Competition Manual

# Smart Cities Accelerator

# The Indoor Climate call: Optimising public buildings using internet of things and indoor climate systems

### *Background for the Open Innovation Call*

In Denmark, 90% of the primary schools struggle with poor indoor climate conditions, including low thermal comfort levels and low air quality. As a consequence, pupils are exposed to unhealthy and unfavourable learning conditions. The situation calls for urgent solutions involving both user involvement and new smart technologies.

The project Smart Cities Accelerator addresses this issue. As a first step, researchers have developed a browser-based platform which gives facility management and school staff an opportunity to constructively do technical and behavioural interventions.

Furthermore, using sensors and actuators, the platform will in near future be able to set up modern smart control strategies for the entire heating, ventilation, and air conditioning (HVAC)-system of an existing school located in the Høje-Taastrup Municipality outside Copenhagen.

### *Description of the call*

Facing this challenging situation, this open innovation call aims to find new and viable technological solutions which involve the monitoring of classrooms and the automation of HVAC-systems. The solutions, sensors and actuators, should attend to:

- Connectivity (open source standards are required)
- Installation costs
- Running costs
- Durability

The call will select wireless sensors and actuators with long life batteries and/or energy harvesting systems. Technologies not yet fully developed can also be implemented and evaluated in our field tests. Furthermore, *partial solutions* are also accepted. Hence, companies developing only specific sensors or actuators are welcome to participate and cooperate with potential partners.

### *The challenge*

The sensors and the actuators must satisfy the following requirements:

1. Open communication standards. We are only interested in technologies with open APIs. In this way, we wish to avoid getting locked into a single vendor, once we use its products.
2. Low installation costs for an easy replicability of the field test into business cases. Our test field is the first step towards a smart retrofit of non-residential, complex buildings.

3. Minimal running costs (easy maintenance and no need for new batteries) and durability. We want low energy, wireless hardware. We aim to eliminate the need for plugs, and even batteries, when possible. Hence, technologies using solar panels, or other energy harvesting methods, are prioritised.
4. Cost effective and "plug and play" monitoring network. We strive not to use existing BMS-systems, nor local wireless networks. We wish to build our own networks for data collection and commands exchange among actuators.

### *Sensors and Actuators Network*

We strive to make a cost effective, "plug and play" type monitoring network. The monitoring network will later on collect all the information that is needed to evaluate the indoor climate and the proper functioning of the HVAC-system.

List of **sensor types** we are interested in (please submit additional types if you think they are valuable within the scope of the project):

- $CO_2$
- Temperature (air, surface, return pipe temperatures on radiators, HVAC-system, etc.)
- Occupancy
- Light
- Window and door opening
- Noise level
- Relative humidity
- Volatile organic compounds
- Water flow (heating water)
- Energy use (heating, electricity)

Furthermore, we are interested in different network technologies (e.g. WIFI, zigbee, LoRaWAN, enocean, etc.).

### *Actuators Network*

List of **actuators** we are interested in:

- Radiator thermostats and valve controllers
- Dampers (ventilation dampers, sometimes needs to integrate with existing dampers)
- Automatic window motors (opening and closing of windows)

Furthermore, we are interested in different network technologies (e.g. WIFI, zigbee, LoRaWAN, enocean, etc.). We may also allow the use of more than one wireless technology, if necessary.

### *IoT Network*

Our IoT network should be as open as possible to permit integration of sensors and actuators in later stages. For the moment, we are considering building up the network on Raspberry Pi, but we are open for alternatives.

### *The test fields*

We conduct our field tests in two fully operating primary schools located in the Høje-Taastrup Municipality, Denmark. The schools offer a heterogeneous group of buildings (see figure 1), built between 1900 and the end of the 1980s. Recent studies show divergent indoor climate conditions from one classroom to another. Hardly any rooms have no indoor climate issues ($CO_2$ level in reasonable range), a large proportion have issues in peak attendance moments and a few rooms have extensive problems which cannot be solved by the current heating and ventilation and air conditioning system (HVAC).

Figure 1. Façade of one of the buildings.

To reach our goals, we need to:

- Expand the sensor network cost effectively – step within this innovation call
- Install a network of actuators in rooms – step within this innovation call
- Take control of the existing building automation system (BAS) – step within this innovation call
- Optimise the control strategies for the HVAC – step started within this innovation call
- Find new retrofit solutions, when the HVAC system is too obsolete to reach the goals – step after this innovation call
- Integrate renewable energy sources in the buildings – step after this innovation call

### *Data*

We store our data on an InfluxDB running on a Docker Container. We expect you to integrate your data into the InfluxDB. Furthermore, we make use of a docker container running openhab. Your sensors/actuators should be able to be run on openhab. Again, we are open to alternative open communication solutions.

### *Skoleklima.dk*

Within this project, we developed a browser-based platform (skoleklima.dk) in which data from various sensors are displayed. The platform skoleklima.dk provides ”live” visualizations of the indoor climate conditions (see figure 2) and thus a stronger foundation for operation management and school staff to address the challenging situation.

We also provide them advices on how to address specific problems (e.g. when and how to optimally ventilate). In addition, through skoleklima.dk, scholars can run experiments to understand the physics behind the HVAC-system and the indoor climate. Furthermore, skoleklima.dk offers the possibility to exchange information related to the indoor climate and the HVAC-system between teachers, and between teachers and buildings' managers.

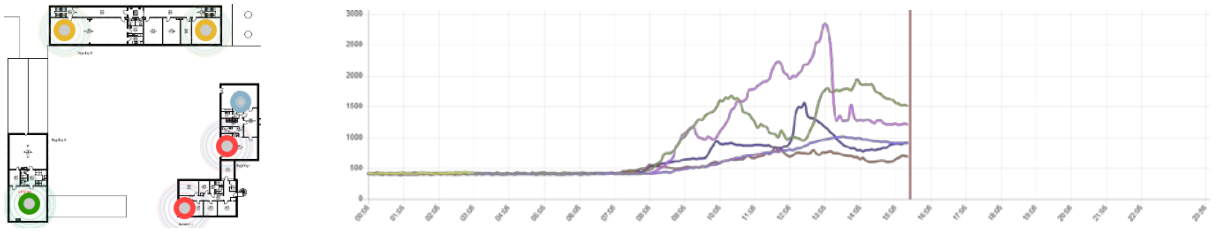

Figure 2 Qualitative evaluation of the CO2 concentration (left) in some classrooms of a school, and related time series visualization (right) for a working day, from the skoleklima.dk platform.

### *Who can be part of the competition?*

All relevant ideas will be taken into consideration. There are no requirements as to how far the idea/proposal/product has been developed. As part of the competition, the idea could be matured towards the finals. The competition is open to everyone regardless of their background, experience and location. Applicants can participate alone or in groups, be private individuals or part of a company, organization or institution.

### *Why participate?*

Indoor climate in schools is an area subjected to an increasing interest. As sensors become less expensive and the attention rises the market for solutions grows. At the same time, the increased data quality and quantity give rise to work with facility management and address the climate agenda and at the same time save money.

This open innovation call gives the participant the opportunity to show and demonstrate their products in a real environment that has potential scale beyond the municipality of Høje-Taastrup. At the same time, it will be possible to research and develop products and solutions in collaboration with all the actors in the project and by that qualify the outcome.

*The Indoor Climate call: Cost-effective optimization of public buildings through proper IoT-setup and HVAC-control* is a dynamic competition, and it is expected that contestants will improve, build and develop their ideas throughout the competition process. As a contestant, you will receive customized consultancy support, if you are chosen as a finalist for the Open Innovation Day following the Open Innovation Call. A network of specialist will be at your assistance to prepare the idea/proposal for the finals. Furthermore, validation and/or implementation of the proposal will be the utmost aim for both the organizing partners as well as the contestants. Additionally, participation will provide great opportunities to engage with relevant stakeholders and expand networks and knowledge about the theme at hand.

*Information about how to get more information, webinars about the call etc.*

Under https://smartcitiesaccelerator.eu/ you can get more information about the Smart Cities Accelerator-project in general. The Open Innovation Call website also provide additional information, e.g. date for webinar regarding this call.

*Competition programme*

The competition will be divided into two stages:

1. The first stage is an open submission process in which all submissions will be reviewed and evaluated and finalists will be selected to join Open Innovation Day.
2. The finalists will be given the opportunity to pitch to a panel made up of representatives from the organising partners on the 18 May 2018 at the City Hall at Høje-Taastrup Municipality. The selected finalist will receive sparring and mentoring as part of the preparation for the Open Innovation Day

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| Open for submission | 9 April 2018 |
| Deadline for submission | 30 April 2018, at noon |
| Announcement of the contestants for the final | 2 May 2018 |
| Individually organized maturation process | 4-11 May 2018 |
| Open Innovation Day | 18 May 2018 |

*Webinar*

A webinar will take place on 24 April 2018, 1:00 o'clock. Sign-up here: https://attendee.gotowebinar.com/register/5427617494551802625

*Application procedure*

All solutions must be presented via the submission form on the website by 30 April, 12 am, 2018. Submissions that are not sent via this route will not be considered.

*Judging and criteria*

The proposals will be judged according to the following criteria. Economic and technical feasibility are absolute demands for a winning proposal.

***Feasibility*** – how likely is it that the solution can be implemented?

- Technical feasibility, e.g. how easy is the sensor to mount, power and communicate with?
- Economic feasibility, e.g. what is the installation and operation costs?
- Replicability, e.g. how well does the solution scale

***Innovation and genius*** – is this solution novel and a possible breakthrough?

- Is this a new concept not elsewhere available?

***Use and function*** – how will the solution work and be perceived on a daily basis?

- Functionality and attractiveness, form and design
- E.g. is the sensor/actuator suited for the "rough" environment in school?

***Social sustainability*** – are social, circular and sustainable considerations, impact and effect described?

- Is the manufacturing green and sustainable? Both from a of materialistic and social point of view?

### *Ownership and responsibility*

The Intellectual Property Rights (IPR) of the idea and related materials are owned by the contestant. The contestants will decide what kind of sensitive business information they would like, or need, to share in the competition. Individually confidentiality agreements to protect sensitive business information will be accepted to protect the business idea. It is the contestants' responsibility to point out the sensitive information and deliver the confidentiality agreement. All submissions will be published on the competition's website as written documentation associated with the competition, on websites of the organizing partners and network or under other circumstances in which the organizing partners and network may want to inform others about the competition and its results. When contestants submit for the competition, they accept that their proposal can be published. Climate-KIC is facilitating professional business assistants and advice throughout the competition within its network. Our goal is to help the contestants in any way possible to mature their idea towards the Open Innovation Day and expose the idea to a high-profile jury and professional audience. It is the contestants' own responsibility to make use of the resources made available in the competition, seek the necessary information and meet the deadlines.

### *Open Innovation Day*

The selected finalists will be invited to a virtual bootcamp and the final pitch event (Open Innovation Day) at Høje-Taastrup City Hall on 18 May 2018. Travel costs for up to two members per accepted proposal will be reimbursed by Climate-KIC in accordance with the terms and conditions provided. The winning proposal will receive professional advice and assistance by EIT Climate-KIC on how best to progress with turning their idea into reality.

### *Contact information*

For further information and questions concerning the competition, please get in touch with:

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