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D1.4 Data management plan. Report and updates

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Abbreviations

AHU	Air Handling Unit
AIoD	Artificial Intelligence on Demand
API	Application Programming Interface
APR	Annual Percentage Rate
BIPV	Building Integrated PhotoVoltaics
CBDC	Central Bank Digital Currency
DB	Database
DMP	Data Management Plan
DPIA	Data Protection Impact Assessment
EC	European Commission
EPC	Energy Performance Contract
ESIE	Efficient, Sustainable, and Inclusive Energy
EUCI	European Union Classified Information
FAIR	Findable, Accessible, Interoperable, Re-usable
GDPR	General Data Protection Regulation
GE	Green Euro
IDS	International Data Spaces
IoT	Internet of Things
IPMVP	International Performance Measurement and Verification Protocol
IPR	Intellectual Property Rights
JSON	JavaScript Object Notation
KYC	Know Your Customer
NGSI	Next Generation Service Interfaces
OA	Open Access

PDL	Power Distribution Limit
PV	PhotoVoltaics
SLA	Service Level Agreement
SSH	Social Sciences and Humanities
SSL/TLS	Secure Sockets Layer/Transport Layer Security
XML	Extensive Markup Language

Executive Summary

This deliverable is the updated version of D1.2 Data management plan (M6), part of FORTESIE WP1 – Project Management and it represents the work conducted for T1.5 – Data Management. Following the Horizon Europe and the Horizon 2020Programme Guidelines in FAIR Data Management it constitutes the final version of the FORTESIE Data Management Plan (DMP), while it addresses the following issues:

- What is the data management life cycle for all datasets to be collected or generated and processed by the FORTESIE project?
- How will the project results and research data be handled after the project?
- What are the data that were collected, processed, and generated?
- What methodology and standards were applied?
- What is the data sharing policy?
- What processes were followed for data curation and preservation?

Based on the D1.2, and the "Guidelines on Data Management in Horizon 2020", this final version of the Data Management Plan (D1.4) has as a main goal to produce data so that researchers may benefit by their use directly, and/or to apply their methods based on data generated by Research in Horizon Europe. Such information includes:

- The scientific publications issued by the project consortium,
- White papers published,
- Open-Source code generated,
- Mock-up datasets used for supporting the development process

The Data Management Plan governs all data generated and collected within the project, the standards that have been used, how the research data is planned to be preserved and what parts of the datasets have been shared for verification or reuse.

1 Introduction

Since data management has been at the core of the FORTESIE project, the consortium has followed and established a series of dedicated activities in publishing, disseminating, spreading, and communicating the project data (outcomes and accumulated knowledge) to external parties, such as interested communities and potential stakeholders, with the aim to leverage existing and create new opportunities.
The main goals of this report are the following:

- To detail the overall methodology for handling the outcomes of the project, in accordance with the Horizon 2020 and the Horizon Europe guidelines regarding Open Research Data.
- To list results, information and data that can be published.
- To describe the open repositories for data management and dissemination.

FORTESIE project partners have provided, through open access, various types of information, such as scientific publications relevant to the project, white papers published, Open-Source code generated, open datasets, anonymous interview results, etc. It should be stressed that the consortium has balanced between open publishing project's related data, collected, or generated, and protecting private or sensitive information (according to GDPR provisions) that may have had legal implications in case of inappropriate treatment.

1.1 Project Introduction

The overall vision of FORTESIE has been to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation packages combined state-of-the-art construction materials and technologies components (prefabricated facades, BIPV, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g., contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC (Energy Performance Contract) value proposition. The renovation packages were tailored to specific target groups needs and optimised to improve ESIE performance considering energy, CO2, and comfort. Each package was demonstrated and validated in real-life use cases and customised for replication in all other partner countries for immediate market uptake. Methodologies from Social Sciences and Humanities (SSH) were adopted for:

a) the creation of collaborative business models that boost the Renovation Wave by considering all stakeholders' value and revenue streams,
b) novel incentivisation and behavioural change models aiming to stimulate long-term engagement with focused interactions to adopt green behaviour
c) the incorporation of a digital currency, green-euro, (€G) for financing, rewarding and creating an inclusive / collective narrative in the fight against climate change
d) the collection of feedback for recommendations to policy and business stakeholders, and
e) the mapping and understanding the complex interplay between the different stakeholders to deliver an engagement strategy across the value chain.

These demonstrations have potentially confirmed the green euro as a rewarding mechanism within innovative renovation approaches. An online marketplace has been established to offer first level advice, directing consumers through the value chain of stakeholders and facilitating access to these "packaged" renovation services.

1.2 Deliverable Purpose

The main purpose of D1.4 Data Management Plan (M43) is to establish and update, if necessary, the process of how data was and will be handled, even after the project duration. Based on the D1.2 and the guidelines of the Open Research Data Pilot in Horizon 2020[1] and the Horizon Europe[2], this process involved:

- A methodology that makes research data generated in the context of the FORTESIE project: findable, accessible, interoperable, and reusable (FAIR principles).
- The identification, classification (i.e., open, or confidential), organisation, curation, preservation, storing and sharing of the data collected, processed and/or generated.
- Requirements related to ethics and legal compliance (i.e., to ensure that the work has been conducted in an ethically sound way) as described in the Grant Agreement and in EU and national legislation.

1.3 Data Protection Legislative Framework

The FORTESIE consortium is fully aware of the ethical implications of the proposed research and respects the ethical rules and standards of Horizon Europe, and those reflected in the Charter of Fundamental Rights of the European Union. Where necessary, the FORTESIE consortium confirms its abidance to national and international laws including Regulation (EU) 2016/679[3] of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, the Directive on Privacy and Electronic Communications (2002/58/EC)[4], Directive on Protection of Privacy in the Telecommunication Sector (97/66/EC)[5], as also replaced by 2005/58/EC[6], The Universal Declaration of Human Rights[7] and the Convention 108+ for the Protection of Individuals with Regard to Automatic Processing of Personal Data (as amended by the Protocol CETS No223) [6],[8]. Article 19 "Ethical principles" of Regulation No. 695/2021 of the European Parliament[9] and of the Council which states the fundamental principles of the Horizon Europe Ethics in research.

1.4 Structure of the Document

This deliverable is structured as follows:

- **Section 1** provides the introduction of the deliverable.
- **Section 2** presents the FORTESIE final data management strategy, thereby exposing classification, archiving, performance, safety and security, FAIR and ethics requirements and procedures for the data.
- **Section 3** lists datasets identified throughout the FORTESIE project.
- **Section 4** presents the implementation aspects of the Data Management Strategy

[1] http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-data-management/data-management_en.htm
[2] https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf
[3] https://eur-lex.europa.eu/eli/reg/2016/679/oj
[4] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32002L0058
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31997L0066
[6] https://eur-lex.europa.eu/eli/dir/2002/58/oj/eng
[7] https://www.un.org/en/about-us/universal-declaration-of-human-rights
[8] https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/223
[9] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0695

- **Section 5** provides the summary and conclusions of the deliverable.

2 Data Management Strategy and Procedures

Data Management Plans (DMPs) are a key element of good data management. A DMP describes the data management life cycle for the data to be collected, processed and/or generated by a Horizon Europe project. As part of making research data findable, accessible, interoperable, and reusable, a DMP includes information about the handling of research data during and after the end of the project:

- What (kind of) data was collected, processed and/or generated and to whom might they be useful later on?
- Which methodology and standards were applied?
- What metadata was required to enable data to be found and understood, ideally according to the standards of a scientific discipline?
- Whether data was shared/made open access.
- How data was preserved (including after the end of the project)?
- How to archive and preserve the open datasets of the project?

More specifically, for Horizon Europe projects a FAIR DMP template[10] has been designed to be applicable to any project that produces, collects, or processes research data (please see Annex A). The FAIR data principles towards promptly disseminating the data outcomes of a research project[11] can be seen below in **Error! Not a valid bookmark self-reference.**.

Table 2-1: Data Management according to the FAIR principles data source and acquisition[11]

FAIR Data Principles	
Data should be **Findable**	F1. (Meta)data are assigned a globally unique and persistent identifier. F2. Data are described with rich metadata (defined by R1 below). F3. Metadata clearly and explicitly include the identifier of the data they describe. F4. (Meta)data are registered or indexed in a searchable resource.
Data should be **Accessible**	A1. (Meta)data are retrievable by their identifier using a standardised communication protocol. A1.1 The protocol is open, free, and universally implementable. A1.2 The protocol allows for an authentication and authorisation procedure, where necessary. A2. Metadata are accessible, even when the data are no longer available.
Data should be **Interoperable**	I1. (Meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation. I2. (Meta)data use vocabularies and definitions that follow FAIR principles.

[10] Guidelines on FAIR Data Management in Horizon Europe, https://horizoneuropencpportal.eu/repository/5b7fcc0e-73da-4e76-8b46-3682a36fa59b
[11] https://www.go-fair.org/fair-principles/

	I3. (Meta)data include qualified references to other (meta)data.
Data should be **Reusable**	R1. (Meta)data are richly described with a plurality of accurate and relevant attributes. R1.1. (Meta)data are released with a clear and accessible data usage license. R1.2. (Meta)data are associated with detailed provenance. R1.3. (Meta)data meet domain-relevant community standards.

2.1 Data Sources and Acquisition

Data collected in FORTESIE were both public/open data available on the internet and internal operational data collected or generated from/by partners, mainly pilot and research organisations. The data collected in FORTESIE involved the following data sources:

- Document-based data, including:
  - Interviews and surveys with stakeholders participating in the pilots during requirements elicitation, as well as validation of the FORTESIE solution.
- Operational data produced during the project execution:
  - Public/Open data, such as energy consumption, weather, ESIE performance data gathered from sensors monitoring the buildings, etc.
  - Internal energy-related data from pilots, such as energy monitoring data, smart meters data, PV plant production, electricity bills etc.
  - Mobile app (users' data) including user's profile, home description, and input regarding the behaviour model recommendations/tips, to be defined in more detail during project specification.
  - Data from stakeholder outreach and marketplace onboarding activities conducted by dissemination partners (e.g., stakeholder contact databases, workshop attendance records, partner registration data for the FORTESIE Marketplace)

2.2 Types of Data

In addition, a main point of the DMP includes the definition of the open access approach over the data. Open Access (OA) refers to the practice of providing online access to scientific information that is free of charge to the end-user and reusable. 'Scientific' refers to all academic disciplines. In the context of research and innovation, 'scientific information' means:

- peer-reviewed scientific research articles (published in scholarly journals) and/or
- research data (data underlying publications, curated data and/or raw data).

Open Access[12] to scientific publications means free online access for any user. The two main routes to Open Access are:

- Self-archiving / 'green' Open Access – the author, or a representative, archives (deposits) the published article or the final peer-reviewed manuscript in an online repository before, at the same time as, or after publication. Some publishers request that open access be granted only after an embargo period has elapsed.

[12] HE Programme Guide, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf

- Open Access publishing / 'gold' open access - an article is immediately published in open access mode. In this model, the payment of publication costs is shifted away from subscribing readers. The most common business model is based on one-off payments by authors.

Research data refers to information, in particular facts or numbers, collected to be examined and considered as a basis for reasoning, discussion, or calculation. In a research context, examples of data include statistics, results of experiments, measurements, observations resulting from fieldwork, survey results, interview recordings and images. The focus is on research data that is available in digital form. Users can normally access, mine, exploit, reproduce and disseminate openly accessible research data free of charge. Figure **1**: Open Access strategy for publications and research data presents the process flow towards defining the open access type in scientific publications and research data.

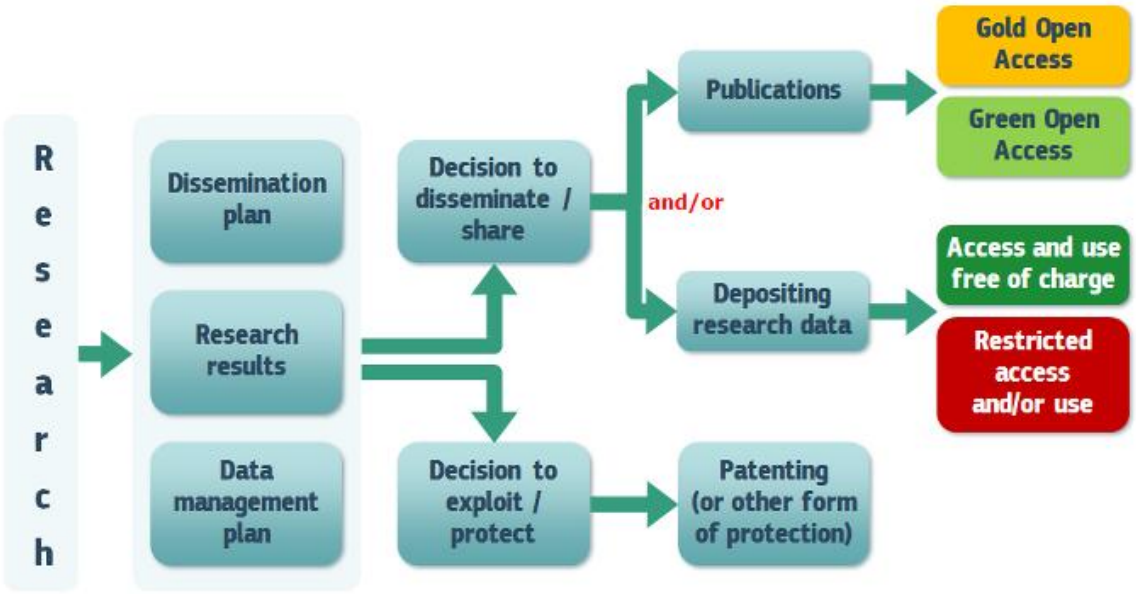


Figure 1: Open Access strategy for publications and research data[13]

The open access mandate comprises two steps:

1. depositing publications in repositories
2. providing open access to them

2.3 Data Management Requirements

The FORTESIE Data Management Process is defined as a management approach for each result generated or collected during the project runtime. Such an approach outlines requirements for several data management aspects, including data classification, data archiving, data performance, data safety and security, FAIR data management and data ethics. These aspects refer to the FORTESIE platform as well as to other assets of the project, namely the FORTESIE Portal, the project's shared repository (ProofHub), the research data online repository (Zenodo), FORTESIE's code repository (GitHub), and the project communication channels. The FORTESIE requirements and corresponding

[13] https://ec.europa.eu/research/participants/docs/h2020-funding-guide/imgs/open-access.png

processes for the aforementioned data management aspects are presented in the following paragraphs.

2.3.1 Data Classification

For proper data handling, datasets needed to be primarily classified as public and non-public. The following questions had to be answered to classify the different datasets:

1. **Does a result provide significant value to others or is it necessary to understand a scientific conclusion?**

If this question is answered with yes, then the result is classified as public (granted for open access). If this question is answered with no, the result is classified as non-public. For example, code that is very specific to the FORTESIE platform (e.g., a database initialisation) is usually of no scientific interest to anyone, nor does it add any significant contribution.

2. **Does a result include personal information that is not the author's name?**

If this question is answered with yes, the result is classified as non-public. Personal information beyond the name must be removed if it should not be published according to the ethical principles of the project and/or applicable data protection laws.

3. **Does a result allow the identification of individuals even without their names?**

This is also a step managed by the legal/ethical framework of the project as we have committed in the FORTESIE project to establish encryption techniques and store personal data securely. Datasets had to be anonymised for impact assessment and research purposes. The personal data collected as part of the project were limited to the project submission and informed consent of participants about the use of personal data was required. Personal identity was protected by the use of anonymous codes. If this question is answered with yes, the result is classified as non-public.

4. **Can a result be abused for a purpose that is undesired by society in general or contradicts societal norms and the project's ethics?**

If this question is answered with yes, the result is classified as non-public.

5. **Does a result include business or trade secrets of one or more partners of the project?**

If this question is answered with yes, the result is classified as non-public. Business or trade secrets need to be removed in accordance with all partners' requirements before it can be published.

6. **Does a result name technologies that are part of an ongoing, project-related patent application?**

If this question is answered with yes, then the result is classified as non-public. Of course, results can be published after the patent has been filed.

7. **Does a result break the security interests of any project partner?**

If this question is answered with yes, the result is classified as non-public.

This is a simple structural approach to determine the different data types defined as part of the DMP. The responsibilities of the FORTESIE consortium partners towards disseminating the project outcomes are defined in the following section.

2.3.2 Data Archiving

As the FORTESIE technical solution grew more mature, more and more data was ingested to the platform. Such data could be public-interest data (e.g., weather data), operational data from smart meters in pilot sites, or personal data from new users. For the first two categories, data was ingested to the systems at very high frequencies, resulting in large volumes of data. Such data tends to be very useful when they are fresh for the development of real-time services, while after a short time from their ingestion they are mostly used for static analysis and for batch processing analytics. Moreover, the probability to update such data is very low, especially after some days. Such data is available (only read permissions) in batches to users only if they are authorised to have access to it. In general, access to data in FORTESIE is granted via an identity management component. This component makes sure that a user is authenticated to FORTESIE and provides access to the requested resources only if access policies to the requested resources are in line with the request. Of course, access policies for each dataset were decided by the data owners.

Regarding personal data, they are stored for a limited period and then deleted. The personal data collected as part of the project was limited to the project submission while informed consent of participants about the use of personal data was also required. Personal identity was protected by the use of anonymous codes. The relation of real names and codes was only known to project partners who kept the records in a secure place.

2.3.3 Data Performance

As already mentioned in Section 2.3.2, FORTESIE made use of large amounts of different types of data coming from heterogeneous sources and providers. Amongst others, the continuous availability of such data is an indisputable attribute that entails high computational and performance requirements.

The FORTESIE complete framework was deployed at pilot sites through controlled environments, decoupled from 'production' environments, with the use of a dedicated data processing infrastructure for experimental purposes exploiting large volumes of historic and live data, anonymised, or simulated. This alleviated the burden of using only the computational resources of an integrated system and transferred the computational load of data processing, analysis, etc. to the pilot sites.

In addition, the FORTESIE platform envisaged an architecture that separately addresses each stage of the data flow within the platform i.e., data interoperability and homogenisation, data streaming, and data storage.

FORTESIE gathered an abundance of data from IoT and other sensors, historical data, data from pilots' private databases, open data from public databases, and data from questionnaires, among others. Regarding data interoperability and homogenisation of IoT and sensor data, data captured was translated by IoT and System adapters to NGSI (Next Generation Service Interfaces) data models and stored in the FIWARE Data Broker[14]. Data Homogenisation was carried on in this layer and, to the extent that it is possible, community smart data models were used. In this way, the upper layers of this architecture, where the processing is held, consist of existing software tools or newly developed ones that are reusable by the community, ensuring standardisation in the industry. The upper layer consists of monitoring and simulation components, task scheduling, reasoning, analytics, and optimisation engines, where each service can be granted access to specific data that is relevant to its purpose and can transfer back processed data to the unified data collection system. Data collected to the data broker from all layers is subject to data sovereignty rules. Permissions to access data is

[14] https://www.fiware.org/about-us/

individually granted or revoked to every data consumer. Authorisation components were used that comply with industry security standards.

2.3.4 Data Protection and Security

Processing of personal data followed the REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and until valid, the repealing Directive 95/46/EC (General Data Protection Regulation - GDPR).

Based on the requirements of the GDPR, appropriate organisational and technical measures were implemented to safeguard the protection of personal data (i.e. anonymisation, pseudonymisation, encryption at rest and in transit, hashing, tokenisation, key management practices that protect data across all applications and platforms, etc). The personal data collected as part of the project was limited to the project scope and informed consent from participants, about the use of personal data, was required. A template of the draft consent forms that were sent to each pilot can be found in Annex B.

Internal operational data that were collected or generated from/by partners throughout the whole period of the project are held in data repositories in the respective servers of each partner. The servers will be kept in locked rooms with strict access mechanisms adhering to appropriate security standards while making use of state-of-the-art security mechanisms. Access to the repositories is allowed only to authorised personnel both at the physical and network level. Where datasets are stored in databases, access is allowed only to authorised users, provided a unique username and password, following access privilege rules. Backups of the databases are stored encrypted and on the premises of each respective organisation. Data backups of devices happen regularly and are stored in devices that follow the same security standards and procedures as the main server.

Transfer of data follows established good practices, such as encrypting files and sharing the keys/passwords via secure means.

Processing of document-based data is supported via a dedicated platform (ProofHub). According to their privacy policy[15] and security information[16]:

- it employs "*state of the art technology to maintain high standards of data security and ensure that … communications are secure, and businesses are protected*",
- "*all data is encrypted via SSL/TLS when transmitted*",
- *"On hourly basis, data gets backed up and copies of the data are saved and secured at an off-site location for disaster recovery"*[17]*, while* "*database backups are encrypted*",
- "*items and files deleted are moved to trash from where they are purged after 15 days*" unless we empty the trash manually in which case "*data is purged immediately*",
- "*data is saved on reliable servers and written to multiple disks and stored in multiple places to remove even the minutest point of failure*",
- access to data is granted "*only to authorised team members*",

[15] https://www.proofhub.com/privacy
[16] https://www.proofhub.com/security
[17] https://help.proofhub.com/plus/account/security-backup-data/

Additionally, ProofHub allows document-based data to be available in a read-only or downloadable format, hindering access to information by unauthorised users. Moreover, it supports file versioning[18].

Documents with restricted access remain in a locked cabinet at the organisation's premises.

2.3.5 FAIR Data

The international FAIR Principles have been formulated as a set of guidelines for the reuse of research data. The acronym FAIR stands for findable, accessible, interoperable, and reusable research data.

FORTESIE takes the opportunity to contribute towards the acceleration of materialisation of GAIA-X[19] in the energy domain and therefore, its architecture supports effective and trusted sharing of data among participants covering all requirements to support future data marketplaces:

(A) Data Interoperability: open source, standardised, and domain agnostic NGSI API ensures the interoperability of data between different systems.

(B) Data Sovereignty and Trust: The Identity Management of FIWARE allows identification, authentication, and authorisation of organisations, and individuals, while IDS Connector facilitates trusted data exchange.

(C) Data value creation: FIWARE NGSI Marketplace will be used to: (i) define new data asset types; (ii) register offerings which typically means providing the description of the asset, the data models, the endpoints, the terms, and conditions of exchanging data including SLAs, legal clauses, and pricing schema; (iii) ability to navigate and search/discover existing offerings based on selected criteria.

All the aforementioned FIWARE functionalities ensure data manipulation in FORTESIE based on FAIR principles (Findability, Accessibility, Interoperability, and Reusability).

2.3.5.1 Making data findable

Storage, processing and sharing (among project participants) is supported via a dedicated platform (ProofHub), whereas interaction with the wider public is achieved through the official project website. Also, data is being stored at the coordinator's private cloud infrastructure repository and is kept for a minimum of 5 years after the end of the project. Where requested, data will be kept for 2 more years.

A naming convention includes a concise description of contents, the host institution collecting the data and the month of publication.

Version numbering was only an issue if a participant requested withdrawal of their data in which case a version number was added to the filename.

Appropriate technical measures were implemented ensuring that data could not identify any individuals and therefore real names of participants were not distributed.

FORTESIE exploits building performance data in relation to some user actions, data collected (or metadata created) by different sources (mostly collected by building monitoring sensors and actuators and user interactions by a mobile app) during the period of renovation/digitisation interventions.

[18] https://help.proofhub.com/plus/files/file-versioning-2/
[19] https://www.data-infrastructure.eu/GAIAX/Navigation/EN/Home/home.html

FORTESIE's data sovereignty module adopted and extended FIWARE components for data manipulation and sharing to create a data platform defining common data model, standardised APIs, and viable data sharing policies (FAIR), and the Orion-LD context broker[20] was adopted and extended with services for data IoT data devices (gateways). Throughout the FORTESIE project, the Marketplace was used to: (i) define new data asset types; (ii) register offerings which typically meant providing the description of the asset, the data models, the endpoints, the terms and conditions of exchanging data including SLAs, legal clauses, and pricing schema; (iii) ability to navigate and search/discover existing offerings based on selected criteria.

2.3.5.1.1 Discoverability of the data

Taking into account the FAIR data principles (meta)data has:

- Been assigned to a globally unique and persistent identifier;
- Contained enough metadata to fully interpret the data, and;
- Been indexed in a searchable source.

2.3.5.1.2 Data identification mechanisms

All documents are identified by the project name, followed by a unique and persistent document type designator and number provided by the coordinator for the submission to the European Commission (EC). Versioning of the document is part of the document name and title.

Document identification also includes the task or deliverable number, used to identify the document, followed by a brief title of the activity or deliverable.

FORTESIE also publishes data through scientific articles, in which case DOIs were provided from the publisher. For other literature, such as reports and policy recommendation, DOIs were assigned via the repository in which they were archived (e.g., Zenodo).

2.3.5.1.3 Naming conventions

To **(i)** enhance data searchability and discoverability, and **(ii)** provide clues to the content, status, and versioning of the files, each set of data produced (dataset, deliverables, etc…) has been named in a uniform way and includes a table with a version control.

The recommendations to name the documents of the project were as follows:

- Choose easily readable identifier names (short and meaningful);
- Do not use acronyms that are not widely accepted;
- Do not use abbreviations or contractions;
- Avoid language-specific or non-alphanumeric characters;
- Add a two-digit numeric suffix to identify new versions of one document.
- Dates should be included back to front and include the four-digit years: YYYYMMDD.

For deliverables: **Project's name - Dx.y - [Name of the deliverable as described in the DoA]** being x - work package assigned to the deliverable y - the number of deliverables within the work package i.e.: D.1.4 - Data management plan. Report and updates M43.

For datasets: **Project's name - P [Pilot number; pilot activity number] - D [Dataset identification number; description of the dataset]** e.g., FORTESIE-Pilot1-Dataset1Easy-to-use search keywords

[20] https://fiware-orion.readthedocs.io/en/master/

were used in FORTESIE to optimise the reuse of data by interested stakeholders. The metadata standards employed by FORTESIE provide opportunities for tagging the data collected/generated and its content with keywords.

In general, the keywords comprised terms related to the topics addressed, such as energy efficiency, energy renovations, smart contracting, innovative business models, fair energy transition, capacity building in the energy sector, green currency, smart renovations, energy efficiency policies, as well as keywords specific to the project, such as FORTESIE, Horizon Europe, etc.

The keywords accurately reflected the content of the datasets and avoided words used only once or twice within them.

2.3.5.2 Making data openly accessible

Data is made available where possible, subject to ethics and participant agreement. FORTESIE uses FIWARE Identity Management via the data sovereignty module, which allows identification, authentication, and authorisation of organisations and individuals, while IDS Connector[21] facilitates trusted data exchange. As a result, data is both accessible and trustworthy.

2.3.5.3 Making data interoperable

The concept of interoperability necessitates machine-readable data and the use of consistent terminology. FORTESIE supports the Data Interoperability principle by providing an open source, standardised, and domain agnostic NGSI API that ensures data interoperability across systems.

2.3.5.4 Increase data re-use

2.3.5.4.1 Increase data re-use through clarifying licences

The use of Creative Commons licences, the default being CC-BY, ensures that data is widely re-usable. This licence is used for research articles, allowing copying, distribution and transmission of work without affecting key author rights. The re-use of data (if needed) is restricted to the research use of the license and anonymous data is being used for scientific publications. Data may not be copied or distributed and must be referenced if used in publications. The collected data is being a consolidation of data from several sources, each one having its own policies.

2.3.5.4.2 Data quality assurance process

The data quality principle comprises that data is being of good quality, i.e., the data has to be accurate and up to date. This implies that personal data processing is done following the EU, national and international laws taking into account the "data quality" principles listed below:

- Data processing is adequate, relevant and non-excessive.
- Accurate and kept up to date.
- Processed fairly and lawfully.
- Processed in line with data subjects' rights.
- Processed in a secure manner.
- Kept for no longer that necessary and for the sole purpose of the project.

[21] https://internationaldataspaces.org/offers/ids-components/

The data quality assurance process is in accordance with the REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.

2.3.5.4.3 Length of the time in which the data will remain re-usable

The Consortium contributes to maintaining data reusable as long as possible after the end of the project. A period of 5 years has been established unless otherwise requested. Data will be kept stored, remaining reusable, in the relevant infrastructures for the required period.

2.3.6 Allocation of resources

Publication of the FORTESIE results and assets to the aforementioned publishing platforms in a way that makes them FAIR did not require extra costs as these services are provided for free to its users.

2.3.7 Privacy and Data Protection

2.3.7.1 Removing Personal Identifiers

Datasets are being anonymised for impact assessment and research purposes. The personal data collected as part of the project was limited to the project submission and informed consent of participants about the use of personal data was required. Personal identity was protected using anonymous codes. The relation of real names and codes was only known to project partners who kept the records in a secure place. The relation of applications was coded and is available for external evaluators with such coding. In case data needs to be transferred to non-EU partners, we will obtain approvals from the competent Data Protection Office, unless those countries are on the list of countries that provide adequate safeguards with respect to the protection of the privacy and fundamental rights and freedoms of individuals and as regards the exercise of the corresponding rights. All copies of approvals /notifications regarding the processing of personal data by the competent institutional Data Protection Office can be made available upon request to the EC. Personal data has been encrypted and stored securely. The personal data protection processes followed the REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons regarding the processing of personal data and on the free movement of such data, and until valid, the repealing Directive 95/46/EC (General Data Protection Regulation).

2.4 Data Archiving and Preserving Infrastructure

Along with the definition of the datasets, special focus was delivered on the selection of the platform to archive and preserve the datasets. Upon the selection of a repository, it was important to consider factors such as whether it[22]:

- Gave the submitted dataset a persistent and unique identifier. This was essential for sustainable citations – both for data and publications – and to make sure that research outputs in disparate repositories can be linked back to particular researchers and grants.

[22] How to select a data repository? https://www.openaire.eu/opendatapilot-repository-guide

- Provided a landing page for each dataset, with metadata that helped others find it, tell what it is, relate it to publications, and cite it. This makes research more visible and stimulates the reuse of the data.
- Helped to track how the data has been used by providing access and download statistics.
- Responded to community needs and was preferably certified as a 'trustworthy data repository', with an explicit ambition to keep the data available in the long term.
- Matched particular data needs (e.g.: formats accepted; access, backup and recovery, and sustainability of the service). Most of this information should be contained within the data repository's policy pages.
- Provided guidance on how to cite the data that has been deposited.

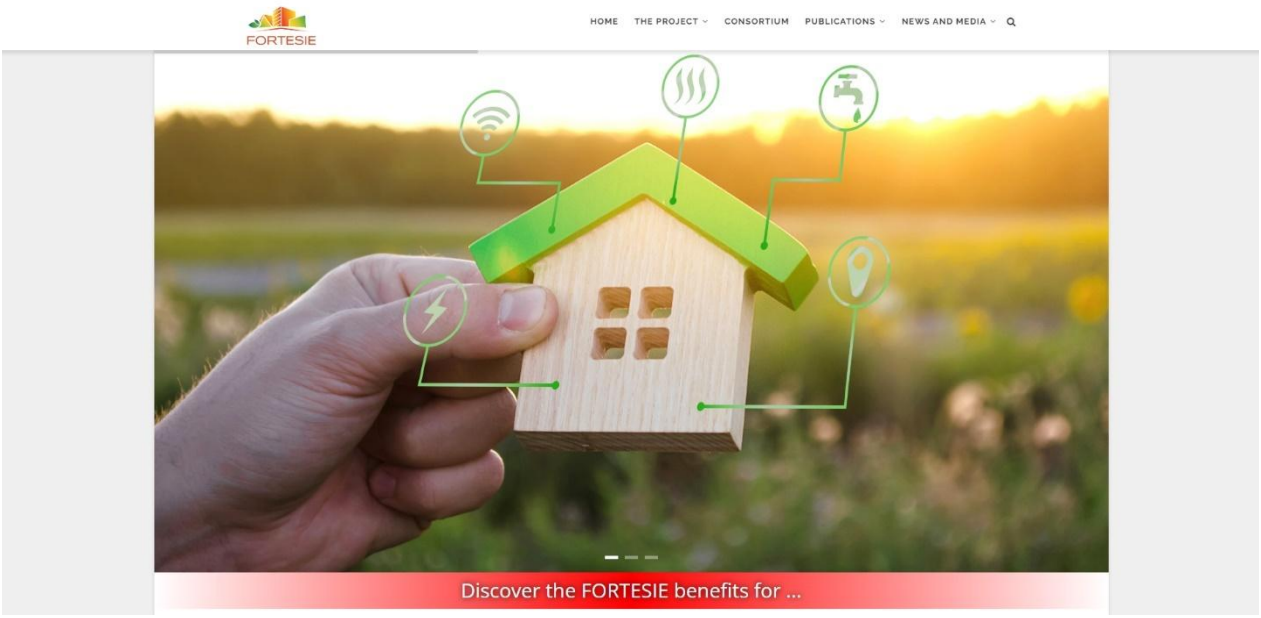
2.4.1 FORTESIE Website

The FORTESIE consortium decided early to set up its own project-related webpage. This webpage describes the objectives and the general approach of the project, the partners, the pilots, and its development status. A "news and media" tab informs about news on a regular basis. A dedicated section for publications (giving the opportunity of downloading) is used to publish public deliverables, reports, and white papers.

All documents that are being published use the portable document format (PDF), while all downloads have been enriched by using simple metadata information like the title and the type of the document. The webpage was designed and developed by the partner of the consortium INCL.

All webpage-related data is backed on a regular basis by INCL. All information on the FORTESIE website can be accessed without creating an account. The webpage has been backed up at regular intervals by INCL.

The FORTESIE webpage has been available during the project runtime and will still be available for at least two years after the official project end.



Web link: https://fortesie.eu/

2.4.2 ProofHub

ProofHub[23] is a project planning software that includes several tools for team cooperation, a calendar for tasks and deadlines, file repositories, chatting functionalities and the possibility to create different topics for parallel streams of activities. It is a web-based browser application, developed by ProofHub LLC in 2011.

ED as the project coordinator has purchased ProofHub "as a service" and the FORTESIE project has used it to store project related data internally in the system. Access to the FORTESIE ProofHub is controlled by ED and given only to authenticated FORTESIE partners.

ProofHub Link: https://eurodyn.proofhub.com/bapplite/#app/overview/project-6585418367

2.4.3 Zenodo

Zenodo[24] is a research data archive/ online repository which helps researchers share research results in a wide variety of formats for all fields of science. It was created through EC's OpenAIRE+ project[25] and is now hosted at CERN using one of Europe's most reliable hardware infrastructures. Data are backed nightly and replicated to different locations. Zenodo supports not only the publication of scientific papers or white papers, but also the publication of any structured research data (e.g., using XML). Zenodo provides a connector to GitHub that supports open collaboration for source code and versioning for all kinds of data. All uploaded results are structured by using metadata, like for example the contributors' names, keywords, date, location, kind of document, license, and others. Considering the language of textual metadata items, English is preferred. All metadata is licensed under CC license

[23] https://www.proofhub.com/
[24] https://en.wikipedia.org/wiki/Zenodo
[25] https://www.openaire.eu/

(Creative Commons 'No Rights Reserved'[26]). The property rights or ownership of a result does not change by uploading it to Zenodo.

All public results related to scientific publications that were produced during the FORTESIE project were uploaded to Zenodo for long-term storage and open access.

Project Zenodo Link: https://zenodo.org/communities/fortesie_eu_project/records

2.4.4 Code Repositories: GitHub

FORTESIE used two different types of repositories for the programming code that it was generated under the context of the FORTESIE technical solution.

Private tools were stored in private repositories or infrastructure belonging to specific project partners, providing access to all consortium members or just the members to whom a specific tool belongs.

For open-source components, the FORTESIE technical team explored various options of open code repositories such as GitHub.

GitHub[27] is a well-established online repository that supports distributed source code development, management, and revision control. It is primarily used for source code data. It enables worldwide collaboration between developers and provides some facilities to work on documentation and track issues.

GitHub provides paid and free service plans. Free service plans can have any number of public, Open Access repositories with unlimited collaborators. Private, non-public repositories require a paid service plan. Many open-source projects use GitHub to share their results for free. The platform uses metadata like contributors' nicknames, keywords, time, and data file types to structure the projects and their results. The terms of service state that no intellectual property rights are claimed by the GitHub Inc. over provided material. For textual metadata items, English is preferred.

Web link: https://github.com/european-dynamics-rnd/FORTESIE_data_model

2.4.5 Project Communication Channels

Besides the FORTESIE website, project-specific Web 2.0 channels have been launched aiming at extending the visibility of the project's activity. These include FORTESIE accounts on:

- LinkedIn: https://www.linkedin.com/company/fortesie-horizoneu/
- Facebook: https://www.facebook.com/profile.php?id=100087107495674
- Instagram: https://www.instagram.com/fortesie_horizoneu/

2.4.6 FORTESIE Platform

From a data management perspective, FORTESIE is a platform in which several datasets (structured or unstructured) from different energy data sources (e.g., sensors, IoT devices, smart meters, etc.) are ingested on a daily basis, either in batches (batch data ingestion) to facilitate aggregate analytics services, and services based on historical data, or through data streaming technologies, to facilitate near real-time services. As a next step, data has been processed, in order to improve their quality, and homogenised and modelled, in order to be efficiently shared with users or sent to the data analytics

[26] https://creativecommons.org/share-your-work/public-domain/cc0/
[27] https://en.wikipedia.org/wiki/GitHub

services in an understandable format. After this step, data are being transferred to a storage, to be queried and utilised by energy analytics services and users.

Of course, a security and access control component, on top of the data management services is of paramount importance. This component is responsible for securing that only authenticated and authorised users and services can have access to the requested resources. So, if a user is not logged in to the platform, the access control component will prohibit access to the requested resources. The same applies to authenticated users that try to access a resource (data or service) and do not have permission to the requested resource. For this functionality user data is stored in a relational database. Regarding security, the provided security framework offers data encryption, vulnerability detection and mitigation, as well as user behaviour monitoring and auditing.

2.5 Intellectual Property Rights (IPR) Guidelines in the context of FORTESIE

In the context of the FORTESIE project, appropriate IPR handling was very important to maximise exploitation and dissemination results and overall projects' outcomes while at the same time ensuring the protection of intellectual property. Therefore, it was crucial to identify the IPR of the datasets, the software, the tools, and the knowledge that was going to be used or produced in the project. This included licensing schemes, terms of usage and access rights of these assets.

IPR handling has been addressed privately within the project. In brief, it concerned IPR management at the Consortium level, covering issues relating to access to the background, ownership of foreground and results, access rights and IPR protection regarding dissemination activities.

In addition, activities of WP5 and more specifically Task 5.4: Exploitation Planning has provided details of IPR and ownership of results to safeguard the rights of all partners. In particular, Deliverable D5.4 and D5.5 have and will provide information on the ownership of background and foreground. In addition, D5.4 and D5.5 describe how IPR will be safeguarded after the project's completion and concern the ownership of the results that may be generated after the end of the grant period.

Furthermore, the obligations, rights and responsibilities of partners are described in Consortium Agreement (CA) signed by all partners. Issues regarding IPR, such as joint ownership of results or cases in which IPR are affected, are also prescribed in CA. In addition, details about the background that each partner brings into the project are described in CA.

3 FORTESIE Datasets

In this section, a list of all the existing results for dissemination is presented, separated into public deliverables, Private and Open-Source software components, publications, and pilot-related data. For each result and in accordance with the FAIR data management guideline we provide a description and name of the standards used for storage and metadata (to make data findable & interoperable).

3.1 Dataset I: FORTESIE List of Public Deliverables

We are considering the FORTESIE Project public deliverables as part of the data management plan. The following table presents the list of public deliverables of the FORTESIE project.

Table 3-1: List of FORTESIE public deliverables

D_ID	Title	Due Date
1.1	Quality, risk and innovation handbook	M3
1.2, 1.4	Data management plan. Report and updates	M6, M43
2.1	End-user and pilot requirements and use-cases description	M6
2.2, 2.5	FORTESIE services co-creation	M9, M25
2.3, 2.6	Reference architecture and components functionality	M9, M25
2.4, 2.7	Business models analysis for each service	M9, M30
3.4,3.5	Report on the renovation technologies selected for each building, and deployment approach	M20, M37
4.2	Engagement Plan and Social Acceptance assessment	M18
4.3, 4.4	Pilots execution documentation and validation assessment	M30, M40
5.3	Interaction with European projects and strategies, ECB and DeFi communities	M43
5.4,5.5	Online OSS demonstrated and exploitation planning and IPR report including alternative financing schemes	M18, M43
6.1	Communication and Dissemination Plan	M3
6.2	Website operational and promotional materials	M3, M18, M24
6.3, 6.5	Communication, dissemination, and stakeholder engagement report	M18, M43
6.4	White Paper: lessons learnt and policy recommendations	M43

3.2 Dataset II: EU Classified Deliverables: Handling of EU Classified Information (EUCI)

The FORTESIE Consortium is obliged to respect the security rules for protecting EU Classified Information (EUCI), as laid down in Commission Decision (EU, Euratom) 2015/444. This means that the FORTESIE partners handle EUCI in line with the principles, rules and procedures established therein. By compromising or losing EUCI we are aware that we do not only breach the grant agreement, but we are also liable to disciplinary and/or legal action in accordance with applicable (national) laws, rules and regulations.

For information marked as such, no Personnel Security Clearance Certificates need to be issued according to the aforementioned Euratom Decision.

However, the FORTESIE Consortium is aware that EU RESTRICTED deliverables require special treatment:

- **Need-to-know**: To access EUCI, individuals need to have a need-to-know (i.e., you need the information to perform a specific professional function or task).
- **Awareness of the Security Rules**: Individuals may only be granted access after they have been briefed on the security rules and have acknowledged their responsibilities.
- **By post**: Documents should be sent in double, opaque envelopes. The inner envelope must be sealed and marked RESTREINT UE/EU RESTRICTED. The documents/USB key/CD ROM inside must bear the same marking.
- **Electronic transmission**: The documents are encrypted with approved encryption tools (i.e., FILKRYPTO) and sent via e-mail. EU classified deliverables shall not be uploaded via the portal.
- **Storage**: When not in use, the documents shall be stored in a locked container or a locked cupboard.
- **Consultation**: Only in secure areas where nobody is able to read or remove the documents.
- **Printing/copying**: Printing and/or copying of documents is not allowed.
- **Notes**: Reference to EUCI in the partners' notes means that the notes should be treated as RESTREINT UE/EU RESTRICTED documents.
- **Communication**: There shall be no communication about the EUCI via phone, e-mail or in unsecured areas. The information shall not be discussed with persons who do not have a justified need-to-know.
- **Meetings**: Meetings on EUCI are organised on an invitation-only basis and all attendees need to have a need-to-know. Attendees should sign an attendance sheet at the beginning of a meeting. Meetings should take place behind closed doors. The windows and blinds in the room must be closed. Mobile phones and other portable devices must be switched off or left outside of the meeting room. Wireless microphones may not be used, and microphones/speakers should be switched off. If RESTREINT UE/EU RESTRICTED documents are distributed at the beginning of a meeting, the exact number of documents necessary must be distributed and they must be returned to the Chair, collected, and accounted for. No stock may be held in the room. If EUCI is presented or projected on a screen, the computer or laptop used must not be connected to a network. During breaks, meeting rooms must be locked and guarded. Feedback on EUCI must be raised during the specific time slot dedicated to its discussion (on the agenda).

- **Breach or compromise**: In case of a (potential) breach or compromise of EUCI, the partner/partners must immediately inform the REA SPOC TEAM (REA EUCI SPOC REA-EUCI-SPOC@ec.europa.eu) and the responsible REA Project Officer. No attachment of EU Classified Information shall occur during this communication.
- **Duration**: Obligations vis-à-vis the protection of EU classified information continue to persist after the life of the project.

3.3 Dataset III: Private and Open-source Software Components

The analysis is performed by considering the list of exploitable components. An indicative list, to be updated (with additions, deletions, etc.) after architecture finalisation, is presented in the following table. Additionally, sections 3.3.1-3.3.8 present information regarding the inputs, outputs, and hyperparameters of each component.

Table 3-2: FORTESIE Software Components

Title	Responsible Partner
Data Sovereignty Module	ED
Gamified Mobile App	ED
Green Euro-Neobanking App	CCO2
Behavioural model and recommendation engine	SIN, NTUA
Measurement and Verification Component	CTIC
Blockchain/Smart Contract based M&V calculation module	CTIC
Online renovation & ESIE Marketplace	ED

3.3.1 Data Sovereignty Module

Table 3-3: Data Sovereignty Module Data Requirements

Data Requirements	
Input data	Data from all sensing devices and external systems (i.e., local weather)
Output data	All input data transformed to the commonly agreed model and compliant with NGSI specification. They were provided to all modules which process data, including almost all of the above, except the online renovation & ESIE marketplace, which deals with separate data.
Hyperparameters	• Stored and made available for all the processing needs of identified/selected system components. • Managed with the FAIR principle

3.3.2 Gamified Mobile Application

Table 3-4: Gamified Mobile Application Data Requirements

Data Requirements	
Input data	• Users' input (i.e., registration of new users, inserting necessary information where needed, profile and building description, performance input (actions, or feedback on recommendations, etc.)) • Data/measurements from the meters/sensors installed in the building/residence. • Newly processed data produced by the FORTESIE platform, using data related to the two previous bullet points
Output data	Processed data. • Visualisation data (i.e., energy consumption for specific time intervals, Savings Display, CO_2 available/gained/spent points, etc.) • Personalised recommendations, game challenges and rewards gained. • Help with complex tasks and tips for improving performance.
Hyperparameters	• Monitor the ESIE performance (daily, weekly, monthly) for the identified measurements for each pilot. • Check graphs that analyse the ESIE performance compared to a baseline (daily, weekly, monthly) • Check the individual sensors' measurements e.g., indoor and outdoor (regional) temperature, humidity, energy consumption, energy bill, etc. • Receive personalised messages and recommendations related to ESIE performance improvements. • Earn Rewarding Green Euros badges of different categories (weekly/streak, tree, monthly, quiz and profile) and visualisation of progress (e.g. "grow" the home "tree" page tree). • Check the earned points Green Euros and Green Euros balance at any time. • Feedback on achieving ESIE: Easy to understand visualisation of ESIE performance data and achievements per pilot (e.g. through in graphics, points shown or/and "tree" page Tamagochi figure (tree growth))Personalised challenges to engage users in actions (vote for reducing comfort levels, or behavioural change actions) • Comparison of challenges to measured achievements.

3.3.3 Green-Euro Neobanking Application

Table 3-5: Green Euro Neobanking Application Data Requirements

Data Requirements	
Input data	• KYC (Know Your Customer) - a legal and mandatory process, part of European regulation. Includes documents and information from the end users (legal information, proof of identity, proof of residency, delivery point, etc.) • Consumption Data from partners (type of heating systems, real consumptions, PDL, etc.) • Proof of consumption (bills, other certified documents)
Output data	• A banking account & credit card (with 0 charges in the euro zone for card payments or transfers) where GE earned are automatically made available. • A banking application • Dashboard on CO_2 emission performance including timelines.

	• A simple application (open source and open data) to estimate, compute and compare carbon footprints (for housing, transport, and food habits) • Personalised recommendations to engage users in actions (renovations, heating system improvements, transports). • Personalised challenges leading to €G rewards in order to reinforce user engagement. • A personalised API to each of our partners to proceed with agreed actions automatically & consult data (e.g., earned, badges, etc.).
Hyperparameters	• CO2 credit transactions and monitoring. • Study a €G smart contract implementation. • A loan offer around 0.5% APR or even negative APRs for projects to renovate dwellings in order to reduce users' energy consumption and CO2 emissions.

3.3.4 Price Comfort Application

Table 3-6: Price comfort Application Data Requirements

Data Requirements	
Input data	• Consumption Data from partners (type of heating systems, real consumptions, PDL, etc.) before and after renovation. • Proof of consumption (bills, other certified documents).
Output data	• An energy saving/ CO2 app where Price-comfort value of the user is displayed, before and after renovation. • Dashboard on Price-comfort and energy consumption after renovation with current monthly values and targeted values. • Dashboard on CO2 emission performance. • Dashboard on inside house comfort data (temperature, humidity, CO2) • €Gs earned are automatically made available. • A simple application (open source and open data) to estimate, compute and compare carbon footprints (for housing, transport, and food habits) • Personalised recommendations to engage users in actions (renovations, heating system improvements, transports). • Personalised challenges leading to €G rewards in order to reinforce user engagement. • A personalised API to each of our partners to proceed with agreed actions automatically & consult data (e.g., earned, badges, etc.).
Hyperparameters	• Price-comfort analysis through various users and geographical regions.

3.3.5 Behavioural Model and Recommendation Engine

Table 3-7: Behavioural Model and Recommendation Engine Data Requirements

Data Requirements	
Input data	a. Users' input (i.e., registration of new devices, inserting necessary information where needed, profile and building description, performance input (actions, or feedback on recommendations), preferences, actions, stakeholders' reactions to proposed energy solutions, etc.). b. Data/measurements from the meters/sensors installed in the residence. c. Data measurements from other mobile devices (e.g., smartphones, smartwatches, etc.) to prove the behaviour/mobility of a user.

	d. Newly processed data produced by the FORTESIE platform, using data coming from a., b., and c. above.
Output data	Engagement recommendations and personalised interaction flows which create user feedback loops that trigger meaningful changes in user behaviour, based on tailored UX, content design, and incentivisation. These will indicatively include: • Education material that empowers participants to learn more about how they can optimise their energy consumption behaviour, thus encouraging ongoing participation and continued app use. • Social rewards for participants, as people want to show that they care and that they behaved according to virtuous values. • Motivation pathways for energy savings. • Enlargement of results by nudging participants towards a bigger, common goal creating a community approach. • AI-based information, aiming at finer-grained energy profiling & forecasting, energy resources management, enhanced comfort & people's well-being. • Personalised suggestions, taking into account individual energy consumption, energy cost, carbon emissions, renewables production and thermal comfort.
Hyperparameters	• **Monitor the user performance** (daily, weekly, monthly) for the identified incentives for each user. • Check **graphs** that analyse the user performance compared to a **baseline** (daily, weekly, monthly). • Check the individual sensors' measurements e.g., **indoor and outdoor** (regional) **temperature, humidity, energy consumption, energy bill, etc.** to ensure that users are sticking to the proposed plan. • Feedback on achieving ESIE and different pathways based on the personal criteria of users to achieve the necessary savings. • Challenges to engaging users to behavioural change actions.

3.3.6 Measurement and Verification Component

Table 3-8: Measurement & Verification Data Requirements

Data Requirements	
Input data	• Measurements of energy consumption • Temperature measurements to calculate degree days • Smart performance contracts data definition (baseline, expected savings, energy price, bonus/malus shares)
Output data	• Savings • Baseline consumption (theoretical consumption based in the degree days based) • Energy billing • Bonus Malus sharing of the consumption • Zero Knowledge Proof of the calculation (encrypted data that proves the calculation without exposing the data)
Hyperparameters	The component takes data directly from the data sovereignty module to calculate the theoretical consumption based on a regression model and makes the comparison with the real consumption. Mimicking the real EPC calculations in the ESCOs to replicate the EPC billing each month. The component generates a Zero Knowledge Proof with the details of the calculations certifying them without exposing the private data.

3.3.7 EPC Blockchain Based Smart contract

Table 3-9: EPC Blockchain- Based Smart Contract Data Requirements

Data Requirements	
Input data	• Zero Knowledge Proofs cryptographic information • Minimal selectable public information (Savings, billing information)
Output data	• Certification of energy savings on a smart contract • Certification of calculations on a decentralised environment • Retrievable public data in a blockchain transaction.
Hyperparameters	The smart contract is designed to be a decentralised oracle that checks the validity of the calculations and publishes the results to be certifiable. This allows a high degree of certainty in the results and capability of issuing carbon credits tokens based on the kWh's savings in each of the contracts. Measuring in the most reliable way the savings and certifying them in a public ledger.

3.3.8 Online Renovation & ESIE Marketplace

Table 3-10: Online Renovation & ESIE Marketplace Data Requirements

Data Requirements	
Input data	a. Data provided by the users to inform about services or products offered, ESIE policies, available actions, and evidence collected per target group, and recommend active players in each region to contact for further support or collaboration. Financing mechanisms and programmes available in each country. (e.g., Exoikonomo, Σπίτι μου in Greece). National renovation policies and stakeholder directories contributed by dissemination partners. b. Success stories.
Output data	Feedback on visits, successful customers, collaborations contracts, and new projects initiated. Access to the relevant uploaded data by organisations registered.
Hyperparameters	Accounts/ profiles of registered organisations with services/ products offered. Knowledge hub concerning best practices, renovation policies and success stories

3.4 FORTESIE Scientific Publications

Along with the dissemination of project deliverables and datasets, scientific publications constitute a core component of the FORTESIE dissemination strategy, as outlined in this Data Management Plan. As of the time of this report, the FORTESIE project has generated a significant number of peer-reviewed scientific publications, including journal articles and conference papers, spanning topics such as energy renovation packages, behavioural change modelling, multi-objective optimisation for building retrofits, energy performance contracts, and demand-side management.

All scientific publications produced under the FORTESIE project are made available following the **Open Access** principles in accordance with the European Commission's Horizon Europe requirements. Specifically, publications are disseminated via the Gold Open Access route, ensuring immediate and unrestricted public access upon publication. Where Gold Open Access has been pursued, Article Processing Charges (APCs) have been covered either through project funding or through the publishing institutions. Publications have appeared in peer-reviewed open-access journals such as *Sustainability* (MDPI), *Energies* (MDPI), *Buildings* (MDPI), and *Open Research Europe*, among others.

In cases where conference papers have been presented and subsequently published in conference proceedings (e.g., IEEE, CEST) that are not publicly accessible, the project partners have ensured that manuscripts are also deposited in publicly accessible repositories where applicable, in compliance with the project's open access obligations. Fo the conference papers that have not yet been published in the conference proceedings, even though presented, authors will await for the official publication of proceedings and then ensure that manuscripts are available.

3.5 FORTESIE Pilots Data

The following data was collected from the project's pilots, based on a common FAIR-related questionnaire. The following table provides the central approach that was employed for pilot data gathering, given that the project developed a central/horizontal technical solution. The data collection template has been completed to reflect the final state of pilot data management at project end

Table 3-11: FORTESIE Data Collection Template

FORTESIE Data Collection **Data Outline**	
What is the origin of the data?	Energy Meters, Smart Meters, Environmental Sensors, Controllers (VFDs), Electrical bills, public weather station
What are the purpose and utility/usefulness of the data collection/generation?	Statistics, Energy Profile Creation, Energy Consumption Monitoring and Optimisation Logic for AHU Fun speed control, Improving current EPC
What is the direct or indirect relation to the objectives of the project?	Direct relation to reducing energy consumption and CO_2 footprint; provide real results and values to be able to improve the IPMVP practices
What are the types and formats of the data collected/generated?	csv, xlsx, JSON
FAIR Data ***Making data findable, including provisions for metadata***	
What metadata will you provide to support the discoverability of data?	Each NGSI-LD entity includes metadata such as `observedAt` timestamps, entity type, data provider, and the NGSI-LD `@context` linking to the FORTESIE Data Models vocabularies. The NGSI-LD `@context` (fortesie-context.jsonld) provides semantic descriptions and mappings for all attributes, enabling discoverability through standardised linked data mechanisms.
How data will be identifiable? What standard identification mechanisms will be used?	Each measurement is uniquely identified by an NGSI-LD URN following the pattern: `urn:ngsi-ld:fortesie:PILOT_NAME:BUILDING_ID: INSIDE_BUILDING_ID: SensorName-XXXX-Measurement` (e.g., `urn:ngsi-ld:fortesie:demo-

Will you make use of persistent and unique identifiers, such as Digital Object Identifiers?	1:building_ax8:dwelling_asx:ieq-001-temperature`). These URIs are persistent, globally unique, and conform to the ETSI NGSI-LD specification (ETSI GS CIM 009).
What naming conventions will be used?	The naming convention follows the scheme: `urn:ngsi-ld:fortesie:PILOT_NAME: BUILDING_ID:INSIDE_BUILDING_ID:SensorName-XXXX-Measurement`, where PILOT_NAME identifies the demo site (e.g., demo-1, demo-2_gar), SensorName indicates the sensor type (eem, tem, ieq, mt, ws), and Measurement specifies the observed quantity (temperature, relativeHumidity, pm25, activePower, etc.). Multi-tenancy is managed via `NGSILD-Tenant` headers (e.g., `fortesie_demo_1`).
What approach for clear versioning will be followed?	Data versioning is inherently handled by the NGSI-LD temporal representation (TRoE) stored in TimescaleDB. Every property update is recorded with an `observedAt` timestamp, providing a full temporal evolution of each entity attribute. The NGSI-LD `@context` (fortesie-context.jsonld) and data models are version-controlled in a Git repository.
What standards for metadata creation will be used (if any)? Otherwise, what type of metadata will be created and how?	Metadata is created following the ETSI NGSI-LD standard (ETSI GS CIM 009) and the FORTESIE Data Model. The FORTESIE JSON-LD `@context` file (fortesie-context.jsonld) maps entity attributes to standard ontologies from Smart Data Models (e.g., `dataModel.Energy`, `dataModel.Environment`, `dataModel.Weather`) and the FORTESIE custom data model.
FAIR Data ***Making data openly accessible***	
What data will be made openly available? What is the rationale behind data being kept closed (if any)?	Energy consumption data, indoor environmental air quality data
How the data will be made available?	Data is made available through the NGSI-LD API exposed by Orion-LD (context broker) for current entity state, and through the Mintaka temporal API for historical time-series data. Access is secured via PEP Proxy (Wilma) with authentication and authorisation enforced through Keyrock (IdM) and Authzforce (XACML PDP).

What methods or software tools are needed to access the data? Is documentation about the software needed to access the data included? Is it possible to include the relevant software (e.g., in Open Sourcecode)?	Data is accessed via standard HTTP REST APIs (NGSI-LD API and Mintaka temporal API) using tools such as cURL, Postman, or any HTTP client. All software components are open source FIWARE Generic Enablers: Orion-LD (context broker), Mintaka (temporal API), Keyrock (IdM), Wilma (PEP Proxy), and Authzforce (PDP). An OpenAPI specification is provided to all relevant stakeholders (miktakaOpenAPISpecs.yaml) and a Postman collection is included for testing.
Where the data and associated metadata, documentation and code are deposited? Are there any privacy issues associated with this process?	Data is stored in Timescale DB (temporal/historical data) and MongoDB (current entity state), both deployed on ED infrastructure using Kubernetes (EKS) with Helm charts. The NGSI-LD `@context` and data models are hosted via an Apache HTTP server within the deployment. Privacy is addressed through multi-tenancy isolation (NGSILD-Tenant per pilot), role-based access control via Keyrock/Authzforce, and PEP Proxy enforcement ensuring only authorised users access specific pilot data.
How access will be provided in case there are any restrictions?	Access to restricted data is controlled through the FORTESIE Data Sovereignty module. Users authenticate via Keyrock (Identity Management) and are assigned roles with specific XACML policies enforced by Authzforce. The PEP Proxy (Wilma) validates each request's OAuth2 token and enforces the access control policies, ensuring only authorised users can read or write data for their assigned pilot/demo.
FAIR Data ***Making data interoperable***	
What data and metadata vocabularies, standards or methodologies you will follow to facilitate interoperability?	The project follows the ETSI NGSI-LD standard (ETSI GS CIM 009) and uses JSON-LD as the data serialisation format. The FORTESIE `@context` maps attributes to FORTESIE Data Models hosted on GitHub. This ensures semantic interoperability with other NGSI-LD compliant systems.
Will you be using standard vocabulary (or more commonly used ontologies) for all data types present in your data set, to allow interoperability?	The project uses FIWARE Smart Data Models ontologies (smartdatamodels.org) for standard attributes such as temperature, relative Humidity, active Power, total Active Energy Import, co2, pm25, wind Speed, and precipitation. Custom attributes not covered by existing ontologies are defined in the FORTESIE custom data model (github.com/european-dynamics-

	rnd/FORTESIE_data_model) and referenced via the JSON-LD `@context`.
FAIR Data ***Data Security***	
How will you address data recovery, secure storage, and transfer of sensitive data?	Data is stored in persistent volumes on ED EKS (Kubernetes) with Timescale DB and MongoDB using dedicated Persistent Volume Claims. HTTPS/TLS is enforced for data transfer via the PEP Proxy (Wilma) and Nginx ingress. Access control is enforced by the Data Sovereignty module (Keyrock + Authzforce + Wilma PEP Proxy) with OAuth2 token-based authentication and XACML-based authorisation policies. Multi-tenancy ensures data isolation between pilot sites

4 Data Management Implementation

This section provides an overview of the specific provisions, foreseen for the management of each project dataset in table form.

Table 4-1: FORTESIE Data Management Implementation

FORTESIE Dataset	Classification	Archiving	Performance	Safety & Security	FAIR	Privacy & Data protection
FORTESIE Project Public deliverables	Public	Each public deliverable is published openly on the FORTESIE webpage (following European Commission review and approval). All earlier versions of it are archived on the project's internal ProofHub repository.	N/A	N/A	Public deliverables uploaded on the project website with the appropriate metadata	N/A
Open-Source Software Components	Public	Software developers share their code base on their own public repository e.g., GitHub.	N/A	N/A	Source code deposited in GitHub or some other type of public repository	N/A
FORTESIE Scientific Publications	Public	FORTESIE Website, Zenodo	N/A	N/A	Publications indexed in the project website and the project's dedicated Zenodo with the appropriate metadata	N/A
FORTESIE Pilots' Public Data	Public	Data is stored in the project DB in two different ways: i) near-real time for data coming from active sensors connected to the platform, and ii) in asynchronous mode for data coming from different pilots' sources	N/A	Project DB is under a private network accessible only to project members and secured under the cloud provider security policy.	Data is translated to NGSI-LD models and stored in the FIWARE Data Broker.	All the stored data utilise the FORTESIE naming convention, so anonymised data.

		such as files or historical DBs.				
FORTESIE Pilots' Private Data	Confidential	Data is stored in each pilot partner database (on premises)		Individual security mechanisms and policies of each beneficiary.	N/A	N/A

5 Conclusions

This document provides the final updates of the plan that the FORTESIE project undertook for data management, and document analysis of the data sources that were used and generated during the project, as identified by the project consortium partners and the way the project results were shared. By project results this deliverable means any kind of information including scientific publications, white papers, Open-Source code, open datasets, anonymous interview results, or mock-up datasets used for gathering customer feedback that could be used or generated from the project. The collected datasets in the current version of the report are research data, related to the project's work packages and are managed according to their level of availability (public or Consortium). The FORTESIE Data Management also follows both the Guidelines on FAIR Data Management in Horizon 2020 and the Horizon Europe Open Research Data requirements, where in both frameworks, the core principle remains consistent: data must be findable, accessible, interoperable, and reusable.

The Data Management Plan introduced in D1.2 and finalised in the present deliverable, D1.4, has proven effective in providing a comprehensive and structured framework for handling all pertinent FORTESIE data throughout the project lifecycle. Spanning public deliverables, EU classified information, private and open-source software components, scientific publications, and pilot data collected across multiple demonstration sites, the DMP successfully guided the consortium in balancing open dissemination with the necessary protection of sensitive, personal, and confidential information in accordance with GDPR and the project's ethical commitments. Data was systematically classified, archived across dedicated infrastructures including the FORTESIE website, ProofHub, Zenodo, and GitHub, and made available under CC-BY licences where applicable, with personal data anonymised and protected through informed consent procedures tailored to each pilot. The application of FAIR principles was supported throughout by standardised NGSI-LD data models, persistent unique identifiers, structured naming conventions, and a data sovereignty module ensuring trusted and controlled data exchange. In conclusion, the FORTESIE DMP has fulfilled its mandate in full compliance with the applicable open research data requirements, ensuring that the project's results and datasets are managed responsibly, preserved sustainably for a minimum period of five years post-project, and made available to the broader research community and relevant stakeholders in a manner that maximises their long-term scientific and societal impact.

Appendix A: FAIR Data Management at a glance: issues to cover in your Horizon Europe DMP

This table provides a summary of the DMP issues to be addressed, as outlined above.

DMP component	Issues to be addressed
1. Data summary	• State the purpose of the data collection/generation. • Explain the relation to the objectives of the project. • Specify the types and formats of data generated/collected. • Specify if existing data is being re-used (if any). • Specify the origin of the data. • State the expected size of the data (if known). • Outline the data utility: to whom will it be useful?
2. FAIR Data 2.1. Making data findable, including provisions for metadata	• Outline the discoverability of data (metadata provision). • Outline the identifiability of data and refer to the standard identification mechanism. Do you make use of persistent and unique identifiers such as Digital Object Identifiers? • Outline naming conventions used. • Outline the approach towards search keywords. • Outline the approach for clear versioning. • Specify standards for metadata creation (if any). If there are no standards in your discipline describe what type of metadata will be created and how.
2.2 Making data openly accessible	• Specify which data will be made openly available. If some data is kept closed provide a rationale for doing so. • Specify how the data will be made available. • Specify what methods or software tools are needed to access the data. Is documentation about the software needed to access the data included? Is it possible to include the relevant software (e.g., in Open Source code)? • Specify where the data and associated metadata, documentation and code are deposited. • Specify how access will be provided in case there are any restrictions.
2.3. Making data interoperable	• Assess the interoperability of your data. Specify what data and metadata vocabularies, standards, or methodologies you will follow to facilitate interoperability. • Specify whether you will be using standard vocabulary for all data types present in your data set, to allow inter-disciplinary interoperability. If not, will you provide mapping to more commonly used ontologies?
2.4. Increase data re-use (through clarifying licences)	• Specify how the data will be licenced to permit the widest reuse possible. • Specify when the data will be made available for re-use. If applicable, specify why and for what period a data embargo is needed. • Specify whether the data produced and/or used in the project is useable by third parties, in particular after the end of the project. If the reuse of some data is restricted, explain why. • Describe data quality assurance processes. • Specify the length of time for which the data will remain re-usable.

3. Allocation of resources	• Estimate the costs for making your data FAIR. Describe how you intend to cover these costs. • Clearly identify responsibilities for data management in your project. • Describe the costs and potential value of long-term preservation.
4. Data security	• Address data recovery as well as secure storage and transfer of sensitive data.
5. Ethical aspects	• To be covered in the context of the ethics review, ethics section of DoA and ethics deliverables. Include references and related technical aspects if not covered by the former.
6. Other	• Refer to other national/funder/sectorial/departmental procedures for data management that you are using (if any).

Appendix B: FORTESIE Consent Forms

Pilot 2

Letter of informed consent

concerning the participation as a volunteer in the FORTESIE project

I. Information Sheet

Dear participant,

You have been approached to participate as a volunteer in the European research project FORTESIE.

The data obtained from you will be processed and further analysed for research within the FORTESIE project. The details as to how your data will be processed will be outlined below. Please read the following information carefully. After you have carefully read this information sheet, please feel free to ask additional questions in case you have not entirely understood this information sheet as well as if you have further questions regarding the FORTESIE project. We then would kindly ask you to sign the consent form which you will find on the last page. Please note that your participation is entirely voluntary. If you do not want to participate, you may decline or withdraw your consent at any time without any negative consequences for you.

Below you will find more information about the FORTESIE project and how the data obtained from you will be protected, including all measures that are being taken to protect your privacy that will enable you to form your opinion before making a decision.

Again, if any points remain unclear, please do not hesitate to ask a FORTESIE representative before giving your consent. Should you have any further questions at a later stage, you may also contact *<Name and mail-address of the person in charge at the interviewing institution>*

1. Aims and scope of the FORTESIE project

The FORTESIE project is an EU-sponsored research and innovation project under the Horizon Europe programme (Grant Agreement 101080029; [fortesie.eu]). The overall vision of the project is to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation of buildings is a key initiative to improve energy efficiency and achieve the objectives of the European Green Deal. The initiative aims to double the annual energy renovation rate by 2030, reduce emissions and create

green jobs in the construction sector. The strategy identifies three focus areas, including tackling fuel poverty and promoting expertise in building renovation. The renovation packages will combine state-of-the-art construction materials and technologies components (prefabricated facades, Building Integrated Photovoltaics, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g. contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC value proposition. The renovation packages will be tailored to specific target groups needs and optimised to improve the ESIE performance considering energy, CO2 and comfort. Each package will be demonstrated and validated in real life use cases and customised for replication in all other partner countries for immediate market take-up.

2. What can volunteers expect to happen?

A technician from one of our project partners will call at an agreed time at your home to fit a number of sensors; these will be placed in relevant rooms and will collect data in relation to energy use / heat retention by the building. Technicians will subsequently call as agreed with yourself in order to service or remove the sensors.

3. What type of data is collected?

During the pilots and validation scenarios, personal information will be collected from participants who agree to be recruited into one of the pilots. Such data will take the following forms: name, surname, gender, age/date of birth, physical address, telephone number, e-mail address, perceptions of indoor conditions at home, satisfaction with the renovations, opinions on the engagement activities of FORTESIE, fossil energy consumption data, Energy consumption baseline data, live energy consumption and behavioural data that will be collected via sensors and the mobile app, building data about a specific building (size, appliances, energy consumption, etc.).

Please note that wherever feasible, data will be anonymised or replaced with mock-up data for the testing of the systems. In other cases, it will be securely pseudonymised (where your details are replaced by a keycode, but the project retains a key to enable reidentification in special cases, such as to inform the volunteer of important matters), so as to protect the confidentiality of the relevant participant.

4. How will the data be used?

Personal data obtained on this consent form will only be stored to ensure legal compliance.

Personal data obtained during the course of the project will be evaluated and analysed in order to train the FORTESIE system including the various software subsystems and their algorithms. This shall improve the accuracy and reliability of the software modules.

5. What are the risks associated with data obtained?

Any processing of data entails the risk of breaches of confidentiality (and in particular the possibility in rare cases, and despite secure pseudonymisation measures, of identifying the data subject).

6. How will the risks associated with data obtained be mitigated and data protected?

To minimise the risk of breach of confidentiality, FORTESIE will take all appropriate technical and organisational measures according to the current state of technology to protect your privacy and data. This also means that personal details will be obtained anonymously (identification of the data subject is not possible) or securely pseudonymised in a later stage. The completed consent form will be kept only with the FORTESIE project partners in charge and access to it will only be granted to validate legal compliance. Access to the data you have provided in the course of the research project will be restricted only to partners of the FORTESIE project. For a partner list, please see: www.fortesie.eu

7. What does your right of withdrawal include?

You are free to withdraw your consent to the use of your personal data at any time without providing a reason for your decision. Your decision to withdraw your consent will not have any negative impact. In the case of withdrawal, personal data will be immediately deleted and no longer be processed by FORTESIE. Any data that could be reconnected to you will be deleted. Please note that personal information that was anonymised in the course of the project, cannot identify you and therefore will not be deleted.

For withdrawal, or in the event of other queries or concerns you may have, please contact:

<Name and mail-address of the person in charge at the interviewing institution>

AND/OR: data.protection@eurodyn.com

Consent Form

Participant: _____

(Name, First name)

- I am aged 18 or over.

- I am aged between [minimum age for valid consent in relevant Member State] and 17, and my parent/guardian approves of my participation in the FORTESIE project.

- I, hereby, agree that my data will be processed by the FORTESIE project and can be used for the project research purposes as described in the information sheet.

- I, hereby, agree that my data may continue to be securely stored for possible use (subject to my further informed consent, which I will be invited to give at the relevant time) for further research purposes after the duration of the FORTESIE project.

I have received and read the information sheet and have had the opportunity to ask questions.

I know that my participation is voluntary and that I can withdraw my consent at any time without giving reasons, and without having to fear negative consequences out of my withdrawal.

_____ _____

Place, date (to be completed by participant) and Signature of the participant

Additional Signature of Parent/Guardian (where participant aged under 18)

_____

The participant received the participant information sheet from **……** before the interview and any additional questions were answered.

_____ _____

Place, date and signature of the FORTESIE Representative

Pilot 3

Letter of informed consent

concerning the participation as a beneficiary in the FORTESIE project

II. Information Sheet

Dear participant,

You have been approached to participate as a beneficiary in the European research project FORTESIE.

The data obtained from you will be processed and further analysed for research within the FORTESIE project. The details as to how your data will be processed will be outlined below. Please read the following information carefully. After you have carefully read this information sheet, please feel free to ask additional questions in case you have not entirely understood this information sheet as well as if you have further questions regarding the FORTESIE project. We then would kindly ask you to sign the consent form which you will find on the last page. Please note that your participation is entirely voluntary. If you do not want to participate, you may decline or withdraw your consent at any time without any negative consequences for you.

Below you will find more information about the FORTESIE project and how the data obtained from you will be protected, including all measures that are being taken to protect your privacy that will enable you to form your opinion before making a decision.

Again, if any points remain unclear, please do not hesitate to ask a FORTESIE representative before giving your consent. Should you have any further questions at a later stage, you may also contact *<Name and mail-address of the person in charge at the interviewing institution>*

1. Aims and scope of the FORTESIE project

The FORTESIE project is an EU-sponsored research and innovation project under the Horizon Europe programme (Grant Agreement 101080029; [fortesie.eu]). The overall vision of the project is to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation of buildings is a key initiative to improve energy efficiency and achieve the objectives of the European Green Deal. The initiative aims to double the annual energy renovation rate by 2030, reduce emissions and create green jobs in the construction sector. The strategy identifies three focus areas, including tackling fuel poverty and promoting expertise in building renovation. The renovation packages will combine state-of-the-art construction materials and technologies components (prefabricated facades, Building Integrated Photovoltaics, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g. contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC value

proposition. The renovation packages will be tailored to specific target groups needs and optimised to improve the ESIE performance considering energy, CO2 and comfort. Each package will be demonstrated and validated in real life use cases and customised for replication in all other partner countries for immediate market take-up.

2. What can beneficiary expect to happen?

A technician from one of our project partners will call at an agreed time at your home to fit a number of sensors; these will be placed in relevant rooms and will collect data in relation to energy use / heat retention by the building. Technicians will subsequently call as agreed with yourself in order to service or remove the sensors.

3. What type of data is collected?

During the pilots and validation scenarios, personal information will be collected from participants who agree to be recruited into one of the pilots. Such data will take the following forms: name, surname, gender, age/date of birth, physical address, telephone number, e-mail address, perceptions of indoor conditions at home, satisfaction with the renovations, opinions on the engagement activities of FORTESIE, fossil energy consumption data, Energy consumption baseline data, live energy consumption and behavioural data that will be collected via sensors and the mobile app, building data about a specific building (size, appliances, energy consumption, etc.).

Please note that wherever feasible, data will be anonymised or replaced with mock-up data for the testing of the systems. In other cases, it will be securely pseudonymised (where your details are replaced by a keycode, but the project retains a key to enable reidentification in special cases, such as to inform the volunteer of important matters), so as to protect the confidentiality of the relevant participant.

4. How will the data be used?

Personal data obtained on this consent form will only be stored to ensure legal compliance.

Personal data obtained during the course of the project will be evaluated and analysed in order to train the FORTESIE system including the various software subsystems and their algorithms. This shall improve the accuracy and reliability of the software modules.

5. What are the risks associated with data obtained?

Any processing of data entails the risk of breaches of confidentiality (and in particular the possibility in rare cases, and despite secure pseudonymisation measures, of identifying the data subject).

6. How will the risks associated with data obtained be mitigated and data protected?

To minimise the risk of breach of confidentiality, FORTESIE will take all appropriate technical and organisational measures according to the current state of technology to protect your privacy and data. This also means that personal details will be obtained anonymously (identification of the data subject is not possible) or securely pseudonymised in a later stage. The completed consent form will be kept only with the FORTESIE project partners in charge and access to it will only be granted to validate legal compliance. Access to the data you have provided in the course of the research project will be restricted only to partners of the FORTESIE project. For a partner list, please see: www.fortesie.eu

7. What does your right of withdrawal include?

You are free to withdraw your consent to the use of your personal data at any time without providing a reason for your decision. Your decision to withdraw your consent will not have any negative impact. In the case of withdrawal, personal data will be immediately deleted and no longer be processed by FORTESIE. Any data that could be reconnected to you will be deleted. Please note that personal information that was anonymised in the course of the project, cannot identify you and therefore will not be deleted.

For withdrawal, or in the event of other queries or concerns you may have, please contact:

<Name and mail-address of the person in charge at the interviewing institution>

AND/OR: data.protection@eurodyn.com

Consent Form

Participant: _____

(Name, First name)

- I am aged 18 or over.

- I am aged between [minimum age for valid consent in relevant Member State] and 17, and my parent/guardian approves of my participation in the FORTESIE project.

- I, hereby, agree that my data will be processed by the FORTESIE project and can be used for the project research purposes as described in the information sheet.

- I, hereby, agree that my data may continue to be securely stored for possible use (subject to my further informed consent, which I will be invited to give at the relevant time) for further research purposes after the duration of the FORTESIE project.

I have received and read the information sheet and have had the opportunity to ask questions.

I know that my participation is voluntary and that I can withdraw my consent at any time without giving reasons, and without having to fear negative consequences out of my withdrawal.

_____ _____

Place, date (to be completed by participant) and Signature of the participant

Additional Signature of Parent/Guardian (where participant aged under 18)

_____

The participant received the participant information sheet from …… before the interview and any additional questions were answered.

_____ _____

Place, date and signature of the FORTESIE Representative

Pilot 4

Letter of informed consent

concerning the participation as a volunteer in the FORTESIE project

I. Information Sheet

Dear participant,

You have been approached to participate as a volunteer in the European research project FORTESIE.

The data obtained from you will be processed and further analysed for research within the FORTESIE project. The details as to how your data will be processed will be outlined below. Please read the following information carefully. After you have carefully read this information sheet, please feel free to ask additional questions in case you have not entirely understood this information sheet as well as if you have further questions regarding the FORTESIE project. We then would kindly ask you to sign the consent form which you will find on the last page. Please note that your participation is entirely voluntary. If you do not want to participate, you may decline or withdraw your consent at any time without any negative consequences for you.

Below you will find more information about the FORTESIE project and how the data obtained from you will be protected, including all measures that are being taken to protect your privacy that will enable you to form your opinion before making a decision.

Again, if any points remain unclear, please do not hesitate to ask an FORTESIE representative before giving your consent. Should you have any further questions at a later stage, you may also contact <Name and mail-address of the person in charge at the interviewing institution>

1. Aims and scope of the FORTESIE project

The FORTESIE project is an EU-sponsored research and innovation project under the Horizon Europe programme (Grant Agreement 101080029; [fortesie.eu]). The overall vision of the project is to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation packages will combine state-of-the-art construction materials and technologies components (prefabricated facades, BIPV, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g. contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC value proposition. The renovation packages will be tailored to specific target groups needs and optimised to improve the ESIE performance considering energy, CO2 and comfort. Each package will be demonstrated and validated in real life use cases and customised for replication in all other partner countries for immediate market take-up.

2. What can volunteers expect to happen?

A technician from one of our project partners will call at an agreed time at your home to fit a number of sensors; these will be placed in relevant rooms and will collect data in relation to energy use / heat retention by the building. Technicians will subsequently call as agreed with yourself in order to install or remove the sensors.

3. What type of data is collected?

During the pilots and validation scenarios, personal information will be collected from participants who agree to be recruited into one of the pilots. Such data will take the following forms: Cooperative member nr., client (Y/N), household typology, nr floors and area, geographic region, householders age, hours spent at home, gas user (Y/N), types of electrical appliances and heat/cooling systems and frequency of use, energy performance certificate, household annual income, household plans, PV registration, Building official registration and ID, pictures and metric measures of the house, temperature, humidity, air quality, energy consumption and production, consumer behaviours, gender, age/date of birth, physical address, telephone number, e-mail address, perceptions of indoor conditions at home, satisfaction with the renovations, opinions on the engagement activities of FORTESIE, Energy consumption baseline data, live energy consumption and behavioural data that will be collected via sensors and the mobile app.

Furthermore, health data as a special category of data will be collected. Such data will take the following forms: health issues related to household pathologies.

Please note that wherever feasible, data will be anonymised or replaced with mock-up data for the testing of the systems. In other cases, it will be securely pseudonymised so as to avoid identifying the relevant participant.

4. How will the data be used?

Personal data obtained on this consent form will only be stored to ensure legal compliance.

Personal data obtained during the course of the project will be evaluated and analysed in order to train the FORTESIE system including the various software subsystems and their algorithms. This shall improve the accuracy and reliability of the software modules.

5. What are the risks associated with data obtained?

Any processing of data entails the risk of breaches of confidentiality (and in particular the possibility in rare cases, and despite secure pseudonymisation measures, of identifying the data subject).

6. How will the risks associated with data obtained be mitigated and data protected?

To minimise the risk of breach of confidentiality, FORTESIE will take all appropriate technical and organisational measures according to the current state of technology to protect your privacy and data. This also means that personal details will be obtained anonymously (identification of the data subject is not possible) or securely pseudonymised in a later stage. The completed consent form will be kept only with the FORTESIE project partners in charge and access to it will only be granted to validate legal compliance. Access to the data you have provided in the course of the research project will be restricted only to partners of the FORTESIE project. For a partner list, please see: www.fortesie.eu

7. What does your right of withdrawal include?

You are free to withdraw your consent to the use of your personal data at any time without providing a reason for your decision. Your decision to withdraw your consent will not have any negative impact. In the case of withdrawal, personal data will be immediately deleted and no longer be processed by

FORTESIE. Any data that could be reconnected to you will be deleted. Please note that personal information that was anonymised in the course of the project, cannot identify you and therefore will not be deleted.

For withdrawal, or in the event of other queries or concerns you may have, please contact:

<Name and mail-address of the person in charge at the interviewing institution>

AND/OR: *data.protection@eurodyn.com*

Consent Form

Participant: _____

(Name, First name)

o I am aged 18 or over.

o I am aged between [minimum age for valid consent in relevant Member State] and 17, and my parent/guardian approves of my participation in the FORTESIE project.

o I, hereby, agree that my data will be processed by the FORTESIE project and can be used for the project research purposes as described in the information sheet.

o I, hereby, agree that my data may continue to be securely stored for possible use (subject to my further informed consent, which I will be invited to give at the relevant time) for further research purposes after the duration of the FORTESIE project.

I have received and read the information sheet and have had the opportunity to ask questions.

I know that my participation is voluntary and that I can withdraw my consent at any time without giving reasons, and without having to fear negative consequences out of my withdrawal.

_____ _____

Place, date (to be completed by participant) and Signature of the participant

Additional Signature of Parent/Guardian (where participant aged under 18)

Funded by the European Union

_____

The participant received the participant information sheet from …… before the interview and any additional questions were answered.

_____ _____

Place, date and signature of the FORTESIE Representative

Pilot 1,5,7

Letter of informed consent

concerning the participation as a volunteer in the FORTESIE project

I. Information Sheet

Dear participant,

You have been approached to participate as a volunteer in the European research project FORTESIE.

The data obtained from you will be processed and further analysed for research within the FORTESIE project. The details as to how your data will be processed will be outlined below. Please read the following information carefully. After you have carefully read this information sheet, please feel free to ask additional questions in case you have not entirely understood this information sheet as well as if you have further questions regarding the FORTESIE project. We then would kindly ask you to sign the consent form which you will find on the last page. Please note that your participation is entirely voluntary. If you do not want to participate, you may decline or withdraw your consent at any time without any negative consequences for you.

Below you will find more information about the FORTESIE project and how the data obtained from you will be protected, including all measures that are being taken to protect your privacy that will enable you to form your opinion before making a decision.

Again, if any points remain unclear, please do not hesitate to ask an FORTESIE representative before giving your consent. Should you have any further questions at a later stage, you may also contact <Name and mail-address of the person in charge at the interviewing institution>

1. Aims and scope of the FORTESIE project

The FORTESIE project is an EU-sponsored research and innovation project under the Horizon Europe programme (Grant Agreement 101080029; [fortesie.eu]). The overall vision of the project is to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation packages will combine state-of-the-art construction materials and technologies components (prefabricated facades, BIPV, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g. contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC value proposition. The renovation packages will be tailored to specific target groups needs and optimised to improve the ESIE performance considering energy, CO2 and comfort. Each package will be demonstrated and validated in real life use cases and customised for replication in all other partner countries for immediate market take-up.

2. What can volunteers expect to happen?

A technician will install sensors in relevant rooms of the public building by arrangement and will collect data in relation to energy use / heat retention by the building. Technicians will subsequently call as agreed with yourself in order to service or remove the sensors.

3. What type of data is collected?

During the pilots and validation scenarios, personal information will be collected from participants who agree to be recruited into one of the pilots. Such data will take the following forms: Name, age/date of birth, address, IP address, E-mail address, gender, level of education, perceptions of indoor conditions at workplace, satisfaction with the renovations, opinions on the engagement

activities of FORTESIE, fossil energy consumption data, Energy consumption baseline data, live energy consumption and behavioural data that will be collected via sensors and the mobile app.

Furthermore, health data as a special category of data will be processed. Such data will take the following forms: heart rate, heart rate variability.

Please note that wherever feasible, data will be anonymised or replaced with mock-up data for the testing of the systems. In other cases, it will be securely pseudonymised so as to avoid identifying the relevant participant.

4. How will the data be used?

Personal data obtained on this consent form will only be stored to ensure legal compliance.

Personal data obtained during the project will be evaluated and analysed to identify the building improvements related to the implemented renovation technologies. This connection is necessary to be able to derive safe estimations of the contribution of each or specific combinations of renovation technologies to the building performance. This knowledge will allow to establish those guarantees for any future investments that secure the investments and maximise the building performance targeting those areas that are mostly required for each particular case.

5. What are the risks associated with data obtained?

Any processing of data entails the risk of breaches of confidentiality (and in particular the possibility in rare cases, and despite secure pseudonymisation measures, of identifying the data subject).

6. How will the risks associated with data obtained be mitigated and data protected?

To minimise the risk of breach of confidentiality, FORTESIE will take all appropriate technical and organisational measures according to the current state of technology to protect your privacy and data. This also means that personal details will be obtained anonymously (identification of the data subject is not possible) or securely pseudonymised in a later stage. The completed consent form will be kept only with the FORTESIE project partners in charge and access to it will only be granted to validate legal compliance. Access to the data you have provided in the course of the research project will be restricted only to partners of the FORTESIE project. For a partner list, please see: www.fortesie.eu

7. What does your right of withdrawal include?

You are free to withdraw your consent to the use of your personal data at any time without providing a reason for your decision. Your decision to withdraw your consent will not have any negative impact. In the case of withdrawal, personal data will be immediately deleted and no longer be processed by FORTESIE. Any data that could be reconnected to you will be deleted. Please note that personal information that was anonymised in the course of the project, cannot identify you and therefore will not be deleted.

For withdrawal, or in the event of other queries or concerns you may have, please contact:

<Name and mail-address of the person in charge at the interviewing institution>

AND/OR: *data.protection@eurodyn.com*

Consent Form

Participant: _____

(Name, First name)

o I am aged 18 or over.

o I am aged between [minimum age for valid consent in relevant Member State] and 17, and my parent/guardian approves of my participation in the FORTESIE project.

o I, hereby, agree that my data will be processed by the FORTESIE project and can be used for the project research purposes as described in the information sheet.

o I, hereby, agree that my data may continue to be securely stored for possible use (subject to my further informed consent, which I will be invited to give at the relevant time) for further research purposes after the duration of the FORTESIE project.

I have received and read the information sheet and have had the opportunity to ask questions.

I know that my participation is voluntary and that I can withdraw my consent at any time without giving reasons, and without having to fear negative consequences out of my withdrawal.

_____ _____

Place, date (to be completed by participant) and Signature of the participant

Additional Signature of Parent/Guardian (where participant aged under 18)

_____

The participant received the participant information sheet from …… before the interview and any additional questions were answered.

_____ _____

Place, date and signature of the FORTESIE Representative

Pilot 6

Letter of informed consent

concerning the participation as a volunteer in the FORTESIE project

I. Information Sheet

Dear participant,

You have been approached to participate as a volunteer in the European research project FORTESIE.

The data obtained from you will be processed and further analysed for research within the FORTESIE project. The details as to how your data will be processed will be outlined below. Please read the following information carefully. After you have carefully read this information sheet, please feel free

to ask additional questions in case you have not entirely understood this information sheet as well as if you have further questions regarding the FORTESIE project. We then would kindly ask you to sign the consent form which you will find on the last page. Please note that your participation is entirely voluntary. If you do not want to participate, you may decline or withdraw your consent at any time without any negative consequences for you.

Below you will find more information about the FORTESIE project and how the data obtained from you will be protected, including all measures that are being taken to protect your privacy that will enable you to form your opinion before making a decision.

Again, if any points remain unclear, please do not hesitate to ask an FORTESIE representative before giving your consent. Should you have any further questions at a later stage, you may also contact <Name and mail-address of the person in charge at the interviewing institution>

1. Aims and scope of the FORTESIE project

The FORTESIE project is an EU-sponsored research and innovation project under the Horizon Europe programme (Grant Agreement 101080029; [fortesie.eu]). The overall vision of the project is to design, demonstrate, validate and replicate innovative renovation packages in the building industry with Smart Performance-Based guarantees and financing, aiming at Efficient, Sustainable and Inclusive Energy (ESIE) use to accelerate the Renovation Wave in Europe. The renovation packages will combine state-of-the-art construction materials and technologies components (prefabricated facades, BIPV, heat pumps, etc.), innovative digital technologies for measurement and verification, and attractive financing (e.g. contractual frameworks for smart performance guarantees, financing mechanisms, engagement techniques, green-euros, etc.), to raise the overall EPC value proposition. The renovation packages will be tailored to specific target groups needs and optimised to improve the ESIE performance considering energy, CO2 and comfort. Each package will be demonstrated and validated in real life use cases and customised for replication in all other partner countries for immediate market take-up.

2. What can volunteers expect to happen?

A technician will install sensors in relevant rooms of the public building by arrangement and will collect data in relation to energy use / heat retention by the building. Technicians will subsequently call as agreed with yourself in order to service or remove the sensors.

3. What type of data is collected?

During the pilots and validation scenarios, personal information will be collected from participants who agree to be recruited into one of the pilots. Such data will take the following forms: Name, age/date of birth, city name, IP address, E-mail address, gender, perceptions of indoor conditions at workplace, satisfaction with the renovations, opinions on the engagement activities of FORTESIE, fossil energy consumption data, Energy consumption baseline data, live energy consumption and behavioural data that will be collected via sensors and the mobile app.

Please note that wherever feasible, data will be anonymised or replaced with mock-up data for the testing of the systems. In other cases, it will be securely pseudonymised so as to avoid identifying the relevant participant.

4. How will the data be used?

Personal data obtained on this consent form will only be stored to ensure legal compliance.

Personal data obtained during the project will be evaluated and analysed to identify the building improvements related to the implemented renovation technologies. This connection is necessary to be able to derive safe estimations of the contribution of each or specific combinations of renovation technologies to the building performance. This knowledge will allow to establish those guarantees for any future investments that secure the investments and maximise the building performance targeting those areas that are mostly required for each particular case.

5. What are the risks associated with data obtained?

Any processing of data entails the risk of breaches of confidentiality (and in particular the possibility in rare cases, and despite secure pseudonymisation measures, of identifying the data subject).

6. How will the risks associated with data obtained be mitigated and data protected?

To minimise the risk of breach of confidentiality, FORTESIE will take all appropriate technical and organisational measures according to the current state of technology to protect your privacy and data. This also means that personal details will be obtained anonymously (identification of the data subject is not possible) or securely pseudonymised in a later stage. The completed consent form will be kept only with the FORTESIE project partners in charge and access to it will only be granted to validate legal compliance. Access to the data you have provided in the course of the research project will be restricted only to partners of the FORTESIE project. For a partner list, please see: www.fortesie.eu

7. What does your right of withdrawal include?

You are free to withdraw your consent to the use of your personal data at any time without providing a reason for your decision. Your decision to withdraw your consent will not have any negative impact. In the case of withdrawal, personal data will be immediately deleted and no longer be processed by FORTESIE. Any data that could be reconnected to you will be deleted. Please note that personal information that was anonymised in the course of the project, cannot identify you and therefore will not be deleted.

For withdrawal, or in the event of other queries or concerns you may have, please contact:

<Name and mail-address of the person in charge at the interviewing institution>

AND/OR: *data.protection@eurodyn.com*

Consent Form

Participant: _____

(Name, First name)

o I am aged 18 or over.

o I am aged between [minimum age for valid consent in relevant Member State] and 17, and my parent/guardian approves of my participation in the FORTESIE project.

o I, hereby, agree that my data will be processed by the FORTESIE project and can be used for the project research purposes as described in the information sheet.

o I, hereby, agree that my data may continue to be securely stored for possible use (subject to my further informed consent, which I will be invited to give at the relevant time) for further research purposes after the duration of the FORTESIE project.

I have received and read the information sheet and have had the opportunity to ask questions.

I know that my participation is voluntary and that I can withdraw my consent at any time without giving reasons, and without having to fear negative consequences out of my withdrawal.

_____ _____

Place, date (to be completed by participant) and Signature of the participant

Additional Signature of Parent/Guardian (where participant aged under 18)

_____

The participant received the participant information sheet from …… before the interview and any additional questions were answered.

_____ _____

Place, date and signature of the FORTESIE Representative