





# LAND OF THE CURIOUS



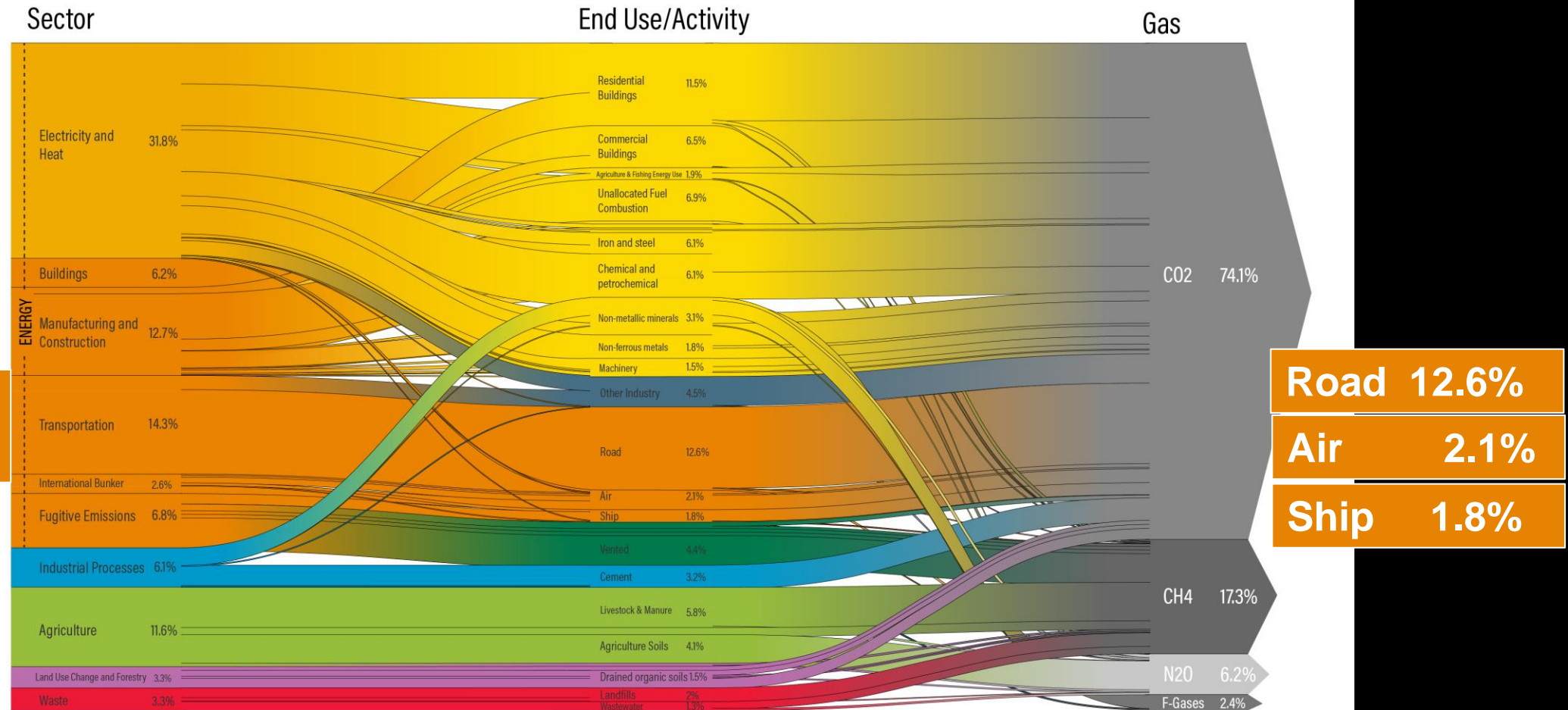


# THE FUTURE OF ELECTRIC TRANSPORTATION - OVERVIEW OF ACTIONS IN LAHTI

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Electric Drives and Power Electronics Laboratory  
20.6. 2023

## World Greenhouse Gas Emissions in 2019 (Sector | End Use | Gas)

Total: 49.8 GtCO<sub>2</sub>e



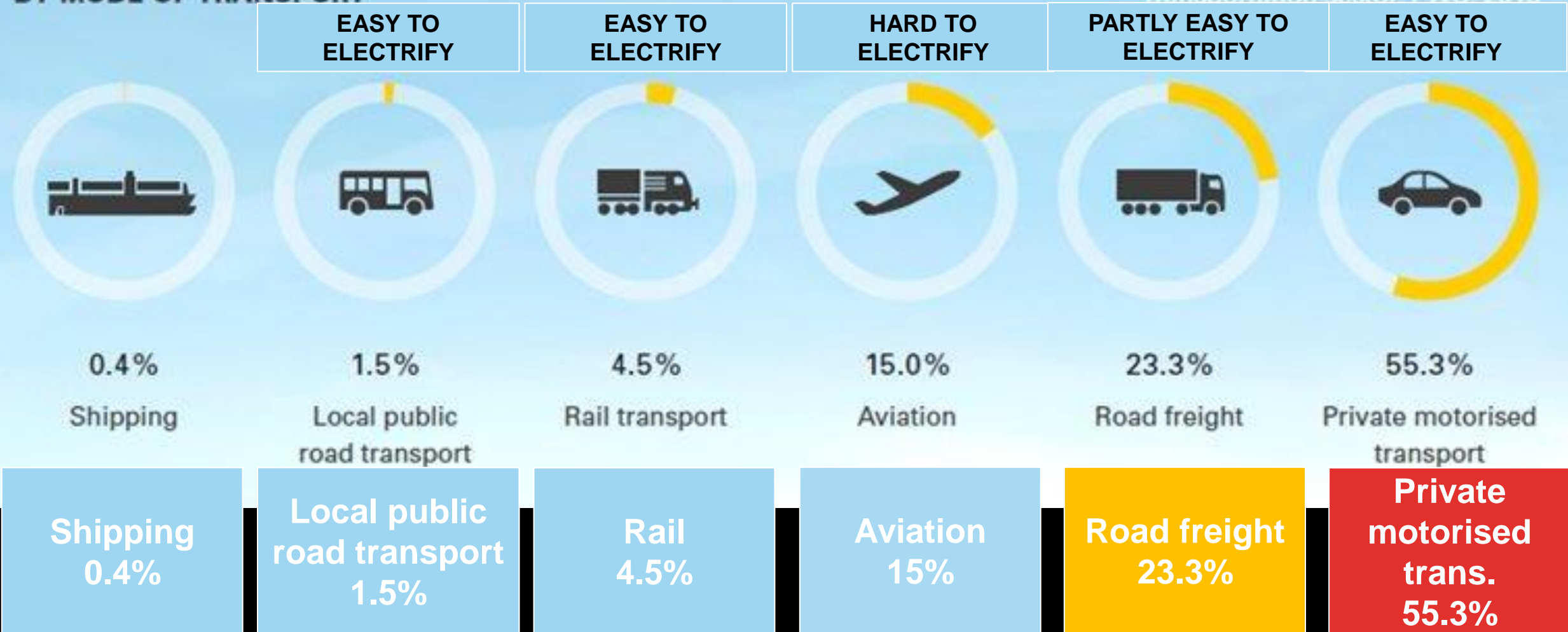
Source: Climate Watch, based on raw data from IEA (2021), GHG Emissions from Fuel Combustion, [www.iea.org/statistics](http://www.iea.org/statistics); modified by WRI.



# ANOTHER APPROACH

## BREAKDOWN OF CARBON EMISSIONS BY MODE OF TRANSPORT

Source: Energiewende Outlook: Transportation sector, PWC, 2015



Shipping  
0.4%

Local public  
road transport  
1.5%

Rail  
4.5%

Aviation  
15%

Road freight  
23.3%

Private  
motorised  
trans.  
55.3%

# TECHNOLOGY IS AVAILABLE FOR ELECTRIC TRANSPORT

- Electric vehicles are at the beginning of their development curve
- Electric transportation and the supporting infrastructure will develop a lot in the next decades
  - Electronic systems become obsolete quickly
    - Trends
      - Higher power density, smaller size and/or higher power
      - Higher efficiency
      - More user friendly
      - Costs are decreasing



Source: LUT-University





# PROFESSIONALS ARE NEEDED

- » Electric transport is emission-free only when the green electrical energy is used
- » In the near future, there will be a need for a lot of experts in electrical engineering
- » Electric transport competes for experts with other fields of electrical engineering e.g. solar, wind-power, smart-grids
- » The basic components are all the same
  - Changing electrical energy from one form to another
    - Power electronics
      - Choppers
      - Inverters
      - Converters
    - Electromechanical conversion
      - Motors
      - Generators
  - Control systems
  - Signal processing and communication



# COLLABORATION IN LAHTI



LAB University of  
Applied Sciences

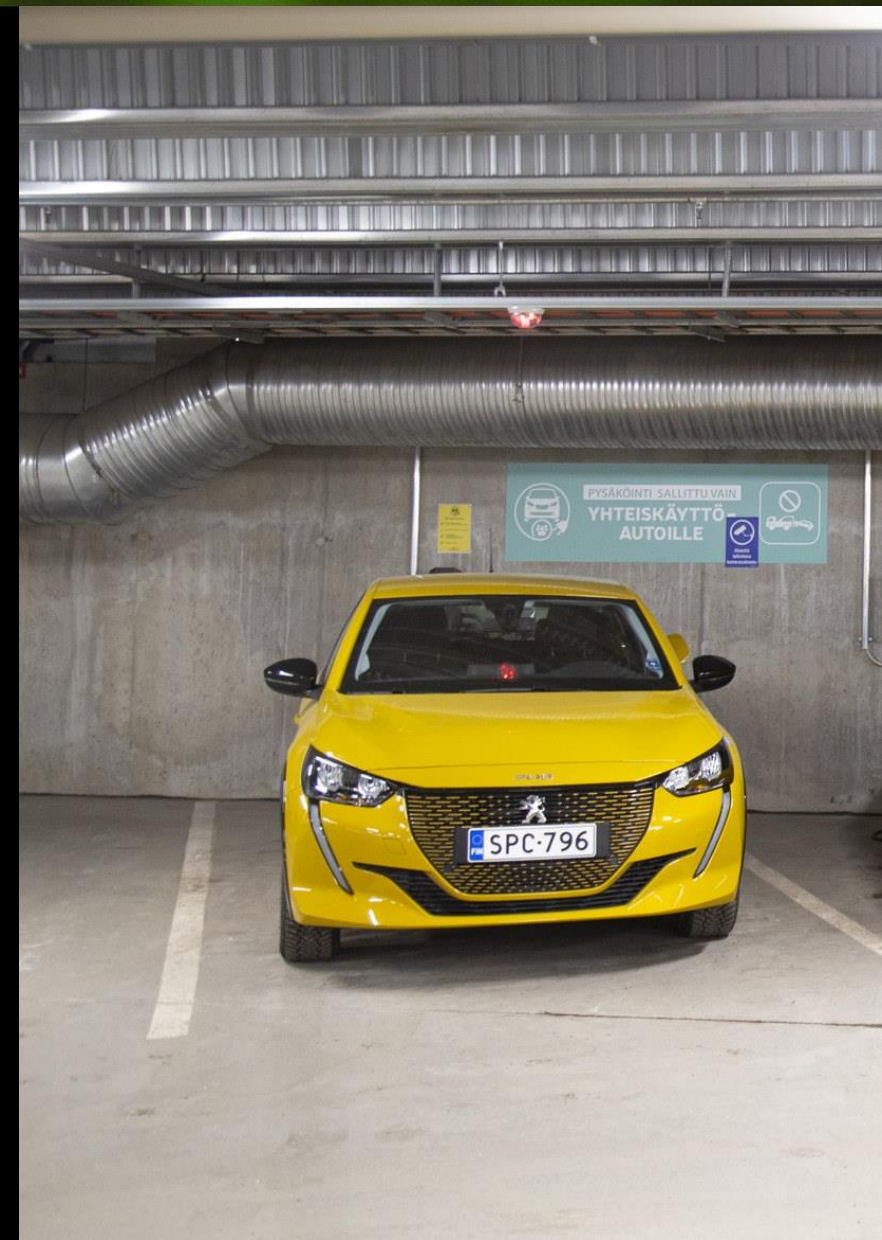


LUT  
University

LAHTI  GEM<sup>+</sup>

 KEMPOWER

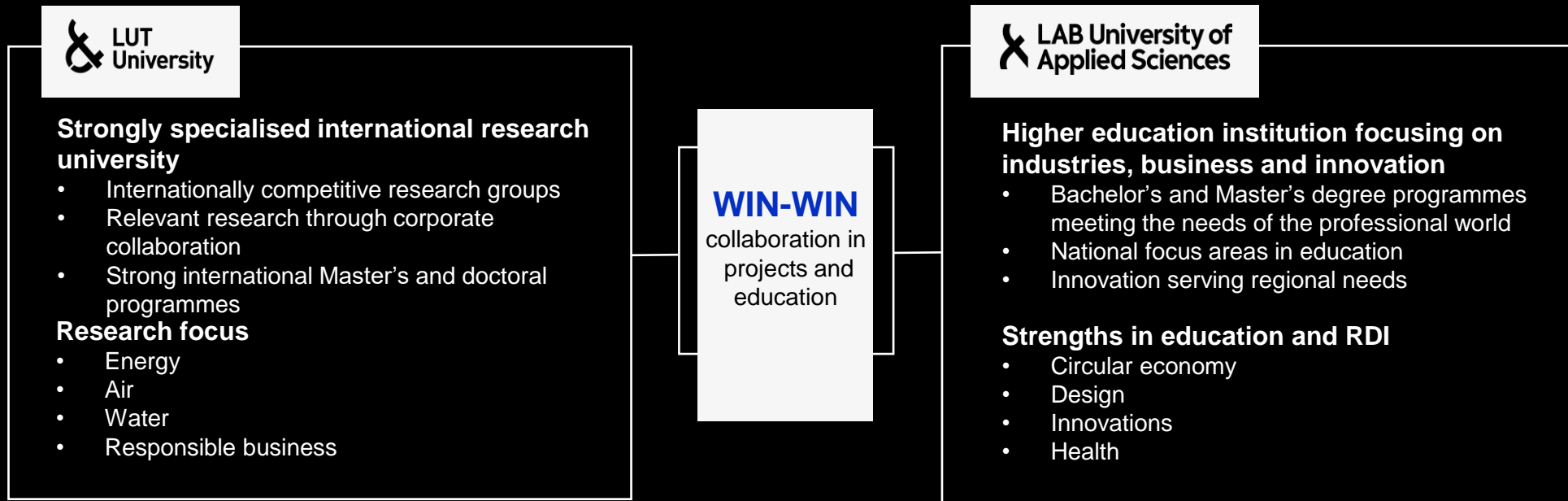
EMRC





2 missions, 2 campuses, 2 organisations

# LUT UNIVERSITIES



**Together  
we are more  
on the Green  
Campuses**

**Education:** digital collaboration, shared Language Centre, continuing professional education, guidance on study paths

**Internationalisation:** international programmes subject to a tuition fee jointly marketed in India, China and Vietnam

**Impact:** Green Campus Open, Business Mill student entrepreneurship, corporate collaboration

**Shared University Services**



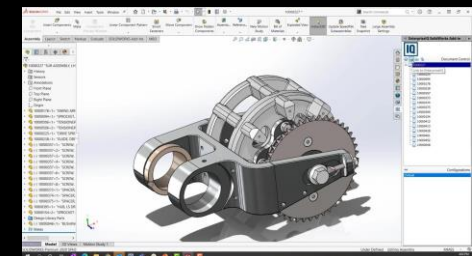
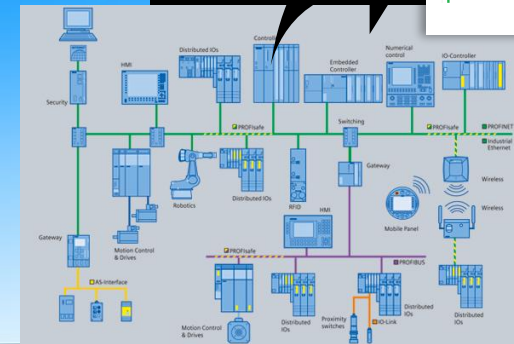
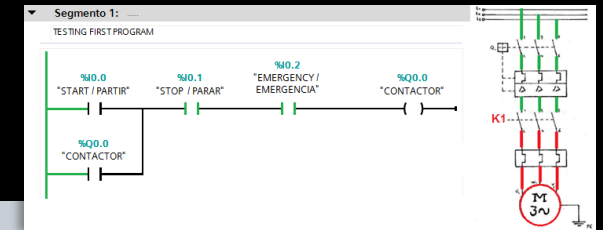
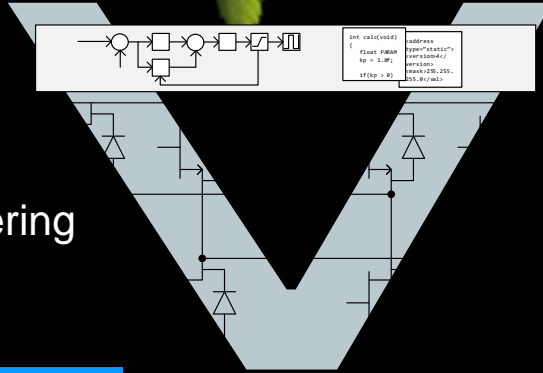
# ELECTRICAL ENGINEERING AND AUTOMATION TECHNOLOGY – OVERVIEW AND INTERFACES



Information and Communications Technology (ICT)



Electrical engineering and automation technology



Mechanical engineering

# — EMOBILITY AT LAB

## »» Key topics

- **Software** engineering, software design, programming – especially in embedded systems
- **Control** engineering – fundamentals, digital control with software
- **Power electronics** – components, converter and charger topologies, inverter and its applications

## »» Graduates can work for power electronics OEMs in R&D, service, and customer projects

- Focus on eMobility, but the skills are universal and applicable to other segments

## »» **Co-operation** with LUT (control engineering, power electronics) and LAB ICT (software skills)

## »» Path developed in co-operation with **LUT** to continue studies in their **Master's Degree Program**

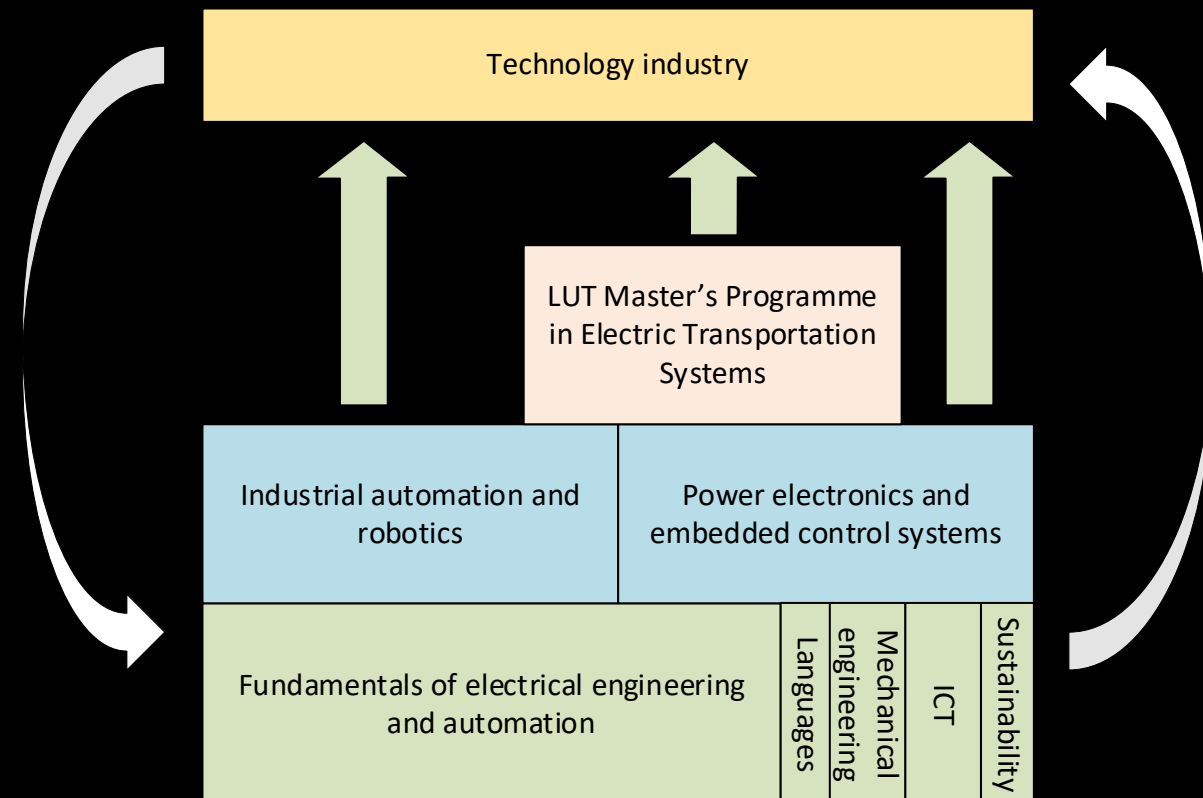
## »» **Research** projects on the roadmap

- LAB, LUT, and partners from the industry make a powerful team!



# DIFFERENT STUDY PATHS

- Engineering studies at LAB contain a strong practical component
  - Projects in co-operation with **industry**
- Strong fundamentals of electrical engineering and automation for all students
  - Possibility to focus on industrial automation or electromobility
- Clear path to continue in the LUT ETS Master's programme for those interested





# ELECTRIC TRANSPORTATION SYSTEMS

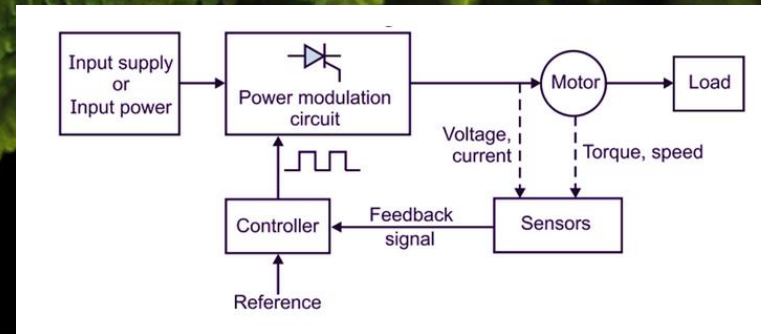
M.Sc. Programme started in 2022 - 2023



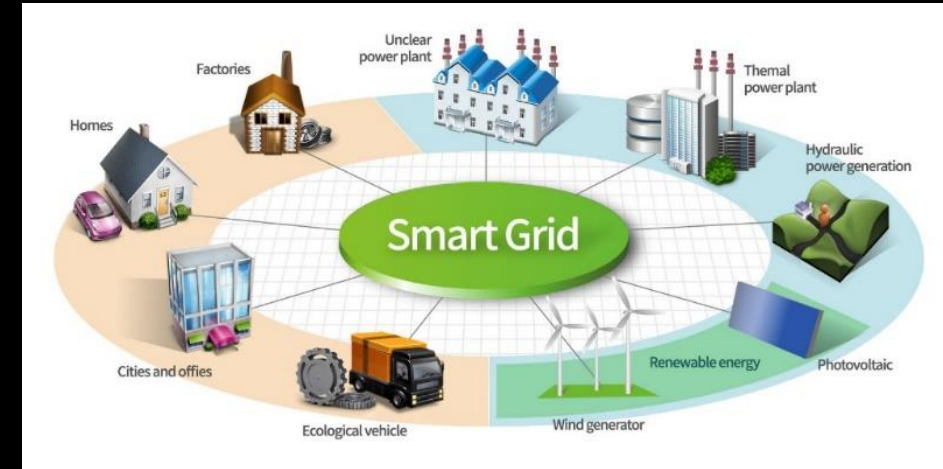
# Power electronics



# Electrical drives

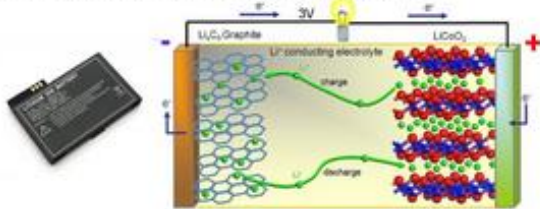


# Smart grids and electricity market

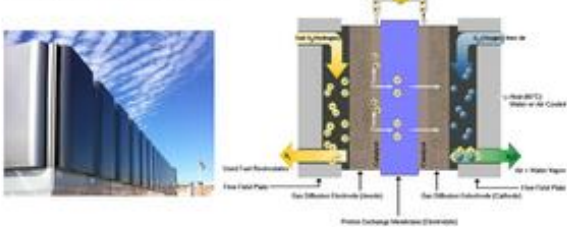


# Energy storages

## Lithium Ion Batteries



## Fuel Cells



## Super Capacitors



**Electric transportation systems**

# Embedded systems and IoT



# ETS-PROGRAMME CONTENT DESCRIPTION

- Master of Science in Technology (M.Sc. Tech.) degree
- Extent 120 ECTS credits
- Duration two years, full-time studies of 60 ECTS per academic year
- M. Sc. degree gives eligibility to apply for scientific doctoral studies



LUT University's Lahti campus



Business  
LAHTI REGION

# LAHTI GEM<sup>+</sup>

Green Electrification of Mobility Cluster

VEHICLE ID : 29388D

 224 KM

CONNECTED  5G



**Carbon  
neutral**

city by 2025

**99 %**

municipal waste  
recovery rate

**LAHTI**

*winner 2021*



**EUROPEAN  
GREEN CAPITAL**

*An initiative of the  
European Commission*



**0 %**

fossil fuels in the  
city's energy  
production

Significant  
investments on  
**sustainable  
mobility**





# COMMITTED TO SUCCEED

Lahti GEM is the platform for companies, research and education organisations as well as cities.

The platform is built up to generate and maintain network for developing and commercialising technologies and solutions for green electrification of mobility.

# LAHTI GEM NETWORK



Single Wing Energy



SYSTEMS & APPLICATIONS



ENERGY SOLUTIONS

VEHICLES & COMPONENTS



DIGITAL SOLUTIONS

LOGISTICS & MOBILITY SERVICES



RESEARCH & EDUCATION



PUBLIC SECTOR



GREEN ELECTRIFICATION OF MOBILITY CLUSTER  
Join us on [www.lahtigem.fi](http://www.lahtigem.fi)



 RESEARCH CENTER

# ELECTRIC MOBILITY RESEARCH CENTER, EMRC

LUT Universities & Kempower cooperation framework

Long-term strategic collaboration platform (phase 1: 2024 – 2028)

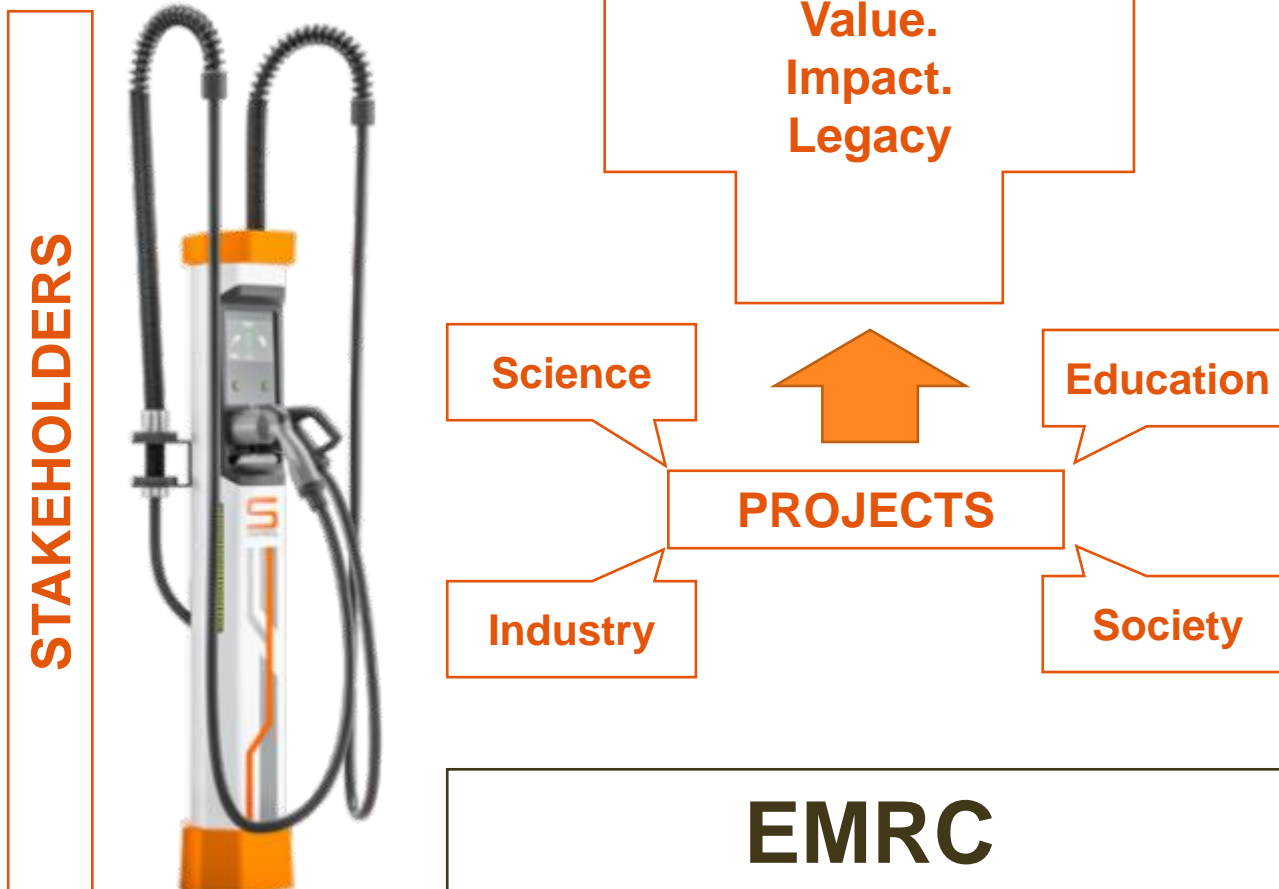




Stronger together

# EMRC AS ENTITY

- Invested EMRC project euro generates multiple euros from external sources
- Declared partnership makes us stronger in applications for EU-funded projects
- Joint projects & application processes strengthen Kempower/LUT staff relations and familiarity of operations and mindset



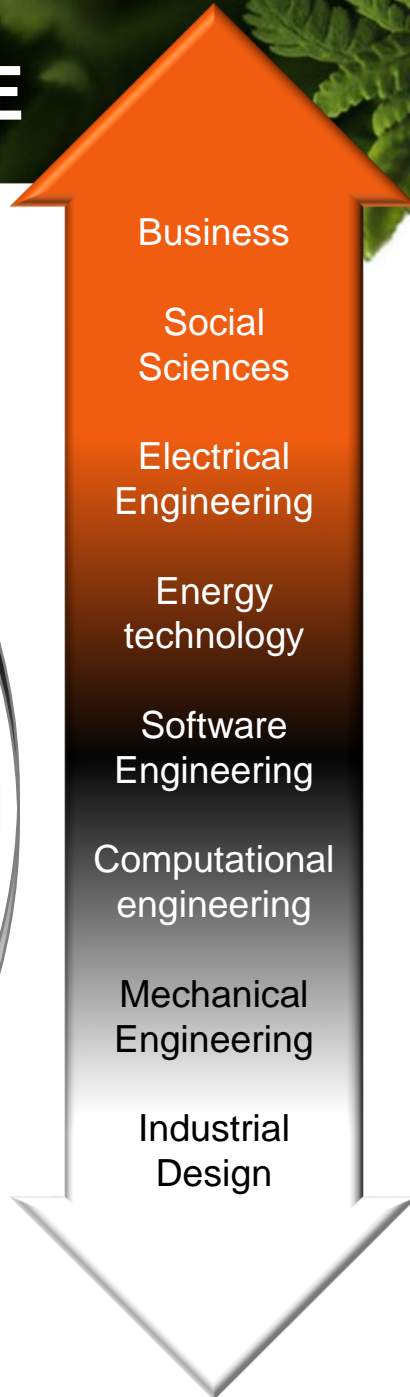
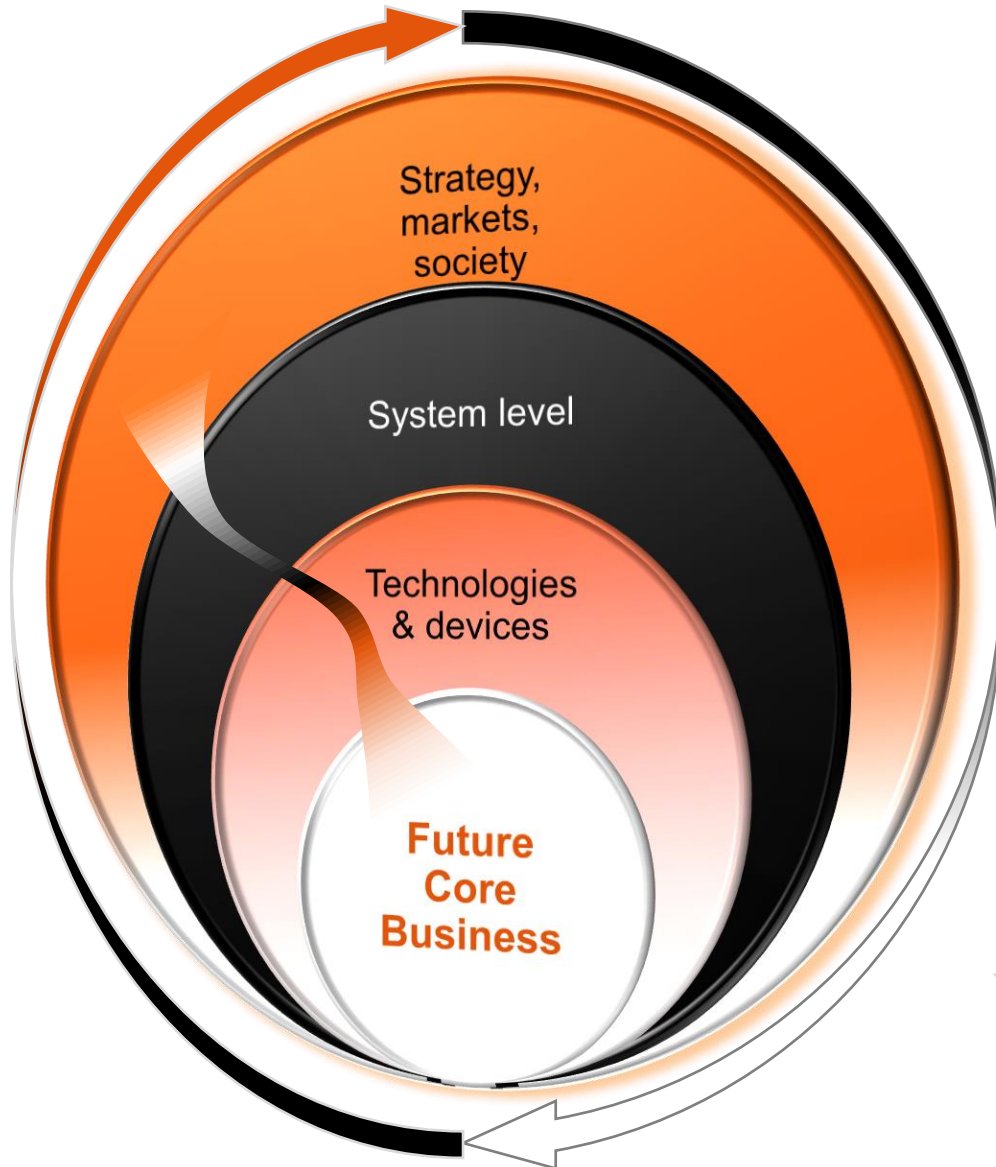


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# EMRC PROFILE

1. Represents Kempower & LUT's shared vision on focus areas
2. Attracts targeted project proposals from multidisciplinary groups

# EMRC THEMATIC PROFILE



- New digital services & digital value creation
  - Decision-making; drivers & uncertainties
  - Corporate collaborations and innovation ecosystems
  - Organizational business analytics capability
  - Responsible business; legal & sustainability aspects
  - Predictive analytics & maintenance
  - Social user profiles, regional characteristics
  - Technical data analytics, battery/device condition
- Grid system resilience and design evolution drivers
  - System & device reliability, component technologies
  - Electrical efficiency and standard development
  - Network harmonics & electromagnetic compatibility
  - DC distribution technologies and system expertise
  - Energy storage supply for high-power charging
  - Thermal management, device & system level
- Bi-directional charging, systems and technology
  - Control of new semiconductor technologies
  - Engineering & testing of embedded software
  - Software process, large-scale agile, hybrid work & global software engineering
  - Cloud services, IOT, machine learning & data analytics and inversion problems, AI
- Industry 5.0 visionary concepts
  - User-centric design & HMI, digital accessibility
  - Analytically augmented design practices & XR
  - Heavy vehicle charging and battery systems, robotics & automation, MW-charging technology
  - Manufacturability: industrial design, modeling and simulation, composites & metals
  - LCA, circularity, sustainability, EU Digital Passport