

D²EPC: Next-generation Dynamic Digital EPCs for Enhanced Quality and User Awareness

Smart Energy Services – Clustering Workshop
17/05/2023



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Project Identity Card



D²EPC: Next-generation Dynamic Digital EPCs for Enhanced Quality and User Awareness

Grant Number

892984

H2020 Call

LC-SC3-EE-5-2018-2019-2020

Type of action:

Next-generation of Energy Performance Assessment & Certification

Duration

36 months

Starting date

1 September 2020

Budget

€ 2,993,687.50

EU contribution

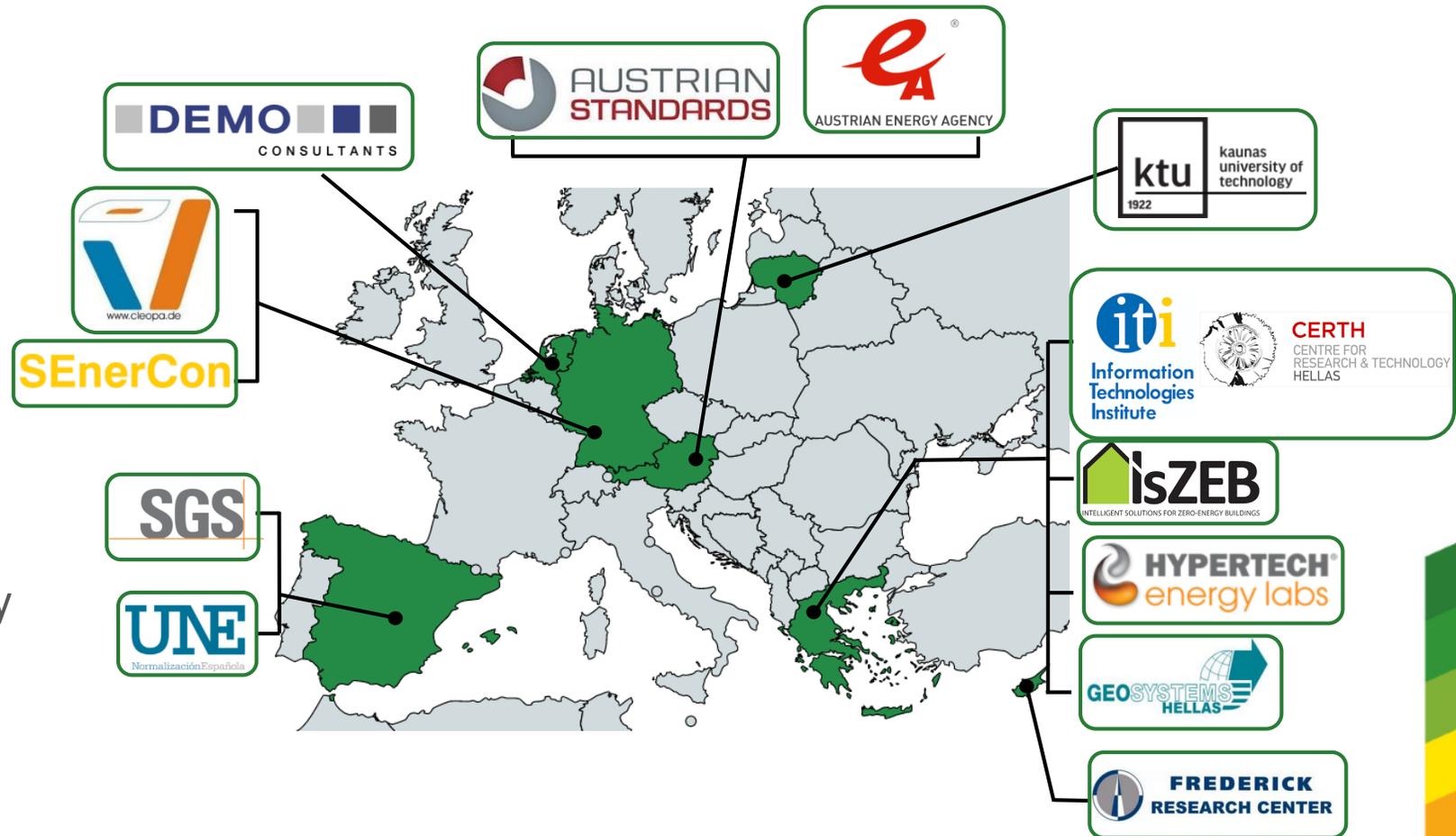
€ 2,499,287.50

Countries

Greece, Germany, Spain, Austria, Cyprus, Netherlands, Lithuania

D^2EPC Consortium

- ❑ 12 Partners
- ❑ 7 EU Countries
- 3 Research Centers
- 5 SMEs
- 2 Standardization Bodies
- 1 Industrial Company
- 1 Energy Association



Objectives

Expected Impact

1

Introduce and establish the concept of next generation dynamic Energy Performance Certificates



- Empower the regular calculation and issuance of an operational certificate
- EU-wide deployment

2

Enhanced multi-parameter assessment (energy, SRI, LCA, LCC, IEQ)



- Facilitate the understanding of buildings' energy performance
- Improve user-friendliness of EPCs

3

BIM-based Digital Twins coupled with a state-of-the-art IoT ecosystem



- Enrich building documentation practices
- Integration of actual operational data from buildings into the EPCs

4

Improved AI-driven assessment recommendations



- Promote energy efficiency & optimal comfort
- Facilitate decision making and planning
- Foster energy saving consciousness

D^2EPC Case Studies



UC1: nZEB Smart house, Thessaloniki



UC2: Multi-family Residential Building, Berlin



UC3: Industrial Building, Velten



UC4: Educational Building, Nicosia

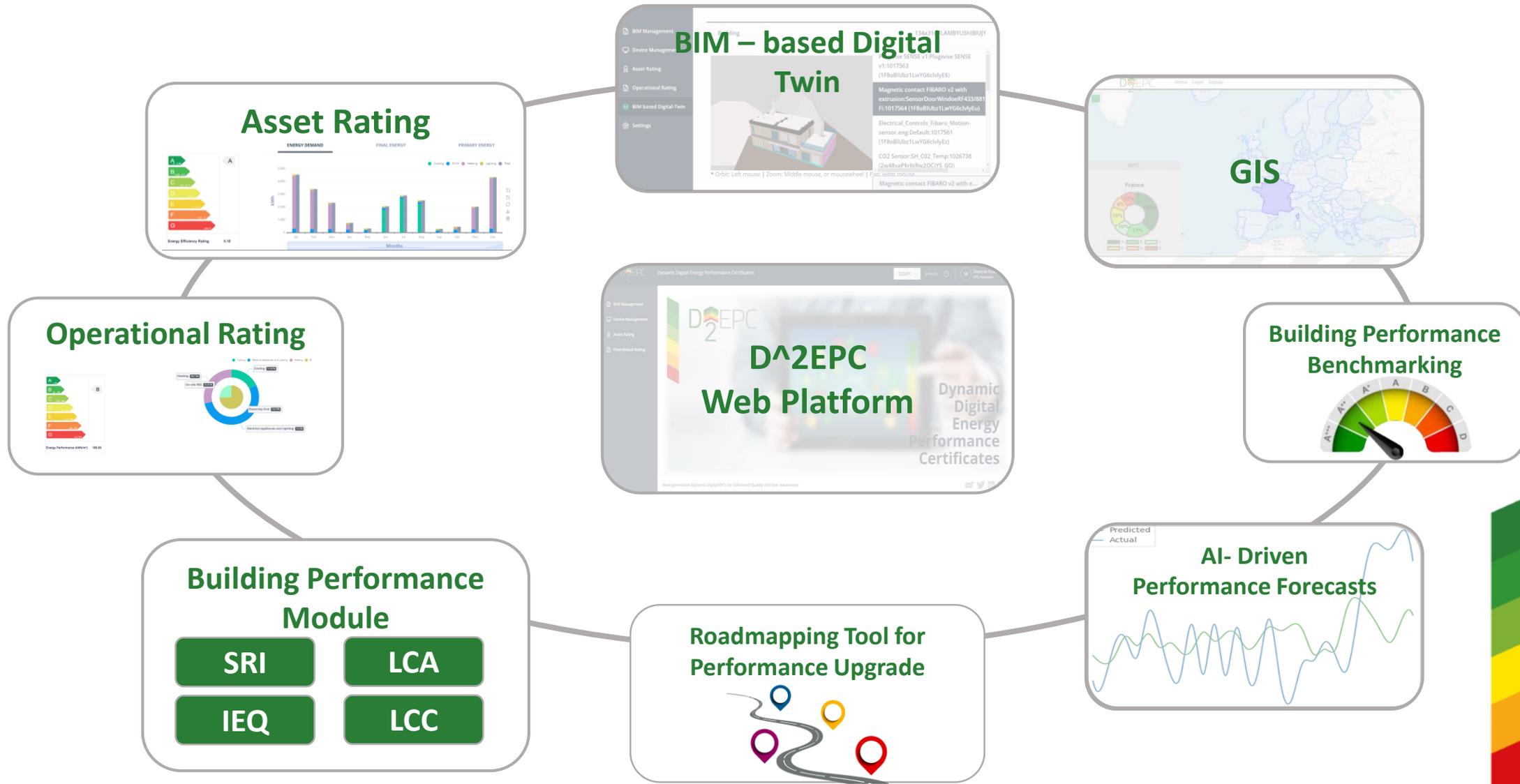


UC5: Multi-family Residential Building, Berlin



UC6: Multi-family Residential Building, Berlin

The D²EPC ecosystem

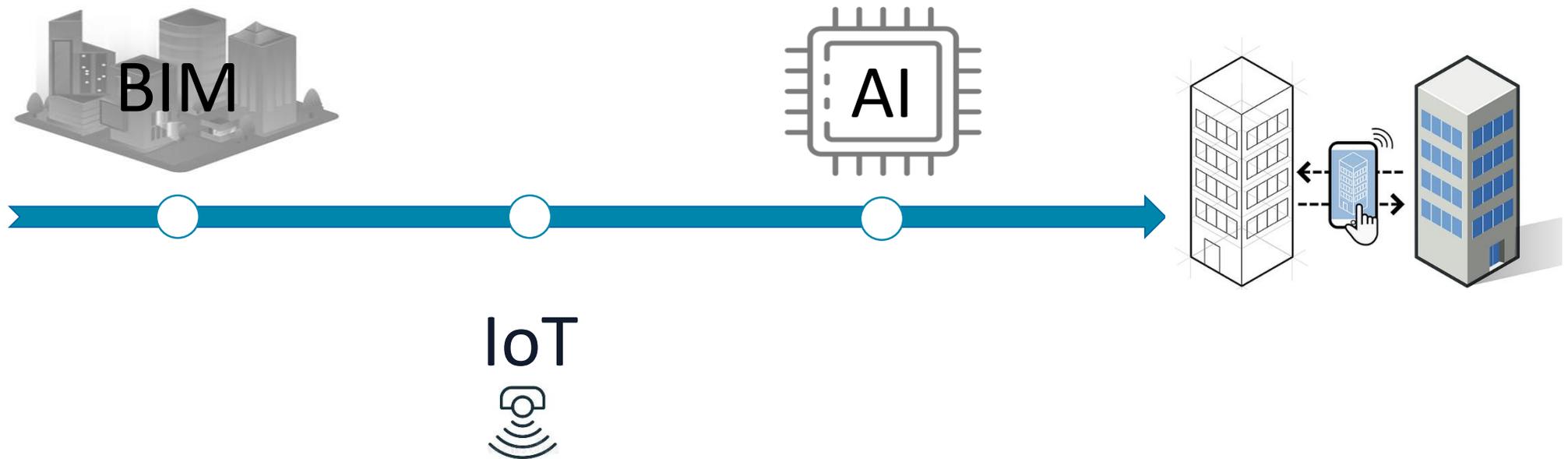


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Smart Energy Services

BIM – based Digital Twin

- Common place for data integration:
 - BIM file (static data)
 - IoT (dynamic data)
 - User Inputs
 - Web APIs
- Data Model utilization for data management and standardization of data relationships
- Near-real time data updates



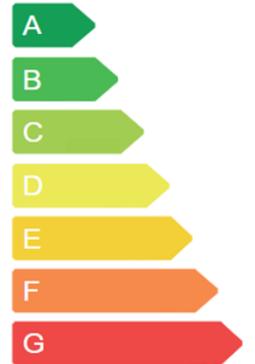
Asset Rating Module

- Common EU- based approach
- Energy Demand Calculation based on **EN ISO 52000:2017** series of standards
- quasi-steady-state monthly calculation
 - Energy Demand → Delivered Energy → Primary Energy
- Energy performance comparison with Reference building
 - Adoption of national values
- Calculated indicators:
 - Primary Energy
 - CO₂ emissions
 - Cost
 - Energy Class [A-G]



Operational Rating Module

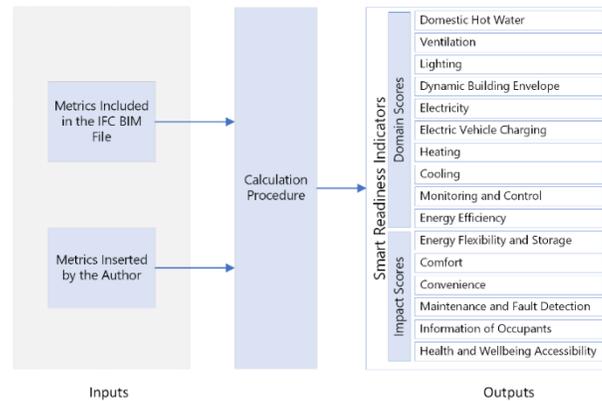
- D²EPC proposed methodology (based on EN ISO 52003:2017)
- Total indicators: 26
- Measured and Calculated indicators:
 - Delivered Energy / Primary Energy
 - Absolute Energy Values [kWh]
 - Normalized values: service/ Area/ Volume / Occupants/ Occupancy Hours
 - Cost (calculated)
 - Energy Class [A-G]
- Energy Classes Definition
 - National level
 - Building usage
 - Construction Year



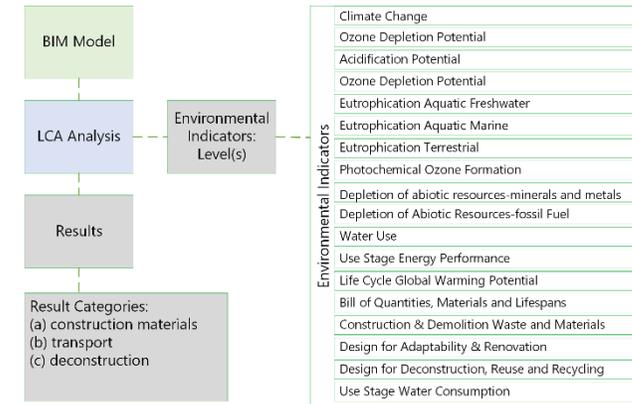
Energy Indicators	Total Power/Occupancy	kWh/occupants
	Total Power/Occupancy Hours	kWh/h*occupants
	Total Power/Area	kWh/m ²
	Total Power/Volume	kWh/m ³
	Heating Consumption per Energy Carrier/Occupancy	kWh/occupants
	Heating Consump per Energy Carrier/Occupancy-hours	kWh/h*occupants
	Heating Consumption per Energy Carrier/Area	kWh/m ²
	Heating Consumption per Energy Carrier/Volume	kWh/m ³
	Cooling Consumption per Energy Carrier/Occupancy	kWh/occupants
	Cooling Consump per Energy Carrier/Occupancy-hours	kWh/h*occupants
	Cooling Consumption per Energy Carrier/Area	kWh/m ²
	Cooling Consumption per Energy Carrier/Volume	kWh/m ³
	Weather-Normalized Heating & Cooling Energy Cons.	---
	Lightning/Occupancy	kWh/occupants
	Lightning/Occupanc-Hours	kWh/h*occupants
	Lightning/Area	kWh/m ²
	Lightning/Volume	kWh/m ³
	Electrical Appliances Energy Consumption/Occupancy	kWh/occupants
	Electrical Appliances Energy Cons./Occupancy-hours	kWh/h*occupants
	Electrical Appliances Energy Consumption/Area	kWh/m ²
	Electrical Appliances Energy Consumption/Volume	kWh/m ³
	DHW Consumption per Energy Carrier/Occupancy	kWh/occupants
	DHW Consump. per Energy Carrier/Occupancy-Hours	kWh/h*occupants
	DHW Consumption per Energy Carrier/Area	kWh/m ²
	DHW Consumption per Energy Carrier/Volume	kWh/m ³

Building Performance Module

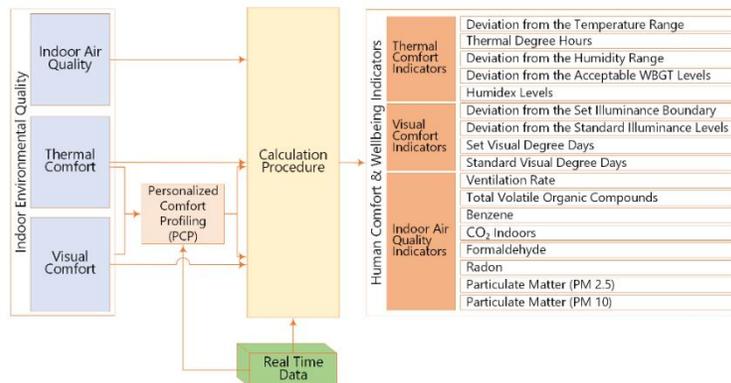
Smart Readiness Indicator



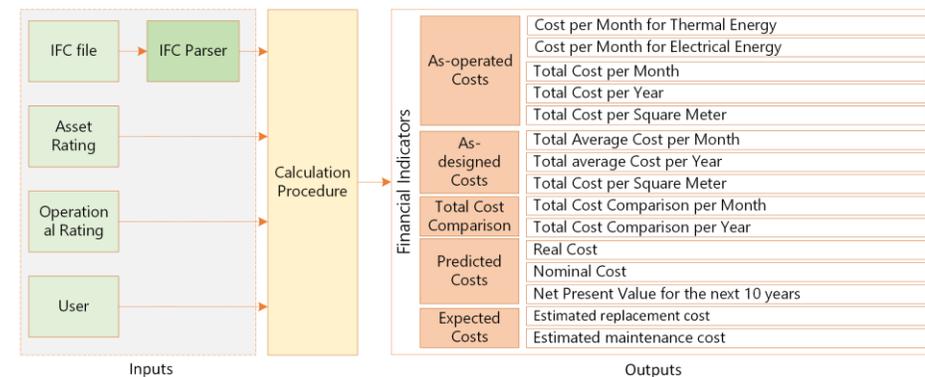
Life Cycle Assessment



Indoor Environmental Quality



Life Cycle Cost



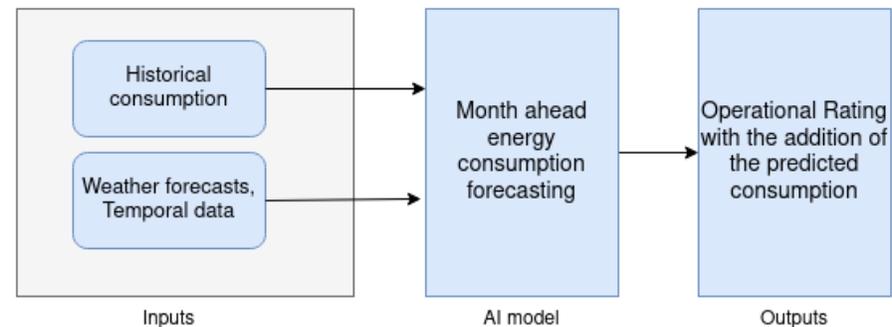
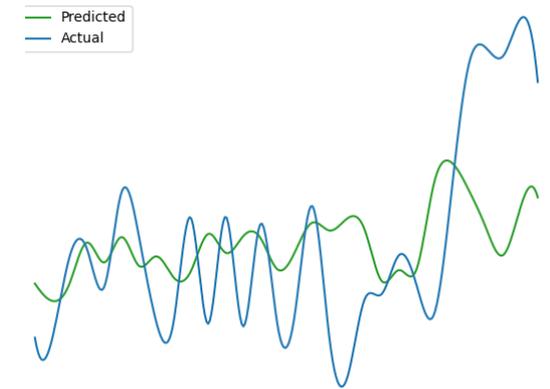
Roadmapping Tool for Performance Upgrade

- Diagnosis of the assets' envelope and technical systems
- Multiple strategic scenarios generation
- Results to the **“Building Renovation Roadmap”**
 - prioritized list of retrofitting actions for improving the asset's energy performance
- Integration with building renovation passports



AI- Driven Performance Forecasts

- Detailed analysis of building's operational information
- Forecast building operational conditions and the impact that specific changes can have in the building's energy performance
- Indicate the patterns that affect negatively the building's energy performance
- Recommendations for improving energy efficiency and human comfort



Energy performance Benchmarking

- Classification based on building's infrastructure and operational characteristics
- Percentile ranking within a defined group of interest
 - Dynamic group definition: location, building type etc.
 - Multi- parameter benchmarking based on the D²EPC certification results (e.g., EPC ratings, and SRI score, LCA score)
- Insight extraction from the correlation between D²EPC certification results
- Path indication for performance improvements

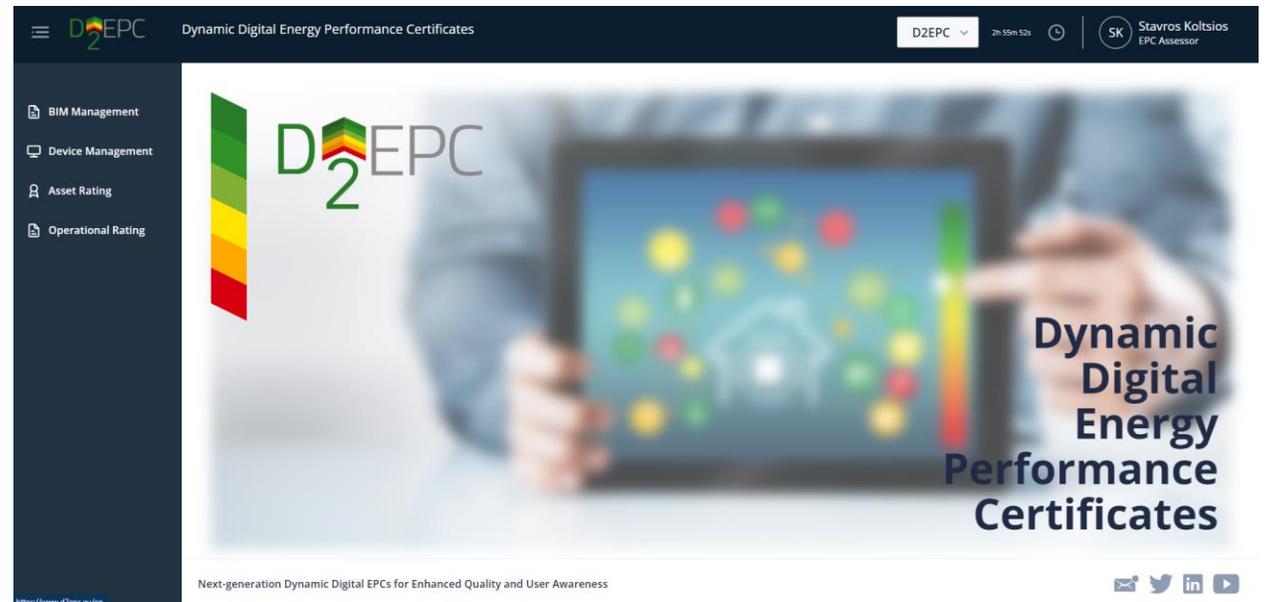


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Smart Energy Services

D^2EPC Web Platform

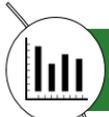
- A common user-friendly interactive environment for accessing all the D^2EPC Tools
- Ad-hoc execution of D^2EPC services
- Dedicated environment for building model initialization
 - Upload BIM file
 - IoT setup
 - Model validation

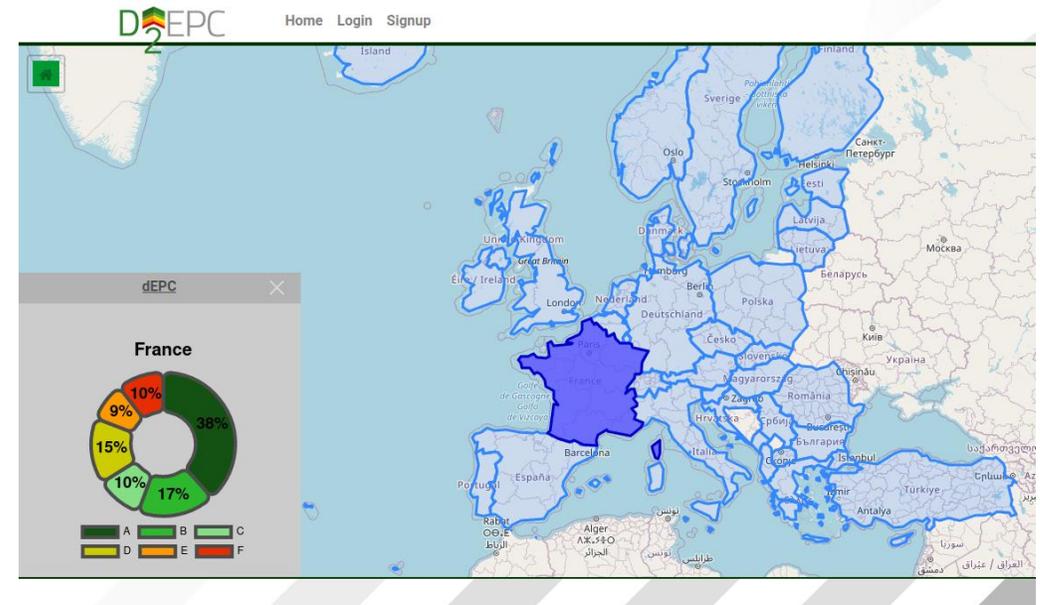


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Smart Energy Services

D^2EPC WebGIS tool

-  Produce dEPC statistics
-  Visualise statistics on map
-  Provide spatial & attribute queries
-  Expose OGC services
-  Visualise BIM models on map



Good practices and recommendations

- The introduction and establishment of the concept of the dynamic EPC (dEPC), an operational certificate to be calculated and issued on a regular basis.
- The integration of smart readiness rationale into the building's energy performance assessment and certification.
- The simplification of EPCs through a novel set of indicators which cover environmental, financial, human comfort and technical aspects.
- The integration of actual operational data from buildings into the EPCs using advanced data collection infrastructure and BEPS tools integrated into BIM.

Milestones

- D²EPC participates in:
 - CEN/ TC 371/ WG 7: “Operational Rating of energy performance of buildings”
 - CEN/ TC 442/ WG9: “Digital Twins *in AECOO sector*”
- Project finalization on 08/2023



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