

# Traction Inverter Technology

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# US DOE Electric Drive Technologies R&D Targets

**Our roadmap defines the pathway to achieving 2025 targets**

## Current Status

**\$1800\***

(\$12/kW 2015 Target)



**Chevrolet Bolt**



## 2025+

**\$900**

(\$6/kW 2025 Target)



**Future Mobility Design Concept**

<b>2025 Targets</b>		<b>2015</b>
<b>Cost (\$/kW)</b>	<b>\$6/kW</b>	<b>\$12/kW</b>
<b>Power Density (kW/L)</b>	<b>33 kW/L</b>	<b>3.5 kW/L</b>
<b>Power Level</b>	<b>100 kW</b>	<b>55 kW</b>
<b>Reliability/lifetime</b>	<b>300,000 miles</b>	<b>150,000 miles</b>

\* Based on 2016 Bolt 150 kW system

Roadmap: <https://www.energy.gov/sites/prod/files/2017/11/f39/EETT%20Roadmap%2010-27-17.pdf>

# Draft – Electric Drive Tech Team Technical Targets

## Electric Drive

Year	2025	2030	2035
Peak Power Level (kW_peak)	100	150	225
Voltage (V)	600	800	800
Cost (\$/kW_peak)	6	4	2.67
Power Density (kW_peak/L)	33.3	50	75

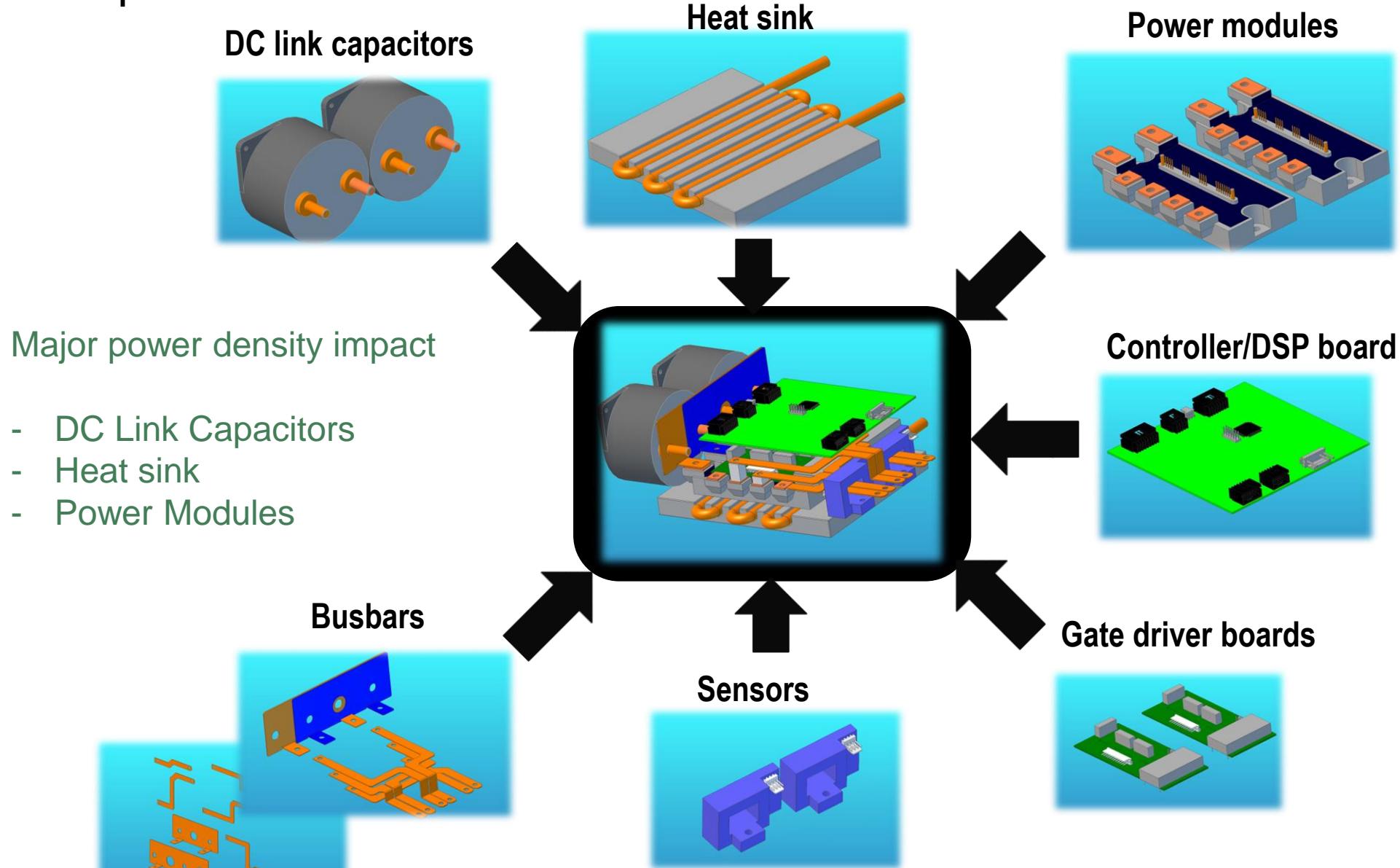
## Power Electronics

Year	2025	2030	2035
Cost (\$/kW_peak)	2.70	1.80	1.20
Power Density (kW_peak/L)	100	150	225

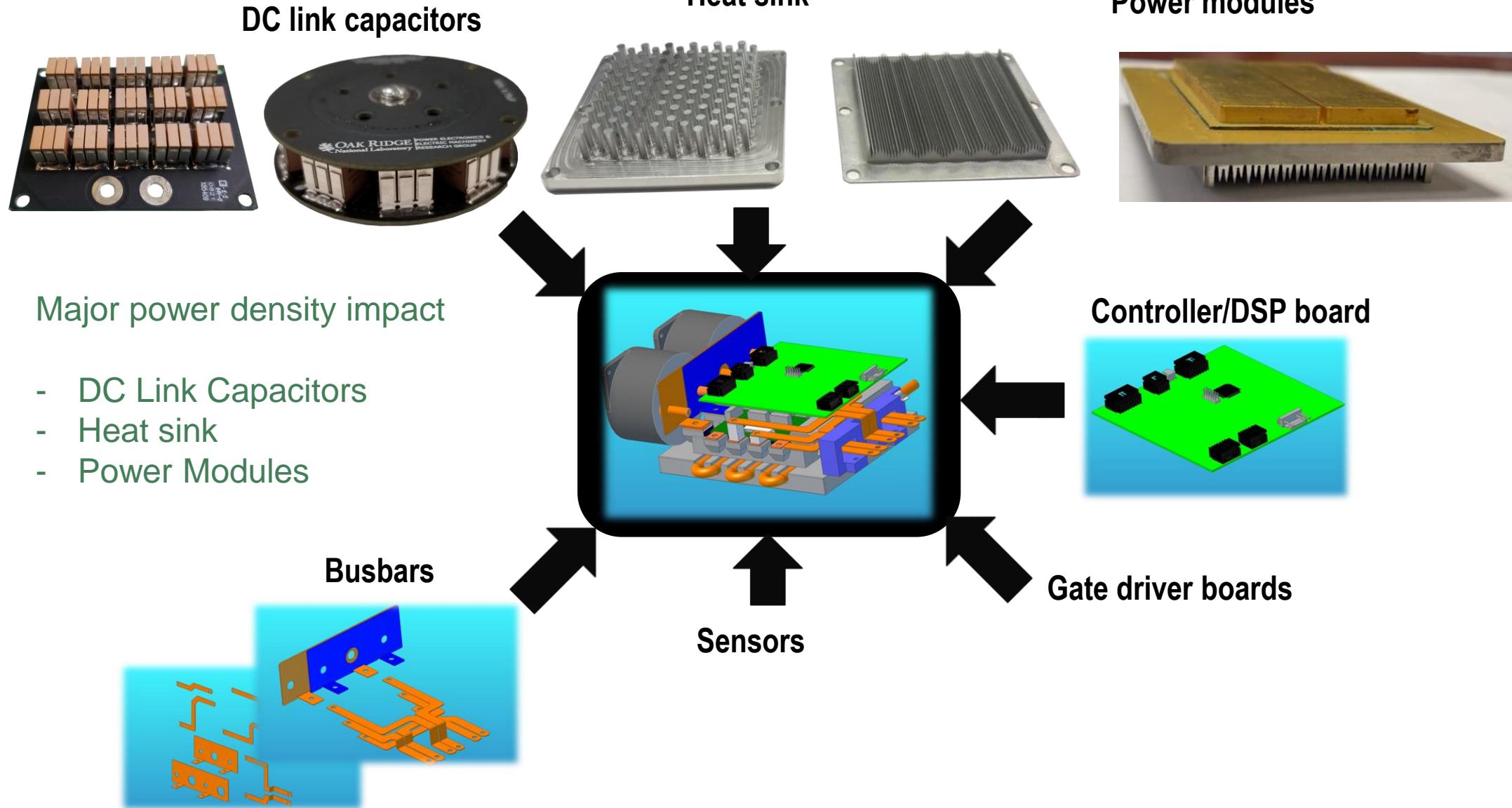
## Electric Motor

Year	2025	2030	2035
Cost (\$/kW_peak)	3.30	2.20	1.47
Power Density (kW_peak/L)	50	75	112.5

# Components of an inverter

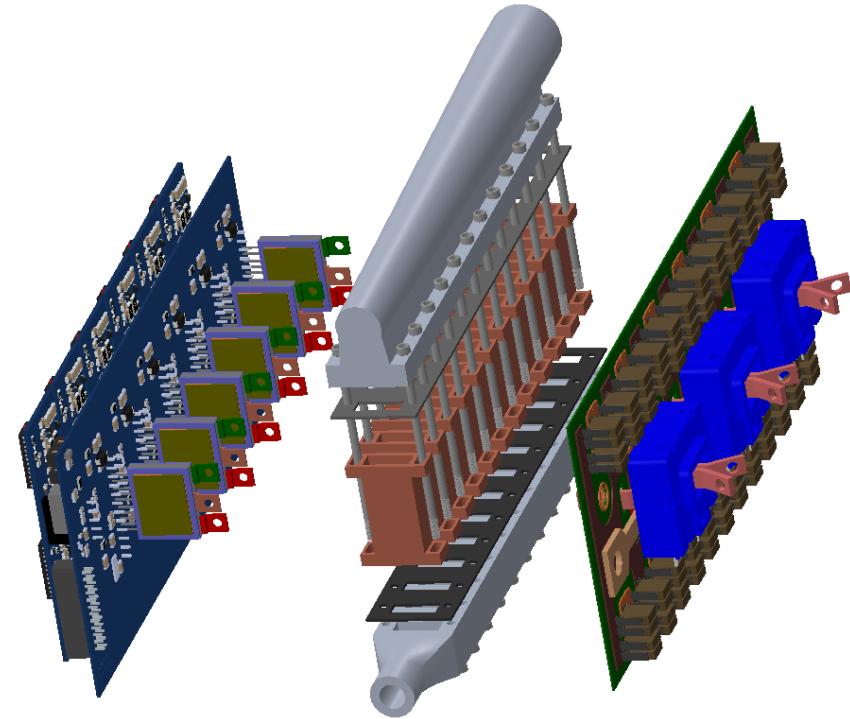
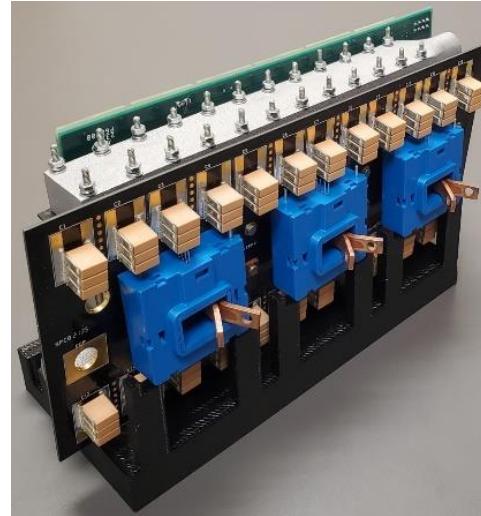
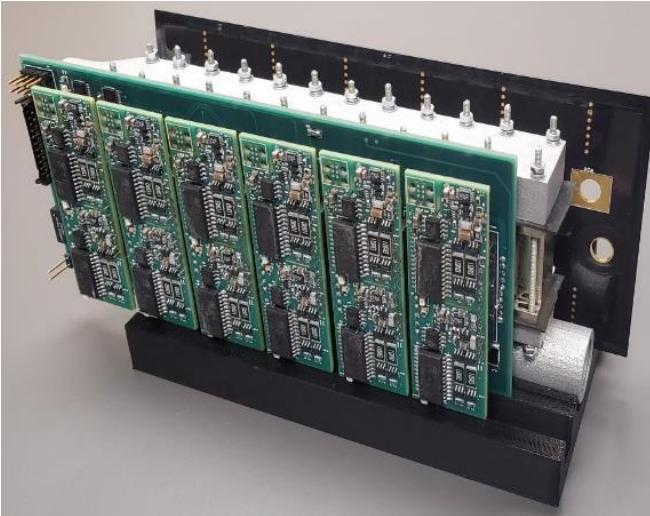
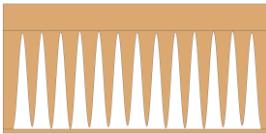
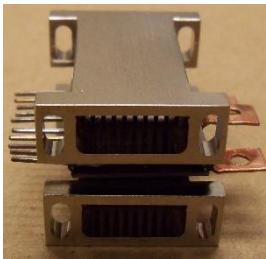
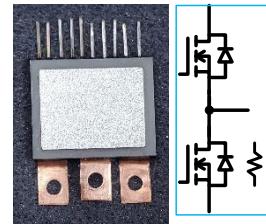


# Focus on Components of an Inverter



Inverter Power Density Target 100kW/L

# The 1<sup>st</sup> Gen 100kW inverter design using the Virginia Tech Phase leg Modules



Exploded view

100 kW/143 kVA segmented inverter @0.98L meets the 2025 targets

# Integrated Electric Drive

Conventional Motor Drive



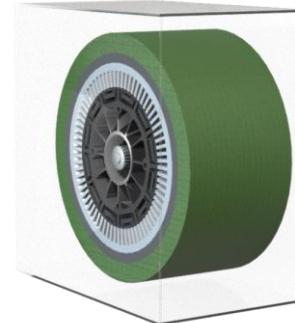
- Easy mounting
- Detachable for debugging
- Separate cold plate
- Separate casing
- Low power density due to the geometry

Motor

Power electronics

Integrated Drive

Radial Stator Mount



- Shared cooling jacket
- Shared casing
- Debugging is difficult

Axial Stator Mount



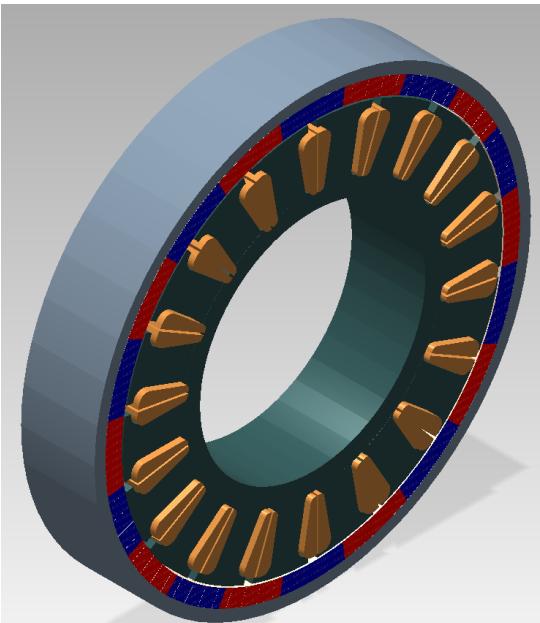
- Easy mounting
- Detachable for debugging
- Shared casing
- Can be shared or separate cold plate

Current ORNL approach

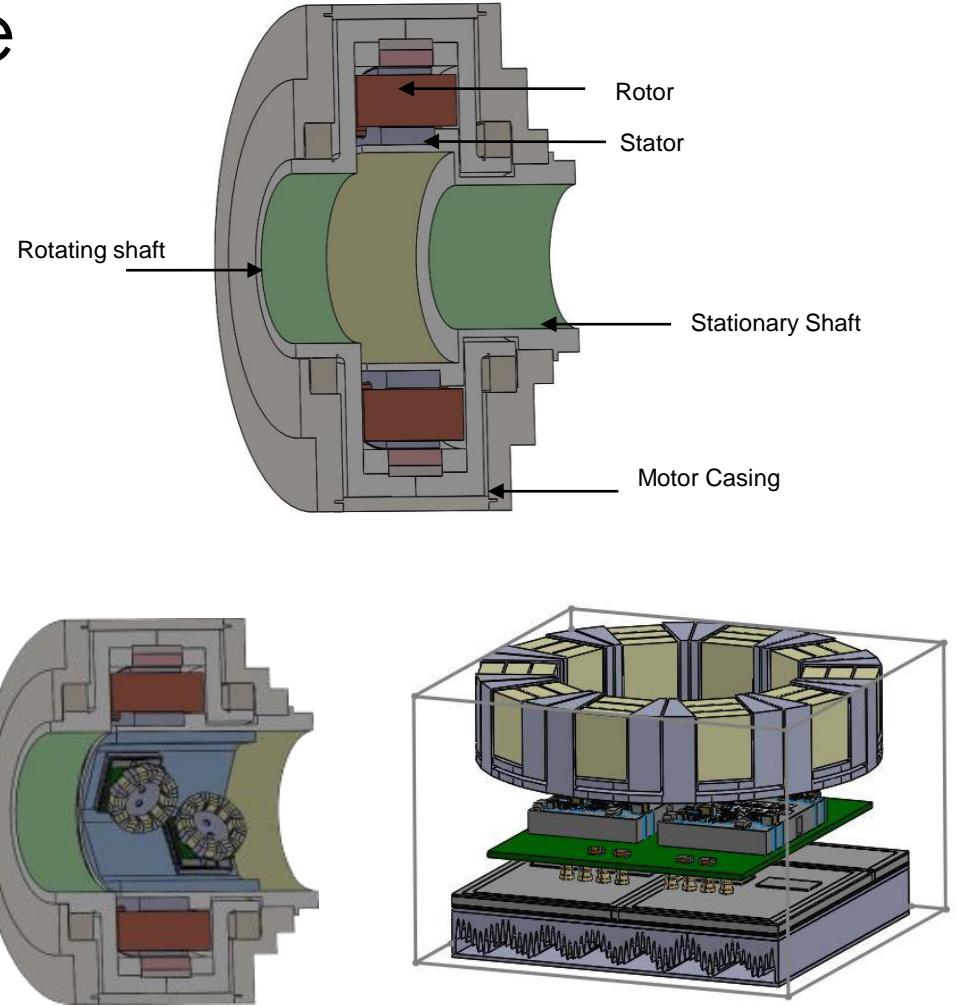
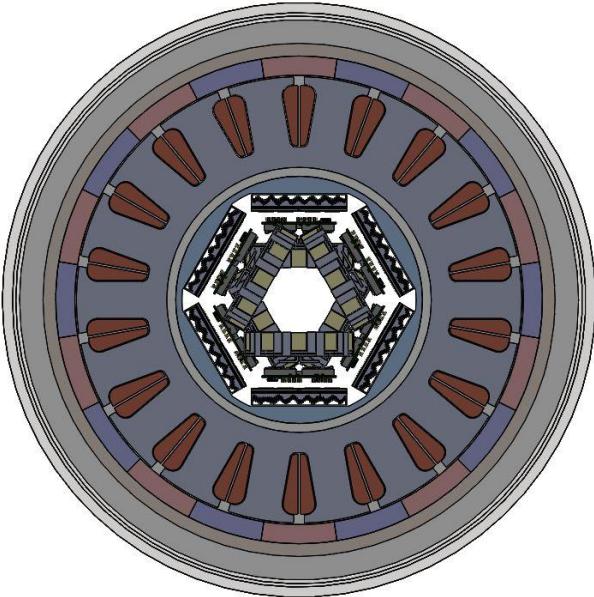


- Outer rotor motor has higher power density than the other variants
- Inverter can be embedded inside the motor
- Shared casing and cooling for tight integration

# Outer Rotor Motor Integrated Drive



Outer rotor Surface Permanent Magnet  
Concentrated tooth winding



Outer rotor motor is selected to achieve higher power density and due to the availability of the inner hollow space for inverter integration

# Questions

