

The background features a vibrant bokeh effect of multi-colored lights (red, green, blue, yellow) with several clear LED light components in the foreground. A white horizontal line with arrowheads at both ends spans across the lower portion of the image.

RECOMMENDATIONS AND OPPORTUNITIES FOR HCL IMPLEMENTATION

TNO, ESADE, Lighting Europe |

TNO innovation
for life



HCL JOB CREATION POTENTIAL

HCL market size estimated at 1.4 billion EUR by 2020 (A.T. Kearney)

- › *Representing: ~7% of the European general lighting market*
- › *~20-25% of its high-end market segment*

SSL-erate economic analyses (ESADE) revealed this would imply approx. **10 000 jobs** in the EU area (partly new).

- › **What is needed to realize this?**



AIM INVESTIGATION

- › Identify **barriers** for take up;
- › Identify **opportunities** for implementation;
- › Recommendations for **market stimulating measures**





GENERAL APPROACH

- › Field study
- › Stakeholder **interviews**
- › Supported by **desk study** (literature)
- › Structured **data analysis** (directed content analysis)



GENERAL APPROACH

› Stakeholder **interviews**: 5 application areas





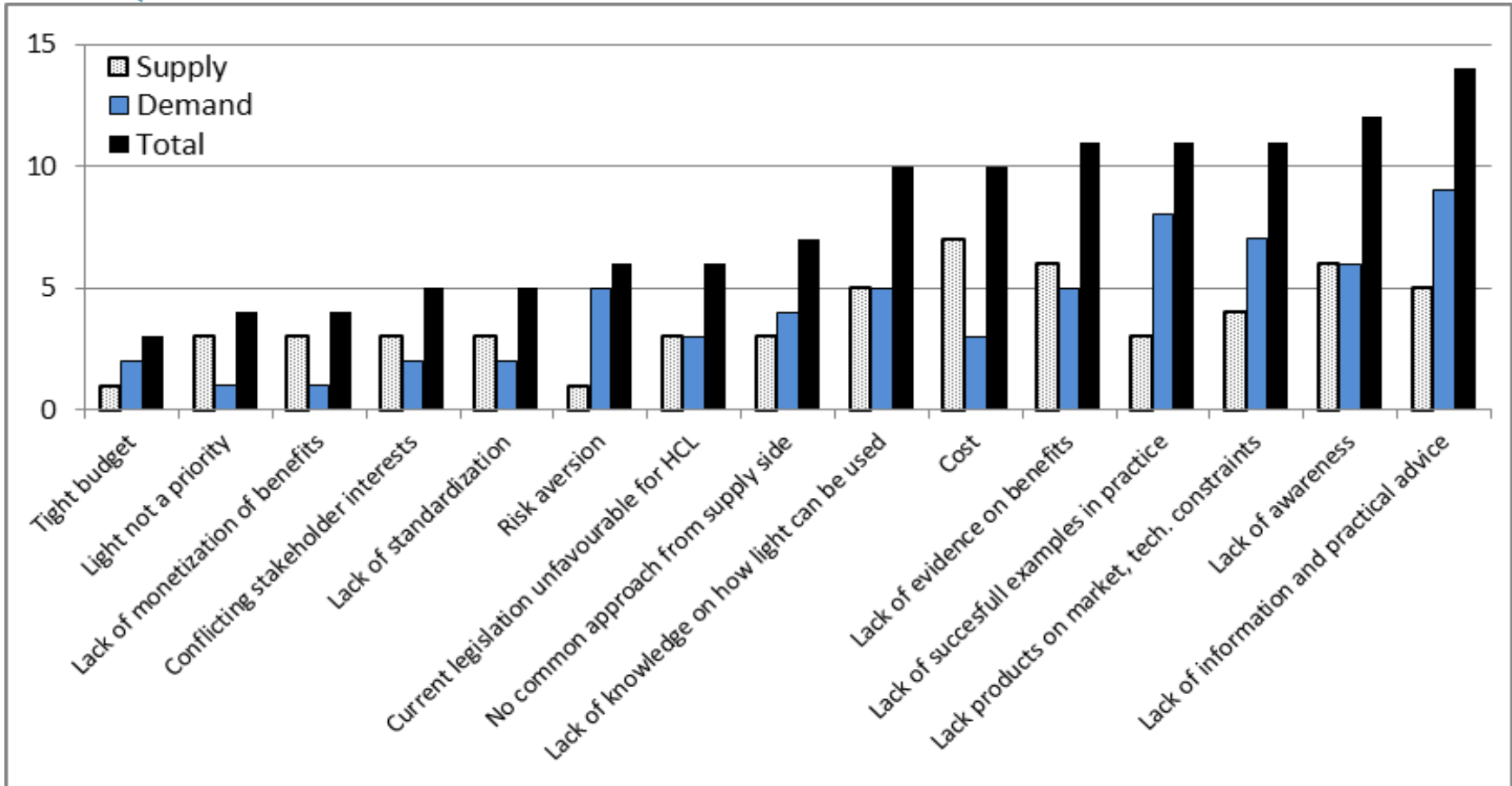
GENERAL APPROACH

- › Stakeholder **interviews: Topics**
 - › Perceived **barriers**
 - › Needs to **overcome barriers**
 - › Market **opportunities**
 - › **Recommendations**



BARRIERS TO OVERCOME

FREQUENCY OF MENTIONING

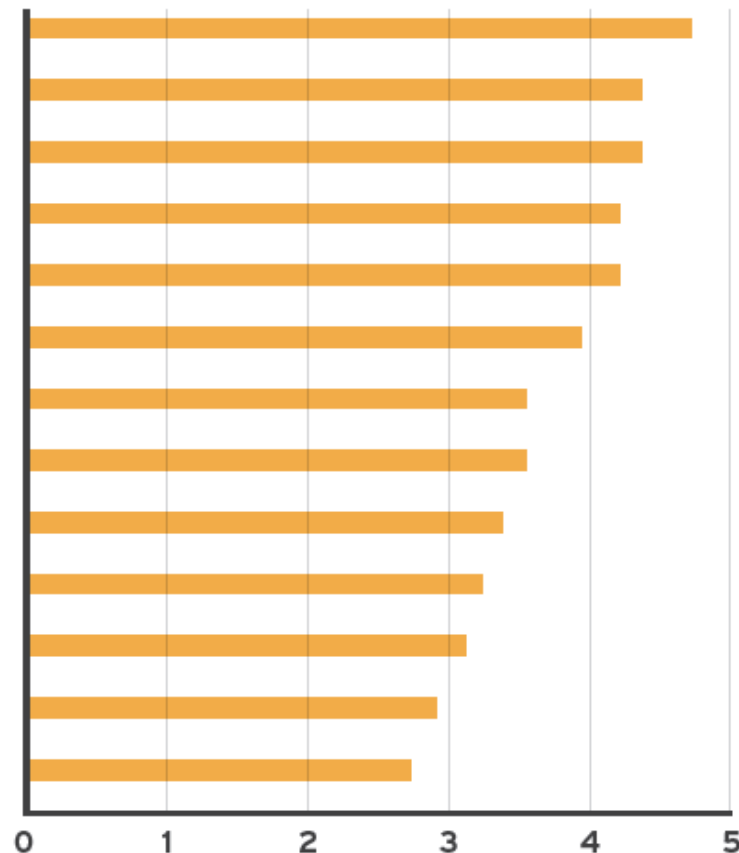




BARRIERS TO OVERCOME

IMPORTANCE RATING

- Lack of examples of previous successful implementation
- Lack of information on best practice with respect to HCL
- Investment cost
- Lack of knowledge of procuring the right /best option
- Benefits not clear compared to reference installations
- Pay back time
- Public skepticism
- Fear of possible lack of reliability, quality, performance
- Lack of standardization/component compatibility between manufacturers
- Procurement constraints
- Heterogeneous, conflicting customer requirements/other party than decision maker enjoy benefits
- Cybersecurity
- People don't care about lightning quality/design





HOW TO OVERCOME BARRIERS

Most frequently mentioned **recommendations for market stimulation**:

1. **Availability and accessibility of practical information**:

- practical and technical information,
- best practices,
- how to practically 'step by step' come to good HCL solutions,
- a 'recipe' for HCL application in practice,
- a 'product comparison system',
- need for specialized knowledge throughout the supply chain on HCL implementation.



HOW TO OVERCOME BARRIERS

Most frequently mentioned **recommendations for market stimulation**:

2. Research to strengthen evidence and further improve products:

- Research on biological efficient lighting in ‘real life settings’ to further strengthen and extend knowledge base on “optimal illumination” for NIF-effects.
- Large representative field studies (intervention studies) to quantify benefits (preferably KPIs applicable in cost-benefit analyses).



HOW TO OVERCOME BARRIERS

Most frequently mentioned **recommendations for market stimulation**:

3. 'Easy to use', 'easy to implement' systems

- Development and increased availability of 'easy to use', 'easy to implement' HCL systems,
- Evidence based (proven to be reliable and to work well in practice),
- Solutions allowing 'easy retrofit'.

4. Successful HCL application examples in practice



HOW TO OVERCOME BARRIERS

Most frequently mentioned **recommendations for market stimulation**:

5. Increasing awareness and experience in practice

- Need for information campaigns
- Need for demonstration projects to increase awareness on HCL advantages in comparison with other lighting technologies.

6. Collaboration within the supply chain

- Closer collaboration throughout the supply chain
- Incl.: Architects, designers and lighting consultants



HOW TO OVERCOME BARRIERS

Most frequently mentioned **recommendations for market stimulation**:

7. Legislation

- Integration of state-of-the-art knowledge in existing norms and standards
e.g. accounting for the dynamic character of HCL lighting by which 'max capacity' no longer seems an adequate indicator of expected energy use.
- Revision of lighting requirements to incorporate aspects of NIF-effects of artificial lighting.
e.g. by making mandatory the minimum requirements for lighting quality, in addition to energy use based requirements



HOW TO OVERCOME BARRIERS

Most frequently mentioned **recommendations for market stimulation**:

8. **Publicity and advertisement** to raise interest on

- Successful HCL solutions,
- Case studies,
- Best practices,
- User experiences.

Through:

- Articles in a broad spectrum of media types to reach both:
 - Professionals within the supply chain
 - Professionals and the general public within the demand side.



HOW TO OVERCOME BARRIERS

Most frequently mentioned **recommendations for market stimulation**:

9. Standardization

- Standardization of HCL products, components, software between manufacturers (and in time)
- Need for internationally agreed quality standards for lighting.

10. Incentive schemes

- Complement efforts on increasing awareness and support through adequate legislation by government backed financial incentive schemes to reduce potential financial constraints inhibiting investments in lighting.



OPPORTUNITIES

Most frequently mentioned **opportunities**:

1. Lighting solutions **supporting alertness/productivity** workplace/education;
2. (Evidence based) solutions **adapted** to **individual** characteristics and/or needs, **time of the day** and **activity**;
3. **Circadian rhythm lighting**: Use the circadian rhythm supporting effects of light, i.e. supporting **awakening** in the morning, **prevent ‘after lunch dip’** (e.g. office) and **support sleep at night**;
4. **Smart lighting with sensors**. Features that were listed included: A structure that allows changes and improvement, flexibility to change and to add new features over time;
5. Lighting solutions supporting **visual acuity for elderly**;
6. **Individually adjustable** lighting solutions.



APPLICATION RECOMMENDATIONS

Workplace

1. Solutions supporting alertness and productivity, adaptable to individual characteristics and/or needs, time of day and activity. Using light in support of circadian rhythm (awakening in morning, prevent 'after lunch dip', contribute to good sleep at night).
2. Smart lighting with sensors, in future proof design, allowing to adapt lighting to individual needs, (depending on presence, time of day, activity).



APPLICATION RECOMMENDATIONS

Education

1. Similar to workplace: supporting alertness and productivity, while contributing to good sleep at night (important for memory consolidation and recovery), with a desired level of flexibility to adapt
2. Lighting systems supporting learning by providing structure to classes during schooldays (e.g. with pre-defined settings for concentrated working, relaxed working etc.) making clear to students what kind of activity is expected.



APPLICATION RECOMMENDATIONS

Health care:

1. Personalized lighting solutions, taking into account (physiological) differences between people, e.g. lighting solutions supporting visual acuity for elderly. Individually adjustable to preferences.
2. Dynamic lighting solutions to support mental wellbeing, to treat and/or prevent depressive symptoms.
3. Dynamic lighting solutions simulating natural daylight quality (in intensity and spectral composition), for 'long-stay' health care facilities (e.g. nursing or elderly homes).



APPLICATION RECOMMENDATIONS

Cities:

1. Smart lighting with sensors to achieve a structure that allows changes and improvement, flexibility, and allows to add new features over time. Providing lighting at the time and place where it is needed.
2. Flora and fauna friendly lighting solutions: Outdoor lighting which is better in tune with the ecosystem (HCL solutions for outdoor lighting in cities and surroundings).
3. Lighting solutions directed to provide a better 'city nightscape' (enhancing aesthetics, ambience, attractiveness, liveliness).



APPLICATION RECOMMENDATIONS

Domestic:



1. Domestic applications for intelligent HCL solutions, focusing on times during which humans are more sensitive to light (early morning and late evening).
2. Solutions supporting awakening (gradual dynamics like dawn simulation may promote a smoother more effective and more pleasant waking up).
3. Solutions allowing to create lighting conditions to set atmospheres for social activities (or studying, or working) at home.

MORE INFORMATION

› <http://lightingforpeople.eu/#downloads>

DOWNLOAD OUR LATEST REPORTS



-  Open Innovation Toolkit
-  Lighting for health and wellbeing
-  Green Business Development Opportunities
-  Report on the most recent LED Business Experiment workshop in Luce in Veneto
-  HCL needs new quantities for light intensity
-  Recommendations and opportunities for implementation of human centric lighting
-  Job creation potential of human centric lighting industry in Europe

ACKNOWLEDGEMENTS

- › We greatly acknowledge experts inside and outside the consortium for participation and support with the interview rounds and valuable feedback

The background features a vibrant array of bokeh lights in various colors including red, green, blue, yellow, and purple. In the foreground, several clear plastic LED components are visible, some of which are illuminated from within, casting a glow. A white horizontal line with arrowheads at both ends is positioned across the lower portion of the image.

THANK YOU FOR YOUR ATTENTION

TNO innovation
for life