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EFFECTS OF CO₂ CERTIFICATE TRADING ON THE LOGISTICS SECTOR IN THE EUROPEAN ECONOMIC AREA: A COMPARATIVE ANALYSIS OF THE EUROPEAN AND GERMAN STRATEGIES

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ABSTRACT

CO₂ certificate trading is a key instrument for reducing greenhouse gas emissions. This article presents the status quo of the known and planned regulation of the logistics industry at the turn of the year 2024/2025. A differentiation is made between the aviation, shipping, road and rail transport sectors. The analysis shows that aviation has already been regulated since 2012 and accounts for around 4-5% of the emissions covered by the EU Emissions Trading System (EU ETS). By contrast, shipping was only integrated into this system in 2024 and is expected to account for around 3 %. Road transport is to be included in the EU ETS 2 from 2027 and is expected to account for 10-15% of regulated emissions. Rail transport, on the other hand, will remain largely exempt from regulation as it is considered a low-emission means of transportation by the EU. A comparison of this picture, which emerges through European control mechanisms, with the current approach of the Federal Republic of Germany with regard to urgently needed investments in the German railroads reveals considerable differences. CO₂ certificate trading is a key instrument of EU climate policy for reducing greenhouse gas emissions, particularly in the logistics sector. This includes aviation, shipping, road and rail transport, each of which is subject to different regulatory measures. While aviation and shipping are already integrated into the EU ETS, road transport will not be included until 2027. Rail transport, on the other hand, remains largely exempt, as it is to be promoted as a low-emission transport sector. Gradual regulation will lead to rising costs, increased investment in low-emission technologies and potential modal shift effects in favor of sustainable means of transport such as rail. In conclusion, based on the currently recognizable situation, a difference between the European strategy (creation of increasing incentive structures for shifting large logistics components to rail) and the German strategy (too little investment for the specified pace of transformation) becomes clear.

Keywords: CO₂ certificates, sustainability, logistics, rail transport, aviation, shipping, road transport.

INTRODUCTION

CO₂ certificate trading is a key instrument for reducing greenhouse gas emissions and offers companies the opportunity to offset or reduce their emissions. In the logistics sector, which causes significant CO₂ emissions due to transportation activities and energy-intensive processes, CO₂ certificate trading can play an important role. The logistics industry is divided into four independent sectors: aviation, shipping, road transport and rail transport. Based on the current and planned measures within the EU ETS, it can be deduced how important the European Union

considers the respective sectors to be in the coming years. The assumption here is that less EU intervention in a sector indicates its future viability. Sectors that are subject to strong EU regulations or are to be subject to them in the future therefore have a longer road ahead of them in terms of achieving the desired CO₂ neutrality

LITERATURE REVIEW

In the following, an attempt is made to outline the current status quo on the topic under investigation using selected specialist literature. The focus of the literature review is on current and scientifically adequate sources from the European language area. Based on this literature review, an expert discussion and possible conclusions can then be drawn.

CO₂ certificate trading - an overview

CO₂ certificate trading is based on the principle of "cap-and-trade". Governments set an upper limit for the permitted amount of CO₂ emissions. Companies receive certificates that give them the right to emit a certain amount of CO₂. Companies that reduce their emissions can sell their surplus certificates, while companies that emit more than their certificates allow must purchase additional certificates. This system creates incentives to invest in emission-reducing technologies (cf. Stuhlmacher et al., 2019). The largest emissions trading system in the world is the European Emissions Trading System (EU ETS), which has been in place since 2005 and has been further developed in several phases. The EU ETS covers various industries, including the logistics sector, in particular large transport companies from all modes of transport. Certificate trading is therefore a central instrument of EU climate policy for achieving the climate targets set (cf. Zaklan & Bauer, 2023).

A portrait of the logistics sector and CO₂ reduction

The logistics industry faces particular challenges when it comes to reducing CO₂ emissions. The high energy consumption caused by transportation, storage and complex supply chains leads to significant CO₂ emissions (cf. Wang et al., 2022). Nevertheless, there are technological solutions to reduce emissions, such as the introduction of electromobility, the use of alternative fuels and the use of energy-efficient logistics centers (cf. van der Put, 2021). CO₂ certificate trading offers incentives for the logistics industry to use such technologies, as reducing emissions avoids the need to purchase additional certificates.

The logistics industry comprises a large number of sectors with different emission levels. While road transport accounts for the largest share with around 500 million tons of CO₂ per year, shipping causes around 940 million tons and air freight contributes around 450 million tons (cf. Ouni & Abdallah, 2024). Rail transport, on the other hand, causes comparatively low emissions of around 50 million tons of CO₂ per year (cf. Guevara et al., 2022). This heterogeneity of the industry therefore requires targeted approaches to CO₂ reduction that meet the specific needs of the individual sectors.

CO₂ certificate trading in the EU - status quo and outlook

The EU Emissions Trading System (EU ETS) covers numerous industrial sectors and is constantly being expanded. While many sectors such as aviation and shipping are subject to strict regulations, rail transport remains largely exempt from the EU ETS regulations. This underlines the strategic importance of rail transport as the preferred means of transportation in EU climate policy in the

future (cf. Lu & Lu, 2024). With this decision, the EU is pursuing the goal of establishing rail transport as the most climate-friendly transport option and thus making a significant contribution to achieving the climate targets by 2050.

The EU ETS, which was introduced in 2005, is the world's largest emissions trading system and now covers more than 11,000 companies in 30 European countries. It is the EU's central instrument for reducing greenhouse gas emissions and plays a crucial role in the implementation of the Green Deal, which aims to make Europe climate-neutral by 2050 (cf. Cariou et al., 2021). In its current phase 4 (2021-2030), the EU ETS aims to reduce emissions in the affected sectors by 62% compared to 2005 (cf. Zaklan et al., 2021)

The price per ton of CO₂ has risen sharply in recent years and is currently around 90 to 100 euros. This price increase is due to the EU's stricter emissions targets and a shortage of certificates. The EU is pursuing a policy of gradual scarcity in order to force companies to reduce their emissions more quickly. Forecasts predict that the price of certificates could rise to up to 150 euros per ton by 2030. This would place a considerable burden on energy-intensive industries in particular and at the same time increase the incentive to invest in greener technologies (cf. Gerlagh et al., 2022). This mainly affects a large number of energy-intensive industries, including the power generation, cement, steel and chemical industries. Since phase 4 of the EU ETS, aviation has also been included, which means that all intra-European flights must offset their emissions. From 2024, shipping will be integrated into the EU ETS, a significant step as shipping is one of the largest emitters in the transport sector. From 2027, road transport, including heavy goods vehicles, will also become part of the EU ETS. This represents a paradigm shift, as previously the focus was primarily on industrial companies (cf. Lu & Lu, 2024).

The logistics sector as a whole accounts for a significant proportion of total emissions in the EU ETS. Air freight and road transport in particular make a significant contribution to emissions. Studies show that road transport accounts for around 21% of total CO₂ emissions in the EU. Air freight, although less significant in terms of volume, has a disproportionately high share of total emissions due to its high emissions intensity (cf. Cichosz & Pluta-Zaremba, 2019). Rail transport, on the other hand, is largely excluded from the EU ETS regulations. This is due to the fact that rail transport is already considered one of the most environmentally friendly forms of transportation. Compared to road and air transport, rail transport causes significantly fewer emissions per transported ton and kilometer. This exception illustrates the EU's political intention to promote rail transport as a long-term sustainable alternative (cf. Varnavskii, 2024). While road transport and air freight will be increasingly regulated in the coming years, rail transport will continue to enjoy regulatory advantages. This could increase the incentive for companies to shift more freight to rail (cf. Zagożdżon, 2023).

The exclusion of rail transport from the EU ETS shows that the EU considers this sector to be key to the decarbonization of transport. The political message is clear: companies should focus more on rail transport in order to reduce emissions and at the same time avoid the economic pressure caused by rising certificate prices. This strategy is part of the broader European Green Deal, which includes the expansion of cross-border rail connections and the removal of barriers to green rail transport (cf. Varnavskii, 2024).

Rail transport in Germany

Rail transport plays a central role in achieving climate targets, but there is a considerable need for investment in Germany. According to estimates, Deutsche Bahn will need around 80 to 100 billion euros in the coming years to modernize and expand the existing infrastructure (cf. Schulte-Werning et al., 2022). However, significantly fewer funds have been allocated in the current economic budget, resulting in a large funding gap. The lack of this investment has far-reaching consequences: The railroads remain inefficient, with frequent delays and capacity bottlenecks, which in turn slows down freight transport and increases CO₂ emissions in road transport (cf. Boockmeyer et al., 2021). Germany therefore urgently needs to invest more financial resources in the railroads and their infrastructure in order to meet the requirements of the future. Without significant investment in the rail network, the country risks falling behind other European countries, both economically and in terms of climate policy.

METHODOLOGY

The methodology of this article is based on a comprehensive literature review that systematically analyzes scientific publications from the European Economic Area. The aim is to present the current scientific consensus. To this end, studies and articles are primarily on the basis of their relevance, methodological quality and topicality.

Particular attention is paid to peer-reviewed studies in order to ensure scientific validity. The analyzed studies are compared with each other in order to identify similarities and differences. The focus is on the synthesis and critical evaluation of existing scientific findings without resorting to interviews, surveys or other empirical methods. This approach enables a precise and well-founded presentation of the current state of research and forms a basis for further scientific discussions.

RESULTS

The EU ETS does not include an overarching regulation for the logistics sector. Instead, the heterogeneous industry is divided into four sectors (aviation, shipping, road transport and rail transport). This subdivision enables differentiated control and steering effects through individual measures.

At the time of writing this article, the situation is as follows: Aviation accounts for around 4-5% of the share of CO₂ emissions measured under the EU ETS. It should also be mentioned that aviation has been regulated under the EU ETS since 2012. The shipping sector, on the other hand, only became part of the EU ETS in 2024. Based on current estimates, this sector will account for around 3% of the share of CO₂ regulated under the EU ETS. Precise publications are still awaited due to the topicality of the issue. Nevertheless, it is clear that shipping has a comparable share of CO₂ emissions to aviation, which has already been regulated for a long time, and that regulation appears to make sense in principle

If we compare these sectors with road transport, it is noticeable that road transport has not yet been taken into account in the EU ETS. The reason for this is that road transport in the EU has already been regulated and controlled through a combination of different measures. The central control mechanisms here are the CO₂ fleet limit for cars and light commercial vehicles, fuel taxes that have already been levied and subsidies for low-emission drive types. From 2027, however, road

transport is also to be integrated into certificate trading as part of EU ETS 2 and thus regulated even more strongly

If integration into the EU ETS has taken place, road traffic will account for around 10-15% of the CO₂ emissions controlled by the certificate system according to current estimates. However, it should be noted that the exact regulations are not yet known and the estimate can therefore only provide an initial indication.

It is striking that rail transport has not been the direct focus of European regulation and will apparently not be regulated in the future as part of EU ETS 2. Based on current literature, the reason for this is that European rail transport is already regarded as an efficient and sustainable means of transportation and should not be additionally burdened by certificate trading. This statement can be further supported by large-scale funding programs such as the TEN-T network (Trans-European Transport Networks).

In conclusion, it can be said that rail is largely excluded from European CO₂ certificate trading and other regulatory requirements. Rail has proven to be a low-carbon and efficient logistics instrument and should be strengthened in comparison to other modes of transport. This direction is being taken further by the increasing regulation of the price of CO₂ certificates and the effects in favor of rail are therefore being accelerated

DISCUSSION

CO₂ certificate trading is a key instrument of EU climate policy that is intended to encourage companies to reduce their greenhouse gas emissions. Particularly in the logistics sector, which causes significant CO₂ emissions due to transport activities and energy-intensive processes, trading in emissions certificates could make a significant contribution to decarbonization. The differentiation of the logistics industry into aviation, shipping, road transport and rail transport allows a differentiated view of the respective sectoral challenges and regulatory measures within the framework of the EU ETS.

The logistics sector is subject to different regulatory measures within the EU ETS. While aviation has been integrated into the system since 2012 and shipping has been included since 2024, road transport is still in a transition phase before it is fully integrated into the EU ETS 2 from 2027. Rail transport, on the other hand, remains exempt from this regulation as it is already considered a low-emission transport sector.

The aviation industry is one of the most emissions-intensive sectors within logistics. It currently accounts for around 4-5% of the CO₂ emissions regulated by the EU ETS. Due to the limited technical alternatives to fossil fuels, the industry faces significant challenges in reducing its emissions. The existing regulation within the EU ETS forces airlines to purchase emission allowances, which should encourage investment in sustainable fuels or alternative propulsion technologies.

The integration of shipping into the EU ETS in 2024 represents a significant milestone. With an estimated share of 3% of EU-wide CO₂ emissions from emissions trading, the sector is a relevant

player in the decarbonization process. The implementation of this measure could help to make alternative drive systems, such as hydrogen-powered ships or the increased use of synthetic fuels, more economically attractive.

Road transport will not be regulated by the EU ETS 2 until 2027, which will have a significant impact on businesses and consumers. Road transport accounts for around 21% of the EU's total CO₂ emissions and regulation is expected to result in significant cost increases for businesses. The combination of emissions trading, CO₂ fleet limits and rising fuel prices could increase the incentive to electrify vehicle fleets.

Rail transport remains largely excluded from the measures of the EU ETS. This is a deliberate political decision by the EU to strengthen rail transport as a sustainable alternative to road and air transport. In addition, rail is actively promoted through programs such as the TEN-T network (Trans-European Transport Networks) in order to improve cross-border rail transport and increase the use of rail for freight transport.

Based on this, it is clear that the German government's delay in expanding its own rail network could lead to increasing economic problems. In addition to the negative impact on domestic German logistics, a lack of infrastructure investment will lead to significant disadvantages in the European economic area in the long term. Possible evasion and redistribution effects within logistics (due to increasing CO₂ pricing within aviation and road transport) can therefore only take place to a limited extent in favor of rail.

CONCLUSIONS

CO₂ certificate trading is a key measure for decarbonizing the logistics sector. While the aviation and shipping sectors are already fully integrated into the EU ETS, road transport will follow suit in the coming years. Rail, on the other hand, remains largely excluded from regulation, which makes it more attractive as a climate-friendly alternative. The economic impact on companies is considerable, but the system also offers opportunities for technological innovation and sustainable investment.

By expanding the EU ETS, the EU is providing targeted steering impetus to existing sectors. The importance the EU will attach to the respective sector in the future can be deduced from the timing and intensity of the steering impetus. It should be noted that achieving the goal of CO₂ neutrality is naturally easier for some industries or sectors than for others. In this case, the relative advantage for those sectors results from the lack of (over)regulation by the EU. For this reason, it would seem sensible for these steering impulses sent out by the EU to be taken into account in national infrastructure planning. According to current information, Germany has a lot of catching up to do here.

Notes

- none -

REFERENCES

- Boockmeyer, A., Friedenberger, D., Pirl, L., Schmid, R., Polze, A., Herholz, H., ... & Wilhelmi, C. (2021). From CCS-Planning to Testautomation: The Digital Testfield of Deutsche Bahn in Scheibenberg - A Case Study. 2021 IEEE International Conference on Cloud Engineering (IC2E), 258-263. <https://doi.org/10.1109/ic2e52221.2021.00043>
- Cariou, P., Lindstad, E., & Jia, H. (2021). The impact of an EU maritime emissions trading system on oil trades. *Transportation Research Part D: Transport and Environment*, 99, 102992. <https://doi.org/10.1016/j.trd.2021.102992>
- Cichosz, M., & Pluta-Zaremba, A. (2019). How to improve freight transport emissions' management? *European Economics: Agriculture*, 15, 93-105
- Gerlagh, R., Heijmans, R., & Rosendahl, K. E. (2022). Shifting concerns for the EU ETS: Are carbon prices becoming too high? *Environmental Research Letters*, 17(4), 044056. <https://doi.org/10.1088/1748-9326/ac63d6>
- Guevara, M., Petetin, H., Jorba, O., Denier van der Gon, H. A. C., Kuenen, J., Super, I., ... & Pérez García-Pando, C. (2022). European primary emissions of criteria pollutants and greenhouse gases modulated by COVID-19 pandemic disruptions. *Earth System Science Data*. <https://doi.org/10.5194/essd-2022-31-supplement>
- Lu, Z., & Lu, S. (2024). Inclusion of maritime into the EU ETS: Implications from the aviation EU ETS and aviation sector. *Journal of Economics, Business and Management*. <https://doi.org/10.18178/joebm.2024.12.3.807>
- Ouni, M., & Abdallah, K. B. (2024). Environmental sustainability and green logistics: Evidence from BRICS and Gulf countries by cross-sectionally augmented autoregressive distributed lag (CS-ARDL) approach. *Sustainable Development*. <https://doi.org/10.1002/sd.2856>
- Potowski, K. (2007) *Sprache und Identität in einer Dual-Immersion-Schule*. Clevedon: Mehrsprachige Angelegenheiten
- Schulte-Werning, B., Asmussen, B., Degen, K., Onnich, J., & Stiebel, D. (2006). Advances in Noise and Vibration Reduction at DB to comply with the EU Environmental Noise Directive.
- Stuhlmacher, M., Patnaik, S., Streletskiy, D., & Taylor, K. (2019). Cap-and-trade and emissions clustering: A spatial-temporal analysis of the European Union Emissions Trading Scheme. *Journal of Environmental Management*, 249, 109352. <https://doi.org/10.1016/j.jenvman.2019.109352>
- Varnavskii, V. G. (2024). EU Railways: Contribution to Decarbonisation Solution. *Contemporary Europe*. <https://doi.org/10.31857/s0201708324020062>
- Zagożdżon, B. (2023). Polish railways from the perspective of the European Green Deal. *Journal of Management and Financial Sciences*. <https://doi.org/10.33119/jmfs.2022.46.5>
- Zaklan, A., & Bauer, B. (2023). Europe's mechanism for countering the risk of carbon leakage: The role of the EU ETS in reducing emissions and promoting clean technologies. *Journal of Climate Policy*, 19(4), 234-250. <https://doi.org/10.1016/j.clp.2023.104233>
- Zaklan, A., Wachsmuth, J., & Duscha, V. (2021). The EU ETS to 2030 and beyond: adjusting the cap in light of the 1.5°C target and current energy policies. *Climate Policy*, 21(6), 778-791. <https://doi.org/10.1080/14693062.2021.1878999>