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A Comparative Study of Bonded Rare Earth and Ferrite Magnet Motors for Electric Two-wheelers

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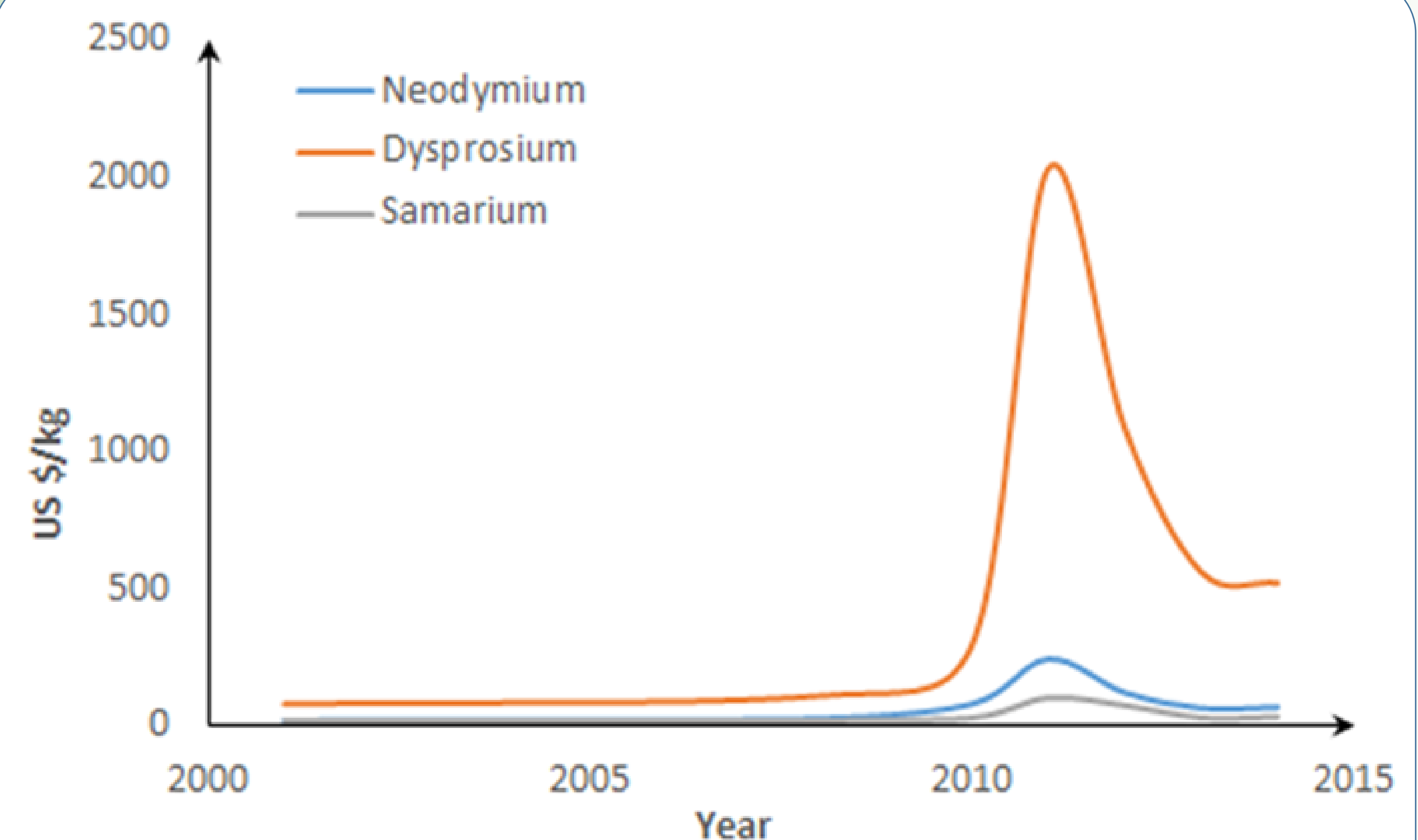
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In recent years, there has been an uncertainty about the availability and the price of rare earth metals. There are large number of applications such as automotive component motors, wind turbines, etc., where rare earth magnets are used only because ferrite magnets do not fulfil the energy product requirements.

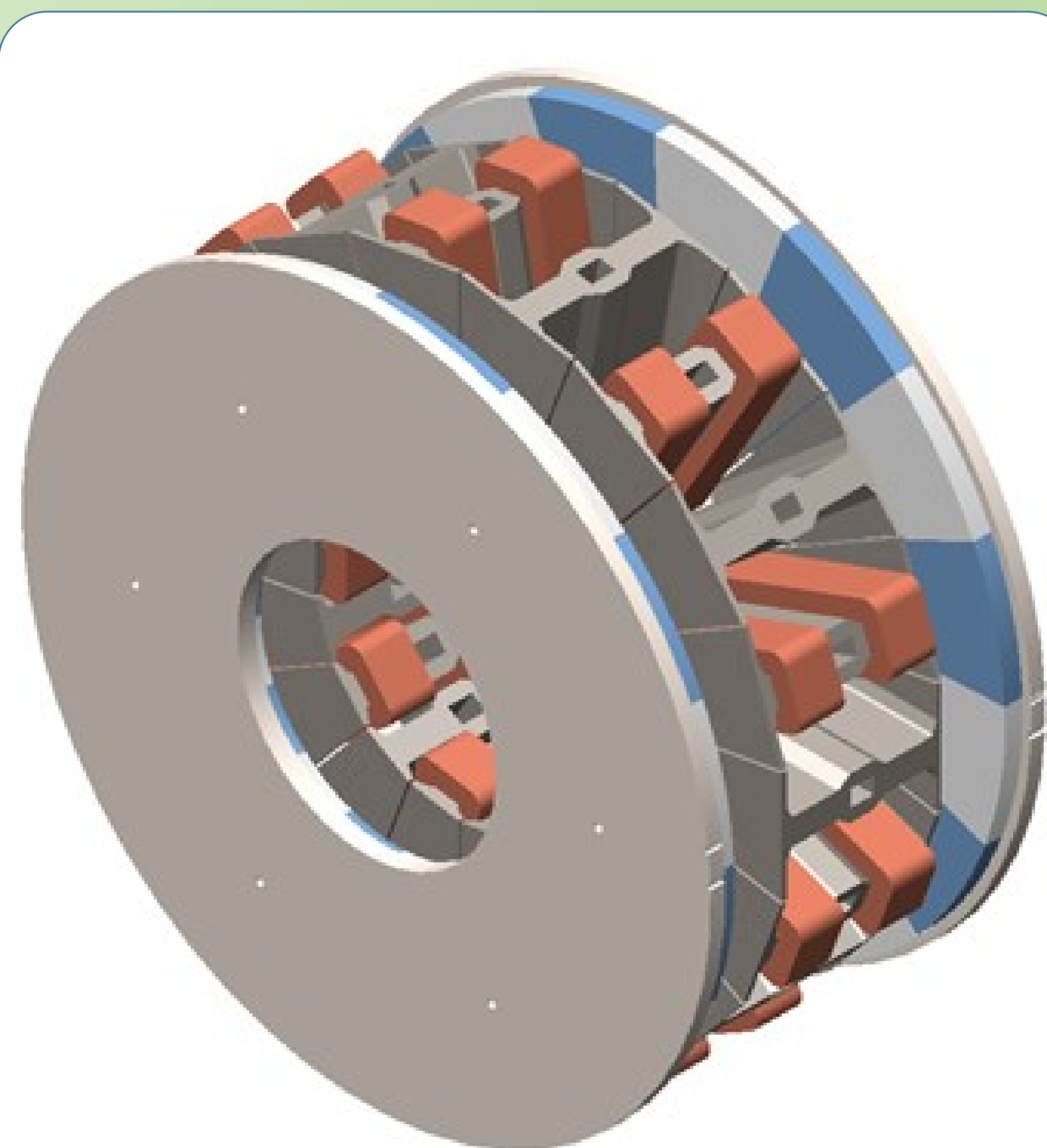
In this project, two PMSM motors made from bonded rare earth and ferrite magnets will be developed and their performance will be compared to an existing sintered rare earth magnet motor.

Project aims to demonstrate

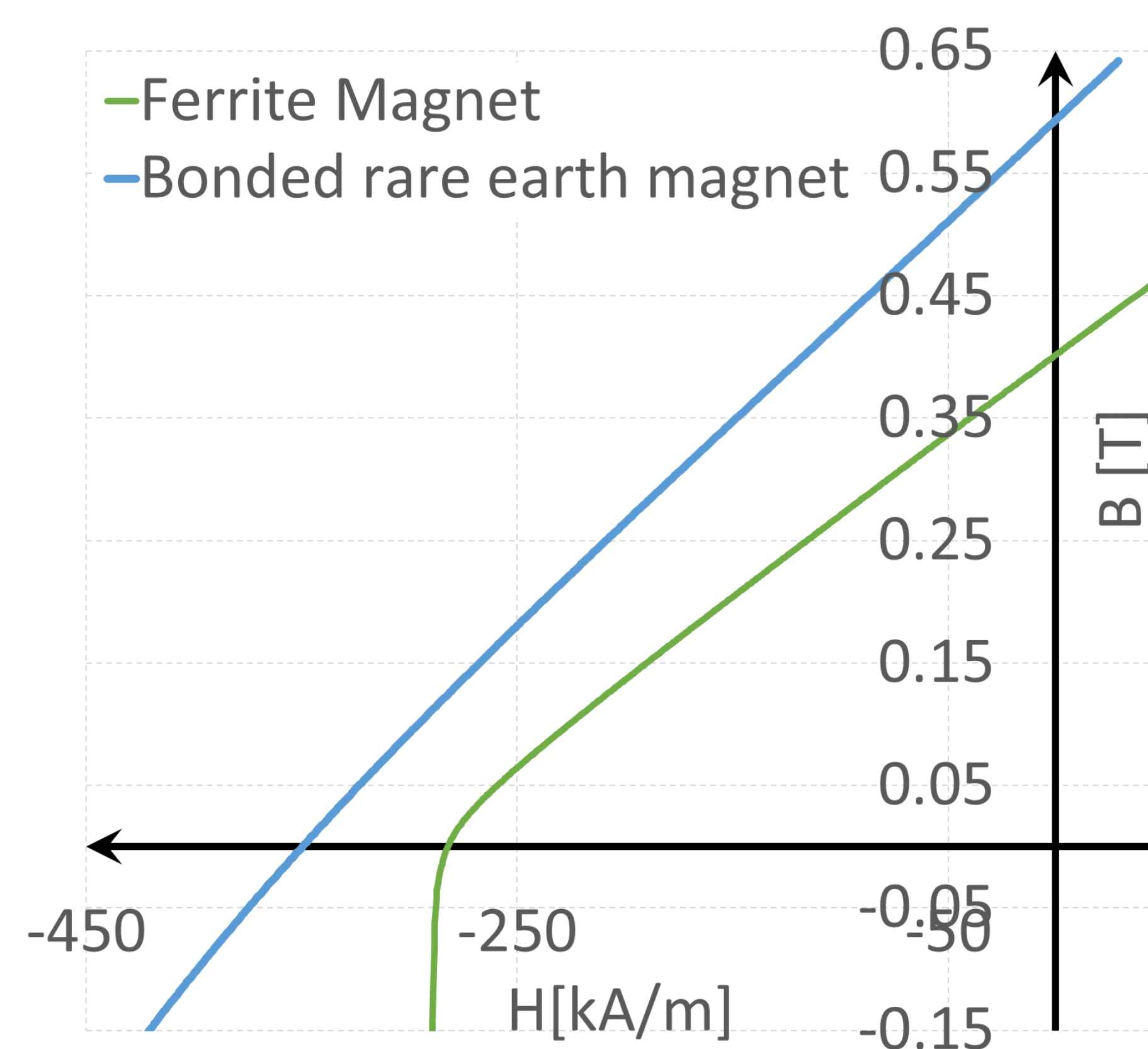
- Stability of ferrite magnets in a demanding application
- Low-cost electric powertrain



Price of rare earth metals

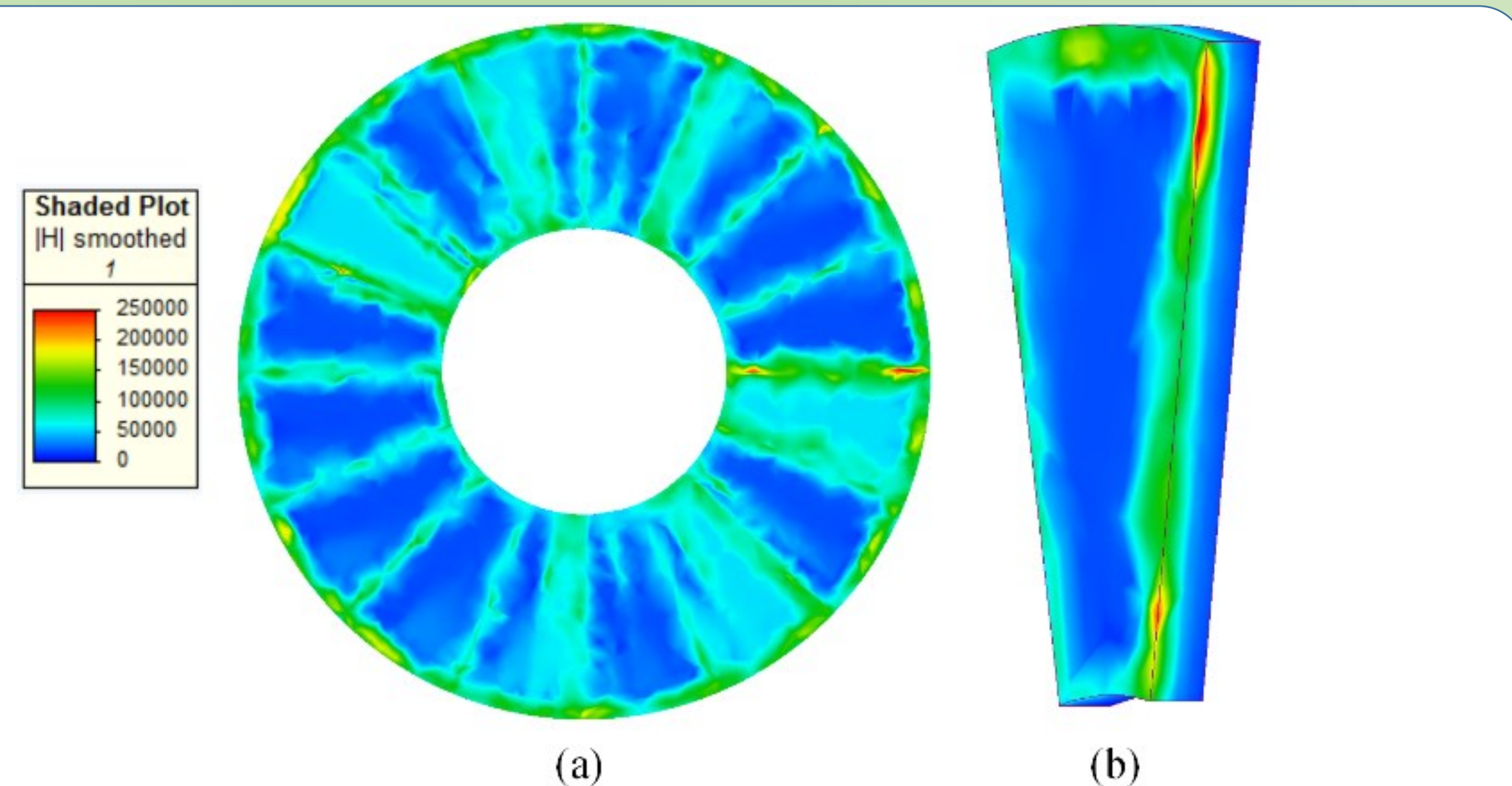


Selected motor topology

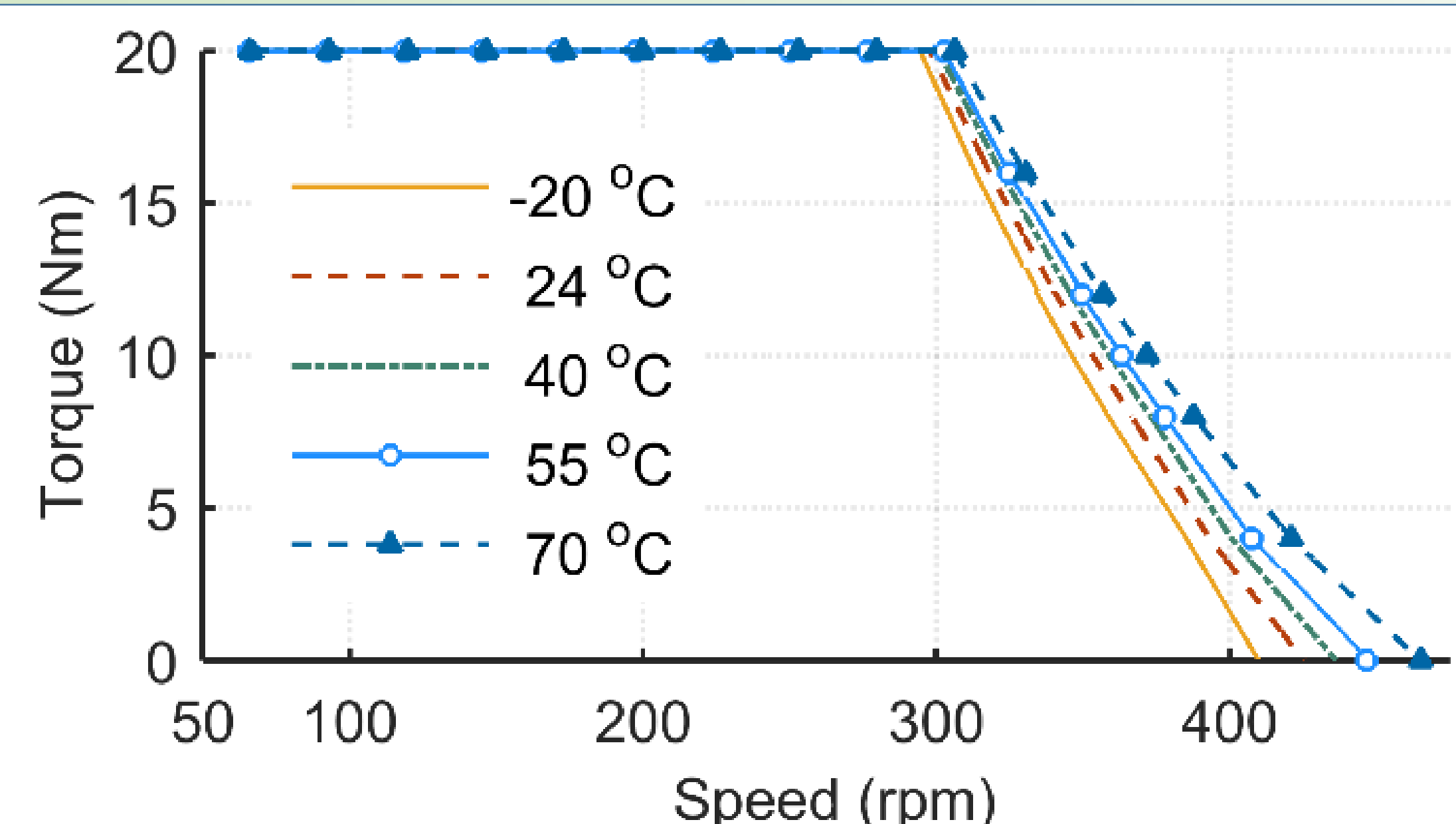


Magnet characteristics

| Design comparisons | | |
|----------------------|-----------------------|-----------------------|
| Parameter | Ferrite magnet | Bonded NdFeB |
| Outer diameter | 275 mm | 260 mm |
| Poles-slots | 16-18 | 16-18 |
| Number of | 18 | 18 |
| Length of air gap | 0.4 mm | 0.4 mm |
| Current density | 4.5 A/mm ² | 4.5 A/mm ² |
| Length of magnet | 7.5 mm | 7 mm |
| Diameter ratio | 0.45 | 0.45 |
| Rotor yoke depth | 6 mm | 8 mm |
| Axial width of tooth | 10.80 mm | 10.20 mm |
| No. of turns/coil | 34 | 28 |
| Length of tooth | 37.56 mm | 32.80 mm |
| Full load current | 22.48 A | 21.96 A |
| Conductive loss | 70.99 W | 53.97 W |
| Length of motor | 65.36 mm | 63.61 mm |



Finite element study to check the possibility of demagnetization of ferrite magnet poles



Output torque of ferrite magnet motor for different magnet temperature