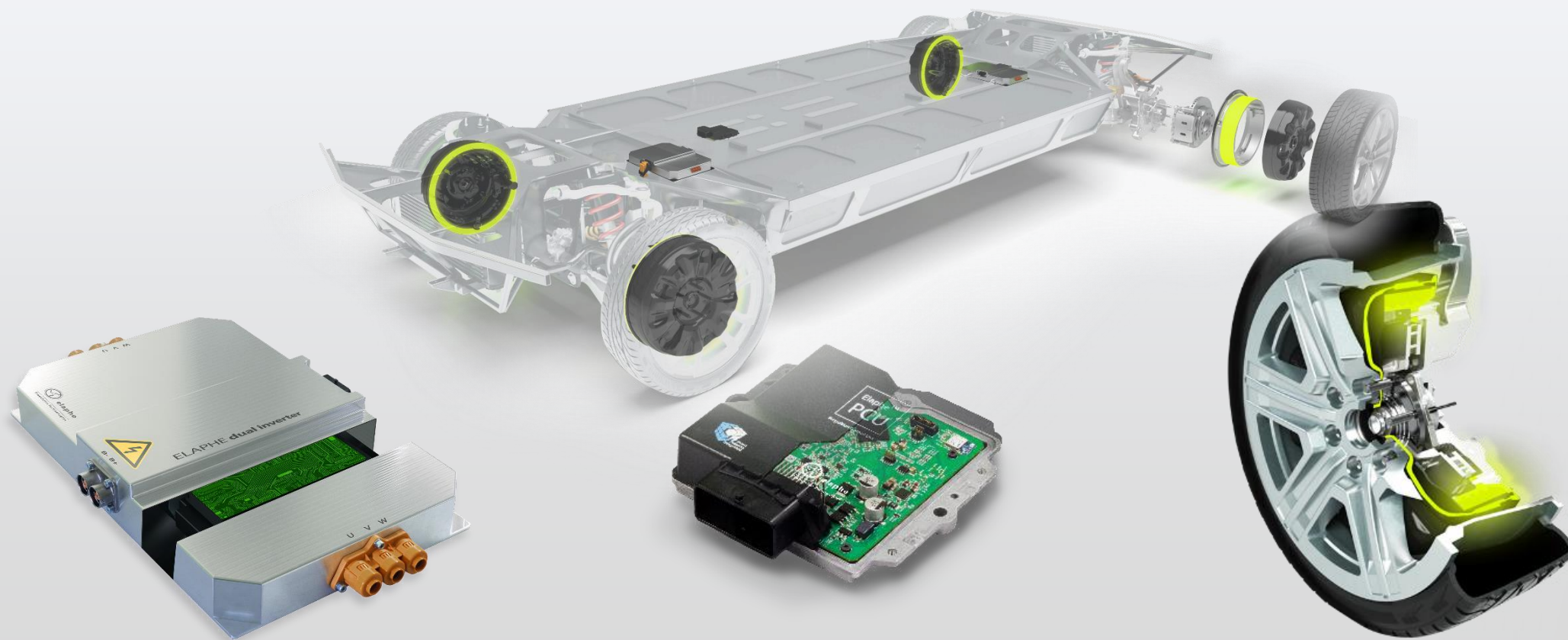


# Elaphe Propulsion Technologies

## Microelectronics, SBRA, EU Chip act



1. Trends in automotive
2. About Elaphe Propulsion Technologies
3. Microelectronics Wishlist for Slovenia

## Market trends

PAST



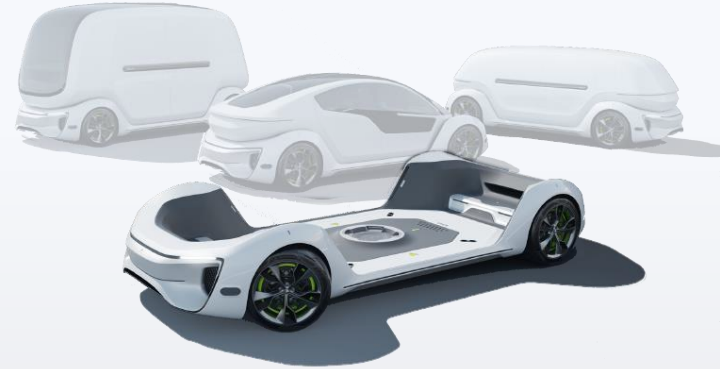
ICE vehicles...

PRESENT

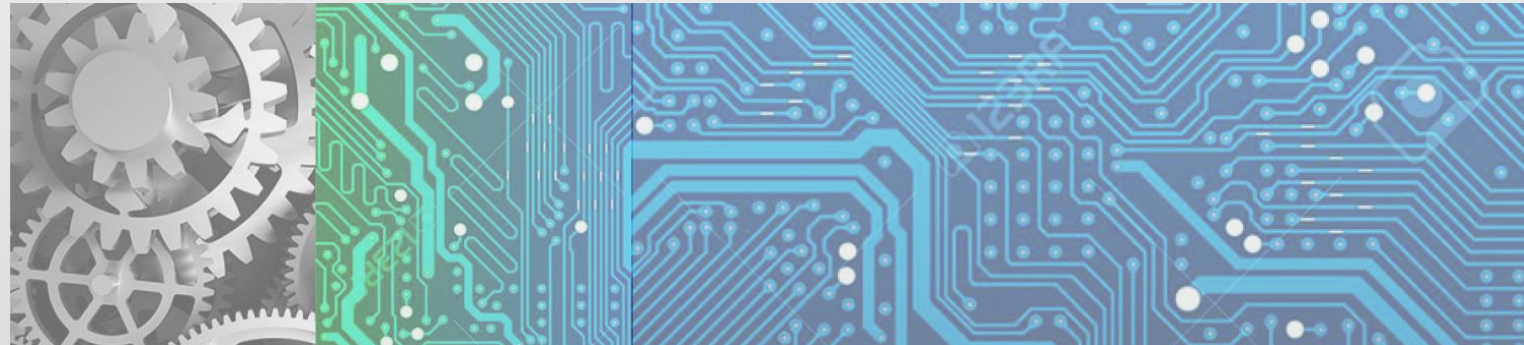


BEV, PHEV

FUTURE AND ALREADY  
HAPPENING NOW



vehicle redesign toward modular  
and flexible platforms.

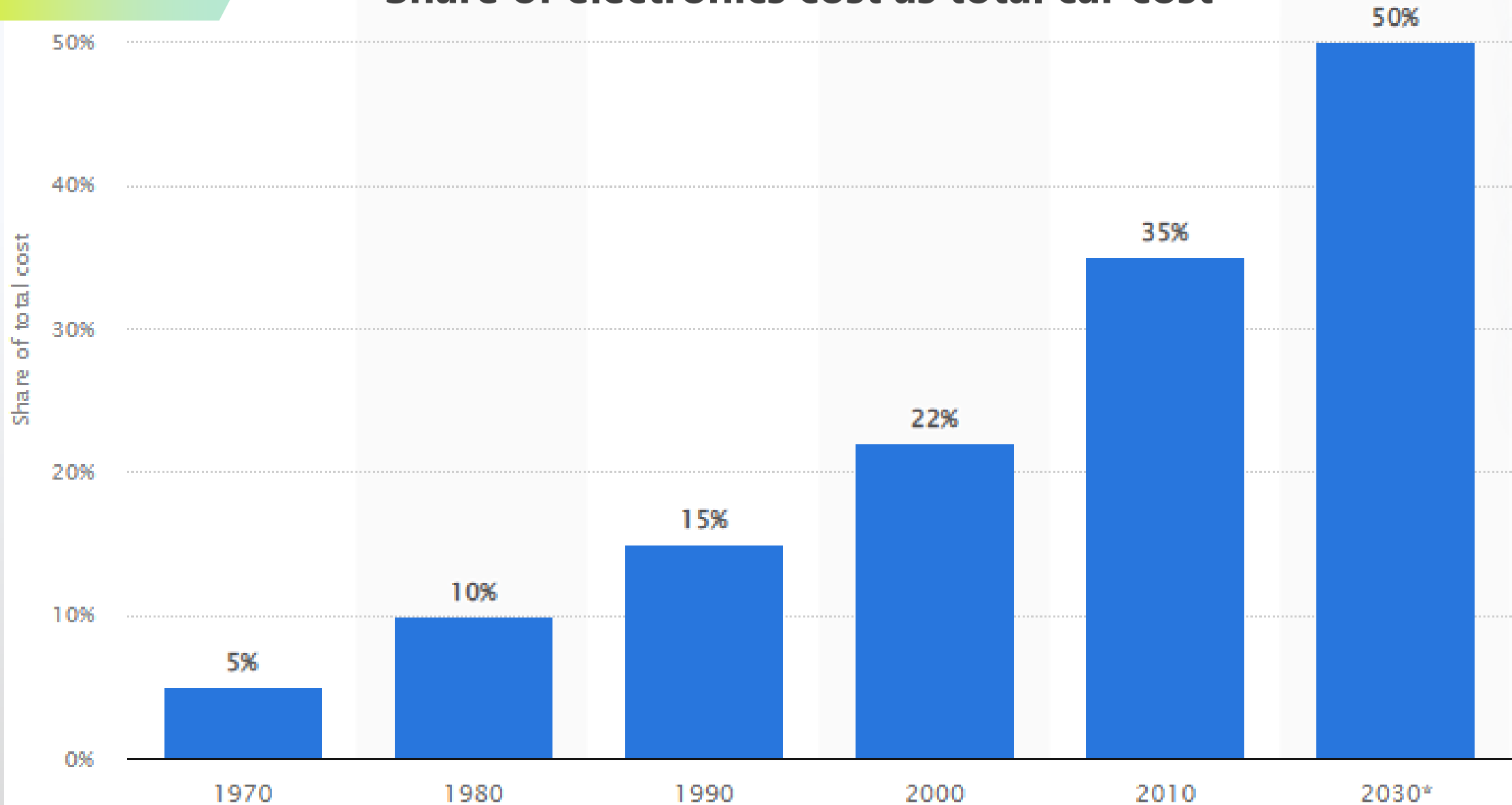


**MECHATRONICS**

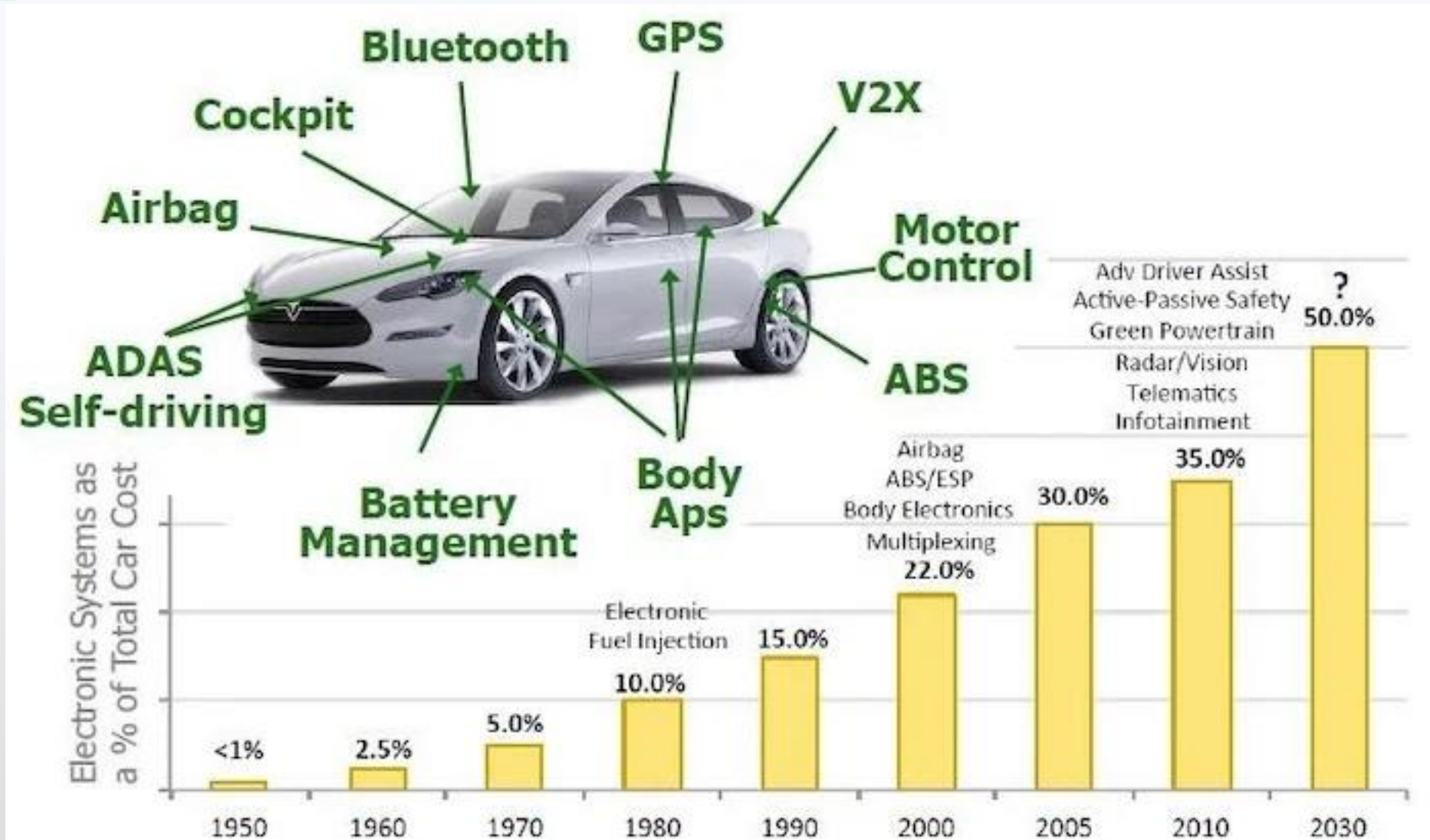
**ELECTRONICS**

**DIGITAL**

## Share of electronics cost as total car cost



## Share of electronics cost as total car cost





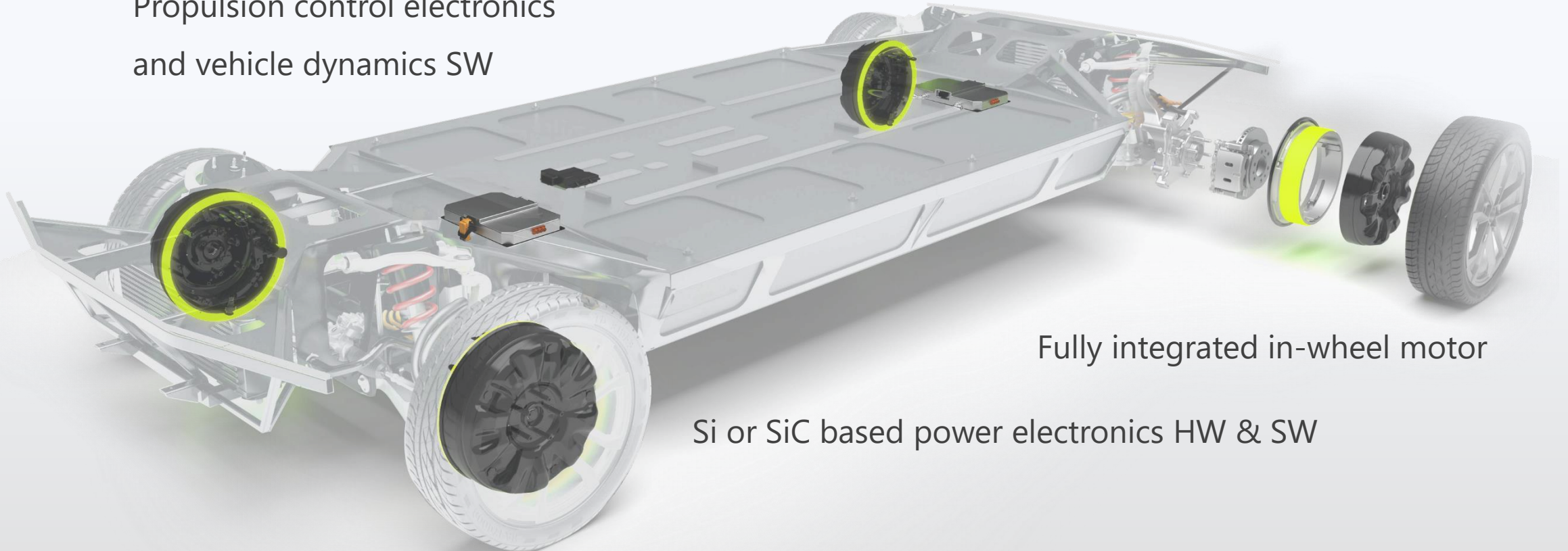
# CEO event @Electronica, Munich, November 2022



- 1) Announcements of several billion EUR investments.
- 2) Expressed the need for global balance in business conditions

# Elaphe: Complete IWM Propulsion System

Propulsion control electronics  
and vehicle dynamics SW



Fully integrated in-wheel motor

Si or SiC based power electronics HW & SW

**ELEGANCE, SIMPLICITY, BEST IN CLASS PERFORMANCE**



# Elaphe in-wheel motor

**Benefits from  
new SiC chips**



**MATURE, FUNCTIONAL and IN USE**



Enablers by Elaphe

# Multiple wheel control electronics

**Aurix Tricore  
Microprocessor  
based**

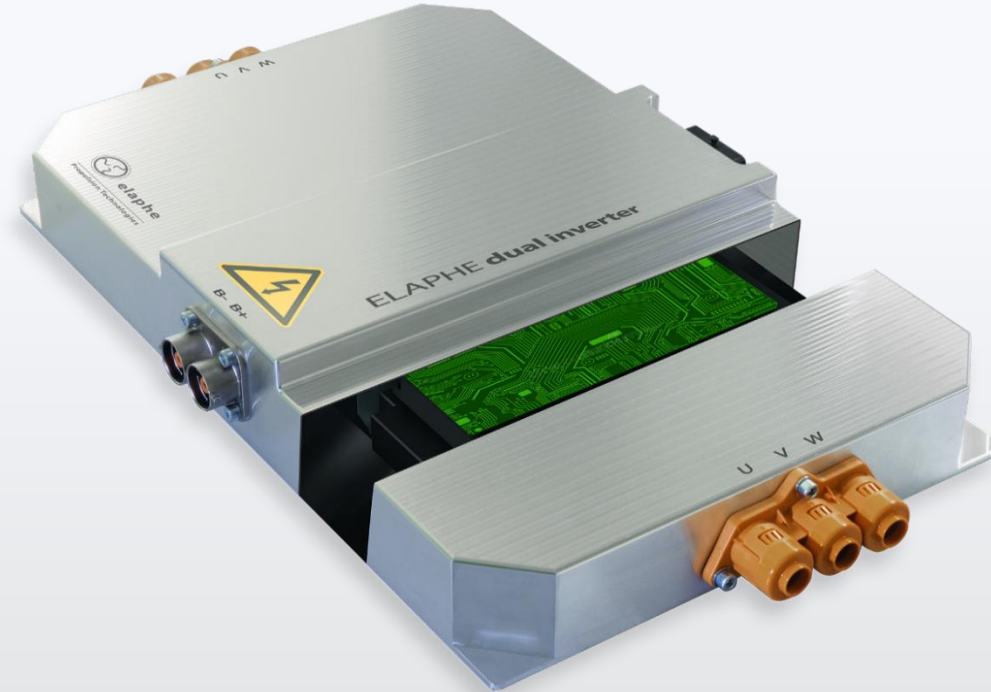


**MATURE, FUNCTIONAL and IN USE**

Enablers by Elaphe

# Power electronics

**SiC and GaN  
focused**



**MATURE, FUNCTIONAL and IN USE**

# IWM and electronics

2022

► 2005



IWM development – By far the most experienced IWM developer globally.

► 2010



Power Electronics SW and later also HW development

► 2012



Vehicle propulsion control electronics SW & HW development.  
Brought Elaphe to offering advanced control electronics to OEMs.

► 2012



System development – The only IWM company able to deliver the complete propulsion system.

► 2008



Vehicle application programs – Complete platform know-how for different vehicle types.



**LMC Endurance**

**Elaphe Customers**  
publicly revealed projects

First all-electric pickup truck. To be manufactured in ex GM's Ohio plant.



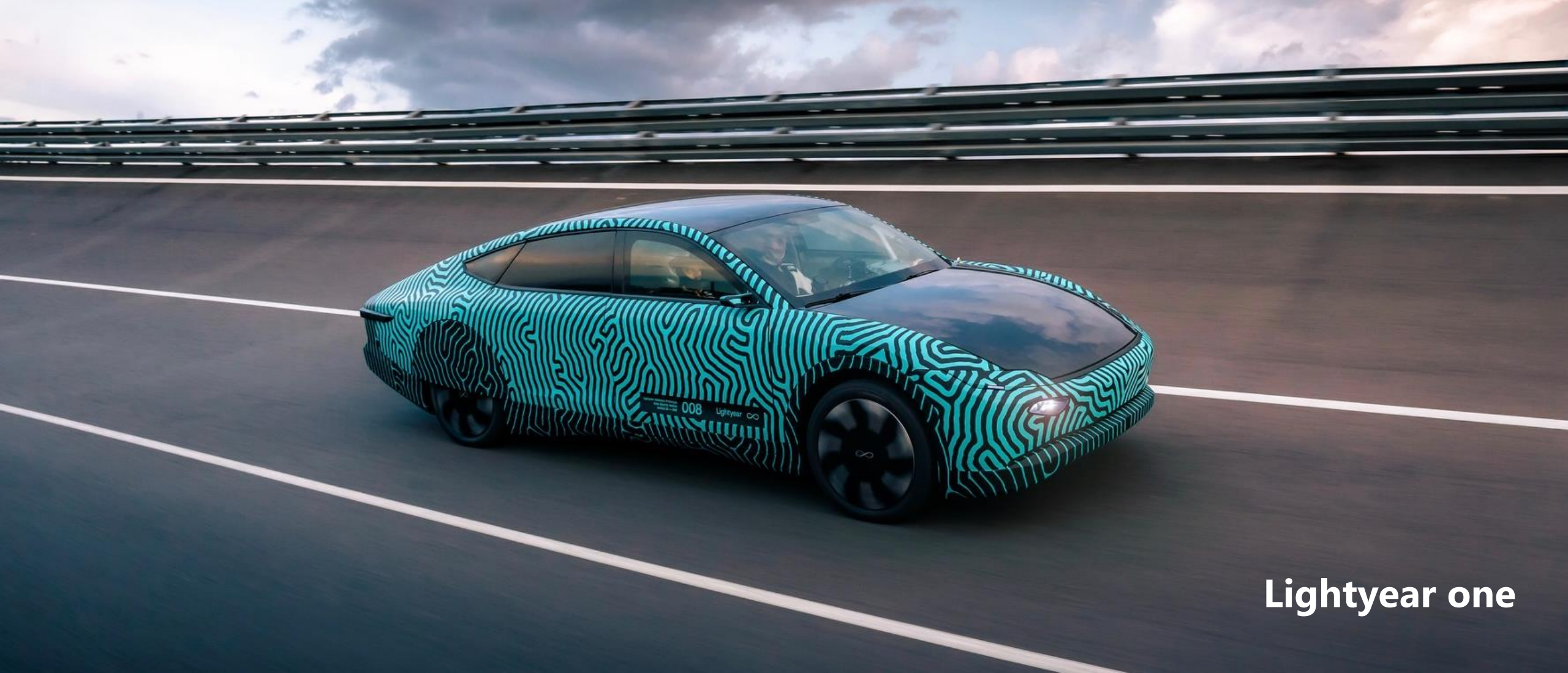
Aptera



Elaphe customers

Chasing the 1000 miles range...





**Lightyear one**

Elaphe customers

Energy efficiency is everything...

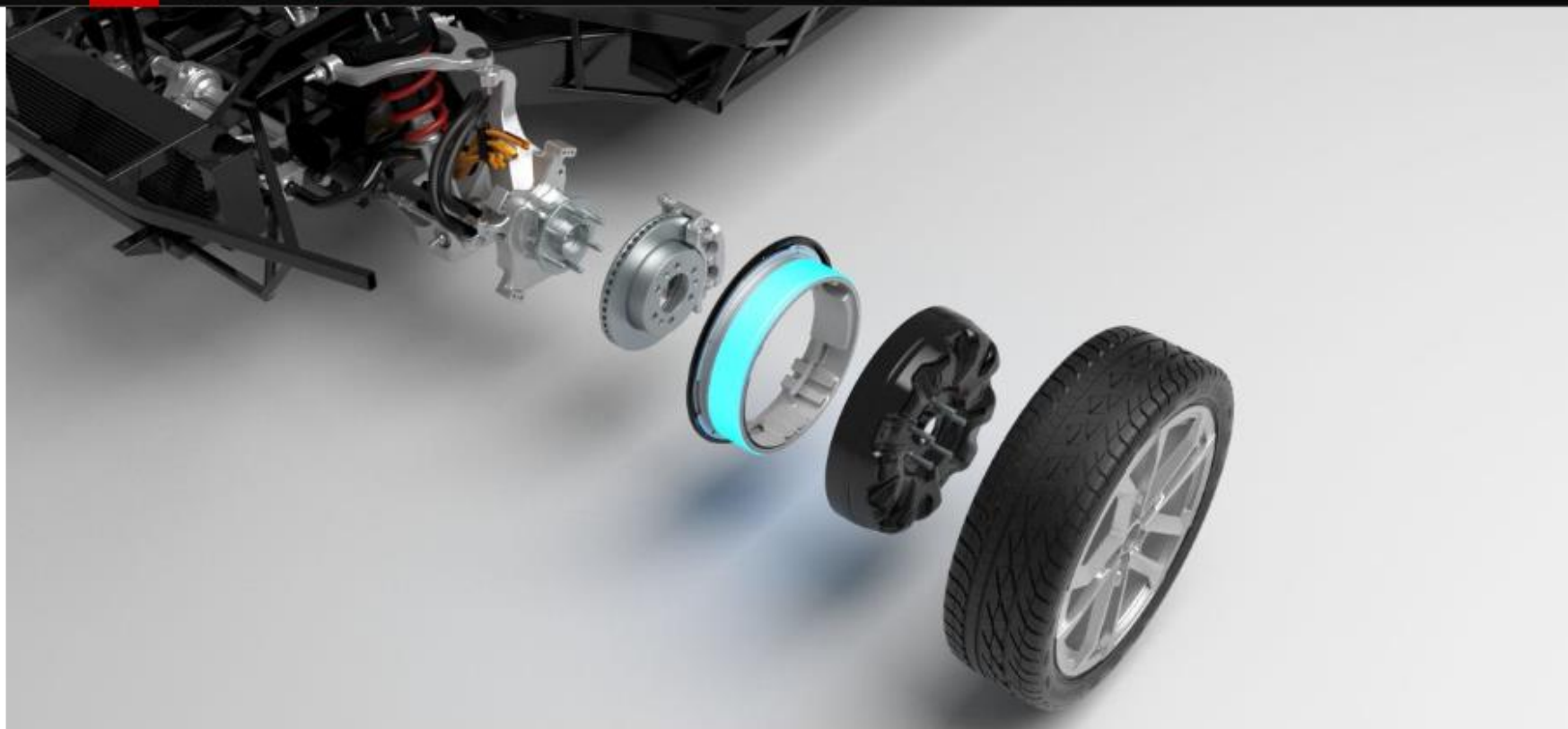


Elaphe customers

Autonomous EV People Mover – Last Mile Solution.

Elaphe is providing the full rolling chassis/skateboard





Elaphe Propulsion Technologies

Elaphe's design incorporates all the parts of a motor within a standard wheel hub, including suspension, brakes and motor rotor.

By packing everything into the wheels, there's no need for other components like a gearbox or a drive shaft which usually transfers power from the onboard motor to the wheels.

This makes the car lighter, Ambrozic tells CNN Business, and it saves energy by reducing the distance the power has to travel. It also frees up space in the vehicle and allows the manufacturer to make the car more aerodynamic. A more aerodynamic vehicle in turn needs less power, which can mean smaller batteries and lighter vehicles, he adds.

<https://edition.cnn.com/2022/10/26/tech/elaphe-slovenia-in-wheel-motors-spc-intl/index.html>

<https://www.forbes.com/sites/jenniferdungs/2022/08/18/1000-miles-per-charge--whats-under-the-hood-of-the-longest-range-electric-cars/?sh=6ea119c7481e>



# Inverters WBG (SiC)

## Selected development milestones



COSVIU project 2014 integrated WBG in cooperation with Fraunhofer IISB



**Dual inverter**, SiC ( Infineon ) based prototype (2021)



30 partners  
>50 million EUR  
funding



Cooperation with state-of-the-art SiC inverter manufacturer (2022)

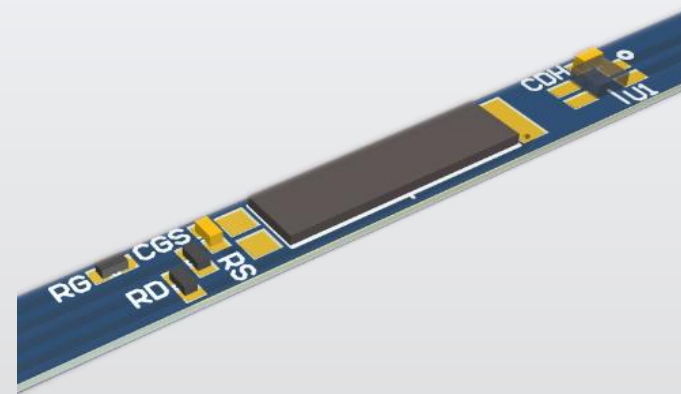
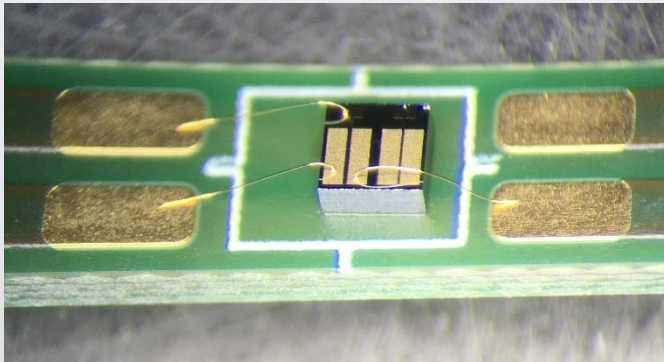
## Vehicle integration:

- First WBG vehicle integration 2014
- Several prototype vehicles with SiC inverter technology co-developed by Elaphe
- Participation in two SOP project with customer WBG inverters in 2022/2023



## Development of GaAs based device.

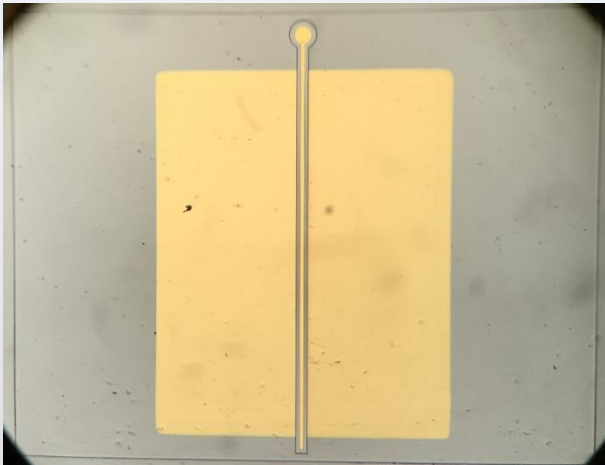
- R&D partners for further optimization of our PoC semiconductor devices
- Processing and Prototyping of next generation PoC semiconductor devices (GaAs, GaN, InAs)
- Global impact with various sensing and other applications with this device
- Excellence, innovation, references and improved chances of project success



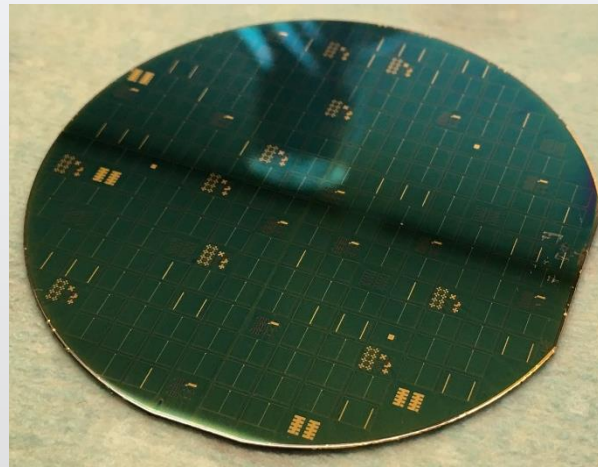
GaAs based sensor device designed by Elaphe and fabricated in CNR-IOM (Trieste) as a part of the NFFA-Europe project in 2017.

## Example of Elaphe Microelectronics

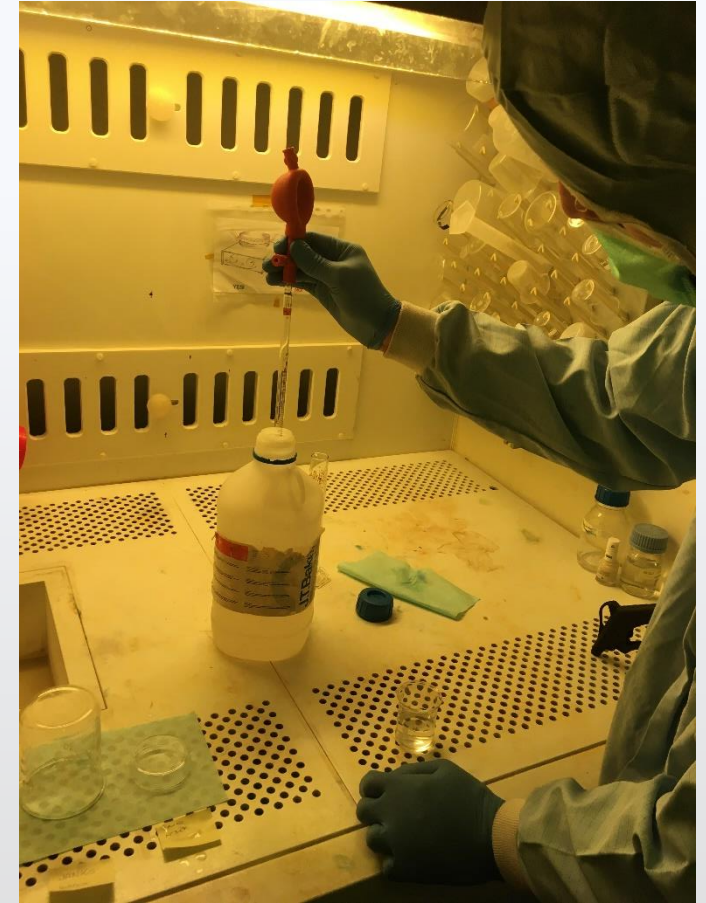
- Interreg-Europe project (InterReg Slovenia – Italy)
- Excellent collaboration with the Italian institute CNR-IOM in Basovizza – since 2017
- Participation in 2 NFFA-Europe projects where 5 different GaAs wafers were fabricated



Final semiconductor structure based on GaAs manufactured in 2021.

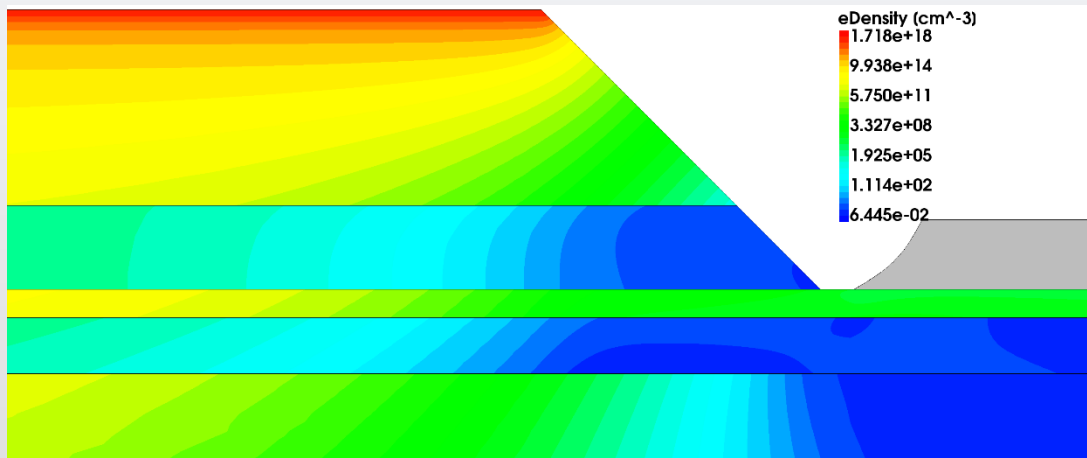


2-inch wafer with structures during processing.

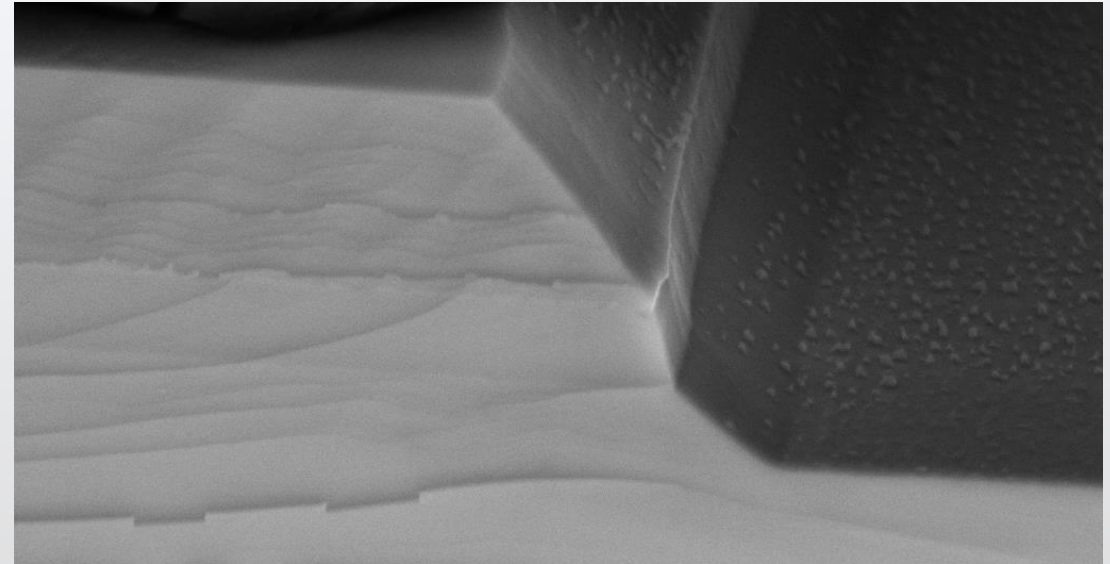


Processing of GaAs wafers in the CNR-IOM clear-rooms.

Experience in the development and optimization of semiconductor process technologies and devices with TCAD computer simulations



Cross-sectional profile of the device  
numerically simulated



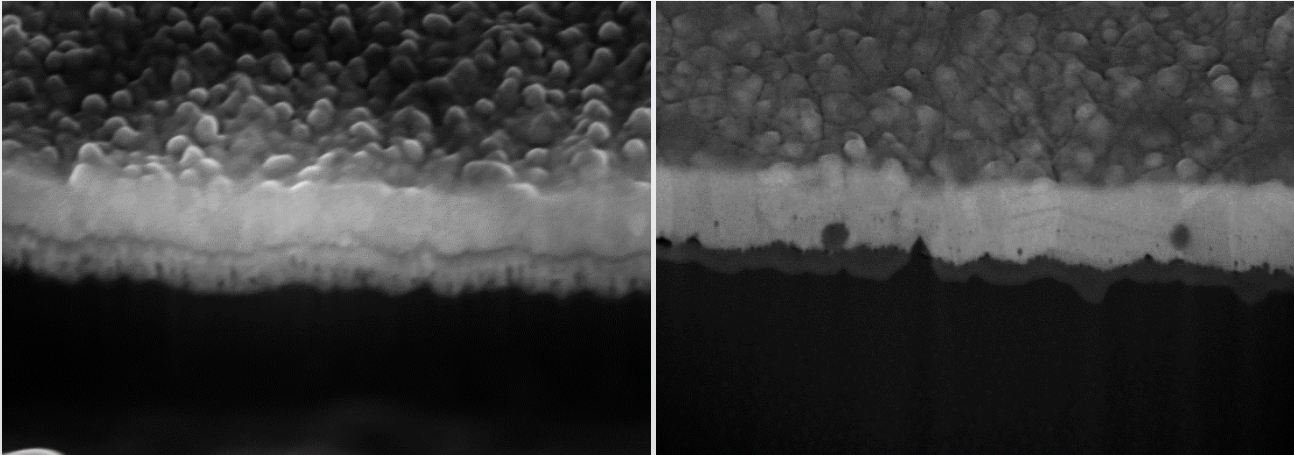
Real device profile inspected with  
SEM (scanning electron microscope)



## Example of Elaphe Microelectronics

### Cooperation in Slovenia

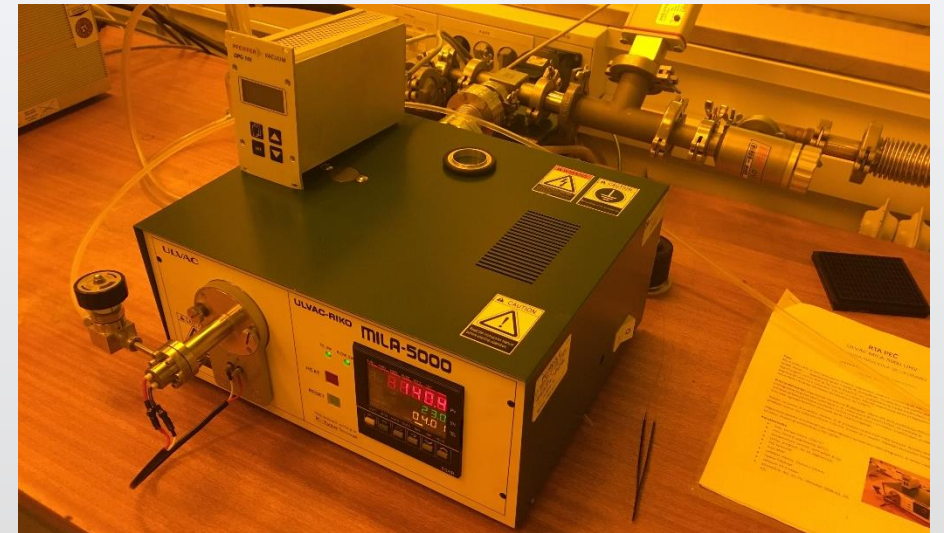
- RLS Merilna tehnika d. o. o.
- Nanocenter (**IJS**)
- Faculty of electrical engineering (UL)
- University of Nova Gorica



Thermal treatment of ohmic contacts. Comparison before and after annealing.



Wire bonding - post processing of samples at RLS d.o.o.



The rapid thermal annealing system at the Nanocenter (IJS) that we used to anneal the ohmic contacts in 2022.

# Slovenian Microelectronics Industry Wishlist

- Highly skilled staff
- Equipment
- EU ( and global ) partners

## Highly skilled staff

- Chip Design
- Chip Simulation
- Production processes
- Validation processes
- Embedded programming

## Equipment (examples...)

- Characterization:
  - Wafer probing station** (with shielded enclosure for measurements in the dark and low noise)
  - Measurement** equipment for precision I-V, C-V characterization (down to fA range)
  - Inspection** (SEM, EDX, FIB)
- Back-end processing:
  - Wafer dicing**
  - Ball bonding** (gold wire with diameter down to 17  $\mu\text{m}$ )
  - Gluings and casting**
- Front end processing:
  - Rapid Thermal Annealing** (with heating and cooling rate more than 50°C/sec in the inert gas atmosphere)
  - In the later stages** also clean rooms for wafer front-end processing (spinner hood, chemical hood for wet and dry etching, mask aligner, profilometer, metal deposition equipment, etc.)





## EU and global partners



**EPoSS**

European Technology Platform  
on Smart Systems Integration



**EGVI**  
European Green  
Vehicles Initiative

