



Creating a Centre of EXCELlence on sustainable Energy at NCSR Demokritos

Deliverable 1.2 – Data management plan

Plan of generated project data and how will be handled, processed, and/or stored

Management Board, NCSR

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Summary The deliverable <i>D1.2: Data management plan</i> is a public document of the EXCELLEND project, produced in the context of WP1, <i>Task 1.4: Data management</i>. The Data Management Plan (DMP) includes a description of data management methodology and standards to be followed, and also information on what data sets is exploitable or made accessible for verification and re-use. This deliverable introduces the first version of the DMP of the project, before the beginning of its research activities, therefore before generating, collecting and reusing most of the expected data. The DMP outlines the ways in which data are generated, collected, handled, and processed throughout the project and after its completion. It aims to ensure data availability, sustainability and reuse for further purposes and applications. All data will comply with the FAIR (Findable, Accessible, Interoperable, Reusable) principles and with the European policies on standards and best practices. Finally, the DMP will be updated throughout the project in conjunction with the other two reporting periods.		
Confidentiality		Type
PU – Public		DMP — Data Management Plan
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Document history

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1 Introduction

The objective of the EXCELLEND data management plan is to ensure continuous data management throughout the project duration, for the produced various outputs and in-line with FAIR principles¹ (Findable, Accessible, Interoperable, Reusable), for collecting, generating, and re-using the large amount of data to be produced. The document includes proposed data management procedures and is partly based on, and refers to the following documents, which it will not replace nor overrule:

- Grant Agreement (GA)
- GA Annex 1 (Description of Action, DoA Part A and Part B)

The EXCELLEND project aims to create and manage a Centre of Excellence (CoE) bringing together all key actors related to sustainable energy at the National Centre for Scientific Research “Demokritos” (NCSR) in a collaborative way. This will be achieved by building a Team for interacting, networking and creating synergies with: (1) NCSR labs, (2) national and international research institutions, and (3) the industry. The focus will be on NCSR excellence and reforms and action’s sustainability, to ensure the future expansion of the Team.

The Team is structured into five groups, with each one addressing a specific research topic, with a large interaction between them. The concluded research topics are the following:

1. Solar energy applications and thermal storage
2. Heat pumps and refrigeration systems
3. Thermal processes and integrated energy systems
4. Energy conversion processes - evaluation and improvement
5. Flexibility and digitalization

This deliverable includes a description of data management methodology and standards to be followed, and also information on what data sets are exploitable or made accessible for verification and re-use. This deliverable will be updated throughout the project in conjunction with reporting periods (Deliverables D2.1 and D3.1 in the other two reporting periods).

2 Data summary

This section provisionally outlines the data/information expected to be handled by the team members during the project, describing the data that will most likely be collected, generated, re-used and/or processed during the scheduled research activities and beyond. As indicated above, this is a first, high-level overview of such research data, as it is based on early-stage information, since research activities are scheduled in the third year of the project (after M30 in WP7). In general, the project is expected to collect, generate and/or use the broad categories of research data/information, with examples provided below. However, these are only preliminary and non-exhaustive at this stage, and consequently subject to confirmation or change in the updated versions of the DMP. Data which are reused and data that will be generated are indicated below per research topic.

2.1 Research topic 1: Solar energy applications and thermal storage

The scientific content of this group deals with experimental and numerical tasks of: (1) solar thermal applications from low-temperature (at 50-80 °C for buildings) up to medium-temperature (at 200-250

¹ <https://www.openaire.eu/how-to-make-your-data-fair>

°C for industry), (2) heat storage for temperatures below 150- 200 °C, and (3) solar-driven and thermal systems. The activities of this group will focus on integrating solar thermal with other energy components, aiming to develop unique configurations of solar-assisted energy systems. For that purpose, the existing expertise and research infrastructure of the Solar & other Energy Systems laboratory (SESL)² of NCSR-D will be used, with access to its facilities already granted. Therefore, some existing data will be reused as other will be generated on this technological field.

Reused data

Solar radiation data, meteorological data (historical and real-time from the local weather station), thermal systems operation data in similar temperature range (for reference reasons), thermal storage specifications and operational data, properties and materials of heat transfer fluids and thermal storage, specifications and performance parameters of an existing experimental concentrating solar thermal field of NCSR-D.

Generated data

Solar share of integrated energy systems, energy needs for buildings and industry, heat flows for solar-driven energy systems, heat storage capacity for solar driven-thermal systems at 150-200 °C, daily thermal efficiency of solar fields operating at high temperatures, temperature profile of charging/discharging of thermal storage units.

2.2 Research topic 2: Heat pumps and refrigeration systems

Experimental and numerical work is in the scope, with main tasks related to: (1) domestic heat pumps dealing with new refrigerants, cycle designs and components, (2) integration of heat pumps in energy systems (e.g. industry, mobility), (3) high temperature heat pumps for waste heat recovery, and (4) relevant services that could be provided (e.g. testing). Data from the linked labs & collaborators will be reused and other will be generated within the scope of this group.

Reused data

Refrigerants' thermodynamic properties, manufacturer specifications of compressors and expanders, heat exchanger specifications as provided by manufacturers, and performance parameters of an existing experimental multi-source heat pump of NCSR-D.

Generated data

Data for compressors and heat exchangers' operation in new cycle designs, performance indicators of new waste heat recovery solutions for variable capacity, COP values and heating capacity of improved heat pump cycles, relative ideal Carnot efficiency/COP of advanced heat pump configurations, COP and performance as a function of the temperature lift in improved high-temperature heat pumps for waste heat recovery.

2.3 Research topic 3: Thermal processes and integrated energy systems

Focus is given on renewable (e.g. solar thermal, geothermal) and waste heat (e.g. from industrial processes) that is converted to power with a thermal cycle, such as an organic Rankine cycle (ORC). Applications span from domestic up to industrial ones, with combined heat and power, tri-generation and Power to-X systems within the scope, as well as the use of green fuels. Data from the linked labs

² <https://inrastes.demokritos.gr/laboratories/solar-other-energy-systems-laboratory/>

& collaborators will be reused (e.g. Environmental Research laboratory – EREL³ and SESL) and other will be generated within the scope of this group.

Reused data

Manufacturers' specifications for compressors/ expanders/ pumps and heat exchangers, refrigerants' thermodynamic properties, solar/meteorological and other low temperature heat resource available data, heat flows of industrial facilities and marine engines.

Generated data

Performance indicators of new waste heat recovery solutions for variable capacity, storage amount of green fuels (e.g. hydrogen, ammonia) in ships for specific routes and operational profiles, thermal cycles' design properties, integration of advanced waste heat recovery solutions in powertrains with alternative fuels, isentropic efficiency values of a reversible compressor/expander unit.

2.4 Research topic 4: Energy conversion processes - evaluation and improvement

Focus is given on advanced exergy-based methods for the evaluation and improvement of energy systems (exergy analysis, exergoeconomics, exergoenvironmental analysis), which will result to further development and more efficient processes and applications. This group will interact with other groups and especially the first and third one. Therefore, existing data will be reused and new will be generated as follows.

Reused data

Same as in groups 1 and 3, heat exchanger design data, boiler efficiency parameters, compressor and turbine performance data, thermodynamic data of fluids (e.g. air, water, thermal oil, flue gases, refrigerants, etc.), equipment cost data, emission factors.

Generated data

Optimized process indicators, exergy destruction rates, optimized design and specifications of energy systems combined with renewables, exergy analysis data, overall system efficiency of integrated energy systems and reduction of costs and environmental impact.

2.5 Research topic 5: Flexibility and digitalization

This group will be interacting with all other groups, since it focuses on smart/intelligent control and optimisation strategies of (sustainable) energy systems. Activities include model predictive control, machine learning, applications of artificial intelligence, and new control techniques of various energy systems. Data from the indicative linked labs & collaborators: SKEL⁴ of Institute of Informatics & Telecommunications (IIT) of NCSR and SESL will be reused and other will be generated within the scope of this group.

Reused data

Existing models and their results for model predictive control, artificial intelligence protocols, manufacturers' specifications for smart control systems, solar thermal systems data, measured heating and cooling loads of an existing office building of NCSR, model results of local weather prediction (ambient temperature, solar radiation).

³ <https://inrastes.demokritos.gr/laboratories/environmental-research-laboratory/>

⁴ <https://www.skel.ai/>

Generated data

Performance data of energy systems once employing new control techniques, machine learning generated performance indicators, AI-based optimization parameters, design optimisation data of processes.

3 FAIR data

FAIR (Findable, Accessible, Interoperable, and Reusable) data principles⁵ will be followed in all project activities, as described next.

3.1 Making data findable, including provisions for metadata

Rich, discipline compliant metadata elements, including keywords, will be linked to the EXCELLEND data to make their discovery easier and provide potential re-use. Metadata including descriptions and keywords of opened data will be made available via FAIR compliant repository for searching and discovery even after the project closure.

3.2 Making data accessible

Decisions concerning the sharing of datasets will be taken by the project management board. The coordinator in collaboration with the dissemination manager and the project team will take all the appropriate measures to make relevant data openly available and usable for third parties for study, teaching, and research purposes, as described in the GA.

The principles of openness and transparency underlie all project activities, fostering sharing and collaboration as early as possible. Open and transparent practices will be implemented in line with the open science policy of Horizon Europe (HEU), favouring the use of the Open Research Europe (ORE⁶) publishing platform and open repositories for the outputs (e.g. Zenodo⁷). In addition, the produced results (e.g. publications, datasets) will become openly available on the project website, according to the open access (OA) guidelines of HEU. The produced scientific papers will be published in journals that follow clear principles of transparency. Except from ORE, others that provide open peer review are, for example, MDPI (e.g. Energies) and Elsevier journals (e.g. Energy, Energy Conversion and Management X) via OA approach.

Open-access practices to be followed will allow authors to deposit a Preprint, a potentially revised author version or, where possible, a final peer-reviewed publisher's version of their publication to a subject repository that allows public access. These materials (or a short version) will be openly available on the project website, once approved by the management board.

In case that permission to re-use the data is required after the project closure, all requests for further use of data will be considered carefully and whenever possible approved by the person mandated with the task, such as the permanent leader of the team once this person is appointed. Permission for data use will be granted providing there are no IPR or confidentiality issues involved or any direct overlap of research questions with the primary research. Permission will be provided by request using the appropriate procedure described in connection with other metadata.

⁵ <https://www.openaire.eu/how-to-make-your-data-fair>

⁶ <https://open-research-europe.ec.europa.eu/>

⁷ <https://zenodo.org/>

Primary focus in data sharing will be on the data underlying prospective scientific publications ensuring the validation of results presented in publications. In addition, operational or raw data will be also open, when benefits and possibilities for successful raw data re-use are recognized and there are no confidentiality or commercialization issues involved nor identified.

The main public and trusted repository for EXCELLEND published and FAIR-compatible data will be Zenodo that provides certified repository services using standardized access protocols. This will allow to enhance long-term accessibility and re-usability of the data. Metadata of deposited data will be open under a Creative Common Public Domain Dedication (CC0) or equivalent (to the extent legitimate interests or constraints are safeguarded), in line with the FAIR principles (in particular machine-actionable) and provide information at least about the following: datasets (description, date of deposit, author(s) and embargo); Horizon Europe funding; grant project name, acronym and number; licensing terms; persistent identifiers for the dataset and the authors involved.

Justification for possible case-specific embargo for published data will be decided by the project team. Embargo will be sought, if necessary, in connection with possible IPR protection or any potential patent, utility mode etc. application based on project results and the wider activities of the project, including for example the future commercialisation of a solution or service.

3.3 Making data interoperable

Variables and value names will be constructed following general data processing conventions and standards common to the research subject. List of value names and used vocabulary will be provided in a separate list. Examples of vocabulary information to be managed within the project will be e.g., units of observation, list of variables with the name and label of each variable as well as its values and value labels, information on the classifications used and meanings of abbreviations used.

3.4 Increase data re-use

To support and increase the reproducibility of the research outputs, the team members will be available to provide details on the results to interested parties (e.g. researchers) for specific assessment activities. All publications will have open access licenses and related datasets will be uploaded to open repositories, where applicable. The research team will regularly check the quality of not just the data, but also related software, algorithms, and workflows when and if changes are made in them.

After the project completion, ownership of datasets will belong to the NCSRD team that generated them. Creative Commons license or similar public copyright license will be used for any open datasets unless there are compelling reasons to select more restricted type of public license. Creative commons licenses will by default also include a disclaimer of liability for the re-use of open data.

Finally, all non-sensitive datasets will be made freely available in the public domain to permit the widest reuse by third parties during and after the end of the project.

4 Other research outputs

Any other project outputs which will be needed for verifying or analysing the data will be open alongside the corresponding data, especially within the frame of the expected collaborations with other research organisations, especially in non-widening countries. However, at this point, it is not yet possible to exactly identify the outcomes of those activities and the generated research data.

5 Allocation of resources

Making research data quality-controlled, FAIR-compatible, and as open as possible should be considered by the CoE while allocating resources to the project. Costs related to making data and other research outputs FAIR may include direct and indirect costs. Direct costs will be charged in the project, considering the eligibility rules and the usual accounting practises. The direct costs may include for example personnel costs and costs related to storage, archiving, re-use, and security.

Datasets are produced in the research topics whose allocated person-months represent the highest share of the budget. At this point, it is not possible to assess the exact allocation of resources for making data FAIR. The Coordinator and the Project Manager are responsible for data management and will monitor the occurred costs, which should ensure that the data and metadata will remain available and findable for 4 years after the end of the project.

6 Data security

There are no sensitive data in EXCELLEND, except from the ones that could be related to future commercialisation. Moreover, the generated data will be safely stored in Zenodo repository for long-term preservation and curation.

7 Ethical aspects

EXCELLEND does not handle any personal data or any other similar type of data. There are no legal or ethical issues raised by sharing the generated data.

8 Conclusions and next steps

EXCELLEND data management plan identifies the ways in which data are generated and processed throughout the project and after its end. Its main scope is to ensure data availability, sustainability and reuse for further purposes and applications. The data generated and reused per research activity is indicative in the current deliverable and it will be specified and finalized throughout the project.

Finally, the current DMP will be updated and adjusted regularly in line with the progress of the project. The first update of the DMP (D2.1) is due on January 31st, 2028 (M36, end of RP2) and the final version of the DMP (D3.1) is due on January 31st, 2030 (M60, end of RP3).