itia NEWSLETTER

INTERNATIONAL TUNGSTEN INDUSTRY ASSOCIATION

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20th Annual General Meeting

Tuesday 25 to Thursday 27 September 2007, InterContinental Hotel, Madrid, Spain

The programme will begin on Tuesday evening with a reception in the hotel. Working sessions will be held on Wednesday and Thursday mornings and papers will include:

- Update on the US Tungsten Market (Osram Sylvania Products)
- Metalcutting for New Aerospace Applications (Bernard North, Kennametal Inc)
- HSE Issues – including REACH
- Recycling of Tungsten in China (Huang Changgeng, Xiamen Tungsten Co Ltd)
- Latest Situation in the Japanese Tungsten Market in 2007 (Motoki Nishino, Advanced Material Japan Corp)
- Mining Projects
  - Malaga
  - King Island Scheelite
- Update on the Tungsten Market in China (China Minmetals Group)
- Review of Trends in 2007 (Nigel Tunna, Metal-Pages Ltd)

Registration and hotel reservation forms may be downloaded from the ITIA website.

It was 22 years ago, in May 1985, that the tungsten industry last gathered in Madrid, on the occasion of the 3rd International Tungsten Symposium, organised by the Primary Tungsten Association (a producer group) and the Consumers' Reporting Group, in conjunction with the Spanish Ministry of Mining and Energy.
These two organisations had met together informally in the late 1970s to create the International Tungsten Indicator, aimed at being a more accurate reflection of market prices than other published quotations, and to convene the first of a series of industry conferences in 1979 in Stockholm, rather grandly known as a Symposium. The Greeks used this word to describe a drinking party, or a meeting for philosophic conversation. How times have changed ….. at least in the latter respect.

In 1985, there was still production in Spain (around 450t of W at 3 mines) but by 1988, it was over and only the Los Santos open-pit scheelite mine, 50 km south of Salamanca, has since been mentioned as a realistic project. The latest news (Ryan's Notes, 21 May 2007) is that Osram Sylvania Products has entered into an offtake agreement with Heemskirk Consolidated to purchase 100% of output, estimated at 700t W per annum, for 6 years.

INSIDE

"Tungsten is still very much an element of lighting"
The ITIA's Technical Consultants continue their series on the many aspects of tungsten, with an examination of the real facts about recent announcements on the demise of the incandescent light-bulb. (See page 2).

REACH….. Tungsten Consortium formed by ITIA …. Member and non-member companies invited to join. (See pages 10 and 11).

Membership

Welcome to:

- **Golden Predator Mines Inc**, currently a wholly-owned subsidiary of Energy Metals Corp, with a portfolio of gold and tungsten exploration and development properties in the Western United States which provides an asset base for this new company focused on precious metal production in North America.
- **Oriental Minerals Inc**, a Canadian-based exploration and mine development company with a diverse portfolio of precious and base metals projects in South Korea. The Company's current projects include the Sangdong tungsten-molybdenum mine, historically one of the largest past producing tungsten mines in the world.
- **Thai Goldfields NL**, an Australian company, exploring and moving toward underground development of a high grade ferberite deposit beneath the historic Khao Soon Mine in Thailand
- **Vital Metals Ltd**, an Australian tungsten explorer, aiming to be a tungsten producer in Australia during 2009.

Tungsten – Still Very Much an Element of Lighting

The light bulb in the focus of global warming

Wolf-Dieter Schubert , Erik Lassner
Institute of Chemical Technologies and Analytics - Vienna University of Technology

TUNGSTEN - STILL A SYNONYM FOR LIGHTING

If you ask the *man in the street* about the uses of *tungsten* he will answer you, most likely (if at all), that it is used for light bulbs in the form of filaments. This answer appears obvious as the use of tungsten filaments for lighting has accompanied us during the years, from youth until old age, and in the long run, the bulb has become a matter of course, in particular in domestic lighting ***(Fig.1)***. However, it has also been known for a long time that such lamps have a low energy efficiency (lamp efficacy) as they produce significantly more heat than light during use and, therefore, energy saving devices should be used instead of the incandescent bulbs for cost and energy savings and thus contribute to a more aware relationship with our environment ***(Fig.2).***

This is nothing new (*see Newsletter December 2004*) but has recently gained enormous attention through public discussions on global warming and CO2 emissions, and quite a few politicians have discovered the light bulb as a showcase for their responsibility towards the environment [1-3].

"BAN THE BULB"

In 2005, the Republic of Cuba was the first government to officially start with the replacement of incandescent bulbs (GLS lamps) through compact fluorescent lamps (CFL; see below) as a contribution to the "*Year of the Energetic Revolution*" (*Año de la Revolutión Enérgética – Operación Ahorro de Energia*). However, this positively driven activity also rapidly showed the disadvantages of a sudden replacement without proper pre-arrangements: supply difficulties in shops, non-fitting of the lamps into a number of old sockets; unfamiliar colour rendering (no technical advice); shortened lifespan through frequent switching; sensitivity of the electronic devices in areas of high humidity; and, in particular, the lacking of appropriate (economic) recycling strategies. In addition, due to the significantly higher initial price of the modern equipment, the materials had to be subsidized in order to render the respective cost savings during lamp use to poorer people.

Therefore, a more critical view of the current discussions on lamp replacement seems wise as the banning of an extremely simple, mature and versatile product (although of low energy efficiency) by discharge lamps or other alternatives needs time to advise professionals and individual consumers to safeguard their interests in terms of light quality (colour rendering), real energy savings, environmental responsibility and individual demands (why not simply ban gasoline guzzling cars or cheap air travel?).

Fig. 1: *Light bulbs are still a synonym for lighting.*
At the dawn of the 20th century they have made the nights to day and brought a revolution to the light market; they are still produced in numbers of up to 12 billion lamps per year worldwide;
photo: © Tim McConville/zefa/Corbis

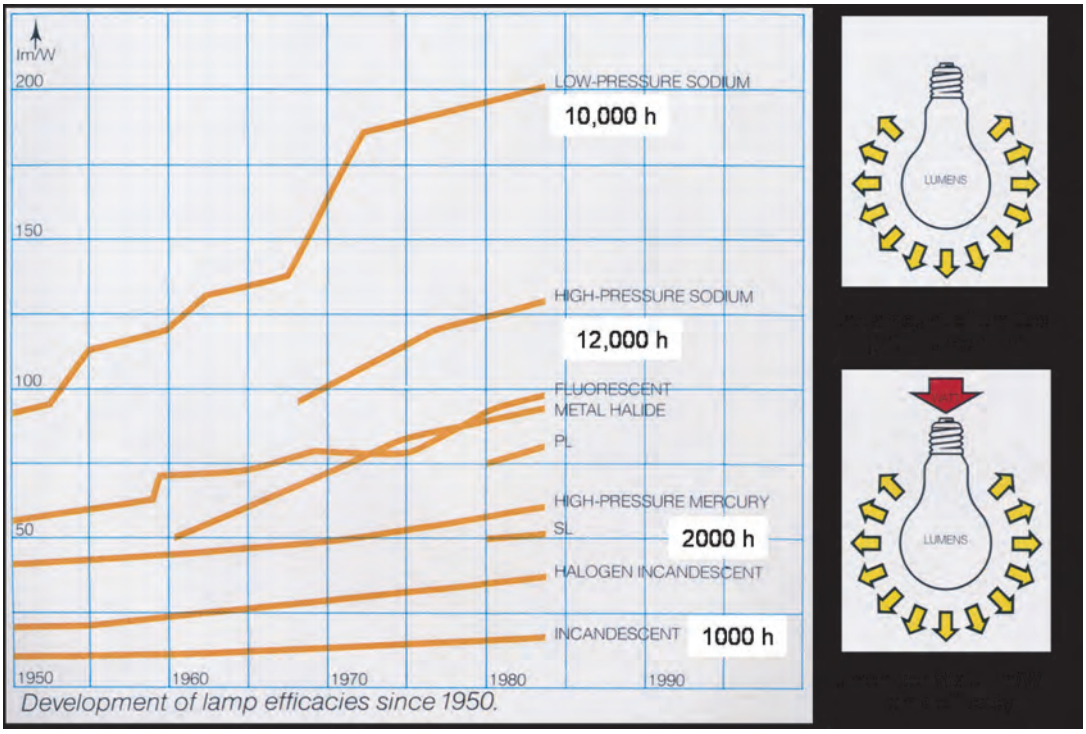

Fig. 2: *Development of lamp efficacies of light sources from 1950 up to 1984 (1m/W).*
Already then a series of alternatives were available with lamp efficacies of up to 200 1m/W; first compact fluoescent lamps appeared in the mid eighties.
Today, incandescent bulbs have a maximum efficacy of 15 1m/W at a burning life of 1000 h (compared to 65 1m/W and 12,000 hours for a CFLi)

THE LIGHTING MARKET

Today, more than 15% of the global electric power produced worldwide serves for light production from several billion lamps [4]. Most of this energy consumed is by discharge lamps (about 70%), the minor part (about 30%) by incandescent lamps (both light bulbs and halogen lamps; ***Fig. 3***) [5,6].

80 percent of the light consumption market refers to professional lighting (industry, commerce, public) and the remaining 20% to private consumers. In this segment (in particular in domestic lighting) still the light bulb dominates the market in terms of lot sizes, besides halogen lamps and, more recently, so called "energy savers" (CFL – compact fluorescent lamps; see below). The number of pieces of CFL lamps is still comparatively low, but with steep annual increases over the past ten years. Their contribution can be estimated today to be in the order of 1.2 billion lamps produced per year worldwide. However, this number is still low as compared to the annual production of filament bulbs, which are about 12 billion lamps per year, with a still increasing number due to the large consumer markets in Asia.

This large number makes high demands on the substitution of light bulbs by industry, in particular in considering the many thousands of speciality lamps with power ratings from a few watts up to several thousand watts which have to be replaced either by discharge lamps or by LED devices (Light Emitting Diodes).

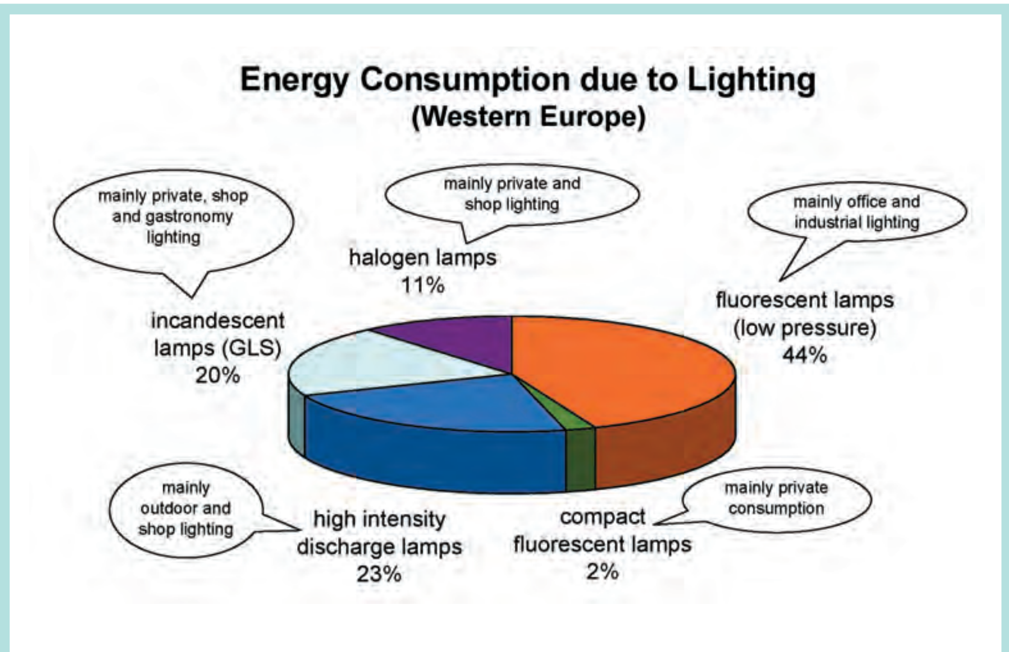

Fig. 3: *Energy consumption due to lighting; about 70% of artificial lighting is generated by discharge lamps.*
80% of energy consumption is by professional lighting and 20% by the private sector; by courtesy of ELC.

EVOLUTION NOT REVOLUTION

Over the last three decades, incandescent lamps have been gradually replaced by more energy efficient discharge lamps. The switch to modern lighting has always been for the lamp industry an evolution and not a revolution [7]. Due to the specific pattern of the lighting market worldwide the European Lamp Companies Federation (ELC) has at first put priorities on street and office lamps. The reason for this decision is the fact that this segment is the most promising in regard to potential savings, as these areas represent a larger proportion of the lamp market and it is easier to identify the purchasers [7].

CLIMATE CHANGE AS MOTOR OF INNOVATION *(Fig.4)*

On 1 March 2007, the ELC announced an industry commitment to support a government shift to more efficient lighting products for the domestic market [7]. This commitment followed just a few days after the declaration of the Australian environment minister to ban traditional bulbs by 2010 and to replace them by energy savers. This would lead to a reduction of 800,000 tons of CO2 per year in Australia (as compared to a total of 564 million tons of CO2 produced annually in 2004; i.e. 0,14% [1]).

On 5 June 2007, a press release followed by the ELC to announce a *New Lamp Industry Initiative* to phase-out the least efficient lamps from the European market by 2015. This period would allow the industry to switch-over to more energy saving devices, such as energy savers or high-efficiency halogen lamps, and thereby lead to a 23 Mega tons reduction of CO2 emissions and savings of 63,000 GWh of electricity per year [8]. Concurrently, new generations of Light Emitting Diodes (with luminous efficacies challenging even discharge lamps) should be studied and tested as further alternatives for the domestic market.

This commitment sounds much more realistic, as it will take time to develop the alternatives for the many different lamps and luminaries, safeguarding the interest of consumers, employees and the lighting supply chain and to advise the salesmen and buyers about the big advantages and peculiarities of the new lighting systems without concealing their current limits. In addition, it will give time to define rules that guarantee the CFL quality for the consumer in terms of safety and performance.

STEP-BY-STEP

The implementation of the above commitment is going to be performed step by step in different phases, starting with highest

Lamp Category	Phase 1 2009	Phase 2 2011	Phase 3 2013	Phase 4 2015	Phase 4+ 2017[vi]
>100W	18 lm/W	20 lm/W			
100W		14 lm/W	17 lm/W		
75W		14 lm/W	16 lm/W		
60W			13 lm/W	15 lm/W	
40W				11 lm/W	14 lm/W
25W				10 lm/W	12 lm/W

Fig. 5: *Typical Wattages and proposed 1m/W values per phase (left); EU Energy Label informing about lamp efficacy (right):* ***A*** *(excellently) to* ***G*** *(not at all efficiently)   Table to the left: ELC Background document domestic lighting; June 2007 [8]*

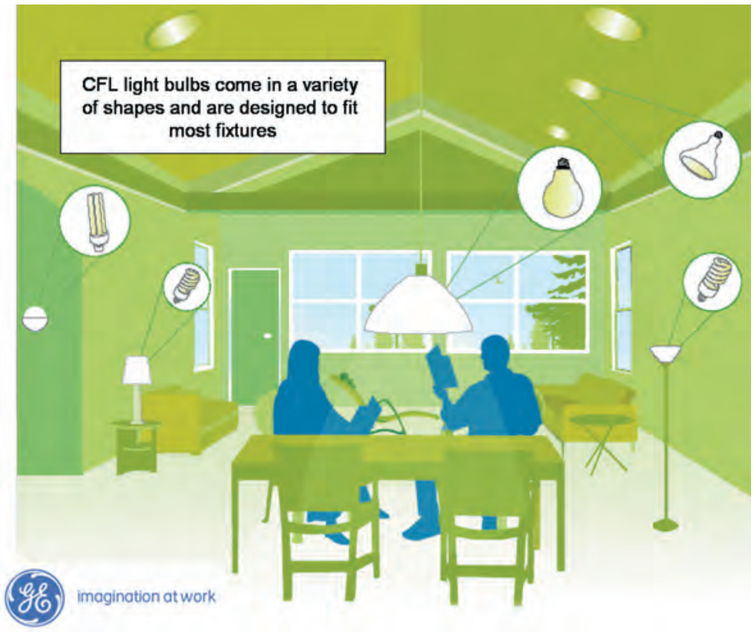

Fig. 6: *Compact fluorescent lamps with integrated ballast (CFLi) were specifically designed to directly replace incandescent lamps in domestic applications;*
source: Compact fluorescent lighting - a product of ecomagination - GE imagination at work.

wattage lamps (>100 W; 2009) and gradually considering lower wattages (25 W; 2015-2017). ***Fig.5*** indicates this strategy for product replacements. At the end of the initiative, only lamps with Energy Efficiency Classes A, B and C will be available on the European market (with some exceptions) [8].

ENERGY LABELS *(Fig.5)*

Labelling of lighting products is performed in the EU, but also in the US and Japan, to inform consumers about the real energy use. In the EU, the energy label refers to different classes from A (excellent) to G (not at all efficiently). Alternatively, in the US, Energy Star Label Appliances were introduced by the US Environmental Protection Agency to meet certain standards of energy efficiency.

MODERN OUTDOOR AND OFFICE LIGHTING

An important contribution to lower energy consumption

Recent discussions on the impact of lighting on saving energy and decreasing global warming among politicians have ignored the importance of outdoor lighting, in particular urban and roadway lighting. It is one of the most important areas in terms of energy consumption and public safety. Recent advancements of Metal Halide discharge lamps with ceramic arc tubes and high pressure sodium lamps with efficacies of up to 150 lm/W and improved electronic ballast characteristics are capable of a 60% reduction in energy consumption and 30% in maintenance costs [9-11]. However, other than the domestic market, this area is the responsibility of communities and governments (i.e. politicians), and up to now progress has been comparatively slow as initial investments have first to be made by the institutions in the adaptation, renovation or implementation of new lamp systems which pay back in 10 years only (while the lifespan of a public lighting unit is 30 to 40 years) [9]. Anyway, in the near future, street lighting systems will be evaluated by the European Community on their compliance with lighting standards (minimum energy efficiency standards).

Use of high quality fluorescent lamps (tri-phosphor lamp) with efficacies of up to 100 lm/W can save 70% energy in combination with electronic control gear for commercial, office and industrial applications [12,13].

COMPACT FLUORESCENT LAMPS

The easy way to a product replacement

Compact fluorescent lamps ("energy savers") belong to the group of low pressure discharge lamps. They were specifically designed to directly replace incandescent lamps as they fit into the same space as the standard light bulbs and can be fixed into standard sockets ***(Fig. 6)***. They use up to 5 times less electricity than standard incandescent lamps and their rated lifespan is between 5 to 15 years (high quality). CFL lamps were introduced in 1985, but have been developed further since then in terms of light quality, durability and substitutability. CFL lamps consist of a bulb, an electronic ballast (integrated or not-integrated) and either a screw or bayonet fitting. They are produced both for AC input and DC input [14].

CFL lamps generate UV-light through a gas discharge (using a small amount of mercury – less then 5 mg) which then transforms to visible radiation by the use of fluorescent powders, which are coated on the inside of the bulb or tube ***(Fig.7)***.
Flickering has been removed and sensitivity to switching and slow starting (as often implied by consumers) was significantly improved ("fast-start" lamps or "heavy duty" lamps with up to 500,000 switching cycles capability) [7].

Some of the lamps (non-integrated ballast) provide dimming (to a certain extent) and are now most popular for professional users, such as the hotel business, gastronomy or outside decorative

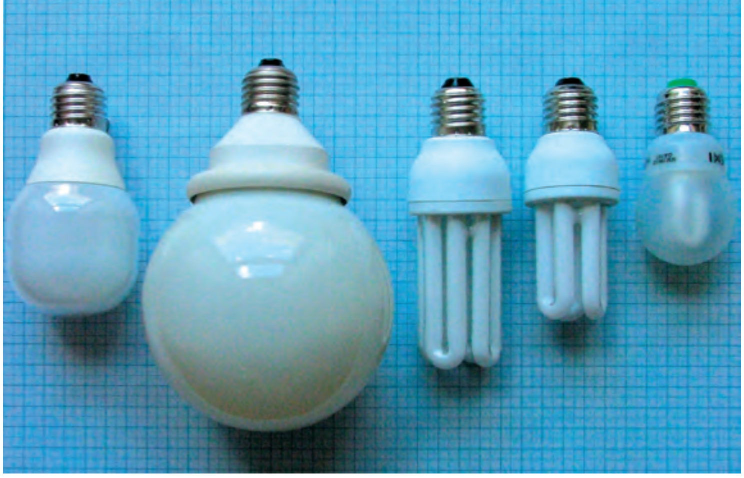

***Fig. 7:** CFLs exist in different shapes, wattages and color temperatures*
White is not White: In the case of fluorescent lamps the light color is determined by the composition of the fluorescent powder; industry now produces lamps with color temperatures from ~2700°C (warm white) up to 6000K (daylight). The adequate light color depends on the respective task (domestic-, shop-, library-, or office lghting, etc.) but also on personal taste or national custom; photo: M.K. Mayer.

lighting ***(Fig. 8)***. CFL lamps may fail to operate at too low a temperature and at higher temperatures (for example, if occurring in enclosed fixtures).

LIFE CYCLE ASSESSMENT AND ENERGY SAVINGS

Simply said, energy savers are only energy saving devices when operating a certain minimum time, as production costs (and wholesale prices) are between 4 to 10 times higher than that of an ordinary light bulb. However, the rated lifespan is between 5 and 15 times that of an incandescent lamp, and energy savings take place during lamp use. Commonly, the higher price of CFLs is already paid off after one year, and energy savings during lamp use (based on the rated lifespan) are in the order of 30-100 euro (depending on the lamp type). In addition, lamps have their greatest environmental impact during the use phase (through reduction in CO_2 emissions), which can reach about 95% of the product life cycle (4% R&D and production; 1% recycling) [13].
Low-quality CFLs ("no-name" products) can have much lower energy efficiency than quality lamps and can contain higher amounts of hazardous substances, such as mercury. They are also prone to frequent switching. Therefore, it seems mandatory that, during phasing-out of the old bulbs, rules are defined that guarantee the CFL quality for the consumer.

In certain countries of the world lighting is one of the major applications of electricity (for example: up to 89% in Tanzania) [9]. In such cases energy saving devices could significantly bring down energy consumption and the cost during lamp use. However, due to the higher lamp prices, subvention seems necessary to pass cost advantages further to poorer people. In these areas, DC CFLs are also used (fed by car batteries or solar panels) to replace kerosene lanterns [14].

RECYCLING OF DISCHARGE LAMPS – STILL A WEAK POINT

Other than incandescent lamps, CFLs constitute electronic devices and, therefore, have to be properly treated/recycled at the end of their life ***(Fig.9)***. They should not enter the domestic waste (as filament lamps) since otherwise hazardous materials (mercury) are emitted during waste incineration or disposal.

Several countries in Europe have built up a recycling infrastructure for gas discharge lamps both for household and professional users, but there is still little conscious dealing in practice. Only recently it has been demonstrated in Germany that in 2006 only 40 million out of 150 million discharge lamps (CFLs, fluorescent tubes, metal halide lamps, mercury and sodium vapour lamps) were properly disposed through a network of collecting points or direct pickup at large scale consumers [15]. The reason for this discrepancy is the broad lack of knowledge in regard to the hazardous nature of the waste. Also, in the US, no special requirements exist for the disposal of mercury-containing fluorescent lamps, and it seems up to the towns and cities to offer recycling activities. Other countries do not have a recycling system at all, and

***Fig. 8:** CFL lamps are increasingly used also in outdoor decorative lighting.*
St. Marcus Place in Venice/Italy - also the pigeons got used to modern energy saving lamps. However, in cold winter they might prefer incandescent bulbs.

Fig. 9: *At the end of their life discharge lamps constitute hazardous waste and have to be properly disposed.*
The "End cut" process is a viable way to recycle substances in old fluorescent lamps (metals, glass, fluorescent powder); by courtesy of Andreas Sirch, MPA Marketing & PR Agentur GmbH; www.lightcycle.de

the lamps are thrown away like the batteries. This problem is particularly present in remote areas without any experience with hazardous waste and this factor has to be critically evaluated on lamp substitution in these areas.

MAKE THE SWITCH [13]

to intelligent lighting

The time now seems ripe for the conscious dealing with energy, and lighting is part of this strategy (*intelligent energy*; [12,13]); ***Fig.10***. Intelligent lighting means to consider the energy efficiency of lamps or lighting systems for the respective areas of uses (public, industrial, commercial, domestic) without *banning* a certain solution; as there are always niche applications where such solutions can remain more reasonable (in terms of light quality, colour rendering or for specific uses). It also means that industry and governments should provide respective solutions (best practice guide) and professional advice via marketing and technicians, for both professional and individual consumers. It is also up to industry and the authorities to guarantee the safety and performance of such solutions to avoid undermining the confidence of consumers in energy efficient products [12,13]. It is the high purchase price of the new lamps or lamp systems and the lack of knowledge of the consumers (administrators) about the long-term benefits which still prevent a greater use of energy-efficient alternatives. The current high price of energy and its steady increases are a good argument to switch over to energy saving solutions *now*. Stimulated demand and restricted availability on the market will contribute in making a change [13].

OTHER ALTERNATIVES FOR DOMESTIC LIGHTING

Besides CFLs a new generation of (dimmable) halogen lamps are available for direct replacement of old bulbs. Such lamps have an Infra Red Coating (IRC) and are 65% more economical than standard halogen lamps. Halogen lamps are frequently used in living rooms, in particular in design oriented compositions, such as dimmable uplighters. Their minimalist dimensions and brilliant light make them optimal solutions for spot lighting. Halogen lamps as headlamps will remain the work horse for automotive lighting, due to their lower price as compared to Xe-HID lamps (with integrated electronics). However, the latter lamp has a 7 times higher lifespan and consumes 50% less energy during lighting.

They provide a brilliant daylight and it has been calculated that they give a full second more time to safely react to road hazards at highway speeds (*safety versus cost*) [16].

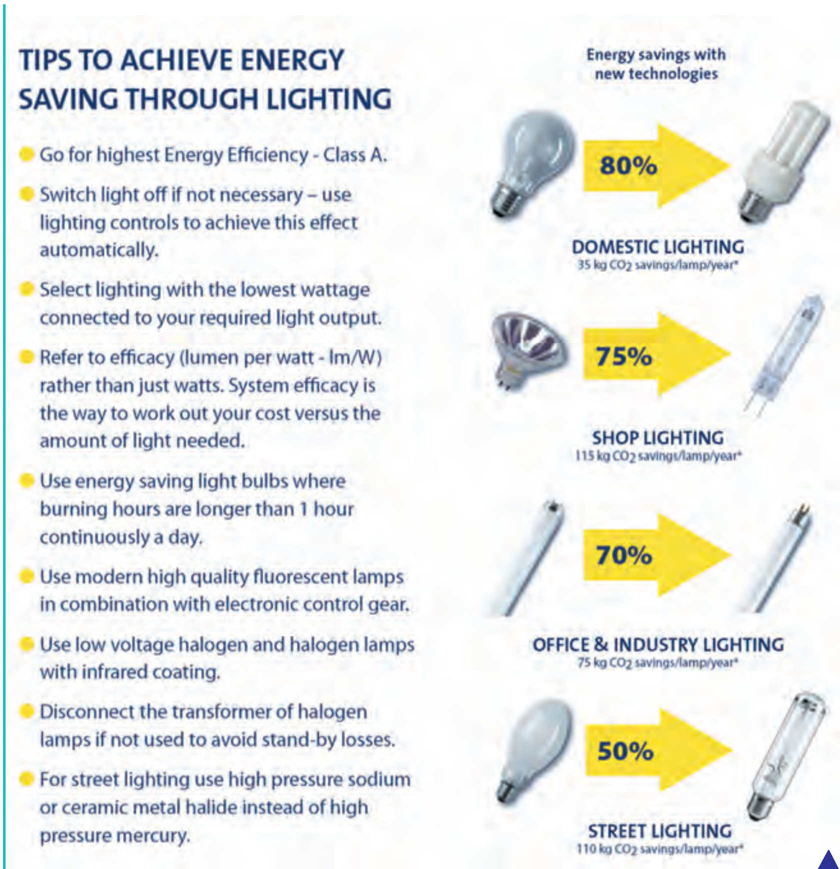

Fig. 10: *Tips to achieve Energy Saving through Lighting*
An activity of the European Lamp Companies Federation [12,13]

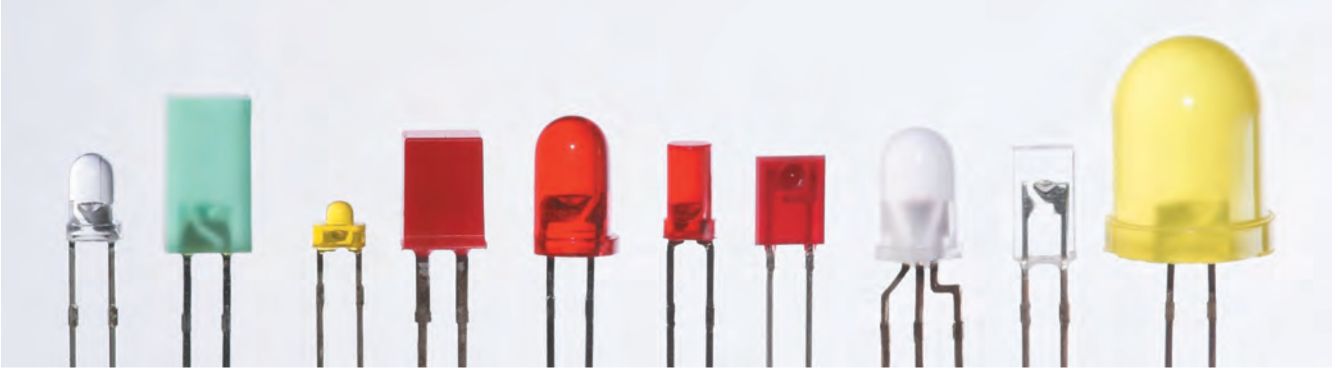

Fig. 11: *Light-emitting diodes (LED) exist in different shapes, clors (red, blue, yelloow, green and now also in white) and sizes. They are potential alternatives to both incandescent and discharge lamps.*
White light was invented in Japan by S. Nakamura of Nichia; Source: Andreas Frank, http://en.wikipedia.org/wiki/Light-emitting diode

LEDs ***(Fig. 11)*** are another alternative for energy saving lighting. They fill niches like traffic lights, car rear-lights, and are frequently used for backlighting of instrument panels, car radios, navigation systems, climate control units, and others. Recently they were introduced as illuminant for flashlights or beamers and are provided as coloured but also white light for the domestic lighting market ***(Fig.12)***. However, the required light output is still scarce (32 lm/W), and it will take some time to provide the desired *full* solutions. However, life span is up to 60,000 hours and current progress to higher efficacies show promise.

TUNGSTEN – STILL AN ELEMENT OF LIGHTING

Since the dawn of the 20th century, tungsten metal has been a synonym for the incandescent bulb filament, and the symbol of the bulb has become iconic for sudden inspiration.
However, after more than 100 years of use in the different fields of lighting, tungsten filament bulbs have been, and are currently being, replaced through more energy efficient solutions; starting with fluorescent tubes in the late sixties, and finally through compact fluorescent lamps in the middle of the eighties. Thereafter, only domestic lighting is still a stronghold of filament lamps, simply because of their low initial cost and convenience.
Replacement of filament lamps through discharge lamps (CFL, fluorescent, HP mercury vapour, metal halide, LP- sodium or HP sodium, short-arc) has not at all lowered tungsten consumption in the field of lighting, because all these lamps contain tungsten in a certain form: either as filament, or as electrode material (coiled filament, coiled-coil, triple coil, rod-like or massive) in the form of tungsten, porous tungsten, emitter-coated tungsten or thoriated tungsten ***(Figs. 13-16)***. In particular High Intensity Discharge (HID) lamps have increased tungsten consumption significantly.
Over the last 50 years, the share of tungsten for lighting has been always in the range of 2-4% percent of the worldwide tungsten demand. Today, we can assume that 2300 tons of tungsten is used for filaments (both GLS lamps and fluorescent lamps) and about 600 tons for HID lamps. This would refer to a share of about 3-4% today at an estimated annual worldwide tungsten demand of 80,000 t (more than 60% are used for cemented carbides). It is difficult to make a serious forecast, but experience over the years indicates a further annual 2-4% increase for lighting applications.

GOOD NEWS FOR TUNGSTEN

Current discussions on modern lighting and global warming and the subsequent product replacements will have no negative effect on tungsten demand in the near future, as we can expect about the same amount of tungsten used in an old filament bulb and a modern CFL lamp ***(Fig.13, 14)***. A negative tendency might be expected in the long term as the lifespan of such new lamps is significantly higher (up to 15 times!). However, more lamps will be necessary than ever (as more light will be produced), and even the number of filament bulbs might still slightly increase in the next few years (and then come down because of the phasing out).

In addition, tungsten is increasingly finding applications in areas where high luminous fluxes are needed for the respective uses (photo lithography; semi-conductor technology; IMAX projection) or in the form of low-pressure cold cathode discharge lamps (CCFL) for scanners, flat screens, laptops, or television.

Electrode weights are in the order of *mg* (CFL: ~10-20 mg; ***Fig.14***) or several g (HID lamps; ***Fig. 15***) but can go up to kg in high performance short-arc lamps for cinema projection ***(Fig. 16)*** (up to 15 kW). Lower demand in the long term has to be expected from the development of electrode-free discharge lamps (induction lamps) and the further development of LED devices (which once might really render a *revolution* in the lighting market).

Fig. 12: *LED lamps made up of sixty bright LEDs giving out yellow, blue, green, red or white light;*
shockproof; life span 50,000 hours; colors temperature 8800 K; source: Chi Ming Electronics Corp., Taiwan

Fig. 13: *Lamps and the respective tungsten wires / electrodes used for incandescent and discharge function; from left to right: light bulb, CFL, halogen, fluorescent and metal halide;*
By courtesy of I. Wesemann and W. Knabl, Plansee, Austria.

Fig. 14: *CFLi lamp and details of the (two) emitter-coated tungsten electrodes; Electrode weight is about the same as that of an incandescent filament;*
by courtesy of J. Reichardt, Osram GmbH, Augsburg, Germany.

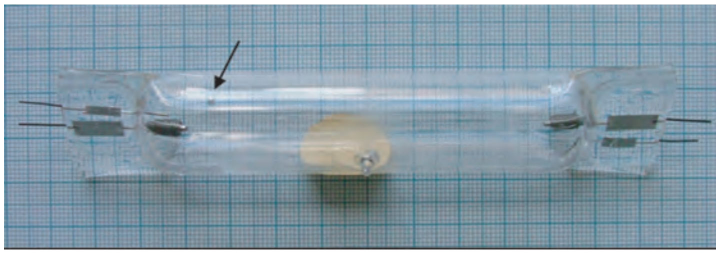

Fig. 15: *Ultraviolet lamp (400 W) with tungsten electrodes and mercury ball (arrow); Gas discharge lamps contain a small amount of mercury (~5 mg); photo: M.K. Mayer.*

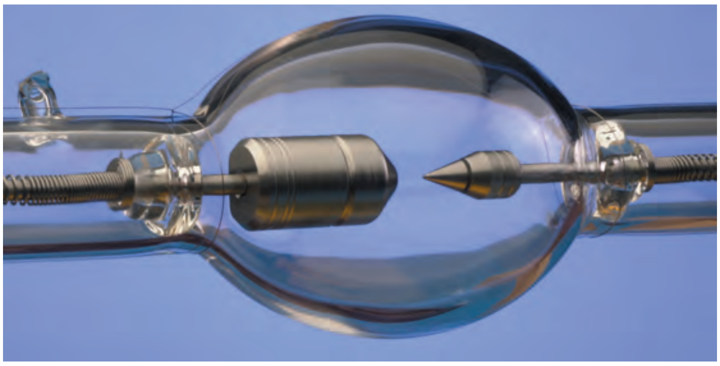

Fig. 16: *15 kW Xe short-arc lamp used in cinema projection.*
Light is produed by striking an arc between two massive tungsten electrodes.
By courtesy of Plansee, Austria.

THE CURRENT SITUATION IN LIGHTING – A RESUME

Intelligent dealing with energy is one of the great global challenges for Man in this century, and lighting is a good example. More than ever, artificial lighting is used worldwide, and it is expected that in future the need for light sources will increase by a factor of 3 [4]. Energy saving devices are therefore mandatory to combat against this enormous rise in consumption, which is accompanied by a steep build up in CO_2 emissions.

Industry has tried to follow the evolutionary path, rather than the revolutionary, to safeguard the interests of consumers, and the replacement of old bulbs by energy saving systems has been performed step by step, over the last 100 years. Recent discussions on global warming have brought back attention to the field of lighting, mainly through striking statements by politicians, which seem necessary to shake-up the population. However, always the technical (scientific) superstructure should be available (through serious and critical advice) and the phasing-out scenery should be realistic. Most energy savings are achievable today through innovations in professional lighting (70% of the energy consumption) and the use of CFLs and the new generation of fluorescent tubes in office and domestic lighting. LED devices are used at the moment for niche applications only, but development for higher luminous fluxes is on its way. Organic light-emitting diodes (OLEDs) are currently in development but are still lacking long-term stability.

Up to now, more tungsten is being used for lighting than ever, due to the still growing global market and the fact that tungsten is used in most of the alternative devices as electrode material. The old light bulb has come to an end as a mass product, but we can expect filament lamps to survive in a series of niche applications (for example: medicine), where then they might still be the more *intelligent* solution.

Further information:

For more details on modern lighting the reader is referred to the respective websites of the major lamp producers, and to the website of the European Lamp Companies Federation (http://www.elcfed.org/index.php?mode=0). Referring to the recycling of discharge lamps, visit: www.lightcycle.de or www.lamprecycle.org.

Literature:

[1] W. Frew, L. Besser, Light bulbs ban to slash emissions; http://www.smh.com.au/news/environment/light-bulbs-ban-to-slash-emissions/2007/02/19/1171733685061.html

[2] Plan to ban standard light bulbs, http://news.bbc.co.uk/1/hi/business/6316635.stm

[3] Lights to go out on inefficient bulbs by 2012, http://www.cbc.ca/canada/story/2007/04/25/lunn-bulbs.html

[4] G. Zissis, Electrical Discharge Light Sources: A challenge for the future; 15th Intern. Plansee Seminar; Vol.1, 2001, 521-537.

[5] ELC: http://www.elcfed.org/index.php?mode=0

[6] R. Pfarrwaller, Emotion und Beleuchtung, Philips GmbH.

[7] ELC: The lamp industry's commitment to support a Government Shift to Energy Efficient lighting products in the home; Questions & Answers.

[8] ELC: Press Release; Brussels 5 June, 2007; The ELCs proposal for domestic lighting.

[9] G. Zissis, An innovative and economical urban lighting system for the city of Albi; 2005; http://www2.cnrs.fr/en/329.htm

[10] ELC: Energy efficient street lighting.

[11] Numelite, Efficient Lighting for the 21st Century; COST Action; project number NNE-2001-00282.

[12] K. Lichtenvort, The Intelligent Energy, Transforming energy efficient lamp markets, European Commission, IEEA; February 2007.

[13] ELC: Make the Switch – The ELC Road-Map for Deploying Energy Efficient Lighting Technology across Europe.

[14] http://en.wikipedia.org/wiki/Compact fluorescent lamp

[15] Lightcycle Retourlogistik und Service GmbH, Gasentladungslampen in Deutschland, Marktstudie 2006.

[16] http://www.nam.lighting.philips.com/us/automotive/products/xenon.php

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REACH .....

Tungsten Consortium formed by ITIA .... Member companies and non-members invited to join ....

These notes are extracts from the set of guidelines which may be downloaded in English and Chinese from the ITIA website.

REACH REGULATION

The REACH regulation requires all manufacturers in Europe and importers into Europe of chemical substances to register detailed technical dossiers about each substance with the European Chemicals Agency (ECHA). The dossiers include their properties, assessing their impacts on environment and human health, and recommending risk reduction measures.

To facilitate data sharing, all manufacturers and/or importers must notify individually the ECHA of their interest to register the chemical substances the European market during the period of 'Pre-Registration' which runs from 1 June to 1 December 2008.

TUNGSTEN CONSORTIUM

REACH is based on the principle of one substance, one registration. For this reason, when a manufacturer and/ or importer pre-registers a substance it becomes a participant in a SIEF (Substance Information Exchange Forum).

The SIEF includes all companies that pre-registered one and the same substance. The SIEF facilitates data sharing between Pre-Registrants, and ultimately, where possible, the joint submission of the technical dossier. The aim is to avoid unnecessary testing, or repetition of tests on vertebrate animals and to ease the financial burden on registrants. REACH does not however provide for clear rules on how the information should be exchanged between the SIEF participants.

Many industry organizations (including ITIA) therefore voluntarily formed consortia to assist their members register their substances in accordance with REACH legislation. No Consortium-formation guidelines are provided by the European Commission but industry is expected to ensure that any Consortium is compatible with EU competition law.

ITIA has been researching and developing the legal framework for a REACH Consortium that will generate the required dossiers.

After an exercise to identify W data-gaps, a research programme has been developed by ITIA to generate the data necessary to conduct the risk assessments on the following W substances which are now covered by the Tungsten Consortium:

- *Ammonium Metatungstate*
- *Ammonium Paratungstate (APT)*
- *Fused Tungsten Carbide*
- *Sodium Tungstate*
- *Tungsten Blue Oxide*
- *Tungsten Carbide*
- *Tungsten Dioxide*
- *Tungsten Metal*
- *Tungsten Trioxide (Yellow oxide)*
- *Tungstic Acid*
- *Ferro Tungsten (if required – see note)*

The EU is still working to agree aspects of the treatment under REACH of alloys but the Consortium will take the necessary measures to ensure the registration of Ferro Tungsten if required.

Licences

Entitlement to obtain a copy of the REACH-registration dossiers, (ie to refer to and to use them, as well as all the supporting data and/or studies) will be on the basis of a separate licence for each substance. If a member company requests more than one licence, all such licences will be granted in the form of one Licence Agreement.

Membership and Finance

Five member companies of ITIA have already committed to join the Consortium:

- *Ceratizit*
- *Kennametal*
- *Osram Sylvania*
- *Sandvik*
- *Wolfram Bergbau- und Hütten*

Consortium Fee

The 2007 budget for the Consortium is US$1,570,000.
Individual contributions towards that budget are based on the funding formula explained in the Consortium Agreement, with a minimum of US$10,000 per annum, and will depend on the number of companies that join the Consortium: the more members, the lower will be each company's contribution.

The calculation is made by multiplying the factor for the number of licences required by the size factor for tonnage of W imported into the EU during the previous year. The resulting number is the "company co-efficient".
As more companies join, the total number of points will increase and thus each company's percentage will reduce.
A similar calculation would apply for calculating an approximate percentage of the total budget - US$5 million over the four years 2007/2008/2009/2010.

Consortium Agreement

This document sets out in detail the terms and conditions (applicable equally to ITIA members and non-members) of membership of the Consortium, including its structure and financing, and a copy may be obtained from the Consortium Secretariat (see below).
Joining the Consortium imposes no obligation to become a member of ITIA.

Enquiries

REACH is a complex, long-term business obligation and it is the responsibility of individual companies to assess what REACH means to them in the impact of their business. The Secretariat will, however, help as much as possible with enquiries directly related to the Consortium.

Please address any questions about REACH and the Tungsten Consortium directly to the Consortium Secretariat as follows:

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