

CO₂ IMPACT OF CAR TRANSPORT ON CLIMATE CHANGE

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Annotation

The article deals with the implementation of sustainable development goals and trends in the growth of CO₂ emissions from vehicle transport i.e. cars and their impact on climate change. The dilemma raised in the case study: climate change as a global problem that requires urgent international cooperation worldwide.

The scientific problem of this study is expressed with the following question: How do CO₂ emissions affect climate change and what actions should be taken to reduce this effect?

The object of the work: CO₂ emissions of car transport.

The aim of the work is to investigate the impact of car transport carbon dioxide (CO₂) emissions on climate change. To achieve the aim the following objectives were set: 1) to analyze the scientific literature on the growth trends of CO₂ emissions from car transport and the impact on climate change. 2) to investigate the EU sustainable development goals in order to reduce the CO₂ impact of car transport on climate change.

Once statistical analysis and comparison were performed, the conclusions were revealed. To reduce the impact of car transport on climate change not only in the EU countries, but also in the whole world, it is necessary to promote and develop the ideology and culture about sustainable development. Encouragement of use more efficient vehicles, such as electric vehicles over ordinary fuel-powered vehicles; support policies that promote sustainable transport use, i.e. public transport, cycling, etc.; optimization and upgrade of the city's infrastructure, enabling efficient and convenient use of bicycle and pedestrian paths; convenient and affordable loan obtainment conditions for the purchase of electric cars; regulated price policy; regulation of fuel quality and price.

Keywords: sustainable development, sustainable development culture, sustainable development goals, car transport.

Introduction

Relevance of the topic: Implementation of sustainable development nowadays is an important research theme. The impact of carbon dioxide and CO₂ on global climate change is a worldwide issue. Climate change is a global phenomenon that has a major impact on urban life. The concentration of greenhouse gases, including CO₂, in the atmosphere is rapidly increasing, causing global warming, and leading to various negative changes on Earth. The transport sector is the second most important sector contributing to the production of CO₂ emissions worldwide, and it is responsible for more than one third of the total energy consumption within the country-members of the European Environment Agency. With the overarching aim of mitigating climate change, policies, regulations, and new infrastructure investments are employed to facilitate the route to a low-carbon economy (Georgatzi, Stamboulis, Vetsikas, 2020).

As global temperatures rise, sea levels rise, extreme weather events such as floods, droughts and storms increase, and the spread of tropical diseases increases, all these results have inevitable impact on urban infrastructure, housing, people's quality of life and their health. Cities are a major source of greenhouse gas emissions. Cities are estimated to be responsible for 75 percent of global CO₂ emissions, with transport and buildings among the largest. Transport is third largest and second fastest growing source of greenhouse gas emissions. The road transport sector makes up 88 percent

of total transport emissions and the projected emissions increase from 1990 to 2020 is 64 percent (Stanley, Hensher, Loader, 2011). Achieving prospective emission reduction targets will pose major challenges for the road transport sector. Promoting active travel should be a cornerstone of strategies to meet net zero carbon targets, particularly in urban areas, while also improving public health and quality of urban life (Brand, Dons, Anaya-Boig, et al., 2021).

Scientific problem. Climate change is a worldwide problem requiring urgent international cooperation. The scientific problem of this research is expressed in the following question: *How does CO₂ emission affect climate change and how can we reduce this effect?*

Object of the work: CO₂ emissions of car transport.

The aim of the work: to investigate the impact of car transport carbon dioxide (CO₂) emissions on climate change.

Work objectives:

1. To analyze the scientific literature on the growth trends of CO₂ emissions from car transport and the impact on climate change.
2. To investigate the EU sustainable development goals in order to reduce the CO₂ impact of car transport on climate change.

Research methods: analysis of scientific sources on the influence of CO₂ on global climate change, analysis of statistical data, comparative analysis, graphic representation.

Car transport significantly contributes to climate change through the emission of carbon dioxide (CO₂), a major greenhouse gas. This results in more extreme weather patterns, rising sea levels, and disruptions to ecosystems. Reducing CO₂ emissions from cars is critical to mitigating climate change and its harmful effects on the planet.

1. The concept of CO₂ emissions from car transport and its impact on climate change

The growing threat of global warming and climate change is one of the world's most significant issues. Emissions of the greenhouse gas CO₂ were examined by Brand, et al., 2021; Day, Jones, Maidment, 2009; Brand, Götschi et al., 2021; Georgatzi, Stamboulis, Vetsikas, 2020; Hao, Chen, Wei, et al., 2016; Stanley, Hensher, Loader, 2011. The concept of CO₂ emission defines the release of carbon dioxide (CO₂) into the environment at a certain time or during a certain period. Emissions come from a variety of sources, including industry, transportation, power generation, agriculture, and other factors. CO₂ is a major greenhouse gas that contributes to climate change because it can amplify the greenhouse effect that causes the planet's average temperature to rise.

Measuring and monitoring CO₂ emissions is important for understanding the scale of the climate change process and its impact on the environment and humanity. It helps governments, organizations and individuals make decisions about policymaking, energy efficiency, multi-sector activities and lifestyles to reduce CO₂ emissions and adapt to the effects of climate change.

Changes in active travel have significant lifecycle carbon emissions benefits, even in European urban contexts with already high walking and cycling shares. An increase in cycling or walking consistently and independently decreased mobility-related lifecycle CO₂ emissions, suggesting that active travel substituted for motorized travel – i.e. the increase was not just additional (induced) travel over and above motorized travel (Brand, Götschi, et al., 2021).

Climate change has a wider impact on energy demand and supply. Therefore, burning fossil fuels is a major source of greenhouse gas emissions, that would affect climate change through its influence on energy consumption. Since the energy demand for heating in winter and cooling in summer is directly affected by the change in ambient temperature, temperature fluctuations caused by climate change could affect its total energy demand so that energy demand should adapt to the changing environment and improving the quality of life. Finally, changes in energy demand leads to changes in energy consumption and associated CO₂ emissions (Day, Jones, Maidment, 2009; Hao, Chen, Wei, et al., 2016).

2. EU sustainable development goals to reduce the CO₂ impact of car transport on climate change

Sustainable development is the kind of development that can ensure better living conditions and quality. At the 70th session of the United Nations in 2015, September 25th, the General Assembly resolution "Transforming our world: The 2030 Agenda for Sustainable Development" was adopted. The agenda is an action plan for humans and planet to reach prosperity and harmony on Earth. The agenda consists of 17 goals and 169 tasks. The goals are based on three aspects of sustainable development - environmental, social, and economic (Directive (EU), 2024).

Climate Action Coalitions work around the world to reduce global greenhouse gas emissions, advance nature-based solutions, accelerate the transition to renewable energy, and invest in resilient cities and communities. This article analyzes the 13th objective, i.e. the fight against climate change. Carbon dioxide CO₂ is an important heat-trapping gas, also known as a greenhouse gas, produced by the extraction, and burning of fossil fuels (such as coal, oil, and natural gas), forest fires, and natural processes such as volcanic processes, etc. As economies around the world grow, transport activities increase, which means that emissions from the transport sector also increase. This is largely because 95 percent of the world's transportation energy still comes from fossil fuels.

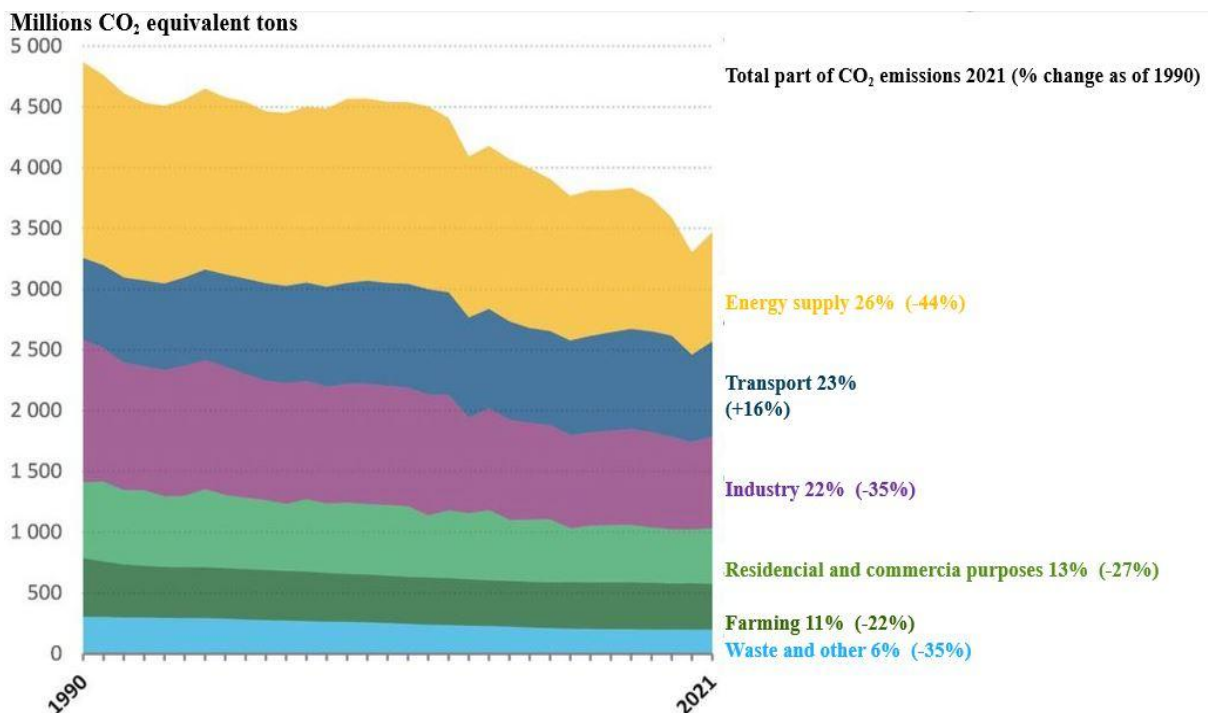


Figure 1. EU 27 greenhouse gas emissions by sector (1990-2021)
 Source: Court of Auditors, EEA data on greenhouse gases, 22 June 2023

At the above shown diagram we can notice, that in 2021, CO₂ carbon dioxide emissions from transport reached almost 23 percent of greenhouse gas emissions in the European Union (EU-27) (see Figure 1). While efforts are being made to reduce CO₂ in other sectors, overall emissions in the EU's transport economy have been gradually increasing since the 1990s.

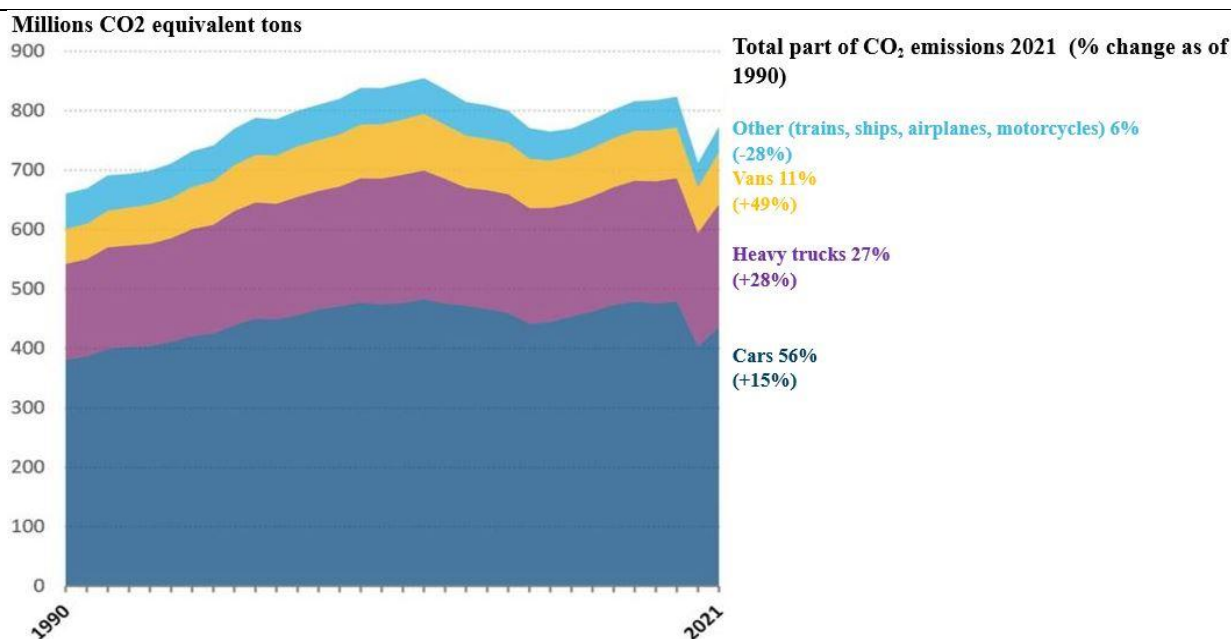


Figure 2. EU 27 Distribution of CO₂ emissions from transport (1990-2021)
 (Source: Lithuania Court of Auditors, EEA data on greenhouse gases, 18 April 2023)

At the following diagram it is shown that in 2021 the amount of CO₂ emitted by passenger cars accounted for astonishing 56 percent of a total transport emissions (see Figure 2). Passenger car emissions had a tendency to increase except during economic downturns such as: the COVID-19 pandemic in 2020.

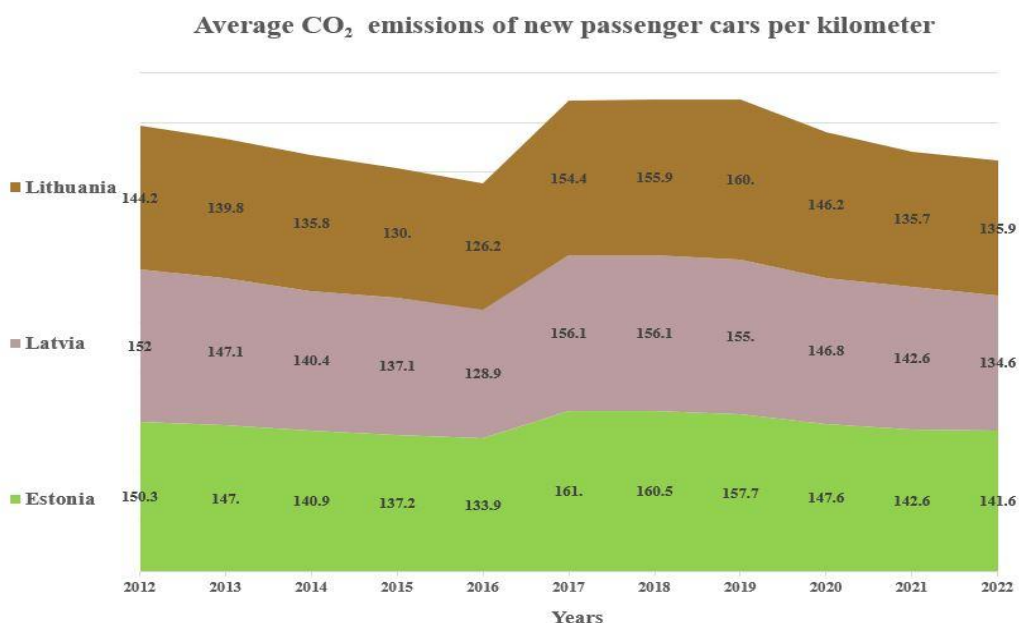


Figure 3. Average statistics of CO₂ emissions per kilometer of new passenger cars
 Source: prepared by the authors based on Eurostat statistics

Analyzing the distribution of total transport CO₂ emissions, we can notice that passenger vehicles display more than half of the total amount, while trucks – 27 percent, vans – 11 percent, and 6 percent consists of all other vehicles such as trains, airplanes, and ships (Carbon Dioxide, 2024) (see Figure 3).

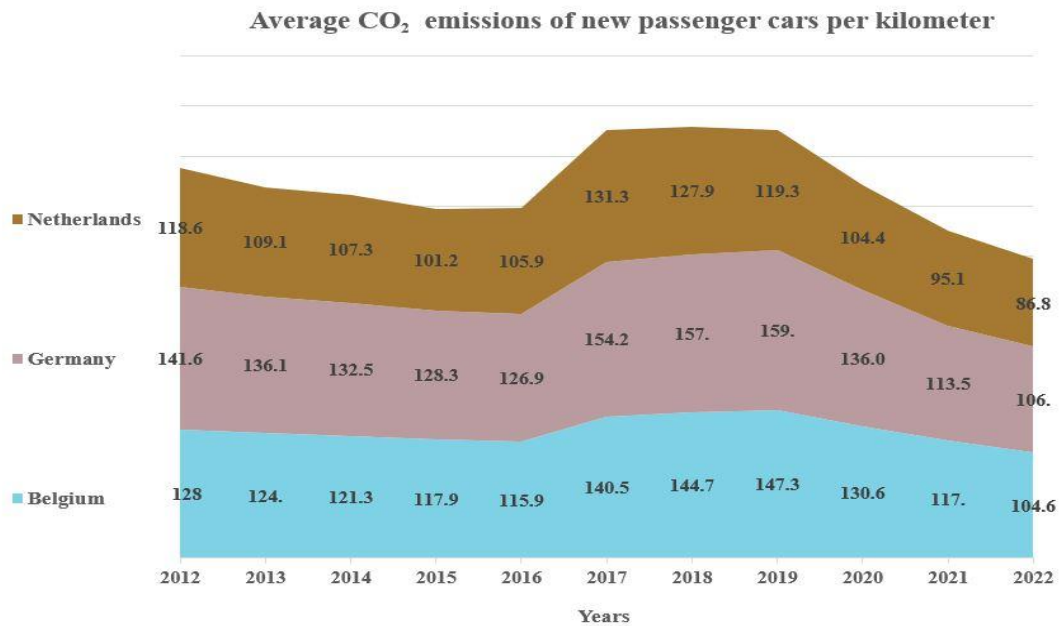


Figure 4. Average statistics of CO₂ emissions per kilometer of new passenger cars

Source: prepared by the authors based on Eurostat statistics

Statistical data shows that during the period 2012 - 2022, the highest amount of CO₂ emissions per kilometer of new passenger cars was recorded in 2017 within all Baltic countries such as Lithuania, Latvia, Estonia, meaning that crisis was recorded (see Figure 4). Then, during the period from 2018 to 2022 there was observed a fixed economical rise, meaning that the amount of CO₂ emissions per kilometer of new passenger cars started gradually to decrease. Following the period from 2012 - 2016 we can notice that the amount of CO₂ emissions per kilometer of new passenger cars tended to decrease, reaching the lowest point in 2016.

Statistical data displayed on this diagram shows the during the period from 2012 - 2022, the highest amount of CO₂ emissions per kilometer for new passenger cars was recorded in Belgium and Germany in 2019 reaching the crisis. In the Netherlands crisis was recorded two years earlier - in 2017. From 2020 to 2022 there was recorder a steady rise, meaning that the amount of CO₂ emission per km of new cars started gradually to decrease in all countries, including Belgium, Germany and the Netherlands due to a start of the COVID-19 pandemic. It was noticed that during the period from 2012 to 2018 CO₂ emissions per kilometer of new passenger cars in Belgium and Germany had tendency to decrease, reaching their lowest point in 2016, while in Netherlands peak of economy occurred one year earlier - in 2015 (European Climate Pact, 2024).

To reduce emissions from road transport, the European Parliament has been actively working on a completion for the proposed CO₂ targets for motor vehicles, i.e. cars and vans, with a following:

- a new emissions trading system for road transport and buildings;
- increased share of renewable transport fuels;
- the removal of tax advantages for fossil fuels;
- a revision of the alternative fuels infrastructure legislation to expand capacity.

As a result, Paris Agreement, a legally binding international treaty on climate change was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015 and it entered into force on 4 November 2016. The European Parliament and EU countries reached an agreement on the final form of the rules in October 2022. It was approved by Parliament in February 2023 and adopted by the Council in March 2023. The legislation entered into force in April 2023.

The revised legislation, regulation (EU) 2023/851 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2019/631 should help Europeans by deploying zero CO₂ emission vehicles more broadly - better air quality, energy savings and lower costs for owning a vehicle - and stimulate innovation in zero-emission technologies. To be more precise, the new

legislation sets the path towards zero CO₂ emissions for new passenger cars and light commercial vehicles in 2035. Intermediate emissions reduction targets for 2030 are set at 55 percent for cars and 50 percent for vans.

The revised legislation establishes a framework for international cooperation on climate change. It avoids a one-size-fits-all approach, allowing countries flexibility while still pushing for continuous improvement through regular reviews and goal setting. The EU is introducing new CO₂ emission targets, which aim to cut harmful emissions from new passenger cars and light commercial vehicles such as vans. Improving and tightening the standards would help to achieve the EU's climate targets for 2030. Passenger cars and light commercial vehicles such as vans produce about 15 percent of the European Union's total CO₂ emissions.

It was considerably noticed that following Global pandemic COVID - 2019, occurred in 2019, CO₂ emission levels have significantly decreased due to a global lockdown and travel restrictions. Lockdowns imposed movement restrictions, forcing many people to work from home, attend school virtually, and cancel or postpone non-essential trips. This significantly reduced car usage for commuting, errands, and leisure activities. Public transportation ridership also plummeted as people stayed home and avoided crowded spaces. With lockdowns limiting movement, people primarily focused on essential trips such as grocery shopping, medical appointments, and work deemed critical by authorities. This shift in travel behavior significantly reduced overall travel demand and the associated CO₂ emissions.

Generalizing the research, it can be claimed that the EU sustainable development goals in order to reduce the CO₂ impact of car transport on climate change are being reached through well developed public transport in Western Countries, what is becoming more and more popular, and the majority of residents give their preference due to its convenience and easy access. As the result people use cars less, CO₂ emissions from transport also decrease.

More frequent use of bicycles and pedestrian roads creates a popular cycling culture in Western Countries. People ride bicycles more often than in other parts of the world. More fuel-efficient cars in Western countries are actively used due to a new imposed rules by the government leading to a lower amounts of CO₂ emissions from transport (Pucher, Dijkstra, 2000).

Western Countries have higher fuel prices than other parts of the world, including other EU countries. People lately give their preference to other transport alternatives, e.g. public transport, bicycle, and etc. Also, Western Countries generally have stricter environmental policies governing emissions from the transport sector. This encourages car manufacturers to create greener cars and drivers to drive more responsibly. Urban planning in Western countries is characterized by many bicycle and pedestrian paths, due to which a healthy lifestyle is encouraged, and less car use is encouraged.

Conclusions

1. After a detailed analysis of the scientific literature and statistics on the amount of CO₂ emissions per kilometer of new passenger cars between the Baltic Countries and Western European countries such as: Belgium, Germany and the Netherlands, an obvious difference in the amount of CO₂ emissions per kilometer can be observed. In the Baltic Countries, statistical indicators are slightly higher than in Western European countries.
2. Having analyzed the EU sustainable development goals in order to reduce the CO₂ impact of car transport on climate change, it can be claimed that motor transport is a major source of greenhouse gas emissions, having a significant impact on climate change. Analyzing the provided statistical data and information, it can be concluded that the amount of CO₂ emissions from all transport has an increasing tendency, which has a fatal impact on climate change and the quality of life of mankind. Based on the presented statistics, there is a noticeable difference in the amount of CO₂ emissions per kilometer in the comparative EU countries. In the Baltic Countries, statistical indicators are slightly higher than in Western European countries. In order to reduce the impact of car transport on climate change, not only in the EU countries, but all over the world, it is

necessary to promote and develop the ideology and culture of thinking of sustainable and more efficient development.

Recommendation

In order to reduce the CO₂ impact of car transport on climate change, it is necessary to create a policy and conditions and encourage people to:

- drive less cars and other vehicles that pollute the atmosphere;
- choose more efficient cars, i.e. electric cars, etc.;
- support policies promoting sustainable transport i.e. public transport, cycling, etc.;
- optimize and update urban infrastructure, for better and more convenient use of bicycle and pedestrian paths;
- impose more flexible crediting opportunities for the acquisition of electric cars and regulation of the price policy;
- regulate the quality and price of fuel.

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AUTOMOBILIŲ TRANSPORTO CO₂ POVEIKIS KLIMATO KAITAI

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Santrauka

Straipsnyje nagrinėjamas darnaus vystymosi tikslų įgyvendinimas ir transporto priemonių transporto, t. y. automobilių, CO₂ emisijos augimo tendencijos ir jų poveikis klimato kaitai.

Atvejo tyrime iškelta dilema: klimato kaita kaip pasaulinė problema, kuriai būtinas skubus tarptautinis bendradarbiavimas visame pasaulyje.

Šio tyrimo mokslinė problema išreiškiama tokiu klausimu: Kaip CO₂ emisija veikia klimato kaitą ir kokių veiksmų reikėtų imtis norint sumažinti šį poveikį?

Darbo objektas: automobilių transporto CO₂ emisija.

Darbo tikslas: ištirti automobilių transporto išmetamo anglies dvideginio (CO₂) poveikį klimato kaitai.

Darbo uždaviniai: 1. Išanalizuoti mokslinę literatūrą ir automobilių transporto išmetamų CO₂ emisijų augimo tendencijas ir jų įtaką klimato kaitai. 2. Išanalizuoti ES darnaus vystymosi tikslus mažinti automobilių transporto CO₂ poveikį klimato kaitai.

Tyrimo metodai: mokslinių šaltinių apie CO₂ įtaką globaliai klimato kaitai analizė, statistinių duomenų analizė, lyginamoji analizė, grafinis vaizdavimas.

Tyrimo rezultatai. Išsamiai išanalizavus mokslinę literatūrą ir statistiką apie naujų lengvųjų automobilių CO₂ emisiją vienam kilometrui tarp Baltijos šalių ir Vakarų Europos šalių, tokių kaip Belgija, Vokietija ir Nyderlandai, akivaizdus CO₂ kiekio skirtumas. Galima stebėti išmetamųjų teršalų kiekį vienam kilometrui. Baltijos šalyse statistiniai rodikliai yra šiek tiek aukštesni nei Vakarų Europos šalyse.

Išanalizavus ES darnaus vystymosi tikslus, siekiant sumažinti automobilių transporto CO₂ poveikį klimato kaitai, galima teigti, kad automobilių transportas yra pagrindinis šiltnamio efektą sukeliančių dujų emisijos šaltinis, darantis didelę įtaką klimato kaitai. Analizuojant pateiktus statistinius duomenis ir informaciją, galima daryti išvadą, kad viso transporto išmetamo CO₂ kiekis turi didėjimo tendenciją, o tai daro lemtingą įtaką klimato kaitai ir žmonijos gyvenimo kokybei. Remiantis pateikta statistika, pastebimas CO₂ išmetimo vienam kilometrui skirtumas palyginamose ES šalyse. Baltijos šalyse statistiniai rodikliai yra šiek tiek aukštesni nei Vakarų Europos šalyse. Siekiant sumažinti automobilių transporto poveikį klimato kaitai ne tik ES šalyse, bet ir visame pasaulyje, būtina skatinti ir plėtoti tvarios ir efektyvesnės plėtros ideologiją ir mąstymo kultūrą.

Raktiniai žodžiai: darnus vystymasis, darnaus vystymosi kultūra, darnaus vystymosi tikslai, automobilių transportas.