Mapping knowledge on low energy lamps and health

Association for the Conservation of Energy

Summary briefing

A summary briefing on a report for Megaman® by the Association for the Conservation of Energy

1) Introduction

The study on which this summary is based reviews the current literature and maps the existing knowledge and opinion on the links between three types of low energy lamps (CFLs, LEDs and metal halides) and health.

The study was undertaken in the context of the early stages of the voluntary agreement between Government and major retailers to implement a stepped phase-out of all incandescent lamps by not replenishing stocks. This voluntary agreement and the widespread provision of CFLs directly to households through the Supplier Obligation (EEC 1 and 2 and CERT) have placed considerable attention on CFLs, which, in the short term at the very least, will be the successors to incandescent lamps. The two other low energy lamps, metal halides and light emitting diodes (LEDs), have received far less academic and media attention, since, for the former, the lamps are unlikely to be used in a domestic setting thus reducing public concern, and the latter, because the technology at the time of writing was not yet widely commercially available at competitive prices.

2) Scope and Approach

The study covered the three types of low energy lamps indicated above and included all identified health risks at the point of use, not during the manufacture or transport of the lamp. The sources reviewed for the study include the full range from academic to anecdotal.

It is very important to note that this research aims to identify and present the full range of evidence, experience and opinion that links low energy lighting to health but not to perform an analysis of risk or identify those health issues that pose most potential risk. The aim was to capture what has been said by which groups and to provide a database of sources and contacts concerned with the issue.

The numerous health risks identified have been categorised by number and variety of sources in which they are mentioned. This gives some indication of the prevalence of the issue in the

academic, political, or public mind. Health issues were divided into three categories: Group 1 Commonly Referenced containings health issues referenced by more than one expert source and at least one less formal source; Group 2 Less Commonly Referenced containing health issues that are referenced by just one expert source, with or without less formal sources; Group 3 Anecdotal containing health issues that have been referenced only by non-expert sources.

3) Findings

The research findings consist of a web of identified links between health issues and one or more of five lamp technical properties: electromagnetic fields (EMF), flicker, light spectrum, mercury and UV. The lamp properties are common to one or more of the three lamp types in the study (CFLs, LEDs, metal halide).

The findings have been presented in the full research report two ways: firstly each lamp property has been discussed and health issues that the sources connect with them are listed, and secondly, each health issue has been discussed in more depth. A short section is also presented on the positive health issues identified. The full report, along with the accompanying database of sources, is intended as a reference document to facilitate easy identification of the relevant material and opinions on a particular technical or health issue.

This short briefing presents the high level conclusions arrived at for each of the five technical lamp properties and also presents a reference list of the connected health issues. Furthermore, the conclusions arrived at for each of the three lamp types are also presented. Finally a diagram of the five technical properties and the bodily systems or groups of health conditions with which they have been linked is also presented. Reference to the full report is recommended for a fuller discussion of both the technical lamp properties and the specific health issues.

a. Electromagnetic fields (EMF)

- Relatively little attention has been focussed on EMF from lamps, the issue being dwarfed by concerns about mobile phone base stations and overhead power lines
- There is very little available informed research on the effect of the electromagnetic fields produced by CFLs and even less that considers the long term effects of exposure
- No references could be found to the relationship between EMF and either metal halides or LEDs, though an impact on health cannot be ruled out
- The available studies indicate that the frequencies and intensities of fields emitted by the CFLs tested are not above those emitted by other household appliances
- There is some concern around the issue of EMF generally, as is indicated by the call from a range of sources for a revision of the international protection guidelines.
- There is a fairly large body of self-reported evidence that links CFLs to the still ill-defined and ill-understood condition of electromagnetic hypersensitivity (EHS).
- Very few UK sources of evidence that we would consider popular or purely anecdotal were found on EMF. This is perhaps an indication that, unlike in countries such as

Sweden, Switzerland, France and to some extent Canada, EMF is not an issue of popular concern in the UK.

Associated health issues

Group 1: Commonly referenced health issues	Group 2: Less commonly referenced health issues
• Electromagnetic hypersensitivity (EHS) encompassing a range of symptoms, most commonly skin reactions and systemic disturbances, such as to the nervous system • Cancer	• Miscarriage • Diabetes • Multiple Sclerosis • Asthma • Migraine • Alzheimer's **Symptoms** • Sleep problems, headaches, eye strain, fatigue and confusion, nausea, dizziness and ringing in the ears, Joint pain, behavioural changes

b. Flicker

- The frequency produced by an electronic ballast CFL is widely accepted to not cause ill-effects
- Studies reveal a wide range of different frequencies produced by lamps currently on the market. This makes it impossible to rule out any negative effects from flicker in CFLs and may cause confusion and mistrust amongst those who are sensitive to flicker.
- Some health sufferers have abnormal sensory profiles which make them more or less sensitive to flicker of different frequencies (evidence only in the Hz range, not in kHz or above). Until more is understood about these different sensory profiles, risk to these groups cannot be ruled out.
- Health problems have not been associated with flicker in metal halide lamps. However, older lamps that use magnetic ballast operate at a frequency that some studies on CFLs or fluorescents have found problematic.

Associated health issues

Group 1: Commonly referenced health issues	Group 2: Less commonly referenced health issues	Group 3: Anecdotal health issues
• Epilepsy • Migraine • Autism • Irlen Syndrome (perceptual problems and forms of dyslexia)	• Conditions affecting balance (Vestibular Disorder and Ménière's Disease) • Retinal diseases linked to HIV/Aids **Symptoms** • Headache, eye strain, visual performance	• Hyperactivity • Irritability • Accidents and misjudgements

c. Visible light spectrum

- Concerns around the visible spectrum of light emitted by lamps fall into two main areas; first, concerns around the colour temperature of the light, second, concerns about the colour rendering index of the light
- A recent study by the Health Protection Agency (HPA) found that all of 73 currently available CFLs emitted light in only a few narrow peaks of the spectrum
- Light spectrum is the technical property found to be connected to the greatest number and widest range of health issues ranging from those affecting the autoimmune system to skin conditions, neurological syndromes, and forms of dementia
- Most commonly the blue part of the spectrum from CFLs has been connected with health issues
- Knowledge on the effects of incomplete spectrum of lighting (or non-full spectrum lighting) and on the effect of particular ranges of the light spectrum is incomplete.
- Particular ranges in the spectrum have been connected with both positive and negative effects on health, depending on application and/or pre-existing conditions.

Associated health issues

Group 1: Commonly referenced health issues	Group 2: Less commonly referenced health issues	Group 3: Anecdotal health issues
• Retina damage • Migraine • Lupus • Alzheimer's (designing for/improving sleep) • Skin erythema (risk reduction) • Skin ageing (reduction)	• Photosensitive skin conditions (cutaneous porphyria and eczema)	• Autism • Asperger's • Irlen Syndrome • Alzheimer's (treatment)

d. Mercury

- There is clear popular concern over the mercury content of CFLs, though no references were found to link metal halides (that also contain mercury) to exposure issues
- Two main focuses of concern are: localised effects of mercury release through lamp breakage in the home, and the effect of mercury release on the global environment
- The informed sources reviewed agree that mercury release from CFL breakage in the home will not cause health risks if clean up guidelines are followed
- On global pollution, there is general consensus in the informed sources that mercury released into the environment is higher with the widespread use of incandescent lamps than CFLs (due to the mercury associated with coal generated electricity use)
- Attention has been given, by both informed and informal sources, to the importance of following cleanup guidelines and recycling lamps at the end of their life

Associated health issues

Health issues related to mercury exposure were not in the remit of this study.

e. Ultraviolet (UV) light

- A recent HPA study indicates that there is a range of different CFLs currently available that emit UV in different bands and intensities. The lack of homogeneity could cause confusion and uncertainty for those concerned about UV exposure or who are light sensitive.
- The HPA study also concludes that UV emissions from many of the CFLs available exceed the INCIRP's "conservative" guidelines
- The HPA indicate that there are health risks associated with UV emissions from CFLs for the general population (at close proximity) and light sensitive disease sufferers
- Double skinned CFLs may mitigate some of the risk for the general population but many light sensitive disease sufferers may still be at risk
- UVR is also produced by metal halide lamps, with older varieties continuing to emit UVR once the outer shell is damaged, risking exposure

Associated health issues

Group 1: Commonly referenced health issues	Group 2: Less commonly referenced health issues
• Lupus • XP • Photosensitive eczema • Idiopathic photodermatoses: PLE, Idiopathic Solar Uticaria, Chronic actinic Dermatosis, Actinic Prurigo • Skin damage • Photokeratitis	• Cutaneous Porphyria • Cancer • Irlen Syndrome

4) Conclusions

As previously stated, it is not in the remit of this study to draw conclusions on whether or which lamp properties or types pose any risk to health. It is possible however, to draw together some general points of note specific to each lamp type that are not directly related to a technical property (which have been summarised previously).

a. CFLs

- The wide variety of lamps available feature different technical properties (spectrum of light emitted, UV range and intensity, EMF, modulation) which carry potential levels of risk to health. In this market of limited standardisation, it is difficult to attribute certainty and rule out risk. Although the academic and technical references do make a distinction between lamps of the same type that have different technical properties, anecdotal sources generally do not. Therefore, public opinion could easily be damaged by the presence of the worst-performing lamps on the market.
- Questions have been raised in the reviewed sources about the risk assessment methodology used in association with some of the less well understood technical

properties (particularly EMF) and health issues (e.g. EHS). The evidence required to show causality and level of precaution used when analysing risk to health has come under question. This could pose a future risk.

- The sources on CFLs and health impacts are contemporary and are continually being updated; the knowledge is incomplete but expanding. Studies identified here will be updated with further sources that should be monitored. The full review report identifies reports on the horizon that will add to the current and relevant body of information of CFLs and provides a list of interested and active organisations (Appendix 2) that will help ongoing monitoring.

b. Metal halides

- There are far fewer references that relate metal halide lamps to health issues than there are for CFLs despite the two lamps sharing several technical properties. Explanations for this may be found in the lamp application: metal halide lamps have limited domestic use and are generally found in commercial or industrial properties. In addition, they are not proposed as a major alternative to incandescent light.
- Reported issues relate to episodic events (eg acute UV exposure through shell damage, or end of life rupture) rather than those resulting from long-term exposure. This is may be a function of the typical setting in which metal halides are used.

c. LEDs

- Discussions in popular press and blogs on the purported negative effects of CFLs on health reveal a perception that concerns over CFLs are temporary provided that LEDs ultimately supplant CFLs as the main future lamp type. It appears therefore that LEDs are well-perceived with as yet no negative health effects reported or alleged.
- Virtually all purported health effects of LEDs identified by this review relate to healthcare and cosmetic applications, rather than general lighting and as such, all asserted effects are positive. It should be noted that a number of the health benefits that have received wide popular coverage have yet to produce solid scientific foundations. There is a small risk that, if not substantiated, these niche applications could prove detrimental to the reputation of the lamp type for more general uses.
- All of the health effects relate to the two extreme ends of the visible light spectrum: near-UV (blue) and near-infrared. Broadly speaking, the former purportedly impacts the circadian system and as a result affects sleep patterns, whilst it is suggested the latter supports cellular regenerative capacity. The science of these links is by no means established and it is important to note that these light properties are not LED-specific.
- Whilst enjoying a relatively 'clean bill of health' at the time of writing, this may be in part due to the focus presently being on CFLs as the 'successor' to incandescent lamps. As the market for widespread application and use of LED lamps matures, it is reasonable to expect that the level of research activity and attention focusing on potential negative impacts of LED lighting on health will increase.

Technical property and health issue summary map