Interreg CENTRAL EUROPE
Dynamic Light
European Union
European Regional
Development Fund

GIS-BASED DATABASES FOR MUNICIPALITIES

D.T. 2.1.3 – FINAL OUTPUT

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INTRODUCTION/BACKGROUND

Bosco Virgiliano, with a total surface of 50000 square meters, of which 14000 are paths and squares, presents a remarkable plant biodiversity. Within the green area, together with the main track there are a labyrinth, a vegetable garden, a vineyard, an orchard, a herbarium and a stretch of water (fed by resurgence water).

Since it was built, its potentialities were very clear: the proximity with important nature conservation sites like the Lakes of Mantova and the Vallazza Natural Reserve allowed the settlement of many animal species of conservative interest, provided with a barrier between residential quarters and natural areas.

The park vegetation is very thick, works as a filter for atmospheric contaminants coming from the northeastern industrial site and is able, on a small scale, to condition the daily and annual temperature excursions, reducing the classic “heat island“ of urban areas.

In Mantova each inhabitant has 50,1 m^2 of green space available, which is the highest availability at a regional level, much above the national average, set at a value of 31,1 m^2.

This is one of the main reasons why we have chosen to dedicate the entire project to the green patrimony of the city.

The importance of green areas within the urban pattern has been growing for the last years, in the same way these areas have to offer safety and usability features that meet people’s needs. Their adequate lighting plays a paramount role in both a better management and the complete users’ satisfaction: the application of advanced LED technology light sources turns out to be the best solution in terms of reliability, energy saving and visual outcomes, as well as drastically reduce light pollution.

The subsequent technological step, tested thanks to this project, consists in the possibility to regulate the light intensity depending on the ways of use and all the related variables, exploiting an adaptive or dynamic mode of operation.

Furthermore, choosing to focus on urban green areas and, as a wider approach, “aggregative lighting areas” allows us to have a large range of experimentation, since the national legislation on public lighting does not impose any of its technical restrictions on this kind of environment. Considering that this is the very first implementation of this innovative technology in Italy, we have found appropriate to opt for this type of areas, for it presents a smaller complexity of users, variables and conditions, particularly in order not to hinder the emergencies management across the city.

TEA S.p.A., which is a joint stock multiutility company, is proprietor of its own SIT with a GIS and Web GIS platform, which have recently been wholly renewed and internally managed, at a both hardware and software level. The entire system is fueled with company’s data assets, that is the lattice of technological networks (water, gas, district heating, public lighting, optical fiber) and related information located in all Municipalities associates’ territories, covering

almost the whole Province of Mantova. The base maps include cadastral maps, vectorial maps and images from aerial photogrammetry (orthogonal and oblique images). To date, geospatial data prove to be fairly complete, although they still need further works of correction and integration, especially in some sectors. The platform remains for the exclusive use of the internal technical personnel of TEA S.p.A. and its operative limited companies, specifically for management/analysis operations and works directly on field.

TEA Reteluce is the TEA S.p.A. limited company that attends to the public lighting networks of 28 Municipalities in the Province of Mantova and their revamping, in order to optimize energy consumption, save money and resources, preserve environment and enhance all the installations. TEA S.p.A. GIS platform only contains part of the overall data about the public lighting systems, the coverage is restricted to the sole Municipality of Mantova and is not complete, lots of portions are still missing, pending their integration. The information loaded on geospatial databases, and available through the Web GIS, are generally listed in the following chart.

1. DATA ACQUISITION / SURVEY AND COLLECTION OF DATA

1.1 DATA SOURCES AND METHODOLOGY USED

All data here presented have been collected with different methodologies, also integrating various software and from specialized technicians.

As for light sources and their technical information, we were supported by TEA Reteluce, that supplied all details about types of lamp, poles structure and switchboards used. The company databases contain all the information related to the consumptions of each light point. This research has been quite easier since the majority of street light sources in Mantova Municipality's territory were replaced with LED systems. As for the "aggregative lighting" elements (about the 35% overall), it was necessary to estimate the consumptions on the basis of type, features and installation date. The company archives include and catalog all the pictures of currently installed light sources, allowing all the operators to perform a quick search of all fixtures.

Most part of GPS coordinates comes from the shapefiles managed by the external company, but they are rather inaccurate and demand verifications. The coordinates of the light points in green areas are instead perfectly correct, since they have been manually recorded by means of GPS detectors and then loaded onto the GIS platform. The switchboards data come from a coordinates conversion operation, as they have been pinpointed on digital cartography by TEA Reteluce technicians through Google Earth and later imported into the GIS platform.

Lastly, as concerns the photometric data, an ongoing productive collaboration has been established between TEA Reteluce and an external company, providing complete and detailed reports.

1.2 STRUCTURE AND NAMING OF THE DATA

- **The detailed description of the collected information**

Pole_ID	Luminaire localization			Swit_ID	OWNED_BY	MAINT_BY	Remote metering	Luminaire criteria			
	GPS_LAT	GPS_LON	Street_Name					Light_Type	Lumin_type	Lum_effic	Lum_flux
[-]	[-]	[-]	[-]	[-]	[-]	[-]	[YES/NO]	[-]	[-]	[lm/W]	[lm]
C01-C02	641592,96100000	5000287,55200000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C03-C04	641538,02400000	5000310,45399999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C05-C06	641471,51700000	5000342,52500000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C07-C08	641415,20800000	5000367,80599999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C09-C10	641356,20300000	5000393,63999999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C11-C12	641296,36400000	5000416,97300000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C13-C14	641236,89400000	5000445,76099999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C15-C16	641186,48500000	5000467,71600000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C17-C18	641154,32600000	5000487,25899999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C19-C20	641120,98800000	5000493,49299999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C21-C22	641129,31200000	5000510,33999999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C23-C24	641217,09100000	5000465,88800000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C25-C26	641273,63000000	5000441,55300000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C27-C27	641336,60900000	5000414,77900000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C29-C30	641392,55000000	5000390,25999999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C31-C32	641451,40700000	5000361,10300000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C35-C36	641572,97000000	5000306,60699999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C36-C37	641514,51700000	5000334,11400000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C37-C38	641631,37600000	5000282,04299999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C39-C40	641689,90100000	5000255,58200000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C41-C42	641728,45500000	5000237,85699999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C43-C44	641756,85500000	5000251,19400000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C45-C46	641780,37500000	5000237,18499999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C47-C48	641760,99600000	5000188,74500000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C49-C50	641733,68100000	5000196,73000000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C51-C52	641724,01200000	5000229,14099999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C53-C54	641687,62100000	5000220,61400000	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100
C55-C56	641658,40100000	5000256,95899999	Bosco Virgiliano Garden	QCD	Municipality of Mantova	TEA ReteLuce	YES	High pressure sodium	Globe	81	8100

Luminaire criteria					Pole						Arm lamp base			Lighting obstructions
WAT	No.	TOT_WAT	INSTALL_DATE	Ann_oper_life	Type	Material	Date_inst	Date_renov	Height	Distance	Type	Height	Arm length	
[W]	[pc.]	[W]	[-]	[h]	[-]	[-]	[-]	[-]	[m]	[m]	[-]	[m]	[m]	
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	61,10	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	73,00	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	61,70	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	64,40	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	64,20	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	66,00	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	54,90	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	37,60	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	33,90	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	18,70	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	34,00	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	66,30	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	61,50	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	68,40	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	61,00	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	65,60	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	65,40	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	68,60	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	64,30	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	64,20	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	42,40	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	31,30	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	27,30	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	52,10	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	28,40	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	33,80	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	37,30	Double-bracket	5,00	0,30	-
100	2	200	Before 1990	4196	Hexagonal	Steel A Zn	Before 1990	2017	5,00	46,60	Double-bracket	5,00	0,30	-

Geo DB Luminaire

Pole_ID	Pole_ID_meas	Localization - light intensity measurement point		Dist_to_source	Road classification (UNI 11248 - 2016)	Photometric data						
		GPS_LAT	GPS_LON			Lum_flux	Lum_inten	Lum_effic	Illum	Luminance	Date_meas	Time_meas
[-]		[-]	[-]	[m]	[-]	[lm]**	[cd]	[lm/W]	[lx]	[cd/m2]	[-]	[-]
C01-C02	-	641592,96100000	5000287,55200000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C03-C04	-	641538,02400000	5000310,45399999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C05-C06	-	641471,51700000	5000342,52500000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C07-C08	-	641415,20800000	5000367,80599999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C09-C10	-	641356,20300000	5000393,63999999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C11-C12	-	641296,36400000	5000416,97300000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C13-C14	-	641236,89400000	5000445,76099999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C15-C16	-	641186,48500000	5000467,71600000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C17-C18	-	641154,32600000	5000487,25899999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C19-C20	-	641120,98800000	5000493,49299999	4,98	P2	6480	-*	64,80	2,84	-*	15/05/2017	21:30
C21-C22	-	641129,31200000	5000510,33999999	4,98	P2	6480	-*	64,80	2,84	-*	15/05/2017	21:30
C23-C24	-	641217,09100000	5000465,88800000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C25-C26	-	641273,63000000	5000441,55300000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C27-C27	-	641336,60900000	5000414,77900000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C29-C30	-	641392,55000000	5000390,25999999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C31-C32	-	641451,40700000	5000361,10300000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C35-C36	-	641572,97000000	5000306,60699999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C36-C37	-	641514,51700000	5000334,11400000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C37-C38	-	641631,37600000	5000282,04299999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C39-C40	-	641689,90100000	5000255,58200000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C41-C42	-	641728,45500000	5000237,85699999	4,98	P2	6480	-*	64,80	1,26	-*	15/05/2017	21:30
C43-C44	-	641756,85500000	5000251,19400000	4,98	P2	6480	-*	64,80	1,26	-*	15/05/2017	21:30
C45-C46	-	641780,37500000	5000237,18499999	4,98	P2	6480	-*	64,80	1,26	-*	15/05/2017	21:30
C47-C48	-	641760,99600000	5000188,74500000	4,98	P2	6480	-*	64,80	1,26	-*	15/05/2017	21:30
C49-C50	-	641733,68100000	5000196,73000000	4,98	P2	6480	-*	64,80	1,26	-*	15/05/2017	21:30
C51-C52	-	641724,01200000	5000229,14099999	4,98	P2	6480	-*	64,80	1,26	-*	15/05/2017	21:30
C53-C54	-	641687,62100000	5000220,61400000	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30
C55-C56	-	641658,40100000	5000256,95899999	4,98	P2	6480	-*	64,80	1,48	-*	15/05/2017	21:30

GEO DB Photometric

Swit_ID	Switchboard			Luminaires		Grid	
	GPS_LAT	GPS_LON	Year of installation	No.	Total Wattage	Operation hours	Consumption
[-]	[-]	[-]	[-]	[pc]	[W]	[h/year]	[kWh/year]
QCD	641593,31000000	5000273,46100000	Before 1990	56	5600	4196	28197

GEO DB Switchboard

- **Data type used (vector, raster, tabular)**

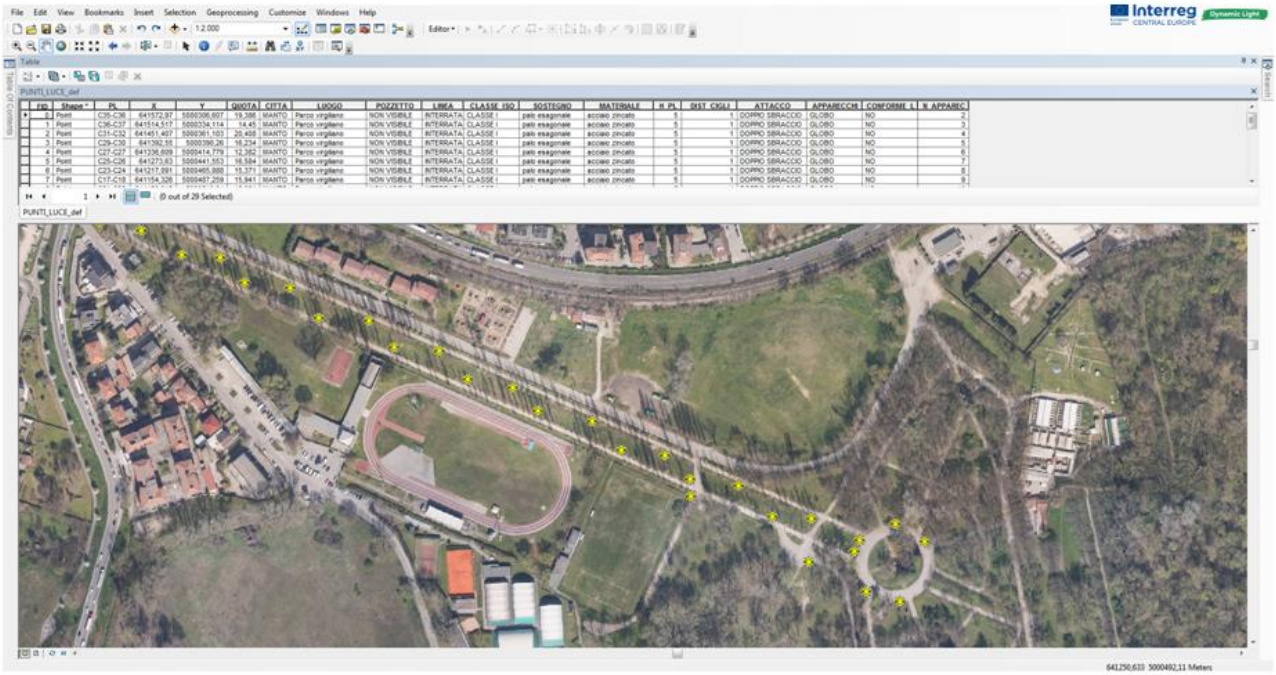
All used data are vectorial and the base cartography are raster files obtained with dedicated plane flights.

- **SUMMARY of the subchapter 1.1**

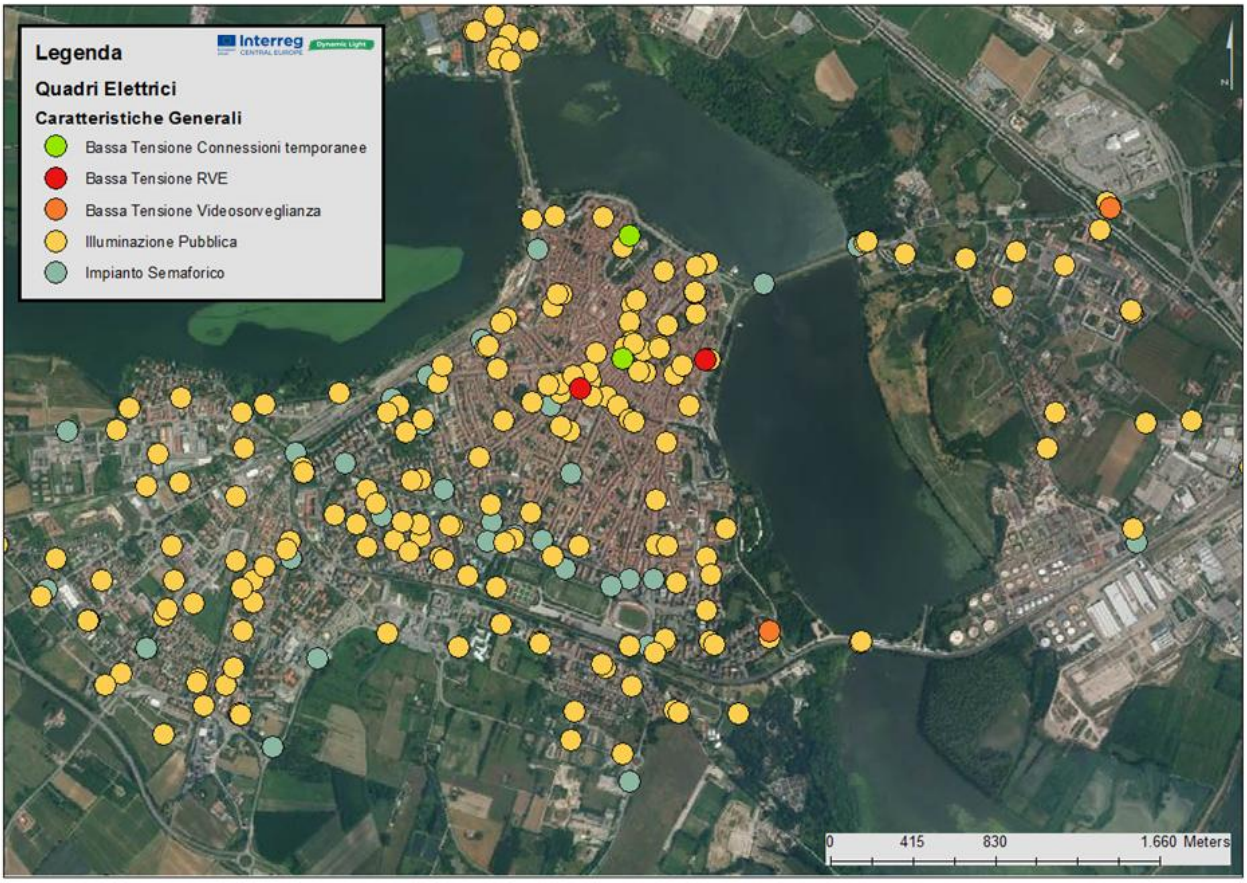
The database is incomplete and needs to be integrated, the data acquisition will be systematically carried on with the help of on-field technicians. The poles census and new labelling will allow to verify the correct geolocalization of light points and electrical network; wherever they will not be available, the data will be detected and archived, possibly taking advantage of the newest technologies.

1.3 SOFTWARE

For all data elaborations TEA owns a system newly based on ArcGIS 10.3.1 software. Here follows a screenshot displaying the base cartography and the table with all main features associated with the light points visualized below.



2. VISUALIZATION OF THE COLLECTED DATA



3. FUTURE USE OF THE GIS DATABASE

The first interventions will undoubtedly concern update and improvement of current GIS database towards all company's business lines, in order to fill possible gaps and secure sensitive data. Among the most important future GIS implementations there definitely is the possibility to equip all societies' operators with devices allowing them to share data directly on field, graphically report situations on different levels (making them visible in real time on desktop devices), perform measurements and analyses through oblique imagery without necessarily being on field. These developments will lead to a reduction of wasted time and resources, as well as to a higher work efficiency.

When the main procedures will be completely in-house and integrated as basic company processes, it will be possible to evaluate further technological developments. The group's ideas include the integration of GIS with company and societies management software platforms, such as the Technical Services Portal – PST (geolocalization of the intervention warnings for monitoring the currently underway activities, integrated management of maintenance works and planning based on operations history analysis), and the future possibility to publish a GIS Web Service, making it available for company associates to consult data.

4. EXPECTED IMPACT AND BENEFITS OF THE TOOL FOR THE CONCERNED TERRITORIES AND TARGET GROUPS

If it is true that every company focuses on increasing its profits reducing waste, stemming the expenses and best investing on its own resources, this is an essential objective especially for a multiutility in particular operating in the energy field. Among other things, Tea S.p.A. concentrated on the growth of its lighting society, specifically dedicated to public lighting: this sector requires a constant and efficient supervision of systems' performance.
The chance to take advantage of the GIS platform may be very useful in terms of energy saving, the software potentialities can generate lots of precious information. The fulfillment of this project has firstly engaged all sector experts, in order to reckon possible waste and assess how to prevent them. Thanks to the society's staff we have learned of all the main technologies in lighting equipment, then we have shared these knowledge with whoever directly works on field. Afterwards, we involved the Municipality of Mantova, the nature protection area Parco del Mincio and the Local Police, which have provided us with some information about urban green areas, our target areas. These information can be possibly used in the future to draw integrated analyses through the GIS.

5. SUSTAINABILITY OF THE TOOL AND ITS TRANSFERABILITY TO OTHER TERRITORIES AND STAKEHOLDERS (IN ITALY)

GIS is fast becoming the tool to use for sustainability and planning as we seek to maximize the efficiency of the environment around us and protect what needs to be protected while maintaining health and jobs in the modern economy. Gis is very useful because of its integrative power and ability to bring together so many data sets into one simple to use graphic and database format. This tool is quick and easy to compile, manipulate and present to a different range of stakeholders. Anyone who deals with urban planning, networks and services will need different information, yet all of these groups may be drawing on the same data sets. Furthermore is important to highlight how conventional mapping looks at the average of a straight line radius and then calculates the average production of an area. With GIS, better logistical planning is possible.

6. LESSONS LEARNED FROM THE DEVELOPMENT/REPRESENTATION PROCESS OF THE TOOL AND ADDED VALUE OF TRANSNATIONAL COOPERATION

Cooperation can provide local projects with a new dimension, since these types of projects provide stakeholders with alternative and novel opportunities to look for and solve issues in innovative ways. Pooling resources and expertise can result in economies of scale and synergies, which are favorable to help achieving project objectives. Implementing a project with partners from different country can help the promotion of local products and the area of their origin. In contrast to potential competition, cooperation enables the partners to take advantage of complementarities, and to benefit from similarities. New visions, new culture, new background and new dimensions can support and promote new ways of working and can help local people discover their own area and history; also by improving the understanding of their own territory, transnational interactions can lead to local actors becoming more open to represent their land. These projects help to meet the needs and challenges addressed in the strategies of the cooperating areas, are deeply linked to the territory and the local development strategies of cooperation partners.