EM-TECH

EM-TECH Project

Innovative **e-m**otor **tech**nologies covering e-axles and e-corners vehicle architectures for high-efficient and sustainable e-mobility

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EM-TECH – Fact sheet

- EM-TECH: Innovative **e-m**otor **tech**nologies covering e-axles and e-corners vehicle architectures for high-efficient and sustainable e-mobility
  - Funding scheme: HORIZON-CL5-2022-D5-01-09
  - Status: Project start by January 1st, 2023
  - Duration: 3 years
  - Consortium: 10 partners
  - Advisory Board: 3 partners
  - Total budget: approx. 4.920 k€
  - Coordinator: AVL List GmbH

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Consortium

Advisory Board

CHANGAN AUTO

PUNCH | Torino

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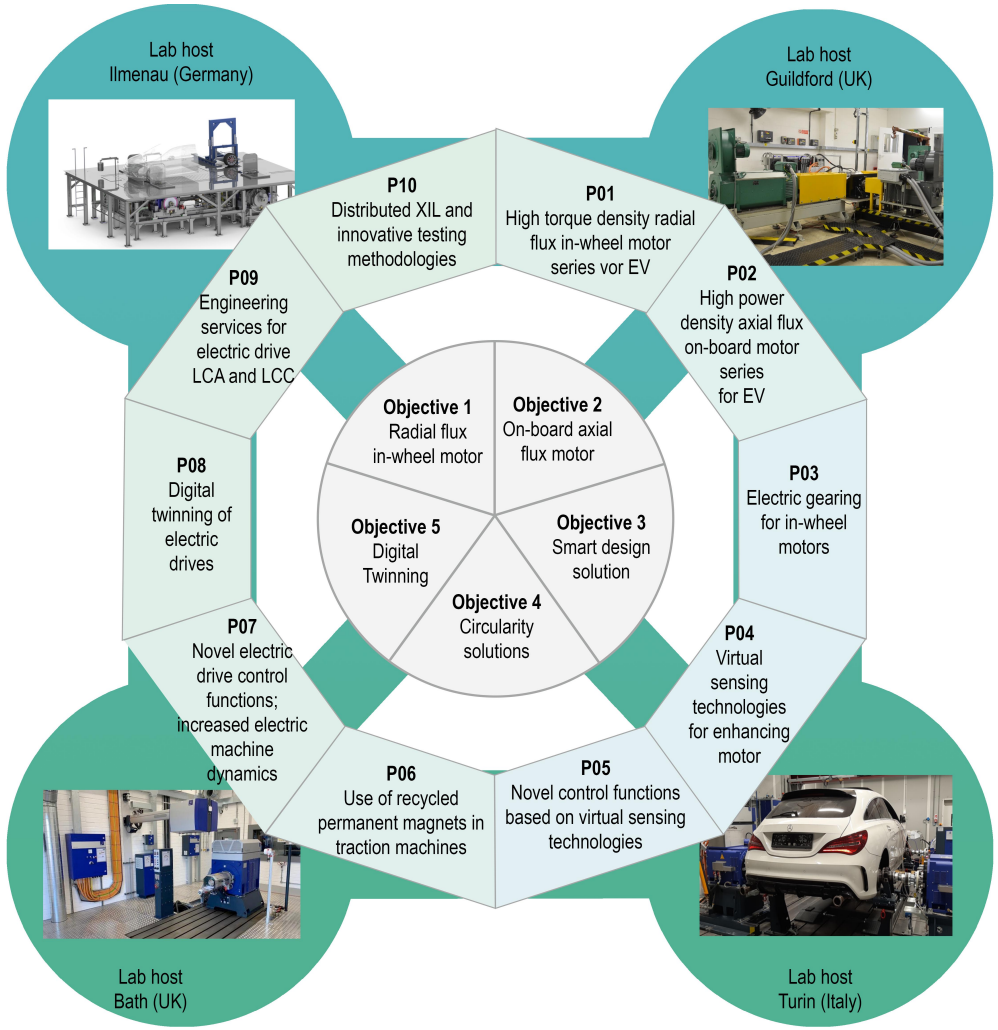
Overall Approach



Target Potential Customers and Users

- *End Users*
- *OEMs*
- *Tier 1-2 suppliers, automotive engineering companies*
- *SMEs*
- *Research Sector*
- *Policy makers and public authorities*

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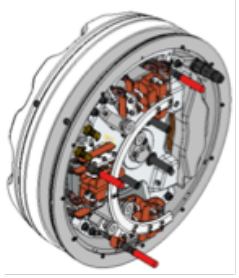
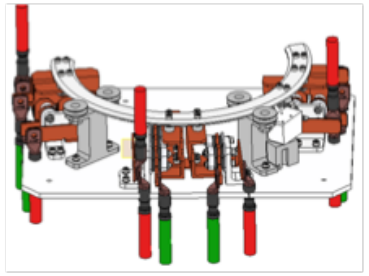
Obj1: Radial flux in-wheel motor (IWM)

OBJECTIVE 1 (O1): Radial flux in-wheel motor (IWM) and drive technologies for high torque density, efficiency, dynamic response, and implementation flexibility of e-corners

- O1.1. Development of a new series of electric corner modules, each of them including a direct drive IWM using radial flux permanent magnet (PM) synchronous technology, and the respective integrated Silicon Carbide (SiC) based inverter (knowledge transfer from the Horizon Europe HighScape project)
- O1.2. Electric gearing (e-Gear) solutions that suitably modify the stator winding arrangements according to the machine setpoint
- O1.3. Overall achievement of continuous torque density >150 Nm/litre and specific torque levels in excess of 50 Nm/kg
- O1.4. Demonstration of the potential of the novel functionalities, e.g., stopping distance reduction, and enhanced drivability performance





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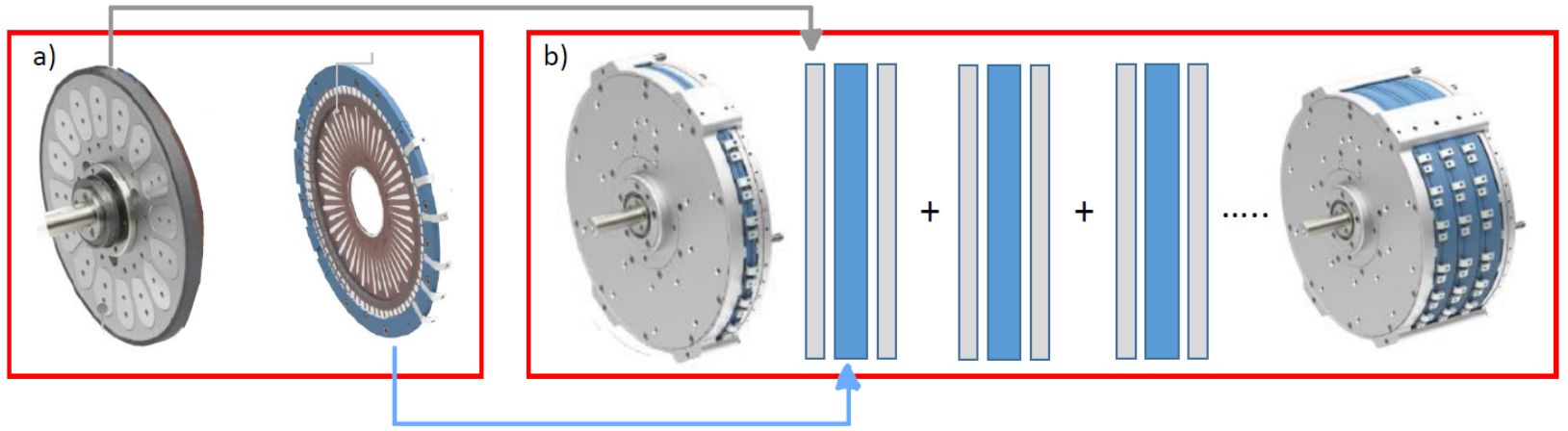
Obj2: On-board axial flux motor (AFM)

OBJECTIVE 2 (O2): On-board axial flux motor (AFM) and drive technologies for high power density and efficiency, and reduced implementation cost

- O2.1. Enhancement of the energy efficiency performance and circularity characteristics of a new series of on-board single stator double rotor type ironless AFMs
- O2.2. Design-for-manufacturing of the EM-TECH ironless AFM solutions, to reduce their production cost by 50%
- O2.3. Evaluation of powder Soft Magnetic Composite (SMC) materials for active parts
- O2.4. Mechanical and electrical integration of the EM-TECH AFM technology with SiC-based power electronics developed in previous projects (knowledge transfer from the European projects EVC1000 and HIPE)



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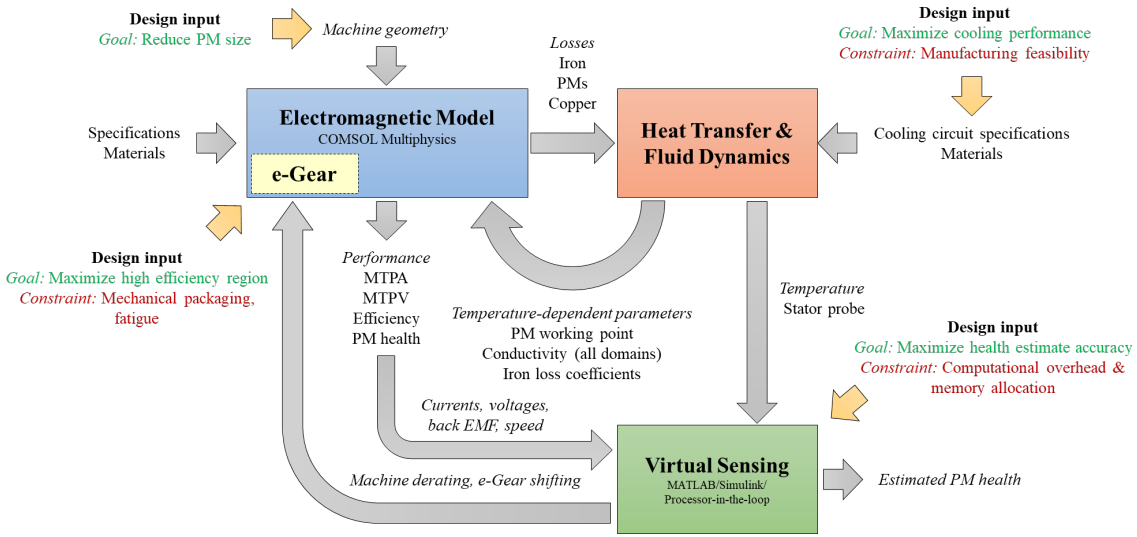
Obj3: advanced cooling and control strategies

OBJECTIVE 3 (O3): Innovative and smart design solutions for increasing the performance and reducing the life cycle impact of the EM-TECH radial and axial flux machines

- O3.1. ~10% temperature reduction in hotspots, including PMs, through more direct and efficient active cooling solutions
- O3.2. Novel virtual motor sensing solutions for real-time monitoring of the temperature distribution within the PMs
- O3.3. Implementation of innovative machine control algorithms, for
  (i) more effective use of the active materials in limit conditions;
  (ii) timely derating, and reduced conservativeness of the safety factors (machine used at its full potential); and
  (iii) enabling the use of lower-grade, lower-performance and recycled/recyclable PMs with low content of Dysprosium.
- O3.4. Implementation of motor geometry optimisation solutions for energy loss reduction along driving cycles



*PM: permanent magnet

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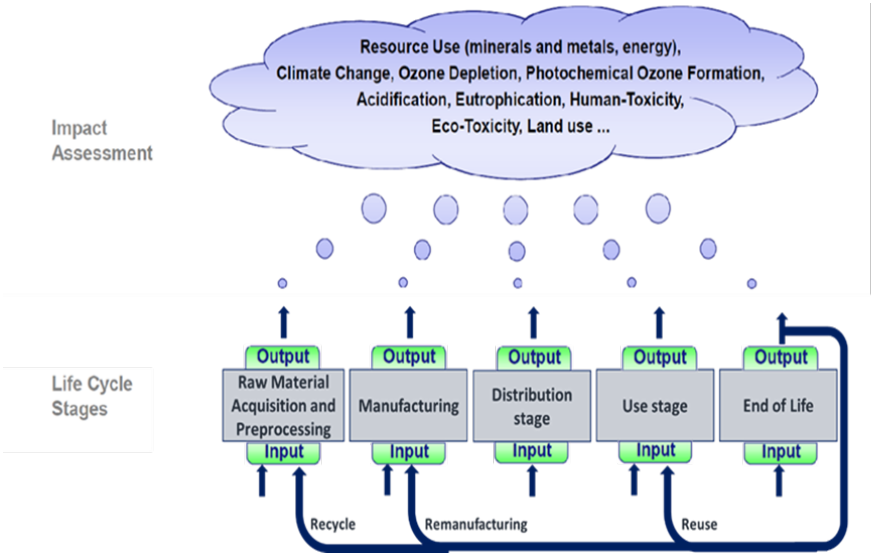
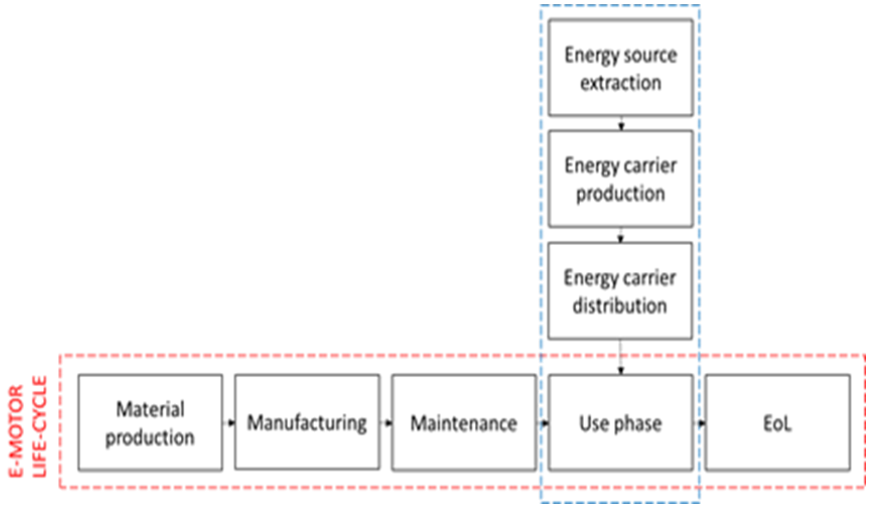
Obj4: Circularity solutions for IWM and AFM

OBJECTIVE 4 (O4): Circularity solutions for in-wheel and on-board motor technologies

- O4.1. Incorporation of Life Cycle Assessment (LCA) methodologies in the motor design optimisation and digital twinning toolchain
- O4.2. Implementation of Life Cycle Cost (LCC) assessment methodologies
- O4.3. Improvements and updates on the LCA/LCC methodologies
- O4.4. >60% reduction of the use of rare earth resources in the EM-TECH machines with respect to the current state-of-the-art designs, and adoption of recycled PMs as a viable circularity solution





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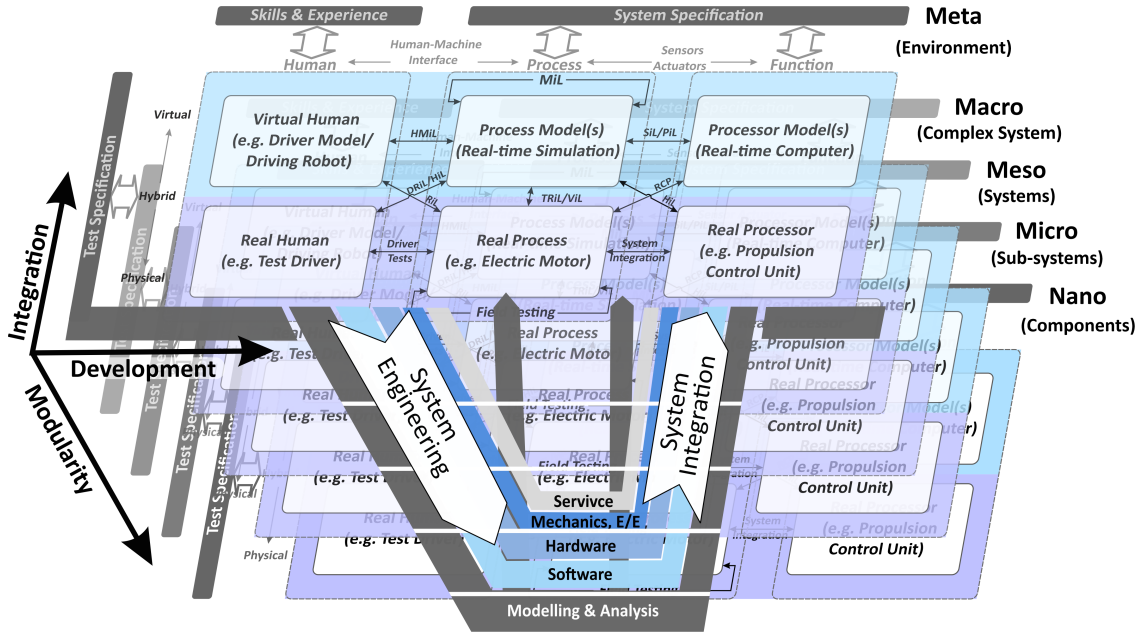
Obj5:Digital twinning

OBJECTIVE 5 (O5): Digital twinning for electric machine performance and circularity optimisation

- O5.1. Set-up of a model-based toolchain covering all stages of the machine design and life cycle process
- O5.2. Innovative digital twinning approach based on:
  i) agile model-based X-in-the-loop (XIL) methods from the Horizon 2020 XILforEV project;
  ii) adaptive interfaces for coupling of virtual and physical systems from different domains and process holders; and
  iii) extension of the XIL concept by networking complex testing facilities at different consortium participants
- O5.3. X-in-the-Loop-based flexible and accelerated testing of electric drives and vehicle corners



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Impact

- Technological: Highly efficient, affordable in-wheel and on-board electric motors for different vehicle segments, which demonstrate above 20…25% energy loss reduction along driving cycles.
- Economic: EM technologies providing cost reduction 5…6 €/kW and lower as well as decrease in rare magnets use >20% (for IWMs) and in total rare earth content >60% (for OBMs).
- Scientific: New validated research methodologies on (i) virtual sensing in electric powertrain applications, (ii) LCA/LCC, (iii) smart EM control within e-corner/e-axle frameworks.
- Social: Increased acceptance of electric vehicles due to increase performance impacting/contributing to a more sustainable transportation; Improvement of vehicle efficiency and therefore a reduction of CO2 and emissions.

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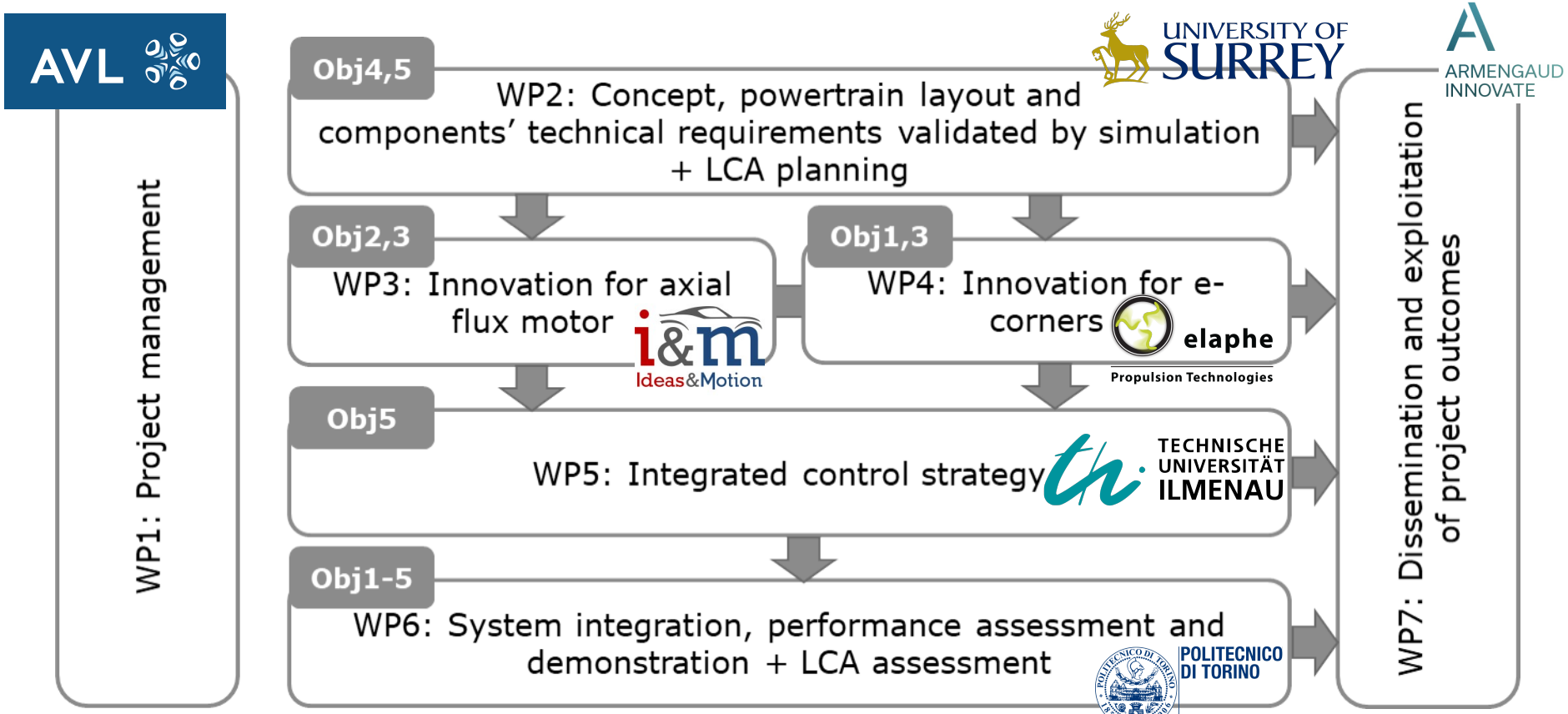
EM-TECH Work-package structure



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EM-TECH critical infrastructures

UNIVERSITY OF SURREY

TECHNISCHE UNIVERSITÄT ILMENAU

POLITECNICO DI TORINO

IAAPS ADVANCING PROPULSION

UNIVERSITY OF BATH

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