enel x

PUBLIC LIGHTING

ENEL X: SMART SOLUTIONS FOR OUR CITIES

Light is a **key element** in our cities. Lighting infrastructures provide Public Administrations with an opportunity to **enhance the usability** of their territory, by bringing more **security, efficiency** and **beauty** to the nocturnal cityscape.

Enel X has developed a **new range of public lighting solutions** for municipalities, in line with the latest technological standards and designed to achieve multiple objectives at the same time, namely economic savings and energy efficiency, maximum usage of existing infrastructure, enhanced resilience, reduced light pollution and, last but not least, a major boost for urban progress.

The **modular design** of the offering, which can be fully **tailored to specific customer needs**, helps ensure constant attention and practical support throughout the solution's lifetime, by using new tools and a re-organized processes.

EFFICIENT LIGHTING

Today's challenge of turning our cities into smart cities, by continuously improving their functionality, efficiency and sustainability, applies to public lighting as much as it does to every other aspect of urban life.

Enel X has recognized this, committed to it and invested in it right from the start. Way back in 2009, Enel Sole (which is now part of Enel X) became Italy's first company to invest in efficient light sources, by introducing the use of LEDs into luminaires made to its own specifications.
Public Administrations can now reap the benefits of the efforts and investments that Enel X has been consistently stepping up over the years, in the form of a **new range of LED products** that comfortably exceed 2019 market standards and are designed to deliver maximum financial and energy savings, first-class visual comfort and outstanding lighting performance.

Enel X LED solutions

› A flexible, comprehensive range: products made to Enel X specifications that have become a benchmark for quality, with luminous efficiency of up to **160 lm/W** and service life of up to **100,000 hours**.

› **Maximum adaptability** to design requirements thanks to the availability of a wide range of optics and product sizes: from 3,000 to 20,000 lumens.

› **Overvoltage protection** threshold of **12 kV**.

› Predisposed for integration with any type of **remote monitoring** system based on radio frequency protocols, using **Zhaga Book 18** and **NEMA** connectors.

› Capacity to supply the product worldwide (Europe, North America and South America).

The advantages

Maximum versatility of application, with solutions (from the most economical to the highest-performing) that can be tailored to the specific technical and economic needs of the customer.

Maximization of energy efficiency (>65%), thanks to the use of latest-generation lighting units with extremely high luminous efficiency (lm/W).

Consequent **reduction in CO$_2$ emissions**, in line with the energy saving achieved.

Excellent quality of light, as a result of the use of latest-generation LED chips with a high color rendering index, which ensure faithful and comfortable perception of the lit environment.

Maximum reliability of the LED products installed, with service life of 80,000 to 100,000 hours and a consequent reduction in the cost and effort involved in maintenance.

Maximum safety and **reliability** in the face of overvoltage risk, with a protection threshold of 12 kV, even in adverse weather or operating conditions.

Flexible use of the solution, with the possibility of profiling the **luminous flux emitted**, by setting simple rules at the time of initial installation or by implementing more advanced "adaptive lighting" technologies (see later paragraphs).

Fields of application

Enel X solutions can be adapted to all possible design scenarios, thus ensuring compliance with the lighting engineering requirements laid down in the applicable regulations.

> **Roads (of all categories), interchanges, roundabouts, underpasses:** installation of new, high-performance LED luminaries, with replacement of old lamp-post heads, fitting of new lighting units and/or possible replacement of the lamp-post and arm if in poor condition.

> **"Sensitive" contexts (e.g. historic centers, pedestrian areas and squares with particular architectural value or specific requirements):** installation of new decorative luminaires with appropriately coordinated styling, or replacement of the old light source with retrofit LED kit plates. These are designed specifically for fitting into the original lighting units, carefully preserving and enhancing the stylistic, cultural and aesthetic connotations of the context in question.

> **Parks, gardens and green areas:** installation of new urban furnishing luminaires incorporating top-level design, styling and technical quality, with a view to giving their host environments the increasingly popular feel of an "urban and social hub", by promoting safe, shared spaces and the community spirit that goes with them.

LIGHTING CONTROL TECHNOLOGIES

As well as its new LED product, Enel X has made another **technological leap forward** with its **lighting control solutions**, designed to enable public administrations to offer a better public lighting service, thanks to the enhanced reliability and safety of the installations and the option of activating a wide range of value-added services.

These solutions are an essential **tool** for the **control and smart, responsive management** of installations, with numerous major benefits for the service operator.

Monitoring and accurate diagnosis of intensity, profile and criticality of **actual energy consumption** (e.g. for the purpose of applying for white certificates).

Detection of **abnormal conditions** and system inefficiencies, thus speeding up maintenance response times.

In the case of "**point-to-point**" remote monitoring, direct capacity to **manage unexpected failures**, by restoring pre-defined powers where necessary.

Adjustment of the system and its operating parameters (e.g. pre-defined dimming).

Enel X lighting control solutions

Enel X offers two different systems of lighting control:

> **"Cluster" system**: enables monitoring of key electrical parameters from the ignition panel, which detects alarm signals (tripping of circuit breakers, differentials, power outage);

> **"Point-to-point" system**: by means of **digital communication** between the module on the light and the management module in the control panel, point-to-point systems provide full diagnostics of individual lamps. A full range of useful information is available for managing the system intelligently and responsively (switching on, switching off, reducing consumption, adjusting light intensity, monitoring operating hours, advance warning of failures or lamps approaching end of life).

Another major advantage is the fact that remote monitoring systems can be used to **enable additional services**, which can thus be installed in the public lighting system at a later date.

These include "value-added" services, or smart services, such as video surveillance solutions for public security, WiFi connectivity, environmental or territorial monitoring, variable message signs and other sensors that provide useful functions for citizens or public authorities.

Control Room

Using Enel X remote monitoring technologies, lights are managed and data is displayed by means of a **simple, intuitive user interface** known as the Control Room, which has a wealth of features designed for **enhanced knowledge, monitoring and management** of your fleet of lights.

Here are a few examples of the features that can be accessed by public authorities.
> Availability and display of a **wide range of data for each light point**.
>   • *Reading of operating status (detects possible faults).*
>   • *DALI connectivity status (or other dimmer device).*
>   • *Radio connectivity status.*
>   • *Reading of specific measurements (power and energy) controlled by DALI.*
>   • *Temperature reading.*
>   • *Tilt angle reading.*
>   • *Operating hours metering.*
>   • *Power consumption measurement.*
>   • *Metadata from video cameras (if present).*

> **Switch-on/Switch-off/Dimming** of lighting units.

> **Remote setting/resetting** of integrated **temperature sensor and inclinometer.**

> Setting **threshold levels** for the display of operating **status and alarms/alerts**, with various pre-settable criticality levels and immediate, precise identification of **position** in relation to the critical situations detected.

> Display of all points of interest (POI) on a map and the possibility of applying filters by specific parameters - with possible 3D display.

But the Control Room was also designed with another goal in mind: **supporting, facilitating and streamlining work procedures and processes** within public administrations.

> Installation on multiple devices (tablet, standard PC, totem, etc.) and **full interoperability** with the mobile devices of users or technicians.

> Easy, intuitive options for **collaborating and sharing** data or representations between the various stations connected to the network.

> Possibility of setting **different profiles** on the basis of different user roles (operational or supervisors) and enabling/disabling specific functions independently.

> **Custom settings** to create dashboards showing the information or representations of most interest to the user in question.

> Immediate access to **multimedia content** (manuals, video tutorials, 3D models, etc.) relating to every field device within the territory.

ADAPTIVE
LIGHTING TECHNOLOGIES

Enel X has taken public lighting to the latest state of the art: **adaptive lighting**, i.e. the possibility of adjusting street lighting on the basis of **actual traffic, weather and luminance conditions**.
This new solution is the most innovative aspect of the recently published UNI 11248 (which corresponds to EN 1320 at European level) and makes it possible to adjust the power of lights on the basis of the actual conditions identified on the road surface.

It can be applied with two different modes, which vary according to the **parameters** used to define the operational lighting category.

- **TAI** ("Traffic Adaptive Installation"), in which the operational lighting category is chosen solely on the basis of hourly **traffic flow**.
  This solution involves the use of a traffic flow meter capable of counting the number of vehicles per lane in real time. Based on this sample, an algorithm then increases or reduces the operational lighting category (with a maximum permitted reduction of 2 categories).

- **FAI** ("Full Adaptive Installation"), which involves the use of a **traffic sensor** combined with a **luminance sensor** for sampling the luminance of the road surface ("category M" in the jargon) or illuminance ("categories C" and "P") and **weather conditions**. This mode provides full knowledge of the operating parameters at all times, and the system can be made to react according to weather conditions (with a maximum permitted reduction of 3 lighting categories).

The advantages

This solution enables the **smartest possible management** of public lighting, thus delivering major benefits for public authorities and citizens.

- **Maximum energy savings**, by eliminating over-use of lighting and helping reduce urban light pollution: from Enel X's first installations, additional energy savings of **20-35%** on existing LED lights.

- **Optimal street lighting**, by adapting the luminous flux to actual road usage in real time (and increasing brightness in response to abnormal conditions of the street, e.g. accidents or road works).

- **Adherence to the principle of caution**, therefore excluding certain light points identified as "sensitive" (e.g. close to pedestrian crossings, roundabouts, etc.), in which the lighting is kept at the highest levels at all times.

- **Possibility of using video analysis for other value-added services**, such as public video surveillance or traffic monitoring for urban mobility plans.

The requirements

Here are the main requirements for the solution.

- The presence of a remote monitoring system applicable independently to individual lights, so as to be able to **adjust street lights individually** according the needs identified.

- The installation of **IP video cameras with pre-processing capacity**, based on the study of the ideal position and number to minimize quantity and maximize impact.
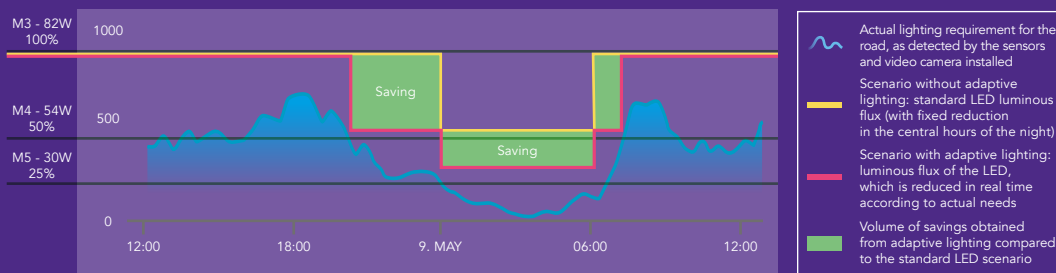
Control Room

For this solution too, the digital interface makes it possible to **display, manage and process data** and functions **easily, flexibly and intuitively.**
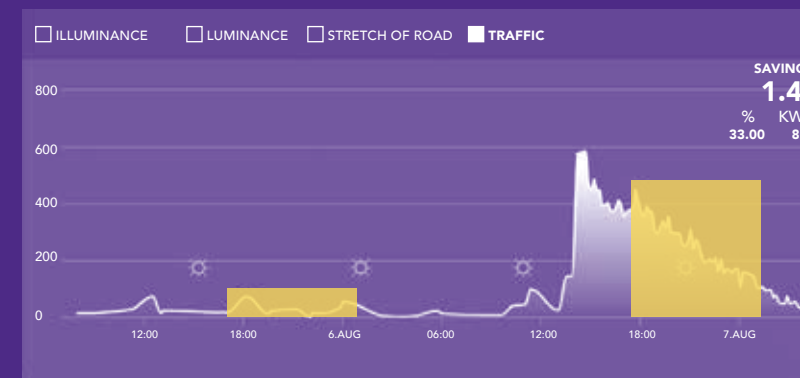
The following features are enabled for adaptive lighting technologies, in addition to the ones listed above for remote monitoring solutions.

> Possibility of **setting configuration parameters** for adaptive dimming (e.g. maximum number of categories by which the brightness can be lowered, % parameters).

> Display of **traffic flow, brightness and weather** data.

> **Reports on the operation** of the technology (e.g. operating hours, lowering vs. raising of brightness on the basis of detected events, consumption data showing the savings yielded by the solution).

ILLUMINANCE   LUMINANCE   STRETCH OF ROAD   **TRAFFIC**

SAVING €
1.41
%   KW/h
33.00   8.30

800
600
400
200
0

12:00   18:00   6.AUG   06:00   12:00   18:00   7.AUG

The dashboard shows how the adaptive lighting system adapts to the actual traffic conditions detected on the road.
In this case, for example, it can be seen that the adaptive technology operated normally during one night, but adjusted the luminous flux the following night in response to the detection of abnormal night-time traffic (caused by an accident on a neighboring road).

Comparison of night-time hours in normal conditions (6 August) vs. abnormal conditions (7 August).

Main dashboard for monitoring and setting the technology

Graphic display of the energy saving yielded by the adaptive lighting system during a typical day

M3 - 82W
100%   1000

M4 - 54W
50%   500

M5 - 30W
25%

0

12:00   18:00   9. MAY   06:00   12:00

Actual lighting requirement for the road, as detected by the sensors and video camera installed

Scenario without adaptive lighting: standard LED luminous flux (with fixed reduction in the central hours of the night)

Scenario with adaptive lighting: luminous flux of the LED, which is reduced in real time according to actual needs

Volume of savings obtained from adaptive lighting compared to the standard LED scenario

Tai - Fai

TAI camera status   FAI camera status
Normal   Normal

Current traffic flow (60 vehicles/hr).

Vehicles flow   Tai category
60 v/h   cat 0   TAI category currently in use.

Technical configuration parameters.

Configuration

Max. flow   Max. category   TAI status
1600 v/h   2   ACTIVE

Dimming set

Cat 0   Cat 1   Cat 2
100 %   75 %   50 %   Dimmer settings.

Fai

FAI specifications.

Exposure   Type of dimming   Target luminance
400000   FAI   0.5 Cd/m2

THE JUICE LAMP

Representing a combination of smart public lighting and electrified mobility, this solution is a perfect example of **integration, efficiency and the utmost innovation**: the **Juice Lamp** is a light designed by Enel X that combines latest-generation **public lighting** and **2 electric vehicle charging points**.

Developed using the latest technologies and attractively designed in 4 different styling concepts, our Juice Lamp looks the part in any urban street setting, and brings the latest innovations to all our cities.

The solution

- A **street light** equipped with **LED** light sources and **lighting control technology**, with the possibility of installing an adaptive lighting system.

- **Two built-in electric charging points**, each delivering charging of up to **22kW**, equipped with the same functions as the charging stations supplied by Enel X.

The advantages

Available in a range of heights and colors, it fits into any roadside setting and comes in one "classic" and 3 "modern" styles to blend seamlessly even into historic centers or artistically sensitive cityscapes.

High-speed electric charging mode, thanks to the power output of up to 22kW for each of two Enel X JuiceBoxes installed.

Interoperability and possibility of fitting any lamp or light source.

Possibility of **installing value-added services** such as video surveillance, traffic analysis, environmental monitoring, connectivity and many more.

Fields of application

No specific constraints or limits on the application or installation of this solution.

EVERYTHING IS EASIER WITH ENEL X

HOW DO YOU SIGN UP?

Whether the task is to re-organize a large metropolis or preserve and enhance a small village, our dense, worldwide coverage and our many years' experience in the field are at the disposal of local administrations so that we can **plan the infrastructures and services of the future together.**

We can deliver the service through all the main purchasing channels, but we don't want to be just suppliers. We want to be a **partner** that helps and facilitates public administrations in choosing the most effective models in order to maximize the benefits for the city and its people, by taking the best administrative and financing opportunities.

HOW MUCH DOES IT COST?

A lot, not much or nothing. For us, designing solutions together means being able to modulate the extent of the investment, the duration and the service level in order to meet the authority's spending targets.

As an example, with the **Project Financing** model we can bear the entire initial investment and pay it off by sharing the energy savings with the city, thus immediately reducing public expenditure, as well as providing a first-class service, at zero cost.

PROJECT FINANCING

Through Project Financing, or Public-Private Partnerships, private operators can **offer and make public-interest investments**, by bearing the cost in place of the public authority and obtaining the resulting asset under license for a sufficient time to ensure its economic and financial sustainability.

Collaboration takes place in the form of a genuine partnership according to the following simple, transparent process.

› **Energy audit:** Enel X conducts an energy diagnosis on the assets covered by the proposal, at its own expense.

› Once the starting point has been identified, both in terms of infrastructure and current expenditure, a **feasibility study** is carried out to identify the technological solutions best suited to achieving the public authority's service or spending targets. Collaboration in this step is essential so as to guide the investment choices along the right path between what the authority requires and what is technically feasible. Enel X bears the full cost of the design.

› On completion of the design phase, the process goes on with following steps:
  • feasibility study;
  • specification of the characteristics of the service and its management;
  • draft agreement;
  • economic and Financial Plan endorsed by a credit institution;
  • risk Matrix, which the institution can use to verify the cost-effectiveness of recourse to a Public-Private Partnership compared with a traditional contract.

- The authority **assesses the proposal** in relation to its needs. It can obviously request further information or certain modifications.

- The assessment comes to a successful conclusion when the authority declares the **initiative to be feasible**.

- The approved project is then put out to **tender**, thus opening up the possibility of receiving bids from any operators that meet the requirements, in complete transparency and under a public procedure.

Why Project Financing?

- It is a **simple, transparent process** that enables public authorities to avoid bearing the cost of the analysis and design phases directly.

- It means the project can be structured on the basis of the actual **specific interest** of the authority, by harnessing the expertise of a private partner.

- **Private investments are higher** than the investments that would be obtained from a normal tendering procedure and generate even higher value in terms of infrastructure and service.

- Project Financing can be customized to the point that it is possible to keep the use of public resources within strict limits and **reduce current public expenditure** immediately.

- The private partner bears the **risk** instead of the authority.

- The process, proposal and service are delivered in **full compliance with the public contracts** code, fitting case by case to the specific local regulations and anti-corruption authority legislations.

ENEL X: SHOULDER TO SHOULDER WITH CUSTOMERS

YoUrban

Enel X is a firm believer in the benefits of **digitalization** and is proud to bring digital technologies into a traditional service like public lighting. As well as the system **control and management platform** for setting and monitoring your fleet of street lights, Enel X has now made **customer care digital** too, with **YoUrban**.

It's a major new development to support the routine and non-routine management of the public lighting service. And it serves a dual purpose, because it is an app for citizens and a portal for public administrations.

🖵 YoUrban: the portal for public administrations

A portal that supports public administrations in monitoring and improving the quality of public lighting service. A direct, customizable, easy-to-read interface that provides a clear view of open support tickets, average resolution times, urgency levels and any operating blockages.

Designed around the actual needs of customers, here are some of its distinctive features.

> **Dashboard** with key indicators on the service level of the public lighting system.

> Section dedicated to open and/or closed tickets relating to **dangerous situations**/urgent disservice.

> Possibility of **reporting faults**, in a way similar to what citizens are offered with the YoUrban app.

> **Display of assets** and related tickets **on a map.**

> **Customizable reports** of various types on data collected by the system (e.g. number of tickets, average resolution time).

> **Integration** with all other ticket opening channels (e.g. app, call center, technicians) and single-source management of the resulting response.

> **Direct engagement** of maintenance technicians and integration with Enel X's field service, with the possibility of accepting online bids and quotes for repair work submitted by Enel X.

> **M**onitoring of all activities in progress.

YoUrban: the citizen's app

An app designed to give the public the opportunity to report faults on the public lighting system and help enhance the safety and usability of their town or neighborhood.

A **user-friendly** interface provides an easy, intuitive and positive experience that also makes it possible to monitor every step of fault resolution and earn points on the basis of your "efforts" for the Community.

Developed directly by Enel X, here are some of its distinctive features.

> **Geolocation**, to facilitate identification of the reported street light on the map.

> **Easy fault type selection**, by browsing through a predefined list.

> Possibility of **adding comments and photos** (or other media) to your report, thus earning more points.

> **Display of tickets already opened** by a user and possibility of confirming ticket status where appropriate.

> **Monitoring** resolution status and the option to receive notifications each time it changes.

> Possibility of **sharing** ticket closures on social media.

> Access to a "**News**" section.

> Possibility of **earning points/rewards** to be used as specified in the app.
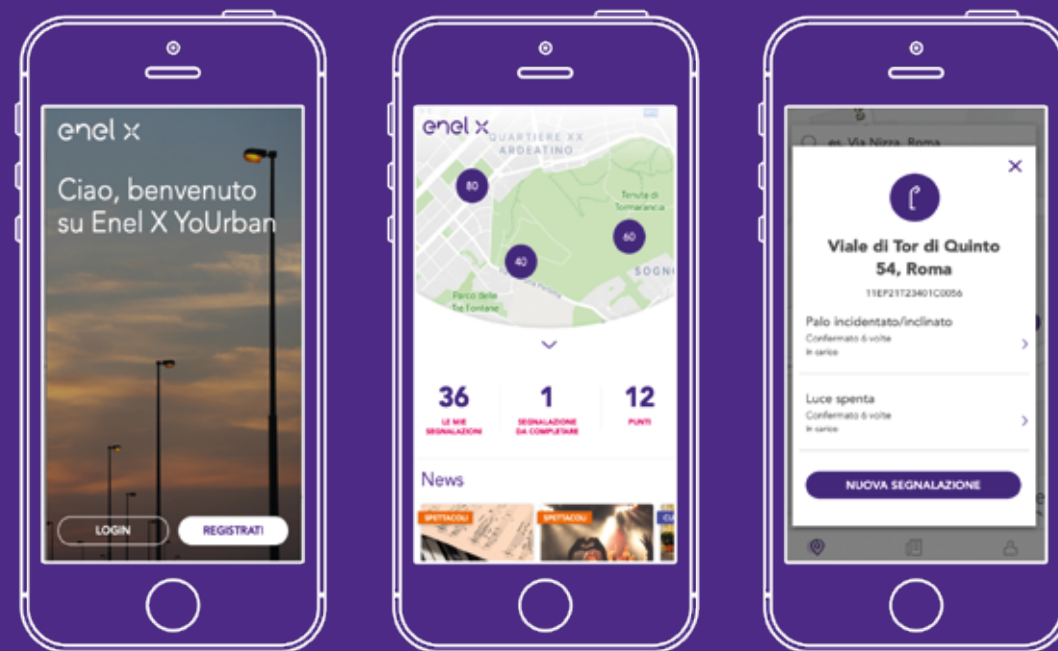
MUNICIPALITY OF BOLOGNA (ITALY)

Enel X developed and engineered a complete plan for the management and redevelopment of the public lighting system for the Municipality of Bologna.

✏️ The project

- Complete management and maintenance of **45,555 light points** and **5,100 traffic lights**.

- Supply of electricity.

- Replacement of 32,600 old street lights with: **21,500** Enel Archilede **LED street-lighting devices, 7,500 urban furnishing devices, 3,600 span-wire LED devices**.

- Modernization of **5,100 traffic lights**.

- Installation of a **lighting control system for 33,000 light points**, for managing and controlling luminaires and distribution boards, and providing a platform for services such as Wi-Fi Hotspots, video surveillance systems, detection stations and traffic control sensors.

- Dismantling of the old medium-voltage boxes and installation of about 300 low-voltage distribution boards and 1,000 kilometres of cable to **increase electrical safety** and **reduce system failures**, thus ensuring better continuity of service.

👍 The benefits

- Reduction of electricity consumption: **-10 million kWh per year**.

- Reduction of CO_2 emissions: **-8 million tons per year**.

- Improvement of **light quality**.

- Improvement of **public spaces**, such as parks, gardens and pedestrian areas.

- Fewer failures and **improved service**.

- **Increased safety** for streets and people.

The city of Bologna also became the **first test site** for a Proof of Concept (PoC) of the **adaptive lighting solution**. The project called for an advanced camera system capable of adjusting brightness automatically on the basis of traffic intensity, in accordance with UNI 11248 / EN 13201. Local sensors carry out automatic analysis and communicate with each other and with a remote server over a wireless connection. The remote server processes the information in turn and also makes it possible to run statistical analyses and store and display data in a control interface.

This technology yielded an additional 35% saving in energy consumption on the lights to which the solution was applied (fleet of lights already using LEDs). The solution also demonstrated how it can increase road safety at night, having stepped up the brightness to maximum over a specific stretch of road when the sensors detected an abnormally high flow of night-time traffic (caused by an accident on a neighboring road).

MUNICIPALITY OF LA CISTERNA (CHILE)

A public lighting project involving the use of **LED technology** and a **lighting control system** for **9,224 light points** has been implemented in the municipality of La Cisterna.

The remote monitoring solution used in the municipality makes it possible to establish different luminous fluxes for each sector or each luminaire, and thanks to the system's technical features, also makes it possible to optimize preventive and corrective management of the lighting network.

The nodes are connected to the management system by a wireless connection with ZIGBEE communication protocol and are organized into sub-networks, grouped under a concentrator.

👍 The benefits

- **Geo-referenced display of assets**.

- Management of **energy saving**.

- Programming of **lighting nodes**.

- Programming of **traffic lights**.

- Planning of inspection and **maintenance activities**.

- **Fault detection**.

- **System reporting** (periodic reports).

- Backup of **information history**.
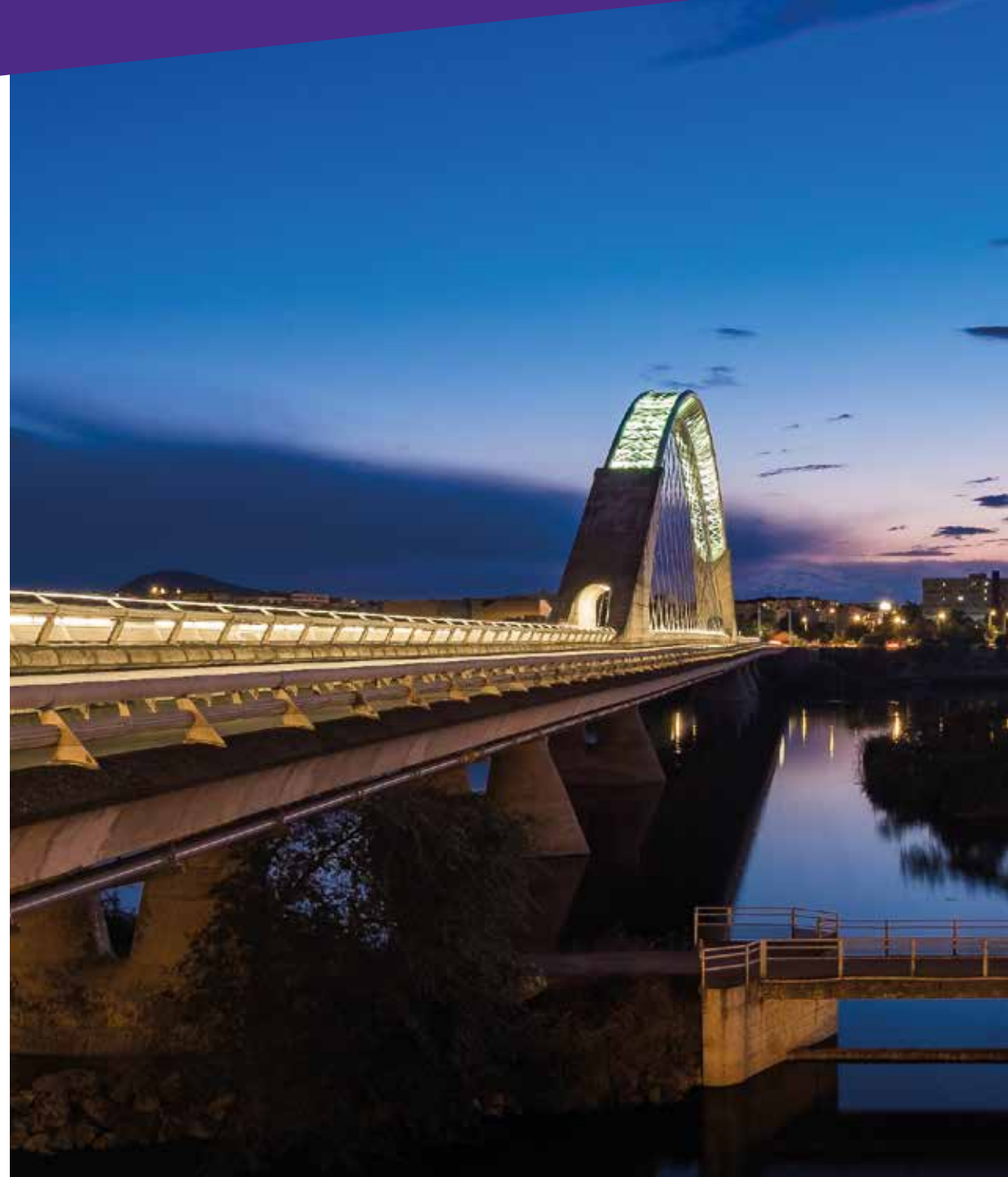
MUNICIPALITY OF MERIDA (SPAIN)

Through its Spanish subsidiary, Enel X Iberia, Enel X manages **17 street lighting projects** equipped with **lighting control systems** that manage approximately **70,000 street lights**.
More specifically, a street lighting project involving the use of LED technology and the remote management of almost **14,000 light points** has been implemented in the municipality of Merida in Spain.

The nodes are connected to the management system by a wireless RF connection, with open communication protocol. Enel X Iberia - which also owns the corresponding IPR - developed the management software that has proved to be an essential tool for optimizing the preventive and corrective management of public lighting networks.

👍 *The benefits*

- **Geo-referenced display** of assets.

- Management of **energy saving**.

- Remote programming of the **lighting system**.

- Planning of inspection and **maintenance activities**.

- **Fault detection**.

- **System reporting** (periodic reports).

- Backup of **information history**.

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