

## **Health effects of wired PLC electrical meters**

Many people are now familiar with the health issues associated with wireless smart meters. Some suggest that wired smart meters are a better alternative. However, the most commonly used wired smart meter technology is not safe either and may in some cases be worse.

Electrical meters using PLC technology communicate by transmitting signals via the electrical wires. The PLC signals are “dirty electricity”, which turns the household wiring and the power lines in the streets into giant transmitting antennas.

Opting out of a PLC meter may not provide any relief, as the PLC signals can still enter the household from other PLC meters and equipment in the area.

There are scientific studies linking dirty electricity with long term health effects. A few people are so hypersensitive to dirty electricity that they had to move out of their home after a PLC meter was installed.

The rest of this article provides more details, as well as references to more in-depth material, scientific studies and government reports.

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### **PLC electrical meters**

PLC stands for Power Line Carrier or Power Line Communication. It is a method to transmit data using existing electrical wires in a house and along the street. The signals create a disturbance in the electricity, which is picked up by a receiver somewhere else on the line.

PLC can be used several ways. The most common is for the meter to send messages to the utility about how much electricity is consumed. These signals travel along the electrical distribution line to a receiver. The receiver is usually at the substation, but it may be hanging on a utility pole.

In some versions, called PLC smart meters, the utility can also send signals to the electrical meter. These can instruct the meter to disconnect the power to the house, do an instant reading or download new software to the meter’s built-in computer.

These types of PLC are mostly used in rural areas and small towns. In densely populated areas, the utilities often prefer to use wireless meters.

PLC can also be used to communicate with “smart” appliances inside the home. The smart meter may instruct the air conditioner or the water heater to turn off during power shortages or when the cost of electricity is high.

Some pre-pay meters use PLC to communicate with a display panel inside the house.

There are hybrid smart meters available, which communicate using both PLC and wireless. These may communicate with the utility via PLC, while they “talk” to the gas meter, water meter and household appliances using wireless.

### **PLC turns the wires into giant antennas**

Communication is normally transmitted on cables designed for it. Examples are telephone cables, coaxial cables and cables for computer networks. These are all designed to limit the radiation from the signals.

The electrical wires in homes and businesses, as well as the power lines along the streets are not designed to carry communication signals. Here, the PLC signals turn the wires into giant transmitting antennas. This is caused by the modification of the electrical and/or magnetic fields created by the PLC signals.

The utilities claimed that there is no such “antenna effect”, but when radio amateurs complained about interference with their radios, the U.S. Federal Communications Commission (FCC) looked into the matter. The FCC Laboratory did measurements on seven PLC systems, and found that all seven of them radiated. Three of them even radiated at or above the radiation limits.<sup>1,2</sup> Those PLC systems were not used for smart meters, but the principle is the same.

Government agencies in Japan and several European countries also found that PLC systems turn power lines into transmitting antennas.<sup>3,4,5</sup>

The British Broadcasting Corporation documented that household wiring can also radiate PLC signals.<sup>6</sup>

Please see reference 5 for a more detailed coverage of this antenna effect. It also provides many additional references, including several articles from engineering journals.

## **The dirty electricity also comes from the neighbors**

The dirty electricity is not just coming from the PLC meter mounted on the house. It can also come from other meters in the area, travelling from house to house as a disturbance in the line voltage.

Utilities have claimed that this doesn't happen, but the U.S. National Institute of Standards and Technology (NIST) thinks otherwise. NIST realized that signals from various PLC equipment in neighboring houses could interfere with each other, so NIST created a workgroup to make sure different vendors' PLC equipment can co-exist. The rationale for the workgroup is very clear: that PLC signals can travel from house to house.<sup>7,8</sup>

The distance that a PLC signal can travel along a power line varies greatly. The Turtle TS1 system can sometimes reach up to 100 miles (160 km).<sup>8</sup> Some PLC systems are blocked by a building transformer, while others are not.

Most modern PLC systems are two-way, which means that the utility broadcast signals out to all meters. These broadcast signals reach all houses, even those which do not have a PLC meter.

This all means that a household that opts out of a PLC meter may not get any relief.

## **The dirty electricity is constant**

Some PLC meters transmit 100% of the time. The vendor of the Turtle TS1 and TS2 systems boasts that their meters are "always on"<sup>9</sup> or in "continuous communication"<sup>10</sup>, so the utility will quickly notice if there is a line break.

Other PLC meters, such as TWACS, may transmit every 15 minutes or less frequently. However, there can be thousands of meters on the local grid, each of which needs to transmit. The signals from many of those meters may reach into a home.

The TWACS system polls each meter in turn.<sup>11</sup> A controller at the substation sends out a broadcast signal each time a meter needs to be read. These broadcast signals will reach into all homes — the system wouldn't work if they didn't.

This all means that even if the meter on a house doesn't transmit much of the time, other parts of the PLC system do, so there can still be a constant presence of dirty electricity inside the home.

## **Dirty electricity can be a health hazard**

There have been a few studies of health effects from dirty electricity, though the field is very new and has not attracted much funding. What is available now provides cautionary information, however.

Research in Canada has found that dirty electricity appears to make elementary school students more disruptive and less attentive, and that people with certain types of diabetes have trouble controlling their insulin levels.<sup>12,13</sup>

An epidemiological study of a California middle school investigated a cancer cluster there. Some of the classrooms had high levels of dirty electricity and most of the sixteen teachers who developed cancer taught in those classrooms. The study concluded that the cancers were associated with the dirty electricity.<sup>13,14</sup>

There have been several studies looking at biological effects from low-frequency (ELF), pulsed and modulated signals.<sup>16</sup> They are not directly looking at dirty electricity, but some may still be relevant for PLC systems.

The only study specifically looking at PLC was done in Italy. The study documented that PLC signals radiate from power lines and put forward some theories about how they can affect humans.<sup>16</sup>

The International Commission for Electromagnetic Safety (ICEMS) is an association of independent researchers in the field of health effects from electromagnetic radiation. In 2006, this organization issued a statement cautioning against PLC systems. The statement was signed by 31 scientists from 23 countries.<sup>17</sup>

The World Health Organization concluded in 2002 that low-frequency magnetic fields may cause cancer. In 2011, they extended that conclusion to radio frequencies as well.<sup>18</sup>

## **Some people are hypersensitive to dirty electricity**

Dirty electricity from PLC meters does not affect everyone. Most people do seem to do fine. Just as some people can smoke all their lives and live to old age, or some tolerate heat or cold or noise better than others, so it is with dirty electricity.

A small subset of the population is particularly sensitive to electromagnetic radiation at extremely low levels.<sup>19,20,21</sup> People with electrical hypersensitivity are likely the group most affected by dirty electricity. Some people have been bothered so much by PLC meters, that they could not live in their homes.<sup>22,23</sup>

Electrical hypersensitivity has come to the attention of the health authorities only in the last couple of decades and limited research is available. It is a complex syndrome, where the symptoms and level of sensitivity can vary greatly from person to person.

PLC systems can generate both pulsing magnetic fields and pulsing electrical fields. Some emit low frequencies, some higher frequencies. Studies of people who are electrically hypersensitive show that they can be affected by both electrical and magnetic fields of all frequencies used by PLC systems (ELF to RF).<sup>24,25</sup>

Several studies have found that about two to five percent of the population consider themselves to be electrically sensitive to some degree.<sup>20,26,27</sup> The number of people severely affected is much lower.

Regardless of how few or how many people are affected, it is not reasonable to impose such a heavy burden upon the affected individuals.

### **Noticing health effects is difficult**

Electrical utilities have stated at various public meetings that there have been few or no complaints about PLC systems. Thus, they contend, there is no problem. It is not that simple:

- Many environmental toxins take a long time to show health effects. Sometimes it takes decades. Examples are asbestos, lead, cigarettes, DDT and X-rays. These were all once thought to be safe, and it took a great effort to get them regulated — often over strong objections from special interests.
- The symptoms attributed to exposure to dirty electricity are typically headaches, tinnitus, fatigue, restlessness and/or dizziness, which all can have other causes as well.
- The symptoms may take months to come on, after a PLC system is installed.
- The health effects from PLC systems may combine with exposures from other radiant sources, such as cell phones and wireless networks, making it difficult to distinguish cause and effect.

- Very few doctors are aware of these issues, as they are still controversial. A physician may not be comfortable suggesting a controversial cause.
- Some PLC meters are mechanical analog models, so people may not even know they have a transmitting meter.
- Many people think their PLC smart meter is wireless.

This all means that it is very difficult for an individual to discover that they are affected by a PLC system.

Some people have been able to make the connection, usually because their symptoms come on rather rapidly when exposed, or are more severe. Some have complained to their utility, but found that their complaint is ignored or even ridiculed.

An observant local physician may notice an increase in patient complaints and make the connection, but it is unlikely. It may take years for the symptoms to ramp up in a local area, since PLC meters are often installed gradually over many months. Physicians are usually busy people, so they may not notice such a trend.

Epidemiological studies will be necessary. These are difficult to do correctly, take years to do, and cost a lot of money. None have been done so far on PLC systems.

### **PLC radiation may be impossible to escape**

With wireless smart meters, it may be possible to stay away from the radiation by sleeping in the other end of the house or apartment. Or, the meter could be moved to a pedestal in the yard. Or, the utility may allow an opt-out. In many cases, there are solutions for people burdened with a wireless meter.

With PLC meters, mitigation is much more difficult.

An opt-out may not help, as PLC signals can still come into the house from the outside. The signals can get inside on the utility line and also as direct radiation from an outside power line near the house.

Every room in the house that has electrical wires in the walls can be affected, so it may not help to spend more time in a certain part of the house.

A buried line radiates much less than an aerial line, but it still carries the PLC signals into the house, where they can radiate from the household wiring.

The PLC signals may travel in the soil itself, especially in built-up areas such as cities, towns and suburbia. In that case, a person may get no relief from being in the yard.

Some PLC systems used in Europe can be blocked by filters. The PLC systems used in North America use lower frequencies, which cannot be filtered.

A safe distance for people who are hypersensitive to dirty electricity has not been established, and is likely to vary greatly with the person and situation. In one case<sup>22</sup>, it was about 50 ft (16 meters) from a house in the country.

### **Filtering is difficult**

Filters have been developed to mitigate PLC meters in Europe.<sup>28</sup> These filters may not be usable in North America.

Filtering is more difficult in North America, due to two technical obstacles:

- lower PLC frequencies (in some cases)
- higher amperage service feeds (due to lower voltages)

This may make filtering on North American homes unaffordable, or simply not practical.

### **Wired PLC may be worse than wireless**

The health issues with the wireless smart meters have received the most attention, and some utilities promote PLC meters as a positive alternative. With PLC meters being more intrusive and much harder to mitigate, some people may be better off with the wireless meters in their neighborhood. Neither technology is as healthy as the traditional mechanical meter without transmission capability.

### **For more information**

More information about smart meters and PLC systems is available on [www.eiwellspring.org/smartmeter.html](http://www.eiwellspring.org/smartmeter.html) and [www.eiwellspring.org/plc.html](http://www.eiwellspring.org/plc.html).

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## References

- (1) The FCC finds power line communication exceeds radiation limit,  
[www.eiwellspring.org/plc/FCC\\_investigates\\_PLC.htm](http://www.eiwellspring.org/plc/FCC_investigates_PLC.htm)
- (2) Federal Communications Commission, ET Docket 04-39, April 29, 2009,  
[www.eiwellspring.org/plc/FCClaboratoryBPLreport.pdf](http://www.eiwellspring.org/plc/FCClaboratoryBPLreport.pdf) (large file).

See reference 1 for direct links to FCC website files.

- (3) Measurements of Harmful Interference in the HF-UHF Bands Caused by Extension of Power Line Communication Bandwidth, Fuminori Tsuchiya et al., IVS CRL-TDC News, No. 21, November 2002.  
<http://www.isplc.org/docsearch/Proceedings/2003/pdf/A7-1.pdf>

See also [http://www.eiwellspring.org/plc/PLC\\_test\\_in\\_Japan.htm](http://www.eiwellspring.org/plc/PLC_test_in_Japan.htm) for interpretation.

- (4) Assessment of Radio Disturbance Generated by an Established PLC-Network at the Swiss City of Fribourg, Pascal Krahenbuhl and Robert Coray, Swiss Federal Office of Communication.  
[www.compliance-club.com/PLT/Switzerland%20PLC%20field%20trial.pdf](http://www.compliance-club.com/PLT/Switzerland%20PLC%20field%20trial.pdf)

See also [http://www.eiwellspring.org/plc/PLC\\_Fribourg.htm](http://www.eiwellspring.org/plc/PLC_Fribourg.htm) for comments.

- (5) Power Line Communication turns electrical wires into antennas,  
[www.eiwellspring.org/plc/PLC\\_antenna\\_effect.htm](http://www.eiwellspring.org/plc/PLC_antenna_effect.htm)
- (6) PLT and broadcasting — can they co-exist? BBC R&D White Paper WHP 099, J. H. Stott, 2004  
<http://www.bbc.co.uk/rd/pubs/whp/whp099.shtml>

See also [www.eiwellspring.org/plc/PLCAntennaEffectDemo.htm](http://www.eiwellspring.org/plc/PLCAntennaEffectDemo.htm) for interpretation.

- (7) NIST Smart Grid Collaboration Wiki PAP-15,  
<http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP15PLCForLowBitRates>  
(scroll down to “Why Is Coexistence Important”)

See also for commentary:

[www.eiwellspring.org/plc/PLC\\_travels\\_into\\_homes.htm](http://www.eiwellspring.org/plc/PLC_travels_into_homes.htm)



- (8) *For the Grid and Through the Grid: The Role of Power Line Communications in the Smart Grid*, Stefano Galli et al., Proceedings of the IEEE, June 2011.  
<http://arxiv.org/pdf/1010.1973.pdf>
- (9) Product Specification Sheet TS1 Residential Endpoints,  
[http://style.landisgyr.com/apps/products/data/pdf1/TS1\\_Residential\\_ProdSheet1.pdf](http://style.landisgyr.com/apps/products/data/pdf1/TS1_Residential_ProdSheet1.pdf)
- (10) TS2 PLC Network Solution, page 2,  
<http://style.landisgyr.com/apps/products/data/pdf1/PLCBrochure.pdf>
- (11) According to SMPA utility disclosure at public meeting in Ridgway, Colorado, December 14, 2011
- (12) Dirty Electricity and Electrical Hypersensitivity: Five Case Studies, Magda Havas and David Stetzer, World Health Organization Workshop on Electrical Hypersensitivity, October 2004  
<http://ebookbrowse.com/dirty-electricity-and-electrical-hypersensitivity-five-case-studies-pdf-d158170049>
- (13) Dirty Electricity, Samuel Milham, iUniverse, 2010
- (14) A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated With Increased Cancer Incidence in Teachers in a California School, Samuel Milham and Morgan, American Journal of Industrial Medicine, 51:576:586, 2008  
<http://ebookbrowse.com/a-new-electromagnetic-exposure-metric-high-frequency-voltage-pdf-d354199154>
- (15) *BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*, [www.bioinitiative.org](http://www.bioinitiative.org) August 2007
- (16) Radiofrequency Exposure Near High-Voltage Lines, Vignati and Giuliani, Environmental Health Perspectives, Supp 6, December 1997  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1469914/pdf/envhper00331-0183.pdf>

- (17) Benevento Resolution 2006 (article 6.6), *Electromagnetic Biology and Medicine* 25: 197-200 (2006)  
[http://www.icems.eu/benevento\\_resolution.htm](http://www.icems.eu/benevento_resolution.htm)
- (18) World Health Organization Fact Sheet 193, June 2011  
<http://www.who.int/mediacentre/factsheets/fs193/en/index.html>
- (19) Electromagnetic Hypersensitivity, Steen Hviid, *Townsend Letter*, January 2010. [www.townsendletter.com/Jan2010/electromag0110.html](http://www.townsendletter.com/Jan2010/electromag0110.html)
- (20) Disturbance of the immune system by electromagnetic fields – a potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment, Olle Johansson, *pathophysiology* 16, 2009. doi: 10.1016/j.pathophys.2009.03.004  
<http://www.pathophysiologyjournal.com/article/S0928-4680%2809%2900035-2/abstract>
- (21) Electromagnetic hypersensitivity: Fact or fiction, Stephen Genuis, *Sci Total Environment*, 2011, doi: 10.1016/j.scitotenv.2011.11.008  
<http://www.sciencedirect.com/science/article/pii/S0048969711012733>
- (22) Driven Out by PLC,  
[www.eiwellspring.org/smartmeter/DrivenOutByPowerLineSignals.htm](http://www.eiwellspring.org/smartmeter/DrivenOutByPowerLineSignals.htm)
- (23) PLC health effect testimonials,  
[www.eiwellspring.org/smartmeter/PLC\\_testimony.htm](http://www.eiwellspring.org/smartmeter/PLC_testimony.htm)
- (24) Electromagnetic Field Sensitivity, William J. Rea et al., *Journal of Bioelectricity*, vol 10 (1&2), 241-256, 1992,  
[www.aehf.com/articles/em\\_sensitive.html](http://www.aehf.com/articles/em_sensitive.html)
- (25) Electromagnetic Hypersensitivity: Evidence for a Novel Neurological Syndrome, David McCarty et al., *International Journal of Neuroscience*, 121, 670-676, 2011, doi: 10.3109/00207454.2011.608139  
<http://informahealthcare.com/doi/abs/10.3109/00207454.2011.608139>
- (26) Prevalence and risk factors of self-perceived hypersensitivity to electromagnetic fields in California, Patrick Levallois, *Environmental Health Perspectives*, August 2002 (vol 110, sup 4)  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1241215/>

- (27) Development and Evaluation of the Electromagnetic Hypersensitivity Questionnaire, Stacy Eltiti et al. *Bioelectromagnetics*, 28: 137-151, 2007, doi: 10.1002/bem.20279
  
- (28) Filtering the new smart electrical meters, Torbjorn Lindblom, [www.eiwellspring.org/tech/FilteringNewSmartMeters.pdf](http://www.eiwellspring.org/tech/FilteringNewSmartMeters.pdf)