Resilience Roadmap for Permanent Magnets drawn up by the European Wind Industry

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Wind EUROPE

FOUNDATION OFFSHORE WIND ENERGY

VDMA Power Systems

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Result of policy labs and stakeholder consultations[1]

1 Background

Europe is in the midst of a major **transition** towards **renewable energies**. While this transition is still ongoing, progress has been made in which the European wind industry has played a vital role. **Wind** power is the **largest source of renewable** energy in the EU[2], and is a result of and testimony to Europe's technological expertise. This success story is the product of both political ambitions and strong entrepreneurship and as such, its continuation rests on both of these pillars. Continued political commitment to wind power is vital to sustain European value creation, however, in the light of evolving market environments, the wind industry also needs to become more resilient.

Considering recent challenges, including evolving geopolitical dynamics and **supply chain disruptions** due to geopolitical events interfering in world trade activities, **enhancing resilience** in the **energy** sector has become **a key priority for policymakers** and **businesses**. The wind industry has an intrinsic interest in diversifying supply and preventing dependencies to a reasonable extent through the establishment of second sources, recycling and technological advancements reducing the demand for critical materials. As an important part of their business and procurement efforts, OEMs and suppliers are constantly developing strategies to mitigate supply chain risks related to one-sided dependencies. Policy makers, in turn, shape the environment in which businesses realize these strategies and can, by considering economic realities with regards to volumes, timing and cost, support their achievement without jeopardising European competitiveness.

In **October 2024**, European wind OEMs convened at a **roundtable** at the German Federal Ministry for Economic Affairs and Energy to discuss the future of the sector and agreed on a set of measures intended to strengthen the local European wind industry. Among others, these measures include an industry **roadmap to reduce dependencies for Rare Earth permanent magnets** – the turbine sub-component exhibiting the strongest and most acute dependencies on supply from China.

Currently, more than 90% of permanent magnets, which are used in a significant share of wind turbine generators, are produced in China[3] – a dependency which extends **across the whole value chain**, including Rare Earth extraction and processing. This high supply chain concentration

1 The policy labs and stakeholder consultation process are part of the technical work process for the implementation and specification of the wind measures paper dated October 16, 2024

2 Eurostat 2024, Electricity from renewable sources up to 41% in 2022 – News articles – Eurostat

3 CEPS 2022

is not limited to the wind industry but representative of the whole global permanent magnet market (also including the EV industry, mechanical engineering, military applications and more) which currently features only insufficient and more costly alternatives to Chinese production. This low level of diversification paired with an expected increase in demand due to the accelerated expansion of wind power capacities to meet European targets spotlights the particular importance of permanent magnets and forms the focus of this roadmap.

December 2024 marked a first milestone in the development of the Resilience Roadmap as key players of the European wind industry came together to discuss the status quo and establish a shared understanding of the dependency challenge. Based on the **collaborative assessment of permanent magnet and Rare Earth needs** and possible **options for action**, including alternative sourcing and technology advancements, the participants agreed that substantial degrees of diversification could be achieved by 2030 and 2035 respectively, particularly if significant volumes of demand for permanent magnets from alternative suppliers can be gathered across European offtake industries. This Resilience Roadmap for Permanent Magnets is proposed by the European wind industry and its development was supported by the German Federal Ministry for Economic Affairs and Energy as a white paper for discussions at the European level under the frameworks of the Critical Raw Materials Act and the Net Zero Industry Act as well as a potential blueprint or inspiration for other European offtake industries.

2 Objective

In drafting a Resilience Roadmap, the European wind industry sets and commits to aspired **resilience targets** for permanent magnets and the Rare Earths contained as well as a **clear course** for achieving them. This roadmap understands resilience as the wind industry's independence from dominant individual countries for the procurement of permanent magnets and, therefore, as a diversified range of supplier options to a certain degree. In addition, resilience is approached holistically, encompassing upstream materials and processes along the value chain, specifically focusing on all extraction and processing steps for Rare Earths. Recycled permanent magnets are understood to be resilient in this definition while technology advancements are also recognized to contribute to resilience.

Accordingly, and in line with the aims of the Critical Raw Materials Act and the Net Zero Industry Act, this roadmap suggests that by 2030, at least 30%[4] of all permanent magnets should and can be obtained from resilient sources, with the aim to increase this share to 50% by 2035. Furthermore, at least 35% of Rare Earths should be sourced resiliently by 2030. Based on the above, European wind OEMs aim to be able to supply wind turbines with the following shares of resilient permanent magnets and Rare Earths:

4 Industry targets are intended to link to NZIA implementing acts and are therefore subject to potential amendments upon their final publication

Table 1: Resilience targets of the European wind industry[4]

	Permanent magnets	Rare Earths
2029[5]	15%	5%
2030	30%	35%
2035	50%	35%

The **objective** of the **Resilience Roadmap** is to identify and **specify milestones** to be accomplished on the path to resilience **to ensure** that the **targets** outlined above are attained. In addition, it aims to serve as a blueprint and encouragement for other offtake industries to develop their own roadmap for permanent magnets with a potential for cross-industry synergies.

3 Roadmap approach

The **Resilience Roadmap** is **structured along key milestones** for the development of new integrated permanent magnet value chains which **set the course** for the operationalisation of the **resilience targets** for 2029, 2030 and 2035. The new **value chains** are **integrated** in that they include the sourcing of resilient Rare Earths in cooperation with the permanent magnet producer. Altogether, while each OEM may follow a different path to establish the aspired level of resilience, the roadmap presents a **joint commitmen**t on the **way stations** and final targets as defined above. The following paragraphs provide an overview of the milestones in their set order, outlining the timeline by which **relevant steps** should ideally be completed to enable commissioning of first projects using the target share of resilient permanent magnets in **2029**. The value chains thusly built can then be **scaled** to achieve growing shares of resilient permanent magnets in line with the targets outlined above.

Milestone 1 (MS 1): Memorandums of Understanding

As a first milestone, OEMs identify potential alternative suppliers of permanent magnets for wind turbines and conduct an initial sounding to ascertain the potential for cooperation. Should this be deemed possible and desirable by both parties, the intention to cooperate is formalised in an official Memorandum of Understanding (MoU). The aim is to secure respective MoUs mid-2025.

Milestone 2 (MS 2): Offtake agreements

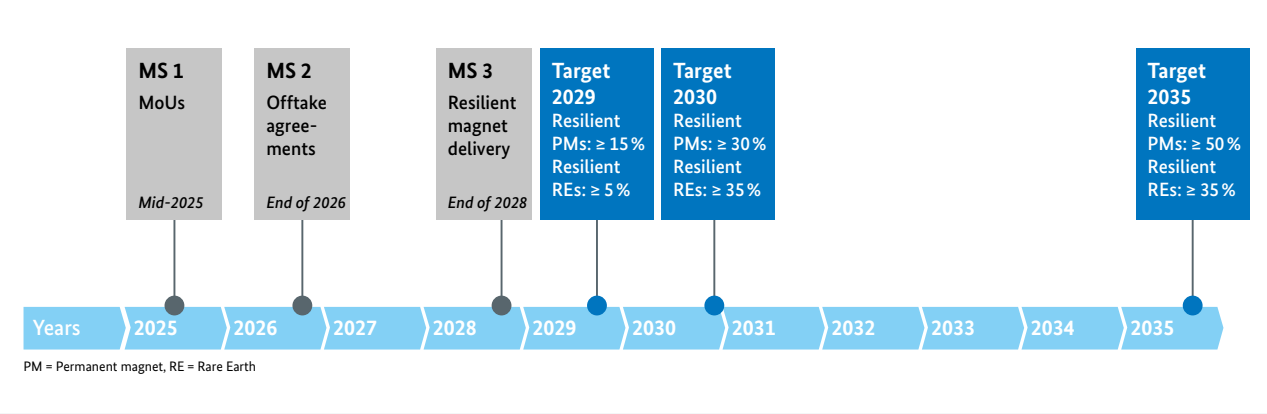
After successful qualification and onboarding of new suppliers, concrete offtake agreements for resilient permanent magnets are negotiated by the OEMs. In accordance with the roadmap targets, OEMs aim to secure offtake agreements until the end of 2026 to enable successful project delivery in 2029.

5 The NZIA intends for EU member states to apply resilience criteria in public tenders starting 2026. To enable the fulfilment of such criteria for onshore auctions, which have a development time of up to three years, the industry has set additional targets for 2029 but aspires to achieve higher levels of resilience in the longer term

Milestone 3 (MS 3): Resilient magnet delivery

Once offtake agreements have been concluded, the development of resilient production capacities to serve the wind industry commences. Utilization of capacities and the delivery of permanent magnets should be achieved by the end of 2028. This allows for the construction of first resilient wind project to begin in 2028[6] with completion and commissioning over the course of 2029.

Figure 1: Roadmap timeline



PM = Permanent magnet, RE = Rare Earth

4 Political support

The development of resilient permanent magnet supply chains to meet NZIA targets requires **demand** from project developers. This demand will be created through public tender **resilience criteria** for the Main Specific Components of wind turbines as stipulated by the NZIA and its implementing acts[7]. To ensure these criteria uphold European competitiveness and avoid market distortions, the wind industry advocates that their **design** be based on the following **guiding principles**:

- **Technology openness:** The design of resilience criteria should not favour any specific turbine technology but allow for competitive technological diversity
- **Implementability:** The measurement of resilience criteria should be such that it can feasibly be incorporated into existing business processes
- **Verifiability:** The measurement of resilience criteria should be such that it can be proven unbureaucratically and reliably along the value chain
- **European harmonization:** The specification and application of resilience criteria should be harmonized across Member States to avoid an excessive administrative burden on European businesses

6 The timeline for 2029 commissioning refers to onshore projects with a construction time of approx. one year. First offshore projects with permanent magnets are only expected to be commissioned after 2030

7 As of January 2024, the current draft of the implementing act on net-zero technology final products and their main specific components includes permanent magnets for on- and offshore wind turbines

- **Flexibility:** The design and administration of resilience criteria should be such that it can accommodate and respond to evolving market maturities and external factors impacting the development of resilient supply chains.

With a view on flexibility, one key design dimension for resilience criteria concerns their **classification as pre-qualification or award criteria**. In light of the presently low levels of maturity of resilient permanent magnet supply chains, the wind industry advocates that any resilience criterion pertaining to permanent magnets should **initially** be classified as an **award criterion**, starting with the first resilience tenders in 2026. Stricter **pre-qualification criteria** are considered conceivable at a later stage, **starting 2030** although the exact timing should be re-evaluated and potentially adjusted in 2028.

Resilience criteria in public tenders create a positive stimulus and demand for resilient permanent magnets. This provides the basis for a viable business case and, thereby, the additional **utilization of existing supply-side measures** which is **desirable** to support the establishment of new, integrated permanent magnet value chains as well as further resilience-enhancing projects. These measures include but are not limited to the following instruments at the EU level and in Germany:

EU

- **Critical Raw Materials Act:** Establishment of a system by the European Commission to aggregate demand for strategic raw materials within the EU and to seek offers from suppliers (launch date not yet announced)

- **EU Innovation Fund:** EU funding programme for strategic and innovative climate-related projects, including Net Zero Technology manufacturing, to advance European technology leadership, competitiveness and resilience (open for applications)

National (here German instruments)

- **Raw Materials Fund:** Minority equity investments into mining, processing and recycling projects in the critical raw materials sector, subject to at least a 5-year offtake agreement with an industrial player in the EU (open for applications)

- **Untied Loan Guarantees and Investment Guarantees:** Guarantees for loans[8] and investments for international projects related to raw materials and transformation projects to protect against political and economic risk with loan guarantees being subject to long-term offtake agreements with a German business (open for applications)

- **TCTF investment grants:** Investment grants for the production of clean-tech equipment as well as processing and recovery of critical raw materials in structurally weak regions in the context of the EU's Temporary Crisis and Transition Framework (TCTF) (open for applications)

8 Loans issued by Germany-based banks

- **Energy Research Programme:** Funding programme for cross-cutting, practice-oriented research and development of innovative solutions for the energy transition with focus topics including energy system resilience and efficiency, renewables and practical applications

To **complement** these **existing supply-side measures** and make sure they are utilized to their full potential, **supplementary opportunities** could be explored such as a pooling mechanism for European permanent magnet demands, a dedicated funding budget for permanent magnets within the European Innovation Fund or the set-up of an additional price index to the Asian Metal index.

The **German Federal Government** supports the common approach of the European wind industry and has indicated its willingness to provide **additional political backing** for the roadmap in the following ways:

- Realisation of the **NZIA** to ensure that resilience efforts by European OEMs are economically viable

- Advocation for the **harmonisation** of resilience criteria and their implementation at the **European level**

- **Support for applications** of promising projects to obtain funding from the EU Innovation Fund

- **Advocation** for an **extension of the TCTF** and the related investment grants beyond 2025

- **Development** and implementation of an unbureaucratic and **standardised process for verification** (e.g. via company declarations, a standardised label or a digital product passport) for the targeted levels of **resilience** of **wind OEMs** and proposal for EU harmonisation of this process

- German Mineral Resources Agency (DERA) and Federal Institute for Geosciences and Natural Resources (BGR) will provide necessary **analyses of Rare Earth sources** on a regular basis

- The Federal Economic Affairs Ministry will provide political backing for the diversification of companies e.g. via government to government agreements and further cooperation. Furthermore, it will act as the **door opener** on **foreign missions** and provide support for **approaching potential suppliers** for permanent magnets and Rare Earths in **non-European countries**

5 The way forward

In developing this roadmap, the European **wind industry has shown initiative** by **drawing up the path towards greater resilience** for permanent magnets in Europe. It is the hope and intention of this paper to provide the **ground for fruitful discussions** with political stakeholders,

including the European Commission and EU Member States, to find a **harmonized approach** to achieve resilience targets and promote fairness, stability and prosperity in the European Union while taking into due consideration the present economic realities. In addition, the wind industry trusts that the targets and milestones presented may serve as a **blueprint for other offtake industries** looking to develop their own resilience roadmap, an initiative both welcome and desirable to realise potential synergies.