

IEA-Advanced Motor Fuels ANNUAL REPORT 2025

Task 65



Task 65: Powertrain Options for Non-Road Mobile Machinery

Project Duration	November 2023–November 2026
Participants Task sharing Cost sharing	Austria, Canada, Denmark, Finland, Germany, Sweden, and USA Sweden to Canada
Total Budget	EUR 1,327,000 (USD 1,532,154)
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Purpose, Objectives, and Key Question

This Task explores the potential of energy and powertrain options and the feasibility for non-road mobile machinery (NRMM) applications in different use cases. NRMM comprises a wide selection of different kinds of machinery operating in different environments. We will dive deeper into questions about what kind of powertrain and energy options offer the best fit for each application without adversely affecting the productivity, usability, and security of supply. The Task will address the following main topics:

- Energy and powertrain options for NRMM.
- Implications for the use of new carbon-neutral and low-carbon powertrains on the security of supply and on productivity.
- End-use perspective of alternative powertrains (fuels and other energy carriers).
- Local air pollutant emissions associated with NRMM, especially NRMM operating in urban areas.
- Perspectives for carbon dioxide (CO₂) regulation in different countries.

Task 65 Status

The Task 65 activities for 2025 are summarized as follows:

- Task 65 participants held five joint task progress update meetings to share information and advance the activities within the working group.
- Tasks 65 participants initiated two sub-tasks related to hydrogen compliance:
 - A white paper positioning the standardization of hydrogen compliance in NRMM by 2030/31, and
 - Activities aimed at providing guidelines on how to apply and improve NRMM H₂ fueling on a practical level.

Sub-task 1: H₂ machine regulatory compliance

- TÜV¹ expertise for the use of H₂ components from the automotive environment in NRMM using the example of wheel loaders.
- Contribution to the publication of an [initial position paper](#) under the leadership of the German VDBUM and the HyCentA.²
- Working draft of an equivalence analysis of automotive directives and the pressure equipment directive relevant for NRMM.
- Participation in the preparation of an International Organization for Standardization (ISO) standards project for H₂ drives for construction machinery with a signaling effect for NRMM in general.
- Information sharing and approach to new stakeholders during committee work and at events, including the following:

¹ TÜV – Independent German technical service providers specializing in testing, inspection, and certification.

² VDBUM – Verband der Baubranche, Umwelt- und Maschinentechni (German Association of Construction, Environmental and Mechanical Engineering); HyCentA – The Hydrogen Research Center Austria.

- Presentation in working groups at VDMA,³ VDBUM, and A3PS,⁴
- [Hydrogen symposium](#) organised by TÜV Austria, and
- [Eco-Mobility Conference](#) organised by A3PS association.
- Recruitment of European original equipment manufacturers (OEMs) as supporters and stakeholders for the strong position papers (e.g., JCB, Fendt, CNH — all major players in the agricultural and construction machinery sectors).

Sub-task 2: Mobile H₂ refueling regulations

- Collaboration in the development and publication of [OVGW⁵ guideline H MB250](#) for portable hydrogen refueling equipment.
 - Involvement of component manufacturers to develop the component-specific approval requirements in the context of the Pressure Equipment Directive (PED) and the Transportable Pressure Equipment Directive (TPED).
 - Application for an accompanying technology development project in which the approval requirements will be tested for the first time using a mobile H₂ refueling device for 700 bar (H₂Site, FFG No. 935055). (This project application was supported by a letter of intent [LoI] from the International Energy Agency (IEA) AMF Task 65 board during 2025.)
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- Ongoing enhancement of a miniature portable emissions measurement system (mini-PEMS) for emissions measurements from recreational vehicles under normal operating conditions.
 - Emissions testing of two all-terrain vehicles (ATVs) on-trail under real-world conditions using mini-PEMS system.
 - Cost-share between Sweden and Canada for work regarding Real World Emissions Characterization of Snowmobile Engines.
 - On-farm tractor testing comparing electric vehicles (EVs) with internal combustion engine (ICE) variants during mowing, tilling, digging, and lifting operations.
 - PEMS tests on Valtra tractor using diesel and different operational settings.
 - Tests on construction machines (hydrogenated vegetable oil [HVO] and electric) on a real-world construction site.
 - Updates of national inventory of NRMM, energy demand, and emissions.
 - Tests on a ground power unit, a jet-air-starter, and a sweeper in Copenhagen (CPH) airport.
 - Submission of a journal article (in March 2025) assessing the impacts of various decarbonization methods for NRMM; the journal article consolidates simulation data for four different use cases for e-based energy carriers (article currently pending final decision).
 - A project report on decarbonisation of Mobile Machine System “DeCarbo” (publication pending).
 - Sharing of engine data regarding various sustainable fuel alternatives.
 - Reporting of real driving emissions and fuel consumption and summary of power takeoff (PTO) test stand data (i.e., limited exhaust emissions, fuel and urea consumption, efficiency) for different agricultural tractors (stage IV and V) operated with various biofuels (e.g., HVO 100, fatty acid methyl esters [FAME] 100, rapeseed oil fuel 100) for completed and ongoing research projects.
 - Assessment of the pros and cons, as well as the availability, of alternative drive technologies and energy infrastructures for agricultural machinery, including biofuel approval, series-produced NRMM, retrofitting technology, and battery electric drives.
 - Reporting of national inventory data from NRMM of the agricultural sector, registered at the German federal motor transport authority.
 - Publication by Germany of three reports on use of renewable energy in agricultural machinery and methods for transitioning from fossil fuel to renewable energy:
 - [Monitoring Report: Renewable Energies in Transport](#)
 - [Use of renewable drive energy in agricultural machinery](#)
 - [Use of renewable drive energy in agricultural machinery: Catalogue of actions](#)
 - Update of national inventory for NRMM energy demand and emissions.
 - Study on market development for zero-emission construction equipment in Sweden.

³ VDMA – Verband Deutscher Maschinen und Anlagenbau (Mechanical Engineering Federation).

⁴ A3PS – Austrian Association for Advanced Propulsion Systems.

⁵ OVGW – [Österreichische Vereinigung für das Gas- und Wasserfach](#) (Austrian Association for Gas and Water).

- Cooperation with Netherlands, Belgium, Norway, Denmark, Finland, and UK road authorities on zero-emission construction equipment.
- Identification of the implications on market trends within NRMM that push forward decarbonization of various off-road equipment.
- Publication of two conference papers regarding research into off-road combustion ignition (CI) engines used with alternative fuels.
- Consolidation of results for Task 65 final report (report to be published by the end of 2026).

Key Findings

- Zero-emission solutions are currently the most mature within the compact- to medium-sized equipment market and are already increasingly relevant for NRMM sectors that can operate close to an available electrical grid.
 - Current cost-development-related studies indicate that zero-emission solutions will become significantly more viable over the coming decades compared with traditional options.
- A working group for ISO standardization on H₂ machine regulatory compliance and refueling was established in 2025 to harmonize standards between on-road and off-road sectors. The ultimate goal is to deploy H₂ NRMM standards by 2030.
- Meanwhile, Task 65 emphasizes the importance of promoting and developing any viable, alternative energy-carrier solutions for other off-road sectors where zero emissions still lack competitiveness.
 - This is particularly relevant for equipment that requires highly energy-intensive operation or that is restricted by limited energy-storage space, facing constraints in both working practices and operational feasibility.
 - For example, promoting the use of sustainable fuels within agricultural and forestry equipment will remain vital, enabling advances in decarbonization without jeopardizing competitiveness or required working procedures.