Life Cycle Assessment of Bio-ethanol fuel Emissions for Passenger Cars in Houston Area of Texas

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***Abstract*—**Life cycle assessment of bio-ethanol fuel and their emissions in the transportation sector are studied in this research. The pollutants studied here include greenhouse gases, volatile organic compounds, nitrous oxide, sulfur oxide, and particulate matter PM10, and PM2.5. The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model is used to simulate the chosen vehicle engines and fuel types for the targeted pollutants. It is found that the fuel cell vehicles using 100% bio-ethanol has shown the most reduction in the amount of all the pollutants from well-to-vehicle emission analysis. For well-to-pump analysis show that only GHGs reduce with higher blends of bio-ethanol.The CO and PM2.5 pollutants' emissions increased for increasing bio-ethanol fuels blend ratio. All other pollutants, VOC, NOx, SOx, and PM10 increased emissions until E85 blending ratio. However E100 bio-ethanol shows a reverse trend for these pollutants emissions.

***Keywords*—**Life Cycle Assessment, GREET, Bio-ethanol, Air pollutants, Air Quality.

I. Introduction

TRANSPORTATION by means of motor vehicles is increasing with increasing population and economical activities. Currently, most of the motor vehicles are using high amount of gasoline or diesel produced from fossil fuels.According to International Energy Agency statistics, the transportation sector accounts for about 60% of the world's total fossil oil consumption [1].The fossil fuel as the main feedstock or the source where the gasoline and diesel are obtained is a limited natural resource. The dependency on fossil fuels has been greatly increasing in the past few decades. With the limited natural resource reserves,this dependency on fossil reserves will not last for a long period. With current consumption trends, the reserves-to-production (R/P) ratio of world proven reserves of oil is lower than that of world proven reserves of natural gas and coal — 41.6 years versus 60.3 and 133 years [1].

For this reason, some other alternative sources need to be introduced to provide for a long term reliable fuel supply. Bio-fuel is emerging as a possible solution to this problem. The advantage of using bio-fuel will be less dependency on the natural fossil fuel resources.

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Transportation vehicles using fossil fuels emit large amount of greenhouse gases (GHG) and other harmful criteria air pollutants which are a threat to global environment and human health. With increasing usage of transportation vehicles, this trend is becoming even worse. According to Goldemberg, motor vehicles account for more than 70% of global carbon monoxide (CO) emissions and 19% of global carbon dioxide (CO_2) emissions [1]. Bio-fuels are obtained from biomass such as plants. The plants biomass gain energy from sun-light and assimilate large amount of carbon dioxide during their growth stages. Thus, the use of bio-fuel will not only limit the dependency on fossil fuel, but will also contribute in the efforts to reduce greenhouse gases emission. The first generation bio-fuels, bio-ethanol and biodiesel are widely used in the United States, which are petroleum based fuels and used as a percentage volume of corn ethanol blended with gasoline and diesel [2].Previous studies suggest that the use of bio-ethanol significantly reduces the emission of greenhouse gases and other pollutants. This is one of the most important advantages of using bio-ethanol instead of fossil fuel. As ethanol contains oxygen, it becomes a better combustible oil than the fossil fuel oils, reducing the emission of pollutants by up to half, depending on the bio-fuel and the blend mix [2].

In Houston metropolitan area great amount of VOC and NOx emissions are released daily from transportation vehicles. These released VOC and NOx plus similar emissions from other sources act as the precursors to ozone formation under favorable weather conditions prevailing in Houston to cause the severe secondary ozone pollution. So the usage of alternative bio-fuels as transportation fuels in Houston area has the additional benefit of mitigating the secondary ozone pollution. The objective of this study is to conduct the life cycle assessment of bio-ethanol from corn. The study will analyze the emissions of GHGs and criterion gases such as VOC, SOx, NOx, CO, PM10, and PM2.5 from the production of bio-ethanol fuels (Feedstock+Fuel) and vehicle usage. Furthermore, various blends of bio-ethanol and gasoline are introduced to study the higher blend trends. The GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation) Fuel-Cycle software is used to analyze the emission of pollutants in kg/day using VMT (Vehicle Mile Travel) report for Houston, TX.