



Deliverable D 5.2

Final Dissemination, Communication and Exploitation Report

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Table of Contents

1.	Executive Summary	4
2.	Abbreviations and acronyms	5
3.	Background	7
4.	Objective/Aim	8
5.	Project summary.....	9
5.1.1.	The consortium	9
5.1.2.	Scope of the FUNDRES project.....	9
5.1.3.	FUNDRES objectives.....	10
5.1.4.	Target audience	10
5.1.5.	Key project results	11
6.	Dissemination activities and communication with other S2R projects.....	12
6.1.1.	Project graphic identity.....	12
6.1.2.	Project public website.....	12
6.1.3.	Project news.....	13
6.1.4.	Newsletters	15
6.1.5.	Social media	15
6.1.6.	Publications/articles.....	15
6.1.7.	Participation in international conferences and forums.....	17
6.1.8.	Link with other Shift2Rail projects.....	17
6.1.9.	Organisation of a final event.....	18
6.1.10.	Project dissemination and promotion KPIs.....	29
7.	<i>Exploitation</i>	29
7.1.	Exploitation strategies	29
7.1.1.	LAPLACE	30
7.1.2.	EPFL	31
7.1.3.	POLIMI.....	32
7.1.4.	UIC.....	32
7.1.5.	S2R JU and IN2STEMPO members	33
7.1.6.	Scientific community.....	33
7.1.7.	Railway operators	33
7.2.	Potential barriers to the exploitation of results	33
8.	Conclusions.....	34

1. Executive Summary

FUNDRES work-package 5 (WP5) covers the dissemination, communication and results exploitation of the project. WP5 has been coordinated by UIC and all FUNDRES partners have been committed first to raise awareness, engage external stakeholders and then disseminate and exploit the project's results within and beyond the Shift2Rail JU. The core objective of work package 5 was to disseminate key findings and outcomes of the project in a structured manner in order to maximise project impact and outreach across key stakeholder groups during and after the end of the project

This document has been prepared to report the communication, dissemination and exploitation activities performed all along FUNDRES project life, and to describe the means that have been used to facilitate the wide-spread of information and knowledge from the results created by the project, among and beyond the members of the consortium.

In this deliverable, we will present materials and strategies used by the consortium partners for communicating and disseminating FUNDRES objectives and results to related stakeholders and the scientific community. Those include:

- The creation of a project identity;
- The creation of a public website;
- The creation of project Newsletters;
- The use of social media;
- Publications/articles on the project objectives and achievements;
- Participation in conferences and forums;
- Interactions with other Shift2Rail projects;
- The organisation of a final event.

The last chapter of this report will be dedicated to the exploitation measures that have been undertaken during the past two years and to the exploitation measures planned beyond the life of the project.

2. Abbreviations and acronyms

Abbreviation/Acronyms	Description
AB	Advisory Board
AC	Alternative Current
APEC	Applied Power Electronics Conference
CFM	Call For Members
CIFI	College of Italian Railway Engineers
DC	Direct Current
ECCE	IEEE Energy Conversion Congress and Exposition
ECPE	European Center for Power Electronics
EPFL	Ecole Polytechnique Fédérale de Lausanne
ERA	European Union Agency for Railways
ETR	Eisenbahn Technische Rundschau
FDCTS	Flexible DC Transmission System
FUNDRES	Future UNified Dc Railway Electrification System
GA	Grant Agreement
IEEE	Institute of Electrical and Electronics Engineers
IP	Innovation Programme
IPR	Intellectual Property Rights
IN2STEMPO	Innovative Solutions in Future Stations, Energy Metering and Power Supply
IRJ	International Railway Journal
JRRT	Journal of Rail and Rapid Transit
LAPLACE	Laboratoire Plasma et Conversion d'Energie
MVDC	Medium Voltage Direct Current Power Link Universal System
PCIM Europe Conference	Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management
POLIMI	Politecnico di Milano
RGCF	Revue Générale des Chemins de Fer
RTR	European Rail Technology Review
S2R JU	Shift2Rail Joint Undertaking
STC	Steering Committee
TD	Technology Demonstrator
TRA	Transport Research Arena
TRL	Technology readiness level
TSO	Transmission System Operator
UEEIV	Union European Railway Engineering Associations

UIC	Union Internationale des Chemins de fer
WCRR	World Congress on Railway Research
WP	Work Package

3. Background

FUNDRES “Future UNified Dc Railway Electrification System” is a 24-month project, funded by the Shift2Rail JU under the European Union Horizon 2020 Research and innovation programme.

FUNDRES project answers to the challenges identified in the Shift2Rail Open Call “S2R-OC-IP3-01-201: Future traction power supply for railways and public transport”. The call is inserted on Shift2Rail Innovation Programme 3 -IP3 “Cost-Efficient and Reliable High-Capacity Infrastructure” of the Shift2Rail Master Plan, and it is related to the topics of Future traction power supply for railways and public transport.

The Call is associated to the Technology Demonstrator – TD3.9: Smart Power Supply.

The present document “Final Dissemination, Communication and Exploitation Report” - Deliverable D5.2 – is the second deliverable within Work Package 5 (Communication, dissemination and link with other projects of S2R) of the FUNDRES project (Grant Agreement No. 881772).

WP5 involves three tasks, as follows:

- Task 5.1 - Project Dissemination and Promotion
- Task 5.2 - Dissemination activities and communication with other projects of S2R
- Task 5.3 - Exploitation plan

This document will present the outcomes of the dissemination and communication activities (material produced, list of dissemination actions, audiences reached), and a roadmap for the exploitation of FUNDRES technologies and project results.

4. Objective/Aim

The core objective of this work package is to disseminate key findings and outcomes of the project in a structured manner in order to maximise project impact and outreach across key stakeholder groups.

As outlined in the FUNDRES description of work, the dissemination objectives are to:

- Identify the main dissemination target groups and ensure the adequate promotion of the project, its activities and results,
- Prepare materials for the dissemination activities,
- Maximise the dissemination potential of the project outputs to the railway community, for the members of Shift2Rail JU and the partners of IN2STEMPO,
- Provide a plan for exploitation of the project outputs and support their long-term effects,
- Organise a final event for the presentation of the project results to the advisory group in collaboration with the JU S2R.

The dissemination of FUNDRES has been essential throughout the project's life and needed to be carried out with the cooperation of all work packages and all project partners. The aim of this document is to provide the dissemination, communication and exploitation activities as well as the impact of these actions to fulfil the objectives of WP5 described in the FUNDRES GA.

This deliverable will show the achievements of WP5, i.e.:

- The development of all planned dissemination tools,
- The creation of all planned publications (project brochure and newsletters),
- The use of social media to communicate efficiently on the project;
- The complete list of disseminated FUNDRES activities at events such as workshops, conferences, webinars and internal meetings,
- The cooperation with other Shift2Rail projects, and
- The organisation of a final event,

It will also detail the exploitation measures that have been undertaken during the past two years and will present the exploitation plan of the project partners after project end.

5. Project summary

5.1.1. The consortium

FUNDRES consortium is composed of four partners. Three of them are technical research centers:

- Institut National Polytechnique de Toulouse (LAPLACE)
- Ecole Polytechnique Fédérale de Lausanne (EPFL), and
- Politecnico di Milano (POLIMI)

The fourth partner is the International Union of Railways (UIC), the worldwide organisation for international cooperation among railways and promotion of rail transport at a global level.

5.1.2. Scope of the FUNDRES project

The challenge for the railway sector regarding energy is to increase the capacity while improving the energy consumption and limiting the environmental impacts, and to decrease the investment and exploitation costs, while maintaining safety and service quality. It makes it necessary to rethink railway power supply under future requests, reflecting the status of different systems.

FUNDRES presents a deep thinking and related work to define the future of railway, based on new Future UNified Dc Railway Electrification System based on 9 kVDC, able to integrate the existing lines during transition period. In the coming years, MVDC power grids will contribute to the deployment of renewable energies and the electrification of transport systems. Compared to classical AC electricity distribution networks, they are generally more energy efficient and facilitate the interconnection of sources, storage elements and loads. In 2018, a new 9 kV DC railway electrification system is presented as an opportunity for railway sector. The ambitions of FUNDRES are to bring substantial improvements in the energy technology area and station for the future unified system based on 9 kVDC. The consortium composed by LAPLACE, EPFL, POLIMI and UIC have developed several scenarios, validated by experimental demonstration at the laboratory level (TRL4). The digital twin offers the possibility to predict the behaviour and the impacts of the proposed unified electrical system based on 9kVDC.

The project outputs are and will be used to deliver new integrated technology demonstrators and scientific progress for the project IN2STEMPO, and more largely for Shift2Rail, which will be implemented in the railway network.

5.1.3. FUNDRES objectives

The main objectives of The Shift2Rail funded project FUNDRES “Future UNified Dc Railway Electrification System” are:

- to define the future unified DC railway electrification including:
 - the study of the strategy for changing the railway electrification system from 1.5 kVDC or 3 kVDC to 9 kVDC;
 - the setting-up of the Flexible DC Transmission System (FDCTS) concept which allows to implement a new DC line, interconnected with different AC lines by means of power electronics devices;
 - the analysis of the integration in a common DC link that acts as an energy hub that collects the electricity production from the other sources (wind or solar) or the braking trains and deliver it to the connected loads, as the trains in traction phase or the charging infrastructures for electric vehicles. These common DC link can be realised at various voltage levels;
- to deliver modelling tools to simulate all scenarios and to implement Digital Twins, both at equipment level and system level;
- to set up representative experimental demonstration to evaluate performances of the future system;
- to give recommendations for the new future unified DC railway power supply to the project’s advisory group, to the members of Shift2rail’s Innovation Programme n°3, to standardisation committees.

5.1.4. Target audience

The consortium has and will continue disseminating the results of FUNDRES at three different levels:

- Cooperation with the S2R JU and IN2STEMPO members
- Scientific community and railway operators
- Public

In collaboration with WP1, a map of the dissemination target audiences was built at the start of the project. This map has been used to tailor the dissemination channels to the needs of these target audiences by defining a distinct strategy of targeted messages, means and language.

The target groups have been identified and described on the basis of the level of interest in the topics and the use of information/communication: conceptual use, impacting levels of knowledge and understanding, strategic use, impacting the definition of policies and broad research themes.

Railway undertakings, Infrastructure managers, Railway associations and Federations: The new concept proposed in the project has been presented to all stakeholders in the railway sector. These include presenting the strong points and main results of the project and highlighting the advantages that MVDC electrification can bring in the current context of using renewable energies.

Railway Traction Power Supply industry: The studies carried out in WP2, WP3 and WP4 have allowed to define a new range of power converters intended for supplying electrified railway infrastructure in MVDC. Project partners have and will communicate on the expected specifications, in particular in terms of functionality and power level.

Electricity Transmission System Operators: Until now, railway lines have been viewed by power TSOs as consumers. The project proposes a new vision for the management of electrical energy on railway infrastructure. Railway lines electrified in MVDC can serve as an energy hub for renewable energies and offer to TSOs new services such as voltage and frequency support. Therefore, WP2 results have and will be disseminated widely to railway operators.

Research institutions and laboratories: The activities of WP2 to WP4 are carried out in research laboratories in the field of electrical engineering and more particularly at the level of power systems and power electronics. The results obtained cover both a system approach with the development of digital models as well as an experimental approach with the implementation of power converter tests and a final demonstrator. These results have been widely disseminated to the community of researchers in electrical engineering.

5.1.5. Key project results

The interfacing of the future 9 kV DC power system with the public grid has been studied. This work was performed on a research platform dedicated to the Modular Multilevel Converter. To study several scenarios, a Real Time Hardware In the Loop (RT-HIL) system has been developed both for MMC and railway system. The RT-HIL system was implemented on a real-time simulator equipment (RT-Box) designed by PLEXIM for power electronics applications. Relevant electrical waveforms were recorded in real-time taking into account the train moving. In particular, they demonstrated the possibility to restore braking energy to the public grid. In parallel with this work, two prototypes of MMC (5 kV / 250 kVA - 48 cells) were built (1 of them will be finished in January 2022). Due to the global semi-conductors shortage, this outstanding test platform will be used to set up an experimental demonstration at the real voltage level of the future DC railway electrification system only in January 2022 when both MMC will be complete.

A Digital Twin (DT) of the future 9 kV DC power system was proposed. The DT was implemented in MATLAB/SIMULINK software. It includes the traction substations, the railway traction circuit (contact line and locomotives), Renewable Energy Sources (wind farm and Solar Plant), Energy Storage System and Electrical Vehicles charging infrastructures. An Energy Management System algorithm has been proposed considering different scenarios. Finally, the DT made it possible to demonstrate the feasibility of the integration of renewable sources into a railway traction system, taking into account the various power flows due to the railroad traffic and the natural variability of the Renewable Energy Sources.

Experimental tests of one elementary module of a Solid State Transformer (SST) have been carried out and outstanding results were obtained in terms of energy efficiency. An electrical model of a three-wire DC power supply, including SSTs, was proposed to prepare for a transition between 1.5 kV and 9 kV electrification systems. A full 3D design of a 9 kV/1.5 kV SST in a container configuration has been completed. The study of the integration of the SST in a 1.5 kV electrification system was carried out using a model implemented in the PLECS simulation software and the simulation results demonstrated full compatibility.

Despite its short duration and thanks to all the academic work carried out, FUNDRES has demonstrated the relevance of developing a new DC railway electrification system. Over the long term, it paves the way to a new European standard of DC voltage level, which will allow better interoperability of rolling stock.

6. Dissemination activities and communication with other S2R projects

Several actions presented below have already been amply explained in deliverable D5.1 (Dissemination, Communication and Exploitation Plan). We will therefore only sum them up and update them all with the latest deliveries (such as FUNDRES newsletters, social media use, publications and final event).

6.1.1. Project graphic identity

The project identity has been created at the beginning of the project. It included:

- Logo,



- Templates for presentations and reports,
- a project brochure,
- and a project presentation.

The project identity has been used all over the lifetime of the project and has helped dissemination activities and ensured a consistent communication of the project concept, objectives and results.

6.1.2. Project public website

The website of the FUNDRES project has been set up at the beginning of the project and is available at the following address: <https://fundres-project.eu/>. This website contains a public area, used for dissemination, in which the content is provided in HTML or PDF format, following EU recommendations. It also contains a private area, implemented in the UIC extranet, for management and collection of the technical information. Figure 1 below will present FUNDRES website homepage.



Figure 1 FUNDRES website homepage

The public area has been designed to display a similar look in most web browsers as well as mobile devices (responsive design style).

Keywords have been used to take advantages of Search Engine Optimization (SEO) techniques and ease indexing by any search engine. This tree structure is pyramidal, with the main page representing the summit of the pyramid and the sections “Overview”, “News”, “Contact” and “Extranet”.

All documents prepared for the project (flyer, newsletters, news, documents for final event, etc.), as well as all approved public deliverables have or will be soon published on the website, announced via twitter and are still available for download. The website will remain active at least five years after the end of the project.

Analysis of the website impact

Google Analytics and Google’s tools for webmasters were used to analyse the RSS feeds and web page use. All along the project life, the website was visited by 1900 users who viewed 3 700 pages (see figure below).

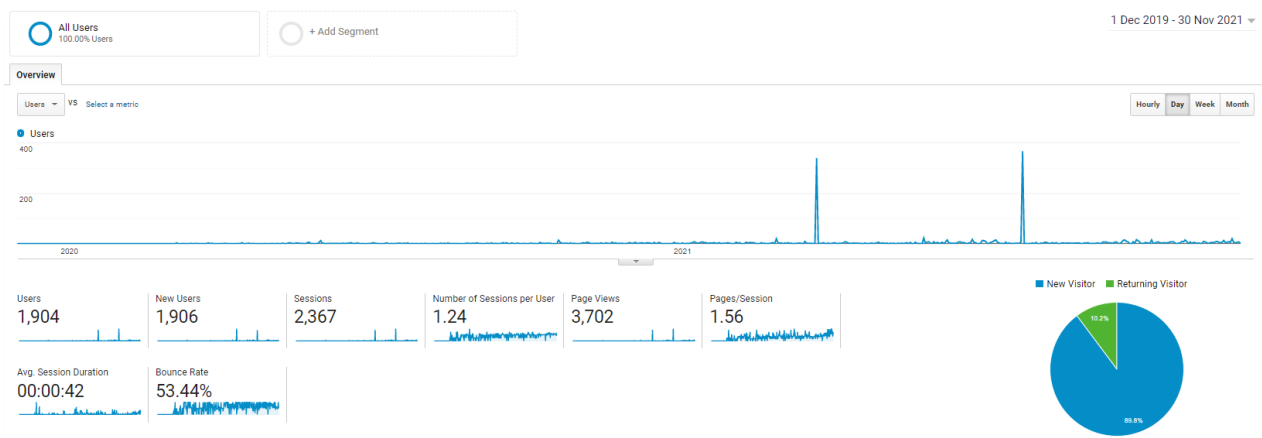


Figure 2 Number of visitors of FUNDRES website

6.1.3. Project news

All along the project life, several news articles were published on the project website:

3 December 2019 - “FUNDRES kick-off meeting held on 28 November 2019 at SNCF RESEAU premises in Saint-Denis, France”:

<https://fundres-project.eu/2019/12/03/fundres-kick-off-meeting/>

15 November 2020 – “Presentation of FUNDRES at the Shift2Rail Innovation Days on 23/10/2020”:

<https://fundres-project.eu/2020/11/15/presentation-of-fundres-at-the-shift2rail-innovation-days-2020/>

13 January 2021 – “FUNDRES held its first Advisory Board online on 1st December 2020”:

<https://fundres-project.eu/2021/01/13/fundres-held-its-first-advisory-board-online-on-1st-december-2020/>

08 February 2021 FUNDRES NEWSLETTER - FEBRUARY 2021:

<https://fundres-project.eu/2021/02/08/fundres-newsletter-february-2021/>

07 April 2021 – “Adapting Digital Twin Technology in Electric Railway Power Systems”:

<https://fundres-project.eu/2021/04/07/the-solid-state-transformer-an-essential-device-in-the-evolution-of-dc-railway-electrification-systems/>

06 May 2021 – “Characterization of a 300 kW isolated DC/DC converter using 3.3 kV Sic-MOSFETs”:

<https://fundres-project.eu/2021/05/06/characterization-of-a-300-kw-isolated-dc-dc-converter-using-3-3-kv-sic-mosfets/>

23 June 2021 – “Flexible and Efficient MMC Digital Twin Realized With Small-Scale Real-Time Simulators”:

<https://fundres-project.eu/2021/06/23/flexible-and-efficient-mmc-digital-twin-realized-with-small-scale-real-time-simulators/>

16 September 2021 – “Shift2Rail-funded IP3 FUNDRES project final event to be held on 17 November 2021 at EPFL in Lausanne”:

<https://fundres-project.eu/2021/11/14/shift2rail-funded-ip3-fundres-project-final-event-to-be-held-on-17-november-2021-at-epfl-in-lausanne/>

11 October 2021 – “FUNDRES/IN2STEMPO/MVDC-ERS joint newsletter – October 2021”:

<https://fundres-project.eu/2021/10/11/fundres-in2stempo-mvdc-ers-joint-newsletter-october-2021/>

On 14 November 2021: “Shift2Rail-funded IP3 FUNDRES project final event to be held on 17 November 2021 at EPFL in Lausanne”:

<https://fundres-project.eu/2021/11/14/shift2rail-funded-ip3-fundres-project-final-event-to-be-held-on-17-november-2021-at-epfl-in-lausanne/>

On 18 November 2021: “FUNDRES Final event held on 17 November 2021 at EPFL in Lausanne”:

<https://fundres-project.eu/2021/11/19/fundres-final-event-held-on-17-november-2021-at-epfl-in-lausanne/>

News were also published in the partners channels:

UIC eNews: On 13 December 2019: "FUNDRES kick-off meeting held on 28 November 2019 at SNCF RESEAU premises in Saint-Denis, France":

<https://uic.org/com/enews/671/article/fundres-kick-off-meeting-held-on-28-november-2019-at-sncf-reseau-premises-in>

UIC eNews: On 28 October 2021: “Shift2Rail-funded IP3 FUNDRES project final event to be held on 17 November at EPFL in Lausanne”:

<https://uic.org/com/enews/article/shift2rail-funded-ip3-fundres-project-final-event-to-be-held-on-17-november-at>

EPFL website: <https://actu.epfl.ch/news/future-unified-dc-railwayelectrification-system/>

POLIMI website: https://www.polimi.it/index.php?id=6414&L=1&id_progetto=312

UIC website: <https://uic.org/projects/article/fundres>

6.1.4. Newsletters

Two newsletters were published during the project life.

The first newsletter was published in February 2021 and can be downloaded on the project website at:

https://fundres-project.eu/wp-content/uploads/2021/02/FUNDRES_newsletter_202102.pdf

The second newsletter was published in October 2021 and was prepared after the IP3 Shift2Rail joint event organised in June by members from FUNDRES/IN2STEMPO/MVDC-ERS.:

<https://fundres-project.eu/2021/10/11/fundres-in2stempo-mvdc-ers-joint-newsletter-october-2021/>

6.1.5. Social media

The LinkedIn and twitter accounts of the project partners have been used to announce the publication of documents and news in the project website, as well as the joint Shift2Rail IP3 event and FUNDRES final event.

Posts on social media will be made after project end to announce the final webinar which will be held online on 18 January 2021 and to go on disseminating information on the project results.

6.1.6. Publications/articles

Several peer-reviewed articles have been published by FUNDRES project partners all along the project life.

Paper entitled “The Evolution of Railway Power Supply Systems Toward Smart Microgrids: The concept of the energy hub and integration of distributed energy resources” published in IEEE Electrification Magazine (Volume: 8, Issue: 1, March 2020): doi: [10.1109/mele.2019.2962886](https://doi.org/10.1109/mele.2019.2962886),

Paper in proceedings entitled “Long-Horizon Direct Model Predictive Control for a Series-Connected Modular Rectifier” at the PCIM Europe digital days 2020; International Exhibition and Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management, 7-8 July 2020, Frankfurt, Germany:

<https://ieeexplore.ieee.org/document/9178019>,

Paper entitled “Adapting Digital Twin Technology in Electric Railway Power Systems,” published in the 12th Power Electronics, Drive Systems, and Technologies Conference (PEDSTC) proceedings, February 2021, pp. 1-6: DOI: [10.1109/PEDSTC52094.2021.9405876](https://doi.org/10.1109/PEDSTC52094.2021.9405876),

Paper entitled “The solid state transformer - an essential device in the evolution of DC railway electrification systems” published in Power & Beyond, the Platform for Power Electronics, 7 April 2021 - Expert article - <https://www.power-and-beyond.com/the-solid-state-transformer--an-essential-device-in-the-evolution-of-dc-railway-electrification-systems-a-1013013/>

Paper entitled “Characterization of a 300 kW isolated DC/DC converter using 3.3 kV SiC-MOSFETs” at the PCIM Europe 2021, digital days, International Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management, Nuremberg, Germany, 3-7 May 2021. Best paper award winner. <https://ieeexplore.ieee.org/document/9472326>

Paper entitled “A resonant DC/DC converter with high efficiency and power” published in Power

& Beyond, the Platform for Power Electronics, 14 June 2021, - Expert Article - <https://www.power-and-beyond.com/a-resonant-dcdc-converter-with-high-efficiency-and-power-a-1030331/>

Paper entitled “Flexible and Efficient MMC Digital Twin Realized With Small-Scale Real-Time Simulators” Published in IEEE Power Electronics Magazine (Volume: 8, Issue: 2, Pages 24– 33, 17 June 2021): <https://ieeexplore.ieee.org/document/9459198>,

Paper entitled “Virtual Capacitor Concept for Computationally Efficient and Flexible Real-Time MMC Model” Published in IEEE Access (Volume 9, page: 144211 – 144226, 18 October 2021).

DOI: [10.1109/ACCESS.2021.3121351](https://doi.org/10.1109/ACCESS.2021.3121351).

Paper entitled “Integration of Distributed Energy Resources and EV Fast-Charging Infrastructure in High-Speed Railway Systems” Published in Electronics 2021, 19 October 2021, 2555. Special Issue of Railway Traction Power Supply. DOI: [10.3390/electronics10202555](https://doi.org/10.3390/electronics10202555).

Paper entitled: “Hardware-in-the-Loop Modeling of an Actively Fed MVDC Railway Systems of the Future” published in IEEE Access (Volume 9, 17 November 2021, page: 151493 – 151506):

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9599687>

6.1.7. Participation in international conferences and forums

Due to the COVID situation, project partners several international events have been postponed or cancelled. Project partners however participated to several international events, mostly online:

Presentation entitled “Long-Horizon Direct Model Predictive Control for a Series-Connected Modular Rectifier” at the PCIM Europe digital days 2020; International Exhibition and Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management, 7-8 July 2020, Frankfurt, Germany: <https://ieeexplore.ieee.org/document/9178019>,

Presentation entitled “Adapting Digital Twin Technology in Electric Railway Power Systems,” delivered at the 12th Power Electronics, Drive Systems, and Technologies Conference (PEDSTC), Tabriz, Iran, 2-4 Feb. 2021: [10.1109/PEDSTC52094.2021.9405876](https://doi.org/10.1109/PEDSTC52094.2021.9405876),

Paper entitled “Characterization of a 300 kW isolated DC/DC converter using 3.3 kV SiC-MOSFETs” at the PCIM Europe 2021, digital days International Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management, Nuremberg, Germany, 3-7 May 2021. Best paper award winner. <https://ieeexplore.ieee.org/document/9472326>,

Presentation delivered at PCIM EUROPE 2021, 04-06/05/2021: “Characterization of a 300 kW isolated DC/DC converter using 3.3 kV Sic-MOSFETs”: <https://youtu.be/tlom97HUwzI>.

Presentation entitled “Braking energy recovery by Modular Multilevel Converters in MVDC Railway Electrification Systems” delivered at the 21st International Symposium on POWER ELECTRONICS Ee2021, Novi Sad, Serbia, 27-30 October 2021,

Presentation entitled “Implementation of DC Micro Grid Tied PV-Storage Based EV Fast Charging Station,” 2021 IEEE International Conference on Environment and Electrical Engineering and 2021 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), 13 November 2021, pp. 1-6, DOI: [10.1109/EEEIC/ICPSEurope51590.2021.9584631](https://doi.org/10.1109/EEEIC/ICPSEurope51590.2021.9584631),

Presentation entitled “DC Railway Micro Grid Adopting Renewable Energy and EV Fast Charging Station,” 2021 IEEE International Conference on Environment and Electrical Engineering and 2021 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), 13 November 2021, pp. 1-6, DOI: [10.1109/EEEIC/ICPSEurope51590.2021.9584729](https://doi.org/10.1109/EEEIC/ICPSEurope51590.2021.9584729).

Presentation foreseen for the incoming WCRR 2022 entitled “Hardware-in-the-Loop modelling of MVDC railway”.

6.1.8. Link with other Shift2Rail projects

All along the project life, there has been intensive exchange of information between LAPLACE for FUNDRES and SNCF Réseau for IN2STEMPO on task 4.2 of WP4.

FUNDRES partners have organised an online Advisory Board on 11th December 2020. This event was attended by participants from SNCF IR, SNCF Réseau, CAF, Alstom, Siemens Mobility and ERA. It offered the AB members an excellent opportunity to:

- Examine the project results with the members of the consortium,
- Provide technical, ethical and legal guidance, input and feedback on the requested objectives and technology needs,

- Propose and encourage the potential interactions of the project with other IP3 project initiatives and activities, and
- Identify the results for dissemination.

FUNDRES was presented at the S2R Innovation Days on 23/10/2020 in a session called Cost-efficient, sustainable and reliable high-capacity infrastructure. Three other S2R projects were presented in the same session: ASSETS4RAIL, IN2TRACK 2 and IN2STEMPO. The presentation delivered by the project coordinator is still available on the project website at:

<https://fundres-project.eu/wp-content/uploads/2020/10/S2R-Innovation-Days-FUNDRES.pdf>

On 29 June 2021, members of the Shift2Rail-funded projects FUNDRES, IN2STEMPO and MVDC-ERS organised a webinar on smart railway traction power supply. The event was organised, attended and animated by the members of the three projects. A round table moderated by the Shift2Rail programme manager was held in the afternoon. The recording of the event has been made available on the UIC YouTube channel at:

<https://www.youtube.com/watch?v=JeUNsAUWsLU>

A newsletter has been prepared and published in October 2021 to present the 3 projects and give a summary of the discussions held during the round table. All Three project partners have been able to send this newsletter by mail. It has also been made available on the project website at:

<https://fundres-project.eu/2021/10/11/fundres-in2stempo-mvdc-ers-joint-newsletter-october-2021/>

6.1.9. Organisation of a final event

The FUNDRES final event was held physically at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in Lausanne on 17 November 2021. This event was attended by around 20 participants from companies, such as Hitachi Energy, ABB Switzerland Ltd., CAF TE and SNCF Réseau and project partners. The event was announced in advance and largely advertised via the project website, the latest IP3 project newsletter, the UIC e-Newsletter, and via e-mails and social media. The advisory board members have been invited to join this event. Unfortunately, only one of them was available to participate.

FUNDRES Final event Programme	
09:15	Welcome by EPFL and project coordinator (LAPLACE)
09:20	Presentation by Shift2Rail IP3 Programme Manager
09:40	Presentation of project objectives by FUNDRES coordinator (LAPLACE)
10:00	WP2: Grid interaction Railway power supply and public grid (EPFL) (presentation 25 mn / Q&A 15 mn)
10:40	Coffee Break
11:10	WP3: Integration of renewable sources, storage systems and charging infrastructures in 9 kVDC railway system (POLIMI) (presentation 25 mn / Q&A 15 mn)
11:50	WP4: Solid State Transformer (LAPLACE) (presentation 25 mn / Q&A 15 mn)
12:30	Lunch (Buffet)
13:45	Visit of the Power Electronics Laboratory at EPFL: demo digital twin and MMC prototype
14:45	Coffee Break
15:00	Round table: Review of the project results and prospects
17:00	End of final event

Figure 3 Final event programme

The presentations delivered during the final event have been made available on the project website. A thank you e-mail has been sent to all participants to let them know how to find the presentations. Announcement has also been made via twitter and LinkedIn.



Figure 4 Twitter post after final event

To reach a larger audience, the consortium partners have decided to organise after project end a 2-hour online event. This event will be held on 18 January 2022 and will be soon largely announced via social media. Members of the Advisory Board will again be invited to participate.

Table 1 FUNDRES Table of dissemination actions

Categories	Date	Location	Name of action/Short description	Link
Social media	All project life	Twitter and LinkedIn	several tweets and posts to announce project documents and events (#FUNDRES)	(#FUNDRES)
Article	03/12/2019	FUNDRES website	Article in the project website: "FUNDRES kick-off meeting held on 28 November 2019 at SNCF RESEAU premises in Saint-Denis, France"	https://fundres-project.eu/2019/12/03/fundres-kick-off-meeting/
Article	13/12/2019	UIC eNews #671	"FUNDRES kick-off meeting held on 28/11/2019 at SNCF RESEAU premises in Saint-Denis, France"	https://uic.org/com/enews/671/article/fundres-kick-off-meeting-held-on-28-november-2019-at-sncf-reseau-premises-in?var_recherche=FUNDRES
Press release	19/12/2019	EPFL website	Presentation of the project	https://actu.epfl.ch/news/future-unified-dc-railway-electrification-system/
Press release	21/12/2019	POLIMI website	Presentation of the project	https://www.polimi.it/index.php?id=6414&L=1&id_progetto=312&L=1&sel_ruolo=Partner&sel_search_name=
Press release	January 2020	UIC website	Presentation of the project	https://uic.org/projects/article/fundres#Project-description
Website	04/01/2020	FUNDRES website	Launch and running of FUNDRES website	https://fundres-project.eu/
Press release	07/01/2020	LAPLACE website	Presentation of the project	http://www.laplace.univ-tlse.fr/FUNDRES

Categories	Date	Location	Name of action/Short description	Link
Scientific paper	March 2020	IEEE Electrification Magazine (Volume: 8, Issue: 1, March 2020)	The Evolution of Railway Power Supply Systems Toward Smart Microgrids: The concept of the energy hub and integration of distributed energy resources	DOI: 10.1109/mele.2019.2962886,
Scientific paper	07-08/07/2020	PCIM Europe digital days 2020; International Exhibition and Conference for Power Electronics, Intelligent Motion, Frankfurt, Germany Renewable Energy and Energy Management	Long-Horizon Direct Model Predictive Control for a Series-Connected Modular Rectifier	https://ieeexplore.ieee.org/document/9178019
Presentation				
Flyer	July 2020	FUNDRES flyer	Preparation of FUNDRES flyer and upload on FUNDRES website	https://fundres-project.eu/wp-content/uploads/2020/09/FUNDRES_flyer_Final.pdf

Categories	Date	Location	Name of action/Short description	Link
Presentation	September 2020	FUNDRES presentation	Preparation of FUNDRES presentation and upload on FUNDRES website	https://fundres-project.eu/wp-content/uploads/2020/10/S2R-Innovation-Days-FUNDRES.pdf
Participation to a Conference	23/10/2020	Shift2Rail Innovation days, online	Online presentation of the project in a parallel session entitled " "Cost-efficient, sustainable and reliable high capacity infrastructure"	https://shift2rail.org/wp-content/uploads/2020/10/S2R-Inno-Days-Programme_21_10_20.pdf
Article	15/11/2020	FUNDRES website	News on the presentation of FUNDRES at the S2R Innovation Days	https://fundres-project.eu/2020/11/15/presentation-of-fundres-at-the-shift2rail-innovation-days-on-23-october-2020/
Organisation of a workshop	11/12/2020	Online	Organisation of the 1st FUNDRES Advisory Board	-
Article	13/01/2021	FUNDRES website	FUNDRES held its first Advisory Board online on 1st December 2020	https://fundres-project.eu/2021/01/13/fundres-held-its-first-advisory-board-online-on-1st-december-2020/
Newsletter	February 2021	Online	Publication of FUNDRES 1st Newsletter	https://fundres-project.eu/wp-content/uploads/2021/02/FUNDRES_newsletter_202102.pdf
Scientific paper	2-4 Feb. 2021	12th Power Electronics, Drive Systems, and Technologies Conference	Adapting Digital Twin Technology in Electric Railway Power Systems	https://ieeexplore.ieee.org/document/9405876
Presentation				

Categories	Date	Location	Name of action/Short description	Link
		(PEDSTC), Tabriz, Iran		
Article	08/02/2021	FUNDRES website	FUNDRES NEWSLETTER – FEBRUARY 2021	https://fundres-project.eu/2021/02/08/fundres-newsletter-february-2021/
Article	07/04/2021	FUNDRES website	Adapting Digital Twin Technology in Electric Railway Power Systems	https://fundres-project.eu/2021/04/07/the-solid-state-transformer-an-essential-device-in-the-evolution-of-dc-railway-electrification-systems/
Digital article on technical platform	07/04/2021	Power and Beyond	RAILWAY INDUSTRY: The solid state transformer - an essential device in the evolution of DC railway electrification systems	https://www.power-and-beyond.com/the-solid-state-transformer--an-essential-device-in-the-evolution-of-dc-railway-electrification-systems-a-1013013/
Presentation	3-7/5/2021	Presentation delivered at PCIM EUROPE 2021	A resonant DC/DC converter with high efficiency and power - Best paper award winner	https://www.power-and-beyond.com/a-resonant-dcdc-converter-with-high-efficiency-and-power-a-1030331
Scientific paper	04-06/05/2021	Presentation delivered and paper submitted at PCIM EUROPE 2021	"Virtual capacitor concept for effective real-time MMC simulations"	https://youtu.be/tlom97HUwzI
Presentation			Characterization of a 300 kW isolated DC/DC converter using 3.3 kV Sic-MOSFETs	
Article	06/05/2021	FUNDRES website	Characterization of a 300 kW isolated DC/DC converter using 3.3 kV Sic-MOSFETs	https://fundres-project.eu/2021/05/06/characterization-of-a-300-kw-isolated-dc-dc-converter-using-3-3-kv-sic-mosfets/

Categories	Date	Location	Name of action/Short description	Link
Digital article on technical platform	14/06/2021	Power and Beyond	A resonant DC/DC converter with high efficiency and power	https://www.power-and-beyond.com/a-resonant-dcdc-converter-with-high-efficiency-and-power-a-1030331/
Scientific publication	17/06/2021	IEEE Power Electronics Magazine (Volume: 8, Issue: 2, June 2021)	Flexible and Efficient MMC Digital Twin Realized With Small-Scale Real-Time Simulators	https://ieeexplore.ieee.org/document/9459198 DOI: 10.1109/MPEL.2021.3075803
Article	23/06/2021	FUNDRES website	Flexible and Efficient MMC Digital Twin Realized With Small-Scale Real-Time Simulators	https://fundres-project.eu/2021/06/23/flexible-and-efficient-mmc-digital-twin-realized-with-small-scale-real-time-simulators/
Organisation & participation in a workshop with other H2020 projects	29/06/2021	Online	FUNDRES/IN2STEMPO/MVDC-ERS Joint event	https://bit.ly/3clq1QK
Participation to a Conference	07-10/09/2021	2021 International Conference on Environment and Electrical	Implementation of DC Micro Grid Tied PV-Storage Based EV Fast Charging Station	10.1109/EEEIC/ICPSEurope51590.2021.9584631

Categories	Date	Location	Name of action/Short description	Link
		Engineering (EEEIC)		
Participation to a Conference	07-10/09/2021	2021 International Conference on Environment and Electrical Engineering (EEEIC)	DC Railway Micro Grid Adopting Renewable Energy and EV Fast Charging Station	10.1109/EEEIC/ICPSEurope51590.2021.9584729
Article	16/09/2021	FUNDRES website	Shift2Rail-funded IP3 FUNDRES project final event to be held on 17 November 2021 at EPFL in Lausanne	https://fundres-project.eu/2021/09/16/shift2rail-funded-ip3-fundres-project-final-event-to-be-held-on-17-november-2021-at-epfl-in-lausanne/
2nd newsletter	October 2021	Online	FUNDRES/IN2STEMPO/MVDC-ERS joint newsletter – October 2021	https://fundres-project.eu/2021/10/11/fundres-in2stempo-mvdc-ers-joint-newsletter-october-2021/
Article	11/10/2021	FUNDRES website	FUNDRES/IN2STEMPO/MVDC-ERS joint newsletter – October 2021	https://fundres-project.eu/2021/10/11/fundres-in2stempo-mvdc-ers-joint-newsletter-october-2021/
Scientific paper	18/10/2021	IEEE Access (Volume 9, page: 144211 – 144226)	Virtual Capacitor Concept for Computationally Efficient	DOI: 10.1109/ACCESS.2021.3121351

Categories	Date	Location	Name of action/Short description	Link
			and Flexible Real-Time MMC Model	
Scientific paper	19/10/2021	Electronics 2021, October 2021, 2555. Special Issue of Railway Traction Power Supply	Integration of Distributed Energy Resources and EV Fast-Charging Infrastructure in High-Speed Railway Systems	DOI: 10.3390/electronics10202555
Presentation	27-30/10/2021	21st International Symposium on POWER ELECTRONICS Ee2021, Novi Sad, Serbia,	Braking energy recovery by Modular Multilevel Converters in MVDC Railway Electrification System	-
Article	28/10/2021	UIC ENews	Shift2Rail-funded IP3 FUNDRES project final event to be held on 17 November at EPFL in Lausanne	https://uic.org/com/enews/article/shift2rail-funded-ip3-fundres-project-final-event-to-be-held-on-17-november-at
Scientific paper	13/11/2021	IEEE Xplore	Implementation of DC Micro Grid Tied PV-Storage Based EV Fast Charging Station	https://ieeexplore.ieee.org/document/9584631

Categories	Date	Location	Name of action/Short description	Link
Scientific paper	13/11/2021	IEEE <i>Xplore</i>	DC Railway Micro Grid Adopting Renewable Energy and EV Fast Charging Station	https://ieeexplore.ieee.org/document/9584729
Article	14/11/2021	FUNDRES website	Shift2Rail-funded IP3 FUNDRES project final event to be held on 17 November 2021 at EPFL in Lausanne	https://fundres-project.eu/2021/11/14/shift2rail-funded-ip3-fundres-project-final-event-to-be-held-on-17-november-2021-at-epfl-in-lausanne/
Scientific paper	17/11/2021	IEEE Access (Volume 9, page: 151493 – 151506)	Hardware-in-the-Loop Modeling of an Actively Fed MVDC Railway Systems of the Future	https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9599687
Organisation of a workshop	17/11/2021	EPFL in Lausanne	FUNDRES Final event	https://twitter.com/Chassoun1/status/1463162208129622035?s=20
Article	18/11/2021	FUNDRES website	FUNDRES Final event held on 17 November 2021 at EPFL in Lausanne	https://fundres-project.eu/2021/11/19/fundres-final-event-held-on-17-november-2021-at-epfl-in-lausanne/
Website	30/11/2021	FUNDRES Website	1900 users - 2300 sessions - 3700 page views	-
Participation in a workshop with other	09-10/12/21	Online	Shift2Rail Innovation Days	-

Categories	Date	Location	Name of action/Short description	Link
H2020 projects				
Scientific paper to be submitted		Special Issue 'Railway Traction Power Supply', Electronics Journal, MDPI	"Smart MVDC Hub based Railway Catenary System: Integration of renewable energy sources, storage systems and charging infrastructures in MVDC railway system"	-

6.1.10. Project dissemination and promotion KPIs

Table 2 FUNDRES final Dissemination KPIs

Action	Initial KPIs	Revised KPIs (during Covid-19)	KPIs at project end
Project website visitors	500	500	1900
Project website duration after project end	5 years	5 years	5 years
Social media	50 posts	50 posts	30
Participation in international conferences and forum	8	5 online or physical	6
Publication of news articles	6	10	16
Publication of peer-reviewed papers	2	2	9
Electronic newsletters	2	2	2
Number of Advisory Board meetings	4	2	1
Number of participants to the final conference	40	80 (if online)	20

7. Exploitation

7.1. Exploitation strategies

The exploitation strategy of FUNDRES is to ensure that the impact of the project outcomes is maximised during the project implementation and especially after the completion of the project activities in collaboration with the advisory groups.

Project outputs have a maximum TRL of 4, thus far from commercial products. Future collaboration with academic or industrial partners have been initiated as part of the dissemination activities of task 5.2. Commercial potential of outcomes has been assessed, such as digital models that could be a commercial output from the project when the deployment of 9kV would be effective. Participation of UIC has contributed and will further contribute to disseminate the ideas and concept of 9 kVDC network together with market sensing.

Accuracy of the economic evaluation has been quite difficult as it depends on equipment in each European country. However, the consortium considered all steps to implement the concept in Europe and gave some indication about the cost of investment based on existing studies.

A further area of exploitation concerns the valuable knowledge generated during the project.

FUNDRES has created knowledge and data, in the project's research and development activities. This constitutes an opportunity for researchers who will continue to work on the topic, taking the project results further in the scientific domain.

Each partners have and will exploit the FUNDRES results as follows:

7.1.1. LAPLACE

During project life:

LAPLACE has developed for Infrastructure managers the concept of Solid State Transformer (SST) which allows a migration from a conventional DC electrification (1.5 kV or 3 kV) to the new 9 kV DC system. A 3D design of a 1.5 MW SST in a container was carried out. A complete study of the integration of the SST in a railway line electrified in 1.5 kV DC was performed.

A paper concerning the test and the characterisation of an elementary module of the SST has been presented at PCIM 2021, the most important conference on Power Electronics in Europe. This paper has received the Best Paper Award (among 270 papers presented).

A paper in IEEE "transactions on power electronics" journal has been submitted on 27 October 2021. At the moment, this paper is under review by the editor.

After project end:

Publications and presentations of the last results concerning the integration of the SST on railway infrastructure are planned for next year:

- *International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM), 22 – 24 June 2022, in Sorrento, Italy.*
- *MDPI open access journal "Energies"*
- *Elektrische Bahnen Journal published by Georg Siemens Verlag GmbH (Germany)*

LAPLACE planned to continue research based on the results obtained in FUNDRES.

During next year, the prototype of the elementary module of SST will be associated to a battery with the view to develop a modular energy storage system for railway lines electrified in DC. The experimentation will be carried out on a test platform. On 26 November 2021, this project has received the support of the French Agency for ecological transition. In the coming year, the prototype will then be placed in a container by an industrial partner in order to be tested on a 1.5 kV DC railway line.

As part of the Future Investments Program proposed by the French government, LAPLACE, associated with academic and industrial partners, responded to the call for expressions of interest from the Research and Development Orientation Committee for Railway Innovation (CORIFER). The objective of the submitted project is to set up a pilot site on the French rail network to test the integration of renewable energy and energy storage system. If this project is funded, there will be a certain continuity with the work carried out in FUNDRES.

7.1.2. EPFL

During project life:

In the initial stage of the project, a novel approach to modelling the modular multilevel converter in real time was derived. In order to reduce the number of state matrices representing the converter in real-time, the use of the so-called virtual capacitors was proposed and this idea was presented on two occasions -

At PCIM Europe 2021 under the name "Virtual capacitor concept for effective real-time MMC simulations" and

In IEEE Access under the name "Virtual Capacitor Concept for Computationally Efficient and Flexible Real-Time MMC Model".

The presented modeling approach allows for the use of small-scale real-time simulators, making the approach extremely flexible and efficient. What is more, the same idea can be applied to another MMC-based topologies, as demonstrated in the publication "Distributed Real-Time Model of the M3C for HIL Systems Using Small-Scale Simulators", which is not related to FUNDRES project though.

Thereafter, the realized digital-twin of the modular multilevel converter was used in the study concerning real-time modelling of the future MVDC railway network. It is evident that an MVDC railway network represents a circuit with time-varying parameters, which is a consequence of trains moving along the line. However, as demonstrated in the paper titled "Hardware-in-the-Loop Modelling of an Actively Fed MVDC Railway Systems of the Future", such a structure can be represented with a combination of fixed impedances and variable voltage sources, which contributes to a significant reduction of the real-time simulation step-size. Once the suitable modelling practice has been established, the potential of a new 9kVdc system was discussed, while the developed real-time platform provides an excellent framework for system-level studies and efficiency assessments.

Last but not least, a medium voltage prototype of the modular multilevel converter was realized at EPFL.

The end goal of this project was to assemble two converter units, each capable of operating with 5kVdc across its DC terminals. By connecting these two units in series, voltage equal to 9kVdc can be synthesized with no effort. However, a global outage of semiconductors prevented the realization of the second prototype and, currently, only one unit is assembled and it is undergoing various tests. So far, all the tests have been successfully conducted. After project end:

In the future, once fully assembled and tested, this prototype can be used for any laboratory activities requiring medium voltage. Also, the assembled digital twins will be used to support any development of control required either for the modular multilevel converter or any other converter belonging to the family of the so-called chain-link converters.

7.1.3. POLIMI

During project life:

POLIMI has brought its expertise about the integration of renewable energy and fast charging infrastructures for road electric vehicles in the future unified electrical system for railway and studied the power flows and the state of the systems (e.g. voltage at the train pantographs) in different scenarios to verify the correct utilization of renewable sources and braking energy from the trains. The model provides useful information also in case of degraded working conditions in case of outage of some elements. The future unified electrical system for railway has been tested considering the same catenary infrastructures currently used for 25 kV 50 Hz and 15 kV 16.7 Hz systems.

Publications and presentations of the results are published at various conferences or on journals:

- IEEE Electrification Magazine,
- PCIM Europe digital days 2020,
- *12th Power Electronics, Drive Systems, and Technologies Conference (PEDSTC)*,
- *2021 IEEE International Conference on Environment and Electrical Engineering and*
- *2021 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe), Electronics*

After project end:

Publications and presentations of the results at some conferences are envisaged.

A paper will be submitted at IEEE ACCESS Journal: H.J. Kaleybar, M. Ahmadi, M. Brenna, F. Castelli Dezza, M. S. Carmeli, "Smart MVDC Hub based Railway Catenary System: Integration of renewable energy sources, storage systems and charging infrastructures into MVDC railway system"

POLIMI will divulgate the results of FUNDRES project in master's degree courses in engineering as "Electric systems for Transportation" and "Electric systems for mobility" and continue this research in master and PhD thesis.

7.1.4. UIC

During project life:

UIC, as the worldwide professional association representing the railway sector and promoting rail transport, has no commercial purposes but has strong dissemination capabilities and a very important network of experts from rail infrastructure managers and operators.

All the UIC dissemination capabilities have been used, namely the electronic newsletter (UIC e-News) that globally reaches about 5000 email addresses, the UIC dedicated website, the social media accounts and the UIC network of experts.

After project end:

UIC will present FUNDRES results in meeting of its Rail System department and energy groups and will keep on presenting FUNDRES results to relevant UIC forums.

UIC will go on promoting the results of the project in related international events, such as WCRR, TRA and Innotrans and on social media.

UIC will also maintain FUNDRES website for the coming five years and update it whenever necessary.

7.1.5. S2R JU and IN2STEMPO members

FUNDRES has set the foundations for developments that will be continued within Shift2Rail's IP3: "Cost-Efficient and Reliable High-Capacity Infrastructure". Therefore, the exploitation of the project's results will have to be ensured towards S2R IP3. The efficient exploitation of FUNDRES results at the end of the project has been and will be after project end assured thanks to:

- An efficient collaboration between FUNDRES and its complementary project, IN2STEMPO and more largely with all IP3 projects;
- A transfer of results between FUNDRES and Shift2Rail;
- A transfer of FUNDRES results to the relevant regulation and standardisation bodies competent for the various transport sectors.

7.1.6. Scientific community

Academic project partners have presented the project objectives and results in several international events and published several peer-reviewed papers to inform the scientific community about the outcomes of the project.

They will go on presenting their results in all relevant international events and technical journals.

7.1.7. Railway operators

UIC has and will inform its members via its channels, such as the UIC eNews, its website and all the UIC groups interested in the project outcomes.

7.2. Potential barriers to the exploitation of results

Even if electric power suppliers increasingly consider developing DC networks, the introduction of a new MVDC electrification system in the railway world will not be easy. We must consider this over a horizon of several decades. It takes time to convince.

Several obstacles remain to be overcome and we can notably mention:

- The development of traction chains capable of operating under 9kVDC.
- The development of circuit breakers for interrupting short-circuit currents under 9 kV DC.
- The writing of normative texts to define the characteristics of this new system and the management rules of energy flows.

The work carried out in FUNDRES, at a laboratory scale, has demonstrated the feasibility. We must now consider experiments on pilot sites. Proof of concept is essential with regard to rail operators. Beyond the desire to innovate, this supposes having financial means.

8. Conclusions

This report has provided a list of the main dissemination and communication activities carried out during the project duration and has described the approach, actions, materials and strategies used for external communication, along with the engagement and uptake of the results by relevant stakeholders and Shift2Rail IP3.

Dissemination activities and events have been carefully planned and defined in the scope of the Dissemination Plan (Deliverable D5.1) which was used as an initial strategy further updated and reviewed on a regular basis during the lifetime of the project. The results of the activities of Work Package 5 and the impact achieved have been monitored by the work package leader (UIC) with the help of all project partners.

Dissemination included a wide range of traditional information channels, such as project brochure, newsletters, social media posts and publication of news regarding the project, but also through the partners' own channels, in order to inform all kind of stakeholders interested in the railway and power supply domain.

The FUNDRES website (<https://fundres-project.eu/>) was designed to be evolutive and dynamic, and all documents and deliverables published by the project partners have been or will be soon made available for download.

FUNDRES was presented in major international rail events, in FUNDRES final event and during several relevant S2R and EU initiatives. A significant number of papers were published during the project lifetime.

A large audience has been reached by FUNDRES and the project has at the same time ensured a proper dissemination towards the Shift2Rail Joint Undertaking to ensure a smooth and effective transfer of results into Shift2Rail projects.

FUNDRES partners are willing to continue disseminating the project results beyond the project lifetime to ensure better sustainability and usability of the project results.