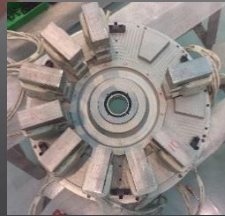


## SWITCHED/SYNCHRONOUS RELUCTANCE MAGNET-FREE MOTORS FOR ELECTRIC VEHICLES

### Background

One of the European Union's key policy objectives for the upcoming decades is cutting 60% of CO<sub>2</sub> emissions from transport, where fossil fuel dependence is around 96%. Electric vehicles (EV) are considered to be the most plausible alternative to fossil fuel-based road transport. While the main focus for the wide scale introduction of EVs so far has been placed on the batteries, where significant research and effort is being put to address its associated long-term performance and manufacturing issues, there is a second source of uncertainty related to the availability of reliable and diversified supply of metals to produce the necessary permanent magnets (PM) to assure high efficiency and high power density electrical motors. The shift from a fossil fuel dependence scenario to a permanent-magnet dependence scenario (even more critical as they can only be found under single source monopolies) could limit significantly the large scale introduction of EVs as PM based motors could not be supplied in adequate volumes at a competitive cost.

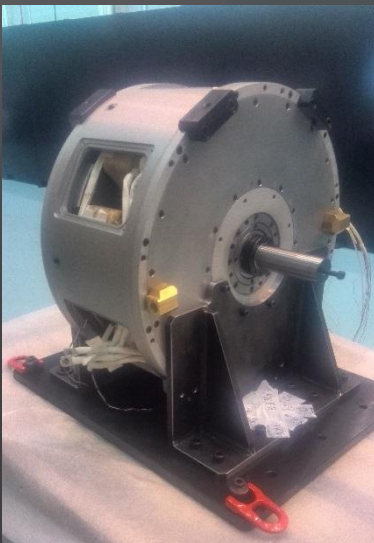


**VENUS** project aims to develop a novel electric drive system for EVs, (i) free of rare-earth magnets, (ii) which meets EV performance requirements (efficiency, power density) and (iii) that is feasible for mass-production.

In order to achieve that, VENUS will develop an axial-flux variable-reluctance machine, SRM or PMSynRM:

- SRM seems to be the trend in magnet-free electric machine technology but it has not obtained yet the desired success. Although axial flux configurations of this technology are being introduced in other applications, their use in EVs would be a genuine breakthrough.

- Axial-flux PMSynRM is a completely novel configuration for any application, combining already known advantages of radial-flux PMSynR machines with the torque increase and advantageous pancake shape of axial-flux configurations, although it requires quite complex manufacturing.



**Project Partners:** IK4-Tekniker (Spain), Lotus Engineering (UK), Fagor Electronica (Spain), Dr.-Ing. Ernst Braun GmbH (Germany), Motor Design Ltd. (UK), Mondragon University (Spain)

For more information please visit the VENUS project website:  
<http://www.venusmotorproject.eu>

VENUS project coordinator:  
Dr. Jon Madariaga  
IK4-Tekniker  
E-mail: [jon.madariaga@tekniker.es](mailto:jon.madariaga@tekniker.es)  
Tel: +34 943 20 67 44

This project has received funding from the European Union's 7<sup>th</sup> Programme for research, technological development and demonstration under grant agreement No 605429

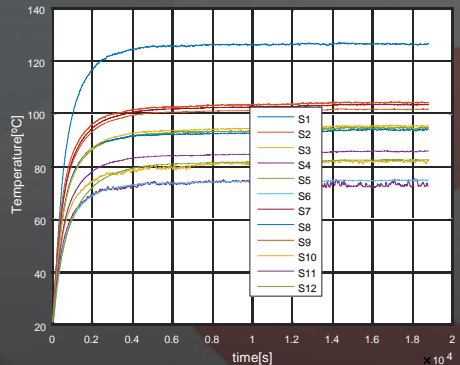
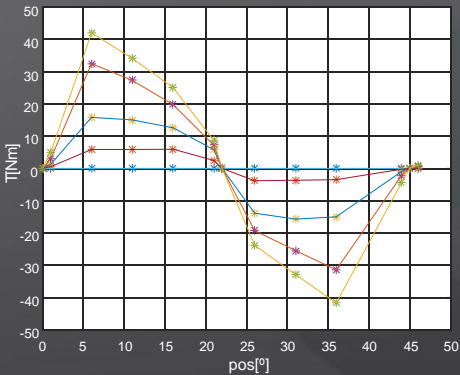
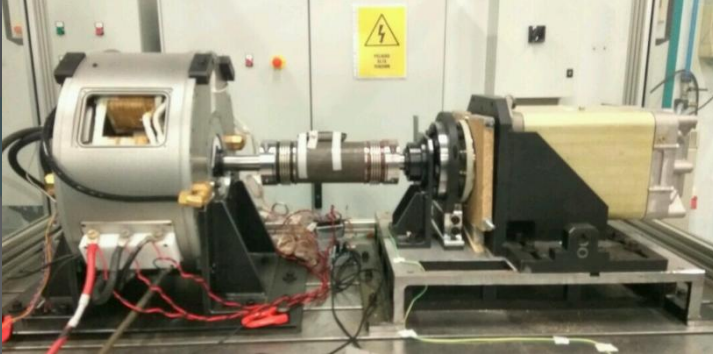


## SWITCHED/SYNCHRONOUS RELUCTANCE MAGNET-FREE MOTORS FOR ELECTRIC VEHICLES

### The motor Prototype tests.

At present different test are being carried out. From the most basic tests for control tuning, to the advanced ones for the motor performance evaluation.

Electromagnetic and thermal performance has been tested in the test bench and now the performance of the motor at different working points is being analyzed



### Upcoming Steps

VENUS project will be finished in October 2016 where the motor will be integrated in a Van. The final results and the mayor conclusions will be discussed in this final meeting.



Project Partners: IK4-Tekniker (Spain), Fagor Electronica (Spain), Dr.-Ing. Ernst Braun GmbH (Germany), Motor Design Ltd. (UK), Mondragon University (Spain)  
For more information please visit the VENUS project website: <http://www.venusmotorproject.eu>

VENUS project coordinator:  
Dr. Jon Madariaga  
IK4-Tekniker  
E-mail: [jon.madariaga@tekniker.es](mailto:jon.madariaga@tekniker.es)  
Tel: +34 943 20 67 44

This project has received funding from the European Union's 7<sup>th</sup> Programme for research, technological development and demonstration under grant agreement No 605429

