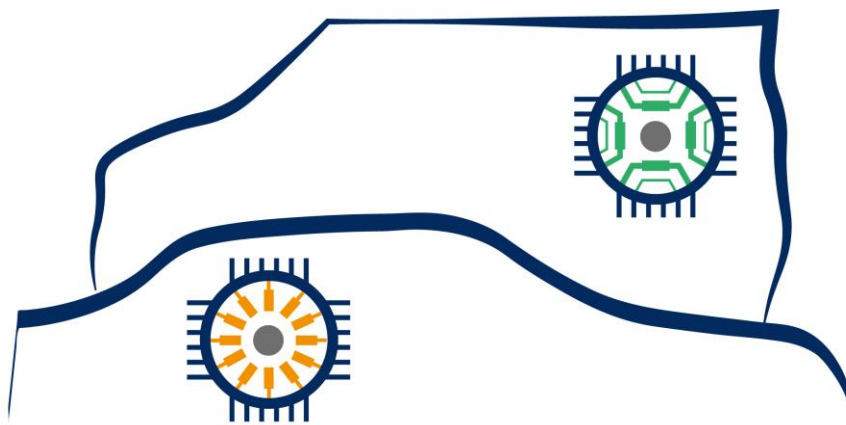


Rare Earth Free e-Drives Featuring Low Cost Manufacturing



ReFreeDrive

Collaborative Project
Grant Agreement Number 770143

Start date of the project: 1st October 2017, Duration: 36 months

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Plan for the Exploitation of Results, first draft

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Abbreviations

In this report, the following acronyms are used:

- **CID:** Fundacion CIDAUT
- **EV:** Electric Vehicle
- **GA:** Grant Agreement (of this project)
- **IM:** Induction Motor
- **IPR:** Intellectual Property Rights
- **MAV:** Mavel SRL
- **PM:** Permanent Magnet (component)
- **UAQ:** Università dell'Aquila

Executive Summary

This report is about the exploitation of the technological solutions that were designed during the project and will be tested before it ends. It is a first draft that covers part of the topics, more specifically we shall prepare the following documentation, according to the Grant Agreement (GA).

- **Market Analysis:** *“perform a continuous market analysis, analysing any change in the customer's' needs and potential competitors as well as identifying the trends and expected growth at European and international level will be carried out ...”*
- **Business Plan:** *“define a Commercialisation Strategy and Business Plan that will be carried out by Mavel SRL (MAV) with the support of Fundacion Cidaut (CID), based on previous tasks and with a more detailed cost analysis. The Business plan will include a refined commercialisation strategy and a proposal for an investment policy.”*
- **Event Attendance:** *“participating in specialist fairs in Europe and throughout the world; the project partners will take part in specialist fairs and it is envisaged to book for a stand during the project final event in one of them, which will be selected during the project, and organized by Università dell'Aquila (UAQ)”*
- **Exploitation:** *“...focused on the industrial exploitation and marketing. A market and technological watch will be established to keep track of new competitors, initiatives as well as research results. This market and technological watch will be carried out jointly by the Project Technical Management Board during the whole project, reporting at the end of each project year”*
- **IPR Management:** *“monitoring of foreground and IPR issues, the project's IPR strategy, etc...”*

Not all topics are due for this deliverable, though, and what is hyphened here below is not included at this stage, but will be included in the next deliverable D8.4, due at the end of the project, M36.

- Market trends and growth
- Customers needs and competitors solutions
- Critical materials analysis and forecast
- ~~Business plan – commercialization strategy~~
- ~~Business plan – economics, proposal for investments~~
- Event attendance: this is reported in D9.x, thus it is not done here
- Exploitation – technological watch
- ~~Exploitation – exploitation plan~~
- ~~IPR issues and strategy~~

This report is divided in 5 main sections:

1. Market and Technological Watch, which describes the positioning of all Electric Vehicles inside the automotive market and the main scenarios defined by the monitoring authorities, as well as the state of the art, from the technological point of view.

The market trend is clearly lacking against expectations, if we consider the latter as defined in the main scenarios issued by government. These are related with reasonable targets (which are close to be strictly necessary), for example IEA 2DS scenario is defined in order to get a global warming not higher than 2°C, by the year 2050.

As year 2020 is approaching, also some declarations by car makers are close to their deadlines, for instance some restrictions and bans must be fulfilled. Fig. ES1 shows this situation, to be compared by today's figure, which is a total worldwide stock of Electric Vehicles (EVs) of about 5.1 Million units.

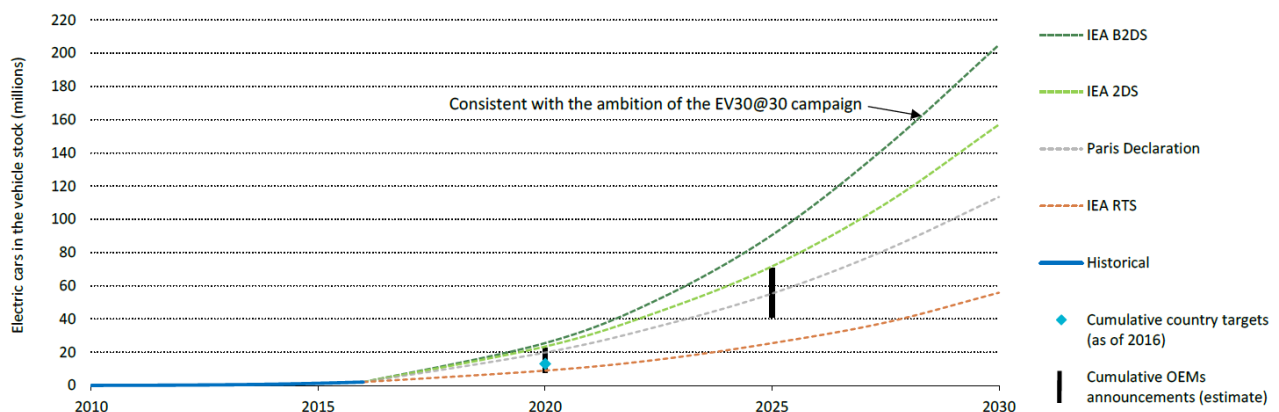


Figure ES1. IEA scenarios

In this situation, we can reasonably expect that Electric Vehicles sales are being supported more than today.

From the technological point of view, the report shows that Permanent Magnet (PM) motors are used in EVs. The only main player in Electric Car making which uses other technologies is the American company Tesla, which by the way recently switched to PM for its last (and cheaper) car, called model 3.

2. Trends in customers' needs and in competitors' solutions, which is trying to describe the main trends in product requirements and technological developments, focusing on the electric motors for automotive traction and considering the supply inverters as well.

The customers' needs can be resumed as following:

- Cost/price
- Reliability (operational expenses are an advantage, and we must be sure to keep it low)
- Range, which means high efficiency and low battery consumption
- Easiness of recharging batteries

As for the competitors' trends, in technological development, we clearly see a wide use of PM motors (today's benchmark), but, on the other hand, also many efforts to reduce the impact of rare earth materials inside these motors. Rare earths are inside PMs, then today's state of the art is a problem and needs a solution or at least an important revision (please refer to section 3 about the problems related with rare earth materials). This is achieved by design reviews, with a limitation of PMs and also by the magnets manufactures through techniques to reduce the amount of rare earths inside PMs, but in any case this cannot be solved in a thorough way.

3. Critical materials is a focus about the state of the art and the forecast request for critical materials, in an electrical drivetrain. It focuses above all on rare earths, showing that these elements are the most critical ones and reporting about the ones used in electric drivetrains.

It is clear that the use of Neodymium is a problem and will remain an issue even in the future, as shown in Fig. ES2. Today we could not find any definitive solution, among the many proposals in literature.

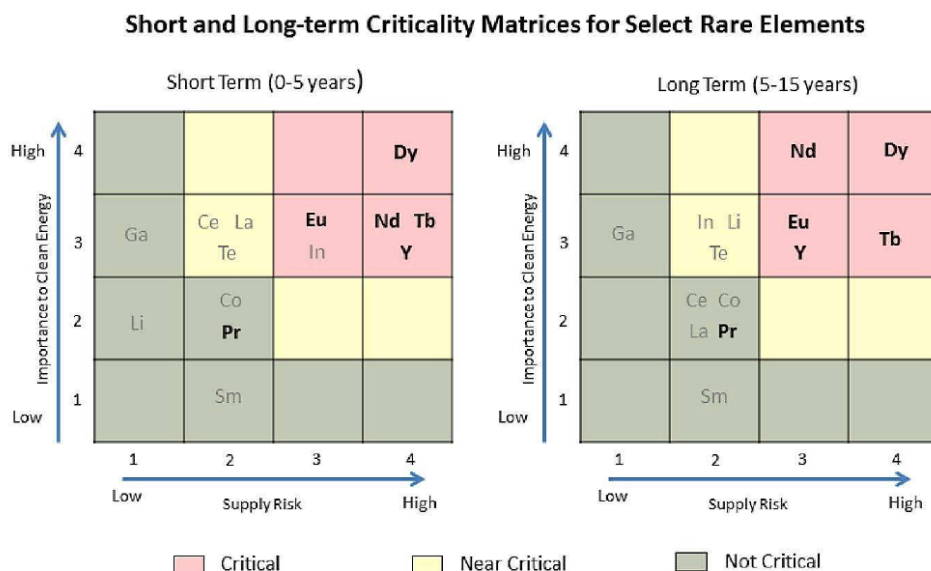


Figure ES2. Critical Materials - source: [20]

4. Intellectual Property Rights, setting up a methodology to allow all partners dealing with this throughout the whole project.

A table was defined and a procedure was shared among the partners in the project. Up today, no intentions for protection are presented by the partners, but a few potential intentions were found.

5. Commercialization Strategy and Business Plan definition; in this first draft deliverable, the assessment reported in the Grant Agreement and the assessment of the break-even are crosschecked, considering the forecast sales and the calculated costs of the products designed during this project.

The calculation shows that, even in the worst case, that is Induction Motor (IM), which has the highest variable cost, we still meet the expectations described in the Grant Agreement and reported in Fig. ES3, that means that the evaluated costs of goods are within the expected one.

	kEuros									
	2020		2021		2022		2023		2024	
SALE INCOMES	2872,4	100,0%	6051,6	100,0%	12428,4	100,0%	25777,5	100,0%	54316,9	100,0%
R&D EXPENSES	200	7,0%	150	2,5%	105	0,8%	65	0,3%	40	0,1%
SALES EXPENSES (included investments)	2722,77	94,8%	5736,42	94,8%	11781,20	94,8%	24435,08	94,8%	51488,19	94,8%
Cost of Goods	2344,68	81,6%	4939,86	81,6%	10145,25	81,6%	21042	81,6%	44338,5	81,6%
Selling Expenses (Marketing)	234,47	8,2%	493,99	8,2%	1014,53	8,2%	2104,20	8,2%	4433,85	8,2%
Overheads (Rental, Energy, ...)	143,62	5,0%	302,58	5,0%	621,42	5,0%	1288,88	5,0%	2715,84	5,0%
EBITDA	-50,4	-1,8%	165,2	2,7%	542,2	4,4%	1277,4	5,0%	2788,7	5,1%

Figure ES3. Incomes and expenses as reported in the Grant Agreement.