Watt is the problem?

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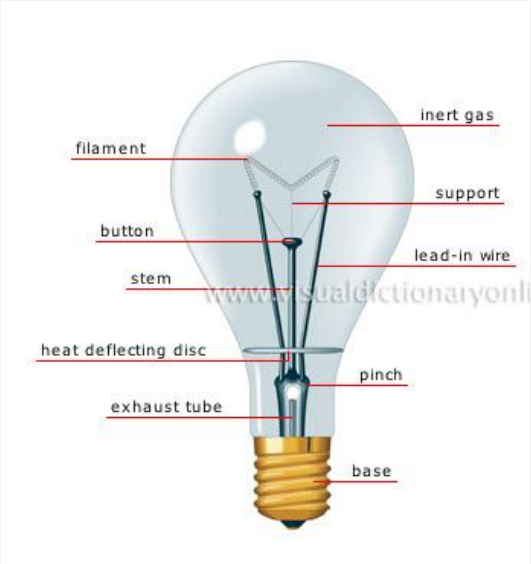
VSL

LED Evenement , 27 Nov 2013,

's-Hertogenbosch, NL

Goal of this presentation

Introduce public into challenges to measure Watt of SSL products



Incandescent → **LED-based**

Lighting technology transition

Outline

- Saving energy on EU level
- SSL comes to your home
- Watt is the problem?
- Glance at ENG05 project results
- Possible solutions
- New Joint Research Project in Metrology Program

EU Strategy 2020

Energy efficiency target of saving 20 % of the Union's primary energy consumption by 2020:

- ***19% of electricity consumption worldwide is used for lighting;***

- ***The EU has decided to progressively phase out existing inefficient incandescent light bulbs from the European market.***

Metrology is needed

Metrology

- *Independent assessment to assure Reliability*
- *Measurement Standards to assure Testing Quality*
- *Contribution to Written Standards to assure Quality, Reliability and Safety*

Customer

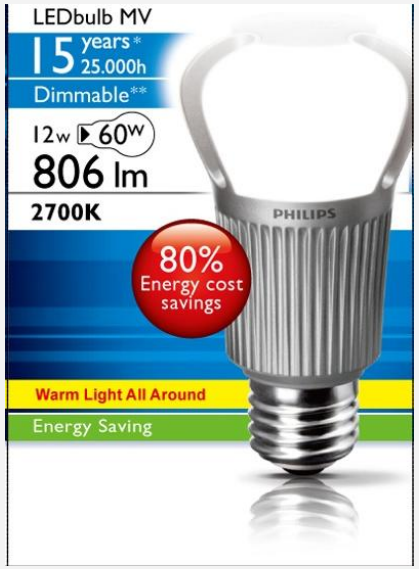
- *Consumer trust through traceability to accelerate deployment*
- *Consumer awareness through national programs*

EU

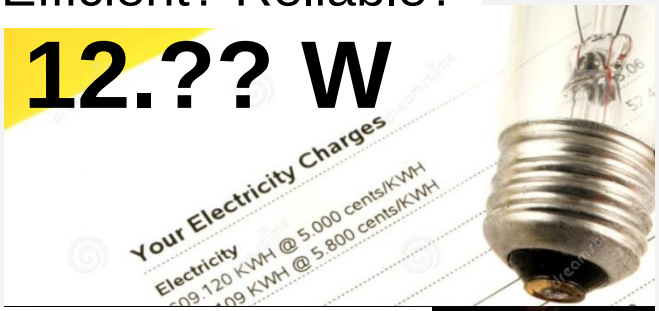
- *Large scale deployment of high-quality Solid State Lighting (SSL) products*
- **Saving 20 % of the Union's primary energy consumption by 2020**

When SSL enters your home

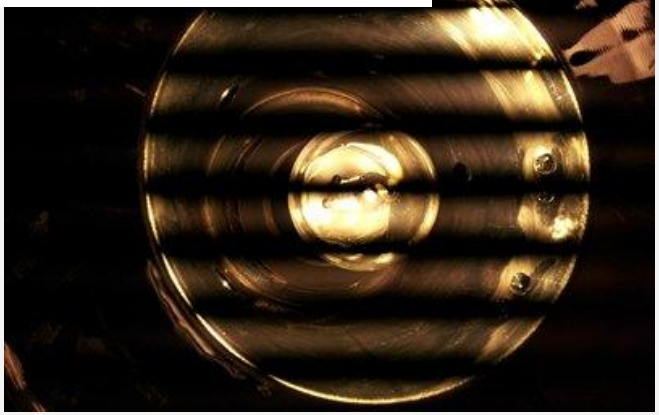
Need for traceable electrical measurements of SSL



- Efficient? Reliable?



- Safe? Pleasant?



Watt is the problem?

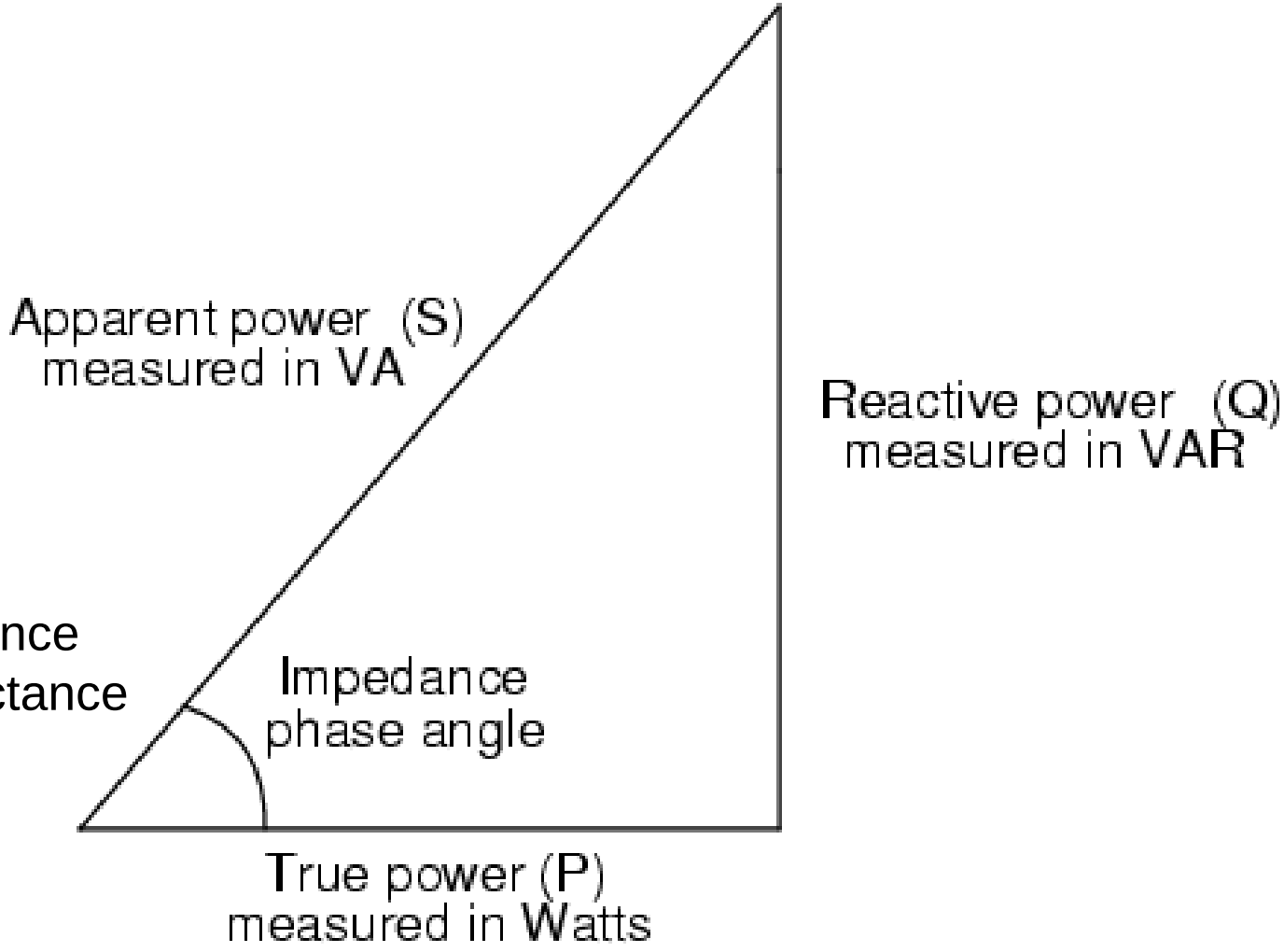
Transformer has to be upgraded from 4.2 MVA to 7.2 MVA, to supply 2.5 MW loads.

	Led- based	Incandescent
True Power	**7.2** W	**60** W
Apparent power	**27** VA	**60** VA
Peak current	0.6 A	0.75 A

The "Power Triangle"

$P = E^2/R$
$S = E^2/Z$
$Q = E^2/X$

R - resistance,
Z - total impedance
X - circuit's reactance



Reactive power accurately measured?
→ Power operator

Reactive power is also important for Power operator

Significant discrepancy between measurement results from different labs

Some discrepancy	Significant discrepancy
P (True power, W)	S (Apparent Power, VA)
Vrms	Irms
	THD (Total Harmonic distortion)
	PF (P/S = Power Factor)

Lab1

Lab2

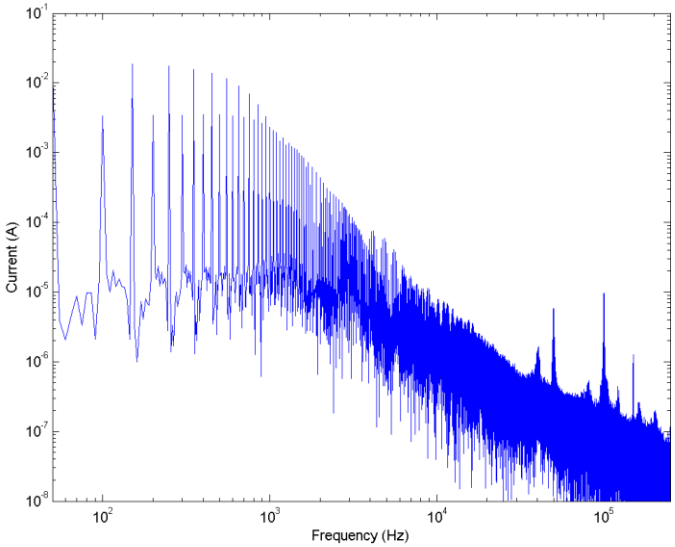
Lab3

Dutch Metrology Institute

Metrology for Solid State Lighting

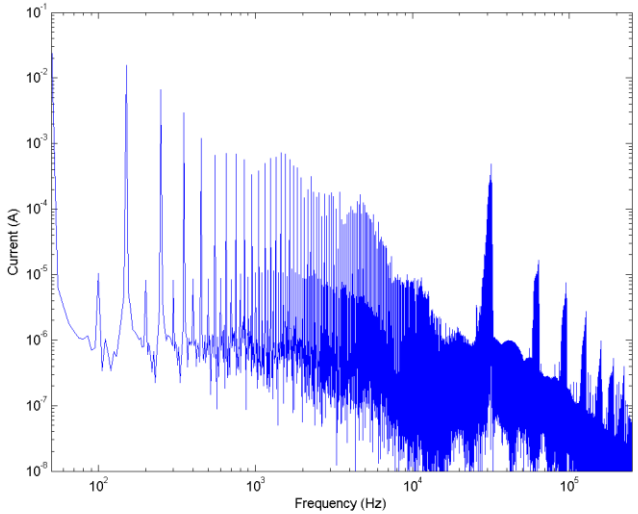
Rich current harmonics in SSL lamps

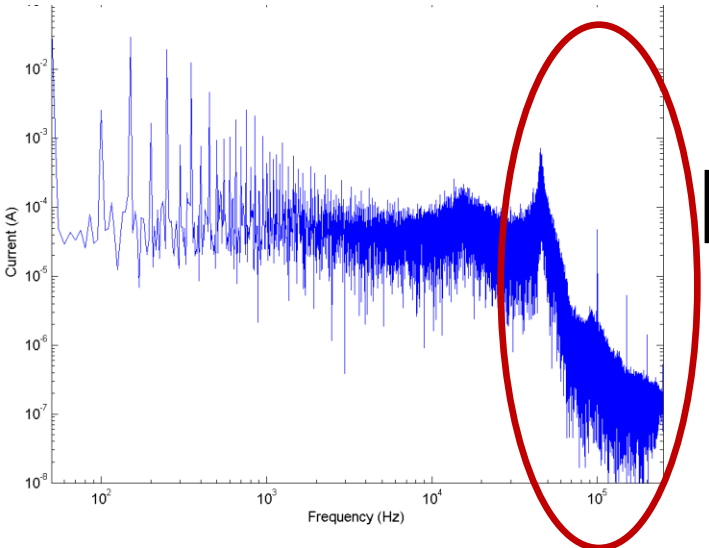
Metrology for Solid State Lighting



L1

L3

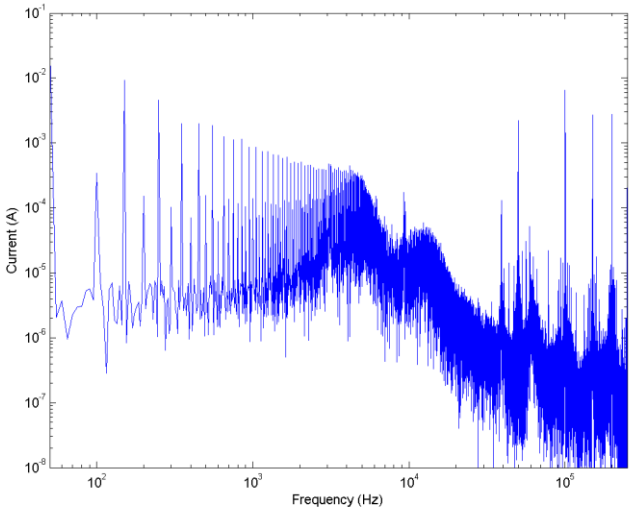




L2

L5

0.2% in I_{rms}



Conclusion from ENG05

Metrology for Solid State Lighting

On NMI level

1. Uncertainty u(P) is within 0.6%
2. Uncertainty $u(I_{rms})$ is high ~3%
3. Difference in power measurements of the same SSL model up to 2%
4. Difference in I_{rms} of the same model up to 3%

Possible reasons for high I_{rms}

1. Higher uncertainty in high frequency range due to digitizer and transducer
2. Resonance of EUT components contributes
3. The transducers (current shunt) can change the current waveform of the EUT

What is
Equipment Under Test (EUT)?

All the network components should be considered:

- ✓**Power supply**
- ✓**Cable** length and type
- ✓**Lamps** (circuit topology, components)

The **EUT** and not single contributing SSL product should be tested

Solutions:

1. Consideration of the **Equipment Under Test** to be tested and not just SSL product (**reported within ENG05**)
2. Measurements done in **stringent measurement conditions**
3. **Calibration** of a complete electrical test system per lamp type **(very inefficient)**

Alternative solution:

1. **Impedance stabilization network** (**first prototype is developed in ENG05, EMRP Call 2009**)

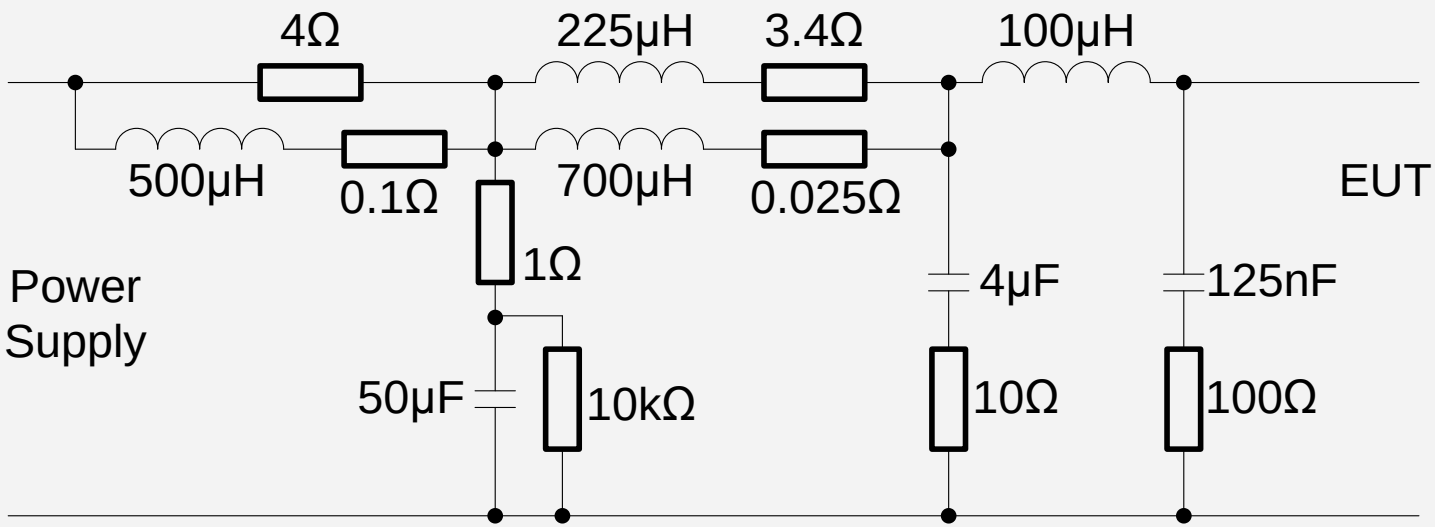
2. **Electrical Measurement Standard** for traceability and to validate the test system (**proposed within EMRP Call 2013: JRP g-10 MESaIL**)

Stringent measurement conditions

Metrology for Solid State Lighting

- **Ambient condition**: 23.0 ± 0.5 °C (25.0 ± 1.0 °C standard)
- **AC Power supply**: THD<0.5% (3% in standard)
- **Voltage regulated** to within ± 0.1% under load (± 0.2% in standard)
- **Stabilization**: burn at least 1000 h after purchasing (standard 100 h)
- **At least 3 readings** of the electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.2% (0.5% in standard)
- **Operating orientation** with lamp upward (**Base-down**)
- **The connection** between the power supply, transducer and lamps must be kept **as short as possible**

Proposed source impedance stabilization network



The Irms deviation calculated becomes less than 0.02 %

EMRP 2014-2017

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

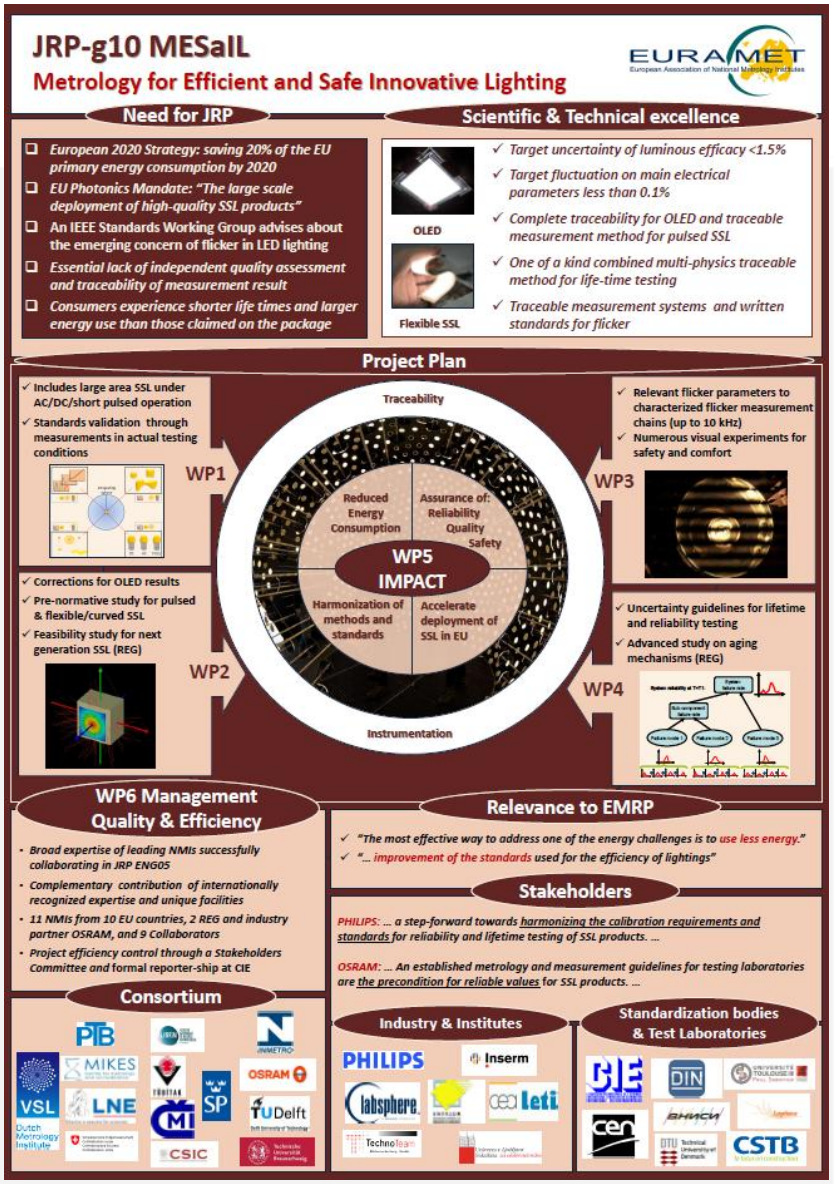
Joint Research Project (JRP)
11 NMIs + 2 REGs+Industry
Budget 3.7 mln EUR

Stakeholders:

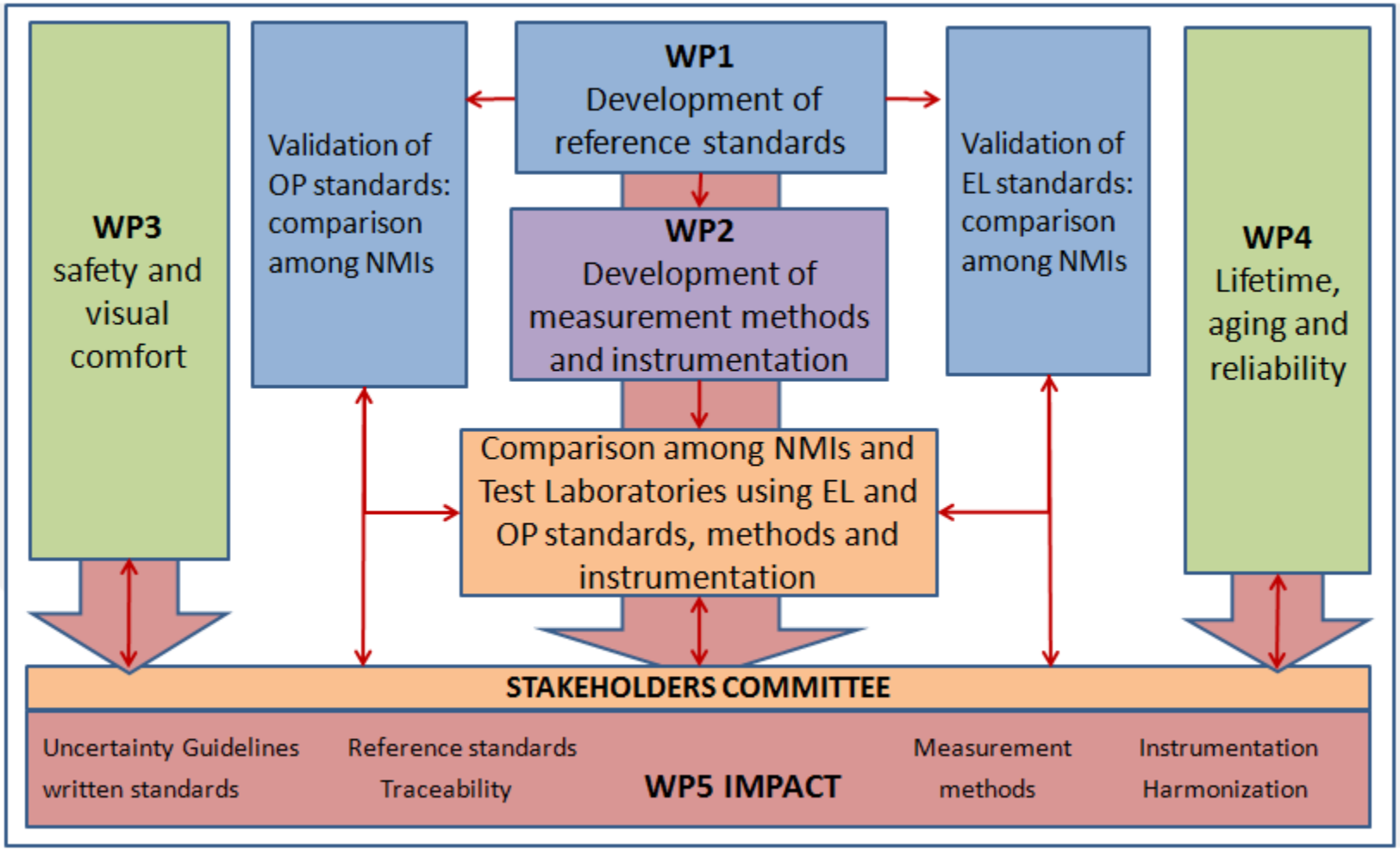
- **Test Laboratories**
- **Standartization bodies**
- **Industry**

Review result: 13 Dec 2013

http://www.emrponline.eu/call2013/SRTs/SRT-g10.pdf



JRP g-10 MESaIL: WPs scheme



JRP g-10 MESaIL:
Main objective for Electrical Measurements

- **Development of electrical test standards -** Develop an electronic load with similar electrical behavior as SSL products. Key features of the electronic load are rapid stabilization and switchable impedance to simulate typical SSL topologies.

- **Electrical measurement methods** - The analysis, design and realization of an impedance stabilization network will be undertaken. To prove its effectiveness, an inter-comparison will take place among NMIs. In the electrical power measurements of SSLs, the frequency range of the highest interest is DC – 200 kHz.

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