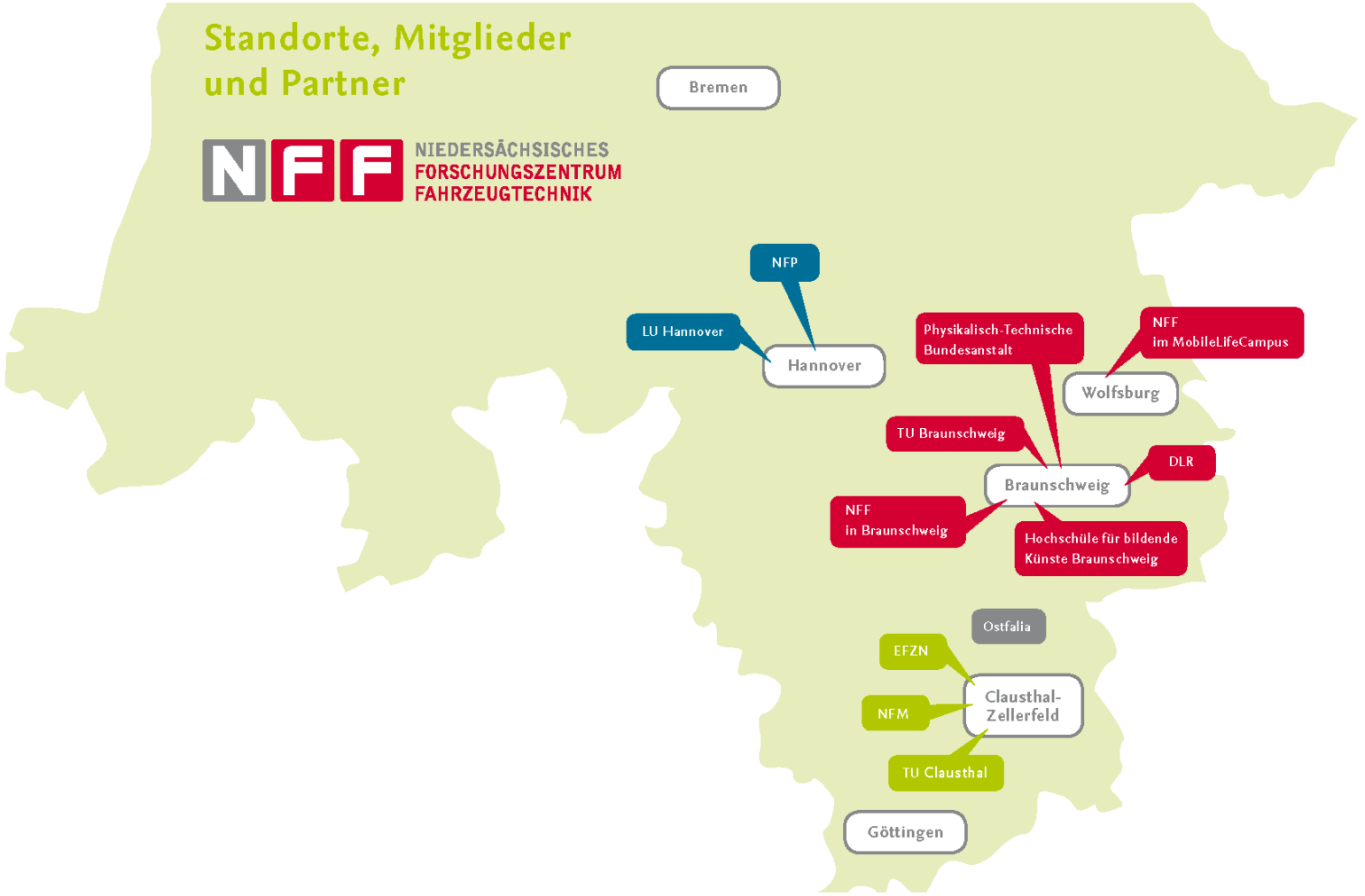
Technische Universität Braunschweig

NIEDERSÄCHSISCHES FORSCHUNGSZENTRUM FAHRZEUGTECHNIK

Automotive Research Centre Niedersachsen – Niedersächsisches Forschungszentrum Fahrzeugtechnik

Braunschweig, November 2015

The Location Concept of the NFF



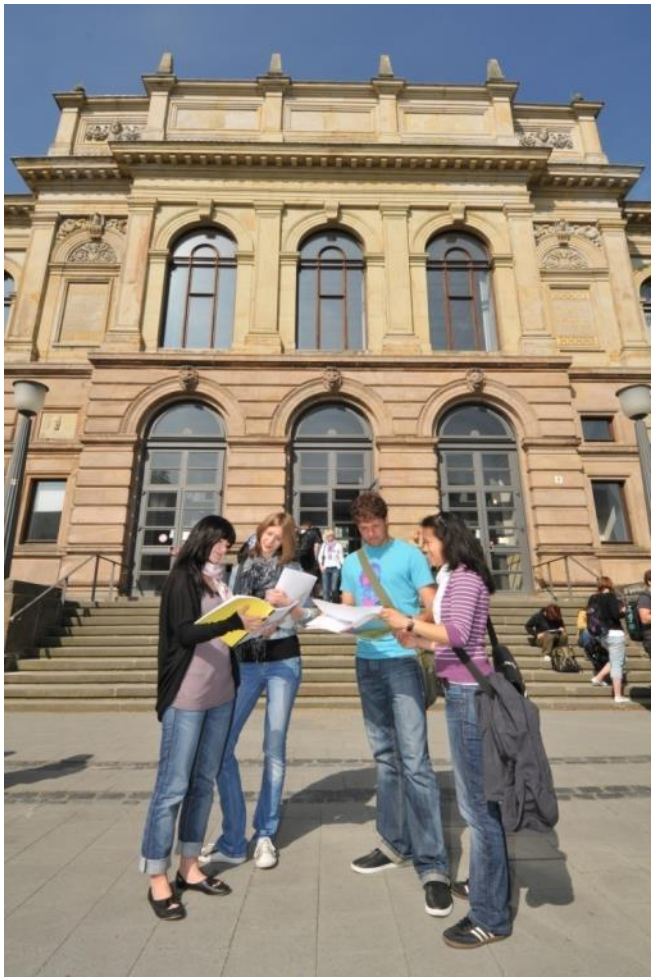
Welcome to the City of Braunschweig

- a population of roughly 250,000
- a rich historical past, exciting present and high-tech focused future
- both historically and presently, the heart of the region
- a dynamic location for trade and economy
- vibrant cultural life
- an exceptional research and science landscape

Technische Universität Braunschweig

1	**university**
6	**departments**
71	**degree programmes**
120	**institutes**
2,089	**scientists**
3,651	**university employees** (full-time)
4,730	**first semester students** (each year)
18,474	**students** (Winter semester 2014/2015)
78,900,000	**euros in outside funding**
298,000,000	**euros in overall budget**

Figures 2013



NFF Key Facts

Interdisciplinary Research Centre at TU Braunschweig

- Founded on 6th December 2007
- Association of 36 institutes from 5 faculties (mechanical engineering, electrical engineering, informatics and economical engineering, civil engineering, life sciences) in the fields of automotive engineering and transportation systems engineering with more than 700 research assistants
  - 19 full members from
    - TU Braunschweig
    - LU Hannover
    - TU Clausthal
    - German Aerospace Center (DLR)
  - 21 associated members from
    - TU Braunschweig
    - LU Hannover
    - University Hildesheim
    - Ostfalia University of Applied Sciences

Ceremonial foundation event on 6th December 2007

NFF Vision and Objectives

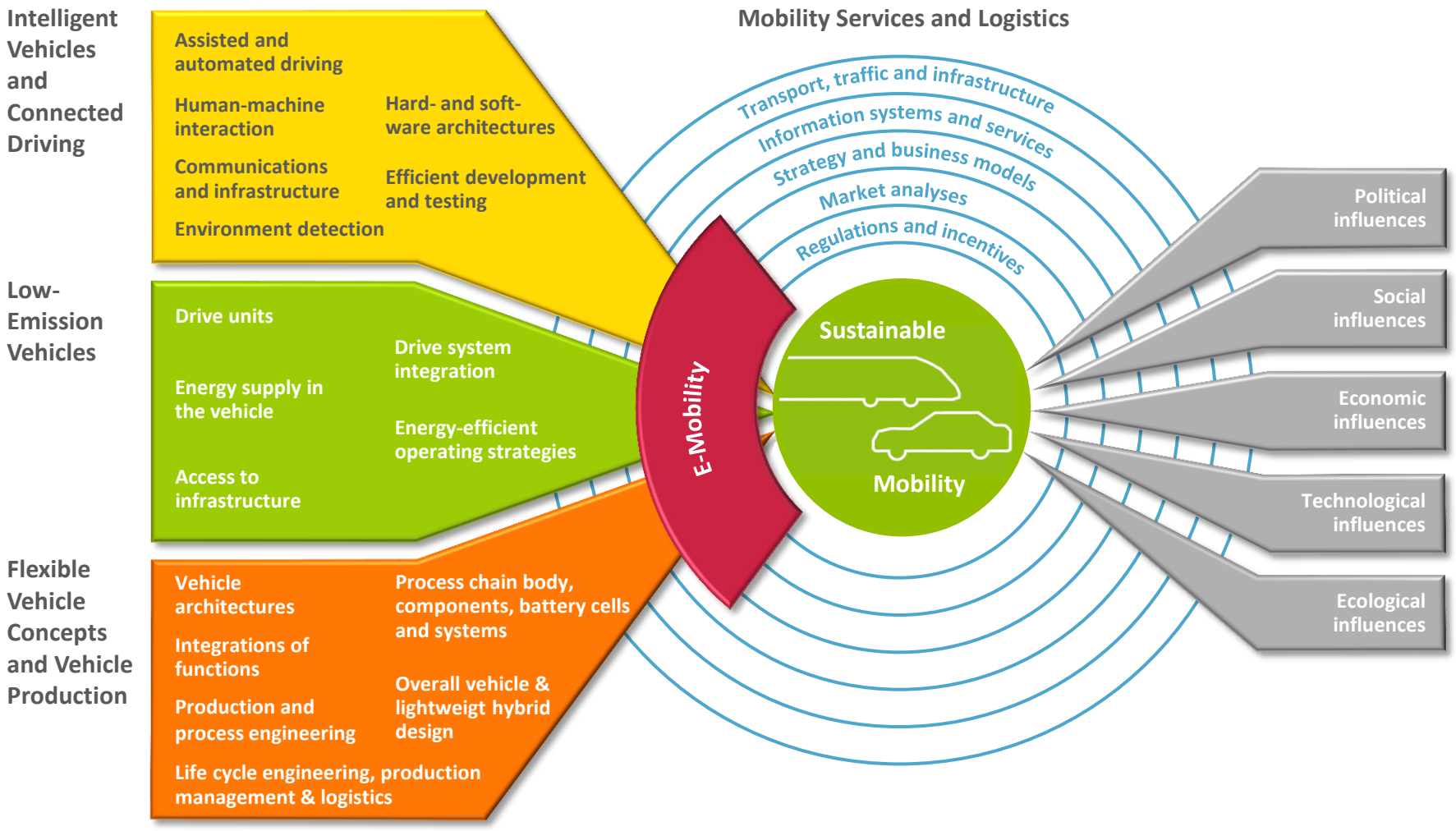
NFF Vision

Establishment of the research region Braunschweig / Wolfsburg as a top region in the field of automotive engineering and sustainable mobility with international visibility

NFF Objectives

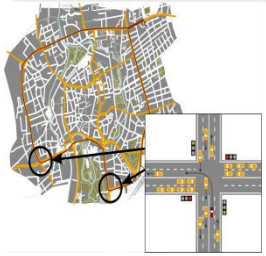
- Bundling of core competencies of 36 NFF member institutions in the field of automotive engineering and sustainable mobility
- New research platform for the cooperation of scientific institutions and industrial partners (“project houses”)
- Interdisciplinary education of highly qualified junior staff for automotive industry
- Securing the university and research position of Lower Saxony in a long-term perspective

NFF Fields of Research



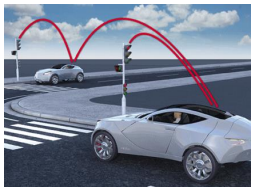
Intelligent Vehicles and Connected Driving

From Assisted to Automated Driving



- Development of driver assistance functions
- Higher levels of automation

Infrastructure and Location



- Test field for automated driving (A2 / A39), digital infrastructure
- Car2X communication
- Highly accurate digital maps and GPS positioning

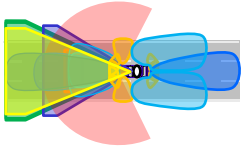
Development of Functions

- Scene interpretation, scene anticipation and behavioral decision
- Trajectory planning
- Actuators and control

Simulation and Test

- Modeling & simulation of sensor models or driving functions
- Software-in-the-loop
- DVRs and experimental vehicles

Environment Perception



- Sensor technologies
- Procedures for object and lane tracking
- Association and generation of driving contexts

Human-machine Interaction

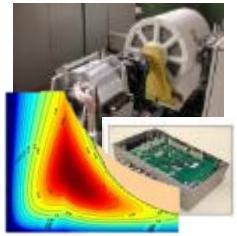
- Driver monitoring
- Input modalities / HMI
- Specific user groups
- Driveability investigations
- Driver handover strategies

Low-Emission Vehicles

Conventional Drive Systems

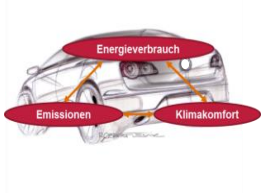
- Optimization of the aggregates (ICE, transmission) reg. power density, cost, …
- Alternative fuels
- Surveying & inspection

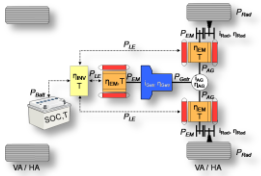
E-Drives and Power Electronics



- Concepts & magn. circuit topolog.
- Design optimization regarding efficiency and power density
- New fast switching semiconduct.
- Surveying & inspection

Energy Management and Emission Optimization

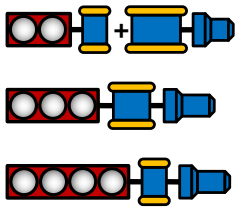




- Application-dependent, multi-criteria optimization of vehicle operation in terms of efficiency, emissions, range and cost
- Thermal management
- Electrification of auxiliary units (power-on-demand)

Drive System Integration

Topologievarianten



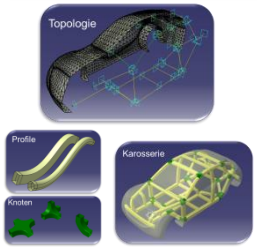
- Concepts & optimum drive topologies
- Modular systems
- Control & operating strategies
- Prototyping

Infrastructure Connections

- Concept optimization in terms of efficiency and performance
- Inductive charging systems
- Production prototypes

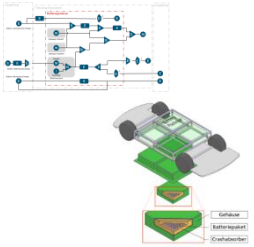
Flexible Vehicle Concepts and Vehicle Production

Vehicle Architectures



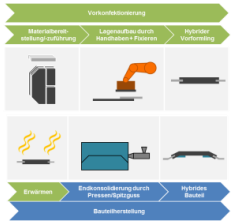
- Modular, flexible, customizable and lightweight vehicle structures
- Package, comfort, safety and economic efficiency
- New production concepts

Integration of Functions



- New approaches to integration
- Integration of sensors, actuators in automotive components
- Weight reduction
- Conservation of resources

Production and Process Engineering



- Production of hybrid components
- Flexible and economical process chains
- Process and automation technology for battery production

Life Cycle Engineering, Production Management

- Methods and tools
- Economy & ecology
- Life Cycle Lab
- Logistics concepts
- Recycling

Research Factory - Open Hybrid LabFactory

- Hybrid lightweight components suitable for mass production
- Design of hybrid components
- Sustainable fiber production
- Production process, recycling

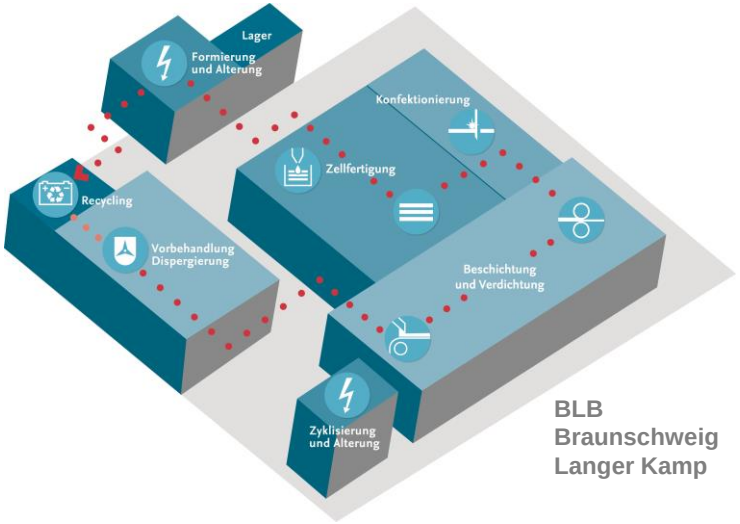
Research Factory - Battery LabFactory BS

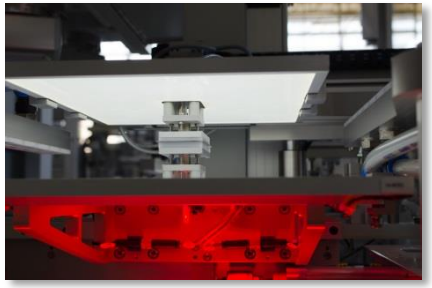
- Production of battery cells and systems; diagnosis
- Modeling & simulation
- Material production, conditioning, recycling

Battery LabFactory Braunschweig

Interdisciplinary Research Factory for Lithium-Ion Battery Cells

- Optimization of battery life cycle:
  - Production and conditioning of materials;
  - Development and production of electrodes, cells, modules and systems
  - Integration and use of battery systems in vehicles
  - Recycling of battery systems
- Diagnosis, modeling, life cycle assessment
- Competence fields: chemistry, process engineering, production engineering, construction engineering, electrical engineering and metrology





- Investment: EUR 9 million
- 7 Institutes of TU Braunschweig, PTB
- Floor space: 900 m²
- Drying room: 160 m²
- 52 scientists
- Opening: June 24, 2015

Open Hybrid LabFactory e.V.

Sustainable manufacturing and production technologies for hybrid lightweight components suitable for mass production

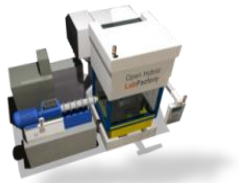
- Public-private partnership for innovation (BMBF), Wolfsburg
- 10 full members and 16 project members (science, industry)

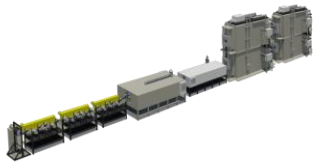
Complete Value Chain

- Design of hybrid lightweight components
- Production of carbon fibers
- Production of hybrid lightweight components, recycling

Research Focus

- Development of design and production technologies for mass production
- Production technologies:
  Hybrid forming / molding technology
- Sustainable fiber production (2018); textile production chain





Mobility Services and Logistics

Transport, Traffic and Infrastructure

- Network planning
- Sustainable logistics
- Traffic modeling
- Safety of traffic infrastructure

Automotive Market Analyses

- Analysis of customer behavior for innovative mobility concepts
- Market modeling and simulation of market penetration
- Sustainability review

Information Systems and Services

- Crosslinking / integration of information systems
- Development of mobile services
- Analysis of acceptance and psychological mechanisms

Regulations and Incentives

- Test of measures to control customer and manufacturer behavior
- Assessment of efficiency and effectiveness of the measures

Strategy development and business models

- Development of new business models and evaluation by real experiments
- Model-based development of launch strategies

E-Mobility

Vehicle

- Vehicle concepts
- Efficiency
- Drive train
- Lightweight construction

Energy Storage

- Manufacturing processes
- Cost reduction
- Diagnostic, modeling
- System integration
- Recycling, life cycle analysis

Infrastructure

- Charging options
- Inductive or conductive
- Renewable energy
- Charging power
- Business models

Mobility

- Services
- Application scenarios
- Public transport; fleets
- Logistics
- Business models

Communication

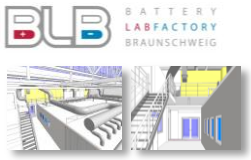
- Information and communication technology
- Safety
- Comfort
- Connected driving

Research Activities – 07/2015

33 research cooperation projects - in total
23 research cooperation projects e-mobility

- among others: Schaufenster Elektromobilität
  - Quicar elektrisch
  - QWeMob
  - MOBIL4e
  - eShuttle
  - eFlotten in der Erprobung
  - emil
  - Fleets go green
- EU HORIZON 2020

Research Infrastructure



Graduate Schools and Courses - extract

- Cooperative PhD program E-Mobility
- GEENI graduate school for energy storage & e-mobility
- DFG graduate school Social Cars
- Master degree programs:
  - Electronic automotive and aerospace systems
  - Electromobility
- Promoting talents: NFF Future for Talents
- CaroloCup

Workshops and conferences in the NFF - extract

- Support of AAET and conference for hybrid and electric vehicles (HEV)
- LIMO workshop low-emission vehicles
- FORMS/FORMAT 2014 SYMPOSIUM
- Innovation workshops (Deutsche Bahn) 2014
- Symposium – Faszination Leichtbau
- LIMO Mobility Forum 2015

NFF Research Building Braunschweig

Infrastructure

- Location at research airport BS
- Investment: € 60 million
- 4500 m² technical center
- 3000 m² offices, project houses
- 7 member institutions, 158 scientists
- Opening: February 11, 2015

Technical Center

- 16 test benches for combustion/hybrid engines
- 2 test benches for electric drives
- Dynamic drive train test bench
- Dynamic vehicle road simulator
- Climate chassis dynamometer - planned
- Rail transportation equipment
- Laboratory for intelligent vehicles
- Component test benches
- 3 fuel laboratories
- Temporary facilities

Fotos: Bierwagen

Technische Universität Braunschweig

NIEDERSÄCHSISCHES FORSCHUNGSZENTRUM FAHRZEUGTECHNIK

Thank you for your attention!

Automotive Research Centre Niedersachsen