REDUCING CO_2 EMISSIONS OF PUBLIC LIGHTING

Interreg CENTRAL EUROPE
European Union, European Regional Development Fund
Dynamic Light

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Public lighting causes ca. 6% of the world- wide electric- energy consumption. The Dynamic Light project focusses on reduction of CO2-emissions and enhancement of energy efficient use of public lighting. In these days many conventional lighting fixtures need to be changed to energy efficient lights. However, public authorities lack a strategic approach to convert their lighting infrastructure into an energy efficient, innovative lighting with a higher quality for the users.

Public lighting thus impacts not only our visual environment and functions, it influences flora and fauna, social interactions and behaviour, and of course energy consumption as well. Public lighting strategy therefore needs to simultaneously address the questions of light quality, ecology and energy. In turn, in order to do this, it is essential to understand the relationships and interactivity between the physical urban environment, the human being (user), and light.

The possibilities offered by the new technologies are the change of the intensity of light, the distribution and the colour temperature. For each of these options there are clear advantages in use.

1. Pilot Actions: Güssing-Austria, Čakovec-Croatia, Cesena-Italy & Mantova-Italy

1.1 GÜSSING- AUSTRIA

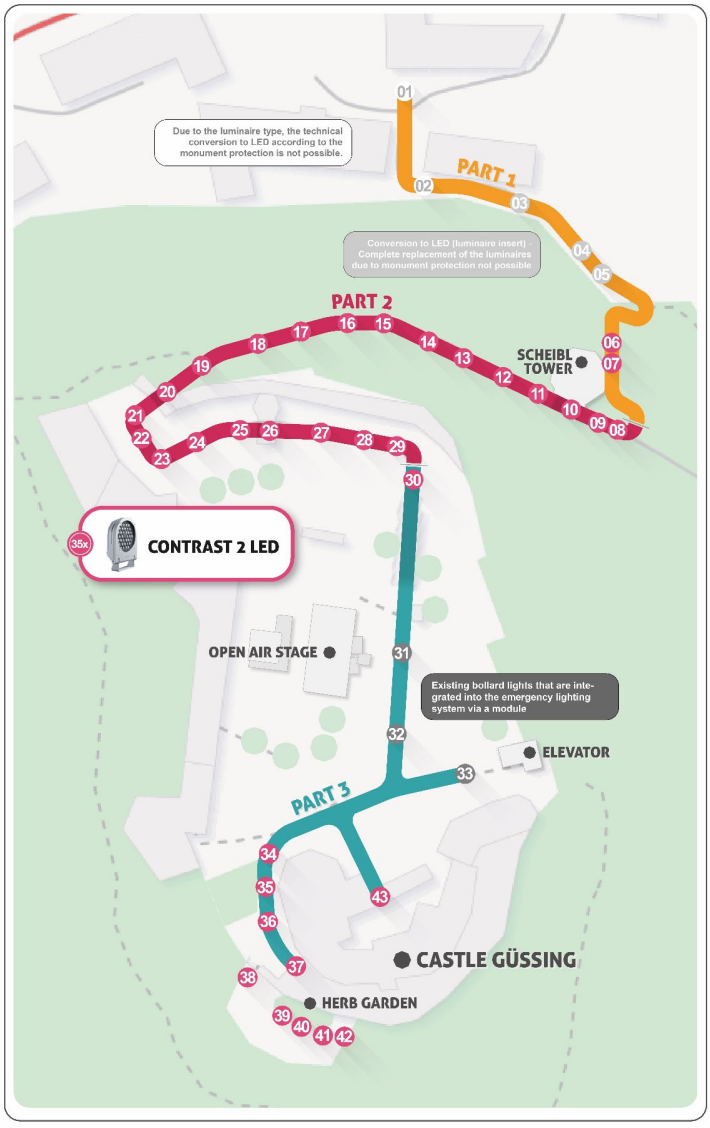
The site of the Dynamic Light installation in Güssing is the historic castle, situated on a long-extinct volcanic cone. Its steep cliffs rising from the plain and the plateau above the crater,
as well as its location in the border area between Austria and Hungary were ideal conditions for the construction of a fortified castle.

As Güssing has a special historical place in the middle of the town, which is the castle of Güssing, it tried to find a solution for an adequate illumination of the pathway up to the castle. As the idea of dynamic lighting was introduced to the municipality, it decided to realize such a concept and to develop a pilot project.
The focus of the pilot action is the path up to the castle of the city. For more than 20 years there is a special annual event on the castle, which is a special theatre, performed by the association "Cultural Summer of Güssing " in the spacious inner ward. For the visitors of the theatre, the way down from the castle always represented a challenge for the people, as the minor path lighting was not sufficient enough. Beside those thousands of visitors of the theatre, also hundreds of visitors from the city and region come each year and complained about the
lighting situation up to the castle.

// The castle of Güssing (Credit: Kultursommer Güssing)

The dynamic lighting concept of the castle in Güssing is divided into three main parts, according to the map.

The first part starts in the city center at the basilica and ends at the first gate of the castle. The main focus in this section lies on basic- and security illumination, to provide a safe and comfortable atmosphere in the formerly dark alley.
The second part includes the pathway from the first gate to the last gate before the top of the castle is reached. In this part it is particularly important that pedestrians always have a good visibility of the uneven and steep terrain, which is in addition necessary for a safe ascent to the castle and even more important for a safe descent at night. In addition, the walkway is illuminated by an indirect lighting with RGB LED spotlights, that are implemented at the walls beside the path of the castle.
The third part is situated on the top of the castle. The illumination is positioned beside the path to the open-air stage as well as beside the path to the herb garden on the backside and over the stairway to the main entrance of the castle.
Also, the recreational- and assembly areas are illuminated to improve not only the feeling of safety but also provide a good orientation at night for the many visitors of not only the theaters, concerts, etc. but also the guest of the restaurant and the castle itself.
The new lighting is intended to create a harmonious and pleasant atmosphere in all areas, so that the visitors can feel safe and it increases the quality of life of the local population, in having one more attractive place to be visited safely day and night.



// Concept for the lighting of the path up to the castle – including light points and sections – (Credit: EEE)


Roland Sinka
PHOTOGRAPHY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PHOTOGRAPHY

1.2 Čakovec-Croatia

Town of Čakovec is placed at north-west part of Republic of Croatia and it is cultural and political capital of Medjimurje county. Total administrative area of Town of Čakovec is 72,80 km2 while total population of area is 27.104. Administrative area of Town of Čakovec consist of Town of Čakovec and 13 suburban settlements.
Pilot action in the Town of Čakovec includes modernization process of road lighting infrastructure which is called “Ring Čakovec” situated in the city centre. Modernization of public lighting includes replacement of 160 existing luminaires (high pressure sodium technology) with 150 LED new ones in streets that are surrounding town centre (park, square, pedestrian and cyclist area). Apart from standard modernization of public lighting, weather condition sensors (rain, fog) and system for control and management of public lighting where installed.

Image 1 – Pilot area in Čakovec – “Ring Čakovec”

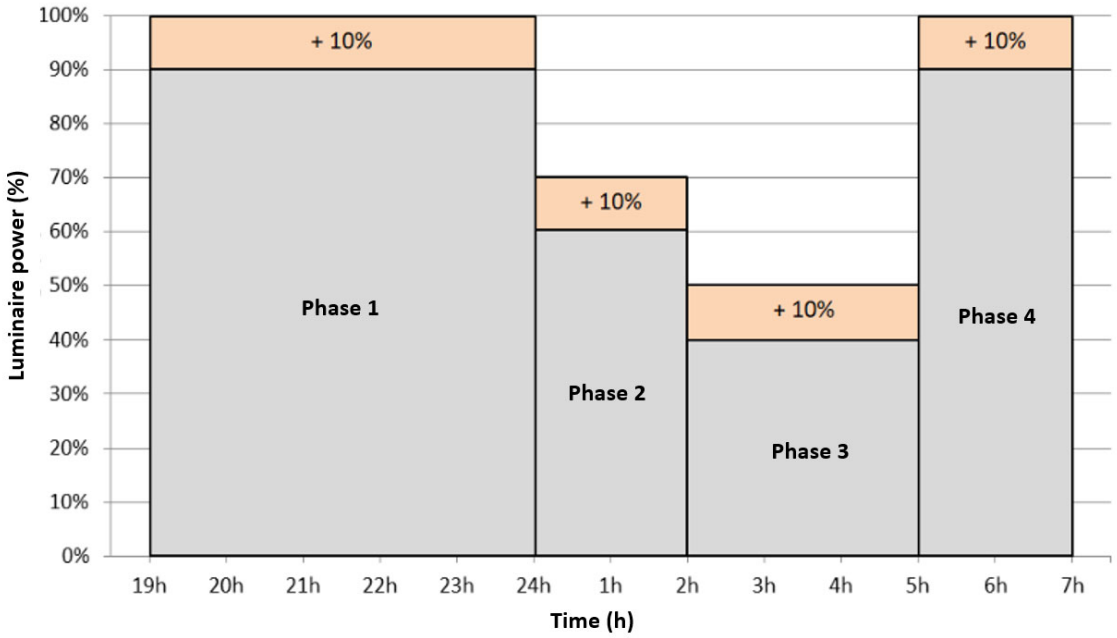
Based on conducted field survey of current state of public lighting and analysis of public lighting in two Town districts - the area “Ring Čakovec” has been selected as a pilot area in this project. Total length of “Ring Čakovec” is approximately 2.71 kilometres. The area is a combination of residential, commercial and combined buildings as well as partly a park area.

In order to satisfy national legislative and norms which refer to the public lighting standards, the existing 160 HP sodium luminaires were replaced with 150 luminaires based on LED technology. Old luminaires had the power from 250 W to 500 W and the new LED ones have from 120 W to 160 W, which reduced total installed power in the pilot area from 58,23 kW to 19,86 kW and the annual consumption of electricity from more than 238,000.00 kWh to a bit over 81,000.00 kWh. With the reduction of the consumption of electric energy, there is also noticeable decrease of the emission of CO2 – from almost 90 tCO2/a before the investment to 30 tCO2/a after the investment.

The lamps that were installed in the “Ring Čakovec” pilot area are Schreder Axia 2.2 and the control and management system is OWLET IoT. There are 67 luminaires with the power of 160 W, 75 with the power of 130 W and 8 with the power of 120 W installed. Their luminous efficacy is ≥90 lm/W for the 160 W ones and ≥110 lm/W for 130 W and 120 W.

Old and new luminaires

As for the control and management system, OWLET IoT is a cloud based platform which uses wireless communication between luminaires, sensors and the platform itself. The sensors that were installed react to the poor weather conditions such as heavy rain or dense fog. After testing several different possible working regimes, it was decided to obtain a working regime where the majority of luminaires work on 90% of installed power, while satisfying relevant lighting standards, until midnight (phase 1), then their intensity is lowered to 60% from midnight until 2 AM, from 2 AM until 5 AM the intensity is lowered further to 40% and at 5 AM risen back to 90% of power. The luminaires that do not change their intensity are the ones lighting up the roundabouts and pedestrian crossings, they work constantly at the nominal power. The intensity of the light is also changing when the weather conditions are poor (rain, fog, snow showers), i.e. it is risen to 100% for all luminaires.



The current dimming regime

Realization of pilot investment in Town of Čakovec demanded lot of engagement in preparatory phase, coordination with external experts, creation of project and procurement documentation and controlling the implementation of works. While carrying out all mentioned activities it was necessary to use knowledge in different fields which needed to be constantly updated. Since partner consortium consist of partners who possess knowledge in different fields, it was necessary to keep in touch with them all and to get useful information and instructions for implementing certain activities. Now that the pilot investment is realized, it represents best practice example to whole partner consortium and points out main benefits but also obstacles in the whole process of realization the pilot investment.

Illumination of the street with new luminaires

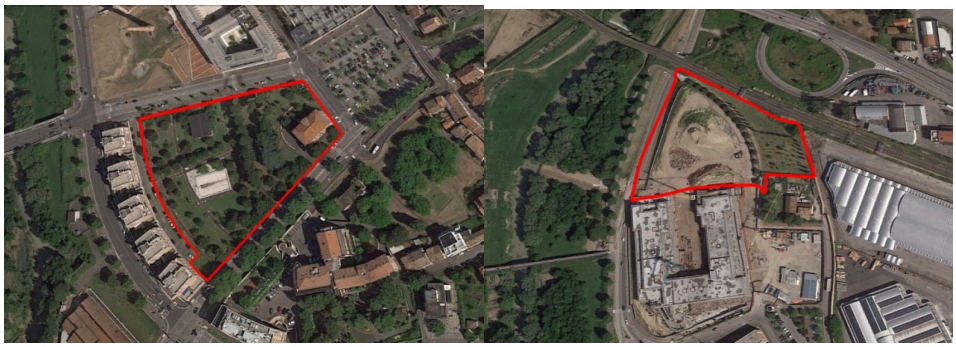
1.3 Cesena-Italy

Cesena is situated in northern Italy within Emilia-Romagna Region and has a population of about 96,935. The pilot investment has developed in the strategic framework of energy efficiency and sustainable development policies of Cesena in particular the new Sustainable Energy and Climate Action Plan (SECAP), the city initiative to reach the new EU 2030 CO2 reduction targets.

To test new dynamic lighting technologies the municipality of Cesena has identified as a pilot area a strategic portion of the city: the Former Sugar Refinery a big discarded industrial area (220.000 sqm) completely redeveloped in 2011 with a new residential headquarters (257 apartments), social housing and student flats, a shopping center (10.000 sqm), a business center (Bank of Cesena, offices.), pedestrian and cycle paths (10.000 sqm).

The Former Sugar Refinery is first of all a residential area with a high recreational potential of use with pedestrian spaces, cycle paths, green areas and has a strategic position within the urban context: located in the northwest it connects the historic old city center, with the Savio river and the large green area of hippodrome. Furthermore, the area has a high social value due to the present of the new University Campus inaugurated in 2018 and the presence of the resident's Committee Zuccherovivo set up in 2015 to revitalize the neighborhood with the municipality/institutions and families. These are the two main stakeholders identified and involved.

Former Sugar Refinery in Cesena.



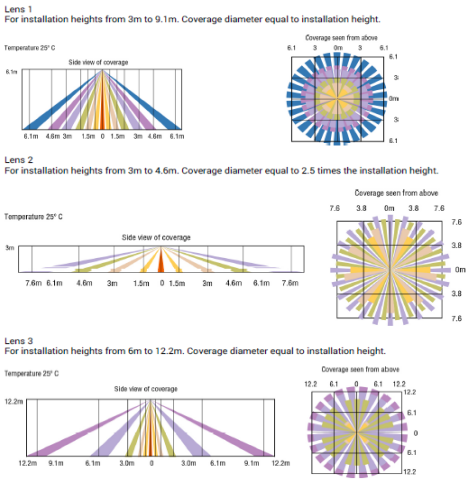
The 2 pilot areas: 11th September 2001 Park and C. Darwin Park.

The social need analysis carried out in collaboration with the Committee with questionnaires, interviews mapping activities showed that the most critical areas for the public lighting are two park: 11th September 2001 Park and the pedestrian path in the C. Darwin Park behind the new University Campus. The two green areas are strategic as passages within the neighbourhood and before the intervention looked dark and abandoned, unsafe and not enjoyable.

Starting from the site specific lighting social needs, the investment focused on a type of dynamic technology to: diminish the sense of insecurity; increase and diversify the attendance time in the two green areas (not only for passing but also for sports, games, recreational activities); increase the attractiveness for economic activities (bar and summer kiosks); create a comfortable and pleasant atmosphere avoiding the light pollution.

The new lighting poles are equipped with occupancy sensors with passive infrared sensing technology (PIR) that can detect the presence of pedestrians at three different distances (6m, 7 m, 12 m). Currently the sensor is set over a distance of 7 meters. The pilot installation includes also the innovative web remote control system GESTART to monitor the system and to change sensor parameters such as high/low mode, sensitivity, time delay, cut off and more, provide a flexible tool to adjust the light to the social activity around each light point and to experiment and validate different dimming profiles.

The investment will allow to reduce the electrical consumption of the plant by 77% also contributing to the reduction of CO2 emissions. This result contributes to the environmental objectives defined within the sustainability plans approved by the Municipality of Cesena and in particular the SEAP and SECAP.



Led streetlights CREE.

The pilot plants during the official inauguration on 22nd October 2018

The investment implementation has allowed the acquisition of new technical know-how for the co-design of dynamic lighting systems that for the first time includes an effective social approach taking into account the specific lighting social needs of citizens, who become not only the final users but also intervene in the preliminary design phase.

The investment has therefore enabled a new way of working on public lighting systems experimenting a real model of smart cities in which the municipality, citizens and technicians work together to improve the liveability of urban spaces starting from the light.

Moreover the investment is a good practice that can be easily replicated in pedestrian and green areas. The Municipality of Cesena leading the Union of the municipalities of the Savio Valley, which includes 5 other small municipalities. In the future this good practice will therefore potentially be replicated in other cities of larger territory.

Participatory co-design process with the Committee Zuccherovivo

1.4 Mantova-Italy

The city of Mantova is located in the Southeastern part of Lombardy Region, in the heart of Pianura Padana. It is surrounded by three artificial lakes and most of the neighboring territory is included in the nature protection area called Parco Regionale del Mincio. The typical main resources are agricolture, livestock farming and all tourism activities: Mantova is an old Renaissance town, UNESCO World Heritage Site since 2008 and Italian Culture Capital in 2016.
Bosco Virgiliano is an “Aggregative Area” of landscape and monumental value that stretches away for about five hectares and locates itself in the southeastern part of the historic city, with the main access from Via Parma.
The main cycle and pedestrian ring path (about 1,3 km, included in EuroVelo Circuit) within it has been selected as the pilot area to be hosting the first European “Bio-Dynamic” lighting experimental implant.
The area occupied by Bosco Virgiliano has been categorized as “Ambito a Sensibilità Paesaggistica Alta – High Landscape Sensitivity Environment” and falls within the Parco del Mincio perimeter.
The park conformation and its location in relation to the city center make it used especially by residents of peripheral quarters, Bosco Virgiliano’s ring path and some neighboring facilities but it also attracts distant citizens and tourists as city green lung.

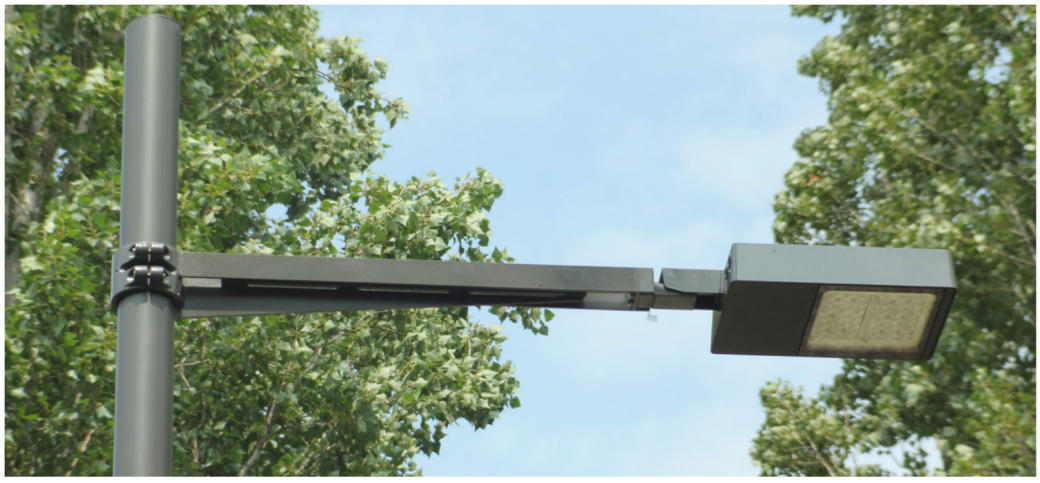
Municipality of Mantova

The project aims at giving a concrete answer to a deeply felt community issue: green areas usability in safety. In particular, main purposes are to protect the users, guaranteeing their safety and making a currently rarely frequented area, inasmuch not adequately illuminated, available to be used again, together with monitoring it in order to discourage elements of social disturbance from stopping over. The complete lighting system redevelopment of the old implant has also assured energy-savings, remarkable light pollution reduction, CO_2 emissions decrease and a high operational cost-effectiveness, as well as the introduction of innovative “Smart City” services which add value to the historic-artistic interest of Bosco Virgiliano.

Bosco Virgiliano's ring path and some neighboring facilities

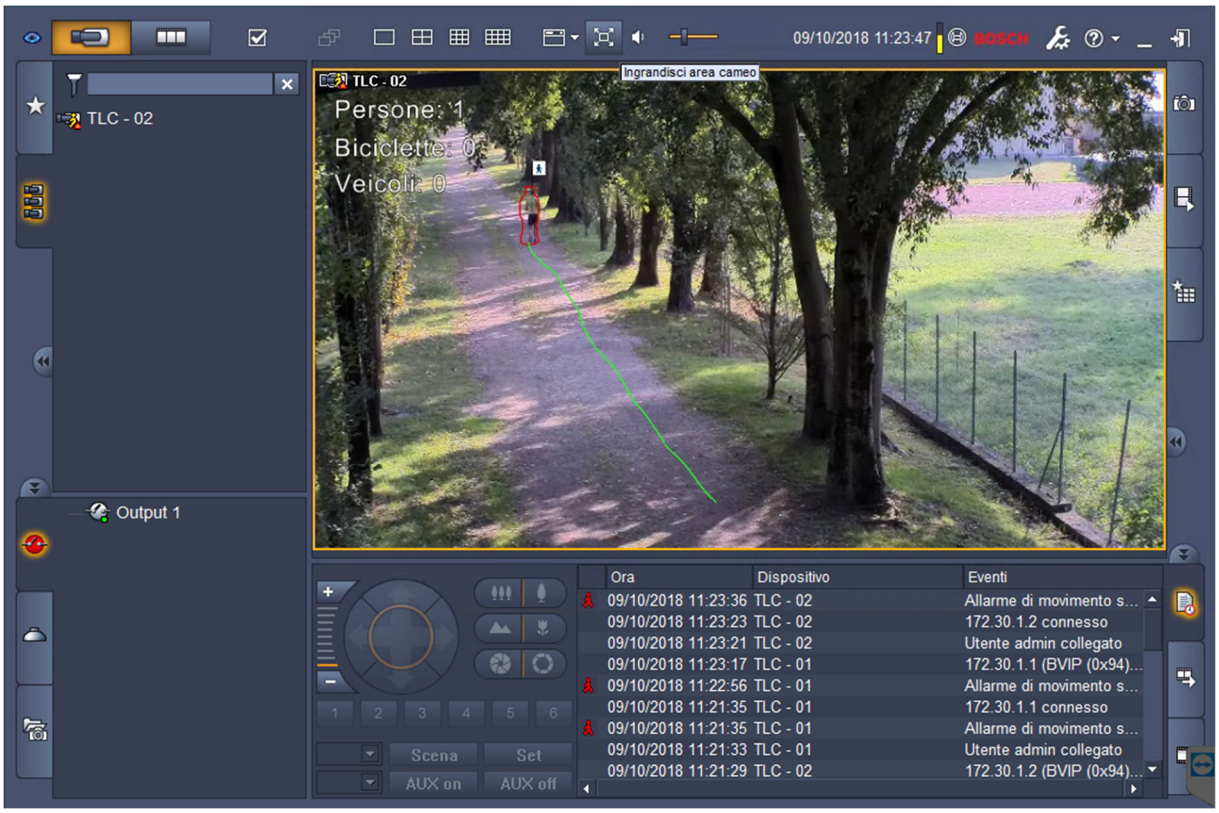
The old lighting system, pretty obsolete and energy-demanding, has been completely revamped. Light points have been improved in quality, increased in number and relocated, with the adoption of high efficiency "Full Cut-Off" standard LED light centers for park's opposite ends (the main monumental entrance and a statue roundabout) to obtain a practically total reduction of light pollution. As ring path's Light Points, such "Full Cut-Off" LED light centers are "Bio-Dynamic", meaning they are able to both change the quantity of emitted light and change its color temperature between 2.700 K (yellow) and 4.000 K (white).

This "Bio-Dynamic" effect is achieved thanks to the implementation of an innovative system: detection of users in the area through a brand-new optical fiber infrastructure and video cameras with onboard "Intelligent Video Analysis". By means of machine learning patterns, this software creates different profiles based on the type of users (pedestrians, bicycles…) and/or specific conditions (fog, emergencies…), through a power-line network transmits the coded information to light centers, which supply the related customized and correct light amount to the interested sectors (six Light Groups of ten light sources each, every Light Group is covered by about 2 Video Cameras). Contextually, the pilot area can also be constantly video monitored.



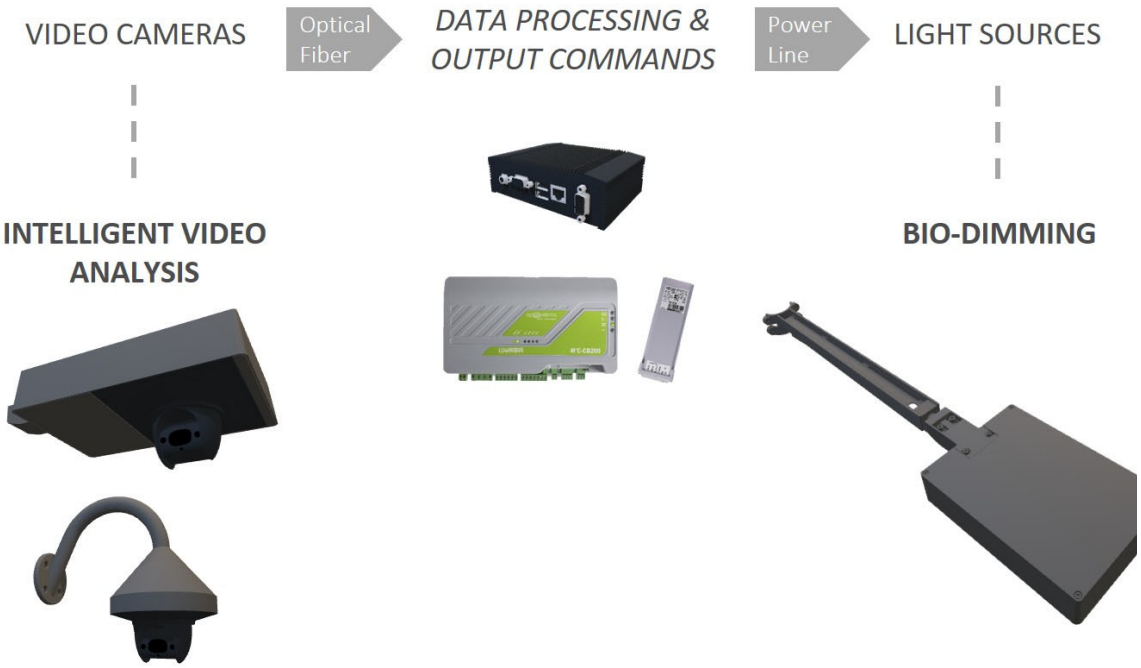
Light Masts

Video Cameras

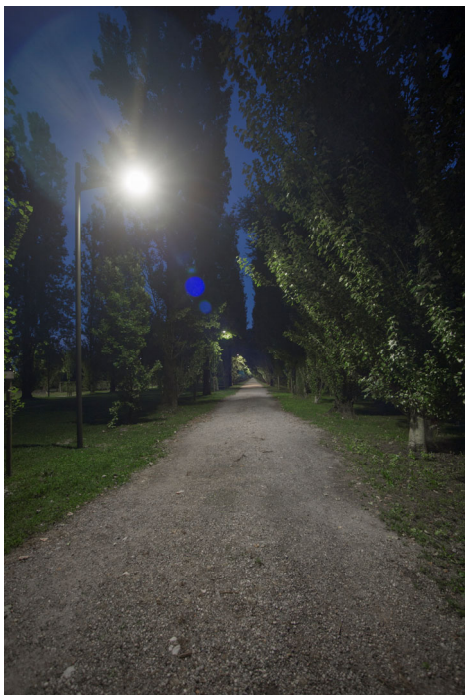


Intelligent Video Analysis

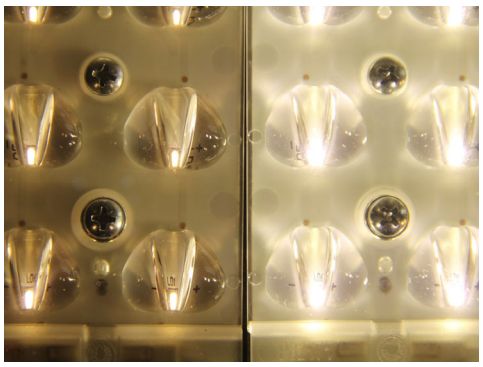
Municipality of Mantova is going to benefit by this cutting-edge technology within its territory, through important energy and costs savings, making a step forward in fight against light pollution and CO2 emissions reduction. All users and public security will also benefit from new Bosco Virgiliano pilot plant thanks to more performing lighting and dedicated videosurveillance. Since Bosco Virgiliano is located in a protected environmental context, the pilot area might hopefully become a scientific educational center about environment and sustainability, as well as being destined for hosting exhibitions and events, also easily reachable by public transports. Taking advantage of the new technological grid, it will be possible to integrate electric mobility stations for cars and e-bikes and prearrange smart parking lots available to people with legally protected statuses, in order to make city more pleasant and liveable and improving citizens life quality.



Pilot action control principle



Pilot action installation



2 Different Colour temperature LED systems

2. Final Conference Wismar March 2019

In March the project results were presented at the final conference of the project in Wismar (26.+27.3.2019).
At the conference the sustainable aspects of dynamic lighting are in focus: how a well-planned dynamic lighting contributes to social, ecologic and economic aspects of life in the city. But also the practical aspects of implementation will be presented and discussed: How the new digital possibilities could be used for an improved user-centered lighting of the public space and how cities currently implement dynamic light (Best practice+ Pilot installations). In April an additional conference in Prague will present the experiences with the implemented pilot installations in detail.

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