PASSENGER

FOR SUSTAINABLE AND EFFICIENT RE-FREE MAGNETS

FACT SHEET

PASSENGER: Applications in Water Pump Motors

HTTPS://PASSENGER-PROJECT.EU

BUSINESS CASE: WATER PUMP MOTOR

integrating PASSENGER permanent magnets

Executive Summary

Electric water pumps are critical components in both automotive and industrial systems, ensuring efficient cooling, lubrication and fluid circulation. Their use has expanded rapidly with the electrification of vehicles and the need for precise thermal management in batteries, power electronics and fuel cell systems.

Currently, most water pump motors rely on NdFeB-based permanent magnets, which create dependency on Critical Raw Materials (CRMs), such as neodymium (Nd) and dysprosium (Dy). The PASSENGER project develops Rare Earth-free permanent magnets based on Manganese–Aluminium–Carbon (MnAlC) and Strontium Ferrite (Sr-ferrite), offering sustainable, EU-made alternatives.

This business case focuses on the fabrication of a rotor for a pump motor using PASSENGER's magnets, demonstrating technical feasibility, economic benefits and sustainability advantages for future water pump applications.

Market need & challenge

Water Pump Motors: strategic importance and supply constraints

Water pump motors are indispensable in multiple automotive and industrial systems, where they regulate temperature and ensure stable operation. In electric and hybrid vehicles, they cool batteries, fuel cells, and power electronics. In industrial settings, water pumps support manufacturing, HVAC (heating, ventilation, and air conditioning)and process applications.

However, the widespread use of NdFeB (neodymium-iron-boron) magnets in pump motors creates significant challenges:

High initial investment costs

Advanced pump rotors using NdFeB magnets require significant upfront capital, limiting adoption among SMEs and organisations in developing regions

Technical complexity and integration issues

NdFeB-based pump rotors are precision-engineered components requiring specialised manufacturing processes

CRM supply risk

More than 90% of global NdFeB production occurs in China, creating strategic dependency for European manufacturers

Price volatility

Rare earth element prices fluctuate due to constrained supply and export restrictions, impacting component costs

Environmental impact

Extraction and processing of neodymium and dysprosium generate substantial CO_2 emissions and chemical waste

Developing Rare Earth-free magnet solutions is therefore a key step toward achieving secure, cost-stable, and sustainable production of motorised pump systems within Europe.

Market Size & Magnet Demand

The global water pump market is expanding rapidly, driven by electrification, smart manufacturing, and efficiency regulations. The EU represents a growing share due to vehicle electrification and clean-tech investments.

Segment	Market Size (2024)	Compound annual growth (2024–2030)
▲ Automotive electric water pumps	€3.4 billion	6.8%
▲ Industrial water pumps (motorized)	€64 billion	5.4%
▲ EU water pump manufacturing	€8.2 billion	4.9%

Sources: Markets and Markets 2024, Fortune Business Insights 2024, European Pump Industry Outlook 2024

PER MOTOR

0.2-0.5 kg
permanent magnets

for each automotive water pump motor, depending on performance class and torque

GLOBAL SCALE

>3 000 tonnes
magnets

annual demand in water pump motors

Application examples relevant to PASSENGER

- **ELECTRIC VEHICLES AND FUEL CELLS**
  Electric coolant and thermal management pumps
- **INDUSTRIAL EQUIPMENT**
  Circulation pumps for HVAC and heat management
- **HYBRID VEHICLE PLATFORMS**
  Auxiliary pumps

strong market opportunity for MnAlC and Sr-ferrite magnets in high-efficiency, CRM-independent pump motor systems

PASSENGER Business Potential

PASSENGER develops a rotor prototype for a pump motor integrating its innovative magnet materials and validating the magnets' performance under realistic torque, thermal, and operational conditions. MnAlC and Sr-ferrite magnets provide a compelling value proposition for pump motor applications, with key advantages:

- **COST STABILITY:** reduced exposure to volatile NdFeB and Dy prices
- **SUPPLY CHAIN RESILIENCE:** EU-available raw materials enable domestic sourcing
- **CORROSION RESISTANCE:** especially relevant in coolant and humid environments
- **THERMAL STABILITY:** enable continuous operation at high-temperature cycles
- **RECYCLABILITY-BY-DESIGN:** facilitates recovery of magnets at end-of-life

PASSENGER'S MAGNET VALUE

MAGNET TYPE	COMPOSITION	KEY ADVANTAGES
MnAlC	Manganese–Aluminium–Carbon	Good magnetic properties, strong thermal stability, reliance on EU-sourced materials
Sr-ferrite	Strontium Ferrite	Economic, corrosion resistant, performance maintenance under various environmental conditions

COST & SUPPLY CHAIN BENEFITS

PARAMETER	NdFeB MAGNETS	MnAlC MAGNETS	Sr-FERRITE MAGNETS
CRM Dependency	High (Nd, Dy)	None	None
Cost (€/kg)	70-150	~20	~6
Supply Risk	Very high	Low	Low
EU Availability	No	Yes	Yes

ILLUSTRATIVE BUSINESS POTENTIAL

Based on initial adoption scenarios in the European industrial market

MnAlC	**€2.0–€2.4M** annual revenue potential in water pump motor applications
Sr-ferrite	**€0.5M** annual revenue potential for auxiliary and low-torque pumps

Sustainability

Incorporating PASSENGER magnets into water pump motor rotors advances Europe's sustainability and industrial resilience goals by decreasing dependence on imported critical raw materials and promoting cleaner, circular manufacturing processes.

LIFECYCLE SUSTAINABILITY BENEFITS OF PASSENGER MAGNETS

Rare-earth-free composition

Avoids the social and environmental impacts associated with mining and processing Nd and Dy.

Recyclability and maintainability

Their streamlined material composition enables easier repair, rotor refurbishment, and supports future remanufacturing initiatives.

Lower embedded emissions

Lifecycle studies show that substituting NdFeB with MnAlC or Sr-ferrite magnets can lower production-related CO_2 emissions by approximately 80–90%, significantly improving the environmental profile of water pump motors.

SUPPORTING CIRCULAR ECONOMY IN PUMP SYSTEMS

Water pump motors have long operational lifetimes and are often maintained or rebuilt.

PASSENGER magnets:
Support component-level replacement with no risk of contamination
Allow clean end-of-life separation of rotors and magnetic assemblies
Facilitate closed-loop magnet recovery for future circular manufacturing

STRATEGIC ALIGNMENT WITH EU PRIORITIES

PASSENGER contributes to EU strategic autonomy and sustainability goals across multiple policy frameworks, including:

EU POLICY CONTEXT	INDUSTRY RELEVANCE
EU Critical Raw Materials Act ⇨	Reduces dependence on imported rare-earths for motor rotors
Ecodesign for Sustainable Products Regulation ⇨	Encourages repairable, durable, and recyclable products
Circular Economy Action Plan ⇨	Advances end-of-life recovery and closed-loop recycling
EU Green Deal ⇨	Targets industrial decarbonization and sustainable mobility
Industrial Strategy for Europe ⇨	Strengthens EU competitiveness and resilience

The PASSENGER Advantage

PASSENGER magnets represent a **reliable and scalable European alternative** to NdFeB for water pump motor applications. By substituting Critical Raw Materials with MnAlC and Sr-ferrite, the project demonstrates that **high performance can be achieved alongside cost stability and environmental responsibility**.

Their integration into rotor systems proves the industrial readiness of Rare-Earth-free magnets and reinforces Europe's move toward **resilient, low-carbon manufacturing**.

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