Research Fund for Coal and Steel project
101034063 — STeELS-EM — RFCS-2020

STabilized ELectrical Steels for Electric Mobility

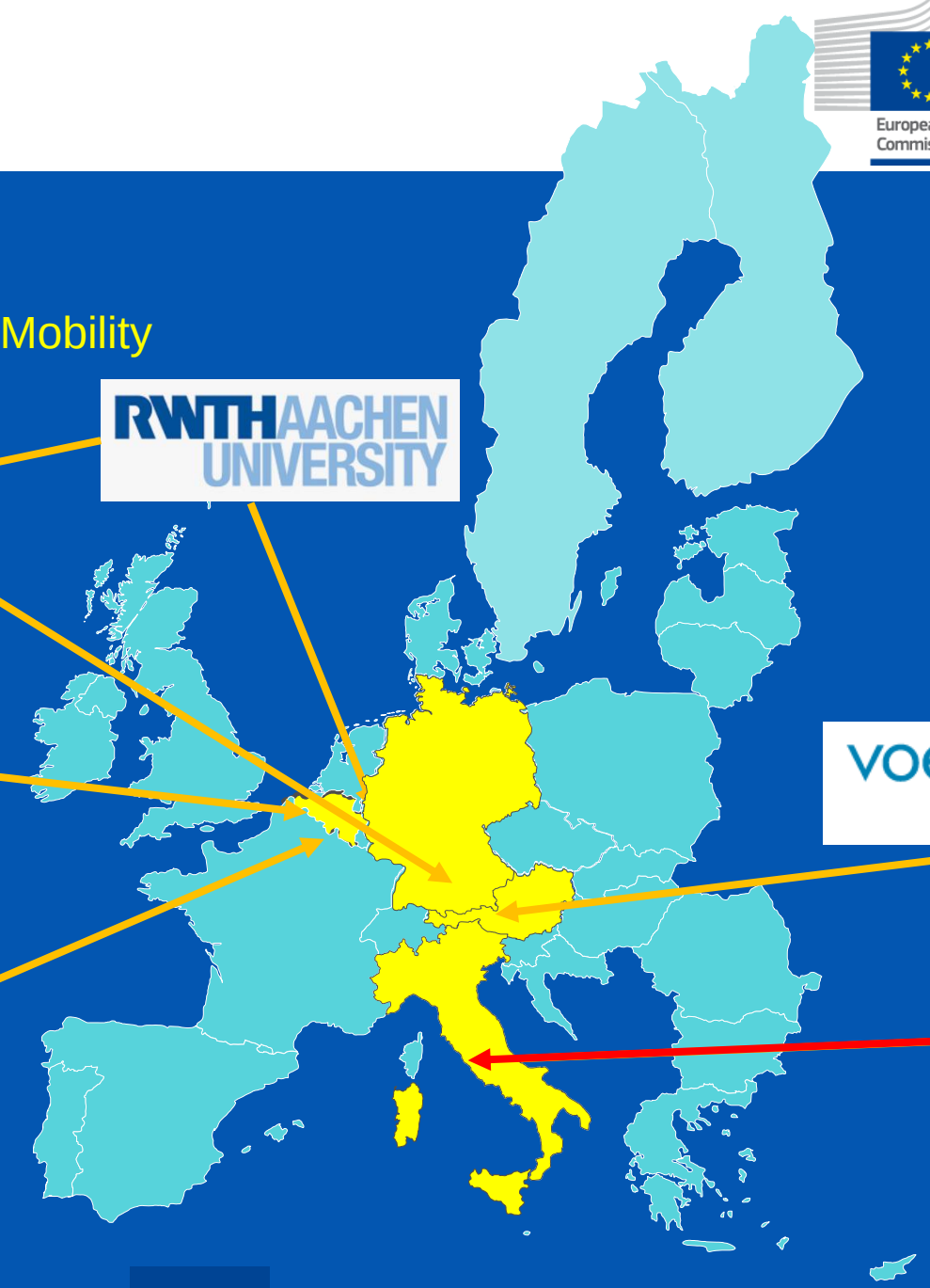
STeELS-EM

RFCS PROJECT N. 101034063

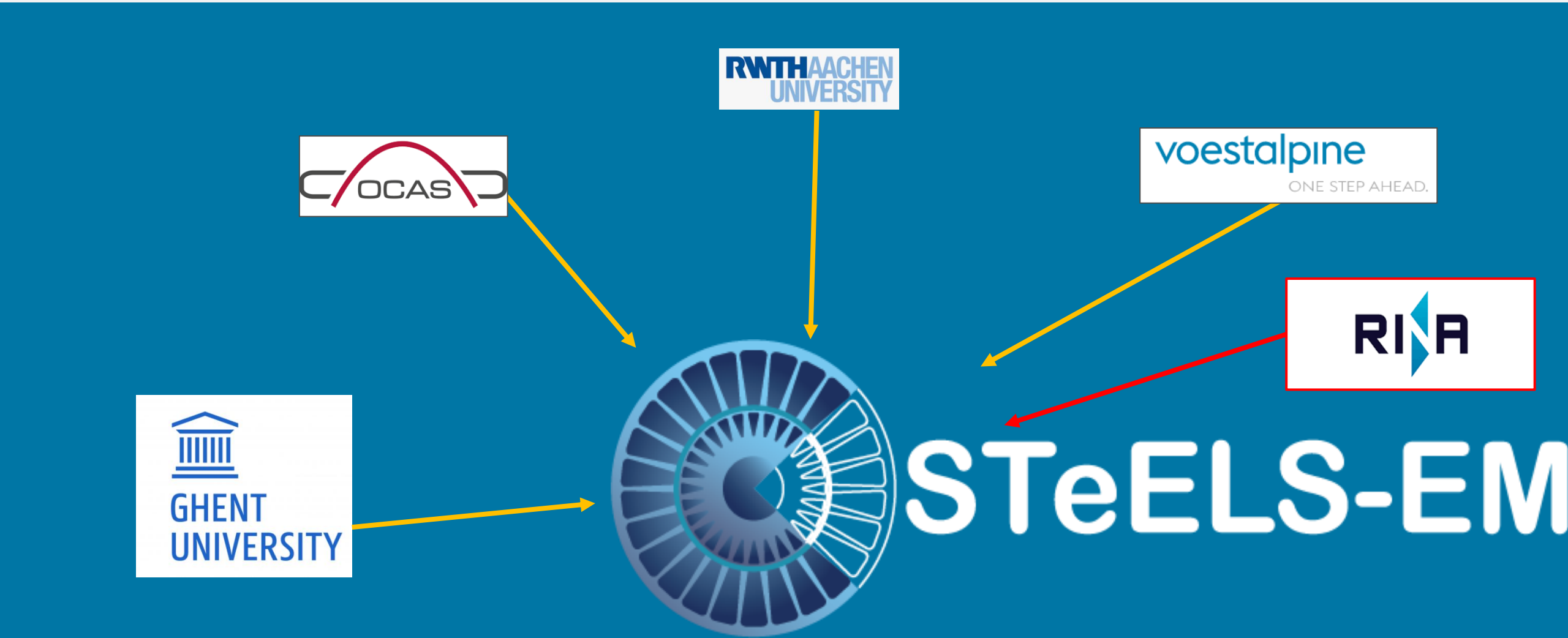
STeELS-EM

Stabilized ELectrical Steels for Electric Mobility

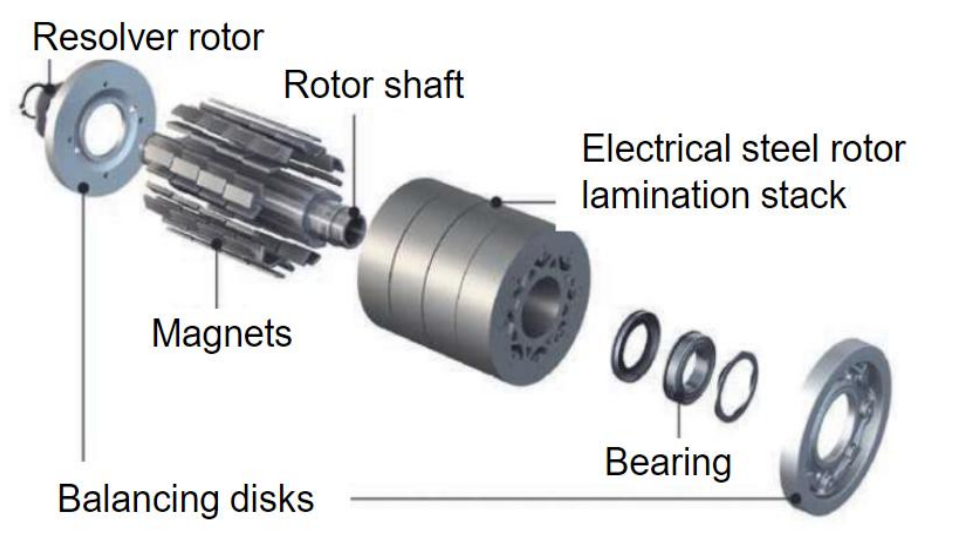
Call: *RFCS (2020)*
Instrument: *RFCS-RPJ*
Start date: 01/07/2021
End date: 31/12/2024
Budget: 1.933.234,00 €

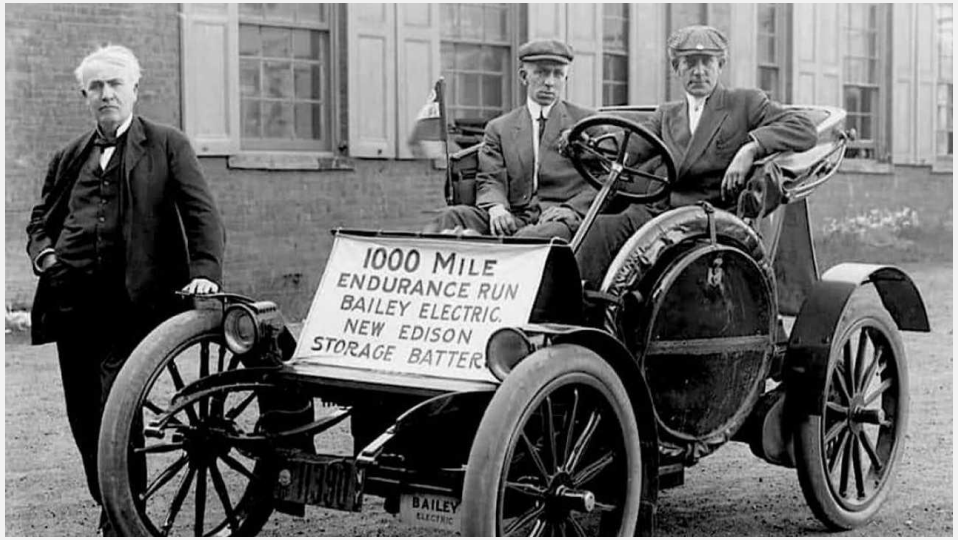


STeELS-EM LOGO



Problem tackled by STeELS-EM Project





- The project tackles the problem of, setting-up a FeSi “Electrical Steel“ material, tailored for high frequency application to be used to channel high frequency magnetic flux in the electric motors for an Efficient Electric Mobility.

- The problem of having high efficiency electric motors to be used as a traction motors in Electric Vehicles it is known by CAR manufacturers since automobile invention.

- Nowadays European producers have the problem of improving the high frequency electric motor characteristics to drive electric cars into a more efficient Automotive sector.

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Aim of the project

- The Aim of the project is to produce **non grain oriented electrical steel** obtained using unconventionally high concentration of **Ti**, in the alloy so that it can act as “scavenger” for interstitial elements as N and C.
- Such elements are captured by Ti in coarse precipitates, avoiding in such a way the formation of fine precipitation, which is expected to be deleterious for the electrical steel characteristics. In fact, fine precipitation negatively interacts with grain growth processes, preventing the formation of an optimal microstructure, as well as interfering with the magnetic domain’s walls displacement during the magnetization processes.

Expected project impact

- The present project intends to support the European electrical steel producers to the “breakthrough” of electrical steels into the automotive sector for electric mobility
- In terms of the related sector i.e. carmakers, the benefits include a new high performing NGO electrical steel, with improved magnetic properties, as materials solution for electrical motors.
- STeELS-EM project contributes, in a general manner, to decrease the overall consumption of fossil fuels and the CO2 emission of the steel industry. All steel plant activities that require the use of an electrical motor i.e. rolling mills, transportation and logistics of raw and processed materials, cranes, trucks, forklifts, etc. will benefit of this project outcome.

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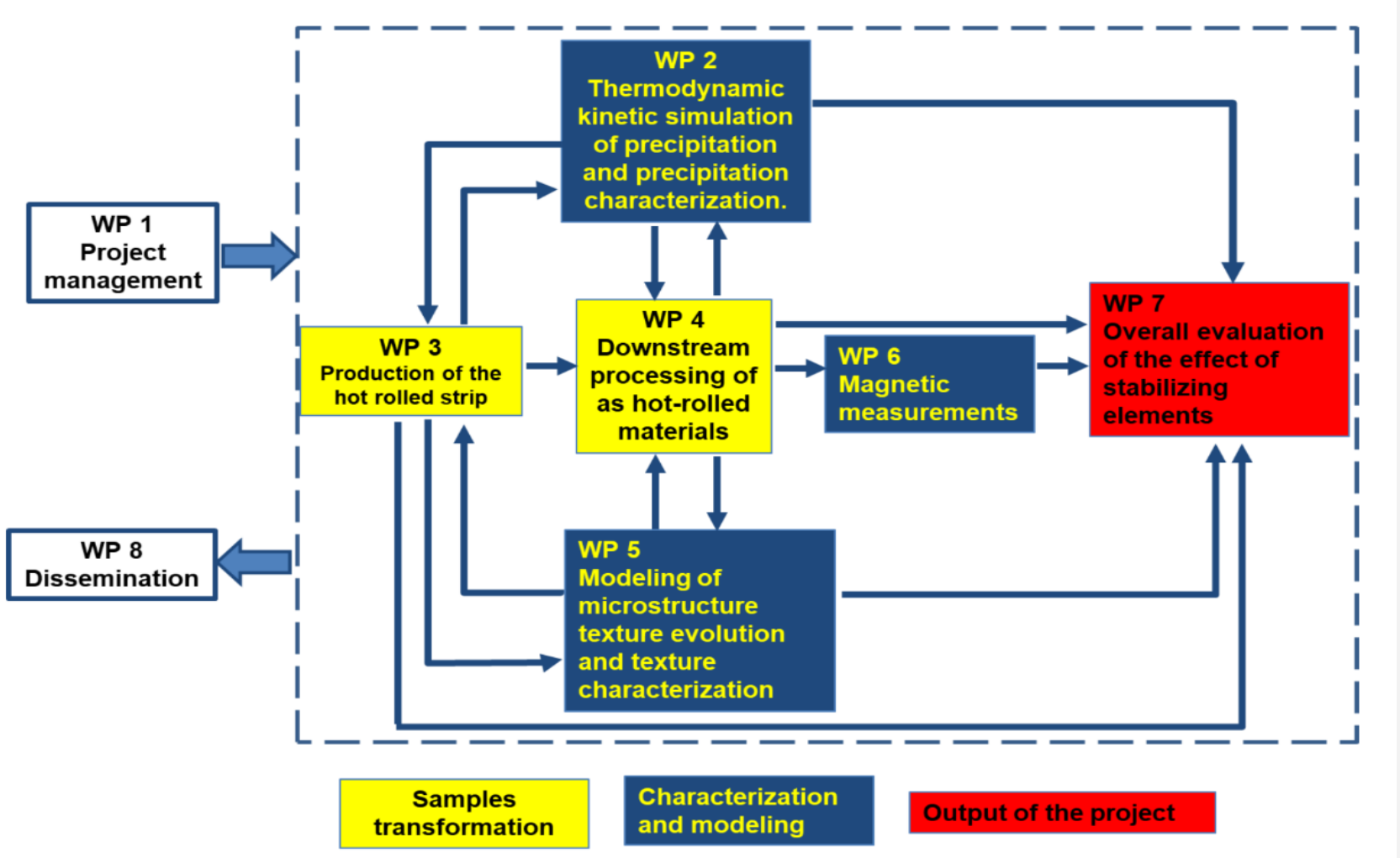
Work Packages



Electrical Steel for High Frequency

Electrical steel is used as material for magnetic core of electric machines.

Differently from major part of steels, it is not used exclusively because of its mechanical properties, but mainly because of its magnetic properties:

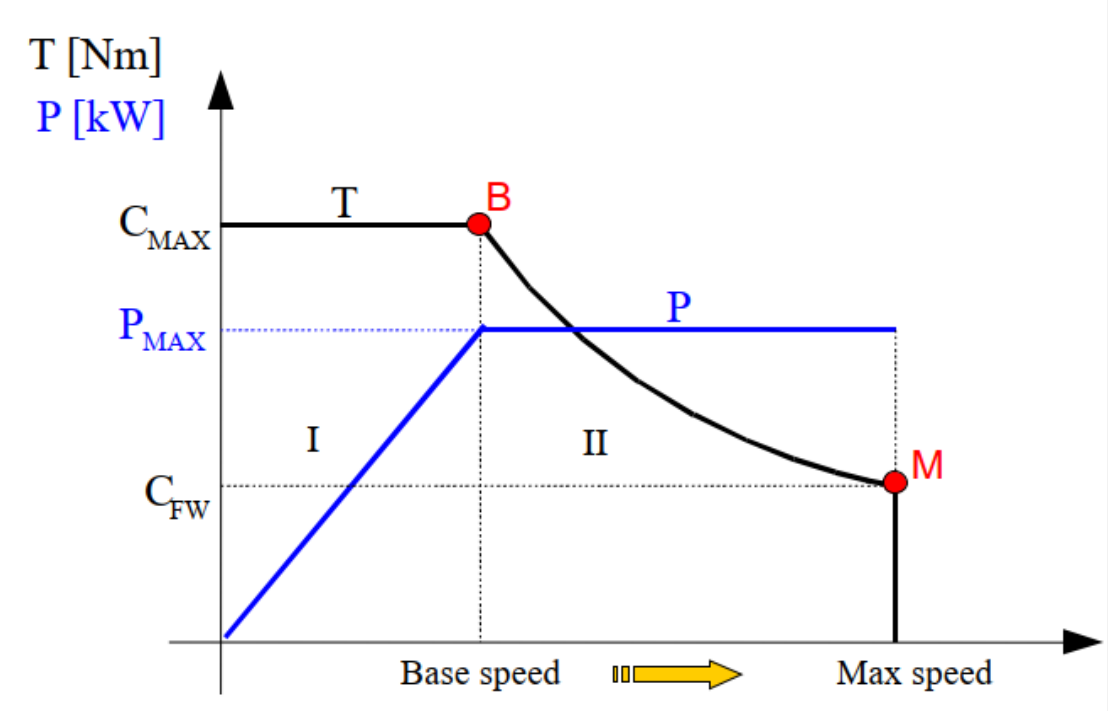
-POWER LOSSES: **P**
(efficiency of electric machine)

-POLARIZATION: **J**
(power-torque density
of electric machine)

NGO Electrical steel required for EV/HEV motors applications must have low core losses at high frequency (P10/400 @ 1T and 400 Hz), high induction J5000 and high mechanical resistance (Rp02; Rm). These characteristics are in fact those that determine the final performances of the machine.

Required Performance of Electric motors and characteristics of the steel

The performance of an electric motor in terms of torque and power is a function of speed



At low speeds: The torque is ideally constant up to the base speed. The dissipated energy is dominated by the copper losses, while the core losses in the iron are relatively low.

As the speed increases, the core losses component increase and the motor torque decreases, reaching a minimum at the maximum speed.

At high speed, the dominant component of losses are the core losses in the iron.

Si distinguono due regioni:

I. Constant Torque region -> high acceleration

II. Constant Power region (Flux-Weakening region) -> high Speed

ACKNOWLEDGEMENT

This project entitled STabilized ELectrical Steels for Electric Mobility (STeELS-EM) has received founding from the Research Fund for Coal and Steel, Grant Agreement No. 101034063.