ENTiCE

ENhancing our understanding of Trade Impacts on Climate, industries, and the Environment

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D2.1 - Data management plan

WP2 – Improved data and empirics on trade and climate

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EC Summary Requirements

1. Changes with respect to the DoA

No changes with respect to the work described in the DoA.

2. Dissemination and uptake

This report shall serve as a guide for all consortium partners on how to handle project datasets. It can also be used by external users to understand how data in the ENTICE project is collected, processed, and disseminated.

3. Short summary of results (<250 words)

This deliverable reports the first version of the open Data Management Plan (DMP) of ENTICE, which will be updated during the second reporting period (D2.2) of the project. The plan ensures that research data collected, processed, and produced will be appropriately documented, stored, and made available to the scientific community and relevant stakeholders. It entails a protocol for handling the data that will be used and created during the project's lifecycle and provides guidelines to ensure the consortium adheres to the four FAIR principles (findability, accessibility, interoperability, reusability), along with details on resource allocation, data security, and ethical aspects. The DMP of ENTICE will be machine-actionable and continually assess and improve the requirements for knowledge and data exchange, assuring that research datasets are handled in alignment with FAIR guidelines.

4. Evidence of accomplishment

This report.

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Preface

In today's interconnected global economy, understanding the trade-climate nexus is more critical than ever. Trade policies significantly influence the environment, while climate change affects trade flows. However, the complex relationship between these areas remains insufficiently explored, often due to data limitations, gaps in economic modelling and the evolving nature of global supply chains. The ENTICE project aims to bridge these knowledge gaps by advancing our understanding of the trade-climate-industry (TCI) nexus. It examines how trade policies impact environmental sustainability and how climate policies shape global trade dynamics. By developing fact-based insights and innovative modelling tools, ENTICE supports informed decision-making at this crucial intersection of trade, climate, and sustainability. This entails upgrading and extending the well-renowned Global Trade Analysis Project (GTAP) Data Base, including a further split of industrial and agriculture sectors, the introduction of new technologies and production processes, the integration of a more refined data on agricultural/land-use and international transportation emissions, as well as the enhanced representation of the flows of materials and critical minerals. A series of leading economic models will also be expanded, focusing on improved sectoral representation, enhanced Agriculture, Forestry, and Other Land Use (AFOLU) processes' representation, material, and transport modelling capacity enhancement, as well as the integration of new trade theories and methodological improvements. Transparency, openness, and knowledge sharing will be promoted, moving beyond stakeholder consultation, onto data enrichment, model co-development, continuous validation of assumptions, co-creation of scenario modelling, evaluation of the desirability and usability of the developed toolbox and insights, and eventually co-production of science and action.

E3M – E3-MODELLING AE	EL	
CMCC – FONDAZIONE CENTRO EURO-MEDITERRANEOSUI CAMBIAMENTI CLIMATICI	IT	
WI – WUPPERTAL INSTITUT FUR KLIMA, UMWELT, ENERGIE GGMBH	DE	
REFORM – FUNDACJA INSTYTUT REFORM	PL	
VUA – STICHTING VU	NL	
HOL – HOLISTIC IKE	EL	
ENEXTGEN – ENEXTGEN S.R.L.	IT	
UoS – UNIVERSITY OF SOUTHAMPTON	UK	
UNIVR – UNIVERSITA DEGLI STUDI DI VERONA	IT	
SEURECO – SEURECO SOCIETE EUROPEENNE D'ECONOMIE SARL	FR	
ICCS – EREVNITIKO PANEPISTIMIAKO INSTITOUTO SYSTIMATON EPIKOINONION KAI YPOLOGISTON	EL	
POLIMI – POLITECNICO DI MILANO	IT	
Purdue – TRUSTEES OF PURDUE UNIVERSITY	US	
ZEW – LEIBNIZ-ZENTRUM FUR EUROPAISCHE WIRTSCHAFTSFORSCHUNG GMBH MANNHEIMRL	DE	
UU – UNIVERSITEIT UTRECHT	NL	
ORDESCYS – ORDECSYS SARL	CH	

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Executive Summary

The ENTICE project entails implementation activities that are expectedly data-intensive. To enhance knowledge and inform policymakers on the trade-climate nexus, the ENTICE project will expand the well-renowned and extensively used GTAP Data Base, improve a series of leading economic models, and conduct scenario analysis by focusing on the impacts of trade on emissions and climate change, while also considering broader environmental effects. The ENTICE modelling and data toolbox, as well as scenario analyses stemming from it, will be entirely co-developed and validated with relevant stakeholders, and will be used to inform policy assessment and transition strategies.

In the context of transparency, legitimacy, and open science and data, upon which the project places considerable emphasis, this deliverable presents a first version of the open Data Management Plan (DMP), outlining the strategy for handling research data generated within the project's lifecycle. The plan also specifies how to make data findable, accessible, interoperable, and reusable (FAIR), while also providing details on resource allocation, data security, and ethical considerations. Furthermore, ENTICE will deploy the ARGOS service of OpenAIRE and EUDAT to ensure the machine-actionability of the data management plan (maDMP), thus enabling the use of metadata and links to datasets generated under project's activities. The maDMP will be continuously updated throughout the project's duration, allowing for modifications, when necessary. This plan will also be updated during the second reporting period of the project, in Deliverable D2.2.

The rest of this report is structured as follows: Section 1 outlines the scope of the ENTICE DMP and defines key terminology—including 'machine-actionability'. Subsequently, Section 2 discusses the rationale for collecting and/or producing data as well as its relevance to the project's objectives, and includes information about the data formats, use, origin, and utility. A thorough strategy for achieving FAIR data is subsequently presented in Section 3, followed by a discussion on the resources allocated to implement these principles in Section 4. Section 5 delves into aspects of data security, recovery, and storage, while Section 6 focuses on the ethical considerations associated with the project's planned data handling activities. Finally, Section 7 presents the ARGOS service, details how additional datasets will be added to the maDMP, and discusses plans for upcoming updates.

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1 Introduction

The first step to comply with proper research data management is to develop a Data Management Plan (DMP). A DMP is a document that outlines, from the start of the project, how research data will be handled both during and after the end of a research project. It identifies key actions and strategies to ensure that research data are of a high quality, secure, sustainable, and—to the extent possible—accessible and reusable (OpenAIRE, 2025).

In this context, this report serves as the first version of the open DMP for the Horizon Europe project ENTICE. It outlines the framework for handling research data, including guidelines and protocols for data collection, generation, processing, and dissemination during the project. Additionally, the plan sets out a transparent strategy for managing open data, emphasising compliance with FAIR principles (findability, accessibility, interoperability, reusability), and thus promoting effective data exchange and knowledge dissemination (Wilkinson et al, 2016).

With the advent of Open Science Movement—bringing with it the FAIR principles—DMPs began evolving into their machine-actionable counterparts (Philipson et al, 2023). To maximise the reuse of the information and automate many typical tasks, as recommended by the Research Data Alliance (RDA) (Miksa, 2024), a machine-actionable Data Management Plan (maDMP) will be developed once the first dataset from the project becomes available. A maDMP facilitates the automated workflow, transforms a DMP into a living document, and makes compliance and monitoring go more smoothly.

The ENTICE project's maDMP will be developed using the ARGOS[1] service provided by OpenAIRE and EUDAT. ARGOS is a web-based platform that facilitates management, validation, and monitoring of maDMPs. Users initiate a DMP and provide structured descriptions of the datasets. DMPs and the related datasets are created privately, with the option to share with partners to support drafting and review. Datasets are classified according to type and/or scientific discipline, ensuring easy access and well-structured information. Once finalised, users may validate a DMP and adjust visibility from private to open, enabling access through the Public Dashboards. Finally, to enhance interoperability, ARGOS can be integrated with the project's Zenodo[2] repository.

[1] https://argos.openaire.eu/splash/
[2] https://zenodo.org/

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2 Data summary

2.1 Project objectives and implication for data collection and generation

Current modelling tools and data used to assess the trade–climate nexus face substantial limitations, among others including data granularity and modelling 'conventionality' (notably in terms of trade theories included/employed in the models). Motivated by the underlying caveats and the need to address them, the ENTICE project aims to create a robust understanding of the impacts of trade on climate and environment, by developing an enhanced toolbox of models, datasets, and methodologies with the required granularity, capacity, and consistency to address broader sustainability concerns related to trade. The toolbox will enable a wide set of projections for the future evolution of economy, trade, emissions, and the environment, while also considering agriculture and land-use changes, material flows, competitiveness effects, transport-induced pollution, and costs for compliance.

Taking up this challenge, ENTICE will enrich the well-renowned GTAP Data Base, which is the core input for the vast majority of macroeconomic Computable General Equilibrium (CGE) models (as well as other types of economic models)—including the ones comprising the ENTICE model ensemble. New data will be collected, and existing datasets will be extended, harmonised, and reconciled. ENTICE aims at upgrading the GTAP Data Base with additional features, including enhanced sectoral detail (focusing on energy-intensive and green industries and distinguishing primary and secondary production processes for key materials like steel), the introduction of clean energy industries and new technologies (e.g. PV panels and wind turbines), the integration of trade-induced transport and land use matrices, the expanded representation of agriculture, materials, and extraction activities, and the refined representation of energy flows and emissions. The more detailed GTAP Data Base will be accompanied by a data disaggregation tool allowing for additional sectoral splits upon provision.

Beyond data enrichment, ENTICE will substantially upgrade a series of leading models with insights from new trade economic theories and methodological enhancements, thus, advancing our understanding of trade impacts on the environment and the design of trade, climate, and industrial policies for supporting decarbonisation. The entire model ensemble of ENTICE (GEM-E3, ICES, GEMINI-E3, FIDELIO, PACE, ENVISAGE, and NEMESIS) will be significantly expanded towards improved sectoral representation, enhanced AFOLU, material, and transport modelling capacity, and the integration of trade theories allowing to go beyond the conventional Armington assumptions. This will enable going beyond the state-of-the-art modelling capacity, which tends to overestimate the dependence on current trade patterns.

The upgraded ENTICE modelling toolbox will be used to conduct scenario analyses to quantify the factors driving changes in sector composition and technology adoption in the production and consumption side of economies. In particular, we aim to enhance our understanding of how changes in the scale, composition, and production technology induced by international trade would affect emissions and the environment. We will investigate the environmental impacts of trade on agriculture, forestry, material resources, and (bio-) energy sectors, as well as the interaction between trade liberalisation and environmental regulations. Additionally, we will quantify the impacts of various Trade, Climate & environment and Industrial (TCI) policies and their interaction through appropriately selected policy scenarios co-designed with ENTICE stakeholders.

ENTICE places considerable emphasis on transparency, legitimacy, and open science (including data). Data developments, which will consolidate ongoing efforts and introduce additional sectoral details, will be

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accompanied with transparent documentation. Any model developments realised in the ENTICE context will be made open and shared in public, while sharing knowledge produced with the broad modelling community will constitute a priority. The project will also leverage existing tools/vessels of the climate-economy modelling community, including the IAM PARIS platform[3] and the IAMC wiki[4]. It will also develop two online tools: a data disaggregation tool and an interactive, simplified version of the developed toolbox alongside visualisations to compare scenario modelling results.

2.1.1 Types and formats of data

Achieving the project's objectives, as outlined in Section 1, requires the generation and collection of data of various types. A non-exhaustive list of data types and formats to be used across project activities is provided in Table 1.

Data used for modelling inputs will be mainly quantitative, typically in spreadsheet format (like xlsx or csv), or—especially for the GTAP Data Base—in header array files (HAR), which is a GEMPACK binary format, or in GAMS Data eXchange (GDX) format. New model code will be in the format of the programming languages used to develop these models. For example, any developments to NEMESIS-World, a multi-sector multi-region macroeconometric model, will be made in Python and thus the code will be available in the Python file format.

Qualitative insights from stakeholder co-creation activities will additionally be elicited and used to inform modelling and scenario development. To this, high-level policy dialogues will be fostered, along with targeted surveys, in the context of a well-established 'listening' mechanism (Task 1.3).

Finally, scenario outcomes will also be quantitative and exported in spreadsheet or other appropriate formats—in line with (Integrated Assessment Modelling Community – IAMC) standards and template and with a view to maximising inclusion in the IPCC AR7—that are easily converted to spreadsheets and will be accessible through the IAM PARIS platform. These output datasets will support project's scientific and policy publications, which will be available in pdf format.

Table 1. Data types and formats per project activity.

Project activity	Data collected and generated	Data formats
Data base	**Collect:** regional input-output, macroeconomic, bilateral trade, agriculture, tariffs, energy volumes, emissions, primary factors, and behavioural parameters (elasticities)	Header array (HAR) files, or in GDX data format
	Generate: reconciling 'collect' data to generate the GTAP Data Base representing the world economy for one or more reference years	
Extend and improve models	**Collect:** code from previous versions of models, outcomes of Task 1.1 literature review analysis, and feedback from project stakeholders and	File formats related to each model's programming language (e.g., Python, GAMS,

[3] https://iamparis.eu
[4] https://www.iamcdocumentation.eu/index.php/IAMC_wiki

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	communities of practice for the different models	GEMPACK), reports documenting the model and stakeholder feedback in pdf
	Generate: new model code and documentation	
Compile the input data for the new models	**Collect:** national and sectoral statistics on socioeconomic parameters, macroeconomic indicators, energy use and supply, industrial indicators, physical demand for products, policy options, technological costs, investment costs, material demand/supply, GTAP Data Base	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, as well as on the TCI developed framework	Reports documenting results and stakeholder feedback in pdf; results in xlsx, csv, txt, json; scenario analysis results will be also uploaded to the IAM PARIS platform as interactive tables
	Generate: trade, economic growth, technology, emissions, pollution, resource exploitation, energy demand and supply, land use, material use, biodiversity, security of supply, and other social, economic, and environmental indicators	

2.1.1.1 GTAP Data Base

The GTAP Data Base is a comprehensive global database representing the world economy by combining bilateral trade patterns, production, consumption, and intermediate use of commodities and services for one or more specific reference years (GTAP Data Base, 2025). The database draws heavily on work carried out at the Center for Global Trade Analysis at Purdue (an ENTICE project partner), as well as research and development efforts at a number of national and international agencies, and it underlies most Applied or Computable General Equilibrium models (Aguiar et al., 2023). For each country/region, the database provides values measured in millions of US dollars. In its current version (v11), the database covers 141 individual countries and 19 aggregate regions, while distinguishing 65 products and services to describe economic activity (Aguiar et al., 2023). Broadly speaking, the database classifies agriculture, food, resource extraction, manufacturing, and service activities to describe the whole economy.

2.1.1.2 GTAP data sources

The database reconciles different data sources at a global scale. The core input for the construction of the database is the regional Input-Output Tables (IOTs), which contain the inter-sectoral linkages for each economy, while additional international data are also used to supplement the IOTs—see Table 2.

Table 2. Selected data sources for the construction of the GTAP Data Base.

Data type	Source(s)
Inter-sectoral linkages	National input-output tables, statistical offices, individual GTAP collaborators

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Merchandise trade data	United Nations Commodity Trade (UN-COMTRADE) statistics (UNSD, 2021)
Services trade data	Balanced Trade in Services (BaTiS) database of OECD and WTO (Liberatore & Wettstein, 2021)
Energy flows	International Energy Agency (IEA, 2025), United Nations (UN, 2021), European Statistics (Eurostat, 2022), British Petroleum (BP) energy subsidies data from International Energy Agency, International Monetary Fund (Chepeliev et al., 2018; Chepeliev, 2024)
Emissions	Approach discussed in Chepeliev (2022)
Protection data	Producer Support Estimates (OECD, 2021), EU JRC (Boulanger, 2018), International Trade Center (ITC, 2025)
International transport margins	U.S. imports of merchandise and North American Transborder Freight data, Eurostat, and the Latin American Integration Association (ALADI) imports data (Nuno-Ledesma & Villoria, 2019)
Labour data	International Labour Organization (ILO, 2025)
Behavioural data	A set of behavioural parameters, including substitution and transformation elasticities, as well as parametrization of the constant difference of elasticities (CDE) final demand system (Hertel and van der Mensbrugghe, 2024)
Macroeconomic data	World Bank, UN Statistics Division

2.1.1.3 GTAP data files

The GTAP Data Base consists of five files, namely: sets, parameters, main data, energy volume data, and emissions (Table 3). All data files are in HAR format, while they can also be available in GDX format.

Table 3. GTAP Data Base files.

File type	Data
Sets	Regions, commodities, primary factors, activities, types of tariffs
Parameters	Behavioural and switch parameters

Main data	Values of flows of goods and services, protection data[5]
Energy volume data	Volume of energy purchases by firms and by households, volume of bilateral trade in energy products
Emissions	Emissions from firms, households, government, and investment

2.1.1.4 Data split

In its current version, the GTAP Data Base provides a disaggregation detail at the level of 65 economic sectors (Aguiar et al., 2023), while GTAP-Power Data Base splits global economy into 76 activities with a detailed representation of electricity generation (Chepeliev, 2023). In ENTICE, a more detailed database will be developed, which will consolidate a number of ongoing efforts and introduce additional sectoral details with a specific focus on clean energy technologies, energy-intensive industries, power system, circular economy, critical materials, agricultural activities, energy, and transport emissions. A high-level representation of the data split aspects is presented in Table 4. Acknowledging that the GTAP Data Base will be extensively used and enriched, the ENTICE project's DMP will prioritise the use of data that is open as possible and secure the FAIRness of data produced. In essence, any new data produced will be made open, stored in open repositories, metadata will be made publicly available for all data used in the project, all data will be released in common formats and structures facilitating harmonisation with existing standards when meaningful, and all releases will feature appropriate documentation and licencing.

Table 4. Data split aspects and indicated economic activities (to be developed in ENTICE).

Data split direction	Related activities
Critical minerals	Enhanced representation for the main critical mineral's (lithium, nickel, etc.) lifecycle, from extraction and processing to intermediate inputs (e.g. magnets, batteries) end-use (e.g. PV panels, electric vehicles)
Energy-intensive industries	Primary, secondary, and recycling activities for steel, aluminium, copper, plastic, etc.
Chemicals	Cement, fertilizers, processing of minerals in chemical processes/activities, etc.
Future/promising technologies and products	Future technologies, such as H2-DRI steel production technology, H2 supply by water electrolysis, green ammonia production, etc.
Land use	More detailed representation of agriculture sectors, livestock, and animal products

[5] It refers to the value of revenue generated from protection measures and the subsidy expenditures related to support measures.

Transport	More refined representation of the international transport activities, focusing on energy use and emission flows

2.1.2 Data processing tools

ENTICE comprises a group of leading models that will be further enhanced in the context of WP3. Table 5 lists the models to be improved in the project's lifecycle, whereas capacity enhancement will focus on the following aspects: sectoral disaggregation, trade modelling, technological change endogenisation, accounting of resources and material consumption, land use change, and other environmental aspects. The data-related developments in WP2 will guide the decisions on sectoral modelling improvements. All *new* model developments will be open-access and code will be published in the existing public repository of each model (e.g. GitHub). Links to these repositories will be also provided in the IAM PARIS platform.

The models under consideration (GEM-E3, ICES, NEMESIS, GEMINI-E3, ENVISAGE, FIDELIO, and PACE) will also be linked with other sector-specific models covering land use and material flows, thus enhancing the interdisciplinarity of the project. In particular, the macroeconomic models will be linked with the GLOBIOM recursive-dynamic bioeconomic model, which covers land-use and agriculture, as well as the DYNERIO input-output framework, which covers critical material stock-flows. To this end, specific modules will be created to soft-link the enriched datasets for land uses and critical materials with the macro-economic models in single- or bi-directional soft-linkages.

Table 5. The ENTICE modelling ensemble.

Models	Scope	Responsible partner
GEM-E3	Dynamic computable general equilibrium model	E3M
ICES	Dynamic computable general equilibrium model	CMCC
NEMESIS	Dynamic macroeconometric model	SEURECO
GEMINI-E3	Dynamic computable general equilibrium model	ORDECSYS
ENVISAGE	Dynamic computable general equilibrium model	Purdue
FIDELIO	Dynamic computable general equilibrium model	CMCC
PACE	Dynamic computable general equilibrium model	ZEW
DYNERIO	Dynamic physical stock-flow model[6]	POLIMI
GLOBIOM	Dynamic bioeconomic model[7]	VUA

[6] Typically used for enabling linking macroeconomic models with material flows and mineral resources.

Some models use the GTAP Data Base as core input (e.g., ICES and GEM-E3). If not, then the input comes from various sources such as Eurostat, WIOD, OECD, EXIOBASE, FAOstat, and FIGARO-e. In this context, MARIO is a Python-based Input-Output modelling framework that provides a scale- and database-agnostic approach, supporting diverse IO tables, from single- to multi-region, monetary- or physical-units, and symmetric (IOTs) or supply-use (SUTs) formats, including the ones listed above (Tahavori et al., 2023).

Beyond data itself, sectoral aggregation and disaggregation capabilities are also important depending on the users' needs. While aggregation is a rather straightforward process and tools to deal with are already provided by the GTAP Center or MARIO, disaggregation is more complex. Therefore, apart from GTAP Data Base enrichment, an open-source data disaggregation utility will also be developed under Tasks 2.2 and 2.6, which will combine methodological routines of the SPLITCOM methodology (Horridge, 2008) with parsing with the MARIO tool, and which will be developed in Python. The disaggregation tool will be accompanied with necessary data inputs, user guidelines and templates, to allow users to refine the existing data inputs/assumptions and introduce additional splits customised to their own model. Furthermore, to facilitate visualisation and uptake of the results, an online capacity development tool with an interactive user-friendly interface will be developed to support the inter-comparison of model-based scenarios.

2.1.3 Data inputs and outputs

In terms of input, beyond the GTAP Data Base, which is the core input for some of the models involved, the ENTICE toolbox will also use fully open datasets when possible or at least provide flexible options for defining inputs, allowing users to choose between open or proprietary datasets for simulations. An indicative list of data inputs and outputs is presented in Table 6. Data outputs will be made fully open access, adhering to the FAIR data guidelines outlined in this report and its updates (Section 3). These guidelines will be also added in the maDMP to facilitate the uptake and reuse of all outputs via automatic parsing of metadata. Datasets will be showcased through interactive visualisations on IAM PARIS, designed to meet the needs of different audiences and to deliver insights and context relevant to both policy and industry. All publications and datasets will be made openly available via the project's Zenodo[8] community, as well as through appropriate repositories. Additionally, all newly developed project code will be released as open source in GitHub. All papers, deliverables, and relevant datasets will be shared at the latest upon publication, using Creative Commons licenses for reusability and DOIs for findability.

Table 6. Key input and output indicators for the models involved in the ENTICE project (Giarola et al., 2021; Pauliuk et al., 2017).

Data type	Category	Input/output
Population	Socioeconomic	Input
GDP	Socioeconomic	Input & output
Employment	Socioeconomic	Input & output

[7] Typically used for accountability of biodiversity.

Household income	Socioeconomic	Input & Output
Terms of trade effects	Socioeconomic	Output
Bilateral trade volumes	Socioeconomic	Input & output
Abatement costs	Socioeconomic	Output
Tariffs, subsidies, and taxes	Socioeconomic, industry	Input
Productivity trends	Industry	Input
Sectoral output	Industry	Input & Output
Imports/exports by sector	Industry	Input & Output
Carbon prices	Industry	Input & Output
Material flows	Industry	Input & output
Fuel substitution	Energy	Input & Output
Energy prices	Energy	Input & Output
Energy consumption	Energy	Input & Output
Air pollutants	Emissions	Output
Technology options	Industry	Input
Land use	AFOLU	Input & output
Energy demand by sector	Energy	Input & Output
Energy mix evolution	Energy	Output
Emissions embodied in trade	Emissions	Output

2.1.4 Data used in scenario analysis

After defining a common set of reference scenarios, the effects of trade on climate and the environment are going to be quantified in WP4 and WP5. ENTICE will first examine the impact of trade limitations on emissions and quantify positive and negative effects. We will then focus on trade and trade-related emissions, disentangling the underlying drivers based on the volume of trade, its sectoral decomposition, as well as the effect of technological change. After analysing the trade-environment nexus, three different tracks will follow to understand in more detail this interaction. In particular, ENTICE will focus on three key aspects: (i) the role of developing countries, (ii) the trade-related environmental impacts in agriculture and livestock, and (iii) the international trade implications on material resource use.

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In the context of co-creation with stakeholders, a common set of scenarios will be defined, accounting for different socioeconomic drivers and aiming to enhance widely established pathways/storylines with trade details. These will embed climate and trade policies, exploiting insights from the assessment of the TCI policies explored in WP5. Scenarios will be first defined in WP4 serving as the basis for scenario analysis and will be further refined under the TCI policy framework. A detailed database of TCI policies will be first developed, followed by a detailed assessment of policy interactions and in-depth qualitative analyses of selected policies. These analyses will directly inform the scenario design protocol for the assessment of the trade-climate nexus, which will be further enriched in stakeholder interactions. A non-exhaustive list of indicative policy scenario aspects along with indicative policy scenario objectives, reflecting initial and TCI-refined scenario analysis and accounting for stakeholder engagement, is presented in Table 7.

Table 7. Indicative policy scenario categories and objectives.

Scenario aspect	Scenario objective
Effect on emissions and environment	Resource allocation
	Adoption of green technologies
	Critical materials required for the transition
	Depletion of natural resources
	Changes in GHG and air pollutant emissions
	Raw materials and energy resources availability
	GHG emissions decomposition
	Water use
Scale, composition, and technique effects	Trade volume effects
	Sectoral trade composition effects
	Changes in production processes and technology
Role of developing regions	Regional representation for Africa, Asia, Latin America
	Region and sector-specific trade liberalisation scenarios
	Tariff homogenisation across upstream and downstream activities
	Offshoring effects
Agriculture & livestock impacts	Land use, water use
	Agriculture production techniques
	Carbon stock

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	CO2 and non-CO2 emissions
	Biodiversity loss
	Impact of specific agreements, e.g. EU-Mercosur, AfCFTA
Resource use, and production/consumption impacts	Energy and material use
	Security of supply
	Production/consumption environmental and material use impacts
	Internalisation of externalities
	Changes in recycling rates
	Efficiency improvements
	Onshoring

2.2 Origin, expected size, and utility

2.2.1 Origin

As previously outlined, ENTICE aims at adding research value to three main axes: (i) enrichment of the GTAP Data Base with further splits and new sectors added, (ii) improvement of leading models' capacity, and (iii) conduction of appropriate scenarios towards disentangling the impact of trade on climate and the environment. Models' capacity will be expanded on top of their existing code, while drawing input from current proven data sources, apart from the GTAP Data Base, as described in Section 2.1.1. These inputs will be enriched through insights collected from the stakeholder engagement activities of the project.

A central goal of the project is to ensure that all *newly* developed modelling code and data are openly accessible. Maximising openness poses a substantial challenge, since selected datasets used in the project are proprietary or not publicly accessible. To overcome this barrier, case-specific strategies will be adopted, thus allowing substitution of proprietary data with open-source equivalents. Whenever such replacements are not feasible, an alternative way may involve converting input data into prebuilt binary format that is readable by the models and *can* be shared openly. An indicative list of publicly accessible data used currently by the ENTICE models (non-exhaustive and subject to change to integrate new trends and developments), which can also be directly deployed by the extended models is presented, in Table 8.

Table 8. Examples of open access data that are currently used by ENTICE models.

Topic	Variable	Context	Indicative data origin	Data format
Socioeconomics	Population	EU27+Norway	Population data from Eurostat: Historical statistics through 2018 (Eurostat, 2023); EUROPOP2019 projections from 2019 through 2100 (Eurostat, 2022a, 2022b)	csv

		OECD+7 except EU27/Norway	Population data from OECD Economic Outlook 109 Long-term baseline projections (available for 1990 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 2022 figures for all years (available from 1960 through 2100, with historical data until 2022) (United Nations, 2022)	csv
		SSP 3.0	SSP 3.0 data (release January 2024) of projections for population (IIASA, 2024)	csv
	GDP	All regions, through 2028	GDP from IMF World Economic Outlook (IMF, 2023) in constant 2017 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 2021 Ageing Report (European Commission, 2021a, 2021b)	csv
		OECD except EU27/Norway, from 2029	Extend IMF forecast with real GDP growth rates from the OECD Economic Outlook 109 long-term baseline	csv
		Rest of World	Extend IMF forecast with GDP growth rates per working age capita from Shared Socioeconomic Pathway 2 (must be calculated using the projected population figures) multiplied by population growth rate from the harmonised population time series	csv
		SSP 3.0	SSP 3.0 data (release January 2024) of projections for GDP (IIASA, 2024)	csv
Techno-economics	Technology costs (for reference scenarios)	EU27 and comparable countries	The EU Reference Scenario 2020 (European Commission, 2021c; European Commission, 2021d)	csv
		Other regions, power-sector	Most suitable option are cost assumptions from IEA's World Energy	csv

		technologies	Outlook 2022 (International Energy Agency, 2022)	
		Other regions, non-power technologies	Options include adapting costs from the EUR Reference Scenario 2020	csv
	Fossil fuel prices	Historical prices	Regional prices from IEA datasets (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 form the World Bank "pink sheet" (World Bank, 2023)	csv
		Price projections	Regional price forecasts from the World Energy Outlook 2022 extended dataset (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, 2021d).	csv
Energy	Energy production and consumption	Historical data	IEA World Energy Balances (International Energy Agency, 2023c)	csv
Emissions	Energy-related CO2, CH4, N2O	Historical data	IEA Greenhouse Gas Emissions from Energy dataset (International Energy Agency, 2023b), if modellers have or can acquire access. Alternatively use EDGAR (2024) (v8). 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. For agricultural emissions,	csv

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			(FAOSTAT, 2024) data can also be used.	
	F-gases and non-energy CO_2, CH_4, N_2O	Historical data	EDGAR (2024) (v8)	csv
	Other emissions	Historical data	CEDS (O'Rourke et al., 2021); EDGAR (2024a) can also be used (v8.1).	csv

2.2.2 Size

Based on insights from previous IAM projects, such as PARIS REINFORCE[9], it is expected that the total volume of data collected, processed and generated through the ENTICE project will reach approximately 500GB, excluding the enrichment of the GTAP Data Base, which is expected to require up to 100 GB of data. A significant portion of the data will stem from model inputs, as well as from the outputs to be produced. Notable additions to the overall data volume include audio and video recordings of consortium and stakeholder meetings (of several hundred MB each)—dozens of such meetings are scheduled. Minutes of these meetings will be condensed into a smaller number of reports which will be no more than a few MB each. Project publications (in PDF format) will require minimal storage space. More accurate estimates will emerge as the project advances and will be incorporated into the revised version of the DMP.

2.2.3 Utility

As ENTICE anticipates enhancing capabilities and knowledge in data enrichment, model improvement, and policy scenario analysis. Therefore, the outcomes generated through its activities are expected to benefit all intended audiences of the project. The extended GTAP Data Base and the enhanced models will be of direct value to academics and modellers working on climate change mitigation, trade and industrial policy, and other relevant fields and projects. Additionally, they will provide value to policymakers at all scales working on climate action, trade, and sustainability in general, as well as to decision-makers from manufacturing, agriculture, extraction, and transport sectors. Emphasis will be placed on disseminating project data to key stakeholders such as the European Commission and EU agencies (e.g., DG-CLIMA, CINEA), national and local governments, businesses, industrial clusters, energy-intensive sectors, financial institutions, and researchers engaged in climate-economy (e.g., IAMC) and trade modelling.

[9] https://paris-reinforce.eu/

3 FAIR data

With the growing significance of data openness, a consortium of academic, industry, and government stakeholders collaborated to establish the FAIR principles. These principles constitute a standard for evaluating how well scientific data meets the criteria of being Findable, Accessible, Interoperable, and Reusable (Wilkinson et al. 2016). Embracing the FAIR principles enables researchers to build on and expand prior knowledge, fostering innovation and scientific advancements. Instead of indicating specific technical requirements, the FAIR framework offers a flexible framework that supports reusability across diverse contexts.

Within ENTICE, we will apply open science principles by creating a transparent framework for model development and data enhancement. The adopted strategy aims at guaranteeing full access to *newly* developed models and tools, including code, interfaces, and datasets. Data used and generated will follow the FAIR principles, fostering a vibrant community of practice focused on industry-academia collaboration for knowledge valorisation, benefiting both creators and users (Mons et al., 2017). Furthermore, it will support the documentation of new data and modelling capabilities for expert and non-expert audiences. The FAIRness degree will be assessed by examining the attributes of data and the relevant infrastructure.

The principal guidelines for evaluating the FAIRness degree of research data are outlined as follows:

- ***Findability:*** Facilitating the access of data by interested parties is crucial. To ensure findability, data must be assigned a unique and permanent identifier, commonly referred as a Persistent Identifier (PID). PIDs provide fixed references to digital objects and remain linked to the data even if its location or access mechanism changes over time. They are a key component of findability, enabling users to access the data, regardless of its storage location. Alongside PIDs, comprehensive machine-readable metadata is essential for the automated identification of relevant datasets and services. These metadata must explicitly include the identifier of the data they describe and should be registered or indexed in a searchable resource, forming a critical part of the FAIRification process (Jacobsen et al., 2020).
- ***Accessibility:*** Accessibility ensures that data is readily available and usable by both humans and machines. Metadata should remain accessible, even if the data itself is no longer available. They should be retrievable by their identifier using a standardised communications protocol that is open, free, universally implementable, and supports an authentication and authorisation procedure, when necessary. Accessibility does not necessarily imply openness; rather, it means data is "accessible under well-defined conditions," which may include protecting personal privacy, national security, and ensuring proper data protection (Mons et al., 2017).
- ***Interoperability:*** Ensuring interoperability is critical for the smooth integration and analysis of scientific data across diverse systems and tools. Achieving this requires that data be structured in open and standardised formats that are easily understandable and usable by a wide range of software and applications. Such an approach facilitates data sharing and reuse across multiple disciplines and domains, thereby promoting collaboration and fostering the interdisciplinarity of research. The use of standardised formats and protocols allows data to be integrated into analytical workflows, enabling researchers to derive insights from heterogeneous datasets (Ravi et al., 2022). Interoperability is accomplished through the exchange of data and metadata among different software packages via application programming interfaces (APIs), adhering to relevant

community standards, and including references to other objects. Therefore, metadata should employ vocabularies that follow FAIR principles and include qualified references to other (meta-) data (Calamai & Frontini, 2018). When used effectively, metadata enables research data to become "mobile" objects (Latour, 1987), in the sense that they can transition between different production contexts while maintaining their evidential value (Pasquetto et al., 2019).

- ***Re-usability:*** To enable effective reuse across diverse applications, data must be carefully organised and thoroughly documented. This entails providing detailed information on the data's provenance, quality, and usage rights, as well as conforming to standardised formats and structures. Enhancing reusability significantly increases the value and impact of scientific data, as well-documented, structured, and metadata-annotated data become more comprehensible and usable (da Silva Santos et al., 2023). This involves providing the origin, quality, and accessibility of the data, while employing transparent, widely accepted, standardised data formats and structures. Promoting long-term reusability empowers researchers to build upon existing knowledge, accelerate the research process, and facilitate collaboration across disciplines and scientific communities.

3.1 Making data findable

To ensure that ENTICE outputs are easily discoverable, we will assign PIDs, provide comprehensive metadata, and incorporate relevant keywords to enhance document retrieval via search engines. All deliverables, policy briefs, and other relevant outputs will be uploaded onto the project's Zenodo community and assigned Digital Object Identifiers (DOIs). Scientific publications will receive DOIs from the respective publishing journals; nonetheless, we will also upload the publications, accepted manuscripts, or preprints to Zenodo to maintain a complete and openly accessible archive of our work. Zenodo's versioning system will be employed to track versions updates, with each version receiving a distinct DOI, while a top-level DOI will link to the latest version.

For each output type, a consistent naming system will be established:

- *Scientific publications*: "{author(s)} {year}" (e.g., Green et al 2025.pdf)
- *Policy briefs*: "ENTICE {title}" (e.g., ENTICE Policy Brief on trade impact on climate.pdf)
- *Deliverables*: "ENTICE DX.X {title}" (e.g., ENTICE D2.1 Data management plan.pdf)
- *Datasets*: "{author(s)} {year} {dataset name}" (e.g., Green et al 2025 Critical Minerals.csv)

All datasets generated during the project will also be archived in Zenodo and assigned a DOI. Upon uploading each dataset, we will link it to the machine-actionable Data Management Plan (maDMP) in ARGOS, providing detailed metadata and keywords in accordance with the Horizon Europe template in ARGOS (see Chapter 7). Furthermore, the finalised model code will be made publicly available via GitHub, linked to Zenodo, and incorporated into the maDMP.

Model documentation, inputs, and outputs will also be made available on the IAM PARIS research platform to further promote their use within the climate-economy modelling community, which has been engaging with the platform since its launch in 2020. Each dataset will be accompanied by links to all related project publications to enhance findability. Additionally, both the modelling platform and the project website will provide comprehensive content and feature an optimised sitemap to ensure visibility in search engines such as Google and Bing.

3.2 Making data accessible

All deliverables, policy briefs, and datasets produced under the ENTICE project will be released under Creative Commons licenses. Most outputs will be published using the highly permissive CC BY license (version 4.0). In specific cases, we may choose less permissive licenses, such as CC BY-SA, to ensure that derivative works remain available under the same open license. Especially, for model code, other kinds of open-source licences[10] will be used (e.g., MIT, AGPLv3). In any case, modelling teams are free to choose their type of licence, at least for the bulk model.

Scientific publications will be submitted/published to fully open access journals, in compliance with Horizon Europe requirements. Whenever feasible, we will choose fully open-access journals, including the Open Research Europe publishing platform. In cases where fully open-access options do not align with the scope of the publication, we will opt for journals offering gold open-access options, prioritising those with which the project partners' organisations have existing publishing agreements, and in any case ensuring gold open access (even if not using project funds).

All newly developed models within the ENTICE project will be released under open-source licenses. Licensing options for each module will be carefully evaluated in collaboration with the respective model development teams. It is important to note that model code and input data may be subject to different licensing terms. In cases certain input data are not available as open access, we will propose suitable alternative datasets that can serve as substitutes.

Regarding file formats, we will prioritise widely used formats that can be accessed using freeware applications, such as pdf, csv, txt, mp3, and mp4. In cases where it is not feasible (for instance, when sharing Excel spreadsheets with multiple tabs), we will provide links to compatible freeware alternatives, such as the OpenOffice suite, alongside the proprietary files.

We are committed to ensuring for as long as possible the accessibility of all open project outputs. Publications and datasets will be stored in online repositories such as Zenodo and GitHub where they are expected to remain available for future use. The project website will also be maintained for a minimum of two years following the project's completion, to support continued dissemination, exploitation, and discoverability of project outcomes. Furthermore, ICCS and HOLISTIC will ensure the IAM PARIS platform's longevity after the project ends, extending its availability *at least* until 2032.

3.3 Making data interoperable

We will ensure high interoperability of project data by utilising appropriate data formats and providing detailed metadata. As described in Section 3.2, all datasets and reports generated by the project will be shared in widely used formats such as pdf, csv, and txt, with an emphasis on avoiding proprietary formats whenever feasible. Documentation for new modules and data produced, as well as the results of scenario analyses, will adhere to the IAMC reporting templates (e.g., the Scenario Compass Initiative). This approach will enhance accessibility for the broader climate-economy modelling community and ensure compatibility with relevant software (e.g., pyam Python package), while also facilitating the inclusion of ENTICE scenarios for review in the IPCC AR7.

[10] https://opensource.org/license

Metadata for all project datasets will be incorporated into the ENTICE maDMP within ARGOS, in accordance with the Horizon Europe format template. Since all information in ARGOS is machine-actionable, the metadata can be converted into alternative format templates if required, thus further enhancing the interoperability of the project's datasets.

3.4 Making data reusable

As already outlined, all ENTICE deliverables and datasets will be released under a CC BY license, thus facilitating their broad reuse by a wide range of interested parties. Likewise, all scientific publications will be made openly accessible and shared with the research community immediately upon acceptance. To ensure the reusability of datasets, the Horizon Europe metadata scheme will be employed within the project's maDMP. This scheme will include a brief description of each dataset, links to related publications and datasets, and specific guidelines addressing FAIR practices, resource allocation, and security and ethical considerations. Aligning to this report, the scheme will offer more detailed data-specific information. Furthermore, modelling documentation and results will follow the IAMC reporting templates to align with guidelines for IPCC AR7, and where appropriate incorporate formats commonly used in climate-economy modelling research, to ensure reusability by the broader modelling community. On an ad hoc basis, in cases the IAMC template is not flexible enough to align with the specificities of the ENTICE model ensemble, alternative formats may be considered.

4 Allocation of resources

Most of the FAIR practices described in Section 3 do not impose any costs for the ENTICE project. All deliverables and datasets will be deposited in Zenodo, which is free-to-use, and the project's new code will be hosted on the free version of GitHub. Similarly, documenting datasets in the maDMP via ARGOS is also free of charge. Nevertheless, certain open data management activities that require dedicated resources have been planned for and included in the project's Grant Agreement. Any IAM PARIS expansion and hosting related activities as well as the development and maintenance of the project website are budgeted under WP7. Additionally, the budget includes provisions for open-access publishing, with recommended journal options presented in Table 9. The Open Research Europe[11] journal is also a publishing option that is fully open access and free for Horizon Europe projects such as ENTICE.

Table 9. Options for open-access scientific publishing in ENTICE.

Access type	Funder	Fees	License
Publish in a fully Open Access journal	ENTICE Grant	Article Processing Charges (APCs); ranging between ~200€ (e.g., Elsevier Societal Impacts[12]) to over 10,000€ (e.g. Nature)[13]	CC BY 4.0, CC BY-NC-ND 4.0
Publish in a journal that has the option of Gold Open Access	Publishing agreements between the organisations of project partners and the publisher; and/or other funds (outside ENTICE or other Horizon Europe projects)		

With respect to data curation, storage, and preservation, the project coordinator and quality manager will be responsible for overseeing data management and ensuring quality control. ICCS will prepare and regularly update this DMP report—with the support of E3M and HOLISTIC.

Each project partner will be responsible for the appropriate handling and curation of data in accordance with the guidelines outlined in the DMP. As previously noted, HOLISTIC will be in charge of maintaining the website, ensuring that all related project data remain accessible for at least two years after the project's conclusion. Furthermore, both ICCS and HOLISTIC are exploring options to further extend the IAM PARIS platform's operational lifespan.

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

5 Data security

Data collected, processed, or stored throughout the research project, as described in Section 2, are classified according to their sensitivity and significance, requiring different levels of protection. To secure all project data, reliable storage solutions and platforms for communication and data exchange have been put in place.

E3M has set up a dedicated workspace within its enterprise version of MS Teams to facilitate internal communication, including video calls and messaging among project partners. Access to the MS Teams platform and SharePoint is restricted to authorised users (consortium members), ensuring confidentiality. The management and security of these systems are overseen by E3M administrators and their Data Protection Officer (DPO), with servers located within the EU to ensure compliance with GDPR and relevant EU regulations. This adherence to GDPR standards is crucial, particularly as MS Teams will also store the contact details of project stakeholders, requiring strong security measures. Similarly, the personal data of newsletter subscribers will be securely stored in HOLISTIC's GDPR-compliant MailerLite account.

In addition to MS SharePoint, which also features a versioning system to protect users from accidentally deleting or modifying data, the project also utilises the databases of the project website and the IAM PARIS platform for data storage. Disaster recovery and backup policies have been implemented for both databases, ensuring data protection against loss due to critical system failures, fire, theft, or natural disasters.

The project's communities on Zenodo and GitHub will be used to store data during the project and, importantly, to preserve all created datasets and publications after the project concludes. For each dataset, only the minimum amount of data necessary to achieve its intended purpose will be released. The risk of data loss in these repositories is minimal, as all files and documents are stored across multiple online servers to ensure redundancy. Additionally, the likelihood of these repositories ceasing operations is extremely low. However, in the unlikely event that this occurs, contingency plans are in place to migrate all content to appropriate archives, such as those managed by the Software Heritage Foundation and Internet Archive.

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6 Ethical aspects

All data collection and management activities within ENTICE will comply with the EU GDPR regulations and the national privacy and data protection laws of each partner country. This includes implementing appropriate measures to protect the privacy and confidentiality of personal data collected or processed during the research, obtaining consent for data processing where necessary, and ensuring secure data storage and handling. While ethical and legal considerations are minimal for most activities related to model development - mainly focusing on respecting the licenses of databases used as sources for modelling inputs - ethical considerations are paramount in all co-creation activities of the project. These activities involve gathering diverse perspectives from project stakeholders through workshops, interviews, and surveys.

During ENTICE workshops, the Chatham House Rule (Chatham House, 2024) will be applied to ensure the anonymity of speakers and participants. Workshop minutes will strictly adhere to this rule, avoiding any direct association between individuals and specific statements. Similar procedures will be followed for documenting interviews, while surveys will collect only the personal details necessary for research purposes, such as academic or policymaking affiliation. Clear and explicit informed consent will be obtained from all participants in engagement activities, with details on ethical aspects.

As detailed in Section 5, all contact details and feedback from project stakeholders will be securely stored within the project's share point, while newsletter subscriber contact details will be maintained in HOLISTIC's MailerLite account. Both platforms are hosted within the EU and are GDPR compliant. Measures will be implemented to prevent the bulk exchange of contact details through insecure channels like email. No transfer of personal data will occur between EU and non-EU countries (e.g., USA). The only information collected will be lists of research questions raised by project stakeholders, ensuring anonymity is maintained. In cases where information of stakeholders is collected (e.g., institutions, positions), this information will be anonymised prior to any processing or transferred.

Finally, ENTICE will consider the wider societal implications of its research, aiming to maximise its positive impact on society. This includes actively engaging with stakeholders to ensure that research outcomes deliver social benefits and effectively respond to key societal challenges.

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7 maDMP in ARGOS

Data Management Plans are essential tools that enable researchers to manage their data effectively, ensuring its quality, accessibility, and reusability during and well beyond a project's duration. To remain a valuable resource for both researchers and stakeholders, a DMP must be regularly updated to reflect the methods employed and the data generated. While it is crucial to maintain a human-readable narrative, there is growing recognition of the benefits of enhancing the DMP with thematic, machine-actionable details to add further value for all stakeholders (Michener, 2015).

To achieve this, the ENTICE maDMP in ARGOS will offer a detailed overview of all datasets generated, curated, or managed throughout the project's duration. The maDMP will be continuously updated whenever a dataset is created or modified, while an updated summary of its contents will be reflected in the subsequent version of this report (D2.2). Personnel from ICCS will be responsible for entering new datasets into the maDMP, while all project partners will ensure the metadata provided for their datasets in the maDMP is accurate. The complete DMP lifecycle in ARGOS is illustrated in Figure 1. The maDMP of ENTICE will be initially created as a draft in ARGOS and will become publicly available when the first dataset from the project is added there.

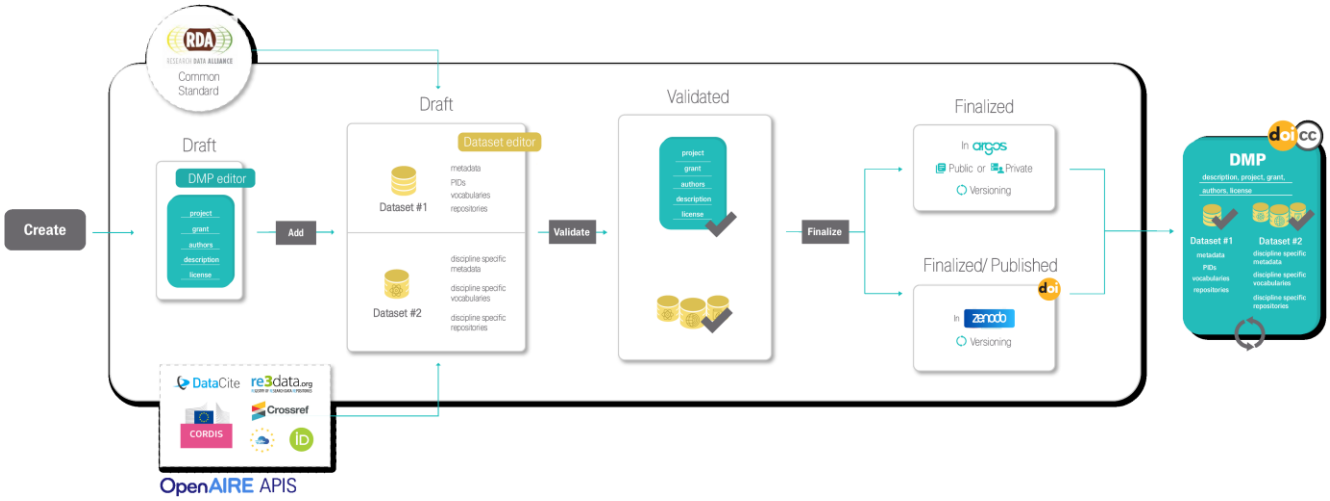

Figure 1. DMP publication lifecycle (OpenAIRE, 2025).

The process of creating a new dataset in the maDMP of ENTICE is outlined as follows:

Step 1. The project partner(s) responsible for creating the dataset (referred to as "data creators") will share it with ICCS (referred to as "data managers").

Step 2. The data managers will upload the dataset to Zenodo.

Step 3. The data managers will create a new dataset entry in the maDMP, pre-filling it by searching for the dataset's name using the ARGOS search engine.

Step 4. The data managers will complete the dataset's metadata according to the guidelines provided in this report and its updates, linking the dataset to relevant deliverables or scientific publications.

Step 5. The data creators will be invited to review the metadata and ensure its accuracy.

Step 6. The data managers will update the maDMP with the newly created dataset.

A similar approach will be applied for new model code, where links will be established between the model

repositories in GitHub and Zenodo to ensure that the code base of the models receives a unique DOI[14]. This Zenodo entry will then be linked to the maDMP and documented with the appropriate metadata, as described earlier. These processes will be continually evaluated based on the experiences of the data managers and creators and may be adapted and optimised as the project progresses.

Finally, if ARGOS is not readily available or functional, as required for the purposes of ENTICE, other alternatives will be considered to ensure machine actionability in line with the requirements set out in the DMP.

[14] https://docs.github.com/en/repositories/archiving-a-github-repository/referencing-and-citing-content

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