DYNAMIC
DIGITAL
ENERGY
PERFORMANCE
CERTIFICATES

D^2EPC

FRAMEWORK ARCHITECTURE

D^2EPC Brochure, July 2021

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HORIZON 2020 PROJECT

D^2EPC Brochure
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The H2020 project D^2EPC

D^2EPC aspires to deliver the next-generation of dynamic Energy Performance Certificates (EPCs) for the operational and regular assessment of buildings energy performance through a set of cutting-edge digital design and monitoring tools and services. D^2EPC relies upon and adjusts accordingly to the smart-readiness level of the buildings and the corresponding data collection infrastructure and management systems. It subsequently builds upon actual data and the 'digital twin' concept to calculate energy, environmental, financial and human comfort indicators and through them the EPC classification of the building in question. In this context, D^2EPC will be based on Level 3 6D-BIM literacy, integrating smart meters, actual performance-related data and activities profiling into the buildings' digital twins. The proposed scheme will provide sufficient background for the delivery of a set of recommendations for the required upgrade of existing CEN standards, to enable the integration of the dynamic EPC concept. Besides, it will integrate the geolocation and the "polluter pay" practices into the EPC rationale. The implementation of the proposed project is also anticipated to foster the energy saving consciousness of buildings' users, through their regular information on the actual energy performance of their buildings and suitable incentivization.

Partners

- Centre for Research and Technology Hellas, Information Technologies Institute, Greece
- Kaunas University of Technology, Lithuania
- Geosystems Hellas A.E., Greece
- Cleopa Gmbh, Germany
- SEnerCon Gmbh, Germany
- Spanish Standardisation Association (UNE), Spain
- DEMO Consultants BV, Netherlands
- SGS Tecnos SA, Spain
- HYPERTECH Energy Labs, Greece
- Austrian Standards International, Austria
- Frederick Research Center, Cyprus
- Austrian Energy Agency, Austria
- IsZEB - Intelligent Solutions For Zero And Positive Energy Buildings, Greece, as linked 3rd party

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D^2EPC objectives

- Introduction and establishment of the concept of the dynamic EPC
- Definition of the drawbacks and discrepancies of the current EPC scheme, as well as the update of European standards on the classification requirements of buildings
- A novel set of environmental, financial, human comfort and technical aspects indicators
- Integration of actual operational data from buildings into the EPCs
- Integration of smart readiness rationale into the building's EPC
- Implementation of intelligent operational digital platform for EPCs

D^2EPC impact

- Recalculation of the operational EPC
- Enriched Building Information Model (BIM) and building digital twin
- LCA, LCC indicators, real-time performance data
- Building smart readiness & human comfort
- GIS environment visualization
- Novel financial schemes – "polluter pays" concept
- Added value services suite for improved energy performance
- Extended dynamic EPCs applications

D^2EPC Viewpoints

A **view** is a representation of a system from the perspective of a related concern held by one or more of its stakeholders, whereas a **viewpoint** is a pattern or template for constructing individual views.

For the D^2EPC project three main viewpoints have been considered for adequately describing all necessary aspects of the overall system architecture. These are the **functional**, the **deployment**, and the **information** views.

The **Functional View** of the system describes the architectural components that deliver the system functionality. These components are represented as functional elements based on their responsibilities and their primary interactions with other elements. This is usually the most important viewpoint, as it reflects the quality properties of the system and influences the performance, the maintainability and the extensibility of the system.

The **Deployment view** documents the physical environment into which the system will be deployed and the dependencies the system has on its environment. Specifically, it captures the hardware/software environment of the system, the associated technical environment requirements and a mapping of the components to the runtime environment.

The **Information view** documents information management including storage and distribution within the system. Similar to a high-level ontology, the information view aims to provide a unique and consistent interpretation of the lifecycles of the information objects handled by the infrastructure. The focus lies exclusively on the data exchanged and not their use by the various components.

D^2EPC Layered Conceptual Architecture

Representation Layer

The Representation Layer constitutes the layer that is offered for interaction with the end-users (engineers, building owners, registries, etc.) or third party platforms / tools (i.e. blogbooks, BIM desing tools, etc.). Within this layer, three D^2EPC components are included, namely: D^2EPC Web Platform, D^EPC Web GIS, and Credibility UI.

Service / Processing Layer

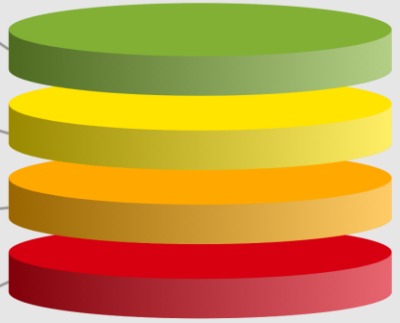
The Service/Processing Layer consists of most D^2EPC components and sub components responsible for delivering all the main functionalities envisioned: BIM-based Digital Twin, D^2EPC Calculation Engine, Added-value Service Suite for D^2EPC, Extended dEPCs Applications Toolkit

Interoperability Layer

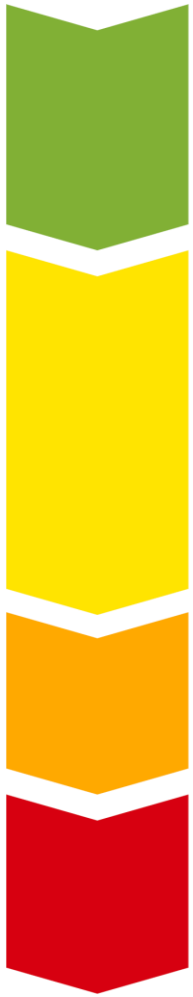
This component is responsible for communicating with the building assets from the physical layer, retrieving the necessary information, translating it to a commonly accepted format and streaming it to the D^2EPC repository to be further utilised in other D^2EPC layers.

Infrastructure / Physical Layer

Within this layer, all devices, sensors, actuators, and in general Internet of Things, and systems are included for collecting the necessary building information for all upper layers. As weather data are also required, in the absence of accessible weather stations on site, external weather APIs will be used to retrieve the necessary information.



Layers consist of one or more components



Representation Layer

- D2EPC Web GIS tool
- D2EPC Web platform
- Mobile app
- Credibility UI

Service / Processing Layer

- Energy Performance Verification & Credibility
- BIM-based digital twin
- Calculation engine
- Roadmapping tool for EPC upgrade
- AI-driven performance forecast
- Performance alerts & notifications
- Building energy performance benchmarking

Interoperability Layer

- D2EPC information management layer

Infrastructure / Physical Layer

Sensors / Devices / Actuators / BMS / SCADA / Weather API / ...

Read more about the components in the following pages

D^2EPC information management layer

The Information Management Layer (IML) is a cloud-based component to collect energy consumption and ambient conditions data strongly related to the building operation through the IoT equipment. The IML component provides a secure environment for data collection and processing, and for communication and data exchange with other clouds. The IML component stores no data within D^2EPC, but streams all information collected to the common project repository.

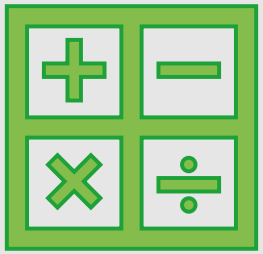
BIM-based digital twin

The already existing BIM methodology is further enriched with real-life building data, resulting in the building's Digital twin. The calculation tool of D^2EPC will retrieve the information through BIM. The digital model will help adding behavioral characteristics to the BIM, while its dynamic nature will allow regular adaptation of the digital model. A set of novel indicators will be calculated on the digital twin level, while simulation and forecasting capabilities will enable proactive or early-stage response to identified deviations.

Energy Performance Verification & Credibility

The Energy Performance Verification & Credibility is a cloud-based tool that aims to facilitate the verification process concerning the credibility of collected data streams through the locally installed IoT infrastructure/ equipment towards ensuring the reliability of the collected data. A particular user-friendly remote monitoring tool will be developed and integrated to the data validation and verification tool with physical representation of the network and ability to report any equipment malfunctions.

Calculation engine



The Calculation engine is one of the fundamental components of D^2EPC. This component is responsible for performing all the necessary calculations for accurately assessing both asset and operational performance. As these required different input parameters, two separate modules will be implemented. In addition, a dedicated module has been identified very early in the project with the sole purpose of performing the necessary calculations for all the additional KPIs foreseen in D^2EPC.

Roadmapping tool for EPC upgrade

The tool will be built upon the evaluation and assessment of building as a whole. This component is responsible for the post-analysis of dEPC data and provision of building-specific recommendations and user centered suggestions that can further enhance the building's energy performance and upgrade its EPC classification. The roadmapping tool will feed the relevant building renovation passports. The identified context will be sent to the Performance Alerts & Notifications to be customised and sent to the user(s).

Performance alerts & notifications

The component is responsible for delivering the recommendations during the process of issuing an EPC and during the actual operation of the building. The users can setup custom alerts. This tool will be able to cover a wider range of recommendations. One of the most interesting functionalities thought, is expected to be the support provided to property owners with accurate and customized recommendations for daily operations, maintenance, and even renovations.

AI-driven performance forecast

This component acts complementary to the Roadmapping Tool by analysing building's operational information. State-of-the-art AI algorithms will be employed to train dedicated models and forecast building operating conditions and their impact in building's energy performance. This tool will feed information into the Performance Notifications and Alerts component, to inform the user during the EPC issuance and during the actual operation of the building in (near) real-time.

Building energy performance benchmarking

This component is responsible for the Classification / Comparison of buildings with reference to certain metrics. Through the detailed analysis of the information deriving from the issuing process, this tool will also act as a classification engine. This classification will indicate the potential paths for performance improvements and can provide valuable insight to the Roadmapping tool and building renovation passports.

D^2EPC Web GIS tool

The GIS Tool will enable energy quality data and dEPC information to be viewed in a GIS environment. The plan is to add multiple dimensions: the time aspect (4D) will give each object the crucial time reference, making it easier to identify the energy needs of each building and its harmonization with present or future legislations and the level of details (5D) concerns the amount of information embedded to the platform and will describe the energy capacity of each building. National mapping data and Cadastre data will be used as base information.

D^2EPC Web platform

The Web platform will host the presentation of all the results from the various components and subcomponents. The platform will deliver a user-friendly and information reach environment for the D^2EPC end-users to interact with. Given the dynamic aspects introduced by D^2EPC, through the web-platform the user will be able to adjust and configure certain components (e.g., roadmapping tool) and to request directly the execution of certain processes ad-hoc, for updating the EPC results.

To follow the progress of D^2EPC project follow our social media, check our website and subscribe to our newsletters!