

Hydrogen propulsion in construction machinery made in Europe and its regulatory challenges

A3PS | Eco-Mobility 2025

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LIEBHERR

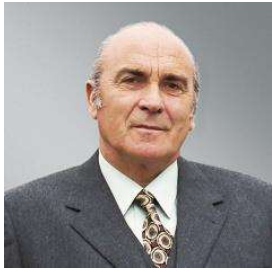
Liebherr-Werk Bischofshofen GmbH



1 Company introduction

Liebherr is a family-owned business in 3rd generation:

Group overview



1949

Founded by Hans Liebherr
in Kirchdorf an der Iller,
Germany

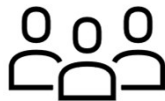


Parent company
Liebherr-International AG
based in Bulle, Switzerland

**Liebherr is a
family-run
technology
company**

13

Product segments



51.321

Employees

40

Production sites



12.589

Turnover in € mio

>140

Companies

<https://www.liebherr.com/shared/media/annual-report/annual-report-2022/pdf/facts-and-figures-2022.pdf>

Earthmoving machinery R+D centres and production plants



Liebherr-Hydraulikbagger GmbH

Kirchdorf an der Iller (GER) | since 1949

R+D

Production

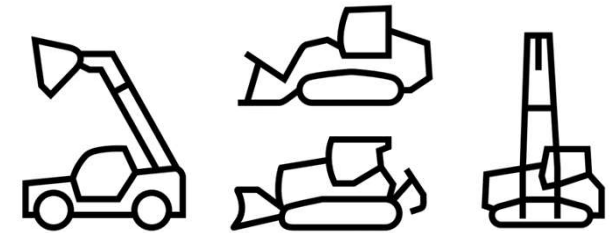


Liebherr-Werk Bischofshofen GmbH

Bischofshofen (AUT) | since 1960

R+D

Production



Liebherr-Werk Telfs GmbH

Telfs (AUT) | since 1976

R+D

Production



Liebherr-France SAS

Colmar (FRA) | since 1961

R+D

Production



Liebherr Machinery (Dalian) Co., Ltd.

Dalian (CHN) | since 2002

Production

Construction machines
for all divisions

Liebherr-Brasil Eireli

Guaratinguetá (BRA) | since 1974

Production

Liebherr in Bischofshofen, Austria

Facts & Figures

- The center of excellence for **wheel loaders**
- Founded in **1960**
- Approx. **170,000 m²** factory area
- Approx. **1,250** employees
- Production 2025: **4,200** wheel loaders
2023: 6.700



2

Wheel loader product portfolio

Liebherr's XPower® large-size wheel loaders have lowest fuel consumption in class:

Product range

Wheel Loader



		L 504 Compact	L 506 Compact	L 507 Stereo	L 508 Compact	L 509 Stereo	L 514 Stereo
Tipping load	kg	3,000	3,500	3,750	3,900	4,430	5,750
Bucket capacity	m³	0.7	0.8	0.9	1.0	1.2	1.5
Operating weight	kg	4,600	4,970	5,550	5,700	6,390	8,860
Engine output	kW / HP	34 / 46	47,5 / 64	50 / 68	47,5 / 64	54 / 73	76 / 103

Small-size

Wheel Loader



		L 518 Stereo	L 526	L 538	L 546	L 550 XPower®
Tipping load	kg	6,550	8,730	9,650	11,010	12,500
Bucket capacity	m³	1.7	2.2	2.6	3.0	3.4
Operating weight	kg	9,190	13,170	14,520	15,410	18,550
Engine output	kW / HP	76 / 103	116 / 158	129 / 175	138 / 188	163 / 222

Small-size

Mid-size

Large-size

Wheel Loader



		L 556 XPower®	L 566 XPower®	L 576 XPower®	L 580 XPower®	L 586 XPower®
Tipping load	kg	13,750	15,900	17,600	19,200	21,600
Bucket capacity	m³	3.7	4.2	4.7	5.2	6.0
Operating weight	kg	19,600	23,900	25,700	27,650	32,600
Engine output	kW / HP	183 / 249	203 / 276	218 / 296	233 / 317	263 / 358

Large-size

XPower®

Decarbonization & examples

Wheel Loader

Tipping load	kg
Bucket capacity	m³
Operating weight	kg
Engine output	kW / HP



L 504 Compact



L 506 Compact



L 507 Stereo

- L 507 E, SOP in April 2024
- Battery-electric, 350 V
- Concept to be scaled to smaller & larger machines

- L 507 FC, demonstrator, 2022
- Fuel cell, first Liebherr developed hydrogen machine
- Technology not yet ready for hard non-road usage

10...400 kWh



Battery-electric

Wheel Loader

Tipping load	kg
Bucket capacity	m³
Operating weight	kg
Engine output	kW / HP



L 518 Stereo



L 526



L 538



L 546

- L 546 E, demonstrator, 2025
- Battery-electric, 825 V
- Innovative high-voltage drive platform concept

100...1,000+ kWh



Hydrogen

Wheel Loader

Tipping load	kg
Bucket capacity	m³
Operating weight	kg
Engine output	kW / HP



L 556 XPower®



L 566 XPower®



L 576 XPower®



L 580 XPower®



L 586 XPower®

- L 566 H, field test machine, 2025
- H2-ICE for 1st hydrogen machine generation
- Customer field test already ongoing



Decarbonization at Liebherr

- Top level goal: Reducing CO2 emissions
- Strong willingness from the owner family to develop zero-emission vehicle (ZEV) technology.
- Large companies ask for zero-emission solutions as a part of their decarbonization strategies.
 - Already required in several European countries for public construction projects.
- Strengthen Liebherr's role as European manufacturer on the global market.
- Securing European value creation for the future with hydrogen propulsion technology:
 - H2-ICE in the beginning.
 - Fuel cells will follow.
 - **Only possible with energy prices in line with the market: How does this work with hydrogen?**

3

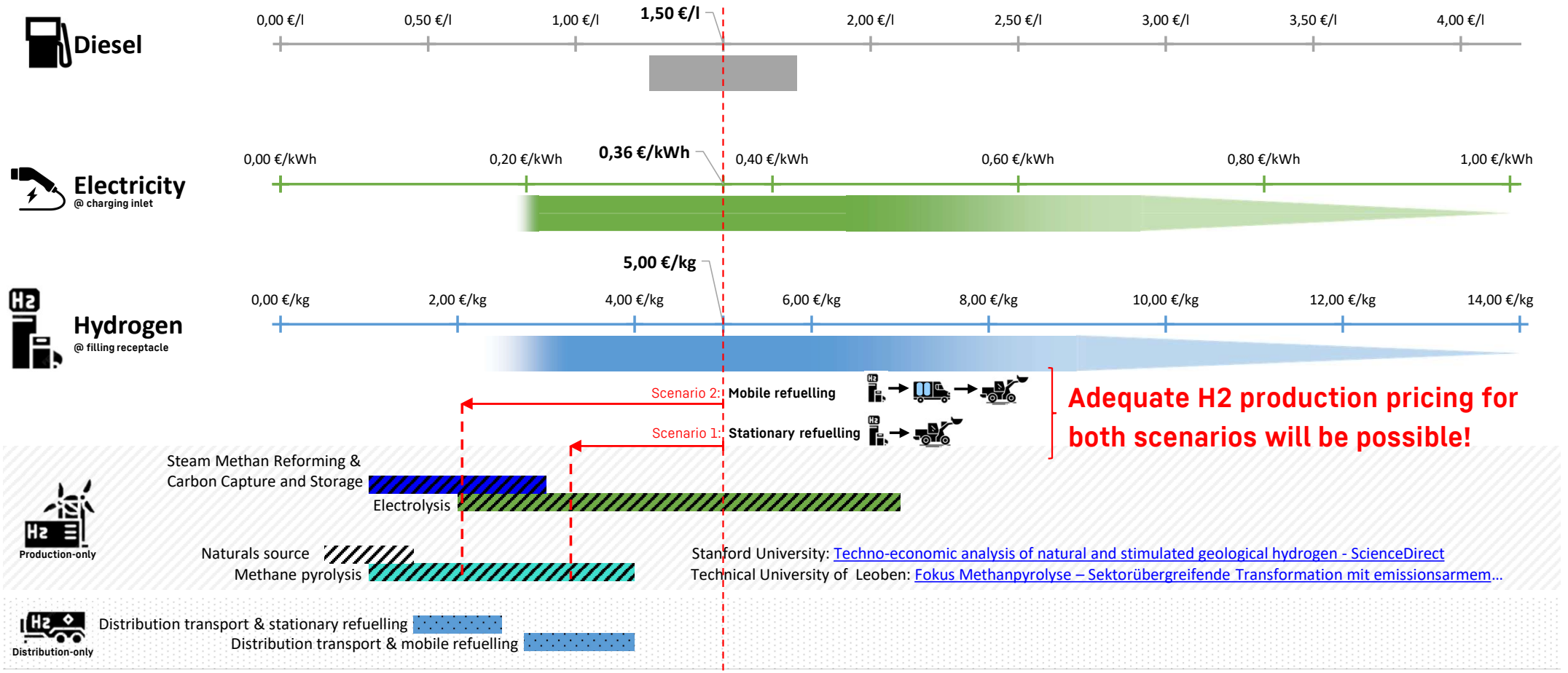
Hydrogen pricing scenarios

Note:

- Energy price studies are carried out by Liebherr with great care.
- Energy prices to be shown apply at the machine's refueling inlet / charging inlet.
- Differences in mechanical/electrical efficiency are taken into account.

- *Additional CAPEX for ZEV is not considered when comparing to Diesel.*
- *Funding and other benefits (e. g. RED III) are not taken into account.*
- *Shown energy prices for ZEV do not include a future substitute for mineral oil tax.*

Comparison Diesel – Electricity – Hydrogen (AT)



Learnings and interpretation at a glance

- (1) Future H2 price will be able to go hand in hand with battery-electric technology in the future.
- (2) Making use of the well-known benefits such as outstanding autonomy, fast refueling and mobile refueling when electric grid is not present.
- (3) Hydrogen propulsion technology must be understood as a major chance to maintain the European industry's sustainability, competitiveness and resilience.

Needs:

- Efforts necessary to ensure that hydrogen technologies for mobility (fuel cells, H2-ICE) are **not relegated to a niche market**.
- A **robust framework is needed to enable the ramp-up** of H2 vehicle technologies incl. grey and blue H2 in the beginning.
- Major component is the **implementation of the public H2 refueling infrastructure (AFIR)**.
- It is now up to society and politics to recognize this opportunities and create an appropriate framework **before the Far East takes over the leadership of H2 technology, too**.

4

Related projects

- Highly-mobile fast-refueling
- Modification of fuel cell technology for non-road application
- Regulatory compliance & certification

Related activities in the field of hydrogen machinery development

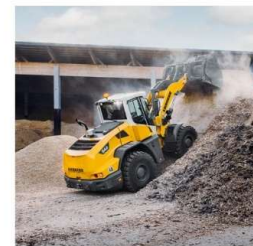
– Development of an on-site refuelling equipment with strong partners

- Highly mobile device
- 700 bar pressure level
- Fast refueling in 10 to 12 minutes
- Scalable fuelling for small to very large machines
- Low additional costs for on-site H2 refueling



– Further development of the fuel cell technology for hard non-road applications

- Based on the 2nd generation of on-road truck fuel cell technology
- Robust against shocks & vibrations, dust and aggressive gases
- Capable for large terrain inclinations



– Preparation of regulatory compliance and certification

- Hydrogen non-road machinery
- Mobile fast-refuelling equipment



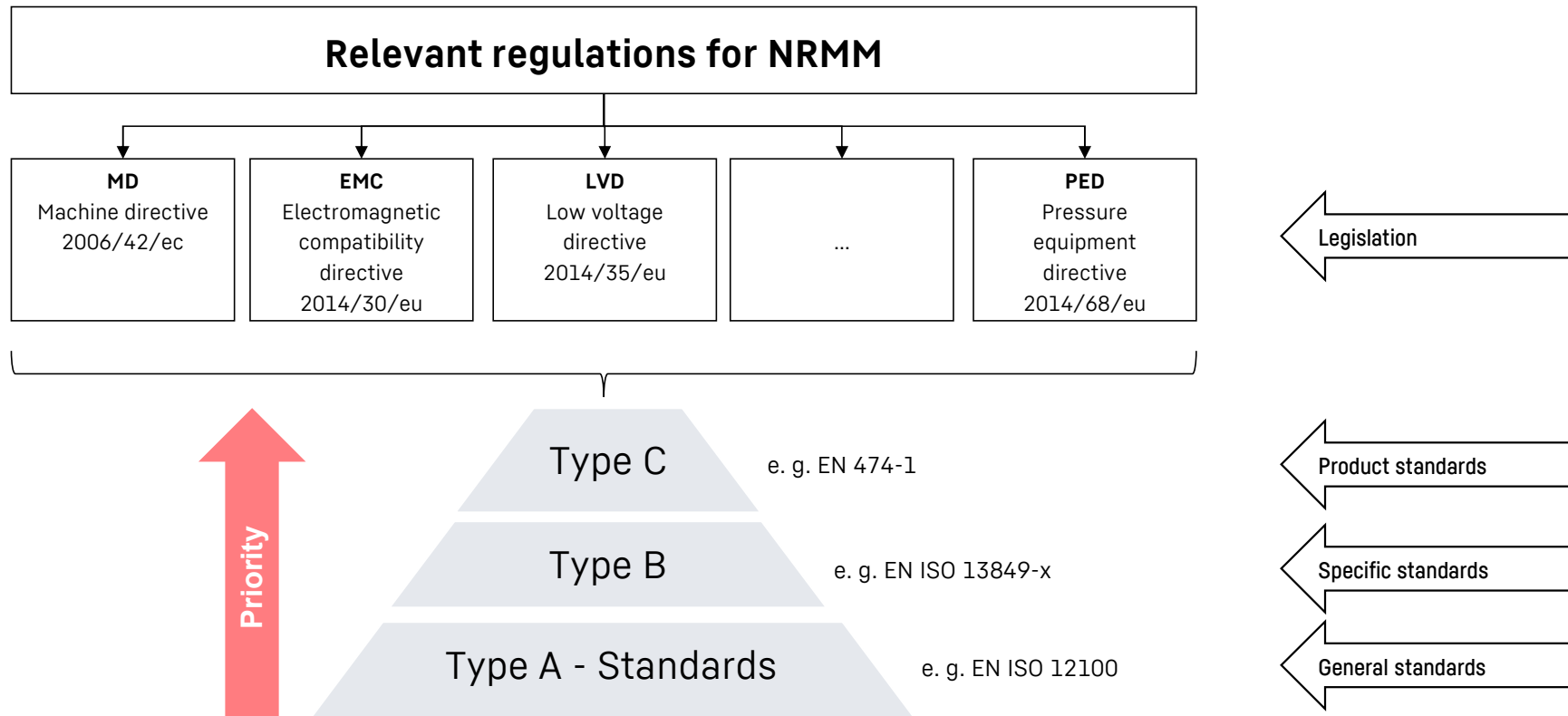
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Regulations & Compliance

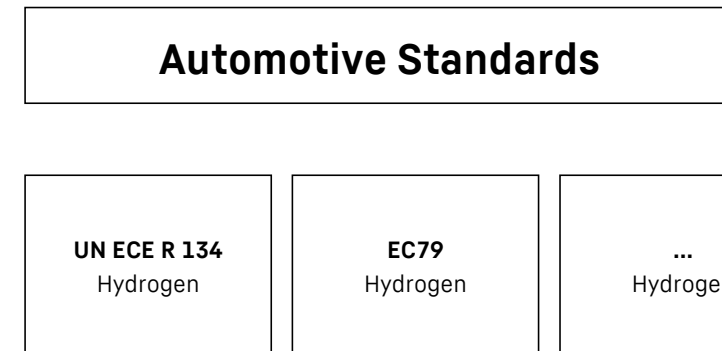
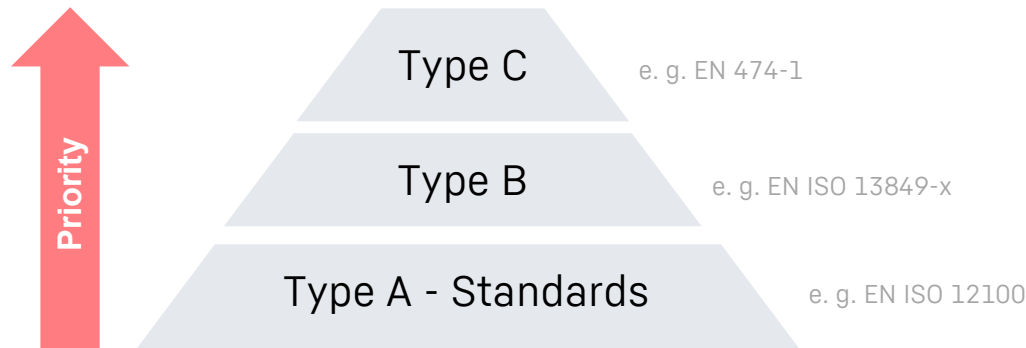
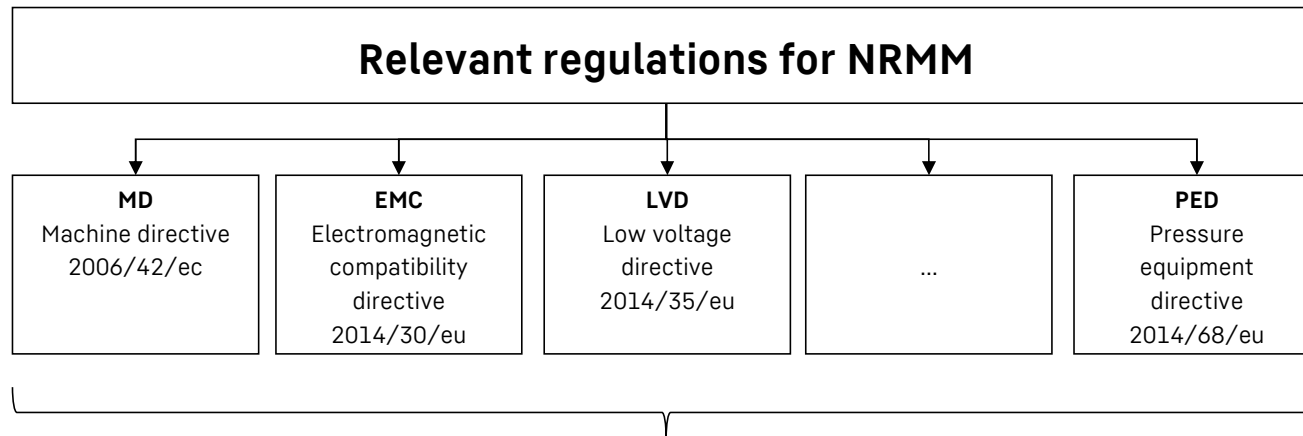
– Focus on Non-Road Mobile Machinery (NRMM):

Regulations for NRMM in Europe



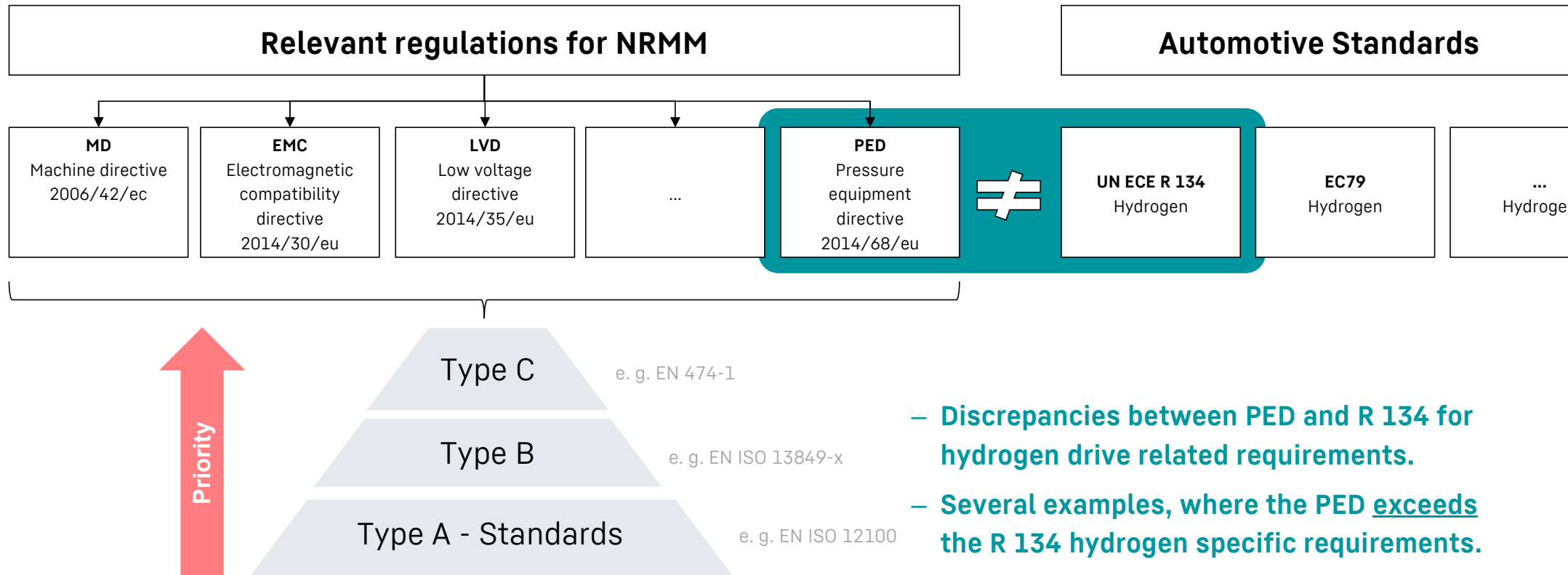
Problem: Standards available do not practically cover hydrogen technology and components so far for NRMM!

Regulations for NRMM in Europe



- Considering R 134 (and EC79) for demonstrator machines, prototypes and test fleets.
- Not a robust argumentation for series production machine regulation compliance.

Regulations for NRMM in Europe



- Discrepancies between PED and R 134 for hydrogen drive related requirements.
- Several examples, where the PED exceeds the R 134 hydrogen specific requirements.

IEA Technical Cooperation Partnership (TCP)

- Development of a technical argumentation which will express that the **basic safety principles can be implemented** by applying automotive standards, so that the **CE labelling regulations will be met**.
- This will allow making use of components with Automotive origin also in Non-Road machines.
- Approach: **Industry supported White Papers** close to a future ISO standard project for H2 construction machinery.
- Activities are organized as part of a research co-operation supported by the International Energy Agency (IEA).
- **The contribution of further participants and supporters is welcome.**

<https://nachhaltigwirtschaften.at/de/iea/technologieprogramme/amf/iea-amf-task-65>

https://iea-amf.org/content/projects/map_projects/65/



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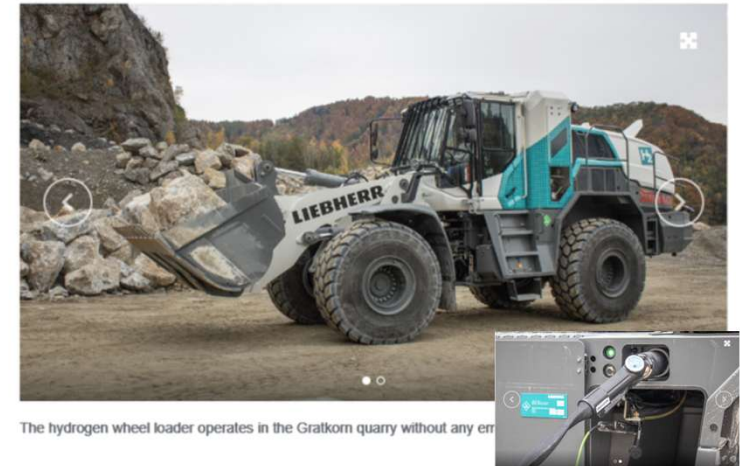
L 566 H: November 2025 milestone

- Long-term customer field test started on 3 November in a large quarry in the north of Graz.
- Goal: 50 hours per week over several years.
- 700 bar hydrogen filling station was installed by Strabag.
- Green hydrogen is supplied by local energy supplier Energie Steiermark produced at its Gabersdorf placed plant.
- Additional test machines will follow in the next months in Austria and Germany.



Decarbonization of the construction industry: Hydrogen wheel loader starts practical test

3 November 2025



The hydrogen wheel loader operates in the Gratkorn quarry without any error.

- ✓ Hydrogen-powered wheel loader to deliver key insights for the sustainable operation of large construction machinery
- ✓ Green drivetrain technologies are a central lever in the company's decarbonisation strategy

A hydrogen-powered wheel loader from Liebherr has now gone into operation at the Kanzelstein quarry in Gratkorn. STRABAG will be testing the new machine intensively over a two-year period, running it at least 50 hours per week. Fuels represent STRABAG's largest source of CO₂ emissions – around 40 percent of total Group emissions are attributable to the diesel consumption of its construction machinery, commercial vehicles and passenger cars.

<https://newsroom.strabag.com/de/presse/konzern/2025-10/dekarbonisierung-der-baubranche-wasserstoff-radlader-startet-in-den-praxistest>

Thank you
for attention.



<https://allianz-wasserstoffmotor.de>