FlexSNG

Deliverable D1.3
Data Management Plan (DMP)

Dissemination level: Public

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Grant Agreement (GA) No. 101022432

Research and Innovation Actions (RIA) project

Granted by: Climate, Infrastructure and Environment Executive Agency (CINEA)

FlexSNG

Document Control Sheet

Project	FlexSNG - Flexible Production of Synthetic Natural Gas and Biochar via Gasification of Biomass and Waste Feedstocks
Call/Topic	International cooperation with Canada on advanced biofuels and bioenergy
Type of action	Research and Innovation Action (RIA)
Grant Agreement No	101022432
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Project Coordinator	VTT Technical Research Centre of Finland Ltd

Work Package No	WP1	Task No	Task 1.3
Due date (in months)	Month 6		
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Lead Beneficiary	VTT	
Contributor(s)	All Partners	
Dissemination level	Public	x
	Confidential, only for members of the consortium (including the Commission services)	

Revision history

Version	Date	Modification	Author
1.0	18.11.2021	Initial draft to partners	Minna Kurkela (VTT), Sanna Tuomi (VTT)
1.1	26.11.2021	Partner input included	Sanna Tuomi (VTT)
1.2	29.11.2021	Final quality check	Sanna Tuomi (VTT)
1.3	20.12.2021	Disclaimer added	Sanna Tuomi (VTT)

Disclaimer

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Table of Content

Appendix 1   Public Deliverables of the FlexSNG project
Appendix 2   FlexSNG DMP Template

Abbreviations and acronyms

CA	Consortium Agreement
CINEA	European Climate, Infrastructure and Environment Executive Agency
DMP	Data Management Plan
DOI	Digital Object Identifier
DPO	Data Protection Officer
ExC	Exploitation Committee
M	Month
OTM	Oxygen Transport Membrane
PC	Project Coordinator
WP	Work Package
WPL	Work Package Leader

1 Executive summary

This deliverable is the first version of the Data Management Plan (DMP) that outlines the data management principles implemented in the FlexSNG project. It describes what type of datasets will be generated, how they will be stored and documented, and what datasets are exploitable or made accessible for verification and re-use after the project. The first version of the DMP is delivered by month 6. Updates will be provided twice during the project (M18 and M36).

The FlexSNG project will follow the FAIR Data principles (Findable, Accessible, Interoperable and Re-usable) with regard to data management and data openness and will strive to make research data easily accessible to the public, whenever possible. Selected research data will be shared through open access publications in scientific journals and presentations at conferences/webinars as well as through open repositories, such as Zenodo. By these actions, the project supports the European Commission's goal of shared data and open science that serves innovation and growth.

3   Introduction

This Data Management Plan (DMP) outlines the data management principles applied in the FlexSNG project and describes what type of datasets will be generated, how they will be stored and documented, and what datasets are exploitable or made accessible for verification and re-use after the project. VTT, as the project coordinator, is responsible for the preparation of the DMP. The Data Management Plan is considered a living document that will be updated during the project as more information on the project datasets becomes available. Updates will be provided in the second (M18) and the third year (M36) of the project.

Data management consists of practices that occur at all phases of the research cycle: planning for data management before the project begins; documenting, organizing and securing data during the project; and archiving data after the research is completed. Good data management makes it possible to recover and share data for future research. The Data Management Plan should be seen as an integral part of project results handling. Research data usually have a longer timespan than the research project creating them. The project ends when the funding ends, but data created from it can be used long afterwards. The lifecycle of research data is illustrated in Figure 1.
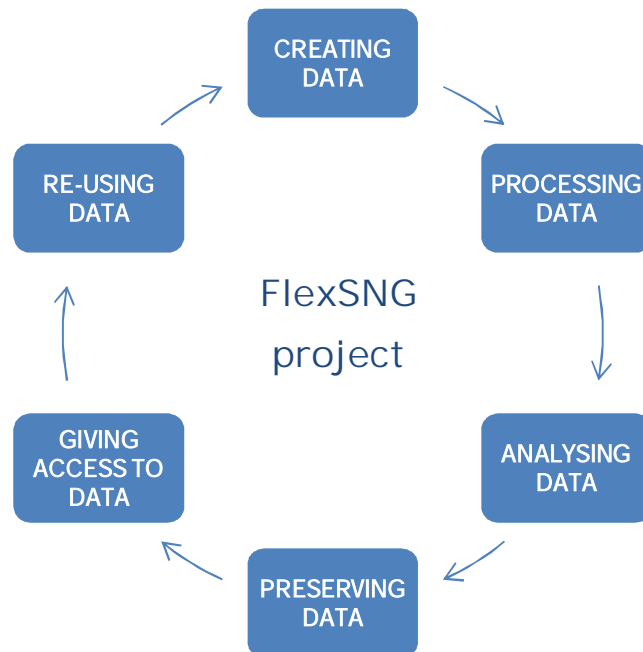
Figure 1. The lifecycle of research data in the FlexSNG project.

The FlexSNG project will follow the principle "as open as possible, as closed as necessary" which is also applied in this DMP. This DMP focuses on the following main points:

- What data will be collected, processed and generated;
- The handling of research data during and after the end of the project;
- Which methodology and standards will be applied;
- Whether data will be shared and made open access;

- How data will be curated and preserved (also after the end of the project)

4   Data management principles

4.1 Data generation

The FlexSNG project will produce various types of datasets throughout the project - both quantitative and qualitative. These include e.g. laboratory analyses, reports and memos, manuscripts, demonstrations, models/simulations, data from dissemination activities, invention disclosures, and patent applications etc. Research data will exist in different formats, e.g. documents, numerical, databases, and images. The data is typically in numerical and graphical format, and it will be collected into reports including the metadata such as measurement conditions, used standards for testing and data collection methods. Photos and video clips will also be taken to support documentation and dissemination.

The data generated during the lifetime of the project will be produced within the nine work packages, as listed in Table 1. The research data will be discussed within the consortium and analysed by the Exploitation Committee (ExC) for potential IP issues. The management of IP is described in detail in the Consortium Agreement. Permission for data use will be granted provided that there are no IPR or confidentiality issues involved or any direct overlap of research questions with the primary research. Ownership of datasets will belong to the project consortium.

Table 1. FlexSNG Work Packages.

No.	WP name	WP Leader
1	Coordination and management	Sanna Tuomi, VTT
2	Sustainable and low-cost feedstock supply	Anders Eriksson, SF
3	Low-cost oxygen production	Wolff-Ragnar Kiebach, DTU
4	Flexible gasification process	Sanna Tuomi, VTT
5	Validation of the key enabling technologies	Ilkka Hiltunen, VTT
6	Bioenergy carriers	Stephan Seidelt, EIFER
7	Process design and techno-economics	Luca Mancuso, WOOD
8	Case studies, environmental analysis and business potential	Konstantinos Atsonios, CERTH
9	Dissemination, communication and exploitation	Stefano Capaccioli, ETA

4.2 Storing of research data

During the project, a significant amount of data and electronic documents is produced. For the partners of the consortium to access and use them most efficiently and appropriately, a document management system is employed. The main target of the document management system is to keep important information securely stored and easily accessible. For this purpose, FlexSNG Microsoft Teams site has been set up. The project workspace is used as a collaborative working space that allows coordinating the project activities internally, exchanging information and securely storing project-related data (e.g. deliverables, minutes of the meeting, draft publications). The aim is

that all participants have the same knowledge level throughout the project, and all data and project documents are easily accessible on one platform. The FlexSNG project workspace also includes subfolders for each work package that can be used for sharing information within and between WPs. The project workspace is only accessible to the project partners and the Project Officer from CINEA.

4.3 Open access and open repositories

The FlexSNG project takes part in the Open Research Data Pilot in Horizon 2020 and will deposit all published research findings and other non-sensitive project data that has longer-term value also for other researchers to an open access research data repository. All peer-reviewed scientific publications will be made available as open access and deposited in Open access repositories. The data needed to validate the results presented in scientific publications will also be shared in open repositories whenever possible. A FlexSNG Community has already been created in Zenodo for this purpose.

The project will also produce a number of deliverables over the course of the project, some of which are public. The list of public deliverables is presented in Appendix 1. In principle, all data that has been used as a basis for public deliverable reports will be made available in open repositories. All public deliverables will also be made available on the project website (https://www.flexsng.eu/), which is the primary repository of public reports generated during the project. Public deliverables can also be uploaded on the FlexSNG Community site in Zenodo. Deliverables that have been characterized as confidential will not be shared (unless expressly stated otherwise).

5   FlexSNG project datasets

This chapter contains more detailed information on the FlexSNG project datasets. At this early stage of the project, the project datasets are divided into the following subcategories based on the work package in which they are generated:

- WP1 Coordination and management
- WP2 Sustainable and low-cost feedstock supply
- WP3 Low-cost oxygen production
- WP4 Flexible gasification process
- WP5 Validation of the key enabling technologies
- WP6 Bioenergy carriers
- WP7 Process design and techno-economics
- WP8 Case studies, environmental analysis and business potential
- WP9 Dissemination, communication and exploitation

Datasets will be collected for each work package and recorded to the FlexSNG DPM template (see Appendix 1) that describes:

- The content and origin of the data,

- Relation to the objectives of the project,

- Type and format of the collected data,

- Expected size of the files,

- Details on archiving, potential confidentiality issues and access level,

- Metadata linked to the dataset, and

- The responsible partner.

The updated version of DMP (due in M18) will provide more task-oriented information about these preliminary datasets.

5.1 WP1: Coordination and management

WP1 is dedicated to coordination and management tasks that aim to guarantee high-level execution of the project work and its objectives in an efficient manner and to maintain good communication and timely reporting to the European Commission. The data collected in WP1 is closely linked to the information that is needed for administration purposes. VTT, as the Project Coordinator, will collect and process the data in WP1.

Table 2. Dataset collected from WP1.

FlexSNG project – WP1 Dataset	
Dataset / Title	WP1 "Management & coordination"
Work package & Task	WP1, Tasks 1.1 – 1.3
Responsible Partner (Creator)	VTT
Description, Content	Data related to project management, quality control and risk management activities, for example: • Periodic reports with technical and financial information collected from partners • Project management plans and related Gantt charts • Quality Assurance Plan (QAP) • List of foreseen risks and associated contingency plans • Statistics on the work progress
Relation to the objectives of the project	This data is collected to: • Ensure effective management of the project and realization of project goals with the required technical and financial quality level and timing • Facilitate effective communication with the European Commission throughout the project lifetime.
Technical description (size, file types, formats e.g. .xls .csv .doc) –	Microsoft Office files: .doc, .docx, .xls, .xlsx, and pdf formats, photographs (.jpg), sizes appr. < 10 MB
Access Level: PU/CO	Mainly confidential, only partly public

Described confidentiality and IPR issues (if any)	Not yet defined
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432
Repository (archiving, preservation)	FlexSNG Teams workspace

5.2 WP2: Sustainable and low-cost feedstock supply

The overall objective of WP2 is to develop and tailor cost-effective feedstock supply chains for the new gasification process to enable secure, long-term supply of sustainable biomass/waste feedstocks with 20% reduction in feedstock supply costs. The work includes: 1) assessment of the biomass residue and waste feedstock potential in target regions in Europe and Canada, 2) definition of low-cost harvesting/collection, pre-processing and handling strategies for the most potential biomass/organic waste feedstocks of FlexSNG using modelling and systems analysis approach, and 2) development of optimization models for the entire feedstock supply chain to minimize the feedstock supply costs. The final outcome of this WP is a set of optimization models that will be transferred to WP8 and used to demonstrate the cost reduction potential in different case study scenarios and selected feedstocks in both European and Canadian conditions.

Table 3. Dataset collected from WP2.

FlexSNG project – WP2 Dataset	
Dataset / Title	WP2 "Feedstock availability & pre-treatment methods and feedstock supply chain modelling"
Work package & Task	WP2, Tasks 2.1 – 2.5
Responsible Partner (Creator)	SF
Description, Content	• Data derived from feedstock potential mapping, incl. feedstock availability in target countries, feedstock composition and other quality parameters, costs, seasonal variation in availability • Data on the pre-treatment and handling strategies tailored for selected feedstocks • Optimization models developed for FlexSNG feedstock supply chains, including models for collaboration in the feedstock supply chain
Relation to the objectives of the project	• Data from feedstock potential analysis will define the target feedstock base for the different case study regions in Europe and Canada. • Preprocessing strategies will be used to define the pre-treatment section of the FlexSNG process for the selected feedstocks. • Optimization models developed for the feedstock supply chains will be used in case studies of WP8 to demonstrate the 20% reduction potential in feedstock supply costs.

Technical description (size, file types, formats e.g. .xls .csv .doc)	Microsoft Office files: .doc, .docx, .xls, .xlsx, and pdf formats, photographs (.jpg), sizes appr. < 10 MB
Access Level: PU/CO	Both public and confidential
Described confidentiality and IPR issues (if any)	Not yet defined
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432
Repository (archiving, preservation)	The Zenodo FlexSNG Community, FlexSNG project website https://www.flexsng.eu/, FlexSNG Teams workspace, Servers of partners involved

5.3 WP3: Low-cost oxygen production

WP3 aims to demonstrate that the novel oxygen transport membrane (OTM) technology can produce high purity oxygen with 50 % reduced energy consumption compared to state-of-the-art technologies. In this WP, DTU will develop and optimize the OTMs for use in the biomass gasification process and, based on the lab-scale results, will design and construct a proof-of-concept OTM module that will be operated in direct integration with the gasification pilot in WP5.

Table 4. Dataset collected from WP3.

FlexSNG project – WP3 Dataset	
Dataset / Title	WP3 "Oxygen production with oxygen transport membranes (OTMs)"
Work package & Task	WP3, Tasks 3.1 – 3.3
Responsible Partner (Creator)	DTU
Description, Content	• Experimental data derived from lab-scale development and testing of the OTMs in biomass gasification conditions, microscopy • Design information related to the proof-of-concept module, including simulations • Data derived from cost assessment of a commercial-scale OTM unit (CAPEX, OPEX)
Relation to the objectives of the project	The data will be used to assess the performance and costs of a commercial-scale OTM unit and supplied to WP7 for feasibility studies.
Technical description (size, file types, formats e.g. .xls .csv .doc)	Text (.doc, .txt, .pdf, .ppt), numerical (.xls, .py, .csv, .txt), multimedia (.jpeg, .tiff, .mpeg, .png, .mp4), models (Solidworks, Comsol, Autocad, Aspen), instrument-specific (XRD data (xy), Oxford instrument data format (EDS); sizes appr. < 10 MB
Access Level: PU/CO	Confidential
Described confidentiality and IPR issues (if any)	Data may include IPR-sensitive results, findings and technical solutions.
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432

Repository (archiving, preservation)	FlexSNG Teams workspace, DTU's servers (local) and other partners involved

5.4 WP4: Flexible gasification process

WP4 will develop a feedstock-flexible gasification process based on a novel Bubbling Circulating Fluidised-Bed (BCFB) gasifier that can switch between two operational modes: 1) Co-production of biomethane, biochar and heat, and 2) Production of biomethane and heat from low-grade feedstocks assisted with biochar co-feeding. The data collected in WP4 will include results from the preliminary pilot-scale experiments. VTT is responsible for the experimental work and modelling activities of WP4. JM, CERTH, SFW and WOOD are also closely linked to the different activities of WP4.

Table 5. Dataset collected from WP4.

FlexSNG project – WP4 Dataset	
Dataset / Title	WP4 "Gasification process and modelling"
Work package & Task	WP4, Tasks 4.1 –4.3
Responsible Partner (Creator)	VTT
Description, Content	• Data collected from the gasification experiments and key parameters calculated from the experimental results, e.g. syngas efficiency, carbon conversion, GHSV • CFD model developed for the BCFB gasifier and related subroutines and codes • Semi-empirical gasification process model and related mass and energy balances (incl. Aspen Plus flowsheets)
Relation to the objectives of the project	• The test run data from gasification experiments will be used in assessing the process performance with various feedstocks. The results will be used as a starting point for the validation experiments of WP5. • The CFD modelling data will define the optimal geometry for the BCFB gasifier and will guide the final pilot plant modifications conducted in WP5. • The results and key features of the gasification process model will be implemented as a sub-model to CERTH's process models that will be used to estimate the mass and energy balances for the overall FlexSNG process.
Technical description (size, file types, formats e.g. .xls .csv .doc)	Microsoft Office files: .doc, .docx, .xls, .xlsx, and pdf formats, photographs (.jpg), raw data, large tables; sizes appr. < 10 MB; Aspen simulation files (.amw, .bkp)
Access Level: PU/CO	Confidential
Described confidentiality and IPR issues (if any)	Data may include IPR-sensitive results, findings and technical solutions.
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432

Repository (archiving, preservation)	VTT's servers (local), FlexSNG Teams workspace

5.5 WP5: Validation of the key enabling technologies

The aim of WP5 is to validate the performance of the key enabling technologies at the FlexSNG process at VTT's fluidised-bed gasification pilot plant with a target of over 200 hours of on-stream. VTT leads the activities of WP5 and is responsible for the final pilot plant modifications and operation of the gasification and gas clean-up process, while DTU operates the OTM module in direct integration with the gasification process.

Table 6. Dataset collected from WP5.

FlexSNG project – WP5 Dataset	
Dataset / Title	WP5 "Pilot-scale validation"
Work package & Task	WP5, Tasks 5.1 – 5.2
Responsible Partner (Creator)	VTT
Description, Content	Data collected from validation test campaigns (e.g. process measurements, analyses of solid/gas samples, etc.)
Relation to the objectives of the project	The datasets will be used in assessing the performance of the gasification process and the OTM module.
Technical description (size, file types, formats e.g. .xls .csv .doc)	Process measuring datasheets, raw data, large tables ~ 400 MB, analysis datasheets < 10 MB, pilot plant data ~ 1-3 GB. (.doc, .docx, .xls, .xlsx, .pdf, .jpg formats)
Access Level: PU/CO	Confidential
Described confidentiality and IPR issues (if any)	Data may include IPR-sensitive results, findings and technical solutions.
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432
Repository (archiving, preservation)	VTT's servers (local), FlexSNG Teams workspace (partly)

5.6 WP6: Bioenergy carriers

WP6 will investigate the different utilization options for the two intermediate bioenergy carriers produced by the FlexSNG process: biochar and biomethane. Biochar samples, produced in WP4, will be analysed with respect to chemical composition, combustion properties and other additional characteristics. Biomethane will be investigated regarding its use for transportation, fuel in a gas-CHP, storage in the gas grid, and shipping as liquefied natural gas. The data generated in WP6 will be used as input in the techno-economic assessments of WP7 and cases studies of WP8. EIFER will be responsible for the experimental characterization and the evaluation of different utilization pathways for biochar. Utilization options for biomethane will be analysed by EIFER, CERTH, WOOD and PM.

Table 7. Dataset collected from WP6.

FlexSNG project – WP6 Dataset	
Dataset / Title	WP6 "Characterisation and end-use of biochar and biomethane"
Work package & Task	WP6, Tasks 6.1 – 6.4
Responsible Partner (Creator)	EIFER
Description, Content	• Results from experimental testing and characterization of biochars • Data and parameters related to the properties of biomethane • Data on market prices, distribution costs and infrastructure, and regulatory framework related to the use of biomethane and biochar
Relation to the objectives of the project	This data will be used to identify the most attractive end-use options for biochar and biomethane from the economic viewpoint and maximization of the energy system's flexibility.
Technical description (size, file types, formats e.g. .xls .csv .doc)	Datasheets, raw data, tables Microsoft Office files: .doc, .docx, .xls, .xlsx, and pdf formats, photographs (.jpg, .tif), appr. < 15 MB
Access Level: PU/CO	Confidential
Described confidentiality and IPR issues (if any)	Data may include IPR-sensitive results
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432
Repository (archiving, preservation)	EIFER's servers (local) and other partners involved, FlexSNG Teams workspace

5.7 WP7: Process design and techno-economics

WP7 is dedicated to the techno-economic assessment of the FlexSNG project. The work starts with the definition of the target process concepts. Based on the experimental results achieved in WP3-WP5, a preliminary design of the commercial-scale FlexSNG plant (50-150 MW) will be developed. The work includes designing, sizing and cost estimation (CAPEX and OPEX) of the front-end gasification plant and subsequent VESTA methanation. The operating principles and safety aspects of the plant will also be evaluated and developed. The work will be complemented with assessment of technical risks related to industrial exploitation of the FlexSNG technologies. SFW will deliver the design package for the front-end conversion process and WOOD similarly for the final gas clean-up and methanation sections.

Table 8. Dataset collected from WP7.

FlexSNG project – WP7 Dataset	
Dataset / Title	WP7 "FlexSNG process design and TEA"
Work package & Task	WP7, Tasks 7.1 –7.5
Responsible Partner (Creator)	WOOD
Description, Content	• List of KPIs defined for the FlexSNG process

	• Data on the target process concept, incl. process flow diagram and definition of unit processes • Aspen Plus process simulation model, incl. flowsheet, input and output data, calculated mass and energy balances • Design and cost estimate of the commercial-scale FlexSNG plant, incl. process layout, equipment dimensions, CAPEX, OPEX • Risk assessment
Relation to the objectives of the project	The data will be used to design and assess the economic feasibility of the industrial-scale FlexSNG plant.
Technical description (size, file types, formats e.g. .xls .csv .doc)	Flowsheets, modelling/calculation data, tables. Microsoft Office files: .doc, .docx, .xls, .xlsx, and pdf formats, photographs (.jpg), appr. < 20 MB, Aspen Plus simulation files (.apw, .bkp)
Access Level: PU/CO	Confidential
Described confidentiality and IPR issues (if any)	Data may include IPR-sensitive results
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432
Repository (archiving, preservation)	FlexSNG Teams workspace, Servers of partners involved)

5.8 WP8: Case studies, environmental analysis and business potential

Case studies will evaluate the implementation potential of the FlexSNG concept in different regions in Canada and Europe. The aim is to identify the most economically attractive environment for a subsequent flagship demonstration through an analysis of the energy markets in case study regions, which are Canada and Northern (Finland, Sweden), Central (Germany, France) and Southern Europe (Greece, Italy). WP8 will also assess the business potential and advantages of FlexSNG over competing technologies. Environmental assessment of the proposed FlexSNG concept will be carried out by CERTH according to standard ISO 14044. CERTH will lead WP8 in collaboration with other key actors PM, EIFER and VTT.

Table 9. Dataset collected from WP8.

FlexSNG project – WP8 Dataset	
Dataset / Title	WP8 "Case studies and environmental assessment"
Work package & Task	WP8, Tasks 8.1 –8.3
Responsible Partner (Creator)	CERTH
Description, Content	• Data related to case studies and business potential assessment, incl. input parameters and calculation assumptions, cost estimates, sensitivity analysis, key performance parameters of competing technologies

	• Data derived from environmental assessment, e.g. life-cycle GHG emissions, emissions reduction potential, environmental performance of competing or fossil-based technologies for comparison
Relation to the objectives of the project	Regional case studies and business potential analysis will be used to: • Identify the most economically attractive environment for a subsequent flagship demonstration • Issue recommendations on how to bring the FlexSNG technology to a full-scale deployment in different case study regions and beyond.
Technical description (size, file types, formats e.g. .xls .csv .doc)	Software, calculation data, tables. Microsoft Office files: .doc, .docx, .xls, .xlsx, and pdf formats, appr. < 20 MB
Access Level: PU/CO	Confidential
Described confidentiality and IPR issues (if any)	Data may include IPR-sensitive results (tbc)
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432
Repository (archiving, preservation)	FlexSNG Teams workspace, partners' servers (local)

5.9 WP9: Dissemination, communication and exploitation

WP9 strives to ensure widespread dissemination of project information and results to relevant industrial stakeholders, policy makers, scientific community and the general public both in Europe and in Canada. Dissemination and communication activities include a number of public workshops, webinars, scientific publications, newsletters and promotional material, project website and social media presence among others. Another essential part of WP9 is to plan the pathway from this RIA project to industrial exploitation of the FlexSNG technology, including: a) industrial demonstration, and b) building of the first commercial-scale production unit, the "Flagship" plant. ETA, as a WP9 Leader, is in charge of dissemination, communication and exploitation activities, and will collect the relevant datasets in co-operation with all participants.

Table 10. Dataset collected from WP9.

FlexSNG project – WP9 Dataset	
Dataset / Title	WP9 "Dissemination, communication and exploitation"
Work package & Task	WP9, Tasks 9.1 – 9.4
Responsible Partner (Creator)	ETA (assisted by VTT)
Description, Content	• List of key stakeholders identified for the project • Dissemination and Communication Plan (D&CP) • Data/material related to dissemination activities, e.g. workshops, events, articles, publications,

	presentations, project website, newsletters, other promotional material, videos etc.
	• Roadmap for industrial exploitation of the FlexSNG technologies, incl. preliminary plans for demonstration and flagship plants.
Relation to the objectives of the project	The data will be used to: • Disseminate and exploit all public research findings • Provide information to the general public and raise awareness of key stakeholders • Establish a concrete plan for follow-on demonstration activities
Technical description (size, file types, formats e.g. .xls .csv .doc)	Microsoft Office files: .doc, .docx, .xls, .xlsx, and pdf formats, photographs (.jpg), videos, large tables; sizes appr. < 50 GB
Access Level: PU/CO	Both public and confidential
Described confidentiality and IPR issues (if any)	Not yet defined (tbc)
Metadata	Title (ID) will be defined later, EU, H2020, grant No 101022432
Repository (archiving, preservation)	The Zenodo FlexSNG Community, FlexSNG project website https://www.flexsng.eu/, FlexSNG Teams workspace, partner's servers (local)

6 FAIR data

The FlexSNG project will promote good research practices related to open science. The consortium will follow the FAIR Data principles with regard to data management and data openness that aim to facilitate the change toward improved knowledge creation and sharing. These principles are: Findable, Accessible, Interoperable and Re-usable.

6.1 Making data findable, including provisions for metadata

Metadata is structural information and documentation that describes data, such as identity, content, format, preservation of and access to research data. To make the data as useful as possible for reuse and validation, the metadata will be stored also in connection with the data in an appropriate data repository. For the FlexSNG project, the following deposition metadata fields can be used to created metadata files:

• Title (ID) & description, files (estimated volume of data), publication date, creator(s), DOI, keywords

Zenodo DOI versioning

Zenodo provides DOI versioning of all datasets (open data, publications, etc.) uploaded to the repository. When an upload is published on Zenodo, two DOIs will be registered:

one DOI representing the specific version of the record, and another DOI representing all of the versions of the record. This DOI feature enables to update the record's files after they have been made public. Currently, up to 50GB per dataset will be accepted.

In addition, Zenodo allows linking uploads to grants from funders, such as the European Commission. Zenodo is also further integrated into reporting lines for research funded by the European Commission via OpenAIRE.

<u>Search keywords</u>

All open FlexSNG data (datasets) deposited in a repository will provide search keywords. The keywords will be selected so that they are suitable for the specific type of data.

6.1.1 Open access to scientific publications and research data

The project will ensure open access – via the repository - to the bibliographic metadata that will identify the deposited publication. Regarding the research data generated during the project, it will be deposited (as agreed inside consortium, by specific parts) in a research data repository and made openly accessible. The metadata is in a standard format and will include:

- the terms "EU" and "Horizon 2020" ("H2020")
- the name of action, acronym "FlexSNG" and grant number 101022432
- the publication date and identifier (e.g. DOI)

The metadata record will be cited in any associated articles and vice-versa to establish links between the published work and the dataset. If published work has no data associated with it, this will be clearly indicated in a separate data availability statement: "No data are associated with this article." This will confirm the absence of data to readers, rather than the absence of data sharing. For articles where all associated data are presented in the article itself, the following statement will be included: "All data underlying the results are available as part of the article and no additional source data are required."

6.2 Making data openly accessible

The FlexSNG project will strive to make research data accessible to the public, whenever possible. Selected results and data will be shared through publications in scientific journals and presentations at conferences/webinars, as well as through repositories. The open data that is produced in the project will be deposited into existing research data repositories, if its use will enhance long-term data accessibility. The following common repository services will be used for storing the project data in the FlexSNG project:

- Zenodo is a repository targeted at both data and publications from EU projects. Zenodo makes scientific outputs of all kinds citable, shareable and discoverable for the long term (free to upload and access). Zenodo also supports FAIR principles. The Zenodo <u>FlexSNG Community</u> has been created in Zenodo for

uploading open research data. Link to the Zenodo Community is provided below:

https://zenodo.org/communities/flexsng/?page=1&size=20

- Public Pure portal (https://cris.vtt.fi) is an institutional repository by VTT. Pure is an open access repository and a research information system (CRIS) gathering together VTTers' publications and other research outputs. Research outputs are visible to the outside world. EU projects from year 2020 onwards are uploaded into Pure from Cordis database.

- FlexSNG project website (https://www.flexsng.eu/) will be open to the public and therefore only public project documents (e.g. public deliverables) will be made available on the site.

6.3 Making data interoperable

Interoperability is a characteristic of good quality data. Open data requires data to be interoperable not only from a technical perspective, but also from a legal and institutional perspective. In the FlexSNG project, the planning for interoperability will start early in the data life cycle. The consortium will follow OpenAIRE guidelines for online interoperability. The interoperability of data can be achieved at the level of the dataset metadata (addressed in Chapter 6.1).

6.4 Increase data re-use

For datasets deposited on a public repository (i.e. Zenodo), the access will be unlimited. Restrictions on re-use policy will be applied for all protected data, whose re-use is limited within the consortium. Other restrictions could include: an embargo period, which may be applied if the data are used in published articles in Green open access.

Open results produced by the project and deposited in an open repository are usable by third parties after the end of the project. However, the data may be deposited in a restricted repository and access may be granted upon request, if confidentiality, personal data protection obligations or IPR issues related to research data forbid open access.

7   Other research outputs

The consortium will also consider and plan for the management of other research outputs that may be generated or re-used throughout their projects. Such outputs could be e.g. software, workflows, protocols, models, etc. or e.g. new materials, samples, etc. Additional details will be reported, as needed, in the next versions of the DMP.

8 Allocation of resources

The costs for data curation and preservation during the project are included in the budget for FlexSNG project management. The amount of costs for making the data FAIR in the project is unknown at this stage of the project. Further information will be provided in the following DMP version. In addition, resources for long-term preservation have not yet been confirmed and they will be solved on a case by case basis.

8.1 Roles and responsibilities for data management

VTT as the project coordinator (and as a Data Manager) will coordinate and facilitate data storage and access during and after the project and is also responsible for keeping the Data Management Plan up-to-date. The work will be supported by other partners involved in managing, storing, and disseminating the results of the project. In addition to the primary researcher(s), there might be others involved in the research process that take part in aspects of data management. The data management responsibilities within the project consortium will be further specified during the project.

9 Data security

Part of the research data will be safely stored and shared in the online collaboration platform, using the Microsoft FlexSNG Teams Workspace. Partners using the Teams Workspace must accept the Terms of Use, following which the Coordinator will release login information. This site has restricted access (username + password) only by partner representatives in the consortium. In addition, a separate folder for research datasets will be set up with stricter access control than the main site. The secure data will be backed up regularly and the database will retain the information for at least 10 years after the end of the project.

Long-term preservation of the open and public data that is produced in the project will be ensured through the public repository Zenodo. Zenodo is a general-purpose open-access repository developed under the European OpenAIRE program and operated by CERN. It allows to deposit research papers, datasets, research software, reports, and any other research related digital artifacts free of charge. For each submission, a persistent digital object identifier (DOI) is established, which makes the stored items easily citeable.

Some datasets will also be preserved on the FlexSNG website and project participants' local servers after the end of the project. Possibility for re-use of the data will be ensured by documenting the data collection methods as well as the contents of the datasets.

10 Quality assurance

Quality control of data is an integral part of all research and takes place at various stages: during data collection, data entry or digitisation, and data checking. It is

important to assign clear roles and responsibilities for data quality assurance at all stages of research. In addition, suitable procedures should be developed before data gathering starts and researchers must ensure that the data recorded reflect the actual observations.

The following quality control measures during data collection will be used in the FlexSNG project:

- Calibration of instruments to check the precision;

- Taking multiple measurements, observations or samples;

- Ensuring the validity and comparability of the sample/record with an expert;

- Using standardised methods and protocols.

11 Legal and ethical issues

FlexSNG partners are to comply with the ethical principles as set out in the Grant Agreement (Article 34 - Ethics and Research Integrity). The Article 34 states that:

"The beneficiaries must carry out the action in compliance with:

a)   ethical principles (including the highest standards of research integrity) and

b)   applicable international, EU and national law."

In addition, the partners must respect the fundamental principle of research integrity, as set out, e.g. in the European Code of Conduct for Research Integrity.

From the standpoint of research ethics, key to responsible scientific conduct are that[1]:

- The research follows the principles endorsed by the research community, that is, integrity, meticulousness and accuracy in conducting research, and in recording, presenting and evaluating the research results.

- The methods applied for acquiring data and information, as well as for research and evaluation, conform to scientific criteria and are ethically sustainable. When publishing the research results, the results are communicated in an open and responsible fashion as befits the nature of scientific information.

- The researcher takes due account of the work and results of other researchers by respecting their work, citing their publications appropriately, and by giving their achievements the credit and weight they deserve when carrying out the researcher's own research and publishing its results.

- The researcher complies with the standards set for scientific knowledge in planning and conducting the research, in reporting the research results and in saving the data obtained during the research.

- The necessary research permits have been acquired and the preliminary ethical review that is required for certain fields of research has been conducted.

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[1] VTT Handbook- Data protection in research, Research Ethics, v 4.0, 1.7.2021 (Metacard ID VTT-497)

- Before beginning the research or recruiting the researchers, all parties within the research project or team (the employer, the principal investigator, and the team members) agree on the researchers' rights, responsibilities, and obligations, principles concerning authorship, and questions concerning archiving and accessing the data. These agreements may be further specified during the course of the research.
- Sources of financing, conflicts of interest or other commitments relevant to the conduct of research are announced to all members of the research project and reported when publishing the research results.
- Researchers refrain from all research-related evaluation and decision-making situations where there is reason to suspect a conflict of interest.
- The research organisation adheres to good personnel and financial administration practices and takes into account the data protection legislation.

Furthermore, the project must comply with the ethics requirements as set out in the following deliverables: "D10.1 H - Requirement No. 1", "D10.2 POPD - Requirement No. 2", "D10.3 NEC - Requirement No. 3", and "D10.4 EPQ - Requirement No. 4".

11.1 Privacy and confidentiality

The privacy of the project participants will be secured. No person or organisation involved (e.g. in surveys) will be unintentionally identifiable directly or indirectly in the datasets. Besides storing separately from the data, all direct identifiers of any respondents or subjects (e.g. names and contact information of persons and organisations) - also indirect references to e.g. lines of businesses, branches or industries - will be removed and destroyed after the anonymised dataset has been checked and validated.

During the implementation of the action and for four years after the end of the FlexSNG project, participants must keep confidential any data, documents or other material that is identified as confidential at the time it is disclosed (Grant Agreement: Article 36 confidentiality - General obligation to maintain confidentiality).

12 Conclusions

This Data Management Plan (DMP) provided an overview of the data management approach applied in the FlexSNG project, including information on the datasets that will be generated during the project, the means for storing and archiving the data as well as the open access repositories that will be used to make the data openly accessible, whenever possible. The relevant guidelines and requirements concerning data management, such as the FAIR Data Principles, that will be followed in the FlexSNG project were also introduced. The DMP will be updated twice during the project (M18 & M36) as more detailed information of the datasets and their access level become available.

Public deliverables of the FlexSNG project

No in WP	Title	Lead Beneficiary	Due Date (in M)
D1.2	Quality Assurance Plan (QAP)	VTT	3
D1.3	Data Management Plan (DMP)	VTT	6
D2.1	Report on biomass residue and waste feedstock potential assessment in Europe and Canada	SF	8
D2.2	Report on low-cost collection/harvesting, pre-processing and handling strategies tailored for biomass/waste feedstocks of FlexSNG	SF	15
D2.3	Report of an integrated co-handling approach for forest and agro feedstocks	SF	15
D3.1	Report on the development and optimisation of oxygen membranes for biomass gasification	DTU	20
D4.4	Conference presentation: Preliminary results of gasification process development	VTT	20
D5.5	Presentation/article on the extended-time validation tests with the FlexSNG process	VTT	36
D6.1	Report on biochar characterization	EIFER	12
D6.3	Summary report of biomethane utilization pathways	EIFER	18
D7.1	Determination of KPIs for the proposed process concepts	CERTH	5
D7.2	Definition of the FlexSNG process configurations	CERTH	12
D8.1	Techno-economic assessment report for the North European case studies	PM	36
D8.2	Techno-economic assessment report for the Central European case studies	EIFER	36
D8.3	Techno-economic assessment report for the South European case studies	CERTH	36
D8.4	Techno-economic assessment report for the Canadian case studies	PM	36
D8.5	Report on FlexSNG environmental analysis	CERTH	36
D9.2	Communication and Dissemination Plan (C&DP) and periodic updates	ETA	3
D9.3	Project website established and social media launched	ETA	4
D9.4	First e-newsletter and promotional leaflet	ETA	6
D9.6	Report and a short dissemination video of the first Industrial Topical Workshop	ETA	18
D9.7	Report and a short dissemination video of the second Industrial Topical Workshop	ETA	36

FlexSNG

FlexSNG DMP Template

FlexSNG project – WP (No) Dataset	
Dataset / Title	
Work package & Task	
Responsible Partner (Creator)	
Description, Content	
Relation to the objectives of the project	
Technical description (size, file types, formats e.g. .xls .csv .doc)	
Access Level: PU/CO	
Described confidentiality and IPR issues (if any)	
Metadata	
Repository (archiving, preservation)	