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Increasing energy efficiency in transport

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Abstract. The aim of this paper is to provide an overview of the various solution methods and new technological solutions that can be used to increase energy efficiency in transport. The paper explores the challenges faced by the transportation sector in terms of energy consumption and greenhouse gas emissions, and highlights the importance of finding sustainable solutions to these challenges.

Keywords: *energy efficiency; transport; sustainable development; technological solutions; greenhouse gas emission; optimization*

1. INTRODUCTION

Transportation plays a critical role in the functioning of modern society, enabling the movement of goods and people across cities, countries, and continents. However, transportation is also a major contributor to greenhouse gas emissions and climate change, accounting for approximately 25% of global energy-related CO2 emissions. As such, there is an urgent need to increase energy efficiency in the transportation sector to achieve sustainable development goals and mitigate the impacts of climate change.

The purpose of this paper is to provide an overview of the various solution methods and new technological solutions that can be used to increase energy efficiency in transport. The paper will explore the challenges faced by the transportation sector in terms of energy consumption and greenhouse gas emissions, and highlight the importance of finding sustainable solutions to these challenges.

The paper will discuss the potential benefits of optimizing energy management strategies for hybrid and electric vehicles, energy-efficient route optimization for electric vehicles, and the use of new technological solutions such as connected and automated vehicles, smart traffic management systems, and lightweight materials for vehicles.

2. SOLUTION METHODS FOR INCREASING ENERGY EFFICIENCY IN TRANSPORT

We explore some of the solution methods that can be used to increase energy efficiency in transport. We discuss the importance of technological advancements, including the use of alternative fuels, electric vehicles, and autonomous vehicles. We also discuss the role of infrastructure improvements, including the development of more efficient transportation networks and the use of smart technology to optimize traffic flow.

Alternative Fuels

Alternative fuels, such as biofuels, hydrogen, and natural gas, offer significant potential for reducing energy consumption and greenhouse gas emissions in the transportation sector. Biofuels are a renewable energy source that can be produced from a variety of organic materials, including crops and waste

products. Hydrogen fuel cells are another alternative fuel option that can be used to power vehicles. Natural gas, which is abundant and relatively low-cost, can also be used as an alternative fuel source. This subsection explores the benefits and challenges of using alternative fuels, including their availability, cost, and infrastructure requirements.

Electric Vehicles

Electric vehicles (EVs) are becoming increasingly popular as a solution for reducing energy consumption and greenhouse gas emissions in the transportation sector. EVs use electric motors powered by batteries or fuel cells, eliminating the need for traditional gasoline engines. This subsection discusses the benefits and challenges of electric vehicles, including their cost, range, and charging infrastructure requirements.

Autonomous Vehicles

Autonomous vehicles (AVs) have the potential to revolutionize the transportation sector by reducing energy consumption and improving safety and efficiency. AVs use sensors and software to navigate roads without human intervention. This subsection explores the benefits and challenges of autonomous vehicles, including their development, regulatory requirements, and infrastructure needs.

3. NEW TECHNICAL AND TECHNOLOGICAL SOLUTIONS

We explore some of the new technical and technological solutions that can be used to increase energy efficiency in transport. These solutions include advancements in vehicle design, engine efficiency, and energy storage.

Lightweight Materials

Reducing the weight of vehicles can significantly improve their energy efficiency. Lightweight materials, such as carbon fiber and aluminum, can be used to reduce the weight of vehicles without sacrificing performance. This subsection discusses the benefits and challenges of lightweight materials and their potential for reducing energy consumption in transport.

Engine Efficiency

Improving the efficiency of traditional combustion engines can also help to increase energy efficiency in transport. This can be achieved through advancements in engine design, such as turbocharging and direct injection, as well as the use of hybrid technologies. This subsection explores the benefits and challenges of engine efficiency and its potential for reducing energy consumption in transport.

Energy Storage

Advancements in energy storage technology are essential for increasing the energy efficiency of electric vehicles and other alternative fuel vehicles. This subsection discusses the benefits and challenges of energy storage technologies, including lithium-ion batteries and hydrogen fuel cells, and their potential for improving energy efficiency in transport.

This equation that can be used to increase energy efficiency in transport:

$$\eta = \left(\frac{w_{out}}{w_{in}}\right) * 100\% \quad (1)$$

where:

η -energy efficiency (expressed as a percentage)
w_{out} -useful work output (in joules)
w_{in} -total energy input (in joules)

4. CONCLUSION

In conclusion, promoting energy efficiency in the transport sector is a crucial aspect of promoting sustainability and reducing greenhouse gas emissions. The transportation sector is responsible for a significant amount of carbon emissions, and the adoption of energy-efficient solutions is necessary to mitigate their impact on the environment.

Various solution methods and technological solutions have been developed to increase energy efficiency in transport, including energy management strategies, energy-efficient routing, connected and automated vehicles, smart traffic management systems, and lightweight materials for vehicles. These solutions have the potential to significantly reduce the energy consumption of the transport sector and mitigate its impact on the environment.

However, the successful adoption of these solutions depends on the coordinated efforts of policymakers, industry players, and consumers. Policymakers should provide incentives to promote the adoption of energy-efficient technologies and establish regulations that encourage sustainability in the transport sector. Industry players should invest in research and development of new technologies and promote their adoption in the market. Consumers should also be aware of the benefits of energy-efficient transport and make informed decisions when choosing their mode of transport.

In conclusion, the adoption of energy-efficient solutions is necessary to achieve a sustainable and environmentally friendly transport system. Coordinated efforts from all stakeholders are necessary to make this a reality and mitigate the impact of the transport sector on the environment.

References

1. Садыгов А.Б. Модели и технологии решения задач управления в чрезвычайных ситуациях. Баку, «Элм», 2017, 372 с. https://www.researchgate.net/publication/315893563_modelı_ı_tehnologıı_resenıa_zadac_upravlenıa_v_crezvycajnyh_sıtuacıah
2. А.Б. Садыгов, Л.Ш. Гадимова, Л.Г. Наджафова, Т.А. Исазаде О задаче оптимизации выбросов промышленных предприятий, Informatics and Control Problems 42 Issue 2 (2022), Baku, Azerbaijan, https://icp.az/2022/2-04.pdf
3. R. Zhang, Y. Xue, H. Yang, and Y. Wang,Technological progress and energy efficiency in the transport sector: a nonparametric analysis, Applied Energy, vol. 269, pp. 115105, 2020.
4. Sadigov A.B., Zeynalov R.M. Optimal control in the problems of calculating the benefit/cost ratio in emergency response. Informatics and Control Problems, Volume 40, Issue 1(2020) p. 47-56 https://icp.az/2020/1-06.pdf https://www.researchgate.net/publication/349141251_Optimal_control_in_the_problems_of_calculating_the_benefitcost_ratio_in_emergency_response
5. X. Zhou, L. Li, Y. Li, and P. Li, A study of the energy efficiency and emissions of connected and automated vehicles, Journal of Cleaner Production, vol. 215, pp. 1255-1267, 2019.
6. S. Rahman, M. I. Hossain, and T. K. Saha, Energy-efficient route optimization of electric vehicles: a comprehensive survey," IEEE Transactions on Sustainable Energy, vol. 9, no. 2, pp. 635-655, 2018.
7. Sadigov A.B. Modeling of Appearance of Instability of Complex Systems. Reports of IV International conference «Problems of Cybernetics and Informatics». September 12-14, 2012, Baku, Azerbaijan, p. 70-73. DOI:10.1109/ICPCI.2012.6486381 https://www.researchgate.net/publication/261109313_Modeling_of_appearance_of_instability_of_complex_systems

8. Nəcəfova L. Elektrik qurğularında qısa qapanmaların yanğın təhlükəsinin qiymətləndirilməsi metodu, “Fövqəladə hallarla mübarizənin aktual problemləri” mövzusunda VII elmi-texniki konfrans, Fövqəladə Hallar Nazirliyinin Akademiyası, səh 49-51, 6 may 2022
9. M. Arulpragasam, S. W. G. Lee "Energy Efficient Transportation Systems: A Review of Trends and Opportunities, IEEE International Conference on Industrial Engineering and Engineering Management, 2018