Your low EMF Home Articles

Your low EMF Home set of articles is separated into 9 sections, each of which can be individually downloaded. It is a 'work in progress' incorporating new information whenever time permits.

Section 3

Lighting, dimmer switches, coloured lights

1. House wiring and EMFs; introduction; what are normal EMFs? Choosing a consumer unit; electric Fields; cables; demand switches; external 'faults' in the supply that can cause high magnetic fields; Wiring in homes - SAGE report July 2007

2. Dirty electricity (DE) – What is dirty electricity? What effect does it have? What sort of levels are you likely to have? What you can do if you have high levels of DE; DE coming into the house; DE generated within the house; dLAN caution

3. Lighting and EMFs; Bulbs, incandescent, energy-saving, fluorescent, halogen, full-spectrum light, daylight, light emitting diode (LED); anglepoise lamps and other metal framed lamps, halogen desk lamps, bedside/bedhead lights, spotlights, standard lamps and table lamps, nightlights; light wiring; light switches, dimmer switches; Physiological effects of blue and red lights; circadian rhythms, melatonin, light and illness, timing of blue lights, timing of red/amber lights

4. Smart meters – What is it all about? Smart Grid; Remote reading meters; Smart meters; Wide Area Network (WAN) technologies; Home Area Network (HAN); RF exposures from Smart Meters; Experiences of smart meters in other countries; Solar storms may affect smart meters

5. WiFi general – brain damage; cancer; diabetes; DNA; electrical hypersensitivity; eyes; heart; heat shock proteins; immune system defects; kidney damage; memory effects; neurodegenerative diseases; neurological effects; oral effects; plant effects; reproductive effects; skin effects; elicited stress response and WiFi technical – WiMAX; Wireless Myths 1) We've been exposed to this radiation for years, it must be safe 2) People only got affected when the scare stories started, it must be psychosomatic 3) Being on a phone for 20 minutes is equivalent to 1 year in a WiFi classroom 4) The WHO factsheet says there is no cause for concern, and they should know; Technical Information for Different Protocols

6. Underfloor heating

Lighting and EMFs

Research into potential health effects as a result of exposure to electromagnetic fields has primarily concentrated on measured magnetic, and some measured electric, fields. All house wiring and the wires to electrical appliances (when plugged in) radiate electric fields. When appliances are switched on they also give off magnetic fields.

In areas where you spend quite a lot of time, such as in bed or in a favourite chair, you should be in fields as low as possible, below 0.15 microtesla (0.1 on the pillow area of the bed) magnetic field and, ideally, below 5 V/m electric field. These are below the levels usually associated with health problems.

All lighting circuits connected to a building's mains electricity create electric fields all the time, even when the lights are switched off. If screened cable is used then these electric fields will be greatly reduced. The problem is usually worst on the floor above the wiring for the lighting - i.e. in a typical two-storey house, the electric fields upstairs are usually mainly created by the downstairs lighting circuits that run under the floor. In multiple occupancy buildings the situation may be more complicated due to the presence of the electricity supply going to other flats.

BULBS

Incandescent

Ordinary incandescent light bulbs didn't cause much of an EMF problem. They used relatively small currents and the relatively low mains frequency (50 Hz) magnetic fields that were created fell off rapidly from the bulb. Much higher magnetic fields can be caused by undetected faults in the lighting wiring, especially due to the fact that two-way (i.e. two switch) lighting circuits are sometimes incorrectly wired. DC lighting (which is possible, especially for low-voltage halogen lamps) does not create problematic EMFs. However, incandescent bulbs are very energy-inefficient in generating light and we are being encouraged to look at energy-saving bulbs, where the situation is more complicated.

Interestingly, of course, incandescent bulbs not only give out light but also a very small but detectable amount of heat, which would no longer be available when replaced with an energy-saving equivalent. We believe the financial saving may not be as large as we are led to believe.

There have been reports that many of the new energy efficient bulbs last nowhere near ten times longer, as is usually claimed. This does not necessarily help the purchaser financially, in fact it may make the situation worse, and add to the disposal problem, below.

It is difficult to imagine that the disposal of the energy-saving bulbs which contain significant amounts of mercury and need to be treated as toxic waste is likely to help the problem with identifying appropriate landfill and ensuring compliance with disposal.

The EU directive banning incandescent bulbs refers only to those meant for household lamps, meaning shops can continue to supply bulbs intended for industrial use, so-called rough-service incandescent bulbs. They will continue to be available from specialist lighting and hardware shops.

Energy-saving

EMFields pocket PF5 can detect up to 60 kHz frequency, emitted by energy saving and other fluorescent bulbs. Most other powerfrequency meters do not measure these frequencies, which are more bioactive and can affect people who are sensitive.

The European Commission is phasing out most incandescent lamps and other 'inefficient' light bulbs as part of measures on domestic lighting implementing the EuP directive. The presidency's resolution says that for some products other environmental criteria, such as water and waste, should be considered "over and above" energy efficiency. Energy saving light bulbs are supposed to require 5 times less electricity to do much the same job as incandescents, cut greenhouse emissions by 60-70% and save users approximately £7 per bulb each year. We do not believe the latter comment is borne out by people's experiences of the length of time CFLs last.

The Lighting Industry Federation said that claims made for the equivalent output of incandescent and CFL bulbs were exaggerated. A CFL is designed to provide maximum light output at 25°C, and when it gets hotter or colder than that, its brightness can be reduced. If the bulb is in a recessed fixture in the ceiling, and it gets warm, there might be a 10-20% reduction in its light output. CFL bulbs can get 20% dimmer over time. Turning it on and off every 15 minutes will more than halve its expected lifespan.

A CFL saves energy by turning itself on and off repeatedly, as many as 100,000 times a second. They are some of the worst culprits for sending transients down electricity supply wiring because of this. See Section 2. Dirty Electricity.

All 'energy-saving' bulbs are fluorescent, giving off high localised electric and magnetic fields. Most modern "all electronic" ones mostly emit higher frequency fields (usually 30-60 kHz, which is within the range Intermediate Frequency 24-100kHz (IF), as defined by the World Health Organisation). There is concern about electromagnetic interference associated with IF and studies have shown that IF fields are biologically active and can have adverse health effects (Havas & Stetzer 2004, Milham & Morgan 2008).

The light they give off can be very intense, rather than the more relaxed gentle light of most incandescents to which we have become accustomed, and the intense light is not liked by a lot of people.

The European Commission Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) has, in many people's opinions, inadequately reviewed the evidence on the electromagnetic fields caused by energy saving bulbs. They have failed to emphasize the lack of research in this area and have omitted important studies documenting adverse effects. Energy-saving light bulbs give off more electromagnetic radiation than incandescent bulbs, and also emit radiofrequency radiation. A Centre de Recherche et d'Information Independantes sur les Rayonnements ElectroMagnetiques (Criirem) document shows that energy-saving lamps generate very strong electromagnetic fields, varying between 2 and 180 volts per metre, up to 1 metre away. According to SCENHIR, this should not be a problem, as the measured values are far below ICNIRP. Criirem says there ought to be a warning not to use energy saving lamps at too close a distance, for example, as desk lamps or as a reading lamp beside the bed.

Dermatological symptoms such as reddening of the skin, tingling, itching and burning sensations have been reported by people sensitive to this sort of radiation. SCENHIR omitted to contact Professor Olle Johansson, the expert in ES and skin symptoms.

A retired chemist reported symptoms similar to sunburn as a result of exposure to CFLs. He experienced a painful reddening and swelling of the right earlobe, which did not respond to the normal ointments. He had replaced the bulb in his reading lamp, positioned a foot away from his ear. Reverting to the incandescent light bulb, his ear problem cleared up within a couple of days.

As well as skin problems, headaches and fatigue have also been linked to CFL exposure. Some people get other body aches and pains; some have difficulty sleeping, they're tired and some have mood disorders. Dr Larry Newman, a neurologist, says that his patients see a relationship to exposure to CFLs and developing a headache.

Current UK building regulations state (in part L1 of the regulations) that a certain number of dedicated low energy light fittings must be installed within 'new build' UK homes and extensions. Certain rules also apply for 'new build' offices and commercial properties. These fittings must have integrated ballasts within the fitting to ensure only low energy bulbs can be replaced (thus stopping the installation of standard, non-efficient, incandescent lamps in the lamp holders). There must be a) one per 25 metre squared of dwelling floor area (excluding garages) or part thereof; or b) one per four fixed lighting fittings (25%). This has been known to be over-zealously interpreted and new sockets have been fitted throughout all new homes and also in older properties being rewired.

We are in complete agreement with the necessity for saving energy wherever possible, although it is important to remember that fluorescent energy-saving bulbs may not necessarily be beneficial for everyone, nor is the real energy saving anything like that claimed. Heat lost from bulbs, which are used more at night and in the winter months, actually warms the building slightly and thereby reduces the need for additional heat which would otherwise be turned on. There is a place for compact fluorescents (CFLs) in hallways and for outside lights.

Public Health England (PHE, used to be HPA) in October 2008 said that some energy saving compact fluorescent lights can emit ultraviolet radiation at levels that, under certain conditions of use, can result in exposures higher than guideline levels. They recommend some precautionary measures:-

- open (single envelope) CFLs shown below should not be used where people are closer than 30 cm or 1 ft - to the bare light bulb for over 1 hour a day. At an inch or less, they emit the same amount of UV radiation as you would get walking in strong summer sunshine.

- The Agency advises that for such situations open CFLs should be replaced by the encapsulated (double envelope) type shown below, where ultraviolet radiation is absorbed by the outer glass container.

As a result of the PHE's advice the Government is pressing the EU to take account of the findings in future European legislation.

People suffering from medical conditions are most at risk as are those whose job involves close work with their hands under a light bulb, such as jewellery makers.

A spokesman for the Royal National College for the Blind said that lower energy bulbs make things more difficult for those with a sight condition. CFLs have 80% less power and provide a diffused light whereas the traditional bulbs give out spots of light and have a high contrast. *"There's quite good evidence that low lighting can lead to a greater number of falls in people with low vision"* he continues. *"Halogen lamps, which do provide contrast lighting, will remain on the market. These offer 30-45% energy savings in comparison to incandescent bulbs."*

PHE scientists observed that a significant proportion of the CFLs tested had a flicker at about 100 Hz. Whilst a 100 Hz flicker will not be perceptible to most people, some will be aware of it if the light bulb is in the periphery of their vision. Lighting industry bodies were informed of this finding prior to publication and further research may be needed on this. There are wide differences in the amount of EMFs caused by different brands of CFL. Manufacturers should be encouraged or obliged to create lamps that cause little or no EMFs.

A person with ES (electrical hypersensitivity) who contacted us suggested that low energy bulbs may change the characteristics of the electric supply they are a part of. He said "when I was using *(ordinary)* incandescent bulbs for reading, I would get a burning sensation, but when I removed all of the low energy bulbs from the house, the problem went away." He also found that the electrosmog detector he had would 'whine' up to 15 cm from a lit CFL fixture. He checked on the internet and found that some people use low energy light bulbs as microwave emitters to test screening material, and that the electronic ballast of CFL can introduce high frequency noise into the house wiring.

David Pye from the University of London (in Physics World August 2007), wondered whether low energy bulbs also emit ultrasound. He investigated 2 different kinds of bulb and found that a U-shaped tube emitted at a fundamental frequency of 27 kHz and a coiled type at 37 kHz. Both gave a rather stronger acoustic signal at the second harmonics (54 kHz and 74 kHz, respectively) and also appreciable signals at the third harmonics (81 kHz and 111 kHz). He pointed out that most of these components are well within the hearing range of some domestic pets, especially cats.

Compact lights also contain electronic circuits and more hazardous materials, including mercury, and take more energy and resources to make than older incandescent bulbs so, as usual, nothing is absolutely right or wrong. Long-life incandescent bulbs are not as bad as often claimed. The short-life, very cheap, bulbs are wasteful of resources - but good for supermarket profits! It's quite odd that environmentalists have embraced the CFL, which cannot now, and will not in the foreseeable future, be made without mercury. Given that there are about 4 billion light bulb sockets in the USA alone, millions of tons of waste are going to be produced.

Large numbers of Chinese workers have been poisoned by mercury, which forms part of the compact fluorescent light bulbs. The surge in foreign demand, since the European Union directive made these bulbs compulsory, has also led to the re-opening of mercury mines that have ruined the environment. Making the bulbs requires workers to handle mercury in either solid or liquid form because a small amount of the metal is put into each bulb to start the chemical reaction that creates light.

An interesting item appeared in Junk Science as long ago as April 2007:-

It cost Brandy Bridges of Ellsworth, Maine about $2,004.28 to change her CFL when it broke in her daughter's bedroom. Aware that CFLs contain potentially hazardous substances, Bridges called her local Home Depot for advice. The store told her that the CFL contained mercury and

that she should call the Poison Control hotline, which directed her to the Maine Department of Environmental Protection, who sent a specialist to Bridges' house to test for mercury contamination. The specialist found mercury levels in excess of 6 times the state's 'safe' level in the bedroom, and recommended an environmental cleanup firm, quoting $2,000 for the job. The room was sealed and her insurance company said she wasn't covered for mercury contamination.

Given that the replacement of incandescent bulbs with CFLs is to save up to $180 in energy costs annually – it will take Brandy Bridges only 12 years to recoup the cost, assuming she doesn't break any more.

The Maine Department of Environmental Protection's advice if you break a CFL:- "Don't vacuum bulb debris because a standard vacuum will spread mercury-containing dust throughout the area and contaminate the vacuum. Ventilate the area and reduce the temperature. Wear protective equipment like goggles, coveralls and a dust mask. Collect the waste material into an airtight container. Pat the area with the sticky side of tape. Wipe with a damp cloth. Finally, check with local authorities to see where hazardous waste may be properly disposed.

Official advice says *Fluorescent lamps contain mercury. Mercury at atmospheric pressure is a silver coloured liquid that tends to form balls. Mercury is a hazardous substance. When one lamp is broken, the best thing to do is to wear chemical resistant glove to clean it up. The gloves can be vinyl, rubber, PVC or neoprene. The gloves you buy in the supermarket for household cleaning are sufficient. The gloves protect your skin from absorbing mercury and from getting cut by the glass. The remains of one lamp can be disposed as normal waste since the amount of mercury is small. However, for future reference, when large quantities of lamps are being disposed you must follow your state and the federal regulation for disposing of mercury-containing lamps."*

As each CFL contains 5 milligrams of mercury, at the Maine 'safety' standard of 300 nanograms per cubic meter, it would take 16,667 cubic meters of soil to 'safely' contain all the mercury in a single CFL.

Fluorescent

Ordinary fluorescent lights give off high levels of magnetic fields up to half a metre from their ballast coils – these fields will go through the ceiling to any room above. The flicker and hum associated with these lights may be noticeable and trigger irritability, eyestrain and headaches. Some high-frequency, low-flicker, energy-efficient, electronic-ballast fluorescent lights emit significant levels of very low frequency and/or radiofrequency fields, although modern high-quality fittings are usually quite good.

Some of the modern high-frequency ones give off high levels of Very Low Frequency (VLF) fields (2 kHz - 200 kHz, usually 32 kHz with some harmonics at 64 and 96 kHz).

Rooms with low ceilings and fluorescent lights (as in some schools and offices) may have readings above 0.2 microtesla at head height. In multi-storey schools with fluorescent lights, although young children may be far enough away from the ceiling fixtures, on upper floors they may still be exposed to EMFs from the lights on the floor below.

Halogen

Halogen lights usually generate a lot of heat and need good ventilation if they are not to be a fire hazard. Most are low-voltage and so require far more current than mains-voltage lamps, generating higher magnetic fields. These are made worse by the 'suspended open-wire' systems they may be designed to hang down from, as the wires are quite far apart and run not far above an adult's head. Often these are not earthed, so they also give off quite high electric fields. To minimise electric fields, it is important that one side of the low-voltage supply coming out of the transformer is earthed.

Many low-voltage halogen light fittings have their own inbuilt transformer which reduces the mains voltage to 12, 24 or 28 volts to supply the lamp filament. Unfortunately, transformers are usually very poorly constructed and give off very high levels of power-frequency magnetic fields close to. If set into the ceiling, with the light projecting downwards, there is not usually an EMF problem in the room being lit; but if there is a room directly above, then areas of high magnetic fields (from the inbuilt transformers) are produced in that room up to about 50 cm from the floor. If this is a child's room they are likely to be highly exposed when playing on the floor, and possibly even when lying on their bed or cot.

To avoid this, you could purchase low-voltage light fittings without built-in transformers and have one high quality torroidal transformer (which will produce low levels of external magnetic fields) feeding all the lights on that circuit. For instance, if you have several light fittings in a false ceiling, a low EMF leakage torroidal transformer can be in one corner of the room, as part of the circuit between the switch and the lamps.

The latest fitted halogens have electronic power supplies rather than transformers.

Most halogen lights come in fireproof metal or metallised fittings. These fittings should be earthed, which will significantly reduce the electric field levels given off. This can be done easily by connecting them to the safety electrical earth that will be present where the transformer is connected to the mains electricity. This would normally be done using standard green/yellow earth wire. If the halogen lamps are supplied from an ordinary transformer, one side of the low-voltage supply to the lamp should also be connected to the electrical safety earth. If they are supplied from an electronic unit, this should not be done as it will make some electronic units fail.

Full-spectrum light bulbs

Full-spectrum light bulbs are beneficial, especially as the majority of people do not get adequate exposure to daylight at work.

Both fluorescent and incandescent full-spectrum light bulbs are available, having different qualities. Fluorescent bulbs have the full spectrum of visible light, and also some ultraviolet, but little infra-red. Incandescent bulbs have the full spectrum of visible light, and also some infra-red, but less ultraviolet. It is not known what aspects of 'non-visible' light are most important in determining our wellbeing. By far the best option is getting as much real daylight as you possibly can.

Avoid using full spectrum bulbs after 8pm, when you should minimise all exposure to bright light because it will reduce your body's production of melatonin during the night that follows. Melatonin, produced mainly at night, is the hormone involved in the repair of cellular damage, and also mood stabilisation. See the separate article in 4 sections on Melatonin. A lowish-power incandescent bulb is better after 8pm. Red light, or weak yellow light, is acceptable later at night; blue light seems to have the same effect as bright light.

Amber light provides a 'cosy' atmosphere, which gives more than adequate illumination to read by, as well as watch TV or chat to family and friends, and it does not interfere with melatonin production. Blue/white light in the morning is stimulating, helps mood stabilisation, and generally gets you going for the day's activities. See the section below on the physiological effects of blue and red lights.

Daylight bulbs

These are usually just ordinary bulbs with a colour-corrected glass coating (bluish for incandescent bulbs and yellowish for fluorescent bulbs) that give a better approximation to daylight for colour-rendering. They are NOT the same as full-spectrum bulbs and are much cheaper. They do not have the health benefits of full-spectrum lighting.

Light Emitting Diode (LED) bulbs

These are highly efficient - more so than compact fluorescents (CFLs), and do not contain mercury. They are available in a number of colour-grades from single colours to yellow-white, neutral-white and bluish-white. The coloured light from LEDs is due to different atomic elements in the LED structure that resonate at different optical frequencies. The 'warm' white ones have little blue (mainly red and green) and the blue they do have is not towards the UV end of the blue part of the spectrum.

Tsybulin (2016) found that exposure to monochromatic red LED light helped protect against oxidative stress caused by exposure to a 900 MHz electromagnetic field (GSM).

Some however, do give off RF emissions, and these are not well tolerated by people suffering from ES. Most are supplied with internal switching regulators, which cause pulsed EMFs and often very fast pulsing light from the LED (too fast to see flicker). Analogue regulators do not give this problem. This can be a problem if parents opt for VLC instead of WiFi systems for their children's schools, as some children are likely to react adversely to the RF from the power supplies.

LEDs installed in Hoogeveen Town Hall caused headaches in employees and caused computer 'wobble'. They decided that the LEDs used were too cheap and inferior. A newer generation of LEDs did not cause the same problems. Andrew Goldsworthy (a UK EMF expert) suggests "*The problem is not the LEDs. The trouble arises due to using cheap power supplies that do not smooth their high frequency pulsed output. These can cause all sorts of health problems similar to those experienced by people sensitive to the radiation from compact fluorescent lamps. LEDs work best on DC and there is no reason (apart from the extra expense) why the pulses should not be smoothed out with a capacitor.*"

Magda Havas says "*CLEDs (LEDs without a transformer) are more energy efficient than CFLs and do not have the adverse effects of UV, mercury, or EMR.*"

'Wind up' or 'shaken' LED torches can give off very high levels of EMFs when they are being wound or shaken.

LEDs can be used as communications devices. Integrating LEDs with optical wireless communications is a new technology that combines brighter light and longer life bulbs with network access provided by the existing infrastructure – light fixtures, power lines or network cabling. You might be able to light a room and, at the same time, enable your laptop, computer, etc. to wirelessly receive data transmissions. Equipping vehicles with LED-based communication in headlights and brake lights supports automatic emergency braking to prevent accidents.

Different types of lamps or lights can give off quite high electric fields from the cable, even when the light itself is switched off, as they usually are only supplied with two-core cable. If you are unsure what type of cable is used, always switch lamps off at the wall, when no electric field will be produced. Use three core flex or, better still for reducing electric fields, screened mains cable.

Lower voltage lights are better only if one wire of the low voltage is earthed. If not, then it is not any better and the magnetic fields will be higher close to the transformer so there is no real advantage.

Anglepoise lamps and other metal framed lamps

These can also give off very high electric fields. Always use three core flex and connect the earth wire to the metal frame. Clean the paint off the metal under a screw and fix the bare end of the wire at that point. If there are no suitable screws, then tightly binding the bare end of the wire to the frame using electrical insulation tape will work.

Halogen desk lamps

These usually have cheap transformers located in their base which should be positioned at least 50 cm away from your body in order to minimise EMF exposure. Although they can produce

attractive 'bright pools of light,' it is important to position halogen fittings to ensure that you do not look at the bulbs directly. Unfiltered halogen lamps can give off high levels of light in the blue part of the spectrum and quite high levels of ultra-violet (UVA and UVB) radiation. The light from some 20 watt lamps, if looked at directly, can exceed the National Radiological Protection Board's safety guidance outlined in their "Hazard assessment of optical radiation sources used in some consumer products" (October 1991) in under one minute! For those 20 watt bulbs which have some built-in filtering, and which run at a lower temperature, it would take about 15 minutes looking at them directly to exceed the safety guidance. Alternative types of desk light are recommended for places where you could be close to these fields.

Bedside / bedhead lights

These can give off high electric and magnetic fields. If you have a poor immune system or a serious illness, it is important to check the fields from the wiring and, if they are high, reduce them by changing the wiring or using lamps on the bedside table or wall lights mounted well above your head level when lying on the bed. Lights give off high magnetic fields all the time they are switched on. Keep them as far away from your head at night as is practical. A study by Tomitsch (2010) found that one of the highest sources of electric fields in people's houses were due to lamps beside the bed (up to 166 V/m.)

Spotlights

These are not normally a problem unless they are halogen lights (see above).

Standard lamps and table lamps

Most have only a two-core mains lead, which will give off high electric fields and should be kept well away from your body. Leads should be tidied safely away, running along skirting boards away from where you sit, wherever possible. This makes practical safety sense for children who spend a lot of time on the floor, and it also protects them from high electric fields from unearthed appliances, which are present even when the appliance switch is off. The wire of a table lamp should lead away from the person sitting next to it.

Nightlights

These should not be used unless absolutely necessary, because the pineal gland best produces melatonin, the body's natural anti-cancer hormone, in the dark. If it is necessary to have one in a child's bedroom use a very low-wattage glow bulb, or low-wattage amber LEDs in a unit well away from the child's bed, keeping the wires as far away from the child as possible.

Nightlights are often originally for the parents' benefit, rather than the child's and it is a good idea not to develop a dependency on illumination, if avoidable.

Light wiring

Re-route wires and / or use metal conduit behind the bedhead if necessary, as the cables from the socket to the light may increase electric and magnetic field exposure to the head. If you are unsure of the levels of field behind your bed, move the bed six inches away from the wall.

Underfloor wiring in the upstairs floors of houses, flats, etc. gives off high magnetic fields, unless the wires are screened or are run in metal conduit. This is not a problem for adults and older children usually, but for young children who can play for long periods of time on the floor, it is worth finding out where the high field levels are, then you can make changes so that the child is not likely to play there, such as by moving furniture there.

Mattresses should not be placed directly on to the floor, unless you are sure where 'safe' areas are.

Light switches

These can give off high levels of electric fields.

One common cause of high magnetic fields is incorrectly wired two-way hall / landing switches. High electric field levels towards the ceilings are usually due to modern lighting wiring practice. Wiring can be traced in the walls as it creates a line of high electric field, from the light switch upwards. When the wiring is in earthed metal conduit pipes (as originally was standard practice - and still is in public buildings) electric fields become almost non-existent.

Light switches can give off RF radiation if they have 'picked up' microwaves travelling round the wiring from a DECT phone base unit or phone mast. If it is from a DECT system, you will need to find the unit, if it is a phone mast, then ferrite filters will need to be clipped around various wiring cables to try to stop the microwaves travelling along them.

Dimmer switches

Cheap dimmer switches and wiring connected to them give off radiofrequency noise that you may be able to pick up on the Acoustimeter or Acousticom 2. As little of this energy is in the microwave part of the spectrum, a better way to detect it is to use a battery portable radio set to receive on the Long Wave or Medium Wave bands and tuned between radio stations. If present, the dimmer 'noise' will appear as considerable electrical interference. Dimmer switches that have been properly CE tested shouldn't result in this sound, though you may hear a little VERY close to them or the wiring, as when they switch off they can cause spikes especially with fluorescent lamp loads.

The difference between good dimmers and poor ones is in the level of high-frequency filtering that they have built into them and that they also use "zero voltage switching" for the end of power where switching spikes most occur. They use both half-cycles, so supply power 100 times every second. Lamps do not normally appear to flicker – though they can do, especially when very dim. Dimmers have got better over the last 15 years due to the EU and UK EMC Directive and Regulations which strictly limit the amount of RF interference such a device can generate.

All electronically light-dimmed AC systems will give off more noise than ones with a simple on-off switch. You might want to think carefully about whether you want to have a dimmer switch if there is a high bunk bed nearby. The electrical 'noise' doesn't just come from the dimmer switch but from all the wiring on that electrical circuit.

A much better low EMF solution would be to have some low-power light fittings in the room for use when you want dim lighting. These could just be plugged in to power sockets (e.g. a low-wattage up-lighter).

It is worth noting that any "light at night" is not good for our health. It is better to sleep in the dark (see the article on melatonin (in 4 sections) http://emfields-solutions.com/library.asp). If children *really* can not sleep in the dark (n.b. this often results from parents' leaving the lights on when they were a baby and thereby 'conditioning' the child to expect light at night!) then a small orange or red plug-top glow light is all that should be used. That is quite adequate to see the room if the person awakes during the night. Recent work by Professor Magda Havas and others have shown that "noisy" electricity can cause all sorts of adverse health problems. See the article on Dirty Electricity.

Physiological effects of blue and red lights

Circadian rhythms, melatonin, light and illness

Almost all living things on earth show a 24-hour circadian and biological rhythm, due to the earth's rotation. This rhythm has a profound impact on biochemical, physiological, and behavioural processes in living organisms (Reppert and Weaver 2002, Reddy and O'Neill 2010). The suprachiasmatic nucleus (SCN) of the hypothalamus in the brain, is primarily responsible for maintaining this 24-hour rhythm, using light as its main cue (Dunlap 2004).

Melatonin is a hormone which is primarily synthesized in the pineal gland and then it goes into the blood. Its 24-hour rhythm is directly driven by the circadian clock from the SCN to the pineal gland. So pineal melatonin is synthesized during the night (normal peak 1-3 a.m.), and during the day, production virtually stops.

Melatonin has been shown in studies in vitro to have antioxidant properties, including scavenging free radicals, preventing tumour cell growth, and enhancing the immune response (Brzezinski 1997, Korkmaz 2009, Reiter 2010).

The response of the circadian system to light is dependent on the timing and quality of light exposure (Rimmer 2000, Thapan 2001, Lockley 2003, Gronfier 2004, 2007, Ozkan 2012, Rüger 2013).

Ill-timed light exposure may result in disruption of circadian rhythms dependent on the type of light (Stevens 2011). Ill-timed exposures to even low levels of light in household settings may be sufficient for circadian disruptions. Bedrosian & Nelson (2013) in a review on the effects of light on mood, concluded that night time exposure to light disrupts circadian organisation and contributes to depressed mood. Exposure to light at night in home settings is significantly associated with increased night-time blood pressure (BP) in elderly individuals independently of overnight urinary melatonin excretion. An increase in night-time BP is associated with an increase in total mortality, which corresponds to approximately 10 000 annual excess deaths in Japanese elderly population (Obayashi 2014).

A comparison between the effects of living room light and dim light before bedtime showed that exposure to ordinary levels of room light suppressed melatonin levels and shortened the duration of melatonin production in healthy volunteers (18-30 years) (Gooley 2011). Wada (2013) found that low levels of evening lighting improved melatonin secretion at night, which induced easy onset of sleep and better quality of sleep in students, including athletes.

It has been suggested that circadian disruptions play an important role in the development of chronic diseases and conditions such as cancer (breast, prostate, endometrial, ovarian, colo-rectal, skin and melanomas and non-Hodgkin's lymphomas), cardiovascular diseases, reproduction, endometriosis, gastrointestinal and digestive problems, premature ageing, diabetes, obesity, depression (especially during winter months when daylight exposure is often reduced for those primarily working in artificial light), sleep deprivation, and cognitive impairment (Haus and Smolensky 2006, Stevens 2007, Takahashi 2008, Frost 2009, Bass and Takahashi 2010, Boyce and Barriball 2010, IARC 2010, Kvaskoff and Weinstein 2010, Mahoney 2010, Rana and Mahmood 2010, Poole 2011, Ortiz-Tudela 2012).

When cryptochrome in the retina is exposed to blue light, it undergoes a series of complicated chemical reactions. One of these intermediates has magnetic properties. It could be a link between the magnetic stage of cryptochrome in the retina and magnetite in the brain. A disturbance in this system could be involved in the development of frontotemporal dementia and other mental disturbances like Alzheimer's disease. There could also be a link between circadian rhythms and memory dysfunction connected to schizophrenia, type 2 diabetes, and blue light (Størmer 2015).

Breast cancer risk has been consistently associated with various aspects of circadian disruptions including being exposed to high ambient light during the night (Stevens 2009). Three studies link breast cancer risk to exposure to non-occupational light-at-night (LAN) in the home (Davis 2001, Kloog 2011, O'Leary 2006), and significant associations were found for women who did not sleep during the period of the night where melatonin levels are normally peaking (Davis 2001), or who frequently turned on the light during the night. An increased breast cancer risk was also found with increasing bedroom light levels (Kloog 2010).

Dauchy (2011) found that even very low levels of LAN in their animal laboratory disrupted circadian rhythms and stimulated cancer growth. Reducing LAN restored these aspects of metabolism.

Pauley, in a meta-analysis (2004), suggested that the proper use and colour of indoor lighting is important to the health of humans. Kent (2009) found that decreased exposure to sunlight was associated with an increased probability of cognitive impairment. We do not know whether daylight spectrum bulbs would have a similar effect.

People with many medical conditions, e.g. lupus, ME and ES, cannot tolerate "blue" lighting, whether fluorescent or otherwise.

Timing of blue lights

Our circadian system is especially sensitive to blue light even at low light levels, though it varies from individual to individual, with genetic differences. In comparison to light at 2500 K, blue-enriched light at 6500 K induced a significant suppression of the evening rise in endogenous melatonin levels in PER3(5/5) individuals but not in PER3(4/4) individuals (Chellappa 2012).

Blue-enriched light is more efficient in melatonin suppression than other wavelengths (Figueiro and Rea 2010, Gooley 2011) and the effects persist (Wahnschaffe 2013), even into sleep (Münch 2006). Computer use at night did not affect melatonin levels as long as there was no blue light nearby (Figueiro 2011). Smartphones, tablets and e-readers should have an automatic "bedtime mode" that stops them disrupting people's sleep, says a leading doctor from Evelina children's Hospital in London. Prof Paul Gringras (2015) argued the setting should filter out the blue light that delays the body clock and keeps people awake later into the evening. If you are in front of one of these devices at night-time it could prevent you falling asleep by an extra hour."

Najjar (2014) found a significant delay of about 30 minutes in the onset of melatonin secretion occurred with standard fluorescent white (SW) light, but not with blue enriched (BE) light. BE light significantly enhanced well being and alertness compared to SW light. The authors believed that this finding could lead to practical applications of light exposure in working environments where background light intensity is chronically low to moderate (polar base stations, power plants, space missions, etc), and may help design lighting strategies to maintain health, productivity and personnel safety.

The threshold level of low wavelength light required to inhibit melatonin production in the horse lies between 3 and 10 lux. Melatonin inhibition can be achieved by exposing a single eye to low wavelength blue light (Walsh 2012). In an experiment where light at night supressed the expected nocturnal rise in melatonin, one shade of blue (between 470and 480 nm) prevented the drop in melatonin, whereas a shade between 452 to 462nm did not (Rahman 2008).

The good side of blue light (Lockley 2003), is that it enhances alertness, (Cajochen 2005, Phipps-Nelson 2009) and gets you ready for the day ahead (Lockley 2006), or increases alertness in the afternoon, close to the post-lunch dip hours (Sahin & Figueiro 2013). Blue light also activates the parts of the brain involved in thinking, memory and mood (Vandewalle 2007a, Vandewalle 2007b, Vandewalle 2009, Vandewalle 2010). Several studies report that shorter wavelengths, such as blue light are significantly more efficient in generating alertness responses than longer wavelengths (red lights) (Cajochen 2005, Lockley 2006, Revell 2006, Vanderwalle 2007a).

Disruption of circadian rhythms by insufficient light exposure seems to be involved in a subgroup of depressed patients (Monteleone 2011). Several studies have shown that light therapy may be an efficient treatment for seasonal affective disorder (SAD) (Monteleone 2011, Westrin and Lam 2007, Wirz-Justice 2005). Recent reports have shown that short wavelength blue light from LED sources (Anderson 2009, Glickman 2006, Howland 2009, Strong 2009) has similar clinical effects to white light sources. Blue light may be even more effective than the bright white light currently used in light boxes to treat SAD and other forms of depression. Maybe it is the lack of exposure to blue sky in the short, often overcast days of winter that make some of us prone to emotional downturns and SAD. Brainard's 2006 study found that blue light also worked better than red light in treating SAD symptoms.

Viola (2008) performed an occupational study where subjects spent the working day for 4 weeks either in a blue-enriched white light environment or in a white light environment. A number of subjective measures of alertness, mood, performance, fatigue, etc. improved in the blue-light condition as compared to the white light condition.

Srinivasan (2008) also suggest that light (especially blue light Figueiro 2009, Lerchl 2009) at night reduces melatonin production, although the low level used in car lights' LEDs did not do so. However, short-wavelength 'blue' light in the ***morning*** helps entrain the circadian system, helpful in promoting alertness in adolescents, delaying melatonin-induced sleepiness (Rea & Figueiro 2010).

The neurologist George Brainard, of the Light Research Program at Thomas Jefferson University in Philadelphia has shown that blue light strengthens and stimulates connections between areas of your brain that process emotion and language. The researchers suspect that blue light may, in turn, help people to better handle emotional challenges and regulate mood over time.

Using blue light in light therapy might be a good thing, but we may also want to think about changing the lighting in our homes and offices, says Vandewalle, one of the foremost researchers into the health effects of lighting, pointing to previous studies that found that people feel better, perform better, and sleep better when working under blue-enriched light as opposed to the light given off by standard bulbs.

"*We ultimately need to be thinking about a revolution in lighting,*" Brainard adds. "*It is in our best interest to have not only light that's adequate for vision but light that's also optimal for our biology and behaviour.*"

In June 2016 the American Medical Association (AMA) adopted guidance for communities on selecting among LED lighting options to minimize potential harmful human and environmental effects. Converting conventional street light to energy efficient LED lighting leads to cost and energy savings, and a lower reliance on fossil-based fuels. However, high-intensity LED lighting designs emit a large amount of blue light that appears white to the naked eye and create worse night-time glare than conventional lighting. Discomfort and disability from intense, blue-rich LED lighting can decrease visual acuity and safety, resulting in concerns and creating a road hazard. Blue-rich LED streetlights suppresses melatonin production during the night. Excessive outdoor lighting also disrupts many species that need a dark environment. For instance, poorly designed LED lighting disorients some bird, insect, turtle and fish species.

Timing of red/amber lights

There have been suggestions that light at the red end of the spectrum, that is not too bright, in the evening and at night time, is less likely to disrupt melatonin production during the following hours of sleep (Stevens 2006, Schernhammer 2004, 2005, Higuchi 2011). The intensity, duration and wavelength of lighting seems to be significant (Glickman 2002, Lockley 2003, Hanifin 2006, Jasser 2006, Carazo 2013).

14-day whole-body irradiation with red-light treatment improved the sleep, serum melatonin level and endurance performance of female basketball players (Zhao 2012).

Alpert (2009) suggested that it is primarily the blue wavelengths of light that are responsible for loss of melatonin. They believe that using blue-free light bulbs for a few hours before bedtime maximises melatonin production and reduces the risk of breast, ovarian and prostate cancer. Bennett (2009) suggested that these red bulbs may be helpful in preventing postnatal depression in women who get up at night to feed their new-born babies.