United Nations Environment Programme
en.lighten initiative

MEPS & available technology solutions
Break out group: MEPS

ECOWAS workshop, Dakar, Senegal
July 2 & 3 2012
Irene Klein- Philips Lighting

Agenda

- Introduction – goal of this presentation
- Standards and legislation: differences & meaning
- MEPS: Focus on quality levels
- Experience :
  - Alternative lamps in the market & choice of consumers
  - Technology neutral or specific MEPS
  - Which elements are relevant to be described in MEPS
  - Power factor – an explanation
  - Advised balanced performance standards for CFL-I & Halogen
  - Engagement stakeholders in switch to energy efficient lighting
- Off-grid lighting solutions for Homes

The goal of standards and MEPS

Protect the end user / consumer:

- Unsafe and very low quality products are kept from the market.
- Interoperability of products is guaranteed. (*So customers have freedom to choose between individual brands*).
- Vendors are being kept to their promise ("*what is on the box is in the box*").
- Protect / safeguard consumers investment in better , more sustainable products

Support the local government:

- A minimum level of energy efficiency is guaranteed, so the energy saving targets can be achieved

Protect the environment:

- Products with high levels of hazardous materials (e.g. Hg) are kept from the market.

Support the industry

- Adequate market surveillance is in place to enable fair business

Standards and legislation: differences & meaning

Safety standard
(IEC 60968 for CFL)
- Sets requirements to ensure **safety** & **interchangeability** of lamps

Performance Measurement standard
(IEC 60969 for CFL)
- Prescribes **how** to measure and test the lamps

National Legislation
(MEPS)
- Defines minimum **performance requirements** (levels) of lamps

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Importance of well defined MEPS

No MEPS or too low level:

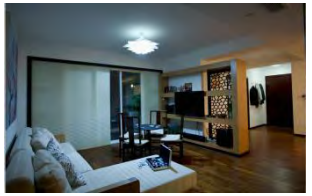
Too high level MEPS:

Irrelevant criteria in MEPS:

Well defined & balanced MEPS:

Experience: Choice for alternative lamp based on cultural & economical differences

- Australia, Europe, Argentina > EcoHalogen preferred alternative
  - Reference is 60W GLS bulb
  - Light effect (cozy) & shape very similar to known GLS bulb
  - Next sales price level after incandescent bulb,
    but with low energy saving (20 – 25%)

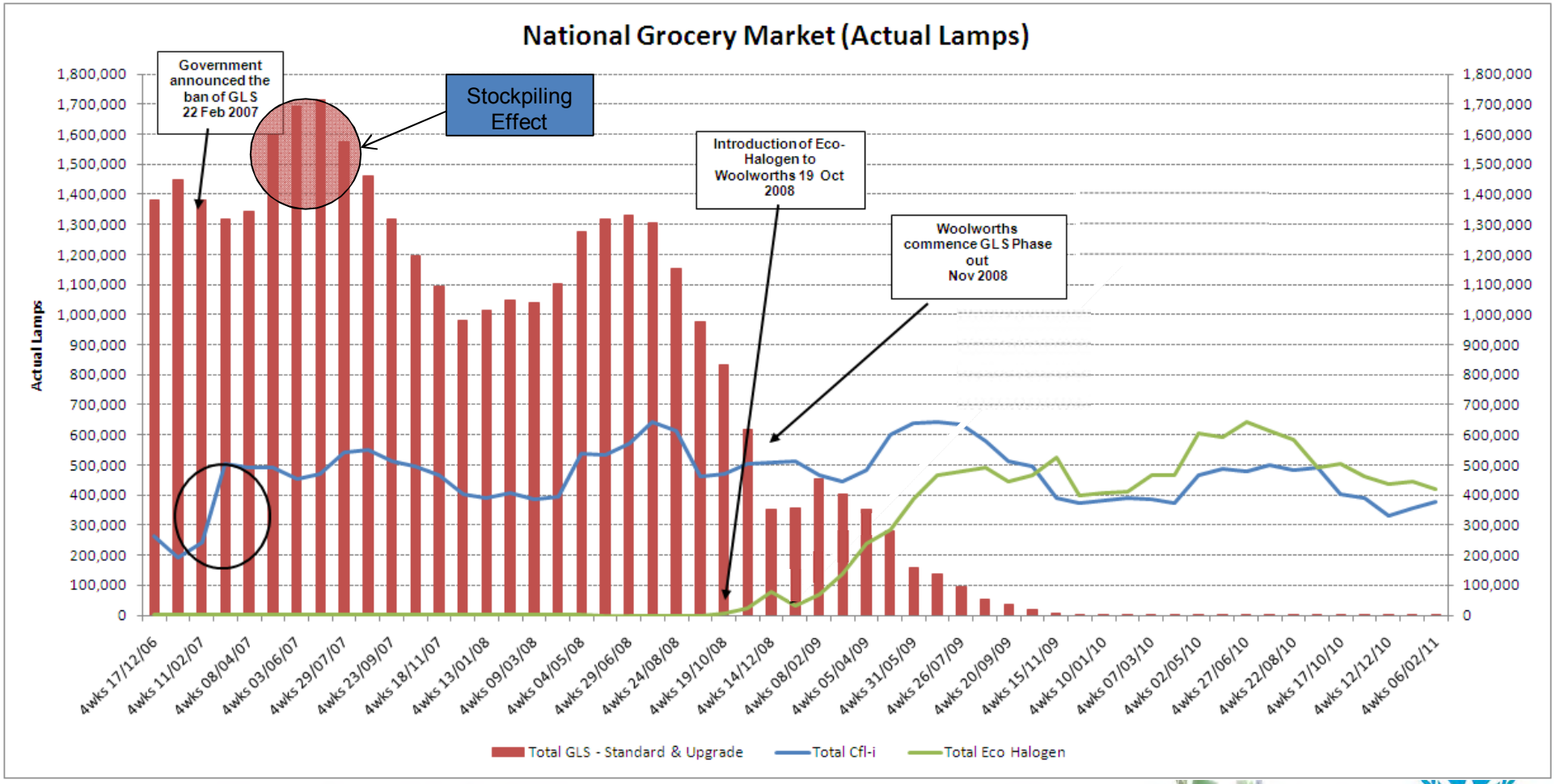


- China, rest of Asia > CFL-I preferred alternative
  - Switch to CFL-I without pressure of legislation because of:
    - Money saving (energy use & lifetime)
    - Bright cool light (6500K = 85% of market)serves single light point
    - Affordable price point (incl. savings)

LED is an alternative technology, but so far has not reached the price levels to make consumers to massively change-over

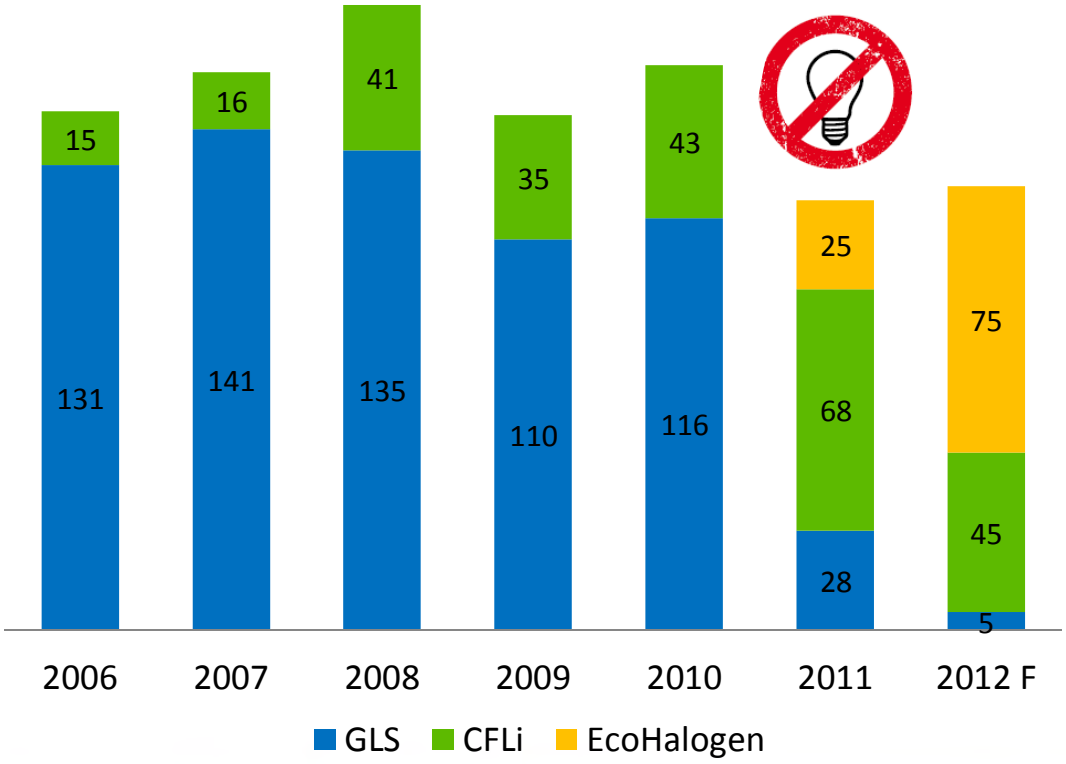
Australian market development – Case Example

Equal market split between CFLi and Eco Halogen.



Argentina market development – Case example

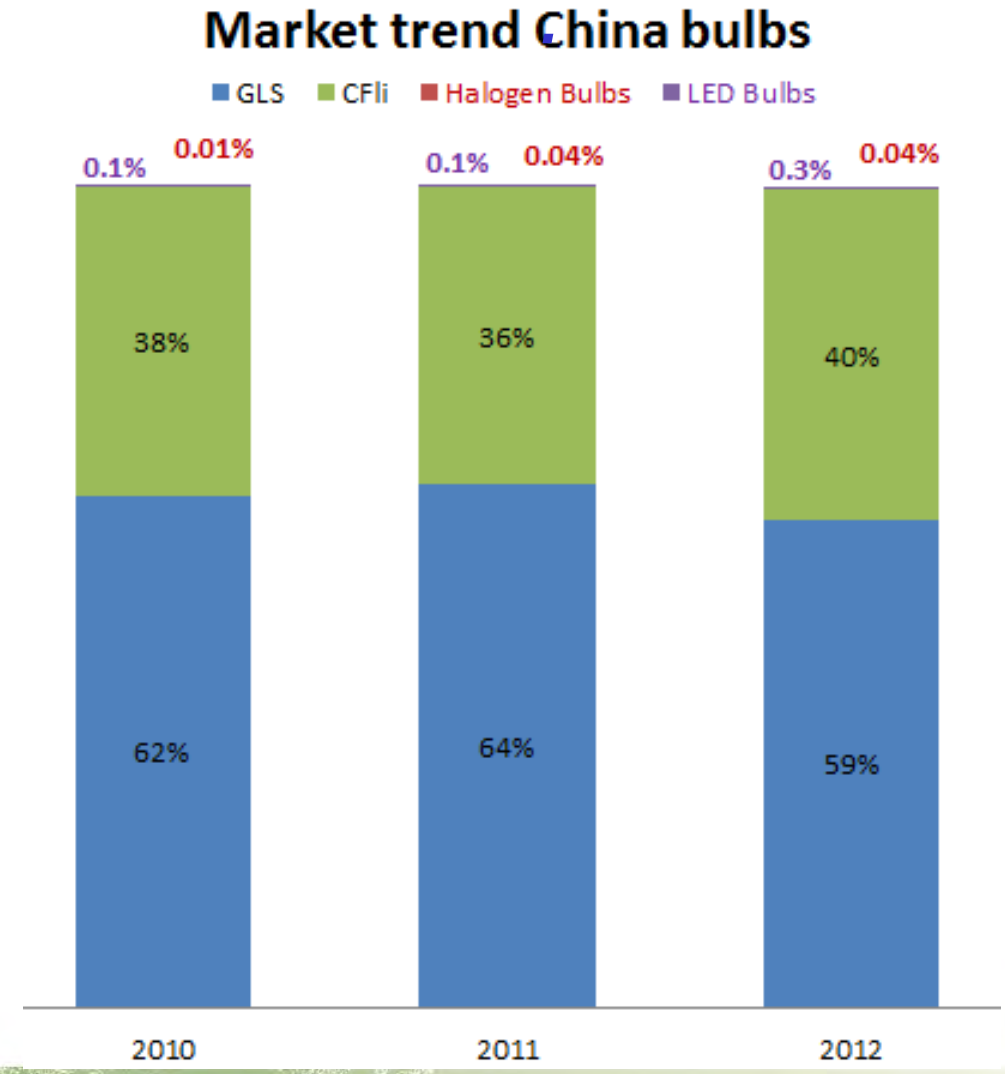
Argentina GLS, CFLi & Halo Market Evolution (Mio Pcs)



GLS Banning:
Since May 31st 2011
All GLS types >25W

China market development – Case Example

Split between GLS and CFL-I, LED will come as 3rd alternative



Should MEPS be technology neutral?

- Critical elements differ per technology, examples:
  - Luminous efficacy (lm/W) is critical to phase out GLS, levels differ for Halogen, CFL-I and LED
  - Mercury is relevant in CFL-I, but not for Halogen or LED
  - Switch cycles are relevant for CFL-I and LED, but not for Halogen
- Making formula's that apply to all technologies are very complicated (hardly possible, e.g. maximum rated Power)

➢ Recommendation:

To keep the MEPS simple and short, best approach is to include a small chapter per technology with the relevant elements.

Which elements should be included in MEPS?

Elements related to the performance of the lamp

- The lamp should work for a certain amount of time > Lamp life
- The lamp should save energy > Luminous efficacy
- The lamp should give normal light quality > Color rendering
- The lamp should be able to turn on/off often enough > Switch withstand
- Also after some time the lamp should still give light > Lumen maintenance

Non-lamp-performance related elements

- Mercury content > important for environment
- Power Factor > important for power supply (or not?)

Labeling & marking for communication purposes

- Marking on the lamps > safety standards like IEC give guidelines
- Labeling on the package > regional labeling keeps prices lower

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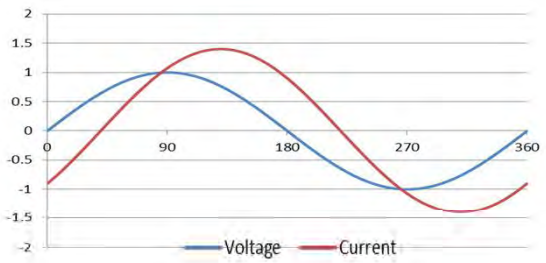
Power factor – a mathematical explanation

POWER FACTOR

=

DISPLACEMENT FACTOR x **DISTORTION FACTOR**

Displacement = cosű

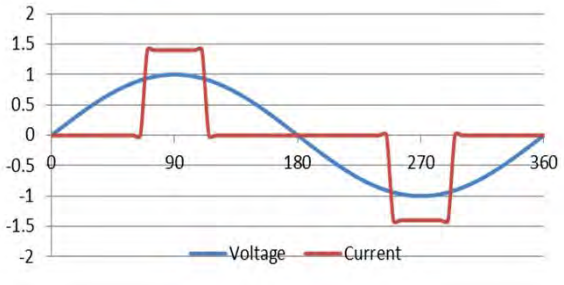


Current is not in sync with voltage

the ***HIGHER*** the displacement,
the ***LOWER*** the cos φ,
the ***LOWER*** the power factor λ

X

Distortion = $\frac{1}{\sqrt{1+THD^{2}}}$



Current has not the same wave shape as voltage

the ***HIGHER*** the distortion,
the ***LOWER*** the distortion factor,
the ***LOWER*** the power factor λ.

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Impact of Power factor

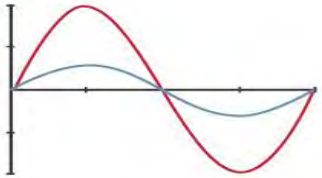
		Displacement gets worse	Distortion gets worse
	Power company	Needs to generate more power that is unpaid for.	No effect.
	Transport & Distribution company	Causes a higher current (I) to flow that requires upgrading of wiring, isolators and materials. It also causes higher losses in the system.	No effect.
	Commercial buildings, Industry	No effect.	Can lead to overheating of the neutral wire in a 3-phase, 380V electrical installation.
	Consumer	No effect.	No effect.

Impact of electrical devices on power factor

Resistive devices:

Heaters

No impact

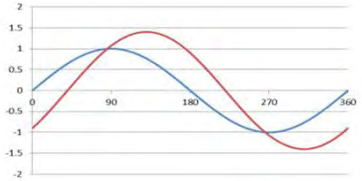


Resistor

Reactive devices: ***Inductive***

Electro engines • pumps • cooling

Displacement only



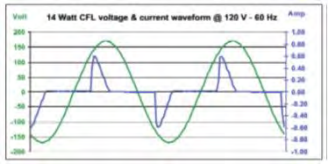
Capacitor

Inductor

Reactive devices: ***Capacitive***

Electronics

Displacement *and* distortion



Diode

Capacitor

Inductor

Resistor

Transistor

BUT

Inductive

Engines • pumps • compressors

+

Capacitive

Electronics

= less displace-ment

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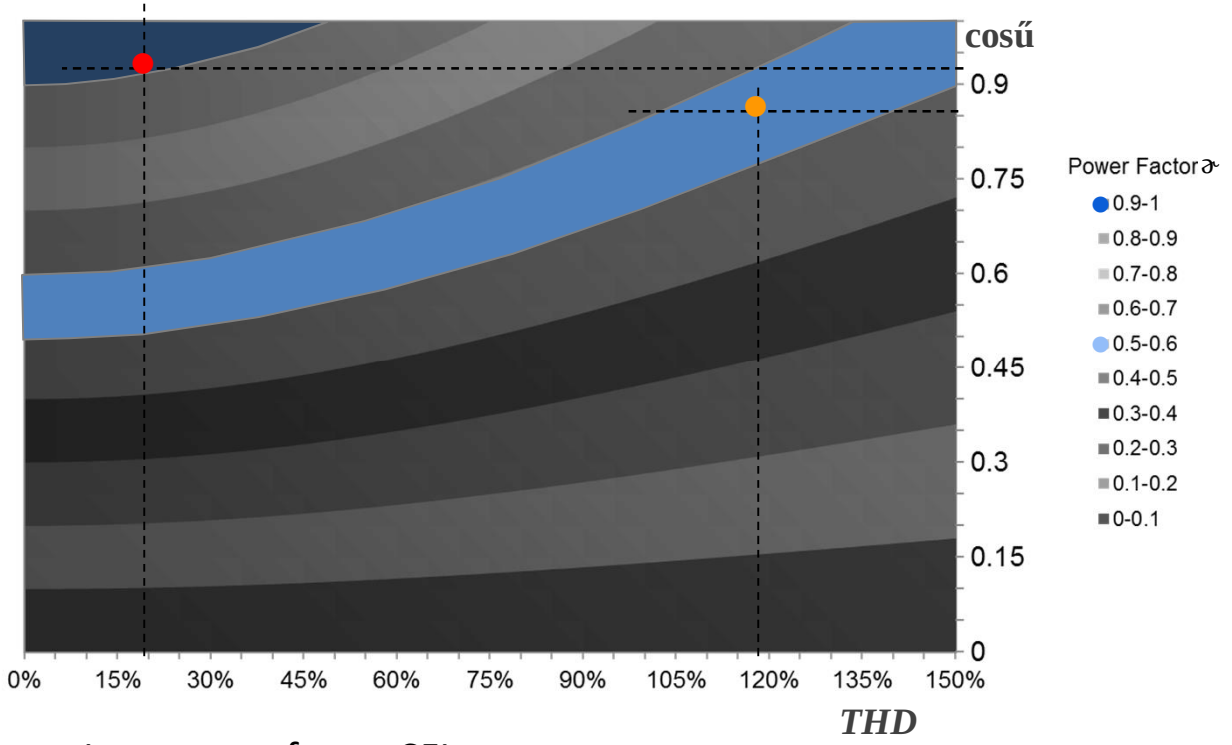
Displacement and Distortion in CFL

Applying the formula $\text{PF} = \cos\varphi \times \frac{1}{\sqrt{1 + THD^2}}$ leads to following theoretical graph:

The power factor of CFLs is within two bandwidths:

- For low power factor CFL this is between **0.5 and 0.6.**
- For high power factor CFL this is between **0.9 and 1**



The typical values for CFL for the 3 metrics: (1) power factor, (2) distortion and (3) displacement are plotted in the graph:

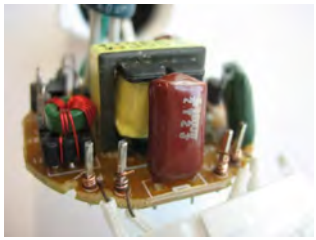
- High power factor CFL:
  1. PF= 0.90
  2. *Distortion* = 20%
  3. **Displacement = 0.92**
- Low power factor CFL:
  1. PF= 0.55
  2. *Distortion* = 120%
  3. **Displacement = 0.86**

High Power Factor is a different spec.
It is NOT higher quality.

Both are trusted PHILIPS quality

$\partial = 0.55$ $\partial = 0.90$

Disadvantages of a HPF CFL



More components = higher cost
More components = less reliability
More components = more E-waste
More components = lower efficacy

NOT higher quality

200 km/h ← Different spec → 300 km/h

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Conclusion

In IEC a lot of topics have been described & standardized. By joining this international association you can participate in working groups & co-write new standards.

ER FACTOR in

and legislation for CFL.

Current existing international standards are sufficient:

CFL with power < 25 Watt:	∂ ≥ 0.55
CFL with power ≥ 25 Watt:	∂ ≥ 0.90(*)

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(*) High Voltage only

Advised balanced performance standard – CFL-i

Main functionality criteria	Adviced minimum performance requirement		Philips additional remark
Lamp life		≥ 6000 hrs	Test conform IEC 60969
Efficacy	Input Power of bare lamp (W)	Initial Luminous Efficacy (lm/W)	The minimum initial luminous efficacy of a lamp model with a cover (no reflector) shall be no less than 85% of the requirements indicated in the table.
		CCT	
		≤ 4500K / > 4500K	
	< 5	40 / 36	
	≥ 5 to < 9	44 / 40	
	≥ 9 to <16	48 / 44	
	≥ 16 to < 25	55 / 51	
	≥ 25	60 / 57	
Colour rendering (CRI)		≥ 80	
Switching withstand		≥ 3000	half the lamp lifetime expressed in hours & 50% samples shall survive at the rated number of switching cycles
Lumen maintenance	@ 2000hrs	≥ 80%	
Start up time (to 1 lumen)		2.0 sec	
Run up time (to 60%)		180 sec	

Non-performance related elements

Power Factor		not included	This element has no effect on quality of the lamp, see Annex B
Mercury content		≤ 5mg	Philips supports the UN Minamata Treaty: <=5mg for CFL <=30W in general lighting

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Advised balanced performance standard – Ecohalogen

Non-directional lamps

Main functionality criteria	Advised minimum performance requirement	Philips additional remark
Lamp life	≥ 1500 hr	
Maximum rated power (Pmax) for a given rated luminous flux (Φ)	0,8 * (0,88√Φ+0,049Φ) Specialties exempted: colored lamps, directional lamps, lamps < 60lm & > 12000lm, lamps with specific radiation	Correction factor: filament lamp requiring external power supply have maximum rated power Pmax/1,06
Lumen maintenance	≥ 85 % at 75 % of rated average lifetime	
Number of switching cycles	≥ four x rated lamp life expressed in hours	
Starting time	< 0,2 s	
Lamp warm-up time to 60 % Φ	≤ 1,0 s	
Premature failure rate	≤ 5,0 % at 200 h	

Non-performance related elements

Lamp power factor for lamps with integrated control gear	≥ 0,95	

Make use of existing MEPS for definitions, formula's & exemptions (e.g. EU directive)

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Stakeholder engagement

- Experience Europe (EU)
  - EU Parliament promised communication to the people
  - In reality market partners have informed their customers
  - National Lighting Associations have communicated through the chain

- Important to decide regarding GLS ban implementation:
  - Stepwise approach (75&100W / 40&60W / all) <> all at once
  - First import/production ban, then retail ban <> off the shelves at once
  - In case of stepwise / phased approach, choose appropriate timing > preparation of consumers, retailers, distributors, government, industry

Off-grid lighting solutions for Homes

- In 2013 600 - 750 mio people in Africa don't have access to electricity yet
- In most parts of rural Africa there will not be cables in the ground for decades
- Still these people will need light, because light means education, productivity, security, community life, healthcare after sunset.
- Solar lighting solutions for homes making their entrance into the market
- Solar solutions are usually LED-based
- Key in this start up is to ensure good balance between quality & affordability
- Make use of Lighting Africa, that works towards improving access to better lighting in areas not yet connected to the electricity grid (www.lightingafrica.org)
- List of Minimum Quality Standards & test methods defined, products tested for compliance to performance standards

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Thank You

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gef

PHILIPS

OSRAM

nLtc National Lighting Test Centre China

Proposal

Currently, a proposal is being discussed to replace the power factor requirement in IEC 60969 by the two metrics Displacement and Distortion that define the overall power factor:

Metric	Limit			
	P < 2W	2W ≤ P ≤ 5W	5W < P ≤ 25W	P > 25W
$\kappa_{displacement}$ $(\cos \varphi_1)$	No Limit	≥ 0.4	≥ 0.7	≥ 0.9
$\kappa_{distortion}$ Regulated by IEC 61000-3-2	No Limit	No Limit	Clause 7.3b	Clause 7.3a

Applying above values in the formula $\lambda = \cos\varphi \times \frac{1}{\sqrt{1 + THD^2}}$ will NOT change the current required values of power factor (λ) for CFL:

CFL with power < 25 Watt:	$\lambda \geq 0.55$
CFL with power ≥ 25 Watt:	$\lambda \geq 0.90$

Power Factor Summary - 1

Power factor consists of two metrics:

Displacement ($\cos\phi$) *and* Distortion (THD)

When the power factor gets worse, it DOES have a negative effect on the efficacy and efficiency of the power system.

(generation, transport and distribution)

Power Factor Summary - 2

When looking at power generation and power transport & distribution, the negative effects are caused by the metric displacement (cosϕ) only.

The metric distortion (THD) can lead to overheating of the PEN conductor that only affects a 3-phase 380V system as used in large buildings.

For the metric that matters, cosϕ, the values for low and high power factor CFLs are very similar.

Low power factor CFL: ∂ = 0.55 → Cos ϕ = 0.86

High power factor CFL: ∂ = 0.90 → Cos ϕ = 0.92

Power Factor Summary - 3

Independent studies of large scale replacement programs, DID NOT find any negative effect of using low power factor CFLs on the overall power factor of the grid in situations of a national grid with mixed load.

Only in the very specific situation of an isolated grid with only CFLs connected, high power factor CFLs can have a benefit.

Power Factor Summary - 4

International standards prescribe a power factor for Lighting equipment of :

with power < 25 Watt:	∂ ≥ 0.55
with power ≥ 25 Watt:	∂ ≥ 0.90

Since there is no advantage of HPF versus LPF CFL, any new NATIONAL standard and/or legislation can copy this.

Governments often ask for HPF for reasons of

Governments think that High Power Factor is higher quality.

False

Governments are ignorant to the power factor subject, so just to play it safe, they ask for high power factor, thinking **High Power Factor will not have any disadvantages**.

False

Governments think that a large replacement of GLS that have power factor of 1 by CFLs with **power factor of 0.55 will have a negative impact on the overall power factor of the grid and thus the efficacy.**

False

Governments say the CFLs are distributed in a newly electrified area. They claim that in situations where **CFLs are the only electrical products connected to the grid, its power factor does matter.**

True

Wattage equivalences for GLS

GLS	Halogen	CFL-i
25W	~ 18W	~ 5W
40W	~ 28W	~ 8W
60W	~ 42W	~ 12W
75W	~ 53W	~ 15W
100W	~ 70W	~ 20W