Keywords: #energymanagement, #electricvehicles, #AI, #datasecurity, #iot-edgecomputing,

EUCloudEdgeIoT.eu

From Vision to Impact

MetaOS Project

Smart Energy Management with IoT and Edge Computing: Revolutionising Domestic Energy Use

Background

In the quest to achieve net-zero emissions, the optimisation of domestic energy use is crucial. Key players in this area include Electric Vehicles (EVs), Heat Pumps, Photovoltaic (PV) systems, and energy storage solutions. These technologies not only enhance energy efficiency but also significantly reduce carbon footprints. A notable initiative in this space is the Energy Management and Decision Support System in Dublin, Ireland, led by SSE Airtricity, in collaboration with CeADAR: Ireland's Centre for Applied AI.

The Companies involved

SSE Airtricity and CeADAR have partnered to develop an innovative solution to optimise domestic energy use. CeADAR, Ireland's Centre for Applied AI, is renowned for its cutting-edge research and practical AI applications. At the same time, SSE Airtricity is a leading energy provider dedicated to sustainability and renewable energy solutions.

The Needs

The primary objective was to create a system that seamlessly integrates and manages various energy sources and storage options to achieve optimal efficiency. This includes predicting future energy demand, forecasting solar PV output, assessing EV charging needs, and anticipating future retail cost signals. The solution needed to navigate the complexities of energy use, storage, and sale amid fluctuating demand, supply, and costs.

The solution

The ICOS device, developed through this partnership, employs a sophisticated algorithm to manage energy resources effectively. The solution is based on an Energy Management and Decision Support System (EMDS) aiming to optimise energy usage within a domestic setting, leveraging Advanced and Reliable Machine Learning techniques. The Energy Management and Decision Support System (EMDS) is constructed using open-source solutions, integrating IoT sensors and a cluster of Edge devices, all orchestrated by the ICOS system and connected to an ICOS Cloud testbed. ICOS utilises both Cloud and Edge computing to optimise resource usage and enhance the performance of users' workloads. By employing the ICOS Meta Operating System, which offers functionalities at both the node and continuum levels, the system achieves several key benefits:

- **Reduced Data Transfers and Latency**: Enhances the speed and efficiency of data processing by minimising the need for data to travel long distances.
- **High-Level Data Privacy and Security**: Ensures that sensitive information is protected through robust security measures.
- **Optimised Computational Resources at the Edge**: Allows for better exploitation of local computational resources, reducing reliance on a central point of control and improving overall system efficiency.

As key components such as Electric Vehicles, Heat Pumps, PV systems, and storage play crucial roles in achieving net-zero emissions, the AI algorithm within ICOS anticipates future demand by forecasting solar PV output, assessing EV charging needs, and considering known or anticipated future retail cost signals.

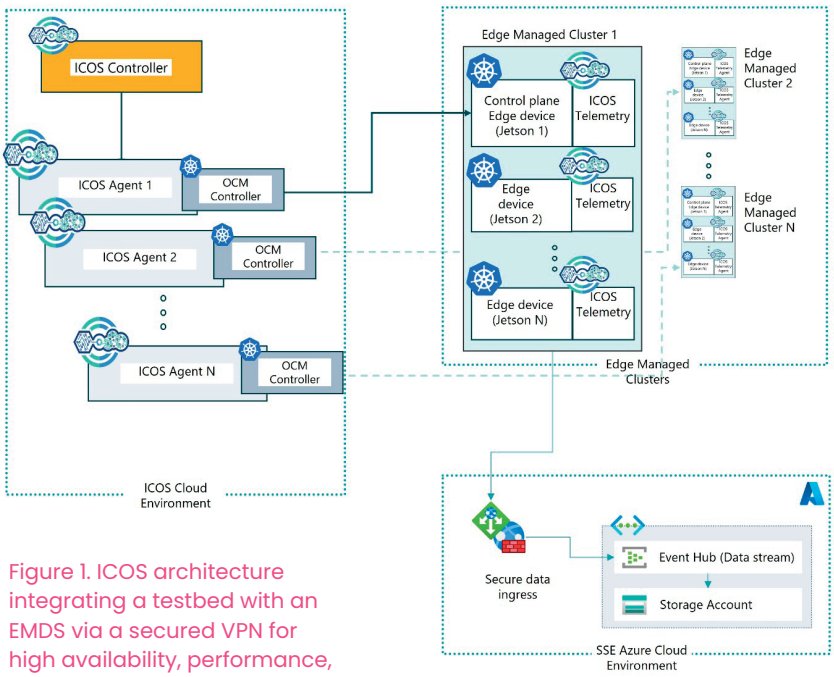

Figure 1. ICOS architecture integrating a testbed with an EMDS via a secured VPN for high availability, performance, scalability, and load balancing.

Funded by the European Union

Keywords: #energymanagement, #electricvehicles, #AI, #datasecurity, #iot-edgecomputing,

EUCloudEdgeIoT.eu

From Vision to Impact

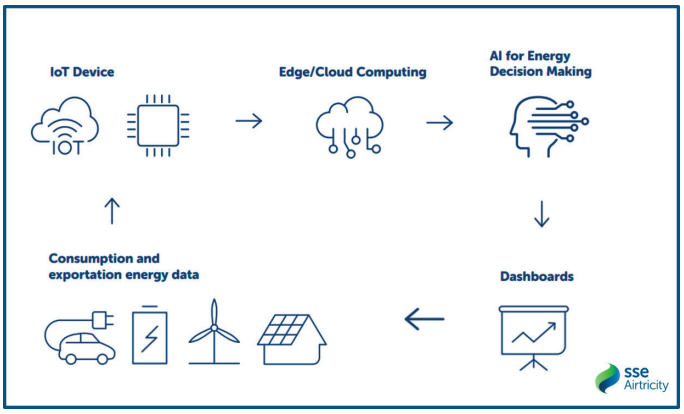

Figure 2. Domestic IoT devices record and send energy data to an edge cluster and the Cloud, with the ICOS system optimising energy usage and displaying results to customers.

The Challenge

Implementing this solution faced several significant challenges. Firstly, there was the need to ensure robust data protection and security throughout all stages of data collection, analysis, storage, and processing. This was essential to protect sensitive information from unauthorised access and breaches, ensuring compliance with privacy laws and regulations. Secondly, the solution needed to provide customised energy solutions tailored to optimise energy usage and increase the adoption of renewable energy sources. This involved developing strategies and systems that enhance energy efficiency and incorporate more renewable energy sources to promote sustainability. Lastly, it was crucial to develop sustainable real-time solutions that could function effectively even in areas with poor connectivity. This required creating technologies and strategies that operate smoothly and reliably in regions with limited internet or network access, ensuring continuous and effective performance.

The Project Involved

The EU-funded ICOS project is set to revolutionise computing by creating a comprehensive ecosystem where the Internet of Things (IoT), edge, and cloud resources merge into a seamless computing continuum. The project aims to develop a meta-operating system that ensures this continuum is open, secure, reliable, and adaptable. ICOS will address key challenges, including device volatility and heterogeneity, virtualisation of continuum infrastructure, diverse network connectivity, optimised and scalable service execution, and resource consumption. Additionally, the project will focus on enhancing security, privacy, and trust within the system.

Impact

The implementation of the Use Case 4 (UC4) EMDS system resulted in significant benefits. First, this system automates complex cost optimisation decisions, addressing the challenging problem of determining whether it is best to use, store, or sell energy when demand, supply, and pricing are dynamic. The solution also involves installing sensors and IoT metering hardware, utilising edge processing, and leveraging a cloud environment for comprehensive data management and processing. This holistic approach ensures customers can automate intricate cost optimisation decisions while retaining control over their preferred choices. The results are increased customer trust and satisfaction, expanded service offerings, waste reduction and an increased usage of green energy.

Future Developments

Future developments aim to enhance the system's capabilities further, including expanding the edge-managed cluster and integrating additional renewable energy sources. The focus will be on making the system more robust, scalable, and accessible to a broader range of users, particularly in areas with limited connectivity.

Recommendations for policymaking

To support the widespread adoption of such innovative energy solutions, policymakers should consider the following recommendations:

- Implement regulations that ensure **robust data protection and security standards**.
- Encourage the development and adoption of **customised energy solutions** that maximise the use of renewable energy sources.
- Invest in infrastructure to support **reliable real-time energy solutions**, particularly in areas with poor connectivity.
- Provide incentives for the integration of **advanced energy management systems** to promote sustainable and efficient energy use.

Useful material related to this story

- ICOS: Official website: icos-project.eu;
- Follow /company/icos-project/ for more!
- CeADAR Official website: ceadar.ie;
- Follow /company/ceadar-ireland/ for more
- SSE Airtricity Official website: sseairtricity.com/ie/home;
- Follow @sseairtricity for more

Liked this #CEI success story?

Follow @EUCloudEdgeIoT on Twitter for more!

Funded by the European Union