



Modular education concept

Deliverable No.: 4.1

WP4 - Policy Development II: Education and capacity building for planners, installers and other target groups



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Introduction

The main target of the Premium Light Pro initiative is to support the implementation of high quality and efficient LED-solutions by appropriate instruments and services. One of the routes to achieve this objective is to provide training for actors involved in the process of lighting system design and installation.

LED technology has been evolving fast in the last decades, and there is still limited knowledge about high quality efficient LED solutions. This WP aims at overcoming the identified capacity barrier.

In order to reach the largest possible audience, a modular education concept was developed that allows for the combination of different materials and, in this way, better tailor the training for the specific needs of each target group. The best option is to organise training for multiple target groups with similar background and interests at the same time in order to maximise the resources.

The identified educational needs for each country are summarised in the table below, which also lists the main target groups for the training actions.

Table 1. Identified educational needs by country

Country	Existing educational offer	Identified educational needs	Suggested Topics	Comments	Partners	Main Target Groups
Austria	<p>Varied offer, some relevant offer are also available in Germany and Switzerland:</p> <ul style="list-style-type: none"> - 1-3 days further education program covering all essential topics of lighting planning - 6-7 days further education program to reach the degree “certified lightning engineer” - 11 days further education program to reach the degree “European lightning expert” - 20 days further education program to reach a master degree on lightning design <p>- Identified further education providers: Society of Lighting Technologies, Professional lighting academy, bartenbach academy, klimaaktiv further education)</p> <ul style="list-style-type: none"> - Furthermore workshops conferences and fairs on specific lightning topics are offered continuously by various providers (e.g. energy agencies, lightning consultants,...) 	<ul style="list-style-type: none"> - More specific training offers on the topic LED. - forced integration of the topic LED in existing education at Technical High School and Universities. - Further education of installers and planners according to the topic LED needed. 	<ul style="list-style-type: none"> - E-learning is not seen as a major approach - Interactive trainings in training classrooms (enabling and forcing information exchange with other participants) are the preferred training method. - Marketing for education and further education services on lighting topics needs to be forced. - One day further education programs preferred - Support for a standardized approach for state of the art procurement and planning is needed. 	<ul style="list-style-type: none"> - E-learning is not seen as a major approach - Interactive trainings in training classrooms (enabling and forcing information exchange with other participants) are the preferred training method. - Marketing for education and further education services on lighting topics needs to be forced. - One day further education programs preferred - Support for a standardized approach for state of the art procurement and planning is needed. 	<p>Education platforms already offering education and further education programs:</p> <ul style="list-style-type: none"> -Technical lighting society - klimaaktiv further education program (typically one day courses) - Professional lighting academy - bartenbach academy - Technology providers: (big suppliers of the national and international EU-market: Zumtobel, XAL, Philips Osrsam etc.) - Universities (e.g. Danube university Krems) - Supporters from the research and planning sector 	<ul style="list-style-type: none"> - Planners - Installers - Public and private procurement officers (e.g. building managers, mayors of municipalities, responsible Public administrators,...)

Czech Republic	<ul style="list-style-type: none"> - In Universities - The Lighting Systems Course / educational platform for lighting specialists - educational platforms for energy specialists and auditors 	<ul style="list-style-type: none"> - The existing educational platforms do not provide sufficient lighting education for high quality and efficient LED lighting. 	<ul style="list-style-type: none"> - basics of LED lighting - differences between LED lighting and conventional lighting at the planning stage - LED quality criteria - real energy saving potential calculation - LED technical parameters; - new trends and market development; - Legal and standardization framework (Czech laws, EN 13201, EN 12464, EN 15193). 	<ul style="list-style-type: none"> - Preference for seminar (physical attendance). - One day programs preferred 	<ul style="list-style-type: none"> - Association of Czech certified engineers and technicians – the base of Czech energy specialists and energy auditors; - The Lighting Systems Course (the national annual lighting conference) – the main national educational platform for Czech lighting experts. 	<ul style="list-style-type: none"> - lighting designers and planners, ESCO lighting engineers - energy specialists and auditors, energy consultants
Denmark	<p>DCL has for years given a basic course in lighting. A new course about street lighting was offered in 2016.</p> <p>Aalborg University has started a new education to become lighting designer (the first designers are graduating this year).</p>	<p>More knowledge about use of LED to obtain a good quality.</p>	<ul style="list-style-type: none"> - EU regulation and standards - LED Technologies - LED proprieties - differences between LED lighting and conventional lighting - Control systems and automation - Lifecycle costing and total cost of ownership - Energy monitoring/evaluation - Retrofit - Best practice examples 	<ul style="list-style-type: none"> - stakeholders request classroom one-day training - interest for simple online tools/calculators. 	<ul style="list-style-type: none"> - DCL - DTU Fotonik - Manufacturers - SBI. 	<ul style="list-style-type: none"> - Installers - Technical staff facilities managers - Procurement staff (municipalities/local authorities) - Indoor lighting designers - Street lighting designers/managers - Energy consultants - ESCO lighting engineers - Architects
Germany	<ul style="list-style-type: none"> - A great variety of educational offers exists for different targets, most by universities and technology transfer institutes. 	<ul style="list-style-type: none"> - Offers for Climate protection managers needed 	<ul style="list-style-type: none"> - Procurement procedures - Life Cycle Cost analysis 	<p>There is the intention to take up already existing educational programmes and to promote them via our project activities. First educational trainings will, therefore be organized in collaboration with partners and Premium Light Pro will</p>	<ul style="list-style-type: none"> - ZVEI - German Electrical and Electronic Manufacturers' Association - German Institute of Urban Affairs (Difu) – Partner in Solving Municipal Problems - Deutsche Energie- 	<ul style="list-style-type: none"> - Planning offices - Energy commissioners - Building authorities - Climate protection managers - Municipalities

				be “co-organizing” the events.	Agentur GmbH (dena) – the German Energy Agency - DENEFF – German initiative for energy efficiency businesses -local energy agencies	
Italy	<ul style="list-style-type: none"> - Several courses for lighting designers are already operating at national and at local level. - post degree master course for experts (600 hour) - courses and seminars for procurers and professional education (technical institutes) 	<ul style="list-style-type: none"> - Offer targeted at technical staff (installers, small projects designers, maintenance staff) and procurers (administrative personnel, policy makers at local level) 		<p>Politecnico di Milano proposes to integrate into its existing offer:</p> <ul style="list-style-type: none"> - lighter training: for technical staff and procurers (1 day, open also to master students, could be repeated more times in a year), - Advanced training: for designers / professionals (2 days or more + examination, only for master students, once a year). - The activities in schools and for procurers will be modular, depending on the size of the events, the availability, ... 	<ul style="list-style-type: none"> - In-house - External professionals orders (depending on the level: engineers, architects, building surveyors) 	<ul style="list-style-type: none"> - technical staff - procurers - designers/professionals - technical institutes students
Poland	<ul style="list-style-type: none"> - Focus on the basic parameters and types of available technologies. - given by lighting equipment manufacturers 	<ul style="list-style-type: none"> - designing process or retrofitting analysis and ways to verify savings, - Legal concerns related to newly erected public service buildings, assessment of economic effectiveness. - Specific trainings aimed at energy auditors - public procurement 	<ul style="list-style-type: none"> - Guidelines for planning of LED systems - Overview on high quality efficient lighting technology - Procurement criteria for high quality efficient lighting hardware - smart devices for lighting monitoring and control - legislation and standards - Best Practice cases 	<ul style="list-style-type: none"> - half-a-day lasting event (4-5 hours) 	<ul style="list-style-type: none"> - Pol Lighting - SZGiP 	<ul style="list-style-type: none"> - Planners, - architects - installers - Procurement staff (municipalities/local authorities) - Building energy managers
Portugal	<ul style="list-style-type: none"> - Main educational offer 	<ul style="list-style-type: none"> - No LED specific courses 	<ul style="list-style-type: none"> - Flexibility of LED lighting 	<ul style="list-style-type: none"> - in presence 1-2 day 	<ul style="list-style-type: none"> - Engineers and Architects 	<ul style="list-style-type: none"> -Designer, architects,

	<p>given by lighting equipment manufacturers</p> <ul style="list-style-type: none"> - lighting design is only taught by a few Universities - The majority of training courses have an average of 20 hours duration and require physical presence 	<ul style="list-style-type: none"> - Need for improvement of existing offer in what concerns LED lighting 	<p>technology</p> <ul style="list-style-type: none"> - LED metrics - Retrofitting - Economic aspects - financing methods - software training - Monitoring and system optimization 	<p>courses</p> <ul style="list-style-type: none"> - e-learning 	<p>Order</p> <ul style="list-style-type: none"> - ADENE 	<ul style="list-style-type: none"> - engineers - Installers - Municipalities - Energy and building managers
Spain	<p>Wide range of educational programs available but the challenge remains on the quality (i.e. data obsolescence) and neutrality (i.e. market interests...) of the offer.</p>	<ul style="list-style-type: none"> - Need for providing informed criteria, documented information and exhibition of successful pilots to break the barrier of lack of awareness and bad reputation of LED products. - Post-educational support service to act as a bridge for professional at implementing LED. 	<ul style="list-style-type: none"> - legislation and standards - LED accessories and their electronic components. - LED programming, remote control and net stability. - Recognised typical problems and their advanced solutions. - Brands, products and options. - Retrofitting - Scoped knowledge (i.e. aesthetics vs efficiency, maintenance, vandalism, competition of vegetation vs lighting) for designers and architects - Measurements with the appropriate tools to monitor and evaluate LED products and systems. - Field visit to exemplary cases (i.e. SIMON). - Options and solutions against vandalism in LED driven installations. 	<ul style="list-style-type: none"> - One day programs preferred - Practical, including hands-on activities in labs and visits to real installations. 		<ul style="list-style-type: none"> - Media - Public admin - Research /Academia/M&E labs - Manufacturer & Associates - Installer/Engineer & Associates - Distributor - Users (i.e. small business) & Associates
United Kingdom	<p>A number of Education Programmes that cover non-domestic lighting exist</p>	<ul style="list-style-type: none"> - How to access funding in the public sector and SMEs - product performance and safety, finding solutions to pilot and 	<ul style="list-style-type: none"> - legislation and standards - LED lighting technology - Economic aspects - financing methods - lighting design aspects 	<ul style="list-style-type: none"> - Preferred methods: - Classroom based training - E-learning - Online 	<p>Energy Saving Trust</p> <p>Partner Organisations</p> <ul style="list-style-type: none"> - Lighting Industry Association Academy 	<ul style="list-style-type: none"> - local authorities - Commercial Property Landlords - Facilities and Energy Managers

		considering design guidance		tools/calculator - One day programs preferred	- National Physical Laboratory - Intertek E-learning providers - Melton Associates	
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The main **target groups** identified were:

1. Architects
2. Designers/Planners
3. Installers
4. Vendors / Distributors
5. Energy specialists / auditors / consultants
6. ESCOs
7. Building managers
8. Public administration / municipalities
9. Secondary technical school / vocational / professional training

Description of the educational concept

To carry out the capacity building campaign a number of training modules will be developed following the topics below. The training modules are divided into two major groups: indoor lighting and outdoor lighting. The developed modules can be combined to suit different types of trainings and different target groups, as shown in Table 1 and Table 2. Unmarked topics are common to both trainings.

Similarly, the topics can be combined into trainings of different durations:

- Half-Day Trainings: Covering, for example, the basics of LED Lighting or more focused subjects such as procurement.
- 1 ½ -2 Days Trainings: for architects, designers/planners and installers covering more advanced topics

Indoor Lighting

The training for indoor lighting is organised in 12 modules, as shown in Table 2 and described below.

Table 2. Education Modules for Indoor Lighting

Module no. + Title	Recommended Duration	Target Groups
1. Fundamentals of Light	30-60 min	1-9
2. Artificial Lighting	30-45 min	1-9
3. LED Basics	60 min	1-9
4. Lighting Controls - Basics	45 min	1-9
5. Economics of Lighting	60 min	1-9
6. Best Practice Case Studies	30-45 min	1-9
7. Human Centric Lighting	30-45 min	1,2
8. Lighting Controls - Advanced	45-60 min	1,2,5,7
9. Lighting Design – Basics	60 min	1-4
10. Lighting Design – Advanced	45-60 min	1,2
11. Procurement Criteria	60 min	1,2-7,8

12. Legal and Standardisation Framework	45 min	1,2-5,6,7
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Description of the indoor Lighting Training modules

1. Fundamentals of Light

Objectives: *The main objective of this topic is to give sufficient background information to understand the basics of lighting - What exactly is light and how do we perceive it. With this topic, the target group should become familiar with basic lighting concepts and terms which will be useful in the following topics.*

- a. Basic theory
- b. Illuminance and luminance
- c. Light reflection and absorption.
- d. Natural and artificial lighting
- e. Light and colour

2. Artificial Lighting (Indoor)

Objectives: *The scope of this topic is to allow trainees to know how to identify the different lamp technologies (incandescent, halogen, fluorescent and LED) used in indoor artificial lighting, understand how they work, and choose the technology according to the design requirements (e.g. efficiency, colour, lumens, lamp life and lamp lumen depreciation).*

- a. Types of lamps
- b. Luminaires
- c. Ballasts / Drivers
- d. Efficiency

3. LED Basics

Objectives: *This topic provides the basic information about LED working principle, its properties, benefits and disadvantages. The target group will be able to understand the technology behind the high efficiency of LEDs and its importance nowadays and recognize the main differences between LEDs and conventional lighting technologies.*

- a. How does an LED work?
- b. LEDs properties
- c. Benefits and disadvantages of LEDs

4. Lighting Control – Basics (Indoor)

Objectives: *Lighting control systems are very important when it comes to energy savings and comfort. This topic allows the target group to get the basic information about the different control strategies and technologies and their impacts. Knowledge of control strategies, manual*

or automatic, such as occupancy sensing, time scheduling or daylight harvesting, will allow trainees to choose the best strategy depending on each situation and necessity.

- a. Control strategies
- b. Manual Control
- c. Automatic control (sensors)
- d. Energy Saving Strategies

5. Economics of lighting (Indoor)

Objectives: *This topic will allow the trainees to have a financial perspective of lighting technological options. Energy consumption costs, technologies life-cycle costs and financial incentive schemes are integrated in this module to give a complete information of economic impact of lighting. A retrofitting example analysis will be made to help consolidate knowledge.*

- a. Understanding Energy Consumption
- b. Life-Cycle costing
- c. Retrofitting example
- d. Financial incentive schemes
- e. Energy Performance Contracts

6. LED Case Studies

Objectives: *To learn about the various aspects of LED lighting discussed in other topics, through selected best practice examples. Case Studies to present are selected from a pool to address specific topics of interest to the target group.*

7. Human Centric Lighting

Objectives: *In this topic, participants will learn about Human Centric Lighting - the designing and tuning of LED light's biological, visual, and emotional effects to foster human health, wellbeing, and performance. They will be able to understand how the proper use of controls for dimming and colour coordinated temperature shifting can improve circadian rhythms, mood, visual acuity and performance in addition to providing substantial energy saving and sustainability.*

- a. Circadian rhythm
- b. Dynamically adjusted light
- c. Advantages to human performance and health

8. Lighting control – Advanced (Indoor)

Objectives: *By the end of this topic, participants will be able to identify various energy saving strategies, lighting control technologies and its integration into a building management system including the current lighting control protocols.*

- a. Energy Saving Strategies (Daylighting, smart scheduling, task tuning, occupancy control)

- b. Energy management
- c. Integration of Lighting, HVAC and Daylighting into Building Management system
- d. Communication Protocols

9. Lighting Design – Basics

Objectives: *Oriented mainly at architects and designers, this topic has the objective of explaining the technical features to be considered in lighting design as well as best practice advice in lighting design. Participants will learn the fundamental aspects of lighting design and how to deal with the key design points as well as the physical and psychological effects of light on humans and the relationship between natural and artificial light.. The main lighting calculation software systems will also be presented.*

- a. Lighting level requirements
- b. Lighting metrics: intensity, flux, illuminance, luminous exitance and luminance
- c. Flicker / Glare
- d. Photometry
- e. Lumen depreciation
- f. Lumen method
- g. Importance of good lighting
- h. Colour rendering
- i. Quality of Lighting - Lighting for human need, lighting for economics and environment, lighting for architecture and building.
- j. Software tools

10. Lighting Design – Advanced

Objectives: *The main factors to consider when designing lighting for specific categories: offices, schools, museums and exhibition, retail and healthcare. Possibilities for improved quality of lighting and increased energy efficiency by use of LED lighting systems will be presented. Extensive use is made of case studies to back up the explanation and techniques described.*

- a. Lighting design for consumer categories

11. Procurement Criteria (Indoor)

Objectives: *The procurement criteria developed during the project will be presented along with guidelines on how to successfully implement them.*

12. Legal and Standardisation Framework (Indoor)

Objectives: *The aim of this topic is to provide information about legal and standardisation framework of lighting design, the current applicable legislations and standards in each participating country.*

Outdoor Lighting

The training for outdoor lighting is organised in 11 modules as shown in table 3 and described below.

Table 3. Education Modules for Outdoor Lighting

Module no. + Title	Recommended Duration	Target Groups
1. Fundamentals of Light	30-60 min	1-9
2. Artificial Lighting (outdoor)	30-45 min	1-9
3. LED Basics	60 min	1-9
4. Lighting Controls (outdoor)	45 min	1-9
5. Economics of Lighting (outdoor)	60 min	1-9
6. Best Practice Case Studies	30-45 min	1-9
7. Photobiological effects and light pollution (humans&animals)	30-45 min	1,2,8,9
8. Lighting Design – Basics	45-60 min	1-4, 9
9. Lighting Design – Advanced (outdoor)	60 min	1,2, 9
10. Procurement Criteria	60 min	1,2-8,9
11. Legal and Standardisation Framework	45 min	1,2-5,6,8,9

Description of the Outdoor Lighting Training modules

1. Fundamentals of Light

Objectives: *The main objective of this topic is to give sufficient background information to understand the basics of lighting - What exactly is light and how do we perceive it. With this topic, the target group should become familiar with basic lighting concepts and terms which will be useful in the following topics.*

- a. Basic theory
- b. Illuminance and luminance
- c. Light reflection and absorption.
- d. Natural and artificial lighting
- e. Light and colour

2. Artificial Lighting (Outdoor)

Objectives: *The scope of this topic is to allow the target group to know how to identify the different lamp technologies (Sodium-vapour, Metal halide and LED) used in outdoor lighting; the importance of luminaire components (e.g. optics, reflectors, diffusors) and characteristics (e.g. light distribution). Understanding of these concepts will enable to select the technology and equipment that will provide the most effective and efficient solution for a particular site or location.*

- a. Types of lamps

- b. Ballasts / Drivers
- c. Luminaires
- d. Mechanical Support
- e. Efficiency

3. LED Basics

Objectives: This topic provides the basic information about LED working principle, its properties, benefits and disadvantages. The target group will be able to understand the technology behind the high efficiency of LEDs and its importance nowadays and recognize the main differences between LEDs and conventional lighting technologies.

- a. How does an LED work?
- b. LEDs properties
- c. Benefits and disadvantages of LEDs

4. Lighting Control (Outdoor)

Objectives: Lighting control systems are very important when it comes to energy savings and comfort. This topic allows the target group to get the basic information about the different control strategies and technologies and their impacts. Knowledge of control strategies, manual or automatic, such as occupancy sensing, time scheduling or daylight harvesting, will allow trainees to choose the best strategy depending on each situation and necessity.

- a. Control strategies
- b. Conventional controls (on-off, dimming)
- c. Intelligent controls - monitoring and remote management systems
- d. Energy Saving Strategies

5. Economics of lighting (Outdoor)

Objectives: This topic will allow the trainees to have a financial perspective of lighting technological options. Energy consumption costs, technologies life-cycle costs and financial incentive schemes are integrated in this module to give a complete information of economic impact of lighting. A retrofitting example analysis will be made to help consolidate knowledge.

- a. Understanding Energy Consumption
- b. Life-Cycle costing
- c. Retrofitting example
- d. Financial incentive schemes
- e. Energy Performance Contracts

6. LED Case Studies (Outdoor)

Objectives: To learn about the various aspects of LED lighting discussed in other topics, through selected best practice examples. Case Studies to present are selected from a pool to address specific topics of interest to the target group.

7. Photobiological effects and light pollution (humans&animals)

Objectives: *In this topic, participants will learn about the effects of lighting on plants, animals and humans; How plants and animals depend on Earth's daily cycle of light and dark rhythm to govern life-sustaining behaviours such as reproduction, nourishment, sleep and protection; The effect of night lighting on trees in photosynthesis and photoperiodism; Effects on Ecosystems; Psychosocial effects. Understand the principles of light pollution (i.e., skyglow, light trespass, and glare) and their effects; know how to evaluate a design to ascertain its contribution to each of these factors, and know how to take steps to mitigate these factors during the design process.*

- a. Circadian rhythm
- b. Effects on Ecosystems
- c. Psychosocial effects

8. Lighting Design – Basics

Objectives: *This topic has the objective of explaining the technical features to be considered in lighting design. Participants will acquire some knowledge about the technical terms and techniques depending on each specification and requirements to get the best lighting design solution.*

- a. Lighting level requirements
- b. Lighting metrics: intensity, flux, Illuminance, luminous exitance and luminance
- c. Flicker / Glare
- d. Photometry
- e. Lumen depreciation
- f. Lumen method
- g. Importance of good lighting
- h. Colour rendering
- i. Quality of Lighting - Lighting for human need, lighting for economics and environment, lighting for architecture and building.
- j. Software tools

9. Lighting Design – Advanced (Outdoor)

Objectives: *By the end of this topic, participants will be able to identify different road lighting classes and their different requirements, establishing design criteria; be able to design a lighting system for an example situation; be able to evaluate an existing outdoor lighting installation for effectiveness, safety, and efficiency, and develop recommendations for improvements where needed.*

- a. Importance of street and road lighting
- b. Lighting classes
- c. Requirements for different road types
- d. Establishing photometric requirements

- e. Choice of systems
- f. Photometric Diagrams
- g. Safety in street lighting

10. Procurement Criteria (Outdoor)

Objectives: The procurement criteria developed during the project will be presented along with guidelines on how to successfully implement them.

11. Legal and Standardisation Framework (Outdoor)

Objectives: The aim of this topic is to provide information about legal and standardisation framework of lighting design, the current applicable legislations and standards in each participating country.

Basic configuration of the training sessions

As the stated above, the modules should be selected and arranged to suit the needs of the target groups and the duration of the trainings. As shown in table 1, different countries identified different needs for the education campaign and, therefore, the trainings should be configured to meet the specific needs identified. Below, are listed a few example of possible configurations which are only indicative.

Indoor Lighting

Training 1		
Target groups	Overall duration	Contents
3. Installers 4.Vendors / Distributors	Half-day (4 hours)	1. Fundamentals of Light 2. Artificial Lighting 3. LED Basics 4. Lighting Controls – Basics 6. Best Practice Case Studies

Training 2		
Target groups	Overall duration	Contents
3. Installers 4.Vendors / Distributors	One-day (8 hours)	1. Fundamentals of Light 2. Artificial Lighting 3. LED Basics 4. Lighting Controls – Basics 6. Best Practice Case Studies 7. Human Centric Lighting 8. Lighting Controls - Advanced 9. Lighting Design – Basics

Training 3		
Target groups	Overall duration	Contents
5. Energy specialists / auditors / consultants 7. Building managers	Half-day (4 hours)	2. Artificial Lighting 3. LED Basics 5. Economics of Lighting 11. Procurement Criteria 6. Best Practice Case Studies

Training 4		
Target groups	Overall duration	Contents
7. Building managers 8. Public administration / municipalities	one-day (8 hours)	1. Fundamentals of Light 2. Artificial Lighting 3. LED Basics 4. Lighting Controls – Basics 9. Lighting Design – Basics 7. Human Centric Lighting 5. Best Practice Case Studies 6. Economics of Lighting 11. Procurement Criteria

Training 5		
Target groups	Overall duration	Contents
5. Energy specialists / auditors / consultants 6. ESCOs 7. Building managers	One-day (8 hours)	1. Fundamentals of Light 2. Artificial Lighting 3. LED Basics 5. Economics of Lighting 7. Procurement Criteria 6. Best Practice Case Studies

Training 6		
Target groups	Overall duration	Contents
1. Architects 2. Designers/Planners 9. Secondary technical school / vocational / professional training	1-1/2 days (12 hours)	1. Fundamentals of Light 2. Artificial Lighting 3. LED Basics 4. Lighting Controls - Basics 5. Economics of Lighting 6. Best Practice Case Studies 7. Human Centric Lighting 8. Lighting Controls - Advanced 9. Lighting Design – Basics 10. Lighting Design – Advanced 11. Legal and Standardisation Framework

Outdoor Lighting

Training 1		
Target groups	Overall duration	Contents
3. Installers	Half-day (4 hours)	<ol style="list-style-type: none"> 1. Fundamentals of Light 2. Artificial Lighting 3. LED Basics 4. Lighting Controls – Basics 6. Best Practice Case Studies

Training 3		
Target groups	Overall duration	Contents
8. Public administration / municipalities	Half-day (4 hours)	<ol style="list-style-type: none"> 2. Artificial Lighting 3. LED Basics 5. Economics of Lighting 10. Procurement Criteria 6. Best Practice Case Studies

Training 4		
Target groups	Overall duration	Contents
8. Public administration / municipalities	one-day (8 hours)	<ol style="list-style-type: none"> 1. Fundamentals of Light 2. Artificial Lighting 3. LED Basics 4. Lighting Controls – Basics 8. Lighting Design – Basics 7. Photobiological effects and light pollution (humans&animals) 5. Economics of Lighting 6. Best Practice Case Studies 10. Procurement Criteria 11. Legal and Standardisation Framework