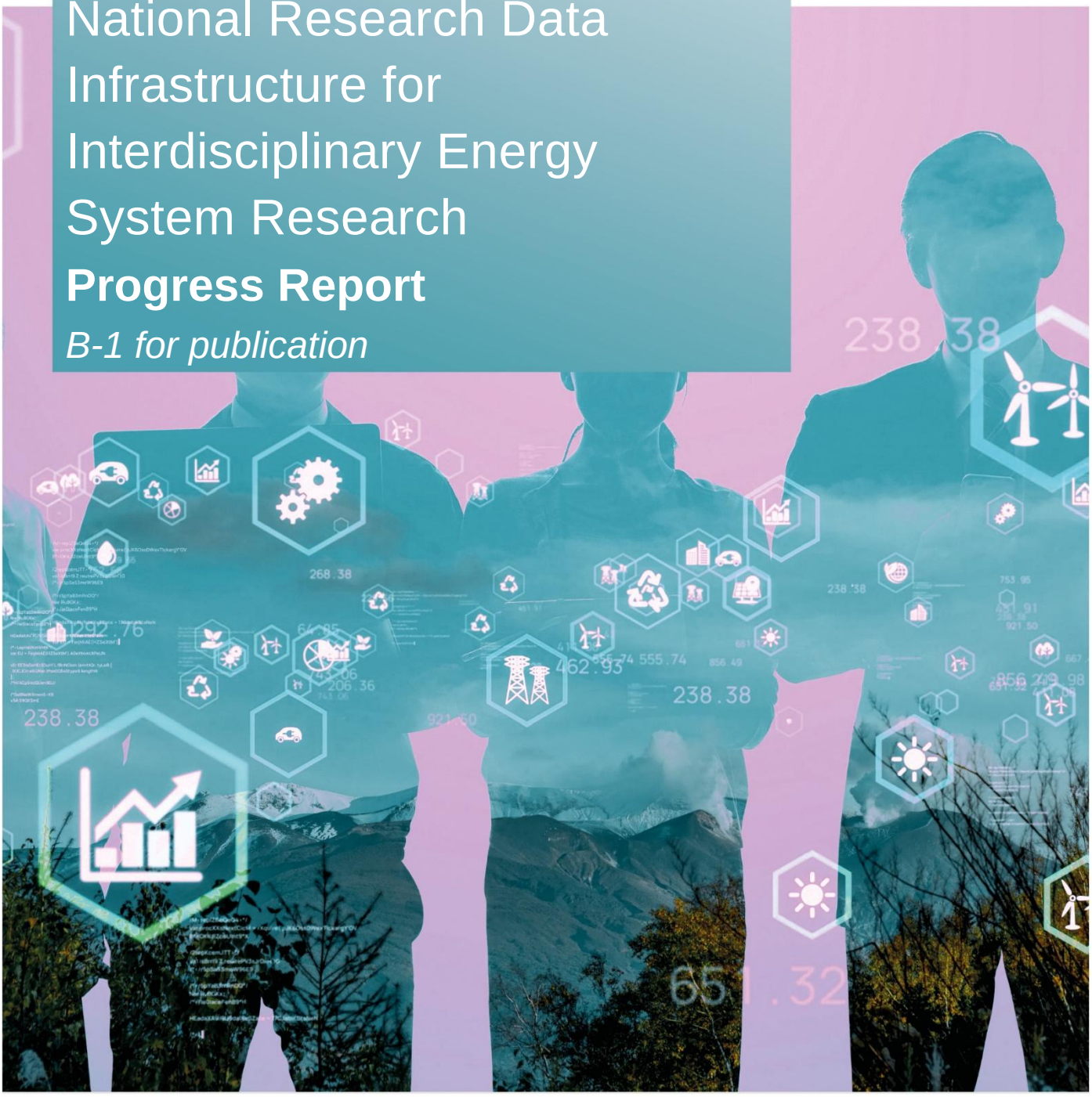
NFDI4Energy – National Research Data Infrastructure for Interdisciplinary Energy System Research

Progress Report

B-1 for publication



Contents

1 General Information

- Name of the consortium

  NFDI4Energy – National Research Data Infrastructure for the Interdisciplinary Energy System Research

- Research domains or research methods addressed by the consortium

  Classification according to DFG review boards:

  - 1.23 Social Sciences
  - 1.24 Economics
  - 4.41 Systems Engineering
  - 4.42 Electrical Engineering and Information Technology
  - 4.43 Computer Science

  As NFDI4Energy, we address interdisciplinary energy system research, which includes technical, social, economic, policy, and socio-technical aspects of the transformation of energy systems. This transformation creates complex research challenges due to strong interconnections between power, heat, mobility, and increasing digitalization. We aim to support reproducible research in energy system modeling, simulation, and analysis by providing community services for managing digital objects such as models, datasets, workflows and scenarios across scales.

- URL of the consortium website and repositories used for publishing output

Website	https://nfdi4energy.uol.de/
Zenodo community for outputs	https://zenodo.org/communities/nfdi4energy/
LinkedIn	https://www.linkedin.com/company/nfdi4energy/

2 Summary

As NFDI4Energy, we aim to make data and software the scientific foundation for a sustainable energy future. Good research data management (RDM) in energy system research is key for the **interdisciplinary collaboration** that is essential to tackle the technical, social, economic, policy, and socio-technical dimensions of the energy transition. By ensuring that research outputs are FAIR (findable, accessible, interoperable and reusable), RDM will simplify the use of artificial intelligence, shorten innovation cycles, reduce duplications, foster excellent research, and drive the scientific advances needed for a sustainable energy future.

We have positioned NFDI4Energy as the **central hub for RDM in the energy domain**. Halfway through its first funding phase, NFDI4Energy in the NFDI association grew from its 10 original members to 26 members through our active community engagement. We conduct **yearly NFDI4Energy Conferences**, which bring together researchers, industry partners, public administrative bodies, and societal actors. More than half of the conference participants came from non-funded organizations, thus showing the success of our community work. In addition, through further community work (for example, by booths and keynotes at conferences), we foster the cultural change towards FAIR data in energy system research. Our work in NFDI4Energy is guided by our professional scientific and industrial advisory boards.

Concrete showcases have proven to be an effective way to turn RDM concepts and services into success stories and to communicate them throughout the community. For example, one showcase illustrates how FAIR climate policy datasets based on ontology-driven workflows can support quantitative policy effectiveness analyses, e.g., for the upcoming assessment of the Intergovernmental Panel on Climate Change (IPCC).

Our **NFDI4Energy service portfolio** integrates services developed by different initiatives. Thereby, it forms the backbone of good RDM in energy system research. By evaluating and adapting these solutions, we built a coherent service portfolio that leverages proven methods while also filling identified RDM gaps. The portfolio is based on a clear sustainable onboarding process to ensure the quality of the services. These services span the entire data lifecycle as follows: the **Terminology Service** offers searchable access to energy ontologies; **RDMO4Energy** provides energy-specific data management plan templates; the **Open Energy Scenario Bundles** allow users to document scenario context and to link studies, models, and data through a knowledge graph; the **Open Research Knowledge Graph (ORKG)** enables semantic description and comparison of publications enhanced with energy-specific ontologies; the **Leibniz Data Manager (LDM)** federates data upload, data linking with natural language queries, and data exploration; the **Open Energy Database** provides a data repository using a community-driven metadata schema; and the **Open Energy Databus** links heterogeneous data across lifecycles

via a metadata knowledge graph. The services will be further enhanced in the second part of this funding phase based on community feedback. Through additional showcases, we will illustrate the benefits of the services to our community and further increase their usage.

An energy-specific **metadata schema** and energy-specific **ontologies** are essential to unlock the full potential of these services and the datasets. For example, better dataset descriptions help to enable the usage of datasets in artificial-intelligence based systems. Therefore, we adopted the Open Energy Ontology (OEO) as the primary domain ontology and contributed new concepts on topics such as long-term scenario modeling. We also established a metadata schema for energy data and synchronized it with the activities in the other NFDI consortia.

Research software is a key research artifact in the energy domain. Recognizing that energy system research benefits from **research software engineering (RSE)**, we started an energy research software engineering community. We introduced a metadata schema for energy research software and incorporated software management plan templates into RDMO4Energy. With this work, we contributed to a better connection between the RSE and RDM communities.

As NFDI4Energy, we foster the **idea of oneNFDI**, e.g., by integrating different **base services** like IAM4NFDI, TS4NFDI, and DMP4NFDI. We contribute to oneNFDI through our support of new service initiatives like nfdi.software, as well as through our active participation in the Conference on Research Data Infrastructure (CoRDI, 2023 & 2025), the NFDI sections, and the NFDI task forces, e.g., on Governance and Sustainability. We collaborate with other NFDI consortia and regularly invite them to our NFDI4Energy Conferences, including active roles, e.g., with keynotes, booths, and workshops. Our collaboration with other NFDI consortia also includes the establishment of Memorandums of Understandings and the preparation of joint calls for **flex projects**.

Through our community work, we have identified additional needs for domain-specific RDM training, which we will address in the next funding phase. There is an increasing demand for reusable, quality-assured, annotated data from academia, public administration, and industry, which we will further concentrate on.

In summary, NFDI4Energy has become **the central hub for RDM in the energy domain**, delivering a dedicated suite of quality-assured services, developing energy-specific metadata and ontologies, integrating existing approaches, and providing showcases as a basis for our successful community work.

3 Composition of the consortium

- Applicant institution

Applicant institution	Location	Duration
Carl von Ossietzky Universität Oldenburg (UOL)	Oldenburg	02/2023 -

- Spokesperson

Spokesperson	Institution, location	Duration
Prof. Dr. Astrid Nieße 0000-0003-1881-9172	UOL, Oldenburg	02/2023 -

- Co-applicant institutions

Co-applicant institutions	Location	Duration
Albert-Ludwigs-Universität Freiburg (UFR)	Freiburg	02/2023 -
Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)	Erlangen-Nürnberg	02/2023 -
Karlsruher Institut für Technologie (KIT)	Karlsruhe	02/2023 -
OFFIS e.V.	Oldenburg	02/2023 -
RWTH Aachen	Aachen	02/2023 -
Soziologisches Forschungsinstitut Göttingen (SOFI) e.V.	Göttingen	02/2023 -
Technische Informationsbibliothek (TIB)	Hannover	02/2023 -

- Co-spokespersons

Co-spokespersons	Institution, location	Task area(s)	Duration
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Prof. Dr. Berthold Vogel	SOFI, Göttingen	TA1, TA2, TA6, TA7	02/2023 -
Prof. Dr. Sören Auer 0000-0002-0698-2864	TIB, Hannover	TA4, TA7	02/2023 -

- Participants

Participating institutions	Location	Duration
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Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. • Fraunhofer Institut für angewandte Informationstechnik (FhFIT)	München Aachen	02/2023 -
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) • Institut für vernetzte Energiesysteme	Köln Stuttgart	12/2024 -
Institut für Angewandte Informatik (InfAI) e.V. An-Institut an der Universität Leipzig	Leipzig	12/2024 -
Universität Osnabrück (UOS)	Osnabrück	12/2024 -
Öko-Institut e.V. (ÖKO)	Freiburg	02/2025 -