

# Project partners

## 4 cities

each 2 pilot sites

## 3 universities

KUL Light and Lighting Lab

UPJV Lab. Technologies Innovantes

TU/e Intelligent Lighting Institute

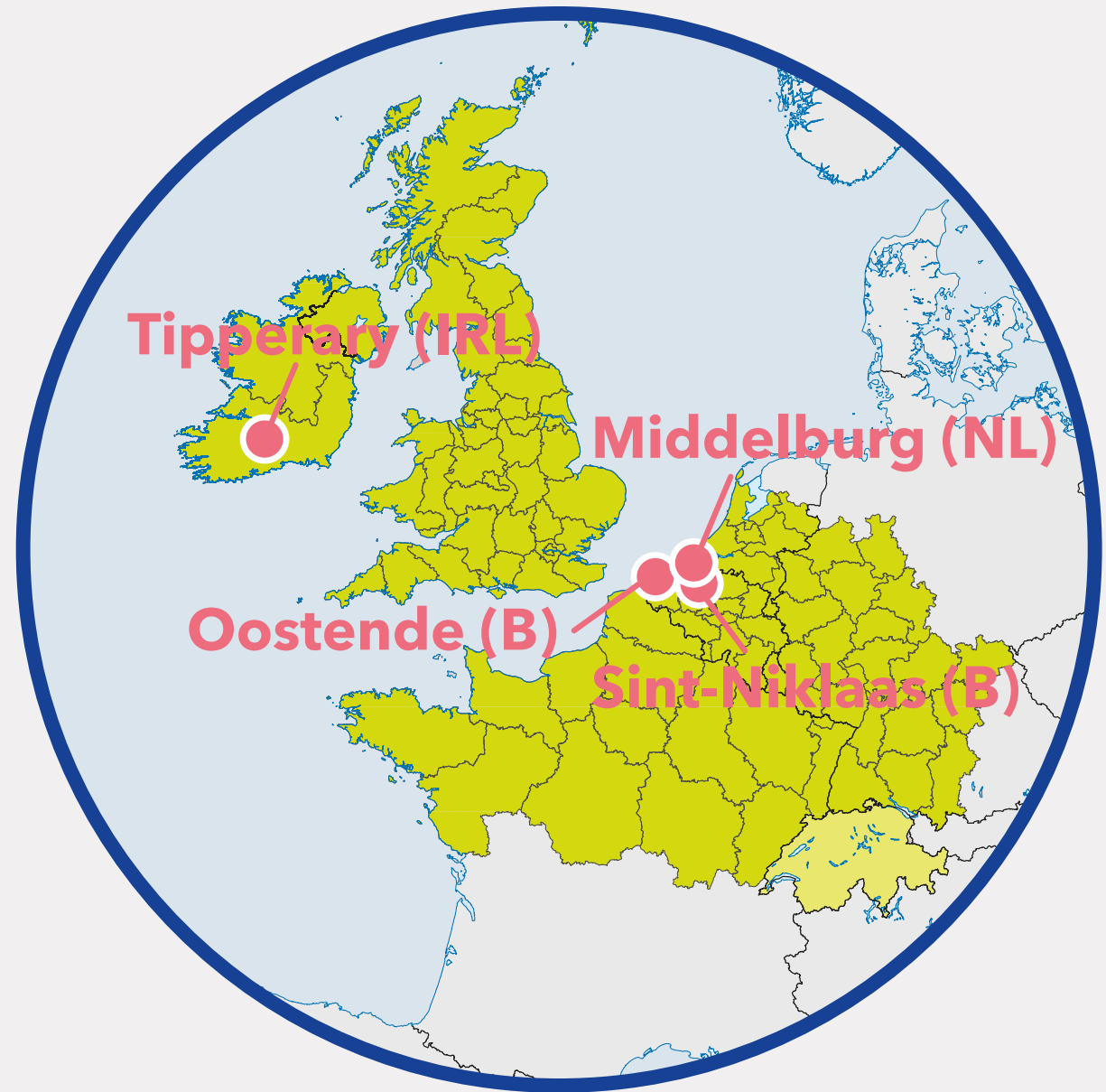
## 2 companies

Spie (Ziut)

Intemo

## 1 network organisation

LUCI



# Aim of the project

SMART-SPACE aims to facilitate the uptake of smart lighting in small/mid-size municipalities to enhance energy-efficiency and reduce CO2 emission.

by

Implementing smart lighting infrastructure in 8 pilot sites

Starting from use needs and wishes

Improve energy use and liveability in public space

# What is Smart Lighting?

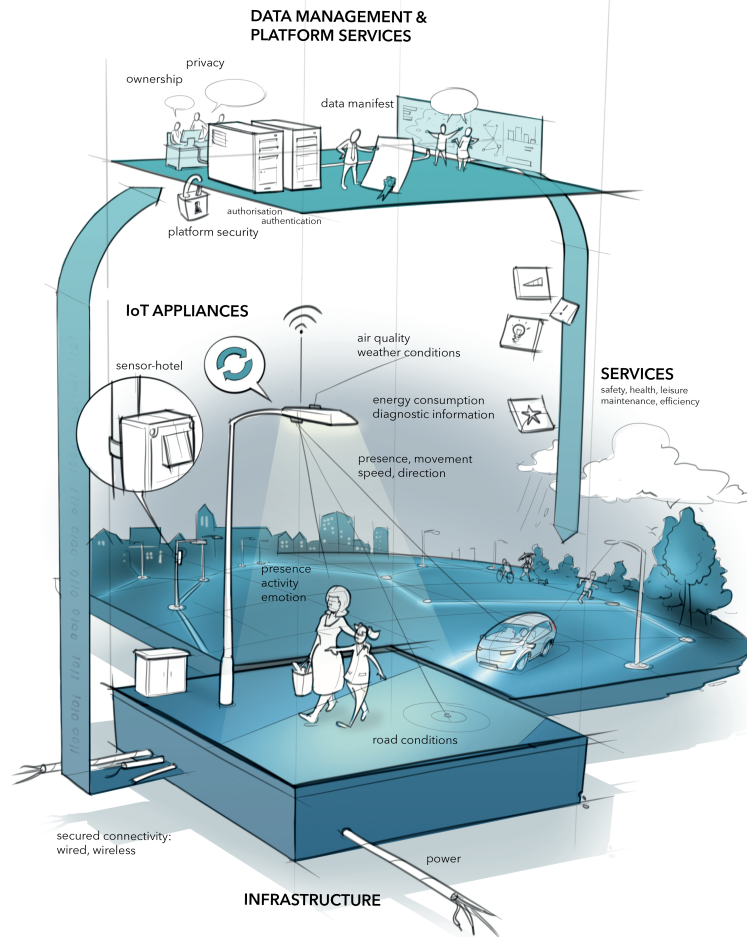
Data management

Controls  
(sensors & software)

Lighting  
(public lighting including special elements)

Infrastructure  
(energy & connectivity)

## Smart public lighting



- enabling people to use and enjoy public space
- providing the right light at the right moment, the right place, and with the right atmosphere
- **realising a higher level of well-being**
- integrating sensors and software controls
- adjusting to the actual local needs
- **realising efficiency energy consumption**

# Approach

Investigating  
citizens needs

Co-creating  
use cases

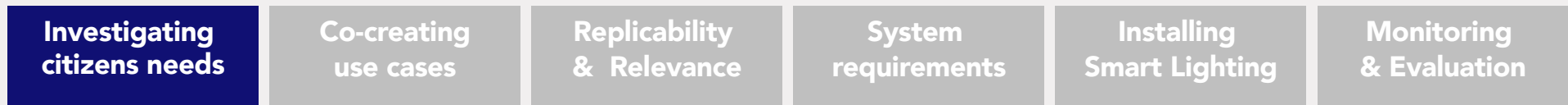
Replicability  
& Relevance

System  
requirements

Installing  
Smart Lighting

Monitoring  
& Evaluation

# Approach



## Cool wall session

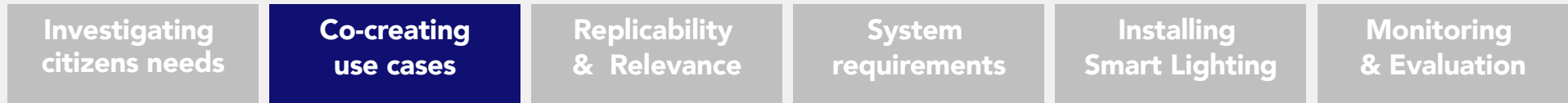
- Playful way to collect insights from citizens and other stakeholders
- Citizens as experts of their living environments
- Start a dialogue through a simple question:
- “What are pleasant or unpleasant places in the area?”

*Why are they (un)pleasant? (needs)*

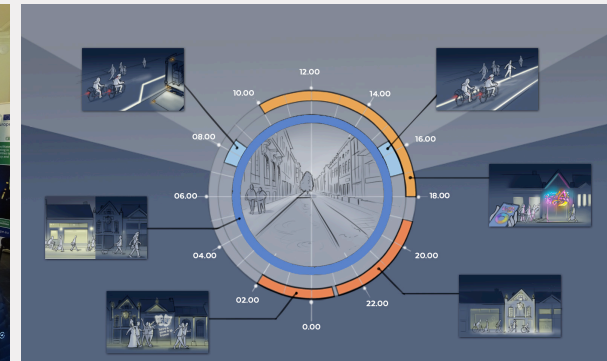
*What is there to improve? (opportunities)*



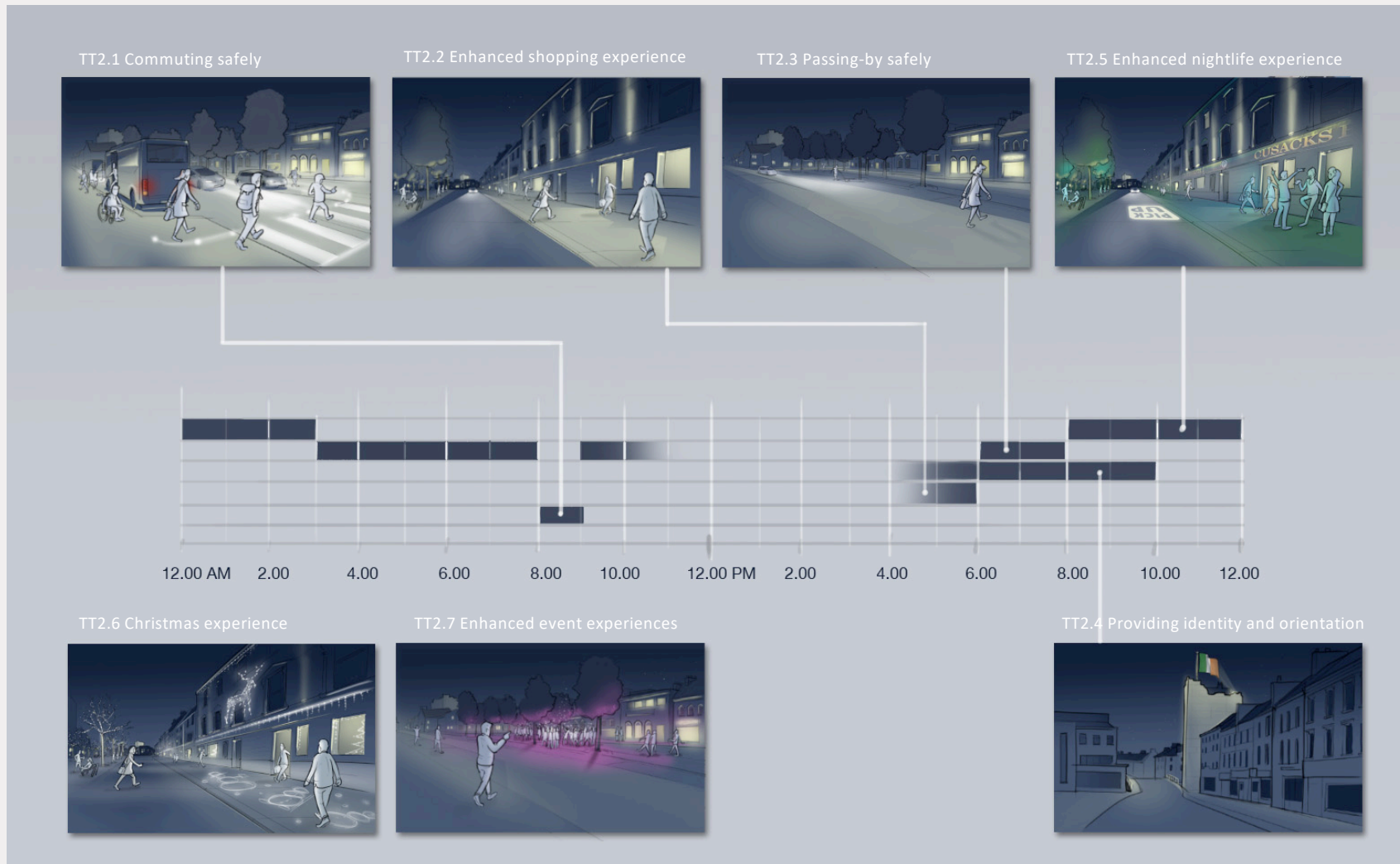
# Approach



- The pilot sites are analysed and 8 use cases are developed with local stakeholders, the municipality and experts
- Creating story boards of interactive use of smart lighting



# Use case example: Supporting event experiences on Liberty Square in Tipperary



# 33 desired scenarios are designed as a basis for the smart lighting system in these places



# Approach



Replicability by validating the use cases in 10 follower cities

Relevance of smart interaction: 3 clusters of anticipated use



# A – Improving safety for all road users

Activity:  
**passing-by, cycling, driving or commuting**

Wants:  
**feeling safe when going from a to b in an efficient and comfortable way**

Need:  
**to orientate and detect (potential) hazard**

Lighting:  
**provide sufficient illuminance on the road with acceptable spread and reduce glare**



Safe walking & cycling along mixed traffic roads (R-roads) in Thurles

# B – Enhancing leisure experiences

**Activity:**  
enjoying life outside for different activities, such as shopping, sports, strolling along, sitting in the park or visiting events

**Wants:**  
doing different activities with an enhanced experience

**Need:**  
an attractive public space that enables the activity

**Lighting:**  
illuminate the vertical elements with the right amount of sparkle



Lively urban space evoking (social) activities in the Victorialaan, Oostende

# C – Increasing security for nightlife

Activity:  
**night life experience where safety and security are important issues**

Wants:  
**support police or camera surveillance as well as de-escalate aggressive behaviour**

Need:  
**(their perception of) safety**

Lighting:  
**balanced spatial illuminance (no hard shadows) with small spread of luminance's (adaptation CCTV) and avoid glare in line of sight**



Perceived safety at the night life area Sint-Nicolaasplein in Sint-Niklaas

# Approach

Investigating citizens needs

Co-creating use cases

Replicability & Relevance

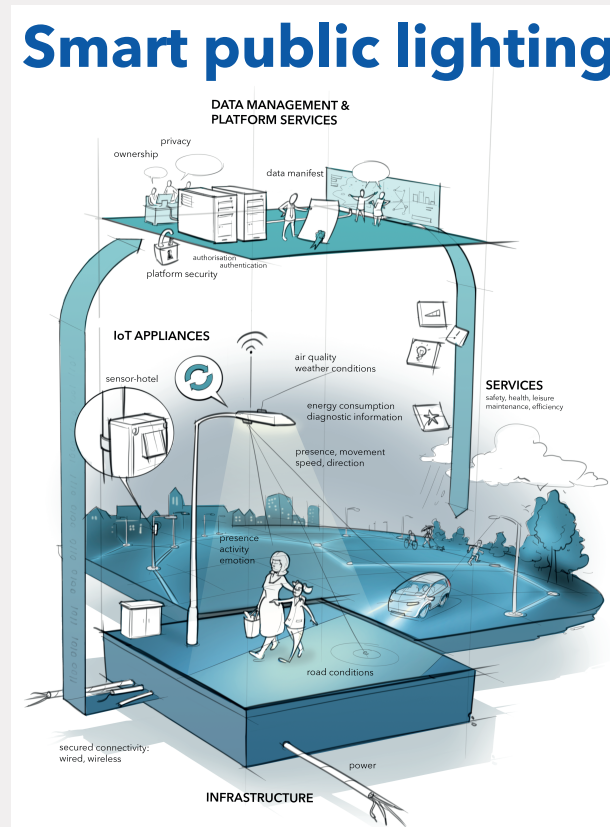
**System requirements**

Installing Smart Lighting

Monitoring & Evaluation

## System design

- Interaction levels for use
- Module design for system
- Functional requirements



# Interaction levels in Smart Lighting

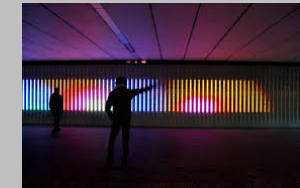
## 5 Intelligent

- Personalised effect
- Decisions based on learning
- Historical data for improvement system



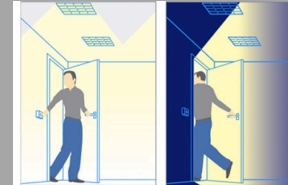
## 4 Interactive

- Dynamic scenes with localised effect
- Multiple triggers or use actions
- Monitoring data



## 3 Reactive

- Multiple static scenes
- Single trigger or sensing
- Logging data



## 2 Active

- Multiple static scenes
- Switch by calendar
- No data

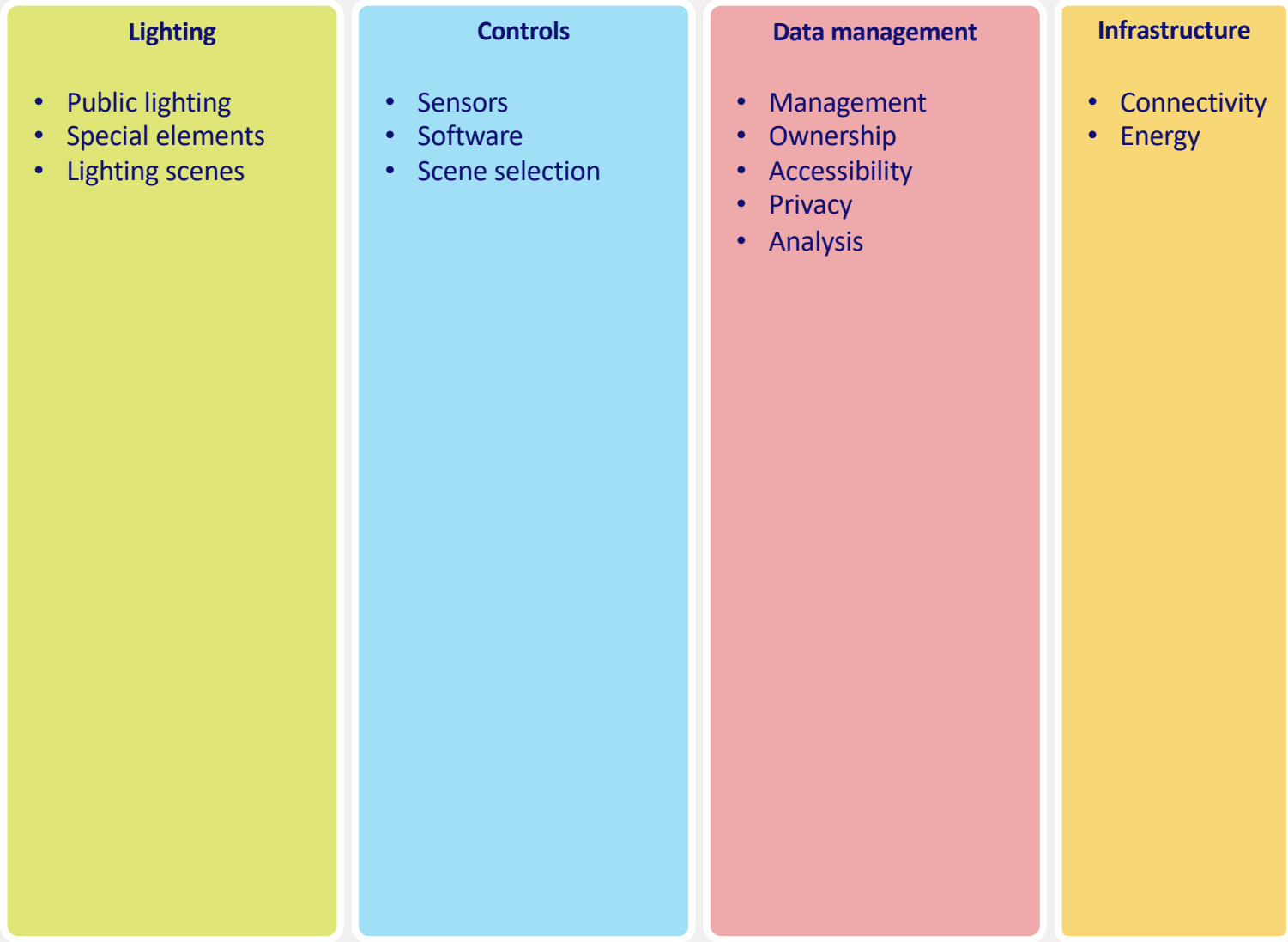


## 1 Static

- One scene
- On/off by clock
- No data

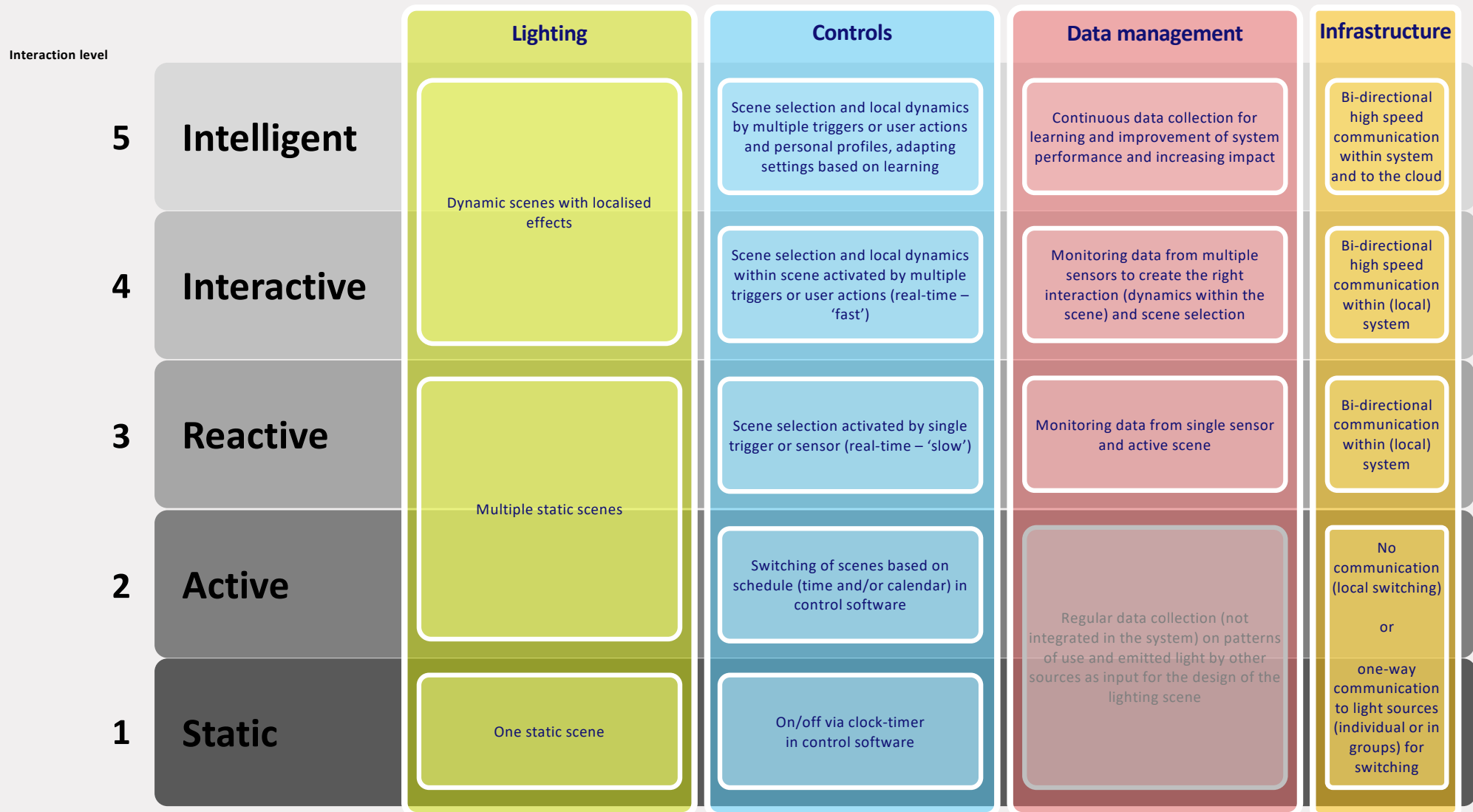


# Smart Lighting System components



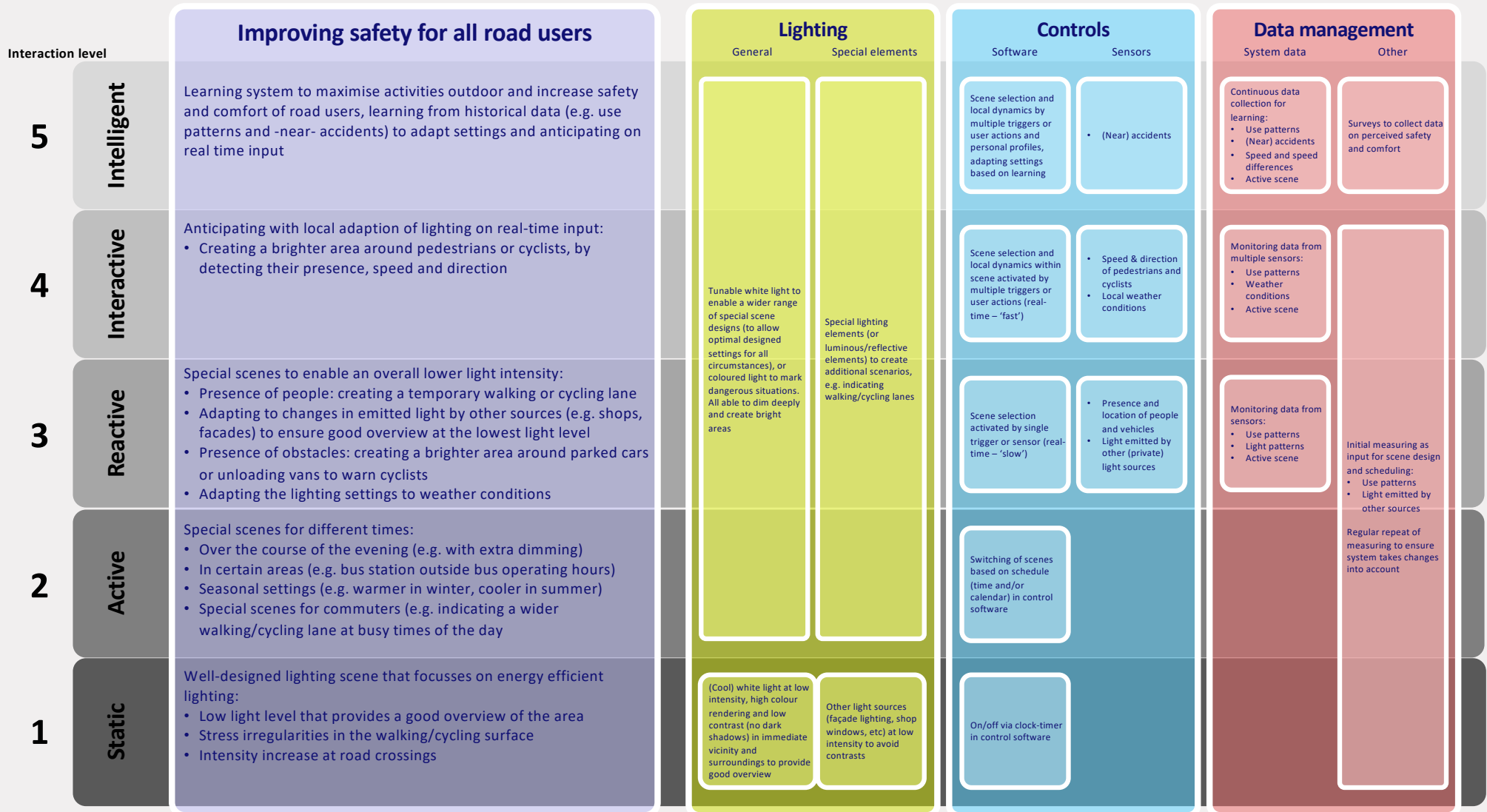
# Interaction levels and requirements for Smart Lighting System

Note: higher levels also need the functionality of the lower levels



# System requirements A – Improving safety for all road users

Note: higher levels also need the functionality of the lower levels



# System requirements B – Enhancing leisure experiences

Note: higher levels also need the functionality of the lower levels

Interaction level		Enhancing leisure experiences	Lighting		Controls		Data management	
			General	Special elements	Software	Sensors	System data	Other
5	Intelligent	<p>Personalised experiences by connecting online user profiles and personal data to select scenes and learning from results:</p> <ul style="list-style-type: none"> <li>Personalised shopping routes</li> <li>Personalised training, e.g. interval training and high score 'show'</li> <li>Turning events into personal experience by e.g. special shows related to favourite team, or special x-mas shows.</li> </ul>		<p>Special lighting elements (sufficient contrast with general lighting) to create interactivity, e.g. active guiding of people, playful interactions with projections or special fabulous x-mas experience or personalised effects</p>	<p>Scene selection and local dynamics by multiple triggers or user actions and personal profiles, adapting settings based on learning</p>	<ul style="list-style-type: none"> <li>Mac/blue tooth detection (for personalised interaction)</li> <li>Mood / emotion</li> </ul>	<p>Continuous data collection for learning:</p> <ul style="list-style-type: none"> <li>Use patterns</li> <li>Emotions</li> <li>Active scene</li> </ul>	
4	Interactive	<p>Anticipating with local adaption of lighting on real-time input:</p> <ul style="list-style-type: none"> <li>Nudging people with dynamic lighting to other parts of the area</li> <li>Guiding people to events</li> <li>Adapting the speed of progressive lighting to the actual running or walking speed</li> <li>Allowing users to make and display own content for projections</li> </ul>	<p>(Tunable) white light to enable a wider range of special scene designs, able to dim deeply and create bright areas.</p> <p>Optional addition of RGB to create special effects and atmospheres.</p>		<p>Scene selection and local dynamics within scene activated by multiple triggers or user actions (real-time – 'fast')</p>	<ul style="list-style-type: none"> <li>Speed &amp; direction of (groups of) people</li> <li>User content</li> </ul>	<p>Monitoring data from multiple sensors:</p> <ul style="list-style-type: none"> <li>User input</li> <li>Use patterns</li> <li>Active scene</li> </ul>	<p>Surveys to collect user feedback on experience</p>
3	Reactive	<p>Special scenes reacting to real-time input:</p> <ul style="list-style-type: none"> <li>Presence and spreading of people to offer a specific scene</li> <li>Presence detection to activate a running track with speed indication by progressive lights 'virtual hare')</li> <li>Detecting type of activity to adapt the lighting and invite others (e.g. strolling along, sitting in the park)</li> <li>Reacting to events (e.g. goal)</li> </ul>	<p>The design of the luminaires and poles can support the experience, e.g. homely lanterns, cosy strings, elegance or resemblance to cultural items.</p>		<p>Scene selection activated by single trigger or sensor (real-time – 'slow')</p>	<ul style="list-style-type: none"> <li>Presence, location and spreading of (groups of) people</li> <li>Type of activity</li> <li>Connection to e.g. websites (live sports game results)</li> </ul>	<p>Monitoring data from sensors:</p> <ul style="list-style-type: none"> <li>Use patterns</li> <li>Light patterns</li> <li>Active scene</li> </ul>	
2	Active	<p>Special scenes for different times to keep it interesting:</p> <ul style="list-style-type: none"> <li>Seasonal settings (e.g. warmer in winter, cooler in summer)</li> <li>Different routes through the city (e.g. based on opening times)</li> <li>For different events (e.g. sports games or music festivals) or occasions (e.g. x-mas)</li> <li>For different activities, evoking people to take part</li> </ul>		<p>Special lighting elements (sufficient contrast with general lighting) to create additional scenarios, e.g. to guide people or create special effects</p>	<p>Switching of scenes based on schedule (time and/or calendar) in control software, especially event scheduling</p>			<p>Initial measuring as input for scene design and scheduling:</p> <ul style="list-style-type: none"> <li>Use patterns</li> <li>Light emitted by other sources (facades, shop windows, event lighting)</li> </ul>
1	Static	<p>Well-designed lighting scene, tailor-made to the environment:</p> <ul style="list-style-type: none"> <li>Warm atmosphere with uniform horizontal lighting at low intensity to emphasise the lighting of shops, facades or events</li> <li>Good lighting for outdoor activities (e.g. running, cycling, playing)</li> </ul>	<p>Shopping: low intensity &amp; contrast (warm) white for a warm atmosphere incl. lighting of shops, facades or events. Outdoor activities: Good lighting to support activities.</p>	<p>Other sources (façade lighting, shop windows event lighting) at (slightly) higher intensity to make the area attractive.</p>	<p>On/off via clock-timer in control software</p>			<p>Regular repeat of measuring to ensure system takes changes into account</p>

# System requirements C – Increasing security for nightlife

Note: higher levels also need the functionality of the lower levels

Interaction level		Increasing security for nightlife	Lighting		Controls		Data management	
			General	Special elements	Software	Sensors	System data	Other
5	Intelligent	Learning and adapt the scenes to avoid incidents or evacuate the area as efficiently as possible, with learnings to increase the attractiveness from the number of people, atmosphere, business at cafes and restaurants, personal profile settings.	(Tunable) white light to enable a wider range of special scene designs, able to dim deeply and create bright areas.  Optional addition of RGB to create special effects and atmospheres	Special lighting elements to create interactivity, e.g. active guiding of people to make them feel welcome, 'say goodbye' at the end of the evening, or create clearly visible escape routes in case of incidents or calamities	Scene selection and local dynamics by multiple triggers or user actions and personal profiles, adapting settings based on learning	<ul style="list-style-type: none"> <li>Mac/blue tooth detection (for personalised interaction)</li> </ul>	Continuous data collection for learning: <ul style="list-style-type: none"> <li>Use patterns</li> <li>Mood/emotions</li> <li>Incidents</li> <li>Evacuation progress</li> <li>Active scene</li> </ul>	
4	Interactive	Reacting to incidents with special scenes to guide people to exits of the area, or distract attention to avoid escalation of aggression, with reacting to the direction of movement (coming in or going away) or adapting the lighting to the mood in groups of people.			Scene selection and local dynamics within scene activated by multiple triggers or user actions (real-time – 'fast')	<ul style="list-style-type: none"> <li>Speed &amp; direction of (groups of) people</li> <li>Mood / emotion</li> </ul>	Monitoring data from multiple sensors: <ul style="list-style-type: none"> <li>Use patterns</li> <li>Incidents</li> <li>Mood/emotions</li> <li>Active scene</li> </ul>	Surveys to collect user feedback on experience  Communication with security control room
3	Reactive	Increasing light levels when incidents or calamities are detected, so emergency services have good visibility, with adjusting the public lighting to the amount of people or to balance with private lighting using active measurements.	(Tunable) white light to enable a wider range of special scene designs, able to dim deeply and create bright areas (e.g. to draw people into the area in the early evening or at exits of the area at the end of the evening, or at calamities).  Optional addition of RGB to create special effects and atmospheres	Special lighting elements (e.g. facades, or decorative lighting) included in overall scene design to make the area more attractive and create special scenes over the course of the evening or seasons.	Scene selection activated by single trigger or sensor (real-time – 'slow')	<ul style="list-style-type: none"> <li>Presence, location and spreading of (groups of) people</li> <li>Detection of incidents</li> <li>Light emitted by private light sources</li> </ul>	Monitoring data from sensors: <ul style="list-style-type: none"> <li>Use patterns</li> <li>Light patterns</li> <li>Active scene</li> </ul>	
2	Active	Special scenes to adapt to other light sources to ensure good visibility over the course of the night, with special scenes for different events, to make people feel welcome and to say goodbye after an evening out.			Switching of scenes based on schedule (time and/or calendar) in control software, especially event scheduling			Initial measuring as input for scene design and scheduling: <ul style="list-style-type: none"> <li>Use patterns</li> <li>Light emitted by other sources (facades, decorative lighting)</li> <li>Location of cafés, restaurants and events</li> </ul>
1	Static	Providing good visibility for cameras and security guards with a lighting scene that creates a warm atmosphere, making use of the features of the area in a layered design, avoiding dark spots (suitable lay out with e.g. low poles and short spacing).	Night life: low intensity & contrast (warm) white for a warm atmosphere Security: high uniformity to support visibility	Other sources (façade lighting, decorative lighting) to create a layered design to make the area attractive and avoid dark spots or high contrasts.	On/off via clock-timer in control software			Regular repeat of measuring to ensure system takes changes into account

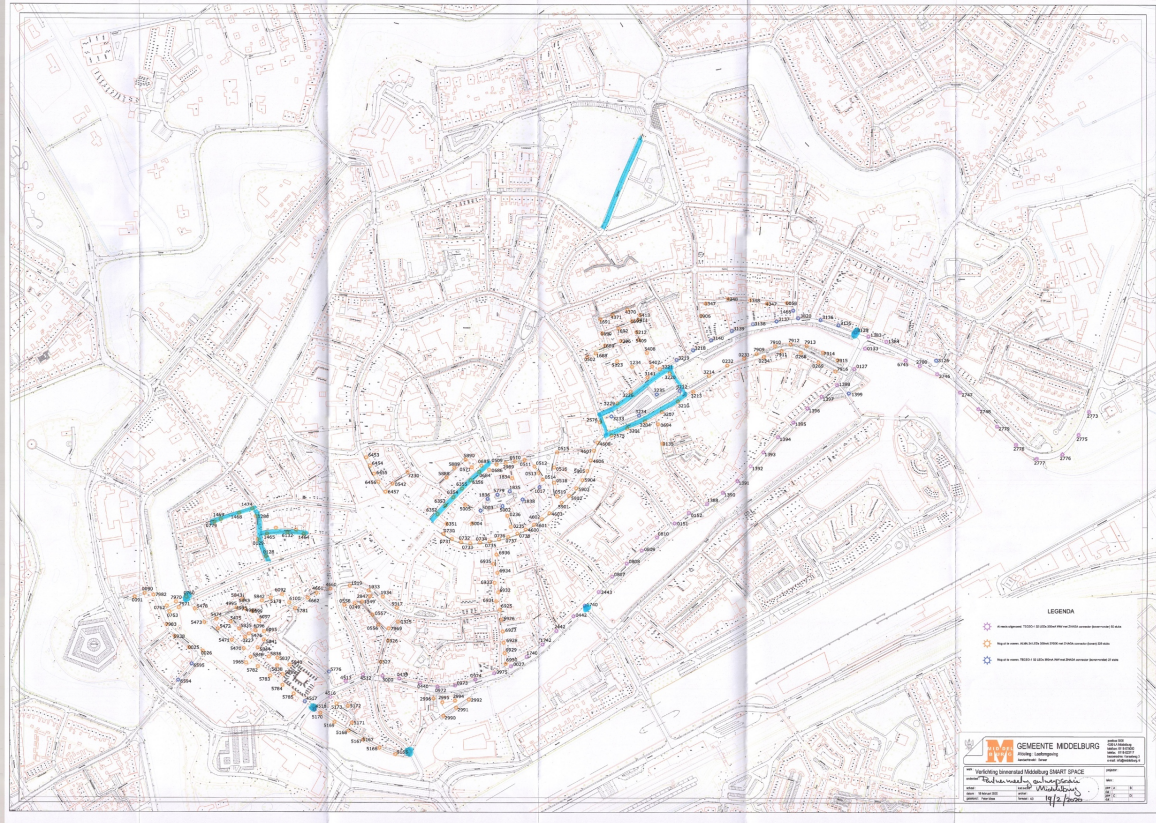
# Approach: next steps



Pilot site lighting design

Smart Lighting System design

Implementation



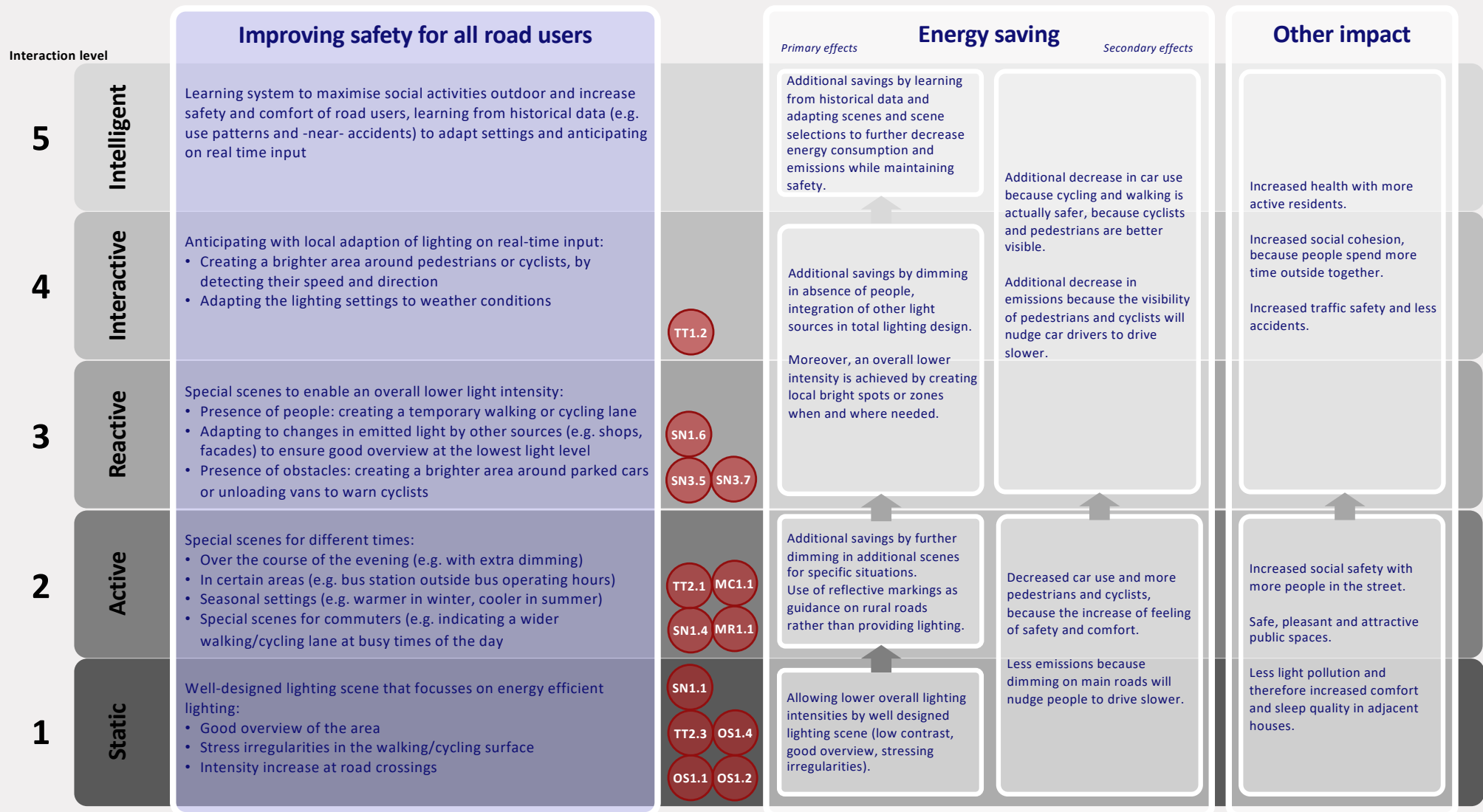
# Approach: next steps



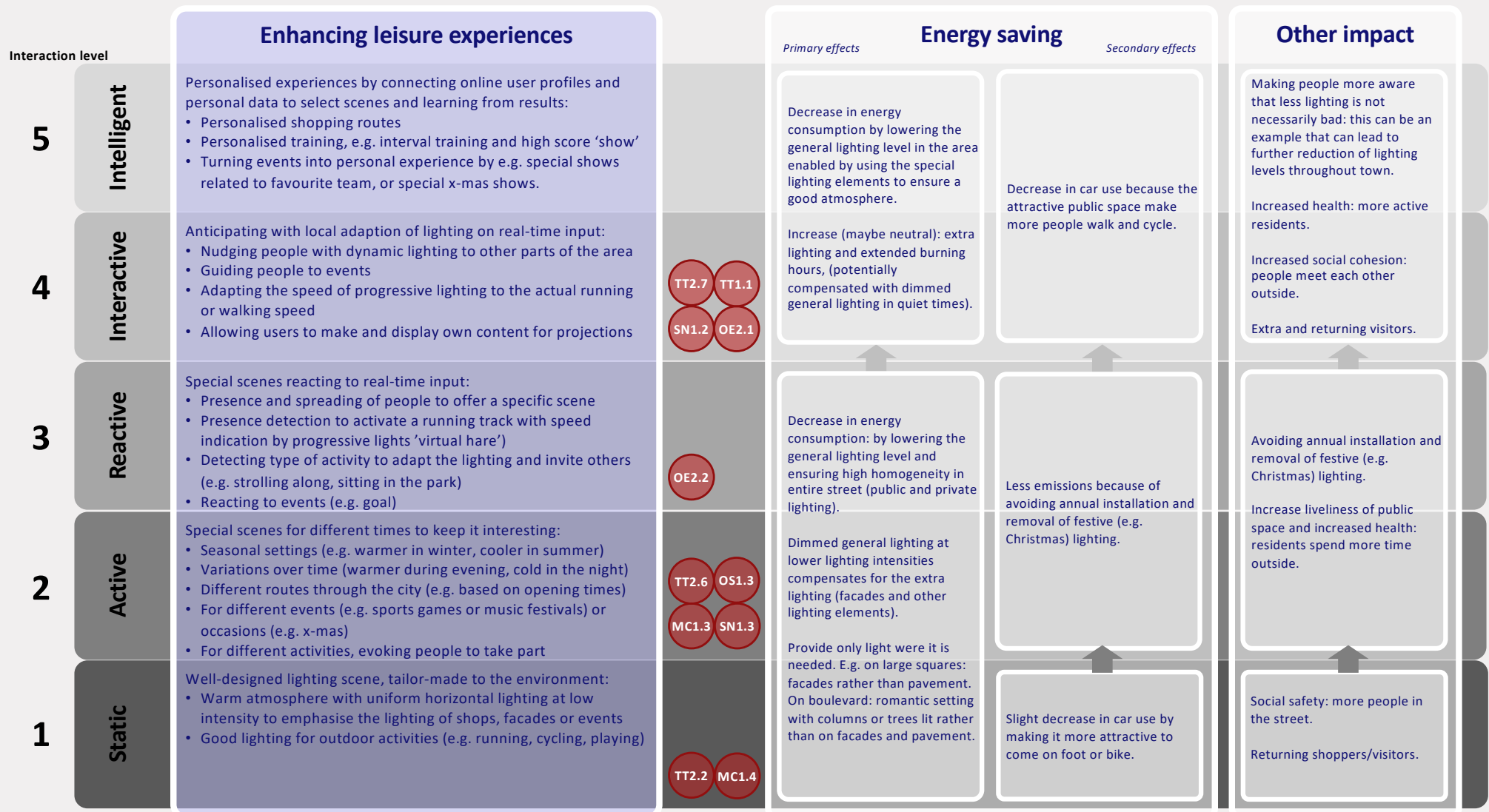
## Monitoring over time

- Energy use
- Light quality
- Citizens perspective

# Potential impact A – Improving safety for all road users



# Potential impact B – Enhancing leisure experiences



# Potential impact C – Increasing security for nightlife

