INTERACT

Integration of Innovative Technologies of Positive Energy Districts into a Holistic Architecture

D3.1 Common inventory methodology for recording current technologies

30.06.2021

Leader: Tornet

Dissemination Level

PU	Public	X
CO	Confidential, only for members of the consortium	

History

Version	Description	Lead author	Date
V1	1st draft	Daniel-Leon Schultis	05.05.2021
V2	Input and Review of LEEF, UASTW, SON, TORNET		12.05.2021
V3	2nd draft	Markus Olofsgård	04.06.2021
V4	Final version for review	Markus Olofsgård	25.06.2021
V5	Review of SON, TU WIEN		29.06.2021

Disclaimer

This project has received funding in the framework of the PED Programme, which is implemented by the Joint Programming Initiative Urban Europe and SET Plan Action 3.2. The project is supported by the Austrian Ministry of Climate Action, Environment, Energy, Mobility, Innovation, and Technology (BMK), Technology Agency of the Czech Republic (TAČR) and Viable cities, a research program founded by the Swedish energy agency, Formas and Vinnova.

Executive Summary

The common inventory methodology for recording current technologies aims to describe need for data and method for data gathering in order to establish the INTERACT-Energy Community. The document presents a common inventory methodology that allows to capture the current status quo of two different project types: greenfield and upgrade (see Chapter 2).

It facilitates and systematizes data gathering and management by defining:

- data categories,
- data sources,
- data types,
- data purpose in the project,
- data management, and
- the inventory workflow.

All relevant data categories are in Chapter 3 initially described in brief, but the following methodology then focuses on the gathering of technical data.

To facilitate data gathering potential within Chapter 4 data sources are described with main drivers and barriers for sharing relevant data and what kind of data that they may provide.

A definition of data types is made in Chapter 5 to distinguish between personal and non-personal data and the Impact it has on data management with regards to GDPR. In Chapter 6 Data management and recording of meta data is briefly described with a reference to a more detailed description in the data management plan of the INTERACT project.

The different purposes of data gathering are defined for both greenfield and upgrade projects in Chapter 7, these purposes are then related to different data needs in the data inventory lists in Chapter 8.

A general workflow for data gathering is described to provide an efficient structure for data gathering in Chapter 9.

List of Abbreviations and Acronyms

REC	Renewable energy community
CP	Customer plant
RPD	Reactive power device
OLTC	On-load tap changer
DMP	Data management plan
GDPR	General data protection regulation
DSO	Distribution system operator
RED	Real estate developer
LV	Low voltage
MV	Medium voltage
BaU	Business as usual
ICT	Information and communication technology
PV	Photo Voltaic

List of Figures

Figure 1: Data collection process for greenfield projects 29
Figure 2: Data collection process in upgrade projects 30

List of Tables

Table 1: Overview of data purposes 21
Table 2 Inventory list for the distribution grid (greenfield projects) 22
Table 3 Inventory list for the customer plants (greenfield projects) 23
Table 4 Inventory list for the production systems (greenfield projects) 24
Table 5 Inventory list for the chargers of electric vehicle, stationary batteries and hydrogen storage (greenfield projects) 24
Table 6 Inventory list for the distribution grid (upgrade projects) 25
Table 7 Inventory list for the customer plants (upgrade projects) 26
Table 8 Inventory list for the photovoltaic systems (upgrade projects) 27
Table 9 Inventory list for the chargers of electric vehicle and stationary batteries (upgrade projects) 27

Contents

LIST OF FIGURES **4**

LIST OF TABLES **4**

CONTENTS **5**

1 INTRODUCTION **7**

1.1 Purpose of the document 7

1.2 Relation to other project activities 7

1.3 Structure of the document 7

2 PROJECT TYPES **9**

2.1 Building from Scratch – the Greenfield Project 9

2.2 Upgrading existing communities and neighborhoods 9

3 DATA CATEGORIES **10**

3.1 Technical data 10

3.1.1 Distribution system data 10

3.1.2 Customer plant data 11

3.1.3 Producer data 12

3.1.4 Storage data 12

3.2 Organizational data 13

3.3 Market-related data 13

3.4 Legislative data 13

4 DATA SOURCES **14**

4.1 Distribution system operator 14

4.2 Customers / house owners 14

4.3 Municipalities / local authorities 15

4.4 Registers and maps 15

4.4.1 Land register 15

4.4.2 Web based map services 16

4.4.3 Open street maps 16

4.4.4 EV charger registers 16

4.5 Real estate developer 16

4.6 Literature / Generic Data-Sets 17

4.7 Manufacturers of appliances 17

4.8 Producer operators 17

4.9 Storage operators 17

5 DATA TYPE **18**

5.1 Personal data 18

5.2 Non-personal data 18

6 DATA MANAGEMENT **19**

7 DATA PURPOSE IN THE INTERACT PROJECT **20**

7.1 Greenfield projects 20

7.1.1 Analysis of planned electricity grid (Purp-1G) 20

7.1.2 Gap analysis to the *LINK*-control structure (Purp-2G) 20

7.1.3 Design of the *LINK*-ICT structure (Purp-3G) 20

7.2 Upgrade projects 20

7.2.1 Technical feasibility of the *LINK*-based REC (Purp-1U) 20

7.2.2 Identification of necessary technology upgrades (Purp-2U) 21
7.2.3 Design of the *LINK*-ICT structure (Purp-3U) 21
7.3 Overview 21

8 DATA INVENTORY LISTS 22
8.1 Greenfield projects 22
8.2 Upgrade projects 24

9 INVENTORY WORKFLOW 28
9.1 Greenfield projects 28
9.2 Upgrade project 28

10 LIST OF REFERENCES 31

1 Introduction

Renewable Energy Communities (REC) are seen by the European parliament as an instrument to drive the green transition locally [1]. The INTERACT project aims to develop the *LINK*-based REC, which builds upon the *LINK*-based holistic architecture and works in harmony with the electricity grid. Prior to the design of the *LINK*-based REC for a specific focus region, the prevailing status quo must be carefully analyzed with respect to technical, organizational, market-related and legislative aspects.

1.1 Purpose of the document

This document provides the common inventory methodology that enables the recording of the technology-related status quo of any focus region. Two distinct types of regions are considered:

- **Greenfields**, where the REC shall be built up from the scratch
- **Existing neighborhoods** that shall be upgraded to properly function as a *LINK*-based REC.

The presented inventory methodology facilitates and systematizes data collection and management by specifying

- the data categories,
- the data sources,
- the data types,
- the data purpose in the INTERACT project,
- the data management,
- the data items to be collected, and
- the inventory workflow.

1.2 Relation to other project activities

The presented inventory methodology will be used to record the technology-related status quo of the INTERACT focus regions. It contributes to the development of roadmaps for the implementing specific *LINK*-based RECs, which will be drafted at the end of the INTERACT project. Furthermore, the metadata files specified within the Data Management Plan (DMP) of the INTERACT project are outlined in this document. With the help of this methodology, other projects aiming to develop a REC working in harmony with the grid are enabled to gather all the data needed for this in a structured way.

1.3 Structure of the document

The differences between greenfield and upgrade projects are highlighted in section two. Section three overviews all data categories relevant for the design of the *LINK*-based REC, including technical, organizational, market-related and legislative data, although this document focuses on the technical aspects. The sources from which the needed technical data may be gathered are discussed in section four. Section five distinguishes between personal and non-personal data to facilitate data management, followed by the definition of the data purposes in the INTERACT project in section six. The data management is sketched in section seven, and detailed lists of technical data to be gathered are given in section eight. Finally, the workflows for data collection are specified in section nine. References are found in section ten.

2 Project types

The technical data to be gathered and the corresponding sources and workflows differ for greenfield and upgrade projects.

2.1 Building from Scratch – the Greenfield Project

A greenfield project is considered as a project in which the infrastructure of an area is built up from the scratch. Initially, no infrastructure is existing in the area, originating the term "greenfield". The Real Estate Developer (RED) and its contractors, such as the Distribution System Operator (DSO), use Business-as-Usual (BaU) procedures to create the detailed development plans for the focus region, including the arrangements of buildings and the courses of the streets, the power system, etc. The design of the *LINK*-based REC for a greenfield region requires the gathering of the BaU plans concerning the power system and the corresponding metering devices, automation schemes and Information and Communication Technologies (ICT). As the electrical infrastructure is built up from scratch, there exists great potential for the close integration of planning and operation.

Gathering of the relevant technical data in greenfield projects is characterized by the following aspects:

- The technical data to be collected is related to planned but not existing installations.
- All needed data should be provided by the RED and its contractors, such as the DSO. No other data sources are relevant.
- Historic measurements of the focus region are not available.

2.2 Upgrading existing communities and neighborhoods

Upgrade projects are considered as projects in which already existing communities and neighborhoods are upgraded to properly function as a *LINK*-based REC. These projects involve the upgrade of existing technologies according to the *LINK*-Architecture, the reorganization of existing institutions and/or creation of new institutions, and the reorganization of the market. Comprehensive data collection is necessary to record the installed technologies in the existing community or neighborhood. Technical data has to be collected from numerous sources, including DSOs, customers, municipalities, registers and maps, etc. Network planning is not part of the upgrade process as the infrastructure is already built up and in use: the integration of planning and operation is possible only in a limited way.

Data gathering in upgrade projects is characterized by the following aspects:

- The technical data to be collected is related to existing installations.
- A lot of potential data sources are available to collect the needed technical data.
- Historic measurements of the focus area might be available.

3 Data categories

The design of the *LINK*-based REC for a specific focus region requires the consideration of technical, organizational, market-related and legislative data. Depending on the project type, the technical, organizational and market-related data may refer to installed technologies and existing organizations and markets (in the case of upgrade projects), or to planned ones (in the case of greenfield projects). The inventory methodology presented in this document focuses on the stocktaking of the technical data; the other data categories are only briefly overviewed.

3.1 Technical data

The technical data listed below refers to installed technologies in the case of upgrade projects and to planned ones in the case of greenfield projects. In the latter case, the technologies are planned according to the BaU procedures of the corresponding DSO and RED. The technical data mainly relates to electrical appliances, measurements and load profiles, metering devices, automation schemes and Information and Communication Technologies (ICT) related to the distribution grid, the Customer Plants (CP), the producers and the storages.

3.1.1 Distribution system data

Static grid data describe the topology and modelling parameters of all relevant lines, transformers and Reactive Power Devices (RPD), as well as the connection points of customer plants, producers and storages.

Historic measurements of physical entities, such as voltage, current, active and reactive power somewhere within the distribution grid (e.g. at the distribution substation level and at the connection points of CPs).

Conventional metering devices may be installed in different points of the distribution grid. Their connection points, the measured entities, the location and ownership of the measurement data storage and the purposes for which the measurement data is used are relevant for the project.

Smart meters may be installed at the connection points of CPs. Their functionalities (e.g. remote disconnection) and ownership, as well as the measurement data ownership, storage and usage are relevant.

Controls determine the tap position of transformers with On-Load Tap Changers (OLTC) and the reactive power injected and absorbed by RPDs.

Communication technologies allow transmitting information between different appliances using communication protocols. Power line communication, internet, cloud technology, fiber optics, etc. may be used for this purpose.

Communication protocols define the rules, syntax, semantics and synchronization of communication and possible error recovery methods.

Data servers manage all the data arising during distribution grid operation. Their location, ownership and the existence of hardware back-ups is of relevance for the project.

3.1.2 Customer plant data

CP type – Customer plants are categorized into residential, commercial, industrial and agricultural CPs.

Number of accommodation units – Residential CPs may include more than one accommodation unit. Furthermore, commercial CPs may include (in addition to the commercial unit) accommodation units for residential customers.

Number of residents describes the number of people living within the corresponding CP or accommodation unit.

Billing demand can be found in the DSO-customer contract. It is specified by the DSO and used to determine the system charges of the customer.

Producers may be installed within CPs. Their static data, such as nameplate data and spatial data of Photo Voltaic (PV) panels, is of primary interest.

Storages may be installed within CPs. Storages include stationary battery systems, batteries of electric vehicles, heating and cooling systems, etc. Their static data, such as nameplate data and storage capacity, is of primary interest.

Historic measurements of physical entities, such as voltage, current, active and reactive power.

Historic consumption and production patterns of CPs from similar areas or projects.

Load profiles (active and reactive power) that the DSO uses to model the different CP types.

Automation may be used for energy, active power and reactive power management at the CP level. Information on the currently automatized appliances (e.g. heating/cooling systems, EV charger) and the involved measurements are relevant. Furthermore, it is necessary to know whether there exists any coordination with the grid.

Communication technologies allow transmitting information between different appliances using communication protocols. Power line communication, internet, cloud technology, fiber optics, etc. may be used for this purpose.

Communication protocols define the rules, syntax, semantics and synchronization of communication and possible error recovery methods.

Data servers manage all the data arising during CP operation. The data is mainly produced by the automation system. Data server location and ownership are relevant for the project.

3.1.3 Producer data

PV systems are expected to be the main producer type within the model regions.

Static data of PV systems includes panel area and efficiency, inverter rating and efficiency, panel orientation (azimuth and altitude), and panel location (longitude and latitude).

Controls of PV systems include var controls, such as cosφ(*P*), *Q*(*U*), fixed cosφ and fixed *Q*, and active power curtailment, such as *P*(*U*) and over-voltage protection.

Communication interface may be available or not. If available, it is important to know which data can be sent through the interface and which protocol is used.

Sensors are usually included within the PV systems. It is important to know which measurement data is accessible.

Historic measurements show the production of the PV system for a specific interval or instant of time.

Historic consumption and production patterns of producers from similar areas or projects.

Additional data include all data which is not listed above.

3.1.4 Storage data

Different storage types may be available in the model regions, such as electric vehicle batteries, stationary batteries and hydrogen storage. As all these storage types are coupled to the grid through inverters, the data to be collected is quite similar. However, the data listed below focuses on electric vehicle batteries and stationary batteries.

Static data of batteries and the corresponding chargers includes inverter rating and efficiency, battery storage capacity and efficiency, maximal charging/discharging power, and information on the controllability of the charger (active and reactive power).

Controls of battery chargers include var controls, such as cosφ(*P*), *Q*(*U*), fixed cosφ and fixed *Q*, and active power curtailment, such as *P*(*U*) and under-voltage protection. These controls are rarely used in EV chargers and especially in stationary battery systems.

Communication interface may be available or not. If available, it is important to know which data can be sent through the interface and which protocol is used.

Sensors are usually included within the battery chargers. It is important to know which measurement data is accessible.

Historic measurements show the consumption of the EV chargers for a specific interval or instant of time.

Historic consumption and production patterns of storages from similar areas or projects.

Additional data include all data which is not listed above.

3.2 Organizational data

The organizational data includes - if existing - the organigram of the REC, the responsibilities of each organ, the members, the statutes, incentives to join the REC, and the geographic extent of the REC. It specifies the boundaries of the REC and thus the area of which technical data is to be collected.

3.3 Market-related data

The REC benefits from an appropriate design of markets for energy and ancillary services. Information on how customers, producers and storage operators participate in the market are of primary interest. Furthermore, it is important to know whether only the transmission system operator, or also the DSO operates the market. However, the market structure does not impact the technical data to be gathered – neither in greenfield nor in upgrade projects – thus it is out of scope of this document.

3.4 Legislative data

The corresponding national legislation greatly affects the design of the REC's organization and the market structure. However, the legislation does not impact the technical data to be collected. But, the collected data is to be treated in compliance with the General Data Protection Regulation (GDPR) [2].

4 Data sources

The technical data necessary to design the *LINK*-based REC for a specific focus region may be collected from various sources that differ for greenfield and upgrade projects. Some of the data sources are natural persons (e.g. house owners) and legal persons (e.g. the DSO); their drivers and barriers to deliver the data are briefly discussed.

4.1 Distribution system operator

DSOs usually have all the data of their distribution systems (see §3.1.1) and some Customer Plant (CP) related data, such as CP type (residential, agricultural, commercial and industrial), billing demand, installed PV rating and the corresponding control strategy, installed electric vehicle charging stations, and installed smart meters. Therefore, DSOs are a very important data source in both greenfield and upgrade projects.

Drivers for data provision:

- The large-scale implementation of RECs is favored by the European parliament. Therefore, the Renewable Energy Directive (EU) 2018/2001 intends the DSOs to cooperate with the RECs´, which may serve as a driver to provide the necessary data.
- The *LINK*-based REC works in harmony with the grid. It solves the voltage control problem in Low Voltage (LV) grids by minimizing the uncontrolled reactive power flows; and provides ancillary services by enabling demand response and end-user and cross-vector sector coupling.

Barriers for data provision:

- Preservation of company secrets.
- Apprehension that RECs may negatively affect the company’s profits.
- Worry that RECs may negatively affect the grid

4.2 Customers / house owners

Customers own the residential, commercial, industrial and agricultural customer plants. They usually have data relevant for upgrade projects such as installed technical equipment, historic measurements, CP type, number of residents, etc.

Drivers for data provision:

- Motivation to support REC establishment due to environmental, economic, and social benefits.
- Technology enthusiasm.

Barriers for data provision:

- Data privacy.
- Lack of time, lack of availability, especially when the customers/house owners don´t want to participate in the planned REC.

4.3 Municipalities / local authorities

Municipalities and other local governance involved in urban planning are responsible for future plans of the corresponding public parts, e.g. on electrification of public transport or other plans that might affect the local storage or consumption.

Municipalities and local governance might be influencing the Energy community by planning of activities in the area such as public transportation, solar panels on public areas etc. The REC area might also include public building which makes the municipality a customer and a potential member of the REC

Depending on the national law, lots of data from municipalities and cities are available to the general public which allows for easy access to relevant data.

Municipalities and local governance will be of interest as a data owner with regards to:

- Future plans might affect prerequisites of REC
- Local restrictions or goals
- Direct or indirect ownership in low voltage grids

Drivers for data provision:

The main driver for municipalities to provide data is that establishing a REC contributes to their overall planning or sustainability goal or to enhance the communicative value of the level of innovation in the municipality

Barriers for data provision:

The technical expertise varies within a municipality if the communication is not adjusted to the technical level of the counterpart the benefits of an REC might not be fully understood and thereby reducing the willingness to participate. Data Privacy Concerns may be another issue, but should affect only to some extent the technical data relevant for the REC.

4.4 Registers and maps

Many registers and maps are publicly available and contain lots of information valuable for upgrade projects.

4.4.1 Land register

Land registers, such as [3], are usually publicly available and contain detailed satellite imagery and area zoning plans of the regions to be upgraded. The area zoning plans contain incomplete information on the course of the underground cables and overhead lines, and on the locations of transformers, switching stations, pumping stations, purification plants, etc. The area zoning is indicative of the CP type as it categorizes areas into residential, agricultural, commercial, industrial, central and special ones. Furthermore, the satellite imagery includes useful information, as the course of the cables can be estimated based on the course of the roads. It shows rooftop PV systems and allows measuring the panel area and azimuth. However, satellite imagery is updated rarely, thus the data is not up-to-date.

4.4.2 Web based map services

Web based map services such as Google maps contain satellite imagery and additional information of the model regions. In addition to the information of the pure satellite imagery, it provides incomplete data on the CP type (commercial CPs, such as restaurants, are often highlighted), and electric vehicle charging stations (the number and charging power is given).

4.4.3 Open street maps

Open street maps, such as [4], contain incomplete information on the course of the overhead lines and underground cables, and on the location of power plants (including distributed generation), transformers, distribution cabinets, switching stations, etc.

4.4.4 EV charger registers

Many public registers, such as Chargemap [5], exists that contain information about the location and characteristics of EV chargers

4.5 Real estate developer

A Real Estate Developer (RED) acquires property upon which they plan to develop their real estate projects, whether for commercial or residential purposes. This makes the real estate developer a key data owner and stakeholder in a greenfield project.

There are two main kind of real estate developers the kind that develops and sells and the kind that develops and manages. A developer of a larger area will most likely be a combination of both. Developing and managing parts and selling of other parts.

In both cases the general attributes for the developing area is important to communicate to both potential buyers and residents as well as to municipalities and the surrounding society. Being an enabler of locally produced energy and participation in an REC will in most cases be seen as a unique selling point for the developers. This means that most real estate developers will likely be willing to share data.

Drivers for data provision:

The main driver for a RED is that a REC contributes with a high degree of innovation and can be used as a tool in building a more sustainable area. Sustainability and modern solutions can later on be used in dialogue with customers and other stakeholders.

Barriers for data provision:

- The needed data needed might not be available since the project has not decided on the details yet.
- More than one RED might be active in the model region. This might lead to fear of losing a competitive edge by revealing details in the project plans in a too early stage.
- The RED needs to be able to communicate the benefits of an REC to the relevant stakeholders, and not the technical solutions. A lack of competence to translate technical solutions into benefits may reduce the willingness to provide data.

4.6 Literature / Generic Data-Sets

Literature and data sets provide generic data that may be used when specific data is not available.

4.7 Manufacturers of appliances

Details on appliances, such as metering devices, can be obtained from the corresponding datasheet of the manufacturer, if the exact appliance is known.

4.8 Producer operators

Producer operators manage production facilities that are directly connected at the distribution grid (not at the CP level). They usually have the corresponding data, which is described in §0.

Drivers for data provision:

- Motivation to support REC establishment due to environmental, economic, and social benefits.

Barriers for data provision:

- Preservation of company secrets.
- Skepticism about RECs.

4.9 Storage operators

Storage operators manage storage facilities that are directly connected at the distribution grid (not at the CP level). They usually have the corresponding data, which is described in §3.1.4.

Drivers for data provision:

- Motivation to support REC establishment due to environmental, economic, and social benefits.

Barriers for data provision:

- Preservation of company secrets.
- Skepticism about RECs.

5 Data type

The GDPR [2] lays down rules relating to the protection of natural persons with regard to the processing of personal data. According to its basic principles, the collection, storage, processing and use of personal data should be minimized and restricted to the absolutely essential.

The management of personal and non-personal data should be specified within a Data Management Plan (DMP) for any organization or project.

5.1 Personal data

The GDPR defines “personal data” as any information relating to an identified or identifiable natural person; an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

5.2 Non-personal data

In this document, “non-personal data” is defined as any information not relating to an identified or identifiable natural person.

6 Data management

In any organization or project, a DMP should be created to specify the management of the collected data. A metadata file should be created and regularly updated for each collected data item or set of items.

The DMP plan of the INTERACT project [6] has the following content:

1. Executive Summary
2. Introduction
    1. General Responsibilities within INTERACT
    2. European General Data Protection Regulation (GDPR)
    3. Data Controller (=Data Owner) and Data Processor Roles within INTERACT
    4. Principle of minimizing Personal Data within INTERACT
3. Expected Data within INTERACT
    1. Aims and Workplan if INTERACT
    2. Expected Data related to Work Packages
    3. More detailed Description of Expected Data
4. Gathering Data, User Consent and Metadata
    1. Metadata-File
    2. Metadata-File Storage
    3. Consent for Data
        1. Consent for Collection Personal Data
        2. Consent for Collection of other Data
5. Storage and Access of Data
    1. Data Storage
    2. Access of Data
    3. Storage Duration
6. ANNEX I – Metadata-File Template

The metadata files used within the INTERACT project contain the following information:

1. Name, Aim and Description of the Data-Set
2. Data Source
3. Information regarding Consent of Use
4. Version History of the Data Set, including dates and responsible partners
5. Data Format
6. Information regarding data quality
7. Information regarding storage, access and sharing
8. Any Restrictions related to the Data Set

7 Data purpose in the INTERACT project

The technical data of the model regions is collected in the INTERACT project for several purposes, which are briefly overviewed in this section for the greenfield and upgrade cases.

7.1 Greenfield projects

Designing the *LINK*-based REC for a specific greenfield involves three fundamental tasks: The analysis of the planned electricity grid, the gap analysis to the *LINK*-control structure, and the design of the *LINK*-ICT structure.

7.1.1 Analysis of planned electricity grid (Purp-1G)

Based on the development plans created by the RED, the DSO plans the distribution grid in the focus region. This grid should be analyzed in the presence of the *LINK*-control structure and the planned PV installations to investigate the possibility for increased PV penetrations.

7.1.2 Gap analysis to the *LINK*-control structure (Purp-2G)

The currently planned automation systems must be analyzed to identify the gaps to the *LINK*-control structure.

7.1.3 Design of the *LINK*-ICT structure (Purp-3G)

The *LINK*-ICT structure shall be designed based on the currently planned ICT systems. The data exchanges between the CPs and the grid, the CPs and the REC, and the REC and the market are specified.

7.2 Upgrade projects

The upgrade of the existing communities and neighborhoods to function as a *LINK*-based RECs involves three fundamental tasks: A preliminary feasibility check, the identification of necessary technology upgrades, and the design of the *LINK*-ICT structure.

7.2.1 Technical feasibility of the *LINK*-based REC (Purp-1U)

The feasibility of an REC in the focus region must be examined with respect to technical, legal and market-related aspects. Validating the feasibility of the *LINK*-based REC motivates the corresponding DSO to cooperate in its realization.

Technical feasibility is checked via offline analysis of the existing electrical network. Load flow simulations allow verifying compliance to the operational (voltage and thermal) limits in the presence of the *LINK*-control structure. The actual status quo concerning the installed producers and storages and increased penetrations shall be analyzed to identify potential technical challenges and the corresponding solution approaches.

7.2.2 Identification of necessary technology upgrades (Purp-2U)

The *LINK*-based REC relies on the *LINK*-control structure to work in harmony with the electricity grid. Technology upgrades necessary to fill the gaps between the status quo and the *LINK*-control structure should be identified.

7.2.3 Design of the *LINK*-ICT structure (Purp-3U)

The *LINK*-ICT structure shall be designed based on the currently existing ICT systems. The data exchanges between the CPs and the grid, the CPs and the REC, and the REC and the market are specified.

7.3 Overview

Table 1 associates all data purposes with IDs, which are used in §8 to allocate the corresponding purpose to each data item.

Table 1: Overview of data purposes

ID	Project type	Purpose
Purp-1G	Greenfield	Analysis of planned electricity grid
Purp-2G	Greenfield	Gap analysis to the *LINK*-control structure
Purp-3G	Greenfield	Design of the *LINK*-ICT structure
Purp-1U	Upgrade	Technical feasibility of the *LINK*-based REC
Purp-2U	Upgrade	Identification of necessary technology upgrades
Purp-3U	Upgrade	Design of the *LINK*-ICT structure

8 Data inventory lists

Table 2 to Table 9 associate for both project types the technical data items to be collected (see §3.1) with the data type (see §5), the purpose of the data in the INTERACT project (see §7), and the potential data sources (see §4). The relevance of the data items is also given.

8.1 Greenfield projects

The technical data collected within greenfield projects are related to planned installations. Here is assumed that the buildings are not allocated to natural persons yet. Hence, the technical data to be collected is categorized as non-personal data.

The analysis the planned electricity grid (Purp-1G) involves the modelling and simulation of the electrical power system, including the grid itself, the connected producers and storages, and the CPs. All data items necessary for modelling the power system are required for this purpose.

The gap analysis to the *LINK*-control structure (Purp-2G) requires knowledge on the planned automation schemes.

The design of the *LINK*-ICT structure (Purp-3G) is dedicated to the specification of the data exchanges between the CPs and the grid, the CPs and the REC-institutions, and the REC-institutions and the market. To define these data exchanges, the planned ICT installations and measurement devices are of primary interest. The number of accommodation units per building is also crucial to define the data exchanges within the buildings.

Table 2 Inventory list for the distribution grid (greenfield projects)

Item	Purpose	Type	Relevance	Primary source
Static grid data	Purp-1G	Non-personal	Very high	DSO
Conventional metering devices	Purp-3G	Non-personal	Low	DSO
Smart meters	Purp-3G	Non-Personal	High	DSO; RED
Controls	Purp-1G; Purp-2G	Non-personal	Medium	DSO
Communication technology	Purp-3G	Non-personal	Low	RED
Data server	Purp-3G	Non-personal	Low	RED

Table 3 Inventory list for the customer plants (greenfield projects)

Item	Purpose	Type	Relevance	Potential source
Type	Purp-1G	Non-personal	High	RED; DSO
Number of accommodation units	Purp-1G; Purp-3G	Non-personal	High	RED
Number of residents	Purp-1G	Non-personal	Low	RED
Billing demand	Purp-1G	Non-personal	High	DSO
Producers	Purp-1G	Non-personal	High	RED; DSO
Storages	Purp-1G	Non-personal	High	RED; DSO
Historic consumption and production patterns	Purp-1G	Non-personal	Medium	RED; DSO
Load profiles	Purp-1G	Non-personal	High	DSO
Automation	Purp-2G	Non-personal	High	RED
Communication technology	Purp-3G	Non-personal	Medium	RED
Data servers	Purp-3G	Non-personal	Medium	RED

Table 4 Inventory list for the production systems (greenfield projects)

Item	Purpose	Type	Relevance	Potential source
Static data	Purp-1G	Non Personal	High	RED; DSO
Controls	Purp-1G; Purp-2G	Non Personal	High	RED; DSO
Communication interface	Purp-3G	Non Personal	High	RED
Sensors	Purp-3G	Non Personal	High	RED
Historic consumption and production patterns	Purp-1G	Non Personal	High	RED
Additional data	All	Non Personal	n/a	All

Table 5 Inventory list for the chargers of electric vehicle, stationary batteries and hydrogen storage (greenfield projects)

Item	Purpose	Type	Relevance	Potential source
Static data	Purp-1G	Non Personal	High	RED; DSO
Controls	Purp-1G; Purp-2G	Non Personal	High	RED; DSO
Communication interface	Purp-3G	Non Personal	High	RED
Sensors	Purp-3G	Non Personal	High	RED
Historic consumption and production patterns	Purp-1G	Non Personal	High	RED
Additional data	All	Non Personal	n/a	All

8.2 Upgrade projects

The technical data collected within upgrade projects are related to existing installations owned and operated – among others – by natural persons. Therefore, some of the collected data is personal and must be treated with special care.

The analysis of the technical feasibility of the REC in the region to be upgraded (Purp-1U) involves the modelling and simulation of the existing electrical power system, including the grid itself, the connected producers and storages, and the CPs. All data items necessary for modelling the power system are required for this purpose.

The identification of necessary technology upgrades (Purp-2U) to enable the *LINK*-control structure requires knowledge on the existing automation schemes.

The design of the *LINK*-ICT structure (Purp-3U) is dedicated to the specification of the data exchanges between the CPs and the grid, the CPs and the REC-institutions, and the REC-institutions and the market. To define these data exchanges, the existing ICT installations and measurement devices are of primary interest. The number of accommodation units per building is also crucial to define the data exchanges within the buildings.

Table 6 Inventory list for the distribution grid (upgrade projects)

Item	Purpose	Type	Relevance	Potential source
Static grid data (topology)	Purp-1U	Non-personal	Very high	DSO; Land register; open street maps; municipality;
Static grid data (parameters)	Purp-1U	Non-personal	High	DSO
Historic measurements	Purp-1U	Non-personal*	Medium	DSO;
Conventional metering devices	Purp-3U	Non-personal	Low	DSO; Manufacturer;
Smart meters	Purp-3U	Personal	High	DSO; Manufacturer; Customer;
Controls	Purp-1U; Purp-2U	Non-personal	Medium	DSO;
Communication technology	Purp-3U	Non-personal	Low	DSO;
Data server	Purp-3U	Non-personal	Low	DSO;

*Non-personal, if the measurement is recorded at a location that does not allow allocating the measurement to a specific customer plant, producer or storage (e.g. at the distribution substation).

Table 7 Inventory list for the customer plants (upgrade projects)

Item	Purpose	Type	Relevance	Potential source
Type	Purp-1U	Personal*	High	DSO; Customers; Municipality; Land register;
Number of accommodation units	Purp-1U; Purp-3U	Personal*	High	DSO; Municipality;
Number of residents	Purp-1U	Personal	Low	Customers; Municipality;
Billing demand	Purp-1U	Personal*	High	DSO; Customers;
Producers	Purp-1U	Personal*	High	DSO; Customer; Google maps; Municipality;
Storages	Purp-1U	Personal*	High	DSO; Customer; Municipality;
Historic measurements	Purp-1U	Personal*	Medium	DSO; Customer;
Load profiles	Purp-1U	Non-personal	High	DSO
Automation	Purp-2U	Personal*	High	DSO; Customer;
Communication technology	Purp-3U	Personal*	Medium	Customer
Data servers	Purp-3U	Personal*	Medium	Customer

*Personal, if the CP owner is a natural person.

Table 8 Inventory list for the photovoltaic systems (upgrade projects)

Item	Purpose	Type	Relevance	Potential source
Static data	Purp-1U	Personal*	High	Registers and maps; customers; producer operators; municipalities;
Controls	Purp-1U; Purp-2U	Personal*	High	DSO;
Communication interface	Purp-3U	Personal*	High	Manufacturer
Sensors	Purp-3U	Personal*	High	Manufacturer
Historic measurements	Purp-1U	Personal*	High	Customers; DSO; producer operators
Additional data	All	Personal*	n/a	All

*Personal, if the producer operator is a natural person.

Table 9 Inventory list for the chargers of electric vehicle and stationary batteries (upgrade projects)

Item	Purpose	Type	Relevance	Potential source
Static data	Purp-1U	Personal*	High	Registers and maps; customers; storage operators; municipalities;
Controls	Purp-1U; Purp-2U	Personal*	High	DSO;
Communication interface	Purp-3U	Personal*	High	Manufacturer
Sensors	Purp-3U	Personal*	High	Manufacturer
Historic measurements	Purp-1U	Personal*	High	Customers; DSO; storage operators
Additional data	All	Personal*	n/a	All

*Personal, if the storage operator is a natural person.

9 Inventory workflow

The inventory workflow focuses on the collection of the technical data. It differs for greenfield and upgrade projects. Therefore, they are described separately below.

9.1 Greenfield projects

Figure 1 shows the data collection workflow for greenfield projects.

The first step is to ask the DSO whether the BaU plans for the electricity grid in the focus region already exit. Their availability is the prerequisite for designing the *LINK*-based REC (planning the distribution grid is not considered as a part of the REC design process). If the plan is available, the details on the static grid topology and parameters, controls, load profiles, producers, storages, etc. are procured from the DSO. The contractors responsible for planning the ICT, metering devices are automation schemes are identified and asked whether the corresponding BaU plans already exist. If yes, the details are procured from the relevant contractors. Otherwise, wait until they have created the plans.

9.2 Upgrade project

Figure 2 shows the data collection process for upgrade projects.

First, key data concerning the static grid topology (position of DTRs and the area supplied by each DTR) are procured from the municipality. Afterwards, registers and maps are used to collect additional data concerning the static grid topology (course of cables and overhead lines), the CPs (CP type and rooftop PV systems), the PV systems directly connected to the LV grid and the public electric vehicle chargers. The data contained in maps and registers is often incomplete and uncertain. Therefore, the missing data is identified, and the DSO is asked to provide detailed information on the electrical appliances, measurements and load profiles, metering devices, automation schemes and ICT systems. The DSO may not provide all the requested data for any reason. Therefore, the missing data is identified again, and the municipality is consulted to provide the still missing data, such as information on the static grid topology, CP type, number of accommodation units per building and residents per accommodation unit, producers and storages. The municipality may not provide all of the requested data for any reason. Therefore, several iterations involving the DSO and the municipality may be helpful to collect as much and detailed data as possible. Now, some data might still be missing. The missing data is identified and the customers, producer- and storage-operators are asked for the relevant data. The data still missing after this procedure has to be collected from manufacturers, the literature and generic data sets.

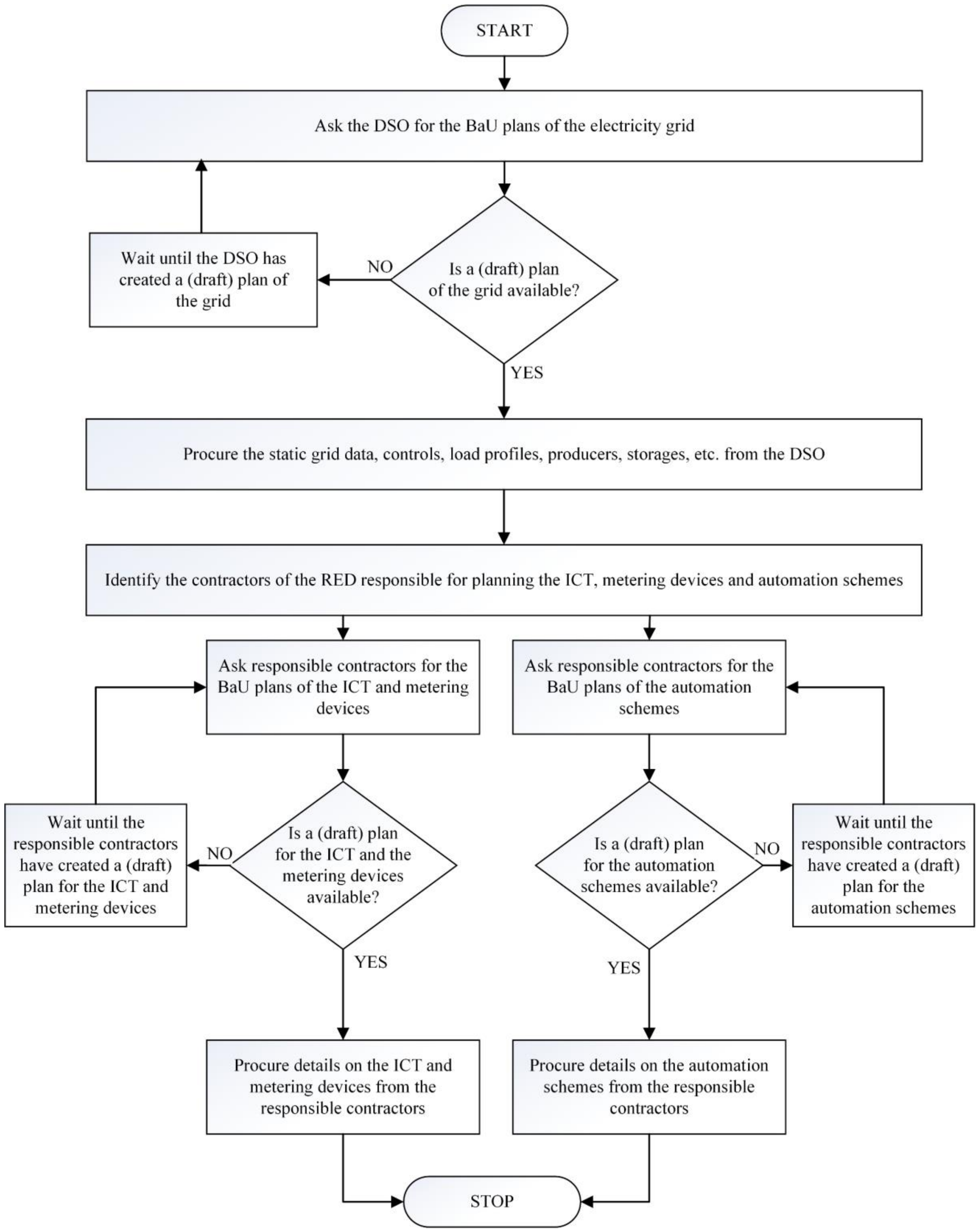

Figure 1: Data collection process for greenfield projects

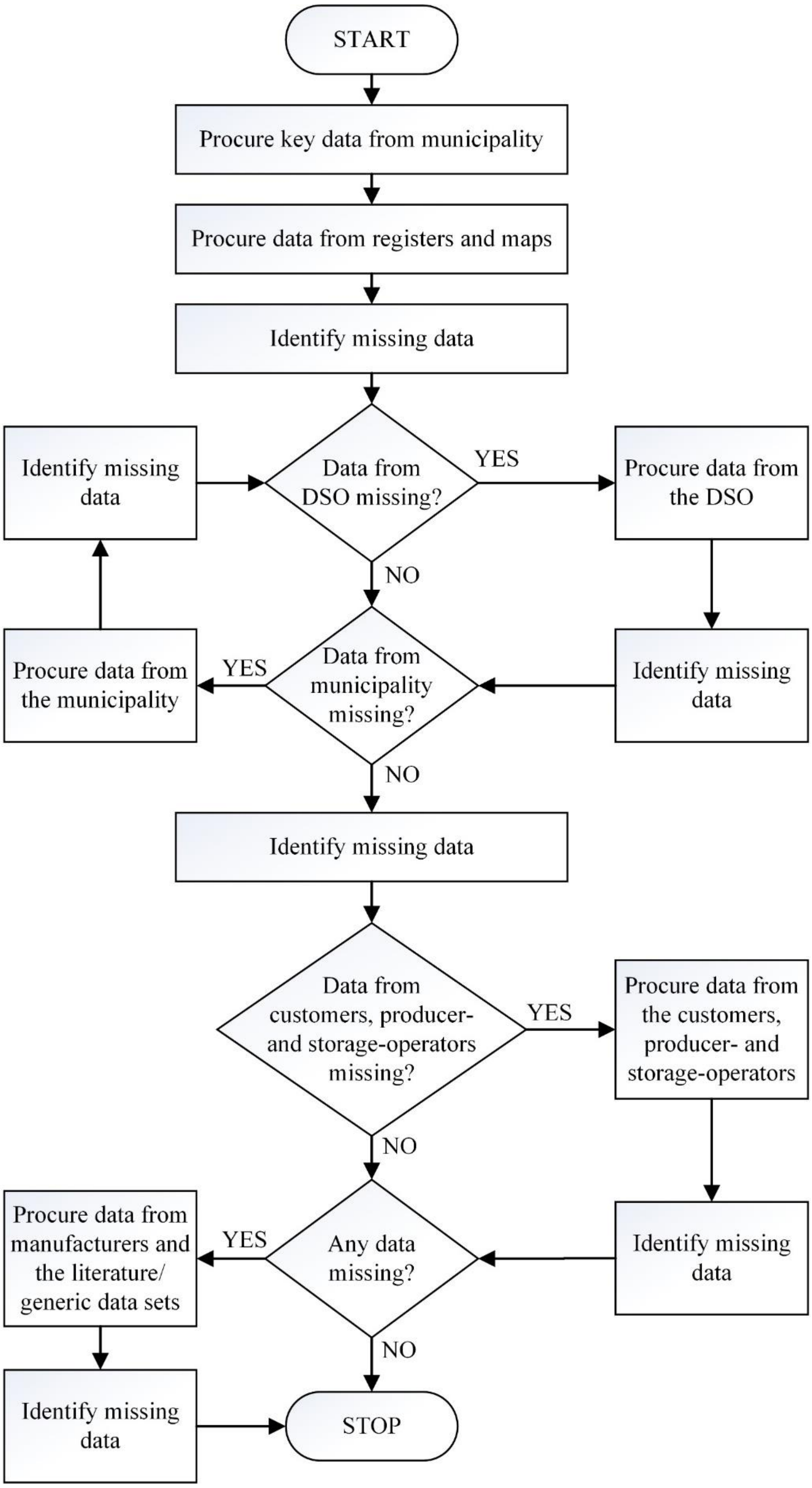

Figure 2: Data collection process in upgrade projects

10 List of references

[1] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (Text with EEA relevance.)

[2] 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 repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA relevance)

[3] NÖ Atlas - Land Niederösterreich. Available online: https://atlas.noe.gv.at/webgisatlas/(S(op0lej3wukqjpc3rzzbw01ad))/init.aspx?karte=atlas_gst (Accessed on 25 06 2021)

[4] Stromnetzkarte auf Basis von OSM-Daten. Available online: https://www.flosm.de/html/Stromnetz.html (Accessed on 25 06 2021)

[5] https://de.chargemap.com/ (Accessed on 30 06 2021)

[6] Interact data management plan v.1 2021-05-10

INTERACT