electricity meters were only read occasionally- some daily, some weekly, and some only when interrogated by a radio vehicle driving up the street on a quarterly basis. This

was especially useful for multi-occupancy properties which often require repeat visits due to the number of people being out when the meter reader calls. These meters are now being replaced by "Smart" meters.

## Smart meters

There are already (when this article was first written in January 2012) about 1,000,000 households in the UK which have some sort of Smart Meter as part of trials and early roll-out. Some of these are not true Smart Meters (and some are effectively just remote reading meters with mobile-phone network connectivity) and will need to be replaced when the final UK Government specification is finalised. Most UK homes will not be getting UK Government Approved Smart



Meters until after 2013.

'Smart' metering, which will always include the remote reading capability mentioned earlier, is much more complex. It is primarily intended to enable electricity demand to be affected by altering the price per unit over a wide cost range (like large industrial users have had for many years - their price can vary from a few pence per unit to over £10 per unit if they exceed their approved demand at peak times!). Smart metering is an automated and advanced version of existing 'off peak' or 'economy 7' discounted price off-peak electricity schemes.

Instead of having fixed times at which cheaper electricity is supplied, the companies will adjust the electricity price at various times depending on demand, surplus load availability and the type of contract agreement you have with the supplier. This level of influence on electricity consumption is because the UK (and most European) electricity systems can often be working at almost maximum capacity, especially during cold periods, and there have been some almost complete automated protective shut-downs. If that happened it would take at least 12 hours to get everyone back on an electricity supply. As the limited gas supplies come under greater demand it is likely that the electronic gas boiler controller will be linked to the Smart Meter communications system so that it can turn down the gas heating consumption when demand gets too close to maximum gas supply capability.

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Households generating their own electricity through rooftop windmills, etc. can sell it back into the National Grid via the meters. Smart meters will also monitor the electricity you can create at your home through wind turbines or solar panels, and will enable you to sell this energy when you do not need it.

The smart meters are told the current price by wired or wireless communication with the electricity supplier. Depending how they have been set up, they either turn circuits on/off or use a WiFi type system to “talk to” your washing machine, electrical heating systems (like storage heaters) and other high-power electrical equipment so that the equipment (depending how you have set it) can decide when to run. There will also be an optional alarm facility to warn you when the price is above a pre-set limit that you have chosen.

This would mean that your washing machine or dishwasher would cost a great deal if you use it at 8 a.m. or 6 p.m. or between 11.00 a.m and 3.00 p.m. on Sunday (for example), but if you had pre-loaded it the previous night and allowed it to start automatically when the price was best (say 4 a.m.) then it would cost maybe one-hundredth of the unit cost than if it were on at the peak times mentioned. Even fridges and freezers would turn off during the most expensive periods unless their temperature was too high for food safety at the time.

In September 2011 Electric.co.uk news reported that a study carried out over a 12-month period looking at thousands of families who were using smart meters found that these smart meters had a very little impact on energy consumption.

## **Wide Area Network (WAN) technologies**

Almost all the smart meters currently on trial in the UK all use a form of RF WiFi/Zigbee/Z-wave or similar inside the house for the Home Area Network (HAN) and a mobile phone network card for contact back to the electricity company over the Wide Area Network (WAN), using public mobile phone networks (GSM, 3G and 4G). A few remote reading meters use proprietary RF communications when interrogated by a meter reading vehicle in the neighbourhood.

The future use of MESH network connected meters (as mainly used in the USA and Canada) and Power Line Carrier (PLC) connected meters (which communicate along the existing power cables as done in Germany and France) has not been ruled out, though allowing PLC meters in the UK would require a change in legislation due to the way the electricity supply industry was privatised.

At present the Distribution Network Operators (DNOs, the local supply companies) are not allowed to carry power usage data. In South Africa the electricity network is using TETRA for the meters as the signal travels through walls and buildings better due to its lower carrier frequency (436 MHz).

MESH networking is a type of networking wherein each node in the network may act as an independent router, regardless of whether it is connected to another network or not. It allows for continuous connections and reconfiguration around broken or blocked paths by 'hopping' from node to node until the destination is reached. MESH networked meters chat to each other most of the time (with a different signal format from anything else) and pass data onwards and eventually get to/from an Area Access Point which is now usually 3G/UMTS based for ongoing communications. This greatly reduces infrastructure costs and most large scale implementations in Canada and the USA are currently using this method. These WiMAX signal levels inside the house can be up to 0.6 V/m at 1 metre and .1 V/m at 5 metres. When measurements were taken in Germany in March 2009, the details were transmitted every 30 seconds. According to the firm that manufactures the meters, the intervals between readings are shorter when the figures are needed for bill calculations and longer during the rest of the time.

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There are systems that could be implemented that would mean that virtually no microwaves need to be used. For example, most 'off-peak' meters in current use pick up a long-wave radio signal (just like a long-wave/medium-wave radio – at tiny levels in most homes) and use that to switch between normal and low rate charge modes.

This type of system could be used to transmit the prices and then either a dLAN (along the house wiring) or a fully signal-wired (like a very simple Ethernet type system, e.g. CAN-bus which is now used in most motor vehicles) system used to communicate with your electrical appliances.

Ways of reading the meters using RF signals transmitted down the mains, rather than wirelessly, have been tested and are in use in Germany and France. However, there have been problems including getting the signal inside houses and interference has been reported by amateur radio enthusiasts. France are using a frequency shift keying method around 80 kHz. This does not produce any microwaves nor does it have changes in amplitude (i.e. no “pulsing”). This will add considerably towards the amount of 'dirty electricity' that would be measurable in people's homes. It may be a useful alternative, though, for multi occupancy buildings, such as flats.

In November 2011 and January 2012, Charles Hendry, the UK energy minister, said: “We believe people will benefit from having smart meters, but we will not make them obligatory.”

<http://www.telegraph.co.uk/financialservices/utilities/Business-energy/9053100/Smart-meters-for-energy-to-be-voluntary.html> However, it is believed that their electricity bills will usually end up being significantly more expensive than for people who fully utilise the smart metering and control functions. It has been suggested that there will be a dearer 'standing charge' for everybody (maybe about £50 per year, mostly to pay for some real people meter readers) and that this charge will be heavily discounted (and maybe credited in full) to families who have smart meters. In the USA such people are also currently being penalised by being charged several hundred dollars per year for meter-reader services.

The government has agreed that you can refuse wireless meters on health grounds. If you have access to the internet you could also sign a form from Stopsmartmeters. This will be sent to almost all UK utility companies refusing them access to your property to fit a wireless meter: <http://stopsmartmeters.org.uk/dont-smart-meter-me-notice-of-non-consent-for-smart-meter-installation/>.

It may be that smart meters could also be used in the future as a way to monitor and control water usage, especially in areas where the water supply is becoming increasingly problematical.

It has been pointed out that smart metering could be achieved using optic fibres, which would eliminate added RF exposure. For individual homes fibre optic cabling is relatively high in cost because of technological limitations, possibly in the order of £600 per household in cities, towns and village streets with lots of houses. The price would be greater for rural areas where there are fewer connections, when the main cabling cost would have to be shared by fewer people.

A combination of communications networks could be possible. The data could be transmitted down a telephone line, the infrastructure for which already exists, and almost all telephone exchanges are now connected by optical fibre, and have acceptable bandwidth speeds. Rural exceptions, such as the Scottish Highlands and Islands, where the fibre optic cabling has not been laid, often use microwave links for their main connection anyway.

So, a good way would be to incorporate a telephone-line-based broadband internet ADSL router (or modem/+ firewall) in every smart meter with an additional Ethernet socket(s) to attach an Ethernet switch for home broadband and for wired appliance control. Such a wired system would allow BT (etc.) to supply subsidised wired broadband to every house, give them the income to

extend and improve their long-distance fibre-optic infrastructure, and allow us to reduce our microwave exposure.

Instead, the mobile phone companies are looking for new ways of making money, now the phone market is becoming saturated; people like Sir John Bond, the chairman of Vodafone, are business advisers to the UK Government; so a new wireless metering company will be set up, that will be then sold off at a vast profit in the future.

## Home Area Network (HAN)

At present there is a strong drive to introduce “smart appliances” that will talk to our smart meters and regulate their operation to use the cheapest electricity and reduce the load on the national grid supply network at peak periods.

The HAN will be operating continuously – like WiFi. There are a number of competing systems, but the Z-wave alliance is probably the leading group of signed up electrical appliance manufacturers. Z-wave uses frequencies close to the 900 MHz mobile phone band. It has a typical range of 15 to 30 metres (50 to 100 feet) and has a short duty cycle – transmitting for less than 1% of the time and can be as low as 0.1% – so it is a pulsing signal, rising in level every time the data is transferred.



It would be good to ensure that, inside our houses, we can have the option not to use RF/microwaves to communicate between the meter and various appliances, without suffering financial consequences. There is no reason why the HAN should not offer a wired option, but at present, it seems unlikely. A dLAN option that sends the data around the mains electrical wiring is a possibility. Such changes in implementation will need a considerable amount of lobbying by a lot of people.

## RF exposures from Smart Meters

There is considerable variation between the RF emitted by different RF connected Smart Meters.

**WAN:** MESH connected meters (mainly USA & Canada) will produce a more continuous lower level RF exposure as the meters chat with each other. In the UK almost all meters will be on normal mobile phone networks, so it is the equivalent of a short SMS text message being sent from a “mobile phone equivalent” inside your smart meter every 30 minutes or so (update period has not been finalised yet). Gas smart meters usually only send data once per day.

**HAN:** This is approximately equivalent to an extra WiFi network in your home, with the main transmitter being located in your electricity meter. If you purchase “smart” appliances, then each of those will also have a WiFi equivalent transmitter in the appliance.

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If you have a smart meter fitted, the only way to determine the microwave RF emissions is to take your own measurements. EMFields ([www.emfields.org](http://www.emfields.org)) hire the Acoustimeter, a suitable and easy to use meter and provide help with understanding the measurements if required.

## Experiences of smart meters in other countries

In **Denmark** and the **Netherlands**, energy savings fell below 5% after the meters had been in place for about 6 months. People in the **United States**, who already have smart meters, complain of unexplained high bills and in some cases they are having to keep the old meters in place alongside the smart meters. Apparently one is that the modern techniques used by the smart meter sensors to measure power used, pick up and measure fast transients that older rotating disc meters could not detect, and this increases consumers' bills.

In **Australia**, 10% of the population has refused wireless smart meters.

Since smart meters have been rolled out in **San Francisco**, thousands of people have reported ill health symptoms, including headaches, nausea, heart palpitations and tinnitus, as a result of the powerful bursts of radiation from the meters approximately once every 4 seconds, 24 hours a day. Independent measurements reveal radiation spikes that are far more powerful than any commonly used household wireless devices, potentially more than 100 times the level of mobile phone exposure. 42 local governments have demanded a halt to the smart meter program because of experienced health effects and fears over long-term cumulative exposure.

**Marin County** board of supervisors is to consider a moratorium on PG&E smart meters, partly because of health concerns. More than 22 cities and 3 counties in **California** have already launched formal objections to the mandatory deployment of smart meters, since many people are concerned about the likely long-term health effects.

Trudy Frisk started suffering from a ringing in her ears, and a prickly sensation all over her body after the installation of a Smart water meter inside her home. The meter was moved outside her home – no better, then into a pit in her lawn, at a considerable cost. However, she seems to be stuck with the problem, which isn't shifting (August 2011).

In **Ontario**, Premier Dalton McGuinty, who was behind a billion-dollar smart meter experiment, now admits the electricity pricing scheme that's supposed to make it all work, isn't (September 18, 2010, Toronto Sun).

Residential fires have been reported as a result of the connection between the smart meter and the house wiring. One company in **America**, PECO, has blamed the customer's wiring, implying that they will bear the cost of the ensuing repair work. 80 PG&E SmartMeters caught fire and burnt out after a power surge in East Pal Alto, August 2011. In **Canada**, a new legal consulting service has sprung up, offering utilities advice on defending against smart meter related lawsuits.

One person, aged 66, who had had a recent heart checkup and had been pronounced fine, experienced heart irregularities and blood pressure increase after the installation of smart meters in her neighbourhood. A 24-hour heart meter showed 'spikes' when she visited her public library where there are many wireless computers and again when she stood near a bank of smart meters. Her GP says she is at risk of a stroke.

In **British Columbia**, a Human Rights tribunal has agreed to hear a representative complaint (like a class action) from Citizens for Safe Technology, that B.C Hydro's installation of wireless smart meters discriminates against medical sufferers who claim electromagnetic hypersensitivity. They seek:

- A declaration that BC Hydro has discriminated against each person by failing to provide a commitment to refrain from installing and/or operating a wireless smart meter at the individual's place of residence and/or residential complex.
- An order that BC Hydro cease installing such meters at the individual's place of residence and/or residential complex.

Citizens for Safe Technology are currently fundraising to bring a tort action against BC Hydro.

The Tribunal has stated that *"A vague and medically unsubstantiated reference by a physician to avoid wireless technology is insufficient to constitute a disability. There must be a medical diagnosis, as well as a contraindication for exposure to such technology because of its effect on the medical condition."*

## **Solar storms may affect smart meters**

NASA is expecting magnetic storms in 2013 when two solar cycles (11-year and 22-year) coincide. Magnetic storms can play havoc with many types of electronic wireless equipment. At the moment it is unclear whether smart meters would be able to continue to function if exposed to such an electromagnetic pulse, thus reducing the availability of power to the majority of homes, businesses, etc.

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