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TASK 65

Technology Collaboration Programme
by iea

Task 65: Powertrain Options for Non-Road Mobile Machinery

Project Duration	November 2023–November 2025
Participants **Task sharing** **Cost sharing**	 Canada, Denmark, Finland, Sweden, and USA Possibly Sweden to Canada, will be decided later
Total Budget	EUR 1,327,000 (USD 1,438,724)
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Purpose, Objectives, and Key Question

This Task will explore 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 explore 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 CO_2 regulation in different countries.

Activities

Canada's task-sharing contribution

- Regulation of NRMM around the globe, including air pollutants and CO_2.
- National inventory of existing machinery.
- Real-driving emissions testing of all-terrain vehicles (ATVs) and snowmobiles and comparison to certification testing results.

Denmark's task-sharing contribution

- Report from an ongoing project on construction machinery, including the following:
  - Emission measurement during actual work by NRMM fueled by biofuel (hydrotreated or hydrogenated vegetable oil (HVO) and battery electric vehicles (BEVs).
  - Development of digital twin models using measurement data.
- Report from an ongoing project for airport ground-handling machinery.
- Report from portable emissions measurement sampling (PEMS) testing results from agriculture tractor.
- Project on greener fuel options for generator sets.
- Facilitation of snowmobile and ATV real driving emissions testing at Sisimiut municipality.

Finland's task-sharing contribution

- NRMM heavy-duty (HD) engine testing data covering different fuel options for spark-ignition (SI) combustion. Engines are tested on a non-road steady cycle (NRSC) and other steady-state operation points covering full-load and partial-load conditions.
- Testing data for an NRMM HD SI engine run with neat ethanol and methane, as well as with RE85 and a mixture of ethanol and methane.

- Testing data for a direct-injected SI-hydrogen (H_2) engine.
- Contribution through Government-funded project related to NRMM energy options and powertrains that includes information about and analyses of the potential of different energy and powertrain options in mining and forestry applications; analyses include both simulation and experimental methodologies.
- Development of a simulation model for analyzing energy and powertrain options for NRMM applications, including H_2 fuel-cell power production and ethanol and methane internal combustion engine (ICE) power production in generator and hybrid powertrain concepts.
- Development of a tool to evaluate machinery-level power generation options depending on use case and available energy options.

Sweden's task-sharing contribution:

- National inventory of existing machinery (described in the previous NRMM annex in AMF and AMF Task 50).
- Availability of zero-emission construction equipment.
- Identification of the need for advanced motor fuel technologies within the construction equipment sector.
- Strategies and visions for zero emissions in different counties (with focus on road and rail authorities).

In addition, Sweden and Canada are interested in emission testing of snowmobiles and possibly ATVs. If testing arrangements are possible, this task would be a joint task with Canada. Sweden is also willing to cost-share emission measurements for different technology pathways for snowmobiles (and possibly ATVs).

USA task-sharing contribution:

- Assessment of the following NRMM applications in the United States with their associated energy use and greenhouse gas (GHG) emission contributions: agriculture, mining, construction, locomotive, and marine applications.
- Assessment of the applicability of different low-carbon fuels and powertrains (including ICEs, hybrid configurations, battery EVs, and hydrogen fuel cells).
- Results of life-cycle analysis (LCA) and techno-economic analysis (TEA) of different fuel/powertrain combinations.
- Exploration of the impacts of GHG reductions, air pollutant reductions, and energy use reductions.

The U.S. contribution will be leveraged with a study by the U.S. Department of Energy in multiple national labs. If needed, the U.S. will assemble its industry stakeholders to present their visions and activities to decarbonize the NRMM sector in the U.S. and globally.

Possible other participants

Other participants are welcome to join the activity. Austria has indicated an interest in joining the Task. However, discussions regarding the country's possible contributions are still ongoing and cannot be confirmed yet.

Expected Results / Deliverables

The task will provide a synthesis of the potential of different energy/fuel options and powertrains for NRMM applications and an investigation of the emissions performance of current technologies compared with possible future regulatory frameworks.

The Task will result in a written Final Report that includes the following:

- Engine dynamometer and in-use NRMM test data: regulated emissions, energy consumption, CO_2 emissions, and alternative energy/fuel options assessed using the well-to-wheel approach.
- Discussion of the feasibility of different energy and powertrain options in NRMM depending on use case, location, available energy sources, and regulation.
- Review of regulatory environment in selected countries.
- National inventories of NRMM and strategies for adapting zero- and low-carbon NRMM in use.