

**THE ROLE OF HYDROGEN TO BUILD A LESS CO2 SOCIETY FOR JAPAN**

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**Overview**

It is expected that hydrogen and fuel cell technologies will play an important role to reduce CO2 emission seriously in the middle of this century in Japan. However, the cost to introduce hydrogen systems and their competitiveness against other technologies to reduce CO2 emission are quite uncertain.

**Methods**

The Japanese Hydrogen Energy Model (J-HEM) was developed to analyze the cost of a hydrogen energy system quantitatively. This model incorporates not only the various technologies for hydrogen production, transportation and utilization including fuel cell vehicles/cogeneration systems, but also the competitive technologies such as hybrid vehicles, electric vehicles and heat pump water heater (Fig.1). Total cost for energy supply towards the year 2050 is minimized under the various constraints. Besides CO2 emission, an index of country risk was calculated and the trade-off relationship between cost, CO2 emission and energy security was analyzed.

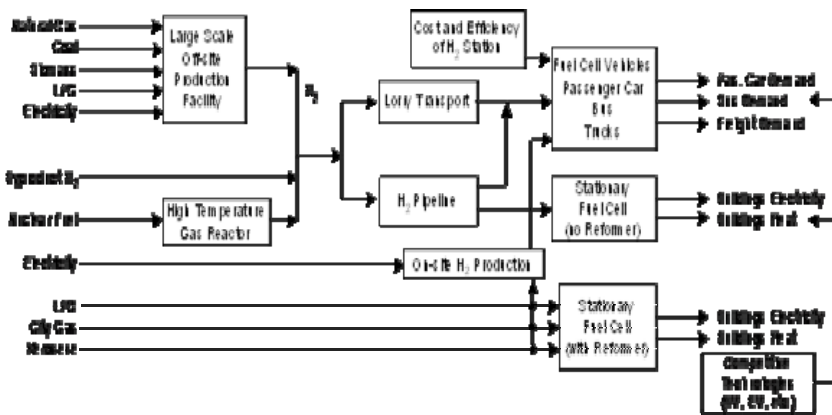


Fig. 1: Structure of Japanese Hydrogen Energy Model (Sector of Hydrogen Production and Use)

**Results**

Even in the BAU case where no constraint for CO2 emission is imposed, fuel cell buses and trucks will be introduced, if the supply cost of hydrogen will be under 40 yen/Nm3 and no tax is imposed on it (Fig.2). This threshold will change to 80 yen/Nm3, if severe constraint for CO2 emission is imposed. The energy source for producing hydrogen will change greatly according to the constraint for CO2 emission. Without CO2 constraint, gasified coal will be the main sources; on the other hand, byproduct hydrogen, biomass, and nuclear heat will be with a severe constraint. The use of fuel cell passenger vehicles and stationary co-generation systems with fuel cells will be limited even if CO2 emission will be restricted. This is because strong alternative technologies such as electric vehicles

and heat pump water heater are available and the cost of the infrastructures of supplying hydrogen is quite expensive. CO2 emission reduction will be neutral to energy security because energy source will be switched from coal to biomass energy largely and the values of country risk of coal and biomass energy are almost same.

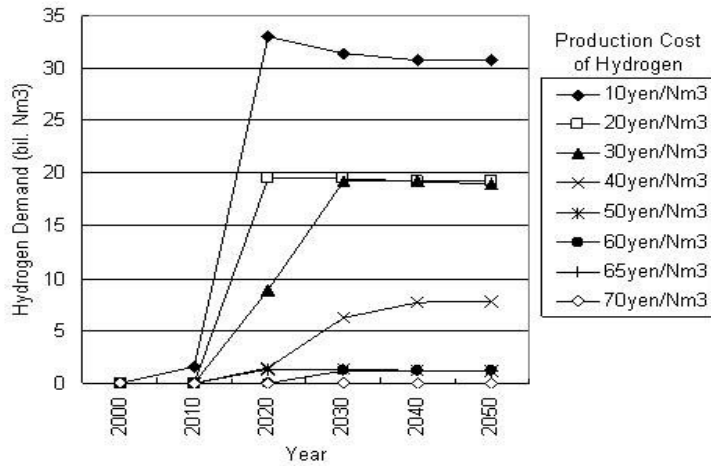


Fig. 2: Relationship between Hydrogen Demand and Its Production Cost (without CO2 Constraints)

### Conclusions

It is confirmed that the hydrogen energy system and fuel cell technologies will contribute to CO2 emission reduction for Japan. This paper evaluated the required production and distribution cost of hydrogen, and severe CO2 constraint will double the cost threshold. Whether energy security will be improved or not with a CO2 constraint depends on the country from which Japan will import biomass energy. This is a quite important implication for the countries whose supply potential of biomass energy is limited like Japan and European countries.