ACCLIMATE

Accelerating Climate Action: Navigating towards a Low-Emissions, Climate-Resilient Future

D7.2 – Data Management Plan

WP7 – Project Management

29/08/2025

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Grant Agreement Number	101184374	**Acronym**	ACCLIMATE
Full Title	ACCLIMATE - Accelerating Climate Action: Navigating Towards a Low Emissions, Climate Resilient Future		
Topic	HORIZON-CL5-2024-D1-01-04		
Funding Scheme	HORIZON Research and Innovation Actions		
Start Date	March 2025	**Duration**	48 Months
Project URL	https://acclimate-project.eu/		
EU Project Advisor	Ariana Nastaseanu		
Project Coordinator	Wuppertal Institut für Klima, Umwelt, Energie GmbH [WI]		
Deliverable	D7.2 – Data Management Plan		
Work Package	WP7 – Project Management		
Contractual Date of Delivery	31/08/2025	**Actual**	29/08/2025
Deliverable Type	Report	**Dissemination Level**	Public
Lead Beneficiary	HOLISTIC IKE (HOL)		
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Keywords	Data Management; Open Source; Open access; FAIR data; data-handling		

EC Summary Requirements

1. Changes with respect to the DoA

I2AM PARIS web platform is referred as IAM PARIS web platform. No other changes with respect to the work described in the DoA.

2. Dissemination and uptake

This report will help all project partners understand how to handle datasets and keep the machine-actionable Data Management Plan in ARGOS up to date. It includes clear descriptions and metadata for each dataset. It can also be useful for people outside the project who want to learn how data in the ACCLIMATE project is organized, stored, shared, and made available to others.

3. Short summary of results (<250 words)

This document presents the first version of the Data Management Plan (DMP) for the ACCLIMATE project. It outlines how data generated through modelling, stakeholder engagement, and policy analysis will be managed according to FAIR principles—making it findable, accessible, interoperable, and reusable. The project expects to handle around 250GB of data, including scenario results and input datasets. ACCLIMATE uses the ARGOS service from OpenAIRE and EUDAT to create a machine-actionable DMP that is regularly updated with links and metadata. All datasets and project outputs will be shared openly through Zenodo and the IAM PARIS web platform using highly permissive open-access licences. Code will be made available on GitHub, and publications will prioritise open-access journals. Outputs will follow standardised formats and include appropriate metadata and digital identifiers. The DMP will be updated as the project evolves with a planned first update at the middle of the project (D7.4) and a second update towards the end of the project (D7.5).

4. Evidence of accomplishment

This report and a dedicated community in Zenodo for ACCLIMATE[1].

[1] https://zenodo.org/communities/acclimate/

Preface

The overall objective of ACCLIMATE is to achieve enhanced integrated national and international strategies for climate-resilient, low-emission development. ACCLIMATE will contribute to improving the transparency, consistency, and clarity of GHG emission reduction commitments and create appropriate tools by developing an assessment framework for mitigation commitments. Working in a bottom-up manner with national experts within an international consortium comprising high-emitting countries from the Americas, Asia and Europe, as well as low-emitting countries from West Africa, ACCLIMATE will identify needs for improvements of NDCs and long-term strategies. A focus will be set on adequacy, fairness and feasibility, as well as on needs for improving current policies and measures to actually achieve NDCs and long-term objectives.

WUPPERTAL INSTITUT FUR KLIMA, UMWELT, ENERGIE GGMBH	WI	
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Executive Summary

ACCLIMATE core objectives involve assessing and improving emission reduction commitments, developing enhanced mitigation pathways, and supporting national and international policy strategies. The achievement of those objectives relies on transparent, high-quality data to produce country-specific and global scenarios, enable model capacity-building, and inform recommendations for strengthening NDCs and long-term climate strategies.

This report presents the first version of the Open Data Management Plan (DMP) for the ACCLIMATE project. The DMP outlines the full data lifecycle for the diverse types of data collected, processed, and generated across the project's work packages. These include model input datasets, scenario results, outputs from policy analysis, and stakeholder engagement materials. The plan provides a structured approach to ensure that all data complies with the FAIR principles, making it findable, accessible, interoperable, and reusable.

ACCLIMATE's DMP addresses key topics such as data description, data sharing and reuse practices, metadata and format standards, storage, security, resource allocation, and ethical considerations. In particular, it covers how data will be made openly accessible through platforms like Zenodo and IAM PARIS, and how software and scripts developed during the project will be made available as open source via GitHub. Outputs will follow established standards and will be shared under permissive open-access licences.

In parallel to this document, ACCLIMATE uses the ARGOS service from OpenAIRE and EUDAT to develop a machine-actionable DMP (maDMP), which will be continuously updated with links and rich metadata for datasets produced throughout the project. Future versions of the DMP will expand upon this initial structure and reflect the evolving needs of the project, including changes in data production and new FAIR data requirements.

Contents

1 Introduction

The main objective of ACCLIMATE project is to achieve enhanced integrated and more coherent national and international strategies for climate-resilient, low-emission development. To assess these goals, ACCLIMATE is built around a set of interconnected specific objectives (SO) that aim to support effective climate action through improved transparency, capacity building, and the development of enhanced mitigation pathways. These objectives directly inform the project's data landscape, guiding both what data is needed and how it will be generated, processed, and used.

Data activities in ACCLIMATE span multiple research areas, including GHG emissions tracking, policy assessment, scenario modelling, and stakeholder engagement. For instance, objectives focused on strengthening NDCs and long-term strategies (SO.1, SO.2) rely on structured policy data and scenario inputs, while efforts to improve modelling capacity (SO.3) involve enhancing model capacity and generating new scenario results tailored to partner countries. Global and national low-emission pathways (SO.4), and the evaluation of trade-offs and synergies with sustainable development goals, require the integration of sectoral data, climate impact information, and socioeconomic indicators.

In addition, strategies for deep system transformation (SO.5) rely on national policy data and outputs from model-based assessments, helping to design consistent and forward-looking pathways. Efforts to strengthen international cooperation and governance frameworks (SO.6) require data on multilateral initiatives, emissions trajectories, and climate diplomacy. Lastly, ongoing stakeholder engagement and knowledge exchange (SO.7) drive the co-creation and continuous refinement of data, ensuring that insights from diverse actors are integrated into modelling processes and policy analysis.

To meet these goals, the project will collect and generate a range of datasets, including model inputs, scenario results, stakeholder feedback records, and policy analysis outputs. These datasets are essential for delivering key deliverables such as country studies, technical notes, and synthesis reports. The design of the data pipeline ensures that outputs are aligned with ACCLIMATE's broader aim of supporting open, transparent, and reproducible research. All data activities will be documented in a machine-actionable Data Management Plan and made available through trusted repositories such as Zenodo and the IAM PARIS platform.

The present document is the first version of the project's Data Management Plan (DMP) and outlines the approaches and procedures for collecting, producing, managing, and sharing data throughout the project's lifecycle. The current version describes the types of data expected, along with the methods planned for processing, curation, and long-term preservation (Section 2). The report covers all phases of data use, both throughout the project and following its completion, and includes a strategy to ensure that all data is Findable, Accessible, Interoperable, and Reusable (FAIR), as detailed in Section 3. This aligns with the project's commitment to open science, ensuring that models, results, publications, and training materials are openly accessible and the subsequent resource allocation planning (Section 4). The plan also addresses issues of data security (Section 5) and ethical considerations around data collection and use (Section 6). Finally, the present document describes the procedure for creating and updating the project's maDMP (Section 7). Two updated versions of the DMP will be released in February 2027 (D7.4) and February 2029 (D7.5) to reflect any updates in data management practices.

2 Data Description

2.1 Project objectives and associated data processes

The ACCLIMATE project aims to support the transition toward a climate-resilient and low-emission future by developing integrated strategies and tools that link national, sectoral, and global mitigation efforts. It focuses on enhancing national and international policy frameworks, modelling pathways aligned with the Paris Agreement, and improving coordination across key sectors such as energy, transport, buildings, land use and industry. ACCLIMATE will strengthen climate action by co-creating decarbonisation strategies and policy recommendations with stakeholders across EU and nine other focus countries, including high and low emitters, while also producing robust global mitigation pathways through improved modelling of sectoral dynamics, land use, non-CO_2 emissions, and climate impacts. The project pays particular attention to feasibility, fairness, and resilience in its design of pathways and strategies, while exploring the implications of EU and international policy instruments for global cooperation.

Modelling activities

The project builds on an established set of integrated assessment and sectoral models to enhance our understanding of climate mitigation strategies across regions, sectors, and timeframes. The project will apply an upgraded modelling framework that includes national-level mitigation scenarios, global IAMs, sectoral and technological detail, and soft-linking between tools. At the global level of sectoral approach (WP4), ACCLIMATE will employ PROMETHEUS (renamed to OPEN-PROM recently) and the GCAM model. These models cover the whole energy system (energy conversion, buildings, transport, industry, sector coupling) and its complex interlinkages with the environment and the economy. In addition, bottom-up, detailed global modelling tools will be used for specific sectors, i.e. ITOM (formerly known as WISEE-EDM) for energy-intensive industry (Schneider et al., 2020; Schneider & Saurat, 2020), the Global Maritime model for the shipping sector (Tsiropoulos et al., 2022), BuiMo for the buildings sector (Fotiou et al., 2022). Major insights from sectoral models will be integrated into the two global IAMs. Consistent data templates and scenario protocols will be established to support integration and traceability across tools.

OPEN-PROM and GCAM will be further upgraded to better represent climate impacts on energy, land use, and agriculture, supporting the development of climate-resilient, low-emission pathways aligned with the Paris Agreement and SDGs. These pathways will be designed in collaboration with stakeholders to assess policy impacts, synergies, and trade-offs across sectors and regions. Data streams from these stakeholder engagements will be codified into structured scenario narratives and indicator sets, shared across the consortium and used to calibrate model assumptions on demand drivers, institutional capacity, and equity considerations.

For national mitigation planning (WP3), detailed models will be applied to energy systems, transport, buildings, agriculture, and industry, using country-specific data and constraints, as well as expert and stakeholder consultation processes. Different aspects of national pathways will be quantified through the use and integrated combination of various national models such as macro-economic models (e.g., IMACLIM or KLEM in Brazil, Nigeria), sectoral bottom-up models (e.g., EU WISEE-EDM for Industry or GLOBIOM Indonesia for AFOLU), and energy system models (e.g., MATRIZ in Brazil, LEAP in Senegal, Nigeria or OSEMOSYS in Sierra Leone). These tools use harmonised national data formats for emissions drivers, technology costs, and activity projections, feeding back into the global analysis.

In the EU context, several EU-regional models and/or model implementations will be used to provide a robust multi-model analysis of EU's pathways towards net zero emissions by 2050, capturing a spectrum of associated uncertainty. These models include the following:

- GCAM-Europe: An open-source regional variant of the GCAM partial-equilibrium IAM, developed in the Horizon Europe project DIAMOND.

- CLEWs-EU: An open-source regional Climate-Land-Energy-Water nexus model implementation of the global CLEWs framework, also developed in DIAMOND.
- JRC-EU-TIMES-Aalto: AALTO's version of an open-source regional variant of the TIMES family of energy system models, originally developed by JRC.
- OPEN-PROM: A new, fully-improved and open-source version of the PROMETHEUS model, recently developed in the DIAMOND project and featuring explicit representation of all member states.

Furthermore, KTH will assist national modelling in African partner countries using OnSSET for electrification planning in unserved areas and OnStove to evaluate the costs and benefits of different cookstove options (Khavari et al., 2023). Data interoperability and reusability are ensured through systematic model documentation, metadata encoding, and linkage with ACCLIMATE's machine-actionable Data Management Plan (maDMP) in ARGOS (see Section 7).

Pathway design

The pathway design framework developed in WP3 builds on the deep decarbonisation pathways approach (Bataille et al., 2016; Waisman et al., 2019) and is designed to support national-level development and climate strategies through a combination of qualitative narratives and quantitative modelling. It involves two main stages: First is the co-developing of strategic, stakeholder-driven storylines that outline long-term national visions, and second, the translating of these narratives into structured dashboards of quantitative indicators using national models. These dashboards quantify emissions drivers and key socio-economic metrics at both macro and sectoral levels. The sectoral breakdown covers energy-related sectors (e.g. transport, buildings, industry, power supply) as well as non-energy sectors like waste, agriculture, forestry, and land use.

Data collection and emissions accounting in ACCLIMATE will support the generation of harmonised and policy-relevant datasets. This includes gathering national-level data for the EU and nine focus countries and compiling activity, cost, and emission factor data for key sectors. Outputs from sectoral models will feed into global models and vice versa, ensuring alignment of assumptions and emissions trajectories. Special attention is given to land-based mitigation options and non-CO_2 gases, whose representation is strengthened in both national and global models. Improved land-use data, dietary transitions, and technological change in agriculture will also be considered.

Data management requirements

The aforementioned research activities imply significant data management requirements, including:

- Systematic collection and structuring of national and sectoral data, covering both qualitative insights and quantitative indicators.
- Integration of diverse data types (narratives, policy assumptions, model outputs) into interoperable formats that will be subject to continuous reviewing and comparison.
- Transparent documentation of assumptions, uncertainties, and methodological choices to allow stakeholder dialogue and revision.
- Version control and traceability across evolving narrative and quantitative scenarios.
- Standardisation and harmonisation of sectoral data for comparability and model integration, including international and national indicators.
- Storage and sharing of structured datasets and documentation in a way that supports accessibility, reusability, and alignment with FAIR principles.

All data and modelling documentation will follow FAIR principles (Findable, Accessible, Interoperable, Reusable) and will be made publicly available via open platforms such as Zenodo, Github, ARGOS and IAM PARIS. These platforms will also host metadata records, model descriptions, and other supporting information needed for others to reuse

the project's outputs. By doing so, ACCLIMATE aims to ensure that its results are not only transparent and traceable, but also reusable by other researchers, stakeholders, and policy processes after the project ends.

In particular for modelling activities, data transparency, harmonisation, and reuse will be supported through a structured and consistent approach to documenting key modelling elements. The project will define common templates and metadata schemes based on IAMC formats and Horizon Europe standards to describe the variables, parameters, assumptions, and outputs used across national, sectoral, and global models. This shared vocabulary will help all modelling teams work in a coordinated way and make the project's data easier to understand and combine across tools, scales, and partners.

2.2 Data types and formats

To meet its goals, the ACCLIMATE project will gather and create different types of data from various sources. These include numbers on national and sectoral emissions, energy use, technology costs, and other key variables. This data will be used in a wide set of models—such as the global PROMETHEUS (OPEN-PROM) and GCAM models, as well as detailed models for specific sectors or countries like WISEE-EDM, BuiMo, OnSSET, and OnStove. The project will follow shared formats and templates to make sure that data can be easily used and shared between models, including formats based on IPCC AR6 and AR7 guidance, and standards used in earlier projects like DIAMOND.

ACCLIMATE will also collect qualitative information, especially during the design of national decarbonisation strategies. This includes ideas and feedback gathered from stakeholders through workshops and interviews. These storylines will help define important assumptions, which will then be translated into numbers through modelling tools. This approach follows an established method for designing long-term climate strategies.

The results from the models will include climate and energy scenarios for countries, regions, and the world. These results will be organised in spreadsheet formats like xlsx or csv, or in prebuilt data formats such as Rda, commonly used in the R programming language, making them easy to share. New model code will be available in the programming languages used to develop the models (e.g., Python .py files). The project's scientific reports and policy briefs will be published in accessible formats like PDF. All datasets, code and documentation will be openly shared on platforms such as Zenodo, Github and IAM PARIS, supporting FAIR data principles and ensuring long-term access for researchers, policymakers, and the public.

Table 1: Data types and formats per project activity

Project activity	Data collected and generated	Data formats
Model development and enhancement	**Collect:** Code from previous versions of models, feedback from project stakeholders and communities of practice for the different models	File formats related to the programming language of each model (e.g., py, R, h, cpp, GAMS), reports documenting the model and stakeholder feedback in pdf
	Generate: New model code and documentation	
Compilation of the input data for new models	**Collect:** Global, national and sectoral statistics on socioeconomic parameters, macroeconomic indicators, energy use and supply, industrial indicators, physical demand for products, policy options; technological cost and innovation data; investment costs; global material demands, supply; global material demands and other modelling inputs	Spreadsheet-like formats, e.g., xlsx and csv, as well as other formats such as txt, json, SQLite databases, etc.
	Generate: Curate the raw data into a	

	format and data structure that is usable by project models	
Scenario analysis	**Collect:** Scenario definitions based on the stakeholder engagement activities of the project	Reports documenting results and stakeholder feedback in pdf; results in xlsx, csv, txt, json. Scenario results will be also uploaded to the IAM PARIS platform as interactive tables.
	Generate: Indicator timeseries, strategies, pathways designs, material imports, sufficiency, future energy demand, fuel mix, jobs creation, resilience to shocks	

2.2.1 Data processing tools

In ACCLIMATE, modelling tools will play a central role in processing data and developing mitigation pathways across national, sectoral, and global levels. The project builds on a suite of well-established models, including PROMETHEUS, GCAM, and several national and sectoral models, all of which will be further developed and linked during the project. These models will be enhanced using updated greenhouse gas emission data, policy inputs, and sectoral insights, and will reflect stakeholder engagement activities. The outputs will feed into a shared knowledge base and support the development of climate-resilient, low-emission development strategies. To support transparency and engagement, ACCLIMATE will offer a user-friendly, web-based interface through the IAM PARIS platform, helping decision-makers explore the connections between long-term climate targets and near-term actions. Table 2 presents the full set of models being enhanced and refined in the ACCLIMATE project to support the analysis and design of national and international strategies for climate-resilient, low-emission development.

Table 2: Models used in ACCLIMATE

Models	Scope of models	Responsible partner(s)
IMACLIM-Brazil[2]	Brazil	COPPETEC/UFRJ
MATRIZ[3]	Brazil	COPPETEC/UFRJ
GCAM-India[4]	India	CEEW
AFOLU-Dashboard[5]	Indonesia	IPB
GLOBIOM Indonesia[6]	Indonesia	IPB
Ex-SS[7]	Indonesia	ITB-CREP
AIM/Enduse Indonesia[8]	Indonesia	ITB-CREP
LEAP-Senegal[9]	Senegal	ENDA ENERGIE
KLEM-Senegal[10]	Senegal	ENDA ENERGIE

[2] Wills et al., 2022
[3] Grottera et al., 2022
[4] Chaturvedi et al., 2021; Chaturvedi & Malyan, 2022; Kholod et al., 2021
[5] FABLE Consortium, 2019
[6] FABLE Consortium, 2019
[7] Dewi et al., 2016
[8] Fujimori et al., 2017
[9] Heaps, 2022
[10] under development

LEAP[11]	Nigeria	UNIPORT
KLEM[12]	Nigeria	UNIPORT
MESSAGE[13]	Sierra Leone	USL
OSEMOSYS[14]	Sierra Leone	USL
GCAM-USA[15]	USA	USMF
WISEE-EDM[16]	EU	WI
OPEN-PROM[17]	EU	E3M
GCAM[18]	Global	BC3/NTUA
GCAM-Europe[19]	EU	NTUA/BC3
CLEWs-EU[20]	EU	NTUA/KTH
JRC-EU-TIMES-Aalto[21]	EU	AALTO

In addition to the models, the project will make use of various data processing applications, including Microsoft Excel for handling xlsx and csv files, Microsoft Word for drafting reports and manuscripts, and Adobe Reader or Acrobat for generating pdf documents. Programming and scripting tools such as Python (e.g., used in WISEE EDM) and R will also be applied for data processing and preparation tasks.

2.2.2 Data inputs and outputs for models

In ACCLIMATE, we aim to use fully open datasets wherever feasible, while also allowing flexibility for users to select between open and proprietary data sources depending on the simulation needs. All data outputs will be openly accessible and will follow the FAIR data principles described in this report (see Section 3). These principles will also be embedded in the machine-actionable Data Management Plan (maDMP) to facilitate reuse through automated metadata extraction. Results from scenario modelling will be made publicly available on Zenodo, both as scientific publications for the academic community and as policy briefs for decision-makers and stakeholders. Datasets will also be featured on the IAM PARIS platform through interactive visualisations, with user-friendly interfaces tailored to different audiences and offering clear, policy-relevant insights. All publications and datasets will be openly shared through our Zenodo community and relevant repositories such as CEADs for emissions data, while all newly developed code will be released as open source via GitHub. Publications and corresponding datasets will be released without delay upon acceptance, using Creative Commons licences to support reuse and DOIs to ensure findability. Table 3 offers an indicative overview of the model inputs and outputs.

[11] Okereke et al., 2023; Tietie et al., 2021
[12] Emenekwe et al., 2023
[13] IRENA, 2018a, 2018b
[14] EMP, 2019; ITCP, 2019; United Nations, Department of Economic and Social Affairs, 2017
[15] Hultman et al., 2020
[16] Schneider et al., 2020; Schneider & Saurat, 2020
[17] GLOBAL with explicit representation of EU member states - Fragkos et al., 2015 – Open-PROM description link
[18] Calvin et al., 2019 - GCAM description link
[19] https://github.com/bc3LC-GCAMEurope
[20] Beltramo et al., 2021 - CLEWs-EU description link
[21] Gago Da Camara Simoes et al., 2013 – JRC-EU-TIMES-Aalto description link

Table 3: Indicative input and output data for project models (Giarola et al., 2021; Pauliuk et al., 2017)

Data type	Category	Input/output
Population	Socioeconomic	Input
GDP	Socioeconomic	Input & output
Employment	Socioeconomic	Input & output
Total gross/real disposable income	Socioeconomic	Input & output
Interest rates and exchange rates	Socioeconomic	Input
Labour participation and productivity	Socioeconomic	Input
Household size and space	Socioeconomic	Input
Physical activity data	Socioeconomic	Input
Macroeconomic and sectoral activity data	Socioeconomic	Input & output
GHG emissions (CO_2, methane, others)	Emissions	Input & output
CO_2 emission factors	Emissions	Input
Abatement curves	Emissions	Input
Water availability	Impacts	Input
Water withdrawal/consumption	Impacts	Output
Air quality (e.g., PM2.5)	Impacts	Output
Installed capacity for different energy technologies and for storage	Energy	Input & output
Electricity and heat production mix	Energy	Input & output
Specifications of energy technologies and availability	Energy	Input
Potential of renewable energy sources	Energy	Input
Network infrastructure specifications	Energy	Input
Conversion technology characteristics	Energy	Input
Sectoral energy intensities	Energy	Input & output
Energy/electricity trade	Energy	Input & output
Food/agricultural demand	AFOLU	Input & output
Land uses, types, and potential as emissions sinks	AFOLU	Input
Energy performance of buildings (HVAC, envelope, appliances)	Buildings	Input
Energy efficiency improvements rates	Buildings/Industry	Input

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Industrial technologies - specifications and availability	Industry	Input
Sectoral productivity and growth	Industry	Input & output
Material stocks and flows	Industry	Input & output
Vehicle fleet and structure	Transport	Input & output
Technological characteristics of vehicles	Transport	Input
Fuel efficiency	Transport	Input
Mobility characteristics and modal shifts	Transport	Input & output
Energy prices	Prices/costs	Input & output
Energy and power technology costs	Prices/costs	Input & output
Technology costs (capital, operating and maintenance)	Prices/costs	Input & output
Fossil fuel prices	Prices/costs	Input & output

2.2.3 Data used in scenario analysis

ACCLIMATE's scenario analysis is guided by a structured pathway design framework that builds on deep decarbonisation methodologies. This framework supports the creation of scenario narratives and structured dashboards that define socio-economic, technological, and emissions-related indicators. These inputs form the basis for national and global mitigation pathways and are used across the project's modelling activities. Figure 1 summarises the overall process which combines qualitative and quantitative analytical methods to design policy-relevant national pathways in WP3.

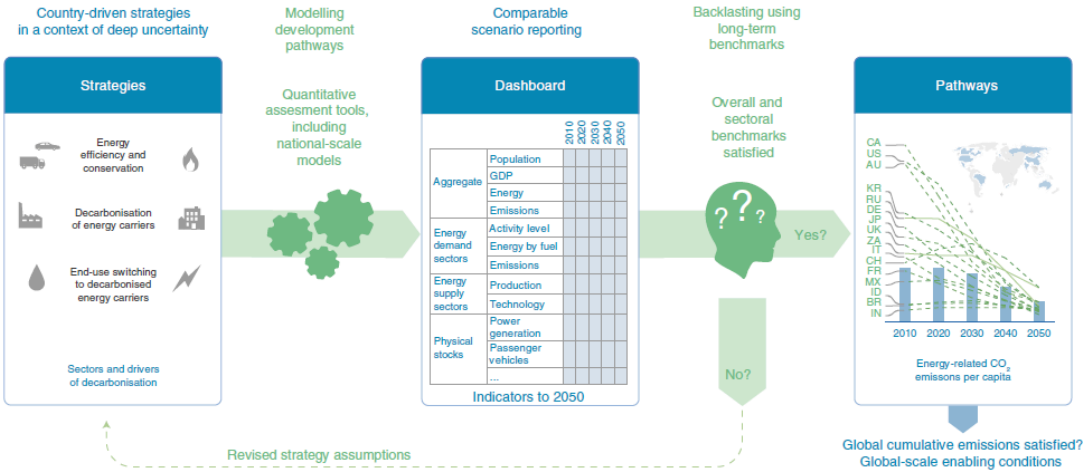

Figure 1: Pathway design framework. Source: Waisman et al., Nature Climate Change, 2019

Scenario analysis in ACCLIMATE will rely on both existing datasets and updated techno-economic assumptions to explore future mitigation pathways. These assumptions, such as data on costs, technology performance, and sectoral trends, will be revised and improved throughout the project. This process will be carried out in close

collaboration with national teams and through co-creation with stakeholders to ensure that the scenarios reflect national circumstances and real-world priorities. The pathway design framework will also integrate insights from sectoral dialogues, national pathway development, and international collaboration analysis. This will allow the project to evaluate the impact of specific climate policy options and examine their broader implications across sustainable development goals and other key socio-economic dimensions. Table 4 provides an indicative list of policy objectives that will be explored in ACCLIMATE.

Table 4: Examples of policy categories and objectives used in scenario analysis (Böck et al., 2020)

Policy Category	Policy objective
Climate action	Reduced GHG emissions
	Improved carbon pricing
	Carbon sequestration
Economy & Society	Green growth
	Reduced poverty and inequality
	Unemployment reduction
Energy Efficiency	Nearly Zero Energy Buildings
	Electrification
Resources & Materials	Treatment of landfill gas
	Reduced use of fertilisers
	Increased use of alternative cement
Energy generation, storage & transmission	Energy system flexibility
	Fossil fuel phase-out
	Fuel shift: Green H2 production & use

Many of the modelling teams participating in ACCLIMATE are already involved in preparing or supporting their countries' nationally determined contributions (NDCs). Their participation strengthens the potential for direct policy impact and real-world application of the results. ACCLIMATE will also contribute to the development of new global mitigation pathways that respond to the needs of the upcoming IPCC AR7 assessment cycle, including scenarios with improved climate feedback, detailed land-use modelling, and refined representations of AFOLU systems. Through its global, national, and sectoral modelling work, the project will deliver future-oriented scenarios that go beyond current NDCs, rooted in local realities and long-term policy objectives.

2.3 Origin, expected size, and utility of data

2.3.1 Origin

As outlined in the previous sections, the modelling activities in ACCLIMATE will build on an established suite of existing tools and datasets. Most models used in the project are open-source or will be adapted from existing open

frameworks developed in earlier projects. Input data will largely be drawn from publicly available sources or from national and international datasets already tailored to the models. When proprietary datasets are required for specific simulations, ACCLIMATE will explore alternative open-access sources or adopt data-handling approaches that preserve transparency without compromising licensing agreements. For example, the project may use pre-processed or binary formats that protect the original data while still allowing model execution and replication.

To ensure comparability and model interoperability, the project will rely on harmonised data templates and standardised nomenclature following established conventions such as the IPCC AR6/AR7 formats, the IAMC variable naming standards, and the Scenario Compass protocols. These conventions will be used across national, sectoral, and global models to align assumptions, emissions drivers, and socio-economic indicators. Data harmonisation efforts will be coordinated through the machine-actionable Data Management Plan (maDMP) and integrated with platforms such as ARGOS and IAM PARIS to ensure that data origins, updates, and version control are fully traceable. An indicative mapping of harmonised data sources and formats is given in Table 5.

Table 5: Indicative harmonisation data, their origin, and format

Topic	Variable	Context	Indicative data origin	Data format
Socioeconomics	**Population**	EU27+Norway	Population data from Eurostat: Historical statistics (e.g., Eurostat, 2023); EUROPOP projections through 2100 (e.g., Eurostat, 2022a, 2022b)	csv
		OECD+7 except EU27/Norway	Population data from OECD Economic Outlook Long-term baseline projections (available for through 2060), to ensure consistency with GDP projections (OECD, 2021). Extend with growth rates from UN WPP2022 after 2060 if necessary (see below).	csv
		Rest of World	UN World Population Prospects figures for all years (available from 1960 through 2100) (e.g., United Nations, 2022)	csv
	GDP	All regions, through 2028	GDP from IMF World Economic Outlook (e.g., IMF, 2023) in constant international dollars unless otherwise indicated by the research question	csv
		EU27+Norway, from 2029	Extend IMF forecast with linearly interpolated real GDP growth rates from the EU Ageing Report (European Commission, 2021b, 2021a)	csv
		OECD+ except EU27/Norway, from 2029	Extend IMF forecast with real GDP growth rates from the OECD Economic Outlook long-term baseline	csv
		Rest of World	Extend IMF forecast with GDP growth rates per working age capita from SSP2 (must be calculated using the projected population figures) multiplied by population growth rate from the harmonised population time series	csv

Techno-economics	**Technology costs (for reference scenarios)**	EU27 and comparable countries	The EU Reference Scenario (e.g., European Commission, 2021; European Commission et al., 2021).	csv
		Other regions, power-sector technologies	Most suitable options are cost assumptions from IEA's World Energy Outlooks (e.g., International Energy Agency, 2022).	csv
		Other regions, non-power technologies	Options include adapting costs from the EU Reference Scenario.	csv
	Fossil fuel prices	Historical prices	Regional prices from IEA datasets (e.g., International Energy Agency, 2023a). If participating modellers do not have access to proprietary IEA data, data for some years and regions can be extracted from the freely available World Energy Outlook 2022 report (International Energy Agency, 2022), or if global benchmarks are sufficient, some of these are available for free from the World Bank "pink sheet" (World Bank, 2023)	csv
		Price projections	Regional price forecasts from the World Energy Outlook extended datasets (International Energy Agency, 2023), requires subscription. Participating modellers who do not have a license can extract some prices visually from charts in the World Energy Outlook 2022 report (International Energy Agency, 2022). For long-term EU-specific exercises that do not need short-term trends, price projections from the EU Reference Scenario 2020 may be used (European Commission, 2021).	csv
Energy	**Energy production and consumption**	Historical data	IEA World Energy Balances (International Energy Agency, 2023c)	csv
Emissions	**Energy-related CO_2, CH_4, N_2O**	Historical data	IEA Greenhouse Gas Emissions from Energy dataset (International Energy Agency, 2023b), if modellers have or can acquire access. Alternatively use EDGAR v7.0 (Branco et al., 2022) which is consistent with IEA but with less detailed breakdowns. Emissions can also be calculated from energy consumption data using default Tier 1 emission factors from the 2006 IPCC guidelines for GHG inventories, which are consistent with IEA emission factors.	csv
	IPPU CO_2 from	Historical data	Production data and emission factors from	csv

	cement		(Andrew R., 2018). Updated data available on Zenodo (Andrew R., 2023).	
	F-gases and non-energy CO_2, CH_4, N_2O	Historical data	EDGAR v7.0 (Branco et al., 2022)	csv
	Other emissions	Historical data	CEDS (O'Rourke et al., 2021)	csv
	Land-use change emissions	Historical data	Check that used or generated data falls within or close to range spanned by 3 bookkeeping models in the Global Carbon Budget 2022 (Friedlingstein et al., 2022). Use an average of the three models if a single harmonised dataset is required and no other constraints are implied by the research question.	csv
	All emissions	Infilling of historical and future emissions	Use Silicone software package to infill missing emission components, if required by the modelling exercise (e.g., for climate impact assessment) (Lamboll et al., 2020, 2022b, 2022a)	csv

2.3.2 Size

Based on previous modelling-based projects such as PARIS REINFORCE, the total size of data expected to be collected, processed, and produced in ACCLIMATE is estimated to be around 250GB. Most of this volume will come from data used in modelling activities, including input datasets and scenario results. Additional data will include materials from stakeholder engagement, such as meeting minutes and recordings, as well as datasets generated in policy analysis tasks. The data management responsibilities will be handled by HOLISTIC and Wuppertal Institute, who will prepare and regularly update an Open Data Management Plan. This plan will outline how data will be curated, stored, and preserved in line with FAIR principles, and will include provisions for handling different data types and ensuring quality assurance. More accurate size estimates will be provided in future versions of the Data Management Plan.

2.3.3 Utility

The data outputs produced by ACCLIMATE will serve a wide range of users and contribute to key climate policy and research processes. The project's upgraded models and scenario results will be directly relevant for researchers working in climate mitigation, energy systems, land use, and Integrated Assessment Modelling. At the same time, they will support policymakers, national and EU institutions, and international agencies by providing robust evidence for designing and assessing long-term climate strategies and nationally determined contributions (NDCs). ACCLIMATE places strong emphasis on disseminating its results to stakeholders such as the European Commission, EU and national policymakers, international organisations, academic institutions, and sectoral actors in energy, land-use, transport, buildings, and industry. Through its open-access platforms and engagement activities, the project will ensure that its findings are accessible, understandable, and useful to both the scientific and policy communities involved in shaping sustainable, Paris Agreement-aligned futures.

3 FAIR data

As open data becomes increasingly important, researchers, public institutions, and private organisations have worked together to shape the FAIR principles. These principles serve as a general guide to help ensure that research data can be easily found, accessed, combined with other data, and reused in the future (Wilkinson et al., 2016). Rather than setting strict rules, the FAIR principles provide a flexible framework that helps improve how data is shared and used across different systems and tools. This flexibility supports new discoveries by encouraging researchers to build on each other's work.

In ACCLIMATE, we are committed to applying the FAIR principles to all data-related activities. This includes both the input and output of modelling work, the observational data collected during stakeholder engagement, and the data used or generated in our policy assessments. Our approach is based on previous experience in similar projects and aims to ensure that data can be used not only within the project but also by others in the future.

FAIR refers to four key principles guiding the project's data: Findability, Accessibility, Interoperability and Reusability. The concept of Findability means the ability to easily locate data by those who are looking for it. For data to be findable, it must be assigned a unique and persistent identifier, known as a Persistent Identifier (PID). These identifiers make it possible to refer to the same dataset consistently, even if its location or access method changes. PIDs are essential tools for ensuring data can be discovered and accessed over time. However, identifiers alone are not enough. Metadata must also be available in a structured, machine-readable form and must include the PID. To support automated searches, this metadata should be stored in searchable systems, making it easier for both people and software to discover the data (Jacobsen et al., 2020).

Accessibility means that data and metadata should be available for use by people and machines, even when the data itself is no longer active or online. Data should be retrievable using the identifier through a standard communication protocol that is open, free, and widely supported. In some cases, access to the data may require authentication or authorisation, for example when privacy or security concerns apply. Accessibility does not always imply openness but rather that access is possible under clearly defined conditions (Mons et al., 2017).

Interoperability is about making sure data can be integrated and used across different systems and tools. This requires using open and standardised formats that can be understood by a range of software applications. When data are created or shared using widely accepted formats and vocabularies, they can be more easily connected and reused in different research areas. Interoperability also relies on structured metadata and the use of common application programming interfaces (APIs). These allow data and metadata to be exchanged between systems while following community standards. Metadata should include references to related datasets using standard vocabularies that follow FAIR guidelines. When applied effectively, metadata help data to move between different settings while keeping their scientific meaning and reliability (Ravi et al., 2022; Calamai and Frontini, 2018; Latour, 1987; Pasquetto et al., 2019).

Reusability means that data can be used again for different studies or applications. To achieve this, datasets must be properly documented. This includes explaining how the data were collected, what they represent, and under what terms they can be used. Good documentation also means using clear formats and structures that others can understand and apply. When data are carefully described, structured, and linked to metadata, they become more valuable for researchers who may want to use them in the future. This strengthens knowledge sharing, speeds up the research process, and encourages connections between people and projects (da Silva Santos et al., 2023).

In ACCLIMATE, we will apply these FAIR principles from the start, with dedicated partners responsible for managing data and monitoring quality. An Open Data Management Plan will guide this work, and it will be regularly updated throughout the project. By making our data FAIR, we aim to improve transparency, promote collaboration, and support the long-term use and impact of the project's findings.

3.1 Making Data Findable

In ACCLIMATE, we will ensure that all outputs can be easily found by assigning persistent identifiers (such as DOIs), providing detailed metadata, and including relevant keywords that help search engines locate and retrieve the documents. All public project outputs such as deliverables, policy briefs, and business guides will be uploaded to the project's Zenodo community, where each item will receive a digital object identifier (DOI), ensuring it is permanently citable and easily accessible. Scientific publications will obtain their DOI through the journal in which they are published, but we will also upload accepted versions or preprints to Zenodo to maintain a complete and accessible archive of our work.

Zenodo's versioning system will be used to transparently manage updates to each file. Every version will have its own DOI, while a main DOI will always point to the most recent version. We will also use a consistent naming system to support searchability and tracking of documents. For example, scientific publications will follow the pattern of author and year, such as Smith_et_al_2023. Policy and business briefs will use the prefix ACCLIMATE followed by a descriptive title, and deliverables will include the deliverable number and title. Datasets will be named with the author, year, and a short description of the content, such as Smith_et_al_2024_Cost_Assumptions.csv.

All datasets created in the project will be archived on Zenodo and assigned a DOI. They will be linked to the machine-actionable Data Management Plan (maDMP) hosted in ARGOS and described with structured metadata and keywords, following Horizon Europe's open science guidance available through ARGOS. Model code will be made openly available via GitHub, and these repositories will also be archived in Zenodo and referenced in the maDMP.

To support wider accessibility and visibility, final versions of model documentation, input data, and results will also be shared on the IAM PARIS modelling platform, which is widely used by the climate and economic modelling community. Each dataset will include references and links to all related publications from the project, further improving findability and encouraging reuse. The project website and the modelling platform will both contain well-structured content and a clear sitemap that helps search engines like Google and Bing locate and index the material efficiently.

3.2 Making Data Accessible

In the ACCLIMATE project, we will apply Creative Commons licenses to all public project outputs, including deliverables, policy briefs, business guides, and datasets. Most of these will be released under the CC BY license (version 4.0), which allows others to use and build upon the work as long as proper credit is given. In specific cases, we may choose a more restrictive license such as CC BY-SA to make sure that any modified versions of our outputs remain openly available under the same licensing terms. This will be particularly relevant for software modules and code developed in ACCLIMATE, as we want to ensure that derivative software stays open and accessible to support ongoing efforts for a climate-resilient, low-emission development across the globe.

Scientific publications will be submitted to journals that support open-access publishing, in accordance with Horizon Europe's requirements. Whenever possible, we will publish in fully open-access journals, and we will also consider using the Open Research Europe platform. If no suitable fully open-access journal matches the topic of a specific publication, we will choose a journal that offers a gold open-access option and is covered by publishing agreements with the institutions involved in the project.

All modelling components developed during ACCLIMATE, will be published under open-source licenses. For each software module, we will work with the respective development team to select the most appropriate license. In some cases, different licenses may be used for model code and input data. If any part of a module relies on data that are not openly available, we will recommend alternative datasets that can be used instead.

To ensure broad accessibility, we will use common file formats that can be opened with freely available software. These include formats such as pdf, csv, txt, mp3, and mp4. In cases where more complex formats are necessary, such as spreadsheets with multiple tabs in Excel, we will provide links to freeware tools like OpenOffice or Google Sheets that allow users to access the files without the need for commercial software.

We are also committed to making sure that all open outputs of the project remain available in the long term. Publications and datasets will be uploaded to established platforms like Zenodo and GitHub, which offer reliable long-term hosting. The project website will remain online for at least three years after the project concludes, to support continued visibility and access to project results. Additionally, HOLISTIC will maintain the IAM PARIS modelling platform after the end of ACCLIMATE, with availability planned through approximately 2032.

3.3 Making Data Interoperable

In ACCLIMATE, we will promote strong interoperability of project data by using suitable file formats and providing clear and structured metadata. As mentioned earlier, all datasets and reports will be shared in widely used formats such as pdf, csv, and txt. We will aim to avoid proprietary formats unless absolutely necessary. When applicable, documentation for new modelling modules and results from scenario analysis will follow the reporting templates of the IPCC AR6 and AR7 cycles. This will allow our data to be more easily accessed and reused by the wider climate-economy modelling community and ensure compatibility with tools like the pyam Python package.

Metadata for project datasets will be integrated into the ACCLIMATE maDMP within the ARGOS platform, following the Horizon Europe metadata template. Since ARGOS enables metadata to be machine-readable and convertible across formats, this structure will further support interoperability by making it easier to align ACCLIMATE data with other platforms and frameworks.

3.4 Making Data Reusable

As described in the previous section on open access, we will enhance the reusability of project outputs by publishing all deliverables and datasets under the CC BY license. This approach will support their use and adaptation by a broad range of interested users. In the same way, scientific publications from ACCLIMATE will be made openly available

through journals that support open access, ensuring that the research community can access and engage with them immediately after acceptance.

To further support reusability, we will apply the Horizon Europe metadata scheme within the project's machine-actionable Data Management Plan in ARGOS. For each dataset, the metadata will provide a clear summary of the content, references to related publications and datasets, and specific guidelines on FAIR principles, allocation of resources, and ethical and security considerations. While the structure of this metadata will be aligned with the overall format of this report, it will contain more detailed information tailored to each individual dataset.

Finally, to ensure that project's outputs are reusable by the broader community, all documentation and results will follow the IPCC AR6 reporting templates. This will help ensure that the modelling work developed in ACCLIMATE remains accessible, transparent and useful across different research communities working on climate mitigation and sustainability.

4 Allocation of resources

Most of the practices described in Section 3 to support FAIR data do not generate additional costs for the project. Datasets and deliverables will be shared through Zenodo, which is openly accessible and free to use. The project's codebase will also be hosted on GitHub under its free-tier services. Similarly, the machine-actionable Data Management Plan will be maintained through the ARGOS platform, which provides its services without charge. Nevertheless, several activities essential to the project's open data strategy do require dedicated resources and have been accounted for in the Grant Agreement. Hosting results in the IAM PARIS platform is supported through the budget allocated under Work Package 6. The design and maintenance of the project website are funded under Work Package 6, with HOLISTIC responsible for relevant procurement. The consortium has also reserved part of the budget for open-access publishing. Table 6 outlines the recommended options for open-access journals.

Table 6: Suggested options for open-access scientific publishing in ACCLIMATE

<table>
<tr><th>Access type</th><th>Funder</th><th>Fees</th><th>License</th></tr>
<tr><td>Publish in a fully Open Access journal</td><td>ACCLIMATE Grant</td><td rowspan="2">Article Processing Charges; ranging between ~200€ (e.g., Elsevier Societal Impacts[22]) to over 10,000€ (e.g., Nature[23])</td><td rowspan="3">CC BY 4.0
CC BY-NC-ND 4.0</td></tr>
<tr><td>Publish in a journal that has the option of Gold Open Access</td><td>Publishing agreements between the organisations of project partners and the publisher</td></tr>
<tr><td>Publish in Open Research Europe[24]</td><td colspan="2">Fully Open Access journal by the European Commission, provided for free for Horizon Europe projects</td></tr>
</table>

The overall responsibility for data curation, long-term storage, and preservation lies with the project coordinator and the quality assurance lead. Wuppertal Institute and HOLISTIC will manage these aspects, including the associated expenses, while also maintaining and regularly updating the Data Management Plan. Each project partner is expected to follow the data handling procedures outlined in the DMP, ensuring that datasets and model code are properly maintained and shared. This includes the regular uploading of modelling code to the GitHub-based ACCLIMATE community or the GitHub organisations of the consortium partners. HOLISTIC will also ensure that the project website and data platform remain operational and accessible for at least three years following the conclusion of the project.

[22] https://www.elsevier.com/about/policies-and-standards/pricing
[23] https://www.nature.com/nature/for-authors/publishing-options
[24] https://open-research-europe.ec.europa.eu/

5 Data security

The data assets identified in Section 2 of this report are classified according to their sensitivity and relevance, as different types of data require different levels of protection. Throughout the project, data security is ensured by using reliable storage solutions and safe platforms for communication and file exchange.

The project will use a layered approach to ensure data security through robust data storage and the use of reliable platforms for communication and data exchange. On the latter, consortium partners use a business version of the Google Workspace provided by the Wuppertal Institute. Specifically, Google Meet is used for communication while a dedicated Google Drive space is used for document exchange among consortium members. The Google Drive will be also used for the exchange of sensitive data among selected EU consortium members, thus avoiding transferring that information through emailing. Similarly, HOLISTIC uses a GDPR-compliant MailerLite service to manage and store the personal data of newsletter subscribers.

In addition to Google Drive, ACCLIMATE relies on the project website and the IAM PARIS platform to store and manage data. Both HOLISTIC and Wuppertal Institute have implemented backup and recovery procedures to protect this information from risks such as hardware failure, theft, or natural disasters. These same safeguards are applied to Google Drive, which also includes a versioning feature that helps prevent accidental loss or unwanted changes to stored files.

Zenodo and GitHub will also be used to store project data during implementation and serve as permanent repositories once the project concludes. Only the minimum amount of information needed for the intended use of each dataset will be made publicly available. These platforms are built on networks of multiple servers, which reduces the risk of data loss. In the rare case that these repositories become unavailable, there are plans in place to transfer the data to stable digital archives such as those managed by the Software Heritage Foundation or the Internet Archive.

6 Ethical aspects

All data-related activities in the ACCLIMATE project are conducted in full alignment with the EU GDPR, as well as with relevant national data protection laws in each partner country. This includes taking appropriate steps to safeguard the privacy and confidentiality of any personal data that may be collected or processed during the course of the research. When required, consent will be obtained from individuals prior to any data processing, and all personal data will be stored and handled with strict security standards. Most activities linked to model development carry limited ethical or legal concerns, primarily involving the responsible use of licensed datasets. In contrast, activities that involve stakeholder engagement, particularly in the early phases of WP1, require more careful ethical attention, as they involve collecting insights through workshops, interviews, and surveys.

During stakeholder workshops, the Chatham House Rule (Chatham House, 2024) will apply to protect participant anonymity. The minutes from these events will not associate names with specific contributions, and the same approach will be used when recording interviews. Surveys conducted by the project will request only the minimum necessary information, such as a participant's professional role or affiliation. All participants will be asked to provide clear and informed consent, and these ethical considerations will be discussed in detail in WP1 deliverables.

As noted in earlier sections, stakeholder contact information and submitted feedback will be stored securely using the project's Google Drive environment, while subscriber details for communications will be managed through HOLISTIC's MailerLite platform. Both of these systems are hosted within the European Union and meet the requirements of the GDPR. Additional safeguards will prevent personal contact details from being shared through unsecured channels. No transfer of personal data will take place between European and non-European countries. Instead, the project will only collect anonymised lists of stakeholder research priorities and questions, without linking them to individual identities.

Beyond these specific protections, ACCLIMATE also seeks to consider the broader societal dimensions of its work. Through ongoing engagement with stakeholders, the project aims to ensure that its outcomes are not only scientifically sound but also contribute to addressing pressing challenges in a fair and inclusive way.

7 maDMP in ARGOS

Data Management Plans play an important role in helping researchers understand and manage their data responsibly, ensuring that it remains high in quality, accessible, and reusable even after the end of the project. A DMP describes the digital methods used in a research project, but these methods are not static. They develop as the project progresses. For this reason, the DMP must also evolve, regularly reflecting how data is being generated, processed, and shared. While a well-written, human-readable narrative remains important, there is increasing value in complementing the DMP with more structured, machine-actionable information that can benefit both researchers and other stakeholders throughout the project's lifetime.

To support this, ACCLIMATE will maintain a machine-actionable Data Management Plan using the ARGOS tool. A draft version of the maDMP for ACCLIMATE has already been created in ARGOS and will become public when the first dataset is added. This maDMP will include detailed records of all datasets created, used, or managed during the project and will be revised continuously as new datasets are produced or existing ones are updated. Staff at HOLISTIC and WI will be responsible for entering new datasets into the maDMP. Each project partner will be expected to review and confirm the accuracy of metadata linked to their respective datasets, helping ensure that the information remains complete and correct throughout the project. The full DMP lifecycle in ARGOS is shown in Figure 2.

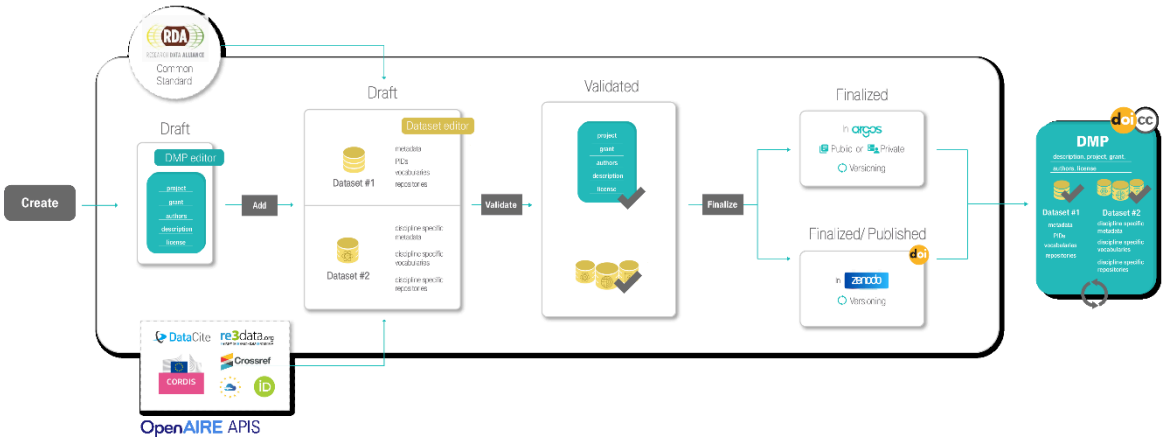

Figure 2: Full lifecycle of the DMP in ARGOS

The following procedure will be followed to register a new dataset in the ACCLIMATE maDMP using the ARGOS platform:

- The project partner or partners responsible for generating the dataset (referred to as "data creators") will share the dataset with the designated data managers at HOLISTIC and WI.
- The data managers will upload the dataset to Zenodo, ensuring that it is publicly accessible through the ACCLIMATE community page.
- Using ARGOS, the data managers will create a new dataset entry in the maDMP. They will begin by locating the dataset via the platform's search engine and pre-populating the corresponding entry.
- Based on the current Data Management Plan and its subsequent updates, the data managers will complete the required metadata fields and establish links to any associated deliverables or scientific publications.
- The data creators will then be asked to review the metadata to confirm its accuracy and completeness before the entry is finalised.

This process ensures that all project datasets are systematically recorded, correctly described, and properly linked to ACCLIMATE's outputs, supporting transparency, traceability, and adherence to FAIR principles.

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