MAtchUP

D4.6: Public Lighting in Antalya. (First version)

WP 4, T 4.4

September 2019 (M24)

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MAtchUP - SCC-1-2016-2017

Innovation Action – GRANT AGREEMENT No. 774477

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N°774477

Technical References

Project Acronym	**MAtchUP**
Project Title	MAximizing the UPscaling and replication potential of high-level urban transformation strategies - MAtchUP
Project Coordinator	Ernesto Faubel Ayuntamiento de Valencia efaubel@valencia.es
Project Duration	1 October 2017 – 30 September 2022 (60 Months)

Deliverable No.	D4.5
Dissemination Level	PU
Work Package	WP 4 - DEMONSTRATION IN ANTALYA
Task	T 4.4 – Improved Concept of Energy Infrastructures at District City Level in Antalya
Lead beneficiary	16 (DEM)
Contributing beneficiary(ies)	14 (ANT), 15 (SAM), 17 (ANP), 19 (AKD)
Due date of deliverable	30 September 2019
Actual submission date	25 September 2019
Estimated person-month for deliverable	8 PM

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Version	Person	Partner	Date
0.1	Ömer Akyürek	DEM	27 July 2019
0.2	Cenk Güreken M.Serdar Yümlü Ali Demir Akgünlü Eser Karakaya Selçuk Ilıkcan Serdar Serdaroğlu Caner Tosunoğlu İbrahim Acar	SAM	9 September 2019
0.3	Cenk Güreken M.Serdar Yümlü Ali Demir Akgünlü Eser Karakaya Selçuk Ilıkcan Serdar Serdaroğlu Caner Tosunoğlu İbrahim Acar	SAM	12 September 2019
0.4	Cenk Güreken M.Serdar Yümlü	SAM	19 September 2019
1.0	Cenk Güreken M.Serdar Yümlü	SAM	23 September 2019

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Abbreviations and Acronyms

Acronym	Description
A	Action
ANT	Antalya Metropolitan Municipality
D	Deliverable
DALI	Digitally Addressable Lighting Interface
LED	Light Emitting Diode
M	Month
SAM	Sampaş
ST	Subtask
T	Task
TL	Turkish Lira

Table 1: Abbreviations and Acronyms

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0 Abstract

This deliverable has been prepared to explain the development process, technical details and results of intelligent public lighting actions (action A8 and A9) planned to be implemented in the MAtchUP Antalya Project area. It is a clear fact that conventional street lighting systems used in today's cities cannot meet the needs of our society in many ways, including security, the environment and energy efficiency standards. Within this scope, Antalya aims to develop innovative and alternative methods with the idea of intelligent public lighting and provides innovative solutions to solve this problem and set an example for smart cities. In this deliverable, the legal basis for public lighting in Turkey is explained, then the existing public lighting data and infrastructure has been described respectively.

Following the explanation of the current situation in Antalya, the technical details and management structure of the public lighting to be constructed in the project area are explained. Furthermore, the planning process, next steps and effects of the action are mentioned. This deliverable is an initial study which describes the details of the solutions to be implemented. The final version will be submitted in M36.

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1 Introduction

1.1 Purpose and target group

The MAtchUP project embodies innovative energy actions including high-performance energy district actions and many associated renewable energy actions. In this context, one of the energy infrastructure actions planned for increasing the energy efficiency and savings in the project is *"Smart Public Lighting"* action.

This report covers deliverable *"D4.6: Public Lighting in Antalya",* which is the outcome of the Task "*T4.4 – Smart Energy Infrastructures"* with the *Subtask 4.4.2 Public Lightning.* The final version of the deliverable will be delivered in September 2020 in M36.

The core objective of the deliverable is to provide a detailed information on the intervention including concept, design, implementation, management and further responsibilities of the deliverable. The requirements for the success of the deliverable as planned within MAtchUP will be detailed.

1.2 Contribution from partners

Partner	Task	Contribution
SAM	4.4	Description of the Technical Design, Implementation, Coordination
ANT	4.4.2	Providing Technical Works Team, Infrastructure, Strategic Progress
ANP	4.4.2	Technical Detail Assessment, Demo Site Evaluation

Table 2: Contribution from partners

1.3 Relation to other project activities

Partner	Task	Relation to other project activities
DEM	Subtask 4.4.1	The objective of Subtask 4.4.1 is to manage and monitor the energy and to make a load management of the energy the dwellings. Since the public lighting system will also be installed in the project area it is also linked to this task.
DEM	Subtask 4.4.3	The objective of Subtask 4.4.3 is to Generate Clean Energy and District-City Level Renewables. Since the proposed LED Public Lighting is a smart and environment-friendly system it is highly interconnected to this task.
D5.x		The objective of WP5 "Technical, social and economic evaluation" is to setup a strong evaluation framework to be deployed in each lighthouse city with the aim to assess the effectiveness of the proposed intervention, deployed in the associated individual actions.

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		Therefore, D4.6 is linked to WP5 deliverables.
D6.x		The objective of WP6 “Exploitation and market deployment – innovative business models” is to design innovative business models and financial mechanisms to foster the implementation of smart city solutions, to identify exploitable results and to design an ad hoc strategy for their deployment and replication. Therefore, D4.6 is linked to WP6 deliverables.

Table 3: Relation to other project activities

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2 General overview

Because of the complexity of the urban settlements and transport infrastructure, various lighting is required to ensure that traffic is flowing, people feel safe and cities can save energy costs. Although conventional street lighting systems used today meet basic lighting needs, they are not sufficient in energy saving and protection of the environment. This necessitates the development of different methods in public lighting. In response to this need, new lighting systems which are called smart lighting which constitutes of smart lighting poles emerged in recent years. Smart Public Lighting is a cost-effective and sustainable option for today's cities preparing cities for the future.

According to a statement from the Turkish Ministry of Energy and Natural Resources, by 2020, 75 percent of street lighting lamps are planned to be converted to smart LED luminaires. An annual savings of 600 million TL is planned. This change is expected to be realized by the changes in the current street lighting system.

In Turkey, principles and requirements for the lighting in public are defined by law. According to the General Lighting Regulation published by the Ministry of Energy and Natural Resources in 2013 with the official newspaper, public lighting should be carried out according to the following principles:

- The establishment and operation of the necessary systems for the illumination of public parks, gardens, walkways, historical sites, underpasses and traffic signalling, which are open to the public and free of charge, belong to the relevant public institutions and organizations. The relevant institutions and organizations may transfer the operational responsibility of such facilities to the distribution company.
- In the scope of general lighting, in the existing lighting facilities and new facilities to be built in public places such as parks, gardens, historical sites and walking paths that are open to the public free of charge, the lighting levels are reduced by fifty percent after 02:00 at the latest.
- With luminous intensity sensor and / or time controlled installation; lighting is provided when necessary and to the extent required. Dimmable luminaires with dimmable features suitable for remote control and automation are preferred in order to reduce the lighting level in newly installed general lighting facilities in public parks, gardens, historical places and walking paths which are open to the public free of charge.

Considering the public lighting frame in Antalya; A total of 5600 km of public roads, square parks and recreation areas are illuminated throughout the province. This service is provided by approximately 160,000 lighting poles. Antalya also conducts pilot studies on smart lighting technologies and smart pole applications. Serdengeçti Park in the city center is illuminated with 90 smart public lighting poles.

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3 Technical definition of the interventions

The deliverable focuses on the demonstrating the technical details of the Smart Public Lightning in Antalya and the integration with the existing electricity grid of the city of Antalya. The design and development of an innovative concept of smart lighting and integrating control strategies will be examined.

In this deliverable two main actions will be evaluated:

- Action 8: LED Public Lighting
- Action 9: Smart Control of Public Lighting

3.1 Public Lighting

In MAtchUP Project, Antalya will establish a lighting plan in the recreational area of the Antalya – Kepez Project demo site (see below) which include the replacement of traditional bulbs for innovative LED lighting. A total of 350 new planned LED-integrated lighting assets will be deployed for public lighting systems in order to save 40% of energy due to lighting consumption. (Action A8) As well, the integration of intelligent communication system will be established in order to monitor and manage the system with the objective of allowing the smart control. (Action A9) The smart public lighting system will be established within the red line given below.

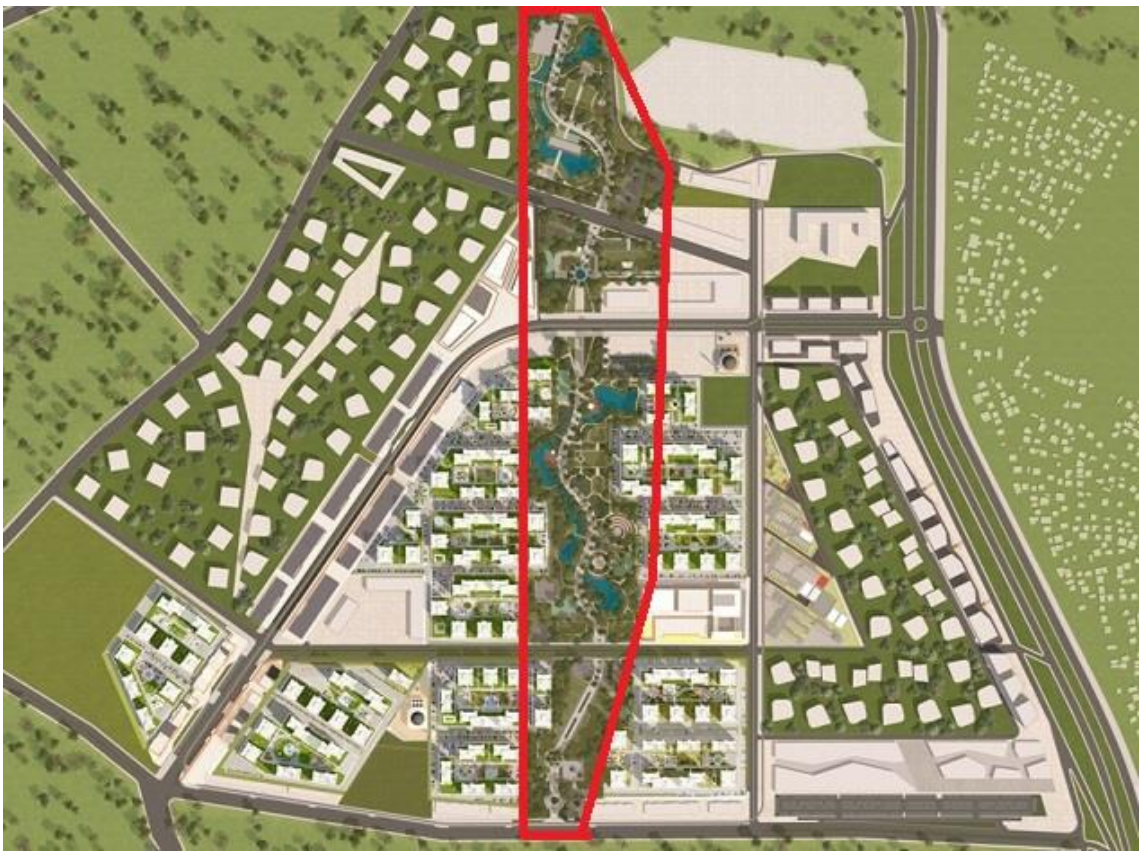

Figure 1: The Public Lighting System Placement Location

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4 Executive project of the actions

4.1 A8 LED Public Lighting

4.1.1 Management structure

The action will be implemented by ANT in Kepez - Santral smart city project area. This action covers the technical, physical components and installation phases of the public lighting application. As it is briefly described in the deliverables D4.1 and D4.14, firstly, the selection of the locations for the lighting poles will be made. Then, the tendering and procurement of 350 poles will be carried out by the municipality. As the procurement process is completed, the smart poles will be placed in the project area and integration process with the electricity network will be started. After the integration process is completed, implementation, monitoring, control and follow-up process will begin. The assembly of the LED poles and related infrastructure will be carried out by municipality. In addition, the management, maintenance, repair and operation of the public lighting system will also be made by the municipality.

4.1.2 Technical specifications of the city infrastructure

The municipality received consultancy services from a private company in order to obtain expertise and knowledge about the intelligent public lighting systems to be implemented. As a result of this consultancy service, smart lighting and smart pole feeding plans were made for the lighting plan that is envisaged to be implemented in the field.

The lighting plan to be implemented in the recreation area in the middle part of the project area and the layout plan of the smart lighting poles are as follows:

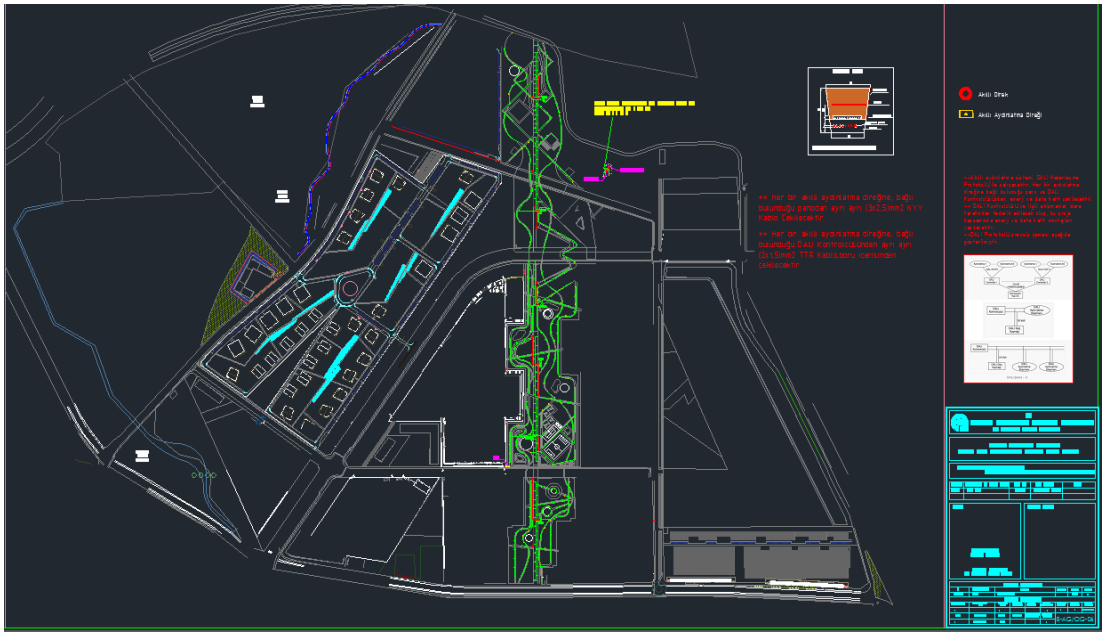

Figure 2: LED Lighting and Pole Feeding Plan

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LED Lighting Poles Capabilities

The characteristics and capabilities of 350 LED lighting units to be used in the field are as follows:

- Remote fault detection
- Can be monitored from a designated center
- Clock-based opening, closing, throttling
- The remaining life of the lamps can be monitored,
- Automatically adjusts daylight based brightness value
- There will be LED illuminators with motion sensors.

The technical specifications of the luminaire recommended by the consulting firm are as follows:

Güç (Watt)	Renk Sıcaklığı	Lens Açısı (X°)	Verimlilik (lm/Watt)	Işık Akısı	CRI	Ağırlık ±%10 gr.	Ürün Ebadı EnXBoyXDerinlik mm	Koli Ebadı EnXBoyXDerinlik mm
30	6500	45-160	155	4.650	70/80	3.000	585x252x70	60x26x10
30	5000	45-160	160	4.800	70/80	3.000	585x252x70	60x26x10
30	4000	45-160	155	4.650	70/80	3.000	585x252x70	60x26x10
30	3000	45-160	130	3.900	70/80	3.000	585x252x70	60x26x10
30	2000	45-160	140	4.200	65	3.000	585x252x70	60x26x10

Şebeke Gerilimi	Çalışma Sıcaklığı	Koruma Sınıfı	Led Ömrü
110-277V	-30°C/+60°C	IP 66	L70>150.000 s

Figure 3: Technical Details of Proposed Armatures for the Public Lighting in Project Area

In addition, the planning proposal for the placement of the proposed LED lighting armatures in the project area has been completed. The general scheme is given below:

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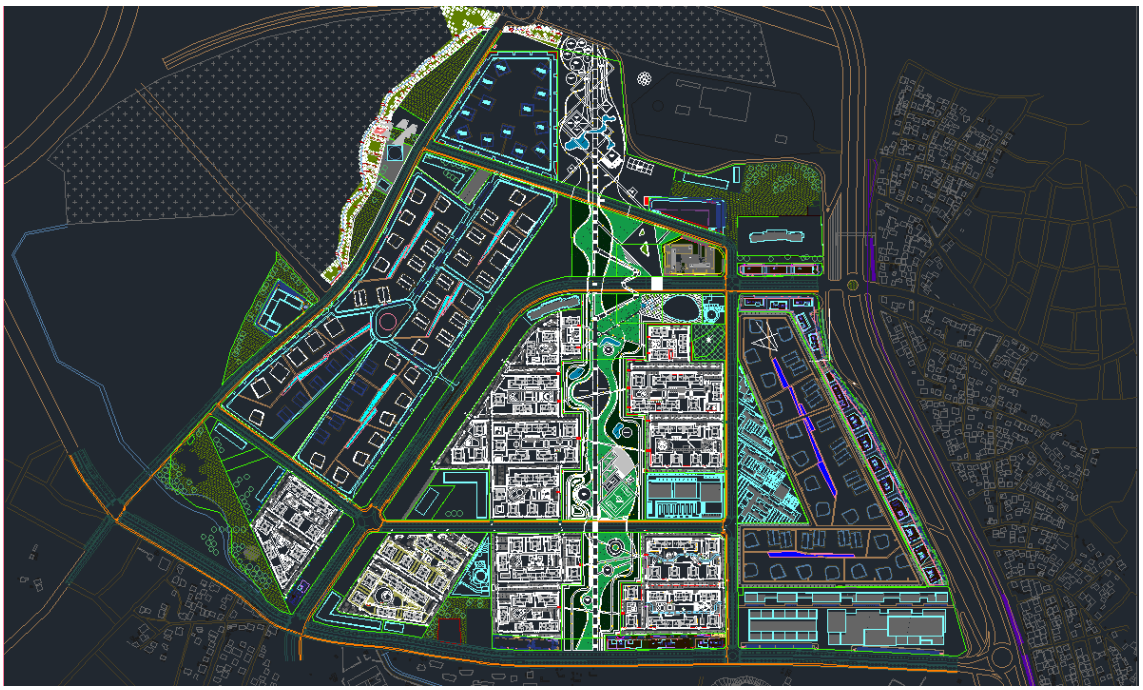

Figure 4: Proposed MAtchUP Antalya Kepez Public Lighting LED Armature Placement Plan

Recreational Area Lighting Plan Design

For the lighting plan designed in the project area, lux data and lighting amounts were calculated by DIALux software. The lighting design scheme for the project area is as follows:

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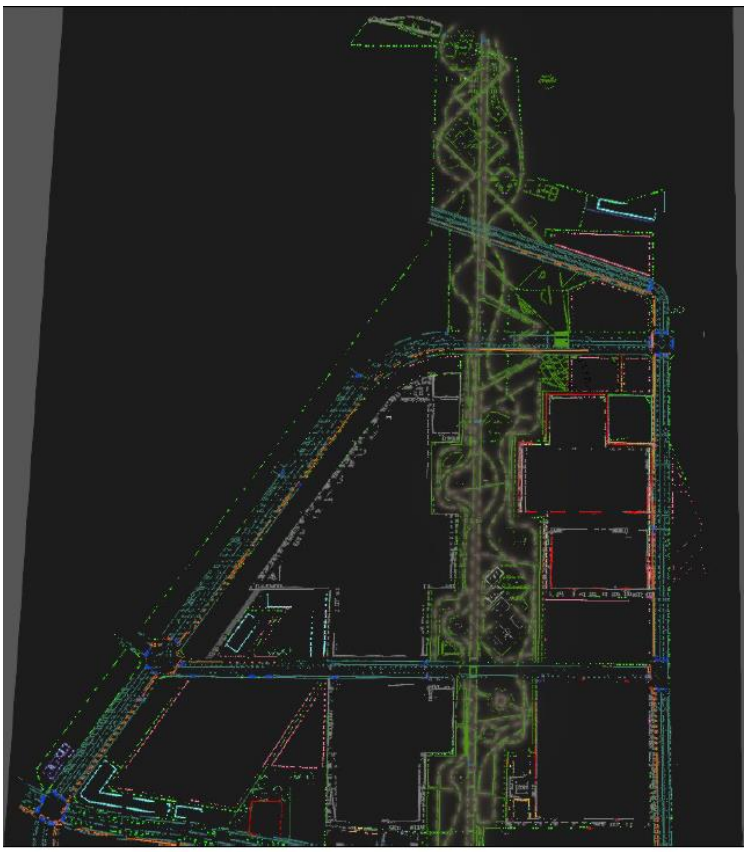

Figure 5: Proposed Illumination Plan of the Area

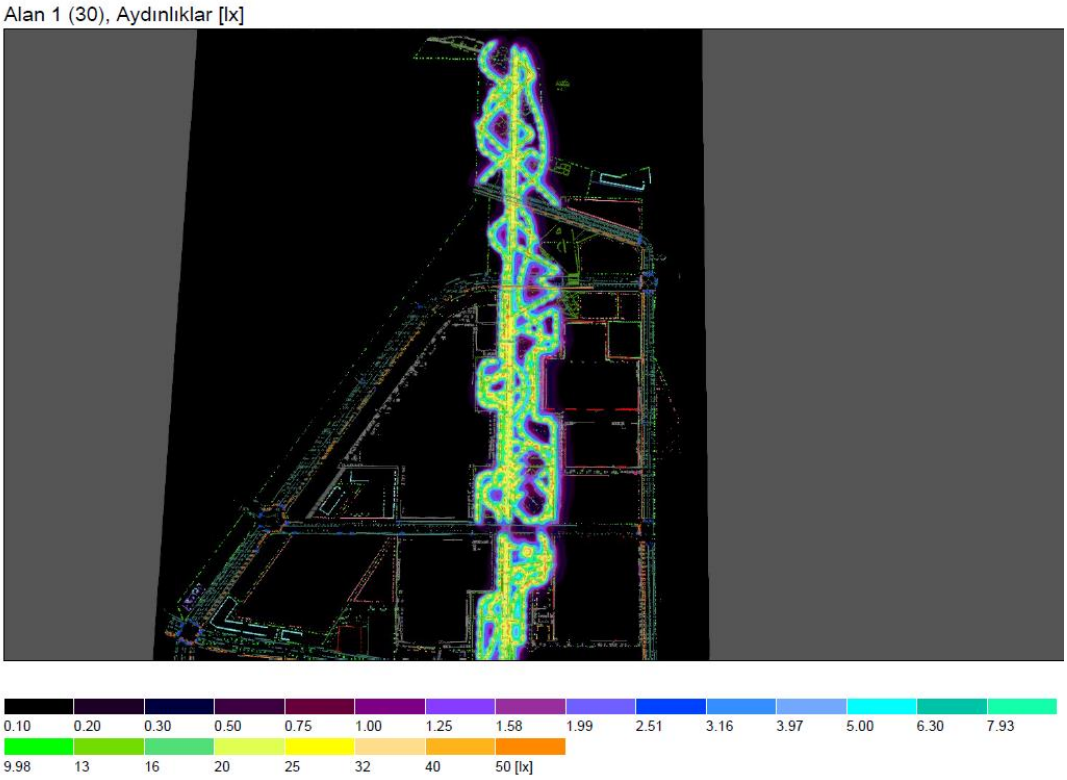

Figure 6: Analysis of the Amount of Light Proposed for the Area.

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The proposed public lighting network will illuminate the area as demonstrated above. This shows a scenario from an analysis on illumination in the recreational area, which is located in middle of the MAtchUP project area. The numbers indicate luminous values. The bigger the number, the brighter. The visual details of the lighting design plans are given below:

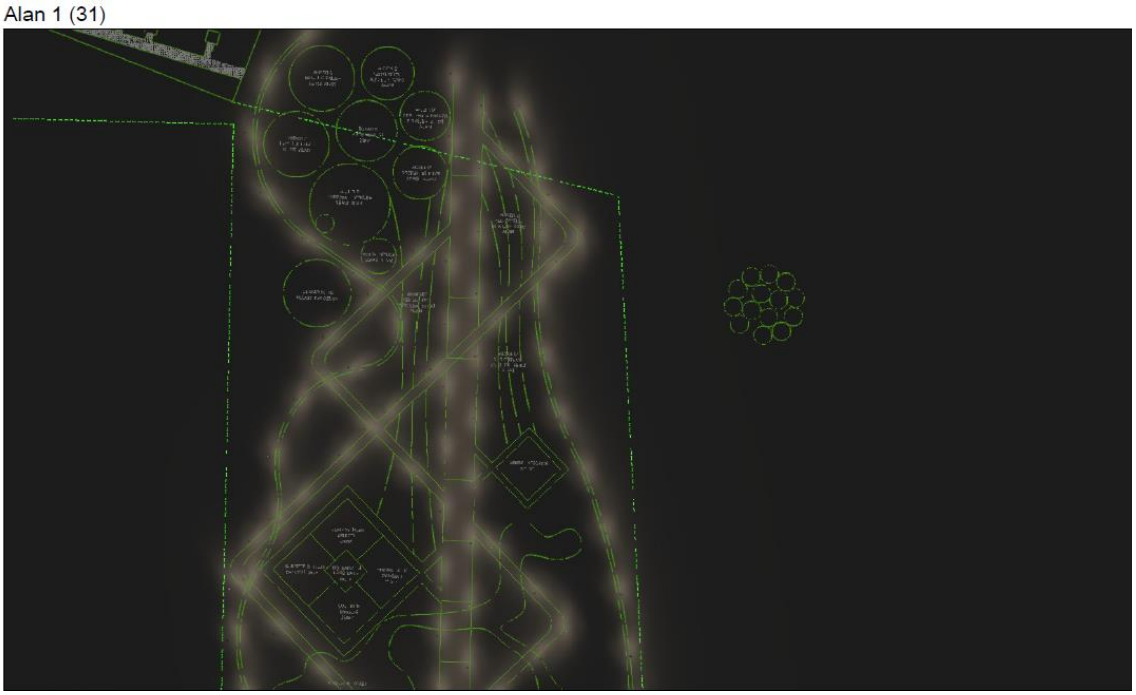

Figure 7: Illumination Design Plan Indicating the Northern Part of the Recreational Area

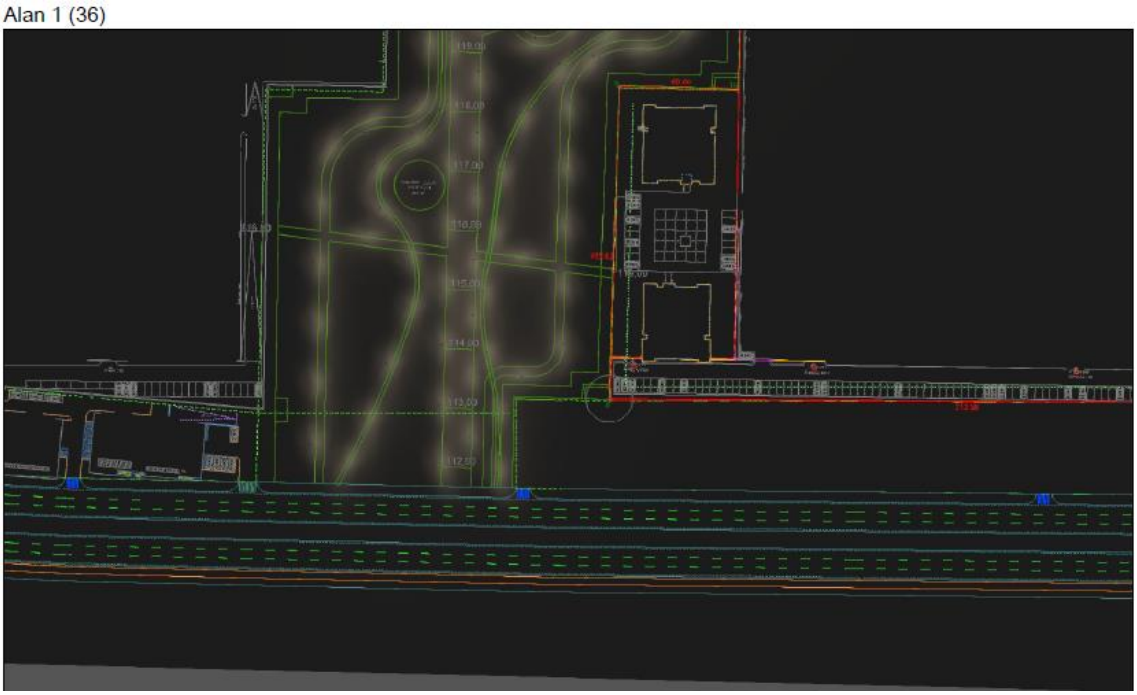

Figure 8: Illuminating Design Plan Indicating the Southern Part of the Recreational Area

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4.1.3 Planning of the tasks

As it was also described in D4.1 and D4.14, during the first two MAtchUP project years M1 – M24 the actions given below had been finalized:

- Selection of lighting locations
- Detailed planning on public lighting infrastructure and design

For the future progress of the actions:

Until 09/2020 [M36]:

Construction of the selected buildings and commissioning of interventions will be finalized.

Until 09/2022 [M60]:

Implementation of the continuous monitoring and evaluation.

4.1.4 Health, safety and waste management requirements

The system to be installed during the application must comply with the Turkish and world security regulations and rules for electrical installation. In addition, compliance with the general technical specifications and application guidelines for electrical installations is mandatory. It is necessary to ensure the safety of the personnel who will work at all stages of the installation, operation and maintenance of the action and to provide the necessary protective equipment. In addition, measures should be taken to eliminate all risks that may endanger the life of the citizen in the area.

4.1.5 Risks and proposed risk-mitigation measures

The risks that may be faced in the project are as follows:

Technical risks that may arise during implementation:

- Failure to implement the project on time,
- Prolongation of the tender process,
- Delays due to technical changes within the project.

The most important measure that can be taken is to trigger the decision processes of the local administration and to elaborate the implementation plan in advance. The technical details in the application phase should be provided in accordance with the program in the contract.

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4.2 A9 Smart Control of Public Lighting

4.2.1 Management structure

This action is led by ANT as the owner of the public lighting and SAM as the technology provider. The action covers the administrative, monitoring and software dimensions of the public lighting application. In order to increase the efficiency in the use of energy sources, public lighting smart control system will be installed to allow the lighting circuits to be controlled automatically from a central point and in accordance with the predefined operating scenarios at desired times. With the lighting control system applications to be established, it is aimed to minimize the human factor within the lighting service companies and to control the plant from a single center by using lighting control systems. The software of the smart control of Public Lighting will be designed by SAMPAS

4.2.2 Technical specifications of the city infrastructure

The aim of this action is to optimize the usability of the public lighting by means of application of gradation, maintenance (no night travels for failure detection) and overcome with lighting needs of the city. Thanks to the modular integration around 40% of energy savings are expected.

Control and monitoring of smart public lighting systems will be provided by a control center which is an urban platform. This platform will work in integration with the energy network and provide data over the fiberoptic cable lines.

The proposed Automation System

The urban platform will host an automation system, which is designed for programming, controlling and displaying lighting fixtures with fiberoptic infrastructure.

The communication line of the system is provided by the fiberoptic cable between the control center and the distribution center. Communication is provided by the data cable from the distribution center to each lighting unit. If desired, wireless communication to the distribution center is also provided. The capabilities of the proposed automation systems are as follows:

- Control software is compatible with Win10 operating system.
- Each luminaire is addressed and managed by ID number.
- The control software runs simultaneously with the system clock of the operating system used.
- DIM, switching on and off can be done manually
- DIM can be done automatically through the local time on and off
- DIM can be done automatically via power-off date and local time
- DIM can be switched on and off automatically via the astronomical clock
- No switch required for switching on / off, the light source is switched on / off by digital command.
- It is possible to control the luminaires individually or in groups
- The status of the luminaires can be monitored (on, off, % x DIM, lamp failed)

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- The power consumption of the system in standby mode is less than 1 watt.
- Unlimited coverage can be provided by using design feature of the modules.
- If there is a fault in the module, it continues to operate at a dim level of approximately 100% (drive-to-drive ratio may vary).
- In the control software, faults occurring in the armature, operating times and dim programs can be displayed and recorded daily.

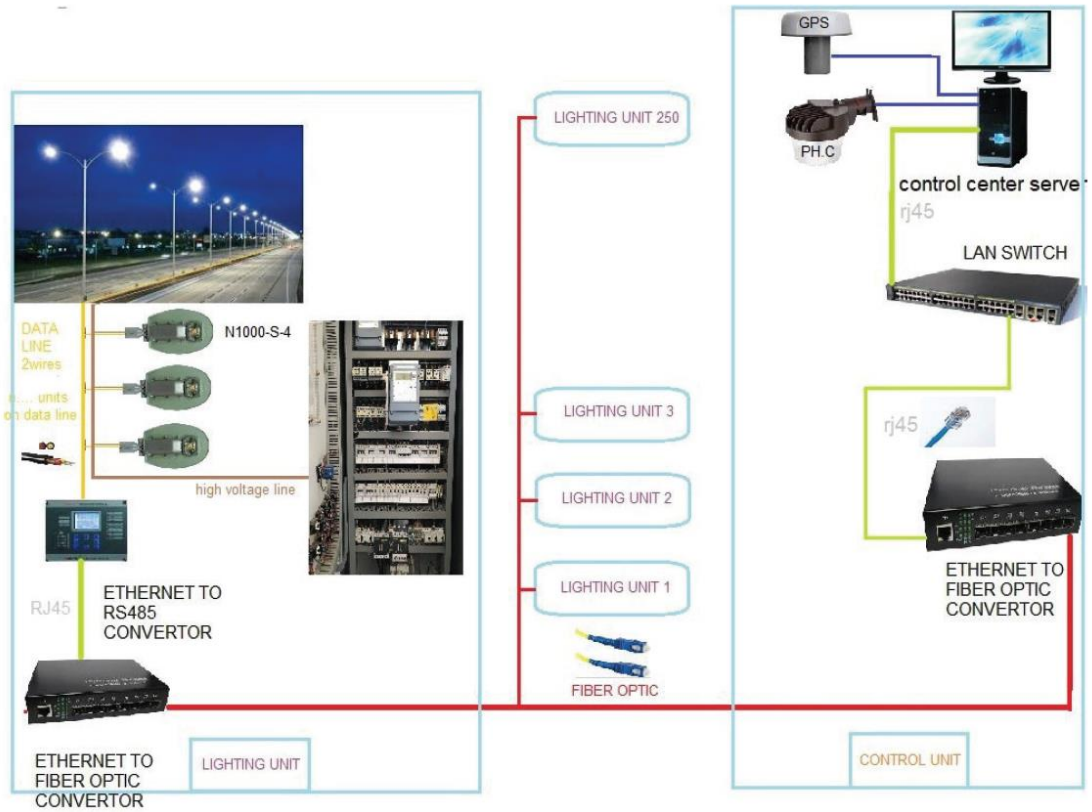

Figure 9: Smart Lighting Communication Hardware Architecture

DALI and IP Control

Throughout the project, DALI ballasts, an application standard in the lighting industry, will be used. (Digitally Addressable Lighting Interface) DALI is the most advanced internationally recognized lighting control system defined in IEC standards. It is also a fully compatible system that can be easily expanded and manufactured by all major manufacturers. Each ballast used in the DALI system is electronically addressed in the system and can be controlled individually or in groups, regardless of energy lining. In this way, a constant level of constant lux can be achieved in different working planes within the same space. The desired scenario can be programmed by integrating with presence and daylight sensors. DALI is a bi-directional communication system, so that ballast and bulb failures can be monitored and reported from the system. In this way, technical service costs can be reduced and ease of operation can be provided.

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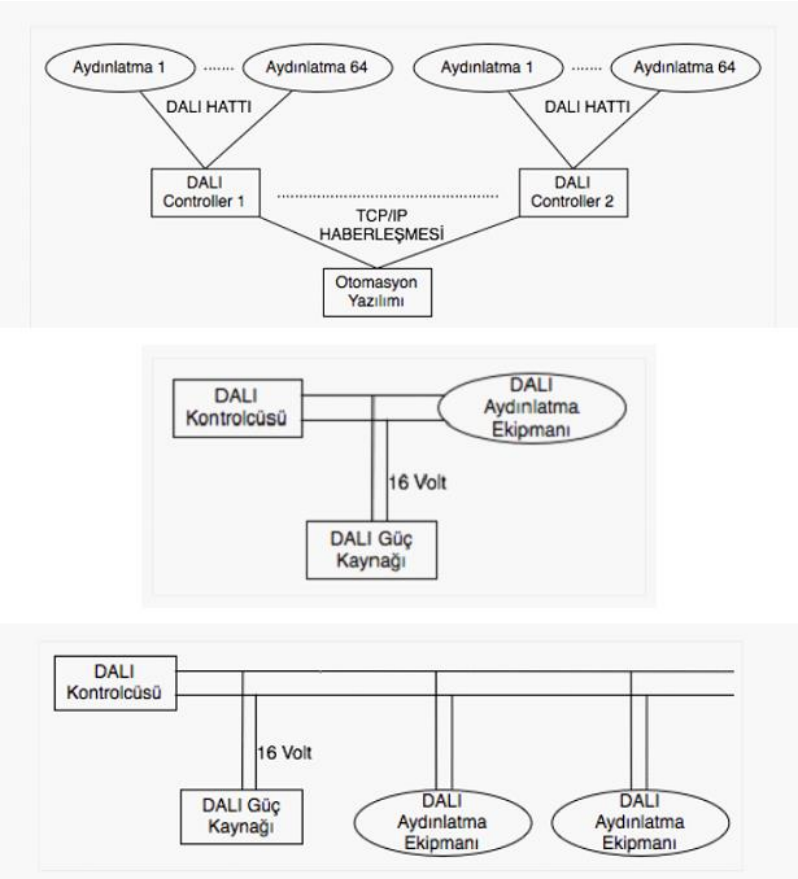

Figure 10: DALI Scheme for the Public Lighting System

4.2.3 Planning of the tasks

As it was described in D4.1 and D4.14, during the first two MAtchUP project years M1 – M24 the actions given below had been finalized:

- Selection of lighting locations
- Detailed planning on public lighting infrastructure and design

Until 09/2020 [M36]:

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provide the necessary protective equipment. In addition, measures should be taken to eliminate all risks that may endanger the life of the citizen in the area.

4.2.5 Risks and proposed risk-mitigation measures

The risks that may be faced in the project are as follows:

Technical risks that may arise during implementation:

- Failure to implement the project on time,
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The most important measure that can be taken is to trigger the decision processes of the local administration and to elaborate the implementation plan in advance. The technical details in the application phase should be provided in accordance with the program in the contract.

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5 Implementation

5.1 Public Lighting

This section covers Action 8 (LED Public Lighting) and Action 9 (Smart Control of Public Lighting)

5.1.1 Status of the intervention

The current stage in actions A8 and A9 is;

As of M24, the location of the lighting poles in the project area was determined. The luminaire layout plan, smart lighting and intelligent energy supply plan were completed in the area. Afterwards, illumination calculations, quantities and lumen values were calculated with DIALux software. Recreation area lighting plan for the project has been completed. The municipality administration took consultancy services from an energy company for the tendering processes and prepared the technical details and specifications for the smart lighting requirements. As a result of the consultancy service, the company planned the green area fixture layout and the skylight parts list was prepared.

5.1.2 Risks found and corrective actions performed

Due to the local elections held in the country in March 2019, there has been a change of mayor and administration in Antalya. In addition to the change in the local authority and management, the economic fluctuations in the country and the exchange rates may cause disruptions in the implementation of the project in the expected periods. These factors may prolong the tendering and procurement process of public lighting infrastructure and related items, which may lead to time delays in the implementation of the project.

5.1.3 Business model and financial scheme applied

There is currently no business model and financial scheme for the action. After the tender and procurement process is completed, the financial statements will be shaped as net.

5.1.4 Citizen engagement strategy implemented

The smart public lighting action to be implemented by the municipality will be one of the pilot applications in Antalya. The Municipality will make all promotions and announcements that will present this innovative and environmentalist application to the public via print out magazines, newspapers, billboards or online websites. Thus, while economic savings and environmental protection is encouraged and recommended to citizens, awareness on this practice will be promoted. In addition to the energy and

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financial savings provided by smart lighting applications in the public sphere, the effect of increasing security and enhancing the visual environment quality will be emphasized to the public. Also, all citizens who have any wishes or complaints about the subject will be able to apply from the wish-complaint section of the urban platform, which is also being developed by SAMPAŞ, or from surveys to be held at the platform on a regular basis. Thus, the citizens will be able to communicate directly with the municipality through the urban platform so that they will be able to alert and solve all kinds of problems at first hand.

5.1.5 Next steps

After the tendering and procurement process is completed, implementation and monitoring phase will begin. With the software to be developed, control phase will be started.

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6 Conclusions

The main outcome of the public lighting action in the Matchup project is as follows: while enhancing the lighting quality and reducing energy consumption in public spaces, it is to develop alternatives to existing lighting systems and to use new technologies.

Within the scope of A8 and A9 public lighting actions, the legal basis in Turkey, and necessary technical studies, illumination plans, allocation plans, analysis were performed. The technical details of the proposal concept and designs have been made and the basis for future procurement and tendering processes has been formed.

In the next step, intelligent lighting system will be put into practice and monitoring process will be started by the M36. Thus, one of the targeted goals for smart cities in the MAtchUP project will be implemented and set an example for future smart cities.

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7 References

General Lighting Regulation published by the Ministry of Energy and Natural Resources in 2013 - http://www.resmigazete.gov.tr/eskiler/2013/07/20130727-20.htm

Antalya Büyükşehir Belediyesi Park ve Bahçeler Şube Müdürlüğü - http://antalya.bel.tr/birimler/park-ve-bahceler-sube-mudurlugu

Serdengeçti Public Park Smart Lighting System Antalya'da Akıllı Aydınlatma Sistemi Devreye Girdi - http://www.aydinlatma.org/antalyada-akilli-aydinlatma-sistemi-devreye-girdi.html

Akıllı aydınlatmalar tasarruf sağlıyor - http://www.hurriyet.com.tr/yerel-haberler/antalya/akilli-aydinlatmalar-tasarruf-sagliyor-41036502

Cadde ve Sokak Aydınlatması Nikki Elektronik - http://www.nikielektronik.com/Home/Products#44

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