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New advanced materials could give electric motors an efficiency boost

Electric motors power everything from cars to household appliances. EU-funded researchers are developing advanced materials that could make them more efficient, saving both energy and resources.

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Electric motors are the largely unseen workhorses of modern life. They power everything from washing machines to factory equipment. Individually, many are already highly efficient. But because there are billions of them, even small improvements could translate into significant energy savings.

When Spanish scientist Dr María Teresa Pérez Prado found out just how much of Europe's electricity is consumed by electric motors, she was astonished: they were estimated to account for more than 50% of all electricity consumed in the EU in 2020.

"When I discovered these numbers, I was completely amazed," she said – and it became a lasting source of motivation in her work.

Improving motor efficiency through Ecodesign measures – EU rules setting minimum energy-efficiency standards products must meet to be sold in the bloc – is expected to save around 106 TWh of electricity every

year by 2030. That is roughly equivalent to the annual electricity consumption of the Netherlands, and would cut energy bills by around €20 billion per year.

Pérez Prado leads research into advanced alloys and metal 3D printing at the IMDEA Materials Institute in Madrid, Spain. As part of the EU-funded AM2SoftMag research initiative that concluded in February 2026, she helped develop new manufacturing techniques that could make tomorrow's electric motors significantly more efficient.

A new generation of materials

That challenge has taken on fresh urgency following the adoption of the EU's Electrification Action Plan in July 2026 to accelerate the shift from fossil fuels to electricity in Europe. But electrification is not simply about producing more electricity. It also means using it more efficiently.

Researchers across Europe are therefore looking beyond conventional engineering to an emerging field known as advanced materials. By designing entirely new materials with unique properties, they hope to reduce energy losses, lower reliance on critical raw materials and strengthen Europe's technological leadership.

Driving that effort is Professor Ralf Busch, who leads the Chair of Metallic Materials at Saarland University in Germany and coordinated the AM2SoftMag research.

Rather than chasing incremental gains from conventional motor materials, Busch has spent years pursuing something far more radical: an entirely different type of metal known as metallic glass.

Unlike ordinary metals, whose atoms arrange themselves into orderly crystal structures as they cool, metallic glasses freeze into a disordered, glass-like structure. That seemingly subtle difference dramatically changes how they behave inside an electric motor.

"In metallic glass you don't have microstructure features, it is frozen liquid with no obstacles," Busch explained.

Inside every electric motor, magnetic fields constantly change direction. Conventional magnetic materials resist those changes, wasting energy as heat. Metallic glasses allow magnetic domains to move much more freely, reducing these losses. Even small improvements could have a major impact.

Printing the impossible

Inventing the alloy, however, was only the first challenge. The researchers also had to find a way to manufacture motor components without destroying the very glass-like structure that gives the material its remarkable properties.

That task fell to Pérez Prado and her colleagues at IMDEA Materials. Using advanced laser-based additive manufacturing, better known as metal 3D printing, they succeeded in producing components that retained the material's unusual glass-like internal structure by carefully controlling how each microscopic layer cooled after the laser passed over it.

"The only way to create such a disordered structure is by cooling the liquid alloy at around one million degrees Celsius per second," Pérez Prado explained. The process demanded extraordinary precision: too much heat and the material would crystallise, losing the properties that made it attractive in the first place.

The breakthrough has attracted growing attention. “We are now getting requests for these materials from other academic teams in Europe,” she said.

Busch was equally excited. “This is the first time that these glass-like metals have been made into components for electric motors. That’s an important step towards bringing this technology out of the laboratory,” he said.

Turning new materials into better motors

Beyond developing and printing the material, the next question was whether these components could deliver meaningful improvements inside a working electric motor.

Matthias Nienhaus, a professor at Saarland University and an engineer specialising in electric drives and high-efficiency motors, led the project’s work on integrating the new materials into practical motor designs.

“If we can make them even one percent more efficient, we will save a lot of energy,” he said.

Ultimately, the researchers hope improvements of up to 5% may be possible in some applications. The benefits could extend well beyond lower electricity bills.

More efficient motors would allow electric vehicles, drones and battery-powered tools to travel further using smaller batteries. They could also reduce demand for critical raw materials.

Some future motor designs using advanced soft magnetic materials may even reduce Europe’s dependence on permanent magnets made from rare earth elements, whose global supply chains are currently dominated by China.

From laboratory to industry

The work is still fundamental research, but the foundations are beginning to fall into place.

Busch’s team has developed new metallic-glass alloys free from cobalt, reducing reliance on another critical raw material associated with supply risks and environmental concerns.

Pérez Prado’s team has demonstrated that these alloys can be manufactured using metal 3D printing. Nienhaus and his colleagues are now working to optimise complete electric motors built around the new components.

Still, challenges remain. Researchers have yet to refine the printing process for industrial-scale production and further reduce electrical losses inside finished components.

“This happens in research,” Nienhaus said. “You begin by answering one question, but you generate new questions.”

Yet he believes the potential rewards justify the effort: “Many devices are now battery-driven. Making electric motors more efficient means those devices can operate for longer without needing larger batteries.”

As Europe accelerates its transition towards an increasingly electrified economy, innovations like these illustrate why advanced materials are moving rapidly from specialist laboratories to the centre of European industrial policy.

Sometimes, transforming the technologies that shape everyday life begins not with a new machine, but with a completely new way of thinking about the materials from which it is made.

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