



GreenDIGIT

Greener Future Digital Research Infrastructures

Deliverable D10.3 Dissemination and Exploitation Report about Period 1, and Plan for Period 2

GRANT AGREEMENT NUMBER: 101131207

Lead Beneficiary:	UTH
Type of Deliverable:	Report
Dissemination Level:	Public
Submission Date:	22.02.2026
Version:	2.0



This project has received funding from the European Union's HE [research](#) and innovation programme under the grant agreement No. 101131207

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Versioning and contribution history

Version	Description	Contributions
0.1	Initial draft – ToC - Contributions	UTH,
0.2	Contributions (chapters 1 & 2) / Change template	UTH
0.3	Contributions (chapters 3 & 4)	UTH
0.4	Partner Inputs / Adjusting content Part II	UTH, EGI, UvA, TUM, GSPT, SU, CESNET, CSIC, MI, CNRS, CNR, EBRAINS
0.5	Adjustments of partner Inputs / Completing 1 st full version	UTH
0.6	Integration of internal review inputs	UvA, UTH
0.7	Refining / removing some parts of content	UTH
0.8	Integrating / applying last IR comments	UTH, UvA
1.0	Finalising for submission	UvA
2.0	Addressing RP1 comments	UTH, UvA, EGI
2.1	Update after internal reviewing of RP1 revisions	UTH, UvA, EGI
2.2	Addressing comments of internal review after RP1 revisions	UTH, UvA, EGI
3.0	Finalising submission	UvA

List of revisions following the project review request

Page	Revision
<i>Section 4.2 - p46 (Matrix)</i>	Adds a column “Status” at KPIs table
<i>Section 4.2.2. - p48 (text)</i>	Adds X deviation justification
<i>Section 5.2 - p51 (text)</i>	Adds a paragraph for declaring KERs – Adds a column “status” at KER table
<i>Section 5.3 - p61 (text)</i>	Adds sub-section 5.3 for IPR strategy as defined in GA.
<i>p “several” (captions)</i>	Several changes at number of tables etc., auto format, please accept changes as tracked.

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Executive Summary

This deliverable includes the dissemination and exploitation activities of the GreenDIGIT project for the first reporting period (M1–M18), as well as the strategy and the plans for the second period (M19–M36). More specifically, it describes the ways, and the actions made, to establish strong visibility, engagement to a broad range of stakeholders, and key outputs delivery, that also form the basis for future adoption. Some of the most notable achievements described, include the successful engagement with numerous Research Infrastructures (RIs) and the continuous intense awareness raising of the targeted stakeholders. The dissemination efforts were supported by a dynamic online presence (website, social media channels etc.), active participation in events (publications, posters etc.), and strong community engagement. Exploitation activities in this period focused on preparing the Key Exploitable Results (KERs), and we outline the KERs completed in period 1 and planned to complete in period 2. The KERs, include a wide variety of material ranging from technical tools, environmental impact methodologies, training resources, and are thoroughly described in this document. Furthermore, the strategy for the second period shifts from broad awareness to targeted exploitation, ensuring that project outputs are embedded within RI operations and training programs. Some indicative actions for achieving that, will include pilot deployments, integration of technical solutions in operational environments, expansion of training modules, and alignment with policy and evaluation frameworks. Through these efforts, GreenDIGIT will maximise its impact, contributing to the sustainability and environmental performance of European RIs, and ensuring the long-term relevance and adoption of its results.



Table of contents

1	Introduction	11
1.1	Purpose of the Deliverable	11
1.2	Structure of the Deliverable	11
1.3	Methodologies and Sources	11
1.4	Overview of Dissemination and Exploitation Strategy.....	12
1.4.1	Objectives and principles	12
1.4.2	Target audiences and stakeholder groups.....	12
1.4.3	Key Performance Indicators (KPIs).....	12
	Part I: Dissemination and Exploitation Activities – Period 1 (M1–M18).....	14
2	Dissemination Activities Performed	15
2.1	Scientific Publications (Conferences, Journals, Workshops).....	15
2.2	Online Visibility (Website, Social Media, Blogs).....	18
2.2.1	Website	18
2.2.2	Social Media.....	21
2.3	Events Participation	23
2.3.1	EGI 2025	23
2.3.2	EGI 2024	28
2.3.3	Dagstuhl Seminar 24462	30
2.3.4	Other	31
2.4	Contributions to Policy	32
2.4.1	Assessment of existing policies and regulations.....	32
2.4.2	Development of self-assessment questionnaire.....	32
2.4.3	Development of the policy recommendations	33
3	Exploitation Activities Performed	34
3.1	Stakeholder Engagement.....	34
3.1.1	Research communities.....	34
3.1.2	Digital Research Infrastructures (RIs).....	35
3.1.3	Policy makers & Public authorities.....	36
3.1.4	Standardisation bodies	37
3.1.5	General public & Civil society.....	38
3.1.6	EOSC community and stakeholders	38
3.2	Adoption and Innovation Pathways Progress	39



3.2.1	Green competences and skills definition for RI Environmental sustainability and energy efficiency (UvA).....	40
3.2.2	Set of training courses on environmental sustainability and energy efficiency for RIs (UvA, UTH, ALL).....	40
4	Impact Assessment for Period 1	42
4.1	GreenDIGIT Objective KPIs.....	42
4.1.1	GreenDIGIT events participants.....	42
4.1.2	Open training materials	43
4.1.3	Framework and instructional methodology for Research Infrastructures.....	44
4.1.4	Framework and instructional methodology for Research Infrastructures.....	44
4.2	KPIs for dissemination and communication	45
4.2.1	Website analytics	46
4.2.2	X followers' deviation	47
	Part II: Dissemination and Exploitation Plan – Period 2 (M19–M36).....	48
5	Updated Strategy and Key Exploitable Results (KERs)	49
5.1	Strategy Overview for Period 2.....	49
5.2	Key Exploitable Results (KERs)	50
5.2.1	KER1: State of the Art (SotA) and Technology Recommendations	51
5.2.2	KER2: Architecture Framework for Digital RI Sustainability by Design	52
5.2.3	KER3: Research Infrastructure Lifecycle Model (RILM).....	52
5.2.4	KER4: User Tools for Lowering the Environmental Impact	53
5.2.5	KER5: Environmental Impact Architecture and RI Prototypes	55
5.2.6	KER6: Environmental Impact Assessment Methodology and Self-Assessment Toolkit	57
5.2.7	KER7: Training Modules and Competence Framework.....	59
5.3	Intellectual Property Rights (IPR) Management Strategy	61
6	Conclusion	62

List of figures

Figure 1. Indicative screenshots of the GreenDIGIT website.....	19
Figure 2. Events page.....	20
Figure 3. News blog page.....	20
Figure 4. Newsletter page.....	21
Figure 5. Example LinkedIn posts.....	22
Figure 6. Example X posts.	23
Figure 7. GreenDIGIT booth at EGI 2025.	24
Figure 8. GreenDIGIT general flyer at EGI 2025.....	25



Figure 9. GreenDIGIT metrics flyer at EGI 2025.	25
Figure 10. GreenDIGIT public session at EGI 2025.....	27
Figure 11. GreenDIGIT poster at EGI 2025.....	28
Figure 12. GreenDIGIT poster at EGI 2024.....	29
Figure 13. Website Visitors.	46
Figure 14. List of Publications.	64
Figure 15. List of Dissemination Activities.	65
Figure 16. List of Communication Activities.	68

List of tables

Table 1.List of Publications	16
Table 2.Innovation Pathways progress first reporting period	39
Table 3.GreenDIGIT event participants analysis	43
Table 4.KPIs for dissemination and communication.....	45
Table 5. List of Key Exploitable Results (KERs)	50
Table 6.List of dissemination logs	63
Table 7. Dissemination Activities Hyperlinks.	66
Table 8. Communication Activities Hyperlinks.	69



List of Abbreviations

Abbreviation	Description
ARL	Adoption Readiness Level
DIRAC	Distributed Infrastructure with Remote Agent Control
DoA	Description of Action
CI	Carbon Intensity
CPU	Central Processing Unit
CSRD	Corporate Sustainability Reporting Directive
DB	Database
FAIR	Findable, Accessible, Interoperable, Reusable
FDMI	Flexible Data Management Infrastructure
e-IRG	e-Infrastructure Reflection Group
EC	European Commission
EED	Energy Efficiency Directive
EOSC	European Open Science Cloud
ESFRI	European Strategy Forum on Research Infrastructures
EU DC CoC	The European Code of Conduct for Data Centres
GA	Grant Agreement
GESA	Green and Environmental Sustainability Awareness
GPU	Graphics Processing Unit
GRI	Global Reporting Initiative
HRP	Horizon Results Platform
HTP	High-Throughput Computing
ISO	International Organization for Standardization
IPR	Intellectual Property Rights
ITU	International Telecommunication Union
JCR	Joint Research Centre
JSON	JavaScript Object Notation
KER	Key Exploitable Results
KPI	Key Performance Indicator
LCA	Lifecycle Analysis
LU	Learning Units
MEB	Management and Executive Briefings
PUE	Power Usage Effectiveness
RI	Research Infrastructure
RILM	Research Infrastructure Lifecycle Model
RIOS	Research Infrastructure Operations and Services
SCI	Software Carbon Intensity
SDG	UN Sustainable Development Goals
SDO	Standards Development Organization
SRIA	Strategic Research and Innovation Agenda



SSES	Software and System Engineering for Sustainability
TTFE	Time to First Experiment
VRE	Virtual Research Environment
WP	Work Package



1 Introduction

1.1 Purpose of the Deliverable

This deliverable (D10.3) intends to document and evaluate the dissemination and exploitation activities performed during the first period (M1-M18) of GreenDIGIT project. Therefore, an analytic description for the followed approach, as well as the specific actions conducted, are contained in the current document. Moreover, the strategic plan for dissemination and exploitation activities for the second period (M19–M36) is described as well. The current deliverable aims to ensure and increase awareness, visibility and engagement regarding the innovations of GreenDIGIT and results in alignment with the project's broader mission, to reduce the environmental footprint of Digital Research Infrastructures (RIs). Finally, this deliverable constitutes a collective effort of the entire consortium to ensure alignment of the strategic goals set in the Grant Agreement (GA) and Description of Action (DoA).

1.2 Structure of the Deliverable

The deliverable can be distinctively separated in two parts.

Part I - Dissemination and Exploitation Activities – Period 1 (M1–M18): This part focuses on the dissemination and exploitation activities executed during the first period of GreenDIGIT. This includes scientific publications, events, policy contributions, stakeholder engagement, and technological development progress. Moreover, the impact assessment is examined as well, through the comparison of KPIs (Target / Achieved) and identified gaps.

Part II: Dissemination and Exploitation Plan – Period 2 (M19-M36): Following Part I, the second part of the deliverable outlines the strategy and actions planned from the consortium, and regarding the dissemination and exploitation activities. This includes the updated partner roles, individual plans for each of them, and updated strategy for second period of GreenDIGIT, which are expressed in several different Key Exploitable Results (KERs).

Annexes: These parts provide supplementary material, such as dissemination logs, examples and templates.

1.3 Methodologies and Sources

Several methodologies, actions and sources were developed and utilised, to monitor and achieve initial dissemination and exploitation goals of GreenDIGIT. Indicatively, the data and analysis provided in this document are based on:

- Continuous internal partner reporting.
- Shared dissemination logs and files (e.g., shared Excel files and the online channels of GreenDIGIT).
- Project events and stakeholder meetings.
- Inputs from several WPs (like WP8, WP10).



- KPIs and metrics defined in the DoA and the Grant Agreement, assessed using both qualitative and quantitative indicators.

This deliverable describes the methodologies proposed in the initial GreenDIGIT proposal and implemented during the first period of the project, including continuous monitoring, targeted stakeholder mapping, and iterative improvement cycles.

1.4 Overview of Dissemination and Exploitation Strategy

This sub-section contains a short description of the characteristics, as well as of the objectives for the dissemination and exploitation of GreenDIGIT. Aligning with the overarching goal of GreenDIGIT, the dissemination and exploitation strategies target to effectively promote the architectural approach, the tools and the services that are being developed for reducing the environmental footprint of digital RIs.

1.4.1 Objectives and principles

More specifically, the dissemination and exploitation activities of GreenDIGIT aim to:

- Maximise the visibility and outreach of project outputs by communicating the results and goals of GreenDIGIT to a broad audience.
- Engage a wide range of stakeholder categories.
- Foster early adoption of low-energy digital solutions.
- Facilitate alignment with European sustainability policies and Open science principles.

Moreover, dissemination is guided by openness and scientific integrity, which is holistically promoted throughout all WPs. Exploitation emphasises more on the sustainable and practical uptake of technologies and methodologies across European RIs.

1.4.2 Target audiences and stakeholder groups

As a result of the scope and objectives of GreenDIGIT, the key audiences include, but are not limited to:

- Scientific research communities.
- RI operators.
- Policymakers and regulatory bodies.
- Technology developers and standardisation bodies.
- Civil society and the general public.
- European Open Science Cloud (EOSC)-related stakeholders and initiatives.

1.4.3 Key Performance Indicators (KPIs)

To effectively observe the progress of dissemination and exploitation, several Key Performance Indicators (KPIs) are being monitored throughout the execution of GreenDIGIT. Specifically, these KPIs have been proposed in DoA and can be categorised in summary in:



- Scientific output (number of publications and conference participation).
- Digital presence (website and social media analytics).
- Engagement metrics (of events, surveys, webinars).
- Stakeholder feedback and policy contributions.
- Policy and standards contributions.

The complete set of dissemination and exploitation KPIs, is used to monitor both the quantitative reach and qualitative impact efforts across the project's lifespan. Analytical description of the progress undertaken is given at Chapters 3 and 4.



Part I: Dissemination and Exploitation Activities – Period 1 (M1–M18)



2 Dissemination Activities Performed

This chapter provides a comprehensive overview for the major dissemination activities carried out by the GreenDIGIT consortium during the first reporting period, as well as the digital and physical means utilised to achieve that. These activities were essential and played a significant role to increase the visibility of GreenDIGIT, share its progress and results with relevant stakeholders and ensure alignment with the KPIs defined in the DoA.

In summary, the dissemination efforts included scientific publications in peer-reviewed venues, sustained online visibility through the project website and social media channels, as well as targeted participation and organisation of events (booth, posters, open sessions) in conferences.

2.1 Scientific Publications (Conferences, Journals, Workshops)

Scientific dissemination is a core element of the GreenDIGIT strategy to engage with academic / research communities, as well as other stakeholders. More specifically, this may include publications in peer-reviewed (conferences, journals, workshops, posters, presentations etc.), and other various dissemination and communication activities. These outputs play a significant role in showcasing and highlighting project's results, methodologies and innovations. Additionally, this also supports and boosts the collaboration between the involved consortium members and RIs.

To ensure effective monitoring and reporting, GreenDIGIT has implemented from M1, a centralised and continuously updated tracking system via a shared dissemination Excel file (see excel analytical information at Appendix A). This Excel file includes 3 different sheets for publications, dissemination and communication activities.

There is an imperative need to keep this Excel document continuously updated as it ensures transparency and consistency across partners. Moreover, it can be used to facilitate periodic KPI assessments and compared to those KPIs set in the DoA. Through this, the reporting obligations toward the European Commission are being supported, as part of the periodic technical reports. Finally, it can help to identify gaps or underrepresented areas if any, enabling corrective action during the project lifecycle.

Each entry in the dissemination logs includes some useful metadata such as the type of output, author(s), affiliated institution, event/publication details, date, DOI or link, and any relevant comments about the impact or audience etc. More specifically, this is separated in two types of information (red - blue columns), where red are the mandatory information also required for the periodic European Commission (EC) reporting, while blue is complementary to that, and helps in the overall understanding of the specific action conducted.

Project partners are constantly encouraged and reminded to update the log in real time as publications / actions are submitted-accepted or take place accordingly. UTH, as WP10/11 leader, periodically reviews the entries to ensure completeness and accuracy ahead of reporting checkpoints. By maintaining a well-documented and up-to-date record of scientific outputs, the GreenDIGIT consortium ensures that research is visible, impactful, and aligned with KPIs, while maximising its contribution to the broader academic discourse on sustainable and energy-efficient digital infrastructures.



This table below contains the simplified form of publications list from M1 – M18. For brevity's sake the following abbreviations are used:

- Conference Publication proceeding/workshop (CPPW)
- Article in Journal (AIJ)
- Other (O.)

Table 1 List of Publications

No	Publication Title	Type	Authors
1	Poster “GreenDIGIT: Project and Initiative to Lower Environmental Impact of Digital Infrastructures” (link)	CPPW	EGI
2	RO-Crate for Testbeds: Automated Packaging of Experimental Results (link)	CPPW	Eric Hauser, Sebastian Gallenmüller, Georg Carle
3	Poster: „SLICES-DE: A Digital Research Infrastructure for Germany and Europe“ (link)	CPPW	Christoph Wen, Eric Hauser, Sebastian Gallenmüller, Georg Carle
4	Poster: „Sustainable Digital Research Infrastructures“ (link)	CPPW	Kilian Holzinger, Johannes Späth, Sebastian Gallenmüller, Georg Carle
5	Presentation and Abstracts “Defining Artificial Intelligence Competences and Knowledge Based on the Job Market Analysis” (link)	CPPW	UvA
6	IEEE GreenCom-2024 Conf on Green Computing and Communication (link)	CPPW	UvA
7	Poster: Post-Quantum Secure In-Flight Communication over 6G Networks	CPPW	Daniel Petri, Kilian Holzinger, Henning Stubbe, Sebastian Gallenmüller, Georg Carle
8	The Importance of System Engineering Competences and Knowledge in Large Scale Digital Research Infrastructure Projects (link)	CPPW	Yuri Demchenko
9	Energy-Efficient Deployment of Stateful FaaS Vertical Applications on Edge Data Networks (link)	CPPW	Claudio Cicconetti, Raffaele Bruno, Andrea Passarella
10	AndroWatts: Unpacking the Power Consumption of Mobile Device's Components (link)	CPPW	Édouard Guégain, Rémy Raes, Noé Chachignot, Clément Quinton, Romain Rouvoy



11	Poster : AndroWatts: Unpacking the Power Consumption of Mobile Device's Components	O.	Édouard Guégain, Rémy Raes, Noé Chachignot, Clément Quinton, Romain Rouvoy
12	Presentation Greener Future Digital Research Infrastructures (link)	CPPW	Raffaele Bolla
13	SLICES Security (link)	CPPW	Sebastian Gallenmüller, Kilian Holzinger, Daniel Petri, Georg Carle
14	Dynamic Resource Allocation and Energy Optimization in 5G O-RAN: Real-World Insights and Testbed Evaluations	CPPW	Caterina Leonelli, Dimitris Kefalas, Serge Fdida, Paolo Bellavista, Thanasis Korakis
15	Aging-aware CPU Core Management for Embodied Carbon Amortization in Cloud LLM Inference (link)	CPPW	Tharindu B. Hewage, Shashikant Ilager, Maria Rodriguez Read, and Rajkumar Buyya
16	Generic and ML Workloads in an HPC Data centre (link)	O.	Xiaoyu Chu, Daniel Hofstätter, Shashikant Ilager, Sacheendra Talluri, Duncan Kampert, Damian Podareanu, Dmitry Duplyakin, Ivona Brandic, Alexandru Iosup
17	A Data-driven Analysis of a Cloud Data Centre: Statistical Characterization of Workload, Energy and Temperature (link)	O.	Shashikant Ilager, Adel N. Toosi, Mayank Raj Jha, Ivona Brandic, Rajkumar Buyya
18	Scalability and Performance Evaluation of IEEE 802.11ah IoT Deployments: A Testbed Approach (link)	CPPW	Kostas Chounos, Katerina Kyriakou, Thanasis Korakis
19	Continuous Integration for Networks Supporting Low-Latency Using Hybrid Network Emulation (link)	CPPW	Florian Wiedner, Dominik Kreutzer, Jonas Andre, Georg Carle
20	TEE Time at P4—Performance Analysis of Trusted Execution Environments for Packet Processing (link)	CPPW	Manuel Simon, Sebastian Warter, Sebastian Gallenmüller, Georg Carle
21	A methodology for reproducible and portable experiment workflows (link)	AIJ	Henning Stubbe, Sebastian Gallenmüller, Georg Carle
22	Dynamic Data Planes Updates using Lua and libmoon (link)	CPPW	Manuel Simon, Sebastian Gallenmüller, Georg Carle



23	im2HW: Modelling Latency Offset Between Network Simulations and Hardware Measurements (link)	CPPW	Johannes Späth, Max Helm, Benedikt Jaeger, Georg Carle
24	n-the-fly Table Insertions on Programmable Software Data Planes (link)	CPPW	Manuel Simon, Sebastian Gallenmüller, Georg Carle
25	Applicability of Hardware-Supported Containers in Low-Latency Networking (link)	CPPW	Alexander Daichendt, Florian Wiedner, Jonas Andre, Georg Carle
26	Honey for the Ice Bear - Dynamic eBPF in P4 (link)	CPPW	Manuel Simon, Henning Stubbe, Sebastian Gallenmüller, Georg Carle
27	Automated Debugging Mechanisms for Orchestrated Cloud Infrastructures with Active Control and Global Evaluation (link)	AIJ	J. Kovács, B. Ligetfalvi and R. Lovas
28	Forward Error Correction and Weighted Hierarchical Fair Multiplexing for HTTP/3 over QUIC (link)	CPPW	Kilian Holzinger, Daniel Petri, Stefan Lachnit, Marcel Kempf, Henning Stubbe, Sebastian Gallenmüller, Stephan Günther, Georg Carle
29	BrowsEm: Model-based Web Site Loading Emulation (link)	CPPW	Kilian Holzinger, Florian Klein, Daniel Petri, Stefan Lachnit, Sebastian Gallenmüller, Georg Carle

Appendix A contains the complete information for the list of *publications, dissemination and communication* activities recorded for the M1–M18 period from the consortium of GreenDIGIT. Furthermore, Chapters 4.1 and 4.2 describe some objective related KPIs and some targeted KPIs for project dissemination and exploitation activity accordingly. There, a comparison is performed with the target and the number achieved / progress at this stage (M18).

2.2 Online Visibility (Website, Social Media, Blogs)

Nowadays, online presence is deemed necessary to widespread effectively the produced results and actions during the project’s execution. Online visibility is a cornerstone dissemination strategy of GreenDIGIT, by providing the project’s progress, access outputs in the stakeholders, and by engaging with the community. This sub-section includes digital presence overview of GreenDIGIT during the first reporting period.



2.2.1 Website

From M2, the official website of GreenDIGIT¹ has been developed and was operational, in order to provide updates, provide ways for communication, and holistically raise the awareness for performed activities in GreenDIGIT. The website acts as a main communication channel by incorporating:

- Clear overview of objectives and structure for GreenDIGIT.
- Regular updates on news and events.
- Access to public deliverables.
- Newsletters.
- Information for involved partners and RIs.
- Contact forms.

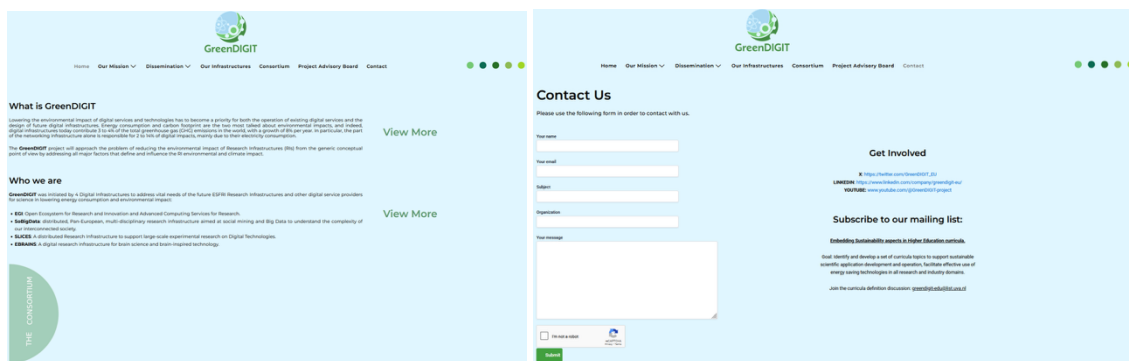


Figure 1. Indicative screenshots of the GreenDIGIT website.

Except from “static” pages (consortium description, RIs description etc.), large emphasis has been also given on the website, to provide valuable constantly updated information. More specifically, there are several pages described below, that continuously provide updates to the public and summarise the project’s progress at each stage.

¹ <https://www.green-digit-project.eu>



2.2.1.1 Events



Figure 2. Events page.

Initially, the Events page on the GreenDIGIT website serves as a dynamic log of the project's participation in and organisation of key scientific, technical, and policy-related events. More specifically, the goal of this page is to highlight the consortium's presence at international conferences, workshops, stakeholder forums, and internal dissemination webinars. Typically, each entry contains event title, date, location, contribution type of GreenDIGIT and a short description. In such a way, the general public and stakeholders can track outreach and engagement efforts in real time.



2.2.1.2 News Blog

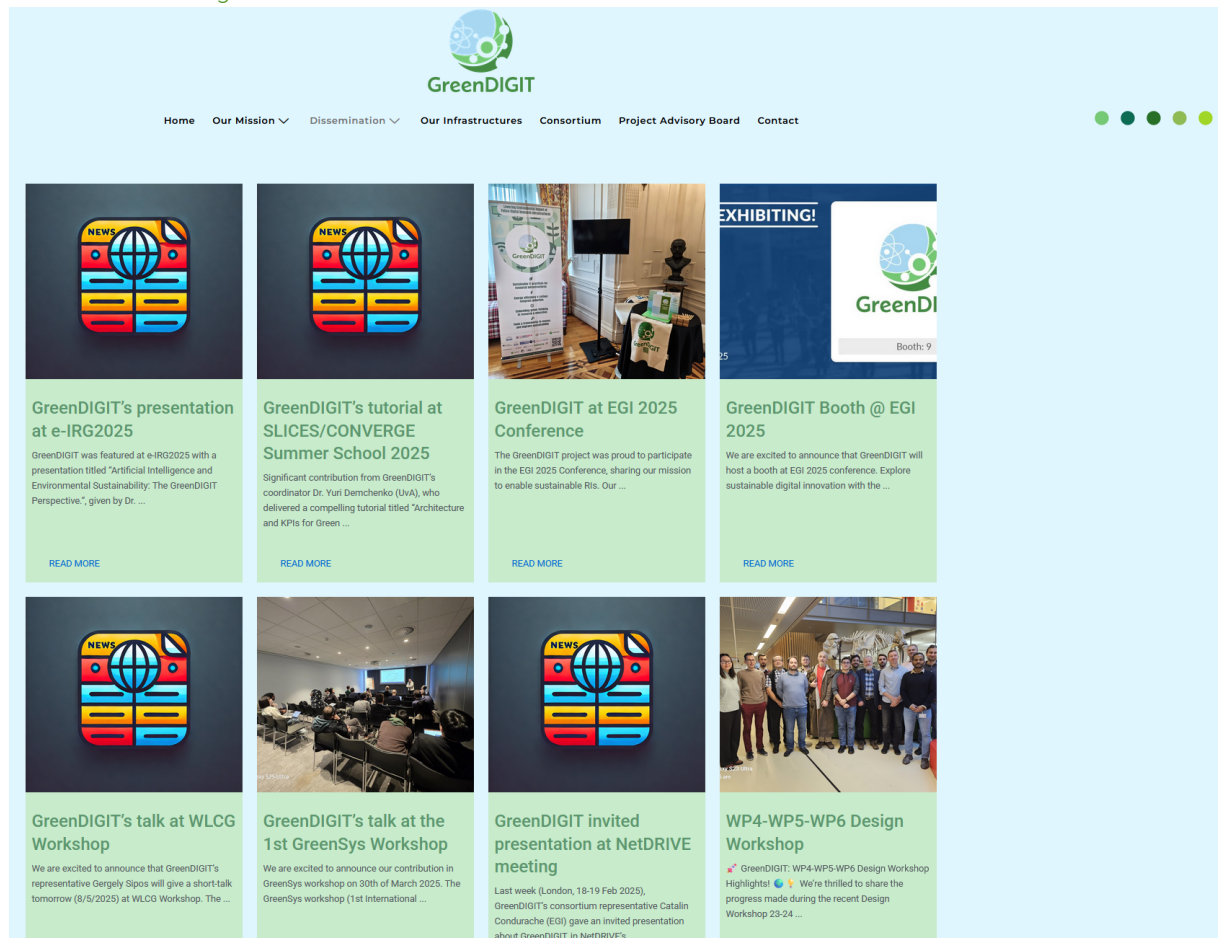


Figure 3. News blog page.

Furthermore, the News Blog page is an editorial section of the website dedicated to share stories, updates, innovations and reflections related to the project. Typical posts include insights from Work Package (WP) leaders, summaries of technical achievements, and thought leadership articles on sustainability in digital RIs. An accessible and engaging tone has been followed in those posts, aimed at both technical and non-technical audiences. New entries are continuously published on the website and are cross shared on social media to drive visibility.



2.2.1.3 Newsletter



Figure 4. Newsletter page.

Finally, this page contains bi-annual issues of the GreenDIGIT newsletter, which aim to inform website visitors (general public, researchers and stakeholders). These newsletters are publicly available online and each edition contains major milestones achieved, featured blogs or deliverables, partner highlights, and upcoming activities. This is an important activity as the newsletters coherently provide updates and aim to keep the wider research and policy community informed about the project's impact and encourage ongoing engagement.

2.2.2 Social Media

Social media also plays a pivotal role in the followed dissemination strategy and operates in conjunction with the website of GreenDIGIT. Through their systematic use, the reach of GreenDIGIT actions to scientific, policy, and industry audiences has been extended effectively during the first reporting period. In addition to those audiences, of course the broader public has been engaged efficiently as well. During the first reporting period, GreenDIGIT maintained a strong and consistent presence primarily through LinkedIn, followed by X (formerly Twitter), and supported by a YouTube channel for multimedia content.

2.2.2.1 LinkedIn

The GreenDIGIT LinkedIn page has been the most actively used and strategically prioritised social media platform. Mostly based on its professional user base and relevance to research, digital infrastructure, and policy communities, LinkedIn provided an ideal environment to share:



- Updates and milestones.
- Event announcements and recaps.
- Published blog entries.
- Partner achievements and spotlights.

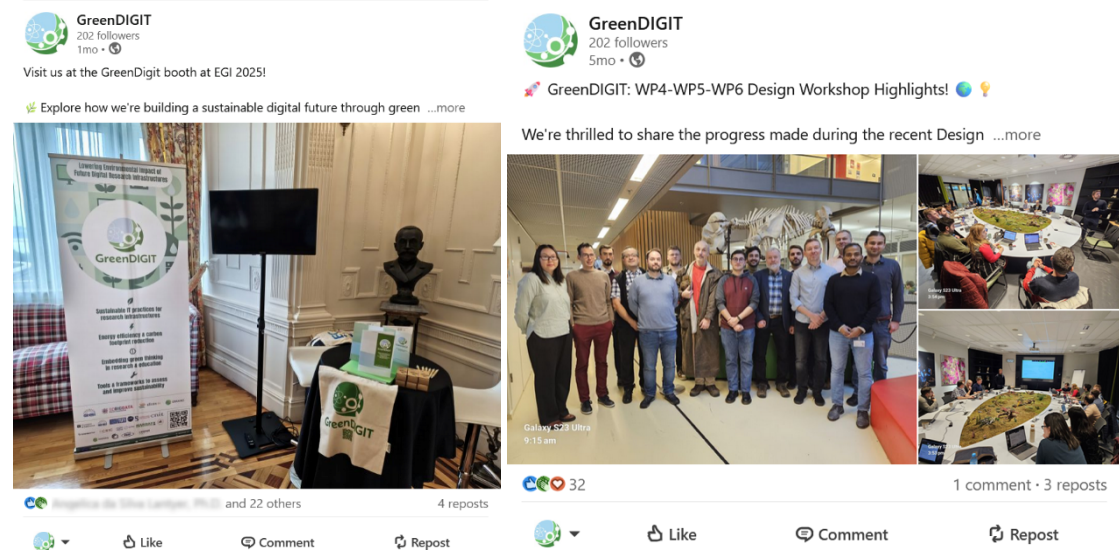


Figure 5. Example LinkedIn posts.

During M1–M18, the LinkedIn channel achieved, steady growth in followers (Chapter 4.2) with high engagement rates. Cross-promotion of content published on the website (news blog, events, newsletters, deliverables). Finally, this platform also supports and boosts the creation of professional conversations around sustainability in digital RIs, building networks and fostering collaboration opportunities with stakeholders from academia, industry, and public authorities.

2.2.2.2 X (former Twitter)

In addition to LinkedIn, GreenDIGIT also maintains an official X account to provide mostly coverage of events enabling real-time visibility. Of course, this channel is also used to inform the broader public about upcoming events and actions, following the “short updates” and simplistic style of this platform.

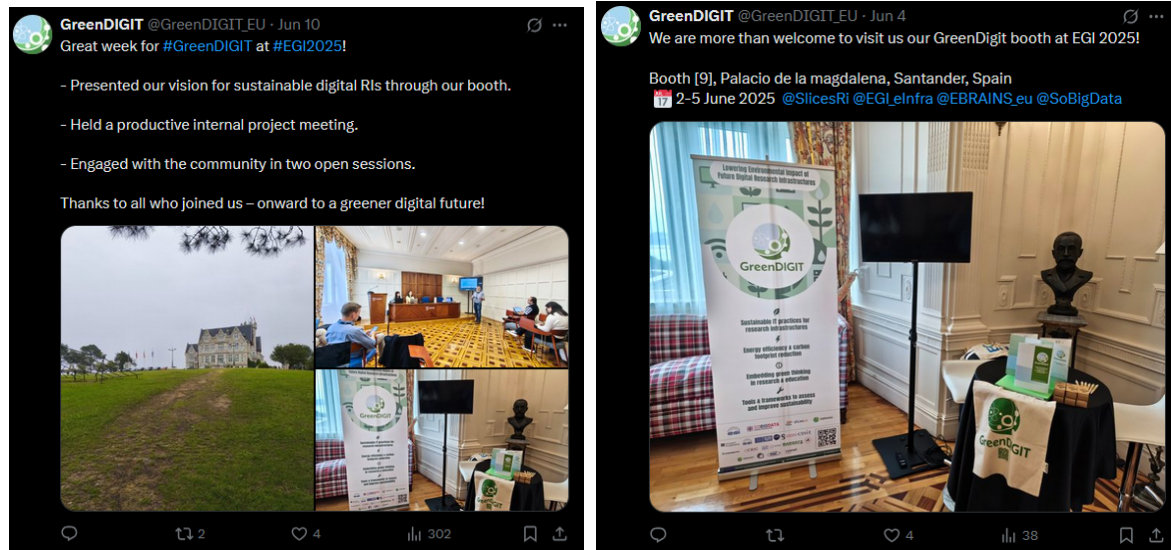


Figure 6. Example X posts.

2.2.2.3 YouTube

Finally, to complement written content, a GreenDIGIT YouTube channel is also active, maintained and accessible to broader public. This channel intends to host recorded webinars, presentations, open sessions, tutorials. At the first period of reporting (M1 – M18), this channel has been primarily used to cover videos of presentations given at open sessions correlated to GreenDIGIT. This will be extended to the dissemination of short educational videos / tutorials about the project’s mission and objectives.

2.3 Events Participation

Active participation and organisation of events is also a key objective of the followed dissemination strategy. At events, significant opportunities for visibility, stakeholder engagement, and cross-project collaboration are provided. During M1 – M18, GreenDIGIT consortium members contributed to a wide range of important international, European, and national-level events—including conferences, policy forums, workshops, technical expos, and community webinars. This helped GreenDIGIT significantly to showcase results, build partnerships, and align with ongoing initiatives in the domains of sustainability, digital infrastructures, and Open Science. This section provides an overview of the events attended, highlighting the nature of each contribution and their relevance to GreenDIGIT.

2.3.1 EGI 2025

GreenDIGIT had a strong presence at the EGI 2025 Conference², one of the most relevant European events focused on advanced computing, digital RIs, and research on digital services. The conference provided a significant opportunity for GreenDIGIT to engage directly with stakeholders from research communities, infrastructure providers, policy makers working across the European Open Science Cloud (EOSC) and researchers. The several GreenDIGIT contributions are described in the sub-sections below.

² <https://www.egi.eu/event/egi2025/>



2.3.1.1 Booth Presence

UTH, UvA and EGI coordinated the preparation, setup and operation of the GreenDIGIT booth located at the main exhibition hall of the conference venue.

Booth expected goals

The main objectives of the booth were to:

- Raise visibility of the GreenDIGIT project among key present stakeholders.
- Communicate the project's goals in reducing the environmental footprint of digital RIs.
- Present early technical outcomes and the progress status.
- Share physical scientific material (flyers, white papers etc.).
- Distribute promotional materials.
- Direct visitors to online resources (e.g., website, blogs, newsletter subscription).
- Network with other projects and initiate future collaboration opportunities.



Figure 7. GreenDIGIT booth at EGI 2025.

Booth description



The booth featured different physical and digital means of dissemination and exploitation. More specifically, the roll-up banner alongside with printed flyers and the first produced white paper of GreenDIGIT, summarised the project goals, progress and vision. In addition to that, the live demo screen in combination with presentation laptops, contributed to a better understanding of the project's objectives by visitors. The booth was hosted by UTH and UvA representatives throughout the conference's duration, and the booth facilitated meaningful dialogue with visitors. More specifically, the physical branding material included:

- Tote bags
- USB-Flash drives
- Pens

Additionally, several flyers (brochures) were shared at the booth containing either general project information (scope, objectives etc.), or more specific metrics and architecture.

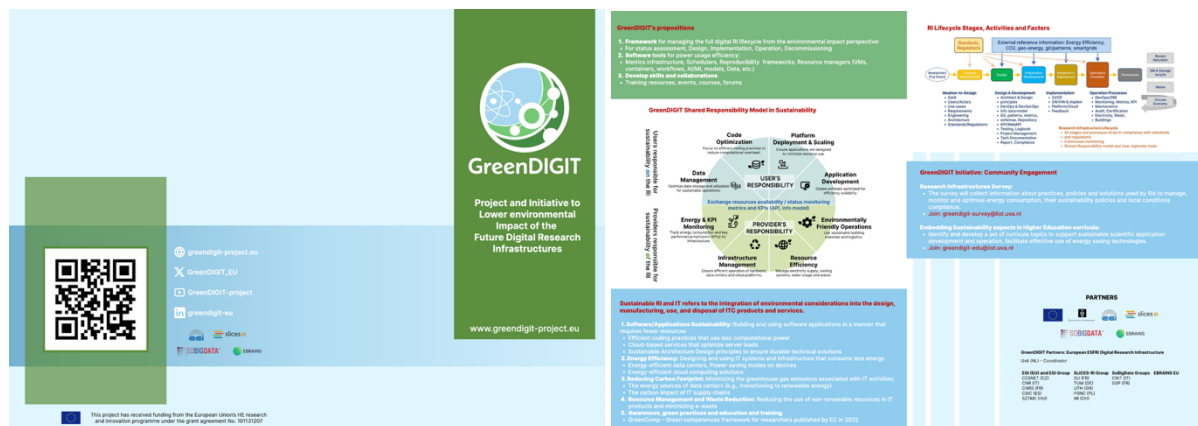


Figure 8. GreenDIGIT general flyer at EGI 2025.

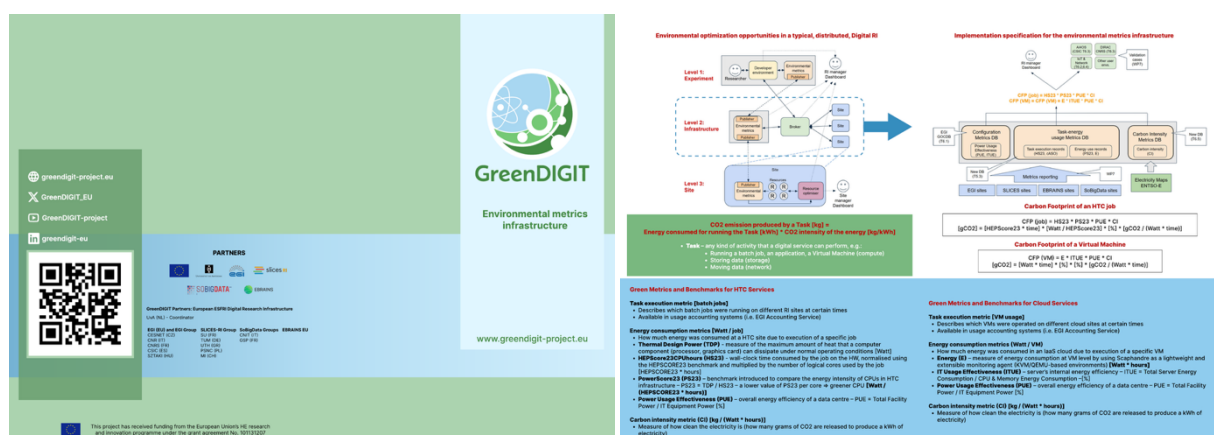


Figure 9. GreenDIGIT metrics flyer at EGI 2025.



Finally, a white paper³ “*Digital Research Infrastructure Lifecycle Model*” was shared with the visitors and gained significant attention.

Outcomes

The presence at EGI 2025 was highly effective in initiating early outreach, and creating interest in the tools and methodologies which are being developed in GreenDIGIT. The most notable outcomes can be summarised as follows:

- Direct engagement with over 100 conference attendees (project managers, infrastructure operators, EOSC aligned project members etc.).
- Positive feedback on sustainability-oriented objectives and progress of GreenDIGIT.
- Positive feedback on the reference architecture proposed by GreenDIGIT, landscape analysis, RI Lifecycle Model and other actions that have been performed during M1 – M15.
- Significant visibility and awareness increment and regarding to the objectives / status of GreenDIGIT.

2.3.1.2 Afternoon Open Session

Besides the booth described in the previous sub-section, the GreenDIGIT consortium, mostly with UvA and EGI coordination, organised a dedicated public workshop (“*Lowering the environmental impact of computing*”), as part of the conference program. This session aimed to provide deeper information into objectives and technical progress of GreenDIGIT to the visitors. It contained:

Public presentations

- Gergely Sipos and Yuri Demchenko: “Solutions from the GreenDIGIT project to lower the environmental impact of digital Research Infrastructures.”
- Sandro Fiore: “A reanalysis approach for carbon intensity data.”
- David Britton/Caterina Doglioni: “Greening WLCG - Activities and experiences from the accelerator physics community.”

Public tutorials:

- Yuri Demchenko: “General Regulations for Green Computing.”
- Shashikant Illager: “User Tools for the lowering of environmental impact of software applications.”

³ <https://zenodo.org/records/15741197>



Figure 10. GreenDIGIT public session at EGI 2025.

By combining booth visibility with targeted, value-driven content delivery through the public afternoon session and tutorials, GreenDIGIT maximised its impact at EGI 2025. These efforts supported both dissemination and exploitation goals, while helping build momentum for wider community engagement in Period 2. Finally, this type of events is a good opportunity to physically gather all the consortium members periodically. For this reason, except from the booth, and the open session, GreenDIGIT also organised an internal consortium meeting, for each partner (Task leaders) to present updates and plans on the execution of GreenDIGIT.

2.3.1.3 *Poster*

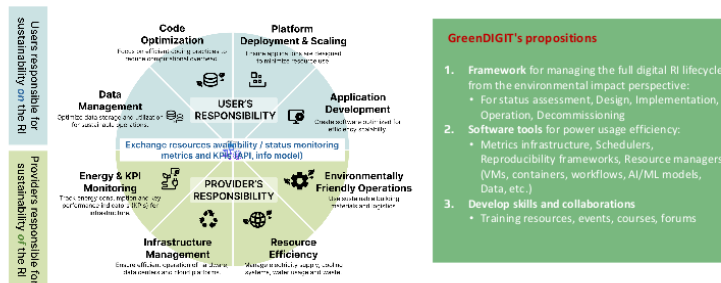
Except from booth presence and internal / public sessions, a poster has been also created hosted by EGI's exhibition. Similarly with the booth and the open session, very positive and meaningful feedback has been collected from the visitors.



GreenDIGIT: Project and initiative to lower the environmental impact of digital Research Infrastructures

GreenDIGIT Consortium (GreenDIGIT Grant number 101131207)

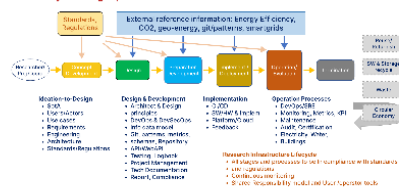
GreenDIGIT Shared Responsibility Model in Sustainability



Sustainable RI and IT refers to the integration of environmental considerations into the design, manufacturing, use, and disposal of ITC products and services.

- Software/Applications Sustainability:** Building and using software applications in a manner that requires fewer resources
 - Efficient coding practices that use less computational power.
 - Cloud-based services that optimize server loads.
 - Sustainable Architecture Design principles to ensure durable technical solutions
- Energy Efficiency:** Designing and using IT systems and infrastructure that consume less energy
 - Energy-efficient data centers, Power-saving modes on devices.
 - Energy-efficient cloud computing solutions.
- Reducing Carbon Footprint:** Minimizing the greenhouse gas emissions associated with IT activities:
 - The energy sources of data centers (e.g., transitioning to renewable energy).
 - The carbon impact of IT supply chains.
- Resource Management and Waste Reduction:** Reducing the use of non-renewable resources in IT products and minimizing e-waste
- Awareness, green practices and education and training**
 - GreenComp – Green competences framework for researchers published by EC in 2022

RI Lifecycle Stages, Activities and Factors



GreenDIGIT Partners: European ESFRI Digital Research Infrastructure

UvA (NL) - Coordinator

EGi infrastructure: EGI Foundation (NL), CESNET (CZ), CNRS (FR), CSK (ES), SZTAKI (HU)

SUCES-RI: SU (FR), UvA (NL), TUM (DE), UTH (GR), PSNC (PL), MI (CH)

SoBigData: CNIT (IT), CNR (IT), GSP (FR)

EBRAINS: EBRAINS AISBL (BE)

Project coordinator: y.demchenko@uva.nl (Yuri)

Project technical coordinator: gergely.sipos@egi.eu (Gergely Sipos)

Figure 11. GreenDIGIT poster at EGI 2025.

2.3.2 EGI 2024

GreenDIGIT had also a strong presence at last year's EGI 2024 conference. More specifically, an open session called *"Green Computing: Towards Greener Digital Services"*. Presentations were given that received a lot of interesting comments / questions from the session's participants.

Public presentations

- Yuri Demchenko: "GreenDIGIT: Project and Initiative to Lower Environmental Impact of Future Digital Research Infrastructures."
- Gergely Sipos: "Landscape analysis of research infrastructure practices and needs for green computing - GreenDIGIT survey findings."



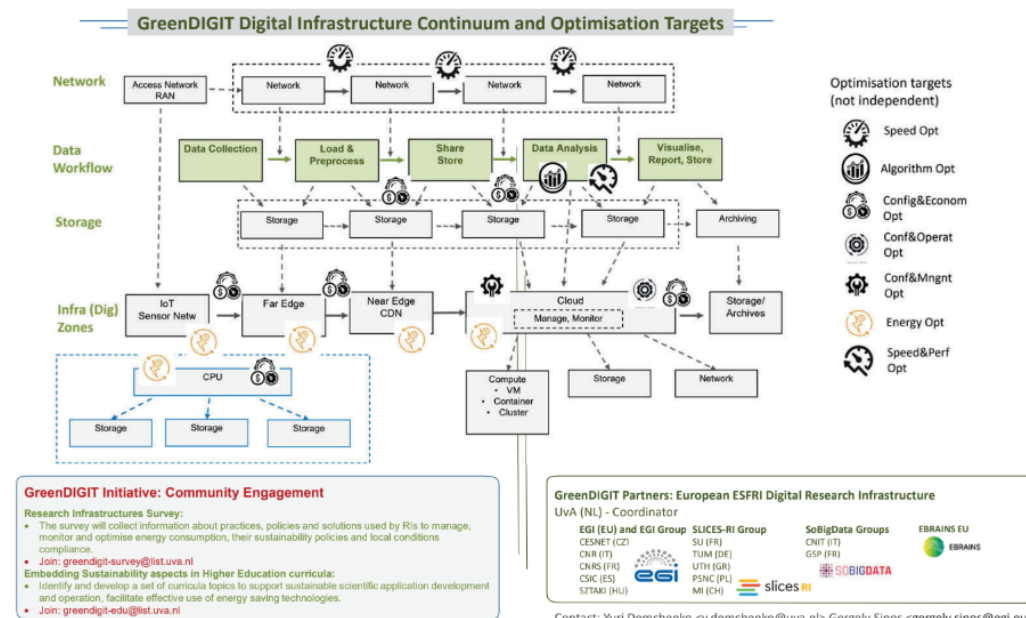
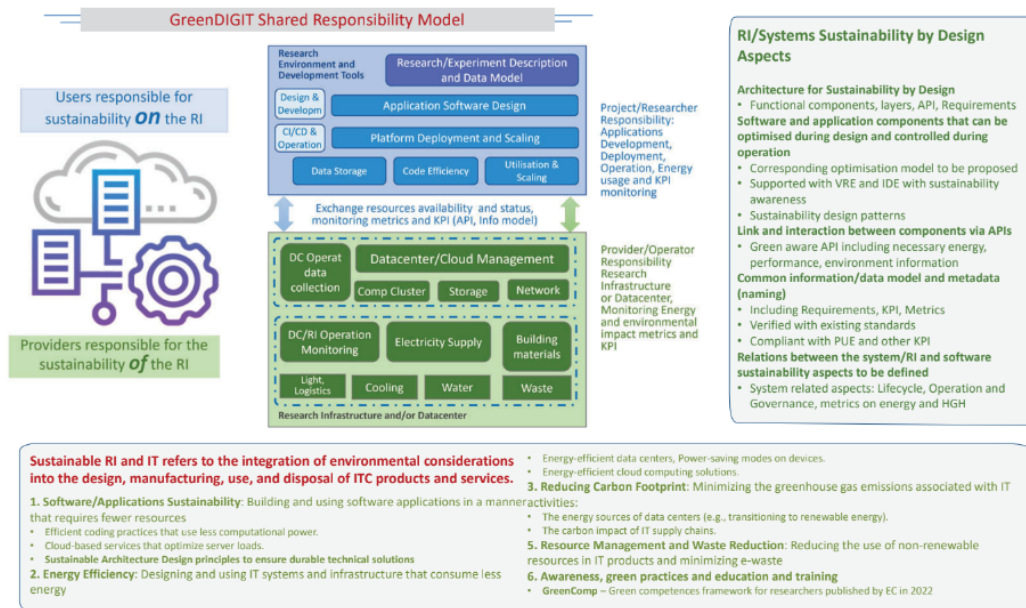
- Roberta Piscitelli: “How to Use AWS Cloud in the Green Economy Era for Research.”
- Jozsef Kovacs: “Energy-optimisation techniques for complex workloads from the Swarmchestrade project.” (remote talk)
- Alvaro Lopez Garcia: “AI4EOSC AI/ML platform power consumption and environmental impact evaluation - problems encountered, lessons learned.”

Furthermore, there was a contribution from GreenDIGIT to the poster session of EGI 2024. The designed poster is depicted below.



GreenDIGIT: Project and Initiative to Lower environmental Impact of the Future Digital Research Infrastructures

GreenDIGIT Consortium (GreenDIGIT Grant number 101131207)



UvA UNIVERSITEIT VAN AMSTERDAM



SOBIGDATA



Figure 12. GreenDIGIT poster at EGI 2024.



2.3.3 Dagstuhl Seminar 24462

In November 10 to 13 of 2024, the Dagstuhl Seminar 24462 on "Research Infrastructures and Tools for Collaborative Networked Systems Research" was held. It was co-organised by Georg Carle and Serge Fdida, two PIs of GreenDIGIT, and brought together experts, scientists, and funding agency representatives from the network and distributed systems testbed community. The seminar's core objective was to bridge the gap between the services offered by large-scale testbed infrastructures and the needs of researchers conducting cutting-edge experiments.

The discussions aimed to enhance the value and impact of research infrastructures by fostering collaboration, streamlining experiment workflows, and developing tools that are not specific to a particular testbed. The ultimate goal is to make experimental research more modular, adaptable, and reproducible, ensuring that experiments and evaluation software can be easily modified, extended, and ported across different testbed environments. Key topics explored included strategies to improve research quality, reproducibility, and reusability, enhance discovery, and optimise the efficient use of research infrastructure resources.

The seminar concluded that large-scale research infrastructures are essential for providing scientists with access to specialised, advanced resources for cutting-edge experiments. Research infrastructures require vital, long-term investment, active participation from research communities, sustained human capital development, and financial sustainability. Open access to shared physical infrastructure and open research data are equally critical. Digital sharing of scientific results accelerates innovation, enhances reproducibility, and strengthens FAIR (Findable, Accessible, Interoperable, and Reusable) data sharing through meta-services. Research infrastructures complement and amplify each other, creating a synergistic network effect that fosters a more rigorous scientific approach, driving greater collaboration and knowledge advancement.

The final seminar report¹ emphasises several key recommendations. It is important to define clear scientific objectives and research questions for infrastructures, while fostering strong scientific community engagement and recognising the effort of support teams. Implementing "EasyFAIR" principles for automated support is vital to ensure that digital assets are Findable, Accessible, Interoperable, and Reusable. Funding agencies should mandate open research data and reproducibility, and scientists who share data should be rewarded. Reproducibility can be enhanced by establishing concrete methodologies for comparing experimental results across different infrastructures. A multi-year investment strategy is needed for the sustained support of research infrastructures, and it is essential to develop common abstractions and standardised models for describing experiments and frameworks. The findability and accessibility of research infrastructures and testbeds can be improved through comprehensive catalogues, and standardised evaluation criteria should be defined to assess the relevance and impact of these infrastructures. User experience should be optimised, potentially using metrics like "Time to First Experiment" (TTFE), and education and training should be emphasised. Interoperability and openness between testbeds are crucial, with the use of open components facilitating the portability of experiments. Finally, flexibility and adaptability should be promoted by providing ready-to-use experimental platforms or "blueprints" that are malleable and support composability and supporting sustainable development goals involves optimising hardware resource usage efficiency and improving workflows.



2.3.4 Other

- “ITU-ETSI Symposium on ICT Sustainability: Standards Driving Environmental Innovation” / *Organised* - 11–12 December 2024, in ITU Headquarters in Geneva, Switzerland *Communication* – Assessment reporting and environmental impact of ICT products, services and networks. CNIT presented GreenDIGIT Project to the community. More information [here](#).
- “Artificial Intelligence and Environmental Sustainability: The GreenDIGIT Perspective.” - *e-IRG2025 presentation* - GreenDIGIT was featured at e-IRG2025 with a presentation which can be found [here](#).
- “Architecture and KPIs for Green IT Networked Systems and Cloud” - *SLICES/CONVERGE Summer School 2025*- Tutorial at SLICES/CONVERGE Summer School 2025. More information [here](#).
- “GreenDIGIT: updates from the WLCG Environmental Sustainability Workshop” - *WLCG Workshop* – GreenDIGIT talk at WLCG workshop. More information [here](#).
- “GreenDIGIT: Towards Environmentally Sustainable Research Infrastructures (RIs).” - *GreenSys Workshop* – GreenDIGIT talk at GreenSys workshop. More information [here](#).
- “GreenDIGIT: Project and Initiative to Lower Environmental Impact of the Future Digital Research Infrastructures”, *Poster, World Sustainable Energy Days WSED 2025 Conference, 4-7 March 2025, Wels, Austria (Yuri Demchenko, UvA)*
- “Greening Digital Infrastructures with Sustainable Architecture and Design Principles.” *Webinar, presentation, technical event by Techstrong Group, 25 January 2025 (Yuri Demchenko, UvA) - <https://www.techstrongevents.com/predict-2025/agenda>*
- “Invited presentation: GreenDIGIT” - *NetDRIVE meeting*-invited presentation of GreenDIGIT at NetDRIVE. More information [here](#).
- “Environmental Sustainability in Digital Research Infrastructures - the GreenDIGIT project” – *WLCG workshop* - GreenDIGIT talk at WLCG Workshop. More information [here](#).
- “Special session on RIs energy efficiency and reduced environmental impact” – *ICRI conference* – contributions of GreenDIGIT to special session. More information [here](#).
- “Privacy Symposium” – GreenDIGIT presentation and flyers disseminated at the Exhibition Area of the 5-day conference. Participation in sessions, including “Sustainable Digital Transformation: Building a Greener Future”.
- “Green Tech Forum Brussels Conference”, 17-18 June 2025. Ulpan Kudaibergenova, EBRAINS, participated in various presentations and disseminated the GreenDIGIT flyers, increasing awareness of the project’s technical work towards enhancing the sustainability of RIs. More information is available [here](#).

It is worth noting that this sub-section summarises only a key number of event organised / participated. The complete set of publication, dissemination and communication activities are contained in Appendix A.



2.4 Contributions to Policy

The GreenDIGIT dissemination team also worked during the first 18 months of the project with WP8, responsible for preparing the first policy recommendations. This involved two levels of activity: ensuring that the project's dissemination strategy is properly integrated into the policy recommendations (for example, aligning the targeted audiences and stakeholder groups), and defining and anticipating the dissemination of the policy recommendations (for example, their distribution to these target groups). The objective of these contributions is to ensure and enhance awareness, visibility, and engagement with policy recommendations of GreenDIGIT, in line with the project's broader mission to reduce the environmental footprint of digital RIs. This includes notably the assessment of existing policies and regulations, the development of a self-assessment questionnaire and of policy recommendations.

2.4.1 Assessment of existing policies and regulations

Assessment of existing policies and regulations relevant to the environmental sustainability of digital RIs was conducted in GreenDIGIT Task 8.1 and reported in D8.2 and Milestone 4 of the project. The analysis highlighted the increasing relevance of international and European frameworks, including the UN Sustainable Development Goals (SDGs), the European Green Deal, and EU regulatory instruments, such as the Corporate Sustainability Reporting Directive (CSRD), the Energy Efficiency Directive (EED), and the EU Delegated Regulation (EU) 2024/1364. The assessment overview also considered four main policy areas impacting digital RIs: Energy consumption, carbon footprint policies, waste management and circular economy, and water use. These focus areas were defined based on findings from the landscape analysis and environmental impact assessment conducted in WP3.

Dissemination planning guided the structure and framing of the assessment outputs. Collaboration between WP10, WP3, and WP8 ensured that the policy review was aligned with the stakeholder groups and priorities identified in the project's dissemination strategy, ensuring alignment with the needs of stakeholders, such as data centre operators, RI managers, and policymakers. Insights gained from early stakeholder engagement informed the identification of policy gaps and practical challenges in implementing existing regulations. This approach supports the goal of fostering uptake of sustainability practices and enhancing policy impact through targeted communication and knowledge transfer.

2.4.2 Development of self-assessment questionnaire

In the context of WP8, EGI led the development of a comprehensive self-assessment questionnaire to support RIs in evaluating their alignment with environmental sustainability goals. The tool provides a structured approach for assessing current practices, identifying gaps, and setting improvement priorities across multiple thematic areas—such as governance, energy efficiency, environmental monitoring, circularity, water use, stakeholder engagement, and lifecycle integration.

The questionnaire builds on contributions from other WPs, particularly WP3 and WP4, to ensure methodological consistency with the GreenDIGIT environmental impact assessment framework and lifecycle architecture model. It incorporates maturity-based scoring, targeted capability levels, impact prioritisation (based on likelihood and magnitude), and automated generation of tailored action plans. A dedicated action-planning sheet supports RIs in estimating effort and deriving implementation priorities.



As of the end of the first reporting period, the tool has reached a functionally complete state and is prepared for piloting. Testing with selected RIs is scheduled for M18, with the aim of delivering a validated version by the end of August of 2025. Feedback from this phase will guide final refinements to ensure usability, relevance, and alignment with project objectives—including WP3’s Deliverable 3.2 and the broader sustainability policy landscape.

2.4.3 Development of the policy recommendations

Initial policy recommendations were also developed in WP8 based on the results of previous actions and analyses carried out in other WPs. These recommendations target digital RIs, ESFRI and Horizon Europe, as well as policymakers, with the goal of supporting internal policies, shaping a sustainable RI framework, and informing future regulations.

In this context, the dissemination WP contributed by ensuring that the recommendations are aligned with the project's communication strategy and adapted to their intended audiences. This included identifying key stakeholder groups, helping to define appropriate messaging and communication channels, and anticipating the most effective ways to share and promote the recommendations. These efforts aim to increase visibility, understanding, and engagement with the proposed measures.

A preliminary analysis of the feasibility of a GreenRI certification scheme was also launched, with initial recommendations produced. While the in-depth study of this certification will be conducted in a later WP, the dissemination team has begun preparing the ground to support future outreach and awareness-building activities around this topic.



3 Exploitation Activities Performed

In addition to dissemination, exploitation activities play also a key role in ensuring that the results, services, and methodologies developed, contain high potential of adoptability, and can be reused and sustained beyond the execution period of GreenDIGIT. During M1–M18, the consortium undertook several targeted actions to identify relevant stakeholders and promote early results for practical uptake. This chapter outlines the exploitation activities carried out across multiple different stakeholder groups. These efforts are directly aligned with the objectives of reducing the environmental footprint of digital RIs through measurable and scalable innovations.

3.1 Stakeholder Engagement

Effective stakeholder engagement is essential to ensure that the project's outcomes are relevant to the key actors across the digital RI ecosystem. During the first reporting period, GreenDIGIT engaged with a range of stakeholders which are described in the sub-sections below.

3.1.1 Research communities

One of the main exploitation objectives is to deliver value directly to the research communities, both internal and external to consortium, that are directly correlated, to utilise or maintain digital RIs. They span various disciplines like engineering that GreenDIGIT aims to optimise. During M1–M18, GreenDIGIT partners engaged with research communities through:

- Collaborative use case development, ensuring that tools (e.g. for energy-aware workload scheduling or green data processing) reflect real research needs.
- Tutorials and webinars target researchers as end-users of GreenDIGIT solutions (e.g., at EGI 2025).
- Knowledge transfer through publications and technical events, increasing awareness of sustainability challenges in the research lifecycle.
- Initial validation activities, where early architectural design and prototypes were tested within or alongside research workflows.

It is worth noting that the consortium actively engaged in major events (presentations, participation etc.) like ICRI2024 (bi-annual top ministerial level conf or RIs) and e-IRG (top EU policy advising body for e-Infrastructure and RIs). There, significant feedback and interactions are gained regarding the project's scope, goals and progress.

All these efforts aimed to raise awareness on the environmental impact of computational research, as well as to provide practical tools for reducing this impact. Furthermore, these actions lay the foundation for the long-term uptake of GreenDIGIT innovations by the scientific community. In the next reporting period, the consortium will continue to intensively engage research communities through pilot deployments and extended feedback, and the expectation is to achieve cross-community knowledge exchange.

Submitted deliverables are also an important exploitation mechanism, which can fit in with most of the sub-sections described in Chapter 3.1. Although most deliverables provide value to more than one stakeholder group, some examples of deliverables affecting research communities are:



- D3.1 “RIs Landscape Review, Best Practices Analysis and Needs.” — provides a comprehensive survey of existing sustainability efforts across ESFRI infrastructures.
- D4.1 “State of the Art in RI and Digital Infrastructure Sustainability and Technologies Assessment for Energy Efficiency and Impact.”
- D4.2 “Architecture Definition, Lifecycle Model and Requirements Specification for Sustainable RI.” — outlines a modular architecture and shared responsibility model designed for practical adoption by research teams and infrastructure providers.
- D10.1 “Dissemination and Exploitation Plan.” — sets out the strategy for targeting research communities and measuring impact.
- D10.2 “Definition of Competences and Skills for Sustainability and Training Modules.” — supports skill-building among researchers and operators to ensure effective integration of GreenDIGIT tools.

It is worth noting that for better exploitation results, all public deliverables can be found online at the [website of GreenDIGIT](#) (hosted, operated and maintained from UTH), as well as at GreenDIGIT Zenodo community⁴ (operated and maintained from UvA).

3.1.2 Digital Research Infrastructures (RIs)

Aside from research communities, digital RIs are key stakeholders in the GreenDIGIT ecosystem, both as potential adopters of the project’s tools and as sources of knowledge about current sustainability practices. For this reason, the engagement with RIs has been a fundamental goal and activity during M1 - M18. In such a way, it is ensured that the progress of GreenDIGIT is aligned with the real-world needs, constraints and considerations of RI operators and technical managers.

The development and execution of a targeted survey coordinated by SU as part of Deliverable D3.1 – “*RI Landscape Review, Best Practices Analysis and Needs*”, was a key milestone during the first reporting period of GreenDIGIT. The survey reached out to a broad cross-section of the European RI community and received detailed responses from:

The 4 GreenDIGIT partner RIs:

- EBRAINS
- EGI
- SLICES
- SoBigData

6 external RIs and research centres:

- CERN
- CLARIN

⁴ <https://zenodo.org/communities/greendigit/records?q=&l=list&p=1&s=10&sort=newest>



- ELI-BEAMS
- GEANT
- SWITCH Cloud
- University of Freiburg Computer Centre

It is worth noting that each of the participating RIs serve from 60 users up to 50 million users per year, which significantly contributed to the diversity and comprehensiveness of the results. The key objectives of the detailed survey were to identify existing best practices for environmental sustainability across RIs and assess the level of awareness, maturity, and commitment to energy efficiency and green IT practices. Therefore, the consortium was able to understand the technical and policy-level needs that GreenDIGIT could address and highlight areas where tools, metrics, or methodologies are currently lacking.

The information collected has been carefully and intensively used to shape the proposed architecture of GreenDIGIT. All insights and results that were extracted and detailed in Deliverable D3.1, were fed directly into the requirements and design of the GreenDIGIT tools (e.g., in Deliverable D4.2). Alongside comments and feedback obtained during public events of GreenDIGIT, they also served to further validate the project's vision.

The survey revealed that while many RIs are starting to be conscious of their environmental impact, they often lack clear methodologies, monitoring tools, and benchmarks. As a result, they struggle to achieve meaningful improvements in energy efficiency. This finding highlights the strategic relevance of the planned outputs and reinforces the need for community-driven exploitation strategies.

3.1.3 Policy makers & Public authorities

Addressing communication and exploitation activities aimed at policy makers and public authorities was defined as one of the priority areas of WP10 and the project as a whole. Many project outcomes target and require policy development to ensure environmental sustainability and energy efficiency throughout the whole RI lifecycle.

The project targeted the following bodies and organisations:

ESFRI⁵ (European Strategy Forum on Research Infrastructures): GreenDIGIT targeted its activity and development at ESFRI goals and the RI community from the very beginning.

- Communication with the ESFRI Chair (Jose Luis Martinez) and the ESFRI Strategy Working Group on Data, Computing and Digital Research Infrastructures was active on environmental sustainability aspects and related ESFRI policies. The activities included organising and presenting at the ICRI2024 conference session (chaired by ESFRI Chair), communicating GreenDIGIT outcomes, advising on potential policy development by ESFRI for RIs environmental sustainability and providing dedicated guidance to RIs for implementing the Environmental Sustainability Strategy as it is defined in the ESFRI Roadmap 2026, in particular presenting the RI Environmental Sustainability Strategy based on the Environmental Sustainability Strategy Questionnaire.

⁵<https://www.esfri.eu/>



e-IRG⁶ e-Infrastructure Reflection Group); a strategic body to facilitate integration in the area of European e-Infrastructures and connected services.

- Recognising the important role of e-IRG in defining technical policies and agendas for e-Infrastructure development in adopting new technologies and following EU policies and recommendations, GreenDIGIT established contacts with e-IRG from the project's beginning. The project developments and recommendations for digital RIs environmental sustainability were presented at the e-IRG meeting on 24-25 June 2025 (Poznan, Poland), links to GreenDIGIT documents provided.

JRC⁷ (Joint Research Centre); EC department to provide independent advice to EU policymakers. JRC plays an important role in providing research reports on different research and technology topics.

- JRC publishes annual reports⁸. The European Code of Conduct for Data Centres (EU DC CoC)⁹ that provides an important framework for defining environmental and energy efficiency monitoring for data centres and corresponding metrics (all aspects taken into account in GreenDIGIT technical development). Contacts with the editor of the EU DC CoC 2022-2024 have been established and information exchanged, but contacts with the new editor of the 2025 report need to be re-established.
- JRC published two relevant documents: The European Green Competence Framework (2022) and The European Competence Framework for Researchers (2023), which have been used in defining the Green Competences for RIs (reported in Deliverable D10.2). Contacts with the new editor have been and a meeting is planned for autumn period. The goal is to propose extensions to the European Green Competence Framework as is suggested in Deliverable D10.2.

Consolidated policy recommendations from the GreenDIGIT project and participating partner RIs are reported in the Deliverable D1.3 “Policy Briefing” that includes policy implications and recommendations. One of the recommendations includes the importance of introducing the necessary incentives for RI by funding and coordinating bodies for developing and implementing an environmental sustainability strategy (as required by ESFRI Roadmap 2026) that should be included throughout the whole RI lifecycle.

3.1.4 Standardisation bodies

GreenDIGIT has initiated its standardisation and policy liaison activities under Task 10.3 by identifying Key Standardisation Organisations (SDOs) and initiatives relevant to the environmental sustainability of digital Research Infrastructures (RIs), including ISO, ITU-T, ETSI, IEC, IEEE, CEN-CENELEC, EMAS, the Greenhouse Gas Protocol, and the Global Reporting Initiative (GRI).

⁶<https://e-irg.eu/>

⁷https://joint-research-centre.ec.europa.eu/index_en

⁸ https://commission.europa.eu/publications/annual-activity-report-2023-joint-research-centre_en

⁹ https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/eu-code-conduct-data-centres-towards-more-innovative-sustainable-and-secure-data-centre-facilities-2023-09-05_en



To build a common understanding within the consortium, an internal workshop on standards, regulations, and best practices was held to present an overview of applicable frameworks. This was followed by a consortium-wide survey to identify and prioritise the most relevant standards for the goals of GreenDIGIT. The feedback is now informing the project's emerging standardisation strategy, to be continued in WP11 after M18.

Externally, the project has begun engagement with broader policy and standardisation landscapes relevant to RIs by contributing to ongoing policy discussions, including with the European Strategy Forum on Research Infrastructures (ESFRI), and participating in relevant events, including with the International Telecommunication Union (ITU), to ensure that the specific needs and sustainability challenges of digital RIs are represented.

3.1.5 General public & Civil society

Although the main stakeholder groups targeted by GreenDIGIT are technical and institutional, the exploitation potential in the general public & civil society is recognised as well. This potential can be indicatively exploited through proper education, environmental advocacy and common sustainability efforts. During the first reporting period, GreenDIGIT made significant steps to ensure that its results are accessible and reusable by non-specialist audiences. As an increased concern for the environmental impact has been thoroughly noticed, the GreenDIGIT consortium focused on:

- Publishing well documented open deliverables (like D10.2 on competences and training) that can inform educational initiatives, sustainability curricula, and public learning resources.
- Making tools and materials available under open licenses, and advocacy groups to adapt and reuse content for local campaigns or digital literacy workshops.
- Producing tutorials and blog posts that translate technical concepts into practical knowledge for individuals and communities, encouraging more energy-conscious digital behaviour.
- Highlighting best practices that can guide citizen-facing services, such as community data projects or low-carbon digital platforms.

In future phases, the project aims to facilitate this further through further collaborations with educational institutions and civil society networks. This will ensure that the outputs are not only known but used for public good.

3.1.6 EOSC community and stakeholders

The European Open Science Cloud (EOSC)¹⁰ is a European Commission initiative aiming at developing an infrastructure providing researchers and innovators with services promoting open science practices. The development of EOSC is steered by the EOSC tripartite governance involving the EU represented by the European Commission, the participating countries (members) represented in the EOSC Steering Board, and the research community represented by the EOSC Association¹¹.

¹⁰https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/our-digital-future/open-science/european-open-science-cloud-eosc_en

¹¹<https://eosc.eu/>



The implementation of EOSC is currently taking place in the context of the EOSC European co-programmed partnership according to a Strategic Research and Innovation Agenda (SRIA), which is co-developed with the EOSC community. A number of EOSC related projects have been funded since 2015 to build the EOSC community, develop EOSC services and EOSC infrastructure. The Horizon 2027 Work Programme on 3. Research Infrastructures includes a dedicated call topic "HORIZON-INFRA-EOSC-01: Enabling an operational, open and FAIR EOSC ecosystem".

The current EOSC operational model includes the EOSC EU Node¹², procured by the European Commission (launched in October 2024) and a number of national and thematic nodes. The EOSC EU Node is the first node of the EOSC Federation, providing a set of data, tools and services to researchers across Europe. It also serves as a reference node and facilitates the interconnection of other nodes in the EOSC Federation. It is implemented by federating data, tools and services by data repositories, research infrastructures, e-infrastructures and other scientific service providers across Europe into a network of nodes.

The whole EOSC organisation and planned infrastructure have many aspects of addressing environmental sustainability aspects, but the current transitional period with the EOSC setup, creates limited possibility to talk to EOSC directly via its governance structure (because of formal national membership and delegation are required). Recent EOSC Symposiums (during the project execution) had a strict procedure of selection to efficiently contribute with dissemination and exploitation activity.

The GreenDIGIT project builds its dissemination and exploitation activity by interacting and cooperating with EOSC members and EOSC related projects, also by actively participating in events organised by ESFRI, e-IRG, GEANT. Further planning and more direct contact with the EOSC governing bodies should be addressed in the second period.

3.2 Adoption and Innovation Pathways Progress

This section presents the progress of the important GreenDIGIT results that can be exploited to support the future greening of RIs. For those, targeted dissemination and exploitation in the second phase of the project will be performed. These activities will include but limited to dissemination through tailored communication (e.g., public deliverables, training sessions, webinars, blogs).

To reflect the adoption of the cross-partner/cross-stakeholder project results such as green competences and training resources (focus of Task T10.4 and Task T11.3), we introduce the Adoption Readiness Level (ARL) to informally measure their exploitation progress. More specifically, the ARL levels can be separated as follows:

- ARL 1: Concept identified (competence topics defined, initial course structure)
- ARL 2: Pilot material developed (draft modules, preliminary testing in events)
- ARL 3: Initial uptake (modules delivered at events, feedback collected)
- ARL 4: Structured deployment (integration into RI or universities / RIs)
- ARL 5: Recognised adoption

¹²<https://open-science-cloud.ec.europa.eu/>



Table 2. Innovation Pathways progress first reporting period

Technology	Start status	Current Status	Planned Result
Green competences and skills definition for RI Environmental sustainability and energy efficiency (UvA)	"ARL1"	"ARL 3"	"ARL5"
Set of training courses on environmental sustainability and energy efficiency for RIs (UvA, UTH, ALL)	"ARL1"	"ARL3"	"ARL5"

3.2.1 Green competences and skills definition for RI Environmental sustainability and energy efficiency (UvA)

Task T10.4 defined a set of green competences required for RIs to address environmental sustainability and energy efficiency during the whole RI lifecycle from design to implementation and operation. The proposed green competences are based on the European Green Competence Framework and extended with additional competences based on the job market analysis and profiled for different organisational roles. The used methodology is based on the verified methodology and results and results of the EDISON (2015-2017) and FAIRsFAIR (2019-2022) projects. This positions the proposed green competences at the level of ARL3 due to their reliance on the existing practices and job market analysis. The whole process and methodology are reported in Deliverable D10.2.

Further development and updates will be based on the experience from delivering the training activity and feedback from both the training and the RI operation. The green competence framework will be extended with skills and required knowledge topics what will create a basis for implementing green competence in academic curricula in cooperation with partner universities.

3.2.2 Set of training courses on environmental sustainability and energy efficiency for RIs (UvA, UTH, ALL)

Task T10.4 cooperated with other WPs and partner RIs in defining the set of training topics, also referred to as Learning Units (LU), that provides a basis for the development of training modules for different organisational roles and the wider community, in particular: general researchers (RI users) and experimental researchers on RI (group GRIU), research application developers (group SSES - Software and System Engineering for Sustainability). RI operator dealing with monitoring environmental Sustainability (group RIOS), managers (group MEB – Management and Executive Briefings), and general users (group GESA - Green and Environmental Sustainability Awareness). Refer to D10.2 for details.

The proposed set of topics and learning units has been discussed at the project meeting and external training events, such as the EGI2025 training event, and SLICES/CONVERGE Summer School.

The EGI2025 training event included two tutorials covering topics related to groups GRIU, SSES, and RIOS (refer to details in the section 2.3.1). SLICES/CONVERGE Summer School tutorial covered topics



related to groups GRIU and RIOS. The tutorials are available from the GreenDIGIT website and shared via Zenodo dedicated GreenDIGIT community group. The estimated number of attendees/trainees is total about 50+ of researchers, developers, operators, and research students. This positions the first set of tutorials at the adoption level ARL3/ARL4.

Further tutorials development in Task T11.3 will cover most of the defined topics and will be contributed by partners with the primary target audience of partner RI and the wider ESFRI community.



4 Impact Assessment for Period 1

There are several KPIs defined in the DoA to help in observing and assessing the dissemination and communication impact of GreenDIGIT throughout the project's execution.

4.1 GreenDIGIT Objective KPIs

The first set of metrics are defined at the objectives of GreenDIGIT and are more specifically correlated with:

O5: "Educate and support digital service providers in the RI communities about good practices on environmental impact conscious lifecycle management and operation of infrastructures and services."

Description of objective: Training courses will be developed and delivered for different target groups identified in the broad RI communities. To extend impact, GreenDIGIT will organise a set of "train-the-trainer" workshops with invited experts in sustainable digital technologies. The target is to establish regular courses and a recognised certificate of attendance. A skill-based approach will be followed to address life-long learning and professional learning with the possibility to propose micro-credentials in order to recognise that these skills have been properly acquired.

Challenge and innovation (results): There are no widely available education or training programs on environmentally aware or sustainable digital infrastructure technologies. GreenDIGIT will solve both tasks on development of instructional methodology and reference training modules. Development of training curricula courses will be supported by the proposed framework for competences and skills related to sustainability and environmentally aware practices for different RI actors: operators/engineers, application developers, researchers, managers/administrators, and eventually policy decision makers. This will be supported by defining the required competences and skills for the main organisational role in RIs and developing a set of reference training modules.

Verification and KPIs:

1. At least 500 participants at GreenDIGIT events.
2. Open training materials in EOSC (at least 20 modules) based on model curricula (supported by knowledge self-tests).
3. Framework and instructional methodology are accepted in at least 2 universities.
4. Training and workshops attended by at least 4 DIGIT RIs and at least 10 ESFRI RIs.

For these KPIs, and similarly with the dissemination and communication activities, GreenDIGIT has implemented a centralised and continuously updated tracking system via a shared dissemination Excel file. This Excel file includes 4 different sheets that each correspond to the KPIs mentioned in the list above. This ensures that the information is effectively shared and updated between the consortium members. Below there is a status update for each one of the four KPIs.

4.1.1 GreenDIGIT events participants

During the first reporting period, GreenDIGIT organised and participated in numerous events, including tutorials, webinars, and public sessions at major research infrastructure conferences (as described at Section 2.3. Across these events, over 500 participants have visited. Most of the participants were



affiliated with RIs, universities, and digital service providers, ensuring strong alignment with the project's target audience. However, interest was also expressed from scientists affiliated with biology, chemistry and other forms of engineering, rather than electrical and electronic engineering.

Progress Status: Achieved

Target: 500 participants by end of project

Table 3.GreenDIGIT event participants analysis

Event No	Date	Name	Num. of Participants
1	Mar-24	EGI - GreenDIGIT Promotional event	7
2	Sep-24	EGI Conference (GreenDIGIT open/joint session)	50
3	Sep-24	EGI Conference (GreenDIGIT poster pitch)	100
4	Nov-24	IPA School in NL	30
5	Jan-25	PREDICT2025 Forum	100
6	Mar-25	WSED 2025 Conference, Wels, Austria	200
7	Mar-25	EGI Conference (GreenDIGIT afternoon open session)	40
8	Mar-25	EGI Conference (GreenDIGIT booth)	40
Sum			567

4.1.2 Open training materials

GreenDIGIT has actively begun the development of modular training content as proposed in the DoA. By M18, 3 training modules have been produced and 5 are drafted for production. These (will) include topics such as:

- Energy efficiency metrics and monitoring.
- Sustainable software development practices.
- Environmental assessment methodologies for RIs.
- Decision-support for sustainable scheduling.

Progress Status: In progress

Target: 20 open modules



Currently, at the of M18, 3 modules have been delivered (plus 5 in development on priority topics in all training groups GRIU, SSES, RIOS, MEB and GESA – refer to Deliverable D10.2¹³)

These modules are prepared and based on the detailed guidelines given in Deliverable D10.2 *“Definition of the competences and skills for sustainability and environmental impact awareness and a set of training modules”*. Thus, the proposed materials will follow a set of rules defined and will be available to public (partner Ris, ESFRI, EGI and wider communities etc.).

4.1.3 Framework and instructional methodology for Research Infrastructures

As part of its collaboration with academic institutions, GreenDIGIT has initiated discussions with university partners within the consortium. More specifically, UvA, TUM and UTH made initial progress on how to pilot the integration of a green competence framework and an instructional model into existing postgraduate programs. At this point, this KPI is still in its early stages, as it strongly depends on the architectural (M1-M18) and the implementation (M13-M36) phases of GreenDIGIT. The next actions will include:

- Review of the proposed framework and its adoption into a sustainability-oriented data science curriculum.
- Preliminary alignment has begun with continuing education offices.
- Explore micro-credential certification possibilities.

Progress Status: On track

Target: 2 adoptions

Current (M18): 2 universities engaged in integration dialogue

4.1.4 Framework and instructional methodology for Research Infrastructures

Similarly with the framework and instructional methodology, the consortium will make active efforts to create high quality training and workshops in the second reporting period of the project. More specifically, training workshops are described in the DoA (WP11) for M18-M36.

Engagement will be facilitated through existing networks and new contact points. Specific emphasis will be also given on practical pilot-oriented content that covers RI operational needs.

Progress Status: In progress

Target: 4 DIGIT RIs + 10 ESFRI RIs

Current (M18): Initial discussions and planning

¹³ <https://greendigit-project.eu/deliverables/>



4.2 KPIs for dissemination and communication

Apart from the KPIs outlined in the GreenDIGIT objectives (Section 4.1), additional KPIs are included in the communication strategy. More specifically, the table below contains these supplemental KPIs with their targets and means of verification.

Table 4.KPIs for dissemination and communication

Measures	Indicators	Target	Means of verification	Status (M18)
GreenDIGIT brochure	No. of brochures distributed	At least 200 per year	Dissemination reporting activities	Achieved, distributed in several events. (e.g. Section 2.3.1.1)
Posters	No. of posters produced	2 in total	Dissemination reporting activities	Achieved (Section 2.3.1.3, 2.3.2)
High-level materials for policy makers	No. of sets	At least 1 per year	Dissemination reporting activities	Ongoing (Achieved up to M18 with D1.3, D8.2)
GreenDIGIT website	No. of unique visitors to website	>1000 visitors/year	Google analytics	Ongoing (Achieved up to M18 with D1.3, D8.2)
Social networks	No. of followers: X/LinkedIn/YouTube	>500/>200/>100	Statistics of social media profiles	Ongoing (Achieved No for LinkedIn, Ongoing for YouTube, X → details at Section 4.2.2)
GreenDIGIT workshops	No. of workshops and No. of participants	3 workshops (30 participants/event)	Attendance proofs	Ongoing (Attendance proof based mostly on event photos)
Videos	No. of videos published on GreenDIGIT YouTube channel / average	2 videos and >500 views per video	Videos published via GreenDIGIT YouTube channel	Ongoing (4 videos uploaded up to M18)



	number of views			
Scientific publications	No. of peer-reviewed papers/articles	5 in total	Papers / articles published	Achieved (Section 2.1, Appendix A)
Presentations	No. of presentations made	At least 3 per year	Published presentations	Achieved (Appendix A)
External events	No. of events attended	6 external events	Attendance proof/photos/videos	Achieved (Appendix A)

Through the intensive efforts of the consortium, significant progress has been made for most of these KPIs. Specifically, the major scientific correlated KPIs (Scientific publications, Presentations, External events, Posters, brochures) have been already achieved during the first period of GreenDIGIT (Appendix A). Nevertheless, significant efforts are planned for them during the second period as well, to further exploit the results of the project.

4.2.1 Website analytics

Additionally, the digital means of dissemination and communication for GreenDIGIT (website and social media channels), seem to be on track to achieve the proposed goals. More specifically, regarding the website >1000 visitors/year were targeted in the DoA while the following figure depicts the visitors for 10 months.

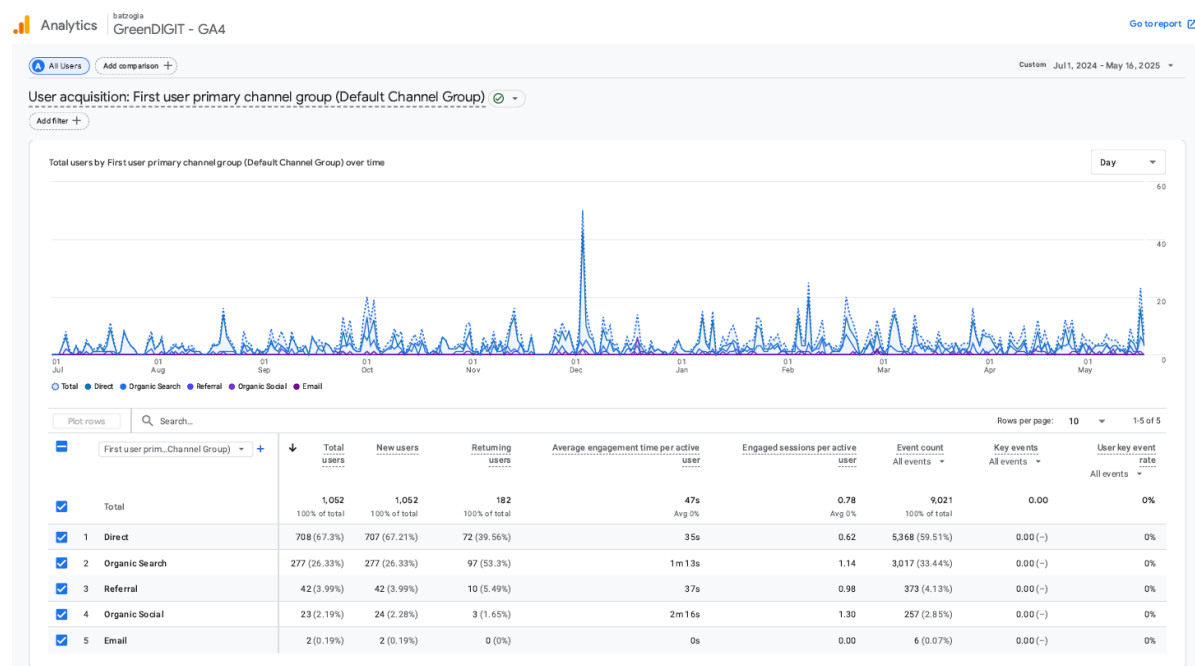




Figure 13. Website Visitors.

4.2.2 X followers' deviation

Planned KPI: >500 followers on X (formerly Twitter). Actual Progress: 35 followers

Reason for Deviation: The consortium has strategically shifted its social media focus from X (formerly Twitter) to LinkedIn due to significant changes in the digital landscape and platform governance. More specifically, radical changes occurred after the project proposal was drafted and project initialisation. Two of the most vital are the "Platform Transformation and Audience Migration" and "Increased Political Polarization". Since the project's inception, X has undergone a fundamental rebranding and policy shift. These changes, including altered algorithms that prioritize paid subscribers and a significant reduction in content moderation, have led to a documented "backlash" within the European academic and research communities. To protect the project's reputation and ensure a neutral, professional environment for scientific discourse, the consortium decided to limit its activity on X to real-time event coverage rather than aggressive follower growth. Thus, specific emphasis has been given on promoting more GreenDIGIT's LinkedIn channel. As a result, LinkedIn has already fulfilled the initially proposed number of 200 follower. Currently it contains 242 followers, a number that is expected to be further increased in the future.

It is noted that the progress and analytics are continuously monitored, to ensure the effective visibility of GreenDIGIT. As for the followers on social media, it is noted that the LinkedIn channel has already achieved its target, while X and YouTube are on track to reach this target. The number of YouTube videos that were targeted to be uploaded has been already fulfilled already as well. Specific emphasis was given for all digital channels of GreenDIGIT, to strategically operate to reach effectively different stakeholder groups. Finally, intensive efforts have been made, and it is expected to be increase further for the remaining KPIs.



Part II: Dissemination and Exploitation Plan – Period 2 (M19–M36)



5 Updated Strategy and Key Exploitable Results (KERs)

5.1 Strategy Overview for Period 2

The strategy for Period 2 (M19–M36) builds directly upon the momentum and outcomes of the first reporting period (M1–M18). While the first phase focused a lot on establishing project visibility, awareness, and stakeholder engagement, the second period will prioritise targeted exploitation and adoption of KERs.

The aim is to convert awareness into measurable uptake by ensuring that outputs of GreenDIGIT are not only known but actively integrated into RI operations, training programs, and policy frameworks. Dissemination will continue as a critical support activity, but messaging will be refined to align with the maturity and readiness of each KER, ensuring communications are relevant to specific user needs.

Key Target Audiences for exploitation include:

- RIs (small - large) as primary implementers of architectures, prototypes, and methodologies.
- RI operators, engineers, and developers responsible for operational integration and technical deployment.
- RI Managers, administrators, and policymakers involved in governance, evaluation, and sustainability decision-making.
- Academic institutions and competence centres that will integrate training modules and curricula into professional and educational programs.

Exploitation Actions in Period 2 will focus on:

- Operational demonstrations to validate tools, methodologies, and frameworks within selected RIs.
- Open availability of technical and methodological outputs through GitHub, Zenodo, EOSC Knowledge Hub, and project channels to support independent adoption.
- Embedding training modules and curricula into competence centres, academic courses, and certification schemes to ensure long-term capacity building.
- Policy-level engagement through EOSC working groups, ESFRI evaluations, and alignment with European sustainability agendas to maximise strategic adoption.
- Targeted dissemination campaigns across website, social media, newsletters, and events to maintain visibility while focusing on conversion to adoption.

The approach for Period 2 ensures that the outputs of GreenDIGIT are positioned for long-term sustainability and impact beyond the project lifetime. By focusing on high-readiness KERs, tailored engagement, and targeted exploitation routes, the strategy is designed to strengthen uptake across the RI ecosystem and secure alignment with European environmental sustainability priorities. A detailed description of the 7 different KERs defined, is given in section 5.2.



5.2 Key Exploitable Results (KERs)

As GreenDIGIT transitions from the initial awareness and engagement phase into targeted exploitation activities for Period 2 (M19–M36), the focus shifts toward KERs that represent the project’s most mature and impactful outputs. These KERs capture the substantial results of the project’s technical developments and methodologies. In this section, each KER (Table 5. List of Key Exploitable Results (KERs)) is described in terms of its components, target audiences, dissemination/ and exploitation strategy, and long-term sustainability. This structured approach ensures that exploitation actions are directly linked to the project’s innovation outcomes and the needs of its intended user communities.

It is worth to note that the KER list represents the strategic pillars of GreenDIGIT’s impact and includes outputs that are at different stages of the innovation lifecycle. While some results, such as the SotA (KER1), are functionally complete at M18, others, such as the Environmental Impact Architecture and RI Prototypes (KER5), are defined as cumulative results. For these technical KERs, Period 1 focused on the design and requirement specifications, while the full 'Exploitable' implementation and deployment are targeted for Period 2 (M19–M36). This roadmap ensures that the project's dissemination and exploitation activities are aligned with the technical maturation of each component.

Table 5. List of Key Exploitable Results (KERs)

KER Name	Correlated WP(s)	Involved Partners	Status
State of the Art (SotA) Overview with Analysis and Recommendations	WP4, WP10, WP11	PSNC, UvA, EGI, ALL	Completed / Available in RP1 (Acted as an input for architectural design)
Architecture Framework for DRI Sustainability by Design	WP4, WP6, WP7 WP10, WP11	UvA, EGI, UTH, IFCA, SZTAKI, ALL	Completed / Available in RP1 (Acts as an input and is integrated in the development (WP6,7) - RP2)
Research Infrastructure Lifecycle Model (RILM)	WP4, WP6, WP10, WP11	EBRAINS, UvA, EGI, SoBigData	In Progress / Under Development (Initiated efforts on the definition for RILM at WP4, that will be integrated in WP6)
User tools for lowering the environmental impact	WP5	UvA, TUM, GSPT	Completed / Available in RP1 (Provided Virtual Research Environments for increasing the awareness of developers /



			experimenters for energy consumed), will be further extended in WP7 (T7.3)
Environmental impact architecture and prototype implementation for RIs	WP6	CNR, DIRAC-CNRS, SZTAKI, IFCA, CESNET, UTH	In Progress / Under Development (Effort on developing the proposals of WP4 within the scope of WP6)
Environmental impact assessment methodology (with guidelines) and self-assessment questionnaire for RIs	WP3, WP8	MI, EGI	Completed / Available in RP1 (Included survey, methodology, guidelines and self-assessment questionnaire)
Training modules	WP10, WP11	UvA, UTH, ALL	In Progress / Under Development (Joint efforts from all consortium to present outputs in a structured way)

5.2.1 KER1: State of the Art (SotA) and Technology Recommendations

The GreenDIGIT Deliverable D4.1 “SotA Overview with Analysis and Recommendations” provided an extensive overview of the technologies and best practices in addressing energy efficiency and environmental sustainability in the design, deployment and operation of the digital infrastructures and related technical components. The SotA analysis included the following technology domains: Metrics for data centre environmental sustainability reflecting partner RIs technologies and best practices at service level, node level, and site level; Energy carbon content collection; Metrics for Energy Efficiency of Network and 5G Infrastructure; Sustainability Aspects in Research Infrastructures for Experimental Research; Sustainable Software Design Practices for Scientific Software; Sustainable Architecture Design Practices by Cloud Providers AWS and Microsoft Azure; Data Management; Ongoing Research on Sustainability in Research Infrastructures.

The SotA analysis is targeted for RIs community, primarily development, implementation and operation. The SotA analysis has a value for a wider community, including industry and SME.

The SotA report will provide rich input for multiple forms of dissemination activities and exploitation: newsletters, whitepapers, input to the design and development of different RI components from infrastructure services to scientific software and applications, providing necessary input for technology selection for energy efficiency and environmental sustainability.

The dissemination and exploitation activity will include such activities as:



- a) Producing one or more whitepapers on the topics covered in Deliverable D4.1, published via Zenodo and distributed via dedicated social media channels
- b) Providing input to training modules on different aspects of digital RI environmental sustainability, scientific applications design.

5.2.2 KER2: Architecture Framework for Digital RI Sustainability by Design

Following the SotA analysis and experience of the partner RIs, the project proposed the Architecture Framework for Digital RI Sustainability by Design, reported in Deliverable D4.2 “Architecture Definition, Lifecycle Model and Requirements Specification for Sustainable RI”.

The proposed architecture framework includes five pillars addressing important aspects in RI design, development and operation: (1) Layered and Modular Infrastructure, (2) Energy-Efficient Software and Scientific Applications, (3) Lifecycle-Oriented Sustainability Management, (4) Common Information Model (CIM) for Sustainability Metrics, and (5) Sustainable Data Management and Storage. The proposed architecture definition provides a basis for sustainable infrastructure design and operation to support energy-aware orchestration, lifecycle planning, and low-impact scientific workflows.

An important exploitable property of the proposed framework is its modularity and layered structure that allows splitting known and identified concerns and challenges in ensuring the environmental sustainability and energy efficiency of the future digital RIs by offering a set of common and reusable design principles and patterns. This is considered the main component for exploiting the Sustainability by Design that, on one hand, proposes usable technical solutions, and on the other hand, ensure interoperability of the different components.

The exploitation strategy for the advanced Architecture Framework for Digital RI Sustainability by Design will include a set of communication activities to disseminate the proposed architecture solutions that may include technical papers, whitepapers, technical briefings, seminars, tutorials and design workshops. This activity will be realised by the project partners throughout the project duration.

It is also important to note that full implementation of the proposed Architecture Framework for Digital RI Sustainability by Design requires a sufficient System and Software Engineering background and corresponding DevOps methodologies (as described in Deliverable D4.2). This provides another exploitation factor in introducing recommended design principles into academic curricula due to its advanced conceptual character and variable curriculum potential. This can be done by partners universities and shared with the wider academic and research community.

5.2.3 KER3: Research Infrastructure Lifecycle Model (RILM)

The Research Infrastructure Lifecycle Model (RILM) is defined as a part (Pillar 3) of the Architecture Framework for Digital RI Sustainability by Design. But RILM has its own value because it formalises the RI lifecycle stages in compliance with the ESFRI lifecycle definition and links lifecycle stage to the required compliance with the European policies and regulations related environmental sustainability and impact monitoring and reporting what is required according to ESFRI Roadmap 2026.



To facilitate the exploitation of RILM to address environmental sustainability by RIs, the project produced a dedicated RIL Whitepaper that was distributed at the joint GreenDIGIT and EGI event during EGI2025 conference and other events with the GreenDIGIT involvement.

Internally, the concepts, models and actors defined in RILM have been used in project activities in WP4, WP5, and WP8 and will provide further input to targeted policy development and developing necessary training modules and activities.

The project and partners will use available events and channels to distribute RILM Whitepaper, engage into discussion and collect feedback.

5.2.4 KER4: User Tools for Lowering the Environmental Impact

5.2.4.1 Jupyter Extension

EcoJupyter is a JupyterLab-based extension tool that provides reproducible, real-time environmental impact metrics for computational experiments within federated RIs. It enables researchers to monitor energy usage and carbon footprint directly within their notebooks through sustainability KPIs, such as Software Carbon Intensity (SCI)¹⁴.

Designed around the GreenDIGIT 4-Pillar Conceptual Reproducibility Framework, EcoJupyter aligns with FAIR data principles and Open Science practices. It extends the typical Jupyter workflow by bundling runtime metrics, metadata, and experimental artefacts into RO-Crate¹⁵-compliant packages. The latter can be automatically published into the Federated Data Management Infrastructure (FDMI, SoBigData)—a catalogue and metadata exchange platform that enables researchers to share, search, and reuse computational experiments and datasets through standardised metadata and API-based publication.

Main Features

- a) Real-time Sustainability Metrics Dashboard: Researchers receive live feedback during notebook execution, integrated with Scaphandre and Prometheus, with data visualised in a lightweight dashboard (React) integrated into JupyterLab as an extension.
- b) Reproducible Experiment Packaging: Captures a snapshot experiment metadata, environment details, and energy readings in RO-Crate format, aligned with FAIR and GreenDIGIT principles. Each Workflow is tied with a notebook, and an Experiment with its running instance.
- c) Automated Publishing to FDMI: On workflow completion, experiments may be submitted to the SoBigData FDMI catalogue prototype using a RESTful API call with a JSON body workload.

Target users

The EcoJupyter tool targets researchers and developers alike using Jupyter-based workflows in Research Infrastructures as its platform. It also supports infrastructure operators interested in integrating sustainability-aware tooling into platforms like EGI, EBRAINS, and SLICES.

¹⁴ <https://sci.greensoftware.foundation/>

¹⁵ <https://github.com/ResearchObject/ro-crate>



Dissemination and Exploitation Strategy

1. Training & Demonstrations: Recorded webinars, live tutorials, and use-case demonstrations (e.g., organised private sessions with partners) should be available via the GreenDIGIT website and/or YouTube channel.
2. Documentation & Examples: The tool's documentation is open-sourced on Github—with installation guides and usage scenarios. Those usage scenarios are conveyed through Jupyter notebooks to execute workflows that makes it easier to understand all the steps necessary for the tool integration.
3. Open-Source Release: All components, configuration and code are available on Github³ and published on PyPi⁴ for transparent reuse and extension.
4. Dissimilation & Visibility: EcoJupyter has been demonstrated through GreenDIGIT events (All-Hands and Technical Meetings), with active collaboration and specification for platforms such as EGI (e.g., we use the EGI-notebook Docker image). A dedicated tutorial was also conducted as a side event at the EGI Conference in Santander, Spain, in June 2025.

Extensibility and Adoption Means

EcoJupyter is developed as a modular, platform-agnostic extension, ensuring easy adoption and integration across RIs. Its long-term maintenance and development are foreseen by GreenDIGIT partners and UvA, where some of its promotion includes:

- Validation and portability testing across federated infrastructures (e.g., EGI, SCLICES testbeds) is also planned (T7.3)
- Integration into existing RI environments (e.g., using JupyterHub and/or Kubernetes with Helm).
- Standardisation efforts through stakeholders' forums.

5.2.4.2 GreenDIGIT VRE extensions and environmental impact assessment framework for testbed experiments

Key exploitable results for the GreenDIGIT Virtual Research Environment (VRE) extensions and environmental impact assessment framework for testbed experiments are outlined through various exploitation strategies, target users, and sustainability means.

Regarding exploitation strategies, the software artifacts currently deployed in the SLICES-RI Post-5G Blueprint will be extended with energy aware reproducibility extensions and adopted for scientific workflows in other research infrastructures as part of WP7. Furthermore, components are already available on GitHub, and comprehensive documentation is included in the public WP5 reports. This effort has also resulted in several related publications.

The primary target users for these developments include researchers and students interacting with the Research Infrastructure. The tool itself will be conveniently accessible from various dashboards.



In terms of sustainability, the publication stemming from this work are expected to significantly impact scientific progress. Additionally, the results will influence the design and evolution of research infrastructures, with their integral components being maintained as parts of the infrastructure.

5.2.4.3 *Experiment sustainability metadata*

This tool is designed to assist the creation of energy and sustainability meta-data for large experiments, composed of a large number of nodes, potentially using different electricity-mixes. Such meta-data allow for analysing and sharing sustainability metrics, while retaining different granularity levels (from the overall impact of the experiment to the individual impact of each node). Use-cases include sustainability accounting of experiments, but also the identification of the most sustainable architecture during experiment design.

The tool is targeted to users of RI, i.e., experimenters.

The tool is implemented as Python package for easy integration into existing experiment workflows, such as Jupyter Notebooks.

This tool allows for organising, storing, analysing, and sharing as open data the sustainability metrics of experiment.

5.2.5 KER5: Environmental Impact Architecture and RI Prototypes

5.2.5.1 *Environmental Impact Collector DB*

The Environmental Impact Collector DB is a centralised data infrastructure designed to monitor and record the environmental impact of various computing sites and systems. It collects standardised environmental metrics from agents deployed on different sources, including cloud services, storage systems, Jupyter environments, grids, and networks. The data is transmitted in JSON format and securely ingested through an authorisation proxy provided by CNR, ensuring authenticated and authorised data submission.

The database is structured under the monitoring schema in PostgreSQL and uses a modular, extensible design. Each computing site is registered with a type defined by a controlled vocabulary (*site_type*), and site-specific metrics are stored in corresponding detail tables. The fact table (*fact_site_event*) acts as the central event log, capturing high-level metadata such as execution IDs, time ranges, common statistics which are common for all the sources (i.e. carbon footprint CFP), and job completion status. Detailed metrics which are specific for different sources, are linked to external tables by references.

To support performance and scalability, the schema includes indexed fields for frequent query patterns. The separation of general and site-specific data allows the system to evolve with minimal disruption, as new types of infrastructures or metrics can be integrated by adding corresponding entries in the vocabulary table (*site_type* and *site_type_detail*) mapping and defining new detail tables.

In terms of sustainability, the Environmental Impact Collector DB is designed for long-term maintainability. It is fully supported and maintained within the SoBigData++ infrastructure, which ensures operational continuity, hosting resources, and governance. The use of open technologies and adherence to best practices in database design make it easy to extend and integrate into broader environmental monitoring frameworks.



5.2.5.2 *Impact-aware Workload Manager*

DIRAC serves as the workload manager and resource broker, capable of selecting suitable computing resources across heterogeneous infrastructures (local cluster, HTC, or Cloud) based on job characteristics. Through Task T6.3, DIRAC will be enhanced to include energy-aware resource brokering by integrating an environmental impact algorithm. This enhancement will rely on both job-specific metrics and site-specific sustainability data to make informed decisions. The goal is to maximise efficiency while minimising the environmental footprint of computing.

A set of new, standardised metrics has been defined in D4.2 and will be integrated into the selection process:

- HS23 (HEPScore23): The normalised wall-clock CPU time used by a job.
- PS23 (Power Score 23): CPU energy intensity, calculated as Thermal Design Power (TDP) divided by HS23.
- PUE (Power Usage Effectiveness): The ratio indicating how efficiently a site uses energy.
- CI (Carbon Intensity): The carbon footprint of electricity used during job execution, expressed in gCO₂eq/kWh.

Based on these values, DIRAC will choose between different resource types (e.g., faster CPUs) and data centres (high environmental performance), according to user-defined policies. For example, a memory-intensive task could be directed to a site with low CI and optimised RAM provisioning, while an I/O-heavy task may be routed to a local centre with better PUE but higher CI, depending on the job's urgency and resource availability.

This functionality is designed to be user-friendly and can be used both by researchers (end users) and Research Infrastructure operator, that are providing VRE to researchers. For example, researchers will submit their jobs through the DIRAC interfaces, and comprehensive documentation will explain the selection mechanism to ensure reproducible workflows. DIRAC will also provide environmental metrics post-execution, allowing users to assess the environmental impact of their jobs. The environmental metrics will be also sent to the GreenDIGIT Metrics DB service which will accumulate data from various computing infrastructures in a uniform way to allow monitoring of activities of research groups and evaluate the corresponding environmental impact. This monitoring is necessary to optimise the efficiency of the eventual impact-aware workload scheduling algorithms.

The dissemination strategy includes promoting this development as a new feature of the existing, well-known workload manager. Documentation will cover technical details of the resource selection algorithm and example use cases. Presentations at scientific computing and infrastructure conferences (e.g., DIRAC User Meeting, WLCG Workshop, EGI Conference) will highlight the feasibility of including environmental requirements in job workflows and assessing carbon footprints.

From a sustainability perspective, the component will be released under the Open Source GPLv3 license and made available on the DIRAC GitHub repository. It will also be archived by the Software Heritage repository. Additional metadata, based on the code meta standards, will be added to the DIRAC repository to enhance the findability and citability of the software. As long as the environmental metrics are published by the computing sites, the component will function effectively. We will also



include a specific module related to this component in the DIRAC standard training documents to enhance both sustainability and dissemination.

5.2.5.3 *Impact-aware Subsystems*

As described above, components belonging to individual levels work together to achieve the desired effect. The task of components at this level is to directly manage resources at the local site level based on energy and environmental metrics (workload characteristics, current carbon intensity of electricity, or other preferences resulting, for example, from the price profile of electricity consumption). A new component here is the energy optimisation controller, whose task is to combine available metrics/signals (current carbon intensity of electricity and regulatory requirements from the electricity grid or local heating network) with local policy. The resulting decision is implemented by the local batch system and auxiliary control components. Control measures may include: lowering the maximal CPU or GPU frequency, temporarily stopping jobs or shutting down the worker nodes, delaying or reshuffling the workload based on its characteristics.

Basically, these are low-level components hidden from the majority of researchers. But understanding their role is key to fine-tuning and improving the results. They provide important metrics on the achieved level of optimisation of the environmental impact, and knowledge of the concept of their functioning is necessary for anyone who designs scientific computing workflows. However, the typical user of these components remains the site administrator, who is responsible for the efficient use of actual resources.

Dissemination strategy: communicate as a technical background that is both professionally interesting and necessary for understanding the overall picture and why user involvement is needed. It is also important to understand the reason behind guidelines for researchers and workflow developers. The main topics: understanding the CPU intensity (CPU vs IO), signals from power grid (carbon intensity) and typical computing node power profile.

From a sustainability perspective, it is important to demonstrate the real benefits of new components. For this feedback, we will collect metrics and show the results specifically in the form of a dashboard (for site managers and operations) and targeted reports (researchers). The training materials currently being prepared will include a chapter focused on evaluating results and understanding the benefits of individual measures.

5.2.6 KER6: Environmental Impact Assessment Methodology and Self-Assessment Toolkit

5.2.6.1 *Environmental Impact Assessment Framework*

The Environmental Impact Assessment Framework, developed in WP3 (MI) and complemented by the self-assessment questionnaire from WP8 (EGI), enables digital Research Infrastructures (RIs) to evaluate their environmental sustainability across four impact categories: Global Warming Potential, Cumulative Energy Demand, Waste of Electronic and Electrical Equipment, and Water Depletion. Grounded in Lifecycle Assessment (LCA) principles, IAM4SDG framework, and tailored to the RI context, it helps users assess impacts across the RI life cycle and enables goal setting and formalising an action plan to mitigate negative environmental impacts.



Primary users include RI managers, sustainability officers, and technical coordinators. Broader stakeholders may include policymakers and certification bodies involved in sustainability monitoring and reporting.

The framework has been tested by GreenDIGIT RIs (EGI, SoBigData, SLICES, EBRAINS). After M18 of the project, it will be developed toward a certification baseline and promoted for wider uptake through engagement with standardisation and auditing bodies.

Continued development will focus on formalising its use in RI sustainability certification, aligning with EU policies, and engaging with existing standardisation, industry, and certification bodies for ensuring long-term relevance and exploitation beyond the project.

5.2.6.2 Self-Assessment Questionnaire

The self-assessment questionnaire, developed under Task T8.2, is a structured tool designed to support RIs in evaluating their environmental sustainability maturity. It covers key thematic areas such as governance, energy efficiency, circularity, monitoring, stakeholder engagement, and lifecycle integration. The tool enables RIs to assess their current capabilities, define target levels, and automatically generate prioritised action plans based on the identified gaps and associated environmental risks.

The primary users of the tool are RI operators, sustainability officers, infrastructure managers, and other decision-makers responsible for environmental planning and compliance. It is also relevant to policy stakeholders, funders, and auditors seeking a baseline understanding of RI sustainability performance.

The questionnaire will be disseminated to targeted RIs during the pilot phase, supported by stakeholder workshops and project communication channels. It is designed for long-term use within and beyond the project, supporting Deliverable D3.2 and potentially feeding into future sustainability certification schemes. The tool may also be made available through GreenDIGIT's digital resources or integration into external RI management platforms.

The tool is intended to remain usable and adaptable after the project ends. Its modular design allows for updates aligned with evolving standards, regulations, and project outcomes. By embedding the questionnaire into the GreenDIGIT methodology, it becomes a central component of ongoing RI sustainability assessment efforts, supporting continuous improvement and policy alignment over time.

5.2.6.3 Experiment sustainability assessment framework

This framework allows for assessing the environmental impact of a given experiment performed on one or many RIs. The framework accounts for the environmental impact of producing the energy used by the experiment, in the region(s) where it is performed, but also the impact of using mutualised resource from the RIs such as cooling or networking infrastructures, through the PUE, and a share of the lifecycle impact of the RIs through an imputation key.

The framework is targeted to users of RI, i.e., experiments.

The framework is designed to be adopted and maintained by RIs. Specifically, components of the framework designed to bridge the knowledge gap between operators and users are expected to be implemented by RI operators, while assessment, prediction, and data management components will be leveraged by users of RI. Nonetheless, this framework is implemented by a collection of tools that



are publicly available on code repositories, allowing external reuse of some or all components of the framework.

This framework allows sustainability assessment in any impact category, and accounts for both the impact of energy used by the experiment, the impact of using mutualised resources of the RI, and the impact of other stages of the life cycle of the RI, conforming with ISO14040/ISO14044.

5.2.7 KER7: Training Modules and Competence Framework

5.2.7.1 *Training modules*

Training modules are one of the key exploitable results and form a critical pillar of the project's exploitation strategy for M18–M36. Building on the foundational work completed in the first reporting period (Section 4.1.2), the training modules aim to provide RI professionals with practical skills and knowledge to implement sustainability principles in the lifecycle management and operation of digital infrastructures.

A structured set of training modules (minimum 20 by M36) is designed to build competences in environmental sustainability and energy efficiency for RIs. Modules cover topics such as energy monitoring, sustainable software engineering, environmental impact assessment, and green decision-support, aligned with the GreenDIGIT competence framework.

The primary target audiences include but are not limited to Researchers seeking to integrate sustainability into workflows, RI operators, engineers, and managers responsible for infrastructure efficiency, middleware developers who build or maintain RI services, Policymakers and policy advisors shaping RI sustainability policies and academic institutions and trainers incorporating modules into curricula.

Furthermore, the dissemination and exploitation strategy for this include Adoption by RIs through integration into competence centers (EGI, SLICES, SoBigData), Open-source training material hosted on EOSC Knowledge Hub, project website, and Zenodo, Publication of pedagogical approach and results in conferences and journals, Public webinars and training sessions, both live and recorded, shared on YouTube and the website, Visibility on the Horizon Results Platform (HRP) to reach wider EU stakeholders and Engagement in RI governance frameworks and evaluation programs (e.g., ESFRI Landscape Analysis).

Finally, the sustainability for this component will include update and integration into university curricula.

5.2.7.2 *Train-the-trainer*

Through the Train-the-trainer component, EBRAINS will support the project's trainers in adopting the GreenDIGIT tools in their training modules for RI's users, developers, and managers. It will coordinate tool owners' efforts to develop and implement resources for instructors through an incremental approach for various categories of trainees. To facilitate uptake by trainers and establish regular training courses in the partner RIs and other European RIs and institutions, sustainability tools will be accompanied by resources including tutorials and knowledge check tests. A dedicated taskforce will enable exchanges of best practices between trainers and tools' owners. The latter category will have a crucial role in making their tools ready to use by trainers and developing targeted materials. The



process will start with the tools that are already suitable for teaching and will establish a list of other tools that are promising from this point of view.

The Dissemination and Exploitation Strategy for this includes the creation of a dedicated page with tools' resources on the GreenDIGIT website, YouTube channel tutorials and regular promotion on X, LinkedIn, newsletter to increase the adoption amongst the project's trainers and attract external trainers from other RIs and universities, as well as promotion through conferences and other training/workshop sessions, both in-person and online.

The sustainability of this component will include maintenance efforts, updates when necessary, and its adoption into trainers' toolbox.

5.2.7.3 Micro-Credential and Certification Path

Description of components: Building on the training modules of GreenDIGIT, introduced in Section 5.2.7.1, CSIC has developed a pilot micro-credential. This micro-credential is designed to provide students with the academic and professional competencies necessary to incorporate an environmental sustainability perspective into digital infrastructures and services. Students will acquire knowledge about the Sustainable Development Goals (SDGs), environmental sustainability policies and regulations, relevant standards, and shared responsibility models for sustainability.

Target Audiences: The primary target audiences include academic institutions, professional organisations, government agencies, private sector companies, non-governmental organisations, and individual professionals. A special focus is towards academic institutions, such as universities and vocational training centres, that can benefit from integrating the micro-credential into their existing programs, enhancing their curriculum with a sustainability focus.

Dissemination and Exploitation Strategy: To expand our reach, we will collaborate with academic institutions, industry associations, and professional organisations. By partnering with these entities, we can integrate the micro-credential into existing curricula, offer it as a standalone certification, and gain endorsements that enhance its credibility. As a pilot for these activities, we have engaged with CSIC postgraduate department, in order to implement a first edition of this micro-credential in the next reporting period.

Sustainability: To ensure the long-term sustainability of the micro-credential, our primary focus will be on securing funding through enrolment fees and support from organising institutions. This dual-pronged approach will provide a stable financial foundation, enabling us to continuously improve and expand the micro-credential offerings.

5.2.7.4 Model Curricula

The Model Curricula will provide a structured framework for integrating environmental sustainability and energy efficiency competences into education. Essentially, it translates the competence framework and training modules developed in GreenDIGIT into an analytical learning program, adaptable for university course.

The target audiences are mostly universities and higher education institutions that deliver under-/post-graduate programs. However, the appropriate structure will also deliver useful material which can also target RI competence centres, managers and decision makers.



The dissemination strategy will mainly include but is not limited to making the curricula openly available through the digital means of GreenDIGIT (website, Zenodo etc.). Furthermore, the produced curricula can be promoted through academic conferences and training events.

Finally, the sustainability actions will include long-term maintenance coordinated by academic partners to include continuous updates.

5.3 Intellectual Property Rights (IPR) Management Strategy

The GreenDIGIT IPR Management Strategy ensures that high-value outputs, with indicative examples such as the Environmental Impact Architecture (KER5) and User Tools (KER4). There, a smooth transition is given from design took place at Period 1 to Period's 2 application. In accordance with the Grant Agreement, ownership of results lies with the generating partner, while collaborative efforts are managed through joint ownership to recognize all contributions. To protect innovation, the consortium evaluates technical tools for formal protection (e.g., patents) before public disclosure, supported by a 45-day review period for all publications to prevent accidental IP loss. Finally, partners maintain access rights for project work on a royalty-free basis, while licensing for community use (via GPL or Creative Commons) is prioritized for software and training modules to maximize uptake and align with Open Science goals.



6 Conclusion

During the first reporting period (M1–M18), GreenDIGIT has built a strong foundation for both dissemination and exploitation. The project achieved significant visibility through the release of public deliverables, engagement of numerous RIs via surveys, workshops, and events, and the development of training content that is now being piloted in real settings. As stated, initial training modules and technical assets have been produced, raising significant interest among target stakeholders in public events. The online visibility has been steadily increasing, with consistent website traffic, active social media channels, and strong participation in events. In the second reporting period (M19–M36), the project will move from general awareness and engagement to targeted exploitation, with a focus on operational demos, formal adoption of training and competence outputs.

The progress made in the first reporting period aligns with the project’s overall objectives, particularly Objective 5, which emphasises educating and supporting digital service providers in environmentally conscious lifecycle management. The competence framework and training modules directly contribute to this objective, providing structured pathways. Technical outputs, including the environmental impact assessment methodology and modular architecture, strengthens the objective of enabling sustainable operations within RIs. Dissemination and exploitation actions have been aligned with the project’s Key Exploitable Results (KERs), ensuring that each activity contributes directly to the achievement of the expected impacts outlined in the Grant Agreement.

The intensive work conducted during the first period, will help GreenDIGIT to enter its second reporting period with a solid base of achievements and a clear strategy for targeted exploitation. Thus, the project’s KERs—whether technical tools, methodologies, or training frameworks—are expected to be integrated into operational contexts where they can have lasting impact. Specifically, RP2 will translate project results into a strategic roadmap for ESFRI and policymakers, while establishing a certification baseline and sustainability framework (WP9). That will align with international auditing standards to ensure the environmentally effective integration of these solutions across the RI ecosystem. The next phase will focus on demonstrating real-world applications, strengthening adoption pathways, and securing the legacy of the project’s results beyond its lifetime.

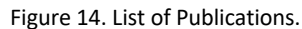


Appendix A. Dissemination Log (Period 1)

This appendix contains attached the complete information for the three major categories used to track publications, dissemination and communication activities during the execution of GreenDIGIT (M1 – M18). This information is continuously updated by the consortium members involved when new entries are available. It is worth noting that the information requested from the partners complies with this, required from EC during the project's reporting.

Table 6. List of dissemination logs

Type	Reference Figure	Hyperlink Table
List of Publications	Figure 14. List of Publications.	Hyperlinks are available to base text (Section 2.1)
List of dissemination activities	Figure 15. List of Dissemination Activities.	Table 7. Dissemination Activities Hyperlinks.
List of communication activities		Figure 16. List of Communication Activities. Table 8. Communication Activities Hyperlinks.

[illegible]

[illegible]

Figure 15. List of Dissemination Activities.



Table 7. Dissemination Activities Hyperlinks

No	Hyperlink
1	https://www.belspo.be/belspo/EUBelgium24/2024060405_ResearchInfrastructures_en.stm
2	https://privacysymposium.org/
3	https://56.euopen.cz/
4	https://www.eunis.cz/
5	https://icri2024.au/call-for-side-events-and-site-tours/
6	https://indico.egi.eu/event/6441/timetable/#20240930 https://www.egi.eu/event/egi2024/
7	https://eosc.eu/symposium2024/
8	https://coalitieduurzamedigitalisering.nl/events/nationale-conferentie-duurzame-digitalisering-2024/
9	-
10	-
11	https://www.dagstuhl.de/24462
12	https://zenodo.org/records/13970506
13	https://www.belspo.be/belspo/EUBelgium24/2024060405_ResearchInfrastructures_en.stm
14	https://networking.ifip.org/2024/
15	-
16	-
17	https://www.horizon-europe.gouv.fr/form/inscrip-maj-2026-feuille-route-forum-strat
18	https://www.wired.it/article/cnr-infrastruttura-digitale-ricerca-slices-d4science-sobigdata
19	https://2024.ieee-educon.org/
20	https://indico.ph.qmul.ac.uk/event/2173/
21	https://indico.cern.ch/event/1450885/
22	-
23	-
24	-



25	https://www.forschung-it-sicherheit-kommunikationssysteme.de/nationale-konferenz-it-sicherheitsforschung-2025
26	https://privacysymposium.org/
27	https://gdrGPL2025.sciencesconf.org/
28	https://www.greentech-forum-brussels.com/
29	https://www.egi.eu/event/egi2025/



No.	Communication activity name	Type of dissemination activity (category)	How - Other (descriptive if applicable)	Target audience reached (entity)	How - Other (descriptive if applicable)	Description of the objective(s) with reference to a specific project output (max 200 characters) (1 to 3)	How? Communication channel	Status of the communication activity	Other (if applicable)	Outcome	Project activities (category)	URL (if applicable)	Additional Information
1	TUM Sustainability Day	Education and training events	Info day	Civil society		experience the diversity and potential of all sustainability topics and activities at our university on TUM Sustainability Day.	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Deferred		Presented poster and small portable testbed demonstration to many interested participants.	TUM	https://www.tum.de/en/About-TUM/Events-and-Activities/Sustainability-day-2024	Kilian Hahnberger, Sebastian Gohmert, Johannes Seith, Georg Cofe
2	Linux Day	Conferences	Czech national OSS conference	Industry/business partners	Primary target group is Linux users and secondary is other open source enthusiasts in C2	Presentation of green concepts in research infrastructures with reference to power-grid flexibility as particular technical aspect.	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Deferred		Presentation and dissemination activity at C2047 booth.	C2047	https://www.linuxday.cz/2024/	Jiří Štěrba
3	Café Industry Day 2024	Education and training events	Industry workshop	Industry/business partners	also research communities	exchange with industrial partners on 6G, quantum computing, AI and sustainability	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Deferred		Presentation of sustainability aspects in the context of 6G/EEG	TUM	https://infocafes.tum.de/industry-day-2024/	Sebastian Gohmert, Georg Cofe
4	Berlin 6G Conference 2024	Conferences	The Annual Networking Event of the German 6G Program: Session on Large Scale Experimentation Facilities	Industry/business partners	also research communities	German 6G projects and their results, 6G 6G programs, regulatory questions such as sustainability, networking	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Deferred		Presentation of GreenDIGIT initiative in the context of 6G methods	TUM, 6G, 6G/EEG	https://www.6g-berlin.de/conference/	Manuel Simon, Sebastian Gohmert, Georg Cofe, Serge Föllmer
5	ITU-T Study Group 47 Sustainability Symposium (Shaping Sustainable Innovation)	Conferences		Research communities		Exchange with industry leaders, policymakers, etc. on the role of standards in promoting sustainable ICT practices.	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Deferred		Event participation	ITU	https://www.itu.int/ITU-T/studygroups/com17/StudyGroup47/Symposium2024/	Kita Lehto
6	Airbus Wireless Workshop 2024 "On-Case to 6G"	Outgoing activities		Industry/business partners		Presentation of Green DIGIT 6G with a poster and exchange. Target audience is the intersection of 6G industry, researchers, and European aviation industry	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Deferred		Event participation	TUM, 6G/EEG		David Patel, Kilian Hahnberger, Georg Cofe
7	EURODIGIT yearly user conference	Conferences		Research communities	IT staff	Awareness raising and promoting sustainable solutions and technologies	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Choice as item	upcoming	Presentation about the GreenDIGIT project	CTM4		
8	EBRANS Website news item	Other	News item on Project kick-off	Research communities		Raising awareness on project objectives and highlighting the role of the four digital research infrastructures, including EBRANS	Other	Deferred		Presentation of the project online	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Caroline Vucelja, Anna Fock
9	EBRANS Social media	Other	Announcing project kick-off on social media	Research communities		Promoted EBRANS' role in the GreenDIGIT project on Twitter, Mastodon, Bluesky and LinkedIn	Social media	Deferred		Presentation of the project online	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Caroline Vucelja, Anna Fock
10	EBRANS Social media	Other	Short video presentation of the session "Research infrastructures in a changing climate: Environmental & Socio-Economic Challenges"	Research communities		Promotion of the Session about Socio-economic and environmental impact of 6G and presentation about Greening of Research Infrastructures	Social media	Deferred		Increased awareness of project's key elements	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Ugoen Sudhasingh
11	Informative GreenDIGIT article on C2047 website	Choice as item	News item on Project kick-off	Choice as item	research communities, general public	Promoting the project	Other	Deferred		Article on the webpage	CTM4	https://www.ctm4.eu/en/press/2024/01/24/ebbrans/	
12	ITU-T Study Group 47 Sustainability Symposium (Shaping Sustainable Innovation)	Conferences		Research communities		Empowering Sustainability: Energy Efficiency and Circular Design in 6G	Event (conference, meeting, workshop, internet debates, round table, group discussion, etc.)	Deferred		Presentation about the GreenDIGIT project	ITU	https://www.itu.int/ITU-T/studygroups/com17/StudyGroup47/Symposium2024/	Radha Balaji, Marianne Nicole Simon
13	ESG Inspired Magazine	Other	Magazine article	Research communities		Promoting the project	Media article	Deferred		Brief presentation of the GreenDIGIT project	ESG	https://www.esg-inspired.eu/en/2024/01/24/ebbrans/	Georgij Sijm
14	ESG Newsletter	Other	Newsletter article	Research communities		Promoting the project	Newsletter	Deferred		Presentation of the project kick-off	ESG	https://www.esg-inspired.eu/en/2024/01/24/ebbrans/	Georgij Sijm, Carsten Conrath
15	EBRANS news item & newsletter article	Other	Website article, newsletter article	Research communities		Promoted the GreenDIGIT Design Workshop (23-24 January 2024) by showcasing the main takeaways	Media article	Deferred		Increased awareness of the event, project and topics	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Caroline Vucelja
16	EBRANS news item & newsletter article	Other	Website article, newsletter article	Research communities		Promoted the 4th hands meeting (26 September - 1 October 2024) by showcasing the main takeaways	Media article	Deferred		Increased awareness of the event, project and topics	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Caroline Vucelja
17	EBRANS Social media	Other	Social media - X, LinkedIn, Mastodon, Bluesky	Research communities		Promoted the GreenDIGIT Design Workshop (23-24 January 2024)	Social media	Deferred		Raised awareness of the event, project and topics	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Caroline Vucelja
18	2 EBRANS Social media posts	Other	Social media - X, LinkedIn, Mastodon, Bluesky	Research communities		Promoted the 4th hands meeting (26 September - 1 October 2024) during and after the event	Social media	Deferred		Raised awareness of the event, project and topics during and after the event	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Caroline Vucelja
19	EBRANS Social media	Other	Social media - X, LinkedIn, Mastodon, Bluesky	Research communities		Promoted the 4th GreenDIGIT newsletter	Social media	Deferred		Raised awareness of the newsletter project and activities	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Caroline Vucelja
20	EBRANS Social media	Other	Social media - X, LinkedIn, Mastodon, Bluesky	Research communities		Promoted EBRANS' participation in the 6G Foundation Annual Conference 2024	Social media	Deferred		Participated in dissemination activities at the GreenDIGIT booth	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Andrea Bordini, Caroline Vucelja
21	EBRANS Website news item	Other	Website article	Research communities		Promoted the main takeaways of the 6G/EEG Conference in September	Media article	Deferred		Raised awareness of the GreenDIGIT consortium's efforts towards more sustainable 6G	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Andrea Bordini, Caroline Vucelja
22	EBRANS newsletter	Other	Newsletter article	Research communities		Promoted the main takeaways of the 6G/EEG Conference in September	Newsletter	Deferred		Raised awareness of the GreenDIGIT consortium's efforts towards more sustainable 6G	EBRANS	https://www.ebrans.eu/press/2024/01/24/ebbrans/	Andrea Bordini, Caroline Vucelja

Figure 16. List of Communication Activities.



Table 8. Communication Activities Hyperlinks.

No	Hyperlink
1	https://www.tum.de/en/about-tum/goals-and-values/sustainability/sustainability-day-2024
2	https://www.linuxdays.cz/2024/
3	https://collab.dvb.bayern/display/TUMtueisecevents/CoC+Industry+Day+2024
4	https://www.6g-platform.com/berlin-6g-conference/
5	https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2024/1211/Pages/default.aspx
6	-
7	-
8	https://www.ebrains.eu/projects/greendigit
9	https://x.com/EBRAINS_eu/status/1778398232084643994
10	https://www.linkedin.com/posts/ulpan-kudaibergenova_environmental-activity-7204421516887826432-tMSL?utm_source=share&utm_medium=member_desktop
11	https://sztaki.hun-ren.hu/en/current/news/2024/greendigit-horizon-europe-project-reducing-environmental-footprint-launches-hun
12	https://www.itu.int/en/ITU-T/Workshops-and-Seminars/2024/1211/Documents/Raffaele%20Bolla.pdf
13	https://www.egi.eu/magazine/issue-2024-02/greendigit-pioneering-sustainable-digital-services-for-research-infrastructures/
14	https://www.egi.eu/article/greendigit-project-kicks-off/
15	https://www.ebrains.eu/news-and-events/making-research-infrastructures-more-sustainable-ebrains-participated-in-the-greendigit-design-workshop
16	https://www.ebrains.eu/news-and-events/greendigit-towards-more-sustainable-digital-research-infrastructures
17	https://x.com/EBRAINS_eu/status/1897256086773825735
18	https://x.com/EBRAINS_eu/status/1858868550502412677; https://x.com/EBRAINS_eu/status/1841458463647453676 https://x.com/EBRAINS_eu/status/1841458463647453676
19	https://x.com/EBRAINS_eu/status/1869772999857164295



20	https://x.com/EBRAINS_eu/status/1933538196513525866
21	https://www.ebrains.eu/news-and-events/ebrains-contributed-to-greener-digital-research-at-egi2025-conference-in-santander