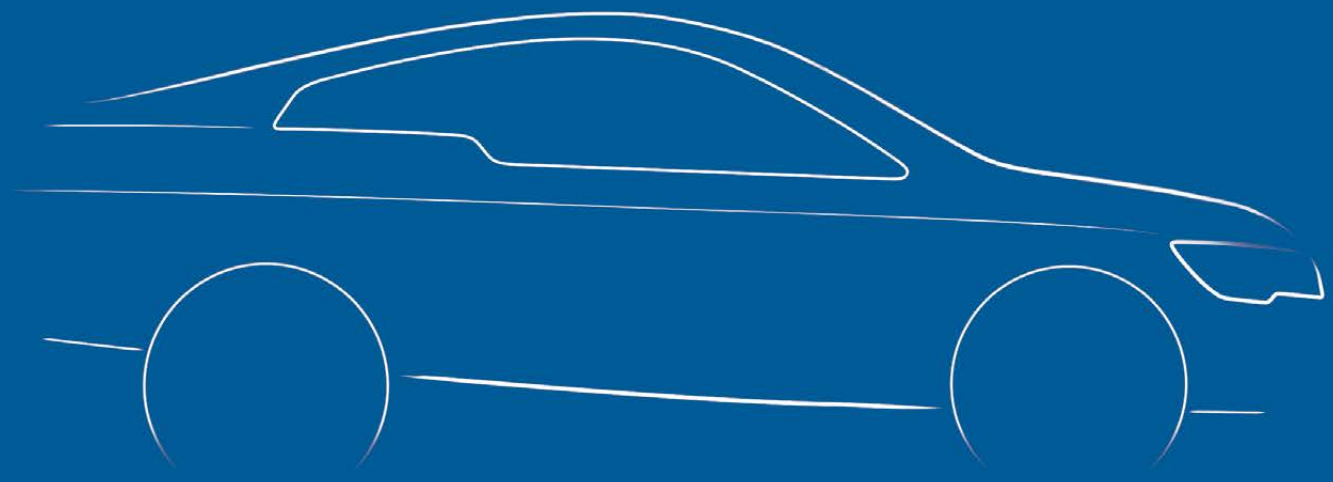
Technische Universität München

VISIO.m

A light-weight electric vehicle for urban mobility.



Technische Universität München

The Technische Universität München (TUM), founded in 1868, is among the leading universities in Europe. The global TUM brand stands for excellence in research and teaching, interdisciplinarity and talent development, strengthened by alliances with business as well as scientific institutions.

The TUM currently has 37,000 students in more than 150 courses of study. Its broad subject portfolio is unique in Europe: the key domains of engineering, natural sciences, medicine and life sciences are flanked by economics and teacher training.

Joint research project Visio.M

In addition to the automotive manufacturers BMW AG (lead manager) and Daimler AG, participants in the Visio.M consortium included the Technische Universität München as a scientific partner, as well as Autoliv BV & Co. KG, the Federal Highway Research Institute (BAST), Continental Automotive GmbH, Finepower GmbH, Hyve AG, IAV GmbH, InnoZ GmbH, Intermap Technologies GmbH, LION Smart GmbH, Amtek Tekfor Holding GmbH, Siemens AG, Texas Instruments Germany GmbH and TÜV SÜD AG.

Fourteen departments from different faculties of the TUM contributed to the Visio.M project. Organizationally the project was embedded in the Electromobility Research Center of the TU München, which is, in turn, one of the four pillars of TUM.Energy, a research initiative that bundles some 100 chairs and departments in eight faculties under the umbrella of the Munich School of Engineering (MSE).

The project was funded in the context of the IKT 2020 funding program and the priority program "Key Technologies for Electric Mobility – STROM" of the German Federal Ministry for Education and Research (BMBF) for a term of 30 months with a total budget of 10.1 million euros.

Funded by

Bundesministerium für Bildung und Forschung

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Vehicle concept

The Visio.M combines a timeless, modern and functional design with maximum efficiency and safety. Perfectly tailored to the user requirements in urban environments, the agile two-seater aims to achieve a lower total cost of ownership than comparable gasoline powered cars.

Aerodynamics

Thanks to its top-class aerodynamic design, the Visio.M achieves a c_d value of only 0.24. In combination with the small cross sectional area of 1.62 m^2 this results in an extremely low aerodynamic drag.

Ergonomics

The driver's head served as a fixed point for the interior design of the vehicle. Respectively, seat height, steering wheel, pedals and user interface elements adapt to the size of the driver. This allowed the researchers to position safety systems optimally and improve the driver's view of the surrounding traffic.

Central user interface

Infotainment system, navigation system and air conditioning are controlled via a central touch-screen user interface. Its open architecture allows the integration of external services like car-to-x communication or access to personal music collections via cloud applications.

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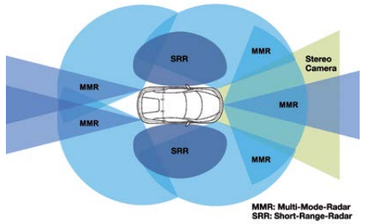
Stable light-weight construction

The rigid passenger compartment made of carbon fiber reinforced plastic grants Visio.M passengers a safe survival space. Novel structural airbags are mounted into the bumpers and doors as additional absorption elements.

Predictive sensors

Using radar and camera sensors, Visio.M senses traffic events in vehicle vicinity. If the software detects an unavoidable, imminent crash, it activates the protective systems fractions of a second before the impact.



Active passenger protection

A 3+2 point seatbelt system holds passengers securely in their seats. In case of a side impact the affected seat is pulled toward the center of the vehicle, moving the passenger out of the immediate danger zone. An airbag placed between the seats keeps the passengers from colliding into each other.

Safe and dynamic driving

ABS and ESC, combined with an active torque vectoring transmission, give the Vision.M very reliable handling properties. Its sporty suspension with McPherson struts on both front and rear axles, together with a low center of gravity and direct steering, ensures that driving pleasure does not suffer.

VISIO.M

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Energy storage

The battery comprising tried and tested lithium-ion cells has a capacity of 13.5 kWh. Thanks to its superb efficiency the Visio.M achieves a range of over 160 km. An innovative bonding technology improves the power density and reduces manufacturing costs.

Powertrain

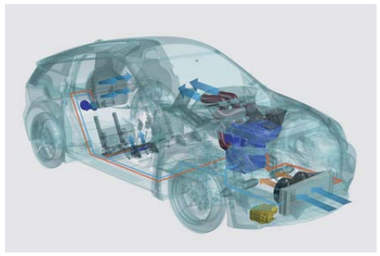
The asynchronous electric motor, which is limited to 15 kW rated power for type approval, accelerates the Visio.M to a top speed of 120 km/h. The active torque vectoring transmission ensures maximum energy recovery (recuperation) during braking.

Consistently light-weight

Decisive for the high efficiency of the Visio.M is its extraordinary low weight. The car's windows are made of specially coated polycarbonate instead of glass. Drivetrain, steering and transmission are all specially developed or adapted light-weight construction designs.

Thermal management

The intelligent system uses waste heat whenever it is needed. Peltier elements in the seats provide a comfortable direct cooling or heating, realizing a high level of comfort with low energy consumption. In very low temperature conditions an auxiliary range-neutral ethanol heating system can be switched on.



Technical data

Vehicle concept

number of passengers	2
vehicle class	L7e, 4-wheeled vehicle, max. 450 kg (excl. battery)
drag coefficient (c_d-value)	0.24
frontal area	1.69 m^2

Weight

tare	535 kg (incl. 85 kg battery)
max. permissible weight	710 kg
vehicle load capacity	175 kg (passengers plus luggage)
luggage storage	510 liters
weight distribution front/rear	45 / 55 %

Driving performance

top speed	120 km/h
acceleration 0 – 60 / 0 – 100 km/h	5.2 s / 12.5 s
range	166 km (NEDC)

Wheels

tire sizing	115/70 R16
rims	aluminum double-spoke wheels

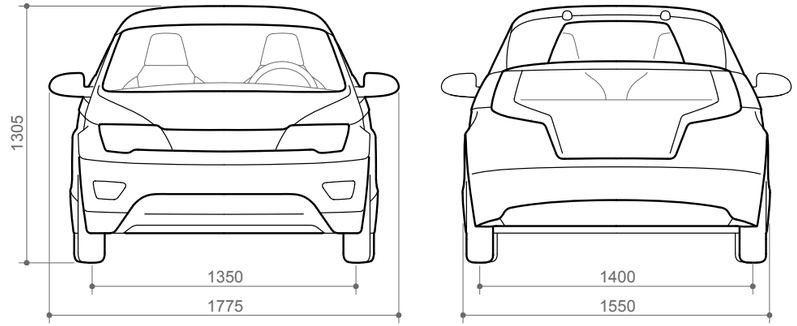
Powertrain

propulsion method	central with rear wheel drive
transmission	active torque-vectoring transmission
engine design	asynchronous motor
power	15 kW (rated power; limited due to vehicle class), 45 kW max.
torque	80 Nm (electric engine)

Energy storage

type	lithium-ion high performance battery (1,296 cells type 18650 in 18 modules)
capacity	13.5 kWh
max. voltage	390 V

Dimensions



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Research partners at TUM

Institute of Automotive Technology (FTM)
Chair of Computational Mechanics (CM)
Chair of Marketing (DTM)
Institute for Electrical Energy Storage Technology (EES)
Research group Energy Informatics
Institute of Energy Conversion Technology (EWT)
Institute of Machine Elements (FZG)
Institute of Industrial Design (ID)
Institute for Machine Tools and Industrial Management (iwb)
Institute of Ergonomics (LfE)
Institute of Lightweight Structures (LLB)
Institute of Product Development (PE)
Institute of Thermodynamics (TD)
Chair for Information Systems (WI)

Project partners

Amtek Tekfor Holding GmbH
Autoliv B. V. & Co. KG
BMW AG
Federal Highway Research Institute (BASt)
Continental Automotive GmbH
Daimler AG
Finepower GmbH
Hyve AG
IAV GmbH
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Bodywork

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