

Messages from Ecodesign regarding RoHS exemptions for mercury in lamps

Presentation February 2020 for DG ENV

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Presentation overview

1. VHK
2. Recent history of Ecodesign for lighting
3. New Ecodesign regulation on light sources
4. Comments on availability of LED lamps
5. Comments on additional costs
6. Recommendation for RoHS

VHK Research Engineers (Delft - NL; Brussels - B)

- >35 years studies and policy support on environmental impacts and ecodesign of mass-produced consumer goods and professional products

Specific for lighting:

- 1991: Electricity consumption lighting in Dutch homes (NL energy agency)
- 2009: Impact Assessment Directional light sources (EC, DG ENER Lot 19)
- 2013: Evaluation CR 244/2009 Stage 6 (phase-out NDLS Halogen lamps)
- 2014: Omnibus review study (including lighting)
- 2014-2015: Review study ENER Lot 8/9/19 (all lamp types)
- 2015-2016: Contribution to Lighting Systems study (ENER Lot 37)
- 2016-2017: Intermediary for EC, seek consensus for lighting regulation
- 2018-2019: Monitoring standards for lighting
- 2018: Impact Assessment for new regulation on light sources
- 2019-: Technical Assistance to EC for lighting
- Lighting experts in VHK: Leo Wierda, René Kemna (www.vhk.nl)



Recent history of Ecodesign on lighting (1)

Ecodesign Consultation Forum December 2015, EC proposal:

- 2018: > 60 lm/W, phase out all incandescent and halogen lamps
- 2020: > 80 lm/W mains efficacy, phase-out:
 - all Compact Fluorescent Lamps (CFLi, CFLni)
 - 75% of Linear Fluorescent Lamps (LFL) T8,
 - 25% of Linear Fluorescent Lamps (LFL) T5,
 - 50% of High-Pressure Sodium (HPS) (low CRI),
 - 27% of MH (90% of quartz versions, none ceramic)
- 2024: > 120 lm/W mains efficacy: **LED-only scenario**
- **No consensus among stakeholders and Member States**
 - VHK intermediary role, seek consensus
 - **Compromise proposal in 2017**

Recent history of Ecodesign on lighting (2)

Ecodesign Consultation Forum December 2017, [EC compromise proposal](#):

Phase out by September 2020:

- Linear Fluorescent Lamps (LFL) T8 with 2/4/5-foot length
- CFLi (Compact FL with integrated control gear)
- FL T2 (no longer exempted from ED regulation)
- High-Pressure Mercury & FL T12 (already phased-out by RoHS or existing Ecodesign)

Allow on the market:

- Other FL T8 (other lengths, not linear, e.g. U-shaped)
- Linear FL T5
- Circular FL T5 and T9
- CFLni (Compact FL without integrated control gear)
- High-Pressure Sodium (HID-HPS)
- Metal Halide (HID-MH, quartz and ceramic)

Stakeholders continued to be divided on LFL T8 phase-out

Recent history of Ecodesign on lighting (3)

Reasons for 2015-2017 change in EC proposal:

- Stakeholder opinions (**compromise required to get positive vote**)
- For LFL T5 and HID (HPS, MH) users made recent investments to replace banned LFL T12, LFL T8 halophosphate and High-Pressure Mercury (HPM)
→ **give users time to amortize investments**
- For LFL T5, HID (HPS, MH), CFLni, Circular FL T5/T9 **scarce availability of LED retrofit lamps (and still expensive)** (based on VHK research 2017)
- For LFL T8: adequate LED retrofits available for 2/4/5 feet lengths, but **availability scarce for other lengths and for non-linear FL T8 (e.g. U-shaped)** (based on VHK research 2017)

Proposals for 2nd regulation tier (2025-2028) to phase-out all remaining FL and HID (LED only scenario) not welcomed: majority of stakeholders preferred to postpone such a decision to the regulation review (now 2024).

Recent history of Ecodesign on lighting (4)

Regulatory Committee December 2018:

- Final EC proposal similar to 2017 proposal, but phase-outs postponed one year (2020 → 2021) (for delays in regulatory process).
 - **Political compromise in Regulatory Committee: phase-out LFL T8 2/4/5 feet lengths by 2023 instead of 2021.**
- **Commission Regulation (EU) 2019/2020 of 1 October 2019 (OJ L315, p.224, 5.12.2019)**

New Ecodesign regulation on light sources (1)

- CR(EU) 2019/2020 of 1 October 2019 (OJ L315, p.224, 5.12.2019)
- Status of light sources implied by Annex II point 1(a):

From 1 September 2021, the declared power consumption of a light source P_{on} shall not exceed the maximum allowed power P_{onmax} (in W), defined as a function of the declared useful luminous flux Φ_{usc} (in lm) and the declared colour rendering index CRI (-) as follows:

$$P_{onmax} = C \times (L + \Phi_{usc}/(F \times \eta)) \times R;$$

Table 1

Threshold efficacy (η) and end loss factor (L)

Light source description	η	L
	[lm/W]	[W]
LFL T5-HE	98,8	1,9
LFL T5-HO, $4\,000 \leq \Phi \leq 5\,000$ lm	83,0	1,9
LFL T5-HO, other lm output	79,0	1,9
FL T5 circular	79,0	1,9
FL T8 (including FL T8 U-shaped)	89,7	4,5
From 1 September 2023, for FL T8 of 2-, 4- and 5-foot	120,0	1,5
Magnetic induction light source, any length/flux	70,2	2,3
CFLni	70,2	2,3
FL T9 circular	71,5	6,2

LFL T5 and FL circular T5 stay on market

LFL T8 2/4/5 feet ban 2023

Other FL T8 stay on market

Magnetic induction, and CFLni and FL T9 circular stay on market

New Ecodesign regulation on light sources (2)

Table 1
Threshold efficacy (η) and end loss factor (L) (continuation)

Light source description	η	L
	[lm/W]	[W]
HPS single-ended	88,0	50,0
HPS double-ended	78,0	47,7
MH \leq 405 W single-ended	84,5	7,7
MH $>$ 405 W single-ended	79,3	12,3
MH ceramic double-ended	84,5	7,7
MH quartz double-ended	79,3	12,3
Organic light-emitting diode (OLED)	65,0	1,5
Until 1 September 2023: HL G9, G4 and GY6.35	19,5	7,7
HL R7s \leq 2 700 lm	26,0	13,0
Other light sources in scope not mentioned above	120,0	1,5 (*)

HID (HPS and MH) stay on market

CFLi ban 2021

(HPM does not come back)

Regulation review: 2024

New Ecodesign regulation on light sources (3)

Exemptions in Ecodesign regulation possibly relevant for RoHS:

(means these light sources are allowed on market by Ecodesign)

- Non-white light sources (range of CR 2019/2020 art.2(1)(a))
- Luminous flux > 82,000 lm
- Luminous flux density > 500 lm/mm²
- From CR 2019/2020, Annex III (1): potentially explosive atmospheres, emergency use, radiological and nuclear medicine, military, civil defence, motor vehicles, civil aviation aircraft, railway vehicles, marine equipment, medical devices, non-road mobile machinery, interchangeable equipment
- From CR 2019/2020, Annex III (2): **double-capped fluorescent T5 with power ≤ 13 W**, spectroscopy and photometric applications
- From CR 2019/2020, Annex III (3): signalling, image capture and projection, specific ultraviolet power > 2 mW/klm, germicidal use, disinfection, fly trapping, generation of ozone, coral zooxanthellae symbioses, sun-tanning, horticulture, HID > 7000 K, **scene-lighting use** (theatre, film, video, photo).

(simplified: see CR 2019/2020 for exact formulation and for details)

Availability of LED substitutes for FL in 2020 (1)

Has LED availability changed since evaluation in 2017 for Ecodesign ?

Answer: **Yes, larger variety of LEDs available, but 'normal progress', no revolution**

- LFL T8: LEDs available in some more lengths, caps, fluxes. Efficiency increase.
- Other FL T8: some more LEDs available for U-shaped T8
- LFL T5: Higher variety of LED models available
- Circular T5 / T9: some more LED models available
- CFLni substitutes: Higher variety of LED models available

LightingEurope (LE) statements on LED availability: 3 of 9 fluorescent lamp base types exist, 6 of 19 CFLni base types exist, 5 of 16 lengths of T8 lamps available.

Not true, even when considering only models from LE-members, availability is higher. Demonstrated by SEA / CLASP report, confirmed by VHK on-line search.

Not sufficient to consider only lengths, cap-types and plug-and-play.

In addition: flux (and light distribution), colour temperature, colour rendering (LED with CRI > 90 ?), lamp dimensions (for CFLni), price

→ **Difficult to make a complete assessment of LED availability and of amount of users that might encounter difficulties after an FL ban.**

Availability of LED substitutes for FL in 2020 (2)

- Adequate LED substitutes available for large majority of FL;
- No technical barrier to create LED substitutes also for less widely used FL;
- Barrier probably more socio-economic (not worthwhile to develop LEDs for FL used in small quantities; loss of money / jobs in FL production in EU);
- Regulation cannot wait until LEDs are available for every FL and every application (compare situation with dimmers in Ecodesign);
- Some users may have to do rewiring or buy new luminaires and thus have additional costs (inevitable now; probably still inevitable five years from now).

- Installing LEDs on existing FL control gears is not the most energy efficient solution (you still have the losses from those control gears).

- LED availability is sufficient: main problem is political acceptance of FL ban.
- Pay attention to exemptions for special applications (see ecodesign)

Comments on additional costs (1)

SEA / CLASP report tables 10/11/12 (data derived by VHK from MELISA):

- Costs for rewiring or luminaire replacement not included
- Only light source costs and electricity costs included

Table 10. Electricity and Cost Savings from the Phase-Out of T8 fluorescent lamps in Europe⁴⁰

Benefits of T8 phase-out	Savings			
Energy Bill Savings				
T8 fluorescent lamps phase-out in 2020 (billion €)	€0.6	€1.2	€1.8	€7.0 billion
T8 fluorescent lamps phase-out in 2021 (billion €)	€0.0	€0.6	€1.2	€5.0 billion

Table 11. Energy and Financial Savings from Phase-Out of T5 fluorescent lamps in Europe⁴¹

Benefits of T5 phase-out	Savings			
Energy Bill Savings				
T5 fluorescent lamps phase-out in 2021 (billion €)	€-0.3	€0.3	€1.9	€4.7 billion
T5 fluorescent lamps phase-out in 2023 (billion €)	€0.0	€-0.1	€1.5	€3.1 billion

Table 12. Energy and Financial Savings from Phase-Out of CFLni fluorescent lamps in Europe⁴²

Benefits of CFLni phase-out	Savings			
Energy Bill Savings				
CFLni fluorescent lamps phase-out in 2021 (billion €)	€-0.02	€0.23	€0.58	€2.8 billion
CFLni fluorescent lamps phase-out in 2023 (billion €)	--	€0.07	€0.49	€1.5 billion

Comments on additional costs (2)

Öko Institut / Fraunhofer report of July 2019:

- Total additional cost of **bn €250** for LED replacing LFL and **bn € 25** for LED replacing CFLni is excessive. As also stated in report: it is a **maximum**.
- **Main issue:** When determining rewiring and luminaire costs, analyses seem to assume that **1 luminaire = 1 lamp**, even if report text states averages of 2 LFL T8 / luminaire, 2.5 LFL T5 / luminaire, 1.5 CFLni / luminaire.

Implies **huge cost difference**, e.g. for LFL T8:

- Luminaire unit cost € 250 x 100 mln lamps
- Luminaire unit cost € 250 x 50 mln luminaires

(100 mln lamps / 2 lamps per luminaire)

Additional analysis by VHK with same assumptions as RoHS report, but considering 2 LFL T8 / luminaire, 2.5 LFL T5 / luminaire, 1.5 CFLni / luminaire, and using latest MELISA version :

(see next slide)

Comments on additional costs (3)

Comparison Öko Institut / Fraunhofer report vs VHK analysis:

Reference is MELISA BAU scenario (without effects of Ecodesign CR 2019/2020)										less than 20% difference
In principle VHK used same assumptions as RoHS study (final report July 2019)										20 to 50% difference
First forced substitution in 2019										more than 50% difference
Selected Assumptions		LFL T8			LFL T5			CFLni		
Share LED plug&play		12%			1%			0-20%		
Share LED+rewire		10%			3%			24-30%		
Share LED+luminaire		78%			96%			56-70%		
N lamps per luminaire		2			2.5			1.5		
Cumulative values over 2019-2025		LFL T8			LFL T5			CFLni		
		RoHS study	VHK	RoHS/VHK	RoHS study	VHK	RoHS/VHK	RoHS study	VHK	RoHS/VHK
Cum. Lamps replaced (mln)		864	882	0.98	361	390	0.92	358	286	1.25
Cum. Energy savings (TWh)		-152	-138	1.11	-30	-38	0.78	-10	-11	0.88
Cum. Energy Cost savings (bn euros)		-27	-25	1.09	-5.3	-6.8	0.77	-1.9	-2.1	0.89
Cum. Costs LED plug&play (bn euros)		3.0	3.8	0.80	0.1	0.1	0.95	0.04	0.08	0.53
Cum. Costs LED+rewire (bn euros)		5.5	5.2	1.08	0.7	0.6	1.19	4.0	3.8	1.05
Cum. Costs LED+luminaire (bn euros)		179	95	1.89	88	41	2.14	23	17	1.33
Cum. Costs FL (bn euros)		0.0	-7.5	0.00	0.0	-3.1	0.00	0.0	-1.3	0.00
Cum. Add. Purchase Costs (bn euros)		187	96	1.95	89	39	2.29	27	20	1.36
Cum. Additional Costs (bn euros)		160	71	2.25	84	32	2.62	25	17	1.42

VHK: Total additional cost of bn €103 for LED replacing LFL, instead of bn €244

Comments on additional costs (4)

Other issues with Öko Institut / Fraunhofer report of July 2019:

- Reference is MELISA BAU scenario (without effects of new Ecodesign and Energy labelling regulations for lighting).

Use MELISA ECO scenario.

- Replacements of FL by LED start in 2019:

More realistic: start in 2023.

- Share FL replacement by LED plug&play very low:

Share probably higher.

- Period 2019-2025 considered.

Better: 2023-2030

Alternative by VHK:

Reference is MELISA ECO scenario (with effects of Ecodesign CR 2019/2020)			
In principle VHK used same assumptions as RoHS study (final report July 2019)			
First forced substitution in 2023			
Selected Assumptions	LFL T8	LFL T5	CFLni
Share LED plug&play	50%	50%	50%
Share LED+rewire	10%	10%	10%
Share LED+luminaire	40%	40%	40%
N lamps per luminaire	2	2.5	1.5
Cumulative values over 2023-2030	LFL T8	LFL T5	CFLni
	VHK	VHK	VHK
Cum. Lamps replaced (mln)	146	308	177
Cum. Energy savings (TWh)	-42	-50	-16
Cum. Energy Cost savings (bn euros)	-8.0	-9.3	-3.1
Cum. Costs LED plug&play (bn euros)	2.2	3.6	0.81
Cum. Costs LED+rewire (bn euros)	0.8	1.3	0.7
Cum. Costs LED+luminaire (bn euros)	8.0	13.6	5.9
Cum. Costs FL (bn euros)	-1.2	-2.4	-0.8
Cum. Add. Purchase Costs (bn euros)	9.8	16.1	6.6
Cum. Additional Costs (bn euros)	1.8	6.7	3.6

VHK: Total additional cost of bn €8.5 for LED replacing LFL (cumulative over 2023-2030), and will decrease after 2030

Recommendations

- Align exemptions with Ecodesign
- Align CFLi ban with Ecodesign: 2021
- Align LFL T8 with Ecodesign: phase-out LFL T8 2/4/5 foot by 2023
- Phase-out other FL T8, LFL T5, Circular T5/T9, CFLni, magnetic induction by 2023-2025 (users and industry deserve clarity)
- For the moment keep HPS and MH on the market (at least high flux).

These are the views of VHK, as the consultant that supported the regulatory process for lighting, but not necessarily the views of the European Commission

Questions ?

Thanks for your attention !

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