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# “Public Procurement Barriers in Promoting Market Uptake of Innovative LED Lighting”

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## Abstract

Innovations in the lighting sector, such as LED-based light sources, have opened up unprecedented possibilities to both save energy and improve the quality of lighting. There is growing evidence of light's importance for human health, moods, work productivity and quality of life in general; but the uptake of new solutions is still rather slow in society.

The public sector can play an important role in opening up markets for innovative new products, lighting solutions and new business models. This paper presents the current status of the public sector's role in facilitating the uptake of innovations in the lighting sector, using Sweden as a case study. The study is based on interviews, case studies and literature reviews. It discusses the role of public procurement for innovation (PPI), analyses technical, institutional and regulatory barriers from the perspectives of different actors and identifies opportunities for action. Our findings suggest that improvement priorities include the closing of knowledge gaps among relevant actors, optimizing the division of responsibilities for decision-taking, avoiding over-interpretation of legal provisions, more effective learning from pilot examples and more innovative thinking in creating service-oriented business models through public-private partnerships

## 1 Introduction

Modern society is difficult to imagine without lighting in homes, offices, schools, universities, hospitals, shops, streets, parking lots, walkways, etc., which globally demands about 20% of the total electricity or ca. 2.5% of the total primary energy. Several lighting technologies co-exist side by side, including incandescent, compact fluorescent, LED, halogen, metal-halide, high-pressure sodium, linear fluorescent T5/8/12, mercury vapour and others. Technology preference largely depends on application areas and uses, be it building exterior/interior, area/roadway, parking lot, directional, ambient or decorative.

Solid State Light (SSL) technology or LED-based lamps are particularly interesting, since switching to LEDs can reduce electricity demand to up to 50% and 20% more can be saved by adding intelligent IT-enabled control [1]. LEDs are also often superior to other technologies in terms of life span, digital compatibility, flexibility in shape and size, and adaptability to the design needs in given premises [2]. Several studies find evidence that smart SSL lighting systems can improve vitality, concentration and alertness, improved health, productivity and learning ability in hospitals, workplaces and schools [3-5].

The share of LED technology is gradually increasing in many application areas with good prospects for growth given rapid improvements in price-to-lumen

ratio. However, despite some optimistic predictions of LED market shares reaching 60-65% by 2020 [22], the real market adoption of SSL is still rather slow. For instance, in 2012 the total LED market share in the EU was just 7% across all applications, while fluorescent tubes, CFL and halogen lamps were still dominant technologies [2]. In 2014 in the US, the leading applications of LED were in small-directional lighting (i.e. home/indoors), area/roadway and parking lot applications with only 22%, 12% and 11% respectively [6].

The main bottlenecks for SSL market uptake are unlikely to be product or technology limitations, as the efficacies of many LED products are reaching projections ahead of schedule and costs are decreasing rapidly following technology innovations and efficiency improvements in manufacturing [7]. It is the demand side where the acceptance of new products, especially IT-enabled smart LED systems, innovative services and new business models for lighting services is particularly slow. High initial price, uncertain investment risks, unfamiliarity with products and especially lack of knowledge about product performance, operation and maintenance expertise are often regarded as the main generic reasons for the barriers on the demand side [8].

Public procurement can play an important role in testing the risks and breaking such barriers, as it has been observed in the introduction of other innovative prod-

ucts, e.g. heat pumps, wind turbines or e-vehicles. This paper discusses the role of the public sector in facilitating the market uptake of innovations from the lighting sector in Sweden. It describes the main issues in procurement practices from the perspectives of different actors, analyses technical, institutional and regulatory barriers and identifies opportunities for action. The paper is based on empiric materials collected through several interviews and case studies conducted in an on-going project “*New business models and commercial opportunities in lighting*” supported by the Swedish Energy Agency, the EU InterReg project “*Lighting Metropolis*” and insights from previous EU-supported projects *ENIGMA* and *SSL-erate*.

## 2 EU Policies and Public Procurement

The public sector is the largest market player in many countries, with significant power to shape market demand and the requirements on the supply side. Authorities in the EU spend about 1.8 trillion euro annually (2015) or on average 14 % of GDP (in Netherlands, Finland, Denmark or Sweden it is close to 20%) and can direct this purchasing power to leverage greener products and service onto the market [9].

Through public procurement of innovations (PPI) the public sector can play a significant role in promoting innovative SSL solutions by sharing innovators’ risks in progressing new technologies and their market replication, including light innovations [5, 10, 11]. The EU policy measures, which support the use of energy efficient lighting solutions, include the Eco-design Directive (2009/125/EC) and Eco-Design Regulation (2012/1194/EU) with requirements for lifetime and efficiency of light sources. The Energy Performance of Buildings Directive (2010/31/EU) and the Energy Efficiency Directive (2012/27/EU) are the EU’s main legislation addressing energy consumption of buildings, which indirectly supports the introduction of LED lighting. Direct policy measures for greening the lighting sector include the EU agreement on a progressive phase-out of incandescent light bulbs by 2012 with the 2016 target to phase out the halogen bulbs (EC No.244/2009) and the public procurement Directives 2014/24/EU and 2014/25/EU with criteria for energy efficient indoor/outdoor lighting equipment.

This also includes the voluntary Green Public Procurement (GPP) initiative (COM (2008) 400) for the member states. Public funds can be used for the so-called *public procurement for innovation* (PPI) - solutions that are not known in advance in order to address a perceived need among users or address a societal issue and/or PPI that aims to commercialise innovations or new inventions that already exist, but are not yet put on the market [12]. Another form of GPP

is *pre-commercial procurement* (PCP) - the procurement of R&D results rather than of finished products. An important market-forming approach is the so-called ‘*forward commitment procurement*’ – when a procurer expresses intentions regarding its future procurement. This practice could be an important catalyst for innovations that require significant investments and/or considerable development time [12].

## 3 Swedish public procurement and lighting sector

In Sweden, public procurement is subject to the Swedish Law on Public Procurement (LOU) [13], which builds on the European Directive (2004/18/EC) regarding the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts. The objectives of the Swedish LOU include improving the use of resources, strengthening the internal market, increasing cross-border trade, preventing corruption, protecting the procurer from undue pressures and the supplier from arbitrariness, and steering the suppliers towards environmental and socially responsible offers.

Besides this, Sweden also has to align its decisions on public procurement to the WTO Government Procurement Agreement. The public sector is today paying attention to green procurement strategies, as well as equity issues and socially responsible purchasing. This further complicates the task of both formulating the tender and selecting best alternatives. The procurement process undergoes a complex sequence of stages, including the definition of need(s) and decision-taking, specification and terms of reference, announcement, qualification of tenders, assessment of bidders, evaluation of their offers, decision-taking, informing the stakeholders, agreement signing, post-evaluation and identification of new needs<sup>1</sup>. All these steps prolong the decision-taking process and add to the transaction costs. The challenge for the bidders is to customise a business offer, while complying with the formalities of the regulated procurement process. From the perspective of the public sector, the formalities are supposed to support transparency and counteract corruption, but in practice there is often too much focus on the law, with frequent over-interpretations and exaggerations, which in turn negatively affects the focus on the needs and the solution itself [12].

During 2014-2016 we conducted more than 50 interviews in Sweden with municipalities (*Helsingborg, Höganäs, Hörby, Kristianstad, Lund, Malmö, Simrishamn, Skurup, Svedala*) and public institutions

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<sup>1</sup> Personal communication with Per Hammarstedt, lawyer, senior consultant, Olga Productions AB (2015-02-13).

(schools, libraries, hospitals, childcare, and elderly care facilities). Within municipalities we also interviewed public officers responsible for outdoor lighting. Other interviews targeted private sector actors, such as housing developers, lighting service providers, energy companies, and equipment manufacturers.

### 3.1 General barriers for lighting innovations

The size of Swedish general public procurement including state-owned utilities is around 19% (2011) of GDP amounting to ca. EUR 50 billion annually [9]. The total electricity consumption for lighting in Sweden is 14 TWh, with about 20-30% consumed for lighting in schools, offices, healthcare and sports facilities. The total saving potential for electricity uses in lighting due to SSL is estimated at about 6 TWh corresponding to the annual output of one nuclear reactor [14]. However, the replacement rate on the Swedish lighting infrastructure is at relatively low 3% rate, which means a total replacement of old installations would take more than 30 years [15]. This is in spite of the recommendation of the Swedish Energy Agency to replace lighting equipment older than 15 years [16]. The replacement of only light sources to LED bulbs (where infrastructure allows) is faster, but no reliable official data is available. The main reasons for the slow refreshment rate is, first of all, because lighting quality and its energy efficiency is often a lower priority for building managers; and second, because lighting retrofitting in the public buildings is typically timed to major renovations. Even then, investment size is often the dominant factor for choosing lighting infrastructure, which is disadvantageous for SSL solutions.

Many of the problems identified through stakeholder dialogues in Sweden are similar to those communicated in the European Commission's Green Paper "*Lighting the Future*" [5]. Our interviews with Swedish industries, municipalities and public organisations<sup>2</sup> showed that formulation of needs, market exploration and evaluation of options is particularly difficult when it comes to procuring new innovative lighting solutions. In general the end-users in Sweden typically have no or very little role in the procurement process, in particular in shaping performance and quality requirements for the lighting systems. This way, there is very little link between the end-users and

solution suppliers. During interviews with different actors involved in lighting issues in Sweden we made several observations and identified a few important issues constraining the uptake of innovative lighting solutions and the role of public procurement in Sweden.<sup>3</sup>

### 3.2 Specific issues for the uptake of SSL through public procurement

**Product quality.** One of growing concerns for the Swedish lighting sector is the increasing amount of low quality SSL products from 3<sup>rd</sup> party producers other than original equipment manufacturers (OEMs). Such equipment sold as OEMs' products has uncertain lifetime and increases investment risks. Another issue particular to SSL products is possible discrepancy between the lifetime of the luminaire and the auxiliary components. For instance, the lifetime of LED bulbs is advertised with long lifetimes (e.g. up to 100,000 light-hours) on the basis of their luminaries, although in reality their lifetime is often shortened by failing electronic circuitry (ballasts, controllers, drivers and similar). Another concern is that LED products' quality might not meet the performance standards of halogen lamps scheduled for phasing out in stage 6 of Eco-design regulatory measure EC No.244/2009, so other technologies are being prioritised [17].

**Compatibility between new and old.** Advocates of improvements in lighting quality often need to consider the constraints imposed by the existing older infrastructure. Hesitation towards innovative lighting is sometimes caused by concerns about the compatibility, inter-operability and inter-changeability of new lighting systems. On the component or product level, for instance, there are issues related to variety of operating voltages, sizes, connectors, operating temperatures, functions (e.g. dimmability) or communication protocols. Poorly compatible products may require

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<sup>2</sup> Based on interviews with seven lighting industries (*Designlight, FOJAB, Elektrolanz, Elektriska installatörsorganisationen (EIO), Philips, Bravida Prenad* and *LU Bygg*), four municipalities (*Höör, Malmö, Svedala* and *Helsingborg*) and several municipal schools in Southern Sweden.

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<sup>3</sup> "*Indoor Lighting for Health and Wellbeing a key aspect of The International Year of Light*" workshop of Lu Open Innovation Centre, Lund, Sweden (Jan 16, 2015); "*Social Innovation in the Light Sector*" workshop, UNESCO's International Year of Light initiative, Lund University, Sweden (Feb 4, 2015); EU FP7 project SSL-erate workshop in Lund, Sweden (Jan 23, 2014); "*Advanced Lighting Solutions for Retrofitting Buildings*" workshop under International Energy Agency's SHC Program (IEA-SHC Task 50), Copenhagen (20 March, 2013); workshop "*Responsibility in the Swedish building sector for innovations in lighting improvements*", LU Open, Lund University, Sweden (Jan 29, 2013).

additional investments or increase the unpredictability of operational and maintenance costs (e.g. shorter lifetime, reduced efficiency). A problem also noted by both the procurers and solution providers is that new lighting solutions are becoming complicated systems that are difficult to install and operate. In turn, they require new competences and knowledge, which is not always easy to find on the market.

**Division of responsibility.** One of the factors influencing procurement is the historic tradition and division of responsibilities among different actors involved in the decision-making process. In Sweden there could be diverse institutions that could be involved in procurement processes, e.g. a dedicated procurement department with area experts; a legal department with hired experts; municipal institutions responsible for operating the infrastructure; or a totally outsourced procurement process. These actors have various degrees of competence in lighting issues and are not always capable of making the right decisions. The degree of “problem ownership” and understanding of user needs and technical possibilities varies greatly in these procurement organisations and the success of uptake of innovations in different countries is varying, depending on many factors.

For instance, building owners (public or private), generally do not have enough competence to place the right demands for lighting efficiency and functionality. Although they are interested in optimizing the total costs and payback times at different time horizons, they need transparent cost structures, and these are not well known for new, innovative solutions. Maintenance costs, lifetime and failure probabilities are the largest unknowns here. In some cases, the building owners may not reap the economic benefits from improvements in lighting utilities (e.g. when the electricity bills are paid by their tenants). The tenants have an even smaller voice in buildings’ energy efficiency issues.

A recent thesis highlighted the difficulties in the Swedish building sector to adopt innovative and energy-efficient lighting solutions [18, 19]. When doing a renovation or building new, there are several actors involved with different contractual relationships, who in Sweden have different interests in the potential improvements (Figure 1).

Although every project has a project leader, he/she is typically working in a tight connection with other important actors and share responsibilities with e.g. the architect, light designers, and technology consultants. This often means that in the end nobody really takes effective responsibility. This often results in situations where often the last word in the decision-making

chain is de facto reserved to the electricity installation contractor or the building contractor.<sup>4</sup> In other countries, for instance Canada, it is an architect who is the main coordinator of the building or renovation projects and always has the last word.<sup>5</sup> This allocation of responsibility will clearly influence the willingness to adopt innovative solutions and decide how streamlined the decision-making process will be.

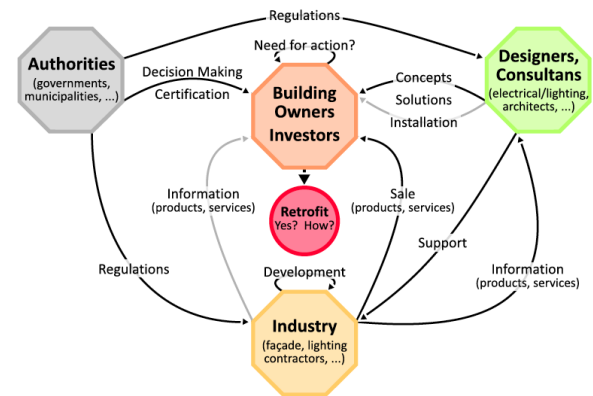


Figure 1. Relations of actors involved in Swedish decision-making on building retrofits [20]

Consultants, although in the capacity to come up with innovative lighting solutions, typically do not follow-up on the building process, nor are they interested in providing feedback if they are not paid for it. It is also rather difficult for the other actors to evaluate the quality of the competence the consultants are selling.

Electricians (installers) in Sweden may often have a surprisingly important voice in deciding the direction of lighting improvements. Although compensated for the time spent, the electricians are often partly also compensated on the basis of how much installation costs they can save. This can discourage them from choosing more expensive installations of innovative lighting solutions. In addition, the electricians often do not have sufficient or relevant education and training to engage with state-of-the-art lighting systems. This problem is not specific just to electricity and lighting, but to several issues in the building sector.

**Running to the lowest bidder.** Authorities, like, for instance, *Boverket* (The Swedish National Board of Housing, Building and Planning), used to play a rather significant role in regulating building standards to reach high standards in many aspects, but recently more and more codes (e.g. national building codes (BFS 2015:3 - BBR 22) and the Planning and Build-

<sup>4</sup> Personal communication, dr. lic. Peter Pertola, WSP 2013-Jan-29.

<sup>5</sup> Personal communication, Marie-Claude Dubois, senior researcher, Department of Architecture and Building Environment, Lund University, 2013-Jan-29.

ing Law (2010:900), do not seem to be oriented to highest possible building standards. In the Swedish public sector one of the main problems is that regulations on public procurement and the organization of building or renovation systems often leads to the lowest cost-driven building process without much weight on the optimization of e.g. running or operational costs; i.e. there is often a lack of a long-term vision in decision making. In addition, historically – compared to heating, ventilation and air conditioning in municipal projects – lighting has never been considered a key issue to address climate change, reduce costs and improve well-being. For this reason there is not sufficient experience developed among public procurers to drive lighting improvements.<sup>6</sup>

**Lack of knowledge and information.** One of the main problems facing people responsible for public procurement is a lack of knowledge about lighting products and systems and poor ability to formulate the performance characteristics of the needed solutions, although guiding criteria for public procurement in lighting are available in Sweden. The Swedish National Agency for Public Procurement provides public procurement criteria for indoor and outdoor lighting products [14]. However, it mainly focuses on light products, energy-saving issues and lifecycle costing (LCC), but little guidance is given to specifications for system solutions and the qualitative, aesthetic and other indirect aspects of light. Quality of light is a complex phenomenon and many of its attributes are not easily measurable. A broad list of characteristics pertaining to “good lighting solutions” include not only light intensity and colour temperature, but also e.g. its distribution, placement, adaptability, reflected light colour, interaction with the texture of a surface, aesthetic suitability to a particular ambient design, flexibility and ease of control, among others. Most of these criteria and characteristics are case and product-specific and require both knowledge and experience from public procurement decision-makers.

Moreover, communication of product characteristics and their performance is also poor from the supply side. It is enough to observe how LED products are presented today in the consumer retail market. Product information is scarce and unfamiliar to ordinary consumers. Performance characteristics, such as lumen-per-watt, say little to an average consumer. The retailers even rarely utilize the option to illustrate the economic gain from energy savings by not clearly visualizing lifetime savings of new LED light sources in comparison to traditional product alternatives. In addition, the new luminaires are often displayed and

lit all together on the same display, so it is difficult to distinguish their performance in terms of difference in colour rendering and how different surface colours and textures reflect the light, which is much a more sensitive issue for LED lights, e.g. in comparison to incandescent lamps. In addition, the background lighting of fluorescent lights in the stores often distorts the visual experience even more. Even in cases of more advanced settings with light sources are displayed with intention to convey their colour temperatures; it is impossible to picture how this product would perform in a particular room with different colours and textures of walls, ceilings and home furnishings.

Procurers in the public sector are traditionally risk averse and in the case of SSL they avoid making radical decisions due to perceived uncertainties of product performance and the benefits of SSL. This owes not only to the short experience curve, but also due to cheap products of poor quality increasingly available on the market and the lack of performance testing standards.

Decision-makers in the public sector are often not well aware about the wider multi-dimensional benefits of SSL solutions, such as health effects, comfort, productivity, well-being, etc. They often still position lighting as a strictly technical subject and pose traditional requirements such as investment cost, energy consumption and luminous output.

Another issue is that knowledge is not spread and efficiently shared among different units of public bodies. For instance, a technology department at a municipality may have a sufficient knowledge of lighting, but they are not the ones devising investment strategies and formulating the needs for procurement decisions. The strategic units formulating these needs often have a conservative perspective and are not prioritizing the well-being related benefits of SSL, and they are still focusing largely on up-front investments, operating costs, and energy savings.

From the demand side one of the perceived problems is that too little information is available for non-professionals. Apart from professional branch magazines, there are virtually no information sources other than marketing material. Even the latter is often oriented to professionals and uses a different language from what is used in communications.

**Bidding barriers.** Solution suppliers also face challenges when bidding in public procurement projects for lighting solutions. For instance, from the technical side there are too few systems/solutions on the market that could be plugged into the existing installations at reasonable cost. Another problem is that control systems can be incompatible. Often the controls are product/solution specific, because standardisation in this rapidly changing sector is still rather poor. The

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<sup>6</sup> Personal communication, dr. lic. Peter Pertola, WSP 2013-Jan-29.

SSL technology sector is somewhat similar to the IT sector: it suffers from rapid technology obsolescence making procurers risk averse when making investments. In addition, there are also many uncertainties related to product warranty, especially for complex lighting systems integrated with other data and telecommunication systems.

Procurers on the other hand, are often tempted to over-specify the requirements of the lighting systems they should buy (e.g. specific distances, heights, density of light sources, etc.), which in a way constrains the providers if their products do not qualify. Examples of technical requirements to lighting systems include: IP-class, robustness, impact resistance, Plug-&-Play function, interactive functionality with the user, standardised protocols for communication, addressable lighting interfaces, voltage range, flexibility to extend/upgrade the system, possibility for simple and quick installation into existing infrastructure/hardware, etc. When it comes to modern lighting systems, there is, however, according to the lighting industry, a lot of flexibility in the quality and functionality of SSL technologies and a wide variety of suitable products. Therefore, too detailed specifications can be counterproductive. In line with this, the suppliers also noted that the procurers (or lighting users) often do not know enough to specify what they want. Generally they have little knowledge about SSL technologies and even less about the products and systems on the market.

**Principle-agent problems.** Agents that are external to the public sector actors (tenants, hospital patients, schoolchildren, and elderly in elderly care) often use public buildings, but there are limited feedback mechanisms between them and public procurement agents. This makes it difficult to shape lighting requirements to the needs of its daily users. Besides, there are also difficulties in aligning priorities and incentives for investments into retrofits and savings between the owners and the users of the public buildings and other spaces. The content of real estate leasing agreements is very important in determining the financial and maintenance responsibilities of the tenant and the owner, which in turn determines incentives for implementing energy-efficient retrofits. It is typical that in the majority of the lease agreements a tenant (lessee) pays for all utilities and the split incentive problem arises for efficiency retrofits when a landlord becomes indifferent to reducing utility costs. The split-incentive problem may also arise in leases where the tenants' utility costs are capped and the tenant has no incentive to reduce energy use under the cap.

### 3.3 Moving forward

The issues with product quality and the rapid market development of LEDs have been noted by the Swe-

dish Energy Agency which recently set up a new testing facility for LEDs to further strengthen market surveillance and lighting is identified as a priority for the next five years at least [16]. The criteria for monitoring include lifespan, colour rendering, flicker but also compatibility with technology (e.g. dimmers) and aesthetics (e.g. pleasant warm white light) [21]. While this may improve many aspects of product quality, the criteria and the reports and tests themselves are not enough to fully describe lighting functions and communicate this to users to help them find the desired lighting, particularly if we consider the wider health aspects of lighting. A suggestion was voiced by the lighting sector during one of the workshops – to develop a uniform tool to describe/define desired lighting functions and express users' the needs. The communication between the supply and the demand side needs to be improved by optimizing communication channels and simplifying the information content.

New business models are essential to address the many issues described earlier and realise the full potential of solid state lighting. Amongst the stakeholders there is a growing interest in finding new business models for the public sector where new forms of public-private sector agreements could promote innovative solutions and alleviate several problems for public procurement, such as detailed technical specifications for lighting installations. For instance, instead of focusing on hardware and procuring and owning a complete lighting infrastructure, the public sector could make an agreement about the provision of lighting services with a manufacturer, a utility, a facility-management company, or a third party. A business model of this type would formulate a service-level agreement for the utility of lighting, in which the procurer pays only for the amount and quality of light and not for hardware and the energy consumed. In such a case, a solution provider would be interested in providing the required lighting with least possible costs for installation, service and the energy consumed. Contracts would include arrangements where the necessary up-front investments would typically be made by the provider. Much of the technical and practical details of the purchasing decision could then be moved away from the building owners, while the new form of contracts for lighting services would for the clients provide a better picture over the total cost of ownership of the lighting utilities [22].

Examples of new business models already exist, such e.g. the Philips' "pay-per-lux" (or pay-as-you go) business models allowing customers to pay for an amount of light in a building while leaving hardware ownership and maintenance in the hands of solution providers). However, these examples are still too few and often too customised to particular local conditions and/or the needs of specific actors, making it difficult



to transfer directly into other contexts. There are indications that some of the producers do truly believe in servicizing as the future of the lighting industry [22], but they may have to compete for supplying such services with new entrants and other actors able to couple lighting with other services, for example energy providing services [23]. It remains to be seen whether the possible range of actors provide increasing opportunities for servicizing or confuse customers further.

## 4 Conclusions

In this paper we point to a significant potential of innovative SSL technology based solutions to reduce energy consumption and improve the quality of light. The public sector with its public procurement for innovations could act as an important catalyst to promote innovative lighting solutions on the market. Although some good examples exist, the process of change is rather slow and there are several barriers that we could highlight from our inquiries with the lighting industry and the public sector in Sweden.

This research indicated that there are still inefficient practices in the organization of building and renovation projects and especially when it comes to distribution of responsibilities, which owes to a distributed decision-taking tradition in the Swedish public sector. This creates obstacles to effective leadership in adopting innovative solutions in public procurement, but lessons can be learnt from good foreign practices.

A very important barrier is a knowledge gap between providers of lighting solutions and the public sector procurers. Awareness of advantages and capabilities of SSL is still poor, while product information is insufficient. Not only are products on the market new (thus little experience exists), but the procurers themselves often lack sufficient knowledge to support their decisions. SSL is a dynamic sector with many and frequent innovations, but the procurers do not seem to know enough about the capabilities of SSL technology, the range of products and system solutions, nor about innovative business models. Information from solution providers on the other hand is often highly technical and incomprehensible for relevant decision-makers in the public sector. This limits their ability to formulate needs, communicate specific requirements and evaluate alternative offers.

A big potential exists in exploiting innovative business models and public-private partnerships where public procurement focuses on purchasing product function instead of products and infrastructures. Public agencies together with the private sector should seek new agreements with distributed responsibilities for product and infrastructure ownership being retained by the solution providers and performance contracting is made the focus of public purchasing. In-

stead of detailed specifications of equipment parameters the procurers should better specify the desired performance characteristics of light. These should be formulated considering not only the traditional lighting parameters, but include parameters, relating to issues such as health, wellbeing, sound activity levels during day-time etc. To achieve such new solutions, closer dialogue is needed between light users, consultants, public authorities, providers, installers and operators.

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