High-tech materials focus area

In high-tech materials, the Centre focuses on technologies essential for advancing the artificial intelligence and electric mobility industries. Research and development efforts are currently underway to extend the service life of OLED displays by a factor of 2–3 through the integration of palladium-containing components which increase the luminescence lifetime of blue LEDs

Traditional uses focus area

In this area, in 2024, the Centre focused on technologies aimed at improving energy efficiency and reducing the carbon footprint through the application of palladium.

- Industrial tests were conducted, and the first commercial batch of new palladium-containing anodes for water disinfection by electrolysis was produced – a more environmentally friendly technology that eliminates the need to produce, transport and store chlorine. These new anodes demonstrate a 10%–20% reduction in energy consumption compared to existing alternatives, have a longer service life, and are more affordable.
- Industrial trials of glass fibre bushings with palladium-based current leads designed to enhance energy efficiency and reduce product costs were successfully completed.

Also in 2025, the Centre intends to complete fundamental research into integrating new palladium catalysts into lithium-sulphur batteries to extend their lifespan and increase power output. Lithium-sulphur batteries are a promising technology that in the future may reduce battery weight by 30%–40% compared to lithium-ion alternatives. This weight reduction would make the new batteries suitable for use in aviation, where low weight, while maintaining other technical characteristics, is a critical factor for energy storage systems. Preliminary estimates suggest that replacing lithium-ion batteries with lithium-sulphur batteries incorporating palladium catalysts could triple the driving range of electric vehicles.

Development of a lithium deposit

Nornickel, together with a partner, plans to develop Russia's most promising lithium deposit, located in the Murmansk Region. The project provides for the production of 45 kt of lithium carbonate and hydroxide per year.

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Decarbonisation projects

Mineralisation of mining waste

Research into the mineral sequestration of carbon dioxide has been under way since the late 20th century, but has significantly intensified over the past two decades due to the global search for safe, environmentally sound, and long-term solutions for CO_2 disposal.

The CO_2 mineralisation process implies the reaction of carbon dioxide with various minerals – such as olivine, serpentine, and other silicates containing calcium, magnesium, and iron. During the reaction, a carbon dioxide molecule binds with the positively charged ions of these elements in the presence of water to form carbonates, thereby converting into a solid phase.

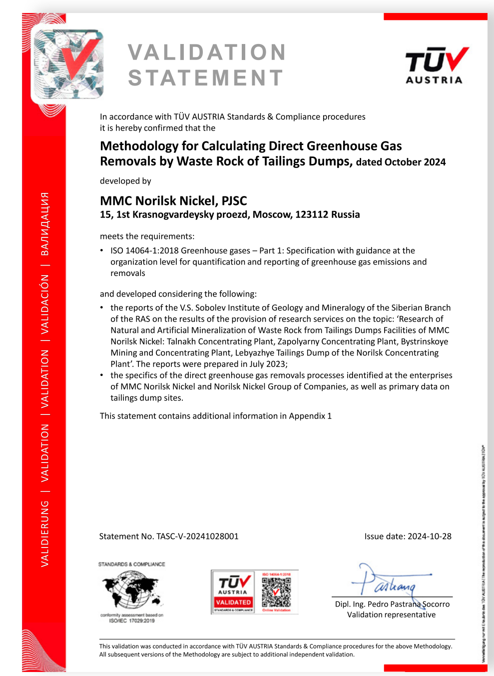
In 2024, TÜV AUSTRIA validated Nornickel's methodology for calculating direct GHG absorption through gangue mineralisation in tailings storage facilities to GOST R ISO 14064-1-2021 Greenhouse gases.

Part 1. Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals. This methodology is unique in Russian practice.

The methodology provides for measuring CO_2 absorption through passive (non-anthropogenic) carbonation of certain minerals in the tailings stored at the Company's tailings storage facilities. The rate of passive carbonation depends on the mineral composition of the parent ore, particle size, climatic conditions, and the chemistry of pore water in the rock mass. One of the key factors influencing the efficiency of the mineralisation process is the acid–alkaline balance of the solution in which the reaction occurs. To estimate the amount of CO_2 absorbed, analytical methods are used, including infrared (IR) spectroscopy, X-ray diffractometry, and CHNS(CN) elemental analysis, which determines the carbon content in the pulp and tailings.

The amount of direct CO_2 absorption depends on the volume of waste rock disposed of at the Company's tailings storage facilities in the reporting period. The amount of actual removals for 2021–2024 was verified by TÜV AUSTRIA.

Nornickel plans to further develop this project, with studies of artificial and active gangue mineralisation in tailings storage facilities scheduled to start as early as 2025. These approaches have greater potential for greenhouse gas capture compared to natural mineralisation.



VALIDATION STATEMENT

TÜV AUSTRIA

VALIDIERUNG | VALIDATION | VALIDATION | VALIDACIÓN | ВАЛИДАЦИЯ

In accordance with TÜV AUSTRIA Standards & Compliance procedures it is hereby confirmed that the

Methodology for Calculating Direct Greenhouse Gas Removals by Waste Rock of Tailings Dumps, dated October 2024

developed by

MMC Norilsk Nickel, PJSC
15, 1st Krasnogvardeysky proezd, Moscow, 123112 Russia

meets the requirements:

- ISO 14064-1:2018 Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals

and developed considering the following:

- the reports of the V.S. Sobolev Institute of Geology and Mineralogy of the Siberian Branch of the RAS on the results of the provision of research services on the topic: 'Research of Natural and Artificial Mineralization of Waste Rock from Tailings Dumps Facilities of MMC Norilsk Nickel: Talnakh Concentrating Plant, Zapolyarny Concentrating Plant, Bystrinskoye Mining and Concentrating Plant, Lebyazhye Tailings Dump of the Norilsk Concentrating Plant'. The reports were prepared in July 2023;
- the specifics of the direct greenhouse gas removals processes identified at the enterprises of MMC Norilsk Nickel and Norilsk Nickel Group of Companies, as well as primary data on tailings dump sites.

This statement contains additional information in Appendix 1

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STANDARDS & COMPLIANCE
conformity assessment based on ISO/IEC 17029:2019

TÜV AUSTRIA VALIDATED STANDARDS & COMPLIANCE
ISO 14064-1:2018 Online Validation

Dipl. Ing. Pedro Pastrana Socorro
Validation representative

This validation was conducted in accordance with TÜV AUSTRIA Standards & Compliance procedures for the above Methodology. All subsequent versions of the Methodology are subject to additional independent validation.