

Report on

CEN-STAR Trent Analysis Workshop

CFL Quality and Strategies to Phase-out Incandescent Lamps

February 26th, 2007
International Energy Agency
Paris (France)

By Prof. Georges Zissis, LAPLACE, Université de Toulouse
georges.zissis@laplace.univ-tlse.fr

Organisation, date and venue

This CEN-STAR Trend Analysis Workshop has been organised with the initiative of EnERLIN (EIE-05-0176) project consortium supported by the Intelligent Energy Executive Agency. The International Energy Agency and the European Commission acted as co-organisers.

The workshop has been held on Monday February 26th, 2007 in International Energy Agency in Paris (France).

Objectives and Background of the workshop

In the context of the Kyoto Agreement, the European Community and individual Member States are looking for cost-effective measures to reduce CO₂ emissions and combat climate change. To this end the European Commission carried out the European Climate Change Programme (ECCP) during which it identified, with stakeholders, cost-effective actions that contribute to CO₂ emission reductions. The ECCP identified residential lighting as an important area. To achieve considerable savings in this sector, a coherent strategy is required to transform the lighting market. To ensure a sustainable growth and use of CFL we propose to develop a European "CFL Quality Charter" guaranteeing that CFLs with this label are fulfilling a number of quality requirements and they are suitable for large residential use.

This workshop aims to explore this issue and begin a process that will enable coordinated international action to reduce reliance on incandescent lighting. In focusing the first session on CFL quality issues it aims to address one of the key barriers holding back the adoption of more efficient residential lighting. Identification of strategies to address this and other barriers will be one of the key themes to be considered.

This workshop has its origins in three ongoing international activities. First, under the G8 Gleneagles Plan of Action, the IEA is working with partners around the globe to focus on climate change, clean energy and sustainable development. The IEA's G8 Gleneagles Programme is promoting energy-sector innovation, better practice and use of enhanced technology. Within this rubric the agency has already made broad-based concrete recommendations to the G8 concerning the adoption of best practice in energy efficient lighting. This workshop will directly contribute to the definition of best practice policy responses towards incandescent lighting. Second, in recognition that the variable quality of CFLs constitutes a key barrier to the broader adoption of CFLs in OECD economies the Joint Research Centre of the European Commission has instigated a CFL quality charter programme. This broad topic is a focus of the 1st session. Third, within the framework of the European Climate Change Programme, EU states identified residential lighting as an important opportunity to realise cost-effective CO₂ abatement. This led to the launch of the ENERLIN project, which aims to develop a coherent strategy to transform the residential lighting market. This workshop is organised as a joint activity of these three initiatives but aims to provide an open forum through which actors in these and other concerned international fora can come together to accelerate the replacement of incandescent lighting with higher efficiency alternatives.

Participation and statistics

More than 80 delegates were present in this workshop. The delegates come from 25 countries. As shown in the following bar chart in figure 1 France, Belgium, UK, Germany and USA represent almost the half of the attendees. As shown in figure 2, 85% of these delegates come from European countries (EU27+Switzerland); 11 delegates come from America, Asia and Australia. We can then consider this event as an international workshop.

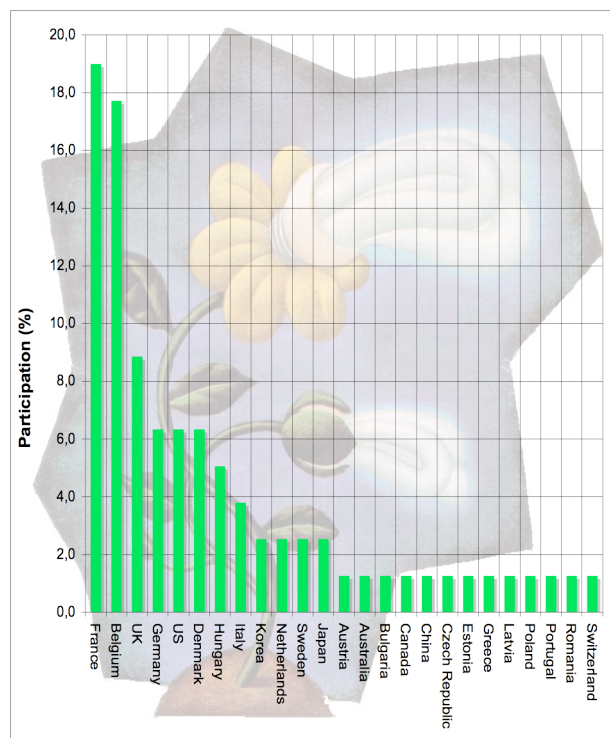


Figure 1 : Delegates' distribution by country

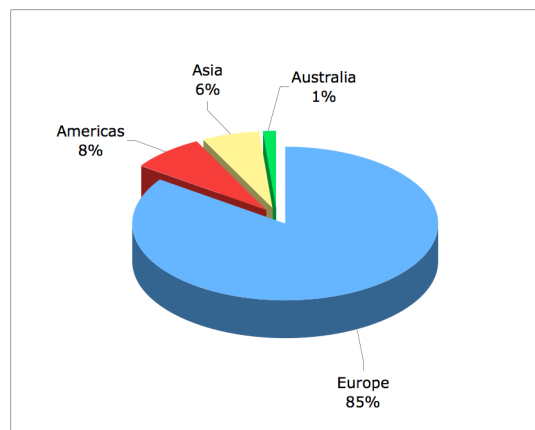


Figure 2: Distribution by world region

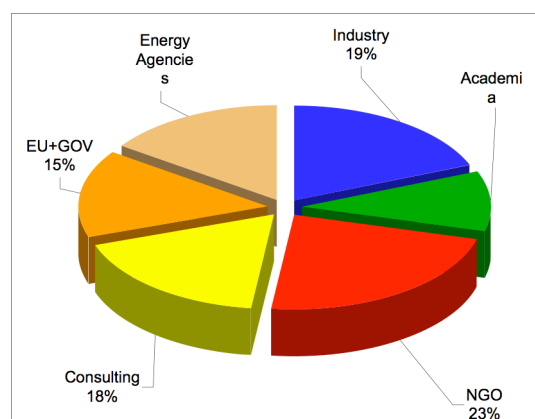


Figure 3: Origin of delegates

It should be noticed an excellent mix between representatives from National Governments, National Energy Agencies, European Commission, Non-Governmental Organizations, Lighting Industry, Academic Laboratories, Consultants on Energy, Policy makers and Standardization Bodies. The figure 3 illustrates that mix.

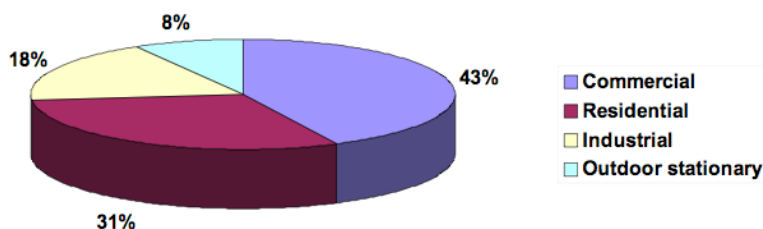
All major lamp manufacturers were present (General Electric Lighting, Osram, Philips, Sylvania Lighting International) as the European Lighting Companies Association represented by his president, the Syndicat de l'Eclairage, the Chinese Association of Lighting Companies sent one representative. European Commission were present through representatives from DG TREN and Joint Research Centre (Ispra), as well as the Intelligent Energy Executive Agency. Energy providers like Dansk Energi Net and Berliner Energieagentur participated, as well as, National Energy Agencies (France, Portugal, Czech Rep., Bulgaria, Italy, Poland, Sweden). The International Energy Agency and the OECD sent also representatives. Representatives from French, Australian, Korean, Japanese, Canadian and Californian Governments were also in the meeting. This list is not exhaustive but illustrates the large interest of the workshop subject.

Overview of presentations

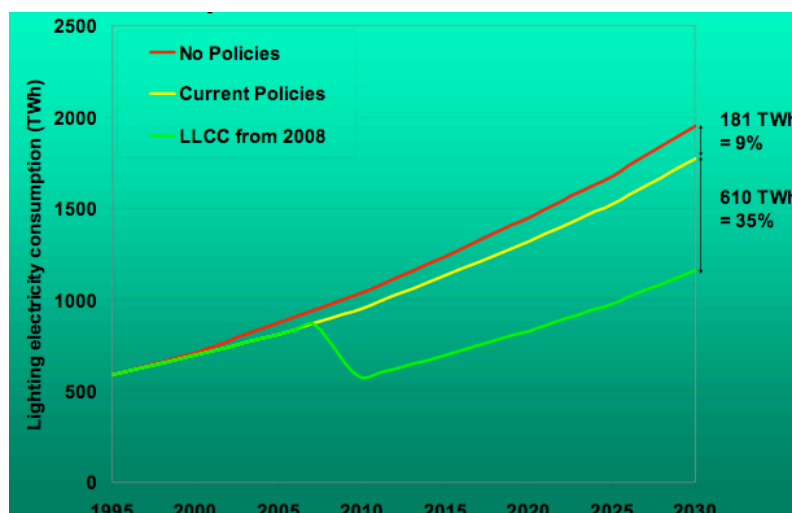
- **Paul Waide** (Int. Energy Agency Energy Efficiency and Environment Division): "Light's Labour's Lost: why action is needed on incandescent lighting and current opportunities".

A first question is posed: "How important is lighting?". The answer is spectacular: 2650 TWh of electricity consumption or some 19% of global electricity use (greater than nuclear electricity production); equivalent to production of all gas-fired power generation, or 1265 power plants. The total cost of lighting is US\$460 billion per annum or more than 1% of

the world's GDP. The following graphics shows that residential sector absorbs 31% of this huge energy amount.



In this sector, even today most energy is for incandescent lighting, but this technology provides only 44% of the light used in the households. The global average luminous efficacy for the residential sector is just 23.7 lm/W, which is very poor compared to technologies like compact fluorescent lamps have an average efficacy of 50-60 lm/W. It is of vital interest to phase-out incandescent lamps but this can be done only if CFL quality is guaranteed to the end-user. The following plot shows clearly that if no new policies for CFL quality adopted the energy consumption in the sector will increase very rapidly.



- **Paolo Bertoldi** (European Commission Joint Research Centre): “Residential Lighting Consumption and Saving Potential in the Enlarged EU”.

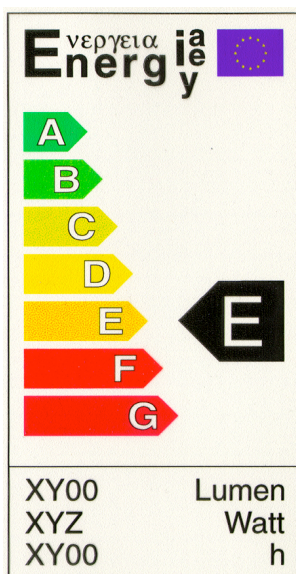
Lighting in the residential sector has been reported to consume 86 TWh per year in the EU-15 in year 1995 in the DELight Study (Environmental Change Unit, Oxford University). The DELight study predicted an increase of residential lighting consumption to 97 TWh by 2010. More recently the European Climate Change Programme (EECP) and the 2004 JRC Status Report calculated the following lighting consumption in the EU-15: 85 TWh growing to 94 TWh by 2010, without additional and new policies and programme introduced. The average number of CFLs per household ranges in EU-15 from 1 in Finland and Greece to 6,5 in Germany, where several promotion campaigns took place. In the new Member States the number of CFLs per household is substantially lower than in the EU-15 Member States, with the exception of the Czech Republic. Identified barriers to use of CFL in households:

- Purchase price is still an important factor (the most important one), even with the much lower cost of CFLs today. This is mainly explained by the fact that customer still do not have clear information about the short payback periods.
- CFL quality. In many countries consumers, who tried earlier version of CFLs, experienced in many cases CFL failures before the claimed lifetime, thus creating mistrust on this technology.
- Aesthetic barriers: shape, size and colour temperature of CFLs. Many of these barriers were created by older and bulkier CFLs, very often producing a very cold

light, and having a slow light output stabilisation time. Many of these aesthetic barriers have been removed (now CFLs come in different light temperature, in much smaller size and get to full output light in a very short time).

- The recent increase in the use of halogen lamps, in the shape of low voltage lamps, reflector lamps, and double ended high wattage lamps (for torchieres), limit the possible substitution of these types of incandescent lamps with CFLs, unless luminaires are replaced.
- In one recent survey in the German market customer were asked if they would purchase a CFL in the future. The same survey confirmed that the major barrier for CFLs is still the 'high' purchase price when compared to incandescent lamps, even though 96 % of interviewed people know that CFL save energy, 86 % know that CFLs last much longer than incandescent lamps and even though 69 % know that the CFL have short pay back period.

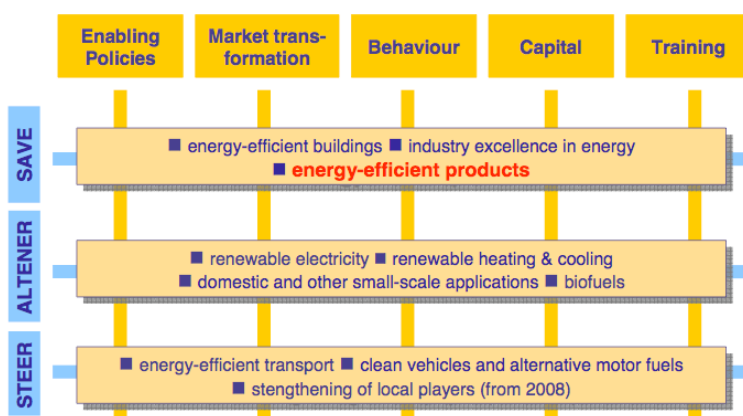
- **Andras Toth** (EC, DG-TREN): "EU legislative instruments for residential lighting products"



Energy Labelling – Directive 92/75 applied to lamps (98/11). A specific label is then created. Ecolabel for light bulbs: Commission Decision 99/568/EC amended by 2002/747/EC. This Ecolabel is awarded on a voluntary basis following some criteria that includes energy efficiency, lifetime, lumen maintenance, mercury content, switch on/off cycles, CRI, flame retardant content, packaging materials, user instructions. EuP DOES NOT deal with environmental impacts (e.g. climate change) but with the environmental aspects of the product, which can be correlated to those impacts (e.g. energy consumption) and can be substantially influenced by product design. EuP addresses all environmental aspects throughout the life cycle, from material selection to end-of-life management. The eco-design requirements of implementing measures will address the significant environmental aspects of the examined product. Product requirements introduced via implementing measures and Stakeholders participate throughout the whole process. Studies to be launched in May 2007 for product groups identified

by Article 16 of the Directive as having significant greenhouse gas emission reduction potential. In that frame domestic and tertiary lighting sectors are equally addressed.

- **Kerstin Lichtenvort** (Intelligent Energy Executive Agency): "The Intelligent Energy – Europe Programme: Transforming energy efficient lamp markets"



"Intelligent Energy Europe" (2003–2006) is the Community support programme to increase renewable energy sources and energy efficiency by overcoming the non-technological barriers (legal, financial, institutional, cultural, social barriers). The new IEE2 program is now included to Competitiveness and Innovation Programme 2007-13

(CIP). IEE2 budget is €3.6 billion (about 20% of CIP global budget). The figure shows the structure of IEE2.

There is an example of IEE2 Priorities for Call 2007:

- Focusing on products with biggest savings potential, in particular motor systems,

- office equipment, lighting and consumer electronics
- Fostering early replacement of less efficient products
- Information campaigns, internet as marketplace
- Communicating independent testing of products
- Stimulating voluntary approaches from suppliers & consumers
- Favouring green procurement, large buyers' groups
- Training sales personnel on energy labels and life-cycle cost principles
- **Stuart Jeffcott** (International CFL Harmonisation Initiative) : “Consumer Confidence and Consumer Confidence and CFL Quality: An international experience”

The main question addressed is “what is consumer’s confidence?”. A potential definition is: Having a set of expectations for a product that are high enough to stimulate purchase. Following purchase, the product meets or exceeds the majority of those pre-purchase expectations. There are some fundamental consumer requests:

- Perform the same function as an incandescent
- Is not “dangerous”
- Will be “better” than an incandescent (Will save Energy/Money/Pollution; Will last a “long time”).

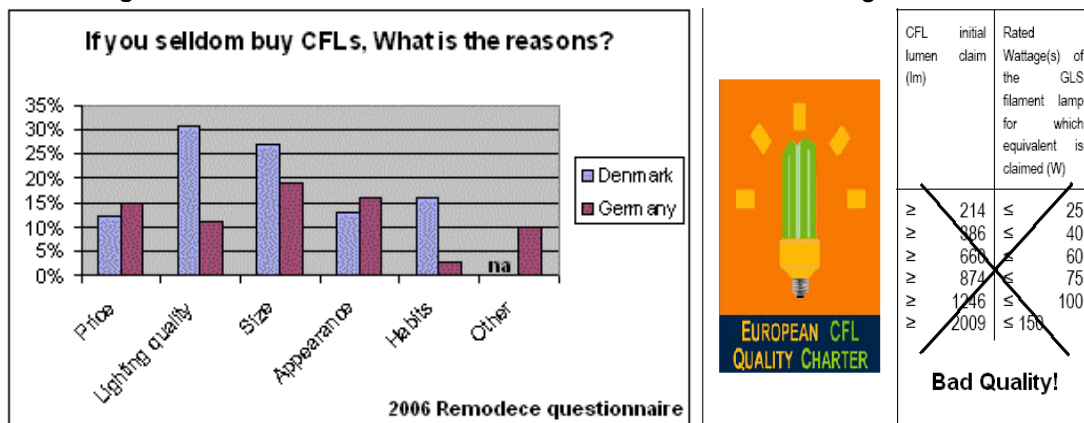
It should be noticed here that “long time” for a domestic consumer means generally more than one year. In order to increase CFL penetration rate in domestic use it is necessary to enhance “Consumer Confidence”. This can be done by stimulating first use (explain why is “better”) and then by minimising first use disappointment. To achieve the last point it is necessary to develop and verify a globally acceptable testing methodology (for submission to the IEC); Develop a range of Performance standards; Enable data sharing and mutual compliance work to reduce cost and enhance effectiveness of compliance.

- **Casper Kofod** (Energy Piano) : “Required Measures to Lock in CFL Quality”

The speaker identified the following barriers for market transformation from GLS to CFLs:

- Bad experience with first generation
- Poor quality
- Do not fit – lack of dedicated luminaires
- Visual appearance – “not good lighting”
- Colour and colour rendering
- Lack of CFLs with dimming in the shops
- Warm up time
- Price

The following bar chart illustrates the consumer’s reactions concerning CFLs



It is clear that reasons are variable from one country to the other and that has to be included in the promotional efforts. It is also pointed-out that very often Customer Complains that “CFLs don’t give good lighting” or, better, “CFLs do not give ENOUGH lighting”. This can be translated to a mismatch on GLS- CFL equivalence proposed by the actual version of CFL-Quality charter. This point has to be reviewed urgently.

- **Kalle Hashmi** (STEM, Swedish National Energy Agency): “Market transformation strategy for promoting compact fluorescents in residential lighting in Sweden”

The speaker presented the Swedish experience on market transformation strategies for enhancing CFL penetration in residential sector. The potential savings from lighting in households exceeds appliances by a wide margin. While savings on the order of 10% can be achieved with major appliances such as refrigerators, lighting technologies can save 50 % or more in typical installations. Furthermore, lighting upgrades involve relatively lower costs when compared with appliances which allows the benefits to be spread more widely than is possible with any other energy efficiency measure. A market transformation program is suggested to bring about lasting changes toward higher energy efficiency in the target market for CFLs. In contrast to traditional energy efficiency programs, market transformation programs typically take a more comprehensive and long-term view of the target market, addressing both the demand and supply sides of the market as well as the sustainability of the changes in the market after the end of the program. STEMs CFL lighting program may consist of several discrete tasks, initial performance specification development, retailer partner recruiting, CFL testing, and spreading of qualified/disqualified CFL product lists to general public, followed by aggressive information and promotion efforts by the stakeholders (e.g. Swedish Energy Agency, Regional Energy Centres, energy advisers, retailers, and manufacturers etc.). The program is seen as a catalyst to enhance market forces. There is a strong emphasis on partnership between government and the private sector in order to achieve common goals. Given the small size of the Swedish market, it is also recommended to team up with one or more (neighbouring) countries to address the CFL issues e.g. through common CFL performance specifications and mutual recognition of tested/approved CFLs. The program strives to:

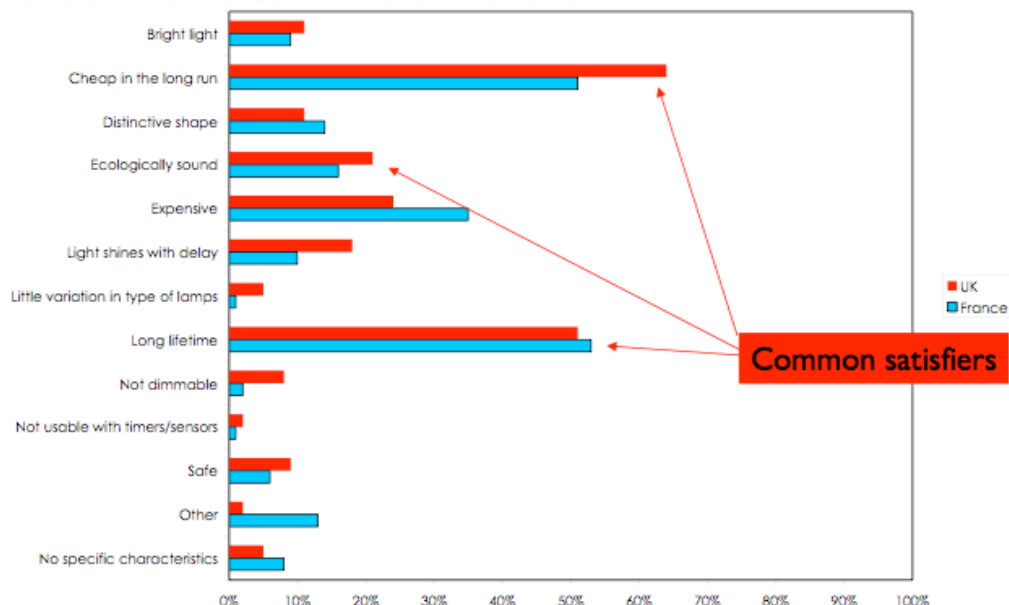
- Minimise the chances of under performing CFLs entering the Swedish market.
- Limit the number of discrete CFL bulbs types being stored and marketed in Sweden.
- Lower the CFL testing costs for suppliers and for STEM.
- Reduce the program administration costs for STEM.
- Reduce the compliance costs for all concerned parties including STEM.
- Provide a reasonable basis upon which STEM can decide to qualify or disqualify a CFL for the Swedish market.

The issue is how to eliminate low quality CFLs from the market? How to ensure that the retail trade only markets high quality CFLs, thus creating consumer confidence in CFLs? China is the world leader in CFL production, with roughly 75 percent of the global production taking place within its borders. Total annual output was estimated to be running at close to one billion pieces in 2004 and the number is expected to continue to increase in the future (Global Sources, 2004). There are an estimated 1000 manufacturers of CFLs in China with multiple suppliers of lighting components, electronics, glass, etc. CFLs of varying qualities are being manufactured in China. A number of CFLs of questionable performance have, therefore, the potential to enter the Swedish marketplace. Swedish consumers have no way of knowing how to distinguish between superior performing CFLs and poor performing ones. Industry collaboration with the manufacturers perhaps would be helpful to ensure CFL quality, though difficult to achieve, given the very large number of manufacturers and most of them being located in China. Finally the speaker pointed-out that it is today vital for Europe to define performance criteria that guarantee CFL quality (safety & performance) to the consumer.

- **Keven Verdun** (CELMA and Lighting Association) : “Measures to drive the market for CFLs”

The speaker presented the UK experience in driving the domestic/residential market in both CFL's and luminaries. The following graphics shows the “common satisfiers and de-satisfiers”, once again some significant differences between two countries appeared.

SPECIFIC CHARACTERISTICS OF ENERGY SAVING LIGHTS



It is pointed-out that CFL use was historically limited by:

- visual impact of 'unsightly' stick bulbs
- perceived difference in light output
- High initial costs for bulb
- Consumer confusion at point of purchase

However, many more lighting consumers would use energy efficient lighting solutions if these issues were addressed. Industry has worked on these issues and this led to learn some lessons: Once a member of the public has purchased a CFL and been disappointed in its performance, appearance and life then research shows that it is very difficult to get that person to buy again no matter what the quality; Maintaining a high quality of product and auditing the quality of the CFL's being sold is vital to market expansion and support from the public. The speaker underlined also that new technologies are now available: Highly efficient low wattage metal halide lamps are now available together with higher wattage fluorescent alternatives that can give energy savings of almost 90%; LEDs could also become an important issue in the near future. All in all, Lighting has a very important role to play in the worlds need to reduce energy consumption but we do need encouragement and financial support.

- **Harry Verhaar** (European Lighting Companies Association & Energy and Climate Change, Philips Lighting): "Industry commitment to phasing out inefficient lighting products in the home"

First of all the speaker pointed out that he presented the position of European. Lighting Companies Association. ELC represents today 95% of total European production, 50 000 employees in Europe and €6 billion European turnover. Currently, appreciatively 2.1 billion incandescent light bulbs are sold in EU 27 each year on a permanent installed basis of 3.6 billions. In average, household penetration CFL lamps in EU is around 15%. Modern CFLs achieves Energy savings of between 70% -80% compared to incandescent ; their life varies from 3-12 years ; they have good colour rendering and their dimability is enhanced. Lighting industry is willing to phase-out GLS but this need some time in order to adapt production capacities. In mean time there are some Suggestions to accelerate market uptake of more efficient products:

- Green Procurement: Set mandatory efficiency targets for home lighting; Minimum product efficiencies (define Eco-profiles following EuP); More effective labelling (quality charter & differentiation); Market Surveillance.
- Financial incentives: Create incentives for manufacturers to switch their production

- (industrial); Broad implementation EE funding schemes; Utility investment per household, with pay-back over electricity bill; Manufacturer incentives to increase education/awareness/marketing of high efficiency products.
 - Disallowing old inefficient products: Differentiated taxation (lower for EE products; higher for inefficient products); Support phase-out schemes (inefficient products); Awareness programs (Government; NGOs; Retail; Industry); Market surveillance/enforcement.
 - Environmental performance targets: Mandatory energy efficiency targets for lighting products; Benchmark projects for home lighting products; Visible measurement of energy consumption (behaviour change); Surveillance of indicators.
- **Chris Calwell** (Ecos-consulting, USA): “The Role of Regulation in Improving General Service Incandescent Lamp Efficiency”

The speaker after a brief historic overview pointed-out that today CFL U.S. sales are roughly 1 billion units/year and 3 to 4 billion units are in use. A general remark was that even after very successful CFL promotions, incandescent still account for 90 to 95% market share of screw-based bulbs on a units basis. In addition wide differences in efficiency still exists among different CFL models of a similar type. In order to bust CFL parts in the domestic market and phase-out gradually inefficient GLS a few different general approaches are possible. One option is to go for an improved version of California's “Tier 2” standards that set minimum efficacy requirements for general service lamps that escalate over time. Near term efficiency targets might allow highly efficient new incandescent to qualify. Longer-term targets would head toward CFL-equivalent levels of efficiency. The goal would be to eliminate many of the exclusions and loopholes that hamper the effectiveness of California's current standards. Another option is to pursue the CALE idea I described in the presentation, and also have it escalate over time. Setting minimum efficiency requirements for general service lamps doesn't necessarily help reduce the market share of incandescent unless the resulting products become much more expensive. For the speaker the ideal situation would be to pursue a policy approach that both improves existing incandescent and urges greater use of CFLs, LEDs, and other emerging technologies. CALE might help with that, but there may be other ways to achieve the same thing that make sense.

- **Timothy Tutt** (California Energy Commission): “Phasing In High-Efficacy General Service Residential Lighting”

The speaker proposed to proceed to a partial incandescent lamp ban after 2011. That would include the following types:

- Medium Screw Base
- 25-150 watt rating
- Specified Shape –Including A-19
- Frosted, Clear, Soft-White

But some specified Exemptions –Including Enhanced Spectrum, Appliance Lamp, etc... may apply.

- **Benoit Lebot** (United Nations Development Programme): “The UNEP/UNDP GEF initiative to phase-out incandescent lighting”

The speaker gave the priorities of Global Environment Facility (GEF) for Climate Change Mitigation (2006-2010). Energy-efficient buildings & appliances (including lighting) is considered as a High Priority Programming Area. The GEF has already support several projects promoting energy efficient lighting in various under development countries. The UNDP/UNEP-GEF vision is to transform markets globally in order to phase out obsolete and inefficient technologies. Lighting is the number one priority in the domain. The Benefits of a successful « global approach » as proposed by the speaker are:

- Greater Market Transparency around the globe
- Reduced Costs for Product Testing & Design

- Enhanced Prospects for Trade & Technology Transfer
- Reduced Cost for developing Government & Utility Efficiency Programs, and future Clean Development Mechanism projects

Round table discussions and Remarks

There are some descriptions of the most important outcomes from the round table discussion:

The ideal situation would be for all of us to reach consensus on some key concepts at the highest level, with the reality that actual numbers and dates would be set locally, to account for local politics and technical differences. For example, could we agree to:

- Shoot for roughly 30-50% improvement in 5 years, and 75% or so improvement over 10. Pursue some sort of sliding scale that would require slightly higher efficacies for higher wattage products. (eg. the 100W replacement would need to be more efficient than the 60W replacement). Some may also want to establish a first tier of roughly 5% better than today's incandescent in a faster time frame, say 3 years.
- Figure out how to prevent the introduction of new two piece inefficient incandescent that would be modular and come with a screw based adapter to make it fit in today's sockets.
- Define what bulb types might be appropriately exempted (eg oven lights, etc.). In the US, the advocates are determined to prevent "full spectrum" lamps from being exempted. As currently designed, these bulbs are even less efficient than a conventional incandescent, and we don't want to create a world where these would still be available and their sales would take off, as they would be the closest thing to today's bulb and would likely be priced lower than the more efficient "regulated" alternatives.

Another question that is beginning to come up here is: should we limit any regulations to just efficacy, or do we also layer on top of that some essential performance parameters to ensure people have a good experience with these efficient products. (candidates could include: minimum lifetime, lumen depreciation, CRI, etc.). The fear would be that some low cost products could come to the market that meet the efficiency requirements but provide horrible light, burn out quickly, etc...

Replacing GLS by CFLs the main problem is the volumes involved: It is estimated that close to 4 billion filament lamps are delivered each year to the 27 EU countries.

Most of the GLS lamps are produced in Eastern European countries. Stopping GLS production may have direct incidence to employment.

There will be enormous costs involved in replacing the production lines as well as the expansion of production in the Far East.

It is not just the expansion of the CFL' production, it will also mean a huge expansion in the world's electronics market. Think mobile telephone numbers then multiply that figure by 20!

The most efficient way to use fluorescent light sources is to separate the ballast from the lamp. A separate ballast will give you 25,000 hours life. In the UK we use this principle for our D.E.E.L.S. (Domestic Energy Efficient Luminaire Scheme) programme.

By subsidising the cost of the lamp and ballast, the luminaire manufacturer/supplier can supply the luminaire to his retail customer at the same price as the GLS equivalent. These D.E.E.L.S. luminaires are designed to use fluorescent light sources so the effect is much more aesthetically pleasing than the retro-fit option, it also removes the switch-back problem.

It is important to ensure that these luminaire programmes are expanded on an annual basis in preparation for the LED revolution.