Repurposing Electric Vehicle Motors for Micro-Grid Wind Turbines in Sub-Saharan Africa



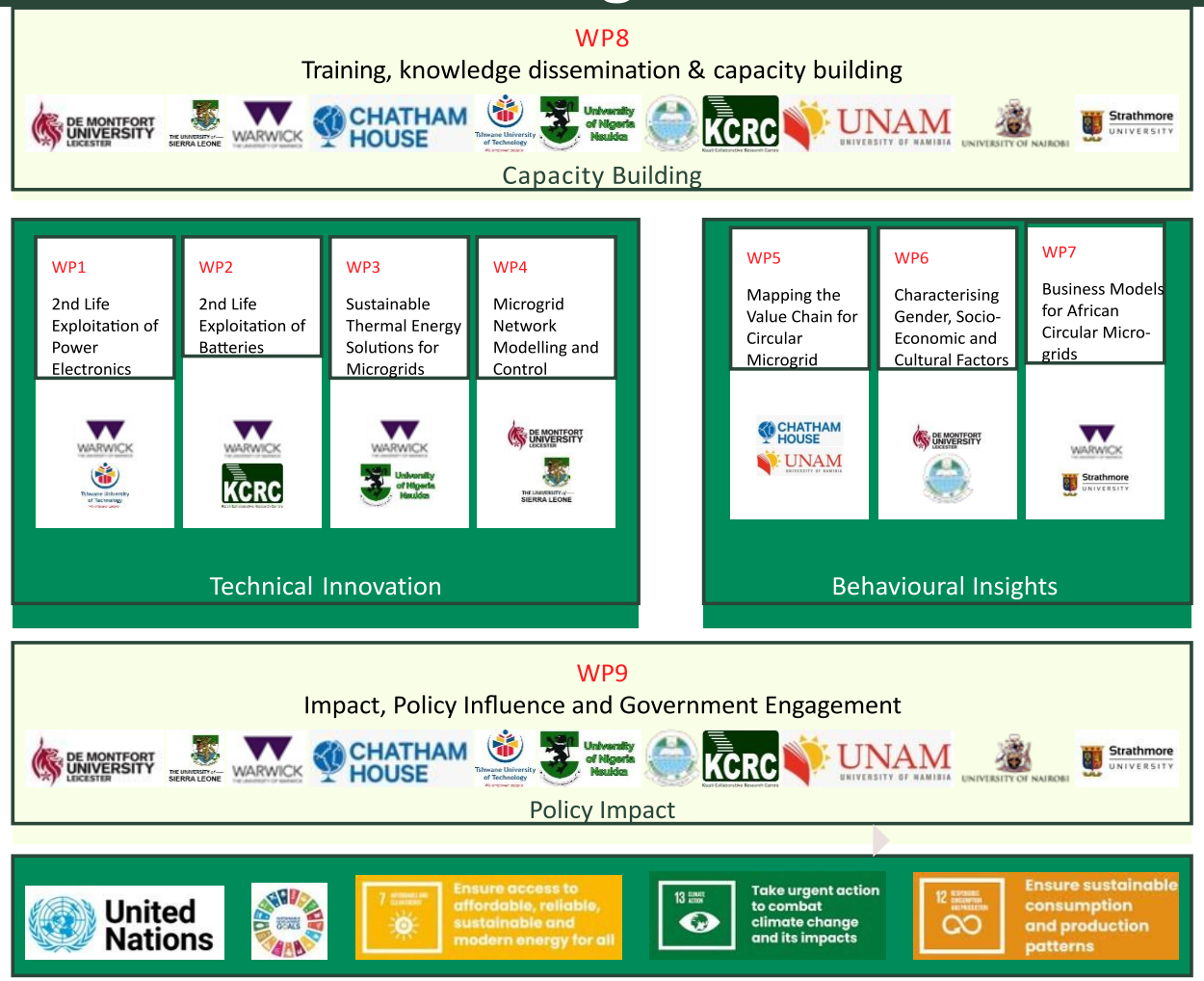
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Policy Power People

CEPREC Work Packages



Technical Innovation

Pioneering solutions to repurpose end-of-life materials for microgrids. WP1-4

Behavioural Insights

Understanding consumer behaviour to drive adoption. WP5-7

Capacity Building

Strengthening local expertise with knowledge and skills. WP8

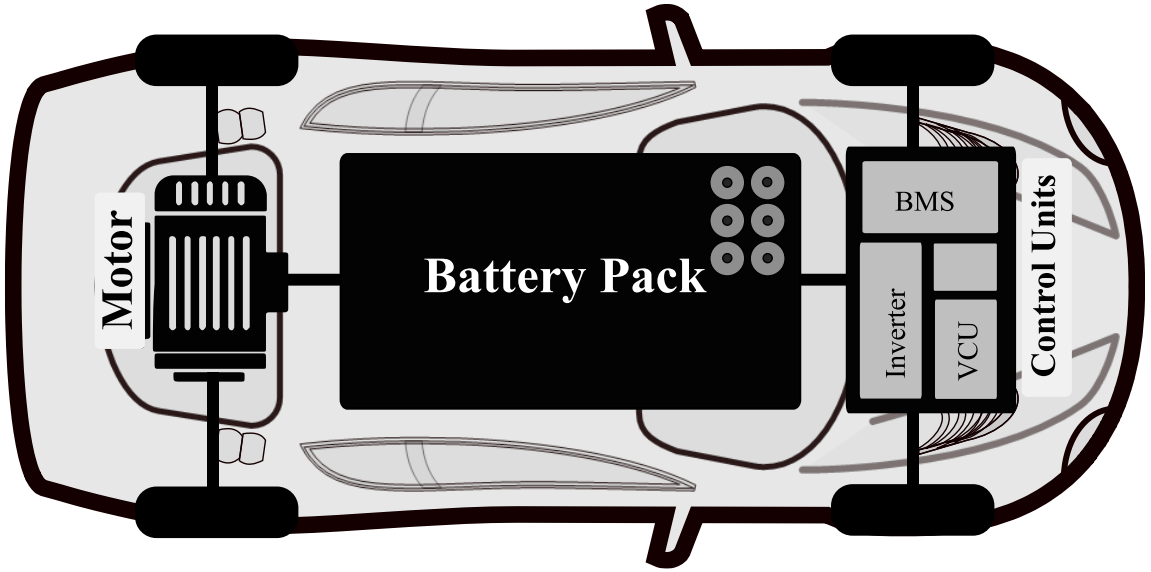
Policy Impact

Informing and supporting policies for sustainable energy access WP9

CEPREC

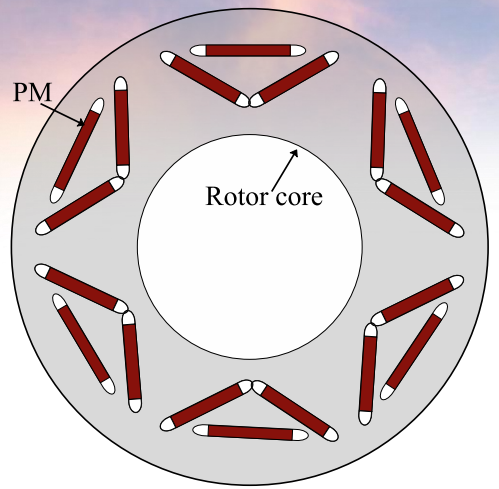
Introduction

- Electrification rates in Sub-Saharan Africa (SSA) are low
- Decentralized systems are typically recommended, especially in rural areas
- Can end-of-life (EoL) EV motors be used as generators in these places?
- Repurposing EV motors is a circular economy approach that can help reduce the environmental impact of EVs.



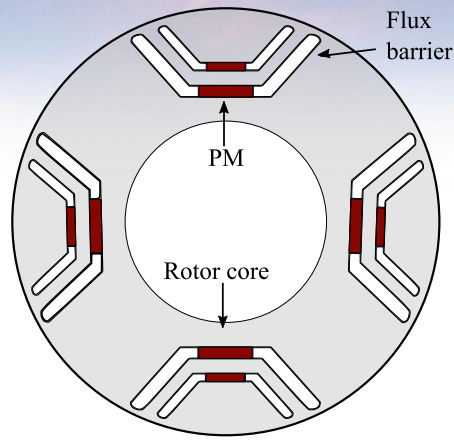
EV Powertrain

- Battery pack instead of fuel tank
- Motor for ICE
- Control units



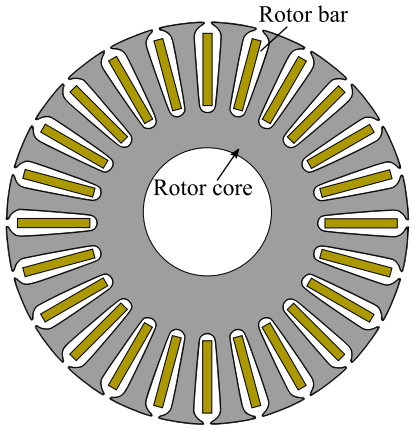
Interior Permanent Magnet Synchronous Machines (IPMSMs)

- Most widely used topology in EVs
- High power density, power factor and efficiency
- Costly PMs, demagnetization risks
- Control issues due to constant PM flux



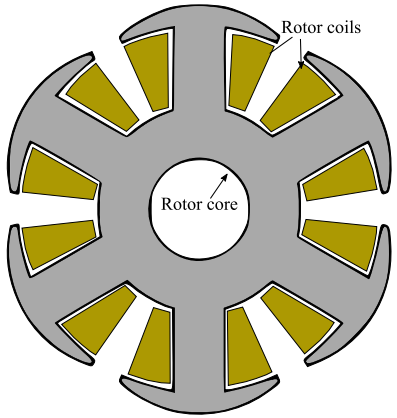
PM-Assisted Synchronous Reluctance Machines (PMaSynRMs)

- High power density and efficiency
- Reduced PM usage and cost
- Better control



Squirrel Cage Induction Machines (SCIMs)

- High reliability
- Low cost
- Lower power density and efficiency



Wound Field Synchronous Machines (WFSMs/EESMs)

- Good flux control
- Low cost
- Needs slip rings and brushes or brushless exciters

Nissan Leaf 2012

~700,000

Units sold globally

Considered a globally pioneering EV model

80 kW

Peak Motor power

Rated power is closer to 40 kW

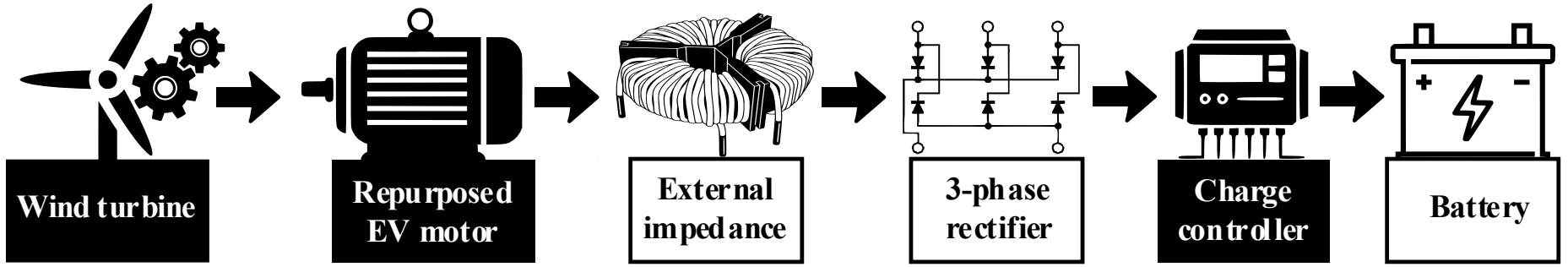
3800 rpm

Motor Rated speed

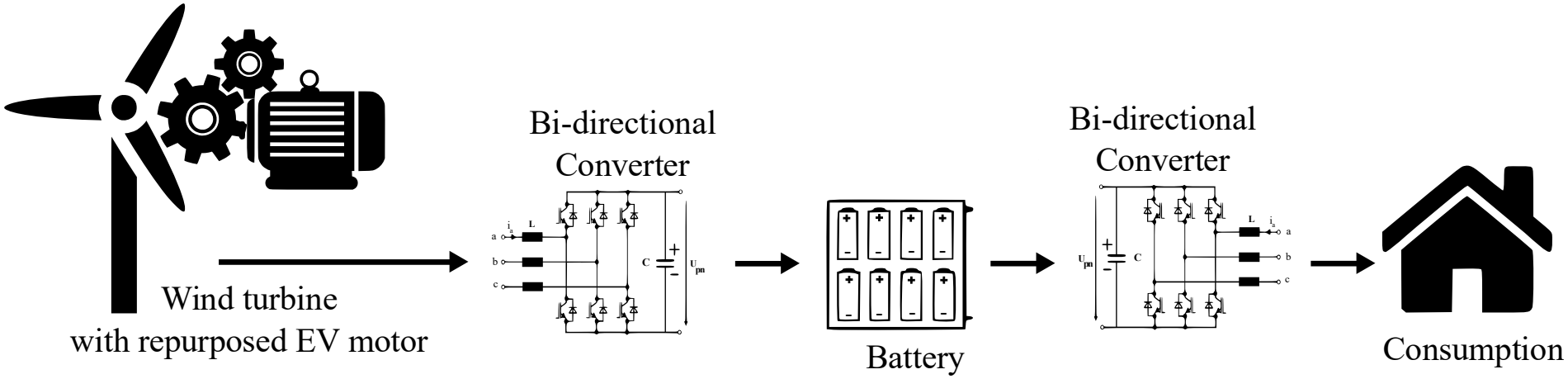
The speed at which rated (continuous) power is reached



Repurpose Applications for EoL EV motors

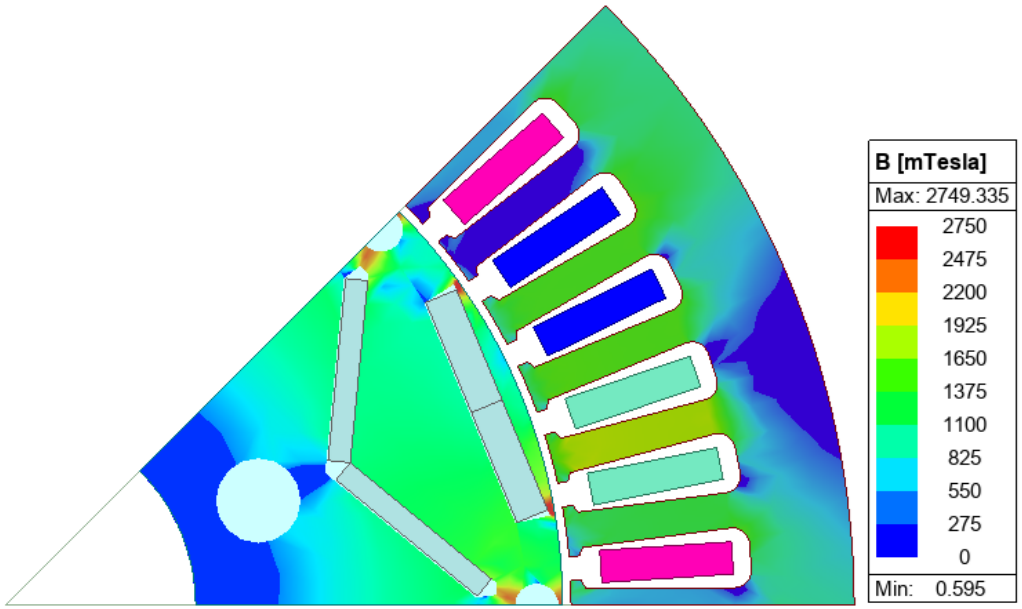


Battery charging



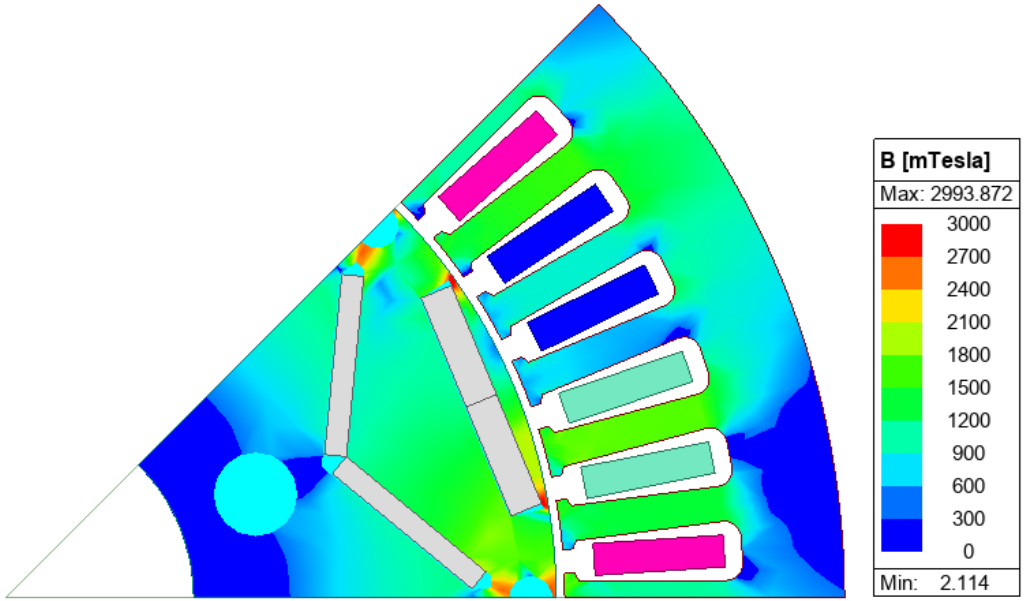
Powering AC loads

Saturation check



Flux density at 50 A

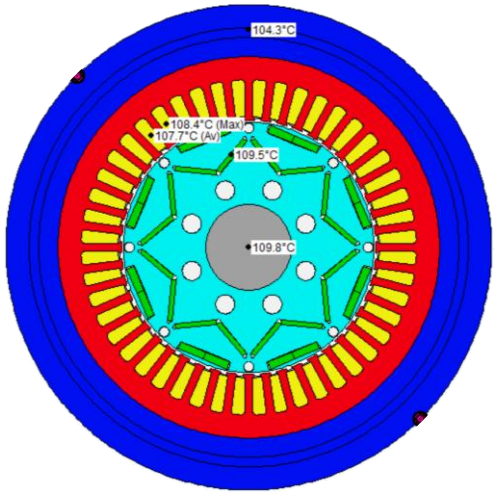
There are many variations of passages of Lorem Ipsum available, but the majority



Flux density at 165 A

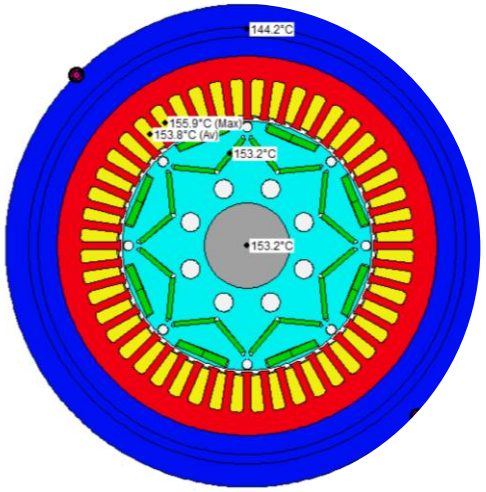
There are many variations of passages of Lorem Ipsum available, but the majority

Thermal Analysis



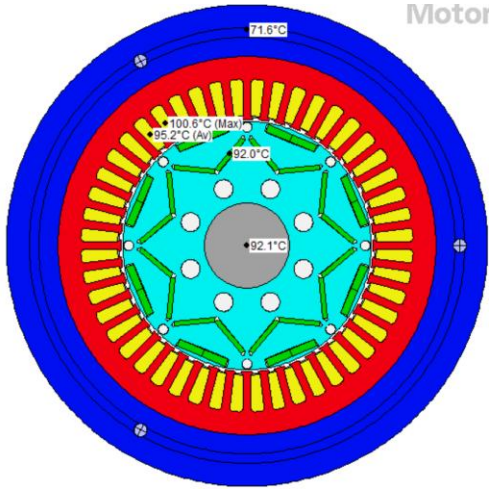
Temperature at 50 A

There are many variations of passages of Lorem Ipsum available, but the majority



Temperature at 100 A

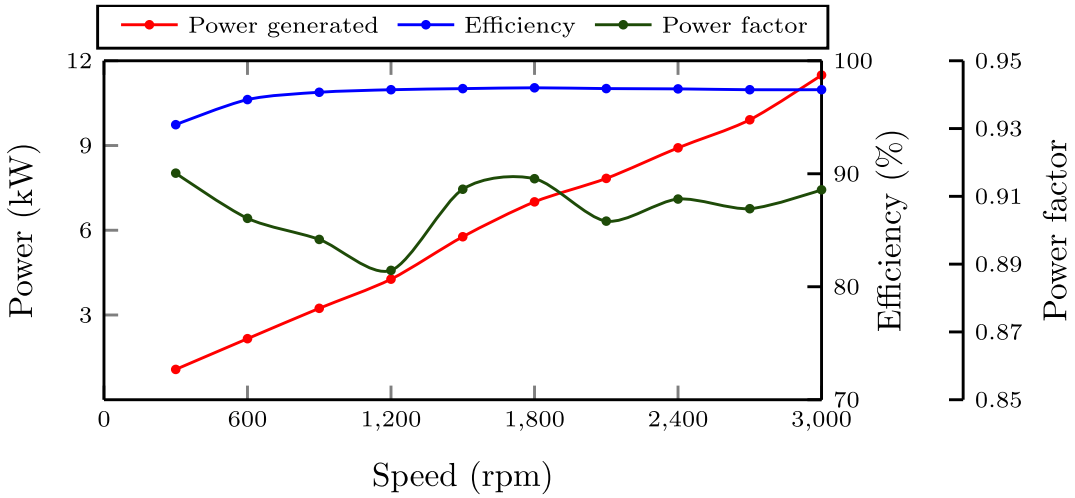
There are many variations of passages of Lorem Ipsum available, but the majority



Temperature at 165 A

There are many variations of passages of Lorem Ipsum available, but the majority

Performance of Nissan Leaf motor

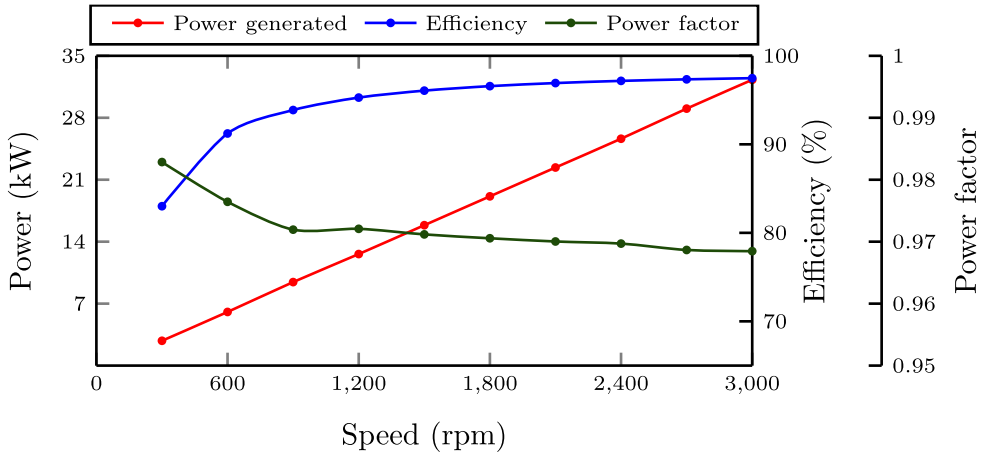


Performance for 50-A continuous current

Power generated at 1500 rpm is ~ 6 kW

Efficiency – 97,5%

Power factor – 0,91



Performance for 165-A continuous current

Power generated at 1500 rpm is ~ 16 kW

Efficiency – 96%

Power factor – 0,97

Discussion

Circular Economy

- Repurposing EoL EV motors can help reduce environmental impact of EV production
- Direct reuse of motors reduces energy required for recycling or remanufacturing

Information about motors

- Accurate information is critical For repurposing EoL EV motors
- FEA models can be used to simulate the motors for 2nd life applications

Practicality

- Transmission is required
- Lifecycle assessment of EoL EV motors is important
- Will these motors be obtained at scrap value?
- Use of other repurposed EV powertrain components can aid feasibility