1 INTRODUCTION

1.1 Background

Human population increase as much as 1.3 % ever year nonetheless this consider to be smaller compare to in 1965-1970 which is 2.1% (globalchange.umich.edu). In spite of that today at much larger population number it is consider as exponential growth rate and must be taken seriously. Experts acknowledge that the world’s current rate of energy consumption is at alarming rate and will be lacking of power unless we find a new alternative form of renewable energy source to confront with the world energy crisis.

![Figure 1-1: Projected world population growth](image)

According to The World Bank Working for a World Free of Poverty website 3 045.01 kWh of Earth electricity consumption per capita in 2011 compare to 2 582 kWh in 2004 approximately 17.9% increase over 6 years period(worldbank.org). The demands for electric power increase immensely especially in developing countries such as in China and South Korea to satisfy the energy requirement for their power plants.
The main challenge is not so much about whether oil will continue to exist, but whether there will be sufficient supplies at affordable prices. For countries such as the United States, who import from others countries for a steady supply of oil, availability and price will be their ultimatum. As oil or resources being use worldwide at rapid rate this lead to acutely surge the market price (fueleconomy.gov)(eni.com).

In a sense of global issues however Middle-Eastern politics plays a major role here since there are a huge amount of energy resources available. These have become a great interest of western economies such as France, Britain, USA and former Soviet Union. Over the past decades Middle East had suffered wars, overthrow of democratically elected leaders, and puppet governments and dictatorships that all rotated around the world’s energy crisis (worldenergy.org).

In conclusion hydrogen will be the new clean energy carrier to replace the world thirst of energy where hydrogen is use in fuel cell engine to provide power. Fuel cells will be available to a wide range of products, from a miniature size use in portable devices such as laptops and hand phones, to huge engine of cars, ships, and airplanes, likewise to provide power in industrial sector (fuelcellenergy.com).

Additionally applying hydrogen in fuel cell systems emit no harmful emissions by products as a matter of facts NASA spaceships burned hydrogen gas leaving clean drinking water for the astronauts (nasa.gov). They are also excellent in Medical and IT field since it make low noise and high power output. Hydrogen and Fuel Cells will serve a better future for both man and environment unlike other resources either toxic or harm to the environment.


1.2 Motivation

Currently as global demand of petroleum based energy increases exponentially each every year, a new more sustainable energy is highly desired. Thus transition from traditional petroleum based energy to hydrogen economy is one of the best solving answer, since hydrogen is a clean energy carrier (Xun Hu. 2014). Moreover, hydrogen is expected to be one of the most important fuels where it can be use in fuel cell to generate electricity and in hydrogen internal combustion engine vehicles (Murat CİNİVİZ. 2012). The benefits of it all are such as to reduce the dependence on non-renewable resources which are very costly and gradually to continue with it depletion, decrease in emissions of greenhouse gases (GHG) and others harmful air pollutions from the combustion of petroleum based fuel. Other than that hydrogen is also used widely in the production of pharmaceuticals, fine chemicals and bulk chemicals such as ammonia and methanol (Wenju Wang, 2009).

Hydrogen can be produced from diverse energy resources, using varieties of processes technologies such as thermochemical, biological, electrolytic, and photolytic. Bio-derived liquid (ethanol) undergo reforming, which is the most plausible way to produce hydrogen since ethanol is a non toxic nature substance, high availability, cheap and a renewable resource. 95% of ethanol production is by fermentation called bioethanol the raw products comes from various range of biomass resources such as cellulose of plant, argro-industrial wastes, forestry materials and municipal solid waste, in Canada they uses grains, Brazil; sugarcane and in the United State; corn. Apart from that ethanol is feasible for large scale production because it is easily to store, handle and transport due to its volatility. The dry reforming of ethanol reaction is as follows (A. Zawadzki.2014).

A non noble metal such as Ni is currently a great interest to be use as catalyst since Ni has high C-C bond breaking activity overall it is cheaper, compare to other noble metals such as Rh, Ru, Pd and Pt (Nader Rahemi. 2013). However the acid sites of Al2O3 promote ethanol dehydration, Ni/Al2O3 catalyst suffers carbon deposition. To subdue deactivation alkaline oxides such as MgO and CaO is use as additives by neutralizing the acidity, apart from that ZrO2 added to Ni/Al2O3 catalyst to improve stability and boost adsorption and dissociation of water on the surface of nickel catalyst (Seung Ju Han. 2014).