



MATRYCS

D6.1 | Pilot operation, preparation, engagement and M&V plan

**WP6 – Deployment and validation in
real environments**

September 2021



www.matrycs.eu

Modular Big Data Applications for Holistic Energy Services in Buildings



Disclaimer

The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission is responsible for any use that may be made of the information contained therein.

Copyright Message

This report, if not confidential, is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0); a copy is available here: <https://creativecommons.org/licenses/by/4.0/>. You are free to share (copy and redistribute the material in any medium or format) and adapt (remix, transform, and build upon the material for any purpose, even commercially) under the following terms: (i) attribution (you must give appropriate credit, provide a link to the license, and indicate if changes were made; you may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use); (ii) no additional restrictions (you may not apply legal terms or technological measures that legally restrict others from doing anything the license permits).



The MATRYCS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no.101000158

Grant Agreement Number	101000158	Acronym	MATRYCS
Full Title	Modular Big Data Applications for Holistic Energy Services in Buildings		
Topic	LC-SC3-B4E-6-2020 Big data for buildings		
Funding scheme	H2020- IA: Innovation Action		
Start Date	October 2020	Duration	36
Project URL	www.matrycs.eu		
Project Coordinator	ENG		
Deliverable	D6.1 – Pilot operation, preparation, engagement and M&V plan		
Work Package	WP6 – Deployment & Validation in real environments		
Delivery Month (DoA)	M12	Version	1.0
Actual Delivery Date	30/09/2021		
Nature	Report	Dissemination Level	Public
Lead Beneficiary	CARTIF		
Authors	Gema Hernández Moral [CARTIF], Sofía Mulero Palencia [CARTIF], Carla Rodríguez Alonso [CARTIF], Víctor Iván Serna González [CARTIF], Nikos Dimitropoulos [NTUA], Elissaios Sarmas [NTUA], Pasquale Andriani [ENG], Tomaz Damjan [BTC], Agnieszka Lukaszewska [FASADA], Jaime Gómez Tribiño [VEOLIA], Marina Bartolomé Lorenzo [VEOLIA], Federico Carere [ASM], Niccolò Primo [COOPERNICO], Marcelo Lampkowski [ICLEI], Alicja Szczepańska [GDYNIA], Alfredo Cadorniga Pedrosa [EREN], Aija Zučika [LEIF], Gints Kārliņš [LEIF], João Gonçalves [HOUSING EUROPE]		
Quality Reviewer(s):	Marco Pau [RWTH], Haris Doukas [NTUA], Vangelis Marinakis [NTUA]		
Keywords	Large Scale Pilots, Validation, Pilot Operation, Measurement and Verification Framework, Key Performance Indicators, User satisfaction, Baseline assessment		

Preface

MATRYCS focuses on addressing emerging challenges in big data management for buildings with an **open holistic solution** for Business to Business platforms, able to give a competitive solution to stakeholders operating in building sector and to open new market opportunities. **MATRYCS Modular Toolbox**, will realise a holistic, state-of-the-art AI-empowered framework for decision-support models, data analytics and visualisations for Digital Building Twins and real-life applications aiming to have significant impact on the building sector and its lifecycle, as it will have the ability to be utilised in a wide range of use cases under different perspectives:








- Monitoring and improvement of the energy performance of buildings - **MATRYCS-PERFORMANCE**
- Design facilitation and development of building infrastructure - **MATRYCS-DESIGN**
- Policy making support and policy impact assessment - **MATRYCS-POLICY**
- De-risking of investments in energy efficiency - **MATRYCS-FUND**



Who We Are

	Participant Name	Short Name	Country Code	Logo
1	ENGINEERING – INGEGNERIA INFORMATICA SPA	ENG	IT	
2	NATIONAL TECHNICAL UNIVERSITY OF ATHENS	NTUA	GR	
3	FUNDACION CARTIF	CARTIF	ES	
4	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	RWTH	DE	
5	ACCADEMIA EUROPEA DI BOLZANO	EURAC	IT	
6	HOLISTIC IKE	HOLISTIC	GR	
7	COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO	COMSENSUS	SL	
8	BLAGOVNO TRGOVINSKI CENTER DD	BTC	SL	
9	PRZEDSIĘBIORSTWO ROBOT ELEWACYJNYCH FASADA SP ZOO	FASADA	PL	
10	MIASTO GDYNIA	GDYNIA	PL	
11	COOPERNICO - COOPERATIVA DE DESENVOLVIMENTO SUSTENTAVEL CRL	COOPERNICO	PT	
12	ASM TERNI SPA	ASM	IT	
13	VEOLIA SERVICIOS LECAM SOCIEDAD ANONIMA UNIPERSONAL	VEOLIA	ES	
14	ICLEI EUROPEAN SECRETARIAT GMBH (ICLEI EUROPASEKRETARIAT GMBH)	ICLEI	DE	
15	ENTE PUBLICO REGIONAL DE LA ENERGIA DE CASTILLA Y LEON	EREN	ES	
16	VIDES INVESTICIJU FONDS SIA	LEIF	LV	
17	COMITE EUROPEEN DE COORDINATION DE L'HABITAT SOCIAL AISBL	HOUSING EUROPE	BE	
18	SEVEN, THE ENERGY EFFICIENCY CENTER Z.U.	SEVEN	CZ	





Contents

1. Introduction	15
1.1 Purpose of the document.....	15
1.2 Structure of the document.....	16
1.3 Connection to other WPs	16
2 MATRYCS' main concepts in pilot operation and validation.....	18
2.1 MATRYCS LSPs.....	18
2.2 MATRYCS development cycles	23
2.3 MATRYCS Evaluation Framework.....	25
3 MATRYCS Evaluation framework	27
3.1 Strategy and general context.....	28
3.2 Data, infrastructures and digital technologies.....	37
3.3 User satisfaction	40
3.4 Main stakeholders.....	41
3.5 Procedures to personalise MATRYCS tools and services	45
4 Pilot operation and engagement plan.....	50
4.1 Pilot operation	50
4.2 Engagement plan.....	54
4.3 Potential risks	56
5 Baseline assessment report.....	58
5.1 MATRYCS PERFORMANCE	59
5.1.1 LSP 1: BUILDING OPERATION [BTC].....	59
5.1.2 LSP 4: SMART BUILDING AS ACTIVE NODE OF A SMART GRID [ASM]	62
5.1.3 LSP 5: ENERGY COMMUNITIES [COOPERNICO]	64
5.1.4 LSP 6: DISTRICT HEATING NETWORK [VEOLIA]	66
5.2 MATRYCS DESIGN.....	69
5.2.1 LSP 2: BUILDING REFURBISHMENT [FASADA]	69
5.2.2 LSP 6: DISTRICT HEATING NETWORK [VEOLIA]	72
5.3 MATRYCS POLICY	72
5.3.1 LSP7: SECAPS [ICLEI].....	73
5.3.2 LSP9: ENERGY PERFORMANCE CERTIFICATES [EREN]	75
5.3.3 LSP11: POLICY MAKING AND IMPACT ASSESSMENT [HOUSING EUROPE]	77
5.4 MATRYCS FUND.....	81
5.4.1 LSP3: ESCO SUPPORT SERVICES [VEOLIA]	81
5.4.2 LSP8: ONE-STOP-SHOPS [GDYNIA]	83
5.4.3 LSP10: DE-RISKING EE INVESTMENTS [LEIF]	85
6 Summary tables	88
7 Conclusions	93
APPENDIX I: Data gathering Template.....	94





APPENDIX II: Service description template.....95

Description of the service95

 Version management95

 Scope and objectives.....95

 Narrative of the service.....95

 Other comments or remarks.....96



Figures

Figure 1: MATRYCS LSPs classification and scope	18
Figure 2: MATRYCS Methodology.....	23
Figure 3: MATRYCS Technology releases.....	25
Figure 4: MATRYCS Evaluation Framework structure.....	27
Figure 5: MATRYCS user satisfaction methodology structure	40
Figure 6: MATRYCS LSPs related to target groups	42
Figure 7: MATRYCS Partners representing Stakeholders (Target groups) within the LSPs	45
Figure 8: Process followed in WP2 to define user stories, usage scenarios and use cases	48
Figure 9: Main objectives of the LSPs' comparative analysis, considering all the recovered data.	49
Figure 10: MATRYCS Pilot operation plan	51
Figure 11: Aspects from evaluation framework considered in the baseline assessment report	58
Figure 12: Pilot building of the kindergarten no. 16 in Gdynia, Poland	70
Figure 13: Monitoring equipment for indoor air quality installed in pilot building in Gdynia.	70

Tables

Table 1: MATRYCS LSPs brief description.....	19
Table 2: MATRYCS' Evaluation Framework pillars and key elements.....	28
Table 3: Strategy and general context KPIs (General KPIs).....	30
Table 4: Strategy and general context KPIs (Pilot-Specific KPIs)	32
Table 5: Technical KPIs overview	37
Table 6: Technical KPIs considered for the baseline assessment.....	38
Table 7: Main stakeholders considered	42
Table 8: Partners representing stakeholders within each pilot	44
Table 9: Phases considered throughout the process of User Stories generation as part of the procedures to personalize MATRYCS, key documents and participants.	46
Table 10: MATRYCS services / pilots' matrix.....	48
Table 11: MATRYCS Pilot operation and engagement plan: steps and deliverables	51



Table 12: Technical contacts assigned per LSP	55
Table 13: LSP 1: Strategy and general context assessment.....	60
Table 14: LSP 1 Technical KPIs assessment	60
Table 15: LSP 1: Main stakeholders	61
Table 16: LSP 4: Strategy and general context assessment.....	63
Table 17: LSP 4 Technical KPIs assessment	63
Table 18: LSP 4: Main stakeholders	64
Table 19: LSP 5: Strategy and general context assessment.....	65
Table 20: LSP 5 Technical KPIs assessment	65
Table 21: LSP 5: Main stakeholders	66
Table 22: LSP 6: Strategy and general context assessment.....	67
Table 23: LSP 6 Technical KPIs assessment	67
Table 24: LSP 6: Main stakeholders	68
Table 25: LSP 2: Strategy and general context assessment.....	71
Table 26: LSP 2 Technical KPIs assessment	71
Table 27: LSP 2: Main stakeholders	72
Table 28: LSP 7: Strategy and general context assessment.....	73
Table 29: LSP 7 Technical KPIs assessment	74
Table 30: LSP 7: Main stakeholders	74
Table 31: LSP 9: Strategy and general context assessment.....	75
Table 32: LSP 9 Technical KPIs assessment	76
Table 33: LSP 9: Main stakeholders	76
Table 34: LSP 11 Pilot selected building characteristics	78
Table 35: LSP 11: Strategy and general context assessment	79
Table 36: LSP 11 Technical KPIs assessment.....	79
Table 37: LSP 11: Main stakeholders	80
Table 38: LSP 3: Strategy and general context assessment.....	81
Table 39: LSP 3 Technical KPIs assessment	82
Table 40: LSP 3: Main stakeholders	82



Table 41: LSP 8: Strategy and general context assessment.....	84
Table 42: LSP 8 Technical KPIs assessment	84
Table 43: LSP 8: Main stakeholders	85
Table 44: LSP 10: Strategy and general context assessment	86
Table 45: LSP 10 Technical KPIs assessment.....	86
Table 46: LSP 10: Main stakeholders	87
Table 47: Data, infrastructures and digital technologies KPIs summary for global KPIs.	91
Table 48: Data, infrastructures and digital technologies KPIs summary for global KPIs.	92
Table 49: Version management.....	95
Table 50: Scope and objectives of service.....	95
Table 51: Narrative of the service.....	95
Table 52: General remarks	96



Abbreviations and Acronyms

Acronym	Description
API	Application Programming Interfaces
B	Business (KPI category)
BAC	Building Automation and Control
BaU	Business as Usual
B2B	Business to business
BMS	Building Management System
CO₂	Carbon Dioxide
CoM	Covenant of Mayors
D	Deliverable
DH	District Heating
DHN	District Heating Network
DSO	Distributed Systems Operator
EC	European Commission / alt. Economic (KPI category)
ECM	Energy Conservation Measure
ENV	Environmental (KPI category)
EE	Energy Efficiency
EPBD	Energy Performance of Buildings Directive
EPCs	Energy Performance Certificates
ESCO	Energy Services Company
EU	European Union
FM	Facility Management
FMCg	Fast Moving Consumer Goods
GA	Grant Agreement
H2020	Horizon 2020
HVAC	Heating, Ventilation and Air Conditioning
IPMVP	International Performance Measurement and Verification Protocol
KPI	Key Performance Indicator
LSP	Large Scale Pilot
LTRS	Long Term Renovation Strategies
LV	Low Voltage
M	Month
M&V	Measurement and Verification
MV	Medium Voltage
NECP	National Energy and Climate Action Plans
O&M	Operation and Maintenance
RES	Renewable Energy Source
ROI	Return on Investment
S	Social (KPI category)
SECAPs	Sustainable Energy and Climate Energy Action Plans





Acronym	Description
TBM	Technical Building Management
UC	Use Case
WP	Work Package



Executive Summary

The EU-funded MATRYCS project will deliver **Big Data applications that provide comprehensive energy efficiency services** in buildings and improve building operation and infrastructure design. An open reference architecture for smart energy efficient buildings will be created to align advanced architecture and vocabularies, allowing B2B sovereignty. The methodology will preserve multi-party data exchange and provide full interoperability of Big Data enablers with smart buildings standards.

The **validation of such framework** will be carried out through the deployment of analytics services focusing on different applications of a building's lifecycle such as digital building twins, improved buildings operation, building infrastructure design, EU/national policy assessment for energy efficiency investments on **11 Large-Scale Pilots (LSPs)**. These will be led by different stakeholders (facility managers, ESCOs, financial institutions, construction companies, municipalities, electricity grid and DH operators, policy makers), who will act as main beneficiaries.

The validation of this framework is the main focus of **Work Package (WP) 6 “Deployment and Validation in Real Environments”**, and the generation of this framework is scope of deliverable D6.1 – “Pilot operation, preparation, engagement and M&V plan”. In particular, the objectives and the activities under Task T6.1 “Pilot planning, Requirements and KPIs” and Task T6.2 “Pilots detailed specifications and preparation” are reported in the present document and aim at developing a plan for the deployment of the pilots throughout the project, establishing the measurement and verification (M&V) plan of the project, assessing and defining the current status of the LSPs.

To this end, deliverable D6.1 “Pilot operation, preparation, engagement and M&V plan” introduces the **objectives pursued in WP6 and Tasks 6.1 and 6.2** (section 1), and presents the **main concepts used in MATRYCS’ pilot operation and engagement** (section 2). In this respect, special focus is placed on the description of MATRYCS LSPs (section 2.1), the development cycles followed in the project (section 2.2) and the main pillars of the **Evaluation Framework**, which are presented in section 2.3. This Evaluation Framework will serve to measure the progress and the impact achieved in the LSPs and guide the validation process. It is composed by three main pillars containing sets of Key Performance Indicators, which address different aspects of the LSP deployment and validation: (1) Strategy and general context, (2) Data, Infrastructures and digital technologies and (3) User satisfaction. To complement these three pillars, two additional ones are proposed to ensure capturing user needs and facilitating the replication of the MATRYCS’ solutions: (4) Main stakeholders and (5) Procedures to personalise MATRYCS.

The interplay and coordination of these elements (LSPs, development cycles and the Evaluation Framework) is what will drive the LSPs’ operation and engagement plan in the coming months. This Pilot operation plan, as well as the envisaged engagement methods and the identification of potential risks are presented in section 4.

Finally, this document also presents a **baseline assessment report** for each of the pilots in section 5. In it, the calculation of all general and specific KPIs that can be calculated at this stage are presented, i.e. the pillars of (1) Strategy and general context, (2) Data, infrastructures and digital technologies and (4) Main stakeholders. To ease comparability among LSPs, summary tables are provided in section 6.

Therefore, this document acts as a guide and the plan will be implemented and followed up in the next stages of the project.



1. Introduction

The EU-funded MATRYCS project will deliver Big Data applications that will be validated in 11 Large-Scale Pilots (LSPs), covering different challenges around energy in buildings in their different stages of their life-cycle, and different perspectives (building, district, city and region).

Deliverable D6.1 “Pilot operation, preparation, engagement and M&V plan” is strongly related to the pilots’ deployment and validation procedures, and it is the first report within **WP6 “Deployment and Validation in Real Environments”**. The objectives of WP6 are presented below:

- Definition of a demonstration plan, which will include a Deployment and Verification plan (M&V) to be applied in each real-life LSP demonstrator.
- Coordination and monitoring of the LSP implementation activities.
- Implementation of training activities with the beneficiaries, in order to assess the value and impact of the implementation of the services and dissemination of the results.
- An evaluation of MATRYCS technologies’ efficiency and added value, highlighting large-scale multi-party data exchange, management / governance and real-time processing in the building sector, as well as effective operation of buildings and provision of innovative services.
- Assessment of MATRYCS ecosystem impact.

1.1 Purpose of the document

Deliverable D6.1 “Pilot operation, preparation, engagement and M&V plan” summarises the activities carried out in Task 6.1 “Pilot planning, Requirements and KPIs” and Task 6.2 “Pilots detailed specifications and preparation”. The main objectives are the following:

- **Framework definition for the pilots’ operation and engagement:** this will include defining a plan of the activities to carry out in each stage, as well as identifying where each activity is reported and the partner in charge of it.
- **Definition of steps and procedures for deployment validation:** steps and procedures for the deployment validation will be defined. These will be materialised in the different elements contained in the evaluation framework, as presented in section 3 “Evaluation Framework”, namely: (1) strategy and general context KPIs, (2) data, infrastructure and digital technologies, (3) user satisfaction, (4) main stakeholders and (5) procedures to personalise MATRYCS tools and services. Each of these elements will contribute in a different manner throughout the project.
- **KPIs definition and assessment measures for each pilot:** the main pillars delving into the assessment of the pilots will be the first three within the Evaluation Framework. In this document, the methodology to define all of these elements will be presented.
- **Baseline assessment analysis of the pilots:** finally, at this first stage of the project and with the view to evaluate the impact achieved at the end, it will be necessary to perform a baseline assessment of the pilots, to evaluate their current status.

1.2 Structure of the document

The document is structured into seven sections, as reported below:

- **Section 1 (Introduction)** presents the objective of both WP6, and the purpose of the document.
- **Section 1.3 (MATRYCS' main concepts in pilot operation and validation):** provides an overview of the main concepts used both in this document, as well as throughout the WP6. In particular, it presents and briefly describes MATRYCS's pilots (section 2.1), the development cycles to be followed in the project, and the main components of the MATRYCS Evaluation Framework (section 2.3).
- **Section 3 (Evaluation Framework):** delves deeper into the components of the Evaluation Framework previously presented in section 2.3. In particular, further explanation is provided on (1) Strategy and general context (section 3.1), data, infrastructures and digital technologies (section 3.2), user satisfaction methodology (section 3.3), main stakeholders (section 3.4), and procedures to personalise MATRYCS' tools and services (section 3.5).
- **Section 4 (Pilot operation and engagement plan):** explains the plan to be followed throughout WP6, which will guide the pilot's operation and validation steps. It also proposes a preliminary approach towards engagement with potential validators and the strategies followed within the consortium to put the plan into practice.
- **Section 5 (Baseline assessment report):** provides information on the current status of each LSP. For this assessment, the key performance indicators (KPIs) defined in the Evaluation Framework have been calculated. These results represent the reference values that will be used at the end of the project to assess the impact achieved with MATRYCS' pilot deployment.
- **Section 6 (Summary tables):** includes summary tables to facilitate the review of the KPIs and results provided for each large-scale pilot.
- **Section 7 (Conclusions):** the last section wraps up the content presented in the document, as well as it highlights the next steps to be carried out in relationship to the present document.

1.3 Connection to other WPs

WP6 "Deployment and Validation in Real Environments", and especially D6.1 "Pilot operation, preparation, engagement and M&V plan" are closely related to other WPs and activities within MATRYCS, as shown below:

- **WP2 "System Requirements and Specifications":** in this WP2, a strong work with the LSPs has been performed to extract requirements and specifications. In particular, special focus was placed on the definition of target groups, personas, user stories, usage scenarios and use cases. These were reported in D2.1 "State-of-the-art analysis and big data value chain", and continue to be used within WP6. In fact, they are integrated in the Evaluation Framework and will be used in the validation process of the LSPs, to assure that the initial user requirements defined are observed in the LSP deployment. Additionally, the data gathering template was launched in this WP2 and will be monitored from WP6.



- **WP3 “MATRYCS data services and semantic enrichment layer”:** WP3 deals with data since it will implement the data services and semantic enrichment layer in the MATRYCS project. The main link with WP6 is established through the monitoring of the data gathered in each of the pilots (presented in the baseline report), as well as the monitoring of KPIs reflected in the Grant Agreement (Pillar 2 of the Evaluation Framework: Data, infrastructures and digital technologies).
- **WP4 “Data modelling & open modular data analytics toolbox”:** in a similar manner to WP3, WP4 is linked to WP6 and the LSPs through the data used from each of the LSPs in the generation of data analytics. In addition, the data generated in the context of each pilot through the application of WP4 analytics and model training will also be observed in WP6.
- **WP5 “Analytics building services”:** building upon WP3 and WP4 developments, WP5 will provide different services that will be deployed in the 11 MATRYCS LSPs. These will be the closest to the end users and will need to address their needs and integrate the insights gathered through the validation processes. Thus, the validation proposed in WP6, and, in particular the user satisfaction, will be linked to WP5.
- **WP7 “Exploitation and business cases development”:** each of the MATRYCS LSPs represents a distinct challenge within the building value chain, where exploitation possibilities can arise. From the in-depth understanding of each of the LSPs, carried out throughout WP6, as well as through the detailed specification of target users and personas it will be possible to feed WP7 with relevant insights for exploitation and business cases development.
- **WP8 “Communication, dissemination and awareness creation”:** the communication, dissemination and awareness creation activities can be informed of the success (or lack thereof) of MATRYCS digital solutions with specific target users. This can contribute to guiding or adapting WP8 activities to be more effective. Additionally, synergies can be found when creating workshops or external activities in WP8, so that these events can also serve to validate specific services or explore user satisfaction.

2 MATRYCS' main concepts in pilot operation and validation

This section presents the main concepts that are going to be used in the pilot operation and validation, throughout the project's lifecycle. To this end, MATRYCS pilots are introduced (2.1), the development cycles to be followed are presented (2.2), and finally, the Evaluation Framework to be used is illustrated (2.3). The latter will be the core of the M&V plan to be deployed during the validation process. The M&V plan is aligned with the elements contained in the evaluation framework, as well as with the development cycles. This will be clearly presented in sections 3 and 4.

2.1 MATRYCS LSPs

MATRYCS Large-Scale Pilots (LSPs) reach a wide scope in the **building's lifecycle**, as they consider **buildings from different perspectives and scales**: buildings as individual entities (building scale), groups of buildings (district scale), groups of districts (city scale), groups of cities (regional scale), and end up covering the national and European levels. This is reflected in Figure 1.

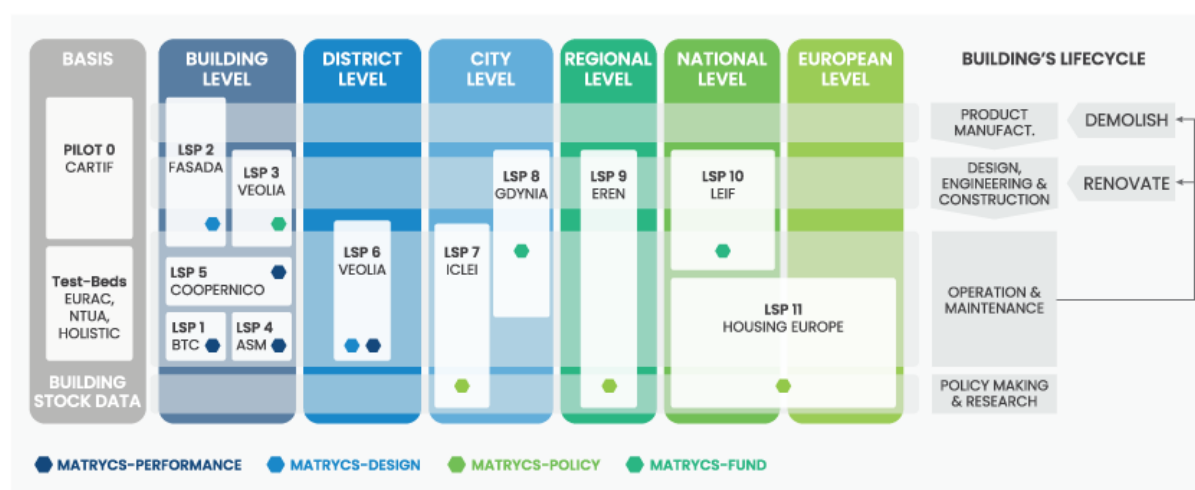


Figure 1: MATRYCS LSPs classification and scope

In addition to this classification, MATRYCS LSPs cover different topics, as reflected in the Figure 1 as well: (1) Performance, (2) Design, (3) Policy, and (4) Fund, which are explained below.



MATRYCS PERFORMANCE: Services and business models based on the **operational stage of buildings aiming at monitoring and improving their energy performance**. Predictive capabilities related to comfort evaluation, energy demand, consumption or generation, will be complemented by optimisation capabilities for the management of comfort-aware building energy consumption, management of district heating networks or energy matching.



MATRYCS DESIGN: Services and business models aiming **at facilitating the design, refurbishment and development of building infrastructure**. In particular, the focus is at the building level design of retrofitting actions, as well as at district level design of networks.






MATRYCS POLICY: Services and business models to support **policy making and policy impact assessment**. They will be targeting three main elements revolving around policies at different scales: Sustainable Energy and Climate Action Plans, Energy Performance Certificates and EU policies impact assessment for buildings.



MATRYCS FUND: Services and business models aiming to address challenges for **enhanced reliability and reduced risks of energy efficiency investments**, tailored to ESCOs and financing institutions, hence contributing to better define Energy Performance Contract conditions. They will also tackle the centralization of building stock data, the analysis of refurbishment actions and the evaluation of their bankability through the testing of one-stop-shops at city level.

More specifically, each of the pilots in the MATRYCS project is presented in below, as well as a reference to where the baseline of each of them is assessed.

Table 1: MATRYCS LSPs brief description

Category	LSP brief description	Base.
	LSP 1: BUILDING OPERATION [FM]: Facility and resources fingerprinting for efficiency and optimal balancing of energy vectors [BTC] . BTC is one of Europe's largest shopping, entertainment, business, commercial, and logistics centres. MATRYCS will enable facility manager efficient management of appliances and subsystems that corresponds to local context and is coordinated on a system level. Utilising historical data and applying the non-intrusive fingerprinting approach to live data streams, the aim is to aid the traditional monitoring systems with reasoning capabilities and thereby evaluate value for holistic BMS. Fingerprinting represents a necessary first step in the realization of next generation BMS that will allow realising higher service efficiency for various energy vectors and scopes of facility management.	5.1.1
	LSP 2: BUILDING REFURBISHMENT: Sustainable building assessment and optimisation of refurbishment options [FASADA] . The expected solution will achieve an improved holistic and cost-effective assessment of the performance of a building from both the energy and sustainability perspectives. The objective pursued will be similar to that of the OptEEmAL project ¹ , where a series of Energy Conservation Measures were evaluated and combined to obtain the best solution according to specific KPIs. The solutions proposed will be tested with datasets provided by FASADA.	5.2.1
	LSP 3: ESCO SUPPORT SERVICES: Energy saving verification service for increasing the trust on Energy Performance Contracts [VEOLIA] . VEOLIA in this pilot is covering the role of ESCO, aiming at generating analytics to improve the ESCO model. This business model is	5.4.1

¹ OptEEmAL: Optimised energy efficient design platform for refurbishment at district level (H2020 project, GA: 680676), website: <https://www.opteemal-project.eu/>

Category	LSP brief description	Base.
	based on achieving a proper balance in between the investment and the energy savings achieved to reduce the ROI as much as possible. In the process of deciding if a project is economically feasible (viable) or not, the “data” are relevant, i.e., data from potential Energy Conservation Measures, cost, energy cost projections, as well as predictions of future energy behaviour / performance. Regarding the Energy Performance Contracting and their compliance, the energy savings verification is a crucial task, so methods (based on protocols like IPMVP) to estimate savings need data: static and dynamic data to build simulations, estimations or statistics approach or real / live data from monitoring / metering networks / devices.	
	LSP 4: SMART BUILDING AS ACTIVE NODE OF A SMART GRID: Smart building comfort-aware predictive energy management and coordination with smart grids and local RES generation [ASM]. ASM is the local multi-utility owned by Terni’s municipality and operates as DSO the LV/and MV electricity network in Terni city, as well as the main shareholder of the Umbria Energy retailer. In addition to this, ASM main offices’ buildings are equipped with a legacy building management system (DELTA BMS) in charge for intelligently managing HVAC (via BMS-controlled heat pumps) and lighting subsystems. ASM DSO is facing already severe network stability problems due to the increasing share of intermittent generation from renewable energy and to the new loads, as energy storage and electric mobility which are modifying the operating conditions of the assets originally designed for almost steady and unidirectional power flow. Coordinated optimisation of building energy consumption and smart grid management may be significantly improved thanks to data-driven cross stakeholder predictive analytics on building subsystem-level (HVAC, lighting) energy consumption prediction, building occupants comfort prediction, local RES generation prediction and weather forecasting.	5.1.2
	LSP 5: ENERGY COMMUNITIES: Services for the better management of self-production systems [COOPERNICO]. COOPERNICO has over 2,000 members and operates as electricity supplier. The participants in this pilot will be chosen from COOPERNICO’s members (~850 users). At least half of them have a supplier contract with COOPERNICO and one-third are prosumers. This pilot aims at creating a service to help its members in order to better manage their self-production system (for prosumers) and to improve the energy performance of COOPERNICO members’ households (for the members with supplier contract). COOPERNICO’s pilot proposes the use of data coming from its members’ smart meters regarding their energy production and to match it to their electricity consumption. This information will be correlated to the type of building, year of construction and location. This will be the data set to design a service where advice is given on how to better use the energy produced, consumed and what improvements can be done to the building itself to improve their energy efficiency. This service could be used by other members who only consume electricity from the grid, giving all data with the exception of the data regarding the production units, and to advise them on how they can improve their building or energy use or to help them tackling energy poverty.	5.1.3

Category	LSP brief description	Base.
	LSP 6: DISTRICT HEATING NETWORK: Energy demand prediction to design, develop and optimize district heating networks operation [VEOLIA]. VEOLIA in this pilot, at a district scale, is covering the role of DH facility manager (FM), aiming at generating analytics to improve FM processes. This pilot involves a district heating network providing heating and domestic hot water to 1,500 households with 20 distribution substations, in Laguna de Duero. One relevant facility where it can be demonstrated how relevant the data are at the district level is a district heating network. Such facility needs information coming from individual apartments (energy demand) from a baseline (static data) as well as in operation (real data). The involvement of individual data from the residential sector is crucial to achieve this. The aggregation of such demand (simulated for designing purpose or measured for operational reason) is needed. The operation of the generation and distribution, how to match the demand to the generation, the prediction considering weather conditions or other kind of social event can contribute to economic benefit. Apart from this, this pilot will be in charge of applying the MATRYCS framework to design, in the aforementioned district, a new DH brand to connect the remaining 11 building blocks to the station of production. Information and data from the current DHN (Veolia HubGrade) will calibrate new models and simulations of alternative scenarios, which will be created using new components and equipment extracted from e-catalogues. Optimization processes will help deciding the best design for the new facility.	5.1.4
		5.2.2
	LSP 7: SECAPS: Services to support SECAPs impact assessment, implementation and monitoring [ICLEI]. Local and regional authorities during the past decade have been actively engaged in sustainable energy policy planning, with efforts also placed the last couple of years on integrating climate planning as well, through the voluntary initiative of the Global Covenant of Mayors (CoM) for Climate and Energy. The authorities produce Sustainable Energy and Climate Action Plans (SECAPs) that are focusing on the climate resilience of the public infrastructure and services, as well as reduction of the local authorities' energy consumption and carbon footprint, through a wide range of actions that mainly target the municipal lighting and transport sectors and the buildings of the municipal, tertiary and residential sectors. SECAPs data are a significant data source for activities of business interest to a wide range of stakeholders. New and innovative pathways in energy and environmental policy planning will be provided, as well as the related market actors, by analysing energy efficiency and renewable energy mitigation actions' data, as well as data from adaptation actions that are focusing on the above-mentioned sectors, and supporting the local market development for the implementation of these actions.	5.3.1
	LSP 8: ONE-STOP-SHOPS: Enablers of the financing of refurbishment actions in the building stock at local level [GDYNIA]. The need to refurbish the building sector is undeniable; however, the implementation of refurbishment of action plans at local level needs to be supported to enable reliable and cost-effective analysis that can lead to an adequate budget allocation, search of financing resources as well as stakeholders to be involved. In order to be able to de-risk the sector and boost this type of interventions, it is necessary to put into practice methods that enable to automatically evaluate the performance of a building and link them to financing mechanisms. In this line, one-stop-shops managed by local entities can act as a central entity to catalyse and ease building refurbishment at city level. A package of solutions will be provided to support the implementation of data-driven services for one-stop-shops.	5.4.2

Category	LSP brief description	Base.
	LSP 9: ENERGY PERFORMANCE CERTIFICATES: Next generation energy performance assessment and certification [EREN]. Considering the vast room of improvement in the field of energy performance certification and the approach shift of the amending EPBD, there are plenty of possibilities for the adequate implementation of a more reliable, high quality and harmonised next-generation of Energy Performance Assessment and Certification. This should contribute to generating trust and to boosting the energy refurbishment market. Policy makers in charge of the Energy Performance Certificates (EPCs) implementation should contribute to boosting the generation of reliable and change-inducing EPCs; however, it is paramount to improve the processes that revolve around EPCs and that can contribute to their accuracy and to increasing their reliability. To this end, a pilot to exploit EPCs with the deployment of big data is proposed, having EREN (Regional Energy Agency) as the main actor and responsible of triggering action. MATRYCS solutions will be deployed to support (1) harmonisation and data share of EPCs, (2) facilitate their compliance and checking procedures and finally (3) contribute to de-risking investments in the EE sector.	5.3.2
	LSP 10: DE-RISKING EE INVESTMENTS: Services to support reliable, cost-effective and better-quality Energy Performance Contracts and Investments [LEIF]. Energy Efficiency (EE) projects are often fragmented, with high transaction costs, while with no evidence-based platform that would allow investors and financial institutions to assess the risk, the financial performance of the investments, as well as the impact on EE. The capability offered by emerging near big data analytics to integrate cross-domain financial and energy consumption is the key for building the necessary market confidence in EE projects and making them an attractive investment asset class. The use of historical data pooled from major market segments can encourage more EE investments and de-risk investments. In this sense, LEIF is the only institution in Latvia that has reliable data on investments in EE and actual performance of investments in terms of energy savings. The pilot concept will demonstrate MATRYCS framework through cross-domain integration of a variety of heterogeneous historical and live data on financial performance, underlying EE impact of the investments, through historical extensive smart meters data integration.	5.4.3
	LSP 11: POLICY MAKING AND IMPACT ASSESSMENT: Data-driven policy making and policy impact assessment for energy-efficient buildings [HOUSING EUROPE]. the European Commission presented its long-awaited proposal for a European Green Deal which, among other objectives, aims at making the continent CO2 neutral by 2050. The EC proposed to work with stakeholders on a new renovation initiative in 2020, whose aim is to organise renovation efforts, lifting national regulatory barriers to renovation, focusing in particular on social housing. The EC wants the member states to engage into a renovation wave, using the long-term renovation strategies provided for by the EPBD as the appropriate policy framework. The public, cooperative and social housing providers, represented by Housing Europe, are in position to play a leading role in this transition, as they are already key drivers of the renovation efforts across Europe. However, the role of the sector in the successful implementation of the future European Green Deal cannot be overestimated but could benefit from the right policy and financial framework. To this end, an extensive processing of these data will be applied, in order to elaborate and categorise policy instruments and risk mitigation strategies, as well as to identify best practices on right policy and financial framework which can be considered as a basis for benchmarking and for policy	5.3.3

Category	LSP brief description	Base.
	implementation and its link to financial mechanisms.	

2.2 MATRYCS development cycles

This section reports about the development cycles that are followed into MATRYCS project evolution. MATRYCS is based on short **iterative cycles of work**, with highly **parallel streams of activities** by adopting an agile software engineering methodology with a view to guarantee a well-defined time to market context. MATRYCS methodology is based on three main phases, as shown in Figure 2: MATRYCS Methodology. Each phase feeds the next one, so that an initial, intermediate and final version of the project framework and related tools will be derived after the end of every phase.



Figure 2: MATRYCS Methodology

The validation methodology will go through different yet incremental stages, starting from an initial smaller-scale validation taking place in a controlled environment where a subset of functionalities and tools will be deployed and validated over a reduced amount of data from all pilot sites aimed to provide early feedback and allow refinements and adaptations based on an early technical integration of the MATRYCS solution. Secondly, we will deploy a reference technical implementation of the entire MATRYCS reference framework along all the datasets made available by all pilot sites. The final validation will also incorporate scalability analysis, where the MATRYCS reference framework will be validated against the larger data sets, which in the meantime have been incrementally made available by all pilots, taking into due consideration the Volume Big Data dimension.

A full development cycle is implemented in each phase:

- Phase 1 || Specification & Technologies adaptation M1-M15:** it will include definition of the scenarios, use cases, the elicitation of user requirements and system requirements, dynamic assessment, modelling, definition of system architecture and data models. The MATRYCS development processes will start by collecting insights through users' /stakeholders' activities i.e. based on review of reference scenarios and user stories about real-time data-driven energy-efficient buildings, as well as based on the analysis of the project's pilots (see WP2 on user stories and WP6 on pilots). This phase will be complemented by information from linked research initiatives, such as flagship big data and energy-efficient buildings projects from partners, relevant standards, as well as project-specific, pilots and data assets requirements, and will be further analysed through requirements engineering techniques. The outcome of this activity will be a set of requirements, each split into a set of prioritised functionalities for the MATRYCS development activities, as needed for enhancing the project's technology capabilities and conducting the pilots. Early technology and asset assessment will be followed by preliminary validation of key solution ideas in local, existing

small-scale pilot-site infrastructure deployed along a subset of pilot sites. **Early data-driven experimentation** will be carried out, through **proof-of-concepts and early technologies probes for a subset of prioritized technology micro-services components (M13)** and will be used for exploratory experiments with selected (historic offline) data pinpointing problems and opportunities for “quick-win” big data value generation (**Pre-pilot phase**). At the building level, it is very important to define models that consider not only energy aspects but also thermal, visual, acoustic comfort information. To do that it is necessary to have a lot of data to test the algorithms and create possible scenarios. This data is not always available, so introducing possible campaign on pilots to monitor comfort aspects could be helpful to increase the number of data available. The MATRYCS concept will be fine-tuned, while reference architectures and blueprints for building real-time AI-based analytics in the sector of buildings will be consolidated, in order to drive developments in all core technology WPs 3-4. Evaluation (M13-M15) will start via prototyping and testing referring to the planned pilots, to identify potential limitations and drawbacks by involving a group of selected users.

- **Phase 2 || Product Integration & Fine Tuning M16-M28:** based on feedback from Phase 1, the scenarios and requirements will be refined, and a **second implementation of advanced functionalities for technological components will be released (M22)**. This phase will focus on the delivery of all the technological enablers and on their deployment on the pilot sites. Hence a second pilot validation campaign (**Full Pilot Phase**) will be performed, based on first release of all the technology enablers of the project’s concept. MATRYCS complete framework will be hence deployed at pilot site through controlled environments, decoupled from “production” environments, with the use of a dedicated large-scale data processing infrastructure for experimental purposes exploiting learning large historic and live data, possibly anonymised or simulated. Beyond full deployment of MATRYCS framework and enablers, first standardisation and certification efforts to match data governance structures with a rich KPI collection and benchmark analysis will be performed. MATRYCS components will be evaluated (M24-M28), during the full pilot operation phase, for both usability and performance levels.

- **Phase 3 || Product Assessment & Market Uptake M29-M36:** This phase will take into due consideration the evaluation results of Phase 2 with a view to enable the refinement of component and system level technology consolidation, through scalability-driven functionality enhancements using **the final versions of the MATRYCS enablers (M30)**. Overall, the final version of the MATRYCS will have been concluded latest by M28, resulting in the final version/iteration of the relevant deliverables in WP3 and WP4. A final pilot validation (M31-M33) will be carried out mostly focused on the scalability and will provide the necessary benchmark to perform the business validation (M33-M36) based on a techno-economic assessment of the business benefits gained by each pilot. Following this assessment, components with the highest maturity and market readiness will be prioritised for exploitation, commercialisation and wider use (WP7).

Summarising, from the point of view of technologies development and releases concerning WP3, WP4 and WP5, as per MATRYCS project milestone as well as depicted in Figure 3: MATRYCS Technology releases, major milestones are in:

- M13 – October 2021 || 1st Technology release and development cycle completion
- M22 – July 2022 || 2nd Technology release and development cycle completion
- M30 – March 2023 || Final Technology release of MATRYCS framework

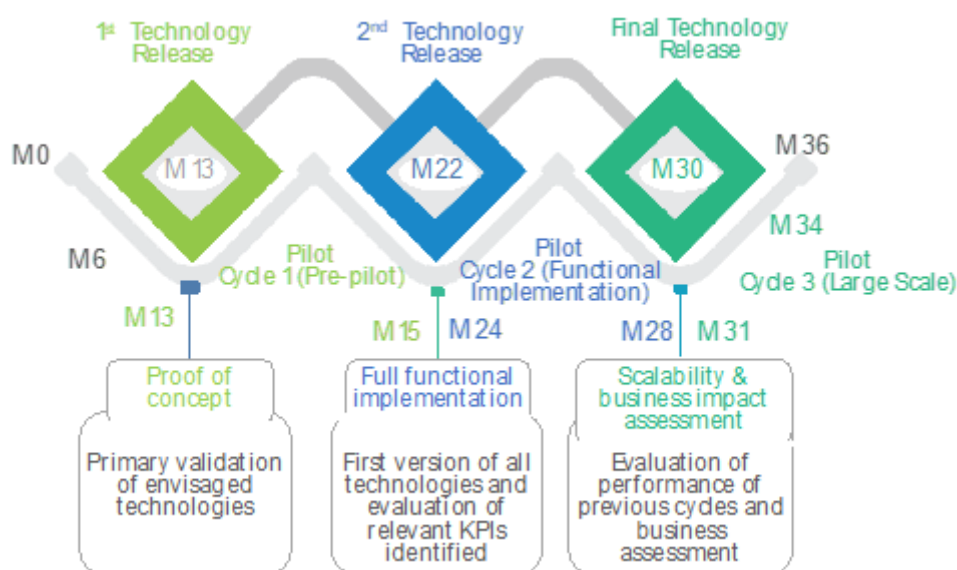


Figure 3: MATRYCS Technology releases

2.3 MATRYCS Evaluation Framework

MATRYCS' Evaluation Framework will be used to track the progress of the pilots throughout the project and evaluate its impact. The evaluation framework consists of three main pillars; (1) Strategy and general context, (2) Data, infrastructures and digital technologies and (3) User satisfaction methodology. These three pillars are complemented by two further pillars, (4) Main stakeholders and (5) Procedures to personalise MATRYCS in the pilots.

- 1. Strategy and general context:** within this pillar, the KPIs framework is defined. This framework is used to evaluate the LSPs impact, containing a common part for all pilots (General KPIs) and specific KPIs for each LSP, which are more focused on the specific topic tackled in each of them. This KPI framework, presented in section 3.1 and calculated in section 5, includes a description of the indicators, their units, calculation formula and relevant comments. In this deliverable, the initial status of both the general and specific KPIs is presented and will be used as reference for the final evaluation, reported in deliverable D6.15 "Report on Pilot's Integration and Validation (cycle 3)" and due for submission in September 2023 (M36).
- 2. Data, infrastructures and digital technologies:** within this pillar the basis upon which the analytics to be provided in MATRYCS will be built is determined. The preliminary identification of data availability for the project and the baseline assessment per pilot of the current status is reported in section 5, which builds upon the work carried out in WP2 "System Requirements and Specifications".
- 3. User satisfaction:** The objective of the user satisfaction methodology is to validate the analytics services by end users through questionnaires, live demonstrations or workshops in the different stages of the project (to be further specified in subsequent stages). This can be used to gather feedback for analytics developers to improve their analytics and personalise them if necessary. The initial version of this methodology is provided in the present deliverable. However, at this

initial stage, the LSPs are not mature enough for the user satisfaction to be evaluated. They will be defined in the next development cycles and reported in deliverables D6.3 – D6.13 due in M27.

4. **Main stakeholders:** the objective of this pillar is to complement the three previous pillars and especially the user satisfaction pillar, by providing alignment with the work carried out in Task T2.1 “MATRYCS Services, Tools & Methodologies Landscape Review”, where target groups and personas had been defined. By observing in each cycle of the process the stakeholders that are validating the solution and assuring the coverage of their types, it will be possible to robustly consider all potential nuances and meet all requirements.
5. **Procedures to personalise MATRYCS in the pilots:** the last pillar of the evaluation framework will consist of methods to personalise MATRYCS in the LSPs. This will be fostered in different manners, by (1) analysing how the same services are applied and adapted in each pilot, (2) observing usage scenarios and by (3) incorporating users’ feedback.

All these pillars are further developed in the following section 3 “Evaluation Framework”. They will be then related with the different development cycles carried out in MATRYCS and will build up the pilot operation plan, which will be showcased in section 4.

3 MATRYCS Evaluation framework

The MATRYCS' Evaluation Framework counts on the following 3 pillars + 2 supporting elements, as displayed in Figure 4.

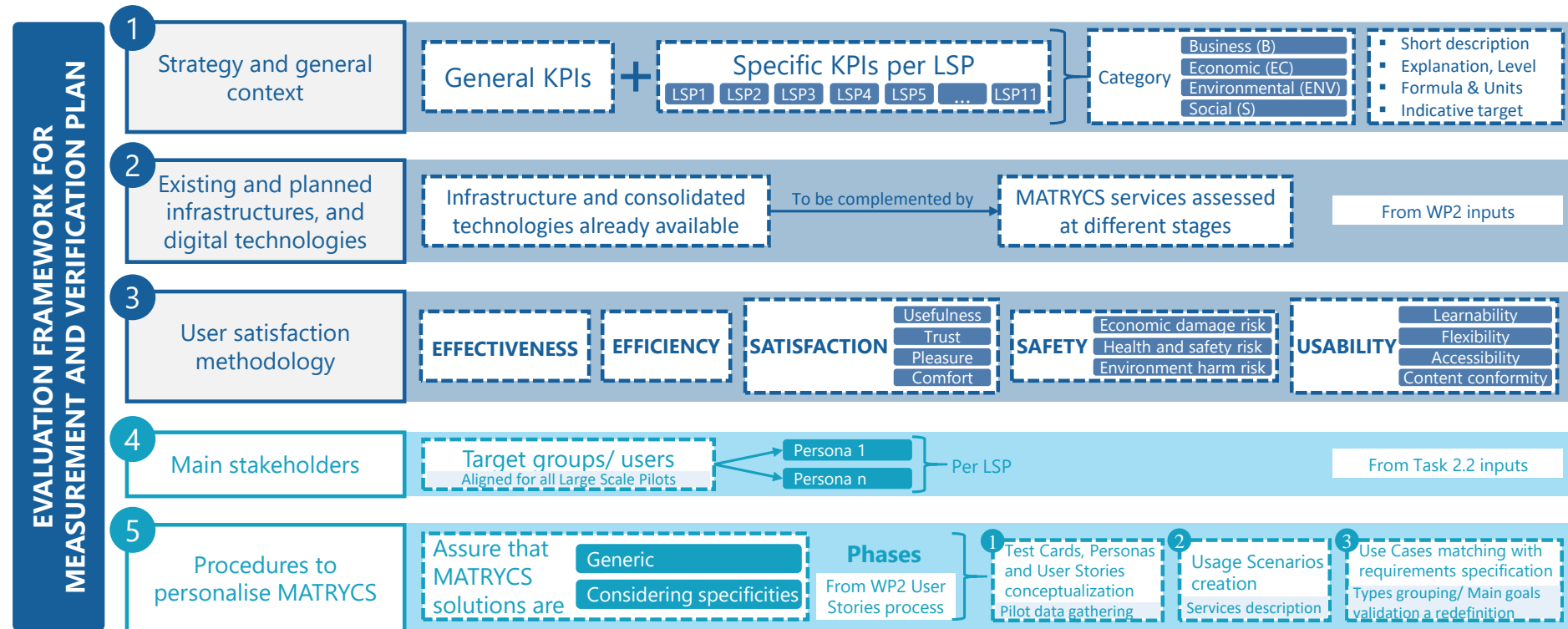


Figure 4: MATRYCS Evaluation Framework structure

A set of observations can be made for each of the elements of the evaluation framework, as displayed in Table 2.

Table 2: MATRYCS' Evaluation Framework pillars and key elements.

1	Strategy and general context
FOCUS ON	<p>KPIs to measure the impact achieved with the pilots' implementation</p> <ul style="list-style-type: none"> General KPIs (applicable to almost all pilots) Specific KPIs per LSP (pilots' specific challenges) <p>All of them cover a series of categories: business (B), economic (EC), environmental (ENV) and social (S).</p>
HOW	By including KPIs short description, explanation, formula, units, level and indicative target
More information on this pillar can be found in section 3.1	
2	Existing and planned infrastructures and digital technologies
FOCUS ON	Infrastructure and consolidated technologies
HOW	The consolidated technologies will be complemented by MATRYCS services and assessed at different stages of the project. Relevant feedback from WP2 will be gathered.
More information on this pillar can be found in section 3.2	
3	User satisfaction methodology
FOCUS ON	Feedback from users
HOW	By following a methodology classified into five categories: (1) effectiveness, (2) efficiency, (3) satisfaction, (4) safety and (5) usability . There will also be the possibility to have subcategories within these main categories, to improve the MATRYCS solutions proposed.
More information on this pillar can be found in section 3.3	
4	Main stakeholders
FOCUS ON	Main stakeholders, target groups and Personas.
HOW	To this end, target groups and personas have been retrieved an aligned from T2.2 input. They will serve as a reference to assure appropriate coverage in the validation actions in the LSPs.
More information on this pillar can be found in section 3.4	
5	Procedures to personalise MATRYCS
FOCUS ON	Generic vs specific solutions implementation
HOW	Specific pilot context analysis has as an objective to assure that the MATRYCS solutions are generic enough to be scalable in other context, as well as they can cover specificities by being adapted to the needs of different types of users.
More information on this pillar can be found in section 3.5	

3.1 Strategy and general context

The strategy and general context KPIs aim to measure the [impact achieved with the deployment of](#)



the LSPs. There are two types of indicators, but both of them cover four main categories: Business (**B**), Economic (**EC**), Environmental (**ENV**) and Social (**S**):

- **General KPIs:** General KPIs contribute to having a common vision among pilots and enable the comparison among them. However, since each LSP is covering a different topic or scale, nuances can appear when calculating them, especially in the cases of LSPs from different groups within the MATRYCS classification. To this end, each General KPIs is not applied to all pilots, but it takes into consideration the topic and scale of each pilot. In order to detect these nuances per pilot, in the baseline assessment report in section 5 they are reported within each pilot and an explanation is provided in each of them. In more advanced development stages of the project, and depending on the progress made in WP7 Exploitation and Business Cases Development, the definition of additional indicators of the Business category may be considered. Each general KPI is measured at the start of the project, as part of the baseline assessment, and will be measured again in the end of the project to validate the impact of MATRYCS.
- **Pilot-specific KPIs:** they are related to each LSP's specific challenges and are also measured at the beginning and end of the project, to assess the impact of MATRYCS in each one.

All the KPIs of the Strategy and General Context are presented in the following two tables (Table 3: Strategy and general context KPIs (General KPIs) and Table 4: Strategy and general context KPIs (Pilot-Specific KPIs). In these tables, Category, KPI name, description, formula, units and level are detailed. For the general KPIs, the applicability to a specific LSP is provided in the last column of Table 3. For the Pilot-specific KPIs, the applicability to each LSP is provided in the first column as it is the main aspect of definition.

It is noted that for some of the general KPIs related to the Business category, the final version of the business models to be followed are needed. These will be clear in M18 (March 2022) with the submission of D7.2 "Business and Exploitation Plan, Mid-term report". For the moment, those KPIs are included in the following list (Table 3). They will be later refined and reported in the following WP6 deliverables, namely D6.3 to D6.13, due in M27.

A classification of the KPIs on three different levels (1, 2 and 3) is meant to indicate differences on the degree of impact MATRYCS' solutions could have in each of the LSPs challenges:

- **Level 1 directly concerns** MATRYCS and its development. E.g., number of services tested and deployed.
- **Level 2** is where BaU process in LSP is **directly affected by the implementation** of MATRYCS' services. E.g., in case of systems optimisation analytics which **directly** affect the operation of a building and going to be applied in the LSP and whose savings can be measured, this would be a real result (energy savings) achieved by the project.
- **Level 3** is where MATRYCS could have an **indirect impact** on the results obtained, e.g., the energy savings derived from the application of ECMs, whose selection is aided with MATRYCS).

Table 3: Strategy and general context KPIs (General KPIs)

ID	KPI name	Cat.	KPI description	Formula	Units	Level	LSP
G01	MATRYCS services deployed and validated in LSPs	B	Number of services (from WP5) deployed and validated in the LSP in MATRYCS project.	[Final services deployed in the LSP / Initial services identified for the LSP]; where Target value is the divisor	#	1	ALL
G02	Reduction in final energy consumption (ratio)	ENV	Final energy consumption per year and square meter in the LSP. Normalization and adjustments should be done in the baseline data so that energy consumption is measured under the same circumstances in both periods (e.g. related to weather/climate data, location, indoor air conditions, level of comfort, etc.).	$[(\text{Final energy consumption per sqm (baseline)} - \text{Final energy consumption per sqm (end of the project)}) / \text{Final energy consumption per sqm (baseline)}] \times 100$	kWh/ year *m ²	3	LSP1, LSP2, LSP3, LSP4, LSP5, LSP6, LSP10
G03	Reduction in final energy consumption (total)	ENV	Final energy consumption per year in the LSP. Normalization and adjustments should be done in the baseline data so that energy consumption is measured under the same circumstances in both periods.	$[\text{Final energy consumption (baseline)} - \text{Final energy consumption (end of the project)}] / \text{Final energy consumption (baseline)}$	kWh/ year	3	LSP1, LSP2, LSP3, LSP4, LSP5, LSP6, LSP10
G04	Reduction in CO ₂ emissions (ratio)	ENV	CO ₂ emissions per year and square meter in the LSP. Normalization and adjustments should be done in the baseline data so that energy consumption is measured under the same circumstances in both periods (e.g. related to weather/climate data, location, indoor air conditions, level of comfort, etc.).	$[(\text{CO}_2 \text{ emissions per sqm (baseline)} - \text{CO}_2 \text{ emissions per sqm (end of the project)}) / \text{CO}_2 \text{ emissions per sqm (baseline)}] \times 100$	Tons of CO ₂ / year *m ²	3	LSP1, LSP3, LSP4, LSP5, LSP6, LSP10
G05	Reduction in CO ₂ emissions (total)	ENV	CO ₂ emissions per year and square meter in the LSP. Normalization and adjustments should be done in the baseline data so that energy consumption is measured under the same circumstances in both periods.	$[\text{CO}_2 \text{ emissions (baseline)} - \text{CO}_2 \text{ emissions (end of the project)}] / \text{CO}_2 \text{ emissions (baseline)}$	Tons of CO ₂ / year	3	LSP1, LSP3, LSP4, LSP5, LSP6, LSP10



ID	KPI name	Cat.	KPI description	Formula	Units	Level	LSP
G06	Average economic savings for end-users	EC	Economic savings generated through the service development to the end-users (e.g., per household, per office building, etc.) of the LSP. Personalised for the case of each LSP where it is measured.	$(\text{€ spent before the intervention or service deployment in an end-user unit per year}) - (\text{€ spent after the intervention in the same end-user unit per year})$	€/ year/ end-user unit	3	LSP1, LSP2, LSP4, LSP5
G07	Return on investment (ROI)	EC	Evaluation of the return of investment by measuring the ratio between the total incomes (benefits – economic savings achieved) and the total investment done for the service developed provided to the LSP. This KPI is defined in the LSP based on a key action (service deployed) that is economically evaluated (the one that causes the greatest economic impact); so this is the reason why it will be refined later, when the services for each pilot are more advanced.	$[\text{€ of total incomes} / \text{€ of total investment}] \times 100$	%	3	LSP2, LSP5, LSP10
G08	Payback period	EC	The time it takes to cover investment costs (e.g., funding received), which is safer when shorter, from the impact generated and economic benefit in the LSPs through the application of MATRYCS services. As the previous one, this KPI is defined in the LSP based on a key action (service deployed) that can be economically evaluated; so this is the reason why it will be refined later, when services for all LSPs are more advanced.	$[\text{Initial investment} / \text{Average annual savings}]$	Years	3	LSP2, LSP5, LSP10
G09	Households impacted	S	Number of households reached in some way or benefited by MATRYCS deployment in the LSP.	-	#	3	LSP3, LSP4, LSP5, LSP6, LSP8, LSP9, LSP11



Table 4: Strategy and general context KPIs (Pilot-Specific KPIs)

LSP	ID	KPI name	Cat.	KPI description	Formula	Units	Level
LSP1	101	Improved O&M efficiency	EC	Improvement in O&M in the LSP thanks to the implementation of MATRYCS services.	<i>(the values for the Likert scale will be defined in the next cycle)</i>	Likert scale	2
	102	Economic savings in O&M	EC	Economic savings generated through the improvement of O&M in the LSP.	(€ spent before the intervention or service deployment in O&M per year) – (€ spent after the intervention in O&M per year)	€/ year	2
	103	New Key Performance Indicators monitored	B	Number of new monitored KPIs defined for the LSP.	-	#	1
LSP2	201	Energy consumption reduction investment effectiveness (Heating)	EC	Measures the effectiveness of the energy efficiency investments made in the LSP for energy consumption reduction (for heating).	Total use of energy for heating per year in kWh on-site before the intervention / Total use of energy for heating in kWh on-site after the intervention	kWh/ €/ year	3
	202	Energy consumption reduction investment effectiveness (Electricity)	EC	Measures the effectiveness of the energy efficiency investments made in the LSP for energy consumption reduction (for electricity).	Total use of electricity per year in kWh on-site before the intervention / Total use of electricity in kWh on-site after the intervention	kWh/ €/ year	3
	203	Energy demand covered by RES	ENV	Percentage of the energy demand covered by renewable energy sources.	[Annual energy demand in the LSP covered by RES in kWh / Total energy demand per year in the LSP in kWh] x100	%	3
LSP3	301	Reduction of error rates	B	Reduction of potential human errors thanks to the solutions implementation in the LSP (e.g. through automatization of certain processes), which is directly linked to economic savings.	[(Number of errors per year (baseline) – Number of errors per year (reporting)) / Number of errors per year (baseline)] x100	% reduction	1
	302	Developed additional saving measures	ENV	Number of additional saving measures tested in the LSP through MATRYCS implementation.	-	#	1



LSP	ID	KPI name	Cat.	KPI description	Formula	Units	Level
	303	ESCOs as beneficiaries of improved M&V energy savings methods	B	Number of ESCOs benefited from improved M&V saving methods.	-	#	3
	304	Number of Energy Performance Contracts affected	B	Number of Energy Performance Contracts affected by MATRYCS services.	-	#	1
LSP4	401	Energy demand covered by RES	ENV	Percentage of energy demand covered by renewable energy sources.	[Annual energy demand in the LSP covered by RES in kWh / Total energy demand per year in the LSP in kWh] x100	%	3
	402	Improved energy consumption prediction	ENV	Improvement in the energy consumption prediction through the deployment of MATRYCS, which is directly linked with a better operational efficiency of the grid.	[Predicted final energy consumption – Real final energy consumption / Real final energy consumption] x100	% deviations	1
	403	Improvement in local RES generation prediction	ENV	Improvement in the prediction of RES generation through the deployment of MATRYCS, which is directly linked with a better operational efficiency of the grid.	[Predicted RES generation – Real RES generation / Real RES generation] x100	% deviations	1
LSP5	501	Improved O&M efficiency	EC	Improvement in O&M in the LSP thanks to the implementation of MATRYCS services.	<i>(the values for the Likert scale will be defined in the next cycle)</i>	<i>Likert scale</i>	2
	502	New investment opportunities identified	B	Number of new opportunities identified thanks to MATRYCS in the LSP to assist in reinforcing energy efficiency and renewable energy investments.	-	#	3
	503	Energy demand covered by RES	ENV	Percentage of energy demand covered by renewable energy sources.	[Annual energy demand in the LSP covered by RES in kWh / Total energy demand per year in the LSP in kWh] x100	%	2
LSP6	601	Economic savings in O&M	EC	Economic savings generated through the improvement of O&M in the LSP.	(€ spent before the intervention or service development in O&M per year) - (€ spent after the intervention in O&M per year)	€/ year	3



LSP	ID	KPI name	Cat.	KPI description	Formula	Units	Level
	602	Reduction of error rates	B	Reduction of potential human errors thanks to the solutions implementation in the LSP (e.g. through automatization of certain processes), which is directly linked to economic savings.	$\frac{[(\text{Number of errors per year (baseline)} - \text{Number of errors per year (reporting)}) / \text{Number of errors per year (baseline)}] \times 100}{}$	% reduction	2
	603	Vulnerable (energy poverty people) households reached	S	Number of vulnerable consumers reached in some way (benefited) by MATRYCS deployment in the LSP (thus measuring the diversity of fairness of the solutions).	-	#	3
LSP7	701	New investment opportunities identified	B	Number of new opportunities identified thanks to MATRYCS in the LSP to assist in reinforcing energy efficiency and renewable energy investments.	-	#	2
	702	Simulated scenarios	B	Number of simulated scenarios related to energy efficiency, renewable energy and/or potential climate adaptation and mitigation actions, in the LSP within MATRYCS implementation.	-	#	2
	703	Performed comparisons	B	Number of performed comparisons among cities' SECAPs data and also from climate reporting platforms data focused on indexes concerning GHG inventories, climate adaptation and mitigation actions, renewable energy sources, water and waste management, transportation and local governance, in the LSP within MATRYCS implementation.	-	#	2
	704	Best practices proposed based on other cities initiatives	B	Final number of analysed best practices on energy efficiency and renewable energy investments, as well as other potential climate mitigation issues, in the LSP within MATRYCS implementation.	-	#	2
	705	Increased engagement	B	Index of the tool's effectiveness by measuring the percentage of questions that cities are answering in the questionnaire per year.	$\frac{[\text{Average of questions answered by cities in the current year} / \text{Average of questions answered by cities in the previous year}] \times 100}{}$	%	3



LSP	ID	KPI name	Cat.	KPI description	Formula	Units	Level
	706	Cities' pilot scenarios generated	B	Number of cities that would choose to share their "vertical" data (e.g. specific datasets about buildings renovation, energy consumption, smart meters, etc.) to create scenario definitions for other cities to consult.	-	#	2
	707	Stakeholders directly involved	S	Number of stakeholders outside the LSP directly involved in the planning and execution of MATRYCS.	-	#	2
	708	Stakeholders indirectly involved	S	Number of stakeholders outside the LSP indirectly involved in the planning and execution of MATRYCS.	-	#	3
LSP8	801	New investment opportunities identified	B	Number of new opportunities identified thanks to MATRYCS in the LSP to assist in reinforcing energy efficiency and renewable energy investments.	-	#	2
	802	Stakeholders directly involved	S	Number of stakeholders outside the LSP directly involved in the planning and execution of MATRYCS (Gdynia One-stop-shop).	-	#	2
	803	Stakeholders indirectly involved	S	Number of stakeholders outside the LSP indirectly involved in the planning and execution of MATRYCS (Gdynia One-stop-shop).	-	#	3
	804	City residents using the One-stop-shop	S	Number of Gdynia city residents (households' tenants) that use the One-stop-shop to get information about building renovations.	-	#	2
	805	Events and EE campaigns promoted through the platform	S	Number of events and campaigns on Energy Efficiency renovation held in Gdynia promoted through the One-stop-shop platform.	-	#	2
LSP9	901	New investment opportunities identified	B	Number of new opportunities identified thanks to MATRYCS in the LSP to assist in reinforcing energy efficiency and renewable energy investments.	-	#	2
	902	Harmonised Energy Performance Certificates (EPCs)	B	Number of harmonised EPCs. An EPC is considered harmonised when its content is translated to a specific data model thanks to the MATRYCS implementation in the LSP.	-	# harmonised EPCs	2



LSP	ID	KPI name	Cat.	KPI description	Formula	Units	Level
	903	Energy Performance Certificates compliance checking	B	Measurement of the number of Energy Performance Certificates that are compliant with legal requirements established by national regulations that has been facilitated by the deployment of MATRYCS in the LSP.	-	# EPCs verified	2
LSP10	1001	New investment opportunities identified	B	Number of new opportunities identified thanks to MATRYCS in the LSP to assist in reinforcing energy efficiency and renewable energy investments.	-	#	2
	1002	New energy saving measures	ENV	Number of additional (new) energy saving measures assessed through the deployment of MATRYCS in the LSP.	-	#	2
LSP11	1101	Tenants (end-users) involved	S	Number of tenants that participate in the thermal comfort scenarios. The tenants of the examined buildings will be exploited towards getting the appropriate feedback for their quality of life before and after the thermal comfort analysis is conducted.	-	#	2
	1102	Analysed EU policies	B	Number of European policies analysed to provide an accurate vision of the impact of implemented policies, thanks to the deployment of MATRYCS in the LSP.	-	#	2
	1103	Energy savings from thermal comfort measures	ENV	Decrease in energy consumption due to the conducted analysis on heating management in the examined buildings, while also maintaining the quality of life of tenants in high levels.	$\left[\frac{\text{Energy consumption } T(n)}{\text{Energy consumption } T(0)} \right] \times 100$ "T" meaning reduction target	%	3
	1104	Energy efficiency investment opportunities proposed	ENV	Number of refurbishment measures proposed towards energy efficiency on buildings in the Basque Country based on real social housing energy consumptions.	-	#	2
	1105	Vulnerable (access to affordable energy) households reached	S	Number of vulnerable energy consumers reached in some way (benefited) by MATRYCS deployment in the LSP (thus measuring the diversity of fairness of the solutions). <i>Vulnerable citizens: number of current inhabitants in social housing</i>	-	#	3



3.2 Data, infrastructures and digital technologies

Data, infrastructures and digital technologies used within the MATRYCS project can be measured considering different groups of indicators coming from the GA. Some of them seem to be closer to the **impact** that MATRYCS project will have at different stages, other to preliminary **objectives**. Therefore, each WP will be able to closely monitor those ones closer to its activity. Table 5, presents the groups of indicators established, depending on the information to which they refer. Each KPI will start with the corresponding initial according to the column "ID Group", which in turn is an indicator of the WP from where it will be monitored. Additionally, the column "Origin" allows associating the indicator to the section of the Grant Agreement where it appears: an objective (technical, scientific or business) or an impact (technical, business, community commitment or sustainability).

Table 5: Technical KPIs overview

ID Group	Origin	Origin Code	Main WP involved
A	<i>objectives_scientific</i>	<i>O_SCI</i>	WP2
B	<i>objectives_scientific</i>	<i>O_SCI</i>	WP3
	<i>objectives_business</i>	<i>O_BUS</i>	
	<i>objectives_technical</i>	<i>O_TECH</i>	
	<i>business generation Impacts</i>	<i>I_BUS</i>	
C	<i>objectives_technical</i>	<i>O_TECH</i>	WP4
D	<i>objectives_technical</i>	<i>O_TECH</i>	WP5
	<i>business generation Impacts</i>	<i>I_BUS</i>	
	<i>sustainability of the matrycs bd vision</i>	<i>I_SUST</i>	
E	<i>objectives_business</i>	<i>O_BUS</i>	WP6
F	<i>business generation Impacts</i>	<i>I_BUS</i>	WP7
G	<i>technical advancements impacts</i>	<i>I_TECH</i>	WP8
	<i>stakeholders' community engagement</i>	<i>I_ENG</i>	
	<i>sustainability of the matrycs bd vision</i>	<i>I_SUST</i>	

From WP6, in addition to monitoring the progress of the closest indicators by the type of activity developed in the WP, the most critical figures associated with the pilots are controlled and monitored, hence the list shown in Table 6 does not only show KPIs classified with the ID 'E'. The list of indicators in this table is measured for the baseline assessment of the LSPs and will be updated as the project progresses. These technical KPIs have been numbered together, which explains why this code does not always start with '01'. The table shows the list of KPIs considered for this benchmarking, their description, the group they belong to and the expected value at the end of the project.

Table 6: Technical KPIs considered for the baseline assessment.

ID	Origin	KPI name	KPI description	Units	Value end
A07	I_TECH	Size of standardized datasets	The size of the standardized datasets refers to the total size of the sets of data based on well-known data models that will be used in the MATRYCS project.	TBs	106
A08	I_SUST	Big data availability for real life research, simulation and policymaking	Big data availability for real life research, simulation and policymaking refers to the total size of the data sets that will be available for the above purposes thanks to the MATRYCS project.	TBs	106 (490 in 2030)
A09	I_TECH	Amount of standardized datasets	A standardized dataset refers to a data set that follows a well-known data format. This common base format facilitates interoperability.	datasets	75
A10	I_TECH	Data repositories	A data repository represents a place that holds data.	data repositories	75
A11	I_TECH	Public national data hubs	A public national data hub represents a place that holds data to preserve and promote a country's national resources data.	data hubs	10
A12	I_TECH	Public supranational data hubs	A public supranational data hub represents a place that holds data to preserve and promote data at a supranational level.	data hubs	38
A13	I_TECH	Private data hubs	A private data hub represents a data repository that contains private information.	data hubs	27
B07	O_BUS	Resources	The resources cover the entire set of software, hardware, systems, services, tools, documentation, etc., which offer everything necessary to support and feed the MATRYCS platform and its different components. In combination, they allow to offer a technological solution for the purposes of the project.	resources	200
D05	O_TECH	Data sources combined included in perform analytics	A data source refers to the location where data that is provided originates. Only data sources included in the analytics tools will be considered.	data sources	60
D06	O_BUS	Types of data sources	Types of data sources refer to the different locations where data to be used comes from	types of data sources	60
E01	O_BUS	Real-life demonstrations	Real-life demonstration sites considered in the MATRYCS project.	demonstrations	11
E02	O_BUS	Service per pilot case developed and tested	This term refers to the number of services developed and tested in a specific pilot.	service/pilot	1

ID	Origin	KPI name	KPI description	Units	Value end
E03	O_BUS	Reports showing results from pilot evaluation/impact assessment (D6.2-16)	Reporting documents to be deployed from WP6.	report	24
E04	O_BUS	User satisfaction accruing from pilot users, from transparent validation methodology	User satisfaction accruing refers to the level of complacency with the implemented services according to the results obtained from pilot users.	%	95
E05	O_BUS	Amount of data	The amount of data refers to the total size of the datasets used within the MATRYCS project.	TBs	350
E06	O_BUS	Datasets	A dataset represents a collection of data, usually presented in a tabular form, which contains information of a particular subject.	datasets	10,000
E07	O_BUS	Users	Users refer to the people expected to be involved in the project. This number will be tracked from a LSP perspective, including profiles such as the personas associated to the Use cases, workshops assistants, etc.	users	1,000

The baseline assessment related to this technical information is included in the corresponding section of each pilot for those values that can be calculated individually (Baseline assessment report). However, some of these indicators are more general, and it has not been considered necessary to specifically track them from each LSP (E01, E02, E03 and B07). For those ones, baseline values have only been included in section corresponding to summary tables. The E04 KPI about User satisfaction is also outside this group, as a dedicated section has been created for this aim.

MATRYCS aims to face the 5 “Vs” Big data challenges: variety, volume, velocity, veracity and value. Data and their characteristics represent a key element to consider in this Evaluation Framework. The Data gathering template was designed from the starting point under this approach (available in Appendix I). This document includes a set of fields for each of the previously mentioned “V challenges”, in order to collect all the relevant details regarding real-time and historical data, their size and associated frequencies, characteristics of the communication interfaces, structure, relation with standards, and other aspects related to ownership or reliability. Additionally, to be able to keep track of several of the previously listed values and given that there are eleven pilots to consider, a new dynamic template was designed, which allows quickly contrasting the collected values with the expected information. The idea behind this template is to be able to update the information progressively, and always have the option of taking a snapshot that reflects the current situation. This allows the information to be broken down by pilot, as it is reflected later in this report in the section dedicated to each of them, within the baseline assessment report.

3.3 User satisfaction

The user satisfaction methodology's main aim is to **gather feedback from users validating MATRYCS solutions** and measure how satisfied the users are. To measure these aspects, it consists of five main pillars, as reflected in the Figure 5 below. Also, some of the pillars could be further specified, if necessary (as it is the case of the "satisfaction", "safety" and "usability" pillars). At this stage, only the approach towards covering the user satisfaction methodology will be provided, and the final questionnaires will be defined in the next cycle (section 4 for more information). This is the reason why no specific section in the baseline assessment reports of each pilot is considered (section 5).

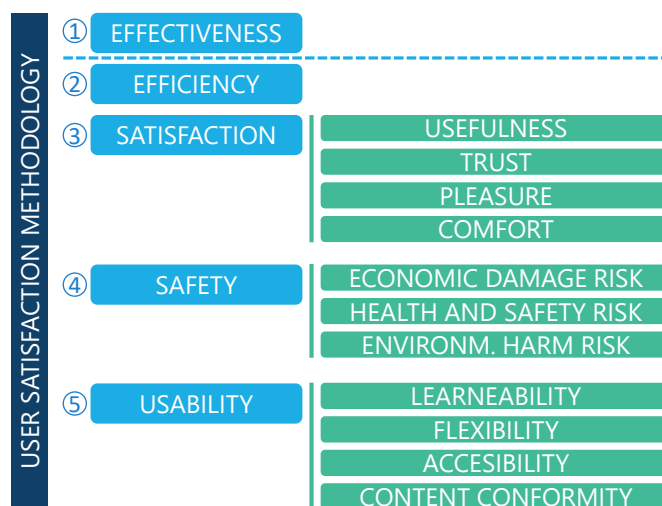


Figure 5: MATRYCS user satisfaction methodology structure

There are 5 pillars consisting the user satisfaction methodology, which can be classified into two groups: (1) effectiveness and (2) efficiency, satisfaction, safety and usability.

- **(1) Effectiveness** is directly related to the LSPs, and measured in a subjective manner, mainly through Likert Scales, which are not quantifiable and specific values cannot be given. These KPIs measure if the needs from the LSPs are adequately addressed, and if the services or analytics provided are effective to meet their needs and goals. Thus, support from the **LSP leaders** will be required in order to define appropriate questions and they will be specific to the challenges addressed in each pilot. Some example questions can be the following:
 - Does the service contribute to an increase of indoor comfort temperature (LSP5)?
 - Does the MATRYCS solution contribute to an improved decision-making process in cities and regions (LSP7)?
- **(2) Efficiency, Satisfaction, Safety, Usability.** The other category includes the rest of the aspects to be analysed as part of the user satisfaction methodology. It is related with the services and analytics developed in MATRYCS, as well as with the general functioning of the platform. Thus, support from **technical partners** in the definition of the questionnaires will be of the utmost importance to ensure that the feedback gathered is relevant. It will contain general questions, related to the overall functioning of MATRYCS, and services- / analytics-specific questions, that will serve to evaluate if the analytics and services are performing as expected, if users are satisfied when using them, if there is any risk or if they are easy to use. Some examples

of general questions can be the following:

- Is the service easy to use?
- Is the service flexible enough?
- Is it easy to access the service(s)?

At this stage of the project, the general structure of this methodology is proposed in this section, but more details will be defined in the next months and reported in the next deliverables of WP6 (D6.3-D6.13 due in M27), as explained in the following section 4.

3.4 Main stakeholders

The MATRYCS project will engage a wide range of stakeholders, through both LSPs and the external audience who will use or exploit its outcomes. The stakeholders' needs will be addressed by the 11 LSPs around the whole building's life cycle and at different scales. This complementary pillar is introduced into the Evaluation Framework in order to assure that the analytics and services developed within MATRYCS still observe the requirements and needs of the stakeholders, and this fact is checked throughout the validation, especially when addressing the user satisfaction.

The process started in Task T2.2 "User Stories and Requirements Analysis", where the goals of each LSPs were analysed and the stakeholders identified. The identification of the stakeholders was a twofold process: first with the identification of the Target groups that apply to each LSP, and then, assigning different Personas to each of the Target groups defined.

A **Target group** is the group of potential users of the service(s) that is going to be provided by the pilots. They are stakeholders or other kind of users/beneficiaries from the service. Target groups were categorised in order to have a common classification and harmonized naming, which was also refined once pilots provided their inputs.

In the following Figure 6 the relation between the LSP and the Target groups can be seen. It provides a useful visualization of what MATRYCS is aiming in terms of coverage (so far).

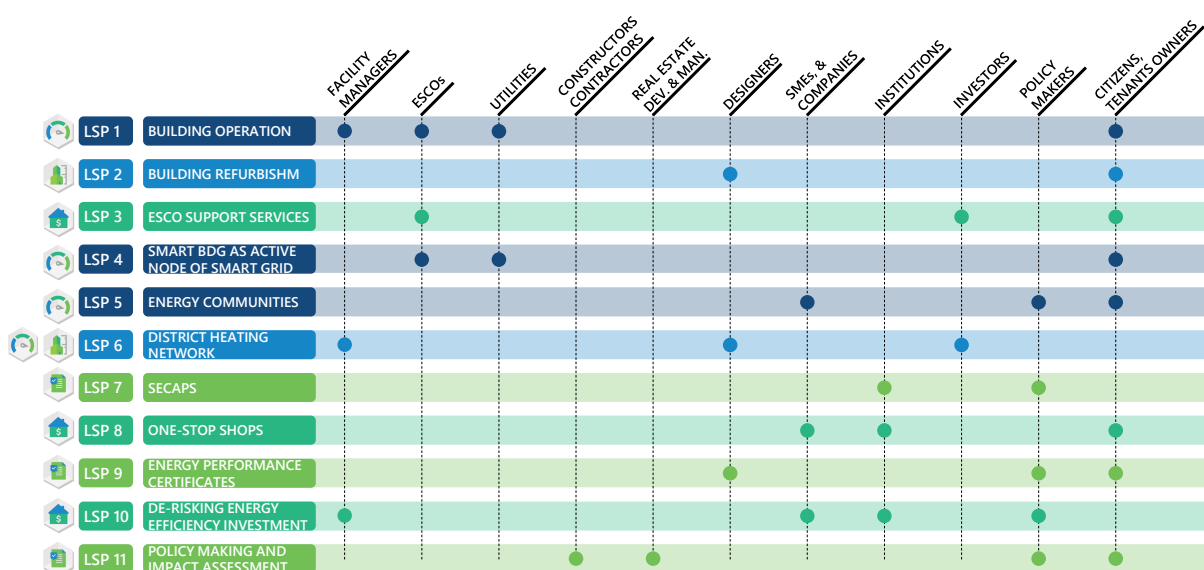


Figure 6: MATRYCS LSPs related to target groups

Personas are fictional characters created to represent the needs, wants and behaviours of the Target groups to ensure that we are thinking from their perspective. Each Persona captures a different point of view of each Target group. Thus, for each target group, several personas or characters can exist.

Table 7 presents the classification of Target groups and the different Personas that have been assigned to them in the context of the LSPs.

Table 7: Main stakeholders considered

Target group	Definition	Personas	LSP
Facility Managers	Manager in charge of the correct functioning of their facilities	<ul style="list-style-type: none"> • Informed facility manager • Sustainability supporter facility manager • Cost-conscious facility manager 	LSP1
		<ul style="list-style-type: none"> • Sustainability supporter DHN manager • Cost-conscious DHN manager 	LSP6
		<ul style="list-style-type: none"> • Responsible manager • Careless manager 	LSP10
ESCOs	Energy Services Companies	<ul style="list-style-type: none"> • Informed ESCO • Sustainability supporter ESCO 	LSP1
		<ul style="list-style-type: none"> • Advanced ESCO • Energy Performance Contract facilitator 	LSP3
		<ul style="list-style-type: none"> • Energy Manager (Private sector) 	LSP4
Utilities	Public and private utilities and aggregators	<ul style="list-style-type: none"> • Informed utility • DSM aware utility 	LSP1
		<ul style="list-style-type: none"> • Large scale DSO head • Small scale DSO head • Energy Manager (public sector) 	LSP4
Constructors & contractors	Construction companies and consulting firms	<ul style="list-style-type: none"> • Worker of a large construction company • CEO of a large manufacturer of energy systems 	LSP11
Real estate developers & managers	Developers and managers of real estate	<ul style="list-style-type: none"> • Director of Project Development within housing manager • Manager of small local housing cooperative 	LSP11
Designers	Architects and engineers in charge of the design, retrofitting or decommissioning of buildings.	<ul style="list-style-type: none"> • Designers of efficient renovation activities 	LSP2
		<ul style="list-style-type: none"> • Profit-oriented DHN manager • Efficiency-oriented DHN manager 	LSP6
		<ul style="list-style-type: none"> • EPC's issuers 	LSP9
SMEs & Companies	Small and Medium enterprises, related and not related to construction	<ul style="list-style-type: none"> • Eco-friendly SME 	LSP5
		<ul style="list-style-type: none"> • Renovation contractors and auditors 	LSP8
		<ul style="list-style-type: none"> • Director of finance 	LSP10
Institutions	Relevant national and European institutions or	<ul style="list-style-type: none"> • Urban planning professional • Local transport department director 	LSP7
		<ul style="list-style-type: none"> • Gdynia and other cities' municipal workers 	LSP8

	departments	<ul style="list-style-type: none"> • Ambitious head of department • Project manager 	LSP10
Investors	Industry and investors related to the real estate management and development	<ul style="list-style-type: none"> • Benefit-oriented bank • Sustainability supporter bank 	LSP3
		<ul style="list-style-type: none"> • Informed investor 	LSP6
Policy makers	Policy authorities and policy makers (local to European level), e.g. urban planning department	<ul style="list-style-type: none"> • Local authority 	LSP5
		<ul style="list-style-type: none"> • City Council member • European Commission staff 	LSP7
		<ul style="list-style-type: none"> • EPC's Regional Registry management service • Regional Energy Efficiency Strategy planners 	LSP9
		<ul style="list-style-type: none"> • Informed policy makers 	LSP10
		<ul style="list-style-type: none"> • Member of the Parliament (Energy and Housing Committees) • Senior official in the European Commission 	LSP11
Citizens, tenants & Owners	Citizens and individual owners	<ul style="list-style-type: none"> • Informed owner • Sustainability supporter owner 	LSP1
		<ul style="list-style-type: none"> • Personnel of the kindergarten • Municipal management staff of educational buildings • Users of the kindergarten 	LSP2
		<ul style="list-style-type: none"> • Motivated owner • Careless owner • Disbelieving owner 	LSP3
		<ul style="list-style-type: none"> • Sensitive office employee • Informed office employee • Reluctant office employee • Dynamic prosumer • Static Prosumer 	LSP4
		<ul style="list-style-type: none"> • Prosumer • EV owner • Environmentally conscious citizen 	LSP5
		<ul style="list-style-type: none"> • Informed owner 	LSP6
		<ul style="list-style-type: none"> • Real estate owner • Building administrator and manager 	LSP8
		<ul style="list-style-type: none"> • Building buyers and sellers, landlords and tenants 	LSP9
		<ul style="list-style-type: none"> • Old citizen in rented house • Student in community group to convince on the installation of solar panels in the roofs 	LSP11

In addition to the stakeholders targeted in each LSP (those in the previous table), the consortium partners also represent stakeholders within the LSPs. The following Table 8 maps the MATRYCS partners into the different Target groups define; this is also depicted in Figure 7 in a visual way.

Table 8: Partners representing stakeholders within each pilot

Target group	Definition	Partner
Facility Managers	Manager in charge of the correct functioning of their facilities	VEOLIA, BTC, COOPERNICO
ESCOs	Energy Services Companies	VEOLIA, ASM, LEIF (<i>planned</i>), COOPERNICO
Utilities	Public and private utilities and aggregators	VEOLIA, ASM
Constructors & contractors	Construction companies and consulting firms	FASADA, BTC
Real estate dev. & managers	Developers and managers of real estate	FASADA, BTC,
Designers	Architects and engineers in charge of the design, retrofitting or decommissioning of buildings.	FASADA, VEOLIA
SMEs & Companies	Small and Medium enterprises, related and not related to construction	COOPERNICO, BTC, FASADA, ASM, LEIF
Institutions	Relevant national and European institutions or departments	HOUSING EUROPE, ICLEI, LEIF, GDYNIA, EREN
Investors	Industry and investors related to the real estate management and development	VEOLIA, ASM
Policy makers	Policy authorities and policy makers (local to European level), e.g. urban planning department	HOUSING EUROPE, ICLEI, LEIF, GDYNIA, EREN
Citizens, tenants & Owners	Citizens and individual owners	BTC, ASM, VEOLIA, FASADA, COOPERNICO, ICLEI, GDYNIA, EREN, LEIF, HOUSING EUROPE



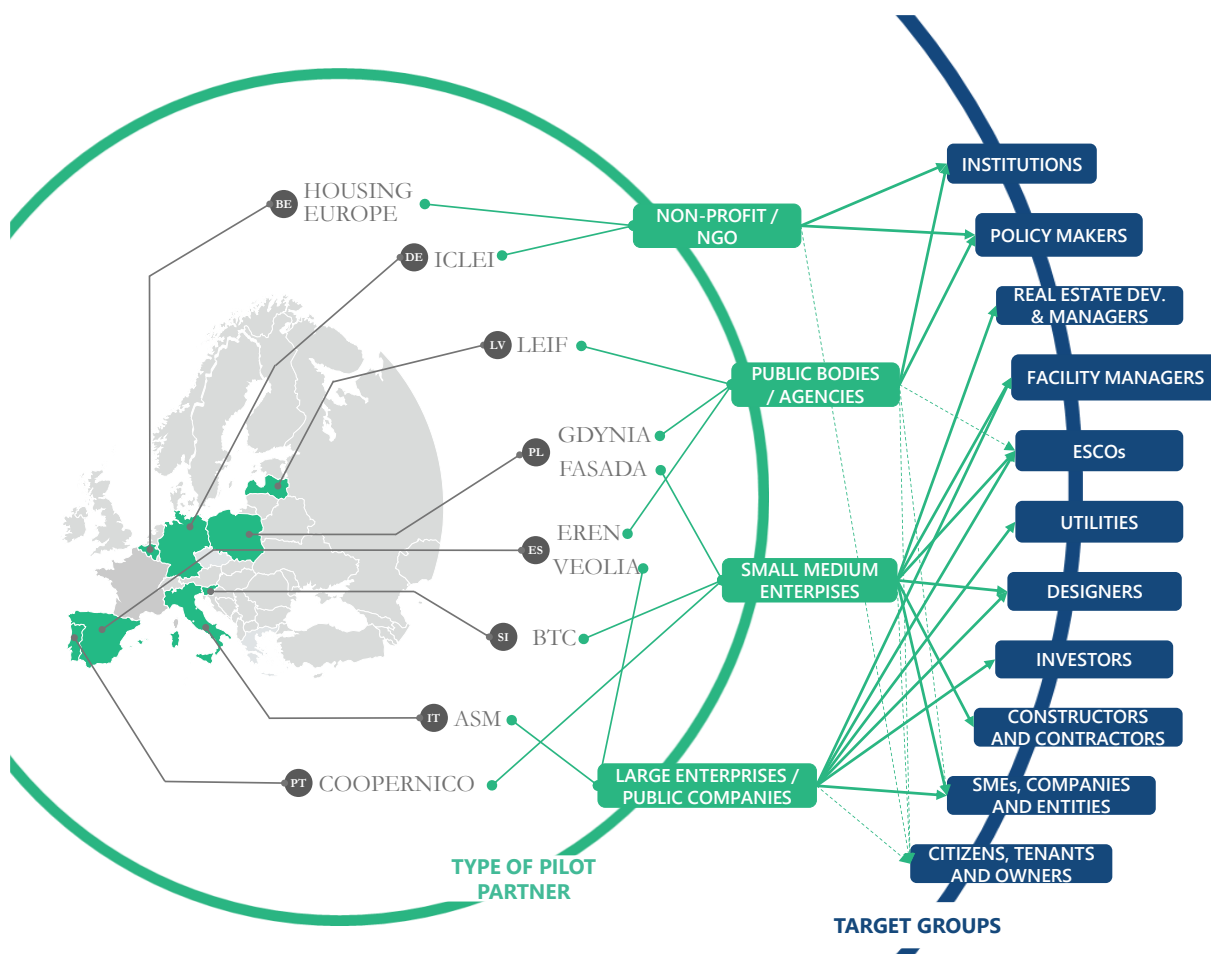


Figure 7: MATRYCS Partners representing Stakeholders (Target groups) within the LSPs

3.5 Procedures to personalise MATRYCS tools and services

Finally, the last element complementing the MATRYCS' Evaluation Framework is given by the procedures to personalise MATRYCS tools and services. The main objective of this element of the framework is to assure that MATRYCS solutions are, on the one hand, **generic** enough to be deployed in different cases as the ones considered in the LSPs, but on the other hand, that they also **consider potential specificities that can arise from the use of these solutions by different types of users**.

This customization begins with the process of User Stories from WP2 "System Requirements and Specifications", and covers **three phases**: it starts with the capture of initial information about the pilots in terms of characteristics and main objectives, types of user and their needs. To complete this **first** overview, it was also considered necessary to know the available data sources and their main technical characteristics. The **second** round, focused on creating usage scenarios, delved more into the details of each pilot and the expected actions. Finally, the **third phase** consisted in an in-depth analysis of all the information retrieved to define a series of Use Cases and requirements to fulfill. This image is complemented with the initial description of the services offered by developers, to better understand the scope of each of them and simplify their application, so that they can be grouped for complete purposes that allow them to face different scenarios. A **final stage** of validation of the main objectives,

contrasting the information collected in this process with that initially contained in the GA, allows assigning priority to the services / groups of services to be applied, ensuring that the main objectives are achieved. The main aspects of each of the phases and the documents involved are presented in Table 9. It should be noted that part of this content has already been reported in D2.1 “State-of-the-art analysis and big data value chain”, but it is further elaborated here and integrated within the Evaluation Framework for MATRYCS pilots. This way, the present document is self-consistent and relevant outcomes of previous activities in the project are fully integrated and aligned with WP6 activities.

Table 9: Phases considered throughout the process of User Stories generation as part of the procedures to personalize MATRYCS, key documents and participants.

Phase 1 Test Cards, Personas and User Stories conceptualization		
First approach to determine the basic characteristics of the pilot, main type of users, characters, roles and their needs.		
Main documents	Main aim	Pilot leaders
Test cards	Main objectives to be achieved by the pilot, the target groups involved and how this would be measured.	
Personas	Fictional characters created to represent specific needs, wants or behaviours. Each persona captures a different point of view of a target group, to which they belong (more details can be found in section 3.4)	
User Stories	These descriptions capture the essential elements of a requirement, from the user’s perspective.	
Pilot data gathering	This template incorporates the description of the data to be provided within each pilot, in terms of volume, velocity, variety and veracity. It can be seen as a first approach to tracking relevant numbers of the pilot in terms of data, along with technical details related to the pilot infrastructure (Appendix I).	
Phase 2 Usage Scenarios creation		
Second iteration with pilot leaders, which included a series of individual sessions with pilots to go into details of the provided information and clarifications. Compilation of the expectations in the Usage Scenarios, and first description of the services by the technical partners in parallel, to complete the whole picture.		
Main documents	Main aim	Main aim
Usage Scenarios	Detailed version of user stories, covering the persona involved, specific pre/post-conditions to consider, and the series of steps/actions needed to complete the objective of the scenario.	Pilot leaders & Technical Support
Services description	The initial description of the services has been done following the Service template included in Appendix II. It provides information about the scope, objectives of the service and its	

	narrative, covering the requirements for inputs, how the service will operate and the outputs to provide.	
Phase 3 Use Cases matching with Requirements specification		
It includes usage scenarios review process (WP2 team and service providers), the use cases creation and the specifications definition.		
Main documents	Main aim	Main aim
Use cases	They include the step-by-step description of all the paths and scenarios in which the service will be used, and all the possible ways in which the user and service can interact so that result in the user achieves the objective.	Technical Partners
Requirements	Functional (describe how the service must behave, what its features and functions are) and Non-functional (describe how the system works or its general characteristics).	
Types grouping	The usage scenarios were clustered into several types combining similar approach and services to be apply, in an attempt to simplify the process and find groups of services that could complement each other, to finally address a need.	
Main goals validation a redefinition	This document summarises the GA goals vs the Test cards goals, in order to detect possible inconsistencies between what was initially defined and during the user scenarios generation process, and to provide guidance in terms of how relevant a service application is in a specific pilot.	

These two opposing dimensions, **generality** versus **specificity**, will be explored within the validation and deployment process by considering the following three aspects: (1) how the same services are applied and adapted in each pilot, (2) observation of the usage scenarios defined in WP2 and (3) listening to users' feedback. These three aspects are explained in more depth below:

(1) How the same services are applied and adapted in each pilot

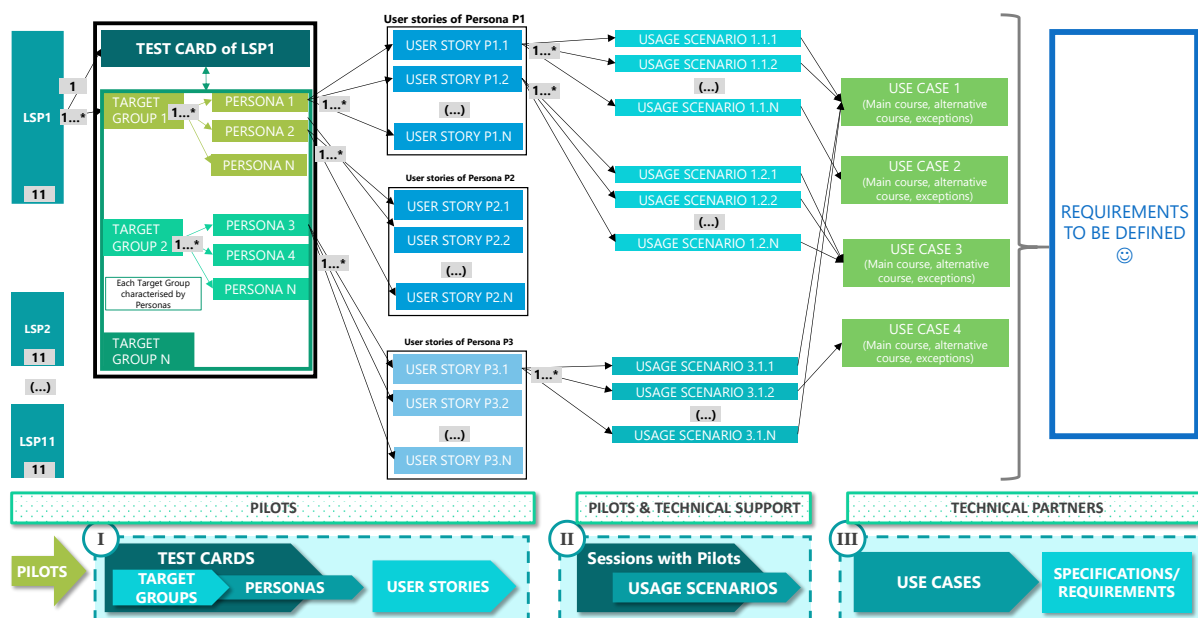
From its conception, MATRYCS will develop 14 different services which will be applied in one or more LSPs. The possibility to apply the services in different environments will facilitate the extraction of guidelines and lessons learned, that will enable to replicate further the solutions proposed in MATRYCS. The services to be developed related to the LSPs were presented in D2.1 "State-of-the-art analysis and Big Data Value Chain" and are presented in the Table 10: MATRYCS services / pilots' matrix below as well. It must be noted that this is the initial plan and will be revisited during the project's duration. As per the objectives reflected in the GA it must be noted that it is mandatory that at least one service is deployed in each pilot. However, the approach followed ensures replicability of the solutions proposed.

Table 10: MATRYCS services / pilots' matrix

			MATRYCS LSPs										
			1	2	3	4	5	6	7	8	9	10	11
MATRYCS SERVICES	s0.1	Digital twins	X	X				X		X	X		
	s0.2	Geoclustering								X			
	s1.1	Energy prediction	X			X	X	X					
	s1.2	Building Automation and Control (BAC)	X			X	X						
	s1.3	KPIs calculation			X			X		X	X		
	s1.4	Technical Building Management (TBM)	X				X						
	s1.5	Optimization for network operation				X		X					
	s2.1	Technologies catalogues					X						
	s2.2	ECM-based scenarios evaluation		X									
	s3.1	SECAPs decision-support							X				
	s3.2	EPC harmonization and compliance									X		
	s3.3	National and EU policy impacts assessment							X			X	X
	s4.1	M&V of energy savings			X			X					
	s4.2	Financing of EE refurbishments		X								X	

(2) Observing usage scenarios

A second way to contribute to the personalization of MATRYCS's solutions is the consideration and observation of the followed methodology for the **definition of the usage scenarios** implemented in WP2. In it, different target groups and personas were defined, which contributed to generate usage scenarios, from which the set of use cases were defined. In particular, the following steps were followed:

**Figure 8: Process followed in WP2 to define user stories, usage scenarios and use cases**

During the third stage, a deep analysis was performed in order to create clusters of services that could work together to address a defined scenario (called types). Finally, objectives included in the GA

description, Test cards and extracted from User Stories and Usage Scenarios analysis were compared, in order to be to settle up how relevant a service application would be for the pilot, as showed in Figure 9.

LSP	Type	From Grant Agreement: LSP descriptions			Processed from GA	From Test Card	Added/Missing in Test Card
		MOTIVATION AND RATIONALE	SHORT PILOT DESCRIPTION	EXPECTED OUTCOMES/ BENEFITS	GOALS from GA	GOALS written by Pilot Leaders	
DING OPERATION (BTC)	ICS-PERFORMANCE	Modern facilities deal with complex data flows related to information from different sources and scopes. Several technological tools are being developed to support active management and coordination of various processes, which in essence rely on composite monitoring of various quantitative, architectural, technological and people-related parameters. Powered by the IoT and adopting the self-optimising strategies, AI increases the ability of facility managers to oversee a	BTC is one of Europe's largest shopping, entertainment, business, commercial, and logistics centres. It is located in the urban catchment of Ljubljana, Slovenia, has a total gross area of 475,000 m2, and includes shopping malls, multiplex cinema, bars and restaurants, hotel, waterpark, entertainment centre and high-rise office buildings. MATRYCS will enable facility manager efficient management of appliances and subsystems that corresponds to local context and is coordinated on a system level . Utilising	The goal of the pilot is to obtain information on the behaviour of individual types of devices based on aggregate measurements , deduce from those the customised aggregates (e.g. per appliance type, per facility location, per BMS function), and feed triggers of analytic services to rules engines and schedulers . The instantiated analytics platform will ingest data through adapters developed on purpose for a given input data. The data will be modelled by a pre-specified schema, indexed, and queried using a no-SQL query	Increase site operational efficiency and aid maintenance and planning activities: enhance assets interoperability and enable the coordination of sub-systems corresponding to different energy vectors. Obtain information on the behaviour of individual types of devices based on aggregated measurements (deduced from those the customised aggregates, e.g. per appliance type, per facility location, per RSM	1 Operation and maintenance based on the reliable analysis: Facility and recourses fingerprinting for efficiency and optimal balancing of energy vectors and thereby better service to our business partners	OK Added: the part of better service to our business partners
						2 Context sensitive monitoring and targeting: Upgrade the system of existing and development of new energy performance indicators (KPI)	Not included in the GA this way. OK: aid the traditional monitoring system. Added: upgrade the system of existing and development of new KPIs

Figure 9: Main objectives of the LSPs' comparative analysis, considering all the recovered data.

(3) Listening to users' feedback

Finally, the procedures to personalize MATRYCS will pay attention to the feedback gathered from users. In this line, specific questions that can address this issue will be included in the **user satisfaction methodology**. Thus, if relevant feedback is gathered from users that can effectively contribute to the personalization of MATRYCS services, it will be implemented in the next development cycle.

4 Pilot operation and engagement plan

The Pilot operation and engagement plan proposed for the MATRYCS project is closely related to the activities carried throughout WP6 “Deployment and Validation in Real Environments”. These are strongly linked to the development cycles carried out in the project, as it can be seen in the Figure 10: MATRYCS Pilot operation plan. Based on them, four steps are envisaged for the deployment in large scale pilots:

- **Cycle 0 - Definition**, from M0 (October 2020)-M12 (September 2021). It is conceived as a preparatory phase, where we currently stood. The main objective is to gather requirements, characterise the LSPs and assess their current status. Additionally, the definition of a plan for the operation and engagement is proposed (i.e. the present section).
- **Cycle 1 – Pre-pilot**, from M13 (October 2021) – M15 (December 2021). The main objective of this cycle is to refine the inputs gathered in the first Cycle 0 and prepare the pilots for the deployment and validation in the next Cycle 2, where validations will be performed. During this cycle, the first technology probes data-driven experiments will take place.
- **Cycle 2 – Functional implementation**, from M24 (September 2022) – M27 (October 2022). After having further progressed in the project in the development of analytics and services in months M15-M24, this cycle will be characterised for having the first validations in the pilots, which will be carried out mainly by internal partners of the consortium, but the potential to engage also external actors will be explored. Assessment reports per pilot will be provided at the end of this cycle (M27).
- **Cycle 3 – Large scale implementation**, from M31 (April 2023) – M36 (September 2023). In the same manner as before, after having performed fine-tunings in MATRYCS services and analytics, this last validation cycle starts. This is the last cycle in the pilot deployment and validation. At this stage, also validation with external actors will be fostered. Lessons learned and guidelines of the process followed will be provided as a wrap up.

As it can be observed, the activity carried out in WP6 will not be linear and will be strongly dependent on the developments carried out in other WPs, since the main aim of this WP6 is the deployment of these developments and their validation.

4.1 Pilot operation

At the current stage of the project (Cycle 0, M12, September 2021), the objective of this report is to prepare the plan to be deployed in the following phases. The illustration of the different steps envisaged, the tasks that are expected to be performed, as well as the document where each of the activities will be reported, is introduced in Figure 10. This is also further explained in Table 11: MATRYCS Pilot operation and engagement plan: steps and deliverables.

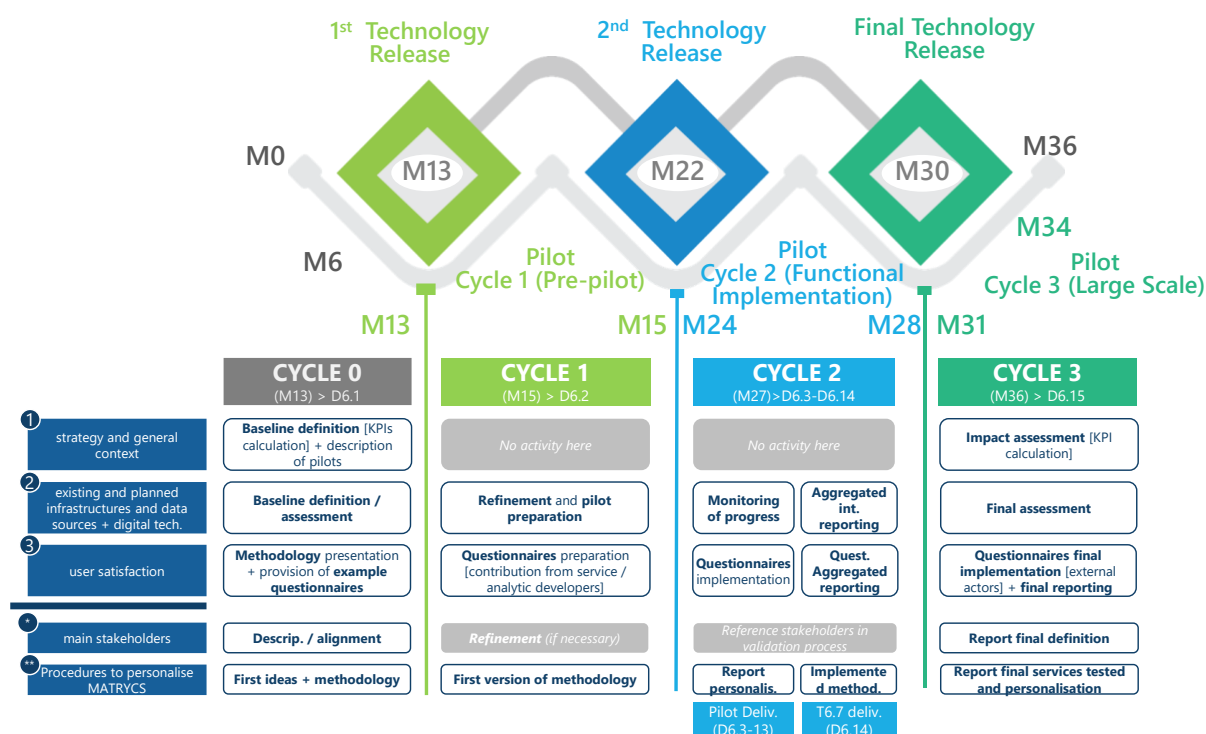


Figure 10: MATRYCS Pilot operation plan

As it can be seen, the plan is directly related to the five pillars established in the evaluation framework explained in the previous section 3: (1) Strategy and general context, (2) Existing and planned infrastructures and digital technologies, (3) User satisfaction methodology, (4) Main stakeholders, (5) Procedures to personalise MATRYCS. The specific activities to carry out in each of the cycles is described in relation to each pillar, as well as a final relation to the deliverables from WP6 where each cycle is meant to be reported.

Table 11: MATRYCS Pilot operation and engagement plan: steps and deliverables

CYCLE 0 – Definition [M0 – M12]	
Reports: D6.1 Pilot operation, Preparation, Engagement and M&V Plan [CARTIF] (M12)	
Pillar	Activity to carry out
1	In Cycle 0, the definition and baseline calculation of the strategy and general context KPIs is provided. This will serve as a basis for the final assessment at the end of the project, and will allow determining the impact achieved by the deployment of MATRYCS analytics in the pilots. More information on these KPIs can be found in section 3.1, and the baseline calculations are provided in section 5.
2	With respect to the existing and planned infrastructures and digital technologies , a preliminary description of the methodology to be followed in the next steps is provided in section 3.2 Also, this is complemented with a brief description of the currently available data in the pilots, gathered in T2.1 and presented in each of the pilots' subsections in the baseline assessment report (section 5).
3	The methodology to be followed in the user satisfaction methodology is drafted in the present deliverable (section 3.3), as well as some examples provided. However, the specific

	questionnaires and how they should be measured in the next stages of WP6 will be defined in the following deliverables.
4	The main stakeholders and ‘personas’ are gathered from the already developed work in T2.1, and are further refined and aligned in order to avoid duplicities and have a consistent list of actors to refer to in the validation process. This is presented in section 3.4.
5	Initial ideas on the procedures to personalize MATRYCS are presented in section 3.5. This methodology will be applied in the subsequent validation cycles

CYCLE 1 – Pre-pilot [M13 – M15]

Reports: **D6.2** Report on pilots’ integration and validation (cycle 1) [CARTIF] (M15)

Pillar	Activity to carry out
1	No activity is planned in Cycle 1 with respect to the strategy and general context KPIs , since they will be evaluated at the end of the project.
2	The baseline calculation on the data provided in T2.1 will be refined in the context of the existing and planned infrastructures and digital technologies . Also, pilots will be prepared for the deployment in the subsequent phases, so a further analysis on their currently available infrastructures and assets should be performed. During this cycle, data integration between pilot and services will be developed and finalised.
3	At this stage, the user satisfaction methodology should be completed, with all questionnaires prepared and reported in D6.2. To this end, it will be necessary to count on the pilot leaders (to ensure that adequate questions can be posed to evaluate their satisfaction in terms of effectiveness of the services provided), and also on the technical partners, who are responsible of the developments carried out within MATRYCS. The latter are crucial to ensure that relevant feedback can be gathered from users that can be applied in the improvement of MATRYCS’ analytics and services.
4	The definition of main stakeholders at this stage would be complete, as it has been defined in Cycle 0 and reported in the present deliverable. However, if some refinement is required after delving deeper into the pilots, it will be reported in D6.2.
5	Given that further progress would be experienced in the services and analytics developments, it would be possible to determine more easily procedures to personalize MATRYCS at this stage. This is the reason why a first version of this methodology will be provided then, and input from technical partners will be required, since it will be strongly connected to the use cases to be developed and the usage scenarios defined.

CYCLE 2 – Functional implementation [M24 – M27]

Reports: **D6.3** LSP 1 evaluation results: BUILDING OPERATION [FM]: Facility and resources fingerprinting for efficiency and optimal balancing of energy vectors [BTC] (M27)

D6.4 LSP 2 evaluation results: BUILDING REFURBISHMENT: Sustainable building assessment and optimisation of refurbishment options [FASADA] (M27)

D6.5 LSP 3 evaluation results: ESCO SUPPORT SERVICES: Energy saving verification service for increasing the trust on Energy Performance Contracts [VEOLIA] (M27)

D6.6 LSP 4 evaluation results: SMART BUILDING AS ACTIVE NODE OF A SMART GRID: Smart building comfort-aware predictive energy management and coordination with smart grids and local RES generation [ASM] (M27)

D6.7 LSP 5 evaluation results: ENERGY COMMUNITIES: Services for the better management of self-production systems [COOPERNICO] (M27)

D6.8 LSP 6 evaluation results: DISTRICT HEATING NETWORK: Energy demand prediction to design, develop and optimize district heating networks operation [VEOLIA] (M27)

D6.9 LSP 7 evaluation results: SECAPS: Services to support SECAPs impact assessment, implementation and monitoring [ICLEI] (M27)

D6.10 LSP 8 evaluation results: ONE-STOP-SHOPS: Enablers of the financing of refurbishment actions in the building stock at local level [GDYNIA] (M27)

D6.11 LSP 9 evaluation results: ENERGY PERFORMANCE CERTIFICATES: Next generation energy performance assessment and certification [EREN] (M27)

D6.12 LSP 10 evaluation results: DE-RISKING EE INVESTMENTS: Services to support reliable, cost-effective and better-quality Energy Performance Contracts and Investments [LEIF] (M27)

D6.13 LSP 11 evaluation results: POLICY MAKING AND IMPACT ASSESSMENT: Data-driven policy making and policy impact assessment for energy-efficient buildings [HOUSING EUROPE] (M27)

D6.14 Report on pilots' Integration and validation (cycle 2) [CARTIF] (M27)

Pillar	Activity to carry out
1	No activity is planned in Cycle 2 with respect to the strategy and general context KPIs , since they will be assessed at the end of the project to be able to measure the impact achieved.
2	Existing and planned infrastructures will be monitored at this stage in order to evaluate if relevant changes have been produced in the course of the development of analytics and services. Relevant highlights, if necessary, will be included in deliverables D6.3 – D6.13, where information per pilot will be provided in independent documents. Also, if necessary, these modifications will be reported in an aggregated manner in D6.14 (Report on pilots' integration and validation (cycle 2)), due in the same month as the previously mentioned pilot deliverables (month 27, December 2022).
3	The user satisfaction questionnaires will be put in practice during the validation process carried out in this Cycle 2. In this case, it will be applied primarily with internal users, that is, partners of the consortium, focusing mainly on Pilot Leaders. In terms of reporting, the results of the questionnaires in each of the pilots will be reported in the individual pilot deliverables, and in D6.4, aggregated results will be presented.
4	The main stakeholders and 'personas' defined will be used as a guiding thread to assure completeness of the validation in terms of types of users validating the services and analytics. However, no modification or refinement of their definition is expected at this stage.
5	Following the procedures to personalise MATRYCS defined in the previous step, at this stage, the specific personalization of the services for each Pilot will be reported. On the one hand, a more detailed description will be provided in the pilot deliverables (D6.3-D6.13), whereas in D6.4 an explanation and overview of the implemented method to personalise MATRYCS will be offered.
CYCLE 3 – Large scale implementation [M31 – M36]	
Reports: D6.15 Report on Pilots' Integration and validation (cycle 3) [CARTIF] (M36)	
Pillar	Activity to carry out
1	At this stage (end of the project) it will be possible to assess the impact achieved through the

	deployment of the pilots. Thus, the strategy and general context KPIs will be calculated again, and the impact achieved will be assessed, in comparison to the baseline measured in Cycle 0.
2	A final assessment on the existing and planned infrastructures and data will be quantified and reported in the present Cycle 3. Also, an assessment on the pilot deployment will be performed as well. Lesson learnt from development, deployment and operation will be extracted, but reported in D6.16, as it will be later explained.
3	The same questionnaires of the user satisfaction methodology will be implemented in the validation process carried out in this cycle 3. This time, external stakeholders will be able to reply to them. To this end, synergies with other activities carried out in the project (communication or dissemination workshops) will be exploited in order to maximise the outreach and most efficiently use MATRYCS' resources.
4	The final definition of the main stakeholders and a summary of those that have been reached in the validation process will be presented in D6.15.
5	The final personalization of the MATRYCS analytics and services will also be presented in this deliverable and will aggregate and refine the results gathered in D6.3-D6.13.
CYCLE 3 – Large scale implementation [M31 – M36]	
Report: D6.16 Best practices and replication guidelines [CARTIF] (M36)	
<p>Finally, as a wrap up from all this process, D6.16 will gather the experience of the pilot partners with the MATRYCS framework, evaluation activities, etc. Thus, it will be the overall assessment and evaluation of the MATRYCS impact and activities carried out in every LSP, through every pillar from those already defined: (1) Strategy and general context, (2) Existing and planned infrastructures and digital technologies, (3) User satisfaction methodology, (4) Main stakeholders, (5) Procedures to personalise MATRYCS.</p> <p>Based on this, some lessons learned (regarding the implementation, operation and execution of the pilots) will be extracted and will be formulated as methodological adoption guidelines for the further exploitation and utilization of MATRYCS.</p>	

4.2 Engagement plan

Maintaining pilot leaders engaged during the validation process, as well as potential external validators, is crucial to carry out a robust validation process. For this reason, several methods have already been established and thought to engage and track consistently the progress in LSPs: (1) establishment of periodic meetings, (2) assignment of technical contacts to pilot leaders, (3) common share point and shared minutes and progress, (4) shared responsibilities with task leaders. Each of the points is explained below and they will be further complemented in the next cycles, as necessary.

(1) Periodic meetings

Periodic WP6 "Deployment and Validation in Real Environments" meetings are established on a monthly basis. This has only been interrupted during the holiday period, since the number of attendants would have been reduced. In these meetings, all WP6 members participated, and together the ongoing activities are reviewed, challenges addressed and any relevant topic raised. This allowed to detect any relevant problem and address it soon. Also, if any concern was meant to be raised in MATRYCS' hierarchy,

input from these meetings were transmitted to the Project Management Board meetings, where all WP leaders are present.

(2) Technical contacts

To further support LSP leaders in the work within the MATRYCS project, technical contacts have been assigned to each of them according to the knowledge each of them has to the challenge addressed, non-existence of language barriers or other relevant aspect. The main objective of these technical partners is to follow the progress of the pilots more closely and holding a technical perspective and understanding of the current developments carried out in the project. Also, this allows to channel technical questions and doubts from other partners through the technical contact and, thus, having coherent communication mechanisms. Also, to ensure that everyone in the consortium can be informed of the progress with each pilot, a common share point is used, as it will be later explained in bullet (3). The list of technical contacts can be seen in the Table 12: Technical contacts assigned per LSP below:

Table 12: Technical contacts assigned per LSP

LSP number and name	LSP leader	Tech. contact
LSP1 BUILDING OPERATION [FM]: Facility and resources fingerprinting for efficiency and optimal balancing of energy vectors	BTC	COMSENSUS
LSP2 BUILDING REFURBISHMENT: Sustainable building assessment and optimisation of refurbishment options	FASADA	EURAC
LSP3 ESCO SUPPORT SERVICES: Energy saving verification service for increasing the trust on Energy Performance Contracts	VEOLIA	CARTIF
LSP4 SMART BUILDING AS ACTIVE NODE OF A SMART GRID: Smart building comfort-aware predictive energy management and coordination with smart grids and local RES generation	ASM	ENG
LSP5 ENERGY COMMUNITIES: Services for the better management of self-production systems	COOPERNICO	HOLISTIC
LSP6 DISTRICT HEATING NETWORK: Energy demand prediction to design, develop and optimize district heating networks operation	VEOLIA	CARTIF
LSP7 SECAPS: Services to support SECAPs impact assessment, implementation and monitoring	ICLEI	NTUA
LSP8 ONE-STOP-SHOPS: Enablers of the financing of refurbishment actions in the building stock at local level	GDYNIA	EURAC
LSP9 ENERGY PERFORMANCE CERTIFICATES: Next generation energy performance assessment and certification	EREN	CARTIF
LSP10 DE-RISKING EE INVESTMENTS: Services to support reliable, cost-effective and better-quality Energy Performance Contracts and Investments	LEIF	NTUA
LSP11 POLICY MAKING AND IMPACT ASSESSMENT	HOUSING EUROPE	NTUA

(3) Common share point and shared minutes and progress

In order to assure that the bilateral conversations to solve technical issues and the agreements reached,

are available for all partners to track, the common share point established for the project (TEAMS) is also used. In it, a “Pilot Data Cockpit” has been included, where relevant progress regarding the data collection of the pilots and other relevant matters are tracked. Also, there is the possibility for other partners to comment or pose questions to the progress done. In this way, fluent and effective communication is established.

(4) Responsibilities shared with task leaders

For the moment, the meetings and activities in WP6 have been led by CARTIF, since the two active tasks (T6.1 “Pilot planning, Requirements and KPIs” and T6.2 “Pilots detailed specifications and preparation”) were led by CARTIF. However, once this deliverable is submitted, CARTIF will act as WP leader, coordinating the activities within WP6, and also tracking their progress within T6.7 “Pilots’ Validation and Assessment and Stakeholders’ feedback”. In the following meetings, Task leaders (ASM, FASADA, EREN and LEIF) will also be in charge of leading and tracking the progress of their corresponding groups of pilots according to the defined plan: **T6.3 – PERFORMANCE -ASM, T6.4- DESIGN-FASADA, T6.5-POLICY-EREN, T6.6-FUND-LEIF.**

4.3 Potential risks

As it has been explained in the abovementioned plan, there are several activities to be carried out in the different cycles, and due to the nature of MATRYCS’ pilots and other circumstances, this brings a series of risks, which are mentioned below:

- **MATRYCS LSP number and topic coverage:** the number of LSPs contained in the MATRYCS project represents an inherent risk due to the variety of challenges addressed with different kind of data. Monitoring each of the pilots closely and assuring the alignment of their scope with that reflected in the Grant Agreement is fundamental to assure addressing all the detected challenges in the BaU building value chain, and guaranteeing that the results obtained will be relevant and useful. To mitigate this risk, there is a Pilot Coordinator partner in the project (CARTIF), and also technical contacts assigned to each pilot, so that the monitoring of potential deviations can be detected in time and solved adequately.
- **Services interaction within the same pilot:** together with the number of pilots in the MATRYCS project (11), there is also a risk with the application of different services in each of them, as reflected in MATRYCS matrix (Table 10). Technically, this will be monitored and observed also within other WPs; but with respect to WP6, special attention will be paid to those pilots where more than one service is applied, to be able to extract the origin of the potential dissatisfaction in the user experience, so that can be directed to the correct service developer within the validation progress.
- **COVID-19 impact:** Within the validation activities, both internal (LSP leaders) and externals (interested validators) stakeholders will be engaged. Most desirably, especially when dealing with external actors, it would be preferable to perform these activities face to face, in order to solve problems and provide explanations directly to the users. These activities could be planned to be aligned with other project’s dissemination or communication activities in order to minimise the costs and find potential synergies. However due to the current COVID situation, alternatives will be found in case they are necessary, such as holding webinars or online activities that can

assure the inclusiveness of all interested stakeholders in the MATRYCS project. In every cycle these aspects will be evaluated to propose the most adequate action.

Further risks will be reported in next deliverables when detected, so as to guarantee their tracking and the implementation of adequate mitigation measures.



5 Baseline assessment report

This section presents the baseline assessment report for each of MATRYCS LSPs, which considers all relevant pillars at this stage of the project. Namely, from the five pillars of the evaluation framework (three main pillars + two complementary), only three of them will be addressed in this baseline assessment report, as it can be seen in Figure 11.

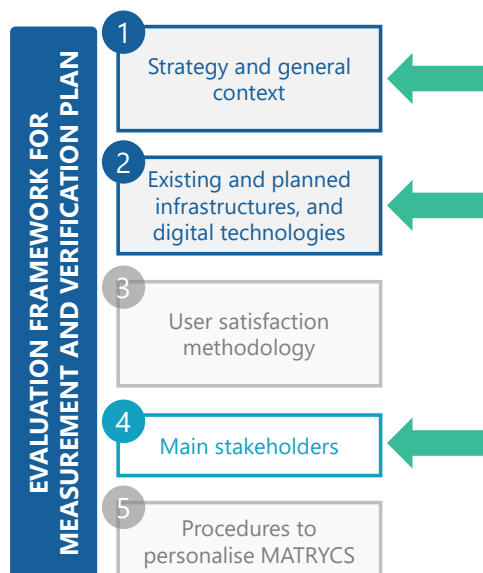


Figure 11: Aspects from evaluation framework considered in the baseline assessment report

These baseline assessment reports are presented in different sections, based on the main focus of the LSP: **(1) Performance** (section 5.1), **(2) Design** (section 5.2), **(3) Policy** (section 5.3) or **(4) Fund** (section 5.4). Under these main sections, each pilot has their corresponding sub-section and is organised in the same manner:

- **(1) Strategy and general context:** as described in section 3.1, two types of KPIs will be covered in each pilot to assess their impact: general KPIs (measured in all pilots) and pilot-specific KPIs. At the end of the project, these KPIs will be measured again, to assess the impact. In order to facilitate having an overview of the baseline, summary tables of these results are provided in section 6, whereas a summary of the KPIs definitions is provided in section 3.1.
- **(2) Data, infrastructures and digital technologies:** the list of indicators related to this pillar and their definitions have been presented in section 3.2. Section 5 includes those KPIs measured pilot per pilot, while section 6 provides summary tables of these results and the values of the indicators measured only at project level.
- **(4) Main stakeholders:** an account of the main stakeholders and personas considered in each pilot will be provided. An overview of the aligned target groups and personas has already been provided in section 3.3

5.1 MATRYCS PERFORMANCE

MATRYCS PERFORMANCE LSPs focus on the **operational stage of buildings aiming at monitoring and improving their energy performance**. Predictive capabilities related to comfort evaluation, energy demand, consumption or generation, will be complemented by optimization capabilities for the management of comfort-aware building energy consumption, management of District Heating networks or energy matching. Four MATRYCS LSPs fall under this category:

- **LSP 1: BUILDING OPERATION [FM]:** Facility and resources fingerprinting for efficiency and optimal balancing of energy vectors [BTC] (section 5.1.1).
- **LSP 4: SMART BUILDING AS ACTIVE NODE OF A SMART GRID:** Smart building comfort-aware predictive energy management and coordination with smart grids and local RES generation [ASM] (section 5.1.2).
- **LSP 5: ENERGY COMMUNITIES:** Services for the better management of self-production systems [COOPERNICO] (section 5.1.3).
- **LSP 6: DISTRICT HEATING NETWORK:** Energy demand prediction to optimize district heating networks operation [VEOLIA] (section 5.1.4).

5.1.1 LSP 1: BUILDING OPERATION [BTC]

LSP 1: BUILDING OPERATION [FM]: Facility and Resources Fingerprinting for Efficiency and Optimal Balancing of Energy Vectors

The BTC Company is one of the leading commercial property development companies in the region. Under the brand name BTC City, it manages one of the largest business, shopping, entertainment, recreational, and cultural centres in SE Europe, located in Ljubljana. The BTC Company also runs a logistics service, one of the leading market companies in FMCG logistics in Slovenia.

In the project, we included three types of facilities: [1] the business tower BTC City, which is entirely intended for tenants' business premises, [2] the Atlantis water park, which consists of indoor and outdoor pools, and various saunas and water attractions, and [3] a Logistics centre, which consists of warehouses and cold stores. The main purpose of the project is an automated and real-time energy operation and planning, achieving operational efficiency, effective maintenance, and sustainable action plans.

The project also includes numerous types of stakeholders, namely personas with different goals, which are cost-, sustainable- or informed- oriented: [1] facility manager, [2] owner, [3] utility and [4] ESCO.

The main goals of facility managers are to do the first pre-feasibility evaluations of all identified performance improvements, create reliable implementation action plans, expose selected energy efficiency and flexibility projects to the potential investors, create reliable monitoring and evaluation plans and procedures for selected energy efficiency, management and maintenance measures, objectively evaluate all positive and potentially negative effects of executed preventive maintenance measures, define the priority list of proposed measures based on their cost effectiveness and to objectively evaluate the cost effectiveness of proposed preventive maintenance measures of the most critical systems.

The main goals of owner are to reach significant energy and money savings, to become aware of the sustainability aspects of the proposed energy and facility measures and of energy and environmental

footprint of his property, to improve greener image and reputation of his property (offices, shops, warehouse) and to improve the user comfort at his working place (offices, shops, warehouses).

The main goals of utility, which is responsible for developing new projects related with energy efficiency with special emphasis on energy flexibility, are to identify interesting energy efficiency and flexibility projects in the selected area and to objectively evaluate flexibility potentials and to identify interesting DSM projects in the selected area.

The main goals of ESCO, which is responsible for developing and implementing new projects related to energy efficiency with special emphasis on energy flexibility and on guaranteeing final energy and flexibility performance, are to identify interesting energy efficiency and flexibility projects in the selected area, and to become aware of the sustainability aspects of the proposed energy efficiency and flexibility improvement measures.

LSP 1: (1) Strategy and general context

Table 13: LSP 1: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	3
G02	Reduction in final energy consumption (ratio)	2568.5	kWh/ year *m ²	2517.13 (2% reduction)
G03	Reduction in final energy consumption (total)	16,309,389	kWh/ year	15,983,201 (2% reduction)
G04	Reduction in CO ₂ emissions (ratio)	0.9907	Tons of CO ₂ / year *m ²	0.9709 (2% reduction)
G05	Reduction in CO ₂ emissions (total)	6742.09	Tons of CO ₂ / year	6607.25 (2% reduction)
G06	Average economic savings for end-users	-	% savings	2%
101	Improved O&M efficiency	-	<i>Likert scale</i>	TBD
102	Economic savings in O&M	-	% savings	5%
103	New Key Performance Indicators monitored	0	#	10

LSP 1: (2) Data, infrastructures and digital technologies

Table 14: LSP 1 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	0	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_TECH	Amount of standardized datasets	0	datasets
A10	I_TECH	Data repositories	8	data repositories

ID	Origin	KPI name	Baseline value	Units
A11	I_TECH	Public national data hubs	1	data hubs
A12	I_TECH	Public supranational data hubs	1	data hubs
A13	I_TECH	Private data hubs	6	data hubs
D05	O_TECH	Data sources combined included in perform analytics	0	data sources
D06	O_BUS	Types of data sources	0	types of data sources
E05	O_BUS	Amount of data	1.24	GBs
E06	O_BUS	Datasets	21	datasets
E07	O_BUS	Users	6	users

LSP 1: (4) Main stakeholders

Table 15: LSP 1: Main stakeholders

Target group	Persona	Definition – User Context
Facility Managers	Informed facility manager	They work at the large shopping, entertainment, business, commercial and logistic centre. They need to know which facility management or energy efficiency measure should be implemented first. They need to know which solutions to propose to be implemented in each building are the best.
	Sustainability supporter facility manager	They work at the large shopping, entertainment, business, commercial and logistic centre. They need to know how to evaluate sustainability aspects of proposed and executed energy and facility management measures. They need to know which aspects of proposed and executed measures are connected with the pure efficiency improvements of selected technical systems and which are connected with better management and maintenance.
	Cost-conscious facility manager	They work at the large shopping, entertainment, business, commercial and logistic centre. They need to know which facility management or energy efficiency measure should be implemented first. They need to know which solutions to propose to be implemented in each building are the best.
ESCOs	Informed ESCO	They cooperate with the large shopping, entertainment, business, commercial and logistic centre, and offer different energy services. They are responsible for developing and implementing new projects related to energy efficiency with special emphasis on energy flexibility and guaranteeing final energy and flexibility performance. They need to know which new projects can be implemented.
	Sustainability supporter ESCO	They cooperate with the large shopping, entertainment, business, commercial and logistic centre, and offer different energy services. They are responsible for developing and implementing new projects related to energy efficiency with special emphasis on energy flexibility and guaranteeing final energy and flexibility performance. They need to know which new projects can be implemented, as well as be aware of sustainability aspects of potential energy efficiency and flexibility measures.
Utilities	Informed utility	They are cooperating with the large shopping, entertainment, business, commercial and logistic centre. They are responsible for developing new projects

		related with energy efficiency and with special emphasis on energy flexibility. They need to know what new projects can be implemented.
	DSM aware utility	They are cooperating with the large shopping, entertainment, business, commercial and logistic centre. They are responsible for developing new projects related with energy efficiency and with special emphasis on energy flexibility. They need to know the potential DSM related projects, as well as the true flexibility potentials and the context of energy use at potentially interesting sites.
Citizens, tenants & Owners	Informed owner	They own shops and offices at the large shopping, entertainment, business, commercial and logistic centre. They are responsible for making decisions about implementation of proposed facility and energy related measures. They are not aware of energy and environmental footprint of their property, but do know that they do not have the proper level of user comfort at their working place.
	Sustainability supporter owner	They own shops and offices at the large shopping, entertainment, business, commercial and logistic centre. They are responsible for making decisions about implementation of proposed facility and energy related measures. They pay for high energy bills and want to reduce them, as well as increase the level of user comfort at their working place.

5.1.2 LSP 4: SMART BUILDING AS ACTIVE NODE OF A SMART GRID [ASM]

LSP 4: SMART BUILDING AS ACTIVE NODE OF A SMART GRID: Smart building comfort-aware predictive energy management and coordination with smart grids and local RES generation

ASM is the local multi-utility owned by Terni's municipality and operates as DSO the LV/MV electricity network in Terni city. ASM main offices are characterized by a HVAC system, which is managed through a BEMS, two PV plants and an ESS of second-life batteries.

The main objectives of LSP4 are listed below:

- Building management optimization: improve the capability to deploy optimal comfort-aware building energy consumption management services
- Operational efficiency: the local smart distribution grid needs to be coordinated with the building consumption
- Decentralized grid management: optimization of building management to exploit RES generation

The benefits derived from MATRYCS project will be evaluated considering the effectiveness of energy consumption prediction, building occupants comfort prediction, local RES generation prediction and weather forecasting. Other measures of the success of the project will be the reduction of reverse power flows, the improvement of building and smart grid coordination and the optimisation of building energy consumption.

LSP 4: (1) Strategy and general context

Table 16: LSP 4: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	3
G02	Reduction in final energy consumption (ratio)	223	kWh/ year *m ²	196 (12% reduction)
G03	Reduction in final energy consumption (total)	646,000	kWh/ year	568,480 (12% reduction)
G04	Reduction in CO ₂ emissions (ratio)	0.11	Tons of CO ₂ / year *m ²	00.097 (12% reduction)
G05	Reduction in CO ₂ emissions (total)	316	Tons of CO ₂ / year	278 (12% reduction)
G06	Average economic savings for end-users	0	€/ year/ end-user unit	0.15
G09	Households impacted	0	#	11
401	Energy demand covered by RES	33%	%	50%
402	Improved energy consumption prediction	5%	% deviations	1%
403	Improvement in local RES generation prediction	5%	% deviations	1%

LSP 4: (2) Data, infrastructures and digital technologies

Table 17: LSP 4 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	10.8	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_TECH	Amount of standardized datasets	5	datasets
A10	I_TECH	Data repositories	5	data repositories
A11	I_TECH	Public national data hubs	0	data hubs
A12	I_TECH	Public supranational data hubs	0	data hubs
A13	I_TECH	Private data hubs	5	data hubs
D05	O_TECH	Data sources combined included in perform analytics	1	data sources
D06	O_BUS	Types of data sources	5	types of data sources
E05	O_BUS	Amount of data	10.8	GBs
E06	O_BUS	Datasets	62	datasets
E07	O_BUS	Users	4	users

LSP 4: (4) Main stakeholders

Table 18: LSP 4: Main stakeholders

Target group	Persona	Definition – User Context
ESCOs	Energy Manager (Private sector)	They work for a private ESCO and are interested in finding the best technical solutions to achieve higher energy efficiency. They are often facing very different scenarios in their activities, therefore they want to deeply analyse energy models.
Utilities	Large scale DSO head	They manage a large distribution system and are interested in improving the energy performance of a district.
	Small scale DSO head	They manage a local municipality in a headquarter located in the city and are interested in cost reduction related to the enterprise building consumption.
	Energy Manager (public sector)	They work in the public sector and are interested in improving the energy performance of a public service.
Citizens, tenants & Owners	Sensitive office employee	They work at the headquarter of their company and are interested in improving their work environment. They consider the energy efficiency a fundamental aspect, from an ecologic and economic point of view.
	Informed office employee	They work at the headquarter of their company and are aware of the benefits derivable from energy efficiency.
	Reluctant office employee	They work at the headquarter of their company and are reluctant about the possibility to improve their work environment.
	Dynamic prosumer	They are citizens that produce and consume energy. They are interested in enhancing the self-consumption and to manage in a better way their energy exchange with the grid.
	Static prosumer	They are citizens that produce and consume energy. They are interested in enhancing the self-consumption but they have no time to analyse and choose new promising systems.

5.1.3 LSP 5: ENERGY COMMUNITIES [COOPERNICO]

LSP 5: ENERGY COMMUNITIES: Services for the better management of self-production systems

Coopérnico, as a national Portuguese renewable energy cooperative counting more than 2000 members and supplying electricity and energy services to over 1700 Portuguese citizens and SMEs, is focused on the development of solutions that will reduce the national carbon footprint while involving citizens and SMEs in the transition toward a more sustainable energy system.

The LSP 5 will focus on developing solutions that will facilitate (1) the installation of new RES plants and the management and operation of existing renewable distributed energy resources, (2) identifying energy efficiency opportunities for citizens and SMEs, and (3) quantification of local policies implementation for local and regional authorities.

LSP 5: (1) Strategy and general context

Table 19: LSP 5: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	2
G02	Reduction in final electricity consumption (ratio)	51.2	kWh/ year *m ²	48.6 (5% reduction)
G03	Reduction in final electricity consumption (total)	244.61	GWh/ year	232.38 (5% reduction)
G04	Reduction in CO ₂ emissions (ratio)	14.38	Kg of CO ₂ / year *m ²	13.66 (5% reduction)
G05	Reduction in CO ₂ emissions (total)	0.916	Tons of CO ₂ / year	0.871 (5% reduction)
G06	Average economic savings for end-users. <i>Value estimated for the installation of a residential solar PV of 0.6 kWp (1/2 modules) in Lisbon, considering the first 10 years of operation.</i>	0	€/ year/ end-user unit	145
G07	Return on investment (ROI) <i>Value estimated for the installation of a residential solar PV of 0.6 kWp (1/2 modules) in Lisbon, considering the first 10 years of operation.</i>	0	%	72
G08	Payback period <i>Value estimated for the installation of a residential solar PV of 0.6 kWp (1/2 modules) in Lisbon, considering the first 10 years of operation.</i>	0	Years	6
G09	Households impacted	0	#	765 (90% of LSP participants)
501	Improved O&M efficiency	-	Likert scale	TBD
502	New investment opportunities identified	-	#	2
503	Energy demand covered by RES	59.9	%	68.3

LSP 5: (2) Data, infrastructures and digital technologies

Table 20: LSP 5 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	0	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_TECH	Amount of standardized datasets	0	datasets
A10	I_TECH	Data repositories	4	data repositories
A11	I_TECH	Public national data hubs	0	data hubs



ID	Origin	KPI name	Baseline value	Units
A12	I_TECH	Public supranational data hubs	1	data hubs
A13	I_TECH	Private data hubs	3	data hubs
D05	O_TECH	Data sources combined included in perform analytics	3	data sources
D06	O_BUS	Types of data sources	4	types of data sources
E05	O_BUS	Amount of data	4.01	GBs
E06	O_BUS	Datasets	202	datasets
E07	O_BUS	Users	6	users

LSP 5: (4) Main stakeholders

Table 21: LSP 5: Main stakeholders

Target group	Persona	Definition – User Context
SMEs & Companies	Eco-friendly SME	The SME is running a bio-grocery, delivering fresh and local products to the local community. The owners would like to further increase their positive impact on the community by lowering their energy consumptions.
Policy makers	Local authority	They are managing a city/village in the countryside of Portugal. They have the objective to invest in a project that will reduce the carbon footprint of the local community while pushing forward social equality.
Citizens, tenants & Owners	Prosumer	They are conscious citizen that decided to invest part of their savings to install PV systems on the rooftop of their house. The goal was to reduce their environmental footprint while saving on their electricity bill through the years. They are experiencing uncertainty related to their PV systems performance, and the need to reduce the surplus electricity to maximise the environmental and economic benefits.
	EV owner	They are citizens that invested part of their savings into an electric vehicle to lower their carbon footprint. They do not know which is the source of the electricity charging in their vehicle, and moreover, they would like to optimize the vehicle charges, when possible, by using local RES.
	Environmentally conscious citizen	They do not have much savings to purchase an EV or PV systems but would like to reduce their carbon footprint, while possibly reducing their energy bills.

5.1.4 LSP 6: DISTRICT HEATING NETWORK [VEOLIA]

LSP 6: DISTRICT HEATING NETWORK: Energy demand prediction to optimize the operation

This pilot consists of a District Heating Network (DHN) that has as its main energy source the biomass. It provides to 1,500 households heating and Domestic Hot Water (DHW) in Laguna de Duero (Valladolid, Spain). This network fed to those households spread over 31 buildings with two separate boiler rooms. One boiler room has 3 biomass boilers with a total capacity of 3.4 MW and covers 80% of the total energy consumption of the facility. The other has 3 natural gas boilers with a total capacity of 8.7 MW.

One of the main objectives of this pilot is to achieve accurate and precise energy predictions in order to anticipate and adjust production as much as possible. Also, the definition of appropriate KPIs and their study and monitoring are key to improving the performance of the installation. It allows from finding low efficiency points to improving them, as well as helping in the maintenance of the facility being able to predict failures and breakdowns. In sum, the ultimate goal is to optimize the DHN.

LSP 6: (1) Strategy and general context

Table 22: LSP 6: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	6
G02	Reduction in final energy consumption (ratio)	81	kWh/ year *m ²	76.95 (5% reduction)
G03	Reduction in final energy consumption (total)	12,616,000	kWh/ year	11,985,200 (5% reduction)
G04	Reduction in CO ₂ emissions (ratio)	0.007	Tons of CO ₂ / year *m ²	0.0067 (5% reduction)
G05	Reduction in CO ₂ emissions (total)	1,093	Tons of CO ₂ / year	1.038 (5% reduction)
G09	Households impacted	0	#	1,488
601	Economic savings in O&M	130,000	€/ year	123,500 (5% reduction)
602	Reduction of error rates	-	% reduction	10
603	Vulnerable (energy poverty people) households reached	0	#	5

LSP 6: (2) Data, infrastructures and digital technologies

Table 23: LSP 6 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_Tech	Size of standardized datasets	0	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_Tech	Amount of standardized datasets	0	datasets
A10	I_Tech	Data repositories	2	data repositories
A11	I_Tech	Public national data hubs	0	data hubs
A12	I_Tech	Public supranational data hubs	1	data hubs
A13	I_Tech	Private data hubs	1	data hubs
D05	O_Tech	Data sources combined included in perform analytics	2	data sources
D06	O_Bus	Types of data sources	2	types of data sources
E05	O_Bus	Amount of data	8.15	GBs

ID	Origin	KPI name	Baseline value	Units
E06	O_BUS	Datasets	26	datasets
E07	O_BUS	Users	15	users

LSP 6: (4) Main stakeholders

Table 24: LSP 6: Main stakeholders

Target group	Persona	Definition – User Context
Facility Managers	Sustainability supporter DHN manager	They operate several DHN and have long experience in the energy sector. They are updated of the latest innovations regarding energy efficiency and foster both environmental sustainability and economic viability of the facilities managed. They are continuously trying to implement the latest energy efficiency measures to their DHNs once these are proven reliable and feasible.
	Cost-conscious DHN manager	They operate several DHN and have long experience in the energy sector. They are slightly updated of the latest innovations regarding energy efficiency, as their main interest is the profitability of the facilities they manage. They are continuously trying to cut costs, trying to optimize the operation and management of the facility and making just the necessary interventions to provide a proper service.
Designers	Profit-oriented DHN manager	They design new DHN or new branches of existing DHN. They have their own standardized method to do the work in order to achieve optimized designing time, which makes all DHN very similar though those have different environments. Their methodology includes a fixed set of components, adapting the scale to the estimated demand and trying to reduce the costs as much as possible, though this may affect the operation efficiency.
	Efficiency-oriented DHN manager	They design new DHN or new branches of existing DHN. They are specialized in creating efficient tailor-made facilities considering many different factors to optimize their design. They make an in-depth research of the environment and the future consumers, which means a high amount of work. However, their designs are highly efficient and reliable, with low consumption and GHG emissions and easy O&M.
Investors	Informed investor	They work for an important private financial company and are interested in investing in the renovation of an existing DHN with the idea of recovering their investment in the long term through the economic savings produced.
Citizens, tenants & Owners	Informed owner	They are owners and inhabitants of one or more dwellings in a building supplied by an old and outdated DHN, and they are interested about the benefits a renovation in the DHN can provide regarding energy consumption, GHG emissions, economic savings and availability. They are willing to carry out this renovation, pushing other owners and trying to convince them about the benefits in consumption, comfort and emissions it would provide.

5.2 MATRYCS DESIGN

MATRYCS DESIGN LSPs aim at facilitating the design, refurbishment and development of building infrastructure, in particular, by focusing at building level design of retrofitting actions, as well as at district level design of networks. There are two LSPs that fall under this category:

- **LSP 2: BUILDING REFURBISHMENT:** Sustainable building assessment and optimisation of refurbishment options [FASADA] (section 5.2.1).
- **LSP 6: DISTRICT HEATING NETWORK:** Energy demand prediction to design and develop district heating networks [VEOLIA] (section 5.2.2). This is another approach for the same pilot as in MATRYCS PERFORMANCE LSP6 (section 5.1.4); in this second section only differentiators have been added.

5.2.1 LSP 2: BUILDING REFURBISHMENT [FASADA]

LSP 2: BUILDING REFURBISHMENT: Sustainable building assessment and optimisation of refurbishment options

The overall goal for this pilot is to support the design process related to the building assessment and evaluation of various refurbishment options. The most efficient renovation scenario needs to be selected in such way that it fulfils the requirements of investor (e.g., financial), it is adjusted to the technical possibilities and futures of the building and it is in agreement with national thermal and energy standards and regulations. Old buildings often do not have actual building documentation, Therefore the first step that is done by the building owner is performance of as-built building survey. Next step is to conduct energy audit in order to assess actual thermal condition of main building components, indicate the elements that need to be improved and provide economic evaluation of potential investment. At this moment the evaluation and selection of renovation scenario is performed based on the fulfilling the national thermal and energy standards and financial criterion of the investment cost.

Within the MATRYCS project, the use of tools supporting the evaluation of energy efficient renovation scenarios will be performed. In addition, it will be demonstrated how the Building Information Model or building digital twin containing static and dynamic data of the building can support the design process. For this purpose, FASADA will use gathered data for the public kindergarten building located in Gdynia in Poland. It is a two-storey building in the part where the children are staying and one storey in the administrative part (see Figure 12).



Figure 12: Pilot building of the kindergarten no. 16 in Gdynia, Poland

The building was constructed in year 1965 and the kindergarten is attended by around 130 children. The building volume is 2712 m³ and built-up area is 464 m². The owner of the building is City of Gdynia. The building is connected to city district heating network. Inside the building there are installed two devices installed for monitoring the indoor air quality. The monitoring activities are performed within P2ENDURE research project funded from the H2020 (<https://www.p2endure-project.eu/>). P2ENDURE promotes evidence-based innovative solutions for deep renovation based on prefabricated Plug-and-Play systems in combination with on-site robotic 3D-printing and Building Information Modelling (BIM), demonstrated and monitored at 10 real projects in 4 geo-clusters with EU-wide replication potentials. The monitoring device is called “comfort eye”, it is developed by Università Politecnica delle Marche (partner of the P2ENDURE project) and it measures temperature, humidity, CO₂, PM₁, PM_{2.5}, PM₁₀. Reading frequency is 1 minute. It was installed in two rooms in the building and it gathers data since middle of 2018.



Figure 13: Monitoring equipment for indoor air quality installed in pilot building in Gdynia

It needs to be highlighted that this pilot focuses on the design; therefore, all the KPIs for LSP2 will be calculated by the MATRYCS tools and software.

LSP 2: (1) Strategy and general context

Table 25: LSP 2: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	4
G02	Reduction in final energy consumption (ratio)	87	kWh/ year *m ²	40 (54% reduction)
G03	Reduction in final energy consumption (total)	64,546	kWh/ year	30,000 (54% reduction)
G06	Average economic savings for end-users	8,750	€/ year/ unit	6,000 (31% reduction)
G07	Return on investment (ROI)	0	%	20%
G08	Payback period	0	Years	< 7
201	Energy consumption reduction investment effectiveness (Heating)	12.73	kWh/ €/ year	9.00
202	Energy consumption reduction investment effectiveness (Electricity)	6.28	kWh/ €/ year	4.5
203	Energy demand covered by RES	0	%	30

LSP 2: (2) Data, infrastructures and digital technologies

Table 26: LSP 2 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	0.025	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_TECH	Amount of standardized datasets	1	datasets
A10	I_TECH	Data repositories	3	data repositories
A11	I_TECH	Public national data hubs	0	data hubs
A12	I_TECH	Public supranational data hubs	0	data hubs
A13	I_TECH	Private data hubs	3	data hubs
D05	O_TECH	Data sources combined included in perform analytics	2	data sources
D06	O_BUS	Types of data sources	3	types of data sources
E05	O_BUS	Amount of data	0.046	GBs
E06	O_BUS	Datasets	4	datasets
E07	O_BUS	Users	2	users



LSP 2: (4) Main stakeholders

Table 27: LSP 2: Main stakeholders

Target group	Persona	Definition – User Context
Designers	Designers of efficient renovation activities	They are designers that plan future renovation activities. They have problems with the access to the most actual information about the building and proposing the most efficient renovation scenario.
Citizens, tenants & Owners	Personnel of the kindergarten	They are workers of the kindergarten. They would like to work in a modern and well renovated building with high indoor air quality.
	Municipal (Gdynia) management staff of educational buildings	They are workers of the City of Gdynia that are responsible for the management of educational buildings. They want to have easier access to the actual data about the building.
	Users of the kindergarten	They are users of the kindergarten building (parents of the children and children attending the kindergarten). They want to have modern and renovated building with high indoor air quality.

5.2.2 LSP 6: DISTRICT HEATING NETWORK [VEOLIA]

LSP 6: DISTRICT HEATING NETWORK: Energy demand prediction to design and develop DHN

The main goal of this pilot is to help in the design of DHN, simplifying it and reducing the time spent in it. It will be done through the generation of a generic model that can be adjusted to each situation and that will allow to predict the behaviour depending on the configuration of the network so the final chosen design will be the optimal one.

More details about the LSP6 are provided in section 5.1.4, as well as the (1) Strategy and general context information, which is the same for this twofold pilot, the (2) Data infrastructures and digital technologies and the (4) Main stakeholders.

5.3 MATRYCS POLICY

MATRYCS POLICY LSPs will deploy services and business models to support **policy making and policy impact assessment**. They will be targeting three main elements revolving around policies at different scales: (1) Sustainable Energy and Climate Action Plans, (2) Energy Performance Certificates and (3) impact assessment of EU policies for buildings. There are three LSPs in MATRYCS that address precisely these three elements:

- **LSP 7: SECAPS:** Services to support SECAPs impact assessment, implementation and monitoring [ICLEI] (section 5.3.1).
- **LSP 9: ENERGY PERFORMANCE CERTIFICATES:** Next generation energy performance assessment and certification [EREN] (section 5.3.2).
- **LSP 11: POLICY MAKING AND IMPACT ASSESSMENT:** Data-driven policy making and policy impact assessment for energy-efficient buildings [HOUSING EUROPE] (section 5.3.3).

5.3.1 LSP7: SECAPS [ICLEI]

LSP7: SECAPS: Services to support SECAPs impact assessment, implementation and monitoring

LSP7 addresses supporting policy mechanisms, mainly the Sustainable Energy and Climate Action Plans (SECAPs) impact assessment, implementation and monitoring.

During the past decade, local and regional authorities have been actively engaged in sustainable energy policy planning, with efforts also placed the last couple of years on integrating climate planning as well, through the voluntary initiative of the Global Covenant of Mayors (CoM) for Climate and Energy. The authorities produce SECAPs focusing on the climate resilience of the public infrastructure and services, as well as reduction of the local authorities' energy consumption and carbon footprint, through a wide range of actions that mainly target the municipal lighting and transport sectors and the buildings of the municipal, tertiary and residential sectors. SECAPs are a significant data source for activities of business interest to a wide range of stakeholders.

LSP7 aims to assist cities and regions in improving their decision-making process by offering benchmarking possibilities, simulating scenarios and practical policy insights, providing policy KPIs and metrics, local actions and other potential inputs for climate strategies, as well as transforming the process data from governmental climate action annual reports into a basis for the planning, development, impact assessment and monitoring of their SECAPs.

Additionally, it can support cities and regions on identifying solutions and best practices aiming to assist the reinforcement of energy efficiency and renewable energy investments and other potential climate mitigation issues.

Measurable elements generated by MATRYCS may foster cities to rethink their decision-making process, placing environmental/social issues as an inextricable part of their development strategies, towards an information society that is inclusive, provides high quality services and promotes quality of life.

LSP 7: (1) Strategy and general context

Table 28: LSP 7: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	1
701	New investment opportunities identified	0	#	≥ 3
702	Simulated scenarios	0	#	≥ 3
703	Performed comparisons	0	#	≥ 9
704	Best practices proposed based on other cities initiatives	0	#	≥ 3
705	Increased engagement	57%	%	> 70%
706	Cities' pilot scenarios generated	0	#	≥ 3
707	Stakeholders directly involved	0	#	≥ 3
708	Stakeholders indirectly involved	0	#	≥ 50

LSP 7: (2) Data, infrastructures and digital technologies

Table 29: LSP 7 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	83	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	83	GBs
A09	I_TECH	Amount of standardized datasets	1	datasets
A10	I_TECH	Data repositories	3	data repositories
A11	I_TECH	Public national data hubs	1	data hubs
A12	I_TECH	Public supranational data hubs	0	data hubs
A13	I_TECH	Private data hubs	2	data hubs
D05	O_TECH	Data sources combined included in perform analytics	2	data sources
D06	O_BUS	Types of data sources	3	types of data sources
E05	O_BUS	Amount of data	83	GBs
E06	O_BUS	Datasets	30	datasets
E07	O_BUS	Users	3	users

LSP 7: (4) Main stakeholders

Table 30: LSP 7: Main stakeholders

Target group	Persona	Definition – User Context
Institutions	Urban planning professional	They work with cities across Europe on climate neutral city action plans. They seek an overview of climate targets and demands from cities across different sectors (transport, buildings, etc.). They have innovative solutions and expertise on issues such as deep renovation of urban districts and green infrastructure; and they lack of understanding on the current European market and which cities require these services.
	Local transport department director	They are the head of the local transport department. They are tasked with operationalizing ambitious political commitments on climate neutrality and defining transport related targets and initiatives. They need to understand which targets other urban transport departments across Europe are setting for themselves, and which proven good practices exist that could be used to achieve these targets.
Policy makers	City Council member	They are elected city council members. They want to promote affordability of building retrofits in their city during the Covid-19 renovation wave. They are developing a cutting-edge policy package for their city. They have considerable time pressure to create an ambitious policy proposal based on European best practices while providing proof for practical viability to the local administration and other stakeholders.
	European Commission	They are staff members of a DG from the European Commission involved in developing calls and tenders under the Horizon Europe Program. They are seeking

	staff	to understand barriers to energy retrofits in buildings in Eastern European cities. They need to understand challenges in increasing the renovation rates in terms of local policy frameworks, need for technical solutions, finance and investments and local stakeholders' collaboration in order to ensure the call for proposals meets the current needs of Eastern European cities.
--	-------	--

5.3.2 LSP9: ENERGY PERFORMANCE CERTIFICATES [EREN]

LSP9: ENERGY PERFORMANCE CERTIFICATES: Next generation energy performance assessment and certification

Considering the vast room of improvement in the field of energy performance certification and the approach shift of the amending EPBD, this pilot will make the most of plenty of possibilities for the adequate implementation for a more reliable, high quality and harmonized next generation of Energy Performance Assessment and Certification.

The pilot will help technicians to issue more accurate EPCs, with reliable and economically assessed renovation solutions that will help to drive building renovation decisions. Moreover, the pilot will help both owners and potential buyers or tenants to have attractive tools adapted to non-energy specialists, which give reliability to the information included in energy certificates, increasing their value and the interest from citizens.

Regarding Public Administration, this pilot will help to registries' staff to limit the registration of energy certificates with data entry errors or calculation errors. It will also help to design better energy efficiency strategies in the building sector, with more precise investment calculations, with a better planning design, prioritizing the areas of action and proposing refurbishment measures with the best energy and economic results.

The main goals of this pilot are the following:

- A better harmonization and data share of EPCs.
- Facilitate compliance with legal requirements and calculation technical verifications.
- An accurate calculation system of the actual energy savings from the refurbishment options included in the EPCs, assessing the real consumption data from smart meters.
- Raise public awareness and confidence in improved new EPCs more accurate and reliable.
- Offer appropriate retrofitting solutions and prioritizing areas of action (neighborhoods or cities) based on data from next-generation EPCs.
- Support in the design and implementation of energy efficiency regional strategies in the building sector.

LSP 9: (1) Strategy and general context

Table 31: LSP 9: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	3





ID	KPI name	Baseline value	Units	Target value
G09	Households impacted <i>Target estimation: 3 EPCs per stakeholder involved in the execution of MATRYCS project.</i>	0	#	180
901	New investment opportunities identified <i>Target estimation: 1/3 of EPCs reached by MATRYCS services deployment, so opportunities for improvement would be identified.</i>	0	#	60
902	Harmonised Energy Performance Certificates (EPCs) <i>Target estimation: 1/3 of EPCs reached by MATRYCS services deployment, so harmonized.</i>	0	# harmonised EPCs	60
903	Energy Performance Certificates compliance checking <i>Target estimation: all the households' EPCs from stakeholders participating in MATRYCS (KPI G09) will be checked by the tool developed in the project.</i>	0	# EPCs verified	180

LSP 9: (2) Data, infrastructures and digital technologies

Table 32: LSP 9 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	54.26	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	36.66	GBs
A09	I_TECH	Amount of standardized datasets	2	datasets
A10	I_TECH	Data repositories	8	data repositories
A11	I_TECH	Public national data hubs	6	data hubs
A12	I_TECH	Public supranational data hubs	1	data hubs
A13	I_TECH	Private data hubs	1	data hubs
D05	O_TECH	Data sources combined included in perform analytics	2	data sources
D06	O_BUS	Types of data sources	4	types of data sources
E05	O_BUS	Amount of data	54.36	GBs
E06	O_BUS	Datasets	37	datasets
E07	O_BUS	Users	3	users

LSP 9: (4) Main stakeholders

Table 33: LSP 9: Main stakeholders

Target group	Persona	Definition – User Context
Designers	EPC's issuers	They are Architects or engineers who issue Energy Performance Certificates (EPCs). They take data from buildings, calculate the energy performance and propose energy efficiency improvements included in the certificates.



Policy makers	EPC's Regional Registry management service	It is the service of the Regional Administration that manages the registry of energy certificates (EPCs) for buildings. They lack tools that facilitate technical supervision of registered certificates, being able to detect possible errors in data entry or in improvement proposals.
	Regional Energy Efficiency Strategy planners	It is the service of the Regional Administration that elaborates and monitors the implementation of the Regional Energy Efficiency Strategy. They lack tools based on real data on the characteristics of buildings, which allow the design of the regional policy for energy efficiency in buildings, as well as the monitoring of its objectives.
Citizens, tenants & Owners	Building buyers and sellers, landlords and tenants	The legislation requires for the transactions for buildings' or dwellings' sale, as well as for the rental of them, the buyer or tenant to be informed about building energy efficiency through the certificate (EPC).

5.3.3 LSP11: POLICY MAKING AND IMPACT ASSESSMENT [HOUSING EUROPE]

LSP11: POLICY MAKING AND IMPACT ASSESSMENT: Data-driven policy making and policy impact assessment for energy-efficient buildings

The public, cooperative and social housing providers, represented by Housing Europe, are in position to play a leading role in the green transition, as they are already key drivers of the renovation efforts across Europe. While the role of the sector is clear in the successful implementation of the future European Green Deal, and more specifically energy efficiency-focused policy instruments (e.g. National Energy and Climate Action Plans (NECPs)), it could definitely benefit from the right policy and financial framework.

MATRYCS shall engage on an extensive collection and processing of data from a local pilot case, with the following objectives

- Goal 1 [**Data analysis of EU Policies**]: the (MATRYCS) services will help to offer an accurate vision of the impact of implemented policies, including testing of EPBD's Building Renovation Passports (retrospective)
- Goal 2 [**SMART policy goals**]: facilitate new Specific, Measurable, Achievable, Relevant and Time-bound goals and milestones in National and EU policies on LTRS by linking to proven actions, outcomes, funding opportunities and business models. (feasible goal-setting)
- Goal 3 [**Inform Long-Term Renovation Strategies (LTRS)**]: elaborate and categorise roadmaps and policy instruments, risk mitigation strategies, best practices, financial frameworks and business models to inform the development of Long-Term Renovation Strategies for the public, cooperative and social housing sector towards CO₂-neutrality by 2050. (measures, instruments and milestones)
- Goal 4 [**Data-based EU frameworks**]: use the generated data and information as input for the revision of the Energy Efficiency Directive

As an expected outcome a more favourable policy framework will contribute to develop cost-effective renovation strategies for the social, cooperative and public housing sector (also a part of a district

approach), namely:

- To select the optimal set of policy options (cost efficient, feasible, and ambitious at the same time) to include in the NECPs and Long-term Renovation Strategies.
- To make informed decisions based on a set of feasible and data-tested options.
- To make reliable predictions about outcomes.

The selection of the pilot case was headed by Housing Europe with the collaboration of NTUA. A strong candidate was identified in the Basque Country. The Basque Government owns a considerable number of buildings, which are then rented at social prices to families. The buildings are managed by Alokabide, a public-owned social housing management company. They manage around 234 buildings (7700 dwellings) spread across the territory. At the moment Alokabide has an on-going collaboration with the University of Basque Country (ENEDI Research Group) and the Laboratory of Quality Control in Buildings of the Basque Country to monitor and inform future improvements in building stock efficiency performance resulting from a series of maintenance work being undertaken at the moment.

The selection of the building was determined by the following criteria provided by the technical partner, NTUA:

- Buildings with centralized energy systems and AUGE system (all dwelling measurements of DHW and heating uses).
- Monitored indoor air temperature and humidity in each dwelling.
- Availability of energy bills of the centralized energy system (gas, diesel, electricity monthly bills)
- Preference for buildings located in cold locations, instead of coastal areas where the potential of renovation is significantly lower.

The selected building, named "ZABALGANA 126", located in Vitoria/Gasteiz, is a D-class building with improvement potentials. ZABALGANA has building scale regular gas boilers to produce heating and DHW, and a solar thermal system supporting the DHW production (which was not working properly). Extensive measurements have already been performed, namely regarding locations of major heat losses.

The following table presents the main characteristics of the selected building:

Table 34: LSP 11 Pilot selected building characteristics

Name of building	Location	Number of Dwellings	Temperature and Humidity Records	Year of construction	Energy Class
ALO-A016 ZABALGANA 126	Vitoria / Gasteiz, Basque Country, Spain	126	Yes	2010	D

Source: Laboratory of Quality Control in Buildings of the Basque Country (LCCE), 2021.

LSP 11: (1) Strategy and general context

Table 35: LSP 11: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	1
G09	Households impacted	0	#	126
1101	Tenants (end-users) involved	0	#	42 (33% of participating tenants)
1102	Analysed EU policies	0	#	10
1103	Energy savings from thermal comfort measures	60	%	65 (8% increasing of reduction target)
1104	Energy efficiency investment opportunities proposed	0	#	5
1105	Vulnerable (access to affordable energy) households reached	0	#	337

LSP 11: (2) Data, infrastructures and digital technologies

Table 36: LSP 11 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_Tech	Size of standardized datasets	0	GBs
A08	I_Sust	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_Tech	Amount of standardized datasets	0	datasets
A10	I_Tech	Data repositories	2	data repositories
A11	I_Tech	Public national data hubs	0	data hubs
A12	I_Tech	Public supranational data hubs	0	data hubs
A13	I_Tech	Private data hubs	2	data hubs
D05	O_Tech	Data sources combined included in perform analytics	2	data sources
D06	O_Bus	Types of data sources	2	types of data sources
E05	O_Bus	Amount of data	0.325	GBs
E06	O_Bus	Datasets	6	datasets
E07	O_Bus	Users	1	users

LSP 11: (4) Main stakeholders

Table 37: LSP 11: Main stakeholders

Target group	Persona	Definition – User Context
Constructors & contractors	Worker of a large construction company	Nial works for a large construction company which wants to make a big step to invest in new technologies in response to the huge demand created by the renovation wave. They are assessing different scenarios about the type of renovation process and elements that will be needed in the coming decennia.
	CEO of a large manufacturer of energy systems	Joelle is the CEO of a large manufacturer of energy systems in Italy. She notices an increasing integration of the supply chain in the construction sector as a consequence of the Eco-bonus which increased the demand for renovations. She would like to collaborate more closely with other companies in order to offer a complete renovation toolkit against unbeatable prices and conditions (in terms of comfort and installation speed).
Real estate developers & managers	Director of Project Development within housing manager	Stephanie works as Director of Project Development among one of the biggest housing managers in Berlin (40,000 units). Her company and the local government have agreed to CO ₂ neutrality in their stock by 2040. She has advised her board to avoid costly deep renovation works that may be regretted later and to prioritize a step-by-step approach for energy renovations.
	Manager of small local housing cooperative	Ben is a manager of a small local housing cooperative in Sweden (40 units). He wants to upgrade the dwellings. His ambition is to turn the community into a Positive Energy District by 2035.
Policy makers	Member of the Parliament (Energy and Housing Committees)	Paul is a Member of the Parliament sitting in the Energy and Housing committees. His party is part of the ruling coalition. While they realize they have to support the environmental goals they also want to make sure this does not hurt the economy, some established business and the energy and housing costs of citizens.
	Senior official in the European Commission	Victoria has been working in Brussels for 10 years as a senior official in the Commission for Europeans. She is drafting the policy measures to increase the energy efficiency of buildings. Unhampered by a sense of realism, she sees a carbon tax as one of the options to finally force building owners to take necessary renovation measures. She feels comforted by the fact that her superiors and top-management have made big announcements recently.
Citizens, tenants & Owners	Old citizen in rented house	Penelope is 71 years old and lives in a dilapidated apartment block in Romania. Her landlord is forced by the government to do renovation works. Although this will improve her health and lower her energy cost, she fears the rent will become unaffordable for her.
	Student in community group to convince on the installation of solar panels in the roofs	Gaangi is a student in anthropology and started a community group to convince the government and the public housing provider to install solar panels on their roofs. She is convinced this is a win-win in terms of energy cost and CO ₂ savings. The representative of the housing provider, Stephanie, has told her they first need to assess the building portfolio and then gradually improve the insulation works.

5.4 MATRYCS FUND

MATRYCS FUND LSPs focus on addressing challenges for **enhanced reliability and reduced risks of energy efficiency investments**, tailored to ESCOs and financing institutions, hence contributing to better define Energy Performance Contract conditions. They will also tackle the centralization of building stock data, the analysis of refurbishment actions and the evaluation of their bankability through the testing of one-stop-shops at city level. There are three MATRYCS LSPs within this category:

- **LSP 3: ESCO SUPPORT SERVICES:** Energy saving verification service for increasing the trust on Energy Performance Contracts [VEOLIA] (section 5.4.1).
- **LSP 8: ONE-STOP-SHOPS:** Enablers of the financing of refurbishment actions in the building stock at local level [GDYNIA] (section 0).
- **LSP 10: DE-RISKING EE INVESTMENTS:** Services to support reliable, cost-effective and better-quality Energy Performance Contracts and Investments [LEIF] (section 5.4.3).

5.4.1 LSP3: ESCO SUPPORT SERVICES [VEOLIA]

LSP3: ESCO SUPPORT SERVICES: Energy Saving Verification Service for increasing the trust on Energy Performance Contracts

This LSP mainly consists of a residential building based in Valladolid (Spain) with two natural gas boilers and a solar thermal installation for the Domestic Hot Water (DHW). Depending on the needs of the project, the option of adding another facility, either of the same type of building or another (educational or administrative), will be considered.

The main goal of this pilot is being able to develop accurate and precise energy and economic savings predictions in order to improve the EP Contracts. For the validation of these savings, the IPMVP could be applied, giving the user the possibility to confirm that the ESCO made accurate and precise savings predictions.

The development of the improved IPMVP, apart from deploying models of the installations, will be able to calculate real-time savings.

LSP 3: (1) Strategy and general context

Table 38: LSP 3: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	1
G02	Reduction in final energy consumption (ratio)	74	kWh/ year *m ²	70.3 (5% reduction)
G03	Reduction in final energy consumption (total)	519,000	kWh/ year	493,050 (5% reduction)
G04	Reduction in CO ₂ emissions (ratio)	0.019	Tons of CO ₂ / year *m ²	0.018 (5% reduction)

ID	KPI name	Baseline value	Units	Target value
G05	Reduction in CO ₂ emissions (total)	130	Tons of CO ₂ /year	124 (5% reduction)
G09	Households impacted	0	#	70
301	Reduction of error rates	-	% reduction	10
302	Developed additional saving measures	0	#	1
303	ESCOs as beneficiaries of improved M&V energy savings methods	0	#	2,500
304	Number of Energy Performance Contracts affected	0	#	3,000/ year

LSP 3: (2) Data, infrastructures and digital technologies

Table 39: LSP 3 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standarized datasets	0	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_TECH	Amount of standarized datasets	0	datasets
A10	I_TECH	Data repositories	3	data repositories
A11	I_TECH	Public national data hubs	1	data hubs
A12	I_TECH	Public supranational data hubs	1	data hubs
A13	I_TECH	Private data hubs	1	data hubs
D05	O_TECH	Data sources combined included in perform analytics	2	data sources
D06	O_BUS	Types of data sources	3	types of data sources
E05	O_BUS	Amount of data	0.33	GBs
E06	O_BUS	Datasets	10	datasets
E07	O_BUS	Users	14	users

LSP 3: (4) Main stakeholders

Table 40: LSP 3: Main stakeholders

Target group	Persona	Definition – User Context
ESCOs	Advanced ESCO	The Advanced ESCO is a company with high experience in the energy sector. They are aware about the benefits that the energy efficiency can provide to their business, so they foster the implementation of energy efficiency measures in the facilities they manage. The knowledge the Advanced ESCO has about some of the facilities they manage is limited, hindering the optimal operation of them.
	Energy Performance	The EP Contract facilitator is responsible of providing the necessary know-how and experience to support the building manager with the successful

	Contract facilitator	implementation of an EPC project. They work with the owners of buildings in order to help them contact ESCOs so these can have an Energy Performance Contract.
Investors	Benefit-oriented bank	It is an international private company with the main interest of obtaining benefits from its operations. It is not specialised in the energy efficiency sector, but they might be willing to enter if an interesting benefit can be foreseen. As energy efficiency is not their primary business, they are hesitant about granting credits with the goal of implementing energy efficiency measures.
	Sustainability supporter bank	It is an international institution that is well seen from the people due to its way of carrying out its activity. This bank is active in promoting social and sustainable actions, which help them maintain its good public image. It does already have knowledge in the benefits the energy efficiency projects have in the environment, as has already participated in other similar projects.
Citizens, tenants & Owners	Motivated owner	They are owners and inhabitants of one or more dwellings in the building, and they are interested about the benefits energy efficiency can provide to the buildings regarding energy consumption, GHG emissions, economic savings and increase of the value of the dwelling. They are willing to implement these measures to the building, pushing other owners and trying to convince them about the benefits in consumption, comfort and emissions these will provide. They are not able to make the investment to carry out to implement energy efficiency measures.
	Careless owner	They are owners and inhabitants of one or more dwellings in the building, and they are not interested about the consumption, emissions or comfort. They pay their energy bills without assuming the cost is regular for the service and they do not care about changing their energy contract or about carrying out an intervention in the building. They do as the community of owners decide and do not have much interaction with other owners of the building.
	Disbelieving owner	They are owners and inhabitants of one or more dwellings in the building, and they are happy about the consumption and comfort. They have no trouble in paying the energy bills but they do not trust the ESCO when proposing Energy Performance Contracts or energy efficiency measures. They believe the objective of the ESCO is just making more money and think that they will have to pay for the intervention, making their energy bill increase while there is no need for any change. They try to convince other owners about their point of view and do not hesitate if they have to argue with the ESCO.

5.4.2 LSP8: ONE-STOP-SHOPS [GDYNIA]

LSP8: ONE-STOP-SHOPS: Enablers of the financing of refurbishment actions in the building stock at local level

This Pilot focuses on the need to refurbish the building sector, since the implementation of refurbishment action plans at local level needs to be supported to enable reliable and cost-effective analysis that lead to an adequate budget allocation, search of financing resources as well as stakeholders to be involved.

To be able to de-risk the sector and boost this type of interventions, it is needed a common exchange

platform, conceptualised as a One-stop-shop managed by the Gdynia Municipality, which provides a package of solutions to support the implementation of data-driven services. These services will support a reliable estimation of the energy status of buildings and calibrate the results based on monitored energy consumption. It will also include the bankability evaluation of the refurbishment solutions and link the refurbishment solutions proposed to the appropriate financing mechanisms.

Local authorities will be able this way to provide a cost-effective assessment of the refurbishment solutions and link that solutions proposed to appropriate financing mechanisms.

The main goals of the LSP8 are:

- Create an available website/platform for city residents with information about energy efficiency renovations in buildings, with funding options for the renovations, containing a database of auditors and contractors and other relevant stakeholders, as well as with information related to Energy Efficiency renovation campaigns that take place in the City.
- Facilitate the search of information for residents: all information at one place (One-stop-shop).
- Provide help in everyday work of municipality workers in serving the municipalities and residents.
- Provide a single platform for renovations where auditors and contractors can announce their services.

LSP 8: (1) Strategy and general context

Table 41: LSP 8: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	3
G09	Households impacted	0	#	100
801	New investment opportunities identified	0	#	≥ 3
802	Stakeholders directly involved	0	#	≥ 2
803	Stakeholders indirectly involved	0	#	≥ 20
804	City residents of the One-stop-shop	0	#	≥ 200
805	Events and EE campaigns promoted through the platform	0	#	≥ 3

LSP 8: (2) Data, infrastructures and digital technologies

Table 42: LSP 8 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	0	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0.161	GBs
A09	I_TECH	Amount of standardized datasets	0	datasets
A10	I_TECH	Data repositories	6	data repositories



ID	Origin	KPI name	Baseline value	Units
A11	I_TECH	Public national data hubs	0	data hubs
A12	I_TECH	Public supranational data hubs	4	data hubs
A13	I_TECH	Private data hubs	2	data hubs
D05	O_TECH	Data sources combined included in perform analytics	1	data sources
D06	O_BUS	Types of data sources	6	types of data sources
E05	O_BUS	Amount of data	0.23	GBs
E06	O_BUS	Datasets	41	datasets
E07	O_BUS	Users	1	users

LSP 8: (4) Main stakeholders

Table 43: LSP 8: Main stakeholders

Target group	Persona	Definition – User Context
SMEs & Companies	Renovation contractors and auditors	They offer to the customers such services as audits, investment projects and building renovations that improve the energy efficiency of the buildings.
Institutions	Gdynia and other cities' municipal workers	They work and manage public buildings as well as help city residents by providing them with needed information. The ones working in smaller municipalities often need help with their actions.
Citizens, tenants & Owners	Real estate owner	They are typical citizens/city residents living in Gdynia which try to renovate their estate so that they can improve their living conditions and so that they achieve savings in their energy bills. They want to get financial help but do not know how to look for the information during the process of the investment.
	Building administrator and manager	They manage multi-family residential buildings in Gdynia. They have to take care of the state of buildings and plan energy efficiency renovations. They want to find information about renovation solutions and financial options and subsidies when planning a renovation.

5.4.3 LSP10: DE-RISKING EE INVESTMENTS [LEIF]

LSP10: DE-RISKING EE INVESTMENTS: Services to support reliable, cost-effective and better-quality Energy Performance Contracts and Investments

LSP10 will demonstrate MATRYCS framework through cross-domain integration of a variety of heterogeneous historical and live data on financial performance, underlying EE impact of the investments, through historical extensive smart meters data integration.

The goals of this LSP are:

- Cost-effective assessment that ensures low risk investments in energy efficiency and helps to categorize investment priorities.



- Holistic and reliable analysis that provides predictive maintenance warnings.

LSP10 will reduce the uncertainty linked to EE investments, which can be attributed to the lack of relevant skills and ability to assess investments. It will strengthen debt and equity financing of EE projects.

LSP 10: (1) Strategy and general context

Table 44: LSP 10: Strategy and general context assessment

ID	KPI name	Baseline value	Units	Target value
G01	MATRYCS services deployed and validated in LSPs	0	#	1
G02	Final energy consumption (total)	60	kWh/ year/ m ²	50
G03	Reduction in final energy consumption (ratio) <i>Reduction ratio (%) increasing at the end of the project (target value) compared to the baseline value reduction ratio</i>	50	%	60
G04	Reduction in CO ₂ emissions (ratio) <i>Reduction ratio (%) increasing at the end of the project (target value) compared to the baseline value reduction ratio</i>	60	%	62
G05	Reduction in CO ₂ emissions (total) <i>Total of CO₂ emissions reduced, comparing baseline value and target value at the end of the project</i>	41,000	Tons of CO ₂ / year	60,000
G07	Return on investment (ROI)	19	%	20
G08	Payback period	8.4	Years	8
1001	New investment opportunities identified	0	#	< 5
1002	New energy saving measures	0	#	< 5

LSP 10: (2) Data, infrastructures and digital technologies

Table 45: LSP 10 Technical KPIs assessment

ID	Origin	KPI name	Baseline value	Units
A07	I_TECH	Size of standardized datasets	0	GBs
A08	I_SUST	Big data availability for real life research, simulation and policymaking	0	GBs
A09	I_TECH	Amount of standardized datasets	0	datasets
A10	I_TECH	Data repositories	4	data repositories
A11	I_TECH	Public national data hubs	0	data hubs
A12	I_TECH	Public supranational data hubs	0	data hubs
A13	I_TECH	Private data hubs	4	data hubs



ID	Origin	KPI name	Baseline value	Units
D05	O_Tech	Data sources combined included in perform analytics	4	data sources
D06	O_BUS	Types of data sources	4	types of data sources
E05	O_BUS	Amount of data	5.39	GBs
E06	O_BUS	Datasets	21	datasets
E07	O_BUS	Users	1	users

LSP 10: (4) Main stakeholders

Table 46: LSP 10: Main stakeholders

Target group	Persona	Definition – User Context
Facility Managers	Responsible manager	They take lead on managing business's property and buildings, ensuring that facilities meet compliance standards and government regulations. They are planning for the future by forecasting the facility's upcoming needs and requirements. They are also overseeing any renovations, refurbishments and building projects.
	Careless manager	They do the work to a minimum extent on managing a business's property and buildings, ensuring that facilities meet compliance standards and government regulations. They are barely planning for the future by forecasting the facility's upcoming needs and requirements. They are also overseeing any renovations, refurbishments and building projects.
SMEs & Companies	Director of finance	They are responsible for the financial health of the company. By combining strategic and operational goals, they manage the accounting and economic aspects of a company by enforcing a financial strategy aimed toward profitable long-term growth. Additional duties include overseeing the ongoing project department, conducting their financial assessments and conducting risk assessments on business initiatives.
Institutions	Ambitious head of department	They work for a government or local municipality and create plans for managing energy consumption by improving operational and maintenance practices. They are also monitoring energy consumption in order to improve knowledge on energy consumption patterns and their consequences (e.g. smart metering and real-time pricing).
	Project manager	They work for a government or local municipality. They are not much interested in managing energy consumption in buildings, but they have to do it, because it is a part of their responsibilities during the project monitoring phase.
Policy makers	Informed policy makers	They are making policies to avoid excessive and unnecessary use of energy through regulation (e.g. building codes and minimal standards) and policies that stimulate behavioural changes.

6 Summary tables

This section gathers the KPIs calculated in all the LSPs presented in each of the above sections (within section 5) to be easily seen and compared.

Target values are indicative, as mentioned before, and **Cat.** Means category, divided in Business (B), Economic (EC), Environmental (ENV) and Social (S).

LSP	ID	KPI name	Cat.	Level	Baseline value	Units	Target value
LSP1	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	3
	G02	Reduction in final energy consumption (ratio)	ENV	3	2568.5	kWh/ year *m ²	2517.13 (2% reduction)
	G03	Reduction in final energy consumption (total)	ENV	3	16,309,389	kWh/ year	15,983,201 (2% reduction)
	G04	Reduction in CO ₂ emissions (ratio)	ENV	3	0.9907	Tons of CO ₂ / year *m ²	0.9709 (2% reduction)
	G05	Reduction in CO ₂ emissions (total)	ENV	3	6742.09	Tons of CO ₂ / year	6607.25 (2% reduction)
	G06	Average economic savings for end-users	EC	3	-	% savings	2%
	101	Improved O&M efficiency	EC	2	-	Likert scale	TBD
	102	Economic savings in O&M	EC	2	-	% savings	5%
	103	New Key Performance Indicators monitored	B	1	0	#	10
LSP2	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	4
	G02	Reduction in final energy consumption (ratio)	ENV	3	87	kWh/ year *m ²	40 (54% reduction)
	G03	Reduction in final energy consumption (total)	ENV	3	64,546	kWh/ year	30,000 (54% reduction)
	G06	Average economic savings for end-users	EC	3	8,750	€/ year/ unit	6,000 (31% reduction)
	G07	Return on investment (ROI)	EC	3	0	%	20%
	G08	Payback period	EC	3	0	Years	< 7
	201	Energy consumption reduction investment effectiveness (Heating)	EC	3	12.73	kWh/ €/ year	9.00
	202	Energy consumption reduction investment effectiveness (Electricity)	EC	3	6.28	kWh/ €/ year	4.5
	203	Energy demand covered by RES	ENV	3	0	%	30
LSP3	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	1
	G02	Reduction in final energy consumption (ratio)	ENV	3	74	kWh/ year *m ²	70.3 (5% reduction)
	G03	Reduction in final energy consumption (total)	ENV	3	519,000	kWh/ year	493,050 (5% reduction)
	G04	Reduction in CO ₂ emissions (ratio)	ENV	3	0.019	Tons of CO ₂ / year *m ²	0.018 (5% reduction)

LSP	ID	KPI name	Cat.	Level	Baseline value	Units	Target value
	G05	Reduction in CO ₂ emissions (total)	ENV	3	130	Tons of CO ₂ / year	124 (5% reduction)
	G09	Households impacted	S	3	0	#	70
	301	Reduction of error rates	B	1	-	% reduction	10
	302	Developed additional saving measures	ENV	1	0	#	1
	303	ESCOs as beneficiaries of improved M&V energy savings methods	B	3	0	#	2,500
	304	Number of Energy Performance Contracts affected	B	2	0	#	3,000/ year
LSP4	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	3
	G02	Reduction in final energy consumption (ratio)	ENV	3	223	kWh/ year *m ²	196 (12% reduction)
	G03	Reduction in final energy consumption (total)	ENV	3	646,000	kWh/ year	568,480 (12% reduction)
	G04	Reduction in CO ₂ emissions (ratio)	ENV	3	0.11	Tons of CO ₂ / year *m ²	00.097 (12% reduction)
	G05	Reduction in CO ₂ emissions (total)	ENV	3	316	Tons of CO ₂ / year	278 (12% reduction)
	G06	Average economic savings for end-users	EC	3	0	€/ year/ end-user unit	0.15
	G09	Households impacted	S	3	0	#	11
	401	Energy demand covered by RES	ENV	3	33%	%	50%
	402	Improved energy consumption prediction	ENV	1	5%	% deviations	0%
	403	Improvement in local RES generation prediction	ENV	1	5%	% deviations	0%
LSP5	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	2
	G02	Reduction in final electricity consumption (ratio)	ENV	3	51.2	kWh/ year *m ²	48.6 (5% reduction)
	G03	Reduction in final electricity consumption (total)	ENV	3	244.61	GWh/ year	232.38 (5% reduction)
	G04	Reduction in CO ₂ emissions (ratio)	ENV	3	14.38	Kg of CO ₂ / year *m ²	13.66 (5% reduction)
	G05	Reduction in CO ₂ emissions (total)	ENV	3	0.916	Tons of CO ₂ / year	0.871 (5% reduction)
	G06	Average economic savings for end-users.	EC	3	0	€/ year/ end-user unit	145
	G07	Return on investment (ROI)	EC	3	0	%	72
	G08	Payback period	EC	3	0	Years	6
	G09	Households impacted	S	3	0	#	765 (90% of LSP participants)



LSP	ID	KPI name	Cat.	Level	Baseline value	Units	Target value
	501	Improved O&M efficiency	EC	2	-	Likert scale	TBD
	502	New investment opportunities identified	B	3	-	#	2
	503	Energy demand covered by RES	ENV	2	59.9	%	68.3
LSP6	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	6
	G02	Reduction in final energy consumption (ratio)	ENV	3	81	kWh/ year *m ²	76.95 (5% reduction)
	G03	Reduction in final energy consumption (total)	ENV	3	12,616,000	kWh/ year	11,985,200 (5% reduction)
	G04	Reduction in CO ₂ emissions (ratio)	ENV	3	0.007	Tons of CO ₂ / year *m ²	0.0067 (5% reduction)
	G05	Reduction in CO ₂ emissions (total)	ENV	3	1,093	Tons of CO ₂ / year	1.038 (5% reduction)
	G09	Households impacted	S	3	0	#	1,488
	601	Economic savings in O&M	EC	3	130,000	€/ year	123,500 (5% reduction)
	602	Reduction of error rates	B	2	-	% reduction	10
	603	Vulnerable (energy poverty people) households reached	S	3	0	#	5
LSP7	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	1
	701	New investment opportunities identified	B	2	0	#	≥ 3
	702	Simulated scenarios	B	2	0	#	≥ 3
	703	Performed comparisons	B	2	0	#	≥ 9
	704	Best practices proposed based on other cities initiatives	B	2	0	#	≥ 3
	705	Increased engagement	B	3	57%	%	> 70%
	706	Cities' pilot scenarios generated	B	2	0	#	≥ 3
	707	Stakeholders directly involved	S	2	0	#	≥ 3
	708	Stakeholders indirectly involved	S	3	0	#	≥ 50
LSP8	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	4
	G09	Households impacted	S	3	0	#	100
	801	New investment opportunities identified	B	2	0	#	≥ 3
	802	Stakeholders directly involved	S	2	0		≥ 2
	803	Stakeholders indirectly involved	S	3	0		≥ 20
	804	City residents using the One-stop-shop	S	2	0		≥ 200
	805	Events and EE campaigns promoted through the platform	S	2	0	#	≥ 3
LSP9	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	3
	G09	Households impacted	S	3	0	#	180
	901	New investment opportunities identified	B	2	0	#	60

LSP	ID	KPI name	Cat. Level		Baseline value	Units	Target value
	902	Harmonised Energy Performance Certificates (EPCs).	B	2	0	# harmonised EPCs	60
	903	Energy Performance Certificates compliance checking	B	2	0	# EPCs verified	180
LSP10	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	1
	G02	Final energy consumption (total)	ENV	3	60	kWh/ year/ m ²	50
	G03	Reduction in final energy consumption (ratio) <i>Reduction ratio (%) increasing</i>	ENV	3	50	%	60
	G04	Reduction in CO ₂ emissions (ratio) <i>Reduction ratio (%) increasing</i>	ENV	3	60	%	62
	G05	Reduction in CO ₂ emissions (total) <i>Reduction of CO₂ emissions increasing</i>	ENV	3	41,000	Tons of CO ₂ / year	60,000
	G07	Return on investment (ROI)	EC	3	19	%	20
	G08	Payback period	EC	3	8.4	Years	8
	1001	New investment opportunities identified	B	2	0	#	< 5
	1002	New energy saving measures	ENV	2	0	#	< 5
LSP11	G01	MATRYCS services deployed and validated in LSPs	B	1	0	#	1
	G09	Households impacted	S	3	0	#	126
	1101	Tenants (end-users) involved	S	2	0	#	42 (33% of tenants)
	1102	Analysed EU policies	B	2	0	#	10
	1103	Energy savings from thermal comfort measures	ENV	3	60	%	65 (8% increasing)
	1104	Energy efficiency investment opportunities proposed	ENV	2	0	#	5
	1105	Vulnerable (access to affordable energy) households reached	S	3	0	#	337

Data, infrastructures and digital technologies KPIs summary tables are included below.

Table 47: Data, infrastructures and digital technologies KPIs summary for global KPIs.

ID	Origin	KPI name	Baseline value	Units	Value end (project level)
B07	O_BUS	Resources	19	resources	200
E01	O_BUS	Real-life demonstrations	0*	demonstrations	11
E02	O_BUS	Service per pilot case developed and tested	0*	service/pilot	1
E03	O_BUS	Reports showing results from pilot evaluation/impact assessment (D6.2-16)	0*	report	24

***Demonstration starts in M13**



Table 48: Data, infrastructures and digital technologies KPIs summary for global KPIs.

ID	Name	LSP1	LSP2	LSP3	LSP4	LSP5	LSP6	LSP7	LSP8	LSP9	LSP10	LSP11	Total	Units	Value end
A07	Size of standarized datasets	0	0.025	0	10.8	0	0	83	0	54.26	0	0	148.08	GBs	106 [TBs]
A08	Big data availability for real life research, simulation and policymaking	0	0	0	0	0	0	83	0.161	36.66	0	0	119.82	GBs	106 [TBs]
A09	Amount of standarized datasets	0	1	0	5	0	0	1	0	2	0	0	9	datasets	75
A10	Data repositories	8	3	3	5	4	2	3	6	8	4	2	48	data repositories	75
A11	Public national data hubs	1	0	1	0	0	0	1	0	6	0	0	9	data hubs	10
A12	Public supranational data hubs	1	0	1	0	1	1	0	4	1	0	0	9	data hubs	38
A13	Private data hubs	6	3	1	5	3	1	2	2	1	4	2	30	data hubs	27
D05	Data sources combined included in perform analytics	0	2	2	1	3	2	2	1	2	4	2	21	data sources	60
D06	Types of data sources	0	3	3	5	4	2	3	6	4	4	2	36	types of data sources	60
E05	Amount of data	1.24	0.046	0.33	10.8	4.01	8.15	83	0.23	54.36	5.39	0.325	167.89	GBs	350 [TBs]
E06	Datasets	21	4	10	62	202	26	30	41	37	21	6	460	datasets	10000
E07	Users	6	2	14	4	6	15	3	1	3	1	1	56*	users	1000

*At this stage, the number represents the personas identified through the User Stories definition.



7 Conclusions

MATRYCS **WP6 “Deployment and Validation in Real environments”** main objective is to facilitate the deployment and validation of activities in LSPs. The present document D6.1 “Pilot operation, engagement and M&V plan” is the first within the WP. As such, it presents the approach taken to create the M&V plan and outlines the activities for the pilot operation and engagement plan. The document can be summarised in three major points, under which the validation will take place:

- The **Pilots’ operation plan**, as well as **engagement processes** to be carried out during WP6 duration and the three development cycles envisaged in the MATRYCS project.
- The **Evaluation framework** with different components to track LSPs development throughout the project from different perspectives: (1) strategy and general context, (2) data, infrastructures and digital technologies, (3) user satisfaction, (4) main stakeholders and (5) procedures to personalise MATRYCS.
- The **Baseline assessment** on the LSPs current status, which will be used as a benchmark and will contribute to assess the impact at the end of the project.

Now that the framework has been established, as well as responsibilities and activities organised, the next Cycle 1 will continue with the proposed plan and will report the findings in D6.2 “Report on Pilot’s Integration and Validation (cycle 1)” (M15). The main focus of this cycle will be to finalise the pilot preparation and refine the Data, infrastructures and digital technologies to be used throughout the project and in the validation process. Additionally, questionnaires to address the user satisfaction will be proposed in M15, which will be defined together with technical partners. Finally, a first version of the methodology with respect to the procedures to personalise MATRYCS will be presented based on the initial ideas contained in this document.

APPENDIX I: Data gathering Template

	Volume & historical data							Velocity				Variety							Veracity			Others		
	MB/day	GB/yr	Starting date	Ending date	# variables	# records	Type	Storage frequency	Read frequency	Update frequency (static data)	Bandwidth limitation	Communication interfaces	Interface documentation	Current storage format	Need processing?	DB available	Data structure	Related standard	Ownership	Reliability	Security of the transmission	Availability (starting date)	Technical contact	
												(i.e. APIs, FTP)		(i.e. JSON, CSV)					(i.e. open, private, licensed)	(data quality mechanisms)				
Dynamic data																							Contextual Building information	
Semi-static data																								
Static data																								

Volume & historical data	MB/day	Size of data collected per day in Mbytes.
	GB/yr	Size of data collected per year in Gbytes
	Starting date	Data collection start date
	Ending date (if applicable)	End date of data collection (if any)
	# variables	Number of variables included in this group
	#records	Number of records
	Type	Type of data that belongs to a category (for example, in case of weather information, it would include parameters about temperature, humidity, etc.)
Velocity	Static /semi-static/ dynamic data	
	Storage frequency	How often the information is stored (for example every minute, every hour, etc.).
	Read frequency	How often the information could be read (for example every minute, every hour, etc.)
	Update frequency	How often information is updated (relevant for static data)
	Bandwidth limitation	Bandwidth restrictions to consider (if any)
Variety	Communication interfaces	Communication interfaces that provide access to information (APIs, FTP...)
	Interface documentation	For example, if there is an standardized API, you should provide the type and version
		If there is an unique API protocol, the related information would be very usefull
	Current storage format	Type of file generated to store the information (.csv, .json, .xml...)
	Need processing	It is necessary to clarify whether the data identification machine is readable or would need processing before
	DB available	If any database stores the data, information about it would be useful
Veracity	Data structure	How data is structured
	Related standard	Relevant standard related to data (if any)
	Ownership	Who owns the data (open data source, private data source, need to have a license, etc.)
	Reliability	How reliable is the data (is there any data quality mechanisms in place?)
Others	Security of the transmission	Security transmission mechanisms (authorisation with token, private key, etc.)
	Availability	Initial date the data will be available to developers
	Technical contact	Person of contact to solve technical issues
	Contextual building information	Relevant building contextual data that could be useful for developers (for example, typical occupancy patterns)



APPENDIX II: Service description template

Description of the service

Version management

Table 49: Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
1.0				
1.1				
1.2				

Scope and objectives

Table 50: Scope and objectives of service

Scope and objectives of service	
Scope	<i>Describe with one sentence what your service does</i>
Objective(s)	<i>Describe with one sentence what is the final benefit that can be achieved with your service</i>
Related business case(s)	<i>Give some examples of related business cases</i>

Narrative of the service

Table 51: Narrative of the service

Narrative of the service
Short description
<i>Provide a short description of what the service does.</i>

Complete description	
Input requirements	<i>Please indicate what are the inputs that are needed for the service in order to work (for example, building model in a specific format, temperature readings with a certain reporting rate, historical data about energy consumption for at least xx years, etc..)</i>
Service operation	<i>Please describe in a simple way relevant details about the service operation (for example, how the service uses the inputs previously indicated in order to run, if it runs periodically (every tot minutes) or only if it is triggered by some events or by a user request, etc.)</i>
Service output	<i>Please indicate what data and/or results will be produced as output by the service and how these will be made available (for example, results stored in a database, results only visualized in some GUI, other)</i>

Other comments or remarks

Table 52: General remarks

General remarks
Service status and additional documentation if existing
<i>Please indicate here if the service to be deployed is new, or if it is based on previous developments. Also, if it is currently being expanded in another project and if those new functionalities are to be provided within MATRYCS, or if there is relevant additional documentation that can be shared and would be of use within MATRYCS.</i>
Other comments
<i>Please indicate here any additional information that was not provided in the previous tables and that can be important to know when considering the use of your service.</i>