Letter of intention
Horizon Europe HORIZON-CL5-2022-D4-01-03
Smart Lighting for Building

PROJECT DESCRIPTION
Scope
Improvement and cost-reduction of technologies to predict, assess, monitor and control in real time the energy performance of buildings, including energy efficiency, renewables, storage and their optimisation.

Position:

- Develop new or enhance existing solutions for interoperability of systems, including between building automation and control systems (BACS) and other technical building systems and devices (including IoT ones), as well as between buildings and the grid.

- Investigate innovative approaches to ensure a high level of security and privacy by design in buildings.

- Investigate approaches to reduce costs of systems allowing the integration of energy efficiency, renewables, storage and their optimisation.

- On the basis of the above, demonstrate the potential for energy savings from energy management solutions based on smart technical building systems (predictive controllers, smart thermostats, active sensors, smart lighting, etc.).

- Assess the contribution of proposed solutions to the enhancement of smart readiness of buildings as rated by the smart readiness indicator under Directive 2010/31/EU.

- Demonstrate that the developed solutions are user-friendly and ensure the desired indoor environment quality and user satisfaction.

- Where possible, demonstrate that such solutions can build flexibly on services/products not originally intended for energy management (e.g. a smart home system).

- Seek to ensure from the design phase that the project is developed with a view to integrate its results/deliverables under a digital building logbook.

Each project is expected to include at least three demonstration sites located in different climatic regions.

Clustering and cooperation with other relevant projects is strongly encouraged; in particular, liaison and synergies with the European Partnership on 'People-centric sustainable built environment'.

PROPOSAL

General problem:

How to optimize the control and maintenance of lighting, in particular by Artificial Intelligence, in Smart building to generate significant energy and cost savings while ensuring the comfort and satisfaction of users?

Although this proposal mainly concerns the field of lighting, it brings together professionals used to working with players in other fields related to user comfort (thermal, air quality, acoustics, etc.) or to the interoperability of systems and protocols used in smart buildings (IoT, GTB/GTC…).

Objectives:

- **Adapt lighting to the needs of each user.** The idea is to provide each person with the right lighting environment: the one they prefer at the time they need it based on their activity in the space they occupy. The smartphone will be used to store the user's preferences for the quality of the indoor environment IEQ (light, thermal, acoustic...) and manifest to the occupied building space.
- **Save energy**. The connection between the taking into account of the occupancy, individual preferences, sensors and technical systems of the occupied space will allow to achieve an intelligent management of comfort that will allow energy savings.
- **Facilitate remote maintenance and save its costs** through the development of a digital duplicate of the building detailing its equipment: which equipment? at which location? The equipment can also by itself report possible malfunctions.
- **Ensure the compatibility of intelligence related to lighting** with other areas. This interaction should be done at the hardware level as well as at the software level.

Methodology:

- **Digital modeling and simulation**. Develop an Artificial Intelligence based predictive and adaptive lighting controller model that can be implemented in building simulation models (Digital building), or for optimized building management. The controller will use current knowledge of visual comfort, rely on innovative input data such as IoT information (beacon, etc.) in addition to already proven sensors, as well as available related indicators (CO_2, solar shading, heating, etc.). Artificial intelligence will be used to train the controller to react to given situations, exploiting already existing record bases. User variability will be a central point of development.
- **On-site experimentation**. The controller model, sensors, and lighting systems will be tested on an occupied building to verify interoperability with systems in other areas as well as expected energy savings. User surveys will be conducted to verify the acceptability of the system.

Demonstrators:

The partners of the proposal have already carried out European projects with real demonstrators, and the complementarity of the partners will allow to identify suitable sites for installations of measurement and demonstration tools (potentially on the LUMEN building).
=> EAS SOLUTIONS and ODELI being important actors of intelligent lighting, we will have no problem to find a customer for the implementation of a demonstrator.

SKILLS & ASSETS

Demonstrators and projects already completed in the field:

Gare d'Austerlitz - Lighting of the Austerlitz station, 600 light points equipped with a radio system on Dali. Time synchronization, time scenes, temperature variation throughout the day. Centralized management on a Wago automaton. Possibility of activating services such as "wayfinding" for users thanks to the "advertise Beacon" technology

Line J - Line J is gradually equipped with radio technology, the platforms receive lighting with radio intelligence in Zhaga format. Person detection, time scenes, passing train trigger a lighting mode specific to the situation.

BOULANGER - Logistics center in Henin Beaumont, completed in October 2018
- o 1075 Luminaires on 80 000M2
- o Server management system
- o Saving: 91% of energy.

JTEKT - production, logistics, offices in Chevigny Saint Sauveur, since 2016
- o 282 luminaires on 16 000M2
- o Server management system
- o Savings: 81% energy.

GRUNDFOS - Production, Logistics and Offices in Saint Avold since 2020
- o 955 luminaires on more than 70,000 M2
- o Cloud management system
- o Savings: 82% energy

CSTB

CSTB skills/technologies/expertise related to smart building:
- Expertise in BIM (IFC) but also in SIG taking into account the so-called "semantic" technologies allowing the development of reasoning (semantic checkers) applied to BIM or SIG digital models.
- Multi-scale digital mockup (from building to city). CSTB has developed tools (viewer/checker/editor/CMS) in heavy client or web solution as well as a collection of specific plugins to meet specific needs.
- Competences in operating BIM and linking data models with field information coming back from different applications, devices and sensors.
- In the field of smart lighting, CSTB is working on innovative sensor technologies and detection modes adapted to new building uses and offering improved functionalities compared to the presence detectors and brightness detectors currently deployed in smart buildings.
- The quality of light and the human impacts of lighting are also part of the CSTB research program. The objective is to provide light whose spectrum, intensity and distribution are optimally adapted to the many uses of the premises. This optimal quality of light is obtained thanks to a combination of well-controlled natural light and LED luminaires offering control modes adapted to the visual needs and circadian rhythm of users.

CSTB's European experiences in the field of smart building:
- WISDOM- Water analytics and Intelligent Sensing for Demand Optimised Management (CSTB worked on sensor management): https://cordis.europa.eu/project/id/619795.

- Ready4smartCities - CT roadmap and data interoperability for energy systems in smart cities- https://cordis.europa.eu/project/id/608711/fr.
- Odysseus - Open dynamic system for holistic energy management of energy supply, demand and storage dynamics in urban areas (SmartDiscrit 2012/2015) - https://ses.jrc.ec.europa.eu/odysseus.

The leading "smart buildings" projects carried out by CSTB in France and abroad:
ECOFFICES (energy competition within a tertiary building using instrumentation to obtain information on its real energy consumption, and to find out how employees use the equipment) https://hal.archives-ouvertes.fr/hal-00769624

CSTB's contributions and strengths:
- CSTB brings its expertise around BIM (display/manipulation/editing/calculation/...) but also its knowledge of semantic technologies applied to the construction field and its expertise as to distributed architectures (Cloud/...). In addition, CSTB is active in associations (such as Building Smart) or standardization committee (AFNOR) or pre-standardization (CEN -TC442 / CIB 078).
- CSTB has technological bricks based on linked-data technologies that allow modeling and managing static and "living" information of a building or a city. These bricks can form the backbone of Smart building or Digital Double applications.
- In lighting, CSTB has unique physical tools (laboratory and on-site measurement equipment) associated with lighting simulation software from its research program. These tools make it possible to address the complex issues of lighting in intelligent buildings by taking into account the connections between equipment performance (lighting, sensors and management systems), energy consumption, visual comfort, health and well-being.

EAS SOLUTIONS
EAS SOLUTIONS is specialized in intelligent low energy lighting solutions. Its solutions allow an important reduction of energy consumption from 75% to more than 95% depending on the use case.
EAS SOLUTIONS designs, develops and manufactures in France indoor and outdoor lighting with many options. We also make custom developments on demand. We also resell a range of LED lighting with high added value, from European and American manufacturers. Our products are guaranteed from 3 to 10 years.
For 13 years EAS SOLUTIONS has acquired many references in different fields of activity and in large French companies: Industrial, automotive, food processing, commercial, tertiary sector and transport. We bring a complete expertise on energy savings in terms of lighting: audit, expertise, studies (BE RGE), proposals for very low consumption and intelligent solutions with calculation of return on investment. EAS SOLUTIONS is based in Floirac (Bordeaux) with a presence throughout France and Europe.

ENTPE
ENTPE is a higher education and research institution. It trains engineers, managers and experts who are called upon to support and deploy the ecological and solidarity-based transition in the territories. To do so, the ENTPE relies on the knowledge and innovations produced in its research laboratories. The Bioengineering and Perception team of the LTDS laboratory has about ten people (researchers/postdocs/doctoral students) working on the field of lighting. Their research focuses on the understanding and modeling of the physical and perceptual aspects of natural or artificial light, as well as on multi-criteria optimization methods integrating user preferences. Their investigation methods are based on the development of psychovisual experiments in the laboratory or in the field. Their approach is interdisciplinary, they know how to work with researchers from the medical world

or the humanities and social sciences. They are involved in several international technical committees of the CIE. Over the last 20 years, the researchers of the team have participated in 5 European research projects, 6 projects with industrialists (EDF, Philips, Schneider, St Gobain...) and 3 ADEME projects. They have also contributed to the creation of 3 startups.

INGELUX

Ingélux is an SME acting in the daylight and artificial lighting design. We specify lighting solutions for numerous applications such as museums, offices, hospitality, stadiums, airports, and outdoor lighting (beautification and streetlighting). Ingélux was created in 2001 as spin-of company of French ENTPE lab. Our work is thus strongly linked with research and development activities, on which we rely to deliver best innovative and field-proved solutions. We perform on-site diagnostics, lighting design, site monitoring with smart control as well as 3D simulations using physical-based tools.

Ingelux has managed various R&D projects dealing with innovative strategies of lighting in buildings together with ENTPE, CSTB, Signify or other partners (peak load reduction strategies/ development of low voltage management of LEDs / development of adapted luminaires for specific applications).

As a field actor, Ingelux has also delivered positive energy buildings (Hikari, Lyon) or Breeam Excellent rated buildings (Aéroville mall).

Ingélux is WP leader of the Ecsel H2020 AI-Twilight European project in which a digital twin of LED luminaires is being developed. We are also partners of other research programs on airports for instance.

Ingélux is based nearby Lyon; it has 11 employees with an annual turnover of 1M. Ingélux is partner of CIE, and is member of the board of French Cluster Lumiere.

ODELI

Based in Issoire, Odeli designs and develops custom LED lighting fixtures for end customers or lighting manufacturers. For 2 years, Odeli has been offering a radio mesh lighting connectivity solution based on Dali protocol. A whole ecosystem around the solution has been developed allowing infrared detection, Doppler, gas analysis, Tunable White, etc ... SNCF in its stations in Paris and Grand Lyon are currently deploying the Odeli solution on Zhaga connector.

Manufacturing and development are done in France. All software development is done by our teams and service providers in RAA. Within the framework of our project a demonstrator can be proposed.