

NTL Lemnis

Balance in Ecodesign

LED as case study

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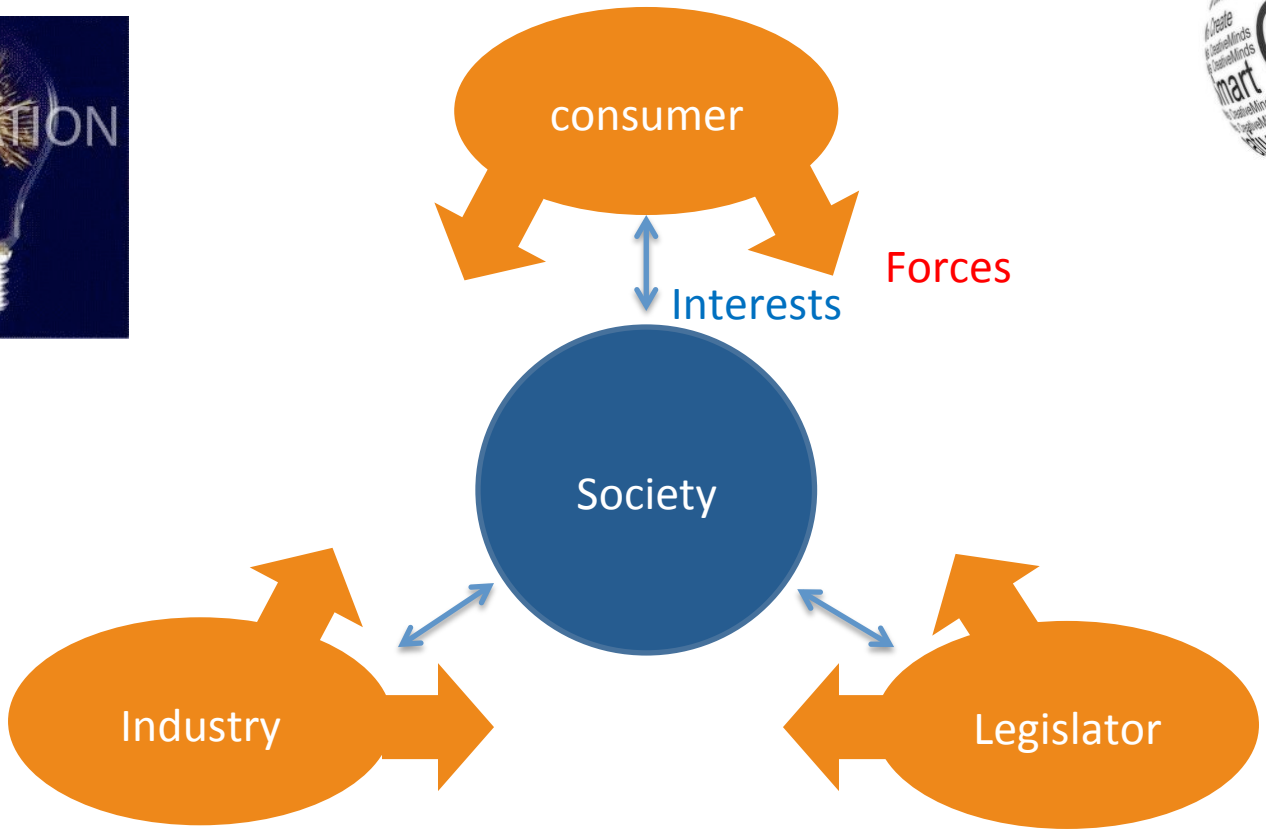
Workshop on Ecodesign
Brussels January 22, 2013

Our belief

‘Ideal’ innovation…



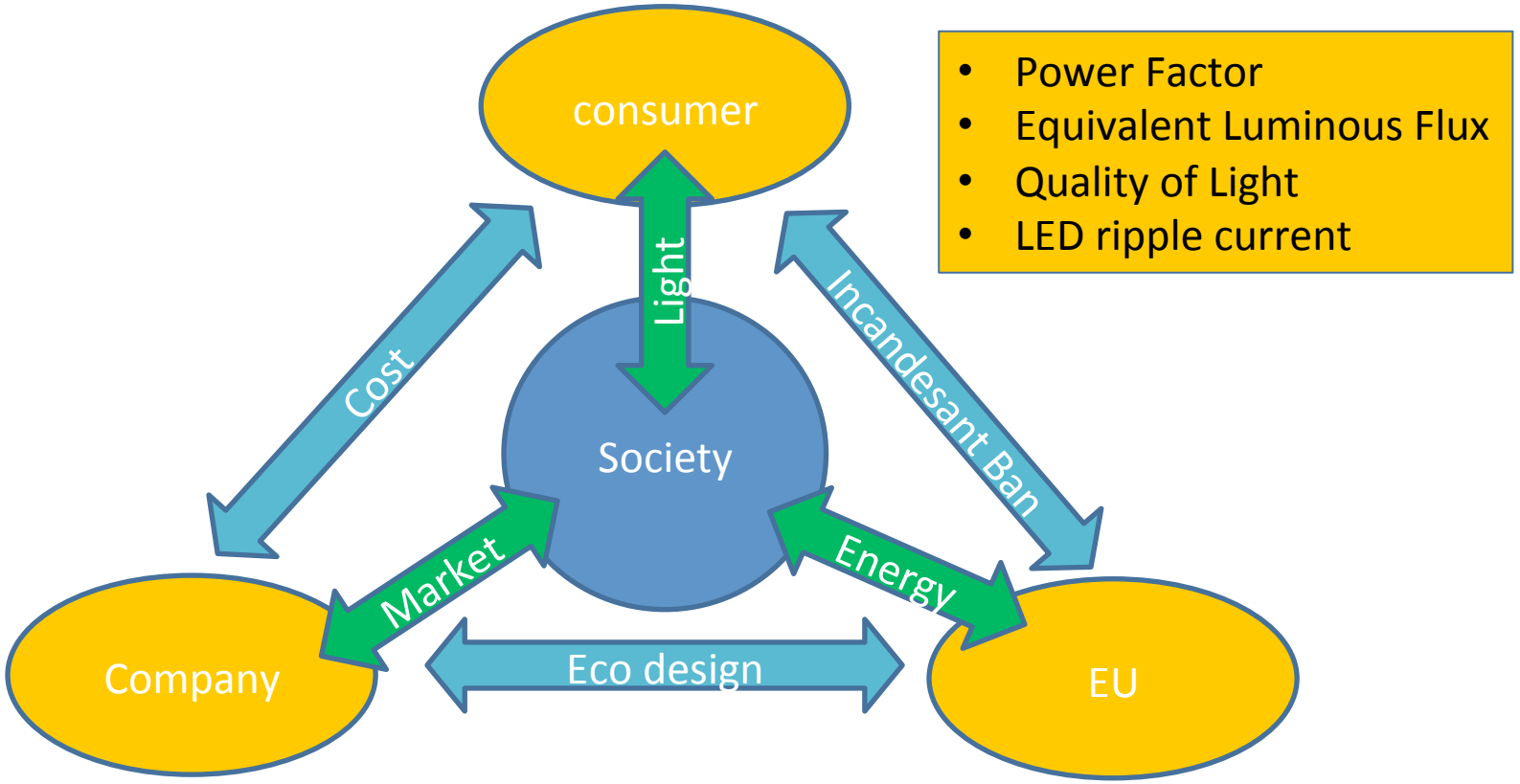




…results when forces balance the interests

The Model

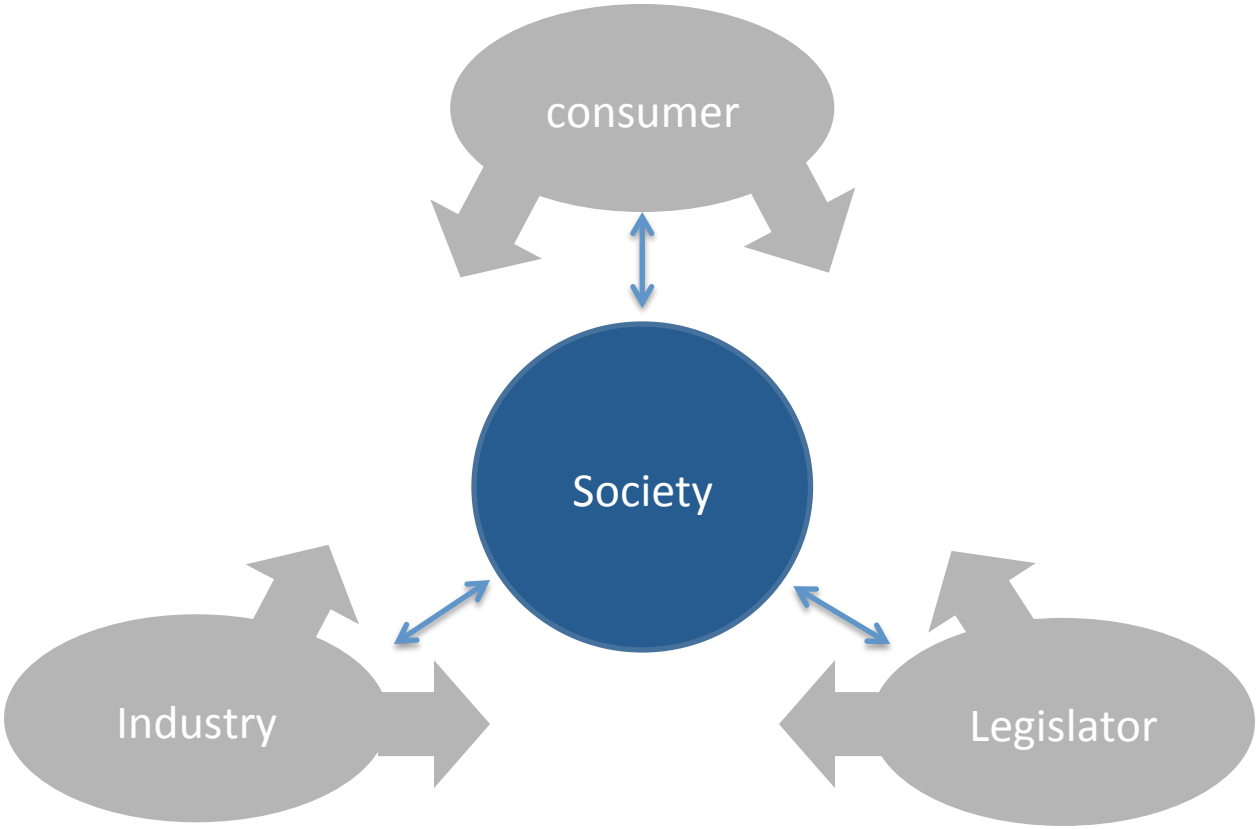
How ***balanced*** are the forces in case of LED?



- Power Factor
- Equivalent Luminous Flux
- Quality of Light
- LED ripple current

Our belief

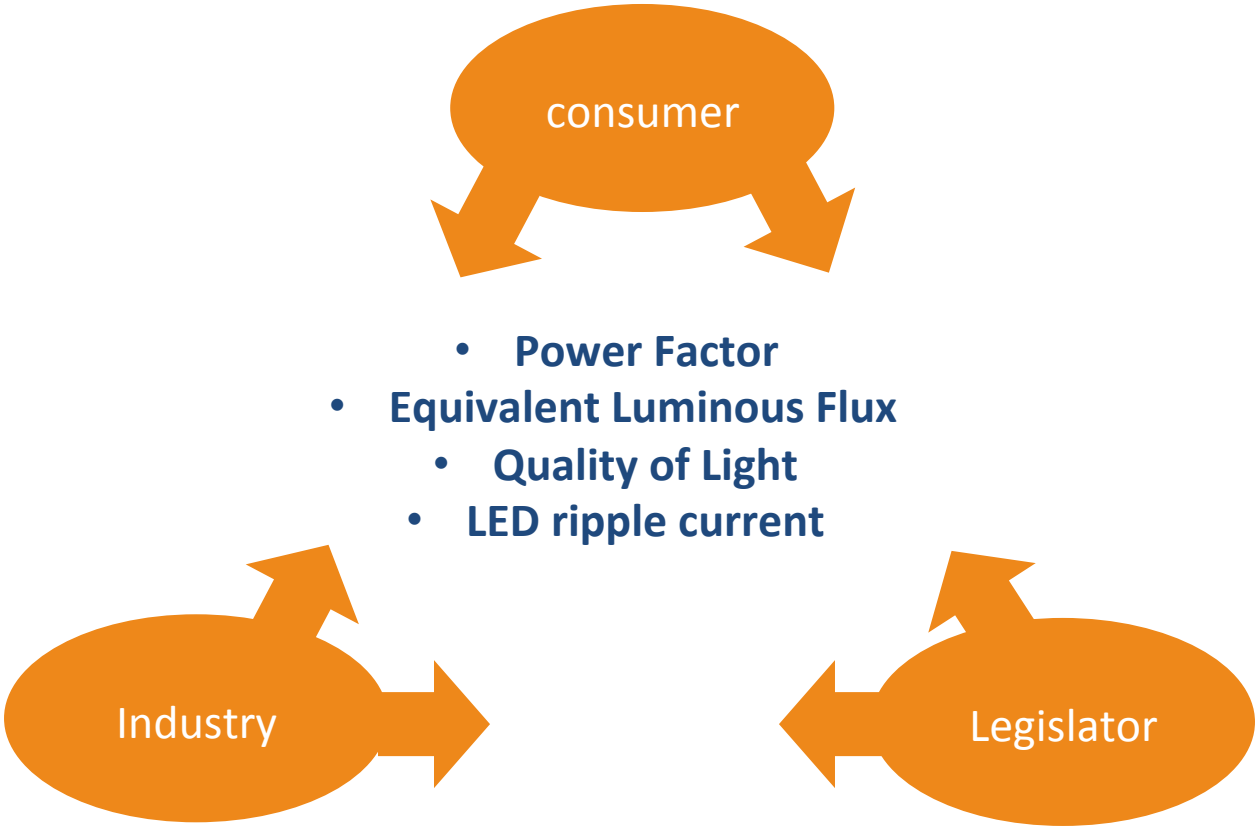
‘Ideal’ innovation…



…results when forces are balanced

Case study

How ***balanced*** are (some) topics in the LED case?



Overview

Item	Context	Balance in Eco Design	Comparison with US (Energy Star)	Recommendation
Power factor	Grid stability	**Good**	Favourable	Also apply on Harmonics. Differentiate between consumer vs professional
Equivalency Claim (25/40/60/75 W)	Retrofit meets consumer expectations	**Poor.** Too demanding.	Similar	Revise
Colour Quality of light	Retrofit meets consumer expectations	**Poor** Too relaxed	Similar	Revise
Stability of light (Flicker)	Avoid 100 Hz ripple	**Poor** Not addressed at all	Unfavourable	Add

Power Factor

- Is a measure for how well grid power supply and demand are in sync.

- In consumer/home context it does **not** play a role of significance due to
  1. Low absolute power level compared to other appliances
  2. Additive (vectorial) property of power factor. If anything ,LED's slightly improve net power factor of a home.
- In a mono-usage/professional context, power factor will play a role

- "Natural" powerfactor in ***balanced*** optimized design comes out at 0,50-0,60.
- Increasing the power factor will lead to increased size and cost of driver and increased LED ripple as well as EMC challenges.
- Tougher requirements are in place for consumer applications in US (> 0,7), India (> 0,9) and Russia (> 0,85).

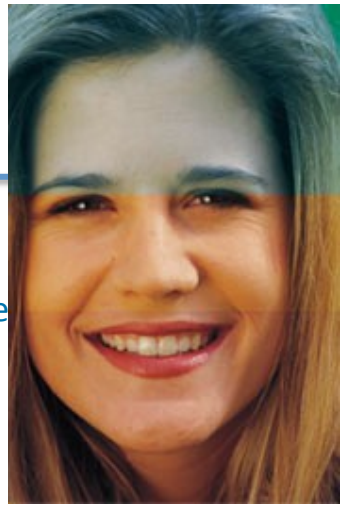
So far, that pressure has led to a proliferation of many different driver solutions, but not to a notably improved adoption/ acceptance In those regions

Equivalency claim; Luminous flux.

- Should make sure that equivalency claim is justified from a consumer perspective.
- Has been impacted by lifetime considerations as follows:
  - Since LED's loose light over lifetime, it was required to compensate for this loss in the initial luminous flux, which comes out much higher.
  - The argument is flawed, because
    - LED's lifetime is 20 fold Incandescant lifetime. At 1000-2000 hours loss of flux is difficult to measure within measurement accuracy.
    - Lifetime value of 70 % of flux is established as a thershold value where people will start to notice the depreciation.
- As a result the equivalent flux comes out very high. For 60 W equivalent it is 806 lm (compared to ~600 what it reasonably should be)
- Has slowed down adoption and confused consumers. Especially since directionality/ beam angle plays an important role in practice
- Result of field test in UK to measure CO2 emission reduction on 5000 households: 360 lm LED bulb replaces on average 56 W incandescants with high customer satisfaction.

Balanced equivalency value should be based on 10-12 lm/W

(Color) quality of light



- Color rendering index Ra > 80 does not meet Consumers expectations
  - Light is too “cold” even at Colour temperatures equivalent to Incandescant and Haloge
  - Ra = average over R1-R8 and saturated red measured by R9, is not sufficent.
  - Impacts skin-tones and colours in fabrics, fruits, wood and the like.

- Extensive research, driven by large retail chains as well as companies like ours, to seek the “voice of the customer” showed that the balanced qualification level is R9 > 50 and CRI > 85 at CCT 2700.

- Dedicated parts that meet this spec are now developed by major LED companies.



This innovation has obtained its own momentum, but should be included in balanced EcoDesign.

LED-ripple current

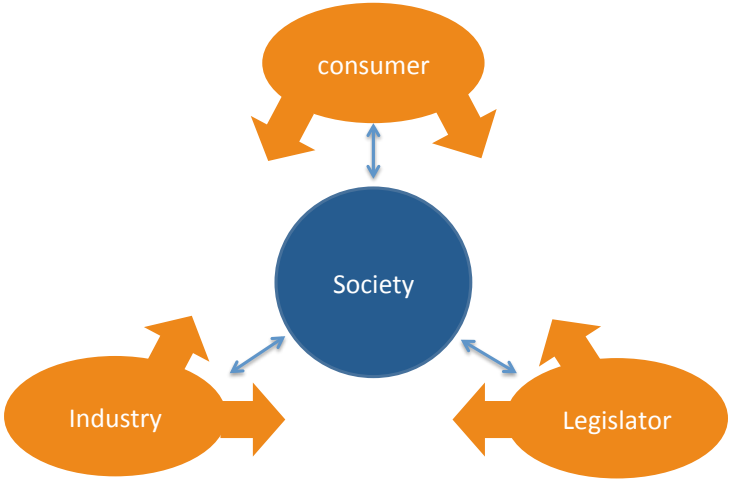
- Some LED solutions have a large light output variation at 100 Hz (double mains freq.)
- The past of fluorescent products showed people to be sensitive to this frequency

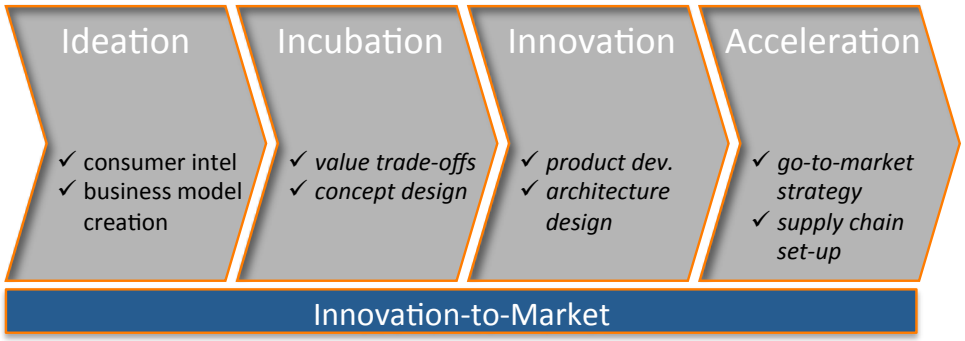
- As long as LED products are a minority in any lit environment, very few people (~1 %) will notice
- When the lighting is dominated by products with large ripple, people will (indirectly) notice. Fatigue and headaches are developed.
  Example: City-Hall of the town Hoogeveen in The Netherlands in 2009.

- Ecodesign should include reasonable upperboud on 100 Hz ripple current.
  (not on the ripple current at switching frequency)
- Given that for most people detection threshold for light variation is at
  80 % a balanced upperbound is Peak-Peak variation/average < 40 %.

Since there are many competing driver design directions this will help direct innovation.

Balancing the forces to drive “Innovation-to-Market”





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