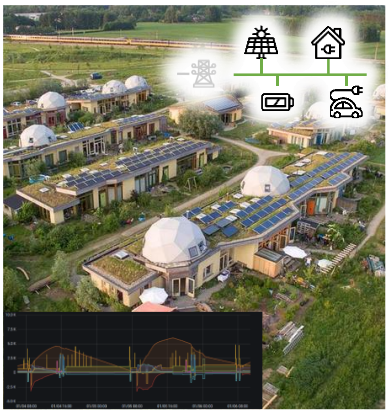
FULL STACK DEVELOPMENTS FOR OPTIMIZED EDGE SOLUTIONS FOR CARBON NEUTRAL COMMUNITIES

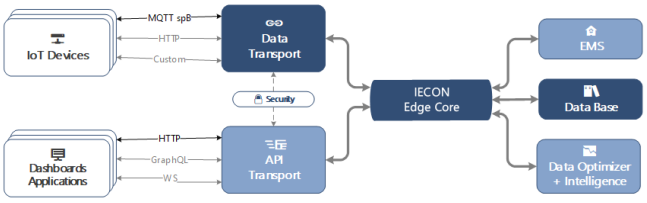
INTRODUCTION



As part of the Horizon 2020 SUSTENANCE project (https://www.h2020sustenance.eu), 21 partners from Denmark, The Netherlands, Poland, and India are working together to develop sustainable energy solutions for achieving, boosting novel carbon and neutral energy communities. The end goal is to enable local energy communities that can operate (almost) autarkic from the main utility grids, operating as “energy islands” while boosting the ussage of sustainable energy sources and minimal carbon generation.

The SUSTENANCE project aims to achieve optimal integration of locally available renewables; for example, solar (PV) panels can be used to charge an electric car or to power appliances in the house directly, but excess PV or wind power might also be stored in a large battery, so that it can be used to operate energy hungry appliances later, without depending on the main utility grid at that time. A key aspect is balancing the energy consumption, user energy behaviour, with the local energy production from renewables. Ways to achieve this include getting detailed insight in your local energy consumption and production, but also development of decision support systems that can for example, suggest delaying the start of the washing machine with a few hours if the expectation is that ‘free’ solar PV power will become available at that time. In the end, the **user should be in control** and remain to have a high level of comfort. The challenge is to provide precise information, via dashboards, mobile applications or generic indicators to display information of the current status of these energy systems (energy situational awareness) of their own houses as well an overview of the energy community that they belong to, in order to enable better decisions towards carbon neutral communities and sustainable energy usage.

CURRENT STATUS



As part of the SUSTENANCE project, the Ambient Intelligence research group is researching and developing a lightweight IoT software framework for IoT data collection and management infrastructure for the energy transition. Such framework, named as IECON “*IoT Edge Computing for carbon neutral communities*”, provides the software infrastructure for IoT data collection, data storage, API interfaces for the end users (dashboards, mobile applications, and generic interfaces) as well as the possibility to incorporate other modular P&P software applications, like for example for the analysis of energy data streams to detect automatic appliances energy usage.

The IoT IECON framework is developed and optimized to run on low performance computing platforms, such as Single Board Computers, in order to provide advanced and optimized ICT services at the edge (home edge server), as well as providing a robust and resilient management system that can run local and distributed Energy Management System applications (management of local energy assets such as charging electrical vehicles, home batteries, heat pumps among many others), making it more resilient to internet disconnections or some type of cyber-security attacks (*ie.* DoS).

THE ASSIGNMENT

We are looking for researchers that could investigate different front-end and back-end technologies for the development of the IECON API transport module, as well as the as a mobile application. The IECON API transport module should provide standard API's interfaces for dashboards, mobile application, or other type of visual indicators (LED's, simple displays), as well as proper user authentication and authorization functionalities.

Previously, several researchers have worked on the User eXperience (UX) and User Interfaces (UI) of these types of mobile applications dashboards for the energy transition, coming up with several reports about best UX practices and tips, as well as two iterations of a realistic mock-up mobile app UI. See the mobile app screen shoots for the latest mobile application UI version. The mobile mock-up version it is currently implemented in Figma, and it doesn't interface nor display any real data from any household but includes the most relevant information that should be displayed. This UI version has already been tested and validated with end users from the SUSTENANCE community members, so we are looking into the real implementation of the mobile application that could display real data from the inhabitant's household data streams.

The envisioned research and development assignment tasks will include, but are not limited to:

- Research and implement the IECON API Transport software module. The software application should provide standard API interfaces for dashboards and mobile application to retrieve information from the timeseries database data. The software module should also provide:
  - Standard authentication and authorizations functionalities, possibilities for SSO.
  - Tools for user management and permissions (CRUD).
  - Secured communication interfaces and user privacy.
  - Optimized for low-performance SBC.
- Research and implement the mobile application from the provided UI mock-up interface, to visualized some of the collected information from the different households. In terms of frameworks, we are inclined to use Flutter, but we are open to other type of frameworks.
- Integration of provided solutions as part of the IECON framework, with emphasis on the selection and optimization of the different selected frameworks. Iterative system tests and validations of the different module components (CD-CI cycle).
- (Optional) User feedback and testing. Incorporate features for user feedback, app monitoring and automatic testing, to enhance the end-users' needs and app performance.

Several instances of the IECON framework are already deployed on several house locations, already collecting, and storing data from multiple energy systems for more than a year. Also, the IECON framework is deployed on cloud VPS servers allowing for the federation of multiple IECON edge instances, to collect data from these edge systems into virtual energy communities.

PRACTICAL INFORMATION

Research profile: Background in full-stack web technologies, cloud architectures, OOP, mobile application development, Docker-based architectures. A proactive attitude capable of independent work, as well as interested in the energy transition applications and user centric solutions.

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