

Rare Earth Free e-Drives Featuring Low Cost Manufacturing



Start date of the project: 1st October 2017, Duration: 42 months

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 770143

Work Package no.:	9
Title of the WP:	Dissemination and Communication
Deliverable no.:	9.6
Title of the deliverable:	Plan for the Dissemination of Results,
	Final Release

Contractual Date of Delivery:	31/03/2021
Actual Date of Delivery:	25/06/2021
Lead contractor for this deliverable:	UAQ
Author(s):	Giuseppe Fabri (UAQ)
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Work package contributing to the deliverable:	WP9
Nature:	Report (Public)
Version:	1.7
Reference Deliverables	D9.1, D9.3, D9.4, D9.5





REVISION TABLE					
Document version	Date	Modified sections – Details			
V1.0	25.03.2021	Draft Outline			
V1.1	29.03.2021	Revised Version			
V1.2	30.03.2021	Revised Version			
V1.3	07.04.2021	minor data updates			
V1.4	09.04.2021	Minor typo and Zenodo statistics			
V1.5	15.04.2021	Revision after quality check			
V1.6	20.04.2021	Revision of some data, paper list fixings, minor content added			
V1.7	24.06.2021	Revision after submission:			
		- CadFem event included in the event list			
		- 3 Papers removed from the paper list			

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Abbreviations

- ADAS = Advanced Driver Assistance Systems
- CID = Fundación Cidaut
- CSM = Centro Sviluppo Materiali
- DEM = Direct Email Marketing
- EGVIA = European Green Vehicle Initiative Association
- ECI = European Copper Institute
- EU = European Union
- EV = Electric Vehicle
- IFPEN = Institut Français du Pétrol et des Énergies Nouvelles
- IM = Induction Motor
- MDL = Motor Design Limited
- **OEM = Original Equipment Manufacturer**
- PM = Permanent Magnet
- PPM = Project Progress Meeting
- PPT = Microsoft PowerPoint Format
- RE = Rare Earth
- RFD = ReFreeDrive
- SynRM = Pure Synchronous Reluctance Motor
- UAQ = University of l' Aquila

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Executive Summary

The present report provides an overview on realized activities, tools, and elements to be used in the dissemination of ReFreeDrive project results to the envisioned audience.

The main goals of these activities were to:

- Create awareness about the potential of the proposed solutions
- Make results available for other potential beneficiaries or users
- Foster competitiveness and growth and increasing benefits to the European Union (EU) economy and citizens
- Create additional value for partners of the project
- Network with other H2020 projects
- Increase competitiveness of concerned industry in EU and sell project results
- Inform EU policy maker

This report contains the results related to the <u>third reporting period</u> of the project and recap the overall campaign data. This deliverable fulfils its objectives, and it was not cause of deviation from the Grant Agreement foreseen regarding its content or timing (in the extended project runtime due to Covid-19 issues now to March 2021).

The activities during the third period of the project have been mainly focused on:

- Continue to update the website (download section and the news);
- Organization and participation at suitable conference and events, even if virtual;
- Organization of webinars as additional networking events due to lack of physical events;
- Organization and participation to the GV04 projects Final Event;
- Dissemination of the project results to the scientific community (Conferences, journals, magazines);
- Updates of LinkedIn page shared with the GV04 projects Drivemode and ModulED.

The results of the campaign are satisfactory and have been mainly tracked through the website visits, papers statistics and LinkedIn statistics. More than 4700 users and 17000 sessions have been collected in the period October 2017 - March 2021 on the website.

Bibliometric data related to the 19 scientific papers published show about 50 citations on google scholar and more than 5000 readings can be estimated stating on different publisher' statistics and Research Gate data. The LinkedIn page reports highlight over 500 followers

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Relating the Third period of the project, the barriers and risks have been updated considering the Covid-19 pandemic. In particular, the lack of physical events has been recognized as a barrier for the increased difficulty in reaching the target audience of the campaign. Webinars have been organized and article on magazines written as a countermeasure. The delay in the activities related to the Covid-19 pandemic was identified as a risk of lack of results to be disseminated. Preliminary results and proper simulation models have been used to achieve data to support the dissemination, even in Conferences and papers. The results of the communication and dissemination campaigns are evaluated as effective in disseminating the purpose of the project and the results achieved. Many stakeholders were reached in the automotive industry, including Original Equipment Manufacturers (OEMs), tier 1, and tier 2 manufacturers confirming the effectiveness of the campaign and the quality of the Research and Innovation Actions carried out.

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1 Introduction

The general plan for dissemination over the three years of the project was outlined as follows:

First period (up to March 2019): the main dissemination activities are focused on the scientific dissemination of the preliminary results and on creating awareness on stakeholders about the objective of the project and expected results.

Second period (up to December 2019): the prototyping stage is ongoing, and dissemination of the results can continue with the technical and scientific contents, first results about final designs and preliminary prototypes can be discussed with potential industrial customers. Joint actions with other GV04 projects can be planned.

Third Period (up to the end of the project, moved to March 2021 due to Covid-19 pandemic): the prototypes are ready, and the dissemination campaign can be focused on stakeholders' meetings to divulgate the results and to engage with potential partners for exploiting our results.

Although there was a delay in the Prototypes manufacturing, we sticked to the dissemination plan thanks to the availability of spare key parts, semi-finished key parts and 3D printed demonstration models.

The core of the dissemination plan, meaning the description of the dissemination goals, the recognized target audience, the selected channels, and the management of the dissemination is already outlined in D9.4. The following chapters report the activities planned and the results obtained during the project (M24-M42), with focus on the third period not already reported.

Each sub-chapter reports the impact of the individual avenue for dissemination actions, the chapters are organized in three parts:

- Actions accomplished
- Results
- Comments and remarks

University of L'Aquila (UAQ) works as dissemination leader (in cooperation with European Copper Institute (ECI) as communication leader), ensuring that all the partners within the Consortium disseminate the knowledge gathered in the project to the scientific and industrial and civil community. The main dissemination goal in the ReFreeDrive project is to communicate the results achieved in the project to identified stakeholder groups through the defined channels.

The detailed plan of the activities and the monitoring of the results are developed yearly and reported in the D9.4, D9.5 and D9.6 respectively for each period of the project.

The project benefitted of 6 Months extension due to Covid-19 pandemic; due to project extension the communication and dissemination campaign was extended accordingly, to cope with the limited travel possibilities the focus was on online events and technical webinars.

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Different actions have been planned to improve the dissemination campaign in the third period and are described in the specific sections.

The Final Status of the communication and dissemination activities is resumed in the following items:

- Project Logo;
- Website developed;
- Dissemination kit;
- Joint social media strategy with other GV04 Partners;
- Communication Plan defined and started;
- Dissemination Plan defined and started;
- 71 news published on the website
- 19 papers accepted at conferences, two at journal, 5292 readings, 47 citations
- 41 Events attended
- More than 500 followers for the Joint GV04 projects LinkedIn page
- 4+ Stakeholder's meetings
- 4 newsletters and 3 articles on magazines
- 3 Common GV04 workshop (including the final joint GV04 virtual workshop event planned for April 2021)
- 3 ReFreeDrive Webinars
- 5 Video interviews

All the partners have been involved in the campaign, in particular: Institut Français du Pétrole et des Energies Nouvelles (IFPEN), Motor Design Limited (MDL), and RINA-Centro Sviluppo Materiali (CSM).

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2 Detail of the activities and results

The following chapters report the details of the communication and dissemination activities carried out in the third period of the project, along with the related results and final comments on the activities. When statistics and data are reported the first and second period are included for completeness.

2.1 Website Updates

The website is online, and its structure is complete, the news section has been continuously updated with about three news per month starting from April 2018. News to be posted are suggested by the partners and approved by Fundación Cidaut (CID) in the monthly Project Progress Meetings (PPM) (see appendix 3.1.1 for news samples).

Published scientific papers reporting project results are uploaded in the download sections and related news are released.

Project deliverables (if public) and deliverables executive summary (for confidential deliverables) are also accessible in the download section.

The website will always be maintained live, at least up to March 2025, news updates will stop in April 2021, deliverables and scientific papers will be uploaded when available.

2.1.1 Results

The number of visits of the website shows an interest and their relevance to our target audience. The monitoring started at M06 and reported several visits matching with specific communication and dissemination actions. Actions with main impact on website visits are listed here (in order of importance):

- Participation at ReFreeDrive Events (Coiltech workshop, GV04 Workshop);
- Scientific Papers or presentations uploaded on the website;
- Webinars;
- Direct Email Marketing (DEM) released by Coiltech about the ReFreeDrive Workshop and related promotion on LinkedIn by the Coiltech organizers (see appendix 3.3.4);
- Leonardo Energy Newsletter (ECI);
- Cidaut Newsletter;
- Events.

Table 1 reports the results related to the website visits by Google Analytics associated with the main dissemination actions carried out, starting from M06.

Figure 1 resumes in a graphic the data from Table 1. It can be noticed a drop of attention in the last period due to lack of news on the website. The usual update rate of the website was reduced

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after the GV04 workshop in Brussels. Nevertheless, we have now recent results and published papers to update the website contents and renew the interest in the project.

The website has more than 100 monthly users that perform about 150-200 sessions. The global data reports up to 4700 users and 16.000 sessions. Interesting to notice that most of the visitors are from USA and India as reported in the detailed statistics in appendix. 3.1.2.

Reference Month	Users	New Users	Sessions	Page views	Main comm./diss. events carried out				
FIRST PERIOD OF THE PROJECT									
Apr-2018	82	70	93	264					
May-2018	125	117	176	527	Coiltech promotion of the World Magnetic Conference including ReFreeDrive				
Jun-2018	102	95	153	481	ECI Newsletter, participation to WMM, CWIEME, ITEC, Others				
Jul-2018	241	225	282	774	MDL paper uploaded in the download section and related promotion				
Aug-2018	145	113	189	498	Starting LinkedIn activities				
Sep-2018	121	104	173	435	News about Coiltech and upload of D2.2; many LinkedIn posts				
			S	ECOND PERIOD	OF THE PROJECT				
Oct-2018	138	122	190	500	Motor Summit, ECI white Papers, many LinkedIn posts				
Nov-2018	136	118	180	498	D3.1, H2020RTR, Coiltech Presentations No LinkedIn updates				
Dec-2018	131	113	176	436	WMM paper, LinkedIn Coiltech PPT and Coiltech video				
Jan-2019	128	111	177	493	World resource forum, LinkedIn: Coiltech PPTs				
Feb-2019	155	140	177	566	Promotion of GV04 dissemination event				
Mar-2019	154	139	192	553	GV04 dissemination event				
Apr-2019	119	112	173	501	None				
May-2019	146	132	203	521	ReFreeDrive @ IEMDC CWIEME, EVS2				
Jun-2019	142	126	180	442	Global Rare Earth Industry Association				
Jul-2019	141	127	164	332	ReFreeDrive@ TAE Colloquium				
Aug-2019	85	76	106	289					
Set-2019	163	148	231	708	ReFreeDrive @ Conf. on Life Cycle Management, ECCE, Coiltech GV04 Workshop				
			•	THIRD PERIOD (OF THE PROJECT				
Oct-2019	167	148	202	510	Downolad ReFreeDrive Presentations @ Coiltech 2020				
Nov-2019	119	106	159	441	ReFReeDRive @ H2020 RTR Conference				
Dec-2019	132	116	167	468	ReFreeDrive Activities Update				
Jan-2020	121	105	147	414	ReFreeDrive @ ZVEI annual meeting				
Feb-2020	109	98	151	430	"ReFreeDrive @ ECI motor Workshop; New papers available for download, SS @ICEM2020"				
Mar-2020	256	245	289	599	ECI motor workshop				
Apr-2020	222	211	286	691	Interviews on LinkedIn (clip1, clip2), webinar reminder, Platinum Article				
May-2020	202	175	310	905	1st RFD Webinar				
Jun-2020	176	150	247	620	2nd ReFreeDrive Webinar, interviews clip3 on LinkedIn				
Jul-2020	82	66	100	306					
Aug-2020	61	52	76	199	Interviews clip 4 clip 5 LinkedIn, ICEM conference				

Table 1: ReFreeDrive Website analytics April 2018 – March 2021.

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Sep-2020	113	100	148	380	Webinar for the European mobility week, Coiltech 2020				
Oct-2020	83	72	101	193					
Nov-2020	90	92	117	300	loss of analytics data, Motor Summit				
Dec-2020	103	97	124	371	H2020RTR conference, Article on Electric Motor Engineering, third ReFreeDrive Webinar				
Jan-2021	110	100	137	391	Posts on LinkedIn				
Feb-2021	147	138	213	570	Posts on LinkedIn				
Mar-2021	183	171	255	608	Milano digital Week Final Event Promotion				
Apr-2021					Final Events				
Total	4930	4430	6444	17214					



Figure 1: Website history data.

2.1.2 Comments

Considering the results, the following actions seemed to be adequate to fulfil the envisioned targets, relevant aspects are:

- Many visits were recorded from US and India;
- LinkedIn page has been used to enhance the website visibility;
- Resharing of LinkedIn posts from event' organizers leveraged the attention on the website.

The website was an effective tool for collecting main project information to be shared in dissemination activities.

2.1.3 Other ReFreeDrive Webpages

Coiltech organizers gave the possibility to setup a ReFreeDrive webpage on the Coiltech website in January 2021. This possibility was accepted to leverage the visibility of the project in the final period. The highlights of the web page are reported in appendix 3.1.3

Article news

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2.2

Conferences and other events

Following the list of the identified events presented in Table 3 – D9.5, and other events proposed during project meetings, the dissemination plan outlined for the third period is reported in Table 2 along with the first and second period attended events for completeness. The same table reports also which partners attended the events and some comments.

2.2.1 Results

In the third period of the project **17 national and international events** have been attended. In these events, the project has been introduced to the scientific community, industry representatives, Original Equipment Manufacturers (OEMs), suppliers, other stakeholders and policymakers. Including data from first and second period total number of events attended is 39.

2.2.2 Comments

The participation of project partners to a wide selection of events allowed the project dissemination in the scientific community, within the policymaker and industrial stakeholders. The comments collected report a general appreciation on the aim of the project and on the results achieved.

Name	Location	Date(s)	Focus	Partner(s) Involved	Comments
Advanced E- Motors	Berlin, DE	13-15 Feb 2018	E-motor design , new materials for cost efficient e-drive systems, enhance heat transfer, testing methods	UAQ	Commercial conference organized by IQPC, Prof Villani presented the project, good interest from the audience.
Safety & Electric Mobility Expo,	Rome, IT	13-15 Apr 2018	A meeting point for the public, market players, media, institutions, associations with the world of electrical mobility (the same days of the of the Rome formula E grand Prix)	UAQ	CANCELED and replaced with a stakeholders meeting. G. Fabri presented the project, leaflet to CEO Volkswagen Italia.
PEMD	Liverpool, UK	17-19 April 2018	Power electronics, drives and machines	MDL	MDL has paper and expo booth
WMM18	Dresden, DE	12-14 Jun 2018	International Conference on Magnetism and Metallurgy	UAQ, CSM	Project introduced to the audience, Electrical Steel manufacturers interested
Speedam	Amalfi Coast (IT)	20-22 June 2018	International Symposium on Power Electronics, Electrical Drives, Automation and Motion	UAQ, IFPEN	Paper presented.
ITEC	Long Beach, USA	13-15 June 2018	Components, systems, power electronics for transportation	MDL	MDL had tutorial and expo booth, project introduced to the audience.
CWIEME	Berlin, DE	19-21 Jun 2018	Winding systems & supplies, motor components & accessories	MDL, UAQ, IFPEN, CSM	MDL will have tutorial and expo booth, project introduced to the audience. UAQ introduced the project to many suppliers of Magnets and other materials
ICEM	Alexandroupoli, GR	3-6 Sep 2018	International Conference on Electrical Machines	UAQ, MDL	UAQ and MDL presented a Paper.

Table 2: Conferences and other events attended.

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			RefreeDrive_D9.6_Diss_Plan_v1.7_reworked		
Coiltech WMC	Pordenone, IT	24 -25 Sep 2018	Includes topics on E-Mobility Drivetrain and Systems	UAQ, ALL	Workshop on RE FREE E-DRIVES FOR ELECTRIC VEHICLES has been organized. All partners contributed.
ECCE 2018	Portland, USA	23-27 Sept 2018	Industry and academics event on energy conversion systems	MDL	MDL submitted papers
EIT Raw Materials	Darmstadt, DE	23 rd -24 th Oct 2018	Magnets & E-Drives: We will look into the rare earth (RE) value chain and electric drives. There will be keynotes on RE Sourcing, High Performance Permanent Magnets, as well as E-drives and Magnetic Cooling. This will be followed by dedicated breakout sessions.	ECI	Project presentation and discussion: - Project is interesting, companies are looking to less critical materials, recycling and new processes
Motor Summit International	Zurich, CH	14 th -15 th Nov 2018	The Motor Summit 2018 International brought selected international experts together from research, public authorities, utilities, manufacturers of motors, pumps and fans, OEM, motor systems users and other interested parties.	UAQ, ECI	ReFreeDrive Project presented, general interest in the aim of the project
ERTRAC H2020 RTR18	Brussels, BE	28 th -29 th Nov 2018	European Green Vehicle Initiative Association (EGVIA) event on various key topics for the future of road transportation in Europe	ECI	RFD is one of the few initiatives on electric vehicles, lot of effort in improving Internal Combustion Engine and Advanced Driver Assistance Systems (ADAS) technologies
World Resource	Antwerp, BE	24 th -27 th	Sustainable material management and	ECI,	Project Presentation, general
Forum	Decession DE	Feb 2019			Interest on the project
Motor Workshop	Brussels, BE	19 Mar 2019	technology innovations in the field of electric motors for industrial applications and will provide an update of the regulatory framework.	All	about technologies and open points for Electric Vehicle (EV) mass production
GV04 EU Projects Workshop	Brussels, BE	19 th Mar 2019	Common GV04 EU Project workshop, introduction By EU Project Officer and conclusion by EGVIA representative	All	Drivemode, ModulED and ReFreeDrive Projects presented their objectives and results. General interest in the Audience
Int. Electrical Machines and Drives Conference	San Diego, CA, USA	12 th -15 th May 2019	IEMDC is one of the most relevant meeting point for electrical machines and drives research experts.	MDL, UAQ	Two papers presented about Pure Synchronous Reluctance Motor (SynRM) and Induction Motors (IM) motors, very high attention from the audience.
CWIEME Berlin 2019	Berlin, DE	21 st -23 rd May 2019	Exhibition and conference on manufacturing technology for electrical machines	UAQ, MDL	Stakeholders meetings with suppliers and manufacturers
EVS32	Lyon, FR	22th May 2019	EVS is the leading international event to address all these issues. The various components of electric mobility will be on display; from markets to vehicle battery technology (hybrid and hydrogen fuel cell); from motorcycles to trucks, and from charging facilities to related services and public policy	ECI, IFPEN	Paper on Permanent Magnet (PM) Assisted SynRM presented, Project Presentation, stakeholders meetings
Global Rare Earth Industry Association	Brussels, BE	25 th June 2019	Best practices for Sustainable RE Supply	ECI	Leaflet distribution, offline introductions to RFD as an alternative technology
TAE Colloquium	Ostfildern, (Stuttgart), DE	2 nd July, 2019	E-mobility, energy & climate, digitalization, new infrastructure solutions	ECI	ReFreeDrive paper, Presentation, Stakeholders meeting
9th Conf. on Life	Poznan, Poland	1 st Sept.	Life cycle management, environmental,	ECI	ReFreeDrive Presentation,

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			ReFreeDrive_D9.6_Diss_Plan_v1.7_reworked		
Cycle		2019	economic and social sustainability.		abstract.
Management			special session on sustainable mobility		
Coiltech 2019	Pordenone (IT)	25-26 Sept 2019	Coil winding industry exhibition and Conference	ALL	GV04 workshop, ReFreeDrive and Drivemode hosted a Session to discuss their innovations
ECCE2019	Baltimore (USA)	Sept 29 - Oct 3 2020	IEEE Energy Conversion Congress and Expo, one of the largest event for the Energy and Electrical System Research Community	UAQ, MDL	2 Papers Presented
IECON 2019	Lisbona (PT)	07-14 Oct	45th Annual Conference of the IEEE Industrial Electronics Society (IES),	UAQ, MDL	2 paper presented, organized Special Session on Electrical machines for e-mobility with reduced RE materials
Conference on Sustainable Mobility	Catania (IT)	14-15 Oct 2019	Sustainable mobility		Drivemode also participated, Project presented
CADFEM ANSYS Simulation Conference (CASCON)	Kassel (DE)	15-17Oct 2019	Conference on CAD simulation and optimization tools	MDL	Presentation on "An integrated multiphysics workflow for optimised design of electric drives" developed within RFD project, stakeholder meetings
EU-US-JP Trilateral conference on critical materials Invited (ECI)	Brussels (BE)	(19th Nov 2019), Refreedri ve	Trilateral conference on critical Materials	ECI	Stakeholders meetings
ZVEI (German Electric Industry Association) annual conference		2-3 Dec 2019	Annual conference of automotive platform, e-mobility steering committee meeting	ECI	Project Presentation, Stakeholders meeting
RTR ERTRAC 2019	Brussels (BE)	4-5 Dec 2019	Conference on results from Road Transport Research projects in H2020.	CID AUR ECI	Project Presentation
9th Int. ECI Motor Workshop	virtual	9-10 June 2020	The workshop will present a series of technology innovations in the field of electric motors for industrial applications and will provide an update of the regulatory framework.	All	Project Presentation, Discussion about technologies and open points for Electric Vehicle (EV) mass production
ICEM 2020	Goteborg (virtual)	23-26 Aug, 2020	International conference on electrical machines	UAQ, IFPEN	Two papers presented, organized Special Session on Application of Electrical Machine in Modern Electric Vehicles in cooperation with the project "Drivemode"
ICREPQ'20	Granada (virtual)	2-4 Sept. 2020	Int. Conf. on Renewable Energies and Power Quality (ICREPQ'20)	ECI	Project presentation, Stakeholders meetings
European Mobility week	virtual	16-22 Sept 2020	Improve public health and quality of life through promoting clean mobility and sustainable urban transport	CID IFPEN MDL UAQ	In this context, the Electric Drivetrain Innovation Cluster organized a webinar on 18th September, titled "Next generation electric drivetrains for fully electric vehicles, focusing on high efficiency and low cost"
Coiltech 2020	Pordenone (IT)	23-34 Sept 2020	Coil winding exhibition and conference (Covid-19 Constrained Edition)	UAQ, R13, ECI	Booth with prototypes, great attention, RFD presentation,
Motor Summit	Virtual	18-19 Nov 2020	The Motor Summit 2020 International brought selected international experts together from research, public authorities, utilities, manufacturers of motors, pumps and fans, OEM, motor systems users and other interested parties.	ECI UAQ	Project presentation, stakeholders' meetings

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WMM 2020	Virtual	03-05- nov 2020	International Conference on Magnetism and Metallurgy	UAQ MDL	Paper presentation, questions form the attendees confirm attention for the project
H2020RTR20	Virtual	30 Nov 01 Dec 2020	Conference on results from Road Transport Research projects in H2020.	CID	Project results presentation
lecon 2020	Virtual	18 Oct 2020	45th Annual Conference of the IEEE Industrial Electronics Society (IES),	UAQ	Paper presentation
Milano digital Week	Virtual	19 Mar 2020	Milano Digital Week Workshop Electric mobility, from research to charge column, the feasible cours	UAQ	Project presentation
Final GV04 Joint Event	Virtual	16 April 2020	Final event presentating the results of the projects Drivemode, ModulED, ReFreeDrive	All	Project presentation, panel session

2.3 Scientific papers

Among the preliminary list of conferences suitable for publication (Table 2 – D9.3) and additional events identified during the project progress meetings, during the third period of the project **12 papers** were published in peer reviewed conference proceedings and one on journals. Details are reported in the following.

2.3.1 Results

The work of the partners has contributed to publish the following papers:

Three scientific papers have been published in the **first period of the project**. The papers report preliminary analyses and results carried out in the early stage of the project. The papers are:

- 1. M. Villani, "High Performance Electrical Motors for Automotive Applications Status and Future of Motors with Low Cost Permanent Magnets" International conference on Magnetism and Metallurgy, June 2018.
- 2. M. Tursini, M. Villani, G. Fabri, A. Credo, F. Parasiliti, A. Abdenour, "Synchronous Reluctance Motor: Design Optimization and Validation" *International Symposium on Power Electronics Electrical Drives, Automation and Motion (Speedam)*, June 2018.
- 3. M. Villani, M. Tursini, M. Popescu, G. Fabri, A. Credo, L. Di Leonardo "Experimental Comparison between Induction and Synchronous Reluctance Motor-Drives" *International Conference on Electrical Machines*, September 2018.

4 scientific papers have been published in the **second period of the project**. The papers report preliminary analyses and results carried out in the middle stage of the project. The papers are:

4. A. Credo, G. Fabri, M. Villani and M. Popescu, "High Speed Synchronous Reluctance Motors for Electric Vehicles: a Focus on Rotor Mechanical Design", 2019 IEEE International Electric Machines & Drives Conference (IEMDC), 2019.

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- 5. N. Riviere, G. Volpe, M. Villani, G. Fabri, L. Di Leonardo and M. Popescu, "Design Analysis of a High Speed Copper Rotor Induction Motor for a Traction Application", 2019 IEEE International Electric Machines & Drives Conference (IEMDC), 2019.
- T. Jezdinsky, F. Nuño, "Innovative E-Drive solutions for battery electric vehicles avoiding rare earths" TAE Colloquium, July 2th 2019, Ostfildern (DE), available on Conference proceedings ISBN Nr: 978-3-943563-08-5 TAE Technische Akademie Esslingen, Future Mobility – automatisiert – vernetzt – elektrisch, July 2019.
- A. Abdelli, B. Chareyron, B. Gaussens, "Design of A 200 Kw Pm Synrm Motor Without Rare-Earth For Electric Vehicle", 32nd International Electric Vehicle Symposium (EVS32), 20th-22nd May 2019, Lyon (FR).

12 scientific papers have been published in the **third period of project**. The papers report preliminary analyses and results carried out in the middle stage of the project. The papers are:

- L. Di Leonardo, M. Popescu, M. Tursini and M. Villani, "Finite Elements Model Co-Simulation of an Induction Motor Drive for Traction Application," IECON 2019 - 45th Annual Conference of the IEEE Industrial Electronics Society, Lisbon, Portugal, 2019, pp. 1059-1065.
- 9. N. Riviére, M. Villani and M. Popescu, "Optimisation of a High Speed Copper Rotor Induction Motor for a Traction Application," **IECON 2019** - 45th Annual Conference of the IEEE Industrial Electronics Society, Lisbon, Portugal, 2019, pp. 2720-2725.
- L. di Leonardo, M. Popescu, G. Fabri and M. Tursini, "Performance Evaluation of an Induction Motor Drive for Traction Application," IECON 2019 - 45th Annual Conference of the IEEE Industrial Electronics Society, Lisbon, Portugal, 2019, pp. 4360-4365
- 11. Credo, M. Villani, M. Popescu and N. Riviere, "Synchronous reluctance motors with asymmetric rotor shapes and epoxy resin for electric vehicles," 2019 IEEE Energy Conversion Congress and Exposition (ECCE 2019), Baltimore, USA, 2019, pp. 4463-4469.
- M. Popescu, N. Riviere, G. Volpe, M. Villani, G. Fabri and L. di Leonardo, "A Copper Rotor Induction Motor Solution for Electrical Vehicles Traction System," 2019 IEEE Energy Conversion Congress and Exposition (ECCE 2019), Baltimore, USA, 2019, pp. 3924-3930.
- 13. A. Rodriguez, J. Romo, G. Fabri, "Horizon2020 ReFreeDrive Project: Rare Earth Free e-Drives featuring low cost manufacturing", Transport Research Arena, 2020.
- 14. Alì Deriszadeh, Filippo de Monte, "On Heat Transfer Performance of Cooling Systems Using Nanofluid for Electric Motor Applications," Entropy, Vol. 22, Issue No. 1, 99, pp. 1-13, 2020. Published on-line on January 14, 2020. Special Issue "Selected Papers from the XII International Conference on Computational Heat, Mass and Momentum Transfer (ICCHMT2019)," Rome, September 3 -6, 2019.

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- 15. L. Di Leonardo, M. Popescu, M. Tursini, F. Parasiliti, M. Carbonieri "Transient Modeling of Induction Motors considering Space Harmonics" Int. conference on Electrical Machines ICEM 2020, August 2020;
- M. Popescu, N. Riviere, M. Villani, G. Fabri "Electrical Steel and Motors performances, the Role of Lamination Thickness" International conference on Magnetism and Metallurgy, November 2020
- 17. Lino Di Leonardo, Mircea Popescu, Marco Villani "Eddy-Current Losses evaluation in hairpin wound motor fed by PWM Inverter" 46th Annual Conference of the IEEE Industrial Electronics Society IECON 2020
- 18. Credo, G. Fabri, M. Villani and M. Popescu, "Adopting the Topology Optimization in the Design of High-Speed Synchronous Reluctance Motors for Electric Vehicles," in IEEE Transactions on Industry Applications, vol. 56, no. 5, pp. 5429-5438, Sept.-Oct. 2020,
- 19. F. Nuño, M. Popescu, M. Villani, A. Rodríguez, M. Milosavljevic, "RARE EARTH-FREE MOTORS FOR MEDIUM AND HIGH POWER ELECTRIC VEHICLES", at Motor Summit 2020 Zurich (virtual event), conference article, Nov 2020.

The partners contributing to these publications are CID ECI, IFPEN, MDL, and UAQ. All the papers are available through open access or green open access and will be uploaded in the Zenodo repository for as public domain.

To monitor the impact of these papers on the scientific community, bibliometric data are collected when available. Data about citations and reads are reported in Table 3.

Paper	Source	Publisher	Scopus	Scholar	Research Gate		
First Period	First Period						
1	Reads:	N/A	N/A	N/A	N/A		
	Citations:	N/A	N/A	N/A	N/A		
2	Reads:	229	N/A	N/A	92		
	Citations:	4	4	5	4		
3	Reads:	278	N/A	N/A	590		
	Citations	10	10	11	12		
Second Period	·						
4	Reads:	446	N/A	45	418		
	Citations	6	9	10	10		
5	Reads:	416	N/A	14	1588		
	Citations	5	6	7	7		

 Table 3: Bibliometric data related to ReFreeDrive Papers (when available – updated 03 June 2021).

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H2020 – GV04 – 2017 – Grant Agreement 770143 – Project REFREEDRIVE
ReFreeDrive D9.6 Diss Plan v1.7 reworked

		herreepine_p		onnea	
6	Reads:	N/A	N/A	N/A	N/A
	Citations:	N/A	N/A	N/A	N/A
7	Reads:	N/A	N/A	N/A	N/A
	Citations:	N/A	N/A	N/A	N/A
Third Period	1	<u> </u>		1	
8	Reads:	278	N/A	N/A	286
	Citations:	3	3	4	4
9	Reads:	494	N/A	N/A	21
	Citations:	4	6	7	5
10	Reads:	192	N/A	N/A	340
	Citations:	4	4	5	5
11	Reads:	280	N/A	N/A	340
	Citations:	4	4	5	5
12	Reads:	350	N/A	N/A	46
	Citations:	3	3	3	3
13	Reads:	N/A	N/A	N/A	N/A
	Citations:	N/A	N/A	N/A	N/A
14	Reads:	1498	N/A	N/A	333
	Citations:	2	2	3	3
15	Reads:	82	N/A	N/A	33
	Citations:	0	0	0	0
16	Reads:	N/A	N/A	N/A	N/A
	Citations:	N/A	N/A	N/A	N/A
17	Reads:	173	N/A	N/A	157
	Citations:	0	0	1	0
18	Reads:	576	N/A	N/A	83
	Citations:	2	1	3	3
19	Reads:	N/A	N/A	N/A	N/A
	Citations:	N/A	N/A	N/A	N/A

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TOTAL	Reads:	5292	N/A	N/A	4189
	Citations:	47	53	65	62

2.3.2 Comments

The reported papers have been uploaded on the website after the embargo period to leverage the dissemination.

A Special Session on *Electrical machines for e-mobility with reduced RE materials* has been organized at IECON conference (Figure 2) by MDL and UAQ to further increase the dissemination in the scientific community and to collect relevant contribution from inside and outside the project. UAQ and MDL also proposed a paper about RFD studies.



Figure 2: Agenda of IECON Special Session on Electrical machined for e-mobility with reduced RE materials.

With the same purpose a Special Session on *Application of Electrical Machine in Modern Electric Vehicles* was organized at the ICEM 2020 Conference by UAQ in cooperation with the Drivemode project (Figure 3). The session collected 30 scientific contributions including a paper from ReFreeDrive IFPEN and one contribution from Drivemode. The session program is collected in appendix 3.4.2.

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ICEM2020 - Gothenburg, Sweden, August 23-26, 2020

Special Session on Application of Electrical Machine in Modern Electric Vehicles

Organized and co-chaired by: Damijan Miljavec, University of Ljubljana, Slovenia, Miljavec, <u>Damijan.Miljavec@fe.uni-</u> lj.si

Giuseppe Fabri, University of L'Aquila, Italy, giuseppe.fabri@univaq.it

Figure 3: Special session on Application of Electrical Machine in Modern Electric Vehicles.

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2.4

ReFreeDrive Specific Events

Specific ReFreeDrive Events have been organized, when possible, in cooperation with the other GV04 projects and co-hosted by third events or initiative in the field to take advantage of a larger potential resonance of the events.

2.4.1 ECI European Motor Workshop 2019

The workshop has presented a series of technology innovations in the field of electric motors and an update on the legal framework. This workshop was a platform for different stakeholders to present know-how and technology, as well as specific studies or projects.

The meeting was held in Brussels, 19th March 2019, organized by European Copper Institute and attended by more than 60 stakeholders in the field of electric motors to discuss about the future of electric motors in Europe, in industrial application but also in the automotive fields. The same audience was then invited to join the subsequent GV04 workshop in the afternoon in the same venue to continue the discussion focused on innovative electrical drivetrains. The agenda and participation list is reported in appendix.

2.4.2 GV04 Shared Workshop 2019

The GV04 workshop has been organized by ECI as a joint event of the ECI European motor workshop on the 19th March 2019 in Brussels. The entire afternoon was dedicated to present the three projects Drivemode, ModulED and ReFreeDrive by the respective partners, to discuss objectives and results with the audience. The Project Officer of the three projects opened the workshop with an intro speech and a representative from EGVIA association concluded with a final summary.

The agenda of the joint GV04 workshop is reported in Figure 4, Figure 5 reports pictures about highlights of the session.



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H2020 – GV04 – 2017 – Grant Agreement 770143 – Project REFREEDRIVE ReFreeDrive_D9.6_Diss_Plan_v1.7_reworked Figure 4: Agenda of the joint GV04 workshop.



Figure 5: Pictures from the joint GV04 workshop: Introduction (left), audience (centre), Wrap up (right).

2.4.3 GV04 Workshop @ Coiltech World Magnetic Conference 2019

After the success of the 2018 edition (See Pictures in Figure 6), a dedicated workshop on "*ADVANCED POWERTRAINS FOR ELECTRIC VEHICLES*" has been also organized in the 2019 edition inside the International technical conference "World Magnetic Conference", involving other EU projects in the field of e-mobility.

UAQ cooperates in the organization of the "World Magnetic Conference", International Conference in the field of the coil winding industry, voluntary based and free of charge. Figure 7 reports the numbers of the visitors of the 2018 edition and the categorization of the attendees.

The GV04 Workshop was organized on Wednesday 25th of September and the agenda is reported in Figure 8 (<u>www.visitcoiltech.com</u>).

During the conference, the first edition of the the DecarbEurope booklet on the electric motor solutions (developed by ECI) was distributed to the audience, ReFreeDrive project is mentioned in the booklet as reported Figure 9.



Figure 6: Pictures of the ReFreeDrive workshop @ Coiltech 2018: audience (left), RFD partners (right).

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Head of Production	10%
Production staff	10%
Product and quality management	4%
Head of R&D	7%
R&D staff	8%
Other Engineering	2%
Research and University	7%
Owner/Co-owner	18%
President/CEO/Vice President	6%
Other top management	3%
Head of Purchasing and sourcing	12%
Purchasing and souricing staff	6%
Other staff	7%

Figure 7: Amount and type of Coiltech visitors.

	ADVAN Workshop on the	ICED POWERTRAINS FOR ELECTRIC VEHICLES P1 latest EU Researches in traction technology for electric vehicles		
10:45	Fundación Cidaut J. Romo			
		ReFreeDrive project presentation and status		
11:00	Jaguar Land Rover	C. Thackwell		
		Rare-earth free drive units for powertrain electrification		
11:25	IFP Energies Nouvelles, Motor Design Limited, University of L'Aquila	A. Nasr, N. Riviere, M. Villani		
		ReFreeDrive project: rare-earth free e-motor solutions		
12:00	Aurubis, Breuckmann, P. Walmsley, D. Schmitz, F. Nuño European Copper Institute P. Walmsley, D. Schmitz, F. Nuño			
	ReFreeDrive Proje	ect, copper rotor manufacturing technologies: die-cast and fabricated profiles		
12:40	Politecnico Torino M. Martino, G. Pellegrino			
	FitGEN: Functionally	v Integrated E-axle Ready for Mass Market Third Generation Electric Vehicles		
14:30	Vtt	M. FarzamFar, A. Smirnov		
		Drivemode project presentation and status		
14:55	Avl, University of Ljubljana	M. Burghardt, D. Miljavec		
		High-speed electrical motor development		
15:20	Semikron J. Mueller, R. Bittner			
		SiC inverter for automotive application		
15:45	Breuckmann	P. Szilagyi		
	Cutting adap rate	r casting technology high performance cast retors with zero peresity		

Figure 8: Programme of the ReFreeDrive Workshop @ Coiltech.

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Developing powertrains for electric mobility free of critical raw materials

So far, permanent magnet technologies using rare earths have dominated the landscape of electric mobility due to their high power and torque density, as well as their high efficiency. The number of electric motors in this sector is expected to grow exponentially. However, rare earths have the highest risk of disruption in the EU supply among all critical raw materials (CRM), according to the European Commission list of CRMs.

Therefore, there is a concern on the viability of this technology for mass production.

Research and development of rare earth-free alternatives should be supported. The performance ratios achieved by their permanent magnet counterparts can be reached and even exceeded. Initiatives such as ReFreeDrive (H2020 EU funded project, **www.refreedrive.eu**) are pushing the boundary of the current induction and synchronous reluctance technologies, achieving unprecedented values of power and torque density, combined with the highest efficiency levels.

Further support for innovation and industrialisation of rare earth-free technologies would help the European industry to go through the critical raw materials bottleneck in electric mobility.

Figure 9: DecarbEurope booklet mentioning ReFreeDrive Project.

2.4.4 Mobility Week 2020, Joint GV04 Webinar

In the context of the European Mobility Week (16-22 September 2020), the Electric Drivetrain Innovation Cluster (REFREEDRIVE, MODULED and DRIVEMODE H2020 projects) organized a webinar last 18th September, titled "Next generation electric drivetrains for fully electric vehicles, focusing on high efficiency and low cost". The agenda is reported in Figure 10.

2.4.5 Comments

Feedbacks from the events are positive, attendance was high and the related networking activities and questionings highlights a general interest on the project activities. Joint events were also appreciated by project partners as chance for additional networking opportunities.

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Electric Drivetrain Innovation Cluster - JOINT WEBINAR

Save the date: 18 September 10am CET Connection details: add link

In the context of <u>European Mobility Week</u>, the GV04 projects <u>Drivemode</u>, <u>ReFreeDrive</u> and <u>ModuleED</u> belonging to the Electric Drivetrain Innovation Cluster will showcase their latest advancements in developing the next generation of electric drives. Don't miss this unprecedented opportunity to learn about the innovative approaches and results achieved by the 3 EU funded projects.

Time (CET)	
10.00 - 10.10	Welcome Introduction
	Speaker: Michal Klima - INEA
10.10 - 10.30	DRIVEMODE Project
	Speaker: Pihlatie Mikko/Farzam Mehrnaz – Project Coordinator
	Title: XXX
10.30 - 10.50	ReFreeDrive Project
	Speakers: Javier Romo
	Mircea Popescu
	Gisuseppe Fabri
	Adrien Gilson
	Title: ReFreeDrive: driving the future of electromobility through innovative
	rare-earth free motor technologies
10.50 - 11.10	ModulED Project
	Speaker: Charley Lanneluc – Project Coordinator
	Title: ModulED: a modular highly efficient and integrated approach towards
	electric mobility
11.10 - 11.20	Q&A



These projects have received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement N°769989, N°769953, N°770143

Figure 10: Agenda for the joint V04 webinar within the EU mobility week initiative

2.5 Newsletter and Magazines

Considering the lack of subscribers to the ReFreeDrive newsletter the plan was modified as follows:

- Partners that usually distribute their own newsletters are invited to release project news in their newsletters.

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- ECI "Leonardo Energy" newsletter from ECI will be used for specific events related to ReFreeDrive, e.g. webinars, workshop etc.
- Communications about the participation of ReFreeDrive in specific events will be included in the DEM of the event.

Dissemination activities on Magazines was also included in the list of the potential activities. In particular, one article was released in the Magazine Platinum (Sponsored within UAQ budget) and some articles on Electric motor engineering (free of charge), first page of the article on Platinum is reported on Appendix 3.3.5. ReFreeDrive SynRM prototypes on the Electric motor Engineering Magazine on Appendix 3.3.6.

A press release was also released in the news section of the Cordis platform after the project closure, a preview is shown in Figure 11.



Next generation of rare earth free electric drives considering mass production features

Project "ReFreeDrive" contributes to avoiding the use of rare earth magnets by developing a new generation of electric drives, ensuring industrial viability and focusing on low cost manufacturing technologies. This project has developed two solutions without rare earth magnets for the electric drive system of electric vehicles: induction and synchronous reluctance machines. The project has developed the new machines for a test validation campaign and a final in-vehicle validation.



NEW PRODUCTS AND TECHNOLOGIES



Figure 11: press release in the Cordis news section.

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2.5.1 Results

The newsletter released by the partners (Cidaut, ECI) and by the Coiltech Events' organizers (QuickFairs) showed relevant success. Newsletter examples are in appendix 3.3.

Feedback data collection from newsletters has been carried out only in few cases due to the complexity of the data collection and limited budget.

An example of the statistics related to the newsletter sent by Coiltech organizers to promote the ReFreeDrive Workshop in the 2018 edition were available in December 2018 and reported in Figure 12. The further campaigns related to Coiltech editions 2019 and 2020 are expected to give similar impact.



Figure 12: Results from the Coiltech 2018 email campaign.

The articles on the Magazines engaged different expressions of interest on the activities of the project received by email and by phone calls.

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2.6 Webinars

Considering the limited traveling opportunities due to Covid-19 pandemic it was agreed to organize a webinar series. Three different webinars have been organized within the project to further disseminate the project concepts and findings.

 RE free motor design for e-mobility. In this webinar Motor Design MDL, IFPEN Energies Nouvelles and University of Aquila explained in detail the design of different motors which can meet the specifications of Jaguar Land Rover vehicles. Multiple innovations have been presented: optimised electrical steels, special copper alloys, new manufacturing methods, hairpin winding and innovative cooling systems, among others.

Speakers: Mircea Popescu, MDL; Andrea Credo, UAQ ; André Nasr, IFPEN.

Date: 13 May 2020

2) Control strategies and electric drive design of induction and synchronous reluctance motor for e-mobility. This session has been devoted to explaining the control algorithms developed for both synchronous reluctance and induction motors, as well as giving some notions about power electronics hardware design and selection

Speakers: Marco Tursini, UAQ; Giuseppe Fabri, UAQ; Fabien Vidal-Naquet, IFPEN.

Date: 29 June 2020.

3) Induction motors for e-mobility: advanced manufacturing features. Three members of the Consortium explained some interesting manufacturing aspects for advanced induction motors: hairpin stator winding, die-cast copper rotor with zero porosity and fabricated copper rotor production process.

Speakers: Denise Willems, AUR; David Schmitz, BREU; Mario Vetuschi, TCM.

Date: 06 December 2020.

An example of the brochures released by ECI for the Third event is reported in Figure 13, while attendance data are resumed in Table 4.

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Figure 13: Brochure of the third Refreedrive Webinar.

Table 4: ReFreeDrive webinars attendance data.

Title	Registered	Attended	#Q&A
RE free motor designs for e-mobility	324	184	36
Control strategies and electric drive design of induction and synchronous			
reluctance motors for e-mobility	126	67	33
Induction motors for e-mobility: advanced manufacturing features	224	90	20

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2.7 ReFreeDrive Videos (Interviews)

During the 24M General Assembly meetings, videos were recorded where each partner involved in the project explained its contribution in the project activities and the expected impact in the field. The video layout was similar to an interview. Those videos have been uploaded on LinkedIn and used to leverage the communication and dissemination campaign on the social networks.

Videos are available at the following links (Table 5)

Table 5: ReFreedrive Videos lists.

Video	Title	Views on LinkedIn
Vid #1 (24 th Apr 2020)	The Project Partner #MDL combined some clever optimization strategies to push the induction motor with copper rotor to meet our challenging specs.	7
Vid #2 (28 th Apr 2020)	Within our #ReFreeDrive Project we will produce for all #induction motor prototypes respectively two manufacturing alternatives: a) fabricated copper rotor b) die casted copper rotor	9
Vid #3 (6 th May 2020)	We avoid using heavy RE in our motor solutions, as these are highly critical raw materialsbut do we get from one criticallity into another ?not with Copper, as there is enough Copper to serve the demand.	8
Vid #4 (4 th Aug 2020)	André Nasr from IFPEN, explains well the opportunties for Ferrite assisted Synchronous reluctance motors to replace PM	12
Vid #5 (4 th Aug 2020)	Prof. Marco Villani from University of L'Aquila explains the benefits of a "pure" Synchronous reluctance motor developed in our project for possible E- vehicles:	27

2.8 Stakeholders meetings

During the last phase of the project, several bilateral meetings with industrial stakeholders have been realized, e.g. Pierburg, CNH Case New Holland, Eurogroup, VonRoll, to explore the exploitation of the ReFreeDrive technology solutions beyond its project lifetime. Several companies showed a-priori an interest in receiving more information and to further discuss with respective consortium partners how ReFreeDrive drivetrains might fit to specific applications.

2.9 Joint final GV04 virtual workshop planned for 16th April 2021

Beyond the official end of ReFreeDrive (extended till 31st March 2021), we decided to organize a joint final event with all 3 projects from the GV04 call to summarize our final projects' results and at least present in a virtual format the demonstrators of all projects in pictures and videos to a larger audience (To-date we have over 237 registrations for this event). Figure 14 reports the flyer developed by ECI to promote the initiative.

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ReFreeDrive	H2020 – GV04 – 2017 – Grant Agreement 770143 – Project REFREEDRIVE
	ReFreeDrive_D9.6_Diss_Plan_v1.7_reworked
NEXT GENERATION ELECTRIC DRIVETRAINS FOR FULLY ELECTRIC VEHICLES	Final event - Next generation electric drivetrains for fully electric vehicles – joint GV04 workshop The EU-funded projects ModulED, Drivemode and ReFreeDrive will share and debate how they have tackled and delivered the challenge set by the H2020 call "Next generation electric drivetrains for fully electric vehicles, focusing on high efficiency and low cost".
16 April 2021 19 Mooi – 13 April 2021 19 Mooi – 13 April 2021	* Functional system integration of electric machines * Reduced need for rare earth magnets * Integration of power electronics with battery charging functions * Modular electric power train components
Register: http://tiny.cc/GV04	AGENDA Introduction by AVERE (Philippe Vangeel, Secretary General) Short presentation of each project (ReFreeDrive, ModulED, Difvemode) Panel discussion with all projects Common KPIs for the three projects Challence & find revealth
 High efficiency compact modular drivetrain ModufED 	Outlook for future adoption of the projects' technology solutions Wrap-up & final remarks by INEA - European Commission (Michal Klima, project officer) DATE
✓ Zero rare-earth electric motors	April 16 th , 10:00 to 12:30 CET Register for the free event here: <u>register</u>



2.10 Social Media

The social media strategy is mainly based on a joint LinkedIn company page activated in August 2018 by ReFreeDrive, the "Electric Drivetrain-Innovation-Cluster" page.

The administration of the page is allocated to project coordinators or communication leaders rotating every three months, with ReFreeDrive partner ECI starting as leader.

In order to guarantee flow of content and posts at least once to three times per month as agreed upon, all project coordinators and communication and dissemination leaders of the three projects of the cluster are setting-up a list of possible topics to be posted and prioritize the sequence and timing of posting.

2.10.1 Results

Our joint GV04 Cluster LinkedIn website has to-date 509 followers.

Over 1,000 visits in the last period, with significant number of visitors from outside EU (USA and India).

2.10.2 Comments

The joint Cluster LinkedIn page will remain active at least until summer 2021 after our final event and for last publications from all three projects.

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2.11 Open Data Management

All the open data have been uploaded on Zenodo platform, they consist mainly on public deliverables and open access articles.

The readings and download statistics are available and reported in Appendix 3.5, they suggest that users prefers to uses project website and specialized website to read and download deliverable and publications.

2.12 *Effects of Barriers and Materialized Risks*

In the third period of the project an un-expected risk has been materialized, the Covid-19 pademic, affecting part of the activities of the project (M30-M42) and then the dissemination and communication activities.

Some of the barriers identified in the D9.4 such as the difficulties in reaching the main stakeholders in the field became more severe due to travel limitations and the growth of virtual events. Many stakeholders' meetings taking place in the collateral networking activities in physical events was lost due to events virtualization. The list of the envisioned barriers has been updated accordingly (Table 6) and countermeasures identified. Proper virtual events such as webinars have been organized and the participation on the physical events was enhanced when possible (Coiltech2020: the unique physical event in 2020).

The Table 7 reports the recognized risks in the dissemination campaign, the selected mitigation actions, and the impact on the project.

Barriers	Severity	Countermeausures	Impact on the project
Protection of methods and results by the owners.	Medium	Each partner is responsible for the exploitation of its own results and will take care of the comprehensiveness of the results to be disseminated.	Minor impact, the countermeasures are valid
Lack of target audience	Low	Selected target audience is wide and comprehensive, feedbacks from the communication and dissemination campaign are used to improve the target audience	Minor impact, the countermeasures are valid
Difficulties in reaching the main stakeholders in the field	High	Main stakeholders could be difficult to be reached and to be convinced, the inclusion of different kind of events in the field i.e. conferences, exhibitions and stakeholder meeting helped in reaching the main stakeholders. Liaison with the other GV04 projects helped in	Minor impact, the countermeasures are valid, the wide selection of events and joint action with other GV04 project are effective

Table 6: Dissemination barriers

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		strengthening the messages	
Target audience not	Medium	Particular attention was paid in	Minor impact, the
convinced of the		highlighting the potentiality of the	countermeasures are
exploitation		results, Tests and demonstrations Steps	valid
potential of the		were extensively documented to	
results		support the dissemination activities	
Loss of networking	high	Organization of proper webinars and	Minor impact, the
chance due to event		preference to physical events when	countermeasure are
virtualization		possible	effective

Table 7: Dissemination risks

Risks	Severity	Mitigations	Impact on the project
Delay in dissemination due to delay in results.	Medium	The dissemination campaign started at the beginning of the project as soon as meaningful preliminary results are available. Preliminary study and adopted methodologies were used in the early stage of the dissemination.	Minor, delays in the tests and in the demonstration, campaign was mitigated by disseminating design results and prototyping activities
Results not convincing	Medium	Comparison of different solutions were provided and validated. Links to a comprehensive reference list about the state of art and literature are provided	Minor, even if some tests provide partial results it was enough to tune the models and to validate the designs
Lack of comprehensive Results	Low	Each partner is responsible for the exploitation of its own results taking care of the comprehensiveness of the results to be disseminated. A list of expected results and data to be collected was discussed among all the partners	Minor, good coordination in dissemination activities and contents
Lack of Resources for Dissemination	Medium	To optimize the resources available will be taken advantage of the skills and the tools of each partners and the initiatives undertaken by them	Minor impact, large participation to events is lightly affecting budget, no issues highlighted by partners up to now
Disclose confidential Information	Low	Each partner is proprietary of the results carried out during the activity in the project and responsible of their dissemination	Not evidence at the moment about disclosure of confidential information

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3 Appendix

3.1 Website

3.1.1 News Section

Some examples of the project website News are reported in Figure 15 and Figure 16.



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, 19 – 22 May 2019 Eurex po Man Part and the Man

ReFreeDrive @ EVS32 The 32nd edition of the Electric Vehicles Symposium will take place on 19-22 May 2019 in Lyon (France). Sustainable mobility is a core concern for all industrial players and public authorities. It affects both our lifestyles and our economy, as well as facing major... read more



ctric Conference Papers on Electric Motor Technologies RefreeDrive project's activities and results have been published throughout 2018 on our various international , as conferences. As a result, now you can find two conference

papers about electric motors available for download at our publications section, both written by... read more

xperimental Comparison between Induction and Synchronous Reluctance Motor-Drive



new deliverables available for download The ReFreeDrive project activities are going ahead, so that in the last weeks new deliverables are available for download in our deliverables section: • Deliverable D2.3 "Functional subsystems full technical specifications". (Confidential). You can download the... read more



GV04 Dissemination Event Overview

Last 19th of March, the joint GV04 Dissemination Event took place in Brussels. The workshop presented the innovations that are currently being developed by three EUfunded projects under the European Green Vehicles Initiative (EGVI): ModulED, ReFreeDrive and... read more



ReFreeDrive @Joint GV04 Dissemination Event

On Tuesday 19th of March, ReFreeDrive project will hold a new dissemination session in Brussels. The goal of the workshop is to present the solutions that are being developed by three EU-funded projects under the European Green Vehicles Initiative (EGVI): ModuIED,... read more



ReFreeDrive @ ECCE 2019

From September 29 to October 3, 2019, the eleventh Annual IEEE Energy Conversion Congress & Exposition (ECCE 2019) will be held in Baltimore, Maryland (USA). IEEE ECCE shares an insight into the recent research and cuttingedge technologies in electrical and... read more

Coiltech 2019

ReFreeDrive @ Coiltech 2019

ReFreeDrive's project partners

had an excellent experience

present at Coiltech 2019,

International Coil Winding

Exhibition and Conference

September 2019 at

Pordenone... read more

which will be held on 25-26th

last year at Coiltech 2018 fair.

For this reason, they will also be



events in the field of electrical machines and drives. IEMDC is a reference forum to disseminate and exchange state of art in the field of Electrical Machines and... read more

ReFreeDrive @ EVS32

place on 19-22 May 2019 in

Lyon (France). Sustainable

industrial players and public

authorities. It affects both our

lifestyles and our economy, as

well as facing major ... read

Vehicles Symposium w

The 32nd edition of the Electric

mobility is a core concern for all

ill take



Colloquium On Tuesday 2nd of July, Tomas Jezdinsky from European Copper Institute (ECI), one of the ReFreeDrive project partners, will take part in the colloquium "Future Mobility" hosted by TAE (Teknische Akademie Esslingen) in Ostfildern, Germany. The colloquium "Future... read more

Reperimental Comparison between Inducti and Synchronous Reluctance Motor-Drive

ous Relucta

Design, Optimization and Validation

mini M. Tilbai, G. Jubi, A. Crole, T. Parallet a cliphonist of bilinearing law and humania

ICEM and SPEEDAM

Conference Papers on Electric Motor Technologies

ReFreeDrive project's activities

published throughout 2018 on

conferences. As a result, now

you can find two conference

papers about electric motors

and results have been

various international



ReFreeDrive Midterm review meeting ReFreeDrive project reached half of its length last March. This means it was time to hold the Midterm review meeting. To this end, all project members and the Project Officer met last 22nd and 22nd of May in Brussels, at Aurubis facilities. During the meeting, the... read more



new deliverables available for download The ReFreeDrive project activities are going ahead, so

that in the last weeks new deliverables are available for download in our deliverables section: • Deliverable D2.3 "Functional subsystems full technical specifications". (Confidential). You can



GV04 Dissemination Event Overview

Last 19th of March, the joint GV04 Dissemination Event took place in Brussels. The workshop presented the innovations that are currently being developed by three EU-funded projects under the European Green Vehicles Initiative (EGVI): ModulED, ReFreeDrive and... read more

Figure 16: View of the news on the website part B.



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3.1.2 Statistics of the website

Global statistics since the kick-off of the website are reported in the following Figure 17, Figure 18, Figure 19.

Audience Overview



Figure 17: Website global audience overview.

Page views

Page	Page Views 🔻	Page Views	contribution to total: Page Views
	17,321 % of Total: 100.00% (17,321)	17,321 % of Total: 100.00% (17,321)	
1. 🔳 /	5,854	33.80%	
2. 📕 /partners	1,400	8.08%	17.3%
3. 📕 /downloads	1,232	7.11%	33.8%
4. 📕 /about	1,209	6.98%	4.1%
5. 📕 /project-progress	1,181	6.82%	5.25
6. 🔳 /deliverables	1,072	6.19%	6.8% 7% 7.1% °.1%
7. 📕 /structure	893	5.16%	
8. 📕 /news	717	4.14%	
9. 📕 /links	446	2.57%	
10. Contact-us	326	1.88%	

Figure 18: Website global page views report.

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Geographic location of visitors



Figure 19: Website visitors: geographic location report.

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3.1.3 **ReFreeDrive page on the Coiltech Website**

The webpage is available at the following link:

https://www.quickfairs.net/visita/?idf=96&id_zona=1&id_menu=28&idl=EN

Figure 20 reports part of the webpage that includes partners descriptions and contacts, while Table 8 resume the statistics related to the promotion of the RFD webpage on LinkedIn within the Coiltech network.



Figure 20: ReFreeDrive page on the Coiltech website.

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Table 8: Statistics related to the promotion of the RFD webpage on LinkedIn within the Coiltech network.

LikeExternal	Impressions	Views	Data Views	Clicks	Click-Through- Rate %
36	1261	1892	26/03/2021	399	5.15

3.2 Leaflet and poster

At the beginning of the project the leaflet in Figure 21 was released.



Figure 21: ReFreeDrive leaflet first release.

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3.3



Newsletters and Magazines

3.3.1 ECI 8th International Motor Workshop

Leonardo energy newsletter was released to promote the event, graphics in Figure 22



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3.3.2 GV04 Joint Workshop.

Leonardo energy newsletter was released to promote the event, graphics in Figure 23



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3.3.3 Join us at Coiltech

Newsletter from ECI was released disseminating the Coiltech Event (Figure 24).

Dear colleagues,

At the occasion of the coil winding tradeshow <u>Coiltech and the World Magnetic Conference</u> (25-26 September, Pordenone, Italy), the <u>ReFreeDrive</u> team will present its key findings at the session P1 "<u>Advanced powertrains for electric vehicles</u>" on September 25th at 11h00 (room C9). We will be happy to meet you there.

<u>ReFreeDrive</u> project develops two technologies for electric vehicles without RE: copper rotor induction and synchronous reluctance. The motor design partners have reached the challenging benchmarks initially set in terms of power and torque density, matching those of its permanent magnet counterparts and reaching efficiency levels up to 96% (hear IFPEN, University of Aquila and Motor Design at 11h15). In parallel, the technology partners have fine-tuned their processes to deliver high quality and low cost manufacturing routes (meet Aurubis and Breuckmann at 11h50).

In the afternoon our fellow project <u>DriveMode</u> will be presented in session P2, with speeches of AVL, VTT and Semikron. DriveMode develops electric drives and compact integrated modular drivetrain components dedicated for mass produced electric and hybrid vehicles Looking forward to seeing you there. We will circulate the presentation materials if you cannot make it.

Kind regards,

Fernando Nuño

European Copper Institute Phone +34 670 80 46 37 Skype fnuno75 www.leonardo-energy.org www.copperalliance.eu

Figure 24: Example of ECI newsletter.

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3.3.4 ReFreeDrive @ World Magnetic Conference

Example of DEM released by Coiltech Organizer to promote the Participation of the EU projects @ Coiltech Conference (Figure 25), Italian version is reported but English version was sent to non-italian recipient.



Gentile XXXXX,

alla sua **decima edizione**, Coiltech si conferma un **punto di riferimento dell'industria elettromeccanica**, dove si danno appuntamento **i leader del settore**.

Nel 2010, abbiamo iniziato con 47 aziende espositrici, divise in 24 stand, in 1 solo Padiglione. 10 anni dopo, a Coiltech saranno presenti:

- oltre 420 espositori provenienti da 26 nazioni;
- oltre <u>3.500 visitatori</u> provenienti da circa 50 Paesi (stima basata sulle preregistrazioni);
- <u>59 presentazioni tecniche</u> in programma per la World Magnetic Conference.

Perché visitare Coiltech - cosa dicono i visitatori delle edizioni passate

"[...]

Sono molto soddisfatto di tutte le aziende italiane e del resto d'Europa che ho incontrato. Sono molto soddisfatto della fiera e **tornerò l'anno prossimo**."

V.L. - IKM Elektro AS - Norvegia

"[...]

Coiltech è anche un **modo per incontrare tutti gli attori di questo settore** e nel corso degli anni ho notato che è **diventata più ampia, c'è più scelta, ho fatto più contatti**."

Y.H. - *AACO Manufacturing Srl* - Italia "[...]

Coiltech è un evento **molto interessante per fare networking** e per essere **sempre aggiornati sulle ultime innovazioni tecnologiche**."



Coiltech è l'unica fiera del Coil Winding i cui dati sono certificati dall'ente indipendente ISFCERT e che ha l'approvazione internazionale UFI.

F.N. - *European Copper Institute* - Spagna La conferenza #1 del suo settore

Può scegliere fra 59 presentazioni per aggiornare le sue competenze tecniche. Il concentrato di qualità e quantità che trova a Coiltech non è paragonabile ad altre fiere.



ORIVEMODE

Uno dei focus di questa edizione sarà l'e-mobility.

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La qualità della <u>World Magnetic Conference</u> è accentuata dalla presenza di **tre progetti 'Horizon2020'**, finanziati dall'UE, che hanno scelto Coiltech per la loro dissemination session in autunno 2019.

- **ReFreeDrive**: sviluppa **motori di trazione e-mobility** senza l'uso di terre rare e coinvolge 13 partner da 6 nazioni, tra i quali **Jaguar Land Rover**;
- Drivemode: sviluppa tecnologie integrate di motori, riduttori e inverter con l'obiettivo di ridurre il costo dei materiali e il "footprint" (l'orma CO2) e coinvolge 12 partner da 6 nazioni, tra le quali Visedo Oy (Danfoss Group) e Semikron;
- **FitGen**: mira a sviluppare un sistema di trazione elettrico integrato, pronto per l'implementazione nei veicoli elettrici di terza generazione.

Anche nel 2019, l'ingresso è libero										
Organized by	With the support of	Certified by	Approved Event	Technical partner	in collaboration with AEMD The Association of Electrical & Mechanical Trades					

Figure 25: Newsletter about ReFreeDrive @ Coiltech World Magnetic Conference.

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3.3.5 ReFreeDrive @ Platinum Magazine

First page of the article for the magazine Platinum written by UAQ (Figure 26)





THE RESEARCH TEAM

Rulare earth permanent magnets are a component that is present in most motors installed in electric vehicles. Have earths are however very expensive (for extraction reasons) and also pose supply risks for this reason the European Union promotes the research aimed at creating electric motors not making use of these elements. The Be-FreeDrive project, a H2020 coordinated in Spain, which also includes the Department of Industrial and Information Engineering and Economics of the University of EAquila among its 13 partners (including Jaguar), starts from this assumption, "Our goal is to study innovative low-cost powertrain wishtioms for mass-produced cars", explains Professor Marco Villani, project manager for the Abruzzo University. During the project, the consorti-um studied three different alternative electric motor solutions asynchronous motors, reluctance motors and motors with ferrite magnets - each one of them with its specific and advantageous pe-cultarities. "In L'Aquila, within the Machines and Electric Drives research team, we studied the reluc tance motor: the cheapest, because its rotor essentially makes of magnet-1110 ic steel", as Villasi continues to explain Attention has been fo-

cused on two sizes, a medium power (75 kW) unit, to be tested on an electric vehicle for freight

other, rated at 200 kW, to be fit ted on premium vehicles. "This has been done to validate the fact that the technology is available for any intermediate power rating -adds the professor - even because these are fully innovative proto-types: they already existed in various industrial applications, but we have improved their characteris-tics to also make them interesting for the automotive sector. The prototypes also include sophisti-cated control electronics developed by R13 Technology, our university spin-off, which manages the whole motor power: some innovations aimed at improving effi-ciency have also been included in this component". After the proto-typing of electric motors, testing on the car is scheduled for May: the project will close in Septem-ber 2020, with the presentation of the experimental results.

transport or urban



PROTOTYPES OF ELECTRIC MOTORS. FOR ALTOMOTIVE APPLICATIONS

Figure 26: ReFreeDrive on Platinum Magazine.

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3.3.6 ReFreeDrive @ Electric Motor Engineering Magazine

The picture of the SynRM prototype has been selected as cover image of the Electric Motor Engineering Magazine (n.4 December 2020) including the related article on the design of the SynRM (Figure 27).



On the cover Immage Prototype of University of L'Aquila funded by EU, ReFreeDrive project - GA 770143 In The design of high speed Synchronous Reluctance motor by a Topology optimization, page 20

Figure 27: ReFreeDrive on Electric Motor Engineering Magazine.

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3.4 Other Events

3.4.1 Special Session @ IECON Conference

Call for paper related to the Special Session organized at IECON is reported in Figure 28.





THE 45TH ANNUAL CONFERENCE OF THE IEEE INDUSTRIAL ELECTRONICS SOCIETY OCTOBER 14-17, 2019 LISBON, PORTUGAL

Special Session on "Electrical machines for e-mobility with reduced rare-earth materials"

Organized by

Mircea Popescu, Motor Design Ltd., UK Marco Villani, University of L'Aquila, Italy Fabrizio Marignetti, University of Cassino and South Lazio, Italy

Call for Papers

The expansion of the electric vehicle (EV) market will impact the socioeconomic dimension of the transport sector. The introduction of new technologies for energy storage and powertrains play a critical role in the development of the EV market. At the motor level, key components and innovative materials must be integrated in the current motor designs. The vast majority solutions rely on permanent magnet technology using rare-earth magnets that offers a good compromise of high specific torque and low losses. However, the high and volatile cost of raw materials for magnets make uncertain their long term availability, especially since the electric traction technology is called to be developed at large scale in the future transportation system. As a consequence, alternative technologies not using rare-earth magnets or reduced rare-earth magnets are of high interest

Topics of interest include, but are not limited to:

- Synchronous motors with reduced rare-earth materials;
- Induction motor for EVs;
- Mechanical analysis of high speed motors for EVs;
- Cooling aspects;
- Modelling and control strategies.

Figure 28: Call for paper Special Session on Electrical Machines for e-mobility with reduced RE materials.

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3.4.2 Special Session at ICEM

Article proposed for the Special Session organized by the GV04 projects at ICEM conference (Table 9).

Table 9: Special session at ICEM2020: Session contributions.

SS13 Applications of Electrical Machines in Modern Electric Vehicles

Session Title	SS Applications of Electrical Machines in Modern Electric Vehicles										
Paper ID	Paper title	Authors	Country	Presen- tation	Link						
SD-005819	Potential of Dual Three-Phase PMSM in High Performance Automotive Powertrains	Daniel Keller, Moritz Kuenzler, Akif Karayel, Quentin Werner, Nejila Parspour	Germany	Oral	Video Q&A Send						
SD-002658	Design and Optimization of Synchronous Reluctance Machine for actuation of Electric Multi- purpose Vehicle Power Take-Off	Branko Ban, Stjepan Stipetic	Croatia	Oral	Video Q&A Send						
SD-011339	Performance Evaluation of Electrically Excited Synchronous Machine compared to PMSM for High-Power Traction Drives	Georgios Mademlis, Yujing Liu, Junfei Tang, Luca Boscaglia, Nimananda Sharma	Sweden	Oral	Video Q&A Send						
SD-005622	Design of a Permanent Magnet assisted Synchronous Reluctance motor using Ferrites	Andre Nasr, Baptiste Chareyron, Abdenour Abdelli, Misa Milosavljevic	France	Oral	Video Q&A Send						
SD-010421	Structural Topology Optimization of High-Speed Permanent Magnet Machine Rotor	Aino Manninen, Janne Keränen, Jenni Pippuri-Mäkeläinen, Damijan Miljavec, Selma ČOrović, Alen Alič, Urban Rupnik, Mehrnaz Farzam Ear, Timo Avikainen	Finland	Oral	Video Q&A Send						

ssion SS Applications of Electrical Machines in Modern Electric Vehicles

Session	SS Applications of Electrical Machine	es in Modern Electric Vehicles			
Paper ID	Paper title	Authors	Country	Presen- tation	Link
SD-003387	Current and Average Temperature Calculation for Electrically Excited Synchronous Machines in Case of Contactless Energy Supply	Björn Berweiler, Bernd Ponick	Germany	Poster	Video Q&A Send
SD-003646	Effect of uneven magnetization on magnetic noise and vibrations in PMSM – application to EV HEV electric motor NVH	Emile Devillers, Paul Gning, Jean Le Besnerais	France	Poster	Video Q&A Send
SD-007455	Computationally Cost-efficient Characteristics Analysis of EV Traction Motor considering AC Copper Loss based on 2-D Magneto-Static Analysis	Jun-Woo Chin, Young-Hoon Jung, Jun-Yeol Ryu, Min-Ro Park, Myung- Seop Lim	Korea (South)	Poster	Video Q&A Send
SD-001767	A high-precision Analytical Method for Fast Calculation of Motor Vibration Based on Tooth Modeling	Jianfeng Hong, Shanming Wang, Yuguang Sun, Haixiang Cao	China	Poster	Video Q&A Send
SD-012068	Review and Trends in Electric Traction Motors for Battery Electric and Hybrid Vehicles	Andreas Krings, Christian Monissen	Germany	Poster	Video Q&A Send
SD-002194	Analysis and Design of Multi-Pole High-Speed IPMSM with SiC Based Inverters for EVs	Xiaowei Ju, Yuan Cheng, Ling Ding, Shumei Cui	China	Poster	Video Q&A Send
SD-007617	Comparison of Methodologies for Calculation of Inductances in Direct and Quadrature Axis	Mario Vukotić, Danilo Makuc, Alen Alić, Damijan Miljavec	Slovenia	Poster	Video Q&A Send
SD-004219	Testing of an in-wheel halbach array motor	lago Martinez Ocaña, Nick J. Baker, Barrie C. Mecrow, Chengwei Gan, Chris Hilton, Simon Brockway	United Kingdom	Poster	Video Q&A Send
SD-007781	Low-Voltage Electric Motor for the Motorization of an Electric Tractor.	Philippe Enrici, Nadhem Boubaker, Daniel Matt	France	Poster	Video Q&A Send
SD-008508	Design of a surface-mounted PM motor for improved flux weakening performance	Stavros Pastellides, Stiaan Gerber, Rong-Jie Wang, Maarten Kamper	South Africa	Poster	Video Q&A Send
SD-011827	Dynamic Current Control to Compensate for Magnetic Mutual Coupling in Electrically Excited Synchronous Machines	Junfei Tang, Yujing Liu	Sweden	Poster	Video Q&A Send
SD-010774	Design of a Power Hardware-in- the-Loop Test Bench for a Traction Permanent Magnet Synchronous Machine Drive	Nimananda Sharma, Yujing Liu, Georgios Mademlis, Xiaoliang Huang	Sweden	Poster	Video Q&A Send
SD-010243	A Comparison between Axial and Radial Flux Permanent Magnet In- Wheel Motors for Electric Vehicle	Feng Chai, Yunlong Bi, Lei Chen	China	Poster	Video Q&A Send
SD-011002	Design and Analysis of V-Shaped IPM Motor for EV Application Considering Irreversible Demagnetization	Farshid Mahmouditabar, Abolfazl Vahedi, Noureddine Takorabet	Iran	Poster	Video Q&A Send
SD-009555	An Overview of PM Synchronous Machine Design Solutions for Enhanced Traction Performance	Buddhika De Silva Guruwatta Vidanalage, Shruthi Mukundan, Wenlong Li, Narayan C. Kar	Canada	Poster	Video Q&A Send
SD-002763	Switched Reluctance Motor for a Trolleybus Traction Application: Design and Modeling	Victor N. Antipov, Andrey D. Grozov, Anna V. Ivanova	Russian Federation	Poster	Video Q&A Send
SD-012025	Cylindrical Wound-Rotor Synchronous Machines for Traction Applications	Federica Graffeo, Silvio Vaschetto, Marco Cossale, Michael Kerschbaumer, Edson Bortoni,	Italy	Poster	Video Q&A Send

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3.5 Open Data statistics

Open Data was stored on the Zenodo repository, access statistics are reported in Table 10

Table 10: Open data statistics.

Document title	Upload date	No. of	No. of downloads
Electrical Vehicles – Practical solutions for power traction motor systems	10-05-2019	33	72
Experimental comparison between induction and synchronous	13-05-2019	18	38
reluctance motor-drives	10 00 2010	10	30
Synchronous reluctance motor: design, optimization and validation	20-05-2019	18	39
D3.2	20-05-2019	42	20
D3.3	20-05-2019	35	33
D1.1	18-09-2019	8	5
D3.1	20-05-2019	30	104
D9.2	18-09-2019	8	5
D9.1	18-09-2019	15	11
D9.3	18-09-2019	9	7
PPR1 (Executive Summary)	18-09-2019	8	7
D8.3 (Executive Summary)	18-09-2019	5	2
D2.1 (Executive Summary)	19-09-2019	7	6
D2.2	19-09-2019	12	8
D3.4 (Executive Summary)	19-09-2019	7	4
D2.3 (Executive Summary)	19-09-2019	4	4
D4.4 (Executive Summary)	19-09-2019	6	5
D5.2 (Executive Summary)	19-09-2019	10	8
D5.3 (Executive Summary)	19-09-2019	5	3
D4.1 (Executive Summary)	19-09-2019	8	5
D4.2 (Executive Summary)	19-09-2019	11	7
D4.3 (Executive Summary)	19-09-2019	12	6
D4.5 (Executive Summary)	19-09-2019	12	6
Innovative E-drive solutions for battery electric vehicles avoiding rare	19-09-2019	20	13
earths	10.00.2010	17	12
Design of a 200kW Pivi Synkei motor without rare-earth Pivi for electric	19-09-2019	17	12
PMa SynRel performance summary	19-09-2019	18	22
D5 1 (Executive Summary)	19-09-2019	10	4
	18-09-2019	8	3
D9 5	16-12-2019	7	8
D5.4	16-12-2019	12	18
D5 5	16-12-2019	10	29
Magnetic and mechanical characterization of electrical steels and core	16-12-2019	10	18
material selection	10 12 2015	12	10
ReFreeDrive's presentations at Coiltech 2019	16-12-2019	7	21
On heat transfer performance of cooling systems using nanofluid for	14-01-2020	11	16
electric motor applications	11 02 2020		6
cooling of electrical motor by using nanofluid in the spiral channel	11-02-2020	14	D
Hydrothermal performance of ethylene glycol and water mixture in a	11-02-2020	11	26
spiral channel for electric motor cooling			
High speed synchronous reluctance motors for electric vehicles: a focus on rotor mechanical design	26-02-2020	9	25
Design analysis of a high speed copper rotor induction motor for a traction analysis	26-02-2020	12	28
Control Algorithm simulation results	16-03-2020	13	6
A conner rotor induction motor solution for electrical vahiales traction	14-04-2020	12	2/
system	14-04-2020	J	24
Synchronous reluctance motors with asymmetric rotor shapes and epoxy	14-04-2020	5	23

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resin for electric vehicles			
Finite elements model co-simulation of an induction motor drive for	15-04-2020	33	35
traction application			
Optimisation of a high speed copper rotor induction motor for a traction	15-04-2020	11	20
application			
Horizon2020 ReFreeDrive project: rare earth free e-Drives featuring low	16-06-2020	13	7
cost manufacturing			
Rare earth free motor designs for e-mobility	25-09-2020	5	0
Control strategies and electric drive design of induction and synchronous	25-09-2020	4	0
reluctance motors for e-mobility			
How copper contributes to sustainable mobility. The ReFreeDrive project	25-09-2020	6	6
ReFreeDrive: driving the future of electromobility through innovative	25-09-2020	8	7
rare-earth free motor technologies			
Performance evaluation of an induction motor drive for traction	05-10-2020	7	12
application			

3.6 Social Media

3.6.1 Common domain clustering all the active GV04 projects

Joint LinkedIn page "Electric Drivetrain Innovation Cluster" logo (Figure 29)



Figure 29: Electric Drivetrain Innovation Cluster Logo.

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3.6.2



H2020 – GV04 – 2017 – Grant Agreement 770143 – Project REFREEDRIVE ReFreeDrive_D9.6_Diss_Plan_v1.7_reworked

Common LinkedIn page clustering all GV04 active projects

Figure 30 reports the main layout of the cluster's LinkedIn page.

	Q Search	Lai ∠26 ⊏1 404 Home My Network Jobs Messaging Not	Factions Me * Work * Premium for Free	
1		ivetrain Innovation	Cluster	
	Modu f ED Modu f ED Modu f ED Manage page See jobs	ationCluster		
	About us The Electric Orientani Innovation Cluster is a cluster of three Europaen 10203 projects that were awarded with funding in topic CV04.2011 "Net generation of electic diversions for to electric verbics. Sociation on Public Michael Nov dort." three Europeen projects are DRVMHODE. ModulEL and RefreeDiven. The constant on this cluster web follows two objectives: joint dissemination of the projects' results and amariness creation on our common goals Know more about these projects at our website!	Recent update See all Following a short introduction of each of the three ongects and the links to the respective webbers 10 DWVBADDL integrated Modular Dumbuted Drivetzain for ElectricHybri.		
	Get exclusive insights on 450,000+ public See company growth and functional trends Check out notable leadership change Recent updates	& private companies Reactivate for Free		
	ElectricDrivetraintmovation Image: Sector Distances 11 updates + 60 followers Sector Distances Following Following a short introduces Following	InfiniovationCluster ****		
	. ElectricDrivetra	inInnovationCluster ***		

Figure 30: ReFreeDrive leaflet first release.

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3.6.3



H2020 – GV04 – 2017 – Grant Agreement 770143 – Project REFREEDRIVE ReFreeDrive_D9.6_Diss_Plan_v1.7_reworked

ReFreeDrive Workshop @Coiltech - World Magnetic Conference

Example of the LinkedIn Visitors campaign carried out by Coiltech staff including EU Projects ReFreeDrive, Drivemode and Fitgen (Figure 31).

The latest results in the field at the World Magnetic Conference (WMC)

On September 25/26, more than 50 speakers, including 18 from Universities, will be presenting their latest results this year at the WMC, organized in parallel to Coiltech, in Pordenone, Italy (near Venice).

The quality of the conference this year is underlined by the presence of ReFreeDrive, DRIVEMODE, and FITGEN. All projects are Horizon2020 R&D, financed by the EU, for the e-mobility who are committed to the public dissemination of research results in a highly technical context. For their fall 2019 dissemination session, they have chosen the World Magnetic Conference as their platform. See below their brief description:





heavy-duty vehicles. herey //drive

The ReFreeDrive project is focused on contributing to avoid the use of rare earth magnets through the development of a next generation of electric drivetrains, ensuring the industrial feasibility for mass production while focusing on the low cost of the



manufacturing technologies.

ORIVEMODE The DRIVEMODE concept stems from the idea of

e-h2020.eu/project/



integrating technologies to provide highly efficient and compact integrated modular drivetrain components FITGEN aims at developing a functionally integrated dedicated to different kinds of cars. These include mass produced electric and hybrid vehicles, low performance and high performance vehicles and different types of electric vehicles. http:// fitgen-project.eu

e-axle ready for implementation in third generation

Each project involves different partners, from several countries, including, for example, Jaguar Land Rover, Visedo Oy - Danfoss Group, and Semikron, among other companies and academics.

With this balanced mix between research results and industry representatives, you can be upto-date with current innovations and best practices.

Click here for the program of the conference.

Access to each Conference Room is free of charge, no additional registration is required for

Figure 31: LinkedIn article for Coiltech visitors: campaign reporting EU projects event.

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3.6.4 LinkedIn analytics during the past 12 month (Mar 2020 to Mar 2021) running of our cluster page:

The next graphs reports visitor's statistics (Figure 32, Figure 33, Figure 34) and follower statistics (Figure 35, Figure 36, Figure 37). Impression trend is reported in Figure 38 and detailed in Table 11, Table 12, Table 13.

a) Visitors









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Visitor demographics 🛛 Time ra	nge: Mar 1,	2020 - Mar 2	26, 2021 🔻	Data fo	or: Industry	•
Top industries						
	Visitors	% of Visitors				
Automotive	260					
Electrical/Electronic Manufacturing	118					12.14%
Research	89				9.16%	
Renewables & Environment	65			6.69%	i i	
Higher Education	42		4.32%			
Mechanical or Industrial Engineering	41		4.22%			
Marketing and Advertising	37		3.81%			
Management Consulting	35		3.6%			
Market Research	35		3.6%			
Computer Software	28		2.88%			

Figure 34: LinkedIn visitors: industry field.

b) Followers



Figure 35: LinkedIn new followers: statistics.

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Follower Demographics 🚱 Data for: Location 👻



Figure 36: LinkedIn new followers: location.





c) Impressions:

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Update metrics 🕝 Time range: Mar 1, 2020 - Mar 26, 2021 🔻 Metric: Impressions 🔻



Figure 38: LinkedIn impressions

Table 11: Cluster page on LinkedIn detailed statistics, part A.

Update engagement								51	ow: 10	-
Update title	Posted by	Created	Impressions	Video views	Clicks	CTR	Reactions	Comments	Shares	Follow
Oil flows and churning torque prediction in DRIVEMODE transmission All followers	Marcello Bardellini	10/8/2018	366		16	4.37%	10	O	1	
ReFreeDrive Dissemination session @ #Coiltech 2018 Next week, ReFreeDrive All followers	Tomas Jezdinsky	9/20/2018	876		27	3.08%	6	O	6	
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Table 12: Cluster page on LinkedIn detailed statistics, part B.

Update engagement 🛛 Time range: Mar 29, 2020 - Mar 29, 2021 - Show:									
Update title	Posted by	Created	Impressions	Video views	Clicks	CTR	Reactions	Comments	Sharm Fol
Join us! On April 16th we will have our final event. http://tiny.cc/GV04 The three All followins	Fernando Nuño	3/21/2021	1,312		125	9.53%	29	1	13
Why reducing drivetrain size can make electric cars even greener - DRIVEMODE All followers	Marcello Bardellini	3/12/2021	312		14	4.49%	7	0	0
The #drivetrain module developed by #DRIVEMODEH2020 brings together All followers	Marcello Bardellini	2/23/2021	466		21	4.51%	9	0	0
High voltage batteries for electric vehicles All followers	Marcello Bardellini	2/18/2021	1,245		68	5.46%	13	з	D
Shifting to 800-volt systems: Why boosting motor power could be the key to better All followers	Marcello Bardellini	2/16/2021	315		7	2.22%	5	D	D
Last but not least, discover latest new on Motor development from sister project All followes	Dorian Oddo	1/18/2021	449		18	4.01%	5	D	D
Sister project #ModulED develops an integrated GaN-based inverter for use in All followers	Dorian Oddo	12/15/2020	489		6	1.23%	6	D	D
Advanced Induction Motor technologies for e-mobility All followers	Fernando Nuño	11/30/2020	517		36	6.96%	з	1	1
Advanced induction motors for e-mobility. Learn how zero porosity copper rotors are All followers	Fernando Nuño	11/29/2020	1,429		115	8.05%	28	1	2
How is sister project #ModulED handling regenerative braking strategies ? More on All followers	Dorian Oddo	10/23/2020	587		23	3.92%	10	D	1
	4								×.
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Table 13: Cluster page on LinkedIn detailed statistics, part C.

Update title	Posted by	Created	Impressions	Video views	Clicks	CTR	Reactions	Comments	Shares	Fol
The clusters's sister project #ModulED explains its take on component and syste All followers	Dorian Oddo	10/15/2020	727		55	7.57%	14	0	1	
Want to know more about the clusters's sister project #ModulED? As the All followers	Dorian Oddo	10/7/2020	428		9	2.1%	2	0	1	
DRIVEMODE: Demo vehicle test-drive All followers	Marcello Bardellini	10/5/2020	517		31	6%	10	0	2	
Next generation electric drivetrains for fully electric vehicles All followers	Dorian Oddo	9/10/2020	315		15	4.76%	4	0	1	
Next generation electric drivetrains for fully electric vehicles All followers	Fernando Nuño	9/10/2020	426		13	3.05%	5	0	2	
Mobility Ideen Contest - Future Mobility All followers	Tomas Jezdinsky	8/31/2020	427		39	9.13%	6	0	1	
RFD video clip #5: see how Prof. Marco Villani from University of L'Aquila explains III All followers	Tomas Jezdinsky	8/4/2020	570	22	27	4.74%	14	1	2	
RFD video clip #4 André Nasr from IFPEN, one of the ReFreeDrive project partners,	Tomas Jezdinsky	8/4/2020	540	13	19	3.52%	14	0	9	
4th Edition of H2020 Road Transport Research European Conference All followers	Marcello Bardellini	6/23/2020	801		24	3%	15	0	1	
2nd ReFreeDrive Webinar - Power Electronics All followers	Fernando Nuño	6/15/2020	549		38	6.92%	7	0	1	
	•									•
<pre> Previous </pre>			1 2 :	3					Ne	xt)
Update engagement 😡 Time range:	agement 🛛 Time range: Mar 29, 2020 -							Show	10 👻]
Update title	Posted by	Created	Impressions	Video views	Clicks	CTR	Reactions	Comments	Shares	Follo
ECI Webinar Power Electronics 2nd ReFreeDrive Webinar, please join us for All followers	Tomas Jezdinsky	6/9/2020	738		59	7.99%	18	0	4	
ReFreeDrive Videos - clip3: We avoid using heavy rare earths in our motor solutions, I All followers	Tomas Jezdinsky	5/6/2020	829	9	25	3.02%	14	0	8	
ReFreeDrive Videos - clip2: Within our #ReFreeDrive Project we will produce for III All followers	Tomas Jezdinsky	4/28/2020	1,236	10	55	4.45%	20	0	7	
ReFreeDrive videos - clip1: Today only a few commercially available #electricvehicles II All followers	Tomas Jezdinsky	4/24/2020	3,076	8	96	3.12%	22	8	6	
Welcome! You are invited to join a webinar: Rare earth-free motor designs for e All followers	Fernando Nuño	4/15/2020	870		41	4.71%	16	0	10	
	•									•
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