Imperial College London

Environmental and Economic Assessment of On-road Electrification in Qatar

Centre for Environmental Policy

Supervisor: Professor Jeremy Woods

Student: Abdulla Alishaq

Overview:

This purpose of this research is to quantitively assess the environmental and economic impact of widespread electrification of road transport in Qatar. It is intended that the research findings will contribute to the development of a framework or toolkit designed to inform about the impacts of electrification. The results should show whether it will be beneficial to electrify vehicles or not given the country's specific circumstances such as the high Gross Domestic Product (GDP) per capita, cheap oil and gas prices, and more.

Background:

Despite being a small country, Qatar is known to be one of the major players in the oil and gas business. The country is the world's largest producer of Liquefied Natural Gas (LNG) with 77 million tonnes annually [1]. Qatar's economic growth is mostly driven by hydrocarbon resources, which accounted for 91% of exports in 2017, making it the highest emitter worldwide in per-capita emissions of carbon dioxide [2]. One of main sources of air pollution and GHG emissions in Qatar is the transportation sector [3]. Moreover, A survey conducted in 2016 where 963 people were interviewed indicated Public transport is not a very popular way to get around in Qatar.

The level of air pollution in Qatar has often surpassed local and international recommended standards. The table below shows the standards used by WHO and the standards set by Qatar. In Qatar's Second National Development Strategy for 2022, it was stated that the concentration of PM10 was 330 μg/m^3 in 2015, while the concertation of other pollutants was oddly not mentioned in the report [4].

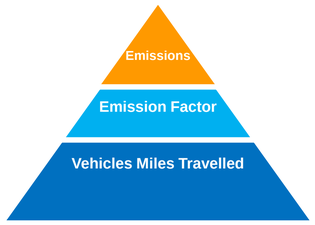
Contaminant	Ambient air quality standard in Qatar QAAQS	WHO	Average period
Photochemical Oxidants, such as O_3 [μg.m^{-3}]	235 120	100	1 hr 8 hrs
PM10 [μg.m-3]	150 50	50 20	24 hrs Annual

Table 1 Qatari and WHO Ambient Air Quality Standards [3]

Qatar, as a country with an emerging economy, is also entering the BEV market with the hopes of reducing its carbon footprint. The country has established a project which aims to set up 400 charging stations by 2022 and to transform 10% of transport vehicles into BEVs by 2030 [5].

Literature:

Many of the necessary variables for this research will have to be calculated and collected from scratch. In almost all developed countries, the computations needed to assess the environmental and economic impact are calculated on an annual basis by designated groups. However, this research is not only the first of its kind in the country, but it will also require quantifying fundamental inputs such as the annual Vehicle Miles Travelled (VMT), the emission factor and other calculations. This step is considered as one of the principle challenges in the project as multiple computation techniques will be required.



Once the VMT is calculated along with the emission factor, that will pave the road towards estimating the amount of harmful emissions such as GHGs and air pollutants that are produced. The last time the transportation emissions were calculated was in a report published in 2016 which used emissions factors and transportation behaviours from other countries rather than computing data specific to Qatar [3].

Before deciding to research the environmental and economic impacts of BEVs, it is important to acknowledge which fuel technology provides the best outcome. Thus, the various available alternatives in the market such as hydrogen vehicles, Natural Gas Vehicles, biogas vehicles and other technologies were discussed as part of the project.

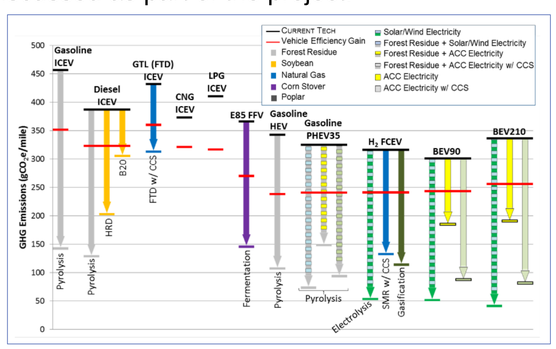


Figure 1 Cradle-to-Grave Lifecycle Analysis of U.S. Light-Duty Vehicle-Fuel Pathways [6]

Methodology:

Once all of these unknowns are calculated, they will be used as inputs in an LCA model to create a baseline comparison between a BEV and an ICEV. There are two suggested software packages that could be used for this process: The GREET model - a popular tool in the U.S. - and SimaPro, which is used often at the Centre for Environmental Policy.

The second part of this project aims to use the GAINS model to identify emissions from different sources such as road transport. The model can be used to evaluate cost-effective GHG and air pollution emission reduction strategies and optimize benefits on all scales.

Next, a transition pathway explorer will be developed to help users predict possible future emission and energy consumption scenarios. The pathway analysis enables users to explore mitigation strategies and contingency plans for the forecasted future. Moreover, the project will also examine the environmental impact of the current policies in Qatar, and how they will serve the goal of reducing harmful emissions.

For the economic assessment, the Total Cost of Ownership will be used to compare BEVs and ICEVs. TCO can be defined as the sum of purchase price as well as all the costs associated with the owning of the vehicle. In this regard, it is a calculation method that determines the overall cost of a product or service throughout its lifecycle.

Challenges:

One of the most tedious issues facing this research is the lack of available data. Collecting data presents a challenge no matter where in the world the data is collected, but in the case of Qatar, it is exceptionally true because there is no national agency that collects and publishes data. Despite growing environmental awareness in the country and the region as a whole, no meaningful progress has been made to improve and expand measurement of necessary data. Some data do exist but require permission from high-ranking people, and it takes a very long time to get a hold of the person who can give permission. For example, the car fleet data was obtained from the Traffic Department at the Ministry of Interior and it will be used for the first time in a study. However, to obtain this piece of data, it required five months of speaking to government officials.

References: [1] Qatargas. (2020). Homepage. Retrieved June 3, 2020, from http://www.qatargas.com/english [2] Complexity, T. O. of E. (2017). Qatar (QAT) Exports, Imports, and Trade Partners. Retrieved June 3, 2020, from https://oec.world/en/profile/country/qat/
[3] *Qatar's National Emission Inventory*. (2016). [4] Lanouar, C., Al-Malk, A. Y., & Al Karbi, K. (2016). *Air Pollution in Qatar: Causes and Challenges*. [5] Kumar, C. (2019). 400 electric car charging stations by 2022 in Qatar - The Peninsula Qatar. Retrieved June 3, 2020, from The Peninsula website: https://thepeninsulaqatar.com/article/17/01/2019/400-electric-car-charging-stations-by-2022-in-Qatar