

# DYNAMIC LIGHT.

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Bedarfsgerechte dynamische Beleuchtung  
Planung und Umsetzung zur Verbesserung der  
Energieeffizienz und der Beleuchtungsqualität

Seminar zur Straßen- und Wegebeleuchtung Rostock 24. 01. 2019

# DYNAMIC LIGHT zielt auf...

## Nachhaltigkeit



Lebenswerter Ort



Gesunder Ort



Wirtschaftlich  
attraktiver Ort

Das „Dynamic Light“ Projekt

Was ist dynamisches Licht?

Nachhaltig und suffizient: für eine lebenswerte, gesunde und ökonomisch attraktive Stadt!

WP 1: Dynamisches Licht planen!

WP 2: Dynamisches Licht in die Stadt integrieren!

WP 3: Pilotprojekte in der Praxis

WP 4: Rechtliche Aspekte und Angleichung der Normen

Ergebnisse/Ausblick



# DYNAMIC LIGHT - DEFINITION



Im Innenraum kennen wir eine differenzierte,  
der Situation angepasste Beleuchtung!



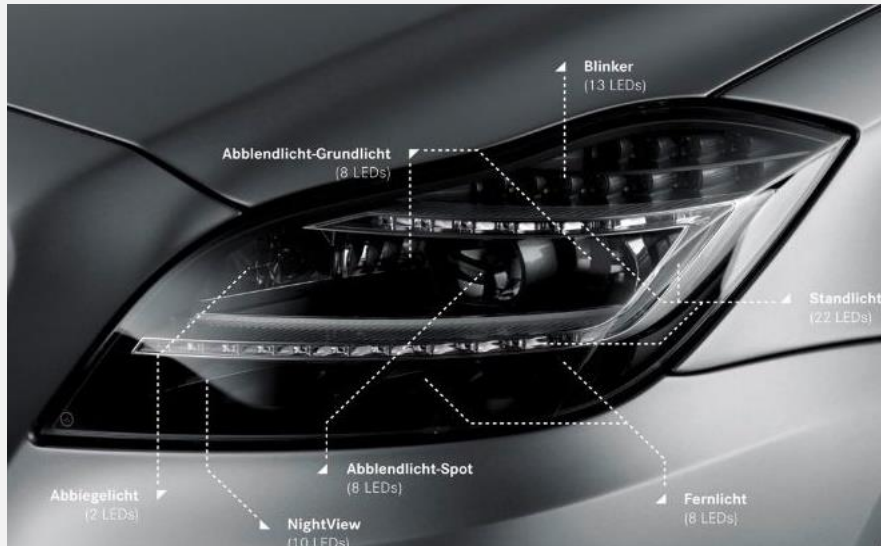
# DYNAMIC LIGHT - DEFINITION



Im Aussenraum gibt es in der Regel nur ein An und Aus!



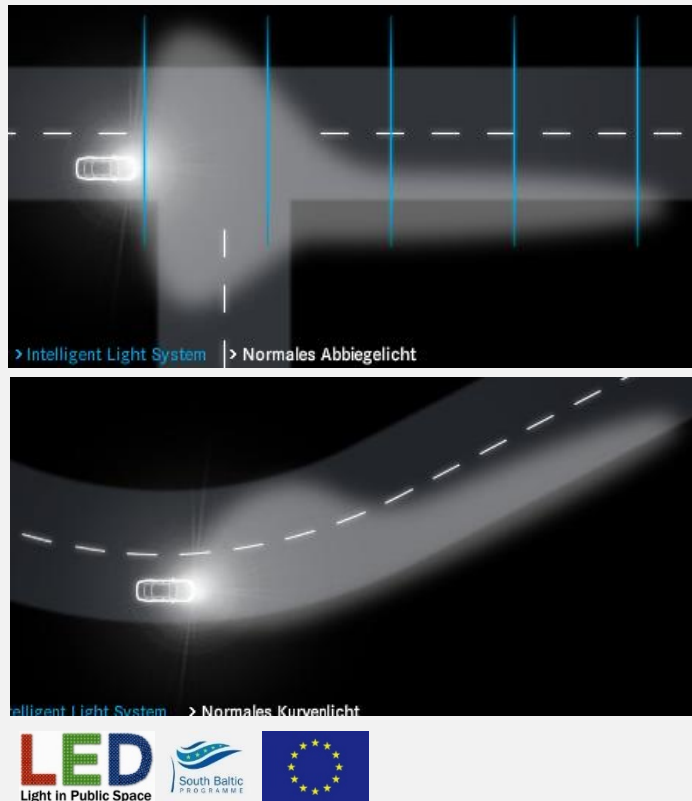
# DYNAMIC LIGHT - DEFINITION



- Abblendlicht
- Grundlicht
- Spot
- Fernlicht
- Standlicht

***DAS LICHT IST  
ADAPTIV!***

# DYNAMIC LIGHT - DEFINITION



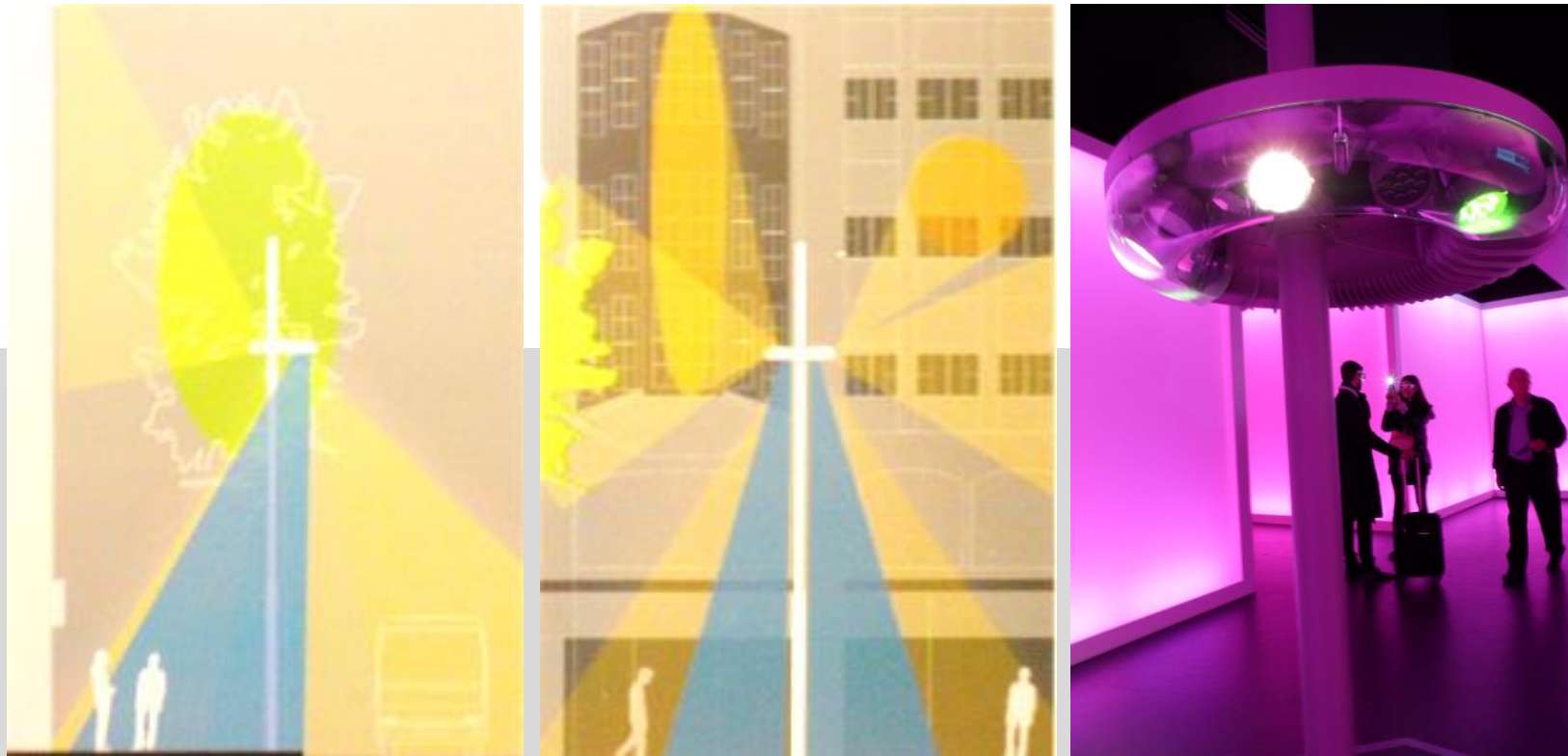
***Neue Sensoren  
erkennen Situationen.***

*Sie erlauben das Licht  
entsprechend des aktuellen  
Verhaltens und der visuellen  
Anforderungen und des  
sozialen Kontext  
zugestalten.*

***DAS LICHT IST  
PROACTIV!***

# DYNAMIC LIGHT - DEFINITION

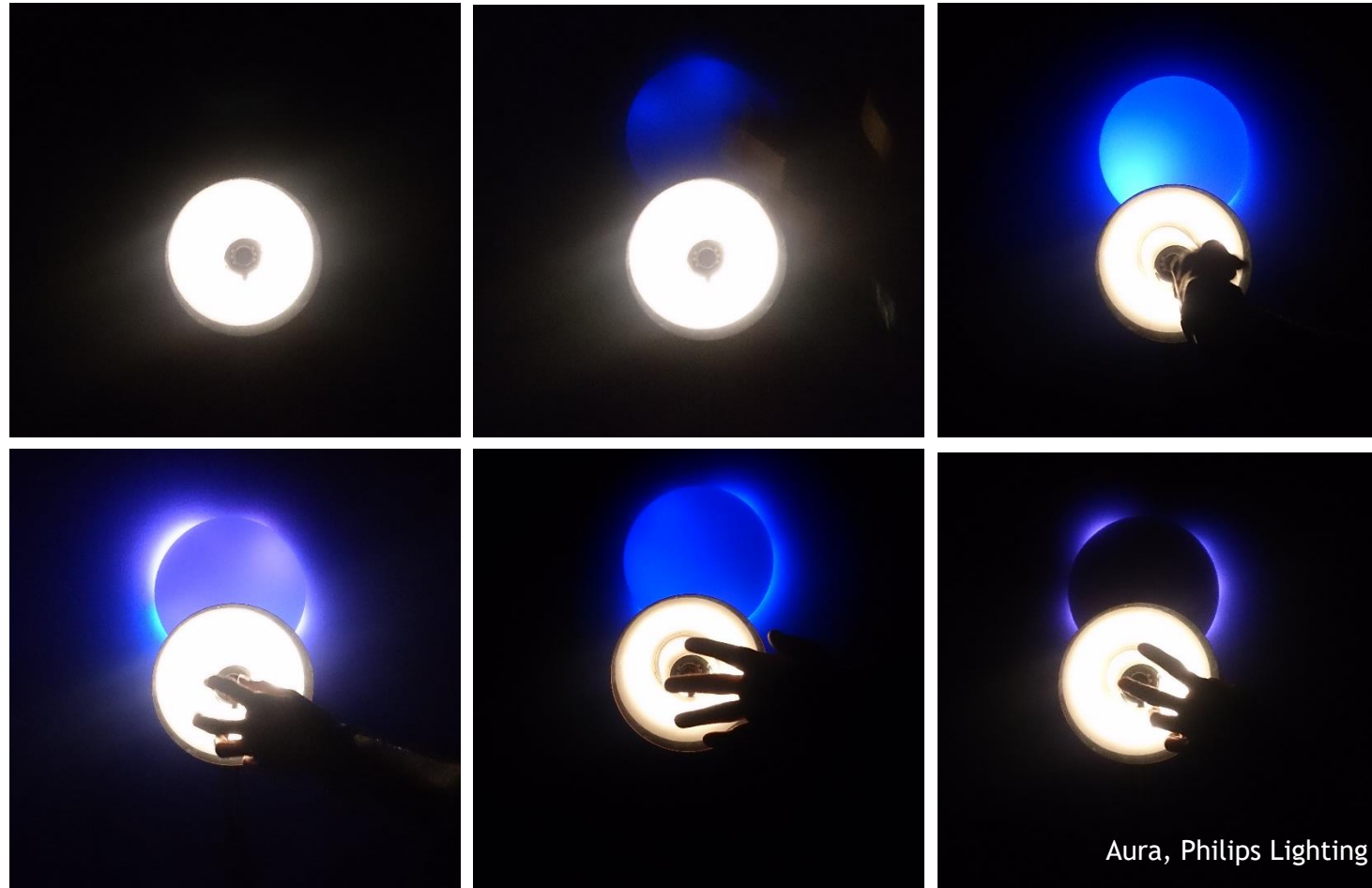
FIVE IN ONE



Multifunktionsleuchte für Hamburg Mönckebergstraße (T.Schlothfeld/ I guzzini)







In dem Projekt werden verschiedene öffentliche Beleuchtungssituationen erforscht, die für europäische Gemeinden typisch sind.

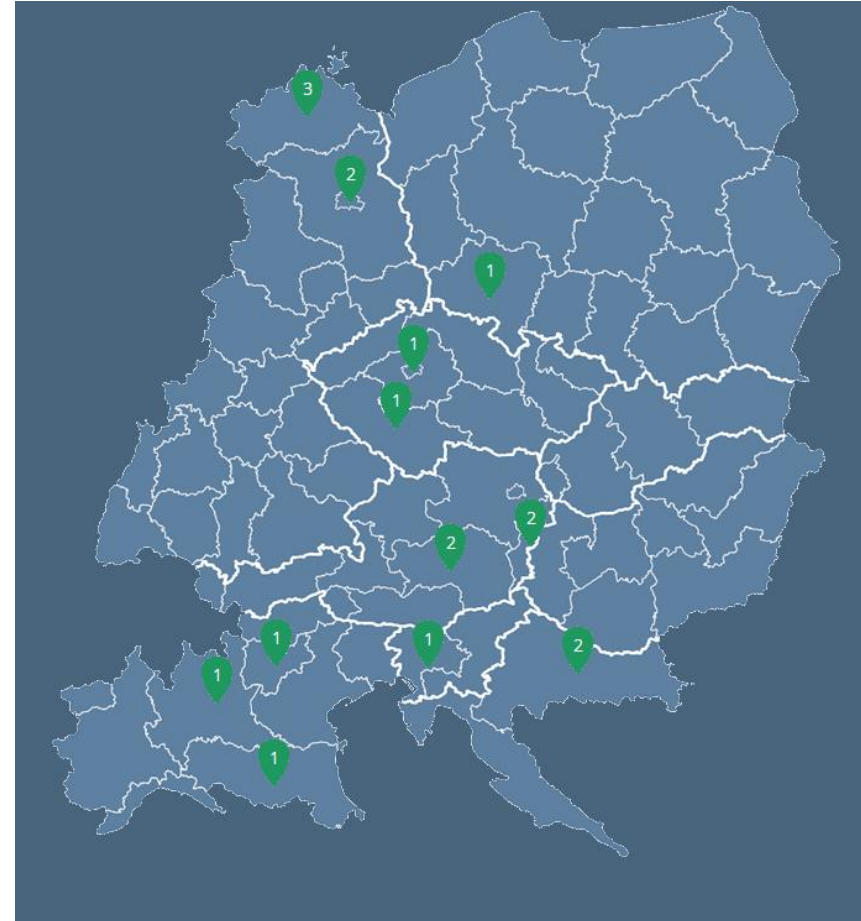
Da die Beleuchtungsinfrastruktur in ganz Europa modernisiert wird, um von Energieeinsparpotentialen der LED-Technologie zu profitieren, wird das Projekt Grundlagen für mehr kontrollierbare und leistungsfähigere Beleuchtungslösungen mit verbesserter visueller Leistung und verbessertem Ambiente sowie Sicherheit im städtischen Umfeld in ganz Europa zu schaffen.

Das Projekt “***Dynamic Light***,, hat die Aufgabe, im öffentlichen Bewusstsein die Vorteile ***proaktiver, adaptiver, also dynamischer Beleuchtung*** zu verankern und Wege zu ihrer Implementierung aufzuzeigen.

# PROJEKT FAKTEN

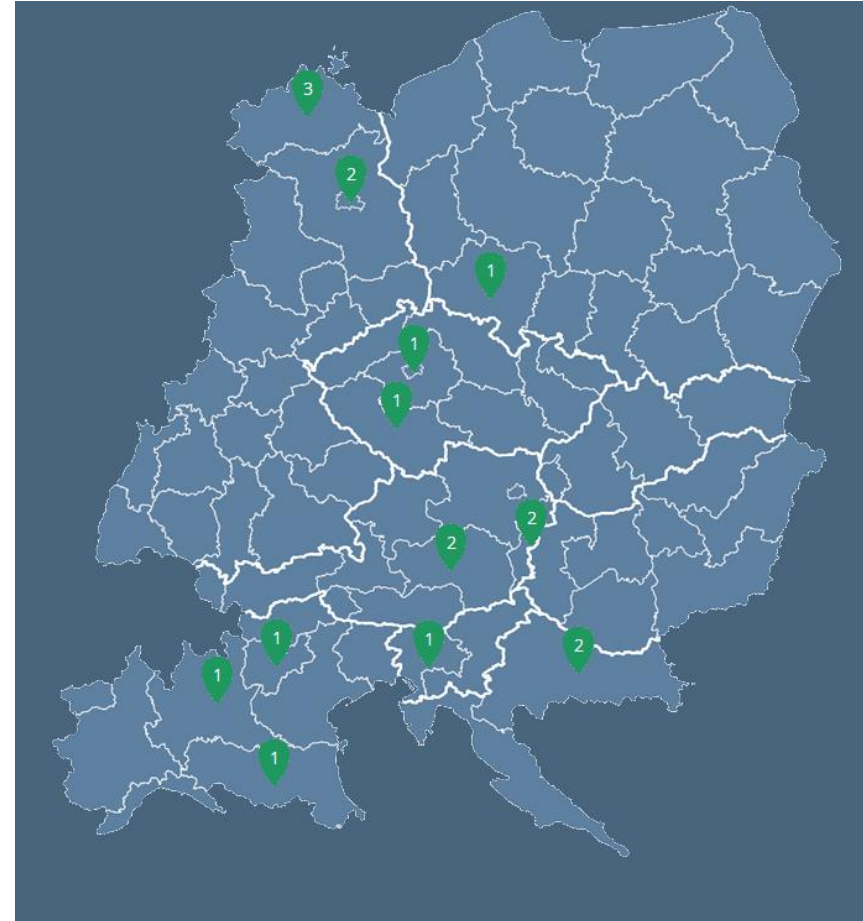
## *Dynamic Light: Interreg Central Europe Programme*

- **17 Partner , 9 Pilot Projekte**
- **Budget: 3 500 000 €**
- **Dauer: Juni 2016 – Mai 2019**
  
- Kommunen, Universitäten,  
Energie Agenturen, Hersteller usw.
- Polen, Italien, Österreich, Kroatien,  
Slowenien, Tschechien, Deutschland
- Hochschule Wismar (Lead Partner);



# PROJEKTPARTNER

- Deutschland:**
- Hochschule Wismar (Lead Partner)
  - LiTG Lichttechnische Gesellschaft
  - Stadt Rostock
  - SWARCO GmbH
  - Universität Greifswald
- Italien:**
- Stadt Cesena
  - TEA Spa (Mantova)
  - Bruno Kessler Foundation
- Kroatien:**
- Stadt Čakovec
  - Menea Energieagentur
- Polen:**
- Poltegor Institut
- Österreich:**
- Europäisches Zentrum für Erneuerbare Energie Güssing
  - Burgstiftung Güssing
- Slovenien:**
- Spath Micro Electronic
  - BSC Business Support Center Kranj
- Tschechien:**
- Porsenna
  - Stadt Sušice



# DIGITALISIERUNG/ CONNECTIVITY

## *in der „24Stunden Gesellschaft“*

### Veränderte Erwartungen der Nutzer

Durch intensivere Nutzung des öffentlichen Raumes während der Dunkelstunden steigen die Ansprüche an die Aufenthaltsqualität und die Beleuchtung.

### Verbesserte Anpassung an die jeweilige Situation der Nutzer

Durch stärkere Vernetzung ergibt sich eine bessere Vorhersehbarkeit der Ereignisse, auch individuellen Situation.

### Neue Möglichkeiten der Beleuchtung:

Digitale Stadtinfrastruktur und im Internet verfügbare Daten als Grundlage für Lichtsteuerung.



Student Project „Darkness“ Akanpinar, Choi, Mankhongphithakkul, Pribadi

## Technologieorientierte Planung

- Welche Daten kann ich wie erheben?
- Wie werte ich die Daten aus?
- Welche Technologien stehen zur Verfügung, um die Daten zu nutzen?
- Welche Verbesserungen ergeben sich daraus für die Beleuchtung?

## Programmierung von Algorithmen!



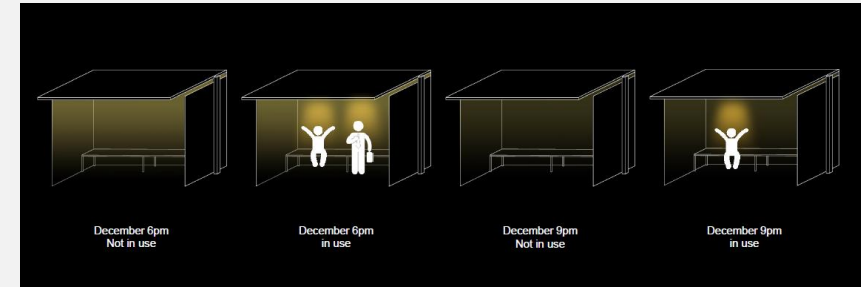
Student Project „Darkness“ Akanpinar, Choi, Mankhongphithakkul, Pribadi

# DIGITALISIERUNG/ CONNECTIVITY

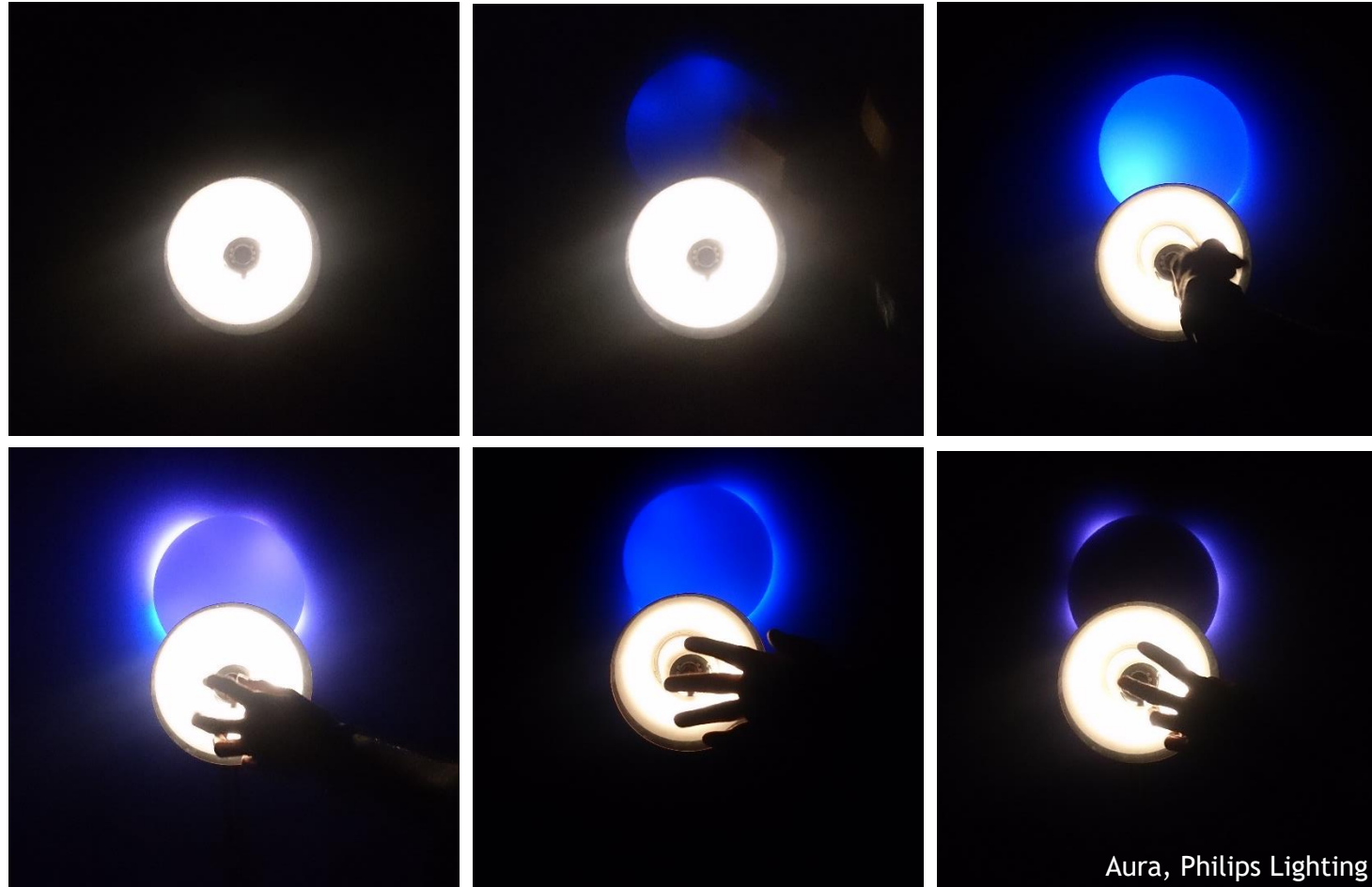
## Nutzerorientierte Planung

- Wer ist der Nutzer?
- Welche Anforderungen hat der Nutzer?
- Welche Verbesserungen kann ich dem Nutzer bieten?
- Wer entscheidet und wer profitiert?
- Welche Technologien stehen zur Verfügung und wofür lassen sich deren Vorteile nutzen?
- Welche Daten muss ich dafür erheben?
- Wie werte ich die Daten aus?

## Programmierung von Algorithmen!



Student Project „Darkness“ Akanpinar, Choi,  
Mankhongphithakkul, Pribadi





# GROTE KERK IN EMMEN



Inviting to come

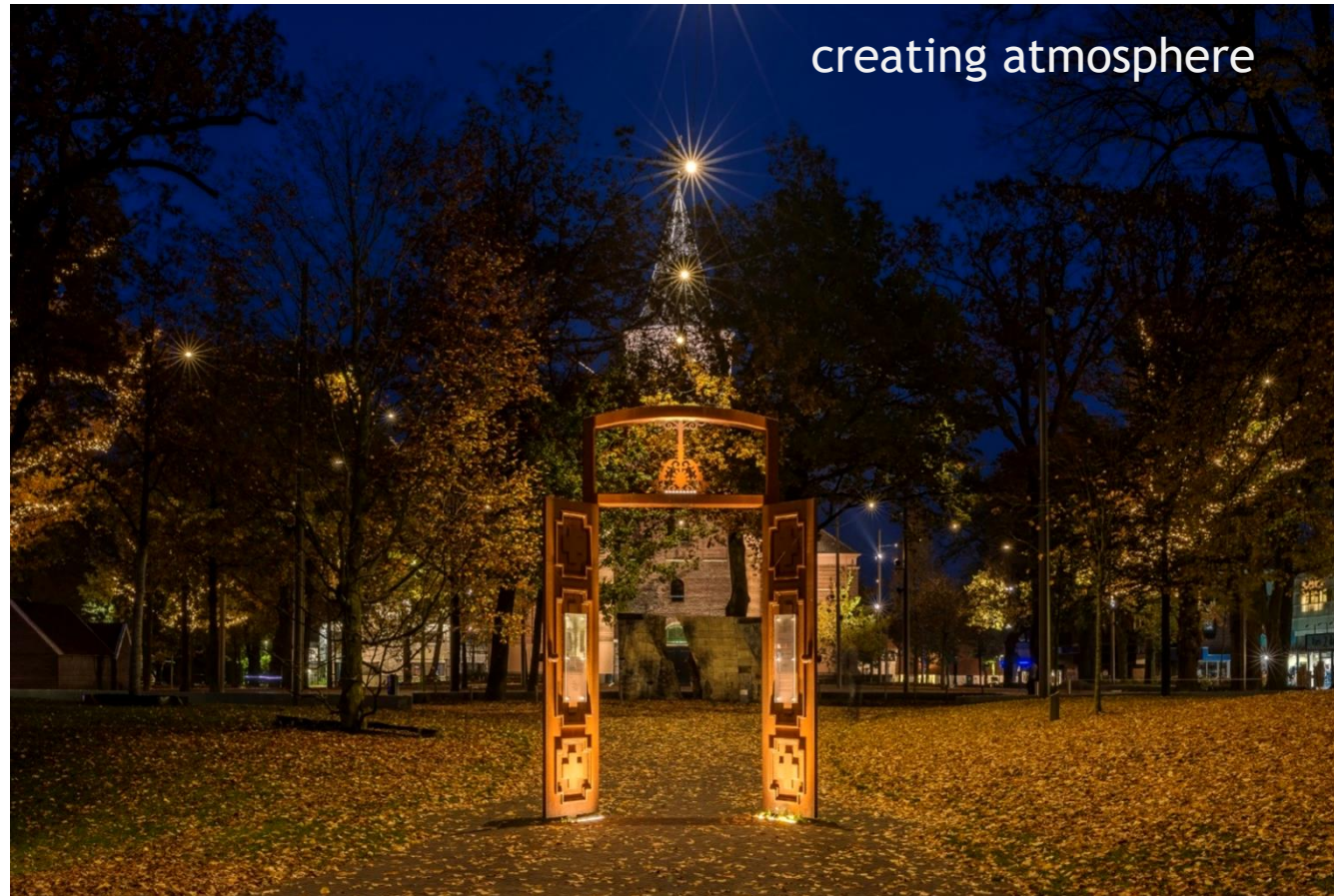


important for orientation

StudioDL\_Emmen\_Dirk-Andre-Betz

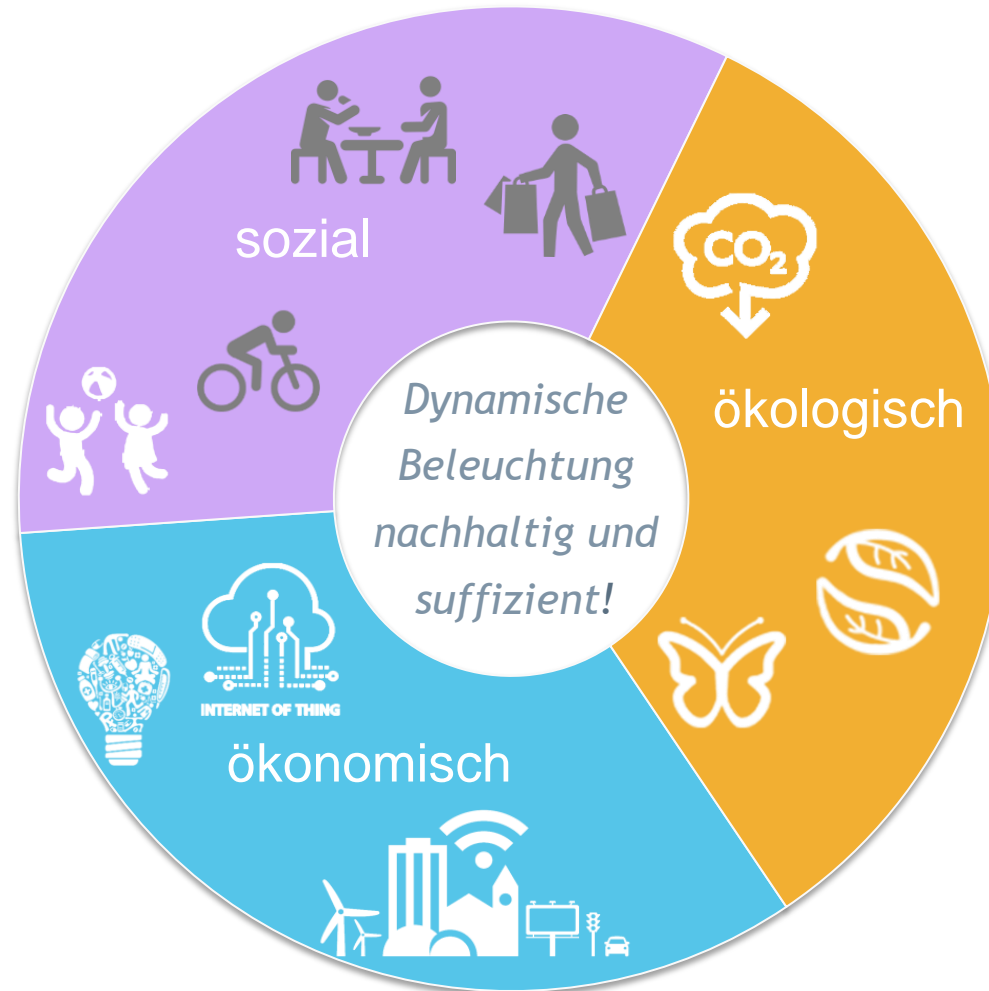


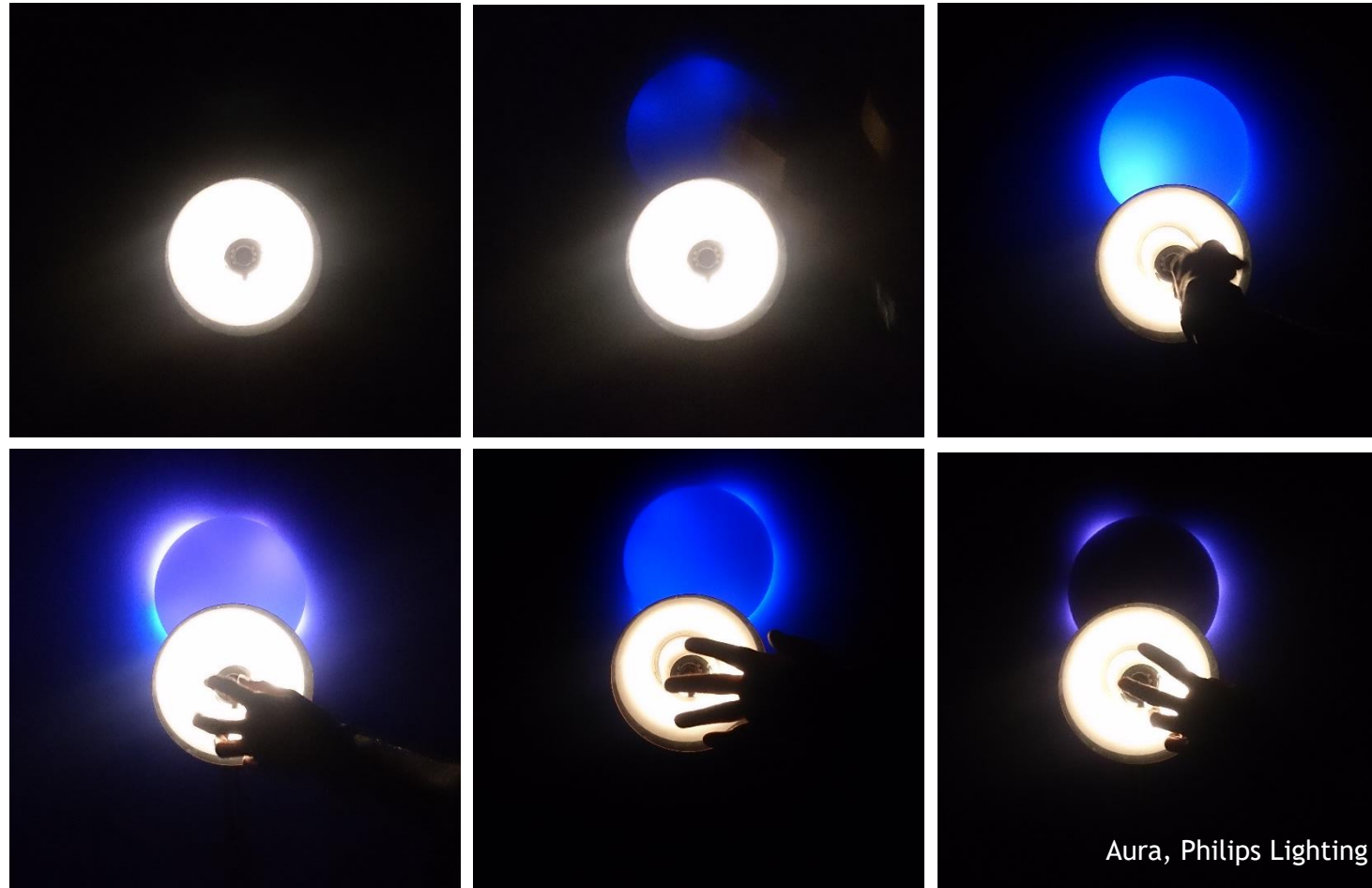
# GROTE KERK IN EMMEN



StudioDL\_Emmen\_Dirk-Andre-Betz

# NACHHALTIGE BELEUCHTUNG





# HYPOTHESEN: SOZIALE QUALITÄT

**Dynamisches Licht** kann die Qualität und Angemessenheit der Beleuchtung im öffentlichen Raum verbessern,

wenn es nach den **sich ändernden** Anforderungen der Nutzer und ihren sozialen Aktivitäten geplant wird!



# MONTFORTHHAUS FELDKIRCH



LDE Belzner Holmes\_Montforthaus Feldkirch Aussenbeleuchtung\_Fotograf Kolm

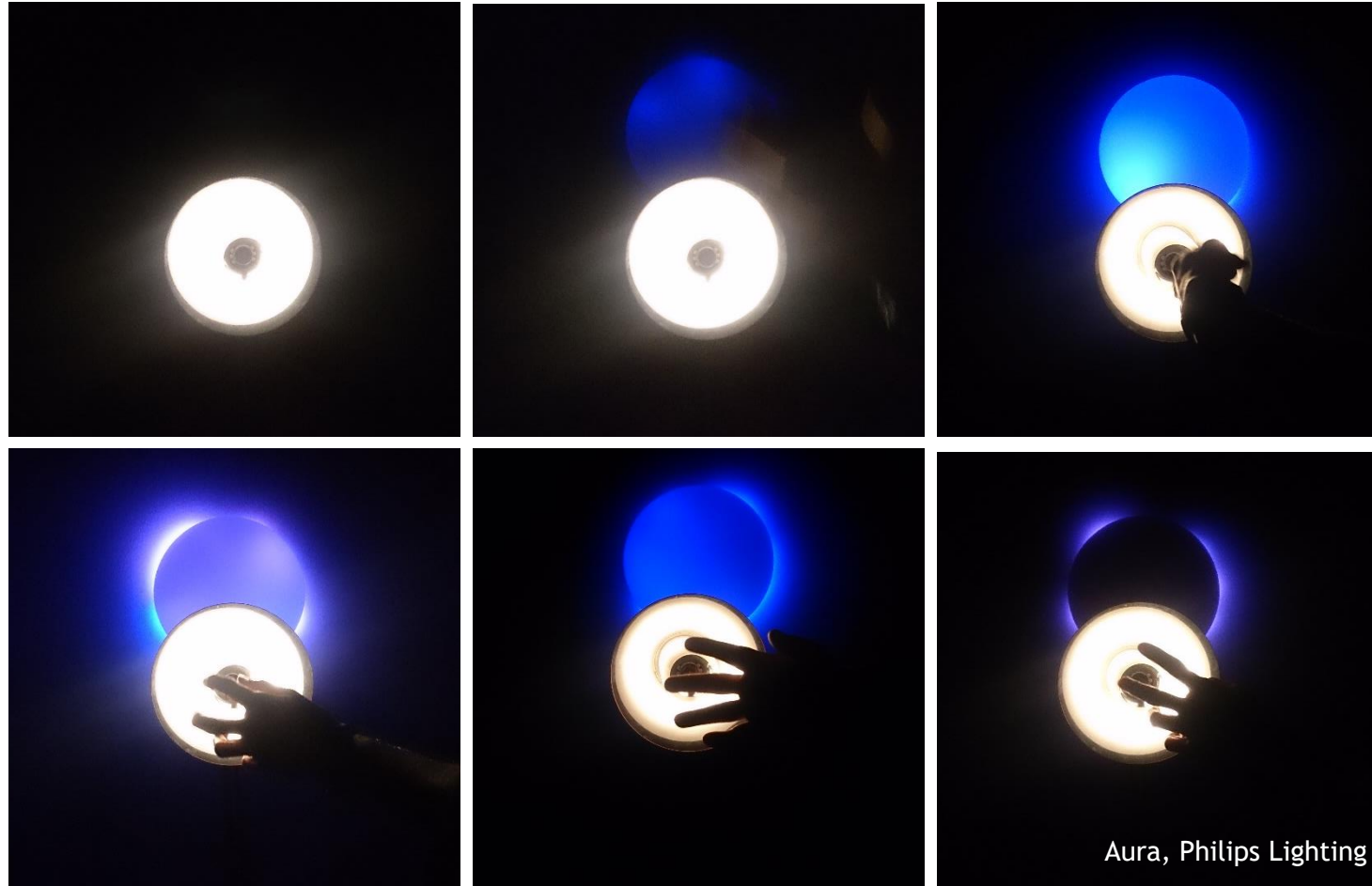
# HYPOTHESEN: SOZIALE QUALITÄT

*Öffentliche Räume bieten Platz für eine Vielzahl von Nutzungen,  
Räume können daher von verschiedenen Lichtszenen profitieren*

*„Schaffen Sie lebendige Orte,  
indem Sie sie zum Ort für vielfache  
Nutzungen machen!“*

*Placemaking: Projekt für öffentliche Räume - ([www.pps.org](http://www.pps.org)) Aspekte der Stadtplanung und -  
planung (Jan Gehl) auf Lichtplanung übertragen, um die Identifikation mit dem öffentlichen  
Raum zu erhöhen*







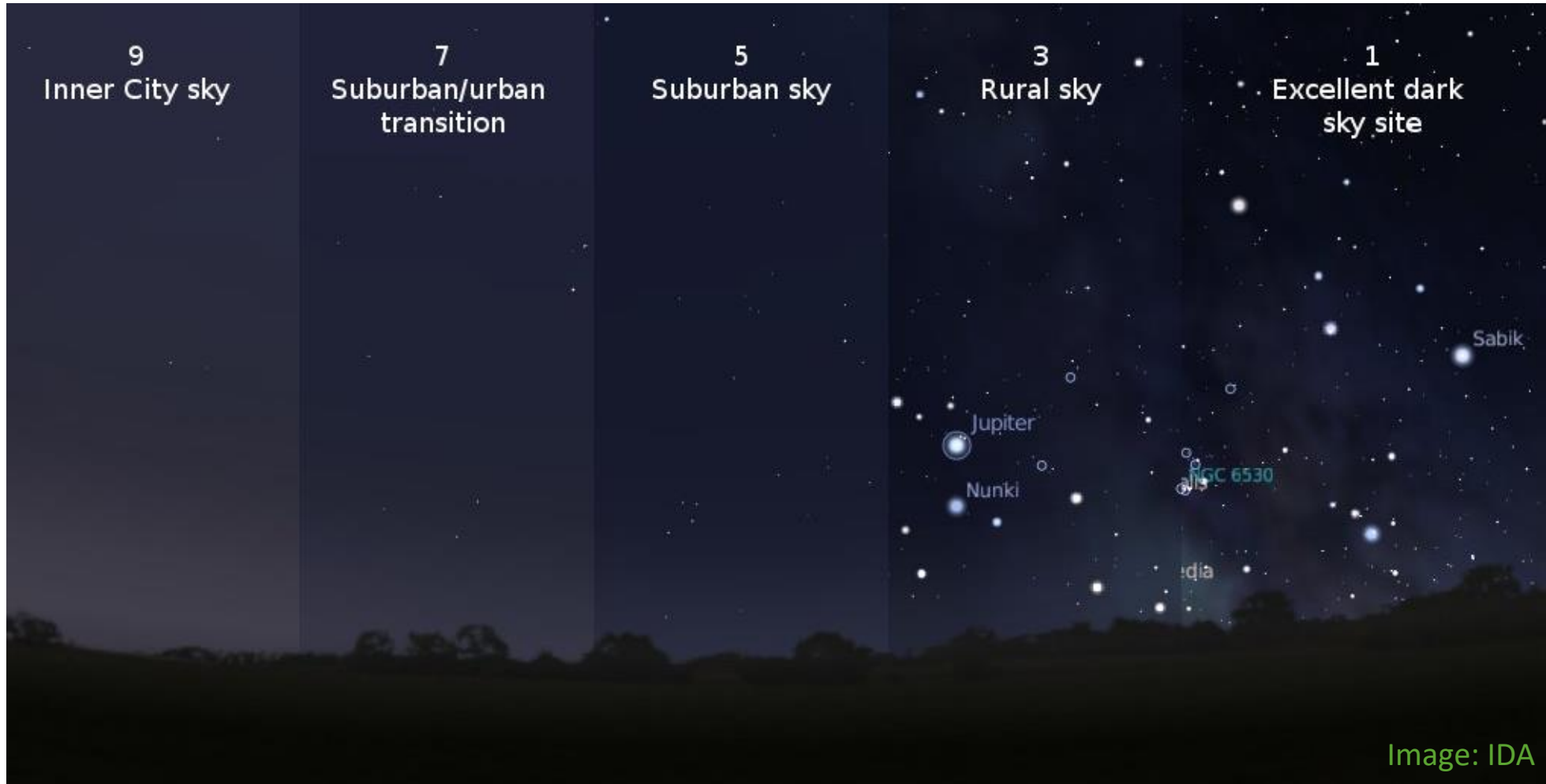
# HYPOTHESIS: ÖKOLOGIE

**Dynamic Light** kann  
Lichtverschmutzung reduzieren  
Fauna und Flora respektieren,

Wenn das Licht  
nur an dem Ort, nur zu der Zeit  
und nur soviel, wie gebraucht wird,  
angeboten wird!



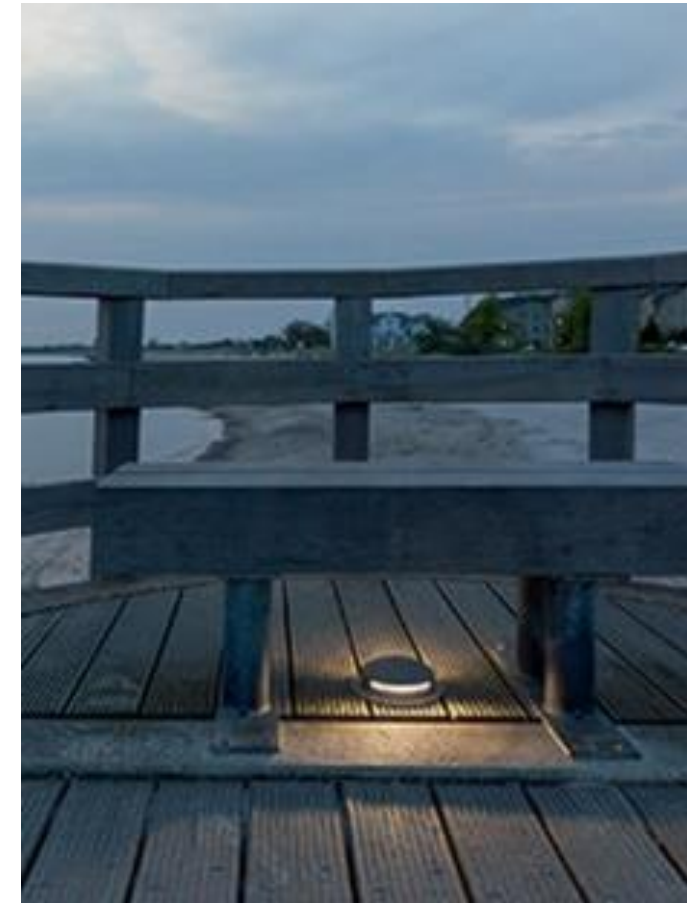
# LIGHTPOLLUTION



# HEILIGENDAMM, SEEBRÜCKE



Foto: Blickle



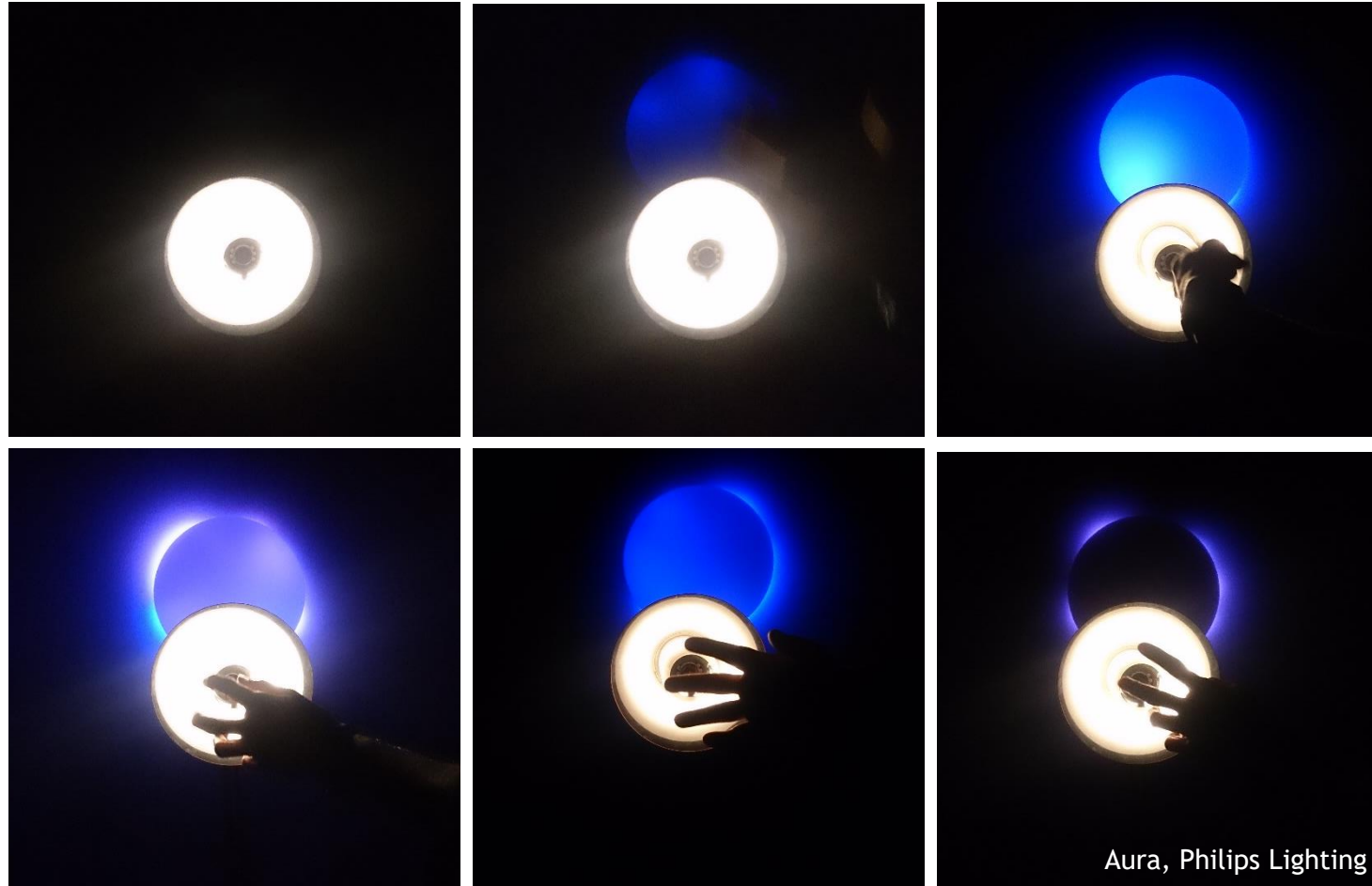
- *Anrainer, Menschen und Tiere, an nächtlich extensiv genutzten öffentlichen Räumen werden nur dann und so wenig wie nötig gestört, wenn dies unbedingt erforderlich ist.*
- *Die Dunkelheit und der Nachthimmel können besser erfahren werden, wenn die Beleuchtung so gering wie möglich und in der Lichtfarbe angepasst ist.*

## WARNUNG!

*Künstliches Licht im öffentlichen Raum ist eine Grundvoraussetzung für zivilisiertes Zusammenleben in größeren Gemeinschaften. Auf eine kontinuierliche Beleuchtung kann nur verzichtet werden, wenn die ständige Verfügbarkeit gewährleistet wird.*

***Ausschalten ist selten zufriedenstellend!***





# HYPOTHESEN: ÖKONOMIE

**Dynamisches Licht** kann, wenn die Beleuchtung den jeweiligen Anforderungen entspricht,

den Verbrauch von elektrischer Energie senken!

**Dynamisches Licht** kann wenn die Beleuchtung Orte zur positiven Identifikation bietet,

die ökonomische Attraktivität einer Gemeinde steigern!



# LECH - ALPINE VILLAGE

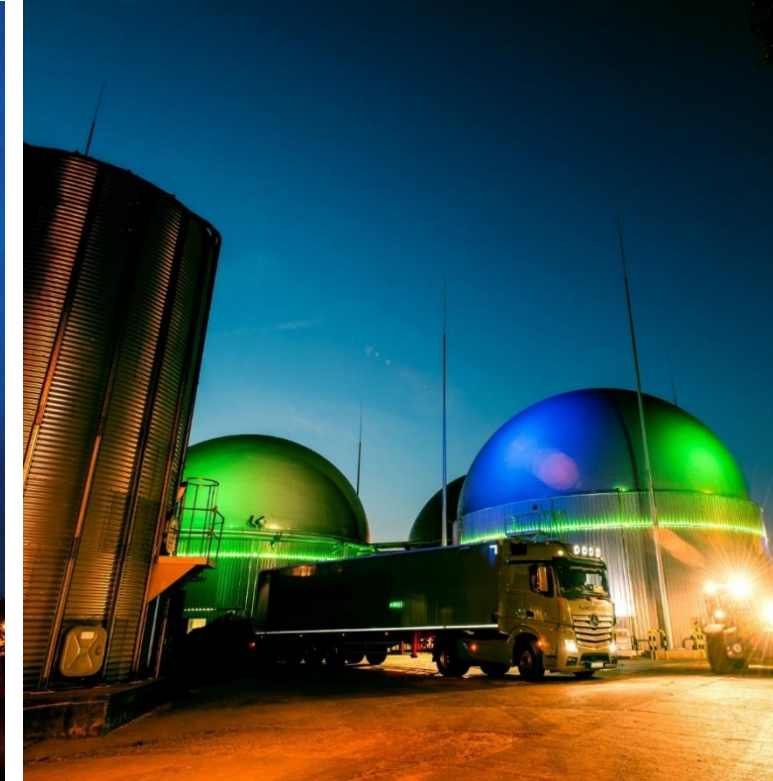
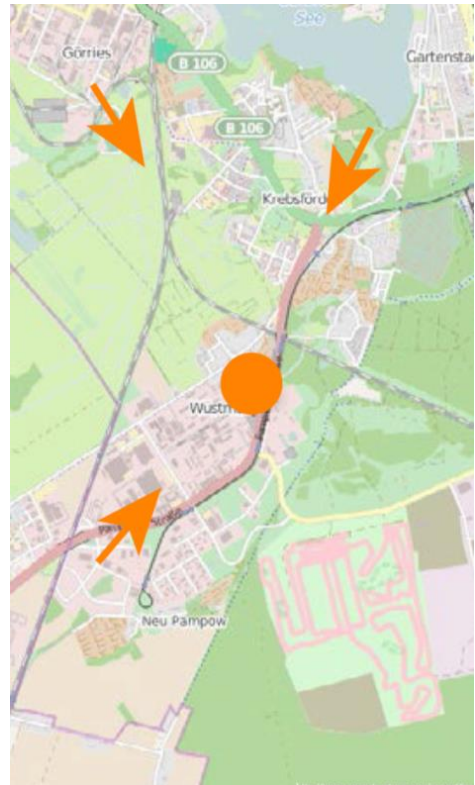


LECH - ALPINE VILLAGE LIGHTING EVOLUTION  
*Bild: © Zumtobel/Lichtplanung Bartenbach*



# KRAFTWERK SCHWERIN

Visuelles Ambiente, Identifikation Postkartenblick





# POWER PLANT SCHWERIN

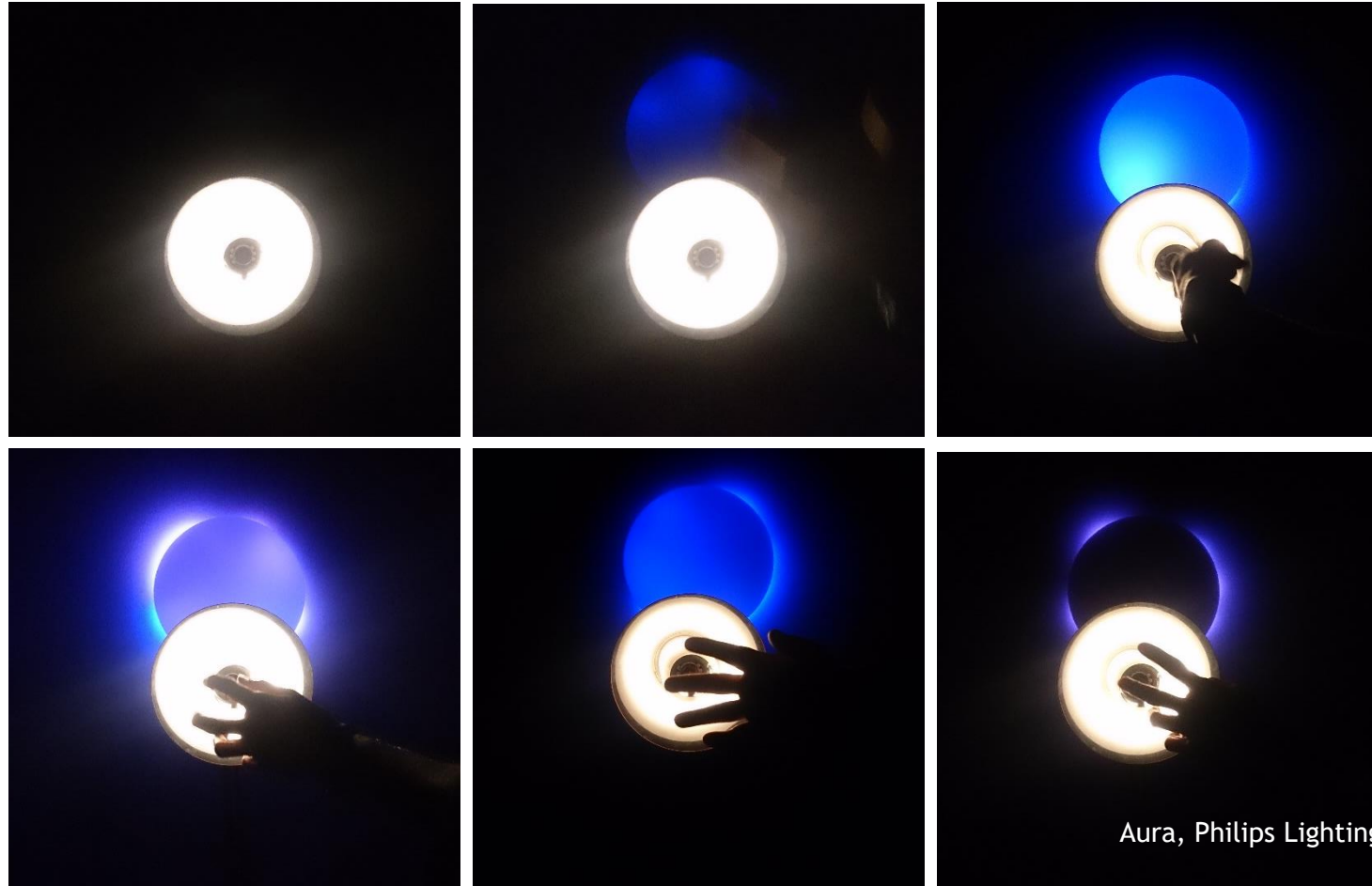
Narrativität



# HYPOTHESEN: ÖKONOMIE

- *Licht im öffentlichen Raum ist oft ausgelegt, dass eine maximale Nutzung ermöglicht wird, es ist damit oft überdimensioniert!*
- *Nutzungsanforderungen an die Beleuchtung unterliegen starken Schwankungen im Laufe von Abend und Nacht, ja sogar mit jahreszeitlichen Unterschieden!*

***Qualitätvolles Licht kann Besucher in die Stadt locken oder Stadtteile zum Wohnen und Arbeiten attraktiv erscheinen lassen!***



# DYNAMIC LIGHT- HYPOTHESIS

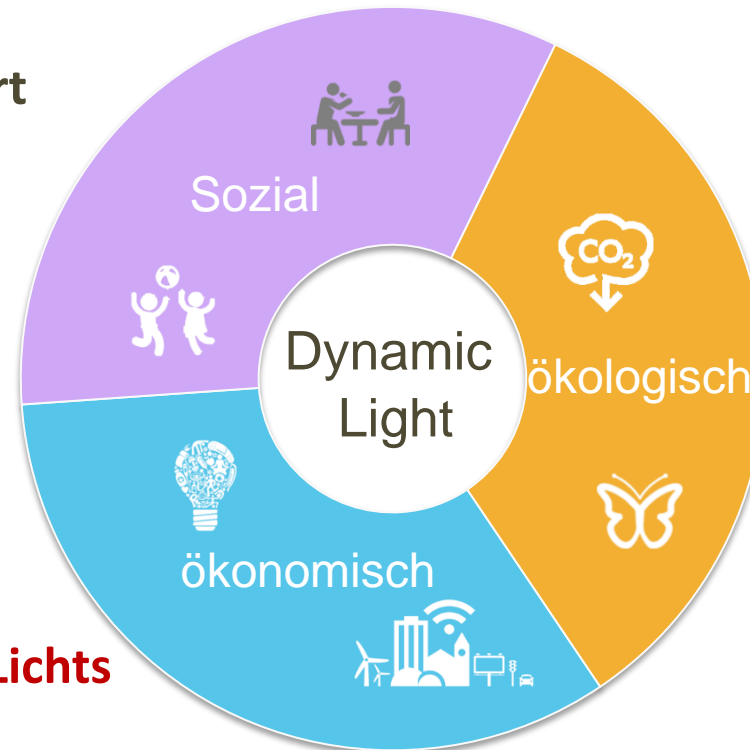


Dynamic Light verbessert die **Qualität des Lichts** entsprechend den sozialen Bedürfnissen!

Dynamic Light kann den Energieverbrauch senken!



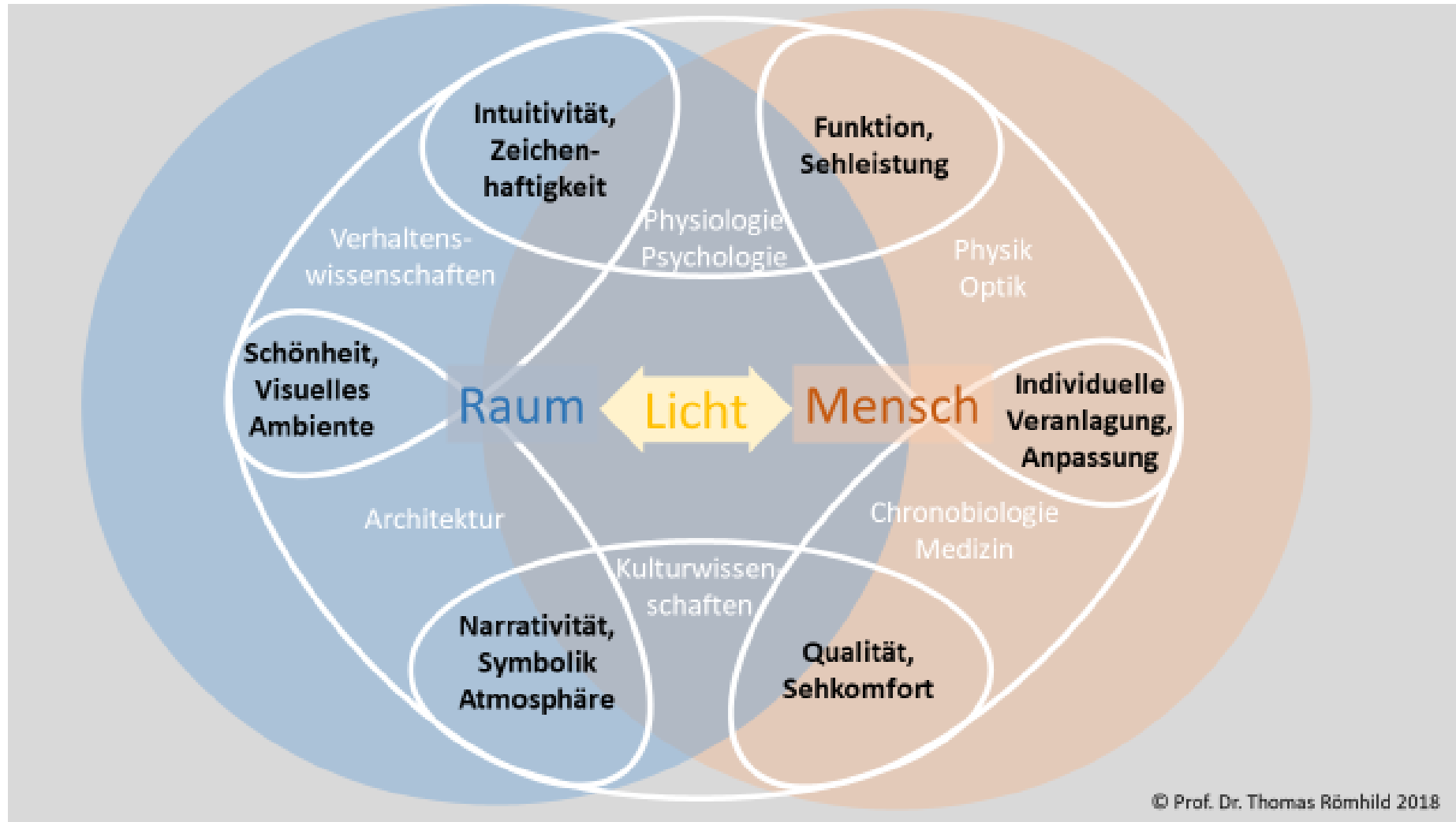
Bessere **Qualität des Lichts** verbessert den Wirtschaftstandort!



Dynamic Light verringert die Lichtverschmutzung!

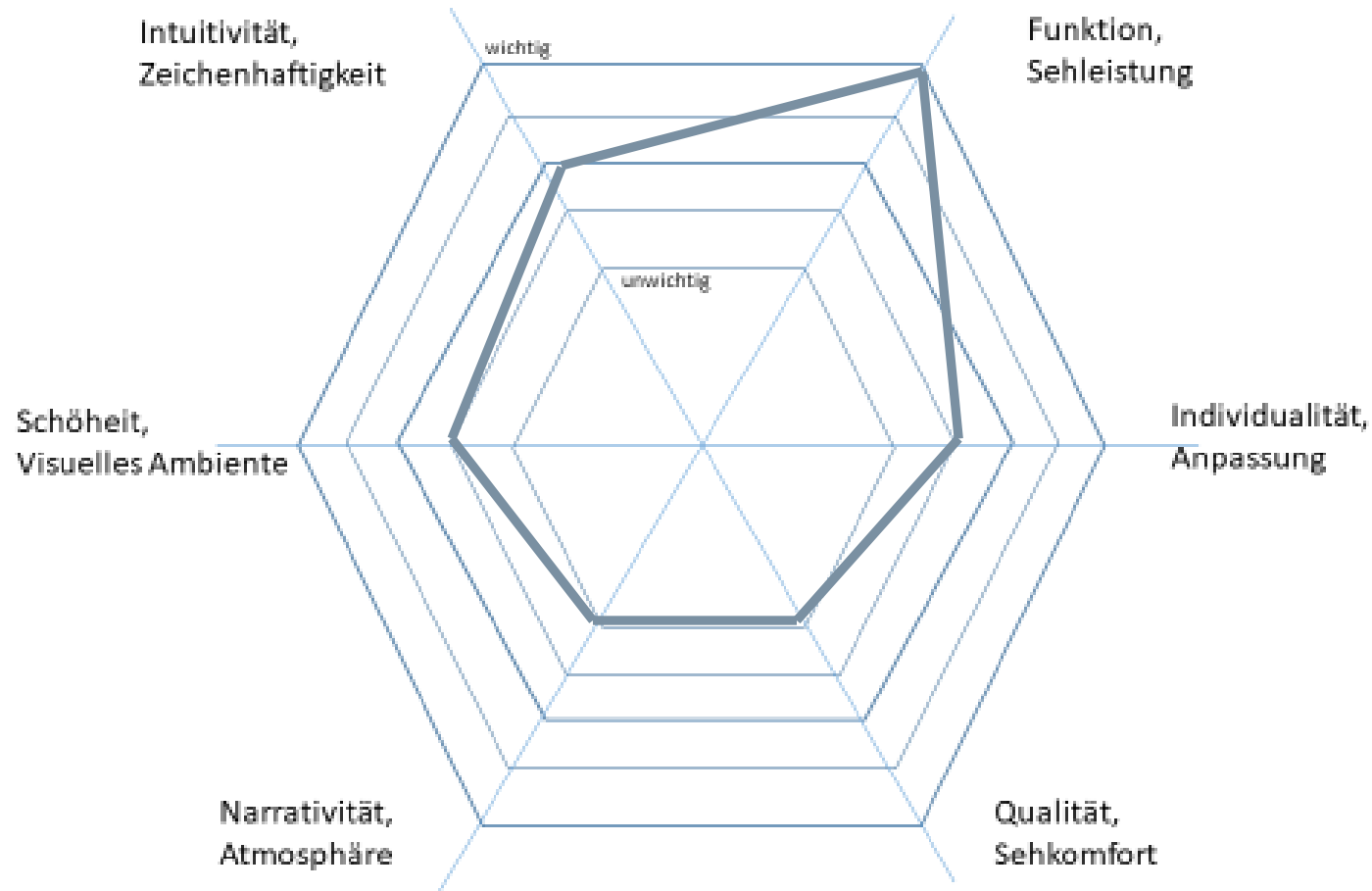
Dynamic Light kann auch die **Qualität des Lichts** für andere Arten erhöhen!.

# LIGHTING DESIGN- QUALITÄTSKRITERIEN



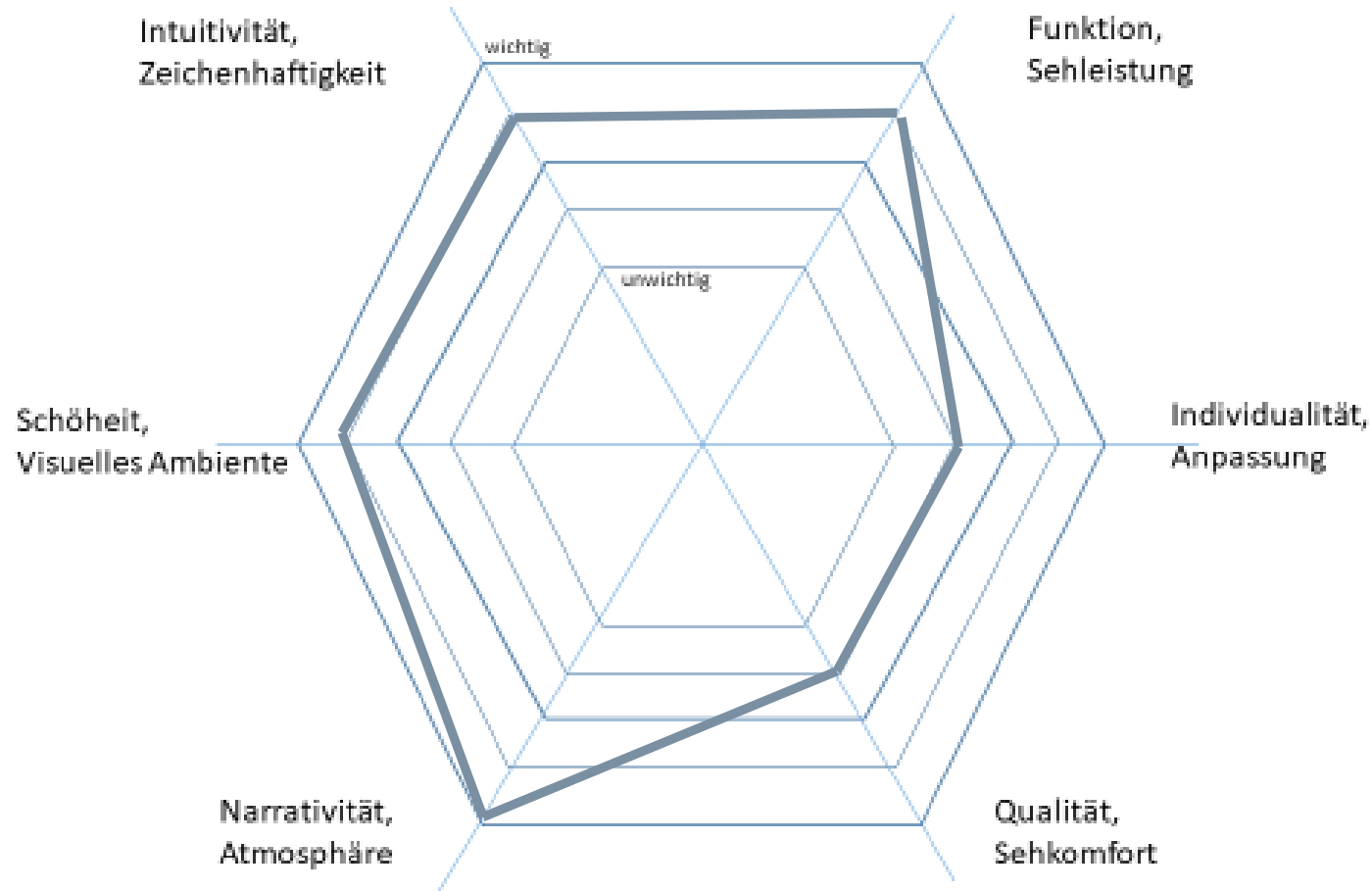
# LIGHTING DESIGN- QUALITÄTSKRITERIEN

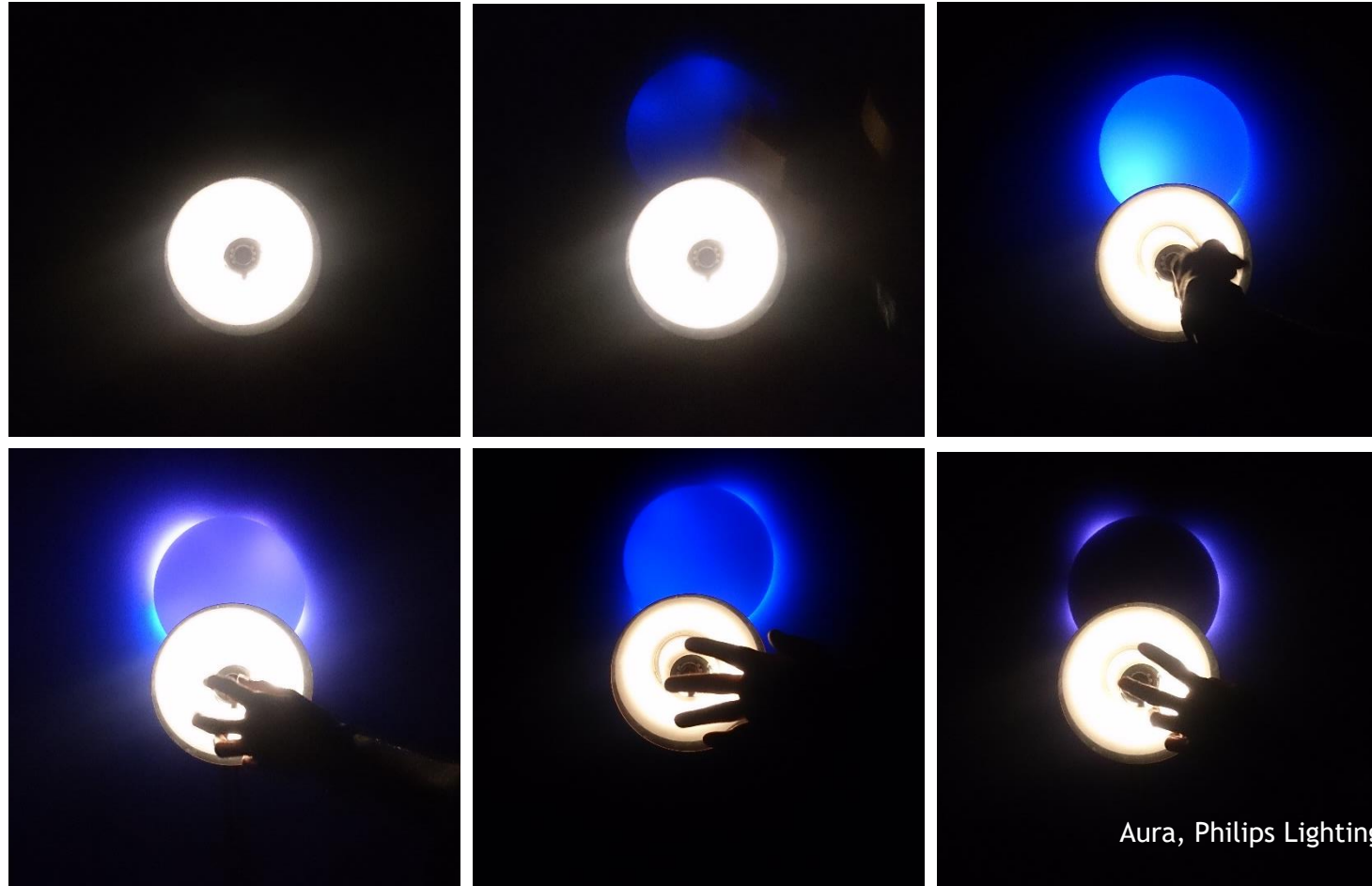
Spinnendiagramm zur Beschreibung der visuellen Effektivität/ gewichteten Lichtqualität



# LIGHTING DESIGN- QUALITÄTSKRITERIEN

Spinnendiagramm zur Beschreibung der visuellen Effektivität/ gewichteten Lichtqualität







# DYNAMIC LIGHT PROJEKT

## WP 1: **Design**

Dynamisches Licht planen!

## WP 2: **Die Stadt**

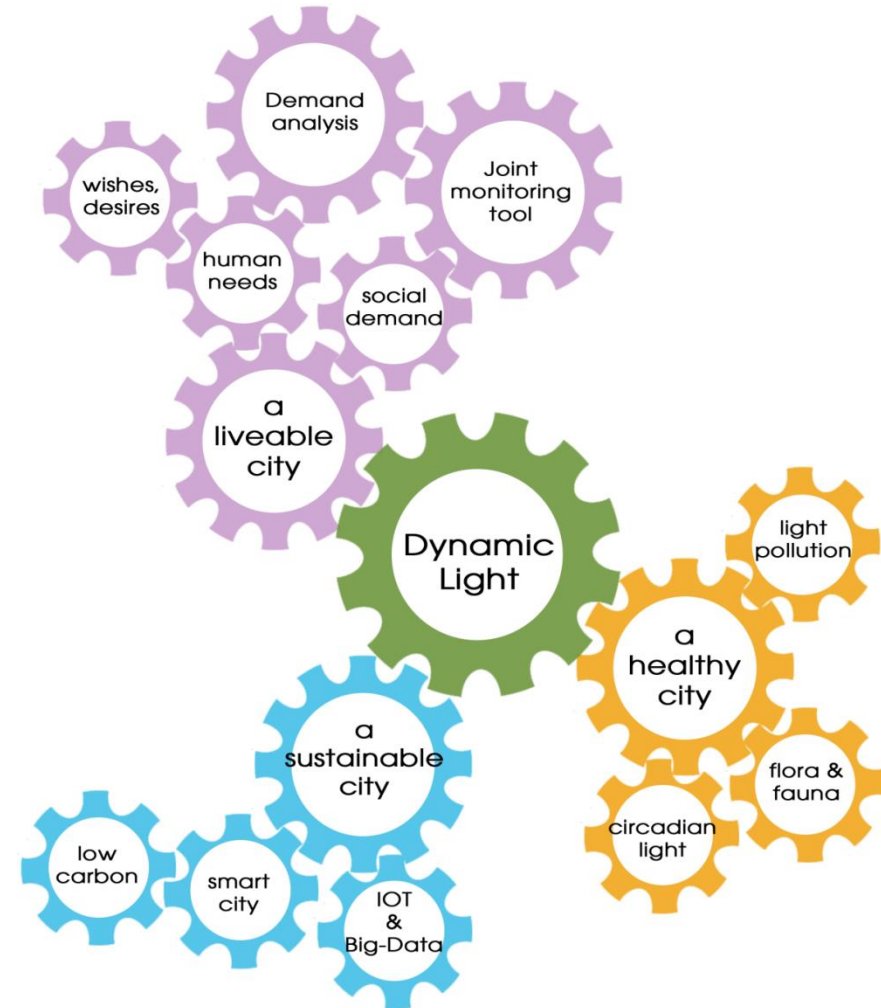
Dynamisches Licht in die Stadt integrieren!

## WP 3: **Praxis**

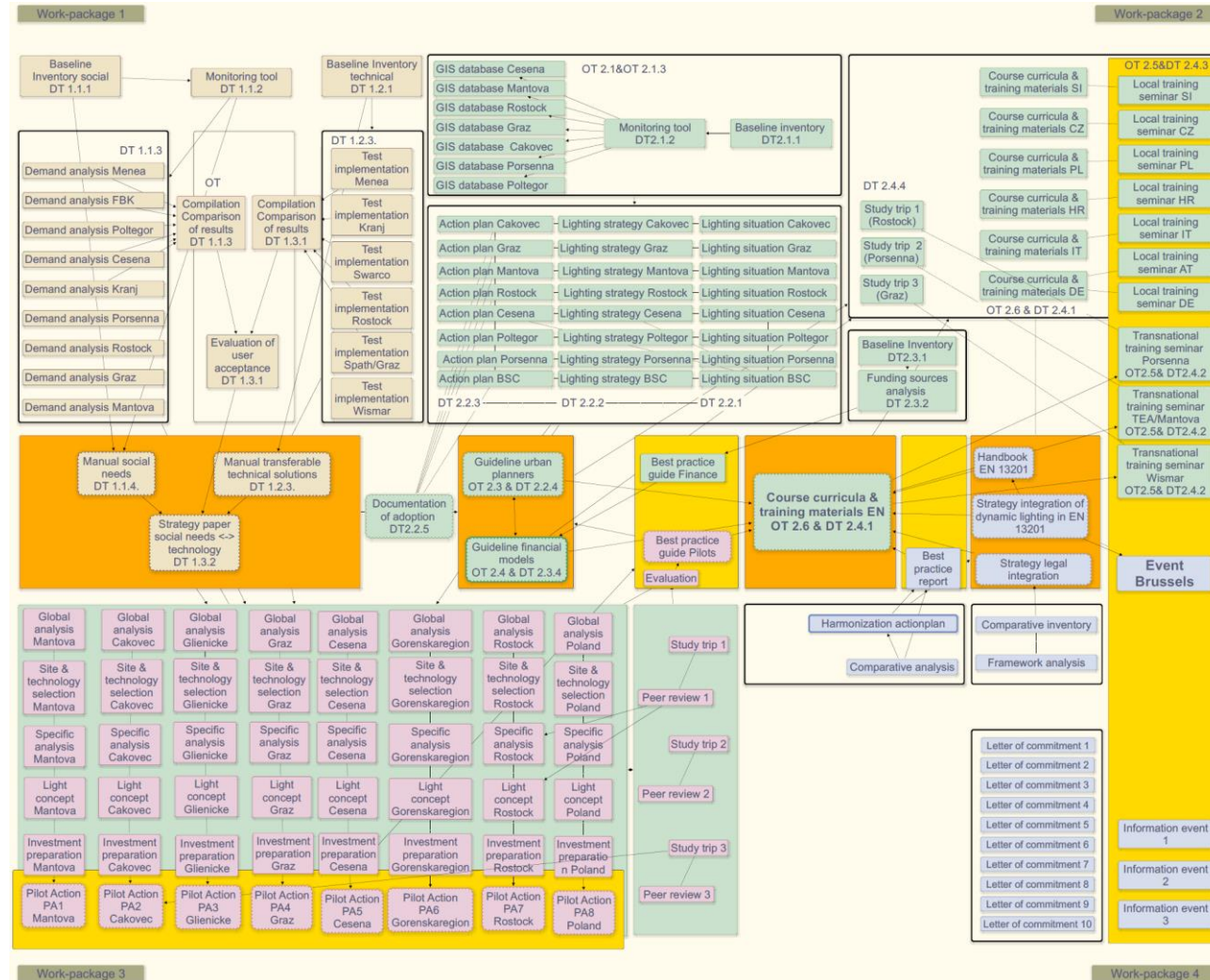
Pilot Projekte in der Praxis

## WP 4: **Rechtliche Aspekte**

Rechtliche Aspekte und die Angleichung der Normen

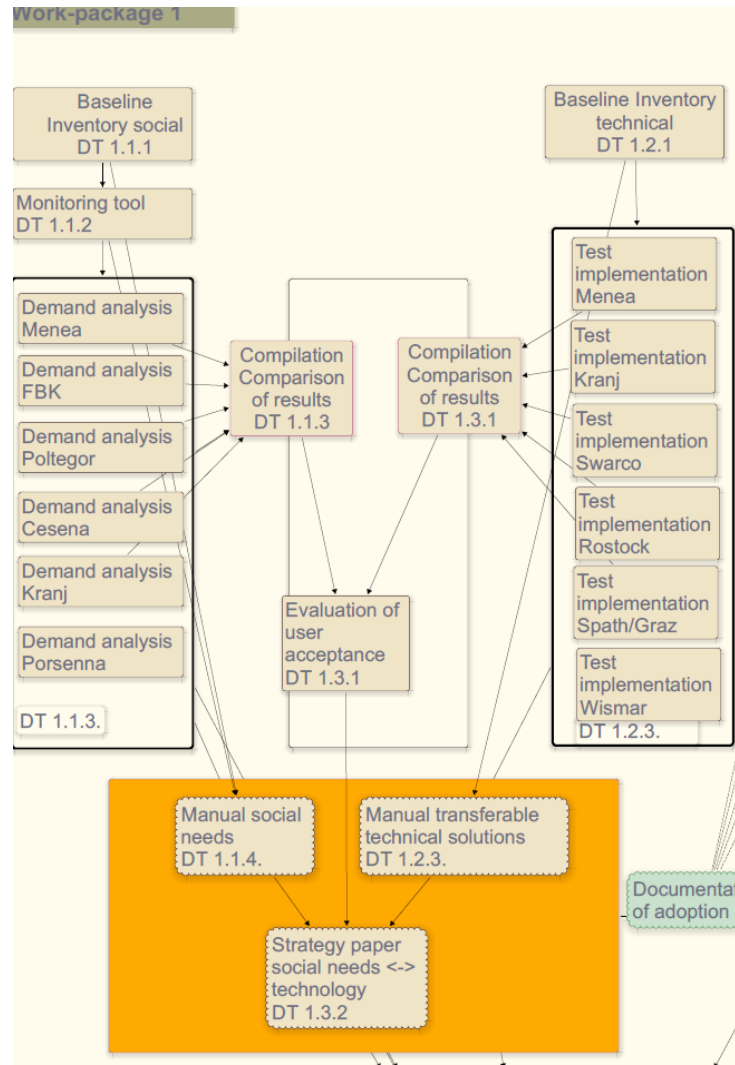


# DYNAMIC LIGHT PROJECT



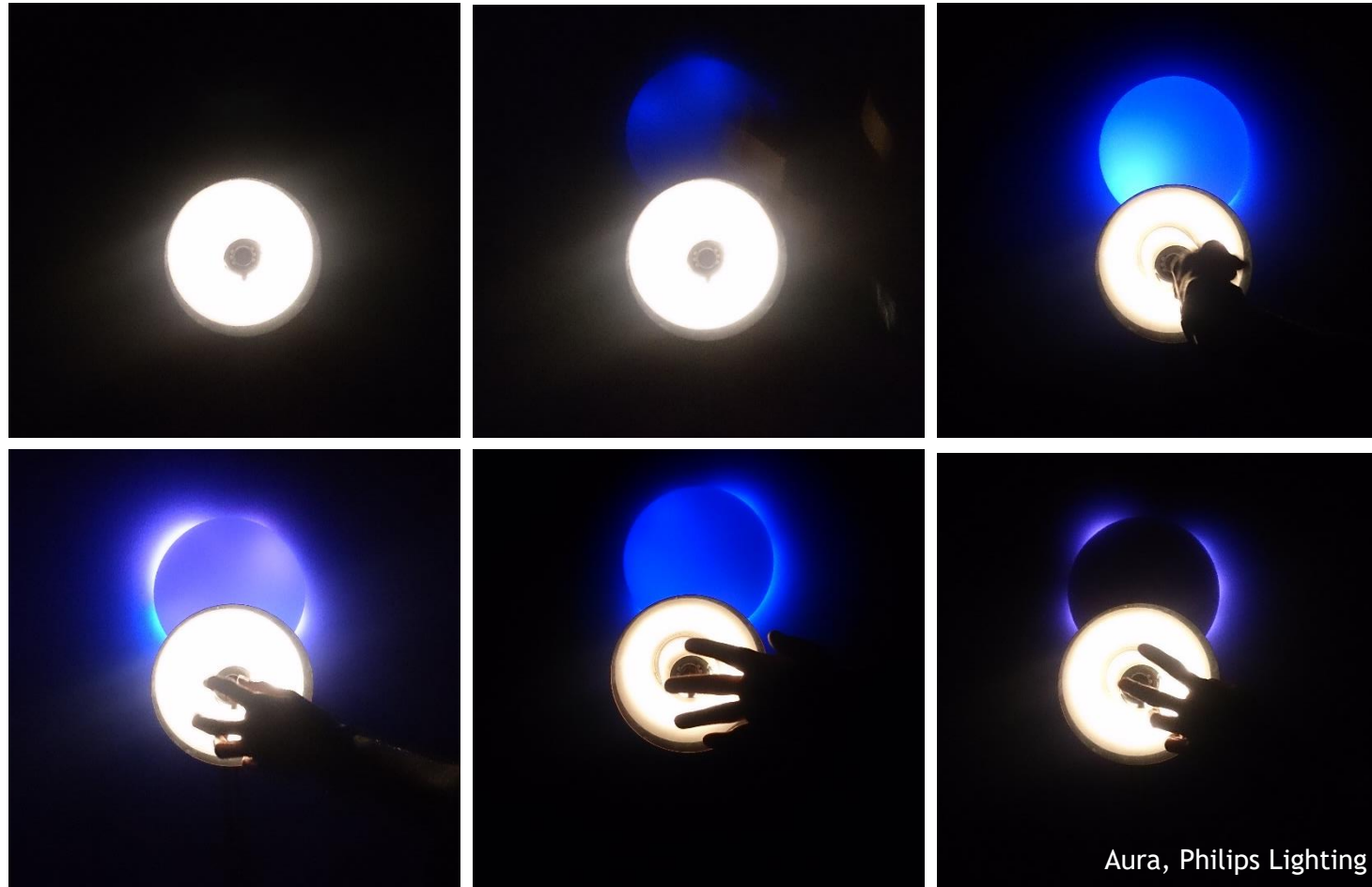
# DYNAMIC LIGHT- WORKPACKAGE 1

## DYNAMISCHES LICHT PLANEN



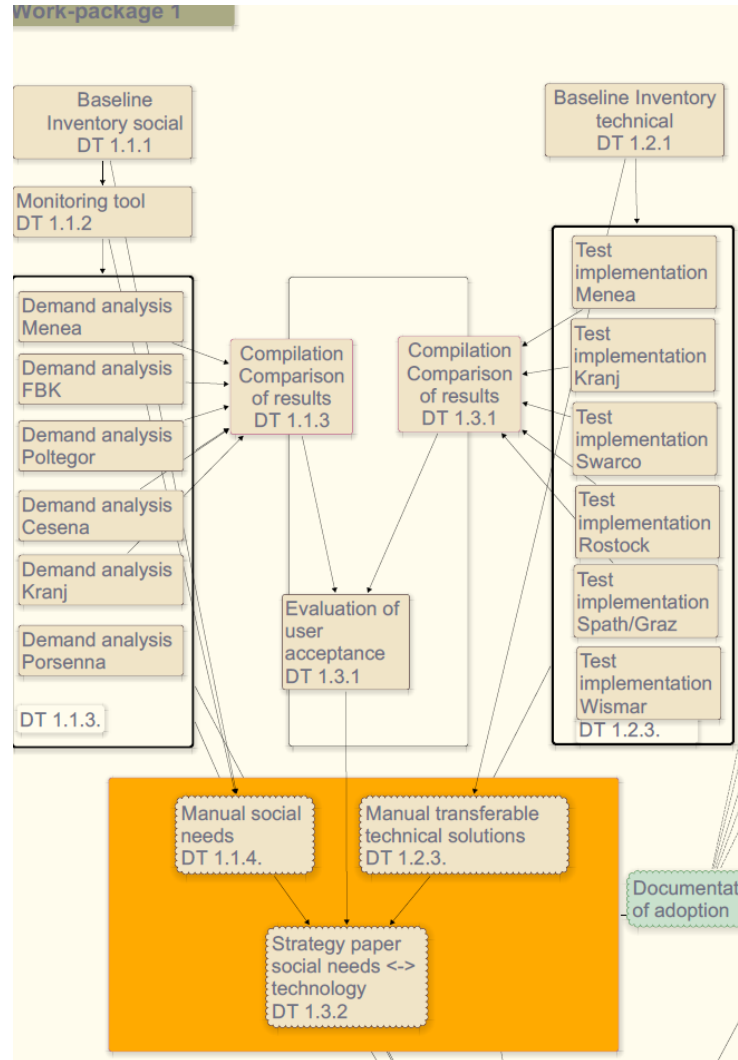
- Monitoring Tool
- Demand Analysis
- Manual Social Needs
- Manual transferable technical Solutions
- Design Strategy





# DYNAMIC LIGHT- WORKPACKAGE 1

## HOW TO DESIGN DYNAMIC LIGHT?

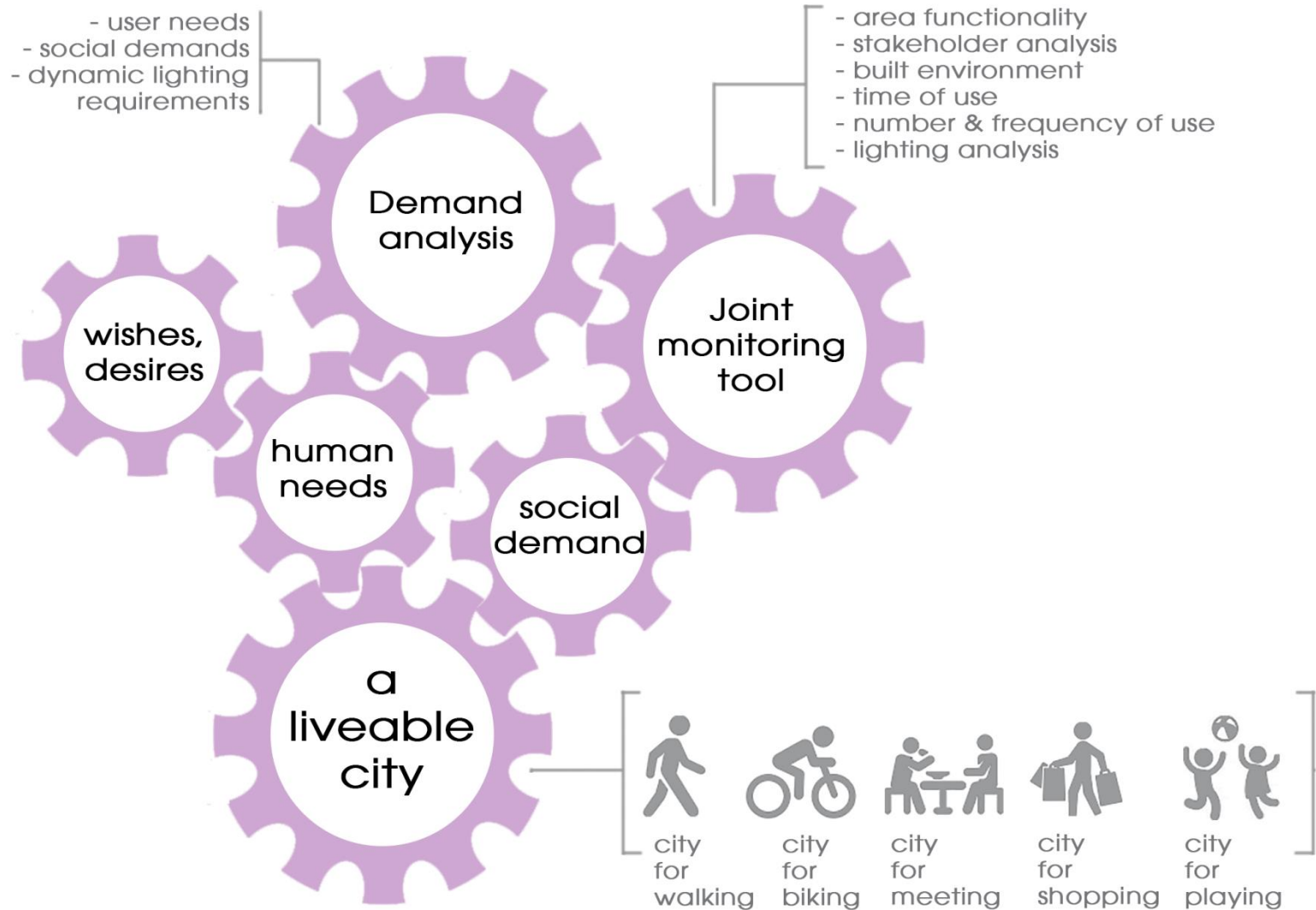


## Design

- Monitoring Tool
- Demand Analysis
  
- Manual Social Needs
- Manual transferable technical Solutions
  
- Design Strategy

# DYNAMIC LIGHT – WORK-PACKAGE 1

## DYNAMISCHES LICHT PLANEN



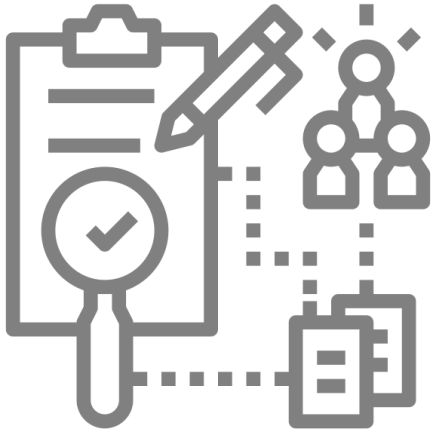
Seminar zur Straßen- und Freizebeleuchtung ROSTOCK 27. 01. 2017



# DYNAMIC LIGHT – WORK-PACKAGE 1

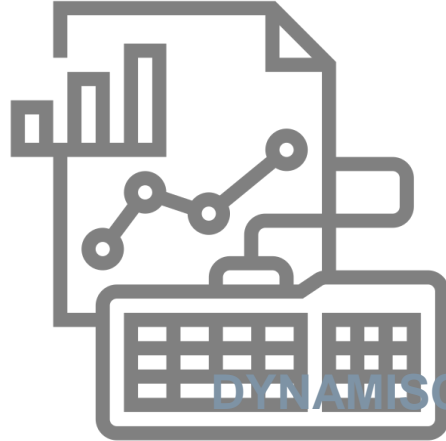
## DYNAMISCHES LICHT PLANEN

### Joint Monitoring Tool



Created by Becris  
from Noun Project

### Demand Analysis



Created by Eucalyp  
from Noun Project

### Manual Social needs



Created by Marie Van den Broeck  
from Noun Project

### Manual Technical solutions



Created by ATOM  
from Noun Project

DYNAMISCHES LICHT PLANEN



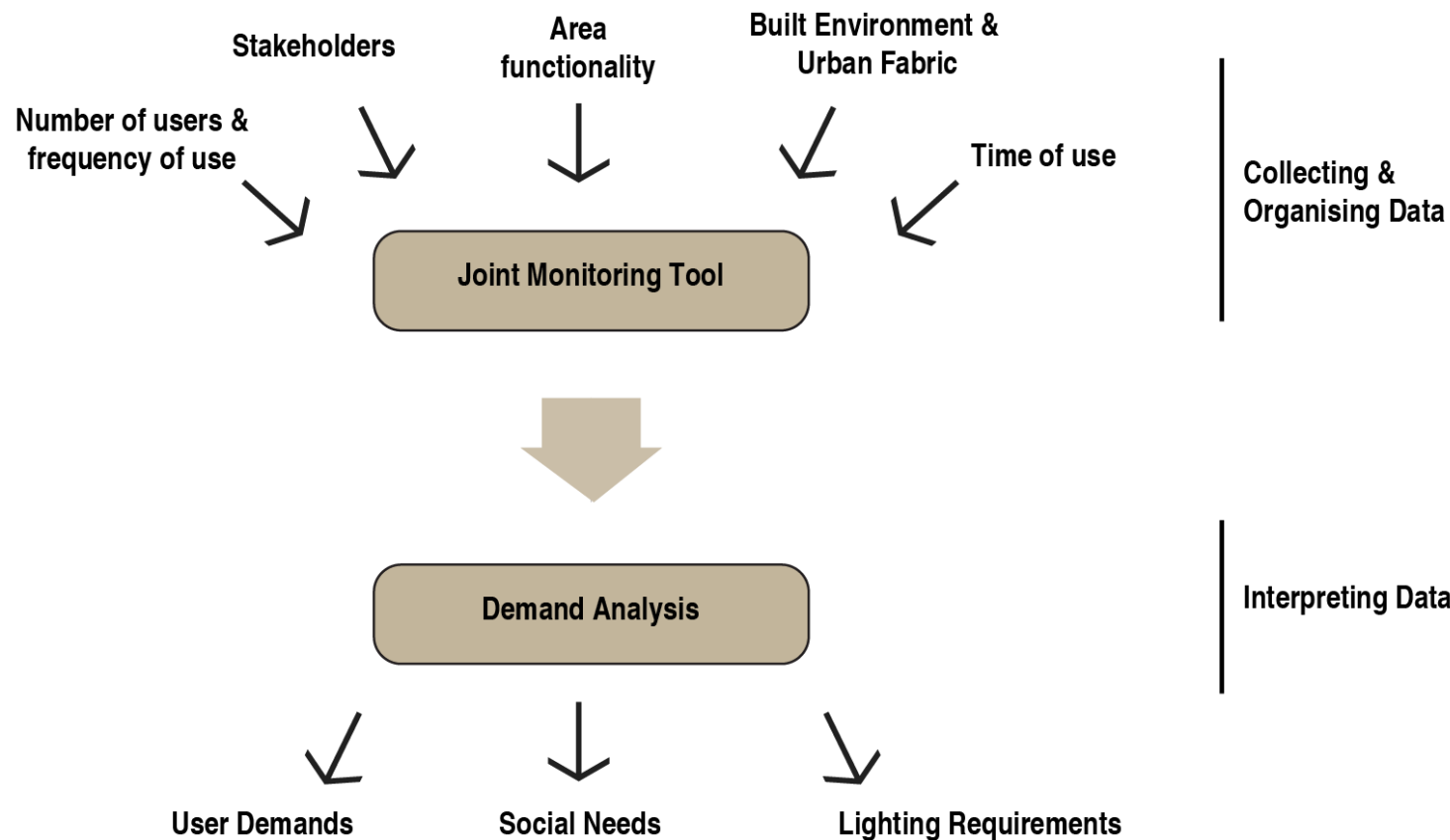
Created by Smalllike  
from Noun Project

## Dynamic Lighting Design Strategy



# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL & DEMAND ANALYSIS



Das Hauptziel der Entwicklung dieser Werkzeuge besteht darin, die Möglichkeiten dynamischer Beleuchtung zu erkennen und zu verstehen, ob eine dynamische Beleuchtungsstrategie für die jeweilige Situation geeignet ist.

Diese Tools untersuchen das Potenzial für dynamisches Licht basierend auf den Anforderungen der Benutzer und deren sozialen Bedürfnissen.



The joint monitoring tool is envisaged as an instrument that can be used to conduct a “demand analysis”; through which the user’s demand for dynamic lighting according to their social needs can be established. This tool establishes the parameters and framework for assessing user’s demand for dynamic lighting based on their social needs.

- AREA FUNCTIONALITY**
- STAKEHOLDERS/ USERS**
- BUILT ENVIRONMENT AND URBAN FABRIC**
- TIME OF USE**
- NUMBER OF USERS AND FREQUENCY OF USE**
- LIGHTING ANALYSIS AND CONDITIONS SURVEY**



# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: AREA FUNCTIONALITY



Cities for walking



Cities for cycling



Cities for meeting



Cities for shopping



Cities for playing



Cities for movement

Each activity has its own particular lighting requirement and demand. Walking, for example, requires good orientation and way finding, while on the other hand shopping and meeting needs good colour rendering, inviting atmosphere amongst other requirements.

An understanding of the different activities and uses in a space combined with the zoning will help in establishing:

- Differentiated lighting requirements for various “activity zones” in an urban space.
- Grouping of “activity zones” with similar requirements for dynamic lighting.
- Identifying the dynamic lighting potential/ appropriateness in “activity zones”

# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: STAKEHOLDER ANALYSIS

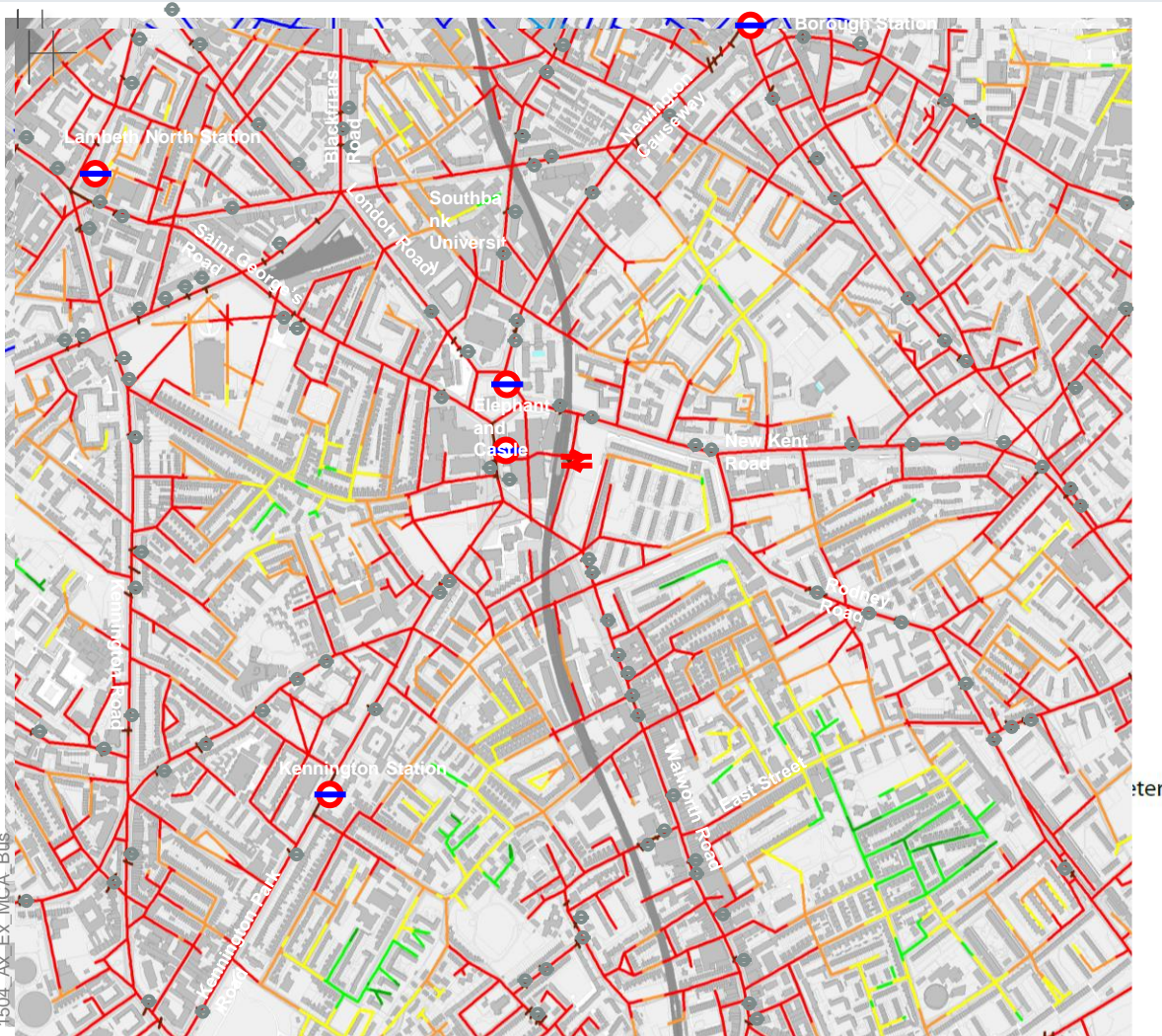


The primary objective of any lighting strategy is to fulfil the requirements of all the users. Through the integration of stakeholders into the lighting plan, it can respond better to the context and users of the space. This clear understanding of the different users will help in the following:

- Tailor-made lighting requirements for different user groups to suit their specific needs.
- Establishing the dynamic lighting requirements in response to the interactions and overlapping of different stakeholder demands and expectation.
- Possible combination of lighting requirements for user groups with similar needs.

# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: BUILT ENVIRONMENT



1504\_Ax-Ex\_MCA\_Bus  
1504\_Ax-Ex\_MCA\_Bus

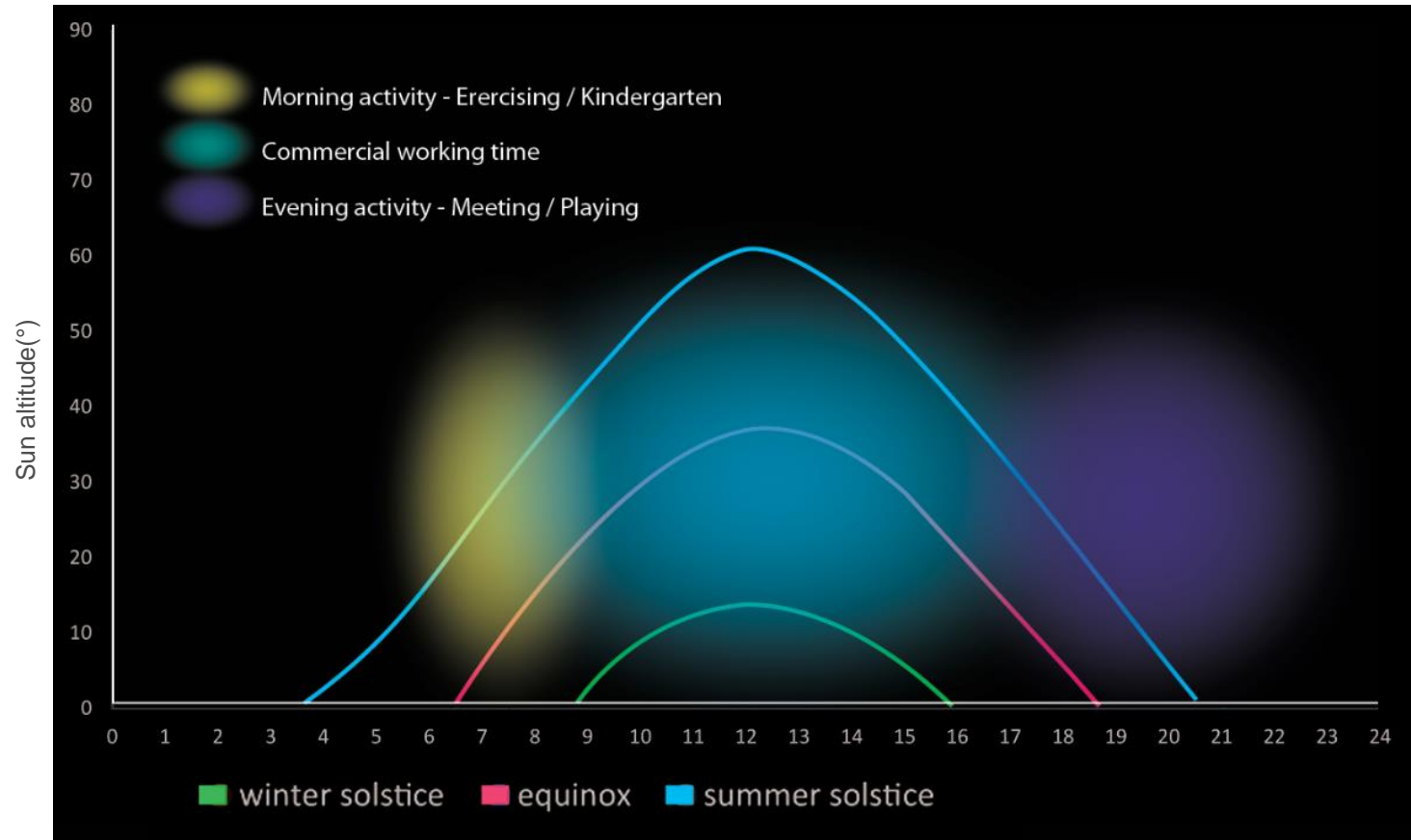
Tim Stonor, UCL

Light is reflected by the architecture and the built environment. Light makes the urban fabric, open spaces, walkways, squares etc. visible. This section explores the built environment and urban fabric where the activities and functions take place by the different users.

- Clear understanding of the changing lighting requirements in a space, to develop dynamic lighting strategies in response.
- Understanding prominent landmarks, features or spaces to develop an appropriate dynamic lighting strategy.

# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: TIME OF USE

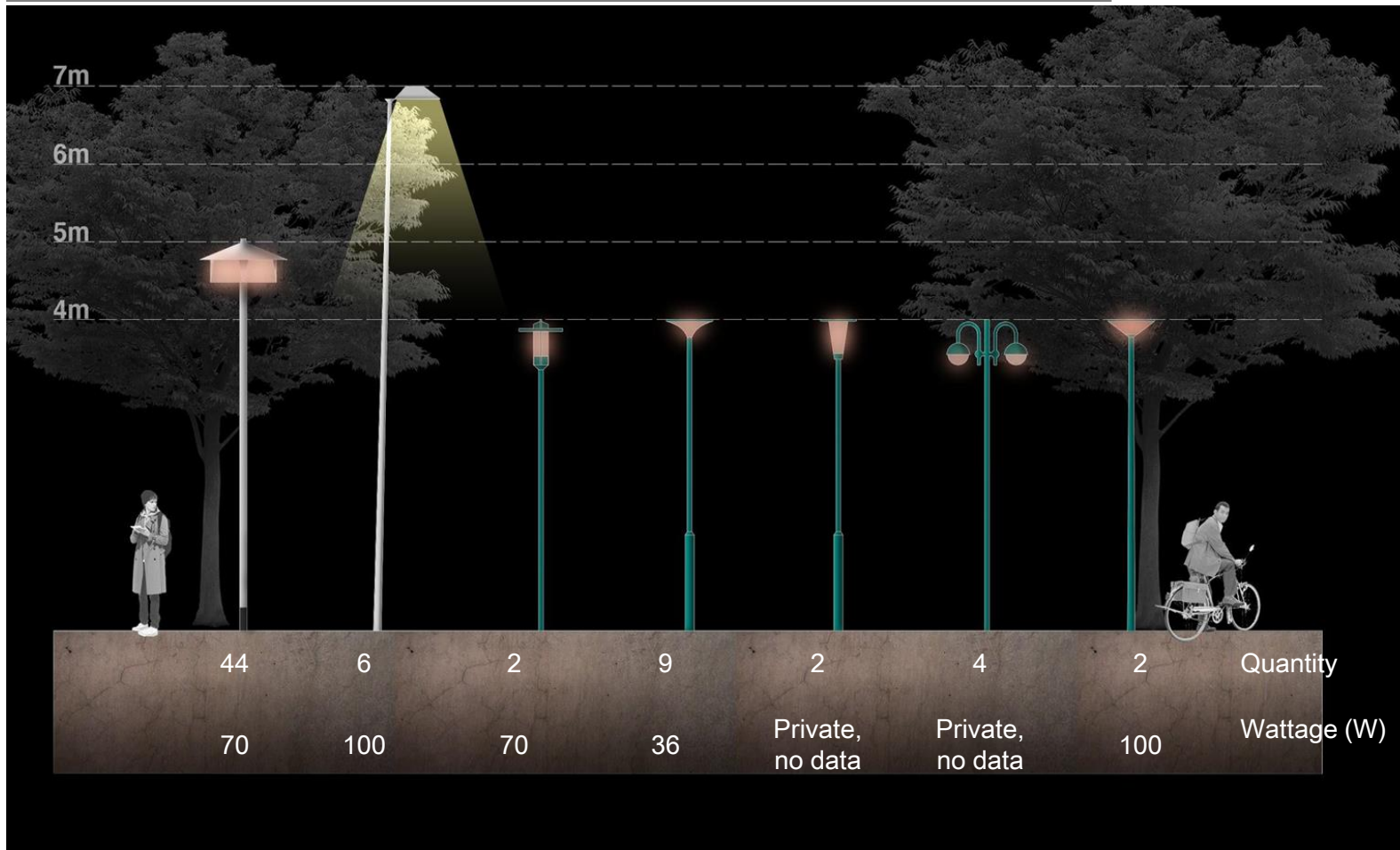


The biggest potential for dynamic light is to understand that during the dark hours of a day the function of the space and the stakeholders are very different. Time of use encompasses not only time of the dark hours but also time of the week, month, year, seasonal variations, weather variations etc.

- A distinct awareness of the changing lighting requirements in a space.
- Suitable dynamic lighting strategies in response to these changing requirements.

# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: LIGHTING ANALYSIS SURVEY

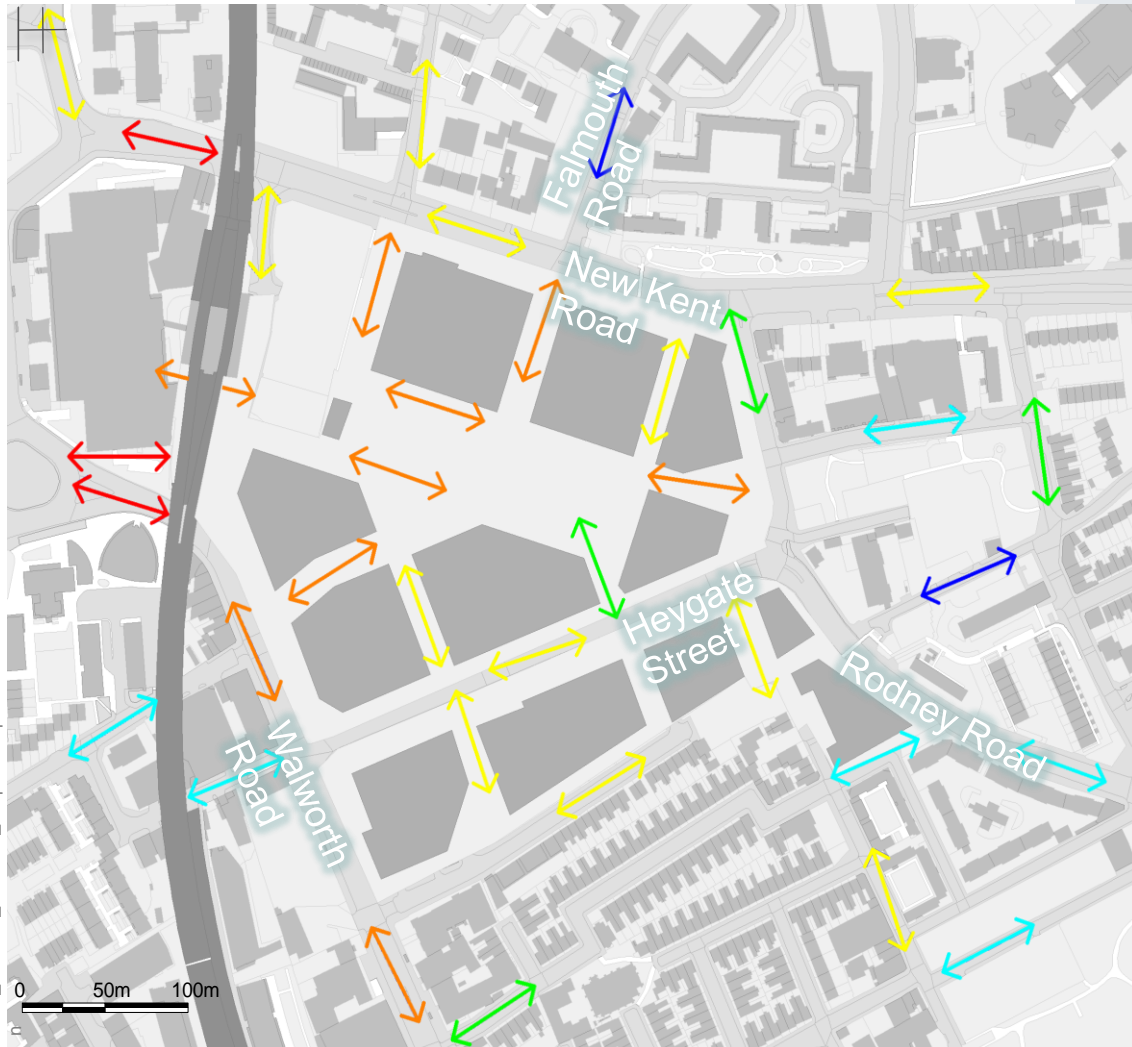


Last but not the least it is very important to understand the existing lighting conditions. Does the existing solutions serve the various functions, stakeholders, urban fabric etc. Does it respond to the changing requirements.

- Creation of a public lighting scheme that truly serves its purpose.
- Studying the impact and acceptance of dynamic lighting strategies.

# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: NUMBER & FREQUENCY OF USE



Tim Stonor, UCL

All the people do not use all the public spaces all the time, users and frequency of use also changes as per the changing activities, uses and time in an urban space.

- Use of presence/ absence sensors, time switches, CCTV for dynamic lighting control.
- Encouraging or discouraging certain social behaviour through dynamic lighting control. Like encouraging pedestrian/ cycling, traffic calming, social interactions etc.



# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: EXAMPLES



- In order to test the robustness of the Joint monitoring tool and Demand Analysis, we provided our students with these tools as part of their Design project.
- The students were given a typical urban situation near Wismar and were asked to develop a public lighting design concept for that area.
- The students utilised the tools in the field and provided us with valuable feedback.
- Using these experiences we were able to further refine and improve these tools.



# DYNAMIC LIGHT – WORK-PACKAGE 1

## JOINT MONITORING TOOL: EXAMPLES

Sunday, December 22 (16:30 - 18:00)					
		Users per group			
		single	couple	group +3	
Uses/ Activities	walking	elderly	X	X	X
		children			X
		office			
	staying	young adults			X
		office workers			
		shop owners			
	meeting	restaurant/ café owners	X	X	X
	play/ fun	parks/playgr ounds		X	X
	safe movement	pathways	X	X	X
	cycling		X	X	X
entertainment			X	X	

Time of day		Time of Week/ Month		Time of year/ Season	
early morning	<input type="checkbox"/>	weekdays	<input type="checkbox"/>	spring	<input type="checkbox"/>
early evening	<input type="checkbox"/>	weekend	<input type="checkbox"/>	summer	<input type="checkbox"/>
late evening	<input type="checkbox"/>	month ends	<input type="checkbox"/>	autumn	<input type="checkbox"/>
late night	<input type="checkbox"/>		<input type="checkbox"/>	winter	<input type="checkbox"/>
others	<input type="checkbox"/>	others	<input type="checkbox"/>	others	<input type="checkbox"/>
Weather		Festivals			
summer	<input type="checkbox"/>	national/ regional	<input type="checkbox"/>		
rainy	<input type="checkbox"/>	religious	<input type="checkbox"/>		
snow	<input type="checkbox"/>	soccial	<input type="checkbox"/>		
others	<input type="checkbox"/>	others	<input type="checkbox"/>		

Flexible and easily modified tables and checklists were created, so as to allow them to be adapted to any project or situation.

These checklists can be used by professionals, municipalities or ordinary citizens alike and are designed to provide clear information.

Further, the checklists can be supplemented with additional information where ever necessary.

	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	12am
Banks																			
Administration																			
City market																			
Shops																			
Café																			

# DYNAMIC LIGHT – WORK-PACKAGE 1

## DEMAND ANALYSIS

### Identification of problems



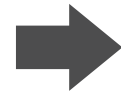
People cannot find their way



Frequent accidents



Fear of crime



### Specific Lighting Requirements



Identify critical pathways



Identify Conflict zones



Facial recognition



### Sufficient solution via dynamic lighting



Illuminating pathways



Higher & uniform illumination of conflict zones



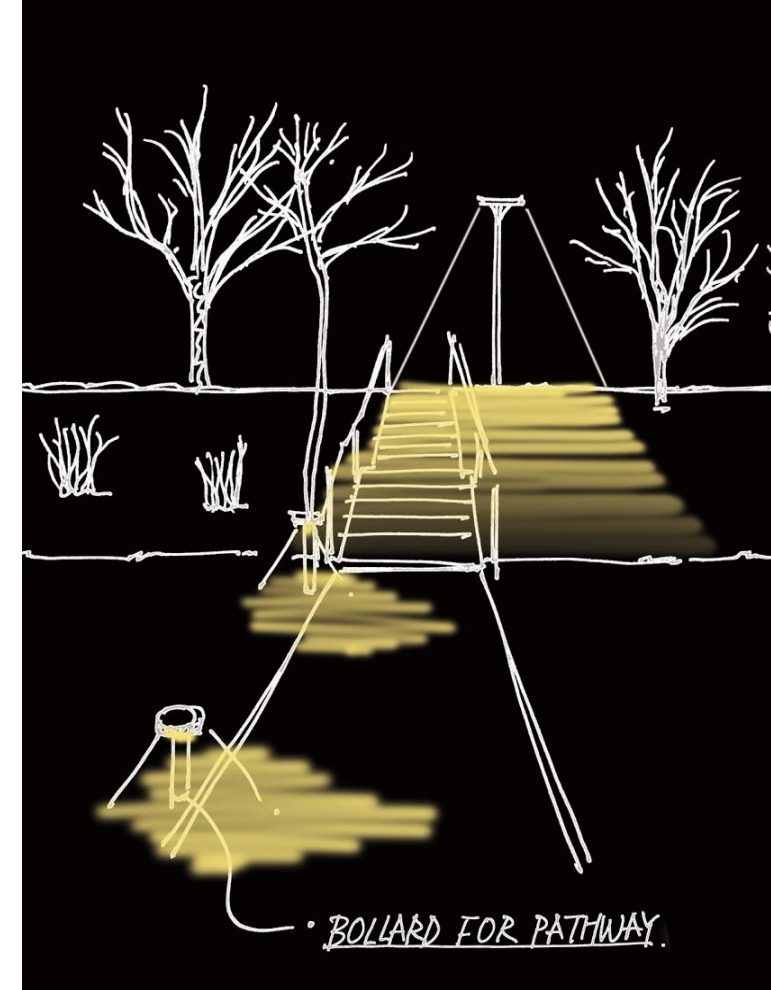
Semi-cylindrical illumination & colour rendering

# DYNAMIC LIGHT – WORK-PACKAGE 1

## DEMAND ANALYSIS

### Sufficient solution dynamic lighting

- Masts on both sides of the street.
- Illuminating pathways according to time and frequency of use
- Good colour rendering and better semi-cylindrical illumination



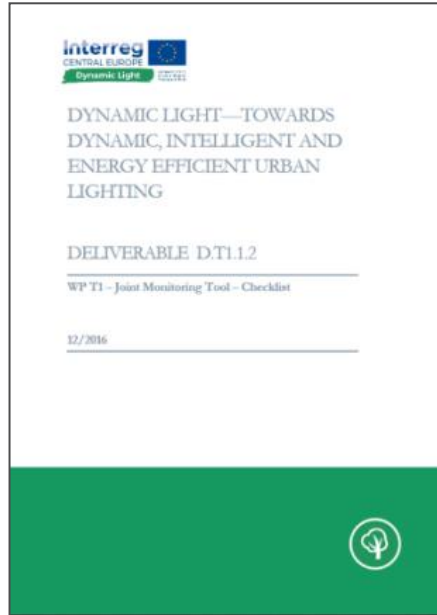
### *Dynamic Light is more complex than Static light*

- **FUNCTION:** What are the activities and uses in the space
- **STAKEHOLDERS/ USERS:** From whom and why is lighting needed?  
What are the expectations?  
What kind of light is appropriate?
- **URBAN FABRIC:** Where is the activity taking place?  
What are the inter-relationship between spaces?
- **TIME OF USE:** When is the activity taking place?
- **NUMBER & FREQUENCY:** How many users and for how long is the space used?

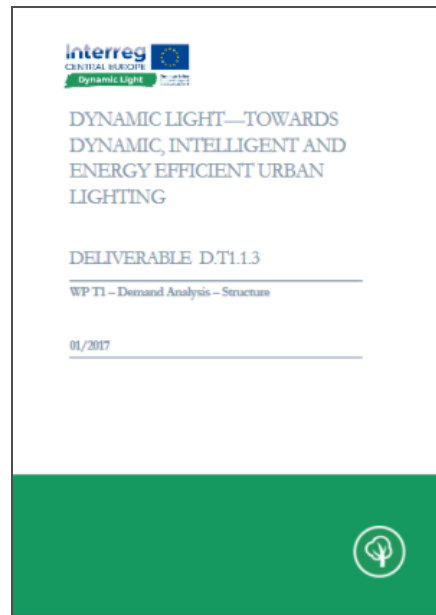


# DYNAMIC LIGHT – WORK-PACKAGE 1

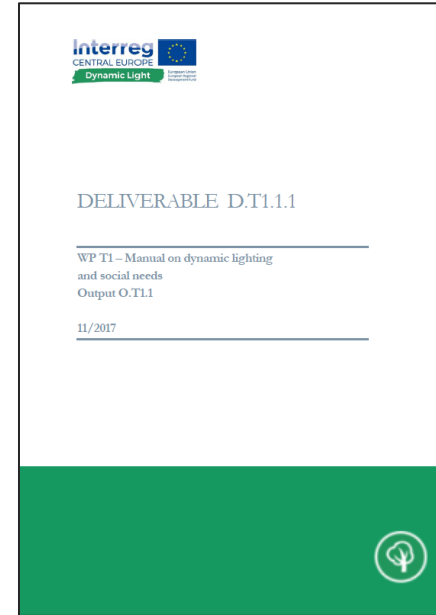
## HOW TO DESIGN DYNAMIC LIGHT?



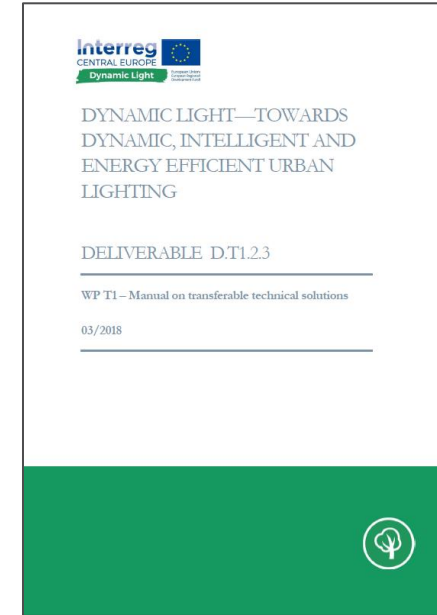
**Joint Monitoring  
Tool**



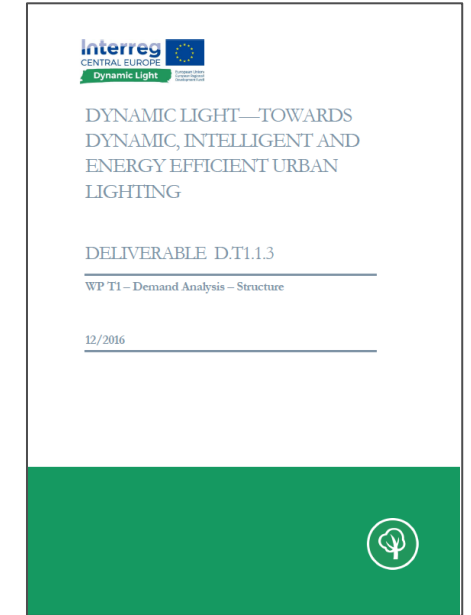
**Demand Analysis**



**Manual Social  
needs**



**Manual Technical  
solutions**



**Dynamic Lighting  
Design Strategy**



# HOW TO DESIGN DYNAMIC LIGHT?

Places des Fetes, Paris  
*Configuring light workshop Oktober 2017*

Method: Pedestrians survey, observation, background information location

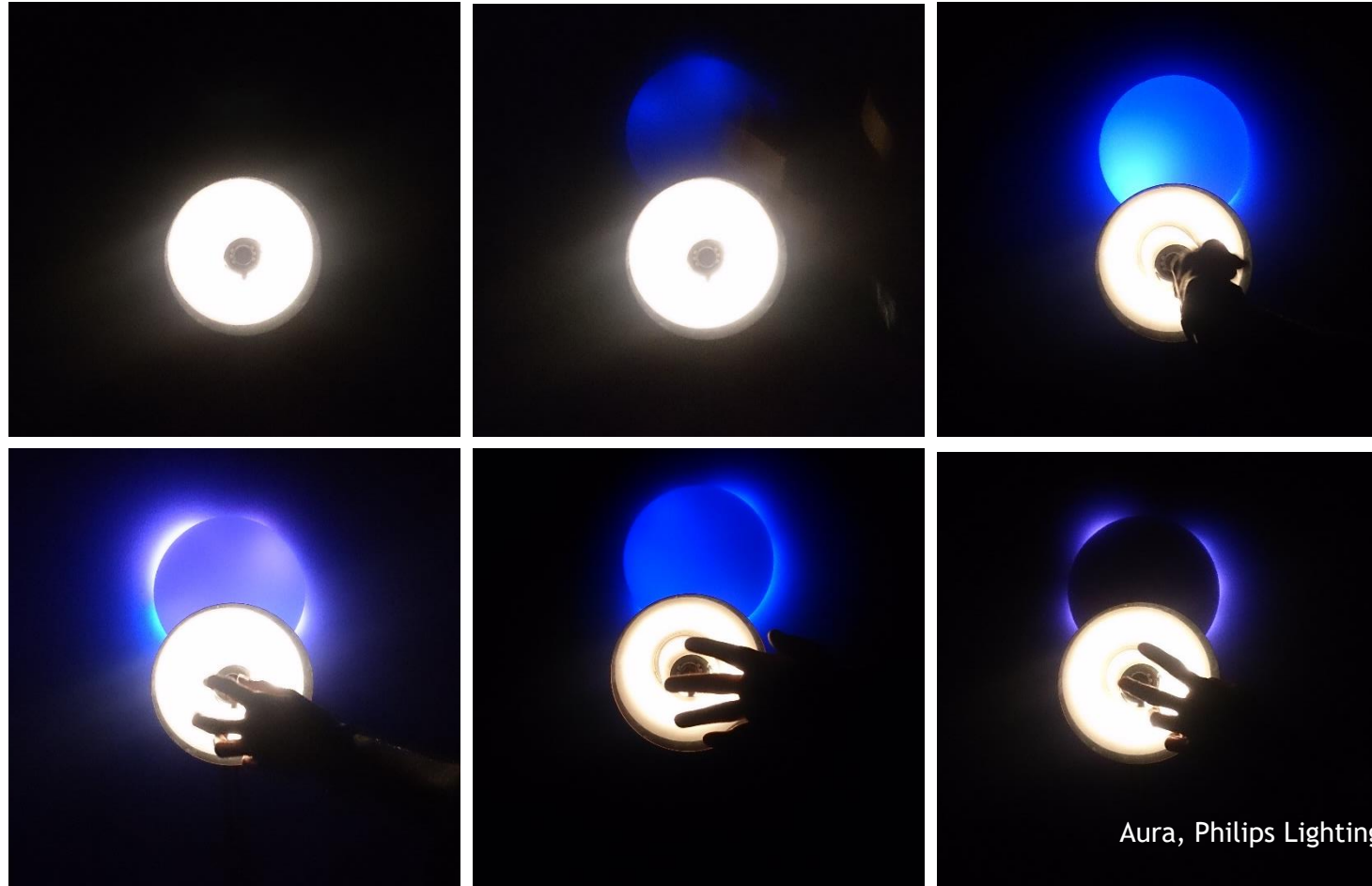
Day-to-day changing functions and user groups with different user needs?

Recovery, play, communication,

Transfer, purchasing, orientation,  
Public <> intimacy,  
festivities, culture ...

timed light scenes in different areas





# KLOSTER BAD DOBERAN



Bad Doberan Monastery

LED  
Light in Public Space

South Baltic  
PROGRAMME



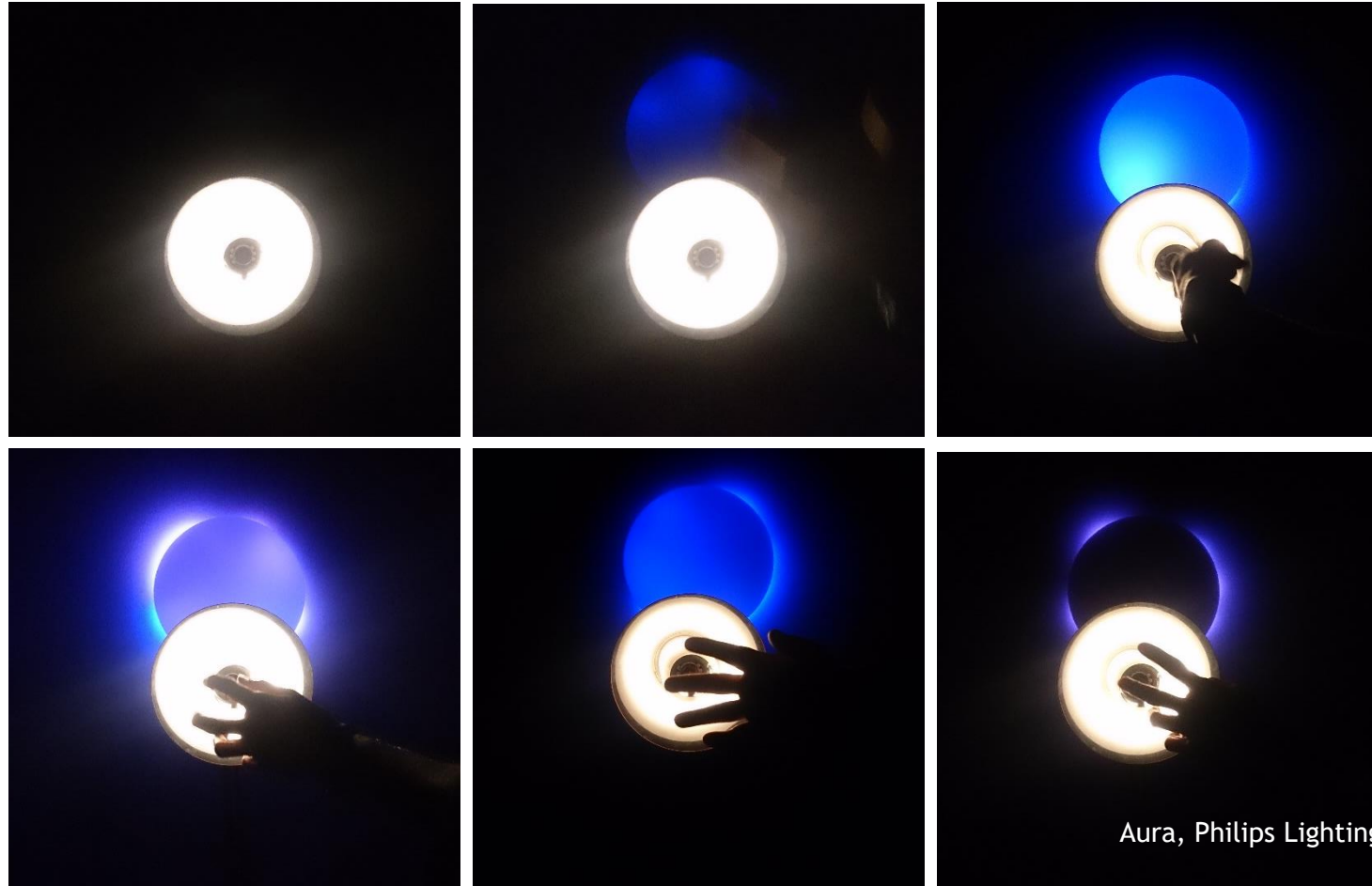


# HAUPTSTRASSE KÜNZELSAU



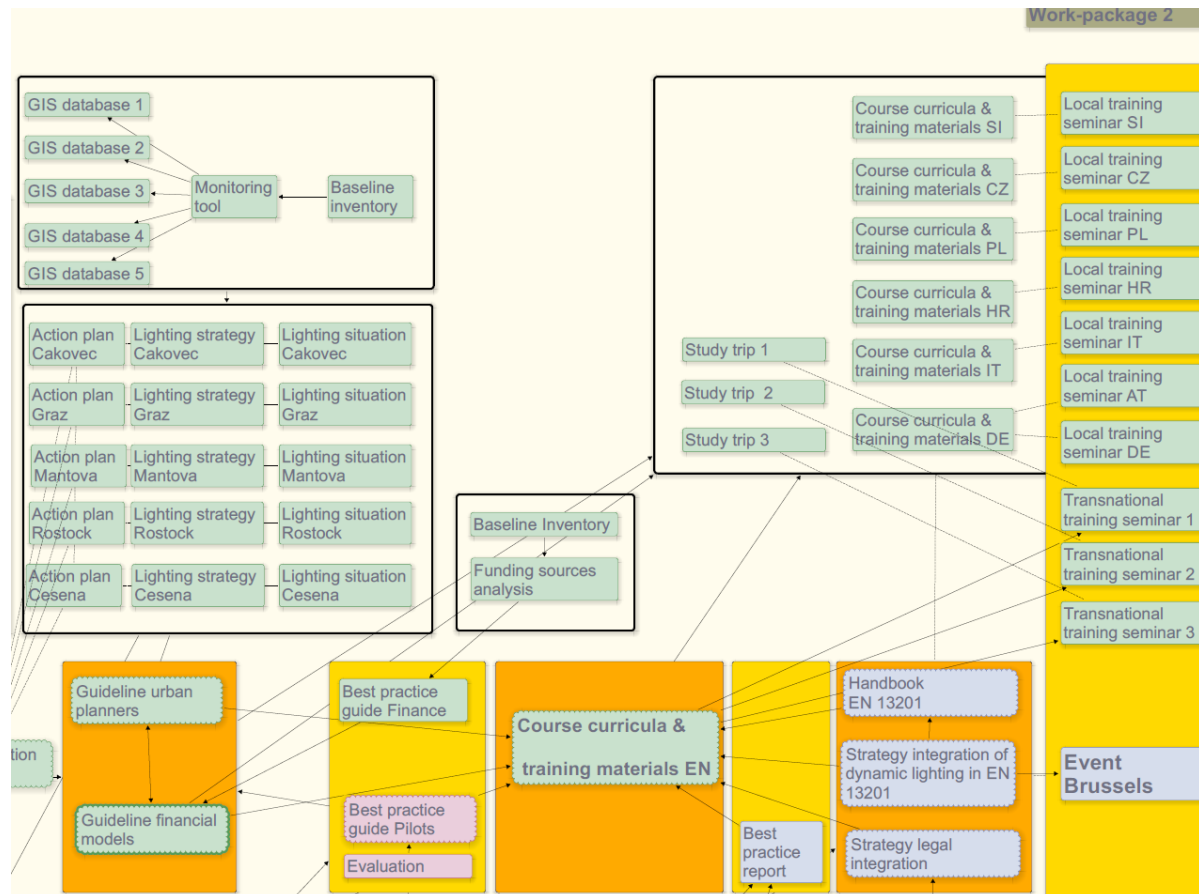
# SCHULHOF WISMAR





# DYNAMIC LIGHT- WORKPACKAGE 2

## Integrate dynamic light into the city!

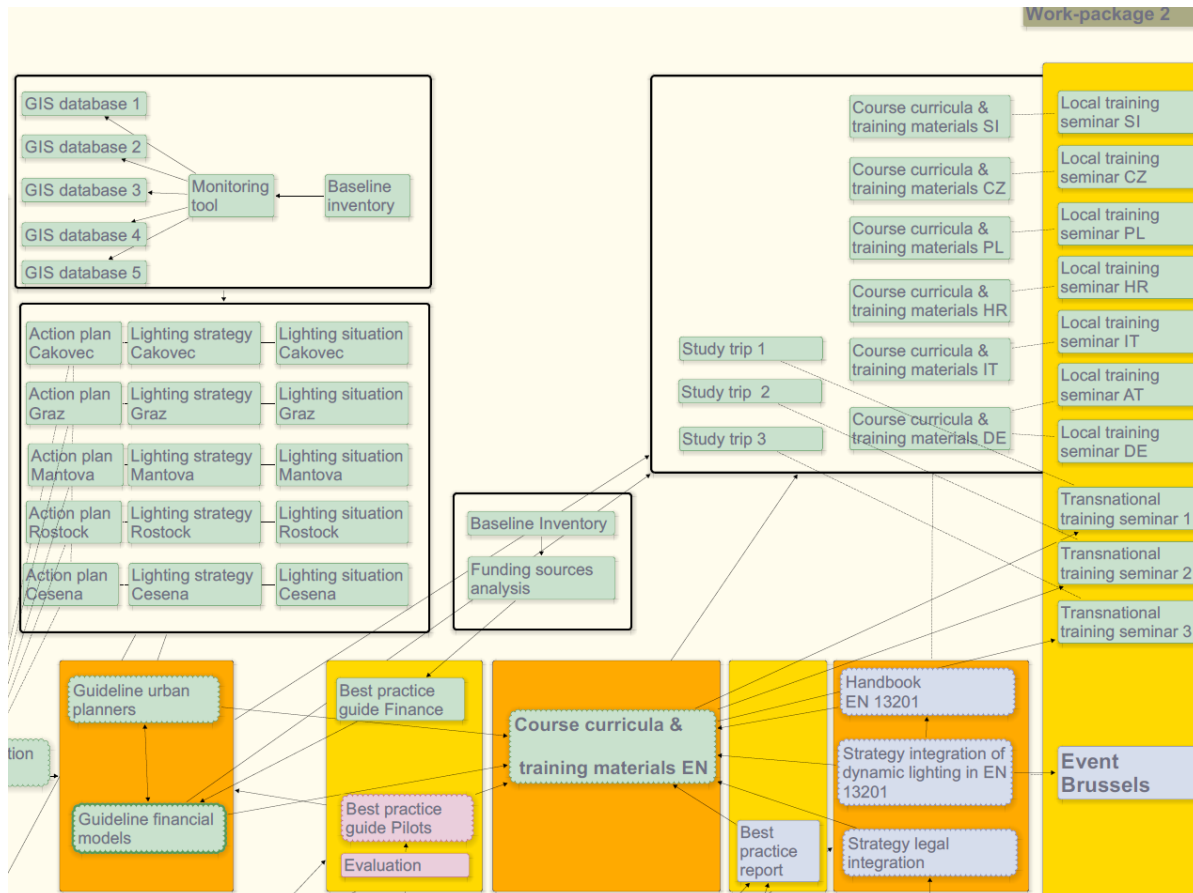


## The City

- GIS Data Base
- Actionplan
- Strategy
- Masterplan

# DYNAMIC LIGHT- WORKPACKAGE 2

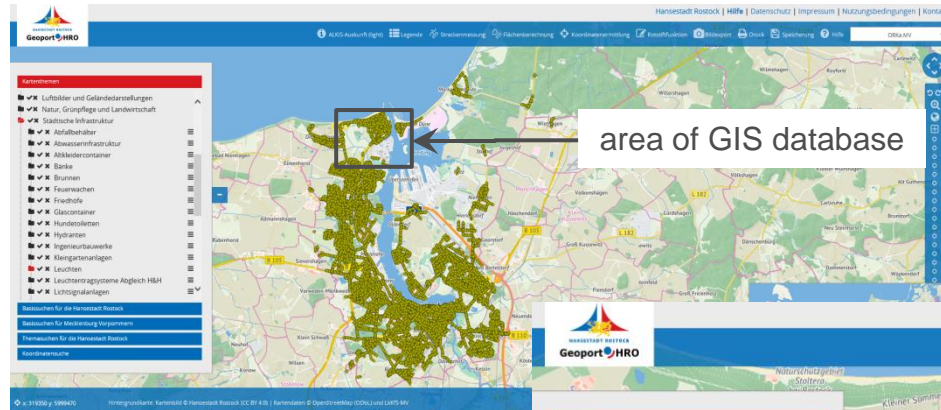
Dynamisches Licht in die Stadt integrieren!



- Actionplan
- Strategy
- Masterplan

# INTEGRATE DYNAMIC LIGHT INTO THE CITY!

## GIS-basierte Datenbanken

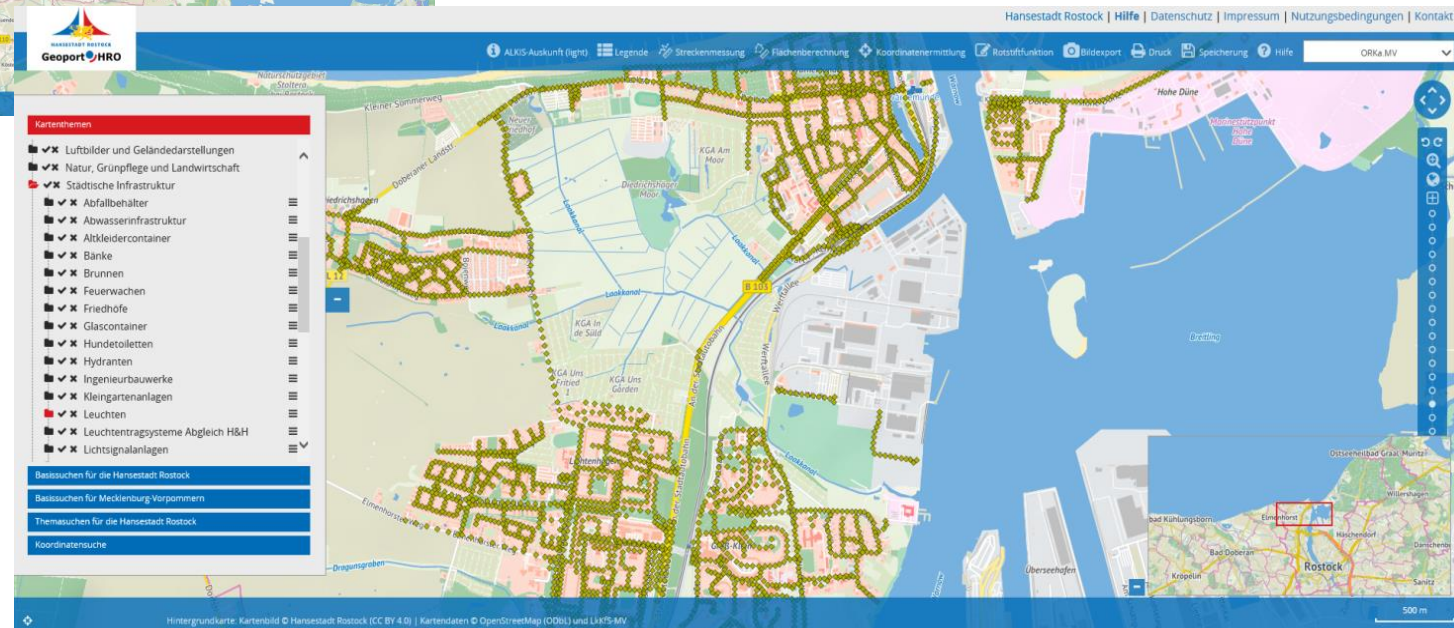


## Area of GIS database

- north-west of Rostock
- around the pilot area
- about 140 luminaires

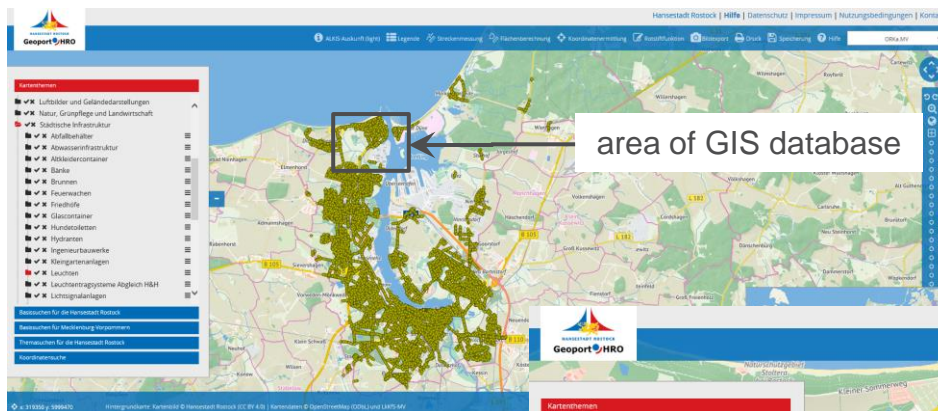
## Hanseatic City of Rostock

- about 22.100 luminaires owned bac HRO
- GIS database „sisnet“ owned and data maintained by SWRAG
- internal free database „Geoport.HRO“ is weekly updated by „sisnet“



# DYNAMISCHES LICHT IN DIE STADT INTEGRIEREN!

## GIS-basierte Datenbanken

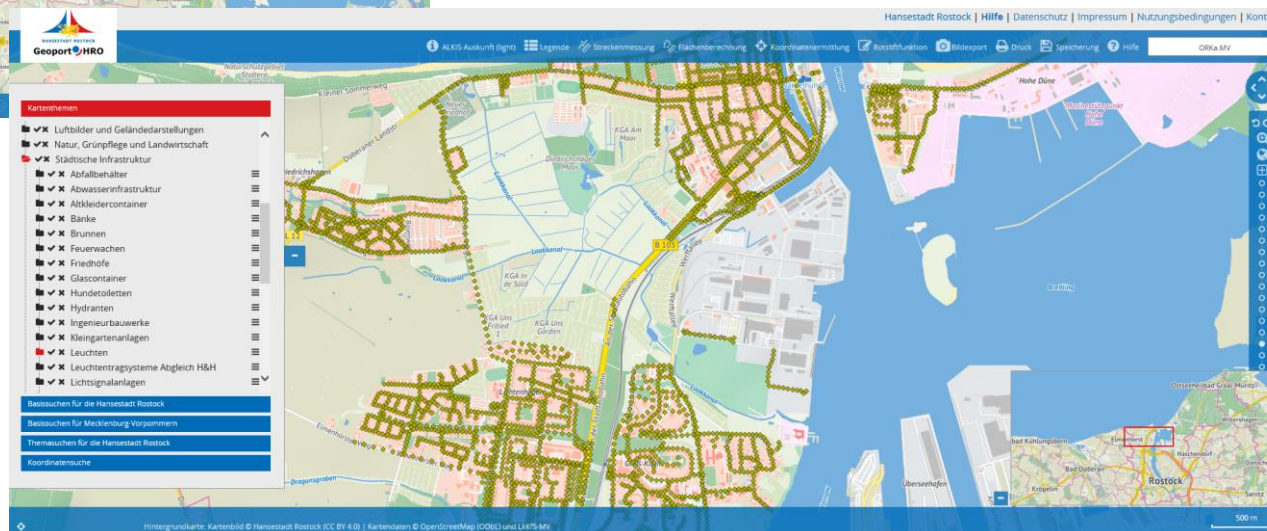


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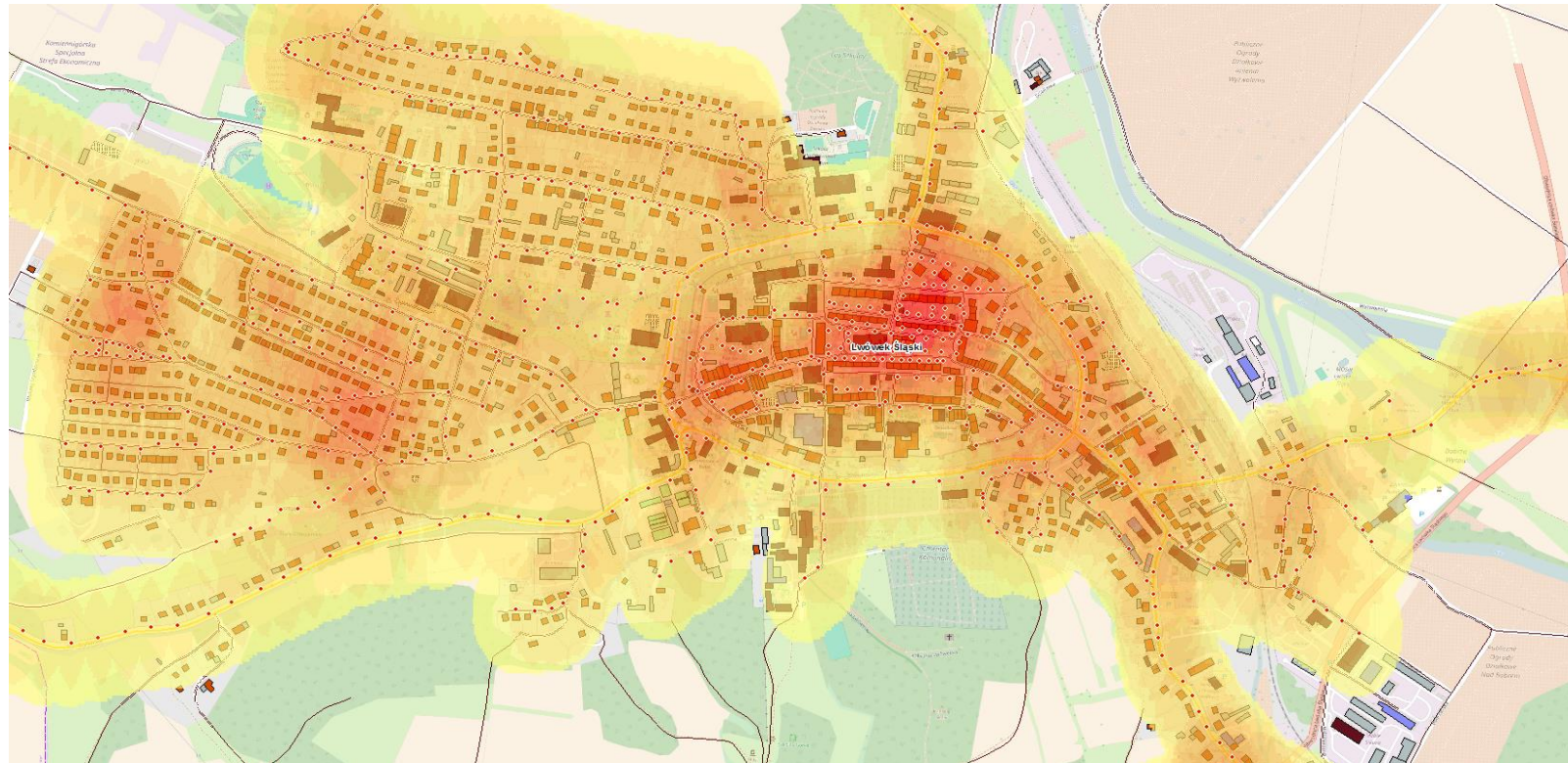
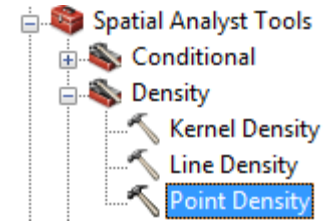


# DYNAMISCHES LICHT IN DIE STADT INTEGRIEREN!

## ANALYSIS AND FINDINGS

### Density Map :

1. What scale of analysis makes sense?



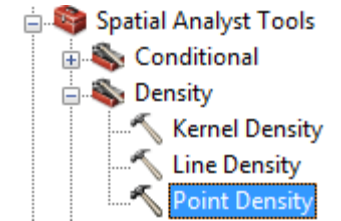
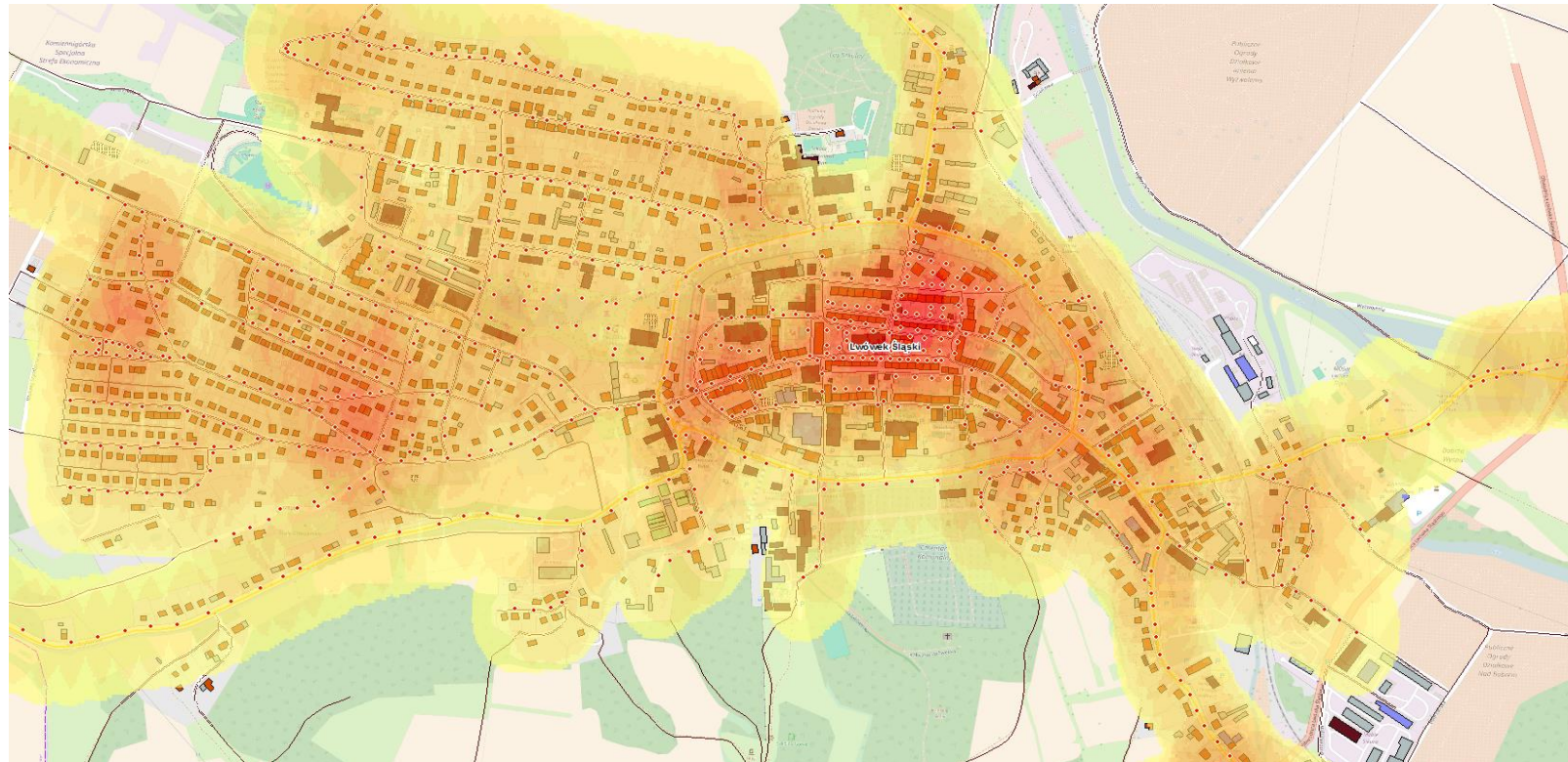


# INTEGRATE DYNAMIC LIGHT INTO THE CITY!

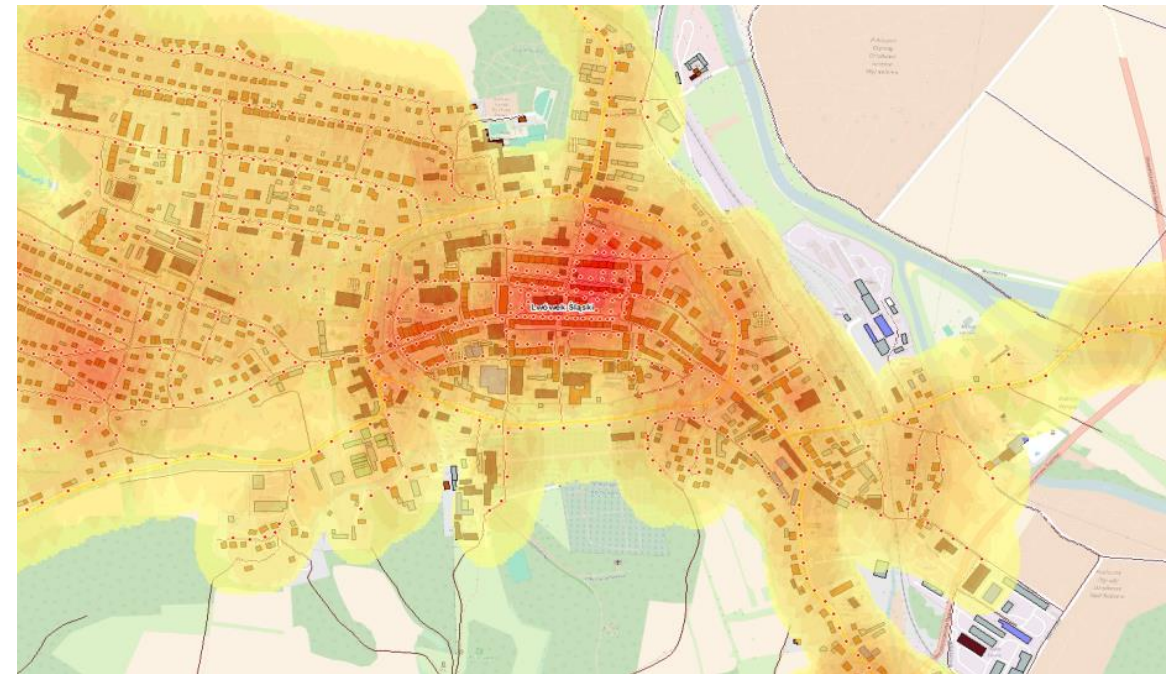
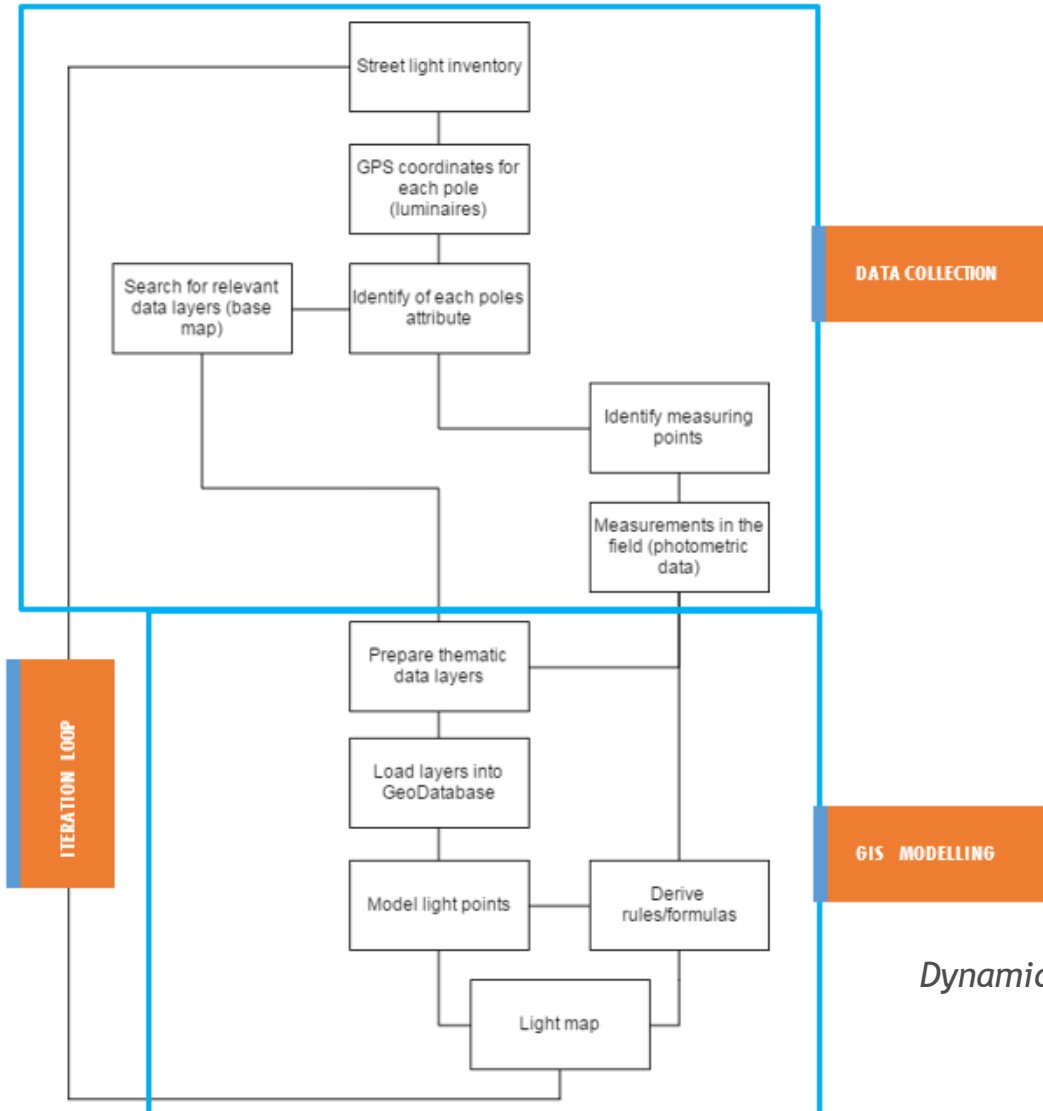
## ANALYSIS AND FINDINGS

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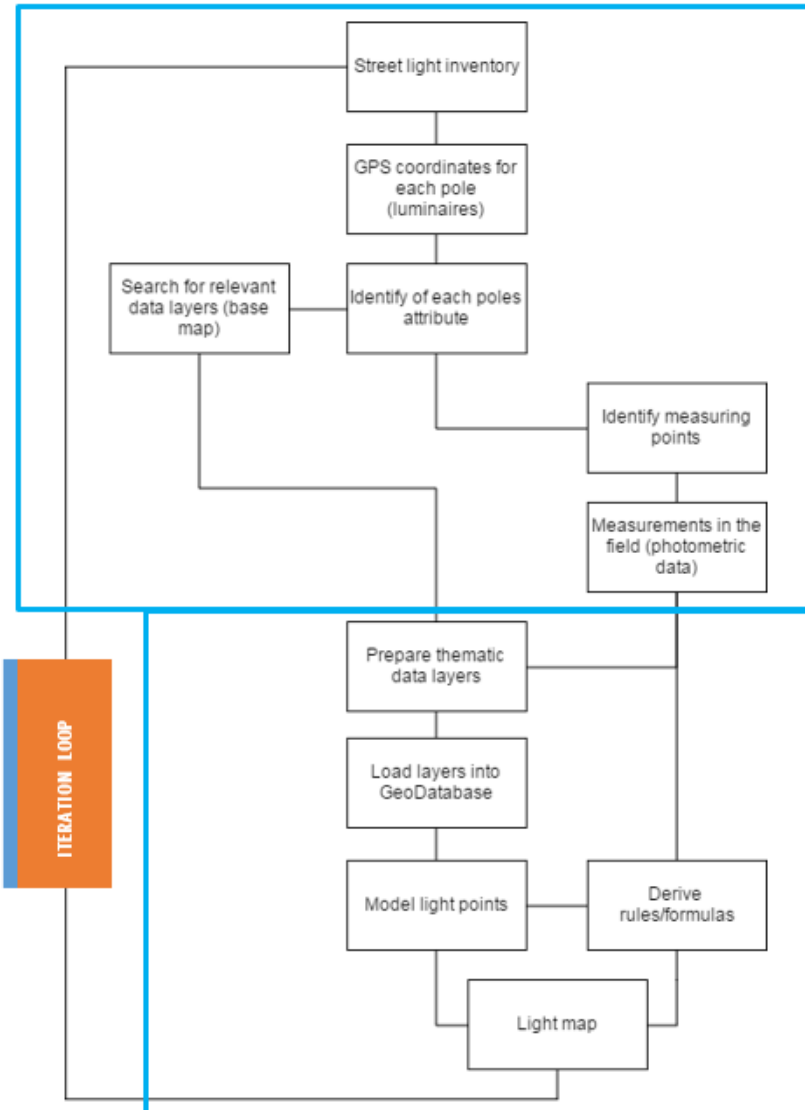
# INTEGRATE DYNAMIC LIGHT INTO THE CITY!



*Dynamic Light - WP2 - D.T2.1.2 - Joint monitoring tool*

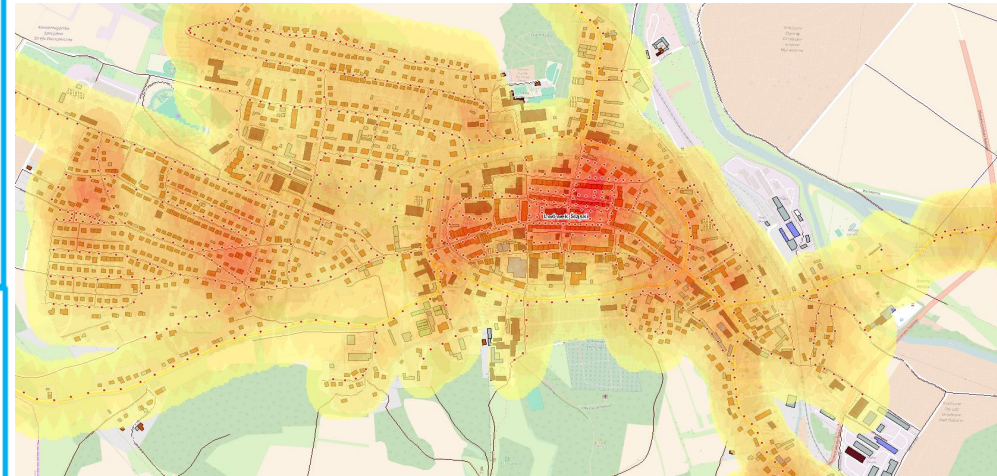


# DYNAMISCHES LICHT IN DIE STADT INTEGRIEREN



*PowerFolder >> Dynamic Light - WP2 -  
D.T2.1.2 - Joint monitoring tool*

**DATA COLLECTION**



**GIS MODELLING**



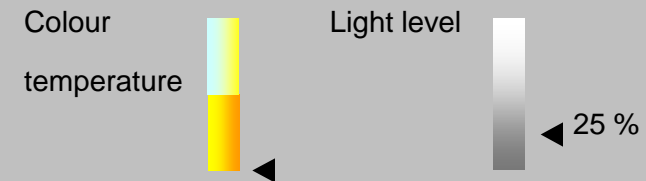
# DYNAMISCHES LICHT IN DIE STADT INTEGRIEREN



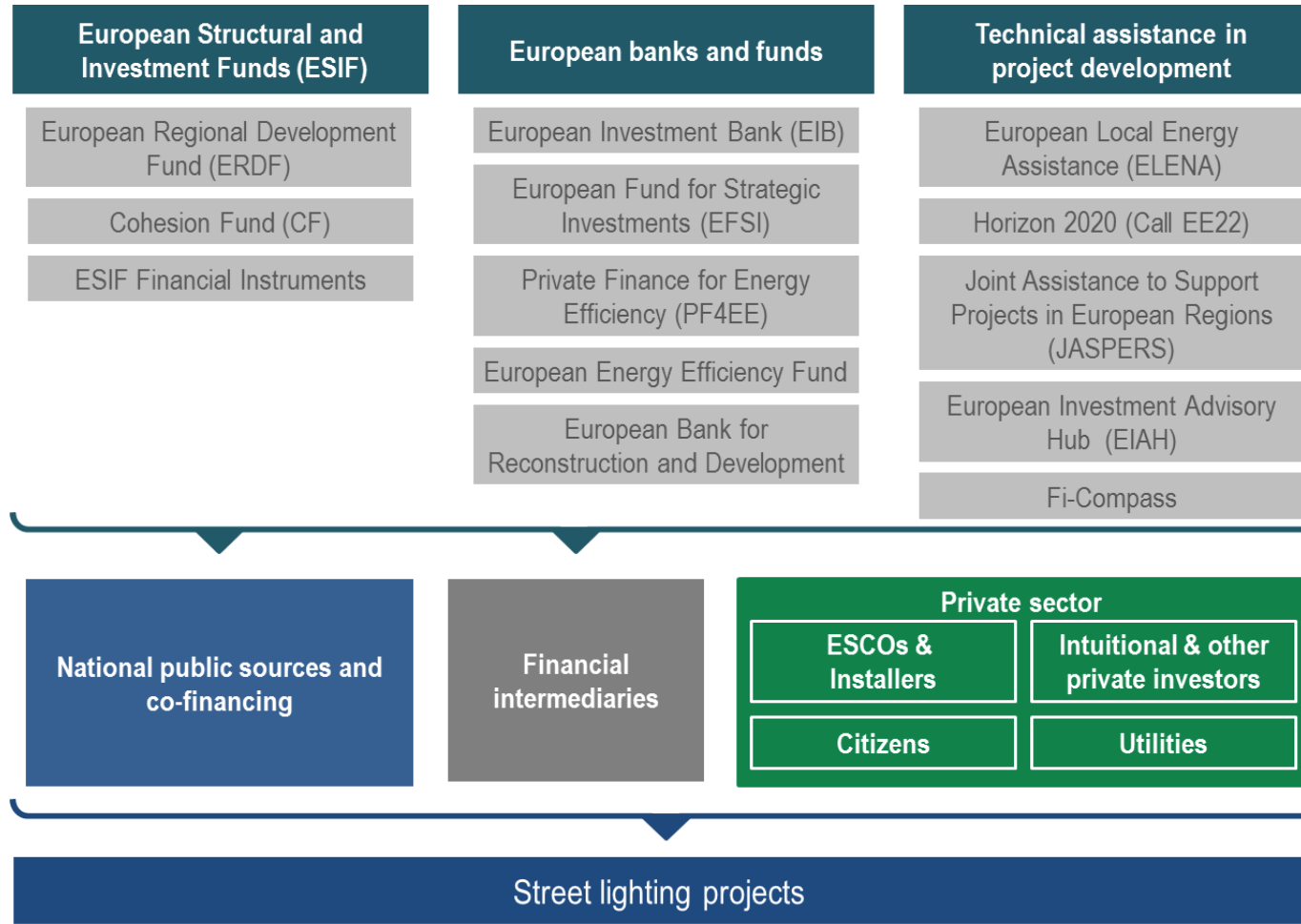
## Masterplan for Dynamic Lighting

In different streets there are different conditions identified, which are leading to variations of light in the fabric of the city during the night.

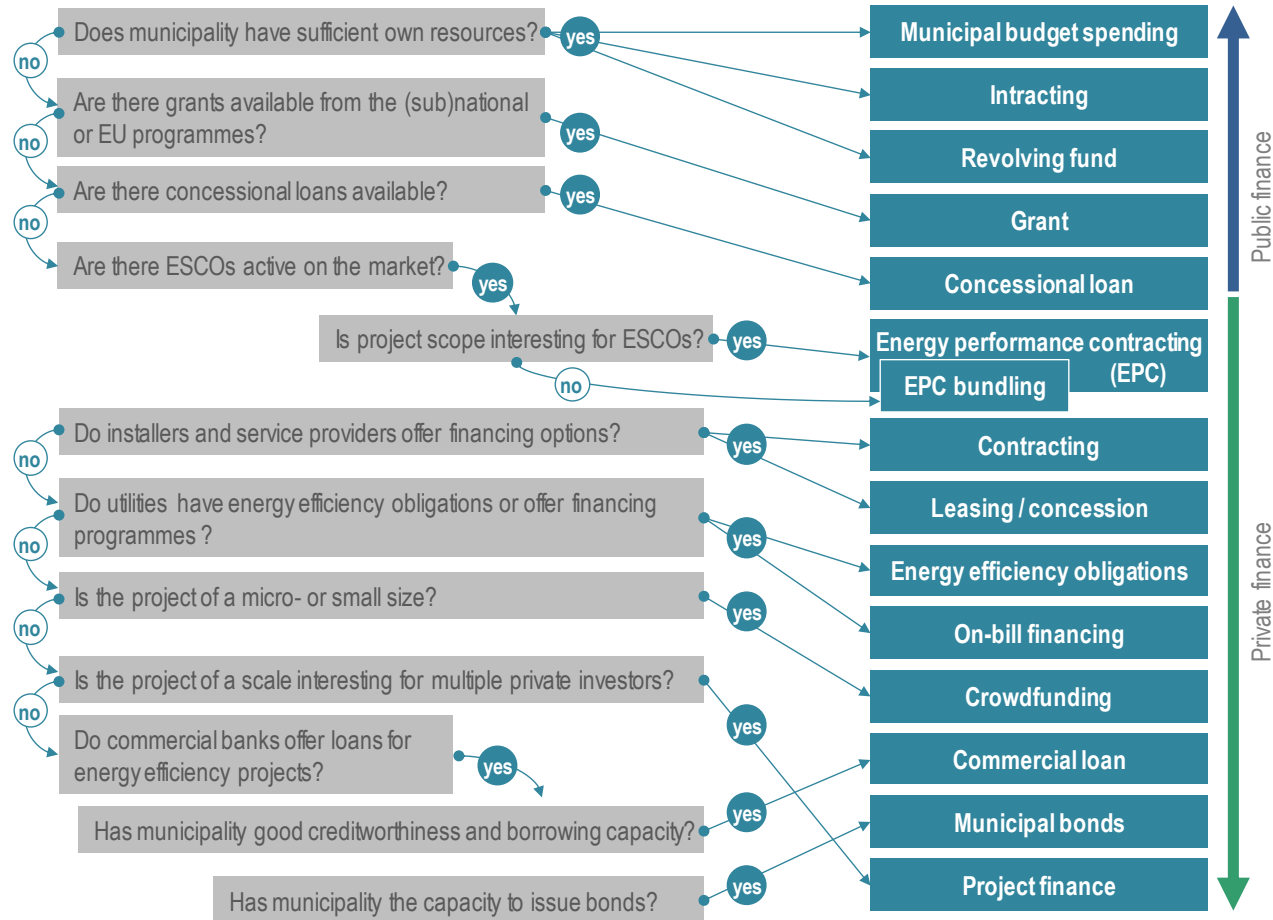
Here the proposal is a differentiation in colourtemperature and light level



# FUNDING SOURCES FOR ENERGY-EFFICIENT STREET LIGHTING



# DECISION-MAKING TREE FOR SELECTING A FINANCING MODEL



# INTEGRATE DYNAMIC LIGHT INTO THE CITY!



## Masterplan for Dynamic Lighting

In different streets there are different conditions identified, which are leading to variations of light in the fabric of the city during the night.

Here the proposal is a differentiation in colour temperature and light level.

Different szenarios for the light are needed!

Colour  
temperature

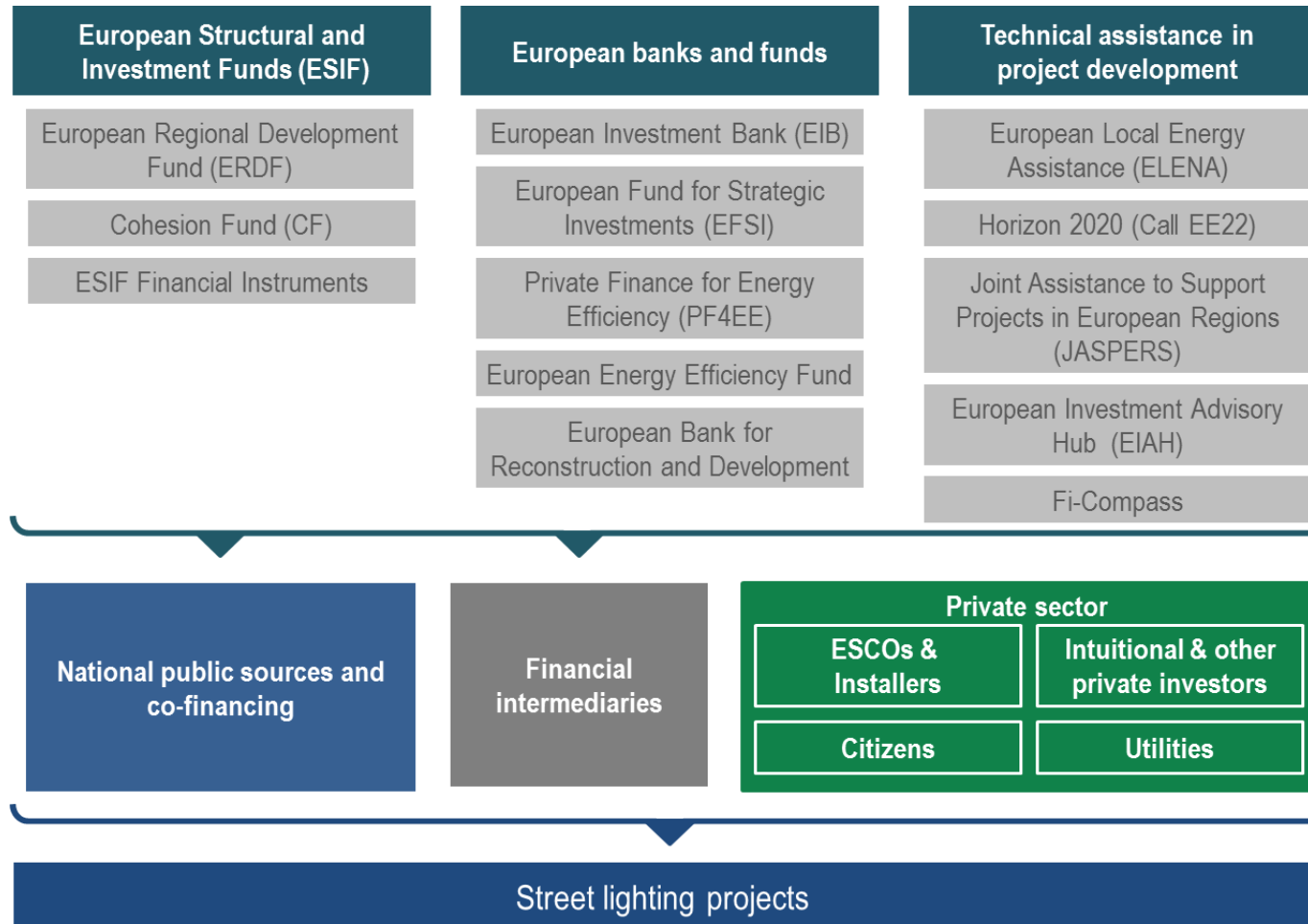


Light level



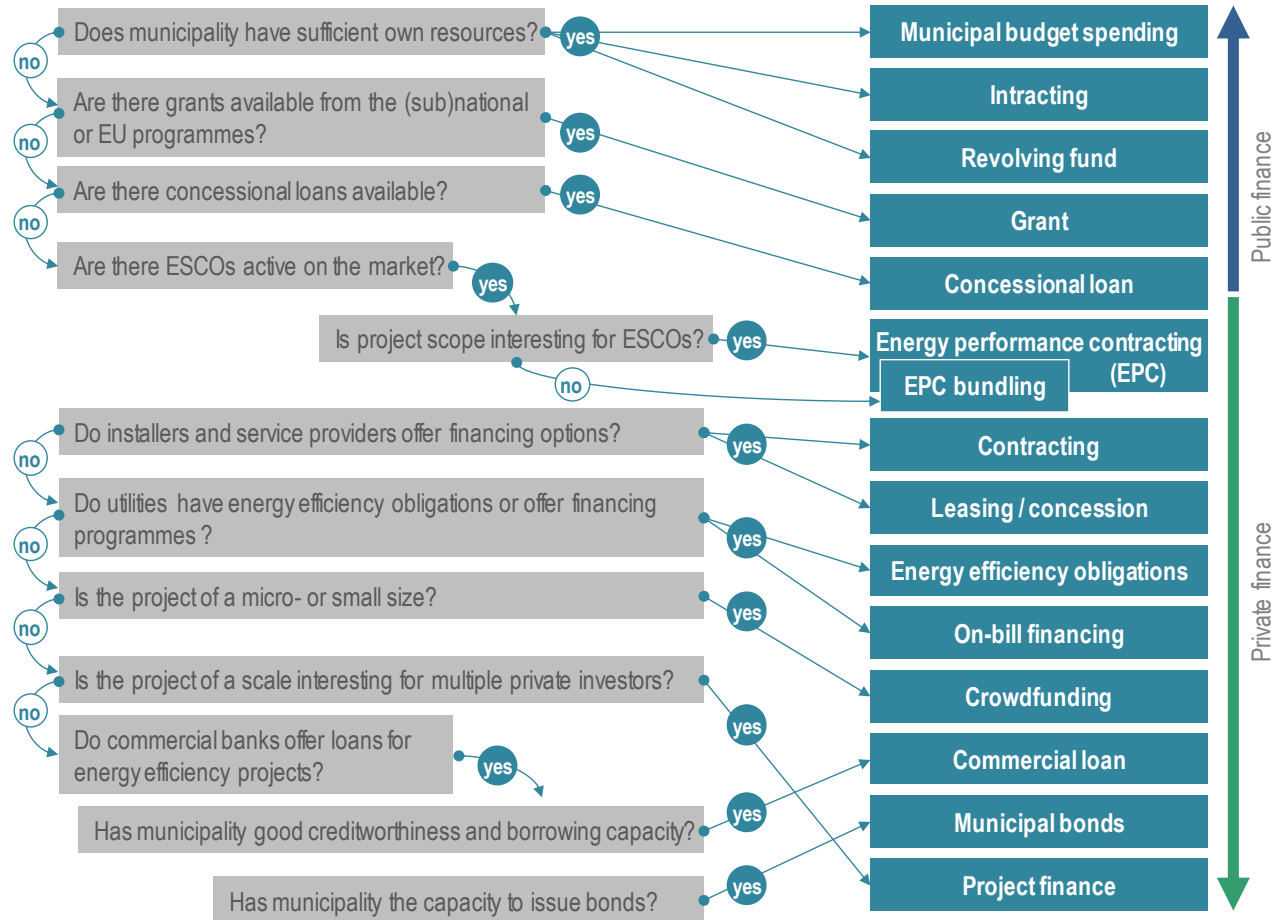
◀ 25 %

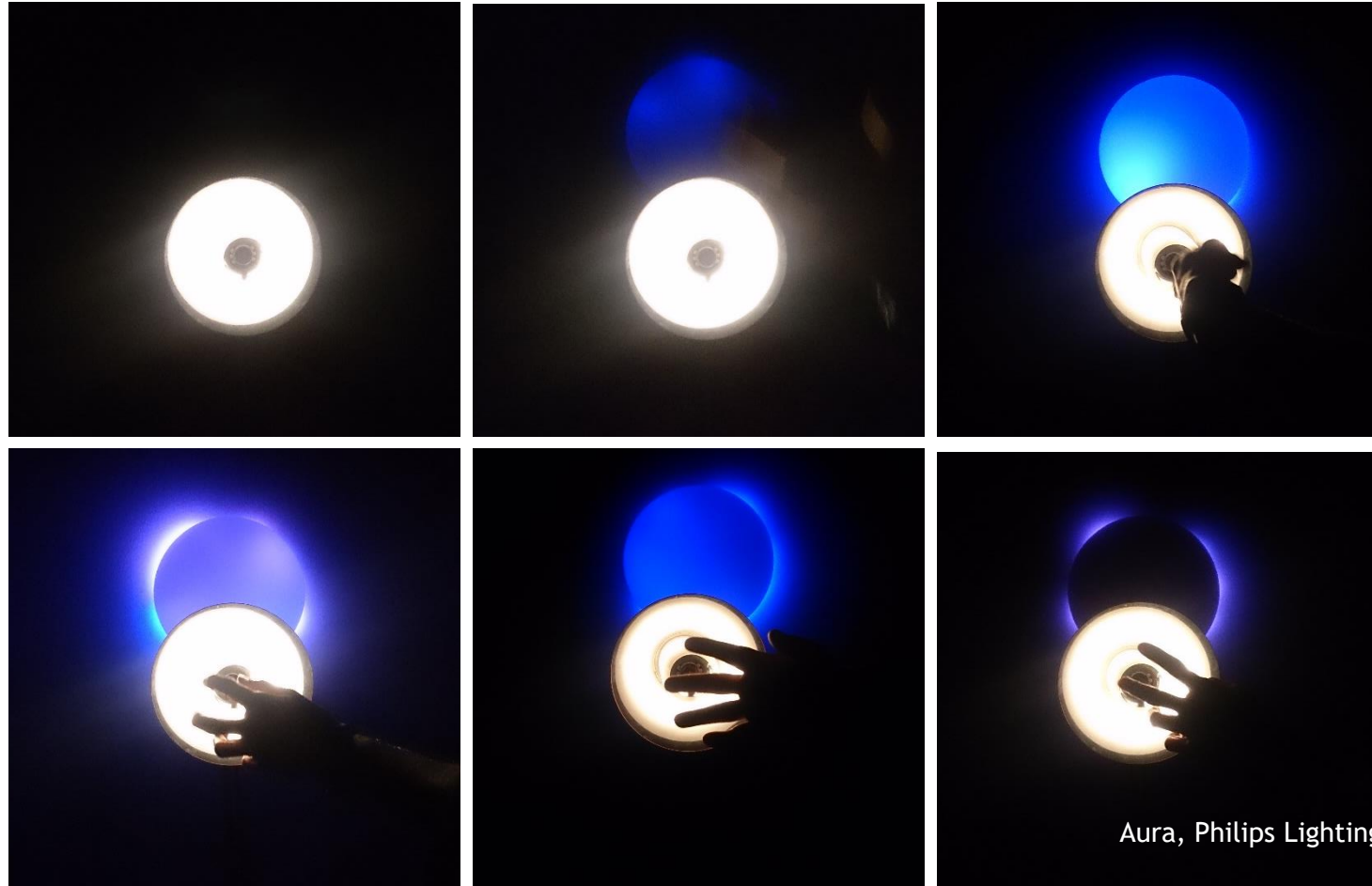
# FUNDING SOURCES FOR ENERGY-EFFICIENT STREET LIGHTING



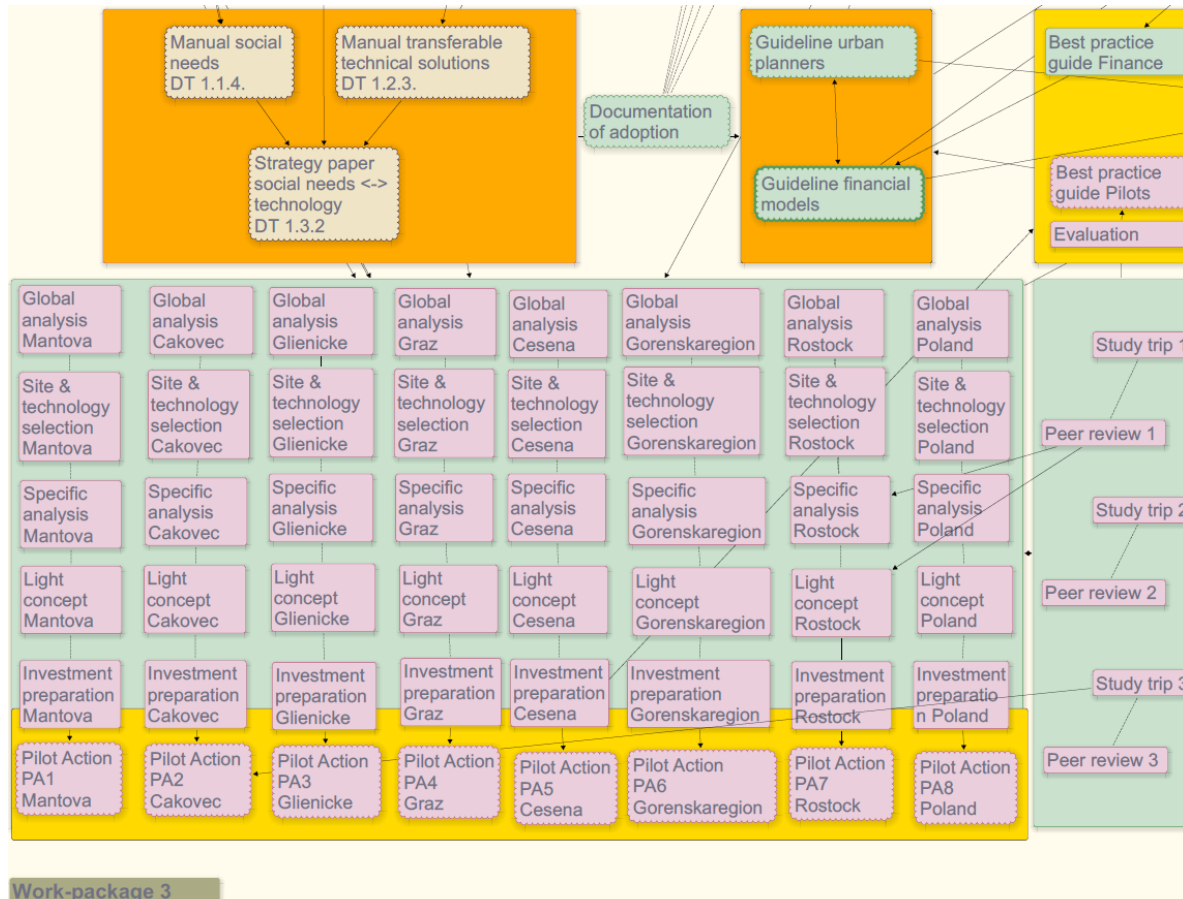


# DECISION-MAKING TREE FOR SELECTING A FINANCING MODEL





# DYNAMIC LIGHT- WORKPACKAGE 3



## Pilot Actions

- Mantova
- Cesena
- Čakovec
- Glienicke-Nordbahn
- Rostock
- Güssing
- Gorenškaregion
- Lwówek Slaski
- Sušice



# PILOT PROJECTS IN PRACTICE

**9 Pilot Installations -  
Planning/Implementation:  
October 2017– December 2018  
Evaluation: Early 2019**

- |                |                      |             |
|----------------|----------------------|-------------|
| <b>Italy</b>   | – <b>Mantova</b>     | ✓<br>✓<br>✓ |
| <b>Italy</b>   | – <b>Cesena</b>      |             |
| <b>Croatia</b> | – <b>Čakovec</b>     |             |
| Austria        | - Güssing            |             |
| Czech Republic | – Susice             |             |
| Slovenia       | – Gorenjska region   |             |
| Germany        | – Rostock            |             |
| Germany        | – Glienicke/Nordbahn |             |
| Poland         | – Lwowek Slaski      |             |



# AIMS OF PILOT INSTALLATIONS

- **Technical implementation**
- Potential of technology: Energy consumption
- Potential of technology: Lighting qualities
  
- **Reasonable Light changes**
- Value/Acceptance
- Multiple uses, multiple light scenes
  
- **Extending the scope to think about lighting**
- not copying what was done with the older technologies
  
- **Adequate lighting in various situations**

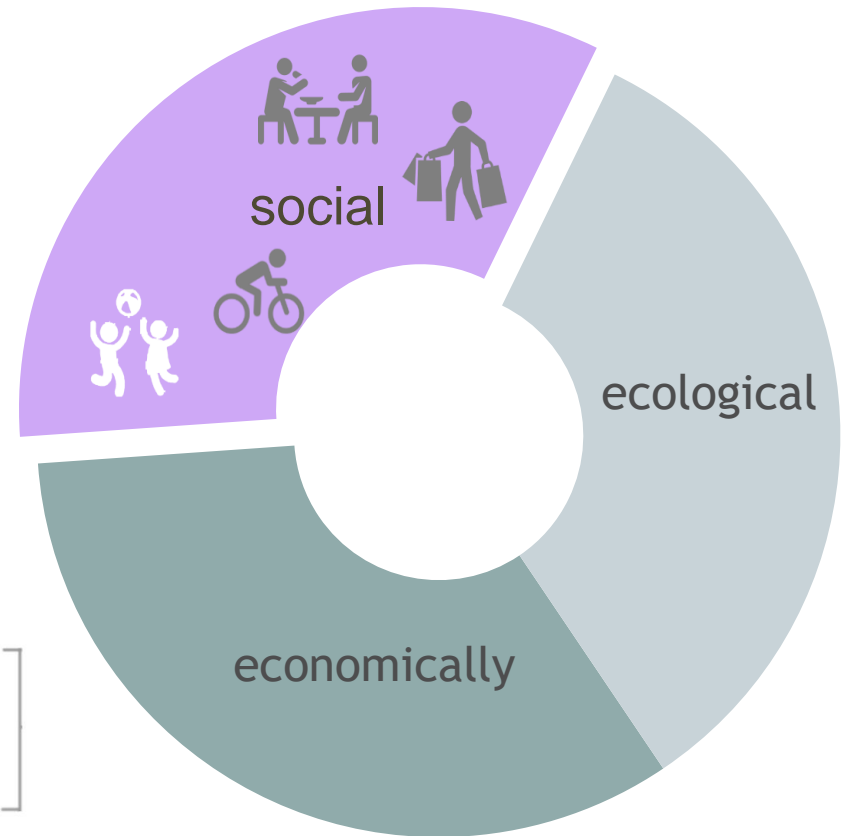
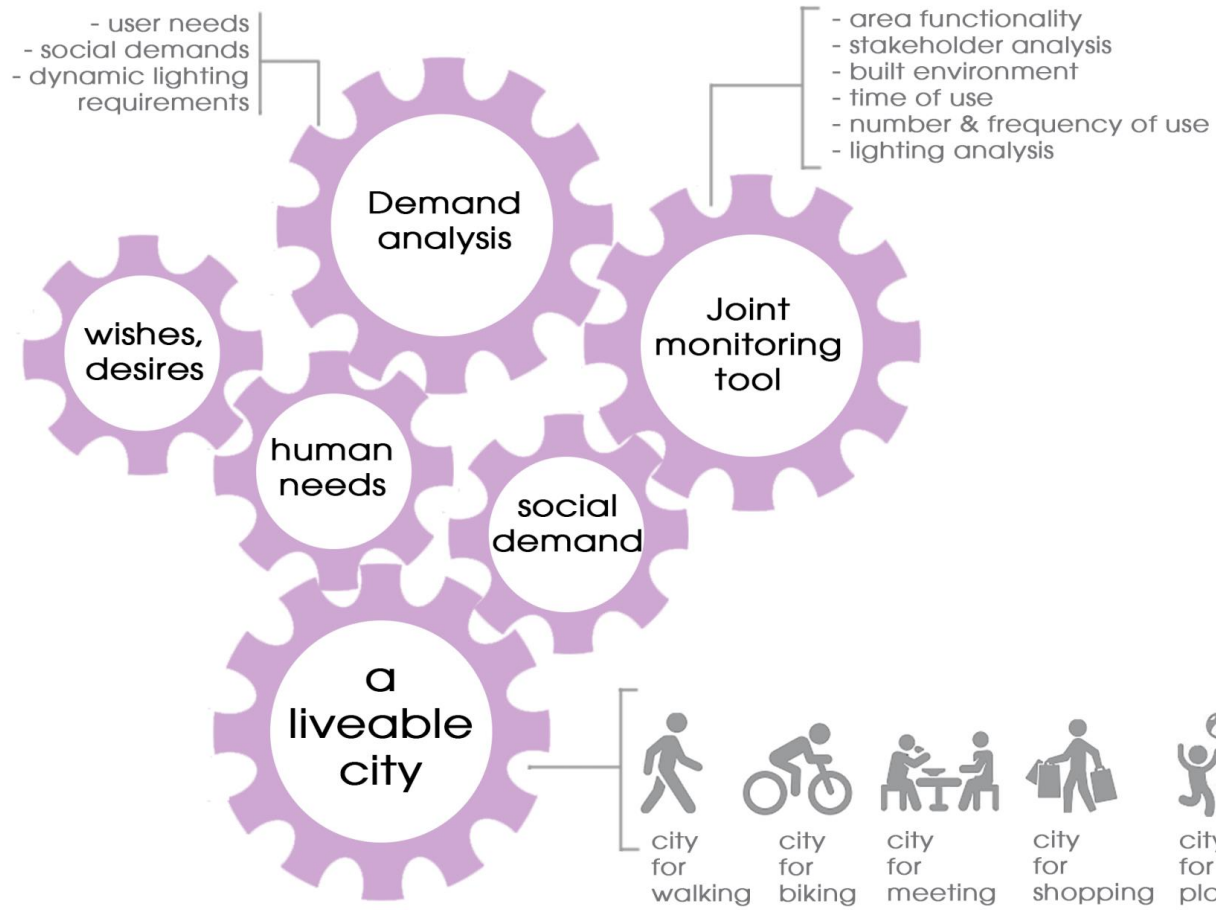


# AIMS OF PILOT INSTALLATIONS

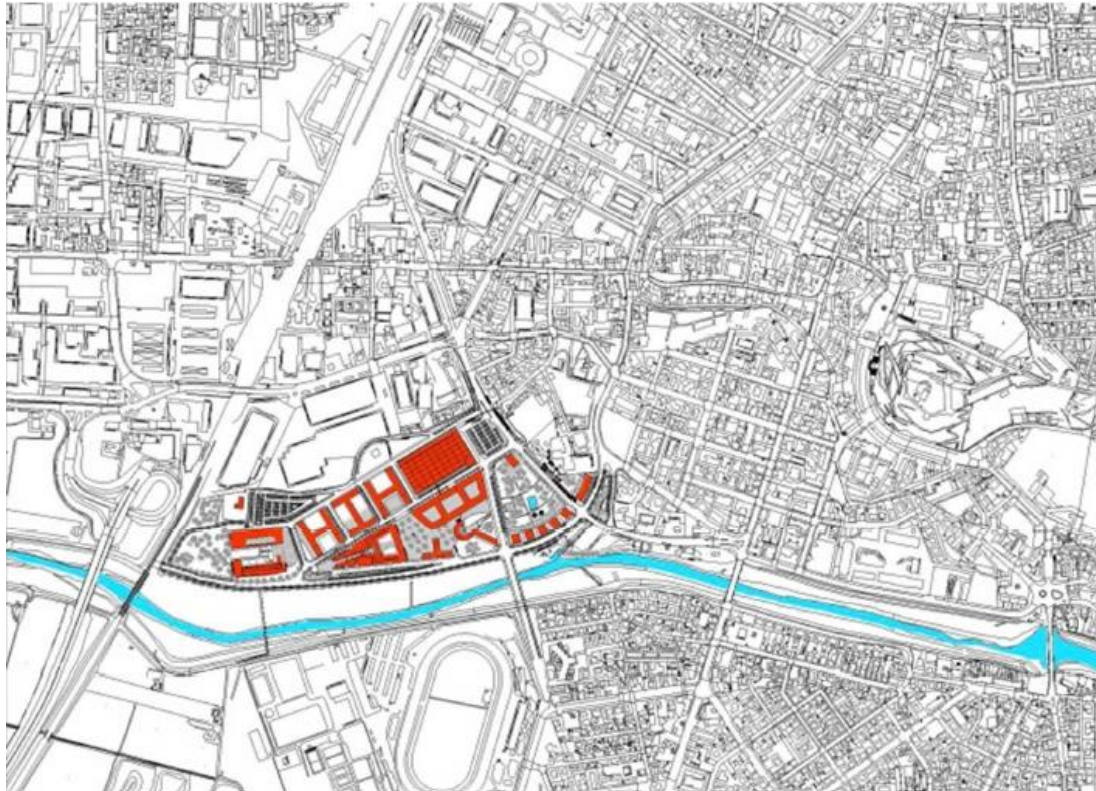
- **Technical implementation**
- Potential of technology: Energy consumption
- Potential of technology: Lighting qualities
- **Reasonable Light changes**
- Value/Acceptance
- Multiple uses, multiple light scenes
- **Extending the scope to think about lighting**
- not copying what was done with the older technologies
- **Adequate lighting in various situations**



# SOCIAL QUALITY



# PILOT PROJECT ITALY-CESENA





# LOCATION EX-ZUCCHERIFICIO

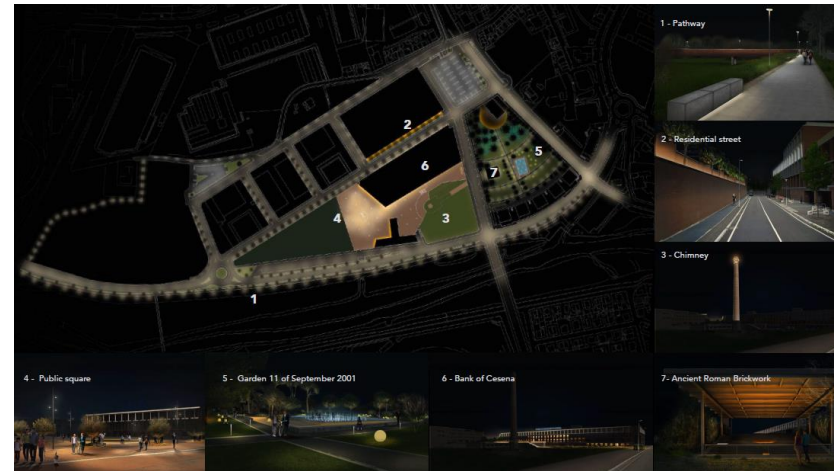


## *Cesena, Start situation*

Discarded industrial area northwest of the city centre (220.000 sqm.)

Redevelopment with

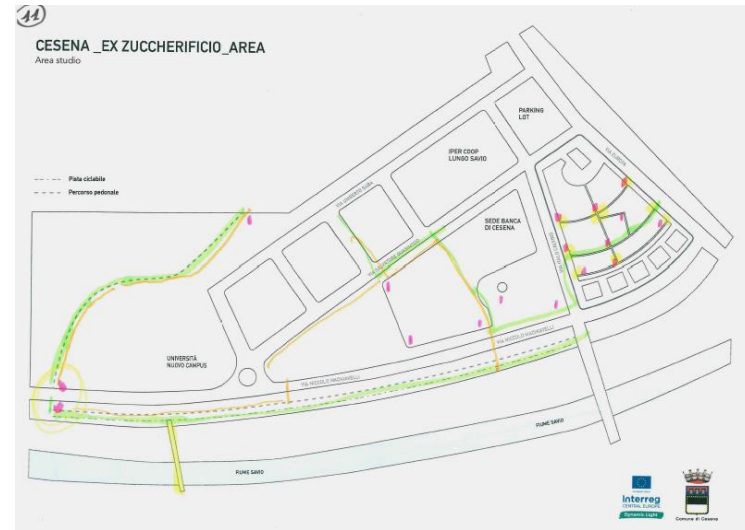
- Characterized by urban decay.
- High social value due to concentration of residential buildings, social housing, apartments for students and facilities etc.
- Social conflicts, citizen participation
- New campus, Vitalizing and upgrading Area



# USER PARTICIPATION

## Approach

- Social Research as a design tool:  
Surprising info about favourite paths, sitting area etc.
- Creating a lighting atmosphere that encourages the use of public gardens, creates a sense of security and brings about a positive change in user behaviour.
- Dynamic light to increase the sense of security and encourage people to use gardens, pathways etc.



# PROGRESS

## Reviving area by lighting

Demand Analysis

High strategic potential

Social Problems

Respecting expectations from citizens

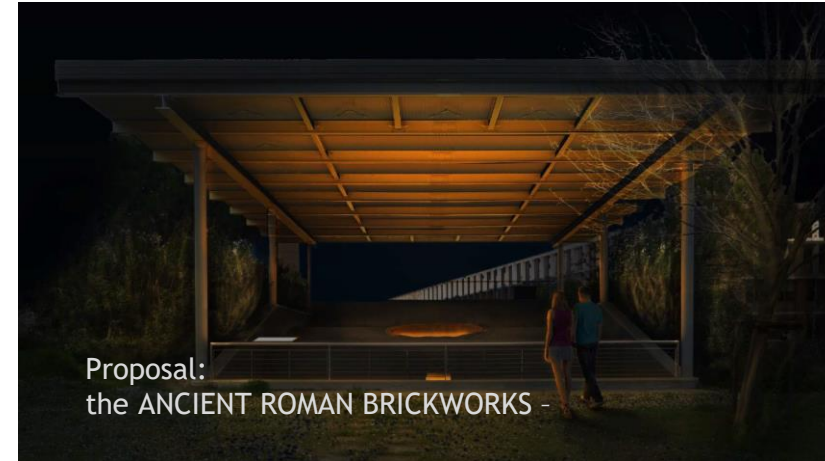
## Concepts for special micro sites:

Respecting rhythm of site use

Encouraging intended use

## Garden 11. September 2001

- Presence sensor-based lighting
- Controlling individual luminaires for special occasions



# OPENING OCTOBER 2018



# PILOT CZECH REPUBLIC - SUŠICE



## Area of the chapel St Angel the Guardian

### Architectural lighting:

Important role in city events

--Show importance with special lighting

### Public lighting:

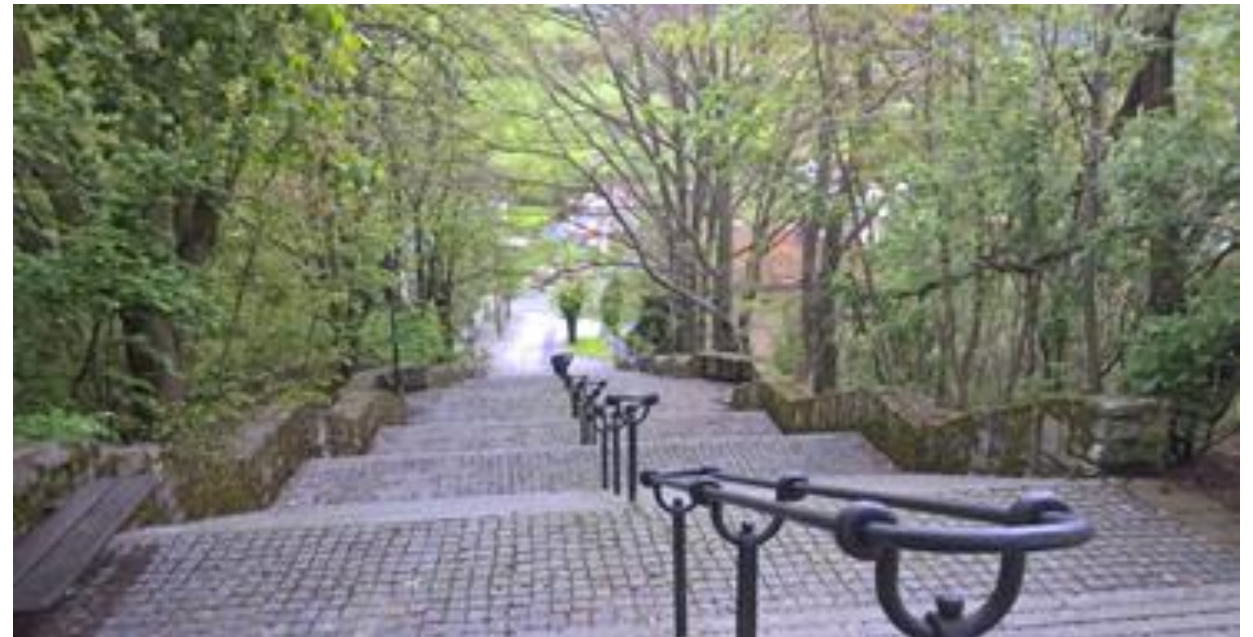
Low energy consumption

Secure use of stairs, Reduce light impact,

Light only when it is needed

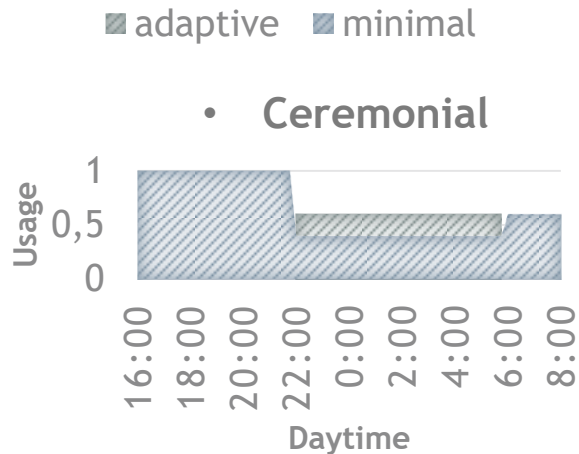
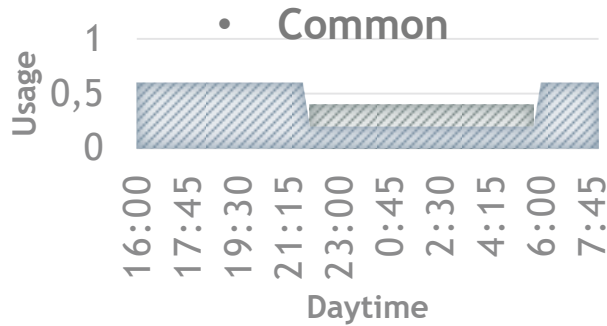
### Showing potential of **Dynamic light**

- bigger areas planned with dynamic light
- Acceptance



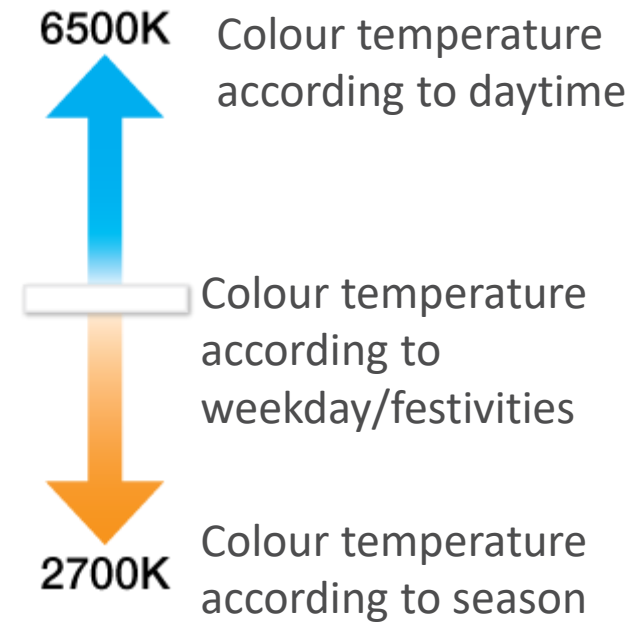
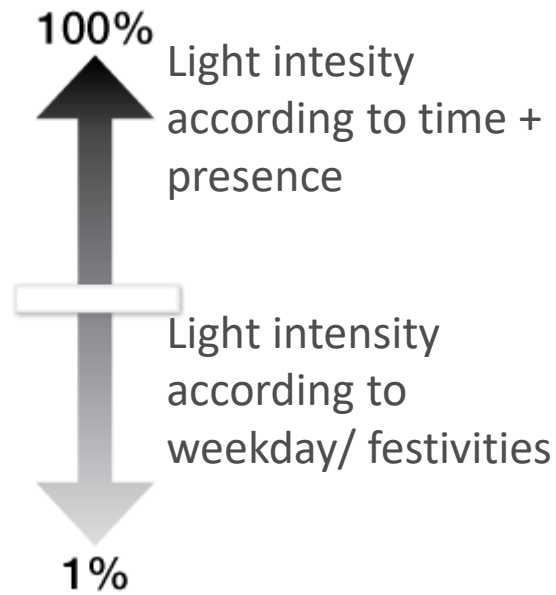
# WHAT IS ADEQUATE LIGHT?

## Sušice



■ adaptive ■ minimal

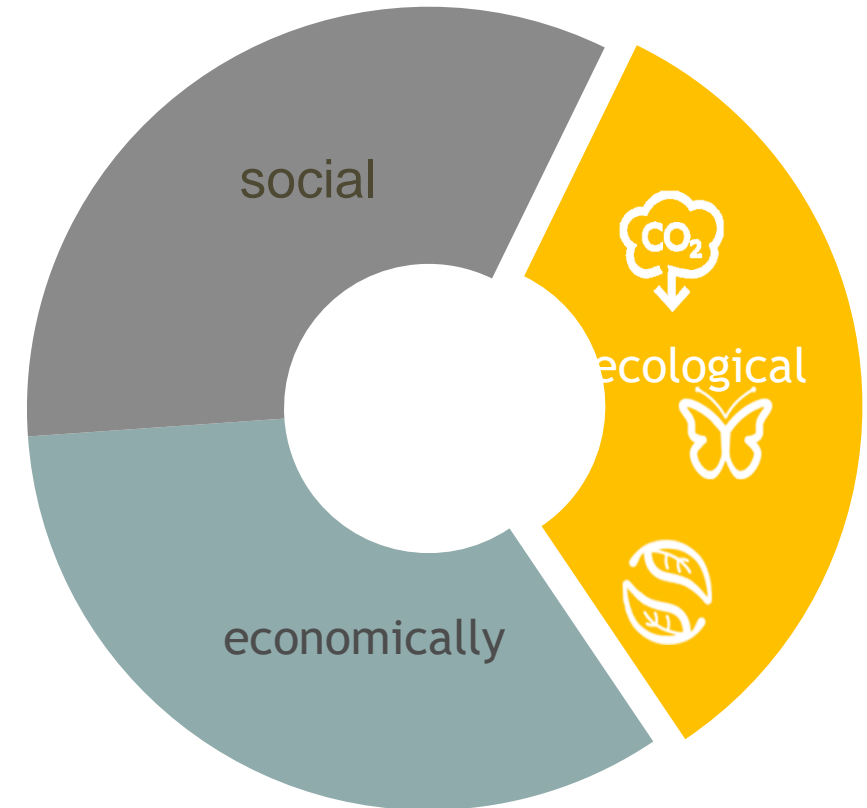
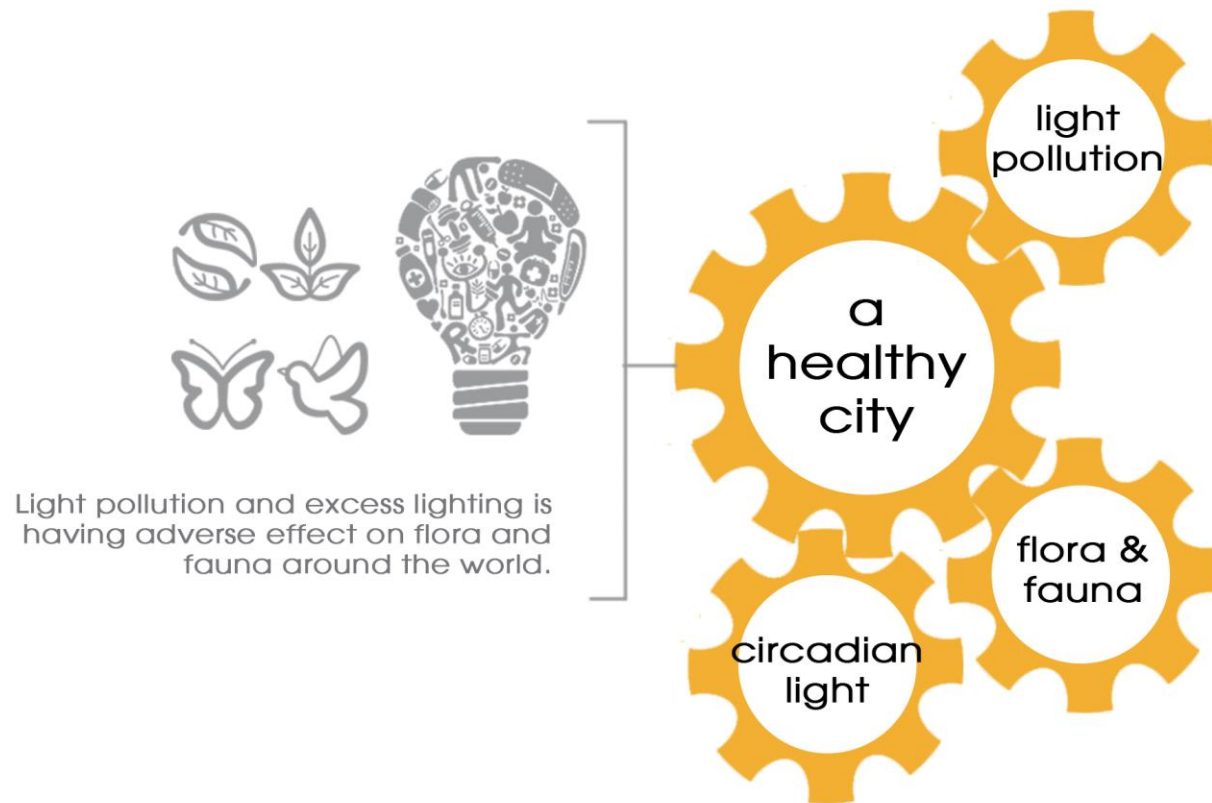
■ adaptive ■ minimal



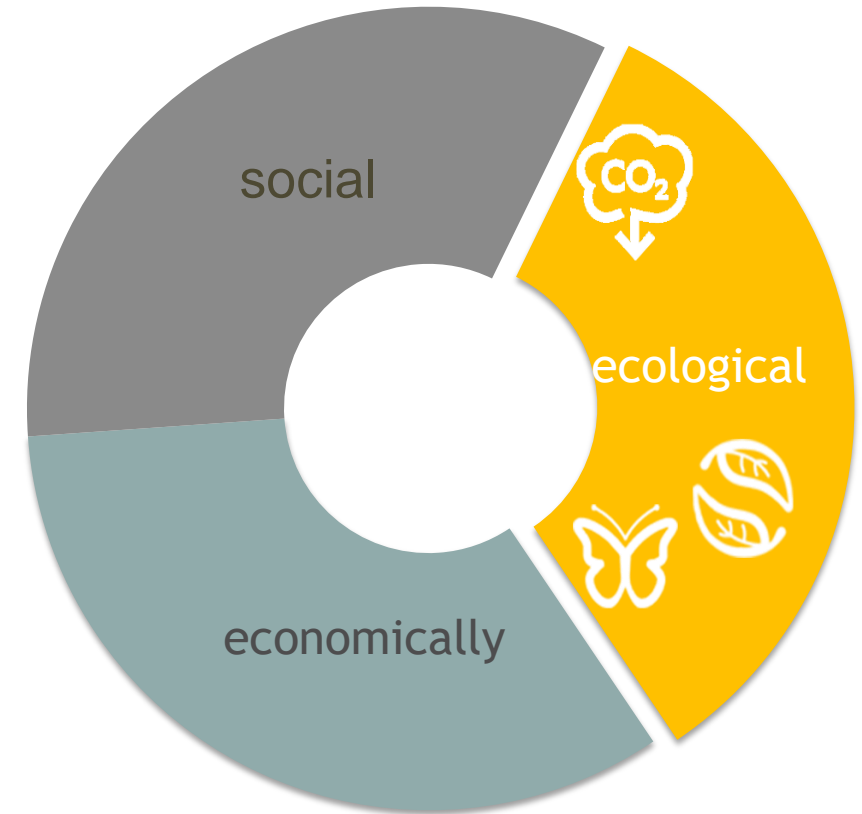




# ECOLOGICAL



# PILOT ITALY -MANTOVA



# START SITUATION

## CRITICALITIES

- Low safety feeling
- Loss of interest historical values
- Old technology
- Light pollution
- Low attractiveness surrounding areas

## Aims

- Encourage use
- Biodynamic lighting
- Respect historical value
- Efficiency
- Security
- Innovative Technologies





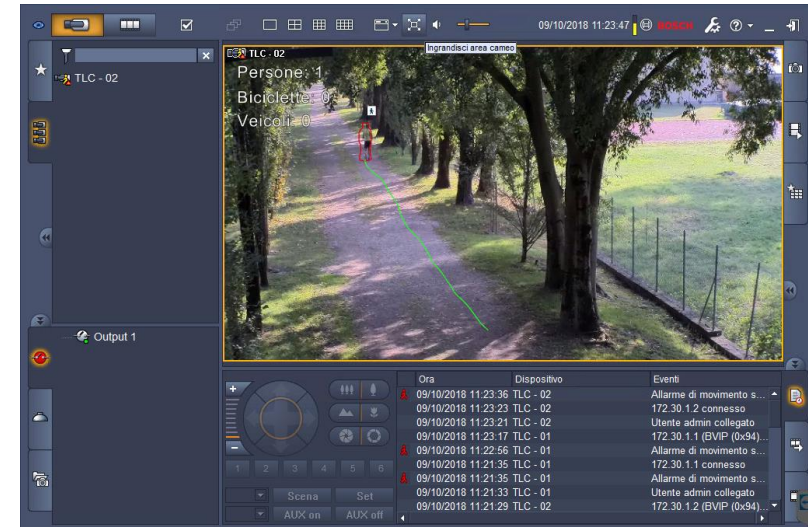
# INTELLIGENT VIDEO ANALYSIS



# LIGHT ACCORDING TO USER CATEGORIES

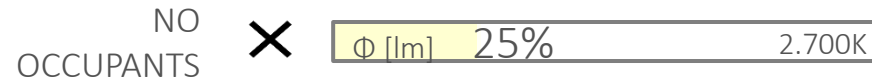
## Parameters

- User groups detection
- Time and frequency of use
- Seasons and weather conditions (Fog!)
- Special events  
(Sports, Educational, meetings)
- Emergency Lighting
- Light intensity
- Colour temperature

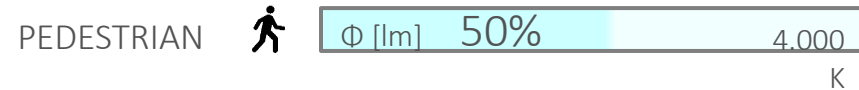


# TUNING THE LIGHT

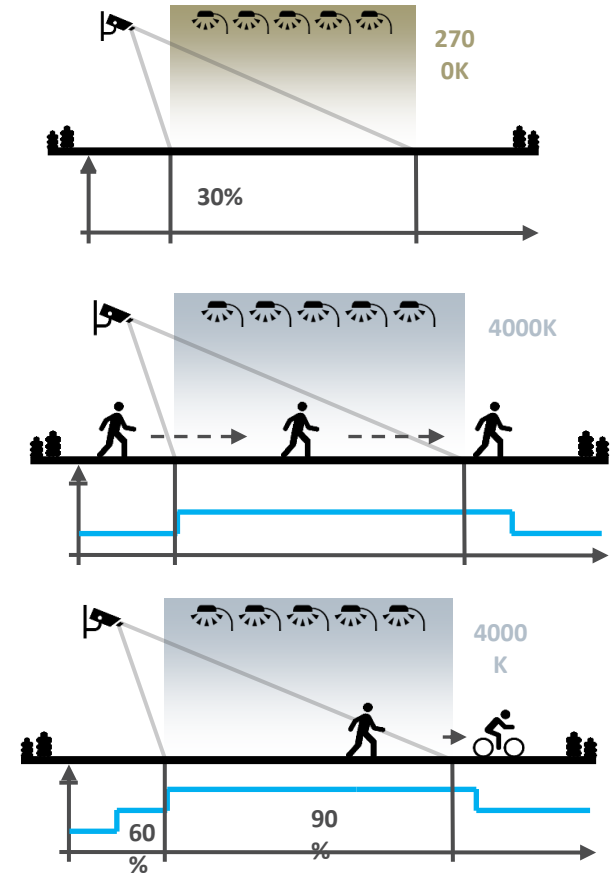
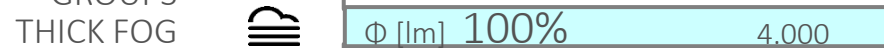
## BASIC SCENARIO > «IDLE» CONDITION



## DYNAMIC SCENARIO > THREE PROFILES



## EXTRA SCENARIO > SPECIFIC CONDITIONS







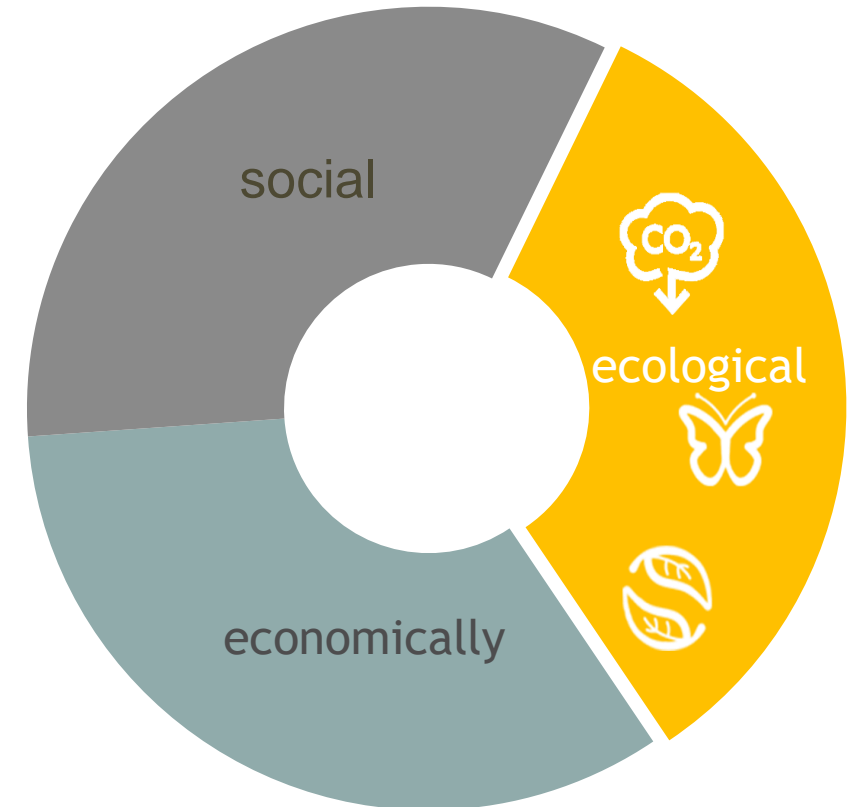
# PILOTS SLOVENIA

## Bled- Lake Area/ Villa Bled

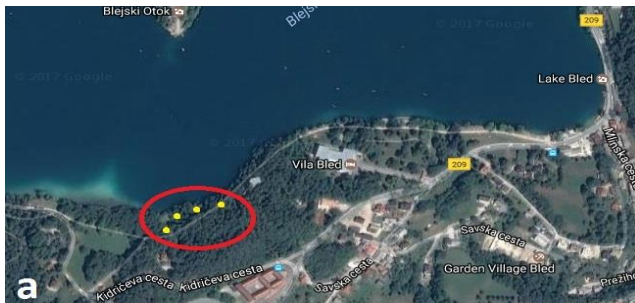
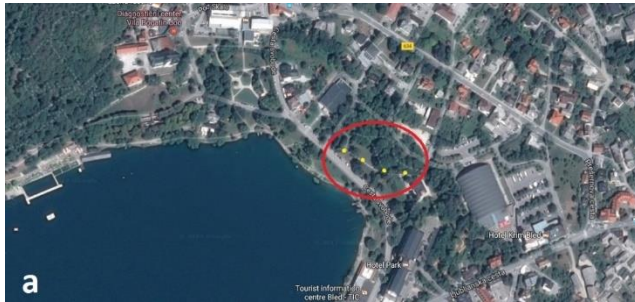
Heritage protected luminaires  
Nature protection  
Light pollution  
Tourism hot spot

## Jezersko - Mountain village

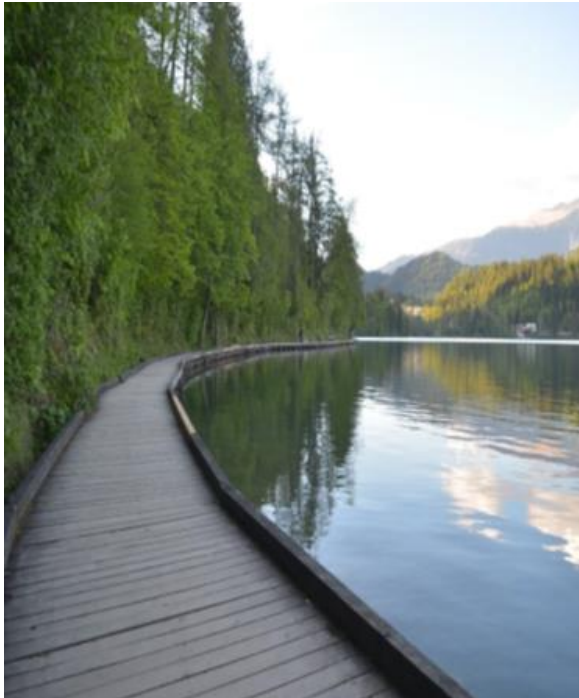
Mountain village  
Street + Cross-country Skiing  
Nature protection area: Natura2000  
Dark-sky status preparations



# BLED LAKE+VILLA



# SENSITIVE SURROUNDING



# Jezersko - Mountain Village



20 controlled luminaires, little street extended by cross-country skiing area

# CURRENT STATE

## **Bled-**

Presence+time-based dimming

## **Jezerško**

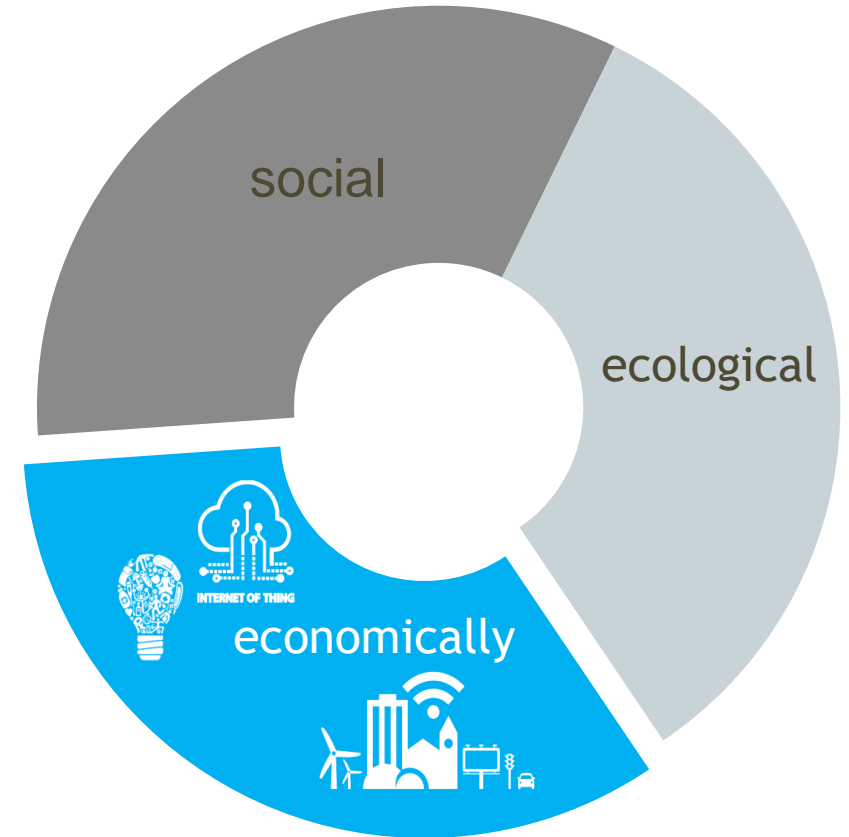
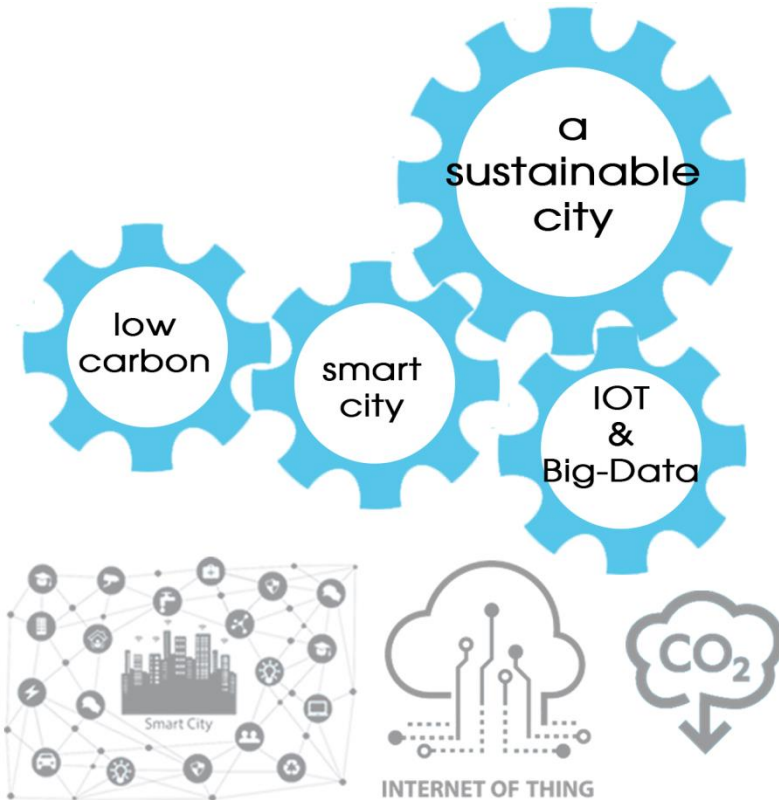
Presence+ time based Dimming  
Flexible light distribution

Installation 12/2018

High interest  
leveraged investment



# ECONOMY



# PILOT ACTION GERMANY - ROSTOCK

## Pedestrian & Cycle path

800 meters long

33 LED-luminaires

Presence-sensor + time  
control



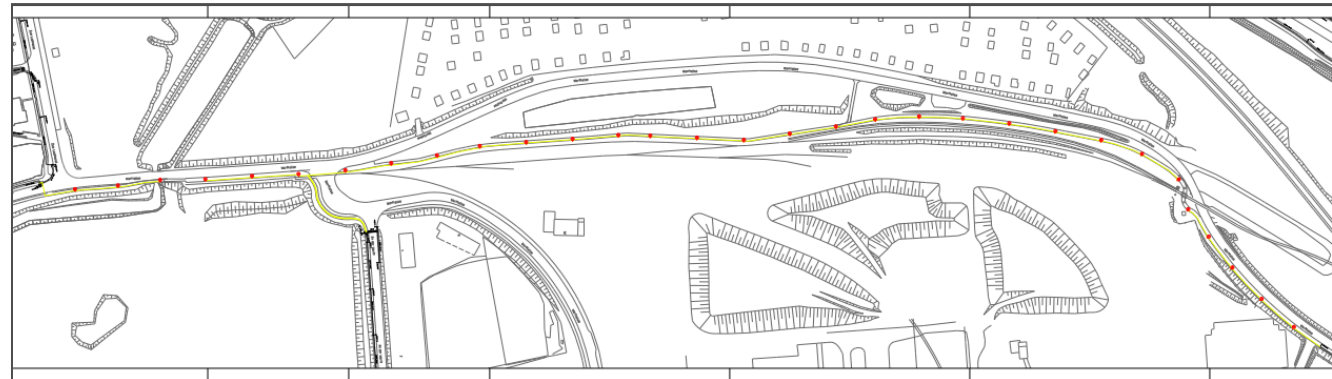
### **Aims:**

*Energy*

*Safety feeling*

*Light pollution*

*Encouraging cycling*

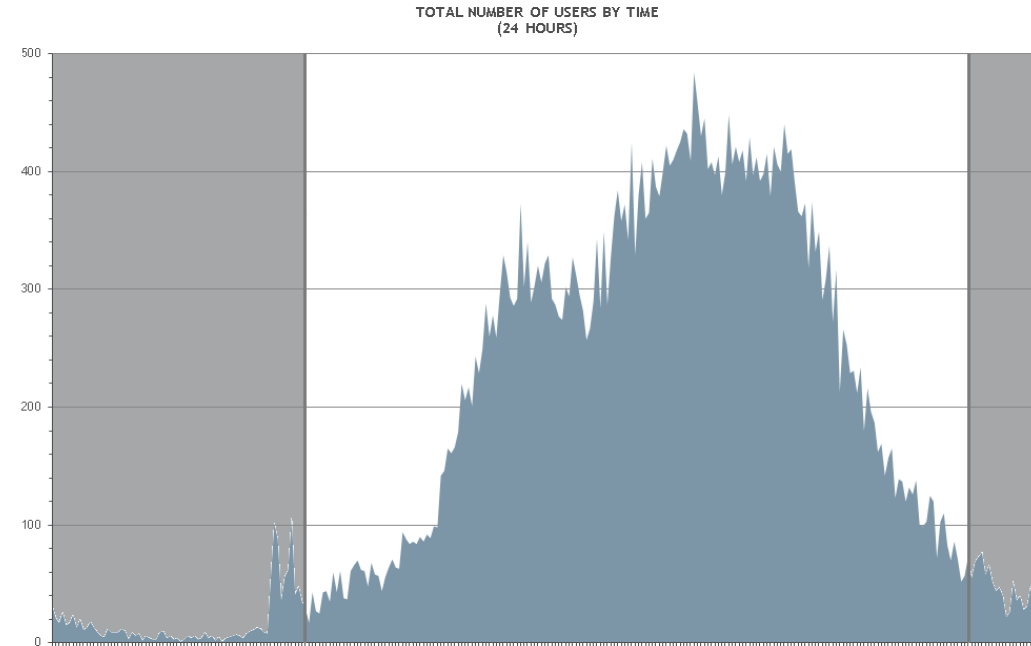
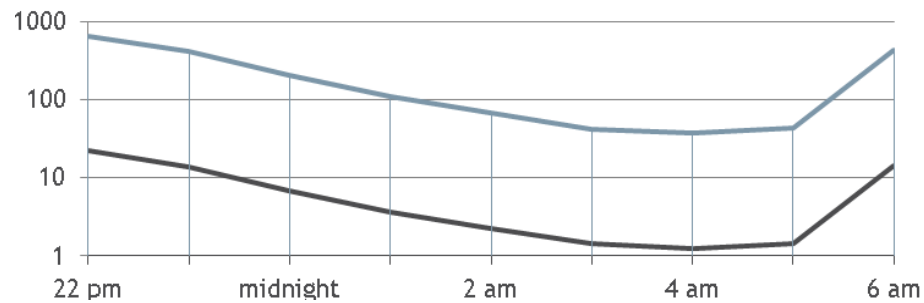


# USING FREQUENCY

## NUMBER OF USERS DEPENDING ON TIME OF DAY

- Determination of the frequency of use by camera-based traffic counting (30 days)
- Ø 900 users per day
- depending on weather & events

high usage by day  
low usage at night



TIME	USERS EACH NIGHT	USERS PER HOUR
24 hours	900	38
10 pm - 6 am	35	6
11 pm - 5 am	17	3
midnight - 4 am	9	2





# USER EXPECTATIONS



**September 18**  
**Climate Day**

**October 18**  
**Local Council**  
**„Warnemünde“**



**October 18**  
**Local Council**  
**„Groß Klein“**

# TEST IMPLEMENTATIONS

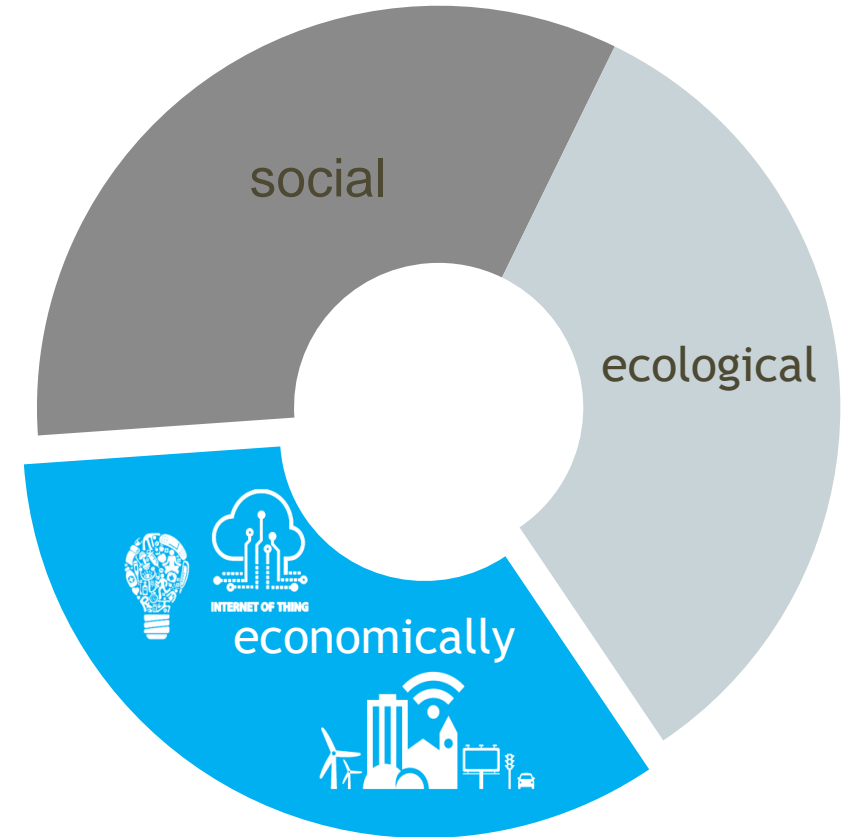
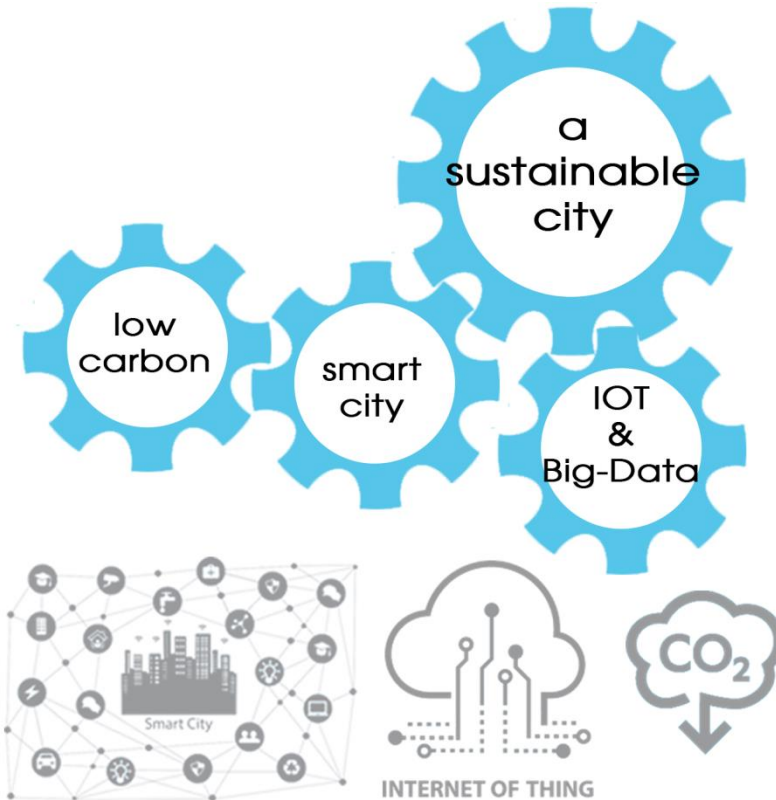
- > Discrimination of Usergroups  
Pedestrians+Cyclists
- > Combination of  
Infrared + Radarsensors
- > Savings up to 50%
- > Adequate lighting scheme:  
quality +low energy
- > Acceptance
- > Model for further cycle paths



# CONSTRUCTION IMPRESSIONS



# ECONOMY



# PILOT ACTION GLIENICKE/NORDBAHN (GERMANY)

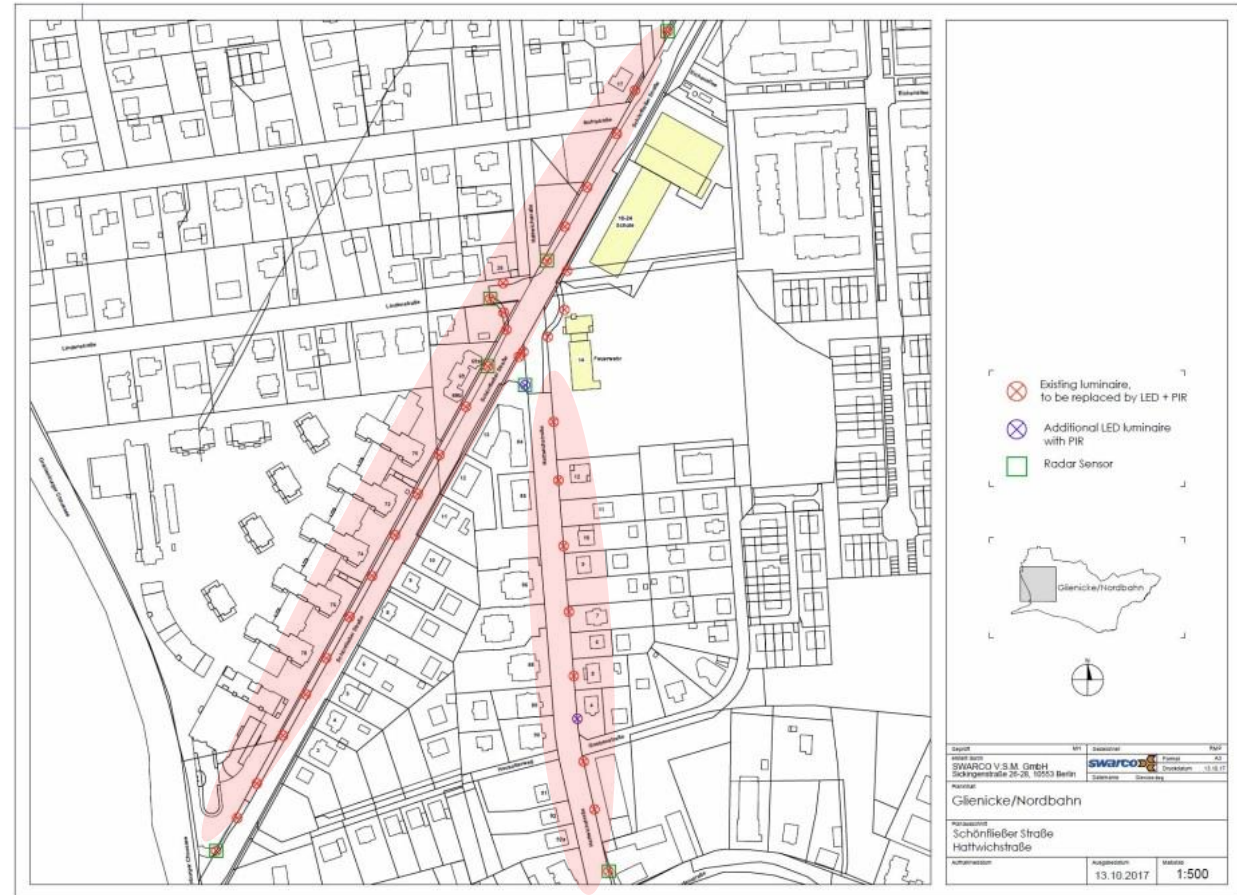


**Location: North of Berlin**  
2 streets different classes:

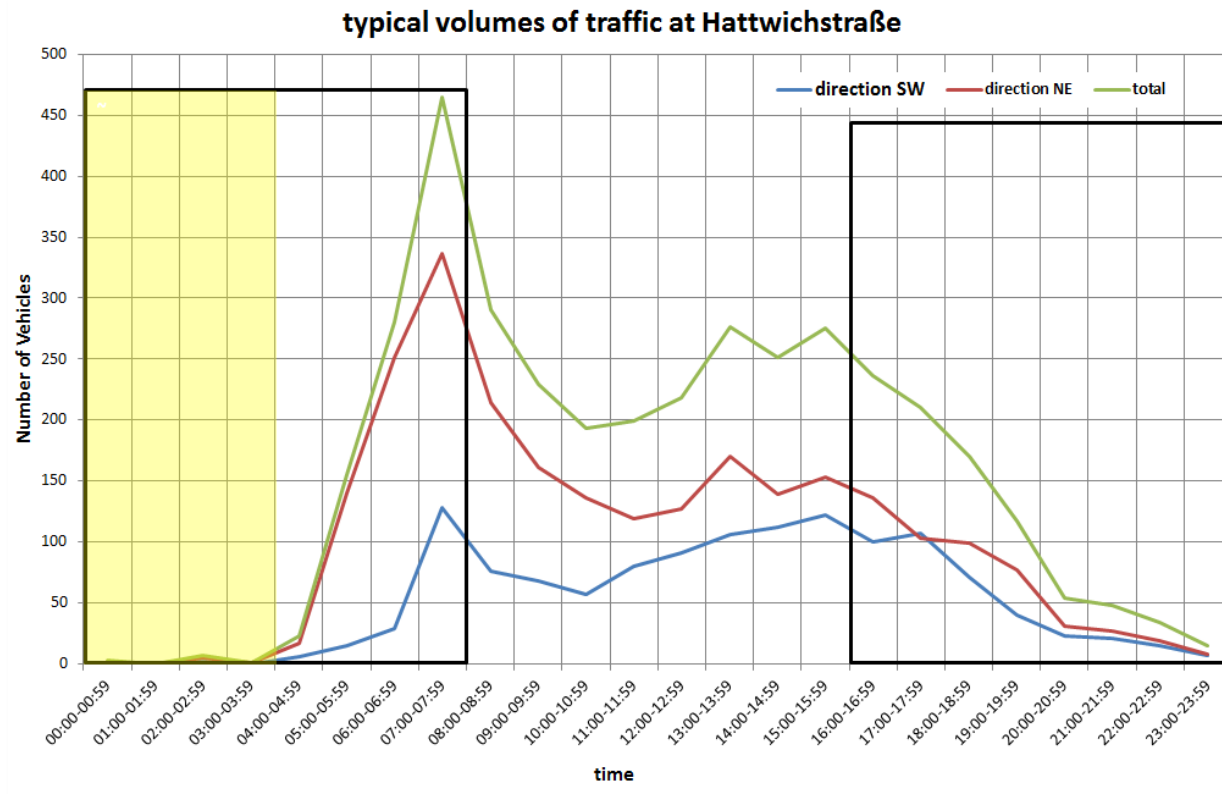
*Hattwichstrasse P3 4000 vehicles/day*  
*Schönfließerstrasse M4 9000 vehicles/day*

*Special interest:*  
*Fire department/ School*

38 LED luminaires  
2 Cameras traffic-counting



# LIGHT AND TRAFFIC VOLUME



VoT: 4.000 vehicles per day

21h-6h: 15 %

0 h- 4 h: 90 vehicles

to be defined:

- 100 % DIN EN 13201:  
lighting class: **P3**  
Em: **7,5 lx**  
Emin: **1,5 lx**

to be cleared:

- high lighting level
- low lighting level
- ramp up and ramp down algorithms

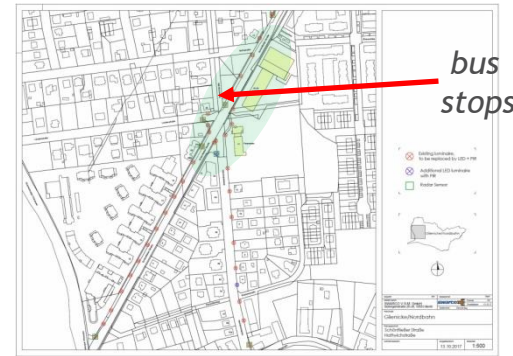
# ALGORITHMS+ DATA

## Use of data sources:

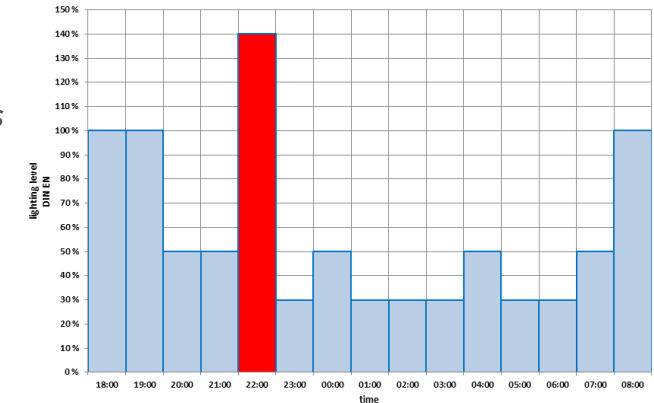
- Special zones: Fire brigade+ School
- Camera/sensors: number of school kids
- Cameras: traffic density
- Weather conditions
- Further step: Environmental sensors

## Testing:

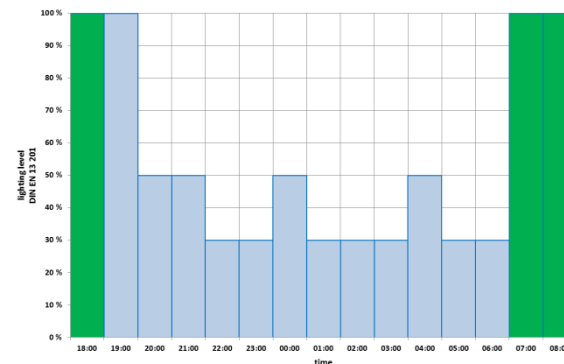
- Adequate detection periods
- Light regimes
- Energy saving potentials
- Acceptance



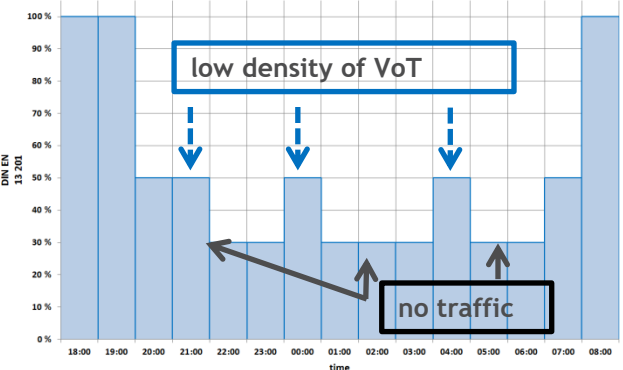
dimming level vs. case of emergency (fire brigade)

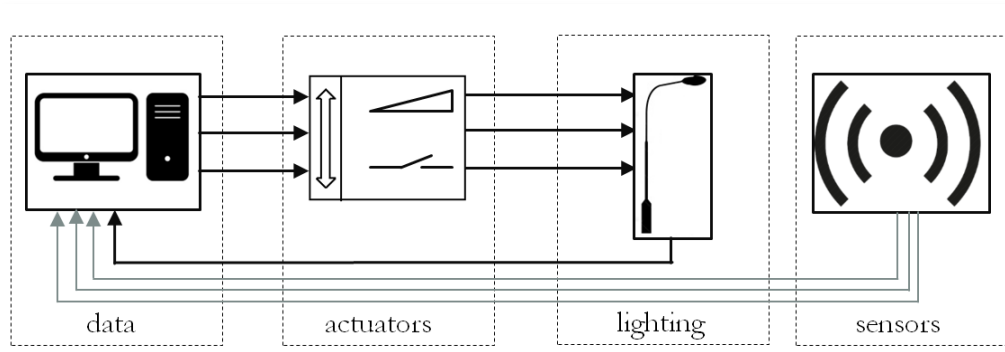


dimming level vs. activities at the school



dimming level vs. traffic density

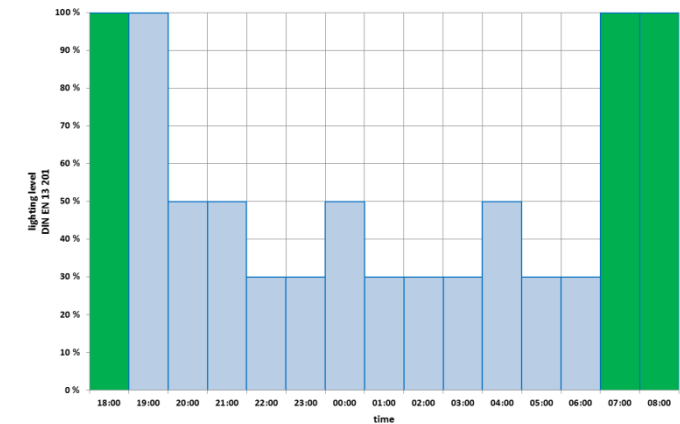




bus stops

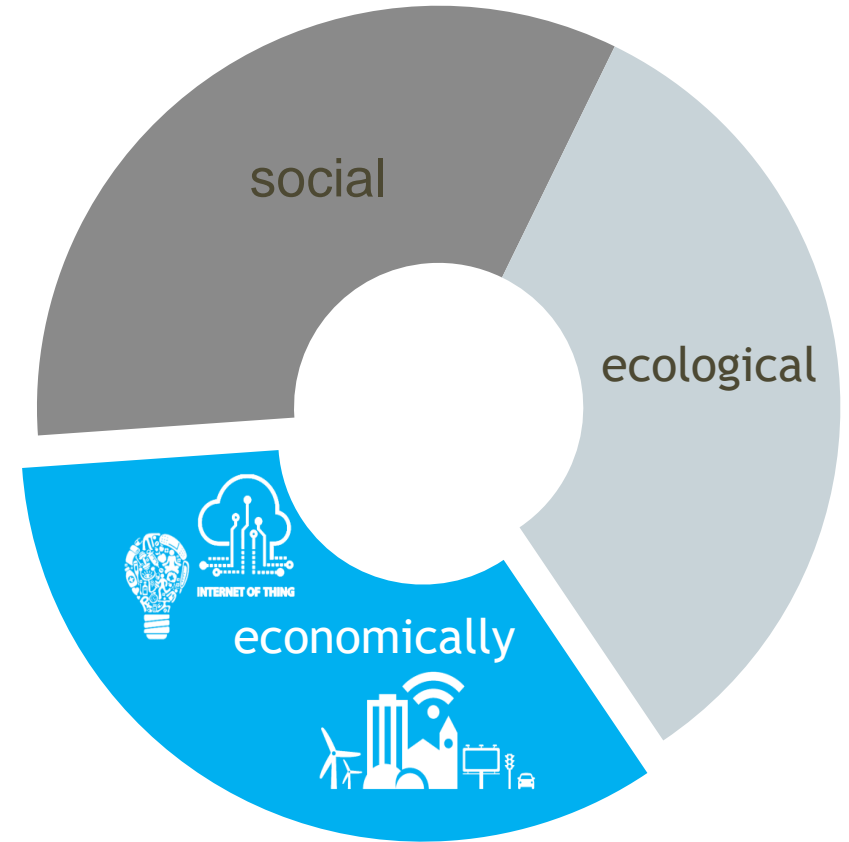
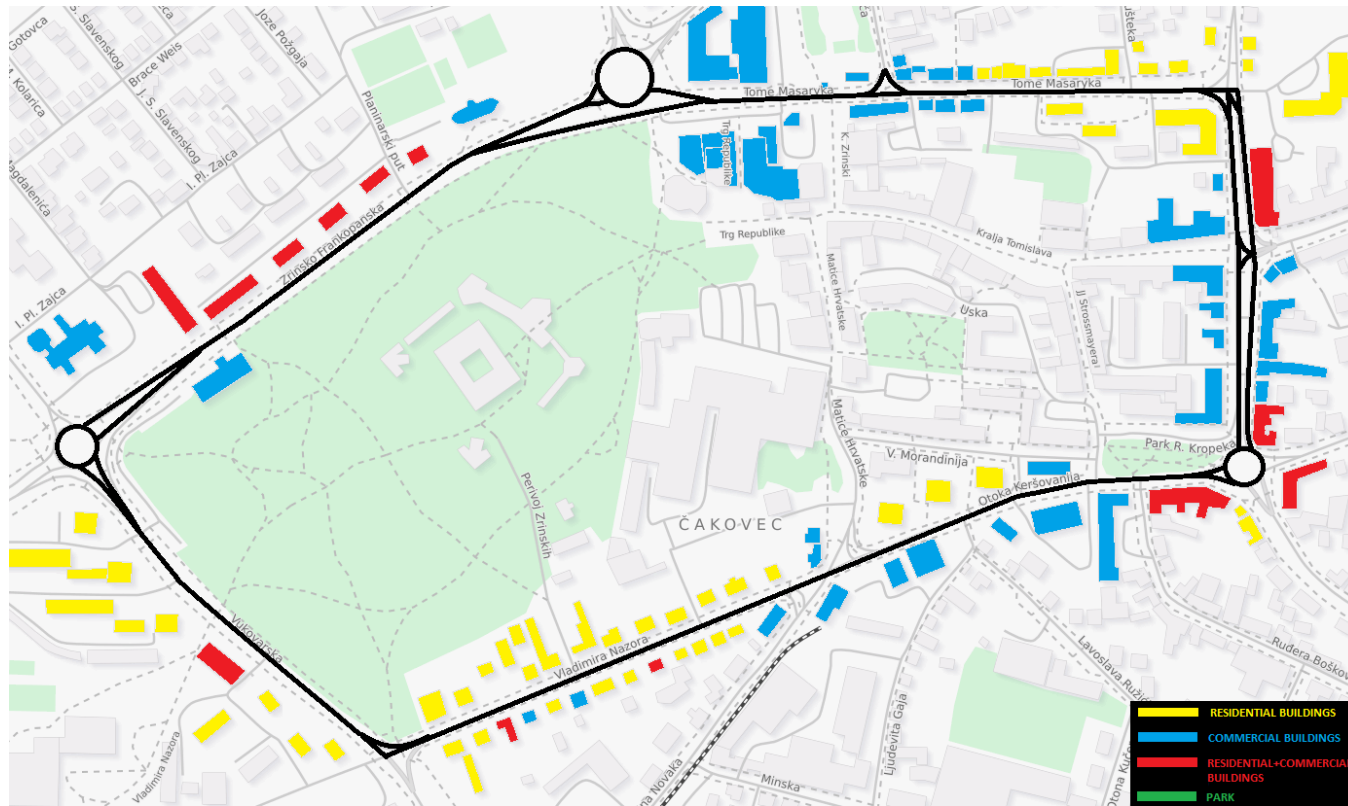
parameter	system answer	detection
volume of traffic participants (VoT)	adaptation of lighting level	radar sensors, induction loops, pir sensors, cameras
detection of emergency	boosting of lighting level	cameras
weather conditions	adaptation of lighting level or changing the luminous intensity distribution	environmental sensors
concentrations of harmful substances	-	infrared CO <sub>2</sub> sensors, chemical sensors
speeds	adaptation of lighting level	radar sensors, induction loops, pir sensors, cameras

dimming level vs. activities at the school





# PILOT INVESTMENT - ČAKOVEC



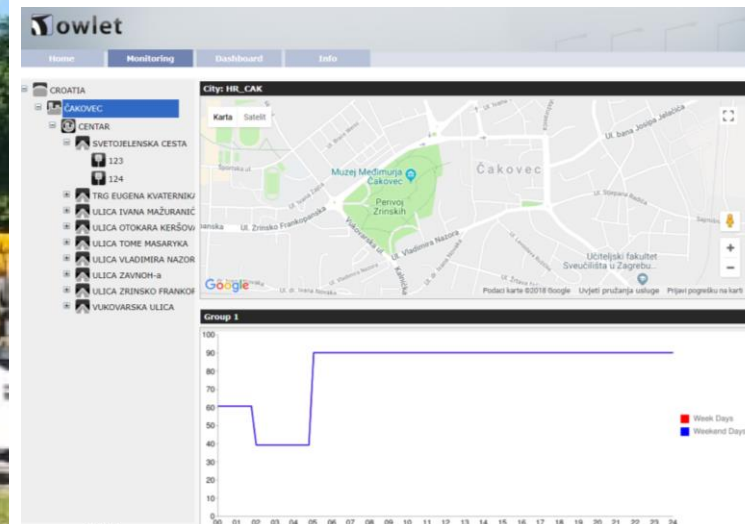
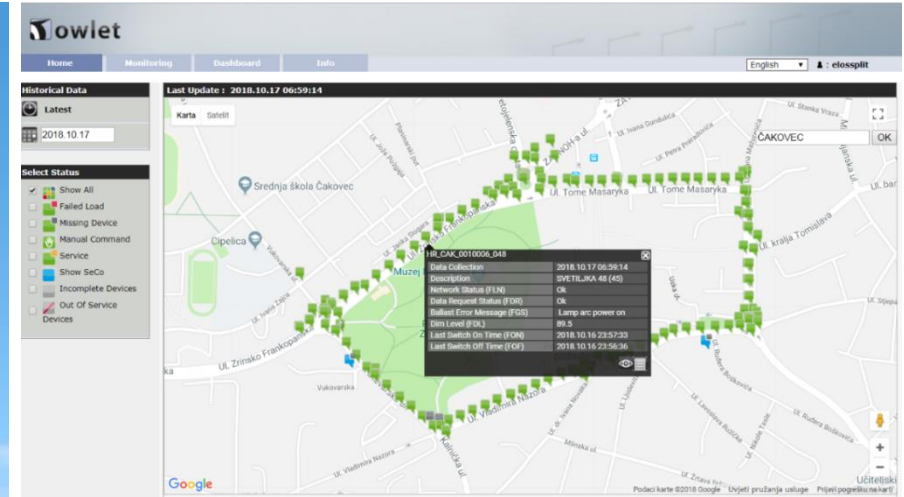
## Comparative overview and expected results

	<u>Before</u>	<u>After</u>
Number of luminaires	160	150
Installed power kW	58.23	19.86
Annual consumption (kWh)	238,743.00	81,438.30
Annual costs (€/kWh)	28,070.00	9,574.50
CO <sub>2</sub> emissions (tCO <sub>2</sub> /a)	89.77	30.60



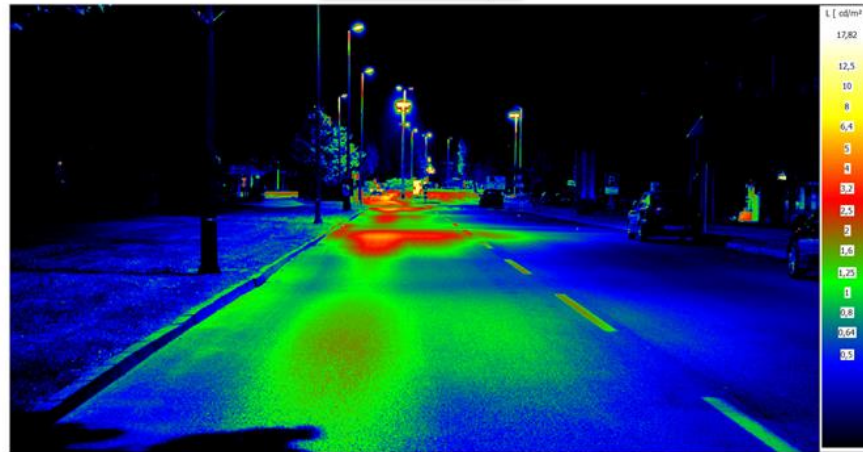
# AIMS

- System Control and Management of Public Lighting
- Light control- Saving energy
- Better uniformity
- Sodium  LED
- Wireless solution
- Weather sensors (Rain and Fog)
- Next step:  
Testing lighting control regimes



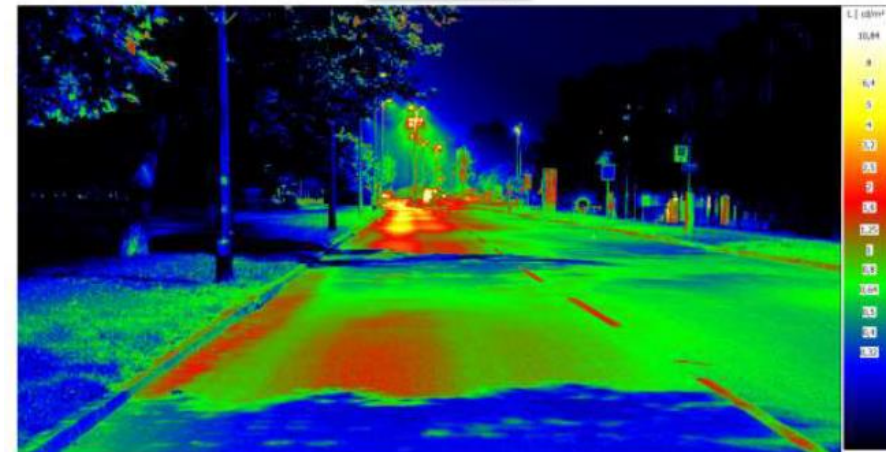
# PILOT INVESTMENT - ČAKOVEC

Before

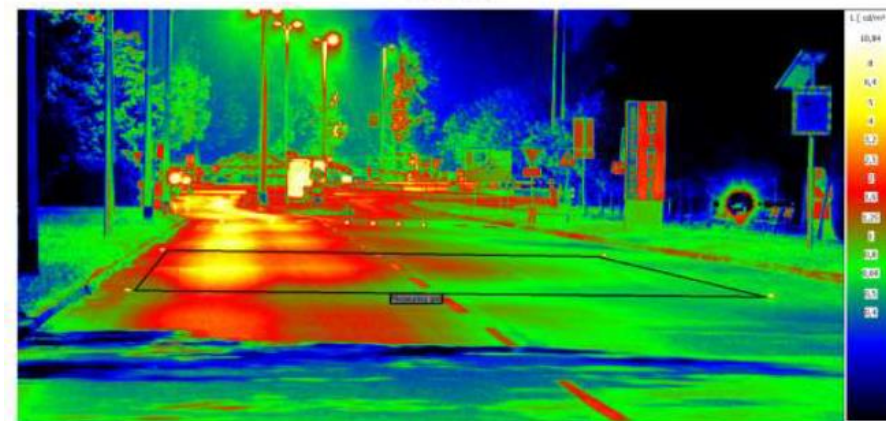
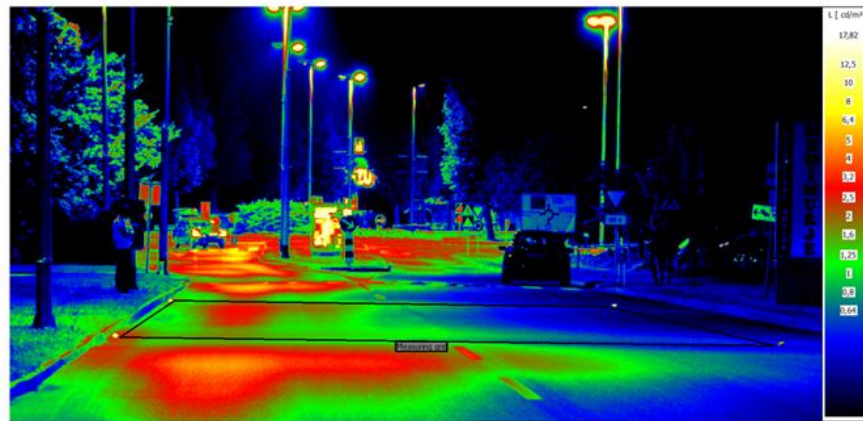


Measurement field

After



Mjerno polje



# SUMMARY PILOTS

Individual analysis of each location is needed  
Clarifying use and context  
Activities and expectations relevant

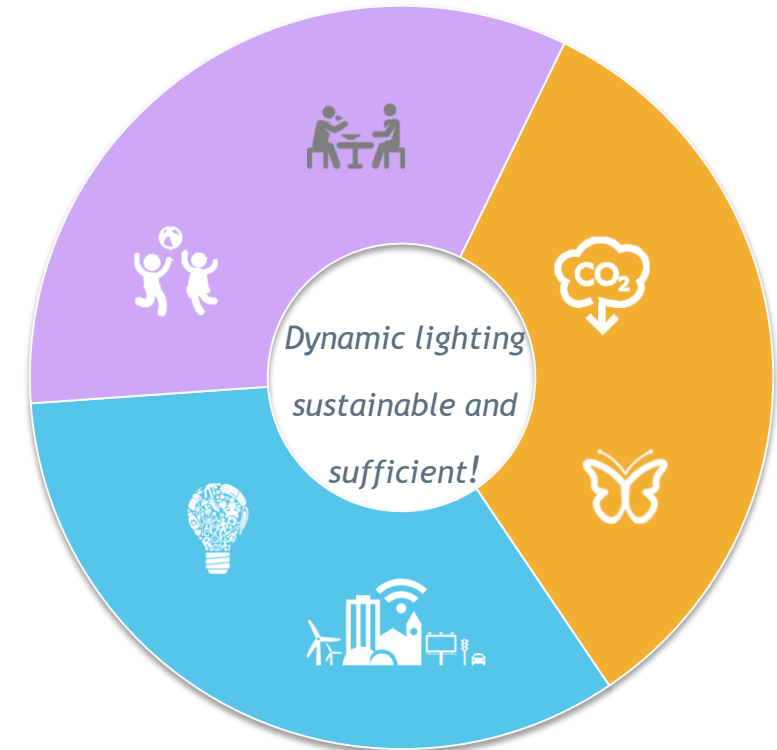
Often simple control regime is sufficient (Time, Presence)  
Use of data helpful to understand the space

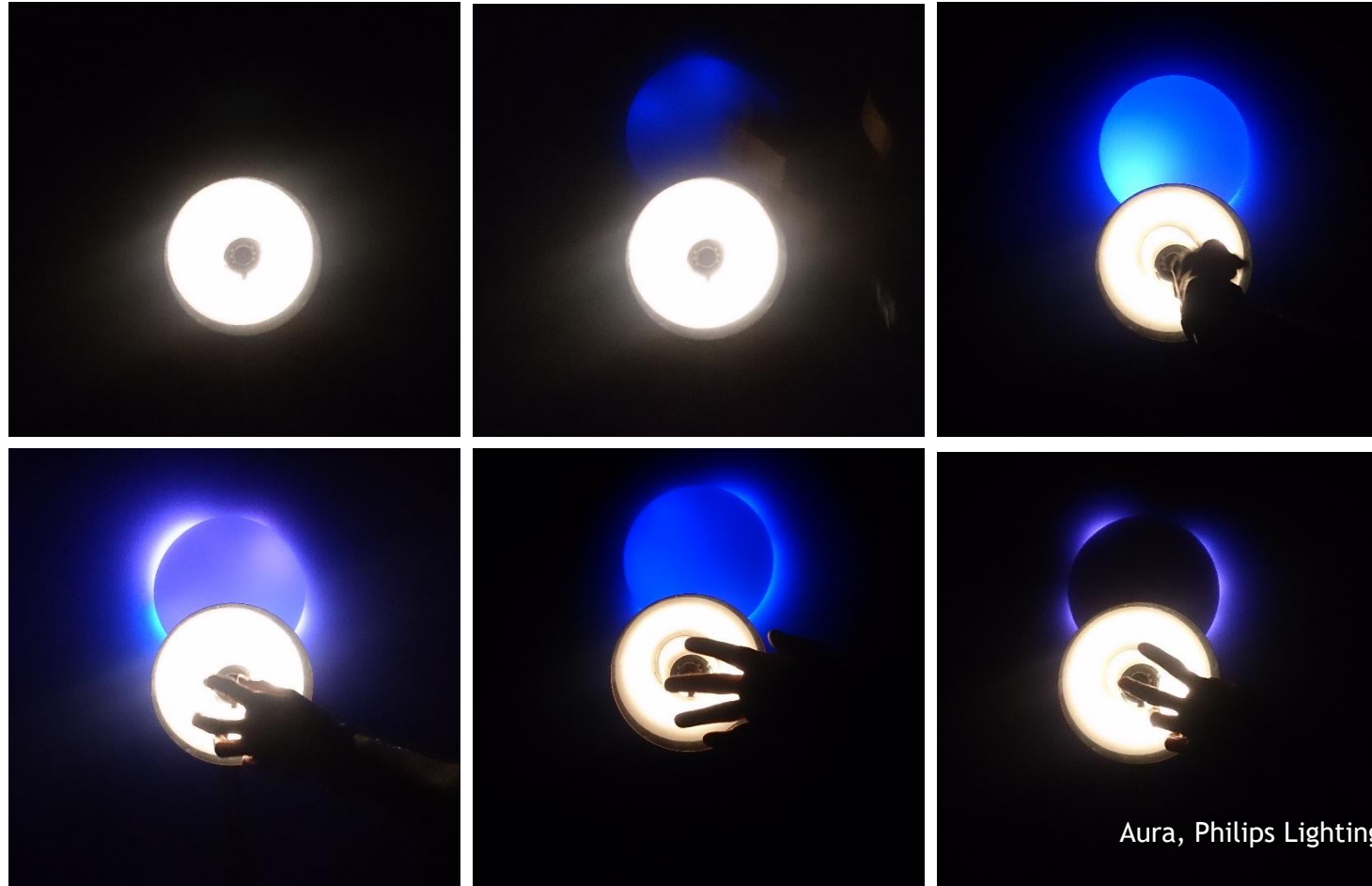
Technology is maturing, more compatibility is needed  
Interchangeable components needed

Full potential of dynamic technology not used  
New technological possibilities not available in all systems –  
„sticking to old functionalities“

**„Technology is the answer, but what are the questions?“**

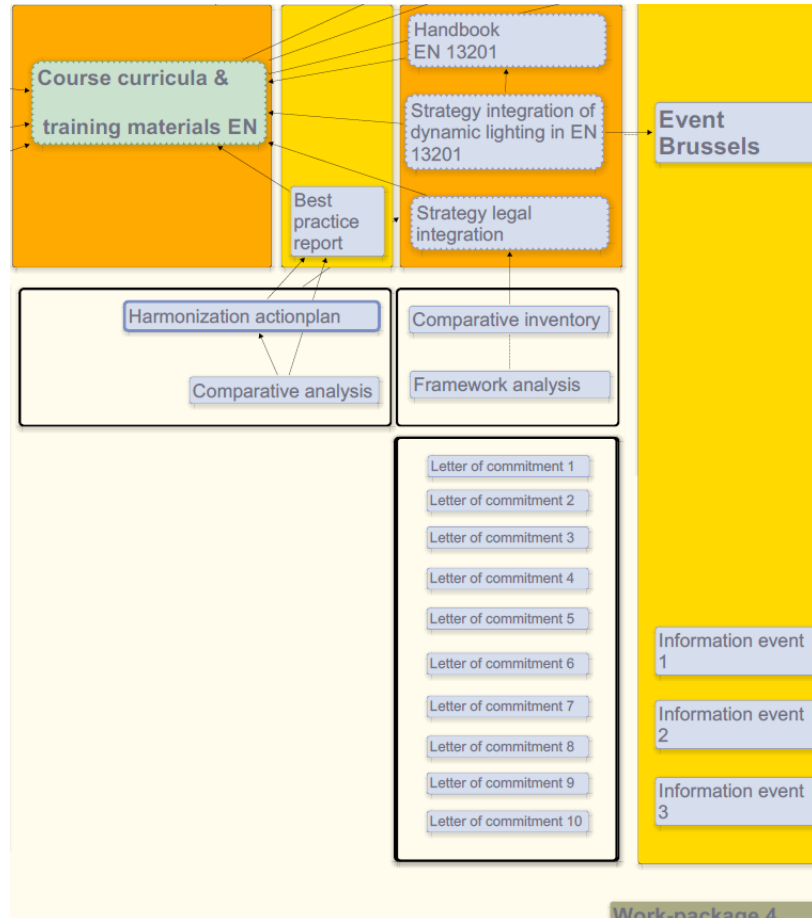
Cedric Price





# DYNAMIC LIGHT- WORKPACKAGE 4

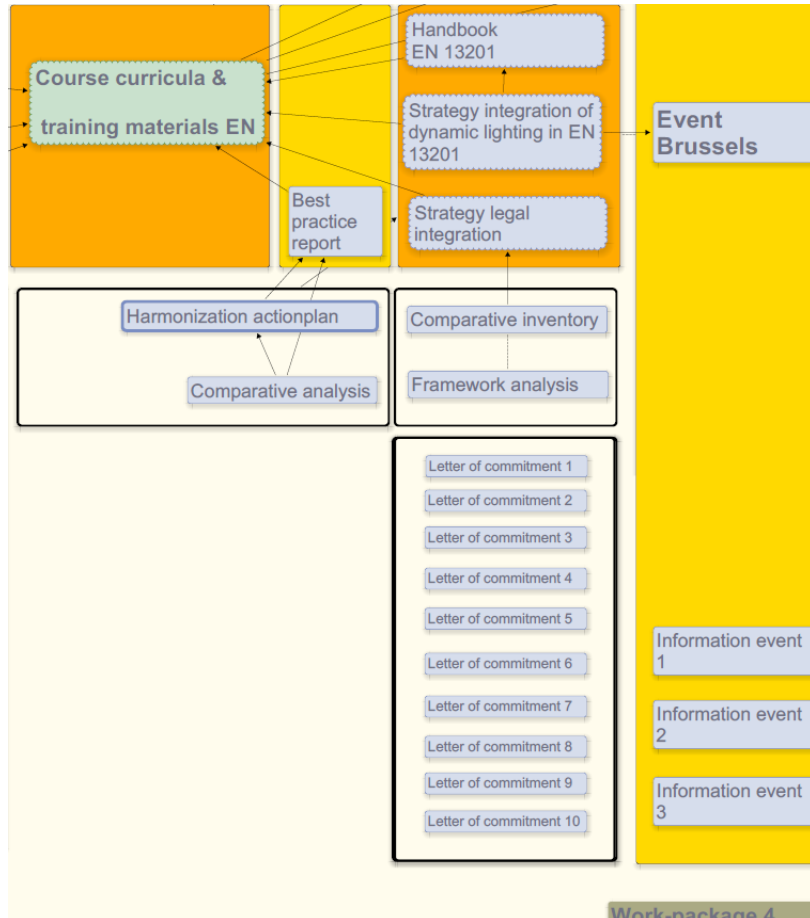
Legal aspects and harmonization of standards



- Harmonization of Standards
- Procurements rules
- EU- Regulations about energy efficiency

# DYNAMIC LIGHT- WORKPACKAGE 4

Rechtliche Aspekte und Harmonisierung der Normen



- Harmonisierung europäischer Normen
- Implementierung von Dynamischem Licht
- Rechtliche Rahmenbedingungen



## Working Definition of Dynamic Lighting

(Urban) dynamic lighting is adaptive and proactive lighting, i.e. it is being provided where and when it is needed depending on different variable conditions, such as travelling speed, traffic volume and/or composition, ambient luminances, weathers and other exterior factors in a way that it reduces light pollution as well as energy consumption; beyond that it recognizes varying human and social needs, such as aesthetics or feeling of safety, as a basic concern and key factor in the design of adaptive public lighting

## Adaptive Lighting, traffic volume related examples

- On a **radial road**, usually a dual carriageway, the traffic volume during peak hours in the morning and in the evening could be very different for the carriageways serving the two directions.
- On a **commercial street** there could be almost no traffic during the weekends.
- A **shopping street** may carry more traffic during the late afternoon hours of darkness compared to the early morning hours of darkness.
- A **residential or local street** leading to a school complex is busier during the hours of darkness in the morning than in the afternoon.
- **Roads providing access to sports and/or leisure facilities** are used more frequently during the hours of darkness in the afternoon or evening than in the morning.
- **Roads servicing exhibition areas or big stadia** may be used only some days during a year.

Ref.: 'Intelligent Energy - Europe' (IEE) project 'Energy Saving Outdoor Lighting' (ESOLi), 2012, [www.esoli.org](http://www.esoli.org)



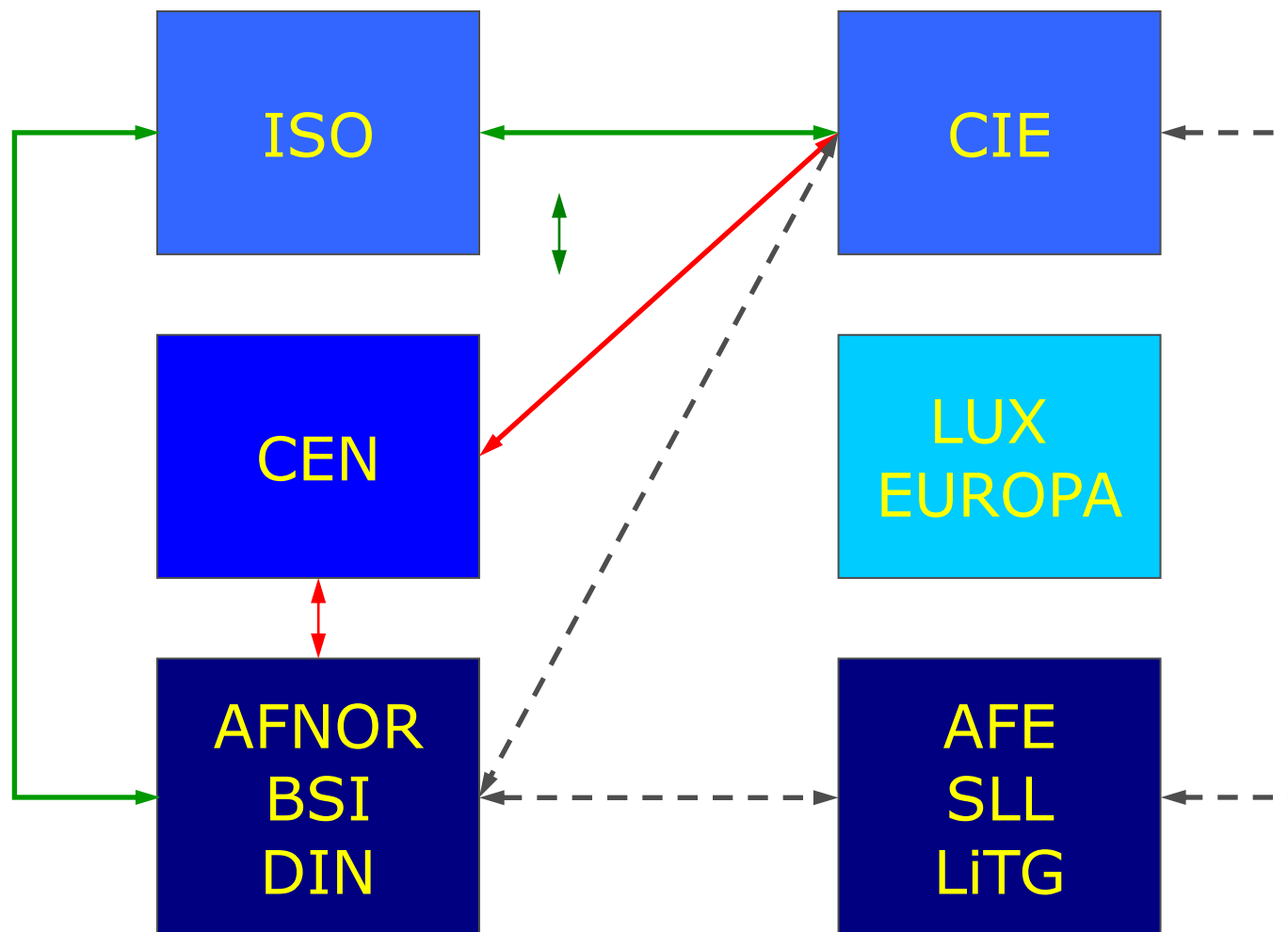
## Handbook Interpretation of EN 13201,

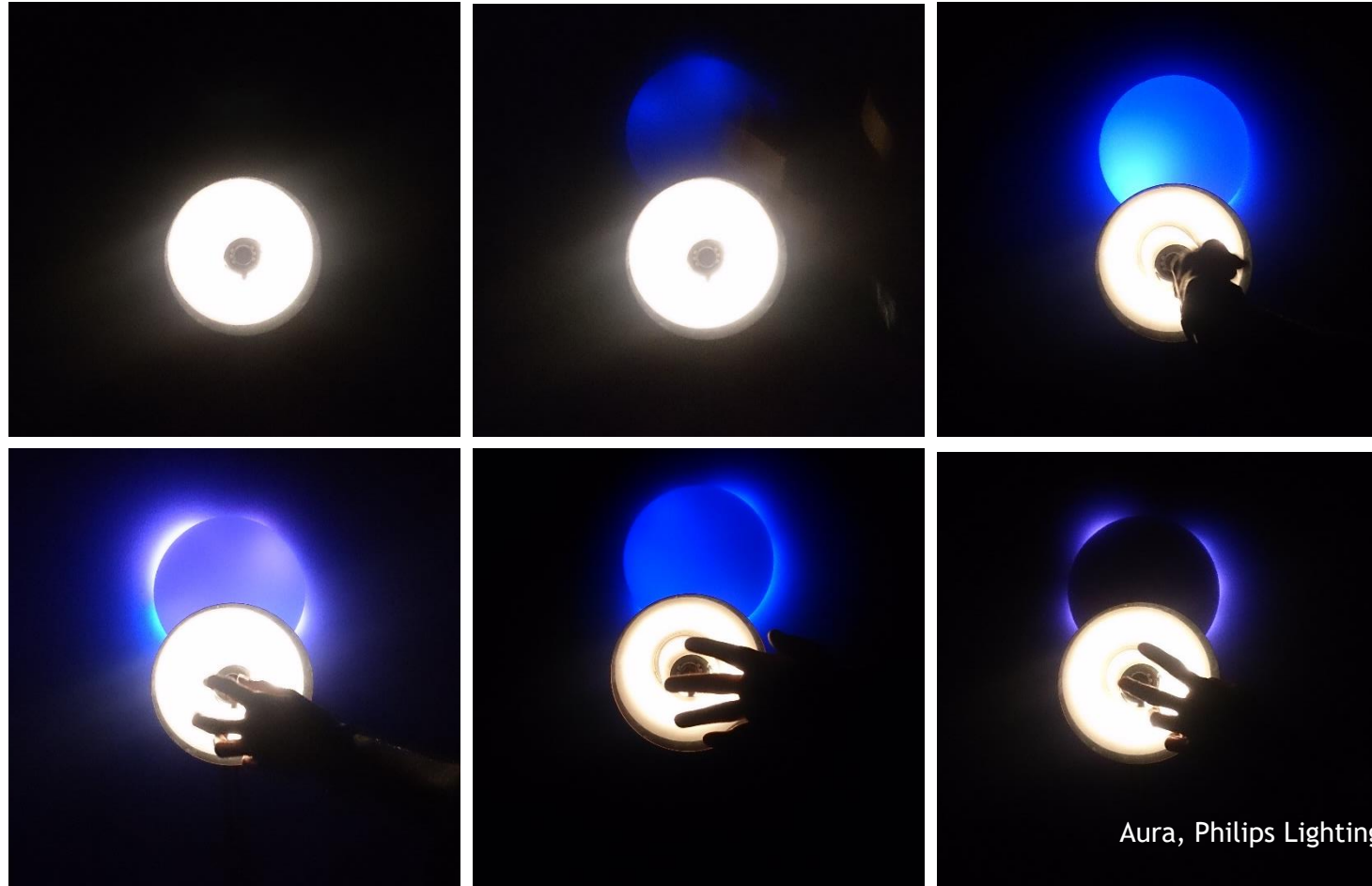
1. Introduction / Scope / Fundamentals
2. Purpose of road lighting
3. Lighting situations
4. Lighting classes
5. Quality criteria and lighting requirements
6. Areas not to be illuminated - obtrusive lighting
7. Adaptive / dynamic lighting - parameters to be considered
8. Energy efficiency indicators / Energy efficiency measures



# LEGAL ASPECTS AND HARMONIZATION OF STANDARDS

## STANDARDIZATION BODIES - THE NETWORK





# DYNAMIC LIGHT

## Summary

Dynamic Light is

**much more complex than static lighting**, both in terms of technology and greater consideration of spatial aspects and user behaviour.

Dynamic Light brings

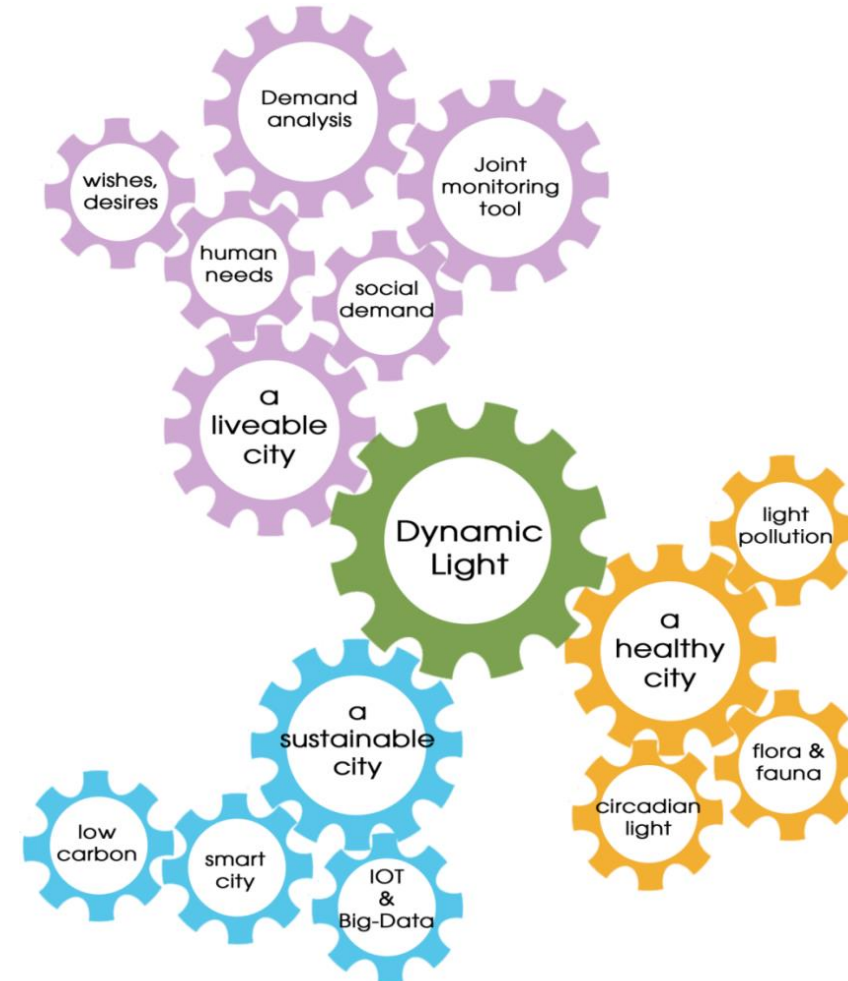
**a temporal differentiation**

in the lighting design.

**Each project requires its own analysis** of situational requirements.

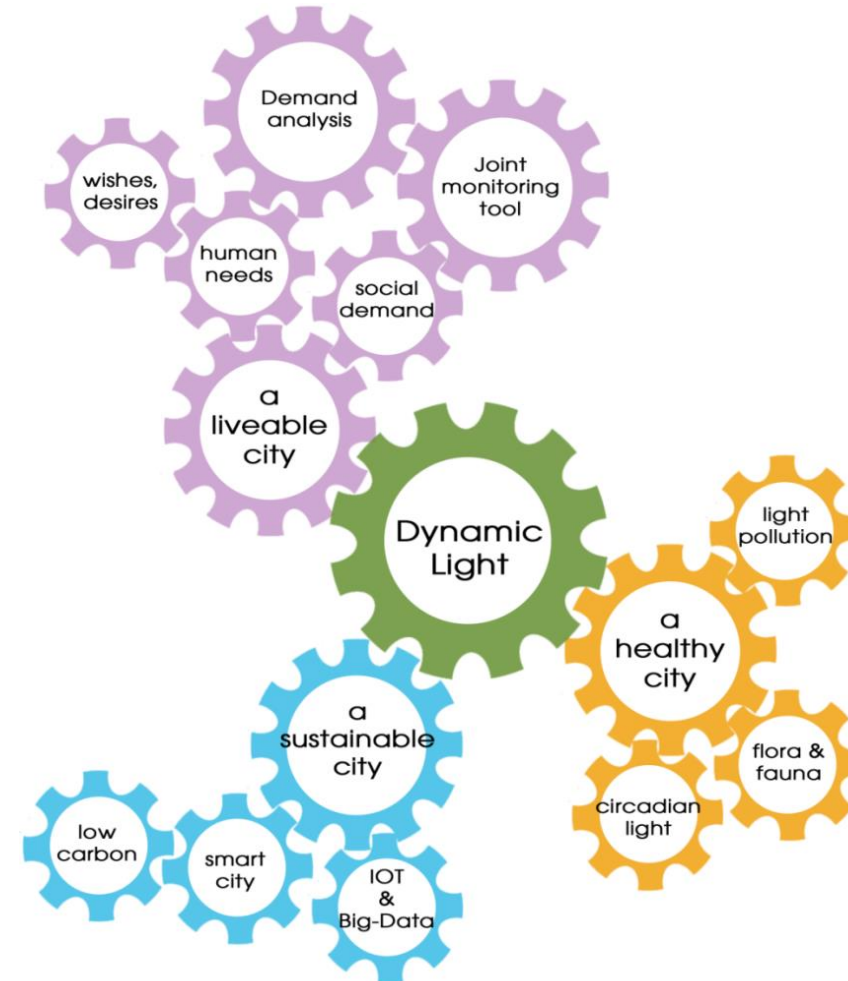
**The parameters have to be evaluated according to the design and the algorithms have to be developed in the same way.**

New data sources allow new applications that can increase the quality of lighting.



## Zusammenfassung

- Dynamic Light ist deutlich komplexer als eine statische Beleuchtung, sowohl in technischer Hinsicht als auch durch eine stärkere Berücksichtigung von räumlichen Aspekten und dem Verhalten der Nutzer.
- Dynamic Light bringt eine zeitliche Differenzierung
- in den Beleuchtungsentwurf.  
Jedes Projekt erfordert eigene Analyse der situative Anforderungen
- Die Parameter sind entwurfsspezifisch zu werten und die Algorithmen entsprechend zu entwickeln
- Neue Datenquellen erlauben neue Anwendungen, die die Qualität der Beleuchtung erhöhen können.

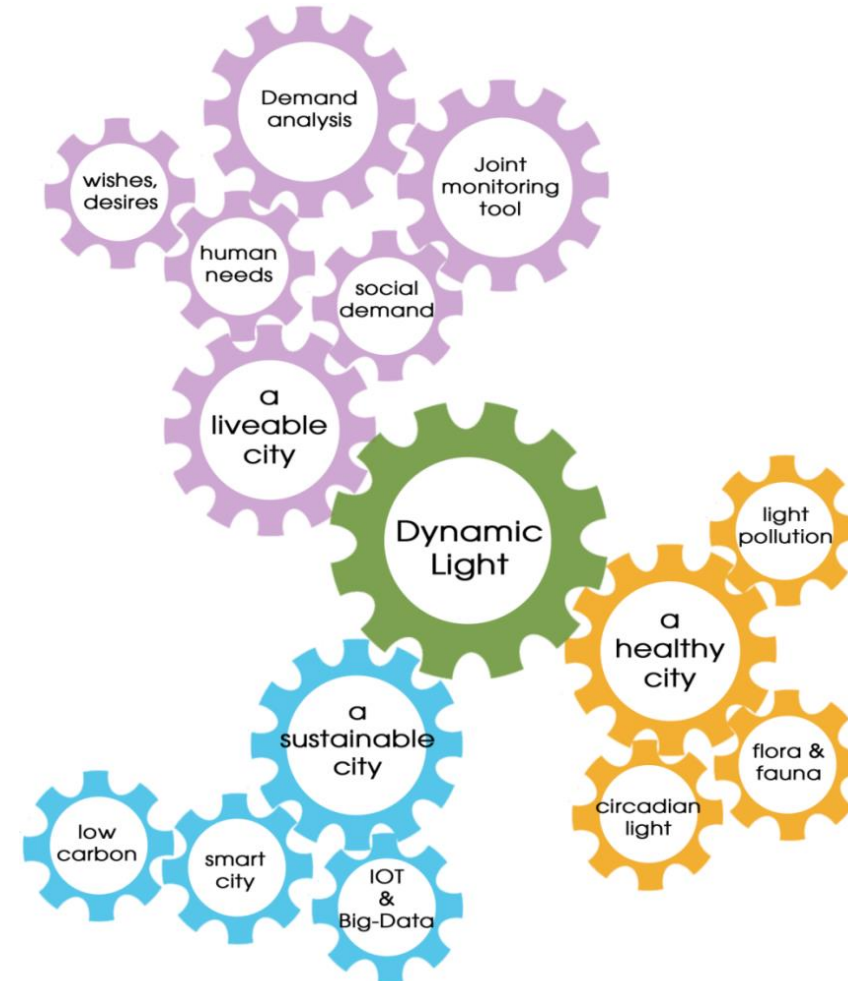


## Zusammenfassung

Die Nutzung der neuen Technologien in Straßenbeleuchtung kann zu einer noch effizienteren Nutzung der Energie führen! Wichtiger ist aber das Potential, die Beleuchtung

- auf die sozialen Bedürfnisse der Nutzer zuzuschneiden,
- die Attraktivität des abendlichen Raumes zu steigern und
- die Fauna besser zu berücksichtigen.

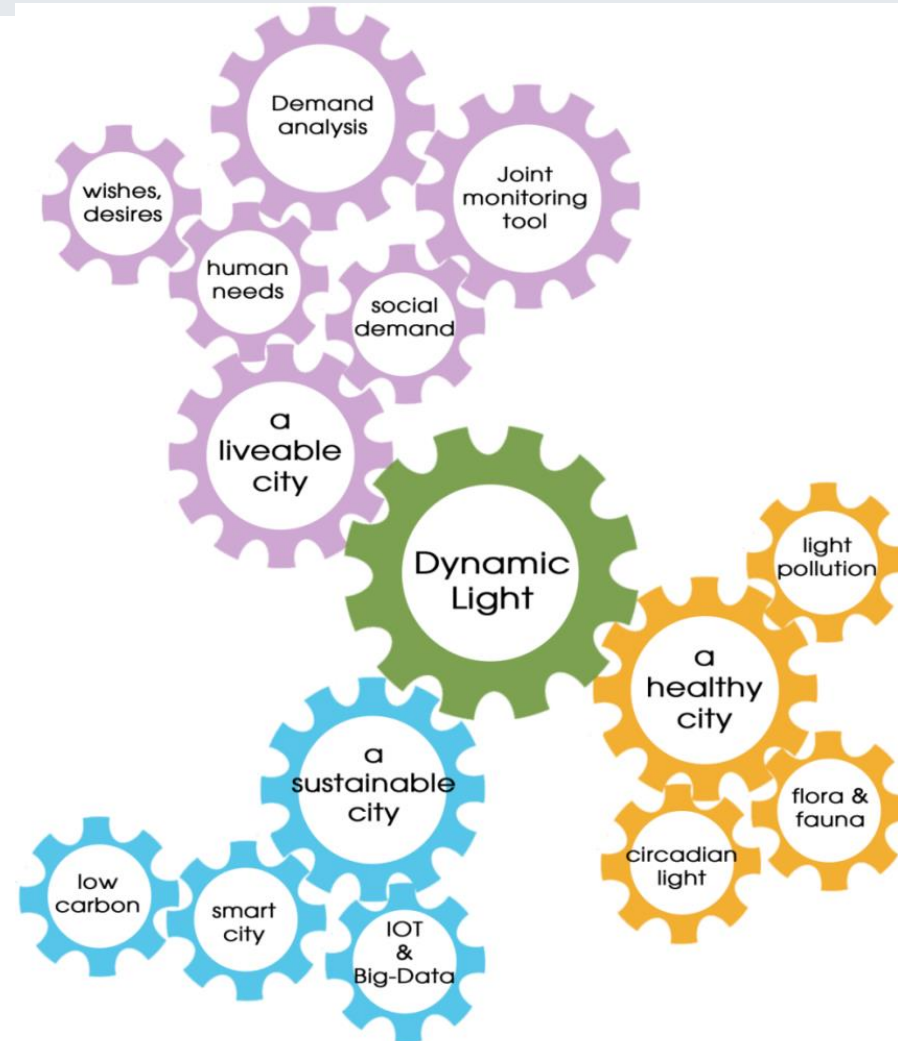
Dynamik Light meint die angemessene Beleuchtung zur Nutzung des abendlichen und nächtlichen Raumes





Zusammenfassung:

***Suffizienz!***



**Danke!**





Prof. Dr. Thomas Römhild



[Thomas.roemhild@hs-Wismar.de](mailto:Thomas.roemhild@hs-Wismar.de)



+49-3841-753-7602



[www.interreg-central.eu/dynamic-light](http://www.interreg-central.eu/dynamic-light)

Newsletter



<https://www.facebook.com/Dynamic-Light-Dynamic-Intelligent-Energy-Efficient-Urban-Lighting-288133781567988/>





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Newsletter



<https://www.facebook.com/Dynamic-Light-Dynamic-Intelligent-Energy-Efficient-Urban-Lighting-288133781567988/>



# DYNAMIC LIGHT

## Summary

The use of new technologies in street lighting can lead to even more efficient use of energy!

- But more important is the potential, **to tailor the lighting** to the social needs of users,
- **to increase the attractiveness** of the evening public space and
- **to reduce light pollution**
- to take better account of the fauna.

Dynamics Light means  
**the "adequate lighting"**  
to use the evening space by night  
In more liveable, healthy, attractive way!



# DYNAMIC LIGHT AIMS TO....

*Sufficiency!*



THANK YOU!

