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Title: An Energy Efficiency Marketplace for Buildings - The ENERGATE System Architecture

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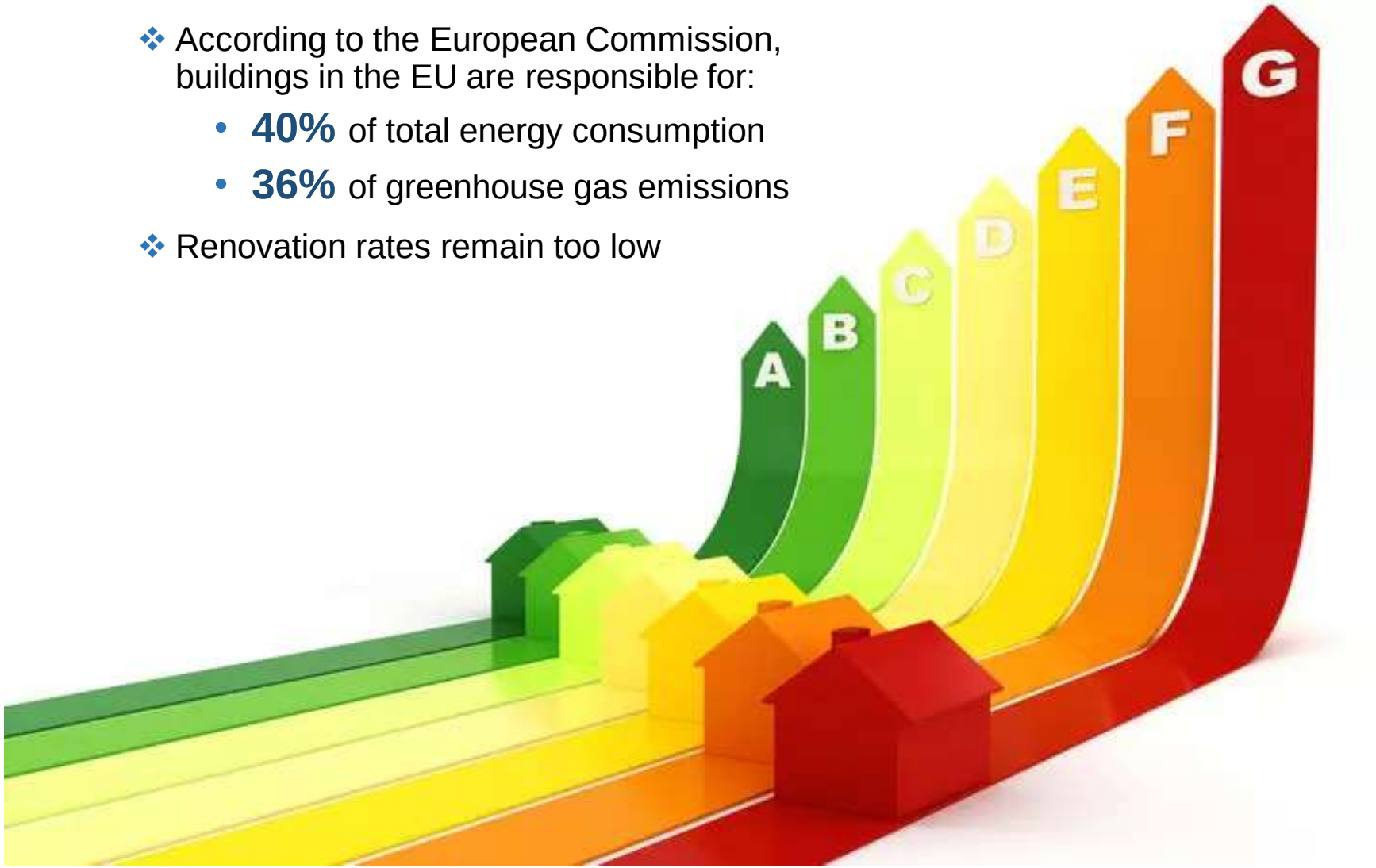
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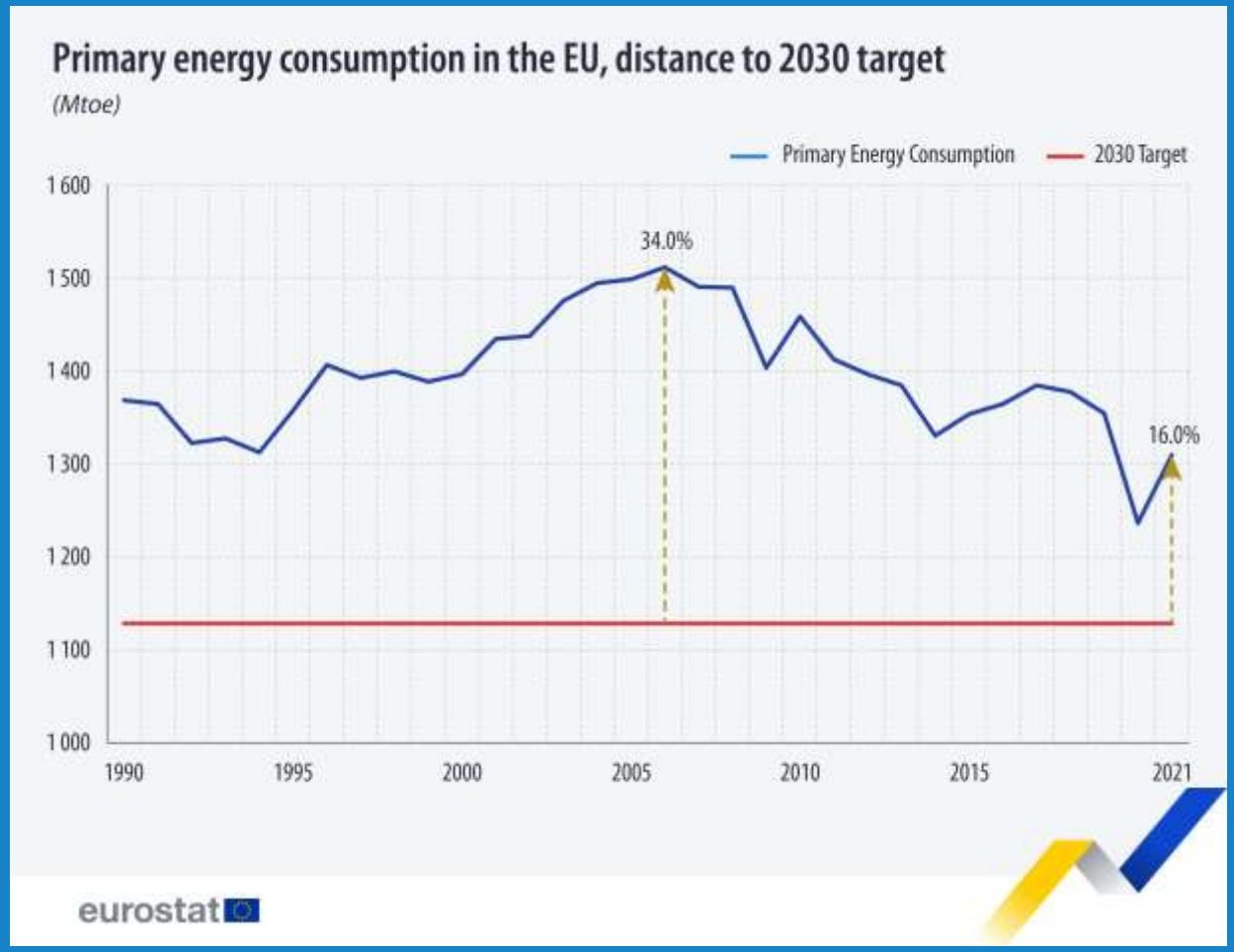
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Introduction (1/3)

- According to the European Commission, buildings in the EU are responsible for:
  - **40%** of total energy consumption
  - **36%** of greenhouse gas emissions
- Renovation rates remain too low



Introduction (2/3)



Source: Eurostat, 2022

- Energy efficiency is one of the main priorities of the European Union's energy and climate policy.
- Reaching energy transition targets is a challenge.
- There is a significant untapped energy efficiency potential in the building sector.
- Building renovation needs to be upscaled.
- Lack of attractive and accessible financing package available for the building sector.

Introduction (3/3)

- The building sector might stay as it is in the long-term future due to the **low building demolition and renovation rates**
- Many **funding schemes** have been created for supporting energy efficiency building renovations and still there are many **barriers** to overcome
- There is the need for an **ICT platform** that will bring together energy services and sustainable financing to:
  - Accelerate the renovation rates
  - Increase the chances of a project to be financed
  - Support decision making on EE retrofitting actions



Scope of the Study

The present paper aims to:

- Propose a **system architecture** to support energy efficiency investment in buildings in web-based marketplace

- The architecture aims to offer:
  - Reliability
  - User-friendliness
  - Integration
  - Interoperability with existing EU standards and platforms

The ENERGATE project (1/4)

ENERGATE
ENERGY EFFICIENCY MARKETPLACE

Smart energy marketplace for sustainable investments

January 2023 – June 2025

5 Pilots

315 Buildings

6 Countries

176M€ Investments

UP TO **55%** Energy savings



Balanced in terms of company types, expertise, role in the value chain

Project Coordinator:
National Technical University of Athens (NTUA)

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The ENERGATE project (2/4)

The ENERGATE vision

Enable easy, predictable and risk-free renovation investments



Project development of retrofitting actions



Access to sustainable finance for renovation projects



Business matchmaking in a user-friendly ICT-enabled platform

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The ENERGATE project (3/4)

Supply side:

Asset managers
Building owners
Project developers
ESCOs



Demand side:

Investors
Financial institutions
Public & Private funds



Fetch

Collection of structured information about projects, ensuring that technical, commercial, and risk-related information is appropriate



Process

Combination of energy efficiency products and financing schemes based on energy-related and financing Key Performance Indicators.

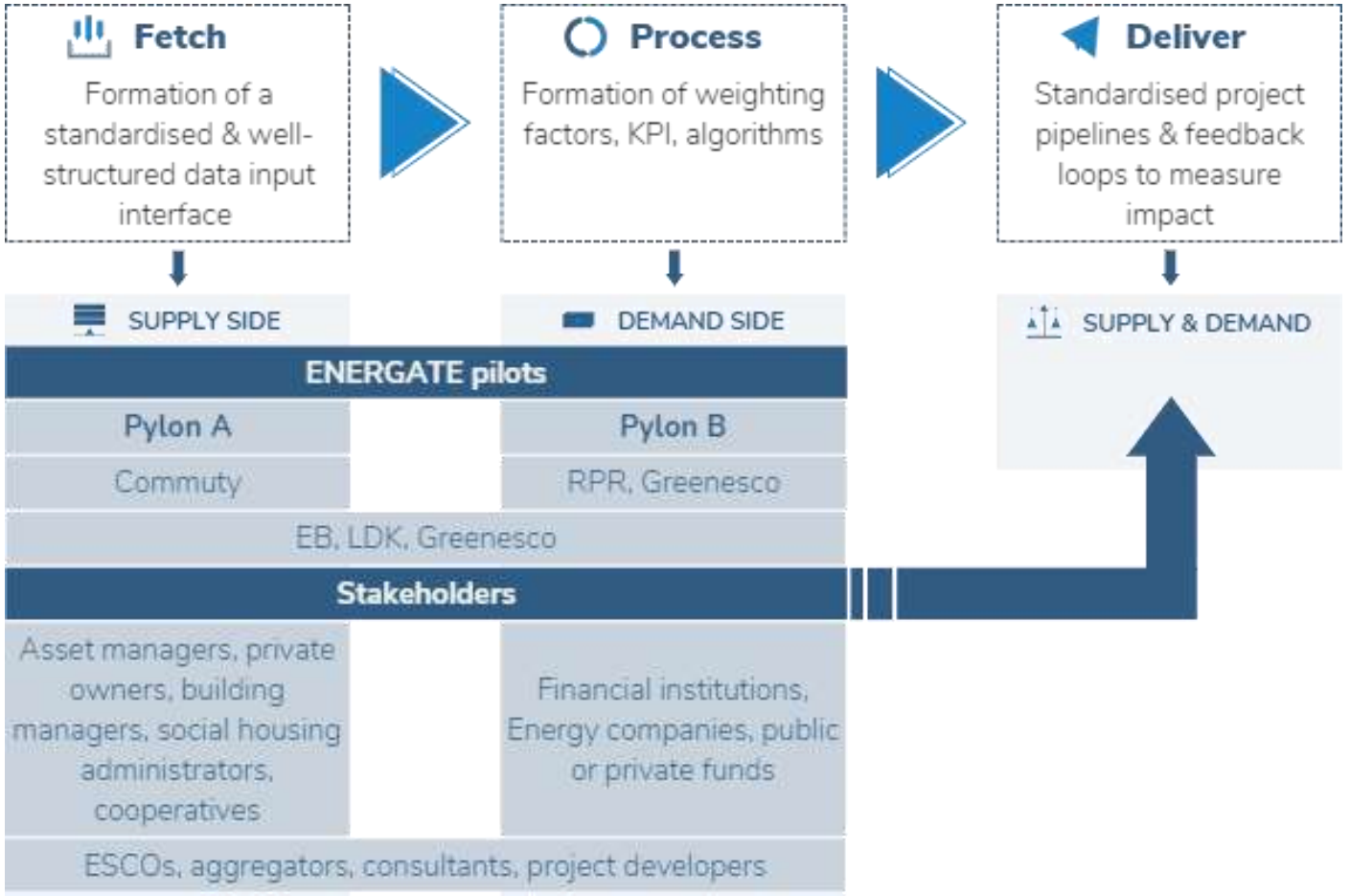


Deliver

Follow-up on projects, M&V, and validation of savings. Increased traceability and standardisation of investments and trust.

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The ENERGATE project (4/4)



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The approach

Step 1

- Specification of the research question: system architecture for the ENERGATE platform
- Review of existing architectures

Step 2

- Examination of big data value chain in energy efficiency for buildings
- Presentation of ENERGATE value chain

Step 3

- Definition of ENERGATE system architecture per stage
- Demonstration of ENERGATE information flow per stage

Step 4

- Extraction of conclusions
- Specification of next steps & prospects for further research

EU standards and architectures

- The basis for designing the ENERGATE system architecture to handle the ingestion, processing and analysis of data.
- Monitor and improve the **energy performance** of buildings.
- Facilitate the **design** and development of **building infrastructure.**
- Support **policy making** and policy impact assessment and to **de-risk investment** in energy efficiency.

MATRYCS

- Decision-making and data analytics solution for energy efficient buildings
- Modular microservices oriented architecture
- MATRYCS governance, processing, analytics toolbox

bridge HORIZON 2020

- Systems related to energy digitalization
- Interoperability between cross domains (electricity, gas, water, transport, building related ICT systems)

BD4NRG Big Data for Next Generation Energy

- Data governance layer guaranteeing confidentiality
- Scalable big data management & Processing layer: Information broker
- Application layer: data combination & exchange

FIWARE

- Addressed Data integration ensuring service provisioning
- Context Broker component: management of updates, queries, registrations, subscriptions

INTERNATIONAL DATA SPACES ASSOCIATION

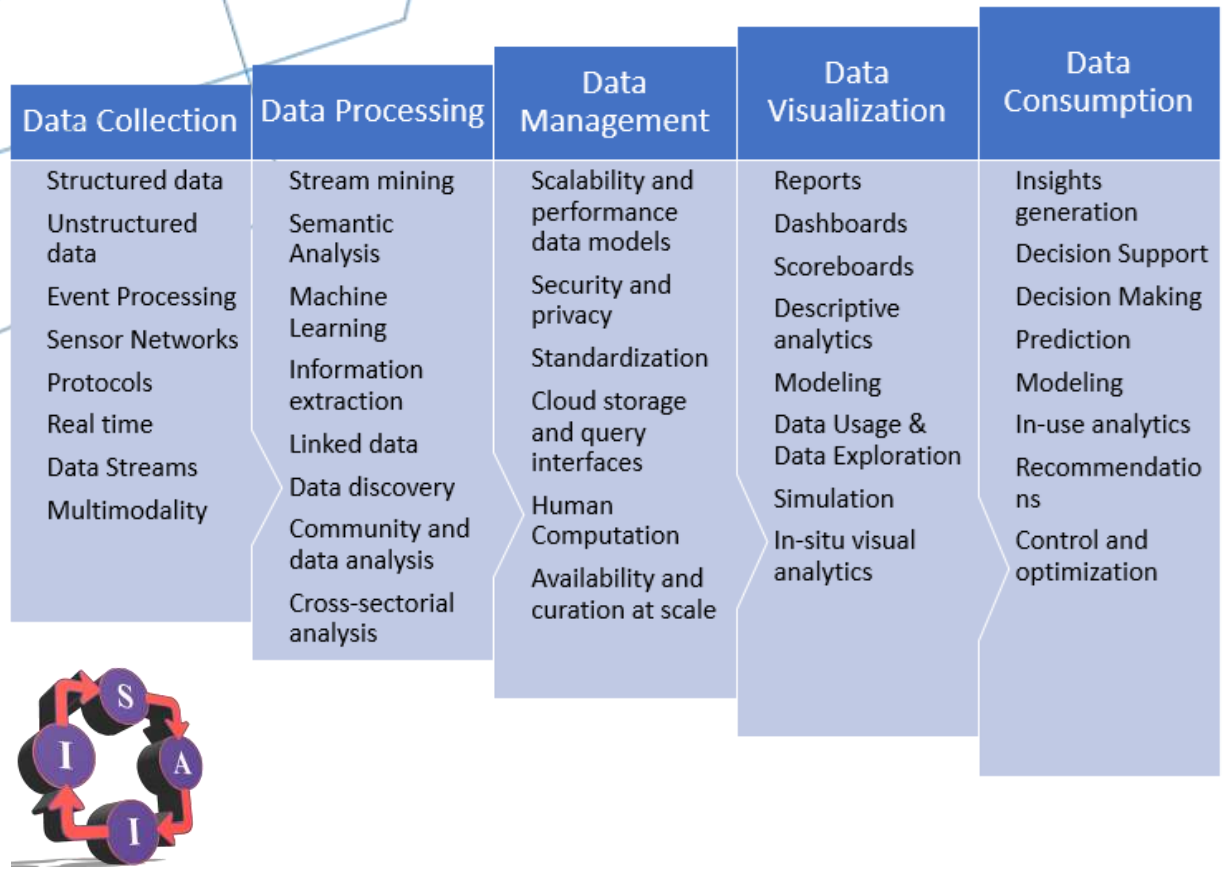
- 5 different layers and targets on securing data transactions between stakeholders
- Data sovereignty principle enabling secure data exchange



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Big data value chain in energy efficiency for buildings

The Big Data Value Chain for a Building Energy Efficiency Data Space provides a framework for understanding how the data flow through different stages to extract hidden patterns.



Data Collection: In this stage data are collected from various data sources (smart meters, sensors, building management systems).

Data Processing: Once the data collection stage is completed, data needs to be processed and analyzed. Cleaning and transformation functionalities are involved in receiving meaningful data and extract hidden patterns.

Data Management: The curated information needs to be stored in a data lake or a data warehouse and by implementing data governance and security policies to ensure that data is used appropriately.

Data Visualization: Visualization functionalities will be offered on top of hosted data and display key performance indicators (KPIs) related to energy efficiency.

Data Consumption: The insights generated from the data can be consumed by various stakeholders (building owners, facility managers, energy managers and others) to perform decisions that improve energy efficiency.

ENERGATE Value Chain

Stage 1 - Fetch



Project Entry Module: Component responsible for inserting project (building) information in ENERGATE Platform

Stage 2 - Process



Aggregation Process: the aggregation process will be based on identifying the similarities between the different products / projects to create the different bundles.

Matchmaking Process: The matchmaking process aims to bring together the buy-side and the sell-side inside the ENERGATE platform. Tries to select the best combination of products and product financing by using MCDSS.

Project Design Module: The project design module is the Frontend Environment that acts as the functional centre for the End users of the Aggregation & Matchmaking Process

Stage 3 - Deliver

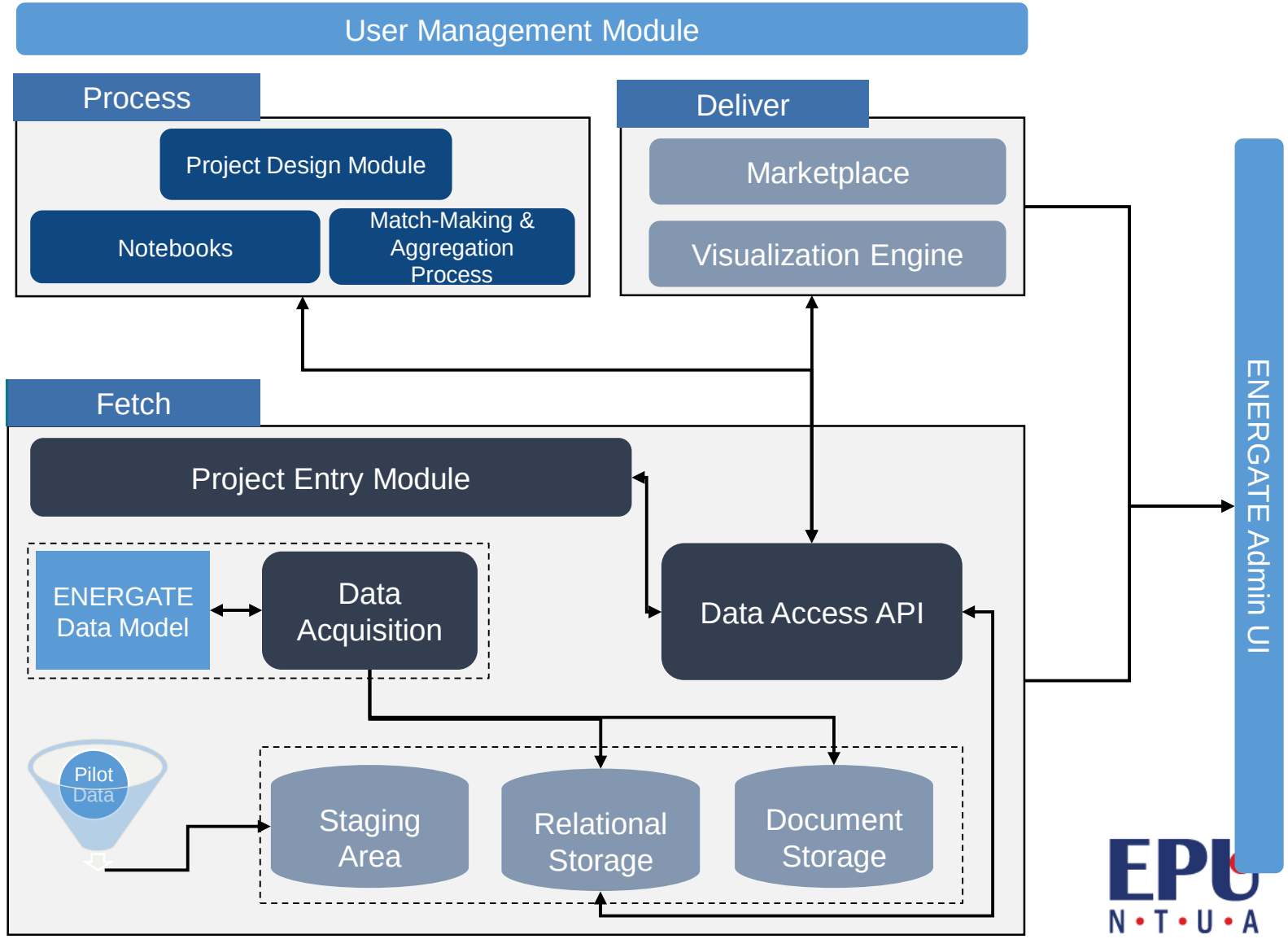


Project Monitoring Module: Upon agreement between buy and sell sides the projects will be monitored from MATRYCS & ENERGATE components

MATRYCS Visualization Engine: helps the ENERGATE admin users to overview the stored information in ENERGATE & MATRYCS Repositories**.**

ENERGATE system architecture (1/5)

- **Fetch**: the ecosystem that performs data collection, data cleaning and data storage functionalities.
- **Process**: the ecosystem that conducts data processing, decision making, data modelling, filtering and recommendations in order to detect the optimal bundles of buildings and investments.
- **Deliver**: set of components that comprise the graphical user interface where ENERGATE stakeholders will interact, visualize the stored information, receive recommendations, aggregations, matchmaking, decision-making and inferences from Stage 2.



ENERGATE System Architecture (2/5)

Stage 1: Fetch components

ENERGATE data lake

Data storage solutions offered by ENERGATE

Staging area: storage of raw data

Regional storage: contains processed data homogenized under the ENERGATE Data Model

Document Storage: Immediate results & metadata

ENERGATE data model & data acquisition

Responsible for parsing data from ENERGATE or external data sources

Data are homogenised and structured under the ENERGATE data model

Data access API

Responsible for data exposition to upstream layers (stages 2 & 3)

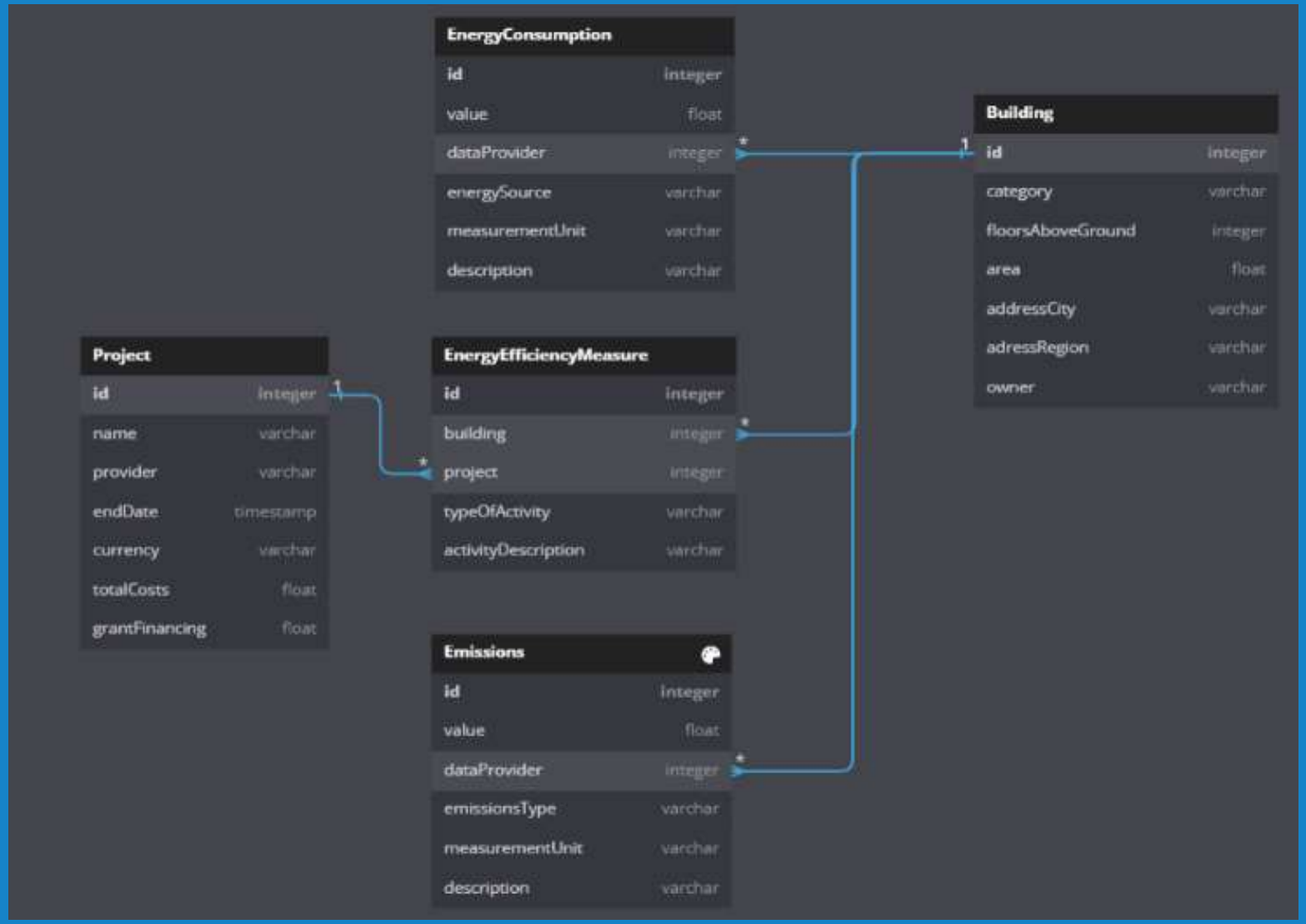
Project entry module

Graphical user Interface

Supply side user insert buildings

ENERGATE System Architecture (3/5)

The ENERGATE data model



ENERGATE system architecture (4/5)

Stage 2: Process components

Matchmaking & Aggregation Process

- Querying the ENERGATE data lake
- Content-based techniques for recommending renovation actions
- Bundling of investment & buildings

Project design modules

- Frontend functionalities
- Filter application
- Possibility for users with technical expertise to code their own models via the ENERGATE ML suite & web-based notebooks

ENERGATE system architecture (5/5)

Stage 3: Deliver components

Front-end application

Features that facilitate deal making for participants that seek investment opportunities and specific partners

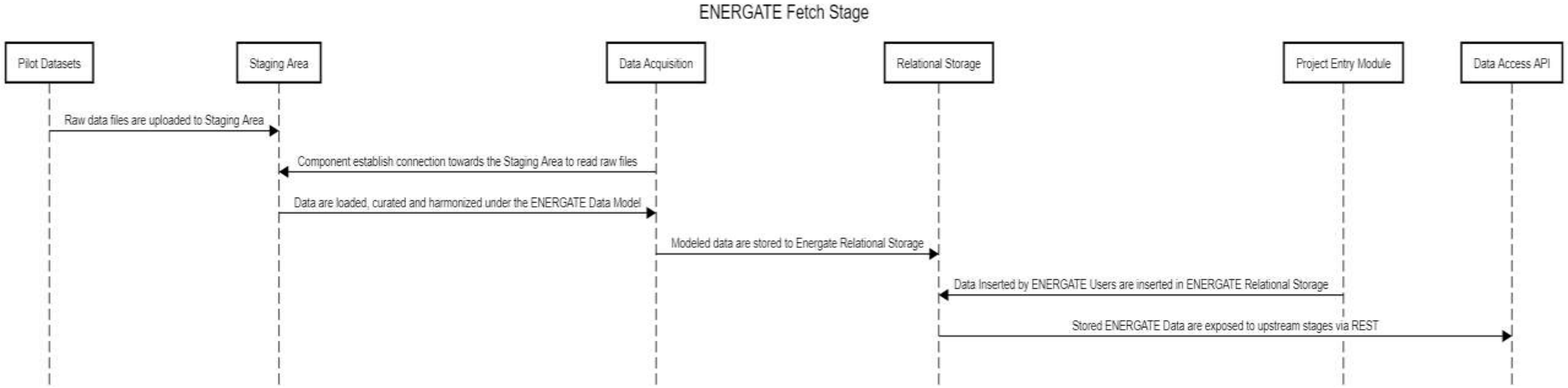
User management functionalities

User profiling functionalities

Indicating user credibility and experience in the form of badges

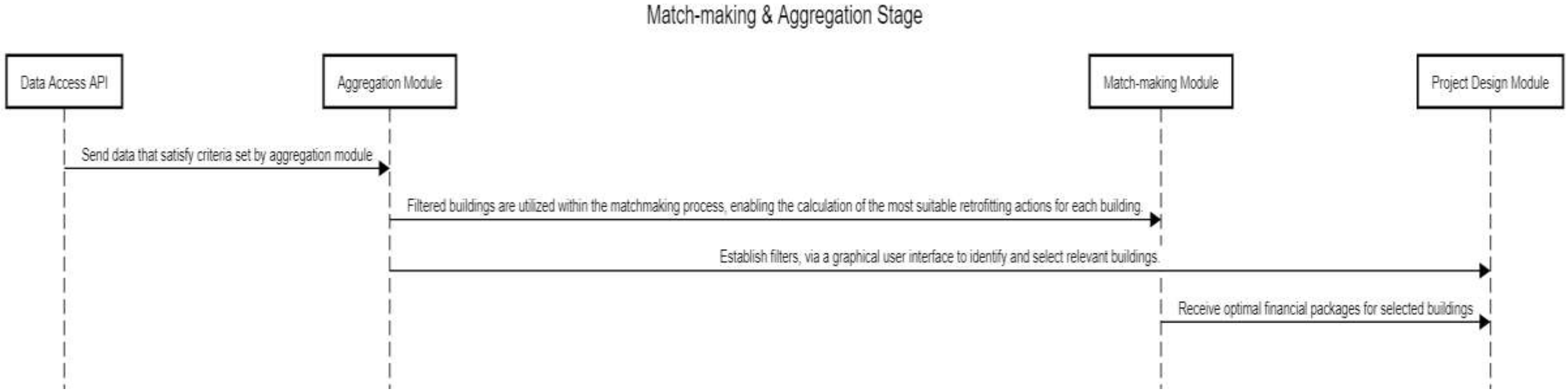
ENERGATE information flow (1/5)

Fetch stage



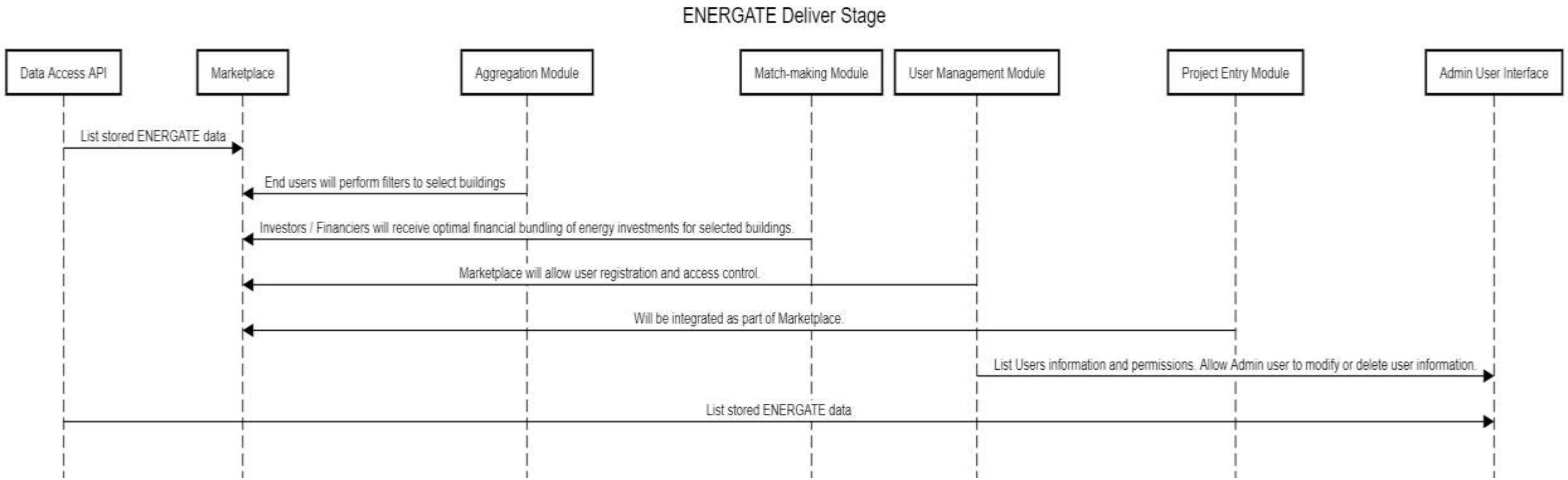
ENERGATE information flow (1/5)

Process stage



ENERGATE information flow (1/5)

Deliver stage



Conclusions & next steps

The proposed **system architecture** aims to:

- Provide a **general framework** for the development of a distributed **energy efficiency marketplace**
- Address each specific step of the **data value chain** through separate stages
- Allow management of **raw information**
- Leverage **aggregations, filters, machine learning** and **multicriteria** decision support analysis
- Create **effective investment plans** for energy efficient buildings

Conclusions & next steps

Future activities will mainly focus on:

- Definition of **KPIs** to support:
  - Decision making
  - User's profiling
  - Matchmaking
  - Aggregation
- Deployment of the system architecture in **pilot countries** (Greece, Italy, Spain, France, Austria, Latvia)
- Incorporation of **specific use cases** in the information flows
- More **detailed analysis** of the impact of **digitalisation** in the decision making for energy efficiency and building's financial packages

THANK YOU

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