**RIGA TECHNICAL UNIVERSITY**

**FACULTY OF ENGINEERING ECONOMICS AND MANAGEMENT**

RESEARCH PAPER

***Methodology of Statistic Data Processing and Analysis***

**TO PROVIDE SUSTAINABLE SOLUTION FOR FUEL EFFICIENCY ON FREIGHT TRANSPORTATION**

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# ABSTRACT

Increasing freight cost and fuel consumption is one of the concerning problems in Latvia. Freight cost will affect the price of products and excess fuel consumption will affect the environment by producing Co2 emission. This study focusses on optimizing the freight cost and fuel consumption in Latvia’s transportation sector through implementing sustainable practices. The study priorities on the potential benefits of adapting eco-friendly technology as well as route optimization to minimize the consumption of fuel. The data is collected through survey, questionnaires and subsequently analyzed using graphs and charts. This research endeavors to substitute with alternative fuels and sustainable practices to lower freight cost and fuel consumption through improvement of environmentally and economically.

Keywords: Sustainable Transportation, Freight Cost, Fuel Consumption, Alternative Fuels, Environmental Sustainability,

# INTRODUCTION

Freight transportation is one of the backbones of any industrial system and it is a major component of the supply chain to ensure the efficient movement and timely availability of raw materials and finished products in local and international markets. (T.G, Crainic, 2003). Transport costs have a very large, usually the largest, share in logistics costs. Transport costs are strongly influenced by fuel prices on the one hand, and fuel consumption in transport, i.e., energy efficiency, on the other . Fuel costs account for a large proportion of the total cost of a transportation company. For example, they typically account for around 32–33 per cent of the freight cost. (Dariusz Milewsk.,2023). The fuel price depends on variety of parameters such as international brent price, oil refining costs or import taxes, fuel marketers margins, distribution costs to deliver the refined products to the final customers, and the national petroleum taxes. (C. Macharis, E., Van Hoeck, E., Pekin, T., Van Lier, 2010). Energy consumption in transport companies depends on various factors, both technical and organizational. Technical progress in transport, including road transport, is very high, which may result in increased energy efficiency. However, the energy prices have a large impact on the profitability of companies. The problem of energy consumption is all the more important, especially since transport is considered to be the sector with the greatest potential for energy savings. (Pimentel & others.2004)

Transport costs are strongly influenced by fuel prices on the one hand, and fuel consumption in transport, i.e., energy efficiency, on the other. Fuel costs account for a large proportion of the total cost of a transportation company. Addition to that, consumption of fuel leads to a greater impact on environment, embodying sustainable practices is an uttermost priority. This will help Latvia to push itself to become one of the eco-friendly environmental countries in European Union.

The aim of this study is to improve energy efficiency in freight transport. researchers have studied a wide range of cost factors and used a broad scope of methodologies to estimate freight transportation costs.

The study also focus on adapting sustainable transportation, this practice will reduce the freight cost and impact on overall operational efficiency and identifying new challenges in implementation. Moreover, it will also uncover the opportunities for achieving sustainable goals while maintaining profitability in the freight transportation

The objective of this research are as follows:

1. To inspect the current practices of fuel usage and freight cost management. The goal is to find the inefficiency of the fuel consumption and key strategies to implement to reduce the consumption of fuel

2. An assessment of the effectiveness of existing policies and initiatives that attempt to stimulate a greater use of alternative fuels in freight transport in terms of reduction of emissions and freight cost.

3 . Suggest a solution for improving fuel efficiency and reducing freight cost by establishing sustainable strategies which helps in optimizing logistic and cost-effective transportation

**Research Objects and Subjects:** The subject of this study is freight transportation in Latvia, concerning over increase in freight cost and fuel consumption. The study focusses on sustainability in transportation sector

The object of the study is the reducing freight cost and fuel consumption by adopting sustainable practices. It encompasses examination of the methods, technologies and policies that may improve freight sector efficiency and environmental performance in Latvia.

**Novelty**: In Latvia, majority of the freight is transported in the mode of road, followed by rail and fleet. The investigation addressed strategies that may reduce fuel consumption and freight costs in transportation operations in Latvia. The study will determine eco-friendly and cost-effective practices to be implemented, determine its effect on total operational efficiency and challenges of implementation. Additionally, it will attempt to reveal the path for accomplishing sustainability goals in the logistics field with the consideration of profitability and affordability of freight cost.

**Short annotation** : The study examines the freight cost in Latvia, focusing on road transportation, fuel price, and fuel consumption. Fuel costs account for 25-40% of freight costs, leading to increased overheads for haulage and freight companies. This has resulted in reduced margins for freight operators, potentially making their businesses unviable. The paper discusses the the increasing freight cost, fuel cost, and consumption in Latvia , emphasizing the importance of sustainability in reducing fuel dependency and minimizing carbon emissions. Freight sector is one of the most significant contributors to Latvia's GDP, and minimizing fuel consumption can increase profits. The study emphasizes the need for sustainable practices to reduce fuel dependency and minimize carbon emissions.

# 1. LITERTURE RVIEW

## 1.1. Green Transportation in Latvia.

Green logistics focuses on reducing the environmental impact of logistics - the aim is to minimize the carbon footprint of the supply chain while maintaining efficiency and profitability. Sustainable logistics is a comprehensive approach that considers the economic and social impacts of activities and aims to enhance societal interests, both economic and environmental (Machari’s et al., 2014).

Striving for a balance between these pillars enables logistics to provide optimal service while also promoting a more conscious use of resources (Logistics Cluster, 2024). There are four areas of implementation of green logistics (Čepinskis & Masteika, 2011):

1. Modal split: modal transport, reverse logistics, alternative modes of transport

2. Energy use: reduction of energy consumption, reduction of environmental pollution, reduction of CO2 emissions, integrating CO2 reduction into corporate policy, measuring the environmental impact of logistics activities.

3. Manufacturing: using clean technology, reducing, treating and managing waste.

4. Extraction of raw materials: sustainable purchasing, use of less polluting materials, recycling of waste, re-use of products.

The main purpose of investing in green logistics include saving resources; waste management improvement; improvement of labor productivity; reduction of the negative impact of the organization's activities on the environment; improving competitiveness; providing an ergonomic working environment (Čepinskis & Masteika, 2011).

### 1.1.2 Government Policies and Initiatives

As early as in 2018, the European Commission adopted a strategy, whose long-term vision is to be achieved prosperous, competitive, and climate-neutral economy stated by European Commission, (2018). In supplement to the “Clean Planet for all” strategy, in 2019 the European Commission introduced a package of specific measures called “The European Green Deal” according to which the EU economy should be free of net greenhouse gas emissions till 2050, and the EU economic growth will not be based and dependent on fossil fuels declared by European Commission . (European Commission.,2019).

Latvia started offering a subsidy for EVs for the first time in 2014, when the Electromobility Development Plan 2014-2016 was issued. Latvia has introduced a subsidy program for electric vehicles (EVs) since 2014 for new EV purchases and plug-in hybrid vehicles starting in 2022. The program offers a subsidy of EUR 4 500 for EV purchases and EUR 2 250 for plug-ins, with a EUR 1,000 bonus for scrapping an old car. (IEA Publications International Energy Agency,.2024)

A project co-financed by the European Regional Development Fund aims to expand fast-charging infrastructure. Other measures to promote EV use include free parking and public transport lanes. The National Recovery and Resilience Plan includes EUR 295 million for an overhaul of the transport system in the Riga Metropolitan area, aiming to create an interlinked, multimodal public transport network and encourage greater use of public transport. The investments are expected to be completed by 2026. (IEA Publications International Energy Agency,.2024)

Additionally, Latvia is developing a roadmap for the deployment of biomethane, outlining potential policy support to mobilize private investment and meet targets. The country has already implemented policies to lower energy consumption in the transport sector, including incentives for EVs, ambitious plans to overhaul public transport, and a new rail project connecting the Baltic states. (IEA Publications International Energy Agency,.2024)

### 1.1.3. The Research Gap: Execution of Alternative fuels

The current study regarding the efficiency of fuel consumption influencing freight cost identify the research gap. After the analysis of different reviews and literature, they are divided into two.

(a) Factors of energy efficiency in transport

(b) Changes in energy efficiency in transport

Various factors influence the energy consumption of different types of freight transport. They can be divided into direct and indirect factors. (García-Álvarez, Pérez-Martínez, P.J.,2013). Direct factors (logistics, technical and operational) are related to the use of the vehicle (train, truck), and indirect factors are related to the construction and maintenance of infrastructure and the production of energy and means of transport and vehicle maintenance. (Van Wee, B.; Janse, P. 2005). Logistics factors include, for example, the use of the vehicle’s payload. Technical factors that affect both energy consumption in combustion and electric engines are vehicle weight, payload, engine type and efficiency, fuel type and aerodynamics (Koopman, G.J., 1997), Advenier, P& others. , 2002)

Fuel costs in road transport generally account for 30–40% of overall costs, which, with usually low margins, is a serious problem in the event of an increase in prices. However, to properly assess the impact of these prices, the energy efficiency of vehicles would have to be considered.

### 1.1.4. Sustainable transportation for minimizing operational cost and fuel consumption

This issue is very important because energy consumption in transport affects the costs of transport companies, and thus the costs of their customers, as well as the external costs of transport. On the other hand, increasing the efficiency of business processes, including logistics, and within them, transport, should also lead to a reduction in the negative impact of these processes on the natural environment. Better efficiency of these processes results in a

# 2. METHODOLOGY

The goal of this study is to explore methods for optimizing freight costs and fuel consumption in Latvia’s transportation by adopting sustainable transportation. To reach this goal, a organized research plan was utilized. This research utilizes a variety of methods, which includes quantitative and qualitative data to fully grasp the subject matter.

The data was gathered through survey by asking relevant questions. The researchers began by conducting a structured literature review to understand the research topology and gain a better grasp of the challenges in the field followed by correlation and regression analysis for statistical analysis

## 2.1 Data analysis

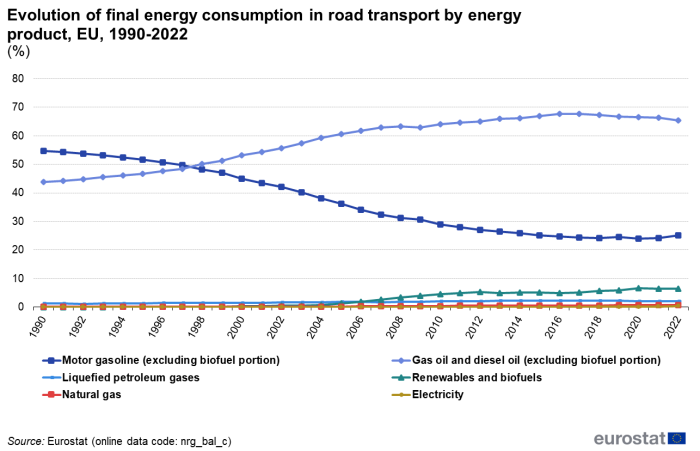
The study examines the impact of fuel costs on freight costs and environmental impact. Road transport, the largest energy consumer in the EU, accounts for 73.6% of transport energy consumption. The energy consumption in road transport increased from 1990 to 2007, reaching a peak of 11 322 PJ. In 2019, consumption nearly reached 2008 levels, but decreased due to COVID-19 restrictions. After lifting restrictions, consumption increased again, reaching 97.4% of pre-COVID-19 levels in 2022.(Eurostat,.2022).

Figure 1. Evaluation of energy consumptionfor the period 1990 – 2022.

*Source: Eurostat*

Data from figure 1 indicates that in 2022, 65.4% of final road transport consumption was driven by gas/diesel oil, with motor gasoline accounting for 25.2%. Renewables and biofuels made up 6.4%, liquified petroleum gases 2.0%, natural gas 0.7%, and electricity 0.3%. The shift from motor gasoline to gas/diesel oil from 1990 to 2017 was steady, but recent years have seen a resurgence. Renewables and biofuels increased from 2004 to 2012, stabilizing around 6.5% in the last three years. Electricity usage in road transport has shown a significant increase from 2018 to 2022, with final consumption increasing from 0.05% in 2018 to 0.34% in 2022, a six-fold increase. (Eurostat, 2022)

Due to the high dependency of fuel, GHG (Greenhouse gas) emission have a greater impact on the environment leading to climate change issues. Emissions from the transport sector increased by 6.9 % between 2005 and 2019, accounting for 27.8 % of total emissions. (Henrique Morgado Simões 2021).

**A graph of energy consumption

Description automatically generated with medium confidence**

### Figure 2. Total GHG emission by sector for the period 2018 to 2019

The EU-wide emissions trading system (ETS) covers emissions from electricity generation and industry. According to the final NECP, ETS emissions accounted for 22.1 % of Latvia's total GHG emissions in 2018. Compared with 2005, ETS emissions in the energy sector are expected to decrease by 22.7 % by 2030. Latvia's NECP identifies three challenges relating to electricity production. The first relates to energy security and the availability of generating capacities, with the NECP alerting to the fact that in the Baltic States half of the generation capacity from large thermal power plants will be shut down. There will therefore be a need to strengthen the transmission network and improve integration with the European electricity market. (Henrique Morgado Simões 2021).

Consumption of fuel not only influences on freight cost but also has a impact on environment causing GHG emission. European Green Deal goal aims to decrease new carbon emission in the year 2050. As transportation contribute significantly for consumption of fuel, developing adapting to energy efficient vehicles is critical. Efficient usage of fuel helps the country economically and also creates significant profit margin for the transportation sector.

## 2.2 Surveys

Analysis of how sustainable transportation possible be adapted for efficient fuel consumption and freight cost. Adapting to sustainable transportation to minimize the environmental impact and provides alternatives fuel option can be done quantitatively in the study. There is no limit to the number of questionnaires distributed, and 75 responses were received and are the citizens of Latvia.

Insights into current freight practices and challenges in Latvia will be gathered from surveys on the topic carried out with logistics professionals, fleet managers and sustainability experts. Questions will be oriented towards different aspects concerning the fuel consumption patterns, cost of transportation and perception of barriers to implementing sustainable practices. This paper will also investigate attitudes towards adoption of green logistics technologies and practices.

|  |  |  |
| --- | --- | --- |
| Variable | category | Distribution |
| Gender | Male | 51 (68%) |
| Female | 24 (32%) |
| Prefer not to say | 3 (6%) |
| Age | Under 18 Years | 1(1%) |
| 18-25 Years | 46(60%) |
| 26-35 Years | 27(36%) |
| 36-45 Years | 2(3%) |

### Table 2.1

**Table 2.1** shows both men and women are involved in the research, but most participants are male. Most survey respondents are between the ages of 18 to 25 followed by 26 to 35 and 3% of the participants are between the age of 36-46.

### Table 2.2

* **Table 2.2** The survey shows that among the 75 respondents, 63 participants, i.e. 84% of the individuals do believe that one of the reasons for price of goods/services increasing due to increase in freight cost, this indicates that increasing freight cost do affect the pricing of the good/services.

### Table 2.3

* **Table 2.3** The survey indicates that 46 out of 75 respondents agreed that the increasing freight cost is due to the increase in fuel cost and 31 of them agreed on fuel consumption and the demand for the product. 5% of the participants see that there are other causes for increase in freight cost. This significs that majority of the participants believe that freight cost is increasing due to fuel cost.

### Table 2.4

* **Table 2.4** The survey revealed that 45 of the participants believe that freight cost does impact the overall GDP of Latvia. Whereas 18 individuals agreed strongly that freight cost significantly affect the GDP of Latvia and 8 respondents see a slight changes whereas 2 of the respondents choose no difference. This concludes that majority of the respondents living in Latvia orient that freight cost do play a major role in overall GDP of Latvia

### Table 2.5

**Table 2.5** The research discovered that 23 induvial believe that extremely important for the government to invest in sustainable transportation and 30 participants consider that it’s somewhat important out of 75 respondents. The minority of the group stayed neutral on this issue. Latvian citizen want their government to invest in sustainable transportation.

### Table 2.6

**Table 2.6** The survey found that out of 75 participants 48 believe that choosing an alternative fuel for freight transportation will reduce the cost of the freight and 23 people do not believe that choosing an alternative fuel will not lower the freight cost. This indicates that majority of the participants have a strong indication that choosing an substate for fuel will definitely lower the freight cost.

### 

### Table 2.7

**Table2.7** The research discovered that 31 out of 75 participants wants a tax incentive from the government, and 47 participants believe that government should subsidies for alternative fuel. 31 of the people believe that they need good infrastructure, these are the measures to implement for reducing the freight cost as per the surveys research.

### Table 2.8

**Table 2.8** The research discovers that out of 75 participants 52 of the people choose electric as substitute for fuel and 28 individuals selected biofuel and hydrogen. They believe that choosing sustainable fuels will reduce the cost of the freight and fuel consumption, making less damage to the environment.

# 3. Justification

This study examines the possibility of using alternative fuel for efficient freight cost and fuel consumption in Latvia. By choosing sustainable fuels for transportation helps to reduce the environmental impact and improving overall cost of the freight. . Conventional freight transportation focuses more on cost and revenue neglecting the increase of greenhouse gases and wastage of other resources beside experiencing high operational cost. These challenges need a gradual establishment of sustainable strategies that creates a bridge between a economical goals and sustainability. Understanding the relationship between freight cost and fuel consumption is essential, improving the revenue of the freight and reducing the cost for affordable freight transportation is crucial for Latvian economy.

## 3.1Justification for Research on Freight cost and Fuel consumption in Latvia

### 3.1.1 Understanding the necessity of growing freight cost and fuel consumption in Latvia

About 25% to 30% portion of freight transportation revenue includes fuel cost followed by operational cost and maintenance cost. Increasing in cost of freight transportation will parallelly make the goods/services more expensive. As fuel price is volatile and depending highly on fuel will influence shipping rate making it vital for business. Furthermore, consumption of excess fuel will also raise environmental concerns. Latvia is highly dependent on the oil and diesel oil for road transportation, usage of non-renewable fuel in a longer run will cause an environmental damage. Analyzing fuel consumption patterns can help identify strategies to reduce emissions and promote more sustainable practices.

### 3.1.2. Potential Benefits of Analyzing Freight Costs and Fuel Consumption

Understanding the relationship between freight cost and fuel consumption helps freight sector to adapt the strategies to optimize the cost efficiency. By implementing profitable shipping routes, better vehicle utilization, companies can save substantial fuel cost. Analyzing the fuel consumption opens a speculative innovation of adapting to alternative fuel, which potentially leads on depending less on non-renewable energy and reduce freight transportation cost making it more environmentally friendly and economical.

Strategically planning different transport mode helps freight sectors to regulate cost effectiveness and in a current market where rising oil prices can potentially lead to increase in consumer price across various sector. In a competitive landscape, focusing on reducing fuel consumption aligns with global sustainability and can offer better pricing while maintaining profitability.

## 3.2 Justification for Chosen Methodology:

This study involves an initial questionnaire distributed to 75 college students. The main purpose for collecting initial data is two-fold.

* **Extensive data gathering:**  Feedback and data gathered from 75 individuals can help identify any issues with the survey's questions. Utilizing insights gained from peers can assist in developing more targeted survey tool for freight transportation companies. Ensuring that the final survey collects the most relevant information. We acknowledge the limitations of using classmates (N=75) as substitute group. And the significance of carrying out further research with diverse sample in Latvia to validate the findings completely.
* **Future applicability**: further enrich the findings there are expert interviews that further address country specific challenges. Scalability of the methodology can be used for further implementation to other regions and adherence to the global trend such as the EU Green Deal guarantees sustainability of the methodology. The study integrates these elements and provides actionable recommendations for freight operation optimization in Latvia.

## 3.3 Expected Contribution of the Research:

This study aims to offer valuable information about regulating freight cost and fuel consumption in Latvia by implementing eco-friendly transportation by reducing the usage of fuel and . It explores feasibility and possible benefits of using alternative fuel for optimizing cost of freight transportation. The outcomes may impact decisions on adopting this new approach. It potentially leads to greener and more efficient way of transportation.

# 4. Result and Discussion

The survey on sustainable logistics in Latvia revealed diverse perspectives among its 75 respondents. Significantly, majority comprising of 84% believe that one of the major reason for certain goods/services to increase is due to increase in freight transportation, where as 16% do not believe that the price of goods and services have an influence of freight transportation cost. Meanwhile, 41% agreed that rising fuel strongly influence freight cost, 27% opted for increase in demand of goods and 5% had different perspectives. Regarding freight cost contributing to the GDP of Latvia, 60% believed that it freights cost does have a moderate impact on overall GDP and 24% strongly agree that it Definity have a major influence on overall GDP.

Opinion divergence immerged regarding government implementation on sustainable practice,22% consider extremely important for the government to invest in sustainable transportation and 42% agree that it is moderately import and 1% have neutral opinion and 14% chose not to be important. Furthermore, regarding government initiatives, majority preferred a better policy amoing them 62% agreed on policies regarding subsidies for sustainable fuels and 41% wanted government to build a better infrastructure.

In conclusion, an overwhelming of 62% chose electric resource as a substitute for alternative fuel followed by biofuel and hydrogen fuel where the response was divided evenly

Overall, the survey highlighted a nuanced landscape of perspectives, indicating both

challenges and opportunities for advancing sustainable logistics in Latvia, with a clear call for

greater awareness, policy intervention, and financial support. To add upon

# CONCLUSION

**Conclusion 1:** The result of the survey indicates that goods pricing is influenced by freight cost in Latvia. During the survey 84% the participants believe that, increasing of goods/service in Latvia is driven by increasing freight cost. This suggest that, if the freight cost is decreased, the pricing of other goods/services also decreases.

**Conclusion 2:** Reducing the dependency of the fuel can minimize the freight cost. As per the research survey 48 out of 75 participants strongly agree that fuel cost plays a major role in freight transportation. Fuel cost and consumption influences the pricing of the freight cost in Latvia. It is indicated that choosing an alternative fuel will lower the freight cost and making a gate way for practicing sustainable practice.

**Conclusion 3:** One of the issues which may rise is adapting alternative fuels are investments from the government, reforming policies and subsidies and improving the infrastructure. However emphasizing the government intervention in promoting sustainability is the key for promoting sustainable transportation. The survey indicates that 52 respondents out of 75 agree that Government investment on sustainable transportation is crucial and 62% of the participants choose electrical transportation as a replacement for fuel. From this, upon research survey concludes that adapting to non-renewable resources is an reasonable option for reducing freight cost and focusing on sustainable goals making it more environmentally friendly causing less damage to the environment.

# PROPOSAL

The study highlights to achieve an efficient freight cost and reducing fuel consumption in Latvia as well as promoting the sustainability of the transport industry in Latvia. To reach this goal, operational efficiency can be made by advance technologies like route optimization software and fleet management systems. A shift towards alternative fuels such as biofuels and electric helps to reduce the dependency of fossil fuels. Favorable Governmental policies along with research institution together with logistics companies is also essential. Very important step is educational programs to educate and train drivers about fuel saving techniques and these are called Eco driving programs. Latvia can leverage the alliance between policy reforms and technological advancements to become an example of enhancing green logistics and simultaneously cost and environmental efficiency. In this way, people of Latvia can able to transport their goods in vast number in a cost effective way

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