



THE CHOICE OF FUEL FOR PRIVATE CARS

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Annotation: *This article explores the choice of alternative fuels in Gotland from a quantitative and qualitative perspective, the complex factors that influence Gotland residents' decisions to adopt alternative motor fuels, in order to better understand how private transport on Gotland is transitioning from conventional energy fuels to sustainable energy systems. In addition, this paper explores the issue of consistency between actions and intentions to adapt and the factors that lead to inconsistency. The paper also seeks to provide meaningful insights for academics and administrators seeking to explore the opportunities and address the challenges of transitioning to sustainable energy options. in order to better understand how private transport on Gotland is transitioning from conventional energy fuels to a sustainable energy system.*

Keywords: *private transport, alternative fuels, limitation, internal combustion, harmful pollutants.*

The aim of this study is to investigate whether the decisions of Gotland residents regarding private cars are consistent with the goals of a sustainable energy transition in the transport sector and to identify the factors that influence their decision-making process. Research questions:

- 1) What are the current fuel alternatives for passenger vehicles used by Gotland residents and what are their preferences for fuel alternatives for their next vehicle?
- 2) What factors influence people when they decide to use fuel alternatives for cars in Gotland?



3) What can be done to encourage greater alignment between people's decisions and Gotland's ambitions for a sustainable energy transition in the transport sector?

The study will cover private transport only, excluding public transport and freight transport. Firstly, it will present a literature review on the factors influencing people's choice of alternative fuels, the AFVs currently available and a LCA of the different fuel vehicles. It will then describe the current distribution of refuelling/charging stations for private transport and AFVs on Gotland. This will be followed by a description of the methodology used in this study. Survey was used as the method to collect data through a questionnaire with both quantitative and qualitative questions. The data from the survey and analysis will be presented next. Quantitative data was analysed by univariate analysis and bivariate analysis and qualitative data was analysed by thematic analysis. Finally, the conclusions and limitations of this study will be discussed.

1. Different types of fuels for private cars

The choice of fuel for a private car is a critical decision with significant environmental, economic, and social implications. In recent years, researchers have conducted several studies on different types of private car fuels to understand their advantages, disadvantages, and potential impacts. The following will provide an overview of previous research into different types of private car fuels, including petrol, diesel, hybrid, electric and alternative fuels.

2. Petrol

Petrol is the most commonly used fuel for private vehicles. Previous studies have shown that petrol has several advantages, such as high energy density, wide availability and compatibility with existing internal combustion engine (ICE) technology (Ayres, 2017). However, petrol combustion emits harmful pollutants such as carbon monoxide, nitrogen 5 oxides and particulate matter, which contribute to air pollution and climate change (Eia.gov, 2022). Researchers have also investigated the use of additives and advanced combustion technologies to reduce emissions from gasoline powered vehicles (Wen et al., 2022).



3. Diesel

Diesel is another popular choice for private cars, especially in Europe (Ridenowmotors, 2016). Despite a significant drop in sales of diesel cars in the European new car market, it remains a popular choice for used car buyers (Autovista24, 2022). Diesel engines are known for their high fuel efficiency and low carbon dioxide (CO₂) emissions. However, diesel combustion releases high levels of nitrogen oxides and particulate matter, which have been linked to respiratory disease and premature death (Anenberg et al., 2017). Recent studies have also shown that diesel engines emit higher levels of greenhouse gases (e.g. methane) than previously thought (Hausberger et al., 2021).

4. Hybrid Electric and Plug-in Hybrid Electric

Hybrid electric vehicles (HEVs) combine an internal combustion engine with an electric motor to improve fuel efficiency and reduce emissions. Although petrol is still the main source of power for hybrid vehicles, they can reduce fuel consumption and emissions compared to conventional cars. Studies have shown that the environmental benefits of hybrids are more pronounced in urban driving (DriveClean, 2021). Some studies have found that compared to HEVs, plug-in hybrid electric vehicles (PHEVs) emit less CO₂ and certain other pollutants throughout the fuel cycle when charged from the grid (Sioshansi and Denholm, 2009).

5. Electric

Instead of an internal combustion engine and a petrol tank, electric vehicles (EVs) are equipped with an electric motor and a battery. Previous research has shown that EVs have 6 several advantages such as zero tailpipe emissions, quiet operation, and the potential to reduce energy consumption (Nanaki, 2021). However, the environmental benefits of electric vehicles depend on the source of electricity used for charging and the production of electric vehicles can also have an environmental impact (Ilgin and Gupta, 2010). Researchers have also investigated the use of advanced battery technologies and charging infrastructure to improve the performance and range of EVs (Liu, Placke and Chau, 2022 & Bupesh Raja, Raja and Kavvampally, 2021) .



6. Biofuel

The raw materials used to produce biofuels in Sweden are mainly from forests, followed by energy crops as well as sewage sludge and food waste (Ericsson and Werner, 2016). Biofuels can be blended with or replace traditional fossil fuels, reducing well-to-wheel GHG emissions compared to traditional fossil fuels (OECDiLibrary, 2023).

7. Hydrogen

Hydrogen vehicles include a variety of vehicles that rely on hydrogen as a power source. The two main types of hydrogen engines are conventional internal combustion engines (use hydrogen instead of gasoline or natural gas) and fuel cell engines (Albatayneh et al., 2023). Hydrogen has the potential to be a low carbon alternative to fossil fuels, producing only water vapour when using hydrogen fuel to power vehicles. However, the production of hydrogen requires significant energy and infrastructure. Currently, most of the hydrogen produced comes from fossil fuels and is accompanied by CO₂ emissions (Albatayneh et al., 2023).

8. Compressed Natural Gas (CNG) and Liquefied Petroleum Gas (LPG)

CNG/LPG vehicles are as reliable as conventional diesel vehicles and the newer the technology, the better the fuel economy results. Studies have shown that CNG/LPG vehicles have significantly lower emission rates of carbon monoxide, nitrogen oxides, 7 hydrocarbons, and non-methane hydrocarbons. In addition, CO₂ emissions are reduced by 7% compared to conventional vehicles. However, the limited availability of current petrol station infrastructure is a technical issue that needs to be improved, which will cause inconvenience to users (Lah, 2019).

2.2 Factors influencing fuel choice for private cars

The choice of fuel for a private car is influenced by a range of factors. These factors can be broadly categorised into economic, environmental, social, and cognitive factors (Ulmer et al., 2004; Knez, Jereb and Obrecht, 2014; Achterberg et al., 2010; Chng et al., 2019; Dutta and Hwang, 2021; Johansson-Stenman and Martinsson, 2006; Engström, Algers and Beser Hugosson, 2019; Achterberg et al., 2010). A study by Asadi et al. (2020) applied the theory of planned behaviour (TPB) method to examine the factors that influence



consumers' intention to use EVs in Malaysia. The authors found that attitudes, subjective norms, and perceived behavioural control were important factors in consumers' adoption of EVs. Furthermore, the authors found that environmental issues play an important role in shaping attitudes towards EVs, which in turn influences willingness to adopt EVs. Additionally, a study by Kowalska-Pyzalska et al. (2022) using a survey of 1,002 AFV buyers found that safety, price and type are the characteristics that a good AFV should have. In this chapter, various studies examining these factors in detail will be reviewed and how this study relate to earlier studies will be identified.

In order to draw valid and reliable conclusions about human behaviour, a more scientific approach is needed when measuring people's beliefs and behaviours (Nardi, 2018). Surveys are a widely used research method in social science, to gather information from the sample through individual responses to the questions (Ponto, 2015). Surveys can be divided into two main types: qualitative surveys and quantitative surveys. Each type of survey has its own unique characteristics, strengths, and limitations, which make them suitable for different research purposes and questions.

Qualitative surveys usually involve open-ended questions that allow participants to express their thoughts, opinions, and experiences in their own words (Holm, 2021). The data collected from qualitative surveys is usually subjective and interpretive, providing insight into participants' views, perceptions, and behaviours (Austin and Sutton, 2014). Therefore, doing qualitative survey research is a way which contributes to gain a deeper understanding of how and why humans think and act as they do (Nardi, 2018). Quantitative surveys, on the other hand, usually involve closed-ended questions with predetermined response options that allow statistical analysis and generalisation of results to larger populations (Holm, 2021). According to QuestionPro (2019), the data collected from quantitative surveys is structured, standardised and numerical data from a large number of participants.

Quantitative surveys are often used to test hypotheses, establish relationships between variables, or make comparisons between groups or populations.



Both qualitative and quantitative surveys have their strengths and limitations, but fortunately their strengths and weaknesses are complementary. Qualitative surveys provide rich and detailed data that capture the subjective experiences and perceptions of participants (Holm, 2021). This can compensate for the lack of depth and detail in quantitative surveys, which are limited to pre-determined answer options. Quantitative surveys, on the other hand, allow for large-scale data collection and statistical analysis, 23 which can provide robust and generalisable results (Holm, 2021). This can compensate for the non-representative nature of qualitative surveys.

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