



TOMAS JONSSON

SCANIA BEV - HEAVY TRUCK TECHNOLOGY AT GLANCE

Power Electronics Day 2024, Grand Hotel Saltsjöbaden

16 May 2024

SCANIA



THE WORLD OF SCANIA

Sales and services network

1,500 dealers and workshops

More than **95%** parts availability

Round-the-clock assistance





TRATON GROUP

– LEADING GLOBAL BRANDS AND STRATEGIC ALLIANCE PARTNERS

TRATON

G R O U P

OWNED BY VOLKSWAGEN GROUP

FULLY CONSOLIDATED



Leader in core markets
with differentiated brands

ASSOCIATE

25% + 1 share¹



¹ Held by MAN SE as of 31-Dec-2020

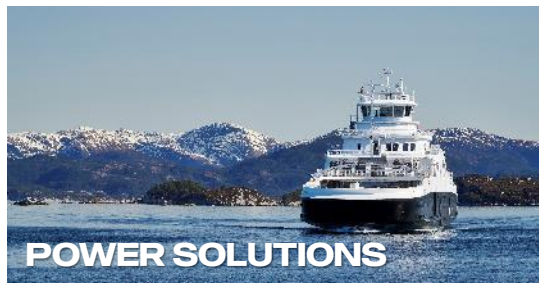
Powerful strategic alliance partners
enabling leading global scale

STRATEGIC PARTNER





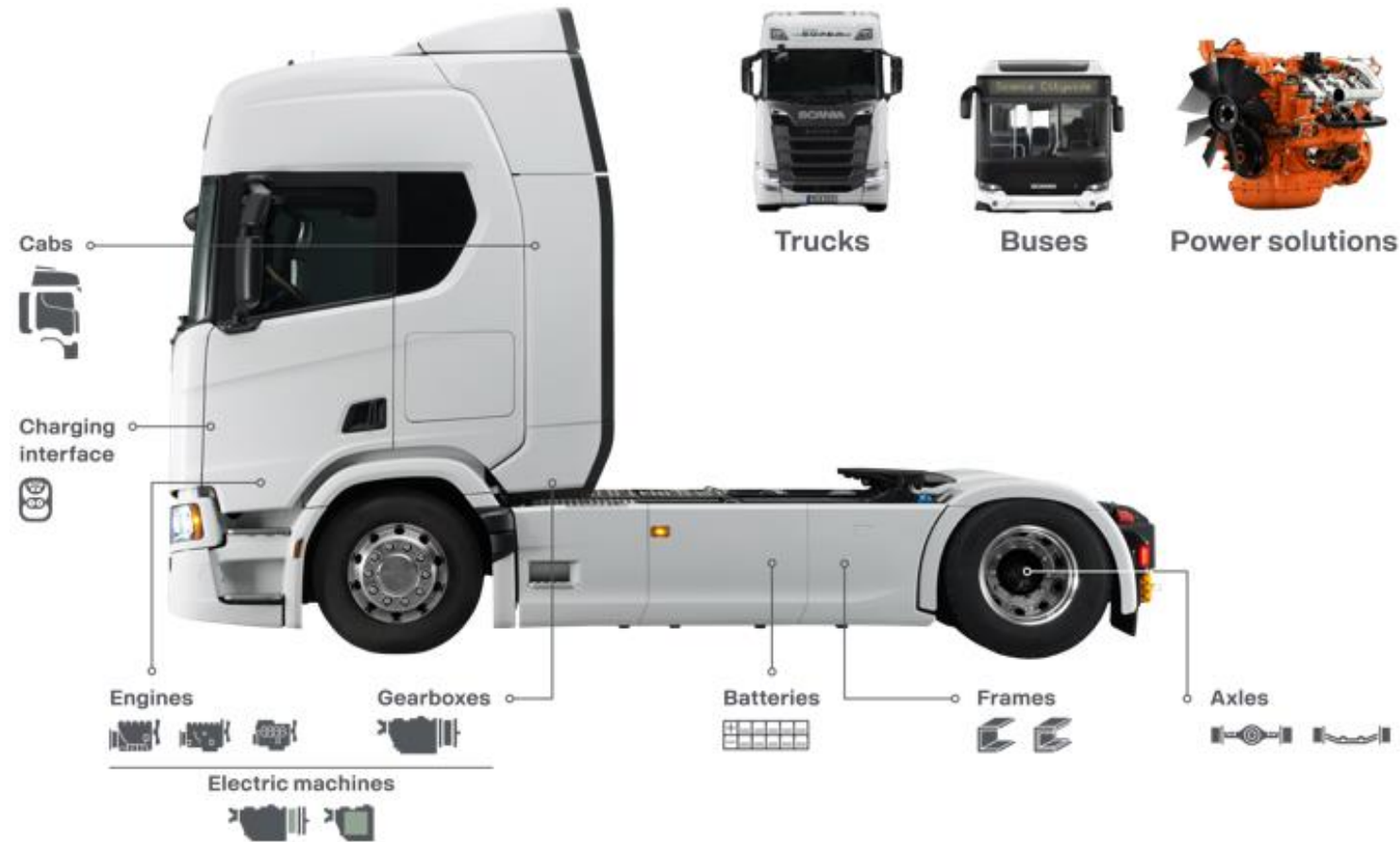
PRODUCTS AND SERVICES





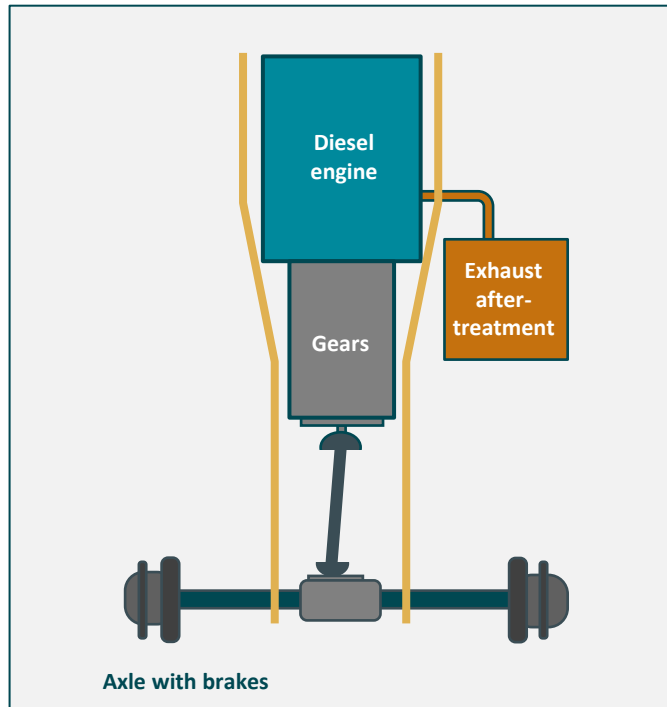
MODULAR SYSTEM

PHYSICAL TAILORED SOLUTIONS

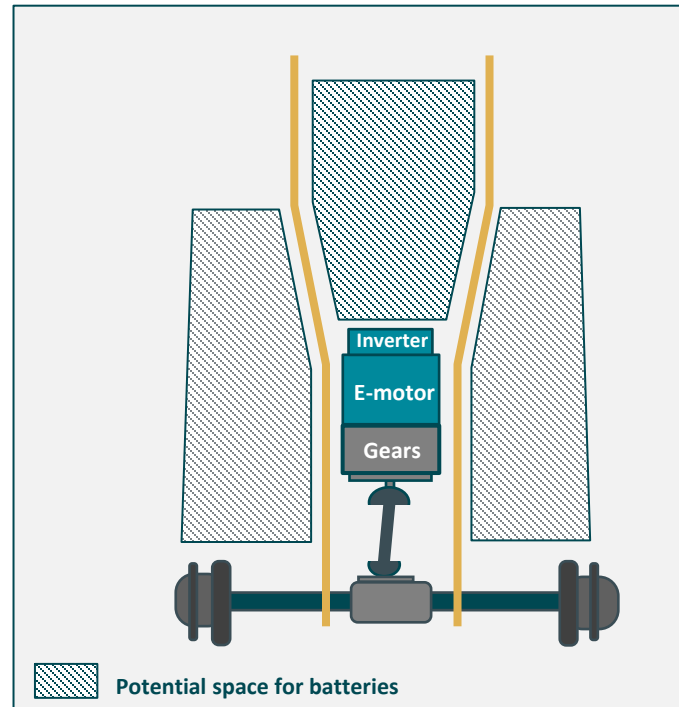


- + Customer value
- + Ability to match specific customer needs
- + Cost
- + Scale benefits

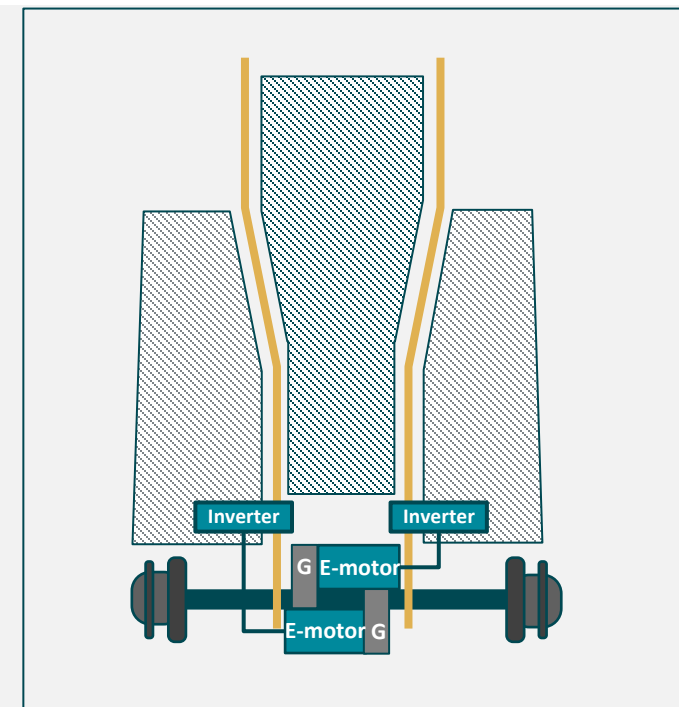
ELECTRIC POWER TRAIN — POSSIBILITIES



conventional



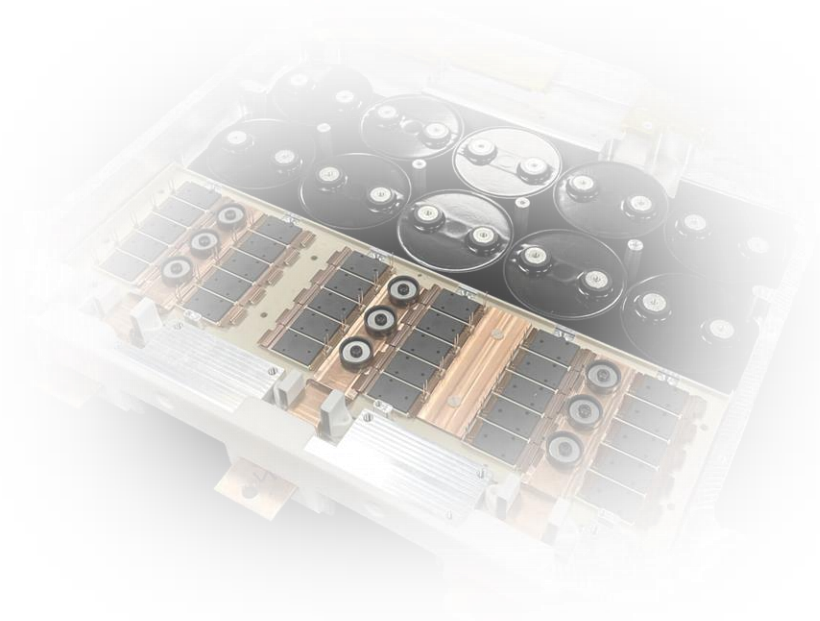
central drive



e-axle

Key requirements for next generations of heavy-vehicle inverters

- Size (Adapted form factor and packaging)
- Coolant (5-25 l/min, -40C to +65C)
- High Power ranges (245kW- 500kW+)
- High voltage ranges (850V-1250V, MCS)
- Central drive and e-axel installation possible
- e-Machine stress and loss reduction
- High inverter efficiency (Losses <5W/A)
- Vehicle SW integration for Scania specific functionality
- Functional safety with redundancy in sensing and safe state
- Reliability, state-of-health monitoring
- Early advanced prototyping in-house

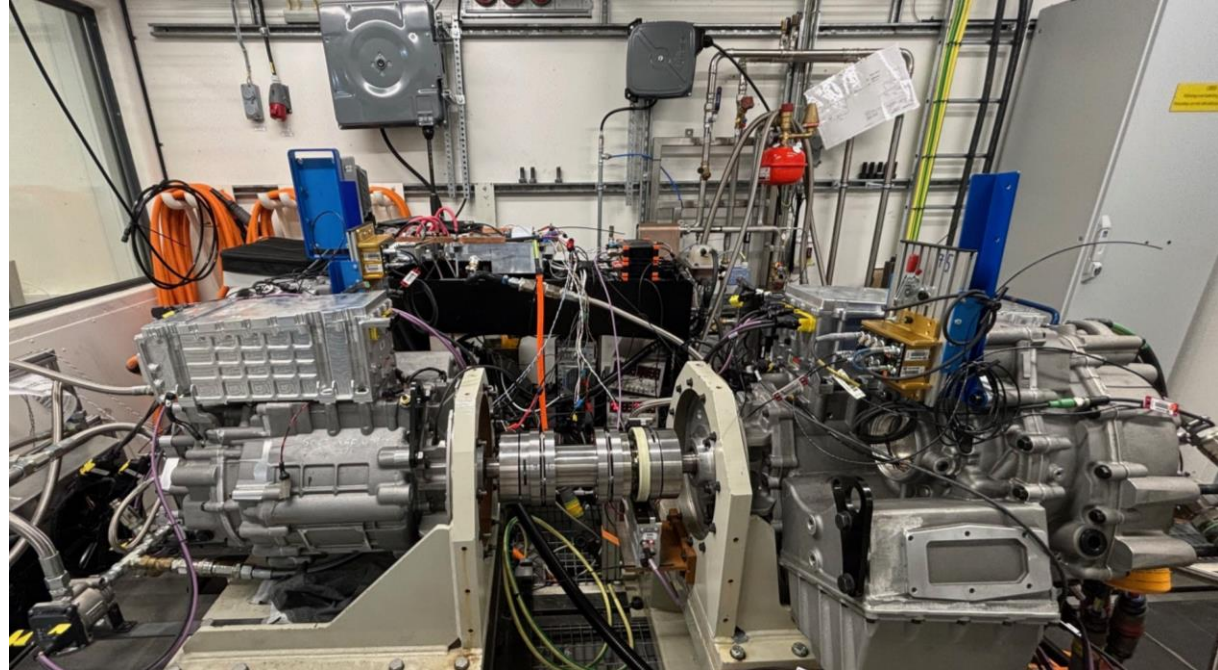
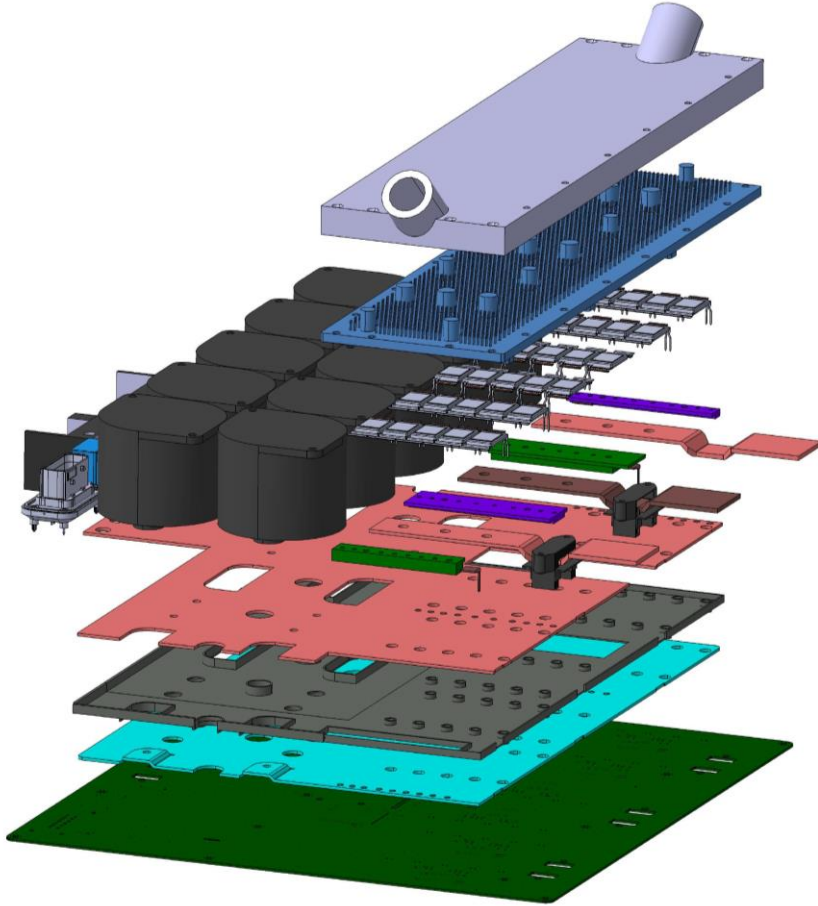


Research activities to build knowledge!



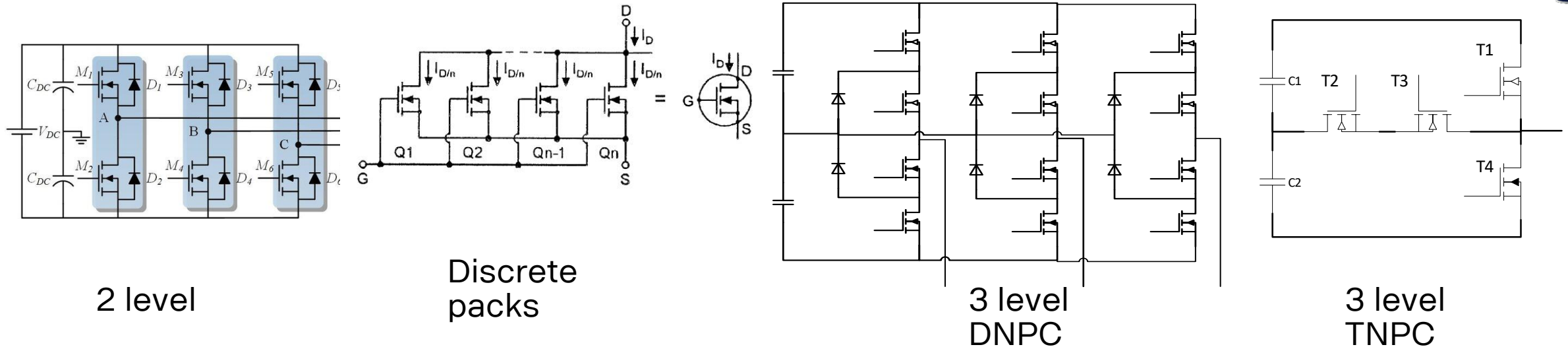
Gen 4 prototype 2-level inverter up to 1200 A, 950 VDC

- high power and high voltage powertrain inverter with inhouse software
- scalable hardware for emachine with or without permanent magnet rotor.



- target easy hardware adaptability and software control flexibility
- scalability with discrete power semiconductor modules
- low inductance loop from dc-capacitor to power devices
- packaging and cooling concepts evaluation

Inverter topologies of our interest

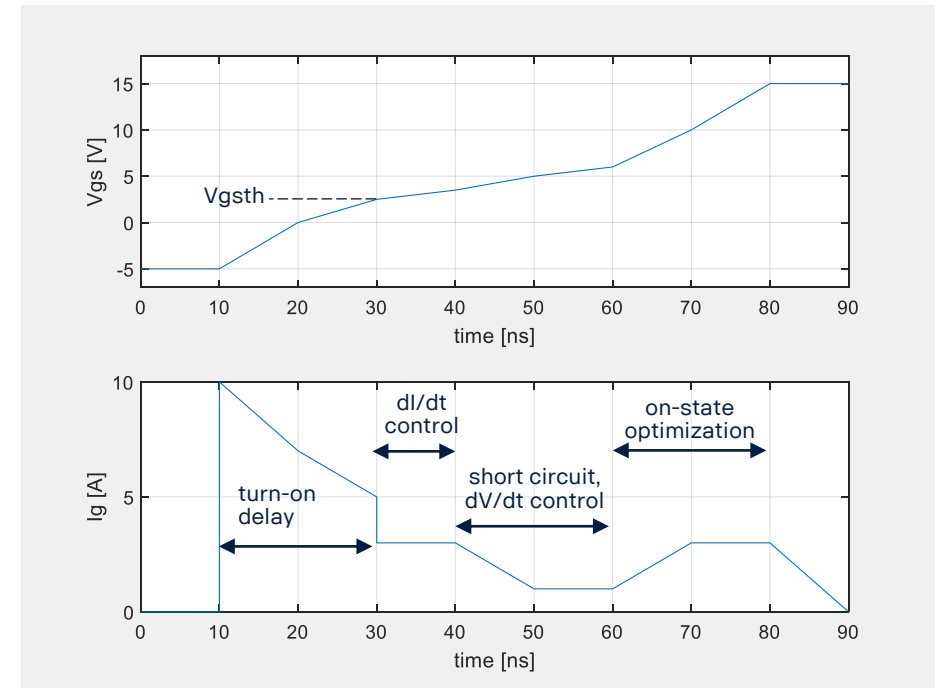


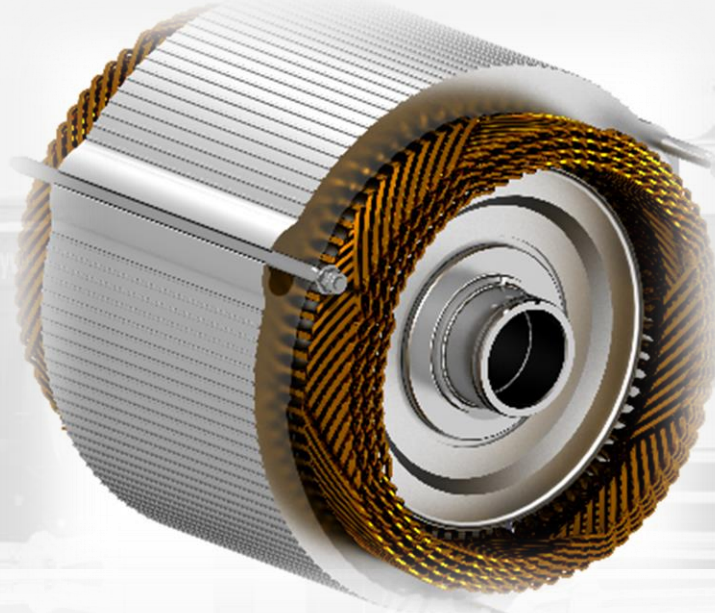
Inverter type	Sub-type	No. of SiC Mosfet packages
2 level	1 or 2 power modules in parallel	3/6
	Discrete packs, eg. 4 in parallel	6x4=24
3 level multi-level	Neutral point clamped	12
	T type	12
Dual inverters	2 level/3 level	12/24



Advanced gate drive evaluation

- Recent gate drive technology offers fast programmable output
- Adaptive gate voltage slew rate control (gate current control) addressing:
 - Switching delay
 - Switching loss
 - On-state loss
 - Voltage overshoot
 - Short circuit current
 - EMI
- Power device state of health monitoring

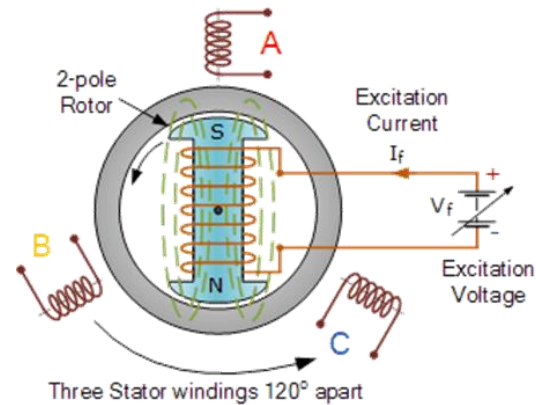




The e-Machine is strategic for Scania to continue offer a fully optimized powertrain for the best operating economy and drivability.

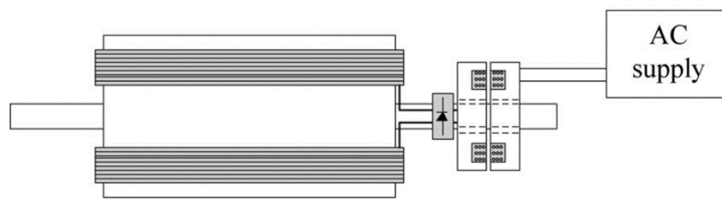


WRSM - THE DOUBLY EXCITED MOTOR

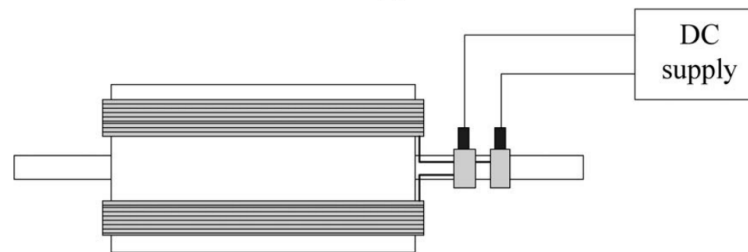


ENERGY TRANSFER TO THE ROTOR

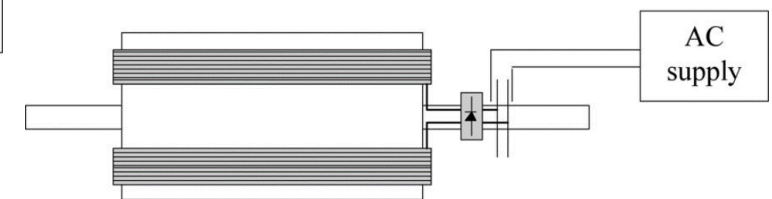
Rotary Transformer



Slip Rings



Capacitive

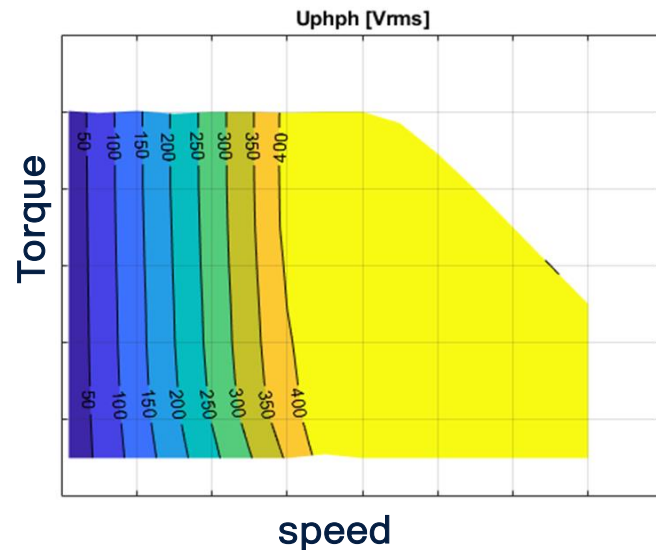




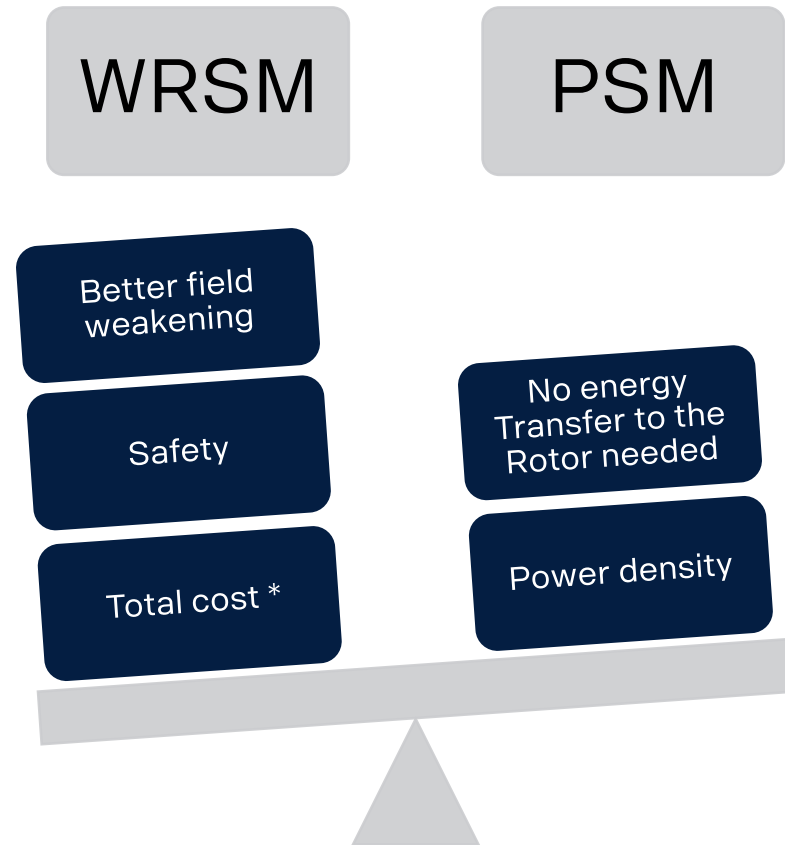
WOUND ROTOR SYNCHRONOUS MACHINE

- PMSM:
 - Induced output voltage (backemf) increases proportional to speed
 - At high speed (w/o field weakening): PMSM voltage > Battery voltage
 - Field weakening required by stator current counter acting rotor PM-field
- WRSM: Rotor current controlled to keep output voltage constant or optimized

$$\text{WRSM} = \text{WFSM} = \text{EESM} = \text{FSM}$$



Rotor energy can be controlled





Energy consumption per day:
1200 kWh

Charger 150kW, 10h

Battery system, specific cycling
capacity: 50Wh/kg

Complete battery system
weight: >20.000 kg



BATTERIES FOR LONG DISTANCE TRUCKS

2015



Energy consumption per charging:
550 kWh (325 km)

Charger >1000kW (Mega), <45min

Battery system, specific cycling
capacity: 180Wh/kg

Complete battery system weight:
4.500 kg



BATTERIES FOR LONG DISTANCE TRUCKS

2025



Energy consumption per charging: 350 kWh (325 km)

Charger >2.000kW, 20min

Battery system, specific cycling capacity: 300Wh/kg

Complete battery system weight: 2.500 kg



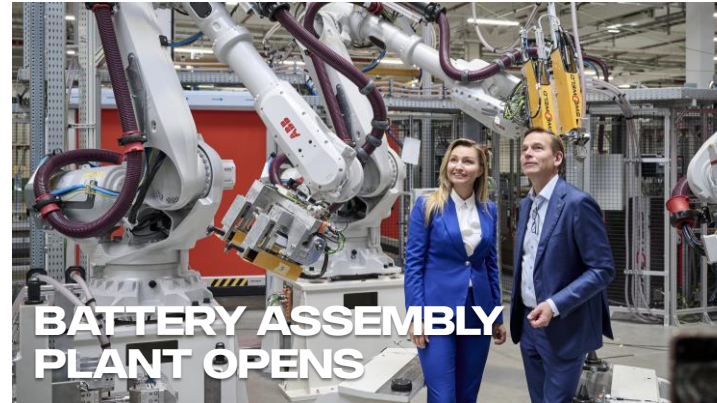
BATTERIES FOR LONG DISTANCE TRUCKS

2035



2023 HIGHLIGHTS

[Inside Scania's Cutting-Edge Battery Assembly \(youtube.com\)](https://www.youtube.com/watch?v=...)



50%

By 2030, more than half of our new vehicles sales volume is expected to come from electrically powered vehicles.



