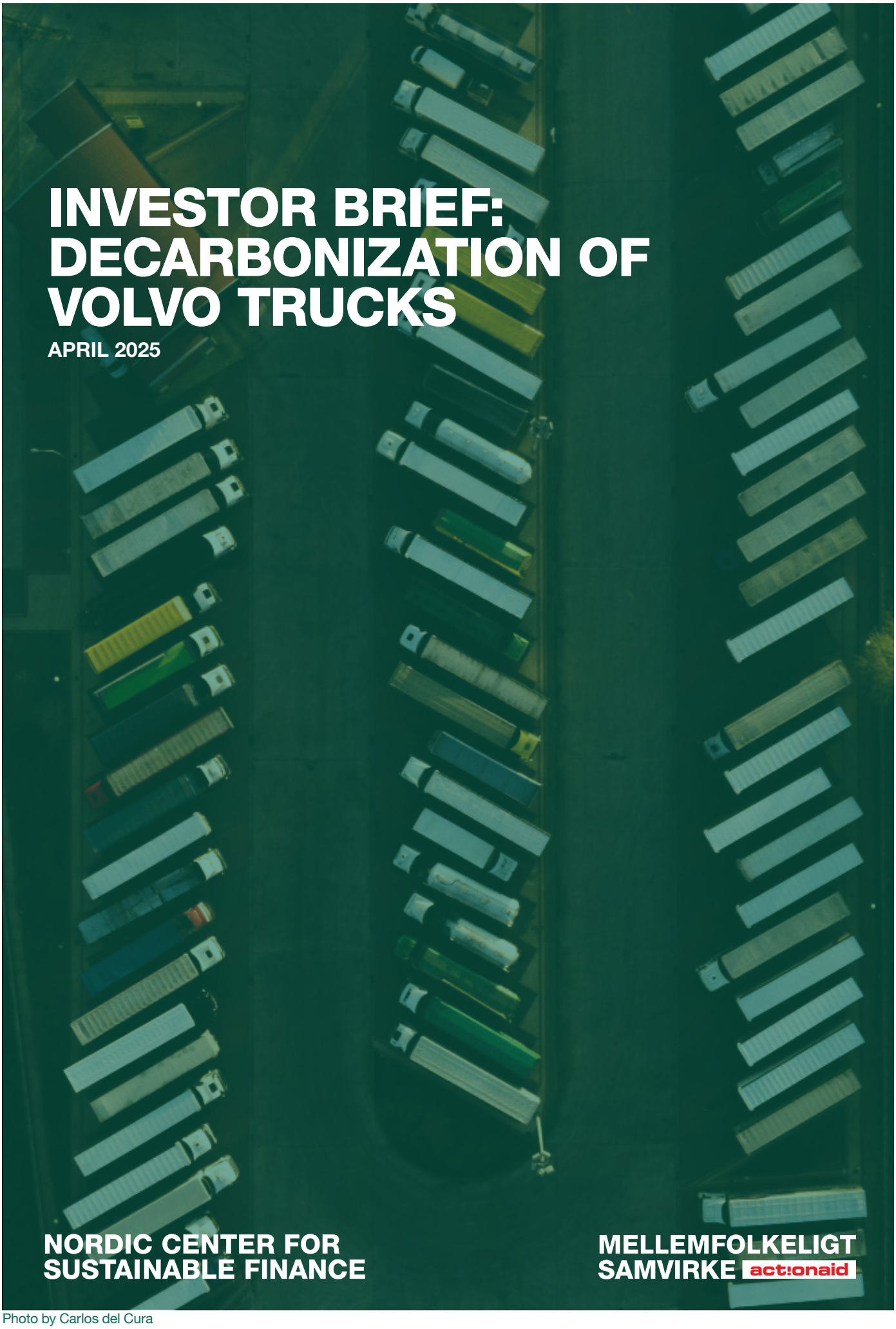
INVESTOR BRIEF: DECARBONIZATION OF VOLVO TRUCKS

APRIL 2025



NORDIC CENTER FOR SUSTAINABLE FINANCE

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Photo by Carlos del Cura

EXCECUTIVE SUMMARY

A BATTERY ELECTRIC TIPPING POINT

The climate impact of trucks is largely overlooked by the financial sector. Yet, trucks are a major climate pollutant, and the sector is only transitioning slowly, far behind passenger cars. This is however about to change, with expected disruptive effects throughout supply chains. As costs of battery electric trucks rapidly decrease (see section 3.1) and new climate legislation enters into force (see section 3.2), the truck market is expected to see a rapid shift from sales of diesel to batteries. Once it kicks in, the BET shift is expected to happen much faster than for passenger cars[1].

This is a major business opportunity (see section 2.2), but also a significant risk for truck manufacturers who will have to compete not only with each other, but also with new market entrants such as Tesla and BYD. This could very possibly lead to a major reshuffling of market shares – today's truck majors have no guarantees to retain their market share if they fail to transition in line with the incoming surge in BET demand (see section 3). For investors, it is high time to consider if investee truck manufacturers are aligned with the incoming changes.

ENGAGEMENT NEEDED TO FUTURE-PROOF VOLVO

Specifically, the Nordic Center for Sustainable Finance (NCSF) recommends engaging Volvo Trucks (hereafter "Volvo"). In essence, the company risks missing the business opportunities tied to the forthcoming surge in BET-demand. While other truck manufacturers have long embraced that tomorrow's trucking is battery electric[2], Volvo has chosen a risky *"three-pronged approach"*[3]: Next to batteries and fuel-cells, Volvo insists on a future for the combustion of fuels such as hydrogen and biofuels[4], which come with a whole host of sustainability issues (described in Appendix). This is further amplified by Volvo's disconnect from the passenger car market, the rapid electrification of which is benefiting truck makers that also produce passenger cars[5].

Additionally, Volvo is prone to risks of greenwashing campaigns. CEO Martin Lundstedt has named climate *"the challenge of our generation"*[6], in stark contrast not only to Volvo's bet on unsustainable fuels, but also the company's public lobbying efforts to water down key climate legislation in the US and Europe (see section 2.1). This poses a major branding risk, which risks not only affecting market valuation, but also spilling over to investors. Lastly, NCSF believes that investor engagement could effectively contribute to a battery-electric transformation of Volvo.

TO FUTURE-PROOF VOLVO TRUCKS, INVESTORS SHOULD ENGAGE ON THE FOLLOWING ISSUES

1) Commit to 100% zero-emission sales by 2035

2) No new production facilities for diesel trucks

3) Align all lobby activities with 1.5 C

1 SUGGESTED INVESTOR ASKS FOR VOLVO TRUCKS

1 COMMIT TO 100% ZERO-EMISSION SALES BY 2035

Volvo's current three-pronged approach to decarbonization is out of tune with policy, technological and market developments, which, as outlined below, are highly favourable to battery electric trucks (BETs). To win back what is already lost in terms of wasted valuable R&D resources on unsustainable technologies such as LNG and biofuels, Volvo should course-correct and commit to truly zero-emission technologies.

Volvo is committed to net-zero emissions across its supply chain by 2050, including the use of its products. As trucks are on average on the road for 15-18 years[7], this should translate to 100% zero-emission sales by 2035 at the very latest. Volvo's current target is *"net-zero value chain"* by 2040 (see section 2.1.1 for why the target should be 100% zero-emission as opposed to net-zero).

2 NO NEW PRODUCTION FACILITIES FOR DIESEL TRUCKS

As demand shifts to BETs, it is likely that ICE assets will become heavily underutilized, implying that newbuild production assets for internal combustion engine (ICE) trucks are likely to become stranded assets. As outlined above, truck manufacturers with net-zero targets by 2050 should not sell any ICE trucks beyond 2034. As truck production facilities have a payback timeframe of about 10 years, any newbuild ICE production assets (property, plant, and equipment (PP&E)) beyond 2024 risk being stranded. As such, truck makers committed to net-zero by 2050 should not bring new ICE assets online from now on.

3 ALIGN ALL LOBBY ACTIVITIES WITH 1.5 C

Volvo Trucks is documented to have been involved in several efforts to push back on key climate legislation in the US, EU and elsewhere[8]. Such activities contradict the company's outspoken support for high-level climate targets . As such, Volvo should align their lobbying efforts with 1.5C, increase transparency about its positions and engagements, as well as of its industry associations. Volvo Trucks should support the Global Standard on Responsible Climate Lobbying, a framework for aligning climate lobbying with the Paris Agreement, initiated by the Swedish state pension fund AP7, BNP Paribas Asset Management and the Church of England Pensions Board.

Zero-emission trucks are trucks without any tailpipe emissions, i.e. battery electric and fuel cell electric trucks powered by green hydrogen. As both costs and policies are highly favorable to battery electric propulsion, BETs are likely to make up the large majority of zero-emission trucks. There are however a small segment of trucking operations where fuel cell technology will be preferable (up to 0.02% by 2040, with the remainer being battery electric)[9].

IF TRUCKS WERE A COUNTRY, IT WOULD BE THE 5TH MOST CARBON POLLUTING IN THE WORLD[10]

In Europe, heavy duty vehicles account for only 2% of vehicles on the road, but close to 30% of CO2 emissions from road transport[11]. Trucks and buses account for 6% of all greenhouse gas emissions in the EU[12], 7% in the US[13]. While passenger cars are rapidly transitioning to battery electric, less than 2% of 2023 trucks sales were zero-emission[14]. The climate impact of trucking is further amplified by a projected increase in trucking activity of 44% towards 2050[15].

Photo by Daniel Fikri

2 BETTING ON UNSUSTAINABLE FUELS RISKS VOLVO'S COMPETITIVENESS

This section outlines how Volvo's diffused decarbonization pathway risks losing valuable market shares when demand switches from diesel to battery-electric trucks. This risk is further amplified by Volvo's disconnect from the passenger car market, and the competition with Chinese truck manufacturers. To future-proof its market position, Volvo should commit fully to zero-emission technologies, in particular BETs, inter alia securing long term supplies of battery raw materials. While Volvo has already wasted valuable time and resources on non-sustainable technologies, there is still time to course-correct and win market shares of the forthcoming BET market.

2.1 VOLVO IS CHALLENGED ON ZERO-EMISSION READINESS

As outlined in this section, there are several reasons to question if Volvo, with its current strategy, will be able to meet its climate targets. A 2023 ranking of the *"zero-emission readiness"* of major truck OEMs scored Volvo well behind a number of competitors (Figure 1), and the lowest of the top three global truck manufacturers; Daimler (Mercedes-Benz), TRATON (MAN, Scania), Volvo (Volvo, Renault)[16]. More recently, Bloomberg found that Volvo is nowhere near target levels and will ***"need a concerted push in the years ahead to meet their own targets, and to stay onside with more aggressive rules coming from regulators in Europe and markets like California"***[17].

2.1.1 Volvo's scattershot decarbonization squanders precious time and R&D resources

While both economic and political (see section 3) developments are highly favourable to battery electric trucks, Volvo has failed to dial in their R&D and public affairs resources towards BETs. Instead, the company continuing to pursue underperforming and non-scalable technologies such as LNG[18], biofuels[19] and hydrogen[20], as highlighted in Volvo's own visualization of the group's decarbonization pathway (Figure 2). In line with this pathway, and contrary to market developments, Volvo keeps investing the internal combustion engine and in April 2024, Volvo's CTO said the company in 2024 would spend more than ever before on internal combustion[21].

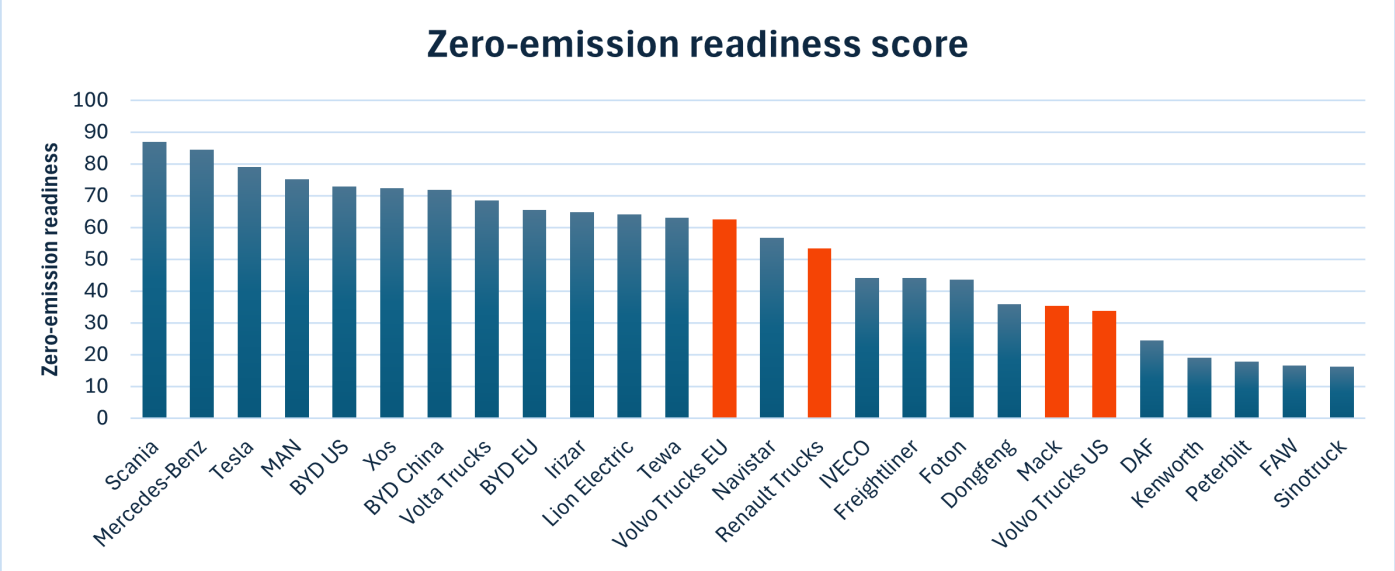

Figure 1: Zero-emission readiness scores of selected truck makers in Europe, China, and the US. Edit: Red highlight of truck brands owned by Volvo Group. Source: Transport & Environment (2023) *Ready or not: Who are the frontrunners in the global race to clean up trucks and gain technology leadership?*

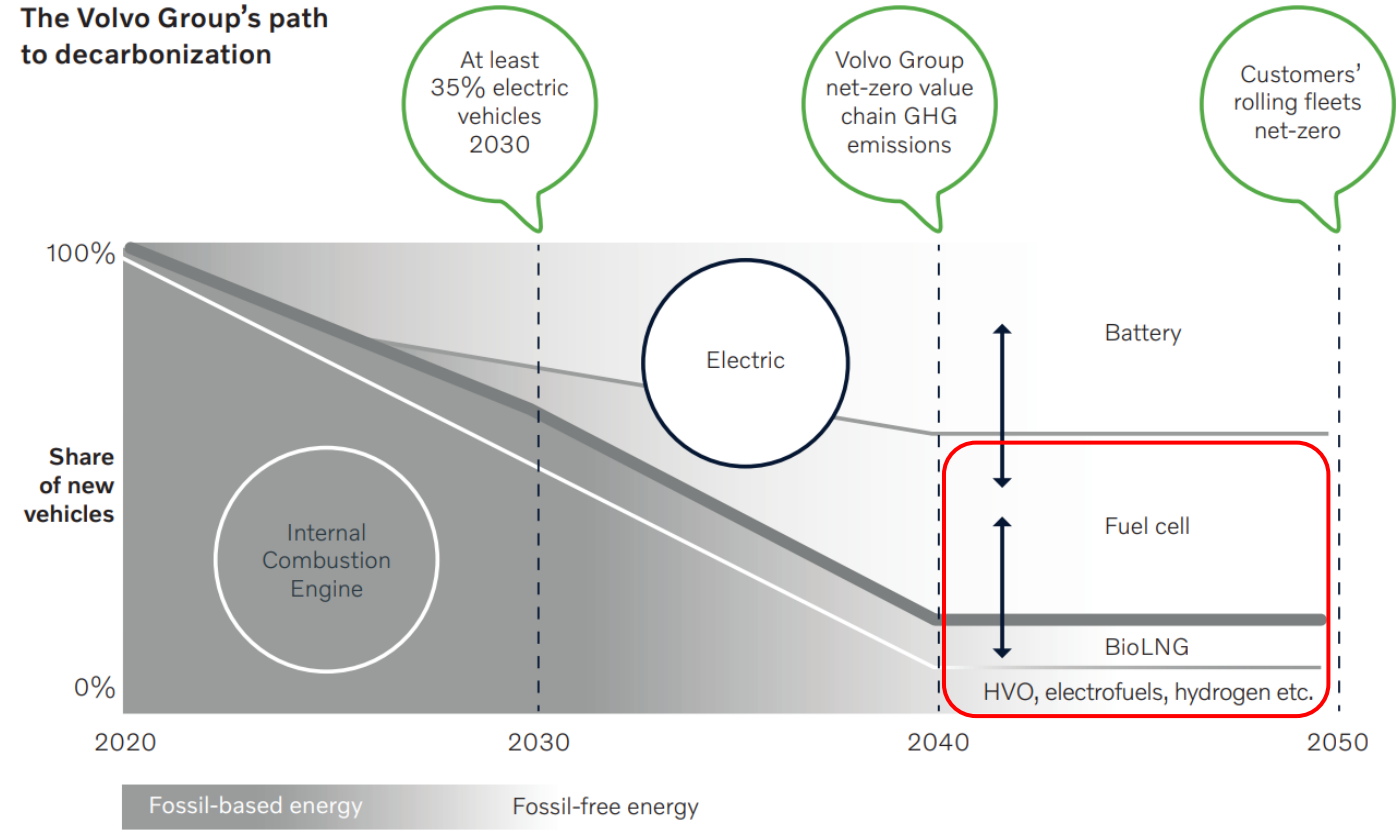

Figure 2: Technology path projections for Volvo Group towards 2050. Edit: Red figure added to indicate reliance on unfavourable and unsustainable technologies. Source: Volvo Group (2024) *Volvo Group Annual Report 2023*

***"LNG-powered vehicles are the first step towards zero emissions"* – Volvo Trucks[22]**

In April 2024, Volvo was planning to spend more than ever before on internal combustion[23]

Speaking to the limitations of Volvo's diffused decarbonization pathway, the company's zero-emission readiness is currently hampered by a limited BET model portfolio, as well as insufficient efforts to secure raw materials for batteries and towards battery innovation[24]. This is likely related to the fact that, unlike its competitors, the Volvo Group does not own any passenger car brands - while Tesla, BYD, and TRATON (Scania, MAN) have all secured long-term supplies of battery raw materials, as they leveraged their own (or their Group's) efforts to secure supplies for the passenger car market, Volvo has not secured such supplies[25].

Hydrogen combustion for trucks requires around 4.5 times as much electricity as BETs[26]. Volvo recognizes the unfavourable cost projections, highlighting a need for public spending to ensure *"incentives for vehicles and infrastructure expansion"* and a *"viable hydrogen price"*[27]. Similarly, Volvo finds that the EU requirements for hydrogen refuelling availability to be insufficient[28]. Considering that the EU regulatory framework favours battery-electric technology for trucks, Volvo's hopes for policy and public financial support for hydrogen seem unrealistic, and the company's further R&D efforts in this regard risk being a dead end.

In essence, Volvo's bet on combustion puts the company's future competitiveness at risk, especially as competitors such as TRATON have long realized that tomorrow's trucking operations are battery electric[29].

WHY VOLVO'S "NET-ZERO" CLIMATE TARGET IS INFERIOR TO A "ZERO-EMISSION" TARGET

Volvo's headline climate target is *"net-zero value chain emissions by 2040"* is incompatible with 2050 net-zero targets, as trucks sold in 2040 will on average be on the road until around the mid/late 2050s[30]. Furthermore, net-zero includes fuels such as HVO (Hydrotreated Vegetable Oil) and bioLNG (liquified biogas), which, in regulatory terms, can count as renewable. There is however broad scientific evidence that such fuels are either unscalable or unsustainable (see Appendix). Given that these fuels are also inferior to battery electric propulsion (see section 3), Volvo should refocus their resources and commit to reach 100% sales of zero-emission technologies by 2035 to ensure that the rolling fleet is zero-emission by 2050.

2.1.2 Chinese BET surge risks marginalizing Western manufacturers

In addition to its technology diffusion, Volvo Trucks is – along with other European OEMs (Original Equipment Manufacturers) - challenged by Chinese truck makers, who sold 9 of 10 BETs in 2023[31]. In December 2023, 10% of truck sales in China were zero-emission[32]. In particular BYD, across its US, EU and Chinese divisions, is significantly better positioned to win BET market shares compared to Volvo and other European OEMs[33]. But other Chinese OEMs are moving into Western markets, e.g. Chinese BET startup Windrose is planning an assembly plant in Georgia, US[34].

Chinese OEMs benefit from the country's leading position in sales of electric passenger cars – In 2023, electric car sales (excluding plug-in hybrids) in China hit 5.4 million, 64% higher than the combined total of Europe (2.2 million) and the US (1.1 million)[35]. In the same year, BYD overtook Tesla as biggest producer of electric vehicles in Q4[36] Further, Chinese OEMs are aided by the fact that nine of the top ten battery cell manufacturers in 2030 are expected to be Chinese, making it is unlikely that Chinese OEMs will have trouble sourcing batteries[37].

In essence, competition with Chinese manufacturers implies that Volvo and other Western manufacturers must step up their electrification efforts, if they are to gain any foothold in the emerging BET market. This again underscores why Volvo should reorient its R&D resources towards battery electric propulsion.

2.2 DUBIOUS CLIMATE LOBBYING ACTIVITIES RENDERS VOLVO PRONE TO GREENWASHING CAMPAIGNS

It is relevant for investors to be aware of investee companies' engagement with regulatory developments. For Volvo, there is material risk that media or civil society could instigate a greenwashing campaign, targeting the say-do gap between the company's support for head-line climate targets, while repeatedly pushing back on climate legislation.

Volvo Group has actively opposed key legislation to decarbonize heavy-duty transport in the US, EU and elsewhere. While the company has expressed support for high-level climate goals such as supporting the Paris Agreement[38] and the 1.5°C target[39], Volvo has actively lobbied against specific truck-related legislation, as exemplified below.

Regarding disclosure of positions and engagement activities, Volvo Group's reporting is limited to top-line climate statements without reference to specific climate-related policies[40]. As a result, Volvo Group appears to have excluded key instances of engagement with specific climate-related policies.

Besides Volvo's individual lobby efforts, Volvo takes part in five industry associations classified as *"Misaligned"* as well as five associations classified as *"Partially Aligned"* with 1.5°C by the CA100+ backed Influence Map[41]. Furthermore, Volvo CEO Martin Lundstedt chairs the Commercial Vehicle Board of the (*"Partially Aligned"*) European Automobile Manufacturers Association (ACEA), which, like Volvo, opposed 100% zero-emission target for trucks[42], as well as any phase-out date for combustion[43]. As with its individual lobby activities, Volvo has failed to disclose an account of its industry associations' positions and engagement activities[44].

EXAMPLES OF VOLVO'S LOBBY EFFORTS TOWARDS KEY CLIMATE REGULATION

European Lobby Efforts

- Opposed a 100% zero-emission target for heavy duty vehicles (HDVs)[45] and the proposed reduction target for 2030 under the CO2-standards for HDVs[46].
- Advocated for expanded LNG and CNG infrastructure[47] under the Alternative Fuels Infrastructure Regulation (AFIR).
- In the UK, Volvo Group subsidiary Renault Trucks, advocated to weaken the stringency[48] of the UK's zero-emission vehicle mandate.

European Lobby Efforts

- At national level, Volvo strongly opposed the proposed EPA heavy-duty GHG standards for 2027 and advocated for a delay of the Phase 3 GHG standards from 2028 to 2030[49].
- At state level, Volvo argued against the Advanced Clean Trucks (ACT) rule in California, Maryland and Colorado[50].

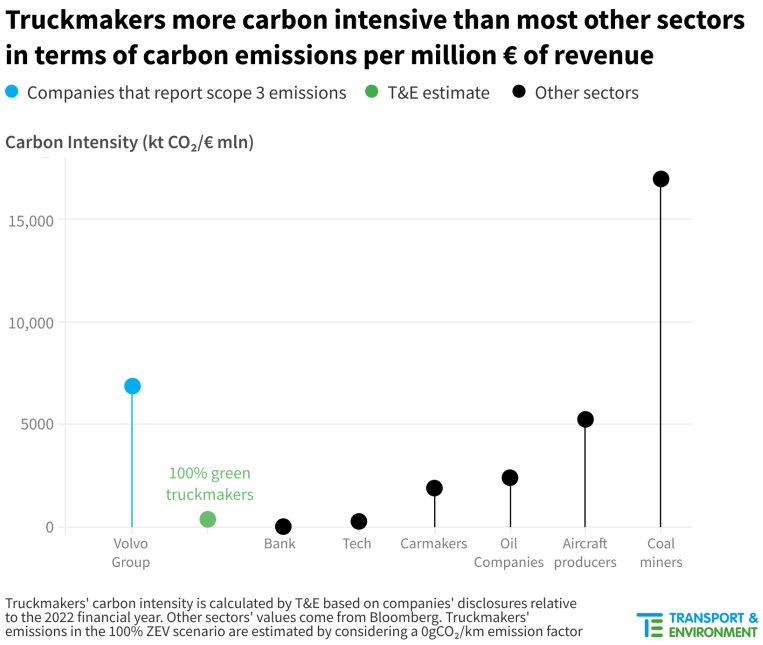

Figure 2: Technology path projections for Volvo Group towards 2050. Edit: Red figure added to indicate reliance on unfavourable and unsustainable technologies. Source: Transport & Environment

2.3 Volvo is more carbon intensive than aircraft producers - a heavy burden for Paris aligned portfolios

Volvo's back-seat commitment to electrification and dubious lobby efforts are not the sole issues for investors. As trucks are heavily used capital goods, they emit large amounts of carbon for years after they are sold. When accounting for this climate impact of Volvo's products (scope 3, use of product), Volvo is more carbon intensive than other highly carbon intensive industries such as steel and aircraft producers (Figure 3).

This will soon be a major issue for investors: starting from the financial year 2024, the European Sustainability Reporting Standards (ESRS) mandates large companies to disclose their scope 1, 2 and 3 emissions, while the Sustainable Finance Disclosure Regulation (SFDR) mandates the same of financial institutions.

Consequently, Volvo shares will come with significant carbon penalty, affecting the carbon intensity of investment portfolios with decarbonization targets.

Such carbon intensity could easily prompt investors to move out of truck manufacturers. However, due to the incoming business opportunities related to electrification of the freight sector (see below) and the associated climate benefits, Nordic Center for Sustainable Finance encourages investors to engage Volvo proactively, rather than moving directly to sale of assets. Such dialogue should have clear and time-bound demands, with an explicit escalation strategy, with divestment being the last resort, if dialogue proves unfruitful (see for example ShareActions guide for effective engagement[51]).

ELECTRIFICATION OF THE FREIGHT SECTOR IS A MAJOR BUSINESS AND INVESTMENT OPPORTUNITY

The rapid industrialization and urbanization of emerging economies, coupled with the global growth of e-commerce and logistics means that the global heavy-duty vehicle (HDV) market is expected to grow from $271 bn (2023) to $433 bn by 2032, reflecting a compound annual growth rate of more than 5%[52]. Coupled with the incoming demand-switch from diesel to BETs (see section 3), investments in the truck manufacturers who manage to win BET market share could prove highly profitable. To align with the IEA NZE scenario, Carbon Tracker estimates that over 13 million zero-emission HDVs must be deployed worldwide between 2024 and 2035[53], implying sizable opportunities for top-line sales growth for truck manufacturers.

3 POLICY & ECONOMICS FAVOUR BATTERY ELECTRIC TRUCKS

This section lays out current trends in economics and the regulatory environment for heavy-duty vehicles, reflecting widespread evidence of an incoming swift transition from diesel to battery powered propulsion. The developments underscore the arguments developed above – Volvo's bet on the combustion engine is a dead end and risks wasting R&D resources which Volvo should prioritize to strengthen its position in the BET market.

3.1 BATTERY ELECTRIC TRUCKS POISED TO WIN

The truck market is extremely cost-sensitive, meaning that the most affordable and efficient propulsion technologies will dominate sales, and investors should be wary if investee truck manufacturers continue to back uncompetitive technologies. As detailed below, BETs are projected to become the most cost-effective and by far the most widely adopted option, beating both diesel (3.1.1) and other alternative fuels (3.1.2).

3.1.1 Trucks are approaching an electric tipping point

Recent literature consistently finds that BETs, over the lifespan of the vehicle's life, will very soon be cheaper compared to diesel trucks, with the latest findings indicating that most or all truck segments are expected to achieve unsubsidized cost advantages compared to diesel trucks in the mid to late 2020s[54]. This is because operational costs are highly favourable to BETs – charging electrons is significantly cheaper than tanking diesel.

A recent Nature meta-study of more than 1.100 recent studies of battery price projections found that BETs *"may realize cost benefits versus DTs [diesel trucks] as of today"*[55]. The study further found that BETs are likely to reach *"breakthrough"* price levels before 2030, and that battery costs are likely to halve from 2020 levels already around 2030. This is significant as 75-80% of the value of BETs is with the battery/electric motors[56]. Correspondingly, several studies find that current and announced BET models will soon be technically competitive with diesel trucks[57]. Regarding fuel cell costs, the Nature study found that, fuel cell trucks may not achieve cost parity during the 2030s due to green hydrogen costs[58].

Even the upfront purchase cost, which currently are still unfavourable to BETs, will decrease rapidly in the coming years. A recent study drawing on Bloomberg New Energy Finance's battery cost forecast found that already by 2030, the purchasing cost for BETs will be lower than their diesel counterparts in four out of five truck categories, excluding only the heaviest long haul tractor trucks. By 2040, it will be lower for all categories[59].

3.1.2 BETs cheapest among alternative fuels

While Volvo foresees the combustion of alternative fuels, the extent to which such fuels will be economically viable is at best highly speculative. A 2023 study found while battery technology will be the most cost-effective across all European truck segments by 2030, combustion of alternative fuels such as HVO, hydrogen or biogas will be 18-52% more expensive compared to BETs by 2040[60]. In essence, Volvo is betting on fuels, which will be significantly more costly than battery propulsion (Figure 4).

FLEET OWNERS GO ELECTRIC TO DECREASE EMISSIONS AND COSTS

- Amazon has ordered 100,000 electric delivery vehicles by 2030. Since summer 2022, over 15,000 vans have been deployed across the U.S., delivering more than 800 million packages. Amazon's electric vehicle fleet includes over 15 models operating in the U.S., Europe, and India[61].
- North American transport company Schneider National has driven more than 3 million battery-electric kilometres with its 92 class 8 Freightliner eCascadias, cutting 3,800 tons of CO2 and one ton of NOx emissions[62].
- Maersk has ordered 300 battery electric class 8 (heaviest category) trucks for its North American shipment operations. The trucks are produced by Chinese BYD and are part of Maersk's target of a fully electric trucking fleet in North America[63].

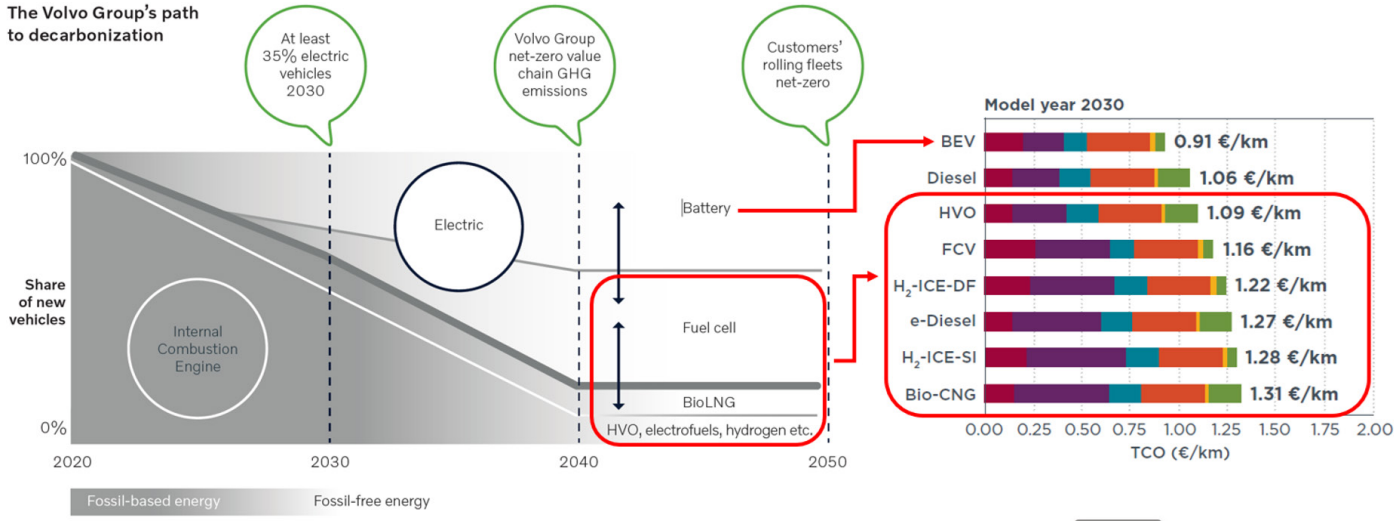

Figure 4. Volvo's costly decarbonization pathway. Total cost of ownership projection for long-haul heavy-duty trucks cross-border (1,000 km) by 2030. Edit: Red figures added to indicate reliance on costly fuels and technologies. Sources: Volvo Group (2024) *Volvo Group Annual Report 2023* & ICCT (2023) *A total cost of ownership comparison of truck decarbonization pathways in Europe*

It is important to note that while choice of passenger cars is performed by non-professionalized individuals and is influenced by a multitude of factors (aesthetics, emotional connection, extra features, etc.), trucks are purchased by professional staff who consider costs and functionality as the key parameters[64]. Thus, once cost turns advantageous for BETs, the shift in sales from diesel to BETs is expected to happen much more rapidly than for passenger cars. Essentially, technological advances means that battery trucks are poised to rapidly take over sales from today's diesel trucks. Conversely, both conventional diesel but especially also the diesel alternatives Volvo is betting on, are anticipated to remain prohibitively expensive and see minimal uptake in the highly price-sensitive truck market.

3.2 Policy developments favour battery electric trucks

While the above relate to the price of unsubsidized costs of BETs, it is relevant for investors to take note, that both regulatory requirements and public subsidy schemes further up the cost advantages and functionality of BETs, again underscoring Volvo's uneconomic confidence in combustion technology. Worldwide, more than 60 policies supporting the uptake of BEVs are in place, creating incentives for vehicles, infrastructure operation.

In Europe, the revised CO2 emission standards for trucks is the primary regulatory framework for truck decarbonization, which requires average CO2 emissions from new trucks reduced 45% by 2030, 65% by 2035 and 90% by 2040[65]. This is complemented by e.g. the Alternative Fuel Infrastructure Regulation (AFIR), which mandates that by 2030 at the latest, the EU's main road network will be equipped with charging pools every 60 km. For comparison, Member States are required to establish hydrogen fuelling infrastructure only every 200 km on the main road network by 2030, implying a priority for BETs over hydrogen trucks.

Policy support for BETs at the EU level is further complemented by national support schemes – a 2022 study found that 16 countries were subsidizing BETs, with several key European markets supporting the purchase of BETs with as much as >60% (France) or 80% (Spain) of the price difference to diesel trucks[66]. Likewise, the EIB has put a firm focus on investments in critical raw materials such as lithium and copper in its new Strategic Roadmap. The bank has in recent years significantly increased its financing for battery gigafactories across Europe, now to be counted in billions of €[67]. A 2023 study concluded that 250 battery factories can be expected to open in Europe towards 2033[68].

IS VOLVO MERELY HEDGING ITS BETS WITH TECHNOLOGY DIVERSIFICATION?

While technology diversification can be a sound investment strategy during early phases of technological development, prudent truck manufacturers must recognize when to phase out unviable technologies. As outlined in this brief, BETs have already today reached maturity for large segments of trucking operations, and there is widespread consensus among academic and industry literature, that BETs will dominate truck sales in the coming decades[69]. As such, although diversification was a prudent initial approach, continuing to spread resources thinly across multiple uneconomic technologies now renders Volvo's decarbonization trajectory diluted and diffused, at a time when the company should be laser-focused on winning battery electric market share.

In the US, the roll out of BETs is similarly supported through the IRA, the EPA's heavy-duty vehicle CO2 standards and California's Advanced Clean Truck (ACT) regulation[70]. As of June 2024, the ACT regulation was adopted by ten additional states. Collectively, these 11 states account for more than 25% of heavy-duty vehicle registrations in the US[71]. Likewise, China is expected to strengthen its tailpipe emissions reduction goals in the near future to align with its 2060 near-zero emissions target[72].

In summary, the regulatory frameworks in key markets are increasingly favourable to battery electric trucks, which only further advances the economic benefits of BETs and the imprudence of Volvo's commitment to combustion fuels.

APPENDIX

As outlined in this brief, Volvo Trucks foresee a significant role for alternative combustion fuels such as HVO, bioLNG, hydrogen and electrofuels. In addition to the local pollution induced by the combustion of such fuels, each fuel come with various sustainability and scalability issues, some of which are briefly spelled out below.

LNG

While Volvo describes LNG as *"the first step towards zero-emission"*[73] this claim is highly misleading. Liquified natural gas (LNG) remains a fossil fuel, at best only offering minimal GHG reductions and no air quality improvements when replacing diesel[74]. Additionally, the production and transport of LNG result in significant methane emissions throughout the supply chain. Given methane's far higher global warming potential over 20 years than over 100 years, expanding the use of LNG trucks on European roads would actually increase global warming in the coming decades[75].

Biofuels: BioLNG and HVO

vCultivating crops for biofuel leads to biodiversity loss, higher greenhouse gas emissions, and risks to food security[76]. While advanced biofuels offer potential emission reductions, contingent on strict sustainability standards, the potential production remains highly limited in scale. The limited biofuels available should be prioritized for sectors like aviation, maritime shipping, and industry, where electrification isn't viable[77]. These sectors are also more likely to pay a premium for these fuels, making it difficult to supply significant amounts to road transport. Currently, 45% of HVO is made from palm oil and its derivatives[78], which have a climate impact worse than fossil diesel[79]. Waste or residue based HVO, such as used cooking oil is very limited in quantities and is expected to be mainly used for sustainable aviation fuel (SAF) production.

Hydrogen and electrofuels

Hydrogen combustion for trucks requires around 4.5 times as much electricity as BETs, and the energy efficiency for electrofuels is even lower - around 6.1 times worse than BETs[80]. Given the limited sources of renewable energy and the availability of more efficient alternatives (BETs), combustion of hydrogen and electrofuels in road freight is both inefficient and unnecessary. Furthermore, combustion of hydrogen would be the most expensive option for truck manufacturers, transport operators[81], and society[82]. Previous studies have shown that hydrogen or e-fuels cannot compete with battery-electric or hydrogen fuel cell trucks, even if the e-fuels were produced in North Africa[83].

Additionally, scaling up renewables, electrolysers and fuel production facilities will take decades and larger quantities are not expected to be available before 2040[84]. As with advanced biofuels, the limited amounts of hydrogen and electrofuels should be prioritized to non-electrifiable sectors such as aviation, shipping and industry, where willingness-to-pay is also expected to be higher than in road transport.

ENDNOTES

1 Carbon Tracker Initiative (2024). *Heavy Lifting Required: Truckmakers' Electric Transition*

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