This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773715

Grant Agreement No.: 773715

Project acronym: RESOLVD

Project title: Renewable penetration levered by Efficient Low Voltage Distribution grids

Research and Innovation Action

Topic: LCE-01-2016-2017

Next generation innovative technologies enabling smart grids, storage and energy system integration with increasing share of renewables: distribution network

Starting date of project: 1st of October 2017

Duration: 42 months

D8.4 – Data Management Plan

Organization name of lead contractor for this deliverable: UdG	
Due date:	M6 - 31th of March 2018 M42: 31th of March 2021 (update)
Submission Date:	28th of March 2018 (V1.1), 29th of March 2021 (v2.0)
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Version	2.0

Dissemination Level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Deliverable reviews

Revision table for this deliverable:		
Version 0.X	Reception Date	19th of march 2018
	Revision Date	20th of March 2018
	Reviewers	Heidi Tuiskula (SIN), Ramon Gallart (EyPESA)
Version 1.1	Reception Date	20th of March 2018
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Version 2.0	Reception Date	26th of March 2021
	Revision Date	29th of March 2021
	Reviewers	Miha Smolnikar (CS), Quim Meléndez (UdG)

Contributions of partners

Description of the contribution of each partner organisation to the work presented in the deliverable.

Partner	Contribution
UdG	Owner and editor of the document in both submissions (M6 and M42 update). UdG has also contributed in the sections referred to the institutional repository that is proposed for storing the data.
UPC	UPC has contributed to specify the data information regarding the data that will be generated in the laboratory, at UPC.
EyPESA	EyPESA has contributed to specify the information for the case of data generated in the real low voltage grid collected by a SCADA system, through the remote terminal units (RTU), aggregator concentrator links and the Data Concentrator Units (DCU) and smart meter as well as DSO data from GIS, ERP DB systems.
CS	CS has contributed to the specification of PMU and PQM management.

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Acronyms and abbreviations

AMI	Advance Metering Infrastructure
API	Application Program Interface
CSUC	Consortium of Libraries Universitaries of Catalonia
CIM	Common Information model
CUPS	From Spanish, Universal Supply Point Code
DB	Data Base
DC	Data Center
DMP	Data Management Plan
DoA	Description of Action
DCC	Digital Curation Center
DSO	Distribution System Operator
FAIR	Findable, Accessible, Interoperable and Reusable
KPI	Key Performance Indicator
LV	Low Voltage
MDC	Meter Data Collector
MDMS	Meter Data Management System
ORD	Open Research Data
PMU	Phasor Measurement Unit
RTU	Remote Terminal Units
R+D	Research and Development
SCADA	Supervisory Control And Data Acquisition
UK	United Kindgdom
w.r.t.	with respect to

Executive Summary

RESOLVD project aimed to join the H2020 pilot on Open Research Data (ORD). The consortium agreement reflects the common position of the consortium w.r.t. data management plan (DMP), which follows the FAIR (Findable, Accessible, Interoperable and Reusable) principles.

In accordance with the "Guidelines on FAIR on Data Management in Horizon 2020" (Version 3.0, 26 July 2016), this deliverable details:

- What data the project has collected and generated;
- Whether, and how, this data will be exploited or shared and made accessible/open for verification and re-use;
- How this data will be curated and preserved.

The first version of the data management plan was submitted in M6 and was approved by the EC the 25th of February 2019. Data Management Plan has been a live document and this new version, submitted in M42 of the project, updates those significant changes or information updates arisen during project execution. This update has been mainly focused on including the data sets and updated information proving the compliance of the project with Article 29 of the Grant Agreement.

1. Introduction

1.1. Objectives

This data management plan aims to guarantee replicability, scalability and benchmarking of validated results of the project; in particular, those presented in scientific publications, addressing the following objectives that will be detailed in the different sections:

- Identification of the types of data that RESOLVD has generated, including typology, origin, volume, formats and files.
- Definition of how the data will be organized and managed and documented guaranteeing the good quality of the data.
- Description of the storage strategy during the project execution and data preservation (repository).
- Definition of the project data policies, including issues related to intellectual property.
- Costs analysis regarding data preservation and storage.

1.2. Report structure

The preparation of this deliverable has consisted on answering the questions requested in the Guidelines on FAIR on Data Management in Horizon 2020. Core sections in D8.4 are organised as follows:

- Section 2: it describes in detail the summary of the data that have been generated/collected in the project, explaining the purpose of the data generation/collection, its relation with the objectives of the project, including also its origin, types and formats, etc.
- Section 3: it includes all the questions referred to make the data findable, accessible, interoperable and re-usable through the proposed repository.
- Section 4: it explains the allocation of resources and cost foreseen for data preservation.
- Section 5: it addresses data recovery as well as secure storage and transfer of sensitive data.
- Section 6: it considers the ethical issues taking into account regarding sensitive information, if it's the case.
- Section 7: New section in the deliverable update (M42), containing the necessary information about the project publications and the research data needed to validate the results presented in the deposited scientific publications.

2. Data Summary

2.1. State the purpose of the data collection/generation

The data used in the RESOLVD project has been oriented to improve knowledge on how power flow behaves in the low voltage grid, considering a relevant increase of presence of distributed renewable generation and high variability on demand. The general purpose of the project RESOLVD is to act (schedule and control) on the low voltage grid in order to increase efficiency. With this aim, data has served (and will be in the future) in the following purposes:

- Enhance grid observability when monitoring: improve knowledge on demand/generation profiles, power flow computation, etc.
- Modelling demand and generation for forecasting purposes: training of machine learning algorithms to forecast demand and generation in specific points of the grid.

- Test and performance evaluation of both, technologies developed as part of the RESOLVD solution, and computation of KPIs during project validation: validation of proposed solution and quantification of improvements based on indicators.

2.2. Explain the relation to the objectives of the project

The overall objective of RESOLVD is to improve efficiency and the hosting capacity of distribution networks in a context of highly distributed renewable generation by introducing energy flexibility and control by acting on the grid. This deliverable describes dependencies of data being collected and generated with specific objectives derived from this primary one:

- Design, develop and test new hardware for monitoring and acting on the grid: These new devices will acquire physical measures of power and energy that will be used for monitoring and control.
- Resilient and efficient scheduling and operation of the LV grid: data from specific point of the grid will be used for modelling demand and generation and further forecasting.
- Analyse potential business models: data from different sources will be used to compute KPIs (D5.4 and D6.5, also submitted in M42) to be used in cost-efficiency analysis of different business models.

2.3. Specify the types and formats of data generated/collected

The datasets collected within the project are experimental, coming from both laboratory and a real scenario provided by UPC and EyPESA respectively. In the case of data generated in the laboratory, at UPC premises, data refers to time series of active and reactive power exchanged by the power electronics device, i.e. energy router (ER) and the state of batteries (level of charge and voltage level). Data is acquired through a test platform where the devices are attached to.

In the case of data generated (see section 6 for ethical issues) in the real low voltage grid provided by EyPESA, information has been collected by a SCADA system, through the remote terminal units (RTU) or / and aggregator concentrator links connected to smart meters. They include electrical variables such as active power, reactive, power, apparent power, voltage and currents and have been delivered as tables in *.csv files extracted from SCADA data base. The real environment has allowed access to data collected by the metering infrastructure through Data Concentrator Units (DCU) and smart meter. This data set includes energy (active and reactive), voltage and/or current acquired periodically and updated daily to the control center. This data is associated to the metering point with an identifier known as Universal Code of Supplier Point (Spanish acronym: CUPS) and the format should be in *.xml or *.csv. It would be provided form the smart metering data base.

Data from PMU and PQM instruments developed within the project and deployed in the pilot has been collected by local ePCs and/or sent via MQTT protocol to collection and control server at Comsensus premisis. PMU data includes time series of voltage phasors, current phasors, grid frequency and change of grid frequency. PQM data includes time series of voltage, current, active power, reactive power, voltage and current estimated THD, power factor, grid frequency and harmonics of current including the fundamental. All data is stored in Influx database and can be access directly via API or exported in CSV format. PMU data is stored on the local ePC for 14 day. Aggregation of the stored data is sent to the main server each second to reduce needed bandwidth and data volume over LTE. In case of event detection the full resolution data is transmitted to the main server and stored in the database.

Data files used for validation of algorithms reported in published papers (see section 7) are also available in *.csv files.

Apart from the data coming from RESOLVD consortia, the project has also used external data collected within the OpenLV project (United Kingdom), signing a confidential agreement through

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UdG. These set of data was used to develop a monitoring strategy within the RESOLVD project. Those data consist of average, minimum, and maximum phase voltage and line current magnitudes, average active and reactive power, and active and reactive energy recorded every minute from June 2018 to December 2019. They were made available in .csv format, with new data updated every month.

2.4. Specify if existing data is being re-used (if any)

Weather data is also relevant for either electricity generation (PV generation) and consumption forecasting. In the 1st version of this deliverable (submitted in M6), the Servei Meteorològic de Catalunya (Catalan Weather Service) was proposed and already contacted to provide hourly data from of the solar irradiation, temperature, wind speed and direction and humidity registered by the automatic weather stations placed in villages of Gurb and Orís. closer to the pilot of the project.

However, the project has opted out this option, and finally, weather forecast required as input for generation (PV generation) and demand forecasting has been provided by global services making RESOLVD forecasting independent of local meteo providers. In that sense data used during the whole project has been obtained from Darksky (https://darksky.net/) and Solcast (https://solcastglobal.com/), thorough the API service they offer. Thus, data is directly available through this provider.

2.5. Specify the origin of the data

Data described in subsection 2.3 are generated within the project. In the case of data collected in the laboratory, it will be gathered by data acquisition systems already installed in the laboratory. Measurements refer to electrical magnitudes. In the case of real low voltage grid provided by EyPESA, the data will be obtained from SCADA and the metering infrastructure through the Meter Data Collector (MDC) systems. As mentioned other instruments as PMU and PQM have been deployed in the grid during the project to provide data specified in subsection 2.3.

External data collected within the OpenLV project mentioned in subsection 2.3, came from OpenLV devices deployed at real LV networks in the UK.

Last, as mentioned in section 2.4, weather data has been directly provided by Darksy and Solcast providers, and information is available in its servers.

2.6. State the expected size of the data (if known)

Data generated in the laboratory, at UPC, the expected size of the data does not exceed few MB in volume in the format of Excel files.

Data from the real low voltage grid scenario, see Table 1, has two main sources with different time resolution: Data coming from smart meters in the validation area generate 75 kB every day with a granularity of 60 minutes. On the other hand, data collected from the SCADA does not exceed 200 kB every day with a granularity of 3 minutes. Representative data is supposed to cover one year representing a volume of around 100MB (275kB x 365= 100375kB). PMU and PQM instruments can supply registers at higher sampling (every second) frequency.

Taking into account the information flow among the different actors in RESOLVD solution at the real, the size of data can be summarised (at 16/3/2021) as:

Information Flow	Description	Size
SCADA -> PED	Petitions every 4 seconds of about 320 bytes	6,9 MBytes/day
SCADA -> RTU (104)	Measurements received every 12 seconds of 320 bytes	2,3 MBytes /day
Platform -> SCADA	Assuming a data poll every minute, and about 1.825 bytes per each poll	2.620 kBytes / day

MDMS ->Platform	Smart meter curves sent once per day	2.725 kBytes/day
PMU -> WAMS	Measurements received every 1 seconds of 700 bytes	61 MBytes / day
PQM -> WAMS	Measurements received every 1 seconds of 300 bytes	26 MBytes / day

Table 1 Information flow and size (real scenario)

In the case of the external data collected within the OpenLV project over a month at individual substations have been made available as .csv files, with approximate size of 300 kB.

Last, regarding the weather data, the size of the files is no higher than 6-7MB for both training and forecasting models.

2.7. Outline the data utility: to whom will it be useful

The datasets generated in the project could be useful for those electricity actors and stakeholders (DSO, aggregators, technology and R+D providers, etc.) that have interest in the low voltage energy management and business models involving LV network operation (distributed resources generation, energy islands, aggregation, demand response, etc.). Data will be also useful for scientists to check theoretical results and test algorithms (see section 7).

3. Fair data

3.1. Making data findable, including provisions for metadata

3.1.1. Outline the discoverability of data (metadata provision)

The metadata standards proposed to describe the dataset will be the Dublin Core and Datacite Schema, as they are a flexible and common used standards and are also the ones adopted by the European Open AIRE repository.

3.1.2. Outline the identifiability of data and refer to standard identification mechanism. Do you make use of persistent and unique identifiers such as Digital Object Identifiers?

Data will be make open through AIRE compatible repositories. Identification of data in such repositories is given by unique and persistent HANDLE. For example, the UdG institutional repository "https://dugi-doc.udg.edu/", assigns a unique and persistent URL to access the document and dataset following the format: http://hdl.handle.net/10256/.

3.1.3. Outline naming conventions used

Datasets identification have not been set in a unique way. They may follow a naming based on the following convention: Data_<WPno>_<serial number of dataset>_<dataset title>. Example: Data_WP2_1_User generated content. In any case, a readme txt file will accompany the different datasets used for publications in the corresponding repository (see section 7).

3.1.4. Outline the approach towards search keywords

Data sets have to be findable easily, rapidly and identically. Therefore, standard measures have to be used to identify the data sets. This can include the definition and use of naming conventions, search keywords, version numbers, metadata standards and standard data identifiers. With respect to keywords, the following list is proposed at this stage of the project execution: Energy systems (production, distribution, application), energy collection, conversion and storage, renewable energy, low voltage grid flexibility, advanced power electronics, storage management at grid level, generation and demand forecasting, scheduling, self-healing, monitoring, PMU, cybersecurity, energy business models.

Additionally, it's been agreed to follow the Smart Grid Architecture *Model* (SGAM) to describe the different use cases proposed in the project in WP1, and therefore, all variables naming will be based on this existing model when covered by the model. Moreover, SCADA systems used by EyPESA respectively use tele-control standards IEC-60870-5-104 / EyPESA Profile, 61850 for standards of substation/grid automation and IEC 61970 (Common Information model, CIM). The data aggregated in WAMS is stored in Influx database as a timeseries. This enables simplified searching by time frame or data type. In the next updates of this data management plan, we will revise if all these standards do have or not, a list of keywords and/or meta data.

3.1.5. Outline the approach for clear versioning

The repository will host the final data. It's not a working tool. Thus, there will not be any versioning management for the data used in the project. Moreover, due to the nature of the data (electrical variables such as active power, reactive, power apparent power, voltage, currents, etc.), it is not necessary to consider different versions of them.

3.1.6. 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

Each file associated with data will be accompanied with unique specified metadata in order to allow ease of access and re-usability. Standards such as the Dublin Core and Datacite following the guidelines recommended by OpenAire. Standards indicated in section 3.1.4 will be analysed to identify metadata they're using (or not).

3.2. Making data openly accessible

3.2.1. Specify which data will be made openly available. If some data is kept closed provide rationale for doing so

In the case of data generated in the laboratory, there is no reason to constrain the open access to the data included. However, the data collected in the real low voltage will have two origins. First EyPESA, as owner of the grid where the pilot will be deployed will provide data collected in its own infrastructure (SCADA, AMI systems). Second, instruments and technologies (i.e PQM and PMUs) developed in the project will produce other data. The second dataset will be made open whereas the first will be supplied by the company to the consortium under private and confidential conditions. When it is necessary to open this first data, for example to illustrate transformation and dependencies with the second set or to make publications replicable and more relevant, a specific authorization from data owner will be managed.

In the case of externa data (OpenLV project), UdG has signed a Confidentiality agreement and therefore this external data will not be publicly published.

For the case of Weather data, it's available in the providers's repositories, as it is mentioned in sections 2.4 and 2.5.

3.2.2. Specify how the data will be made available

Laboratory and PMU/PQM data will be made available after publication of corresponding research. Research could be included either in project deliverables or articles. No embargo expected.

Company owned data (EyPESA) will follow two strategies depending on the typology of data:

1) Data needed after publication of a contribution of research: will be opened without constraints.
2) Data needed to exchange information with the platform and stakeholders, without reproducing any specific research result being published: criteria explained in the section 3.2.1 of this document will be followed.

3.2.3. Specify what methods or software tools are needed to access the data. Is documentation about the software needed to access the data included. It's possible to include the relevant software (e.g. In open source code)

Data from experiments, delivered as data tables, will be made available in text files ('xlsx', 'csv', 'xml', 'json') easily accessible with any text editor, spreadsheet software or read commands available in any software environment. When necessary a header or configuration file will be included to facilitate the reading. It is also expected to use an API, specifically from smart meters DB should be used the tool Rabbit MS in the case of asynchronous communications. For the SCADA DB it is executed to exchange information from/to folder using text files ('xlsx','csv', 'xml', 'json') easily accessible as mentioned before. Finally, data messages coming from PMU/PQM are JSON objects encoded as utf-8 strings. This historic data that are transmitted through MQTT may be accessed through an HTTP API. The API exposes InfluxDB database and enables SQL-like queries.

3.2.4. Specify where the data and associated metadata, documentation and code are deposited

The final decision about the repository where the data and publications will be deposited has been agreed to be selected by every partner. For example, UdG as the coordinator of the project, is using its institutional repository: https://dugi-doc.udg.edu/ for the publications and https://dataverse.csuc.cat/ for the data sets, and data from the UPC are stored in its institutional repository (https://upcommons.upc.edu). The rest of the partners will use other repositories such as Zenodo or equivalent.

Data coming from smart meters and SCADA are located in BDL data base and mySQL data base in tedisNET respectively, in the DSO Data Process Centre.

3.2.5. Specify how access will be provided in case there are any restrictions

According to the articles 29.2 and 29.3 of the Grant Agreement, each beneficiary must ensure open access (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results. Depositing in a research data repository, the data, including associated metadata, needed to validate the results presented in scientific publications as soon as possible. Data may be used by third parties under proposed CCBY license taking into account that these data will be used under data protection law according to the agreements achieved whenever necessary.

3.3. Making data interoperable

3.3.1. Assess the interoperability of your data. Specify what data and metadata vocabularies, standards or methodologies you will follow to facilitate interoperability.

In order to facilitate interoperability, we use OAI service, that allows to serve items in XML format for harvesting metadata from other repositories.

OAI server allows to ask for records in different formats (OAI_DC, METS,DIDL, DATACITE -We only allow this format for the openaire-data set).

Besides metadata, METS and DIDL formats offer file download uri and its preservation metadata in order to check file integrity.

OAI_DC and DATACITE formats provide only metadata. The main problem of the OAI_DC format, which is currently the most used standard, is that Dublin core metadata element qualifier is lost during harvesting. This may be very confusing, that's the reason why controlled vocabularies for some of these metadata elements have been created.

These vocabularies have a root that provides information on which metadata the values belong to. Specifically, they provide document type, version, access rights and whether they belong to some research program.

For item language we use ISO 639-3 standard. The DATACITE format provides a hierarchical structure that gives related information that adds value to other servers harvesting us (Not specifically DSpace repositories, they don't need to have a Dublin Core metadata system).

Finally, as stated in 3.1.4, Smart Grid Architecture *Model* (SGAM) and standards such as IEC-60870-5-104 / 60870 and standards for substation/grid automation IEC 61970 (Common Information model, CIM, 61850) will be checked in the next updates of this data management plan to analyze if they could have own vocabularies to facilitate interoperability.

3.4. Increase data re-use (through clarifying licenses)

3.4.1.Specify how the data will be licensed to permit the widest reuse possible

The documents and files associated to the datasets are proposed to be licensed through an CC BY-NC-ND 3.0 license (https://creativecommons.org/licenses/by-nc-nd/3.0/es/). During the project execution, data have been internally available for the consortium partners. It will also be findable and reusable through the final depositing repository and from OpenAire, the latest by the end of the project.

3.4.2. Specify when the data will be made available for re-use. If applicable, specify why and for what period a data embargo is needed

The data will remain re-usable after the end of the project by anyone interested in it, with no access or time restrictions.

3.4.3.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 re-use of some data is restricted, explain why.

Data may be used by third parties under proposed CCBY license taking into account that these data will be used under data protection law according to the agreements achieved whenever necessary.

3.4.4. Describe data quality assurance processes

Since data mining algorithms developed in WP3 will rely on the availability of data specified in section 1, it must be standardized and organized for and easy access and guaranteeing data quality. Application of data pre-processing procedures for cleaning data (missing values, repair of abnormal values, outliers avoided, etc…), and appropriate storage in files are proposed for this purpose.

3.4.5. Specify the length of time for which the data will remain re-usable

The length of time for which the data will remain re-usable correspond to the time period the repository system will be available, in accordance with the project consortia.

4. Allocation of resources.

4.1. Estimate the costs for making your data FAIR. Describe how you intend to cover these costs

There are no costs associated to the described mechanisms to make the database FAIR and long term preserved. For example, this is a structural service for EyPESA, CS, UdG and UPC, and therefore, not associated to extra costs in the projects these organizations are participating. The cost will be covered at the local hosting in the context of RESOLVD, as part of the standard network system maintenance.

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4.2. Clearly identify responsibilities for data management in your project

The project coordinator, supported by data providers, has the ultimate responsibility for the data management in the project. Moreover, the project coordinator will be the liaison between the data owners and EC.

4.3. Describe costs and potential value of long term preservation

There are no additional costs associated to the described mechanisms to make the database FAIR and long term preserved. For the case of the institutional repository at UdG and UPC, this is a structural service in the UdG not causing any extra costs in the projects in which the organization is participating.

5. Data security

5.1. Address data recovery as well as secure storage and transfer of sensitive data

We are differentiating the data being used during the project execution and the final datasets that will be uploaded and made available at the institutional repository at the end of the project.

While the project is running and during the implementation of work, institutional secured google drive in the case of UdG and the UPC, Dropbox or equivalent systems have been used, so a copy of data is automatically performed. This data will not include sensitive information, as is stated in deliverables included in work package 9 (see section 6 in this document). They are hosted in a Windows 10 enterprise server.

Regarding the institutional repository at UdG, full copy is backed up 4 times a year using corresponding exportation and backups systems. In addition, there're several periodical backup on demand, and also before and after main System and applications updates.

For PQM/PMU live access, DST Root CA X3 (also called TrustID X3 Root) root certificate is required for connecting to the MQTT broker and must be installed on a system or explicitly included when using programmatic access.

For the data being provided by EyPESA during the project execution, the company has two Data Centres (DC) houses with the suitable power systems , storage and applications necessary to support their business. The infrastructure of the DC is the center of the ICT architecture, from where all the data originates or passes. The design of the network infrastructure of the DC is critical, factors such as performance, resistance, scalability or flexibility are taken into account.

The network design of the DC is based on a layered architecture, the layers into which the network of a DC is divided are Core, Aggregation and Access:

- Core: The Core layer provides packet switching at high speeds for all input and output flows of the CPD, as well as load balancing connectivity between the Campus Core and the aggregation layers.
- Aggregation: Provides functions such as definition of level 2 domains (VLAN) and spanning tree. Traffic between servers crosses the aggregation layer and uses services such as firewalls or load balancing to optimize and secure applications.
- Access: To which the servers are physically connected to access the network.

Like the rest of the CPD systems, the communications system is also redundant in each of its layers. This endows the system with robustness, scalability and flexibility.

Estabanell has two DC in different locations with hot connection. In case that a DC fail, the data always are saved in two data bases.

6. Ethical aspects to be covered in the context of the ethics review, ethics section of DoA and ethics deliverables.

The ethical aspects are related to the use of personal data and are already addressed in the project in the following deliverables, which have all (except D9.4 which is still pending to be evaluated), been approved by the EC:

- D9.1 (M1) to confirm that the ethical standards and guidelines of Horizon2020 are rigorously applied, regardless of the country in which the research is carried out.
- D9.2 (M1) to provide documents detailing secure data management procedures to guarantee ethics and privacy
- D9.3 (M3) to provide a document with EPESA authorization and conditions of use and manage the data.
- D9.4 (M19), detailing how ethics and privacy issues related to data management comply the EU legislation.

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7. Data Sets

The table below presents updated information proving the compliance of the project with Article 29 of the Grant Agreement. It contains information about the project publications and the research data needed to validate the results presented in the deposited scientific publications. Completed information about publications themselves are available in D7.6.

Type of scientific publication	Title of the scientific publication	DOI	Authors	Title of the journal or equivalent	Place of publication	Year of publication	Peer-review	Is/Will open access provided to this publication	Publication Repository	Dataset Repository
Publication in Conference proceeding/Workshop	Real-Time Connectivity Capabilities of Cellular Network for Smart Grid Applications	n/a	Miha Smolnikar, Marko Mihelin, German Corrales Madueno	EuCNC 2018 conference	Ljubljana	2018	YES	n/a	n/a	n/a
Publication in Conference proceeding/Workshop	Reasoning on Adopting OPC UA for an IoT-Enhanced Smart Energy System from a Security Perspective	10.1109/CBI.2018.10060	Stefan Marksteiner	2018 IEEE 20th Conference on Business Informatics (CBI)	Vienna	2018	YES	Yes - Green OA	n/a	n/a
Publication in Conference proceeding/Workshop	Novel power electronics and used EV batteries in grid optimisation	http://doi.org/10.5281/zenodo.3205125	Francisco Díaz-González	INVADE Black Sea 2018 Workshop	Varna	2018	NO	n/a	n/a	n/a
Publication in Conference proceeding/Workshop	Low Voltage Grid Operation Scheduling with Uncertainties	http://doi.org 10.1007/978-3-030-20055-8_47	Albert Ferrer, Ferran Torrent-Fontbona, Joan Colomer	SOCO- International Conference on Soft Computing Models in Industrial and	Sevilla	2019	YES	Yes- Green OA	http://hdl.handle.net/10256/16678	Confidential

				Environmental Applications						
Publication in Conference proceeding/Workshop	Methodology for the sizing of a hybrid energy storage system in low voltage distribution grids	10.1109/MPS.2019.8759696	Francesc Girbau-Llistuella, Francisco Díaz-González, Andreas Sumper, Mònica Aragüés-Penalba, Luisa Candido, Ramon Gallart-Fernandez	A: International Conference on Modern Power Systems. "Proceedings of 2019 8th International Conference on Modern Power Systems (MPS)	Cluj-Napoca	2019	YES	Yes	https://doi.org/10.5281/zenodo.3240014	https://upcommons.upc.edu/handle/2117/337124
Publication in Conference proceeding/Workshop	Resolvd - renewable penetration levered by efficient low voltage distribution grids. Specifications and use case analysis	http://dx.doi.org/10.34890/888	Joaquim Melendez, Isidoros Kokos, Heidi Tuiskula, Andreas Sumper, Stefan Marksteiner, Ramon Gallart, Ferran Torrent	25th CIRED 2019	Madrid	2019	YES	Yes-Green OA	http://hdl.handle.net/10256/16683	n/a
Publication in Conference proceeding/Workshop	Impact of batteries in the hosting capacity of a grid with photovoltaic generation	http://dx.doi.org/10.34890/940	Marc Cañigueral, Joaquim Meléndez,Joaquim Meléndez	CIRED, International Conference on Electricity Distribution	Madrid	2019	YES	Yes	http://hdl.handle.net/10256/16682	10.34810/data19
Paper in Proceedings of Conference/Workshop	Identification and validation of new business models for DSO business environment using business mod	http://dx.doi.org/10.34890/947	Heidi Tuiskula, Sanket Puranik, Iliana Ilieva, Christian Kunze	The 25th international conference and exhibition on electricity distribution	Madrid	2019	YES	Yes	https://cired-repository.org/handle/20.500.12455/725	n/a

Publication in Conference proceeding/Workshop	Detection of Voltage Fluctuations in Low-Voltage Power Distribution Networks with Principal Component Analysis		Laiz Souto, Ferran Torrent, Sergio Herraiz, Joaquim Melendez	PAC World Conference	Glasgow	2019	YES	Yes-Green OA	http://hdl.handle.net/10256/16568	Confidential data
Article in Journal	Cyber security requirements engineering for low-voltage distribution smart grid architectures using threat modeling	https://doi.org/10.1016/j.jisa.2019.102389	Stefan Marksteiner, Heribert Vallant, Kai Nahrgang	Journal of Information Security and Applications	Elsevier	2019	YES	Yes	n/a	n/a
Publication in Conference proceeding/Workshop	A power sharing algorithm for a hybrid energy storage system based on batteries	10.1109/ISGTEurope.2019.8905502	Francisco Díaz-González, Mònica Aragüés-Peñalba, Francesc Girbau-Llistuella, Marc Llonch-Masachs, Andreas Sumper	Proceedings of ISGT Conference	Bucharest	2019	YES	Yes		
Publication in Conference proceeding/Workshop	Proyecto RESOLVD: Penetración de renovables apalancada por redes de baja tensión eficientes	**http://hdl.handle.net/10256/17831**	Joaquim Meléndez	Proyecto RESOLVD: Penetración de renovables apalancada por redes de baja tensión eficientes	Libro de Comunicacions del VI Congreso smart Grids	2019	NO	Yes-Green OA	http://hdl.handle.net/10256/17831	n/a
Article in Journal	Statistical Detectability of Power System Transients Gathered by Multiple PMUs		L. Souto, S. Herraiz, J. Meléndez	Statistical Detectability of Power System Transients		Submitted	YES	n/a	n/a	n/a

				Gathered by Multiple PMUs						
Article in Journal	A comparison of power conversion systems for modular battery-based energy storage systems	10.1109/ACCESS.2020.2972412	Francisco Díaz-González ; Daniel Heredero-Peris ; Marc Pages ; Eduardo Prieto-Araujo ; Andreas Sumper	IEEE Access	IEEE Xplore	2020	YES	Yes - Gold OA	n/a	n/a
Publication in Conference proceeding/Workshop	Fault Location in Low Voltage Smart Grids Based on Similarity Criteria in the Principal Component Subspace	10.1109/ISGT45199.2020.9087707	L. Souto, S. Herraiz, J. Meléndez	Fault Location in Low Voltage Smart Grids Based on Similarity Criteria in the Principal Component Su	USA	2020	YES	Yes- Green OA	http://hdl.handle.net/10256/17787	Confidential data
Article in Journal	Monitoring of Low Voltage Grids with Multilayer Principal Component Analysis	https://doi.org/10.1016/j.ijepes.2020.106471	L. Souto, J. Meléndez, S. Herraiz	Monitoring of Low Voltage Grids with Multilayer Principal Component Analysis	The International Journal of Electrical Power & Energy Systems	2021	YES	Yes-Gold	http://hdl.handle.net/10256/18471	OpenLV (Confidential data)
Article in Journal	Proving a Concept of Flexible Under-Frequency Load Shedding with Hardware-in-the-Loop Testing	https://doi.org/10.3390/en13143607	Denis Sodin,Rajne Ilievska, Andrej Čampa ,Miha Smolnikar, Urban Rudez	Energies 2020	Energies	2020	YES	Yes	n/a	n/a

Article in Journal	Advanced Distribution Measurement Technologies and Data Applications for Smart Grids: A Review	10.3390/en 13143730	Antonio E. Saldaña-González, Andreas Sumper, Mònica Aragüés-Peñalba and Miha Smolnikar	Energies	-	2020	YES	Yes - Gold OA	n/a	n/a
Publication in Conference proceeding/Workshop	Comparison of Principal Component Analysis Techniques for PMU Data Event Detection		L. Souto, S. Herraiz, J. Meléndez	Comparison of Principal Component Analysis Techniques for PMU Data Event Detection	Montreal-Canada	2020	YES	Yes- Green OA	http://hdl.handle.net/10256/18472	https://www.nrel.gov/docs/fy15osti/61664.pdf
Publication in Conference proceeding/Workshop	Fault Location in Power Distribution Networks using Arbitrary Similarity Criteria in the Principal Component Subspace	Doi.org/10.1109/SEGE49949.2020.9182029	L. Souto, J. Meléndez, S. Herraiz	Fault Location in Low Voltage Smart Grids Based on Arbitrary Similarity Criteria in the Principal Co	Oshawa, Canada	2020	YES	Yes- Green OA	http://hdl.handle.net/10256/18573	Confidential data
Publication in Conference proceeding/Workshop	Performance Comparison of Quantitative Methods for PMU Data Event Detection with Noisy Data	10.1109/ISGT-Europe47291.2020.9248826	L. Souto, J. Meléndez, S. Herraiz	Performance Comparison of Quantitative Methods for PMU Data Event Detection with Noisy Data	The Hague, The Netherlands	2020	YES	Yes- Green OA	http://hdl.handle.net/10256/18570	https://www.nrel.gov/docs/fy15osti/61664.pdf
Article in Journal	Threat Modelling and beyond - novel approaches to cyber		JR	Cybersecurity and Privacy-Preserving in	2021	2021	YES	Yes	n/a	n/a

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	secure the smart energy system			Modern Smart Grid						
Publication in Conference proceeding/Workshop	Overhead versus Underground: Designing Power Lines for Resilient, Cost-Effective Distribution Networks under Windstorms	10.1109/RWS50334.2020.9241269	L. Souto and S. Santoso	Overhead versus Underground: Designing Power Lines for Resilient, Cost-Effective Distribution Networ	Salt Lake City	2020	YES	Yes- Green OA	http://hdl.handle.net/10256/18579	Confidential data.
Publication in Conference proceeding/Workshop	Fault Behavior of Power Distribution Networks with Distributed Generation and Uncertainties		L. Souto	Fault Behavior of Power Distribution Networks with Distributed Generation and Uncertainties	Montevideo,	2020	YES	Yes- Green OA	http://hdl.handle.net/10256/18572	http://svn.code.sf.net/p/electricdss/code/trunk/Distrib/IEEETestCases/
Publication in Conference proceeding/Workshop	Evaluation of Power System Resilience Enhancements in Low-Income Neighborhoods	https://doi.org.10.1109/TDLA47668.2020.9326216	L. Souto and S. Santoso	Evaluation of Power System Resilience Enhancements in Low-Income Neighborhoods	Montevideo, 2020	2020	YES	Yes- Green OA	http://hdl.handle.net/10256/18571	n/a
Peer reviewed Application	Analytical Dead-Band Compensation for ZCS Modulation Applied to Hybrid Si-SiC Dual Active Bridge	https://doi.org/10.5821/data-2117-337041-1.	Macià Capó-Lliteras, Daniel Heredero-Peris, Francisco Díaz-González, Marc Llonch-Masachs,	https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9211392 IEEE access		2020	YES	Yes- Green OA	n/a	https://upcommons.upc.edu/handle/2117/337041

			Daniel Montesinos-Miracle							
Article in Journal	Day-ahead scheduling of controllable switches and Energy storgage for optimal power flow considerin forecast errors		Albert Ferrer, Ferran Torrent-Fontbona, Joan Colomer	Energies		Submitted	Yes		n/a	n/a
Article in Journal	Advanced edge-cloud computing framework for automated PMU-based fault localization in distribution networks	-	Denis Sodin, Urban Rudež, Marko Mihelin, Miha Smolnikar, Andrej Čampa	MDPI Applied Sciences	-	2021	Yes	Yes	n/a	n/a

Table 2 Data sets used in RESOLVD publications (n/a: Not applicable)

8. Further support in developing your DMP

At Spanish level, Law 14/2011 of June 1st, on Science, Technology and Innovation (Article 37 Dissemination in open access) is being considered for data management procedures.

This DMP has been created with the support tool "Pla de Gestió de Dades de Recerca", http://dmp.csuc.cat

Research Data Management Plan is a development of Digital Curation Center (DCC), adapted by the Consortium of Libraries Universitaries of Catalonia (CSUC). It is based on the open source DMPRoadmap codebase. These institutions work closely with research funders and universities to produce a tool that generates active DMPs and caters for the whole lifecycle of a project, from bid-preparation stage through to completion.

9. Conclusions

This deliverable has provided details about the data management plan envisioned within the RESOLVD project. A first version of the DMP was delivered after 6 months of project, and now, this document has been updated in the last month of the project (M42). This update has been mainly focused on including the data sets and updated information proving the compliance of the project with Article 29 of the Grant Agreement.