

**On the bright side of light:
International efforts to accelerate
market adoption of LEDs while
avoiding the pitfalls with CFLs**



ssl.iea-4e.org

**IEA 4E SOLID-STATE
LIGHTING ANNEX**

Eceee Summer study 2013

Peter Bennich, Swedish energy agency; annex chair

Nils Borg, Operating agent

Michael Scholand, Operating agent support

Table of Contents

1

The rapidly changing lighting landscape

2

SSL Annex Overview

3

Tasks 1 through 3

4

Upcoming Plans

4^E

Transformative *lighting* technology

- LEDs are developing fast, and promises a lot...
 - Outstanding energy efficiency, allowing for a reduction in overall electricity use for lighting
 - Large flexibility thanks to integrated controls and systematic approaches
 - Etc!

4^E

US DoE projections

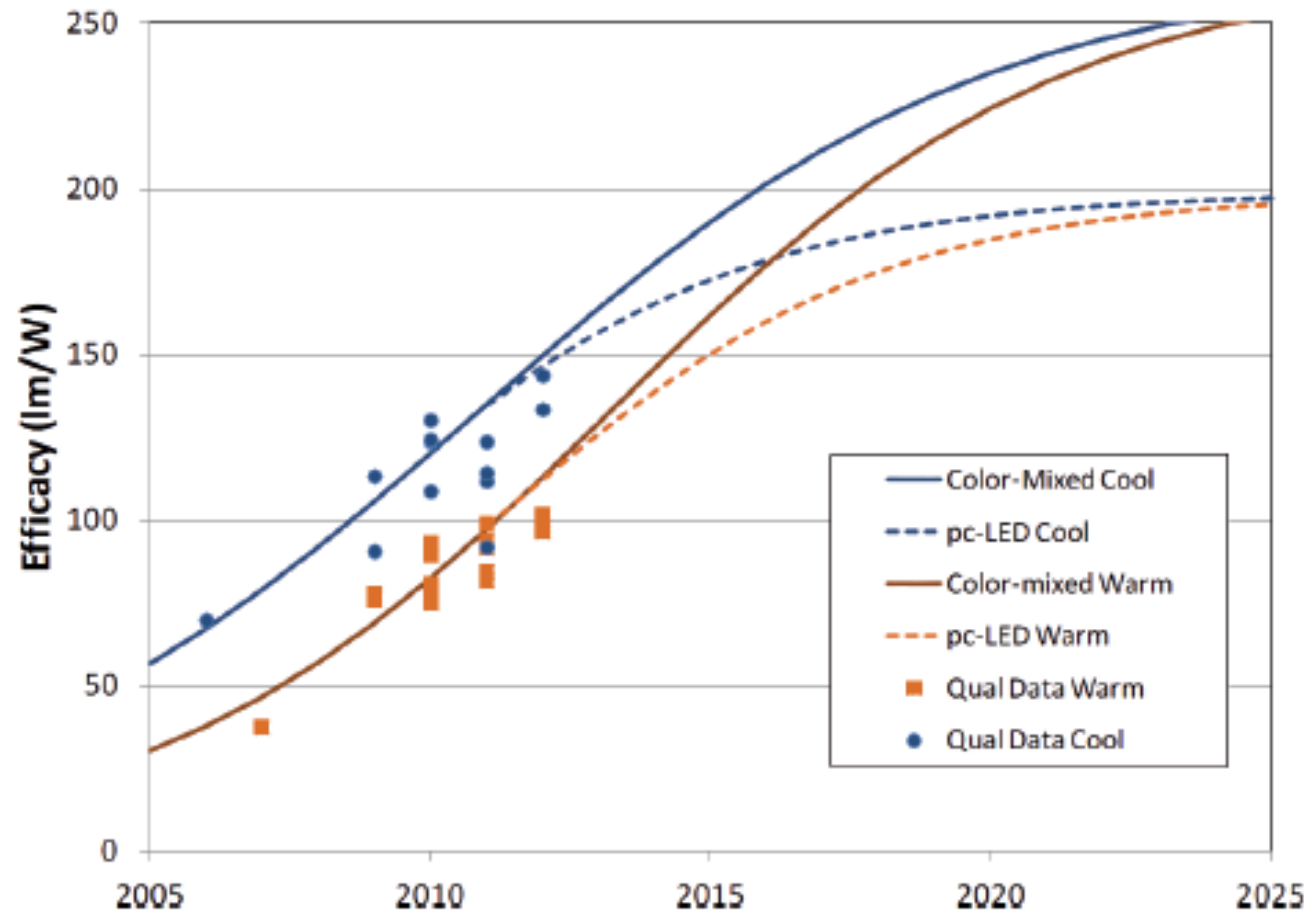
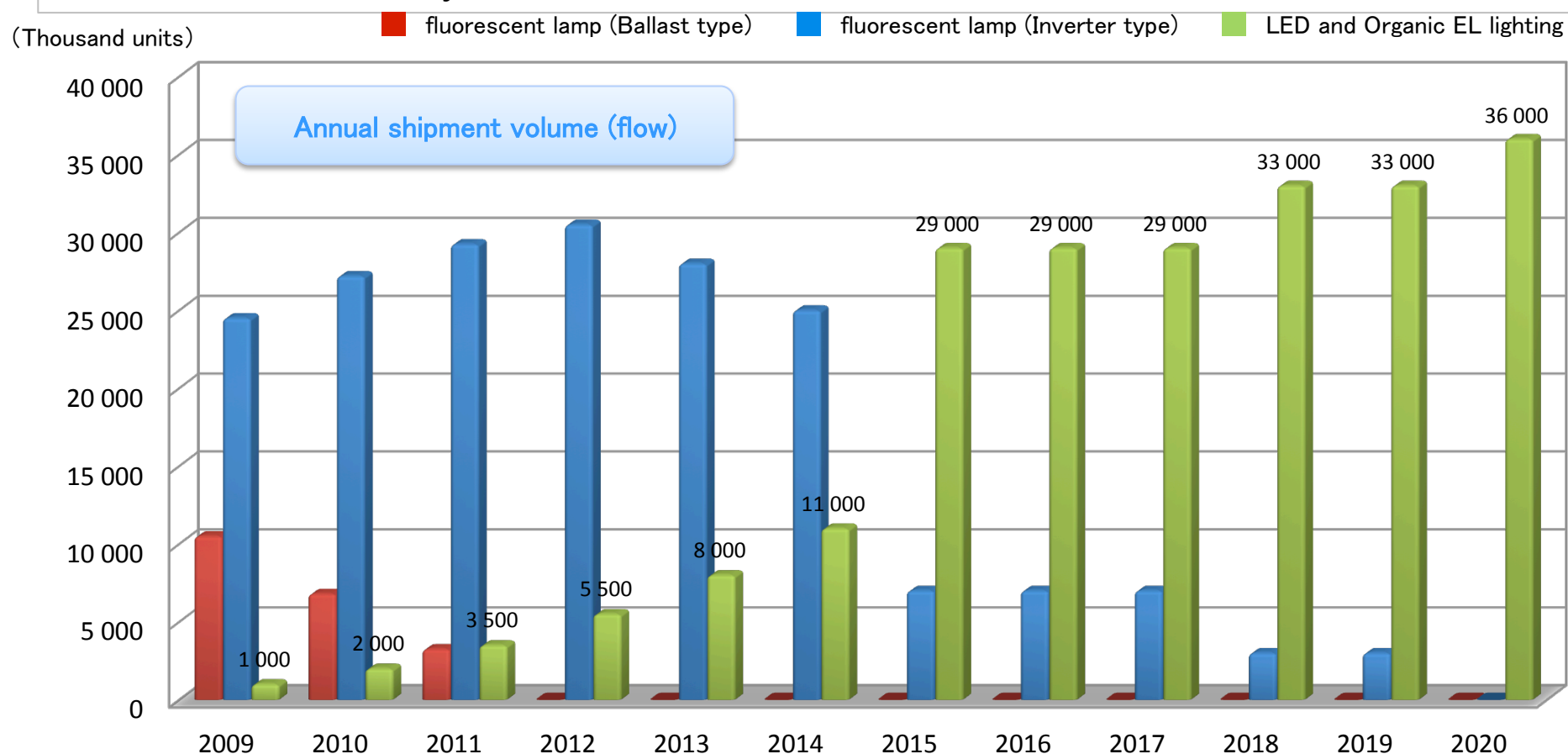


Figure 1. US DOE Actual and Projected Packaged LED Efficacy.

Strategies toward further growth of LED industry

Japan declared to be a leading nation in environment protection and energy conservation by promoting the “Green Innovation” initiatives. Japan aims to increase solid state lighting and organic EL lighting up to 100% in their flow by 2020, and up to 100% in their stock by 2030.



4E

But there are some concerns...

- New actors enter the market
- With new business models and new product configurations, the buyer and the consumer have difficulties making choices
- Quality issues of the new technology

In particular:

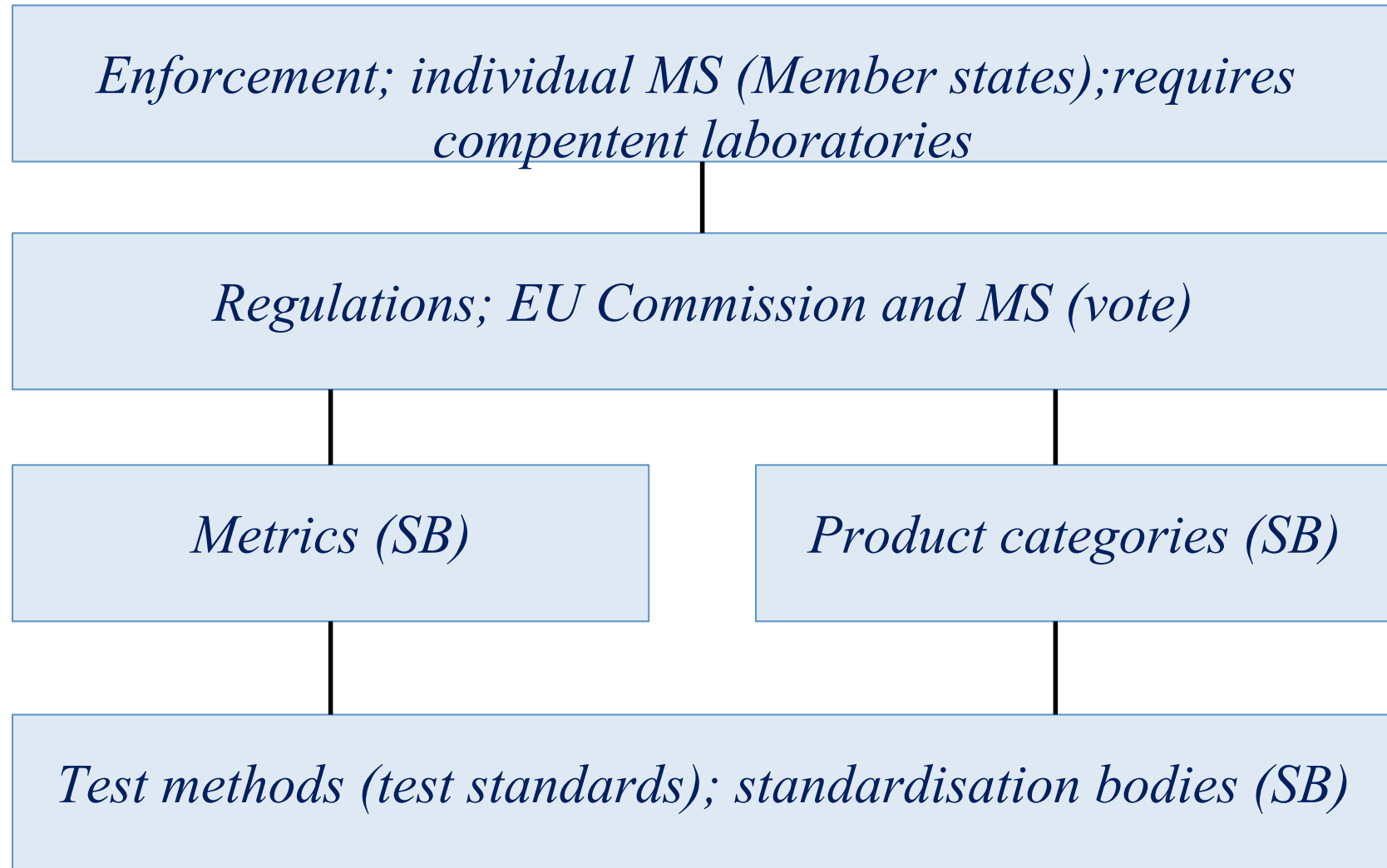
- The introduction of CFLs created a lot of consumer dissatisfaction – fear of repeating previous mistakes!

4E

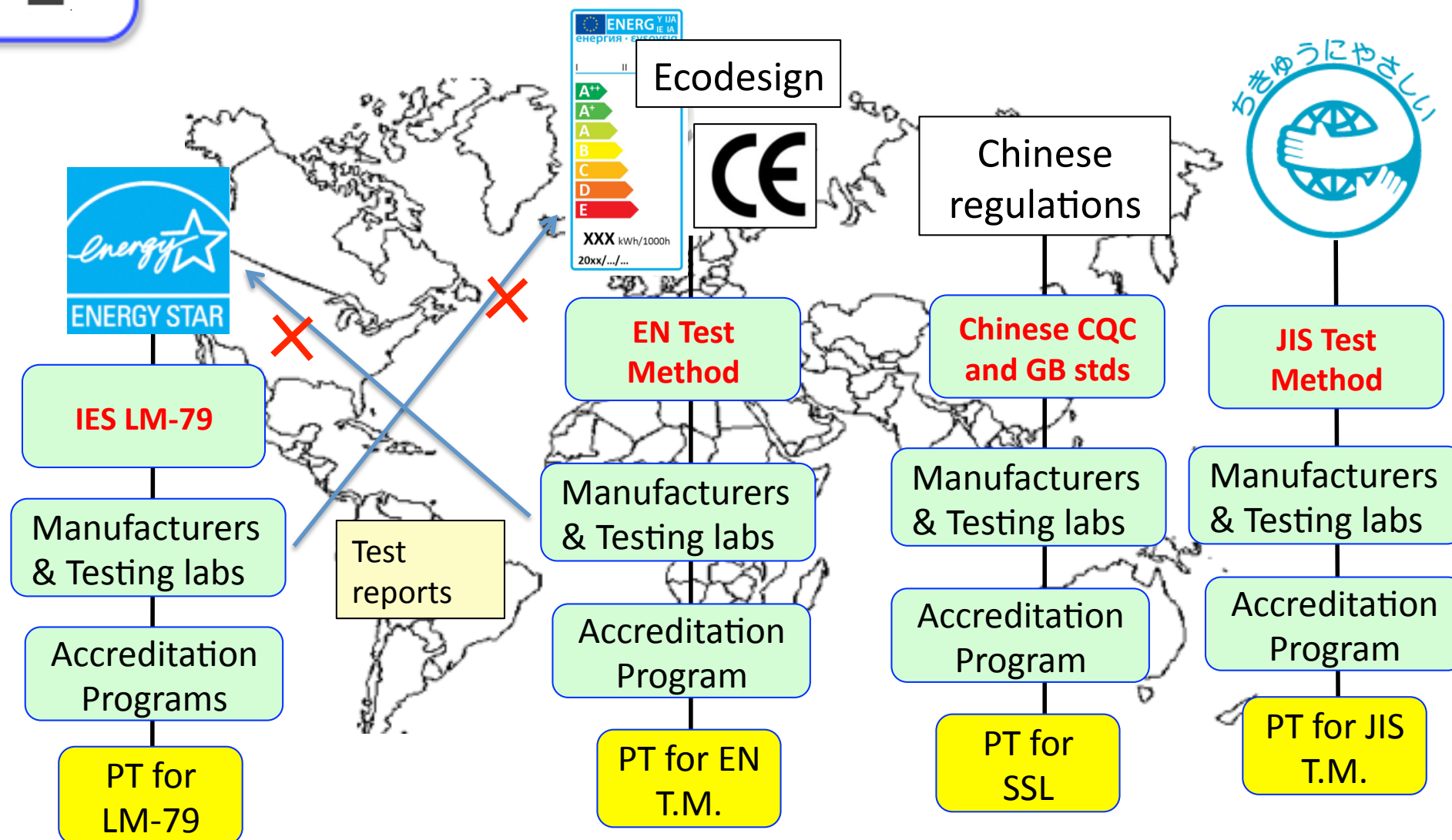
And more concerns...

- Test and accreditation programmes *are not mutually* recognised between regions, creating barriers
- Different regulations create some barriers, too, but to a lesser extent
- Not easy to be a producer or a importer or a test lab... or a regulator!

From test methods to enforcement

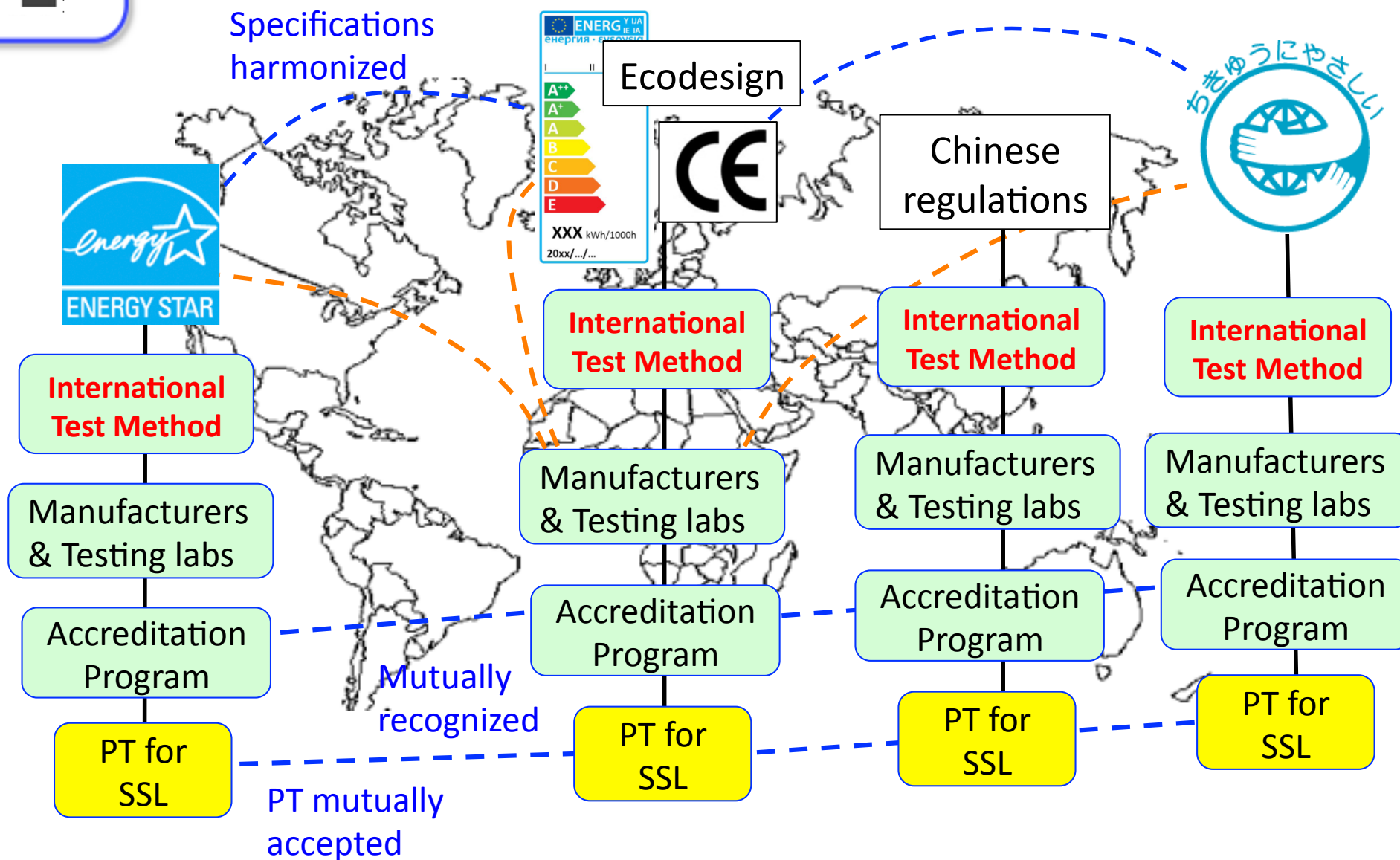


Need for International harmonization



Different Test methods, different APs, different PTs

Ideal scheme – global harmonisation



4^E

Interest for governments?

- Lighting one of the largest end-users of electricity, ca 2500 TWh/year (16-19%)
- Future BAU scenarios don't look good – policies are needed to meet saving targets (such as the 20-20-20 goal in EU)
- Regulations are not enough - to secure a fast overall market transformation pace, governments need to increase their efforts on
 - promoting *harmonisation* of test standards etc on a
 - *global* scale – (interregional level) and
 - stimulating increased *lab capacity*

Table of Contents

1

The rapidly changing lighting landscape

2

SSL Annex Overview

3

Tasks 1 through 3

4

Upcoming Plans

4^E

IEA 4E Implementing agreement

- **IEA** – International Energy Agency, the energy co-operation forum of OECD countries
- **IEA 4E** – Efficient Electrical End-Use Equipment – so called Implementing Agreement: Multilateral research and deployment activities.
 - Mapping&Benchmark Annex (M&B Annex)
 - Electrical Motor Systems Annex (EMSA)
 - Standby Annex
 - Solid State Lighting Annex (SSL Annex)
- <http://www.iea-4e.org/>



IEA 4E SSL Annex

- IEA 4E **SSL** 2011-2012: 9 Funding Countries
 - France, Australia, The Netherlands, United Kingdom, Sweden, Denmark, Japan, US, China (*expert status, not full member*)
- 2012-2013: 10 Funding countries
 - The Republic of Korea joined
- Other countries welcome
- <http://ssl.iea-4e.org/>

4

Goals of the SSL Annex (2010-2014)

To provide funding governments with:

- Tools to assess the performance of SSL,
- Information assisting formation of energy-efficient lighting policies, and
- Provision for harmonised test procedures and laboratory accreditation

To ***increase confidence in the SSL in the marketplace.***

4E

Management Committee (MC)

- The MC is comprised of delegated representatives of the funding governments
- The MC reports to the IEA 4E Executive Committee, consisting of delegated representatives of the same government. May or may not be the same persons.
- Tasks:
 - Set the priorities for the SSL annex
 - Approve the timeline and budget
 - Validate and approve the results of the SSL annex expert group

4^E

Expert Group

- Do the actual work assigned by the Management Committee
- Experts appointed by participating governments
- Four nucleus labs (mostly governmental NMI's):
 - NIST, Washington (NMI)
 - NMIJ, Japan (NMI)
 - NLTC, China
 - VSL, The Netherlands (NMI)
- Assigned experts from these labs, from different universities, and others (in-kind contributions)

Table of Contents

1	The rapidly changing lighting landscape
2	SSL Annex Overview
3	Tasks 1 through 3
4	Upcoming Plans

4^E

SSL Annex: Three Main Tasks

- Task 1: Develop SSL product quality assurance
 - Create performance tiers, address equivalency claims
 - Collect data on Life Cycle Assessment, Health issues
- Task 2: Harmonised SSL testing and lab comparison
 - Provide for harmonized national and regional testing protocols (CIE, IEC, ANSI, etc.)
 - Interlaboratory Comparison: exercise to calibrate 4 Nucleus laboratories
 - Wide international *Interlaboratory Comparison* testing to calibrate participating laboratories
 - Propose proficiency testing procedure for accreditation
- Task 3: Provide for harmonised International Accreditation

4^E

Task 1: Product quality Assurance

- Minimum Performance requirements for 4 product categories



Non-
directional
Lamps



Directional
Lamps



Downlight
Fixtures

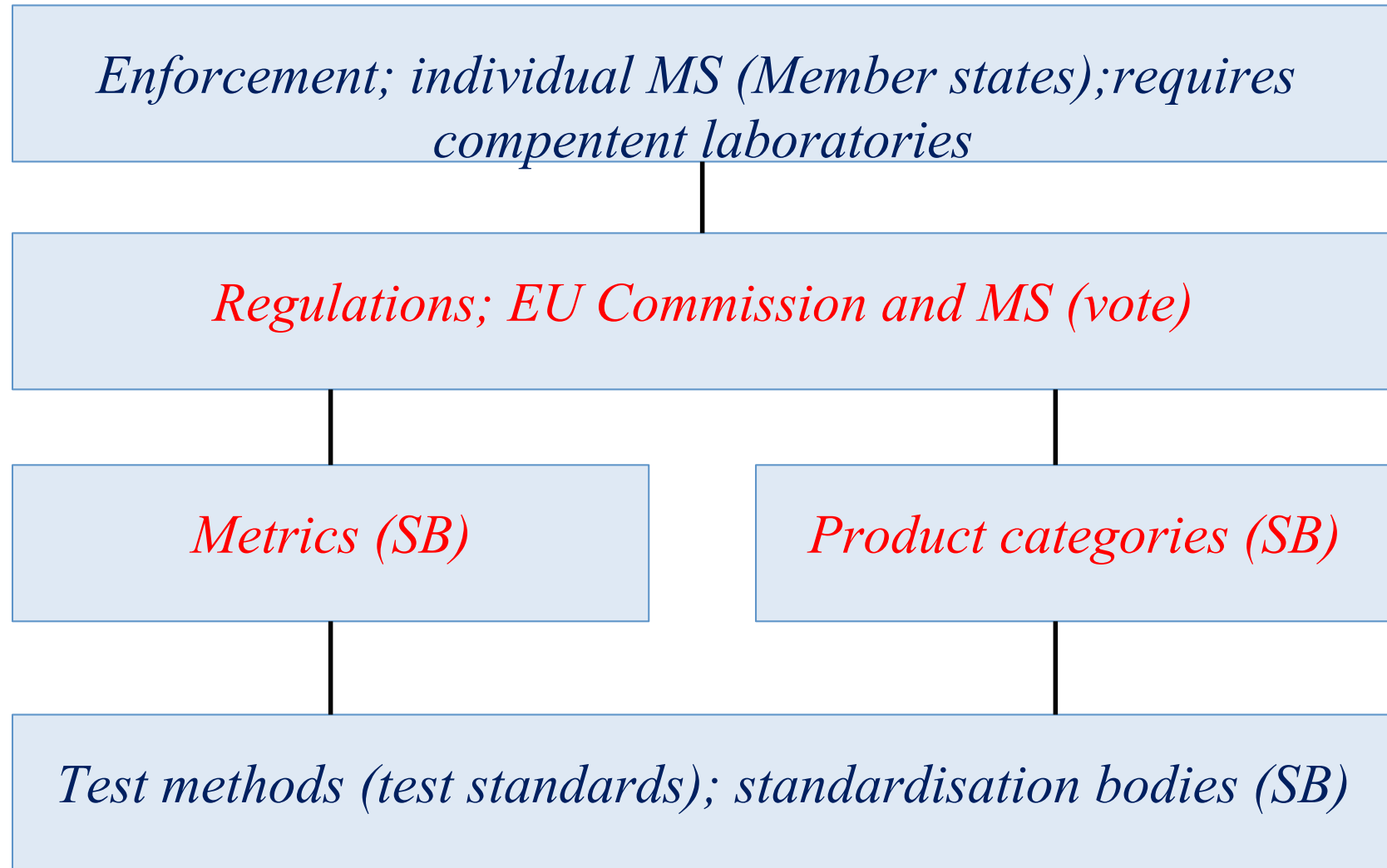


LED Linear
Fluorescent
replacement
lamps

- Street lighting final expert review, close to being published
- New products under way (see workplan 2013-2014)

... To serve as a *basis* for regulations for governments and regions

From test methods to enforcement

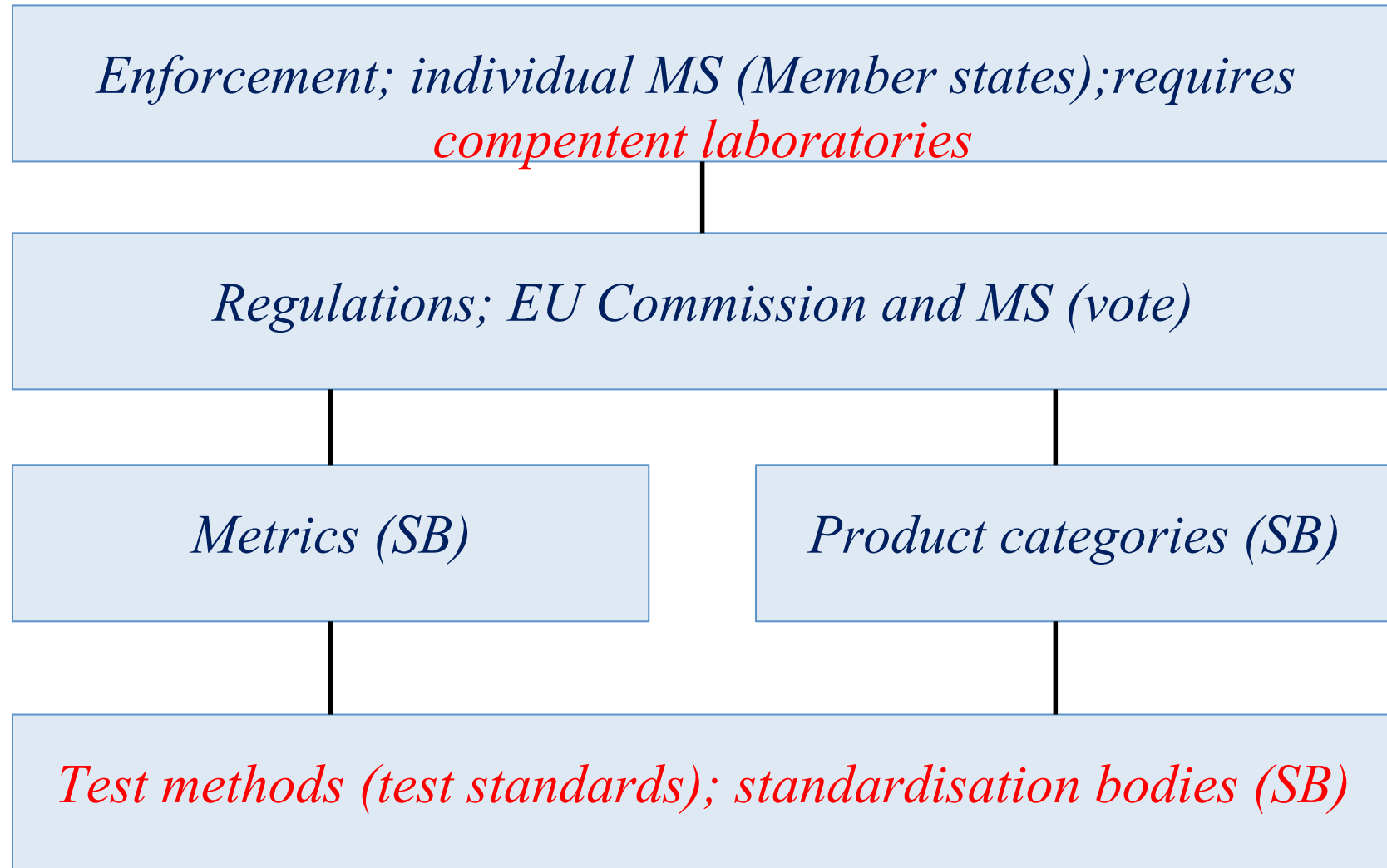


4^E

Task 2: Harmonised testing and lab quality comparison

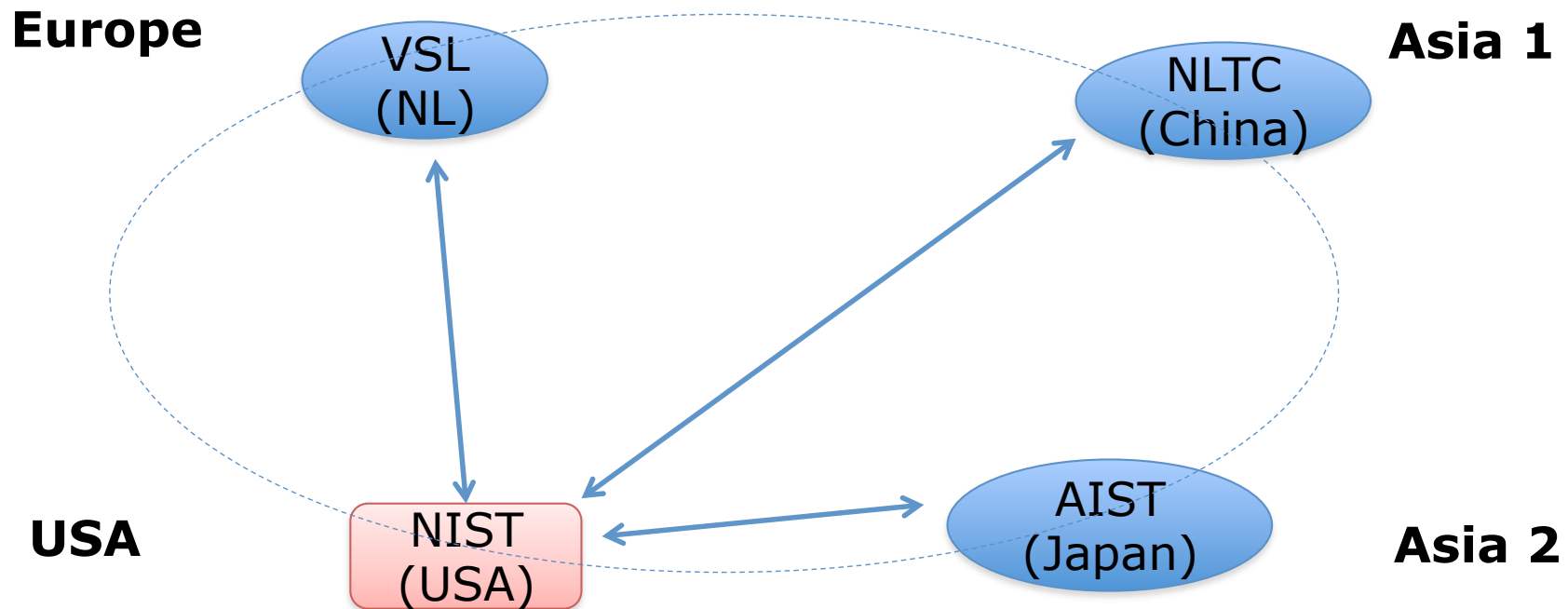
- Task 2 looks at test methods and laboratory comparison
- Two-step approach:
 - One *interlaboratory comparison* test between the *nucleus labs* (4 labs): 2011-2012
 - Then a larger *interlaboratory comparison* test between *many labs* with the nucleus labs as core sites: 2012 - 2014

From test methods to enforcement



4^E

Task 2: Nucleus Laboratories: Interlaboratory Comparison Testing



4_E

Task 2: Test parameters and methods

Ideal for a test method:

- Repeatable, Reproducible and Representative (3R)

Therefore, the lab's are required to test:

1. Light output, or luminous flux [lumen]
2. Luminous Efficacy [lumen/watt]
3. CCT
4. Chromaticity and Duv
5. CRI
6. Power [W] and Power Factor

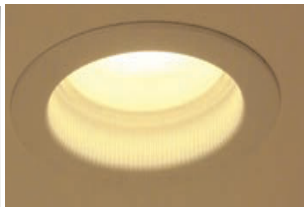
according to test methods *based on the current different and best test methods available.*

4_E

Task 2: Chose tricky artifacts

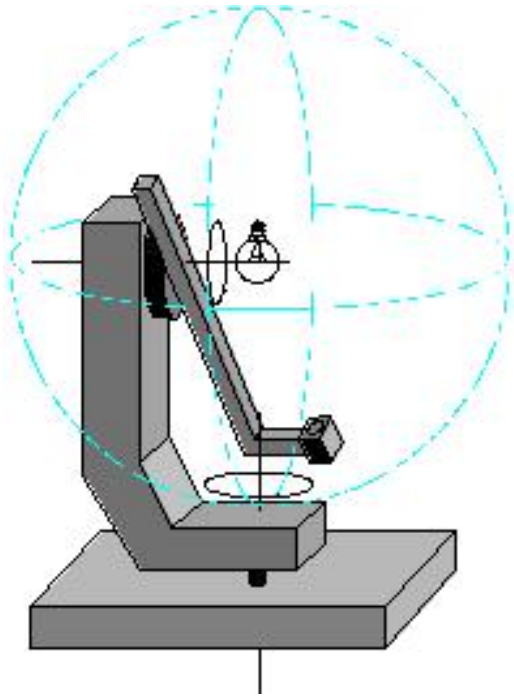
6 lamps test labs' ability to competently test SSL

- Philips lamp: measure remote phosphor products
- LSI-G25 lamp: measure current waveform with large THD
- CREE LR6: measure active feedback
- Sylvania PAR20 : measure directional lamp
- LED DC Linear replacement lamp: Measure high CCT
- Incandescent standard lamp compares fundamental laboratory photometric measurement quality



4_E

Task 2: Principle instruments



Goniophotometer:

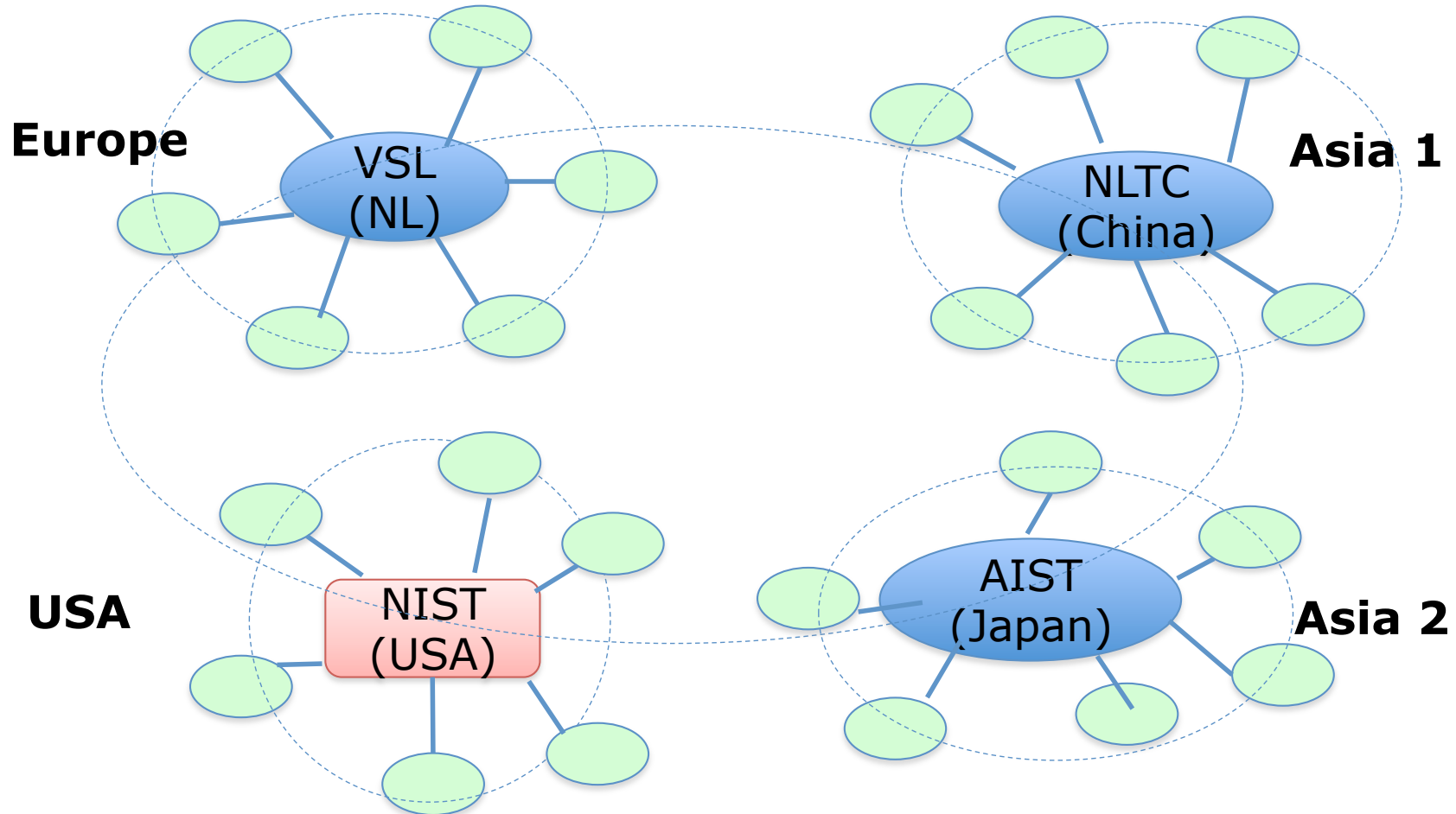
Luminous intensity [candela] etc
Angle-resolved measurements



Integrating sphere:

Integrate the intensity over
the full sphere ->
Total luminous flux [lumen] 27

Task 2: SSL Annex 2013 Interlaboratory Comparison Testing



4_E

Interlaboratory Comparison (IC 2013) launched

- Joint work of Task 2 & 3
- IC 2013 launched October 15, 2012.
- Designed to be recognized as **Proficiency Testing (PT)** for *any* of the SSL test methods currently being used or in draft
- Prepared in compliance with **ISO/IEC 17043** *Conformity Assessment – General requirements for proficiency testing*.
- Open to labs in non-member countries (with additional fee) as well as member countries.
- 55 laboratories from EU, China, USA, India (?), Korea participates

IC 2013 Protocol: Artifacts

✧ The following *five* different types of lighting products are selected by each each Nucleus Lab considering the needs in the region.

- 1) Incandescent lamp (AC operation)
- 2) Omnidirectional LED lamp
- 3) Directional LED lamp
- 4) High CCT LED lamp or luminaire (>5000 K)
- 5) Low power factor LED lamp (PF <0.6)

✧ In addition to the above, IC testing in each region can include one or more of the following optional artefacts considering the needs in the region:

- 1) Incandescent lamp – DC operation
- 2) Tubular type LED lamp 3
- 3) Remote-phosphor type LED lamp
- 4) Street lighting LED luminaire

Details are specified in **Regional Protocols**, available from Nucleus labs.

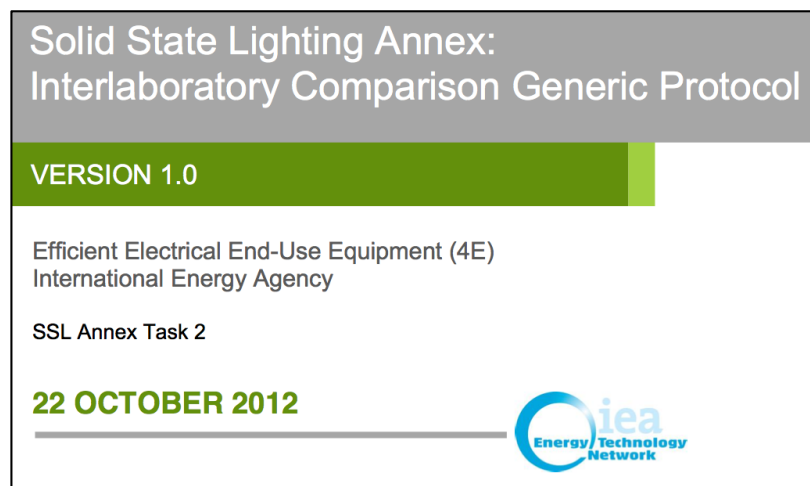
SSL Annex IC Test Method



Available at

http://ssl.iea-4e.org/files/otherfiles/0000/0051/SSL_Annex_2013_IC_Test_Method_v.1.0.pdf

- This test method was developed specifically to **support IC 2013**, especially with absence of a published international standard.
- Encompasses requirements in
 - IES LM-79
 - CEN/CIE test method (draft)
 - IEC 62722 (LED luminaire), IEC 62612 (LED lamp) Annex
 - Chinese CQC and GB standards related to SSL testing
 - JIS 7801, 8105-5 related to SSL testing
- Select the **most stringent** requirements of above.
- Select requirements **relevant to SSL Annex IC**.
- Covers measurement of **electrical, photometric and colorimetric** characteristics of **LED lamps and LED luminaires**. (Life and reliability testing is not covered)
- **Test Method Comparison Table** is in Annex.



available at

http://ssl.iea-4e.org/files/otherfiles/0000/0053/SSL_Annex_IC_Generic_Protocol.pdf

Written in compliance with ISO/IEC 17043.

3. Description of the Comparison Artifacts

- Type of products (required, optional)
- Electrical operating condition
- Operating orientation

4. Properties measured for Comparison

- Total luminous flux (lm)
- Electrical power(W), voltage, current
- Luminous efficacy of source (lm/W)
- Chromaticity (x, y), CCT, CRI

5. Reference Values and Assigned Values

6. Testing Period and Shipping Instructions

8. Measurement Procedure

SSL Annex IC Test Method

11. Evaluation of the Performance

12. Reporting to the Participants

14. Eligibility of Participation and Fee

4E

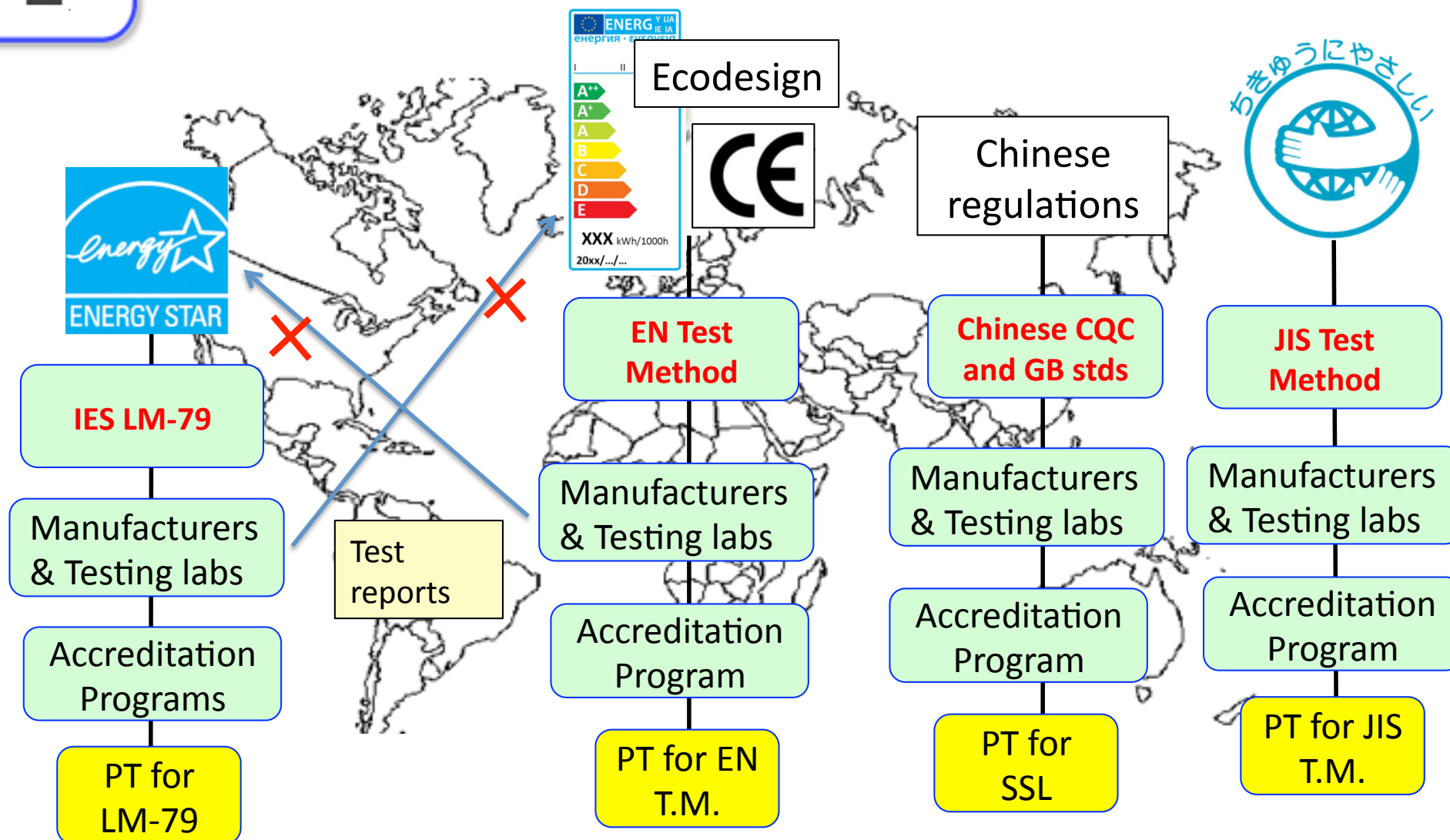
Task 3: Methodology, Process, Its use by stakeholders

- If a laboratory successfully passes IC2013,
 - It can claim that it has the competence to conduct the tests under especially stringent conditions.
 - It can also show the results of the comparative study on a common artifact between **IC2013 testing method** and its **daily procedure** to be accredited.
- **Background** : On the application for accreditation, the AB requests that the applicant laboratories:
 - Establish and implement the documented procedures for a specific test method (LM79 in case of ENERGY STAR)
 - Provide evidence of their competence to carry out the tests, such as:
 - Proficiency test results or **similar evidence**
 - Other evidence required by the scheme owner

If one stop SSL proficiency testing program is established:

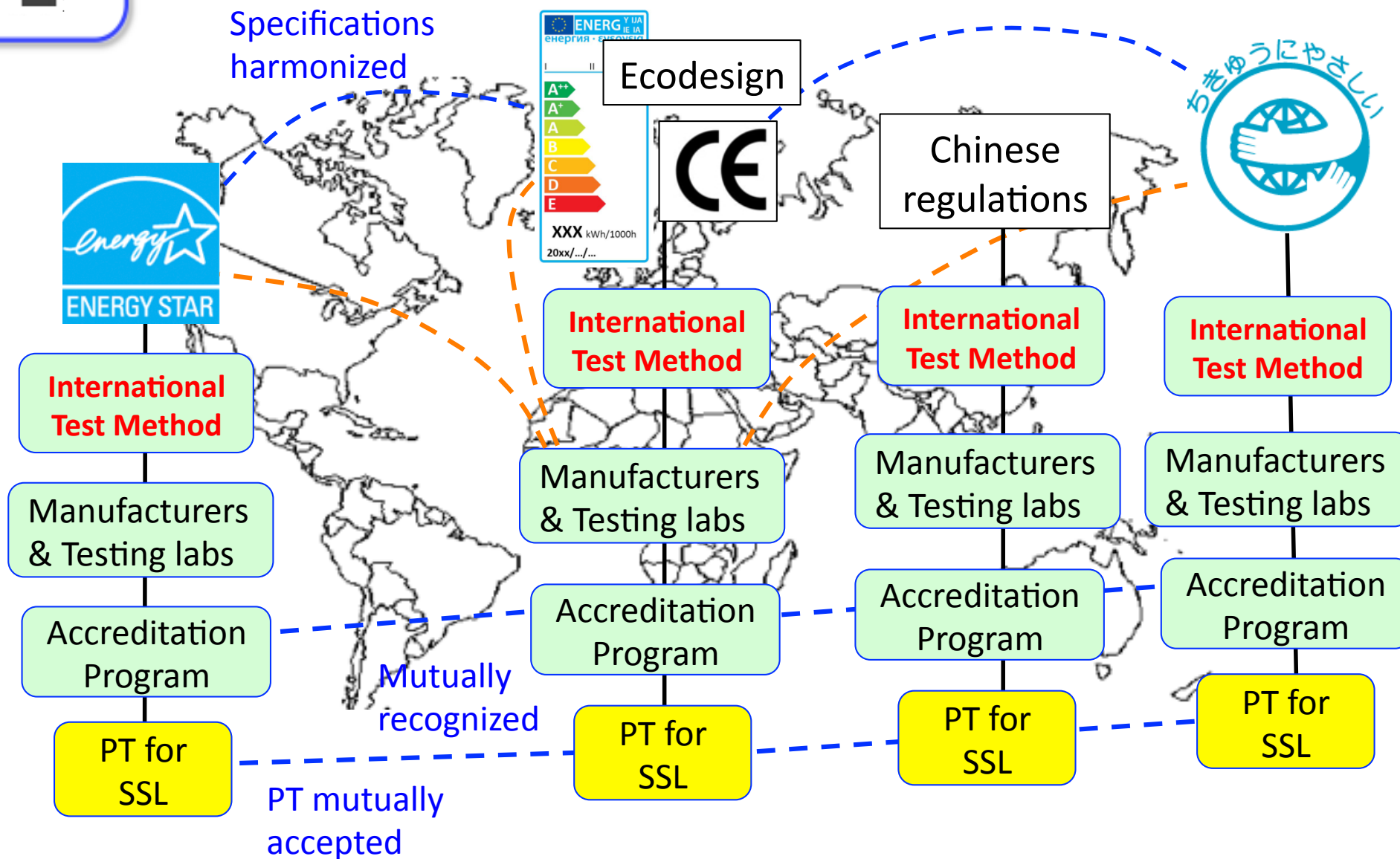
- ABs do *not* have to organize PTs for *each* measurement method.
 - AB may use of 2013 IC result as the evidence of the competence to carry out the assessment for different measurement methods.
- The participating laboratories will *not* have to participate in *additional* PTs.
- By using a method for IC2013, PT for SSL will be simplified. It will benefit ABs, laboratories and scheme (mark) owners.
- IC 2013 have been accepted as PT by **NVLAP (USA), IA-Japan**
- Communication with **EA** in progress
- **CNAS unclear** – but APLAC PT program (CNAS/NLTC) is linked to IC2013.

Need for International harmonization



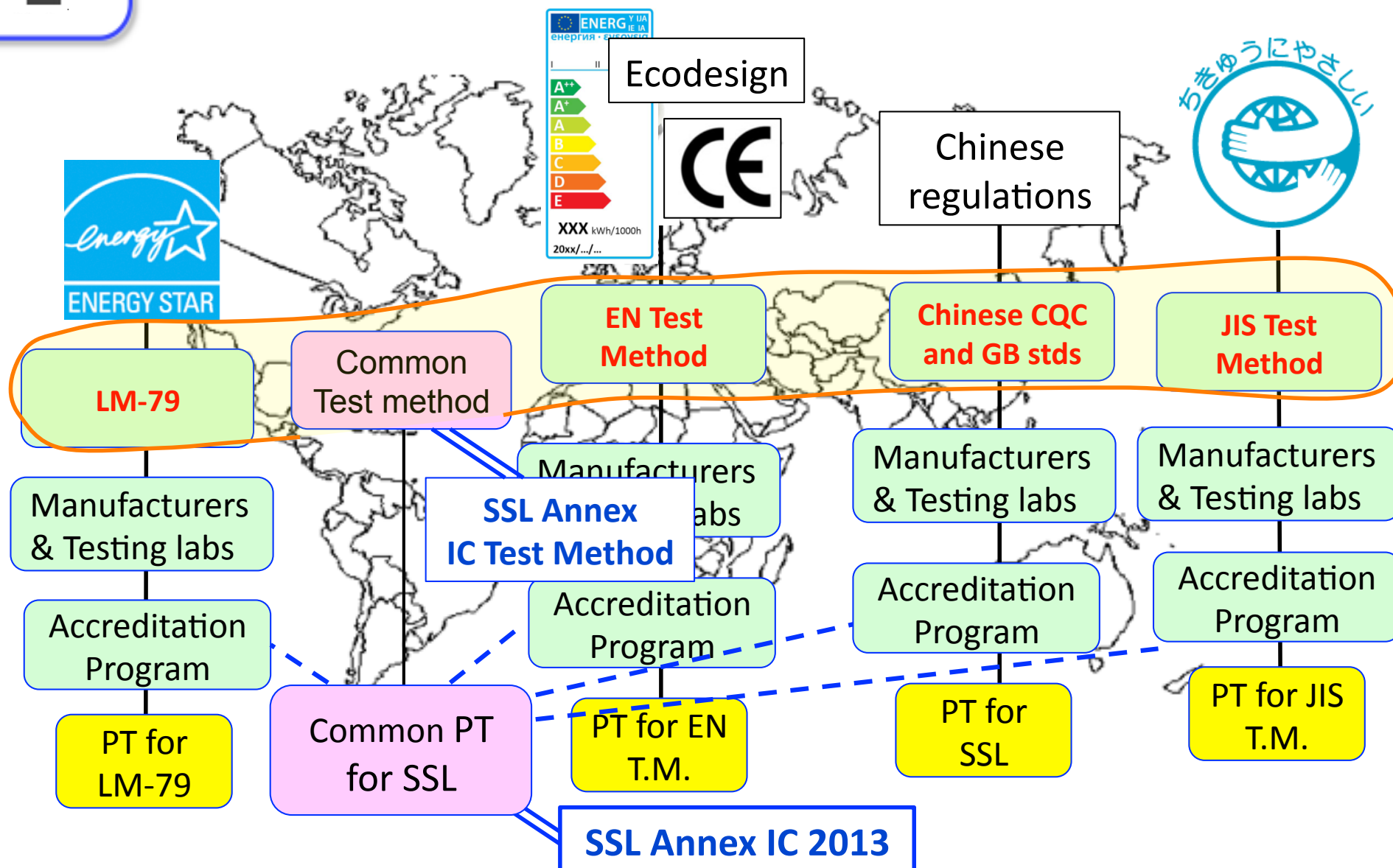
Different Test methods, different APs, different PTs

Ideal scheme – global harmonisation



Short-term solution

Common PT (SSL Annex IC 2013) using IC Test Method



4^E

One stop SSL PT program can be realised

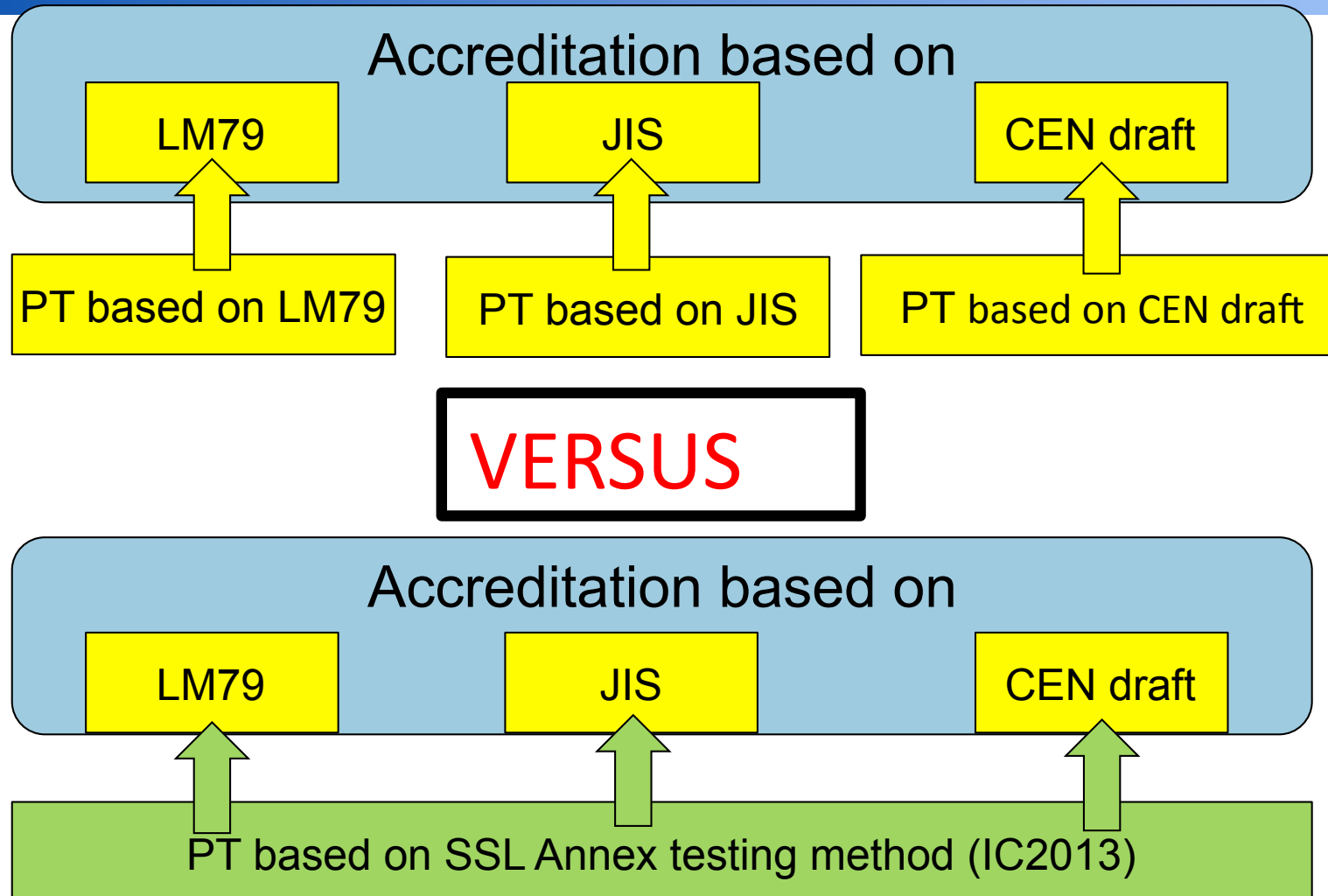


Table of Contents

1	The rapidly changing lighting landscape
2	SSL Annex Overview
3	Tasks 1 through 3
4	Upcoming plans and ideas for the future

4^E

Upcoming plans including ideas for a possible extension beyond 2014

2013 - 2014

- Completion of task 1 – 3
- Possible joint event with CIE (standardisation body) and GLA (Global Lighting Association) at Frankfurt Light + Build 2014
- Support the SEAD Awards for Lighting 2014
- Plan for a possible new term after 2014

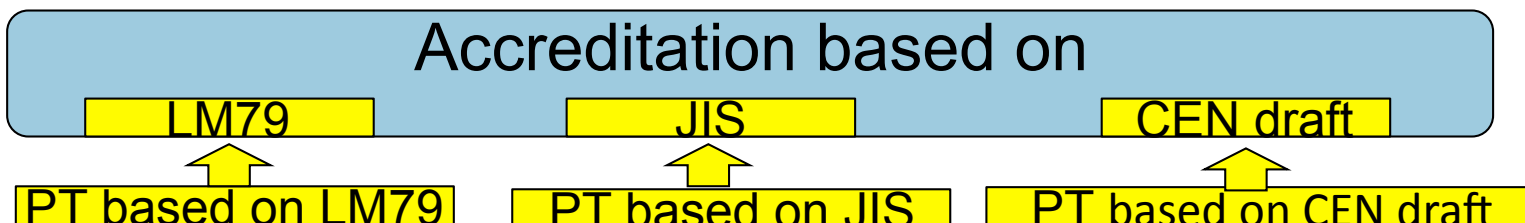


2014 – 2017 (2019)

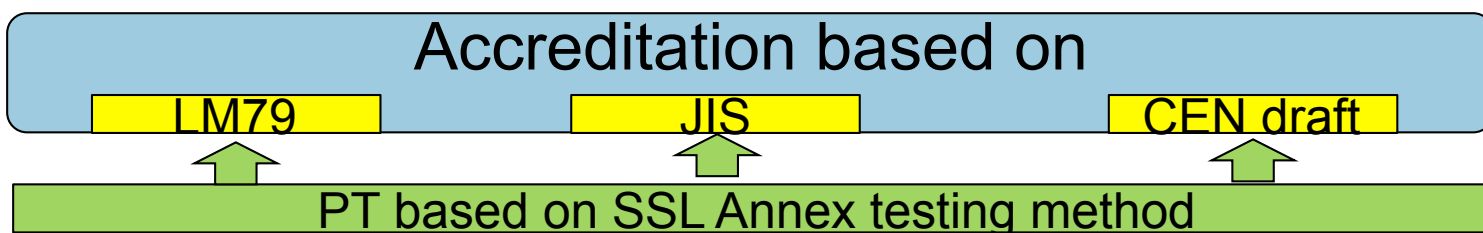
- More work to achieve the ideal scheme

A future IC programme?

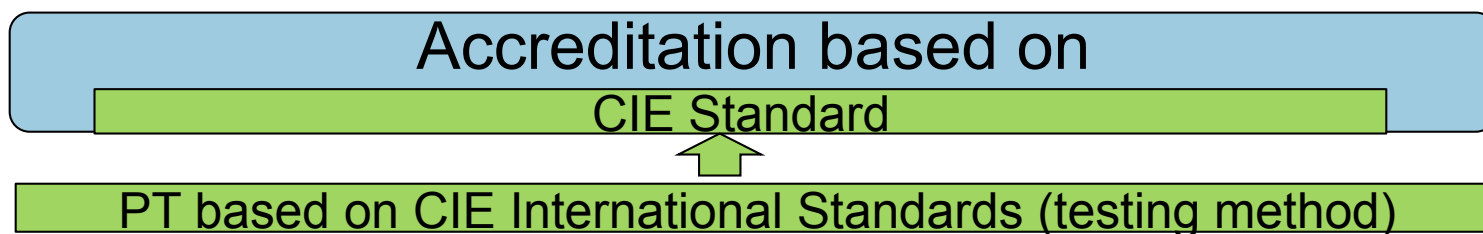
Past



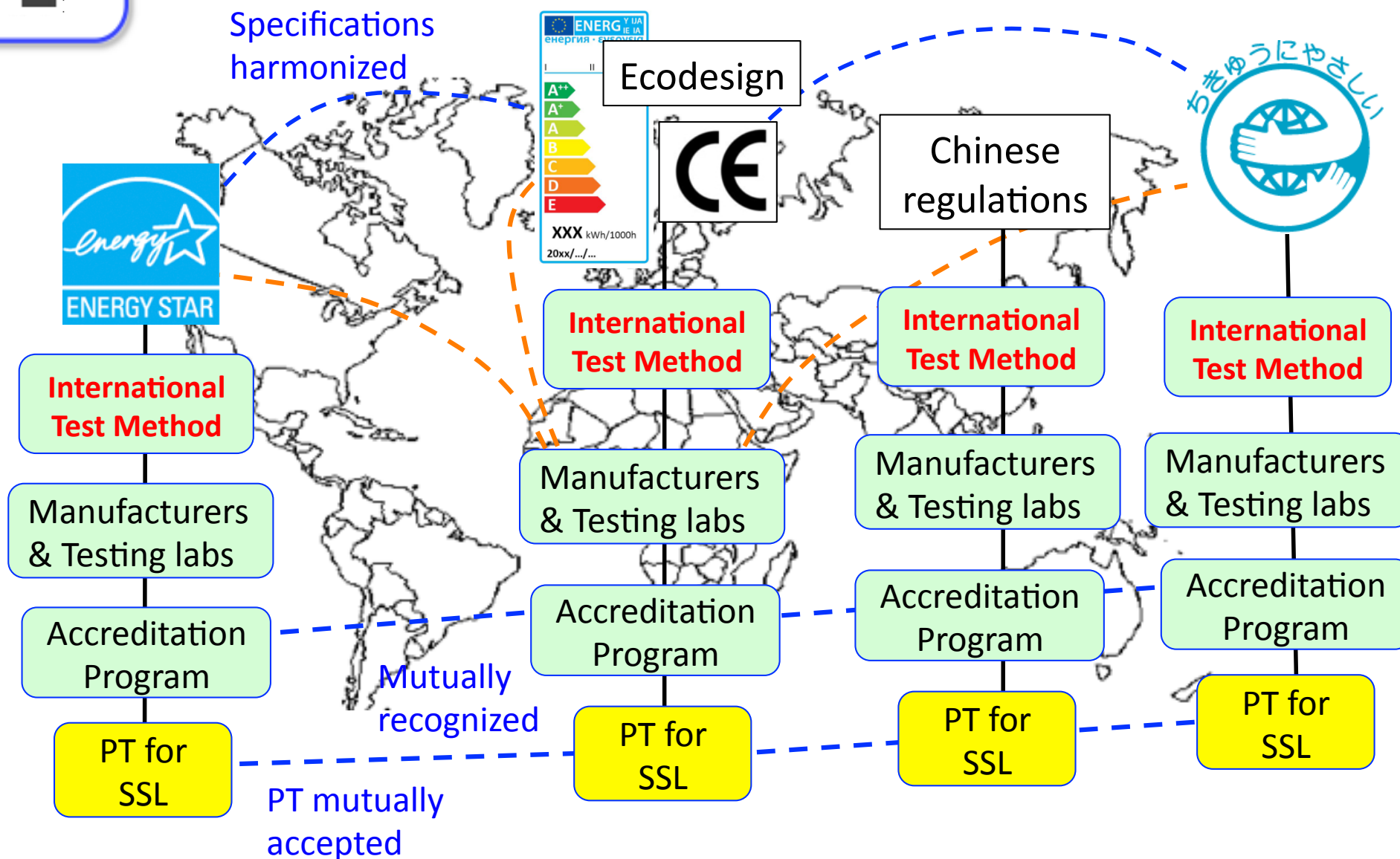
IC2013



Future



Ideal scheme – global harmonisation





Thank you!

-
- <http://ssl.iea-4e.org/>
 - Contact:
 - Peter Bennich, Chair Management Committee
Peter.Bennich@energimyndigheten.se
 - Nils Borg, Operating Agent
ssl.annex@gmail.com
 - Michael Scholand, Operating Agent Support
mscholand@n14energy.com