Sustainability in transport logistics – fleets and alternative drives

Study on CO_2 accounting, alternative drives und actions for sustainability in B2B-transport logistics

–Survey and workshop findings–

October 19th, 2022

Project Frame

Nachhaltigkeit in der Logistik – Flotten und alternative Antriebstechnologien

Sehr geehrte Damen und Herren,

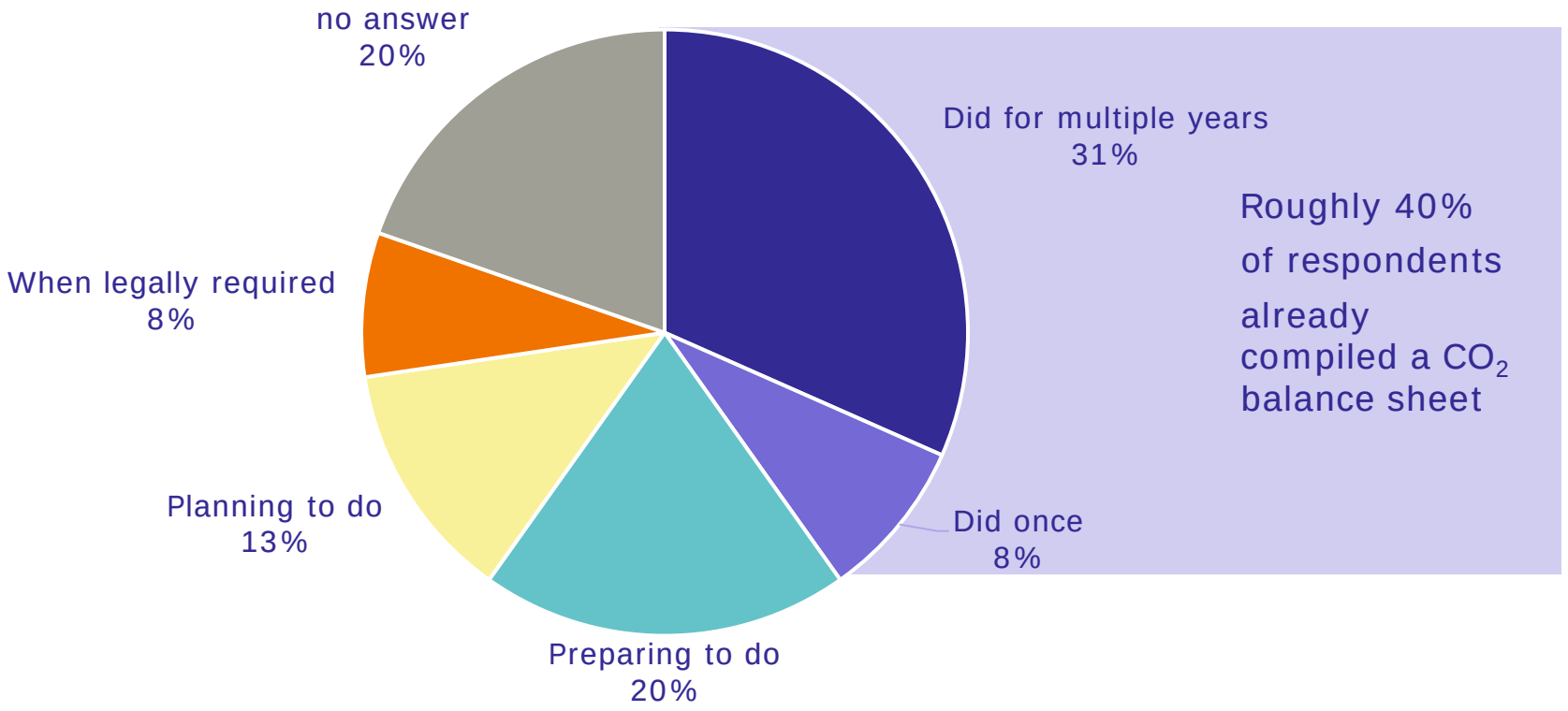
HERE Technologies und die BVL führen gemeinsam eine Studie zur CO2 Bilanzierung, alternativen Antriebstechnologien und Nachhaltigkeitsbestrebungen in der B2B-

- **Focus: Discover Sustainability Efforts in Road Freight Transport with Focus on Alternative Traction**
- **Method**: Online survey in the BVL network (n=117)
- **Duration**: July 4th to September 12th, 2022
- **Expert workshop** on September 15th, 2022
  - Validation and questioning of survey results
- **Target group**: Fleet and logistics managers with insights on their fleet.
- **Data analysis** of „day in the life“ of DHL Freight Germany
  - Understand GHG savings potential across entire fleet

Study result example:

Compiling a CO_2 balance sheet for fleet utilization seems not yet common

Does your company compile a CO_2 balance sheet?

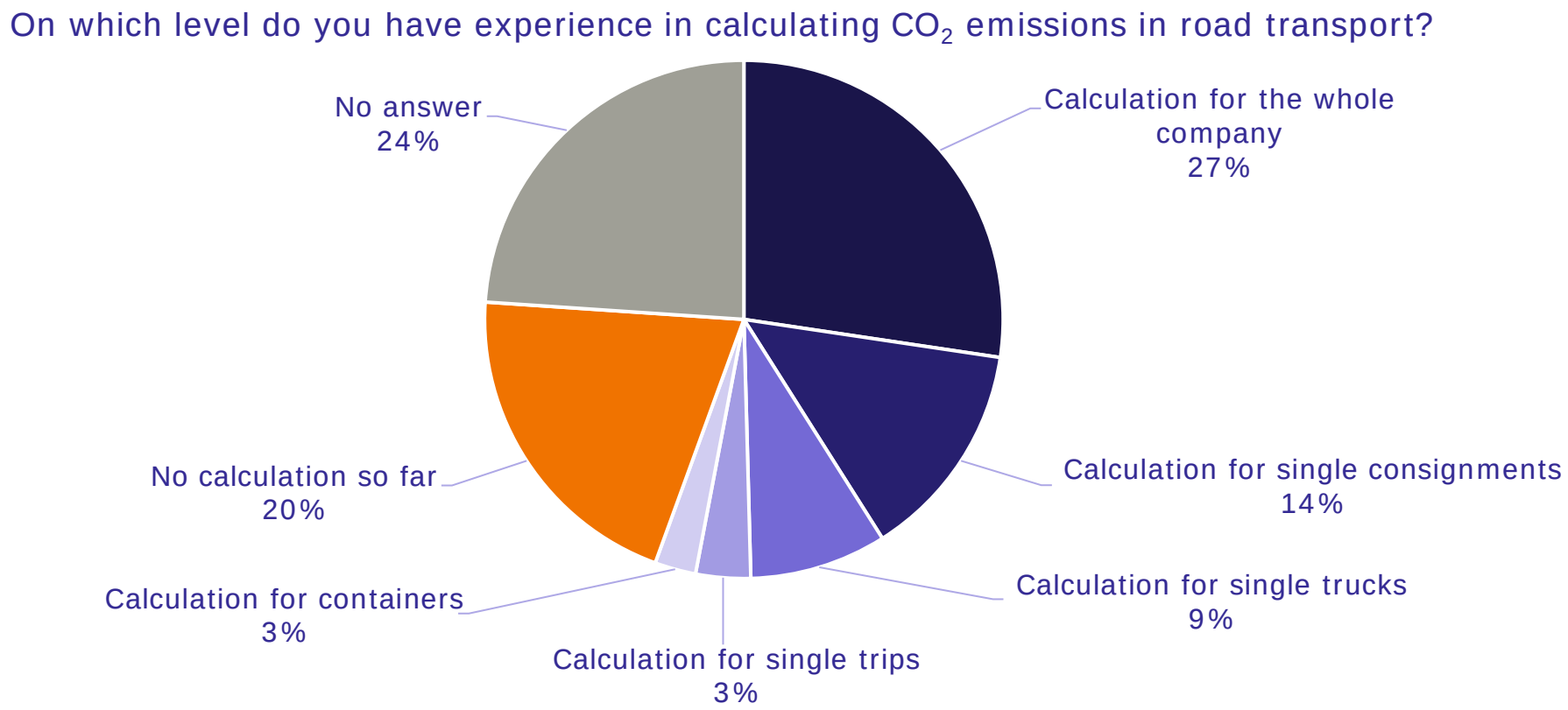


Roughly 40% of respondents already compiled a CO_2 balance sheet

n=117

Study result example:

Experience with calculation of CO_2 emissions in road transport



n=117

Big hairy question for fleet managers: Modernize my fleets? How and when?

Increased CO_2 taxation impacting profit margins

Consumers demand "greener" products

Shippers expect emission reporting on transport level

Shipper RFPs start to include emission level commitments from carriers

Dilemma

Alternative drivetrains (BEV, H_2, Biogas) become available and affordable, however not 1:1 replacement for existing Diesel trucks due to operational constraints (max. range and availability of charging/refueling infrastructure)

"But which loads and transport lanes can I already move to a greener alternative? I need some **decision support** powered by **trusted data**"

Source: HERE Technologies

Data analysis

Methodology and tooling

Why map attributes matter for energy consumption modeling

- Accuracy matters for bottom-up calculations

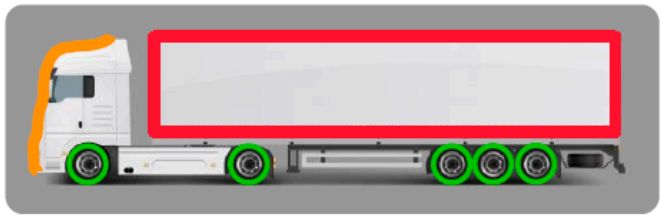
Static map attributes with influence on energy consumption:

- Elevation
- Slope
- Curvature
- Road classification

10% difference in fuel consumption after ~10 km

Parameters for the power calculation and CO_2 emissions

From the physics of the truck …



Folgende Widerstände müssen durch die Antriebskraft überwunden werden, um einen Lastwagen zu beschleunigen:

Air resistance F_L:

$$F_L = \frac{1}{2} \cdot c_w \cdot \rho \cdot A \cdot v^2$$

Rolling resistance F_R:

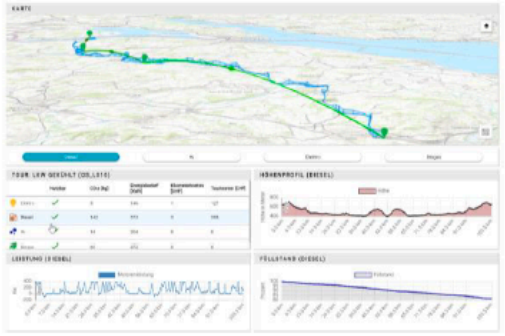
$$F_R = \mu \cdot m \cdot g$$

Acceleration resistance F_B:

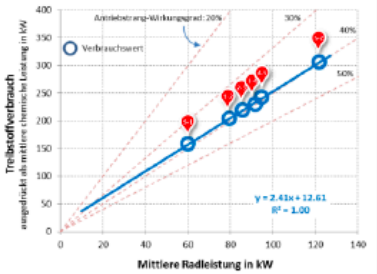
$$F_B = m \cdot \frac{dv}{dt}$$

Incline resistance F_A:

$$F_A = m \cdot g \cdot \sin(\alpha)$$

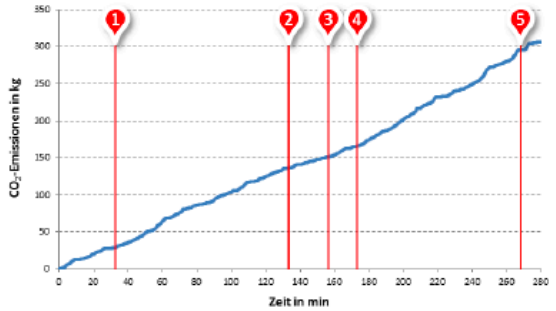


… to the detailed CO2 emissions profile



Die digitalisierte Route (linkes Bild) eines Transports wird für einzelne Zeitschritte (z.B. pro Sekunde) hinsichtlich der erforderlichen Radleistung analysiert. Über ein Wirkungsgradmodell des Lastwagens (rechtes Bild) wird für jeden Zeitschritt die erforderliche Treibstoffleistung ermittelt.

Durch Aufintegration der Zeitschritte kann ein detailliertes Verbrauchs- und CO_2-Emissionsprofil (siehe unten) für Streckenabschnitte oder die gesamte Route erstellt werden (siehe unten). Darauf basierend können die CO_2-Emissionen pro Transportgut ermittelt werden



CO_2-Emissionen eines Diesel-Lastwagens über der Fahrzeit

Source: HERE Technologies

HERE CO_2 Insights - Drag-and-drop carbon impact calculations for road transportation based on minimal viable TMS data and real-world analytics

Data

Location data
Map content
Truck attributes

Algorithm*
Vehicle profiles
Real-world analytics

Fleet/TMS data
Fleet details
Tour information

Processing

Geocoding and addressing

Road elevation and slope data

Truck-enabled routing

Modeling of drivetrain behavior

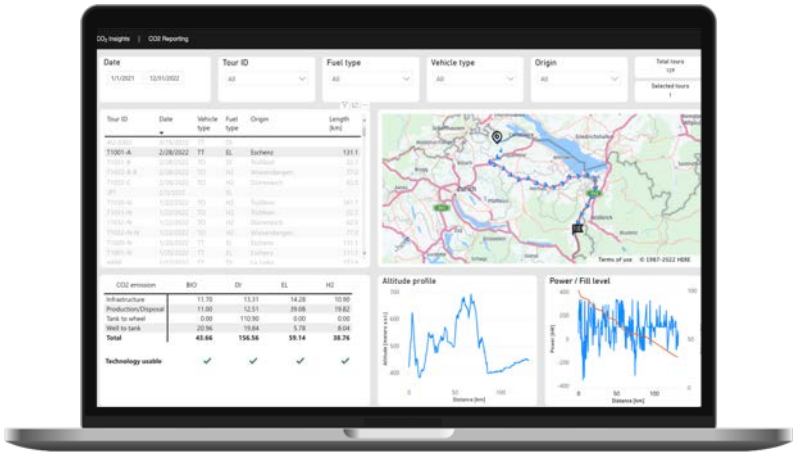
Analysis of CO2 impact

Results

Reporting
Review impact for single tours

Forecasting
Estimate impact of new fleet configurations:
Diesel vs.
- **BEV**
- **H_2**
- **Bio-CNG**

HERE data Certified formula Fleet data



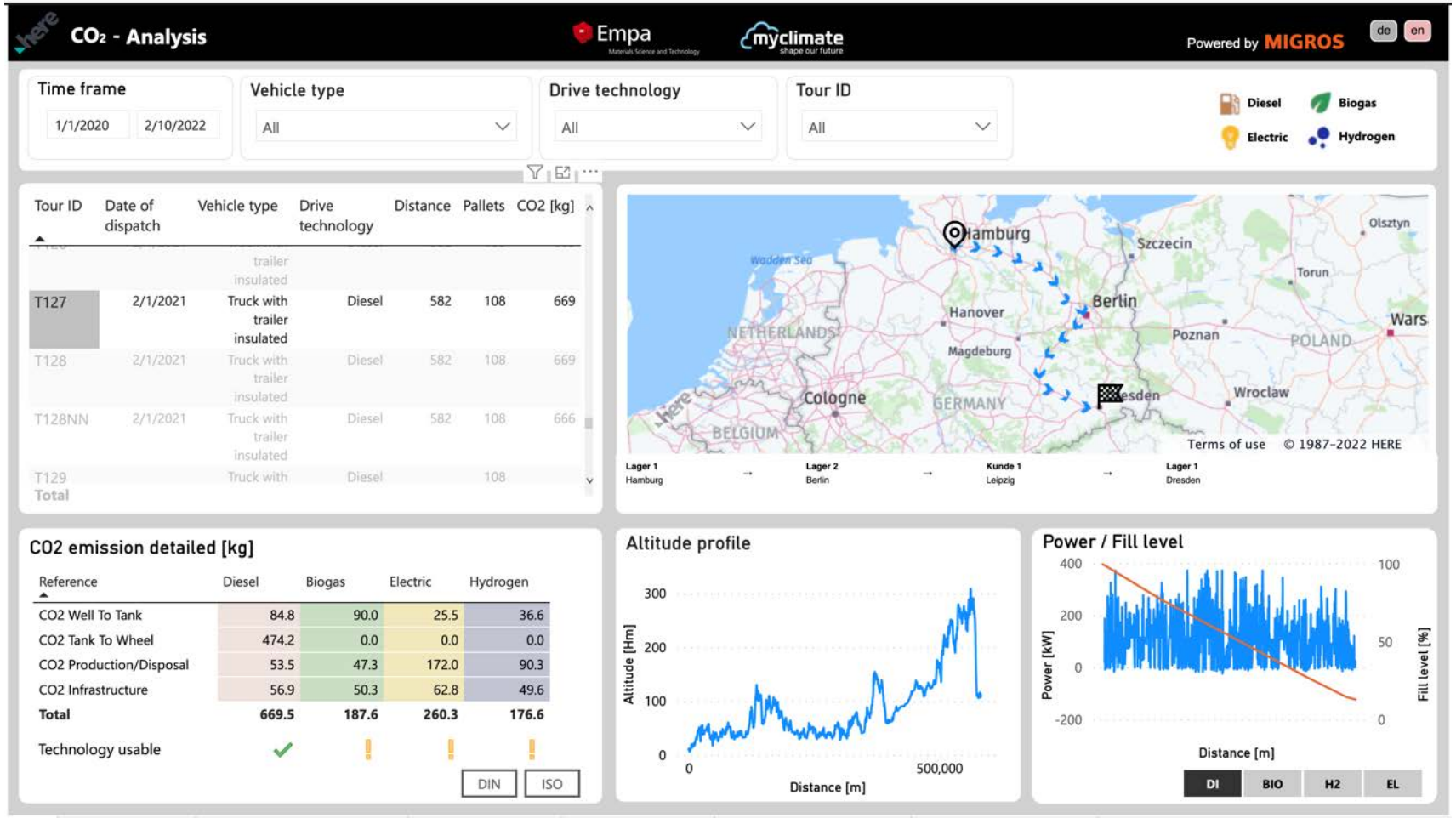
*) powered by MIGROS

certified by myclimate shape our future

Source: HERE Technologies

CO_2 Analysis

Single or multi-stop tours



How does it work?

Upload tour information

Including start and end addresses, vehicle type, and vehicle weight.

HERE Routing calculates details

Using truck-specific attributes to identify the actual roads traveled, as well as their slope and elevation.

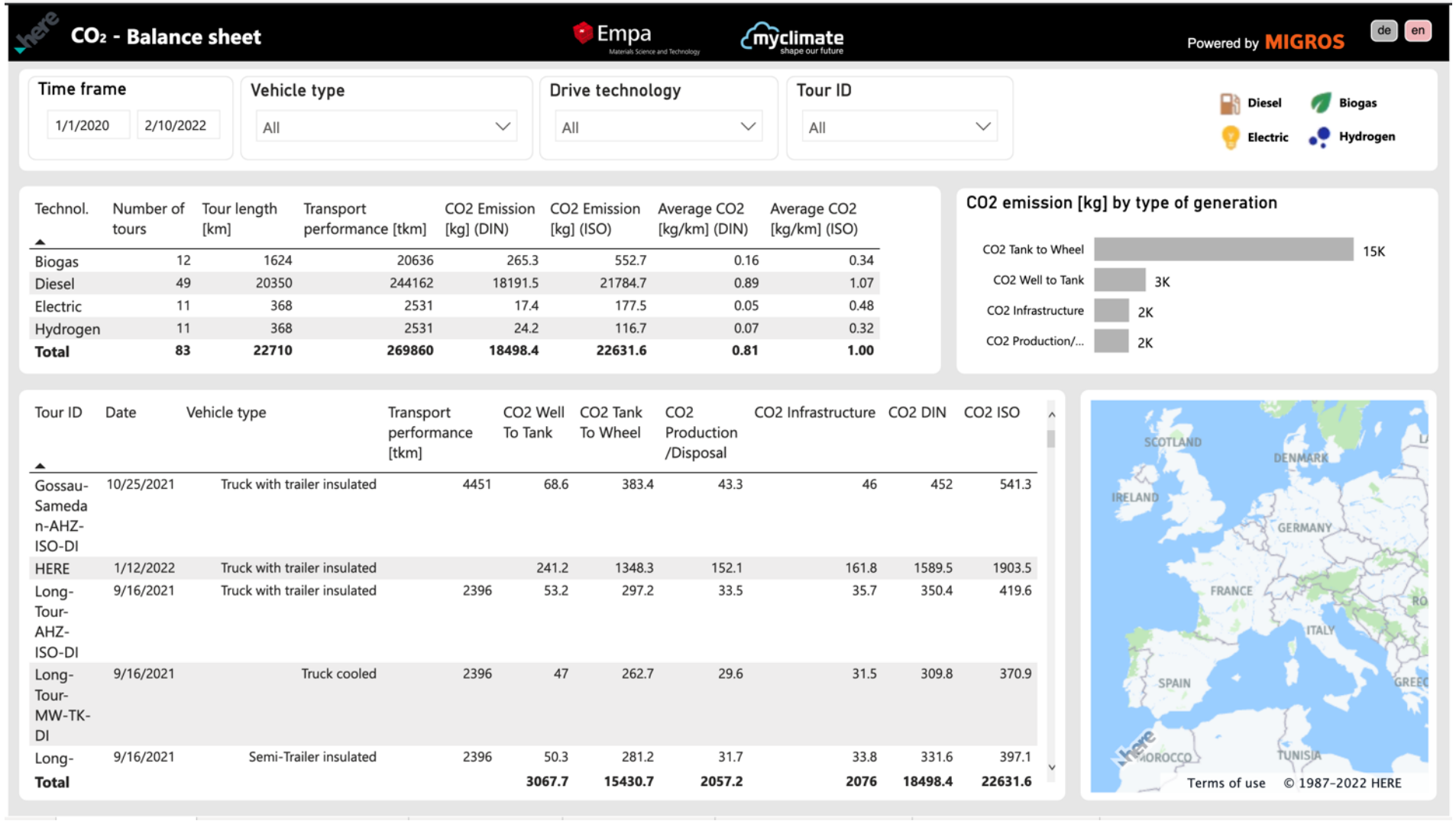
Review carbon impact

With a detailed profile of the route showing power / fill level over time.

Source: HERE Technologies

CO_2 Balance Sheet

Tour, Vehicle or entire Fleet



Technol.	Number of tours	Tour length [km]	Transport performance [tkm]	CO2 Emission [kg] (DIN)	CO2 Emission [kg] (ISO)	Average CO2 [kg/km] (DIN)	Average CO2 [kg/km] (ISO)
Biogas	12	1624	20636	265.3	552.7	0.16	0.34
Diesel	49	20350	244162	18191.5	21784.7	0.89	1.07
Electric	11	368	2531	17.4	177.5	0.05	0.48
Hydrogen	11	368	2531	24.2	116.7	0.07	0.32
Total	**83**	**22710**	**269860**	**18498.4**	**22631.6**	**0.81**	**1.00**

Tour ID	Date	Vehicle type	Transport performance [tkm]	CO2 Well To Tank	CO2 Tank To Wheel	CO2 Production /Disposal	CO2 Infrastructure	CO2 DIN	CO2 ISO
Gossau-Samedan-AHZ-ISO-DI	10/25/2021	Truck with trailer insulated	4451	68.6	383.4	43.3	46	452	541.3
HERE	1/12/2022	Truck with trailer insulated		241.2	1348.3	152.1	161.8	1589.5	1903.5
Long-Tour-AHZ-ISO-DI	9/16/2021	Truck with trailer insulated	2396	53.2	297.2	33.5	35.7	350.4	419.6
Long-Tour-MW-TK-DI	9/16/2021	Truck cooled	2396	47	262.7	29.6	31.5	309.8	370.9
Long-	9/16/2021	Semi-Trailer insulated	2396	50.3	281.2	31.7	33.8	331.6	397.1
Total				**3067.7**	**15430.7**	**2057.2**	**2076**	**18498.4**	**22631.6**

Source: HERE Technologies

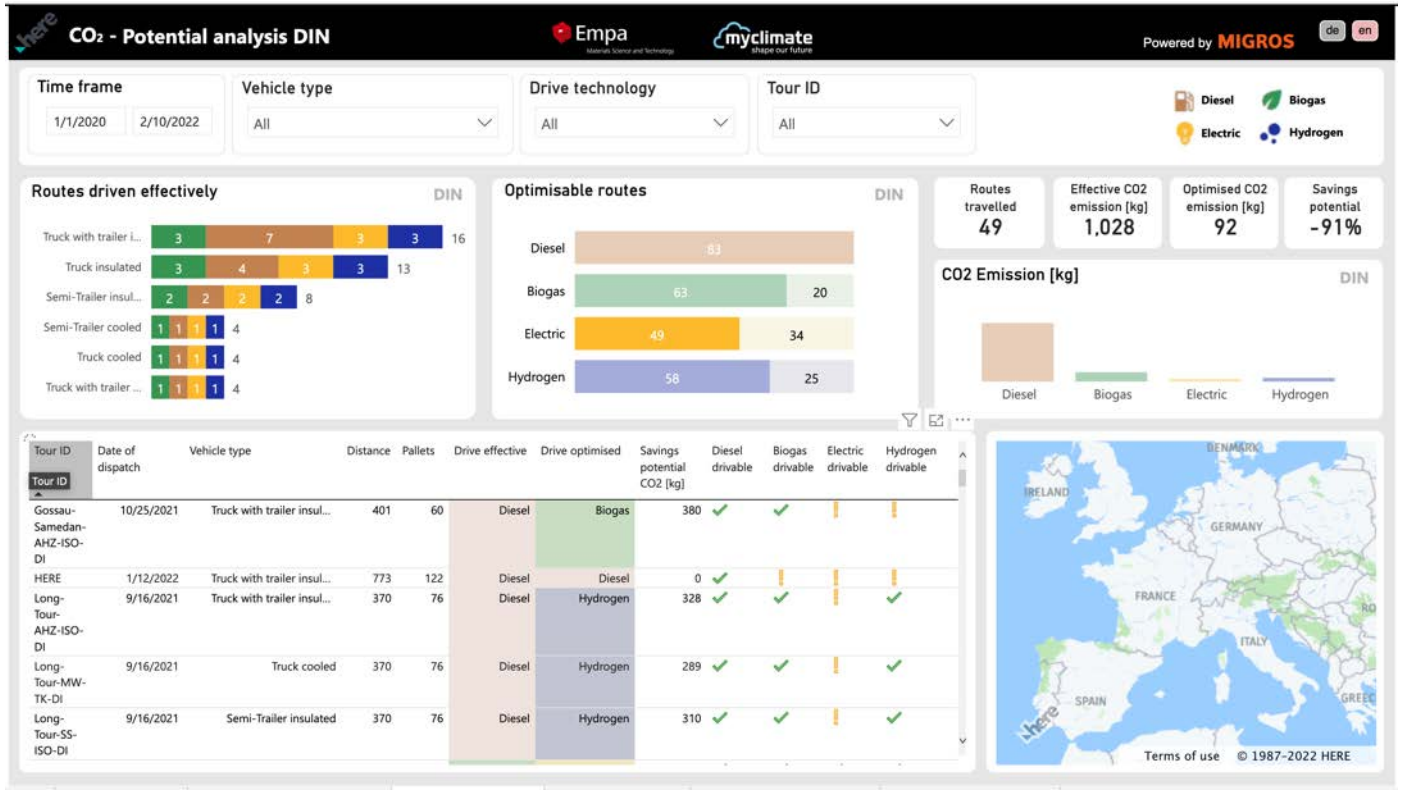
Fleet potential analysis DIN EN 16258

Input: historic or planned tours based on existing vehicle types

Output: optimal alternative energy type per tour

Transport Emissions:

- Greenhouse gas emissions from transportation services
- Scope 1:
  Direct emissions = Tank to Wheel (TtW) Energy consumption for transportation
- Scope 2/3:
  Indirect emissions = Well to Tank (WtT)
  Energy manufacturing
- Scope 1-3:
  Well to Wheel (WtW)
  Energy production + consumption for transportation



Results

Data analysis at DHL Freight

DHL Freight: For a high-level validation of select key technologies, a sample of real-life truck lanes in Germany was analyzed in the project

Overview of sample

- Basis of the analysis is a sample of **real-life truck lanes** in Germany from the DHL Freight groupage network
- **Over 500 (daily) lanes, mainly long-distance**, are in scope
- Analysis is done as a **snapshot** in Summer 2022 with exemplary vehicle data based on **existing truck models** (generations 2017-2020)
- Outcome may look different with other assumptions or at another point in time, e.g., **batteries are getting more performant**, enabling higher ranges
- Technologies **in scope** were **(only) bio-CNG, hydrogen and battery-electric trucks** – other technologies, such as bio-LNG or rail, were not considered nor analyzed

Important assumptions and restrictions

- Analysis is **purely potential based**, i.e., "how the situation would look like provided that alternative fuels became **widely available**"
- Real situation regarding **infrastructure was not considered** – due to current highly limited availability of renewable CNG and green hydrogen in Germany
- Still, it was assumed that **all lanes depart with a full tank** or with fully charged battery
- **Longer fueling / charging times** for alternative technologies at the point of departure were not taken into account and may have an operational impact in practice
- **No options to refuel on the way were considered** to avoid further potential impact on operations and schedules

Findings DHL Freight: Analysis confirms potential for carbon reduction from bio-CNG, hydrogen & battery-electric – with different use cases

Significant impact of load and elevation profile on usability	• **Reachable distance varies** by at least 100% per technology • E.g., hydrogen: 200 km to >450 km
Bio-CNG with high potential …	• **More than 70 % of lanes** (theoretical) potential • Remains **a key bridge technology** to decarbonize
… followed by hydrogen …	• **40-50 % of lanes** (theoretical) potential • **Promising long-term solution** towards 2030
… while battery-electric trucks work on short distances	• Only ~ **10 % of lanes** (theoretical) potential • **Main use cases within local and regional traffic**
Potential varies strongly by network site	• **Certain locations better suited** for alternative technologies • E.g., terminals in the **middle of Germany** or with **lower loads**

1) Other technologies, such as bio-LNG or Rail, were not in scope and could not be analyzed

Source: DHL Freight GoGreen

HERE Case Study

Migros (CH)

CO_2 Insights Case Study at Migros

- *2.000 stores*
- *1.000 daily trucks on the road*
- *50 M truck km per year*

- 50 Diesel trucks replaced with alternative drivetrain technologies
  (mix of BEV, Bio-LNG, H_2)

- >10% net savings in 1 year

- Climate pledge: on track for 70% reduction of GHG by 2030 from road transportation

Source: HERE Technologies

Summary

Location intelligence helps to reduce GHG emissions

Migros has used data driven insights to transform their own road freight operations and are on track to reduce GHG emissions by 70%

HERE is offering the same capabilities and tooling for fleet operators worldwide

Appendix

About HERE Technologies

HERE is the world's leading location data and technology platform

- Access accurate and fresh map content
- Build custom location-based services
- Create live maps
- Securely exchange location data
- Innovate while safeguarding personal data and privacy

Source: HERE Technologies

HERE location platform in numbers

48
use cases served across multiple industries

34.000.000+
vehicles
supplying probe/sensor data

2.000.000+
indirect
developers

500k
direct
developers

160.000.000+
vehicles with HERE maps on board

1.000.000.000.000
API calls per month

200.000.000+
points of interest

Source: HERE Technologies

Transport & Logistic customers value our enterprise grade quality and partnership approach

Why HERE?

- #1 location platform with enterprise-grade quality
- Trusted B2B player with data privacy at its core
- Strong product portfolio to support today‘s logistics challenges

Our customers (selected)

FedEx, C.H. ROBINSON, SAP, DSV, MAERSK, UPS, DHL, leogistics – Optimizing your Supply Chain

Source: HERE Technologies

Sustainability in transport logistics – fleets and alternative drives

Study on CO_2 accounting, alternative drives and actions for sustainability in B2B-transport logistics

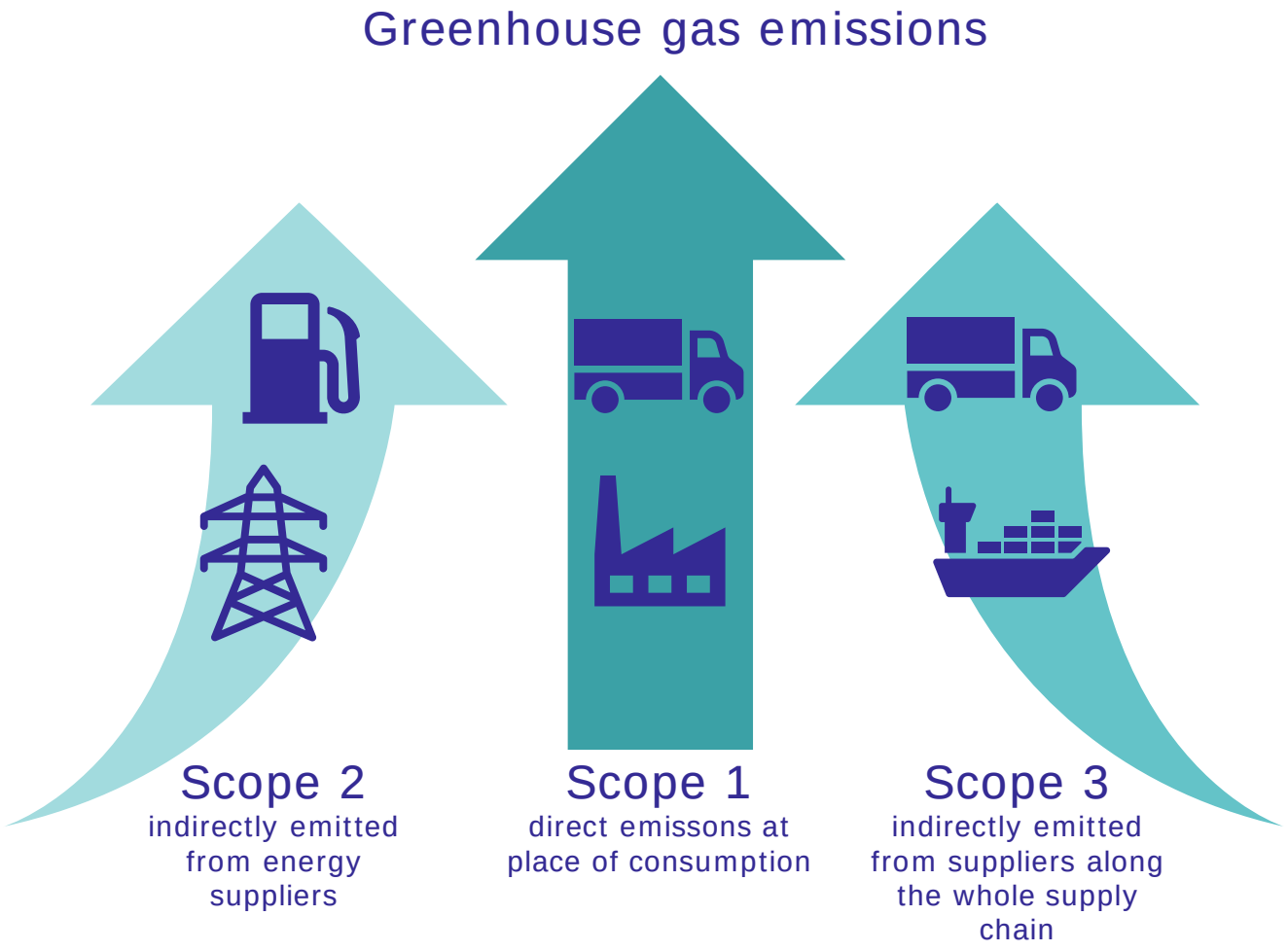
–Survey and workshop findings–

October 19th, 2022

Project overview

- Motivation:
  - The need to become more sustainable is an economic megatrend with direct implications for fleet owners and users in the transportation sector
  - The logistics sector is under pressure to reduce its carbon emissions
- Research goal: Discover sustainability efforts in road freight transport with focus on alternative drives

Basics: The concept of scopes 1 to 3



The scope concept transferred to fleet utilization

Scope 1: exhaust emissions by owned trucks

Scope 2: emissions from refineries for fuel production, emissions from coal-fired power generation, etc.

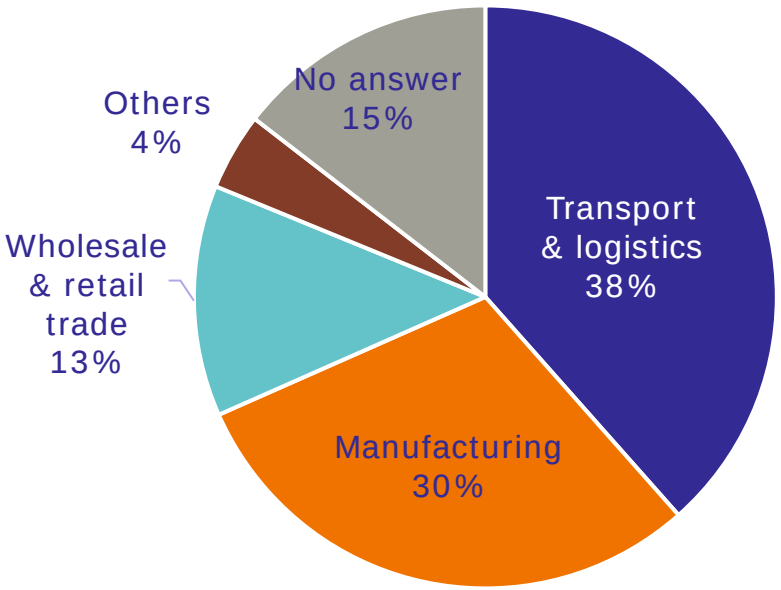
Scope 3: emissions from service provider's freight trucks, emissions from vehicle production

The conducted survey

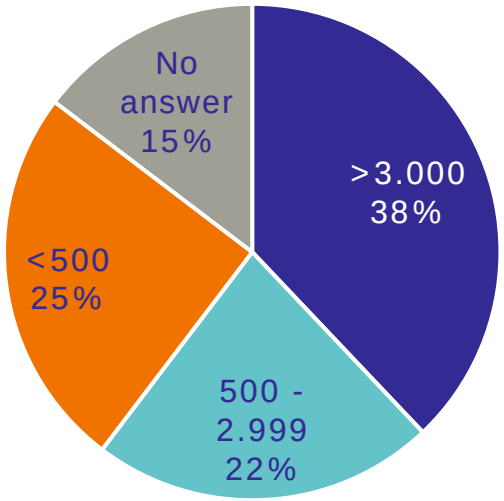
The surveyed sample

The sample encompasses transport and logistics as well as shipping industries

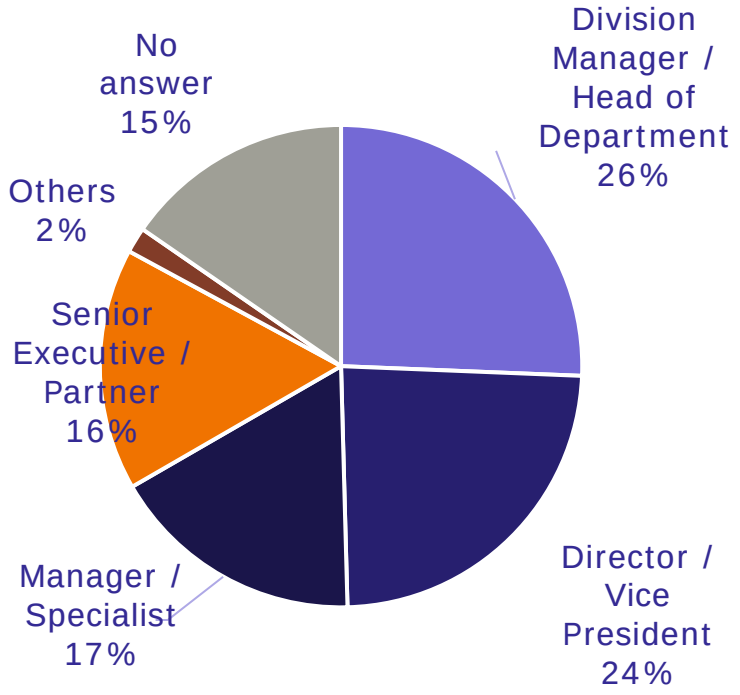
Which type of industry do you represent?



How many employees does your company have?

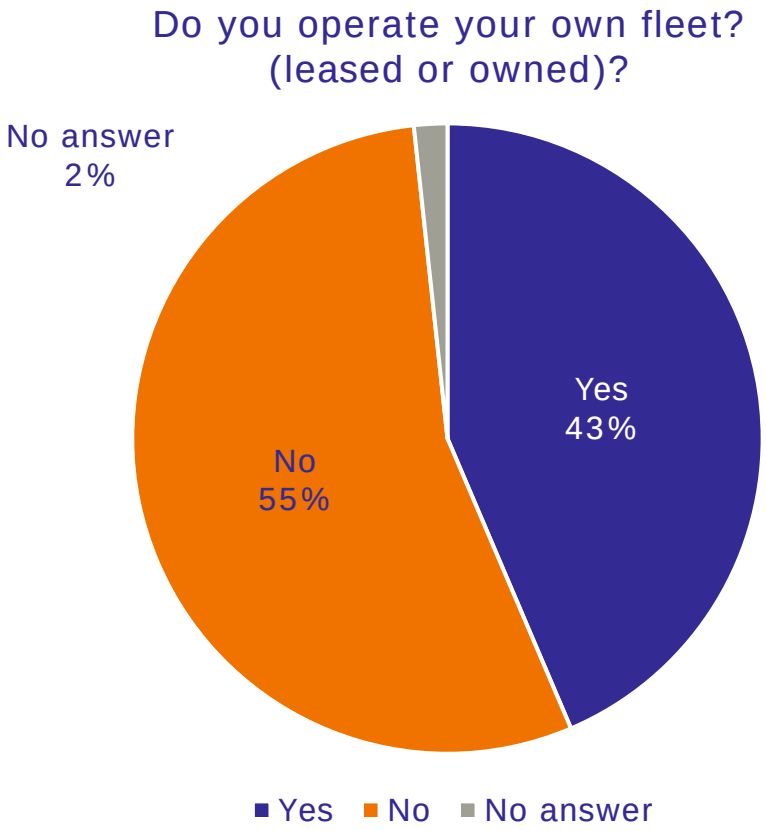


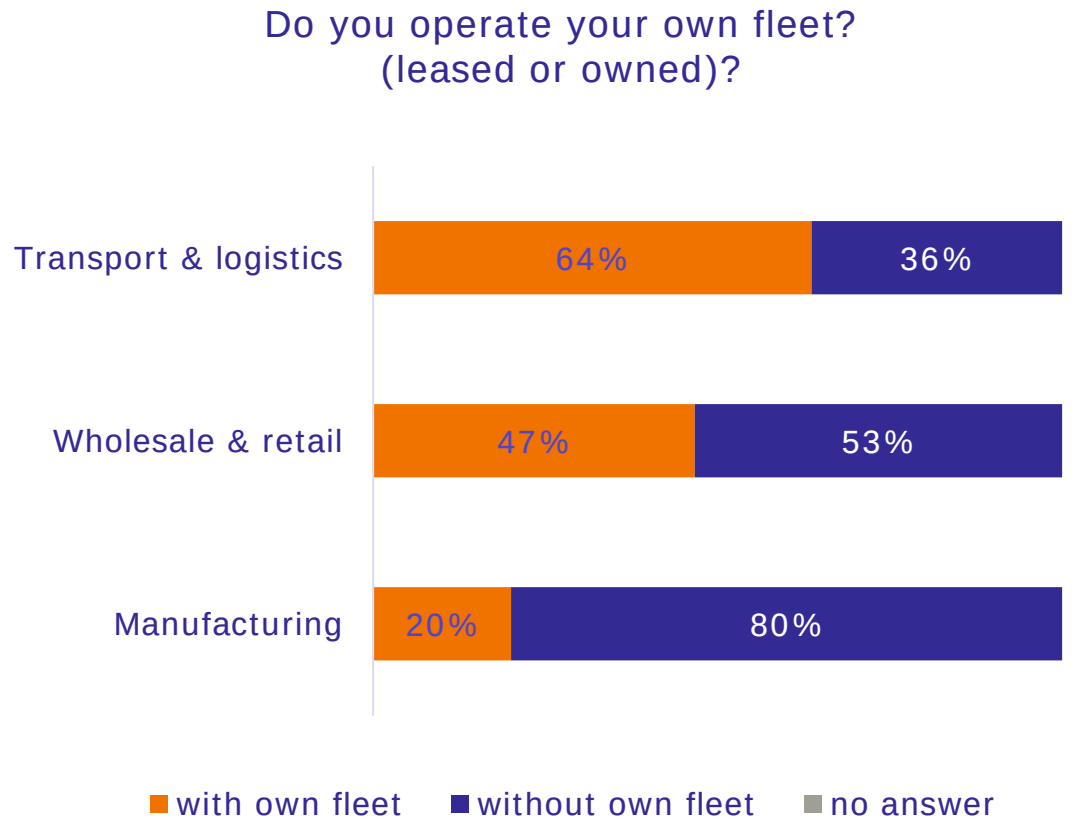
Please describe your function in your company



n=117

43 % of participating companies are fleet operators

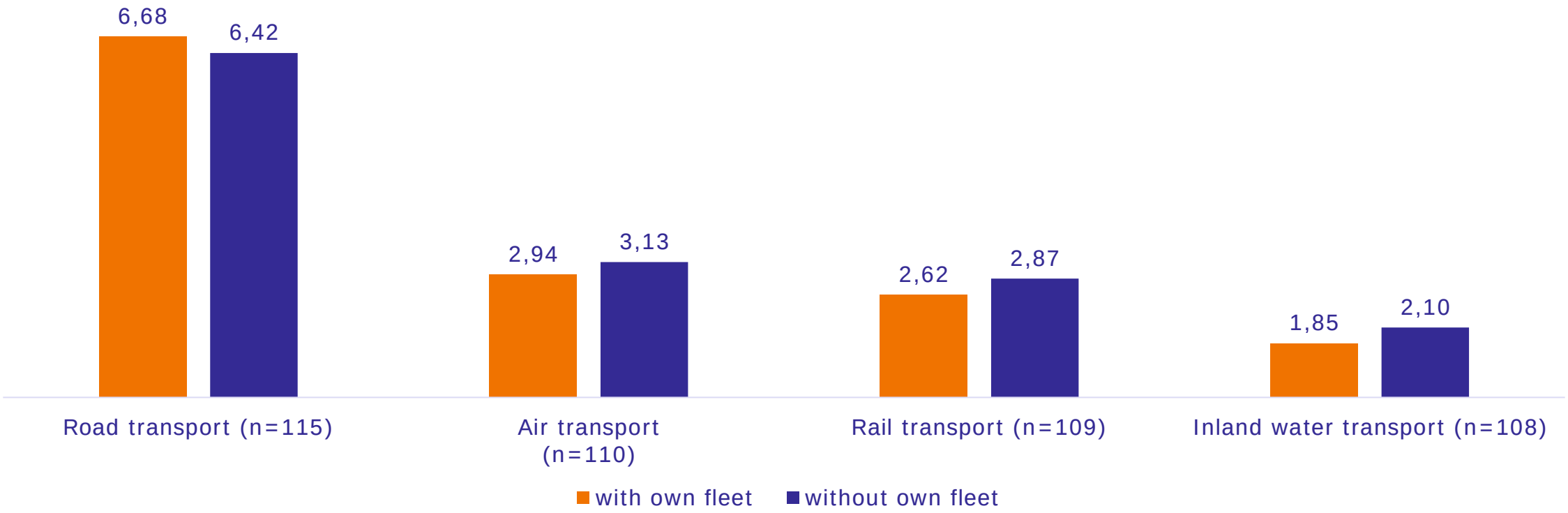




n=117

Non-fleet-operators more likely to use alternative means of transport

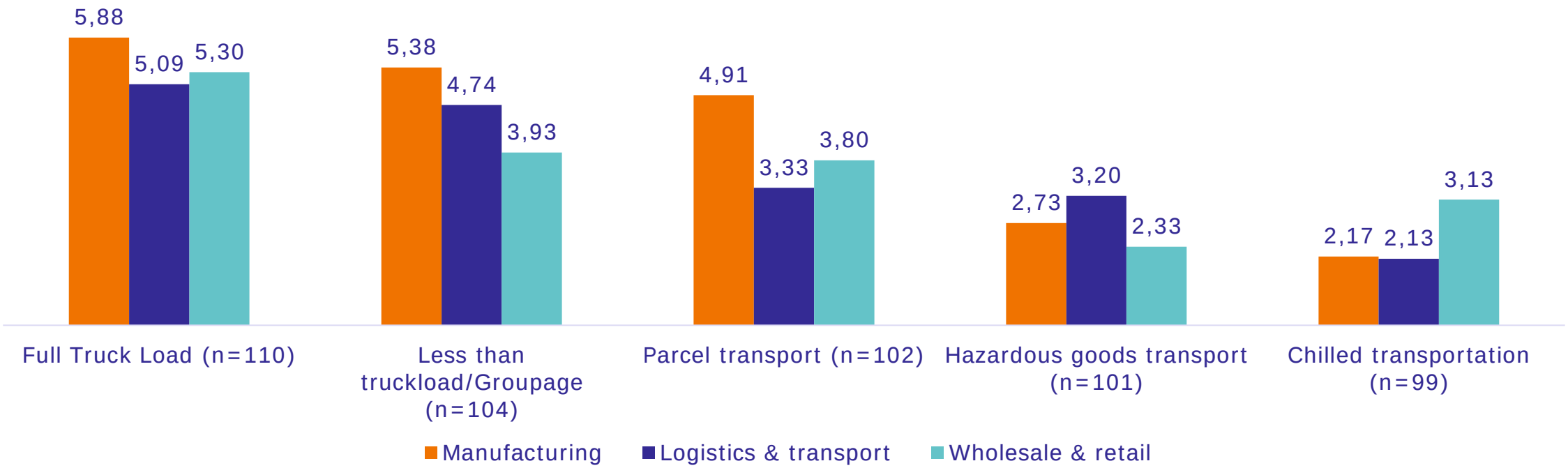
Modal split: Which mode of transport do you use?
[7="very intensive use"]



n=108-115

Manufacturing demands for parcel transport retail demands for chilled transports

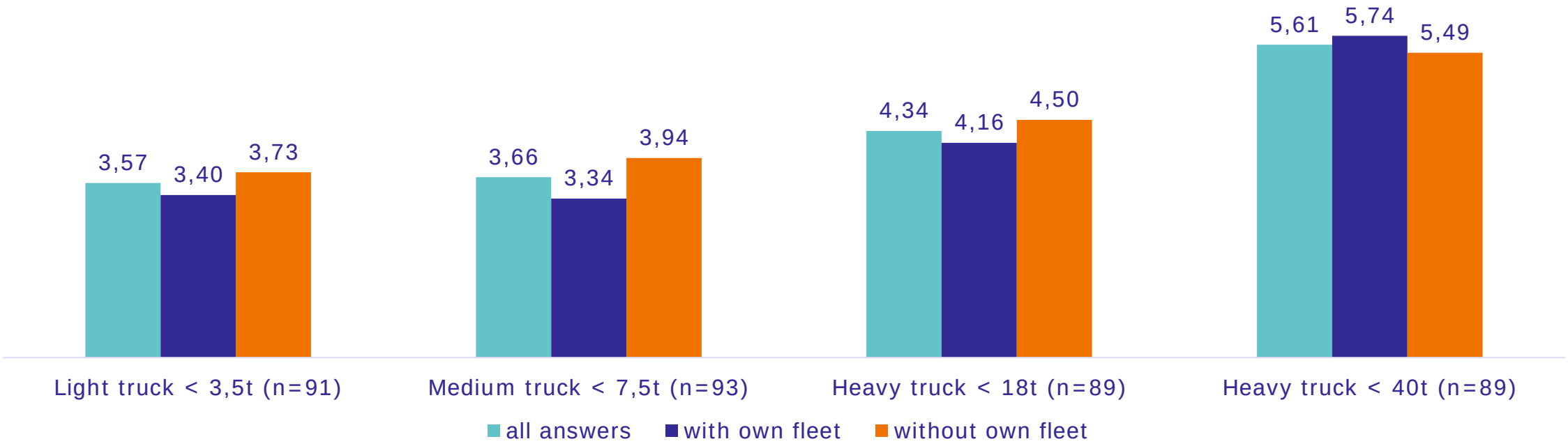
Which cargo type is important to you?
[7="very important"]



n=99-110

Heavy trucks are first choice

Which vehicles do you use most often?
[7="very intensive use"]

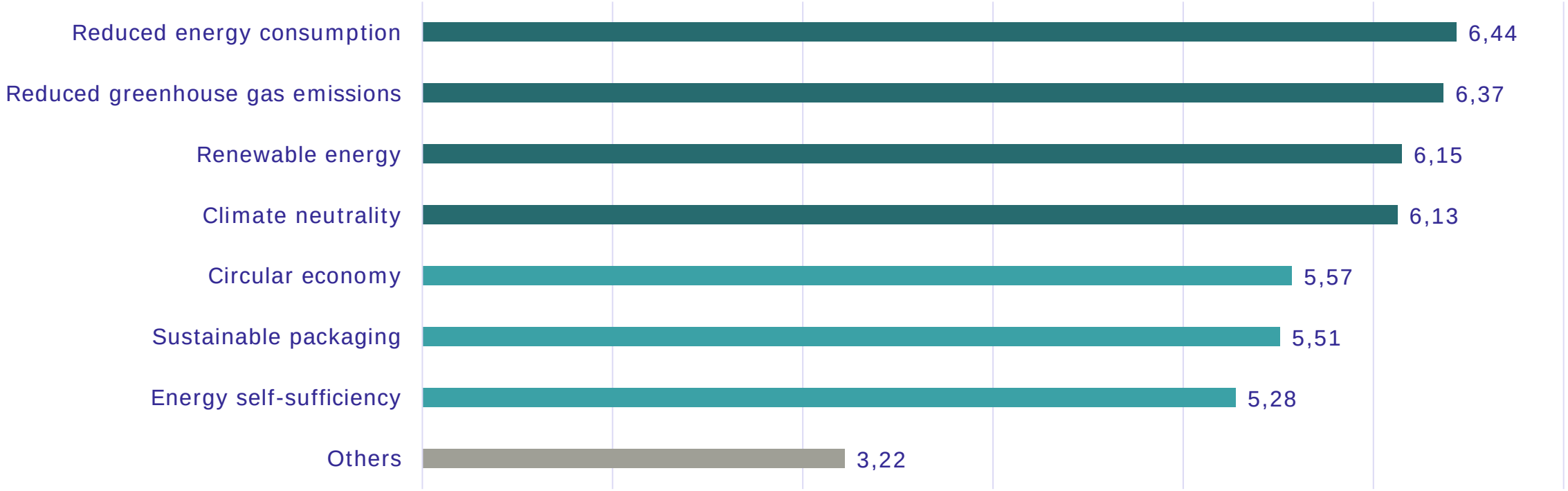


n=89-93

What is important to fleet owners and charterers?

Reducing energy consumption as well as carbon emissions of utmost importance

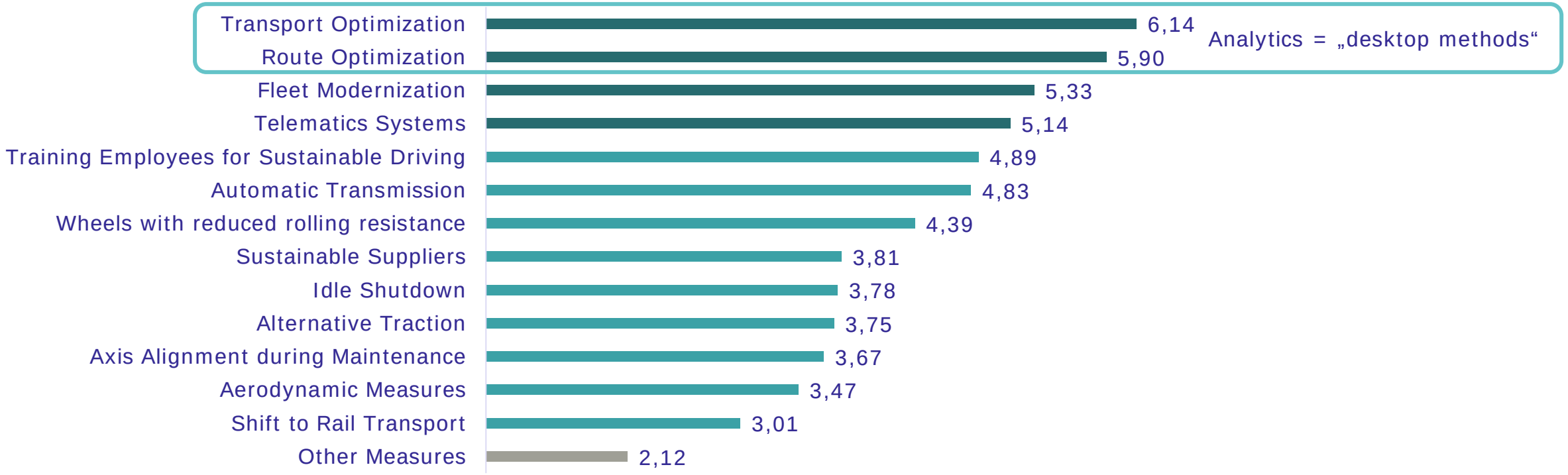
Please rate the following issues according to their perceived importance from 1 “not important“ to 7 “very important“



n=94-103

„Desktop methods“ are first choice for reducing CO_2 emissions

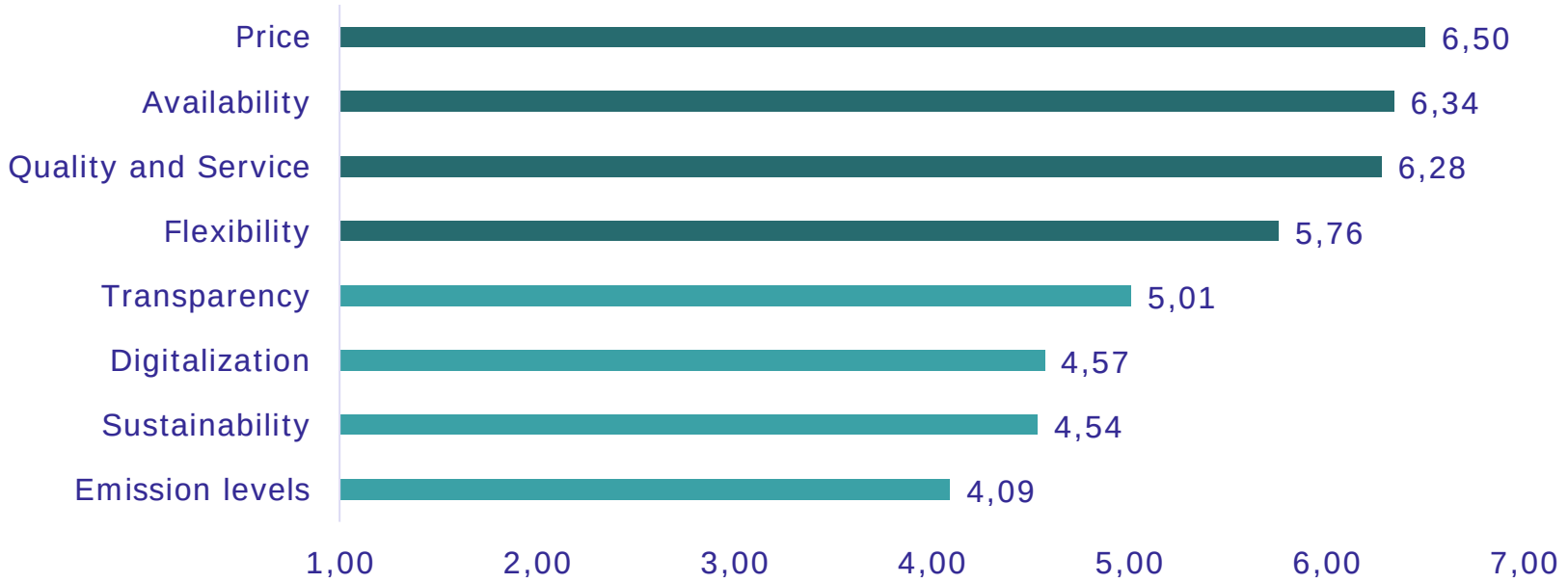
Which tools do you use in order to reduce CO_2 emissions in road transport?
[7=“very intensive use"]



n=56-99

Price and availability of services are most important to customers

In your opinion, which is the most important touchstone when putting transport contracts out to tender?
[7=”very intensive use“]



Claas Bunjes
Head of Mobility & Digital Solutions
L.I.T Cargo GmbH

“The topic of sustainability has partly disappeared from the tenders. Availability counts. LNG commercial vehicles have completely disappeared from the scene in long-distance transport.”

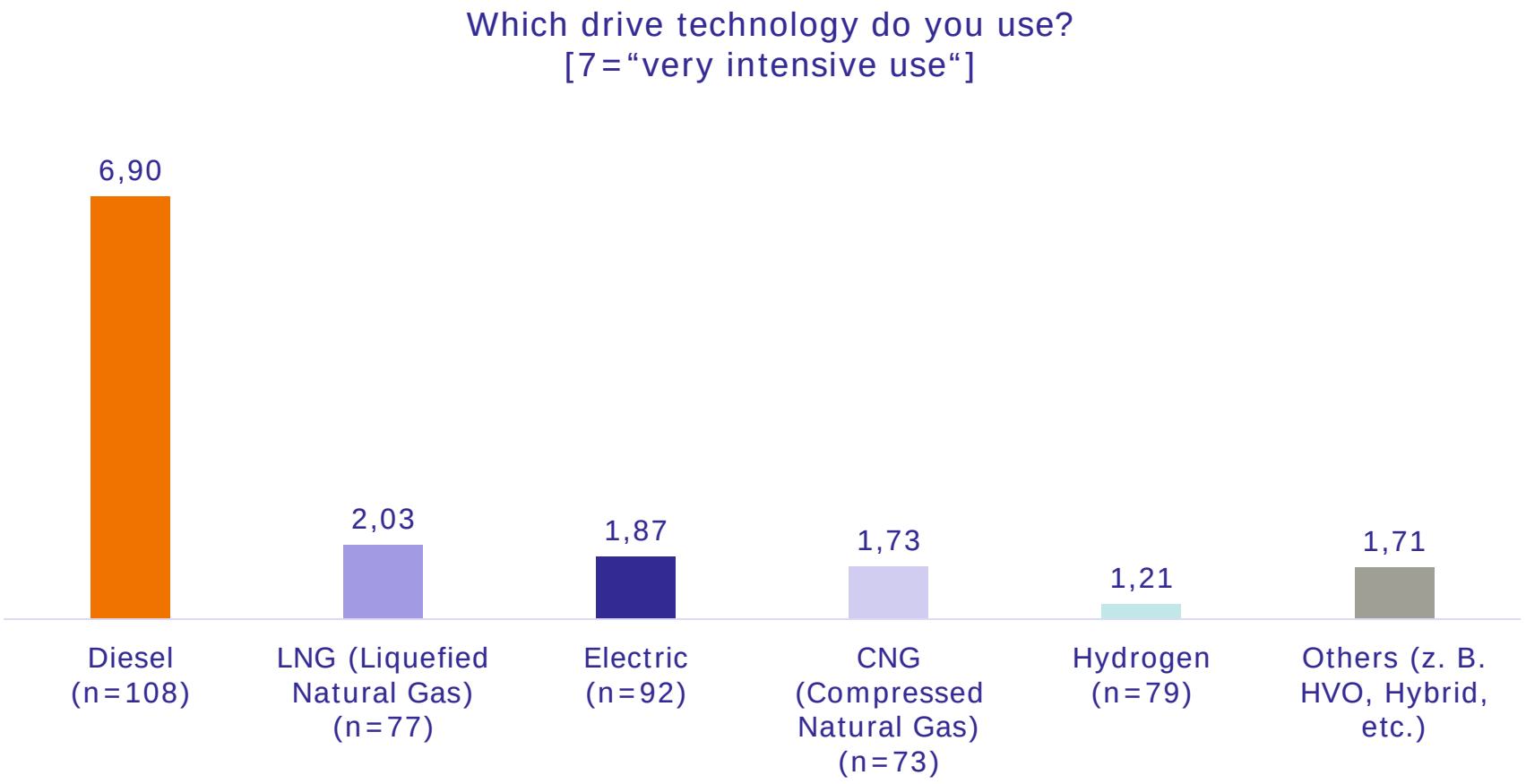
Annotation

- Sustainability only ranks 7th
- Companies seek for resilience and therefore demand for availability, flexibility, transparency and digitalization of transportation services

n=97-99

Drives and energy

Diesel is dominating – experience with other types of drives is lacking

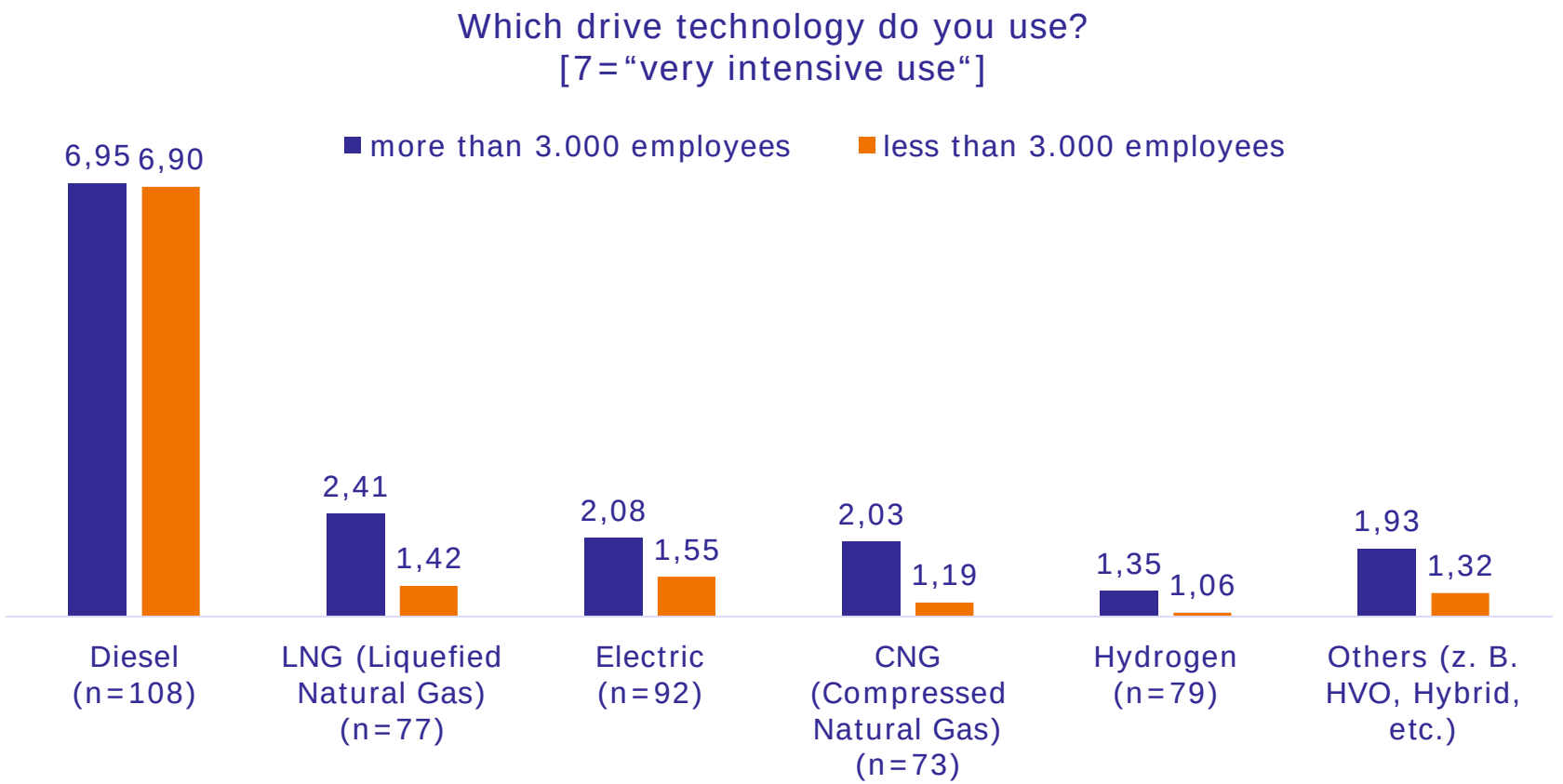


Annotations

- Diesel can be used for **short**, **medium** and **long distance** transport, making it a universal drive technology
- LNG has a similar range as Diesel
- Electric drives are limited to **short distance** transport or roads with overhead wire
- CNG is suitable for **short** and **medium distance** transport

n=79-108

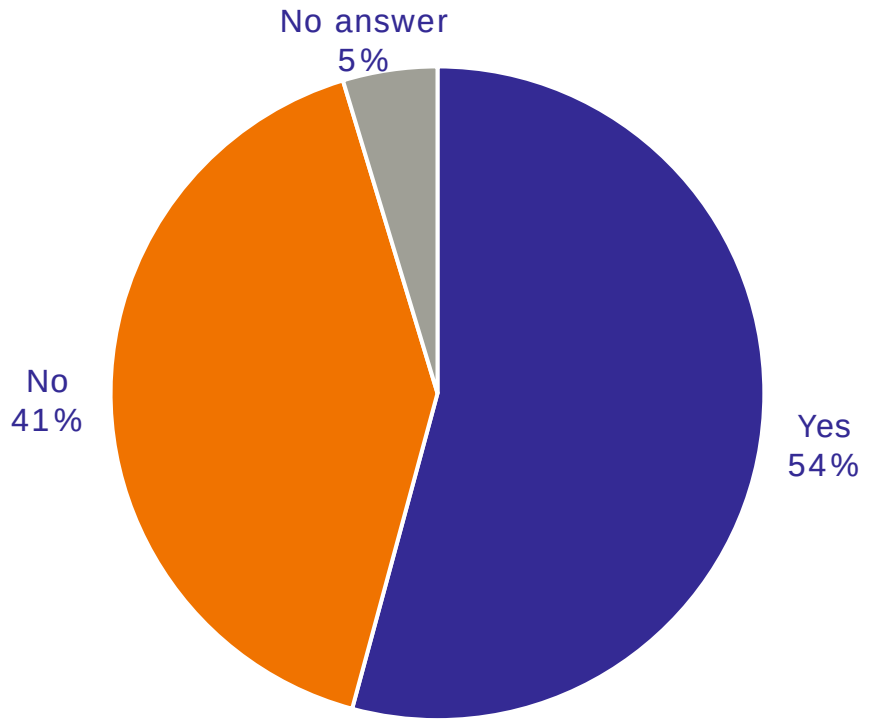
Big companies are more likely to try new technology



n=79-108

Pilot projects with alternative drive technologies

Did your company start pilots with alternative drives?



Comments on conceptual pilots

- Transport planning
- Intermodal transport
- Hubs for different drives

Further comments on technology pilot projects

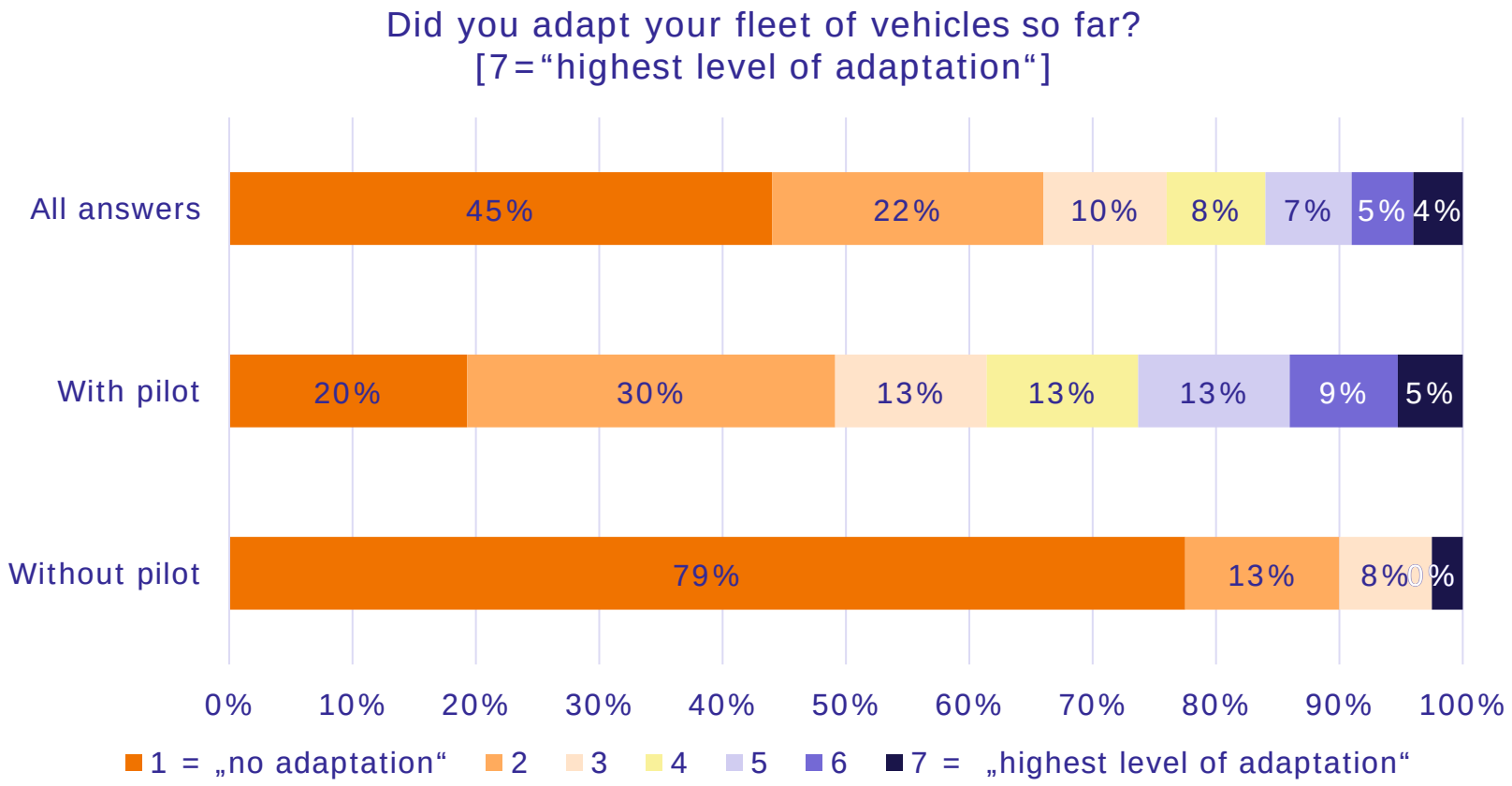
- Vehicles with reduced power/less energy consumption
- CNG for short-distance transport
- LNG for long-distance transport
- Electric trucks for selected projects

Annotation:

Companies which did not conduct any pilot mainly commented on lacking economic viability of alternative drive technologies

n=117

The surveyed sample seems quite reserved regarding fleet adaptions



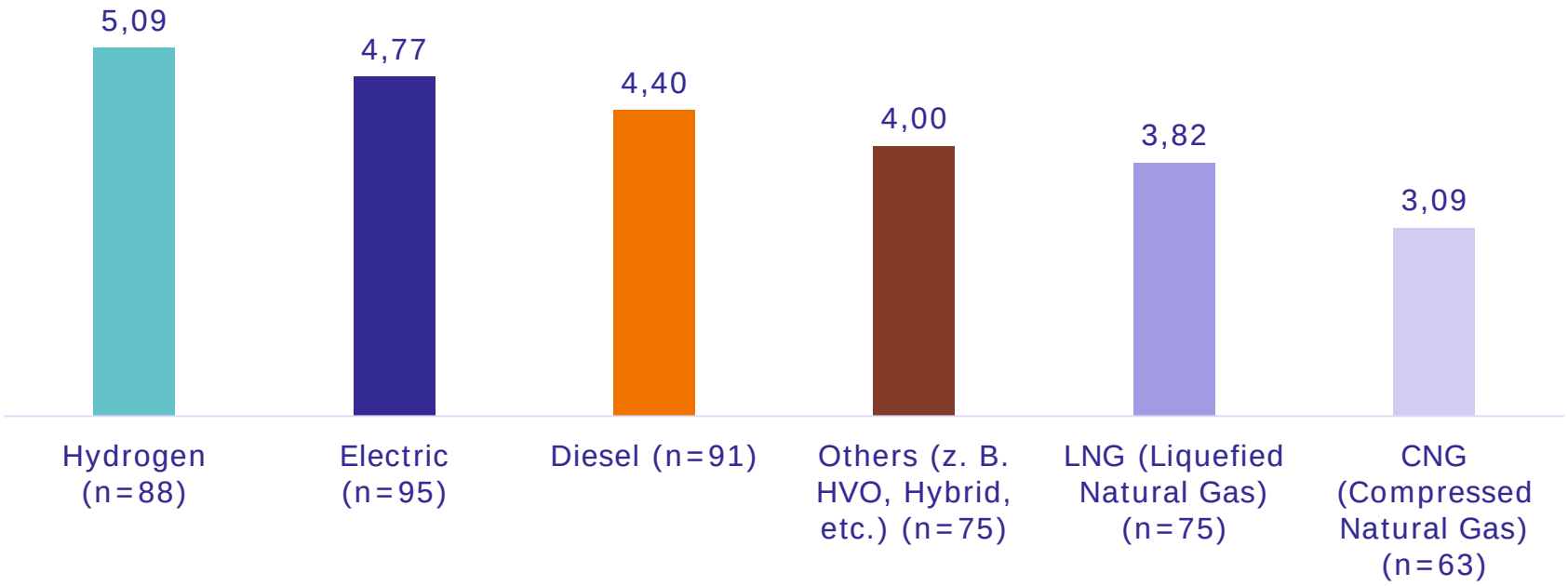
Annotation

- Experienced companies, which already have made pilot projects, are more likely to adapt their fleets (see middle bar)
- Companies without conducted pilot projects are quite reserved in terms of fleet adaption

n=100

Hydrogen is first choice

Which drive would you prefer to use in future?
[7="very intensive use"]

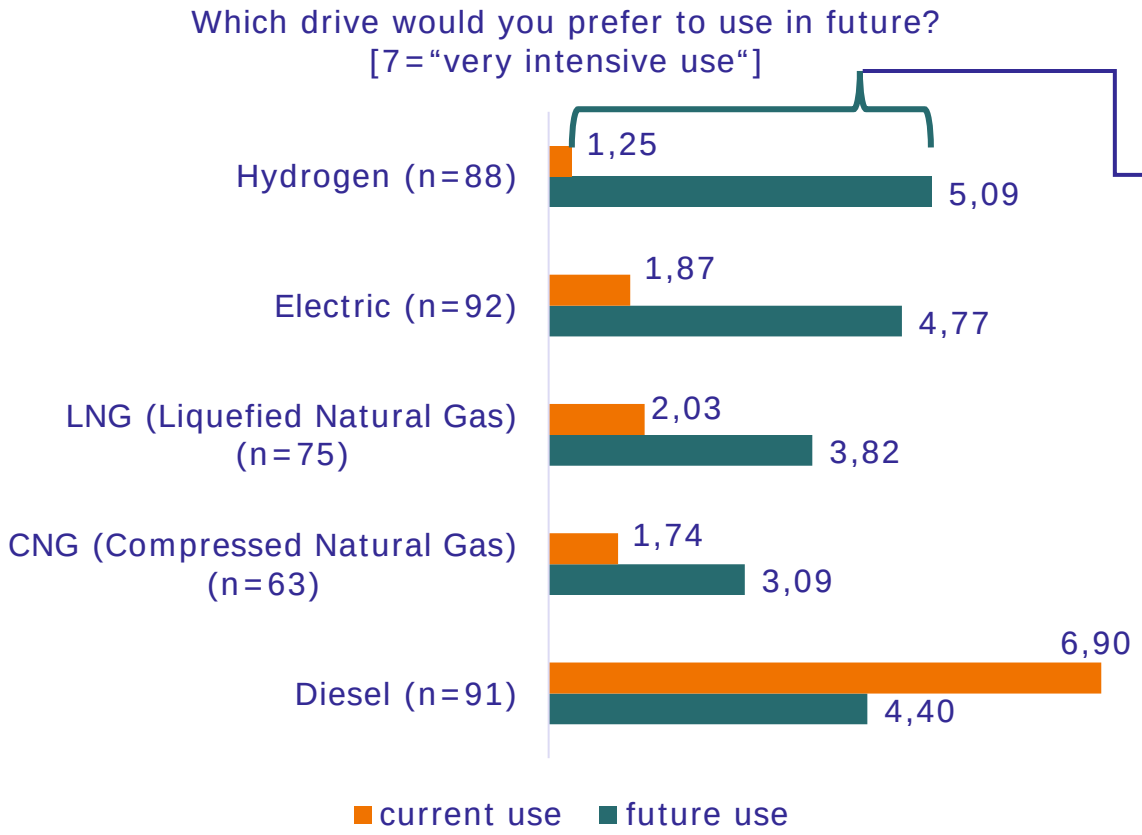


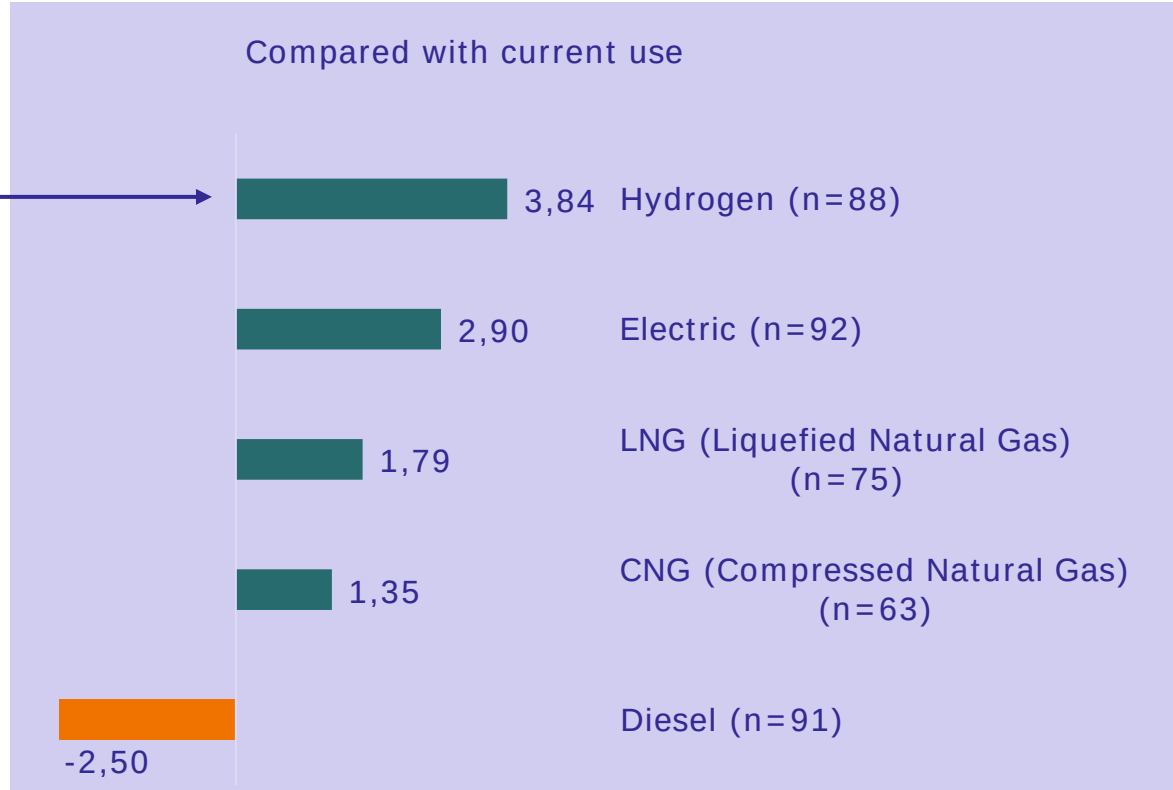
Annotation

- Hydrogen trucks seem to be a fitting solution to fleet owners and charterers
- Hydrogen trucks do not emit CO_2 provided this hydrogen was produced with renewable energy
- These Hydrogen trucks can lose fuel (H_2) when idle, thus reducing power efficiency

n=64-97

Comparison of current and future usage – hydrogen seems to be a Beacon of Hope





Annotation

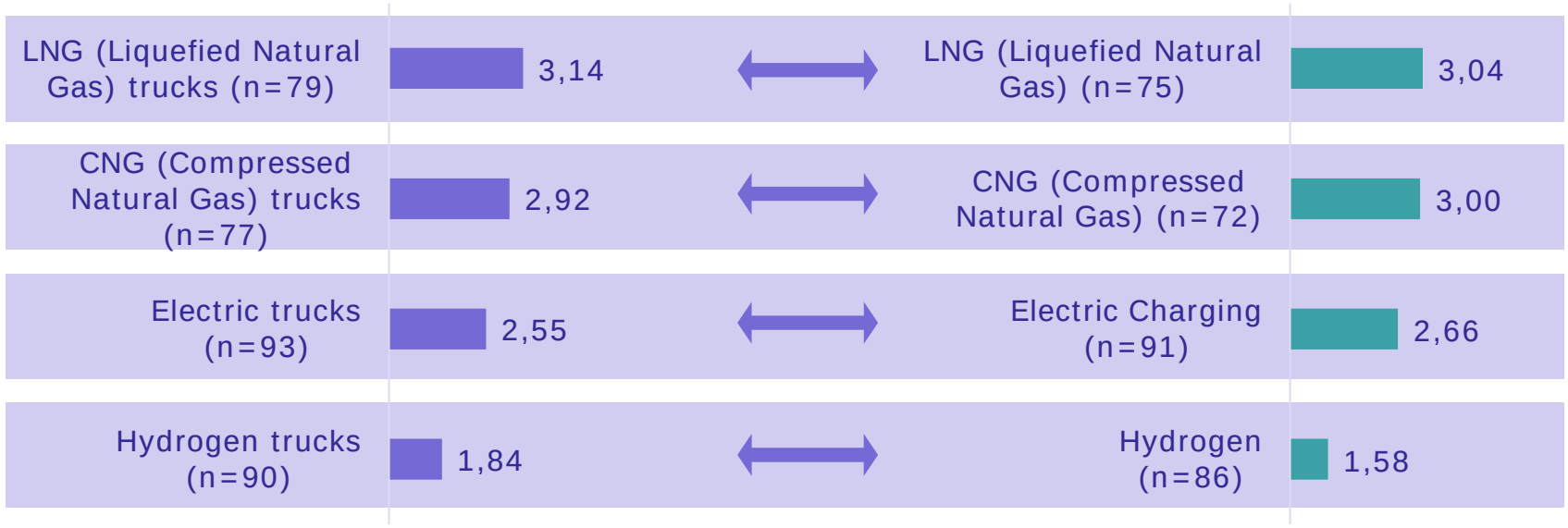
- Sorting shows future expectation vs. current usage
- Higher figures represent higher discrepancy between current figure and future expectation
- Less Diesel drives seems to be agreeable

n=64-97

Technology and charging infrastructure availability are perceived mediocre

How would you evaluate the availability of trucks with alternative drives?
[7="available everywhere"]

How would you evaluate the availability of charging and filling stations for selected drive technologies
[7=„available everywhere"]



Annotation

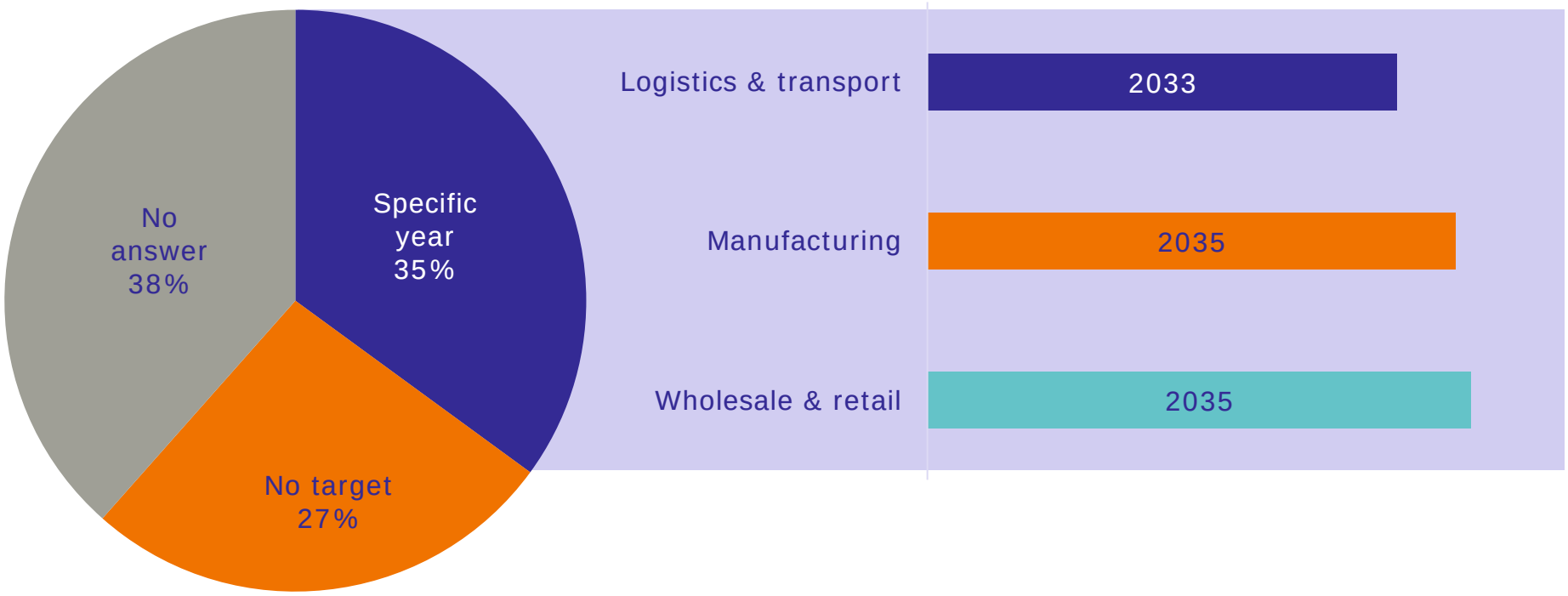
- 68,275 electric charging facilities, only 5,737 of them are suitable for trucks in Germany (as of 2022/09/01)
- 800 public CNG filling stations in Germany
- 120 public LNG filling stations in Germany
- 100 hydrogen filling stations in Germany
- 228 hydrogen filling stations in Europe

n=65-91

Targets and Implementation

Can we achieve climate neutrality until 2034?

Does your company have a target year for climate neutrality?



Annotation

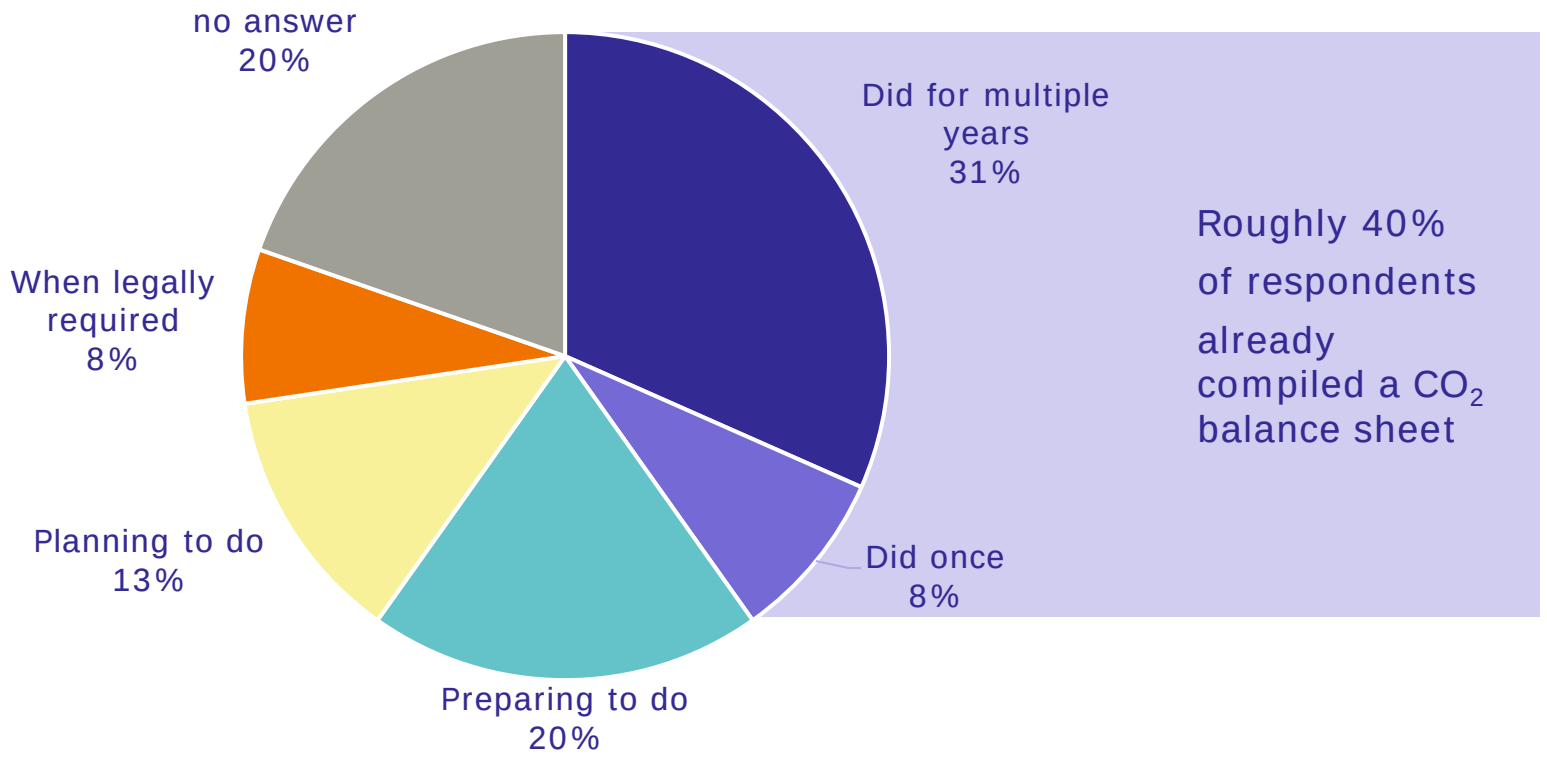
- Only a third of companies in the sample communicate goals when to be climate neutral
- From the experts' point of view these goals seem extremely ambitious
- Neutrality in all scopes 1 to 3 seems hardly achievable due to indirect emissions from connected service providers

In short: What is climate neutrality?

- There consists a lack of clarity regarding the definition what climate neutral is
- Either:
  - No greenhouse gas (GHG) emission or
  - full compensation of emitted GHGs
- Compensation e. g. through:
  - Solar power
  - Biogas plants
- CO_2 neutrality is less comprehensive than complete GHG reduction; CO_2 neutrality only includes a balanced CO_2 budget
- EU Commission draft defines a GHG neutrality target by 2050
- Future emission-pricing as a further incentive to become climate neutral

Compiling a CO_2 balance sheet for fleet utilization seems not yet common

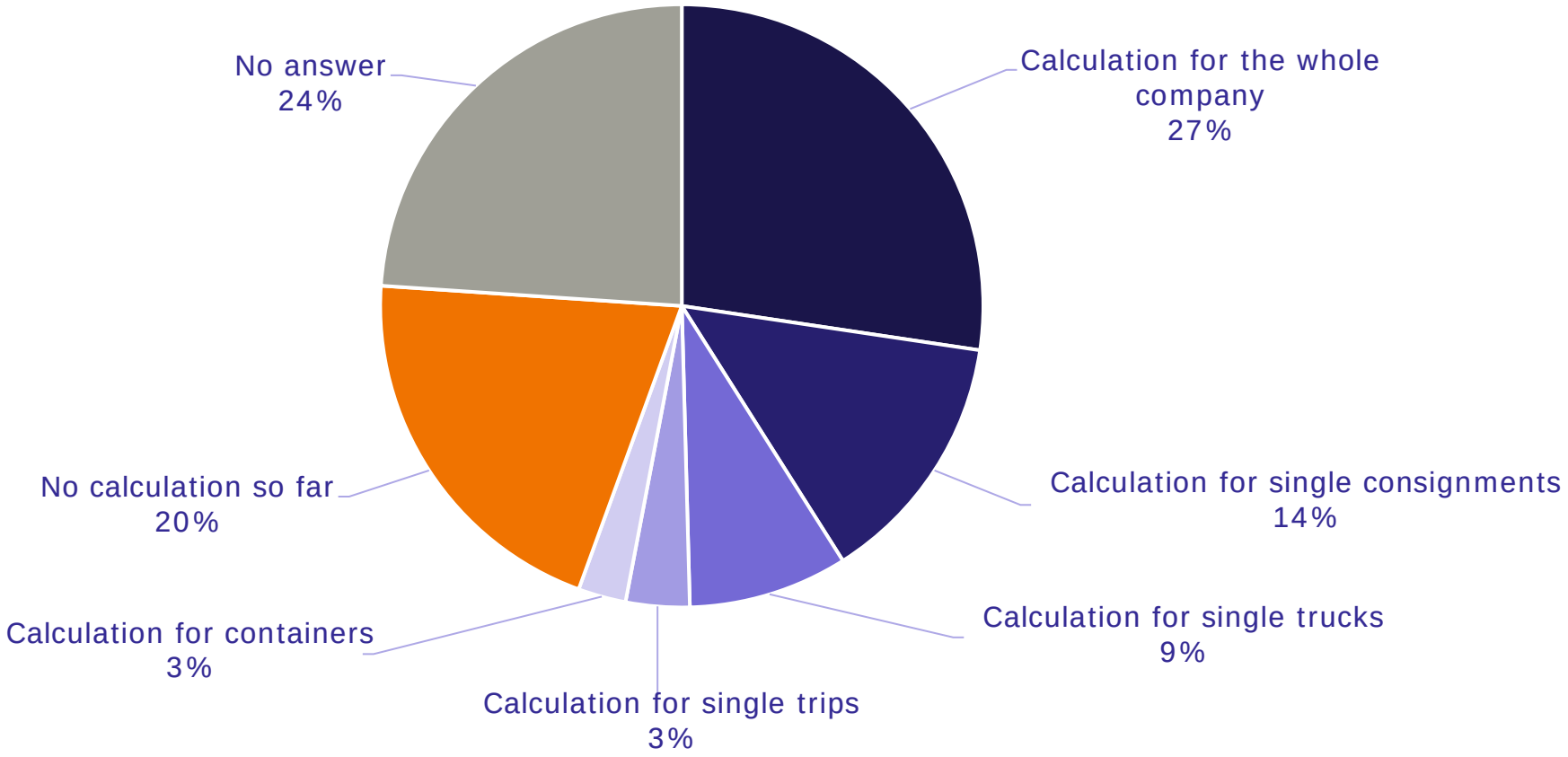
Does your company compile a CO_2 balance sheet?



n=117

Experience with calculation of CO_2 emissions in road transport

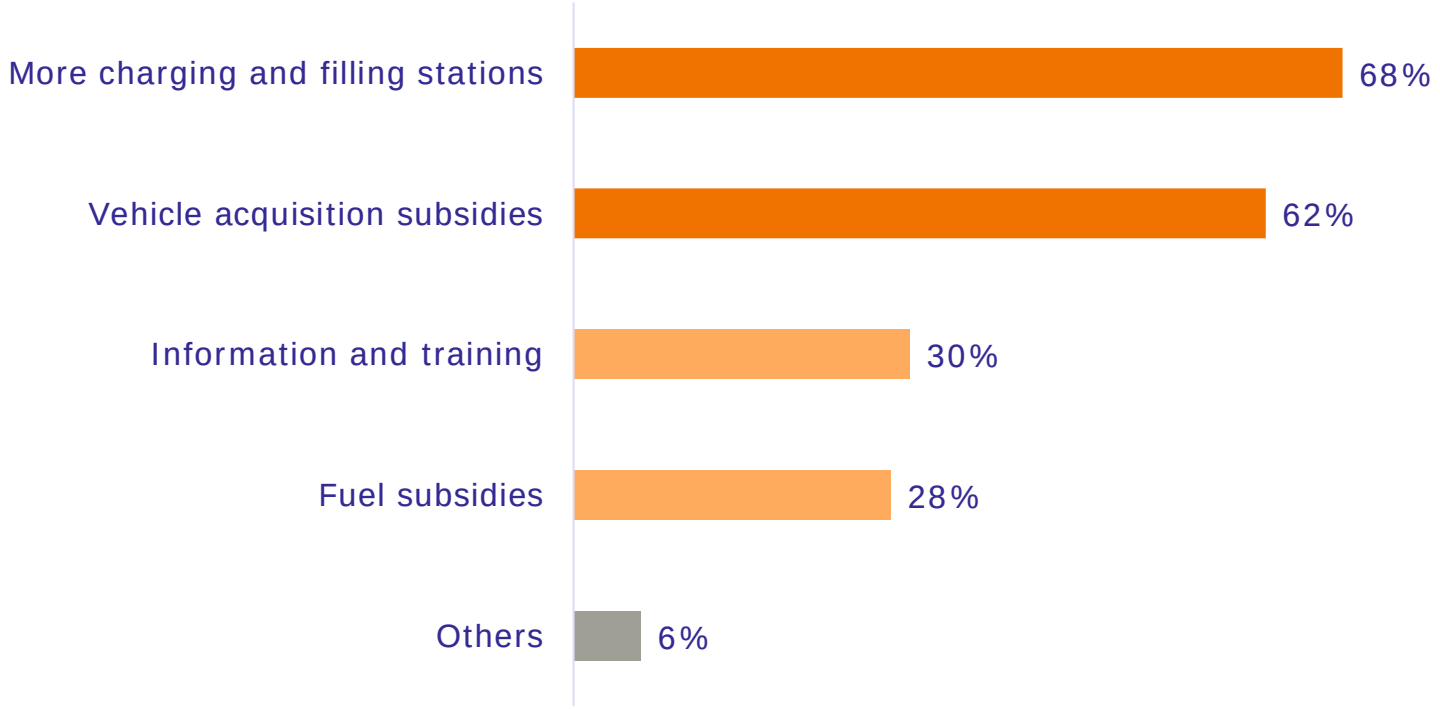
On which level do you have experience in calculating CO_2 emissions in road transport?



n=117

Government aid for alternative drives

Which kind of government aid would encourage you to use alternative drives?



Prof. Dr. Hanno Friedrich
Associate Professor of Freight Transportation – Modelling and Policy
Kühne Logistics University

"The current measures do not seem sufficient to become climate neutral. Moreover: climate neutrality will cost an extremely high amount."

Annotation

- More charging and filling stations seem crucial for broader acceptance and dissemination of alternative drive technologies
- Subsidies could help to alleviate high vehicle investments

n=115

Current challenges

Stephanie Adam
Senior Manager, Program Management
Amazon Transportation

"In the context of the study, the question arises as to how the respondents understood "climate neutral" in concrete terms. Are all emissions, i. e. Scope 1-3, really taken into account?"

Annotation

- Wordcloud painpoints were extracted from the survey and complemented in expert workshop discussion
- Insufficient data exchange means lacking efforts to share emission and routing data along the supply chain which prevents collaborative planning/optimizing

Executive Summary

Tackling the challenges ahead

Executive Summary – Sustainability in transport logistics – Observations

Learnings from the survey and expert workshop

- The necessity to reduce carbon dioxide emissions in land transportation seems broadly accepted
- Alongside sustainability practitioners also need to cope with volatile developments and disrupted supply chains (e. g. war, COVID-19, trade barriers)
- The surveyed sample collects experience from the land transportation sector; the sample is not representative;
- Reduction of energy consumption and carbon emissions are of high importance to the sample
- Analytical methods like transport and route optimization turn out to be most prominent tools to start reducing carbon emissions – this is highly plausible as these methods can easily be started to be used
- Shift to rail transportation seems hardly carried out at the moment
- Participants perceive hydrogen drives as first choice for their future usage of alternative drives. Followed by electric drives and again followed by Diesel drives
- Only a third of participants from the sample state goals when to be climate neutral regarding fleet utilization

Dennis Caldwell
Future Energy & Transport Manager
Hermes Germany GmbH

"Companies are trying to make the current situation climate-neutral on a one-to-one basis, but this is not possible."

Executive Summary – Sustainability in transport logistics – Hurdles

Hurdles

- Only about 40% of participants state that their companies already compiled a CO_2 balance sheet
- At time being, trucks with alternative drives are not broadly used; companies are quite reserved to invest in trucks with alternative drives due to high necessary investments
- Trucks with alternative drive technology differ in their usage profile (esp. range with one tank filling) and therefore are not perceived really suitable for a one on one replacement of currently dominantly used Diesel trucks
- Charging and filling infrastructure is not in place at the moment
- Companies lack experience with alternative drives and only reluctantly make first steps

Prof. Dr. Christian Kille
Professor for Retail Logistics
University of Applied Sciences
Würzburg

"The biggest challenge is that a large number of vehicles have to become climate neutral. But we cannot invest everything at once. Questions are: Where do we start to build up the necessary infrastructure; We need to develop a good roadmap on that."

Executive Summary – Sustainability in transport logistics – Possible paths

Paths to cope with hurdles along the way

- It starts with measuring emissions – Companies that own or charter fleets are recommended to start calculating emissions
- Conventional trucks might not be replaceable on a one-to-one basis; Instead, shifting to more sustainable drives should be approached with a holistic perspective:
- A mix of different types of alternative drive technologies seems to fit best – different types of trucks can be used with their respective strengths (e.g., electric trucks for short distances, CNG trucks for medium distances, LNG trucks for long distances, hydrogen and Diesel trucks for specific routes, shift to modal)
- Conventional planning schemes need to be put to the test; more sustainable transportation may differ from current transport execution
- Intermodal transport should be reconsidered even for shorter distances (e. g. <200 km)
- Diesel trucks might still be of use for special scenarios where alternative drives do not turn out to be feasible
- High potential is seen in collaborative approaches (data exchange) to optimize transport and routing across system and company barriers; idea: Platform for shared usage of alternative trucks for hands-on testing

Stephanie Adam
Senior Manager, Program Management
Amazon Transportation

"In relation to different load and route profiles, there will most likely be a mix of drive technologies."

The project team

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