Identifying and Ranking of Alternative Fuels by Using AHP and PROMETHEE II Methods to Find Best Fuel for Bus Rapid Transit System

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ABSTRACT

Nowadays, one of the most significant concerns is regarding to air pollution. Carbon dioxide, a greenhouse gas, is the main pollutant that is warming Earth. Industrialized countries have worked to reduce levels of sulfur dioxide, smog, and smoke in order to improve people’s health. The problem of air pollution in the metropolises of Iran has been increased. The identification and development of clean fuels and also alternative fuels can play an important role in solving pollution problem. In this article, to find best fuel in terms of economic, social and environmental aspects which are part of sustainability. So, the multi-criteria decision-making techniques like fuzzy hierarchy analysis method and PROMETHEE used to rank and determine the preferred option for alternative fuels used in high-speed buses in Tehran. The results show that the biodiesel was selected as the best fuel to prevent the air pollution emission among the available options.

KEYWORDS

Clean Fuel, Fuzzy AHP, Multi-Criteria-Decision Making, PROMETHEE

INTRODUCTION

According to existing surveys, there are 1000 to 1500 billion barrels of crude oil stored on Earth and no fossil fuel are being produced due to the environmental condition on Earth. Based on projections, the usage of crude oil resources, natural gas and coal will be possible until 2080, 2047 and 2180 respectively. So, it is necessary to use of renewable biofuels which are compatible with environment. In the past, development was only meaningful in economic aspects but today the concept of sustainable development is used extensively. In sustainable development, environmental aspects and the social effects of development are also considered in addition to economic aspects, and decision-makers are seeking to achieve development which satisfies these three aspects to the desired extent. One of the aspects of sustainable development in the field of energy is the use of biofuels. This is proved that, in case of commercial utilization, biofuels are fulfilling all aspects of sustainable development (Kafa et al., 2014). The supply of alternative fuels is based on cost and greenhouse gas emissions per mile, therefore it can be considered as a sustainable and viable option for buyers in the market. In spite of these potential benefits, the market share of alternative fuels is limited due to some factors which some of are related to cost and others are not (Bree et al., 2010). In the last two decades of the twentieth century, concerns about the pollution of large cities have

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increased and the major contribution of these pollution is related to the road transport sector which the type and quality of used fuel in this section has a significant impact on air pollution, increasing of greenhouse gases emissions and global warming (Dakov et al., 2008). In other words, transportation is the pioneer and main factor in emissions of greenhouse gases, which plays a major role for most pollutants. For example, in Canada, 25% of greenhouse gases is belong to the transportation sector, which is 76% of that belongs to road transportation (Safaei-mohammadi et al., 2009, Kangas et al., 2006). The development and management of the transportation system is important in the economic and social development of each country, and there are many challenges, problems and issues related to the transportation system such as security, cost and quality, which requires creating effective and improve solutions for them (Mardani et al., 2015). Urban transportation is one of the concerns of managers in the field of urban management. The excessive increase in personal cars and population in urban areas, caused many serious challenges in the medium and long term. The development and expansion of the public transportation leads to facilitates the citizen’s transportation and also it is a good incentive to decrease the use of personal vehicles and air pollution reduction. In recent years, the usage of the bus rapid transit (BRT) in Tehran has been considered and the citizens of Tehran have been satisfied to a large extent. BRT is important because of its effect in reducing traffic load and air pollution. On the other hand, urban transportation has always undergone changes due to lack of a long-term codified planning and not having a specific policy during the year (Ji et al., 2015).

**LITERATURE REVIEW**

According to previous researches, road transportation has the most contribution in pollution generation (Turcksin et al., 2011), that we need to use efficient vehicles and clean fuels in transportation to reduce the pollution. Therefore, there should be some solutions in order to protect the environment, prevent excessive global warming and more emission of greenhouse gases. One of them is the use of alternative clean fuels, for example, hybrid electric fuels for vehicles, natural gases, methanol, ethanol and biodiesels rather than fossil fuels. Different types of alternative fuels have different features that require a lot of attention and care. This variety in alternative fuels performance makes users confused about which of them is better (Yavuz et al., 2015). For this reason, researchers have begun studies on the quality and performance of different alternative fuels in order to help users to identify the best types of fuels.

Different studies have been done in the multi-criteria decision-making context, which will be briefly reviewed in the following. Mohammadabadi et al. (2009) presented a model for ranking vehicles in the transportation sector. They use the PROMETHEE method and criteria such as cost, environment, community, fuel stations, costs of equipment related vehicles to rank renewable and non-renewable fuels. Kahraman et al. (2010) proposed a fuzzy multi criteria decision-making methodology for the selection of energy policies. Their methodology is based on the analytic hierarchy process under fuzziness. It allows the evaluation scores from experts to be linguistic expressions, crisp or fuzzy numbers. Turcksin et al. (2011) proposed a model by the aim of recommend a multi-instrumentality policy package to the Belgian government which the objective is to reduce environmental externalities by encouraging people to make a more sustainable vehicle choice. They used an integrated approach for the decision-making problem that combines the Analytical Hierarchy Process and the PROMETHEE. Perimenis et al. (2011) presented the basic framework for a decision support tool to evaluate biofuel production pathways, with the purpose of providing the decision makers with a structured methodology that will lead them to the final decision. The tool integrated the most important aspects along the entire value chain (i.e. from biomass production to biofuel end-use), namely the technical, economic, environmental and social aspect. The functionality of the tool had been tested for the case of biodiesel from rapeseed in Germany. Tadic et al. (2014) provided a framework for the selection of the CL concept which would be most appropriate for different participants, stakeholders, and which would comply with attributes of the surroundings. CL participants have different, usually conflicting goals.
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