WORKING PAPER

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Electricity crediting for depot charging: Assessing a cost advantage for truck operators in Poland

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INTRODUCTION

Electromobility has drawn increasing interest from policymakers and industry in the European Union (EU) as a primary strategy to reach the region's net-zero climate target. The 2021 "Fit for 55" package of legislative proposals to align EU laws with regional climate goals included several measures related to electromobility (Baldino, 2023). Member States are expected to continue a trajectory of rapid battery electric vehicle (BEV) adoption, underpinned by laws and policies such as carbon dioxide (CO_2) emission standards and electric vehicle charger deployment mandates in the Alternative Fuel Infrastructure Regulation (AFIR; Regulation (EU) 2023/1804).

A provision introduced in the Renewable Energy Directive (RED) III, the European Union's overarching clean energy framework, can further support BEV adoption once implemented by Member States (Directive (EU) 2023/2413). Under the Directive, renewable electricity consumed by on-road vehicles contributes towards a Member State's overall renewable energy or greenhouse gas (GHG) reduction targets for transport, meaning that charging points can generate credits to sell to fuel suppliers who are obligated to demonstrate RED compliance. A 2023 ICCT policy update provides an overview of the RED III and this credit mechanism (Baldino, 2023). The RED III entered into force in November 2023, granting Member States 18 months to implement into national legislation.

In this paper, we explore the economic impact that RED III charging credits could have on reducing the total cost of ownership (TCO) of long-haul heavy-duty trucks operating in Poland, particularly when charging depot operators are able to benefit from these credits. Poland provides a case study of the substantial potential of these credits to yield TCO reductions, as it ranks first in the European Union in terms of annual tonne-kilometers of road freight transport (Eurostat, 2024c). The country has also not yet implemented the RED III into national law. We explain best practices from other EU Member States that Poland could consider incorporating to maximize the economic and environmental benefits of BEV charging for its heavy-duty trucking sector.

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POLICY BACKGROUND

In 2021, the European Union passed the European Climate Law, enacting its commitment to achieve region-wide climate neutrality by 2050 (Regulation (EU) 2021/1119). Shortly thereafter, the European Commission released the Fit for 55 package, aiming to align EU laws and policies with a GHG reduction target of 55% by 2030 relative to 1990 levels (European Council & Council of the European Union, n.d.).

Adoption of zero-emission vehicles will be critical to achieving regional carbon neutrality targets in the transportation sector. Revised heavy-duty vehicle (HDV) CO_2 standards, passed in 2024, require vehicle manufacturers to reduce tailpipe CO_2 emissions by 15% by 2025, 45% by 2030, and 90% by 2040 from the 2019 reporting period baseline (Mulholland, 2024). Vehicle manufacturers can comply by improving the fuel economy of combustion engine vehicles or by increasing sales shares of BEVs or hydrogen fuel-cell vehicles. Past ICCT research has shown that BEV sales are the most cost-effective option for manufacturers to comply with the CO_2 emission standards for both light- and heavy-duty vehicles (Mock & Díaz, 2021).

The AFIR, which came into effect in 2024, introduced an infrastructure strategy to support BEV adoption. The regulation requires that 15% of the entire Trans-European Transport Network be equipped with fast charging stations for trucks and buses at least every 120 km by 2025, increasing to 50% in 2027 and 100% in 2030 (Bernard, 2023). Separate charging requirements were introduced for passenger cars and vans. Between 2024 and 2025, the EU Alternative Fuels Infrastructure Facility (AFIF) program has made €1 billion in grant funding available for projects to increase infrastructure deployment in alignment with the AFIR (European Climate, Infrastructure and Environment Executive Agency, 2024); during this phase of the program, new funding opportunities are available for megawatt HDV charging stations. The AFIR and AFIF funding streams are expected to support the uptake of HDV segments such as long-haul tractor-trailers that utilize public charging infrastructure over long distance trucking routes (Bernard et al., 2022). Still, these vehicles may meet the majority of their charging needs at private or semi-public depots that are often owned and operated by the fleet operator (Speth & Plötz, 2024). Such depots are not directly addressed by the AFIR or AFIF.

RENEWABLE ENERGY DIRECTIVE

The RED, implemented at the Member State level, provides an additional incentive to promote electric vehicle uptake. The most recent revision of the Directive, the RED III finalized in 2023, set an updated target for renewable energy use in transport of 29% by 2030; alternatively, Member States can achieve a minimum 14.5% GHG reduction from the fossil baseline defined in Article 27(1)(b) of the Directive. Like renewable liquid fuels, electricity derived from renewable sources that is consumed in the transportation sector counts toward RED III compliance.

Under the energy-based target, the total amount of renewable electricity and renewable fuels delivered to the transportation sector, adjusted by multipliers, is divided by the total quantity of energy consumed by all transport fuels to determine whether the 29% threshold has been met. Member States that implement an energy-based target must count all fuel types, including renewable electricity, when calculating the energy consumed by transport fuels (Article 27.1.c). The share of renewable resources in delivered electricity is calculated based on “the average share of renewable electricity supplied in the [Member State’s] territory…in the two previous years, unless electricity is obtained from a direct connection.” In the latter case, it can be assumed that 100% of delivered electricity is sourced from renewables.

Under the GHG reduction target, the emission intensities of renewable fuel supplied to the transport sector, certified by a third-party auditor, are used to calculate GHG reductions relative to the emissions baseline for a given Member State. Emission savings for renewable electricity consumed in transport are 183 grams of CO_2-equivelent per megajoule (CO_2e/MJ), which represents the savings of renewable electricity (0 g CO_2e/MJ) compared to a fossil electricity comparator (183 g CO_2e/MJ). To calculate baseline GHG emissions in the transport fuel denominator, through the end of 2030, Member States must multiply the amount of energy supplied to the transportation sector, regardless of whether it is liquid or electricity, by the 94.1 g CO_2e/MJ petroleum comparator (Article 27.1.b). After this period, they must multiply the share of electricity used to charge electric vehicles in the transport fuel denominator by 183 g CO_2e/MJ. This change in the crediting formula is to account for a greater share of electricity in the transport fuel mix in later years. Appendix B presents the pre- and post-2030 crediting formulas for Member States that adopt a GHG reduction target.

The RED III introduces a credit mechanism for electromobility under which "[e]conomic operators that supply renewable electricity to electric vehicles through public recharging points shall receive credits." These credits are sold to fuel suppliers to use towards their obligated renewable energy or GHG intensity reduction target. In other words, charge point operators (CPOs) can, for example, generate credits that represent a unit of renewable energy or one metric tonne of avoided CO_2e emissions, which can be sold to suppliers in a Member State that has implemented the RED III as a GHG reduction target. Importantly, the RED III also provides that Member States may choose to credit renewable electricity delivered to private recharging points such as depots if it can be demonstrated that the electricity was solely supplied to electric vehicles. This credit incentive can be maximized as the share of renewables on the electricity grid grows toward 100%, or when a charge point connects directly to a renewable installation.

The electricity crediting system established under the RED III provides an opportunity for CPOs to offset the costs of charger installation. For countries that have implemented provisions within national legislation to credit private charging events, vehicle owners are typically designated as the primary credit generator. However, because direct credit transactions between vehicle owners and fossil fuel suppliers are inefficient at small quantities, electricity credits are typically bundled on third-party trading platforms and sold to fossil fuel suppliers at market price (ChargeUp Europe, 2024a).

Under energy-based targets, electricity supplied to the transport sector receives credit multipliers when RED compliance is demonstrated. The 2015 Fuel Quality Directive introduced credit multipliers to incentivize the use of BEVs to meet compliance targets, asserting that renewable electricity is a key component in "addressing many of the challenges in the transport sector as well as in other energy sectors" (Directive (EU) 2015/1513). Further, multipliers are used to correct for renewable electricity consumed in the transport sector that is unaccounted for due to a lack of dedicated metering. The RED II assigned a 4x multiplier for renewable electricity consumed in on-road vehicles and a 1.5x multiplier for the same electricity consumed in rail; these multipliers have been carried over for the purpose of RED III compliance calculations. That is, 1 MJ of renewable electricity supplied to the transportation sector via BEV charging corresponds to 4 MJ of renewable energy in the compliance calculation. Other fuel types such as advanced biofuels receive different credit multipliers that increase their competitiveness relative to conventional fuels (Baldino, 2023).

If Member States choose to implement a GHG reduction target, the RED III does not provide for multipliers for renewable electricity consumed in transport. However, the GHG savings for renewable electricity (183 g CO_2e of savings per MJ of electricity supplied) is expanded compared to other pathways, where savings are calculated relative to a lower, 94 g CO_2e/MJ petroleum baseline. For example, some biofuel pathways only provide around a 50% GHG reduction, equivalent to savings of 47 g CO_2e/MJ. Comparatively, 1 MJ of renewable electricity delivered to the transport sector would contribute roughly four times as much toward compliance. We explain this effect in more detail in a 2023 policy update (Baldino, 2023). Because of the high GHG savings per MJ provided by renewable electricity paired with the higher efficiency of electric drivetrains, economic operators receive a greater number of credits per MJ of electricity delivered to the transport sector than other parties that sell biofuel to fuel suppliers. Member States may also enact legislation defining their own multipliers for calculating the value of tradeable GHG reduction quotas.

REVIEW OF EXISTING RENEWABLE ELECTRICITY CREDITING SCHEMES

In this section, we review and compare the electricity crediting mechanisms of the previous update of the Directive, RED II, in the five countries that have introduced such schemes: Austria, Belgium, France, Germany, and the Netherlands.[1] These countries vary in their choice of target (energy-based or GHG reduction), use of multipliers, and eligibility guidelines for crediting renewable electricity consumed in the transport sector.

As shown in Table 1, the five selected Member States are currently split in their choice of renewable energy-based versus GHG intensity reduction targets. Austria and Germany currently have GHG reduction targets, while France and the Netherlands have indicated that they may switch from energy-based to GHG reduction schemes by 2026. In terms of renewable electricity credits, Member States do not have to adhere to the multipliers (or lack thereof) specified in the RED for their national level implementation. As noted above, multipliers are not considered under GHG reduction targets, but Member States may use them to demonstrate compliance with their own national legislation and credit markets. For example, Germany uses a 3x credit multiplier for renewable electricity consumed in road vehicles, while Austria, France, and the Netherlands all use a 4x multiplier. For Member States that have adopted a GHG reduction target, multipliers increase the value of fuel delivered to the transport sector for fuel producers rather than increase their contribution toward annual RED compliance. Within national-level crediting schemes, the value of GHG savings from renewable electricity delivered to the transport sector is adjusted by an efficiency factor of 0.4 for BEVs (Council Directive (EU) 2015/652).

1 ChargeUp Europe has published a comprehensive overview of existing programs that can be used as a guide for Member States implementing their own national programs (ChargeUp Europe, 2024a).

Table 1

Overview of renewable electricity credits used for RED II compliance at the Member State level

Member State	Compliance target type	Renewable electricity multiplier	Credit generators	Metered depot charging eligible	Certification
Austria	GHG intensity reduction	4	Electric vehicle owners that consume at least 100,000 kWh per year of metered electricity and operate at least one public recharging point, third-parties, charge point operators	Yes, semi-public depots	Measured directly at public charge point; fixed values for private charge point
Belgium	Renewable energy share	4	Fleet operators and charge point operators with a minimum 50 kW power output	Yes	Measured directly at public or depot charge point
France	Renewable energy share (GHG expected in 2026)	4	Charge point operators via direct connection with production facilities downstream of the same delivery point (Ministère de la Transition Énergétique, 2023)	No, public only	DC charging: Dedicated meter installed by public distribution network manager with a 10% discount on consumption to account for transformation losses[a] AC charging: Measured directly at charge point[a]
Germany	GHG intensity reduction	3	Electric vehicle owners, third parties, charge point operators	Yes, semi-public depots	Measured directly at public charge point; fixed values for private charge point
Netherlands	Renewable energy share (GHG expected in 2026)	4	Electric vehicle owners beginning in 2026, entity responsible for delivery to end-user via an exclusive connection or connected to a production facility with a Measuring Instruments Directive-certified meter (Nederlandse Emissieautoriteit, 2022)	No, public only	Measured directly at public charge point

Note: "Third parties" refers to companies managing trading platforms where electricity credits are bundled and sold to fossil fuel suppliers at market price.
[a] DC charging, sometimes referred to as DC fast charging, uses direct current, while AC charging uses alternating current.

The five existing trading schemes credit renewable electricity delivered to on-road vehicles according to different techniques and eligibility guidelines. Member States may carry over these techniques or change them when they amend national legislation under RED III implementation. Germany and Austria credit private charging, including charging at depots, using fixed values for different vehicle classes based on average charging behavior; France, Belgium, and the Netherlands rely strictly on metered data to measure the quantity of energy delivered to battery and plug-in electric vehicles at public charging locations. For example, a privately charged passenger car is assumed to consume 2,000 kWh per year while a privately charged bus consumes 72,000 kWh per year under Germany's crediting system (Bekanntmachung der Schätzwerte, 2023). Fixed values are typically used at unmetered charging locations such as home chargers. Germany is intending to move toward metered values for private charging in later years by using vehicle telematics data. Neither Germany nor Austria has determined a fixed value for plug-in hybrid electric vehicles, so the share of renewable electricity supplied to these vehicles remains ineligible under current schemes when charged at non-metered locations.

National crediting schemes can differ from the RED II and III in how they account for electricity in charging, and some are conservative in how they credit the share of renewable energy consumed during public charging events. To qualify as 100% renewable, renewable energy must be delivered via a direct connection from an off-grid direct renewable electricity source or behind the same metered connection point. That is, CPOs that have procured a contract or power purchase agreement for renewable electricity generated offsite must apply the grid-average renewable electricity share when calculating the value of electricity credits.

Of the five Member States, Austria, France, and the Netherlands support crediting of 100% renewable electricity supplied via direct connection under certain metering restrictions and auditing requirements (ChargeUp Europe, 2024a). Belgium currently does not support 100% direct connect crediting, while Germany requires renewable energy systems and charge points to be located behind the same grid connection point and tracked in 15-minute intervals without the use of battery storage. These restrictions render 100% renewable electricity crediting infeasible in practice. Germany is exploring expanding the definition for renewable power generators with a direct connection to CPOs based on their physical distance to the delivery point for added flexibility (ChargeUp Europe, 2024b).

Member States have also established varying definitions and tax structures in their translation of the RED II into national law. For example, in Germany, revenue generated by fleet operators is taxed at a corporate rate pursuant to the Value Added Tax (VAT) Act, while registered private car owners are exempt from additional taxes (Wachstumschancengesetz, 2024). At public charging stations, there is no guarantee that CPOs will pass on revenue to vehicle owners, but revenues can be used to offset the costs of charging infrastructure. At eligible depot charging stations, credits can also be used to offset the cost of capital and operational expenses associated with fleet ownership. Depot charging stations may qualify as semi-public recharging points if they are open at least 1 hour per day to the public. Privately owned depots may also qualify for electricity credits if they are made eligible via national legislation.

Member States have established registries and markets for different categories of fuels to trade credits, which cannot be traded outside of a given country. The value of credits fluctuates over time based on the supply and demand of renewable or low-carbon energy in the transport pool and ambition of each program. Typically, CPOs and third parties sell credits to fuel suppliers to streamline reporting and verification on trading platforms. For example, Austria set a minimum threshold of 100,000 kWh of metered electricity for entities to sell credits directly to fuel suppliers, while in Germany, private EV owners often enter into contracts with third parties that pool together credits from public and private charging (Transport & Environment, 2023).

CASE STUDY: IMPLEMENTING THE RED III CREDITING MECHANISM IN POLAND FOR PRIVATE HEAVY-DUTY VEHICLE CHARGING

As it aligns its own national-level implementation of the RED III, the Polish government could consider including depot charging within its crediting scheme, including metering requirements to accurately quantify the share of renewable electricity delivered to depot charging infrastructure. This case study explores the economic benefits that implementing the RED III, including a provision for depot charging, could have on long-haul trucking in Poland.

Poland is the European Union's leading transporter of goods by volume and sixth largest economy (International Monetary Fund, 2024). In 2021, the country operated 1.15 million HDVs and transported nearly 380 billion tonne-kilometers of goods (Miniszewski et al., 2023); long-haul trucks made up 70% of new HDV registrations in Poland in the first half of 2024 (Ananda et al., 2024). Poland's renewable electricity output lags that of other Member States. The country has been slower than others in the European Union to adopt clean power sector commitments, and in 2023, its electricity generation GHG emissions intensity was among the highest of all EU Member States (European Environment Agency, 2024). The Polish government has established biodiesel and bioethanol blending mandates under the Act on Bio-Components and Liquid Biofuels (Lieberz & Rudolf, 2022) but has not yet implemented RED III compliance targets or established a market-based mechanism for fuel suppliers. With the release of an updated National Energy and Climate Plan for public comment last year, however, the government has demonstrated interest in renewable electricity investment to meet RED III implementation targets and broader EU climate goals (Ministry of Climate and Environment Republic of Poland, n.d.).

As of 2025, the TCO of long-haul battery electric trucks (BETs) globally remains higher than that of diesel counterparts, but costs are rapidly dropping. BloombergNEF assumes that the TCO of trucks with a gross vehicle weight above 15 tonnes will decrease up to 57% between 2022 and 2030 (Miniszewski et al., 2023). According to a 2021 ICCT study, long-haul BETs operating in Poland are expected to reach cost parity with diesel trucks in 2027 (Basma et al., 2021). That analysis did not account for the impacts of RED III electricity crediting, which we assess here.

METHODOLOGY

We estimate the quantity of renewable electricity credits that long-haul tractor-trailers in Poland could generate annually based on several decarbonization trajectories for the country's electricity grid. We consider three scenarios for renewable energy adoption—Accelerated, Moderate, and Lagging—based on existing commitments and potential policy developments. As renewable electricity credits can be used by private fleet operators to offset the costs of owning and maintaining charging equipment at depots, we calculate by how much renewable electricity credit generation could lower the 5-year TCO of long-haul tractor-trailers. Though public charging events along highway and other network corridors also generate credits, we assume these savings are not passed onto the consumer and are instead retained by the CPO to increase profits.

Our use case is for tractor-trailers that cover more than 500 km per day before returning to their depots. This distance represents a typical round trip in the European Union, though daily distances can be longer depending on the available public charging infrastructure (Wentzel, 2020). We assume that 80% of the energy consumed by long-haul tractor-trailers came from overnight metered depot charging to reduce their charging costs and the remainder came from en-route public fast chargers during a mandatory 45-minute driver's break. This means that the distribution of energy delivered between public and private charging determines the TCO savings for trucks. Other sections in this paper examine the impact of the public-private charging interplay on the TCO.

The TCO methodology is documented in Basma et al. (2021) and the most recent TCO assumptions and data are highlighted in a supporting paper (Basma & Rodriguez, 2023). A summary of these assumptions is included in Appendix A. Our analysis does not consider any short-term financial incentives, such as purchase subsidies or preferential EV tariffs.

PROJECTED SHARE OF RENEWABLE ELECTRICITY IN TRANSPORT

The share of renewable resources used in Poland's electricity grid is the primary determinant of the quantity of credits each MJ of delivered electricity receives under the RED III. Pursuant to the RED III, Member States are granted flexibility in estimating the share of renewable energy consumed in transport (Transport & Environment, 2023). Data can be collected from surveys and national statistics as well as estimated for the road sector based on the stock share of electric vehicles, electricity efficiency, and average vehicle kilometers traveled (VKT) assumptions per vehicle class.

In 2023, 26% of electricity in Poland's grid came from renewable resources (Eurostat, 2024b). We consider three scenarios for Poland's renewable electricity uptake:

» **Accelerated**, in which Poland complies with the EU's Fit for 55 and net-zero electricity targets, requiring that renewables make up 69% of delivered electricity in 2030 and approximately 78.6% in 2040 (European Commission, 2023).[2]

» **Moderate**, in which Poland adheres to electricity projections from its revised draft of the National Energy and Climate Plan for 2021–2030, which projects a renewables share for the power sector of 50.1% in 2030 and 59.1% in 2040.[3]

» **Lagging**, in which Poland follows a previous energy strategy adopted in 2022, the Energy Policy of Poland until 2040, which targeted 32% renewables in 2030 and 40% renewables in 2040 (Ministry of Climate and Environment, 2021).

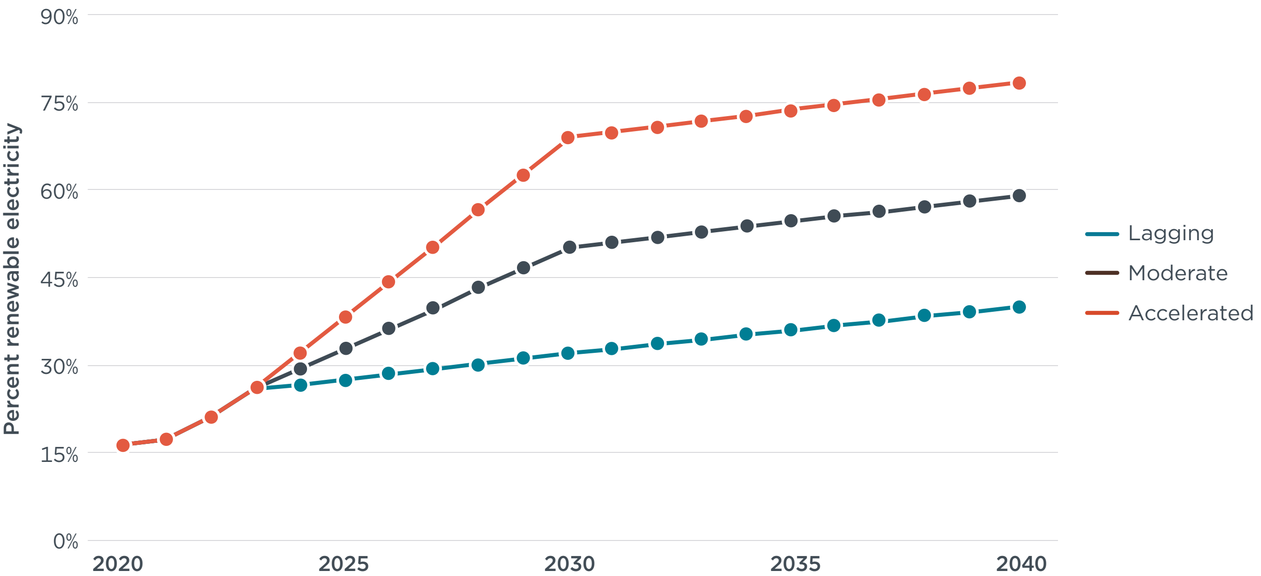
For all scenarios, we assume that Poland's electricity grid will undergo a linear increase in renewable electricity supply until 2030 and another linear increase between 2030 and 2040. We display the annual renewable electricity share in Poland's electricity grid for each scenario in Figure 1.

2 Targets for 2030 are based on the RePowerEU communication, while 2040 targets are less certain and based on electricity production projections by the European Commission.

3 The Polish legislature is currently considering whether to raise the ambition of the draft plan, but no changes have yet been adopted.

Figure 1

Projected share of renewable electricity in the Polish grid across three policy scenarios



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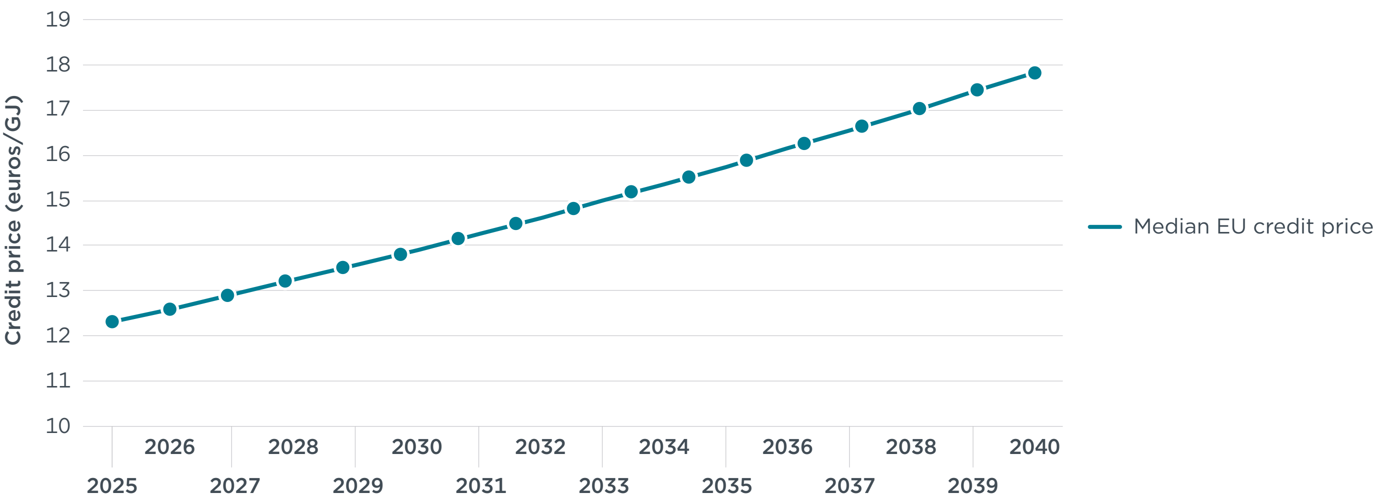
PROJECTED CREDIT PRICES

For each of these three renewable trajectory scenarios, we apply future credit prices if Poland were to implement a crediting system under the RED III.

Our future credit prices are based on 2024 median credit price data from other Member States that operate market-based trading systems. Though credit transactions occur bilaterally and transaction data are not publicly available, we use credit price data reported by ChargeUp Europe converted to euros per GJ (ChargeUp Europe, 2024a). In early 2024, prices ranged between €0.03–€0.04/kWh (€8–€11/GJ) in Belgium and €0.08–€0.10/kWh (€22–€28/GJ) in Austria. Based on these data, we assume credit prices are fixed at €0.04/kWh (€12/GJ) in 2024 euros, adjusted for inflation. We assume a 2.5% annual inflation rate based on average 2024 EU area data across all consumer goods from Eurostat (2024a). We present our credit price assumptions in Figure 2.

Figure 2

Credit price assumptions used in the total cost of ownership analysis, assuming a 2.5% annual inflation rate



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The presence of renewable electricity credit multipliers in the RED increases the value of credits that charge point operators can generate during credit transactions with fuel suppliers. We assume that CPOs receive 4 times the value of credits on the market per kWh of electricity delivered, raising the effective credit price to €48/GJ in 2024 euros. This is consistent with cost estimates calculated by CPOs under Netherland's credit trading scheme (iwell, n.d.). In practice, administrative overhead may reduce the value that CPOs receive during bilateral transactions.

RESULTS

We present the results of our TCO analysis in three segments:

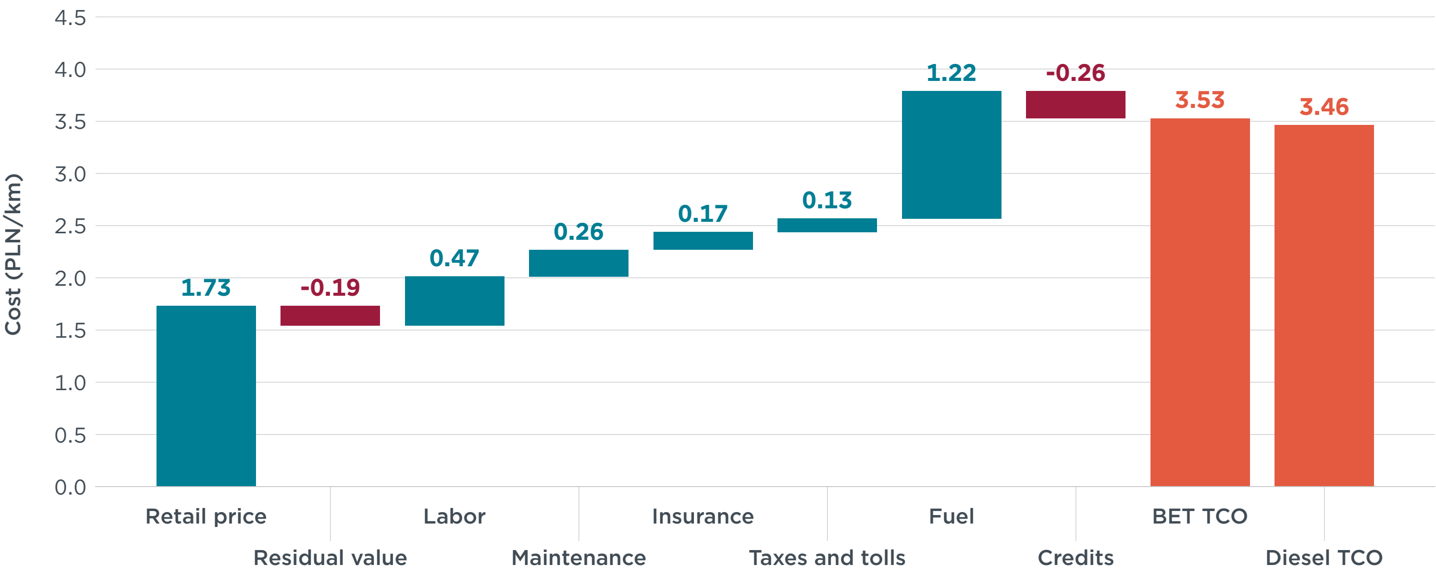
1. A baseline analysis of a truck purchased in 2025 and 2030 considering the Moderate renewable electricity uptake scenario with median EU credit prices;
2. A public versus private charging analysis that quantifies benefits for fleet operators and CPOs considering different public and metered depot charging patterns; and
3. A sensitivity analysis that considers several additional scenarios for the share of renewables and credit prices.

BASELINE ANALYSIS

Figure 3 shows the TCO breakdown for a model year 2025 truck that operates until 2030 and performs 80% of its charging at a metered depot. The figure shows the truck's retail price, residual value, labor cost, maintenance, insurance, taxes and tolls, fuel costs, and the credits obtained per kilometer in Polish złoty (PLN). By 2025, the TCO for the BET is expected to be 10% higher than the diesel truck when excluding the value of credits. With the use of credits, the TCO gap between the BET and the diesel truck drops 7 percentage points so that the gap is less than 3%. With additional short-term financial incentives, such as purchase subsidies or preferential EV tariffs, which we did not include in this analysis, the total cost of ownership could be even lower than diesel trucks.

Figure 3

Total cost of ownership in 2025 assuming a moderate share of renewables and median EU credit prices



Note: Assumes 80% metered depot charging and 20% public charging

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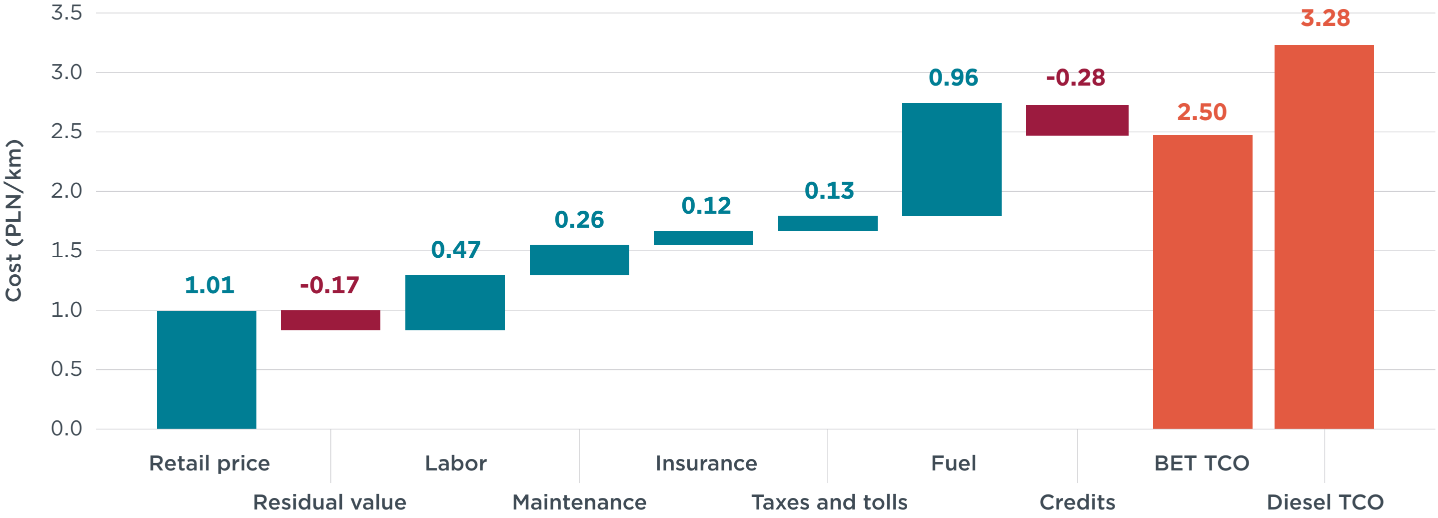
Figure 4 shows the model year 2030 truck analysis under a Moderate renewable electricity uptake scenario and median EU credit prices. Under this scenario, the projections show a lower TCO for the BET than the diesel truck, even when excluding the value of credits or short-term financial incentives. With the use of credits, the truck is projected to record a 10% lower TCO than in a scenario where credits are not included, widening the TCO advantage electric trucks are expected to have by the end of the decade. The 10% TCO reduction is significant, given the tight profit margins in the freight sector in Poland.

Figure 4

Total cost of ownership in 2030 assuming a moderate share of renewables and median EU credit prices



Note: Assumes 80% metered depot charging and 20% public charging

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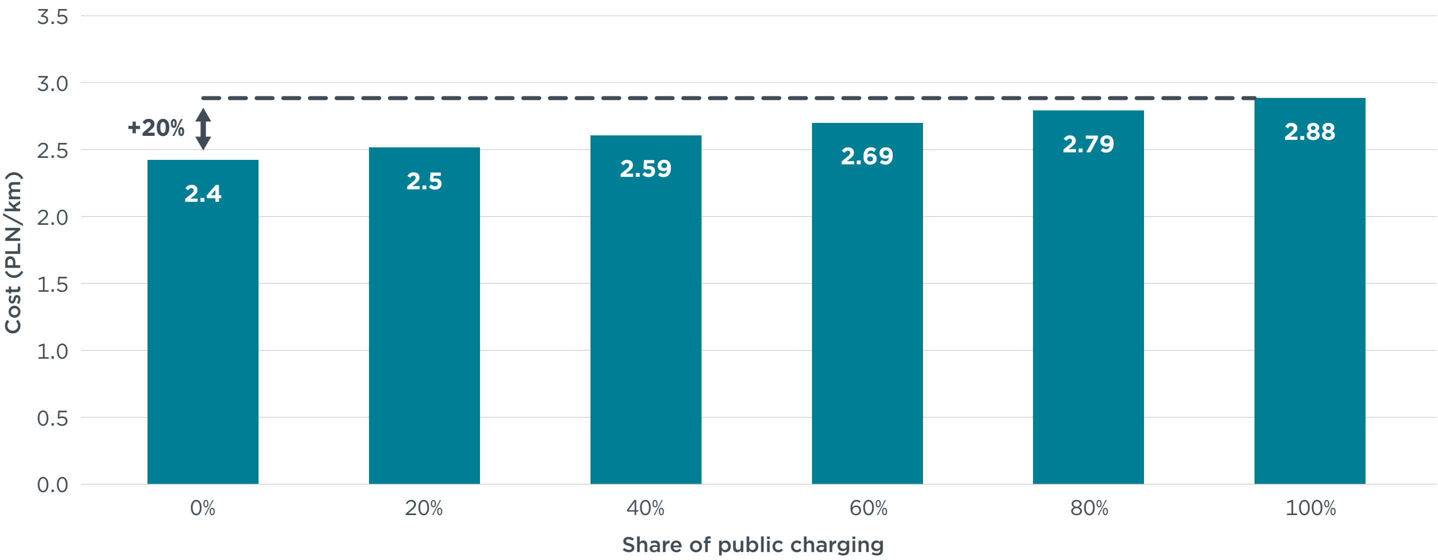
PUBLIC VERSUS TRUCK-OPERATOR OWNED DEPOT CHARGING ANALYSIS

The TCO analysis presented above assumes that 20% of charging takes place at public chargers, where CPOs can retain 100% of credits without passing on the RED credit value to the truck operator, while 80% occurs at private depots, where CPOs own and operate the trucking fleet and 100% of credit benefits are passed onto the truck operator. This assumption strongly shapes the resulting TCO benefits, which increase with higher shares of private depot charging.

Figure 5 illustrates how relative shares of public and truck-operator owned charging affect the TCO of the BET. Intuitively, when relying solely on public charging where renewable energy credits are assumed not to be passed on to the consumer, the TCO of the BET is expected to be 20% higher than a scenario in which charging takes place entirely at operator-owned depots. This 20% difference is not solely a result of the renewable energy credits but is also due to the lower operator-owned charging cost relative to public charging cost, as highlighted in Appendix A.

Figure 5
Impact of public charging share on the total cost of ownership for a model year 2030 truck



Note: Assumes a moderate share of renewables and median EU credit prices

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While crediting public charging may not directly benefit the truck operator, it does benefit CPOs, an integral part of the electric truck ecosystem. Table 2 shows the renewable energy credits obtained by CPOs under different scenarios for renewables shares and credit prices in 2030. We estimate charge point operators can obtain credits valued from zł0.24/kWh to zł0.75/kWh (€0.06/kWh–€0.17/kWh).[4] Comparing the credits with the expected charging prices offered by the CPO, we consider two possible charging tariffs:

- A tariff of zł1.2/kWh (€0.28/kWh) based on the ICCT's modeling for 2030; or
- A tariff of zł1.7/kWh (€0.39/kWh) based on tariffs currently offered by Milence, a CPO joint venture between Daimler and Volvo Trucks that operates public megawatt charging stations in several EU Member States.

Under the Moderate scenario for renewable electricity uptake, credit values could cover 31% of the charging price in the case of a zł1.2/kWh tariff and 22% of the price with a zł1.7/kWh tariff, offsetting a significant portion of the costs incurred by CPOs. For a scenario in which the metered depot has a direct connection to a renewable electricity installation, the credit value could cover up to 62% of the charging price in the case of a zł1.2/kWh tariff and 44% of the price with a zł1.7/kWh tariff.

4 We assume an average exchange rate of zł4.316 per euro in 2024 (European Central Bank, n.d.).

Table 2

Renewable energy credits obtained by charge point operators under different renewable share and credit price scenarios in 2030

Renewables scenario	Credit price scenario	Credits (zł/kWh)	Credits (€/kWh)	Percentage of charging price at zł1.2/kWh	Percentage of charging price at zł1.7/kWh
Lagging	EU median price	0.24	0.06	20%	14%
Moderate	**EU median price**	**0.37**	**0.09**	**31%**	**22%**
Accelerated	EU median price	0.51	0.12	43%	30%
100% renewables	EU median price	0.75	0.17	62%	44%

SENSITIVITY ANALYSIS

This section presents several other scenarios regarding the share of renewables and credit prices in Poland and how they would affect the TCO. In addition to the three scenarios discussed earlier (Lagging, Moderate, and Accelerated), we consider two additional hypothetical scenarios: a reference scenario with a 0% share of renewables and a scenario with a 100% share of renewables, assuming a direct connection to a renewable electricity installation.

Figure 6 quantifies the credits obtained by trucking companies with metered depot charging under the five renewable share scenarios, in PLN per kilometer. Intuitively, with a higher share of renewables, trucking companies can obtain higher credits: The value reaches zł0.53/km (€0.12/km) in a scenario with a 100% share of renewables, up from zł0.18/km (€0.04/km) in a scenario with a Lagging renewables trajectory, a ten-fold increase. Across all scenarios, we assume that the entirety of the credit value from depot charging is passed onto the trucking company; in reality, it is likely that a portion of this value would be directed toward the standalone renewable electricity generator in the 100% renewables case.

Figure 6

Renewable energy credits under different renewable energy shares for model year 2030 trucks

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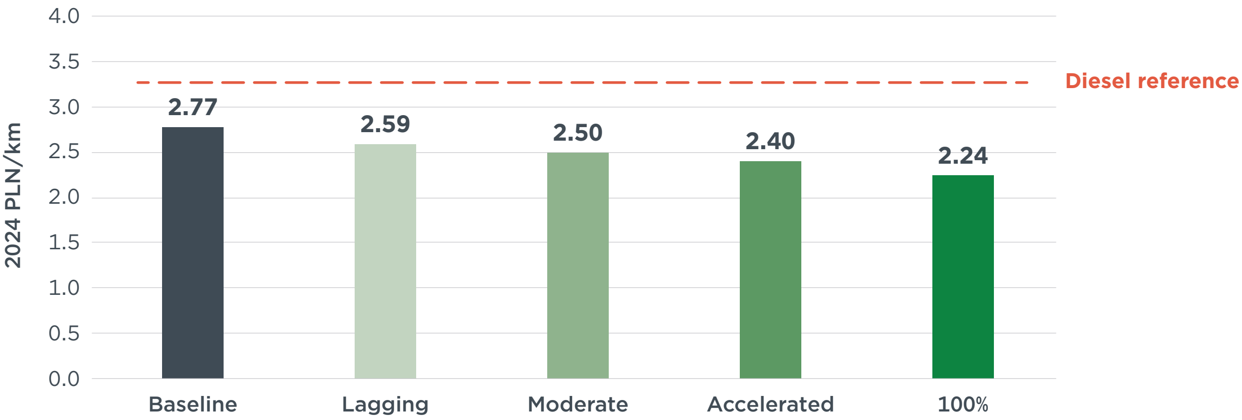
As shown in Figure 7, relative to a Baseline scenario without renewable electricity credits, the TCO for trucks purchased in 2030 can be reduced by 6% in the Lagging renewables scenario and as high as 19% in the 100% renewables scenario. In all scenarios, the impact on the TCO is significant, suggesting credits could effectively incentivize trucking companies to accelerate their decarbonization efforts.

Figure 7

Total cost of ownership under different renewable energy shares for model year 2030 trucks



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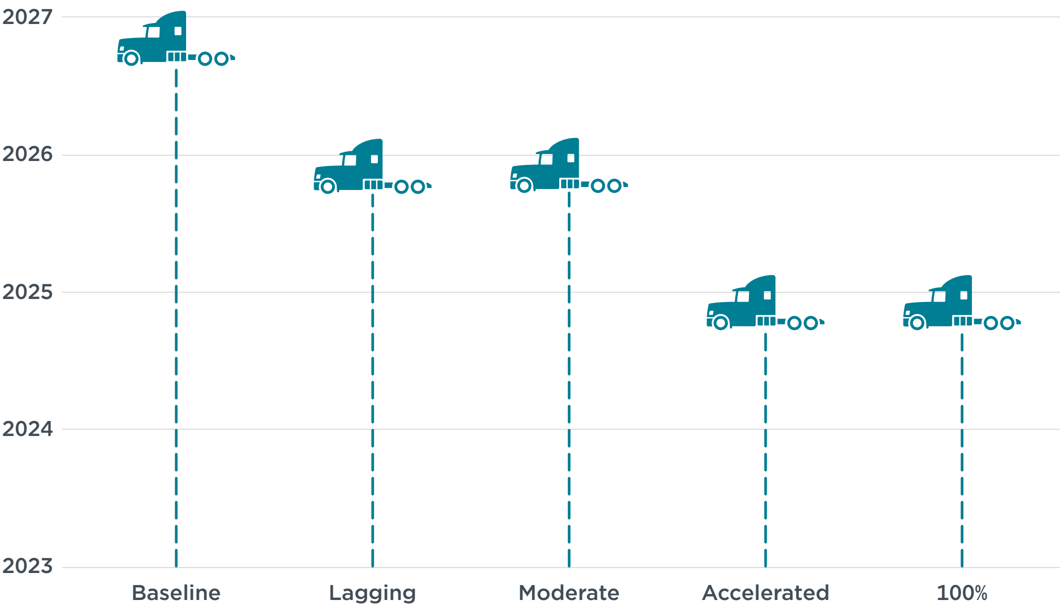
Renewable electricity credits can also advance the year of TCO parity between diesel and electric trucks, as shown in Figure 8. Depending on the scenario considered, TCO parity can be advanced by 1 to 2 years, enabling a quicker shift from trucks fueled by fossil diesel to zero-emission trucks. Parity is achieved by 2026 under all scenarios where RED III electricity crediting is implemented.

Figure 8

Year of total cost of ownership parity between diesel and electric trucks



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CONCLUSIONS

We estimate that approximately 22%–31% of the charging price for long-haul BETs in Poland could be offset by RED III electricity credits under a scenario that assumes median EU credit prices and a moderate share of renewables in the electrical grid. With median EU credit prices and an accelerated renewables trajectory, this increases to 30%–43%. The TCO for long-haul trucks purchased in 2030 could be reduced by up to 19% in Poland if depot operators pursue a direct connection to a renewable power installation. With a median EU credit price and moderate share of renewables on the grid, the TCO for long-haul trucks reduces by 10%.

Based on these results, we find that long-haul trucks in Poland could reach cost parity with diesel trucks between 1 and 2 years earlier, in 2025 or 2026, if depot charging can benefit from the RED III credits compared with a case without such credits. Because fluctuating credit prices have a large impact on the 5-year TCO, maintaining stable credit prices allows the RED III crediting scheme to increase pass-through revenue for fleet owners and investment certainty for charging infrastructure.

The results of our analysis suggest that the Polish government can reduce the TCO of long-haul trucks as it electrifies the HDV sector by implementing RED III electricity crediting, particularly for charging at metered depots. To maximize its crediting opportunities, authorities could consider extending eligibility to depot charging during national implementation of the RED III, which should be complete by May 2025. Upon RED III implementation, public depots, typically defined as those that are open to the public at least 1 hour per day, could automatically be eligible for electricity crediting. The Polish government could also broaden eligibility to depots that are privately owned within its national legislation to maximize support for depot charging.

At the project level, CPOs have the option to exceed the average share of renewables on the grid if they use a direct connection to a renewable power source. This strategy can maximize the quantity of electricity credits CPOs receive while simultaneously boosting deployment of renewable energy sources such as wind and solar. More broadly, the Polish government could consider expanding renewable electricity crediting eligibility to include private home charging, increasing the share of renewables on the grid to align with the EU Fit for 55 package and net-zero climate targets, and adopting a 4x credit multiplier in alignment with the RED, which would increase the total crediting revenue delivered toward electrification.

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APPENDIX A: TOTAL COST OF OWNERSHIP INPUTS AND ASSUMPTIONS

	Truck technology	Model year 2024	Sources and comments
Fuel/energy consumption	Diesel	29.6 L/100 km – 2024 technology 23.2 L/100 km – 2030 technology	Basma and Rodríguez (2023)
	Battery electric	133 kWh/100 km – 2024 technology 101 kWh/100 km – 2030 technology	
Battery size	720 kWh – 2024 technology 405 kWh – 2030 technology		Estimated based on a 500-km daily driven distance
Retail price	Diesel	zł665,000*k* – 2024 technology zł720,000*k* – 2030 technology	Basma and Rodríguez (2023)
	Battery electric	zł1,550,000*k* – 2024 technology zł840,000*k* – 2024 technology	
Fuel/energy price	Diesel	zł5.4/L	DKV Mobility (2024)
	Battery electric	zł1.05/kWh – depot charging zł1.2/kWh – public charging	Energy prices based on Eurostat (2023) Infrastructure costs based on Basma et al. (2023)
Maintenance	Diesel	zł41/100 km	Diesel costs taken from Comité national routier (2020) BET costs calculated similar to Basma et al. (2021) Data is adjusted for inflation
	Battery electric	zł29/100 km	
Road tolls	Diesel	zł30/100 km	Basma and Rodríguez (2023)
	Battery electric	zł15/100 km (50% exemption)	
CO_2 road charges	Diesel	zł34/100 km	
	Battery electric	Exempt	
Labor	All	zł53/100 km	Comité national routier (2020) Data are adjusted for inflation
Insurance	All	Annual cost of 2.5% of retail price	Comité national routier (2020) Only considers collision insurance
Annual mileage	All	Year 1: 173,000 km Year 2: 173,000 km Year 3: 160,000 km Year 4: 146,000 km Year 5: 139,747 km	Emisia et al.(2013)

APPENDIX B: RED III CREDITING FORMULAS

Equation 1 presents the crediting formula that EU Member States with renewable energy targets use for RED III compliance:

$$\frac{\sum_{i.} MJ_i \times Multiplier_i}{MJ_{total}}$$

Equation 1. Renewable energy formula for RED III compliance

Where:

i	refers to the renewable fuel type and usage eligible under the RED (e.g., advanced biofuel consumed in rail)
MJ	refers to the quantity of energy supplied to the transport sector in Megajoules using conversion factors from Annex III or relevant ESO/ISO standards
Multiplier	refers to the compliance adjustment stipulated in Article 27.2 of the RED

For Member States that adopt a GHG reduction target, GHG savings are multiplied by the energetic quantity of renewable fuels supplied to the market and an adjustment factor to account for the powertrain efficiency of different engine technologies. Battery electric and fuel cell vehicles are adjusted downwards by a factor of 0.4 while conventional internal combustion engines are assigned a factor of 1 (Council Directive (EU) 2015/652). We provide a sample calculation for the GHG intensity of the transport fuel pool in Equation 2:

$$\frac{\sum_{i,liq.}(E_{F(t)} - \frac{gCO_2e}{MJ_i} \times AF_i) \times MJ_{i,liq.} + \sum_{i,elec.}(EC_{F(e)} - \frac{gCO_2e}{MJ_i} \times AF_i) \times MJ_{i,elec.}}{E_{F(t)} \times MJ_{total}}$$

Equation 2. GHG reduction formula for RED III compliance (pre-2031)

Where:

$E_{F(t)}$	is the baseline fossil fuel comparator (94 gCO_2e/MJ)
$EC_{F(e)}$	is the baseline fossil fuel comparator for electricity (183 gCO_2e/MJ)
i	refers to the renewable fuel type and usage eligible under the RED (e.g., advanced biofuel consumed in rail)
gCO_2e/MJ	refers to the emissions intensity for a given fuel type
AF	refers to the conversion efficiency adjustment factor (0.4 for BEVs)
MJ	refers to the quantity of energy supplied to the transport sector in Megajoules using conversion factors from Annex III or relevant ESO/ISO standards

The RED III requires Member States to account for electricity supplied to the transport sector in their GHG intensity calculations beginning in 2031; this adjustment is made once electricity begins to make up a greater share of the total fuel pool. This change in the crediting formula is reflected in the denominator in Equation 3:

$$\frac{\sum_{i,liq.}(E_{F(t)} - \frac{gCO_2e}{MJ_i} \times AF_i) \times MJ_{i,liq.} + \sum_{i,elec.}(EC_{F(e)} - \frac{gCO_2e}{MJ_i} \times AF_i) \times MJ_{i,elec.}}{E_{F(t)} \times MJ_{i,liq.} + EC_{F(e)} \times MJ_{i,elec.}}$$

Equation 3. GHG reduction formula for RED III compliance (post-2030)

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