Comparative Study on Hydrogen Economy Policy of China and Korea*

Yaowu Song*
and
Mingqi Chen*

Harbin Institute of Technology
Harbin, P.R. China

Abstract

In this paper, we compare the hydrogen economy policy of China and Korea. We point out that the two countries have their respective advantages such as strong motivation from necessity, national support by law and diversity in regional policies for China and leading strength from government, academic support by universities and participating energy of enterprises for Korea. Also China and Korea are facing some common challenges like lack of supporting policy, lack of advanced technology and lack of human resources. That is why we need to cooperate in the fields of building a technology network for hydrogen energy research, founding a bilateral hydrogen economy park and playing a more important role in some regional cooperation systems.

Keywords: Comparative Study; Hydrogen Economy; Policy
JEL classification: Q01, Q28, O38

* The authors are grateful to Wu Lili for her useful information about Korean hydrogen economy.
* Professor, Dean of School of International Relations of Economics and Trade, Harbin Institute of Technology. #1228, No.13 Fayuan Street., Harbin, 150006 P.R.China. Tel:86-451-86402305, 13904657064(Cell).Fax: 86-451-86402306. E-mail: songyaowu@hit.edu.cn
* Corresponding author. School of Municipal and Environmental Engineering, Harbin Institute of Technology. E-mail: qiqi9426@163.com

1.Introduction

Hydrogen is the most plentiful gas in the universe and is pointed to as a solution to economic and environmental problems. It is known as one of the most promising alternatives to limited fuels such as gasoline. For Korea—the world's 10th largest energy consuming nation (2002), and China—the world's 2nd largest energy consuming nation (2004), we both need to work out measures to advance the schedule for research, development and deployment of hydrogen production, storage, transport and end-use technologies, and present examples in other advanced countries. That means public policies will play a very important role in the process of Hydrogen economy development of China and Korea.

We think that the two countries have some differences in policy-making background, policy focuses and policy implementation. Structures of energy consumption and supply are showing dissimilarities for countries on different stages of development like China and Korea. That leads to various public policies. Although the two countries are both at R&D stage prior to demonstration, we are facing the challenging issues such as safety codes/standards and market introduction policies not to the same extent. So we will lay unlike emphases on public policies for hydrogen economy. In view of the important role of private sectors such as Samsung and Hyundae motor company in Korea, its policy implementation model will be also different from that of China.

2.Respective Advantages of the Two Countries

When we compare China and Korea in the area of hydrogen economy policy, we can point out their own advantages in many different aspects. These advantages are deeply rooted in the countries' different policy-making background.

China has three main advantages as follows:

First, there is a strong motivation from necessity. Necessity is the best motivation for technical innovation and diffusion. China is both a leading energy producer and consumer. In 2004, the primary energy output reached the equivalence of 1.845 billion tons of standard coal while the total yearly energy consumption is equivalent to 1.97 billion tons of standard coal, ranked the second in the world. The self-reliant rate topped 94%, showing that most energy China consumed came from domestic supply. Fast growing necessity of energy has motivated China to promote a movement of saving energy in the whole society and to optimize its energy consumption structure. According to Cambridge Energy Research Associates (CERA), energy intensity of China is much higher than developed western countries and Asian countries like Japan and Korea (See Table1[1]). The proportion of coal in primary energy consumption dropped from 76.2% in 1990 to 67.7% in 2004, while that of oil rose from 16.6% to 22.7%. The percentage of natural gas, hydropower, nuclear power, wind power and solar power in total jumped from 7.2% to 9.6% in the same period[2]. According to a recent research using the method of limit analysis, the structure of electric

[1] Commentator, Provide Energy Guarantee for Sustainable Development of China's Economy, Petroleum& Petrochemical Today, Vol. 13 No. 6, Jun. 2005

[2] China's Policies on Energy, Oil and Natural Gas in the New Century---- Keynote Speech on the Sixth Sino-US Oil and Gas Forum, Mr. Zhang Guobao, Vice-chairman National Development and Reform Commission, June 28, 2005, New Orleans, the U.S.

Table 1 Energy Intensity of Different Countries and Regions

Countries and Regions	Energy Intensity(TOE （tons of oil equivalent）/thousand USD of GDP)			
	1980	1990	2000	2001
North America	0.39	0.31	0.27	0.26
U.S	0.39	0.30	0.26	0.25
Latin America	0.29	0.28	0.28	0.28
West Europe	0.19	0.17	0.16	0.16
M&E Europe	1.27	1.15	0.64	0.63
Russia	2.08	2.12	1.82	1.74
Middle East	0.28	0.54	0.66	0.65
Africa	0.73	0.85	0.85	0.83
Asia Pacific	0.35	0.31	0.31	0.32
China	3.41	1.98	0.99	0.97
India	1.46	1.31	1.01	0.97
Japan	0.11	0.09	0.09	0.09
Korea	0.28	0.27	0.32	0.32

Translated into English by the authors.

power in 2035 can be forecasted as table 2[3]. In November 2004, the government issued its first Mid-to-Long Term Specific Plan for Energy Conservation. According to this plan, China will work hard to innovate and apply various energy-friendly technologies.

Second, there is a national support by law. On February 28,2005, China adopted a new law called Law of the People's Republic of China on Regenerable Energies which will become effective on January 1, 2006. In this law, "regenerable energies" is defined as Non-Fossil energies such as wind power, solar power, hydropower, bio-mass power, geothermal power and ocean

Table 2 Structure of electric power of China in 2035

Type of Power	Capacity (billion kW)	Operating Time Per Year (hour)	Electric Power (billion kWh)	Ratio of Capacity (%)	Ratio of Electric Power (%)
Hydro Power	0.33	3500	1155	22.0	16.2
New Energy	0.12	2500	300	8.0	4.2
Gas Power	0.07	3500	245	4.7	3.5
Coal Power	0.70	5000	3500	46.6	48.8
Nuclear Power	0.28	7000	1960	18.7	27.3
Total	1.50	-	7160	100	100

Translated into English and modified by the authors.

[3] Xu Damao, Accelerate the development of nuclear power—the best way for adjustment of energy sources structure, Energy of China, Vol. 27 No. 8 Aug. 2005, pp6-9

power, etc. Hydrogen energy is regarded to be included in the judicial support system for regenerable energies. The new law called the energy sectors of State Council to take the responsibilities in resources survey and development planning, industry instruction and technical support, promotion and application, price administration and cost sharing, economic motivation and supervision.[4]

Third, there is diversity in regional policies. Technical changes could have economic meanings only if harmonious relation is built between policies of central government and local government, especially for a country like China covering a variety of different parts. Regional diversity should be regarded as a productive actor for the development of a new industry like hydrogen economy. In other words, competition between cities or provinces makes resources distributed reasonably. Shanghai is one of the most vigorous cities in China. It also shows its energy in developing hydrogen economy in designing a policy called "Green Power system" for promoting renegerable energy[5], building a research center for hydrogen energy with Italy government[6] and supporting companies like Shanghai Shenli High Tech Co., Ltd who is a leading company in developing hydrogen power and has a plan to help Shanghai Automobile Industry Company to fulfill its dream of starting small-volume production of hydrogen fuel cell cars before 2010[7].We can also find regional policies for supporting hydrogen economy in Northeast China Revitalization Strategy.

Korea also has three main advantages as follows:

First, we can see the leading strength from government. Korean government has put forward several programs to develop hydrogen energy technologies in the last decade. Most of energy technologies in Korea are supported by two Ministries – MOCIE (Ministry of Commerce, Industry and Energy) and MOST (Ministry of Science and Technology). MOCIE is more interested in the development of technologies, which could be applicable or commercialised in short and mid-term. MOST is more oriented towards the development of fundamental, basic technologies from the longer-term perspective. Table 3 is the summary of hydrogen R&D programs in Korea[8].

Table 3 Hydrogen R&D program in Korea

Program	Sponsor	Period
High-Efficient Hydrogen Production Program	**MOST**	**2000-2003**
Alternative Energy Technologies Development Program	**MOCIE**	**1992-**
21st Frontier Hydrogen Energy R&D Center Program	**MOST**	**2003-2013**

Also Korean government played a very important role in coordinating the function of research institutes, universities, enterprises and government sectors. In fuel cell technology, for example, 18 private companies and 3 public research institutes are actively involved in its research and development. The government will help establish industrial parks that make use of hydrogen-based fuel cells, wind and solar power, other clean energy sources and more energy efficient insulation.

[4] Law of the People's Republic of China on Regenerable Energies, www.ndrc.gov.cn.
[5] www.ndrc.gov.cn.
[6] http://www.shanghai.gov.cn
[7] http://www.sl-power.com/
[8] Korea IPHE summary, www.iphe.net.

Second, we can see the academic support by universities. The Korean Hydrogen and New Energy Society was established in July 1989, in order to promote hydrogen energy technology and exchange of information. This society is originally university-centralized. 16 out of 25 of the leaders of this society are from universities like Chonnam National University, Gyeongsang National University, Dankook University, Sungkyunkwan University, etc. They organize Annual Meetings of Korean Hydrogen & New Energy Society every year and publish an academic journal named Journal of the Korean Hydrogen & New Energy Society. Their research interests covered hydrogen production, storage, transmission, utilization, as well as the economical, environmental and international aspects. [9]

Third, we can see the participating energy of enterprises. Deokyang Energen Corporation, Samsung SDI Corporation and Hyundae Motor Company are the best examples in Korea. Deokyang Energen Corporation, located in the Ulsan petrochemical industry complex, achieved the patent for hydrogen storage material cooperating with KIST after years of research and development for hydrogen absorption material. Kim Heoung Sun, President of the Korean Hydrogen and New Energy Society is from this company. Dr. Seok Yeol Yoon, CTO and Executive Vice President of Samsung SDI Co., Ltd. said, “The ubiquitous use of tomorrow's powerful mobile phones will not be limited by information technology, but by battery capacity. Even if today's lithium-ion batteries' capacity could be doubled, they would not meet future demands. Samsung, as a global leader in "Digital Convergence", therefore focuses on the development of mobile Fuel Cells.”[10] Hyundae Motor has succeeded in road testing for the fuel cell vehicle (called Santafe) in 2001.

3.Common Challenges

Apparently, China and Korea are facing some common challenges not only today but in a long period from now.

Our first challenge is lack of supporting policy. Comparing to the U.S, who is leading country in hydrogen economy development, China and Korea are both in state of pushing a new economy with the support by less policies.

On March 10, 2004, the U.S. Department of Energy (DOE) released its “Hydrogen Posture Plan,” a document that outlines the activities, milestones, and deliverables that DOE plans to pursue to support the U.S.shift to a hydrogen-based transportation energy system. This plan identifies milestones for technology development over the next decade, leading up to a commercialization decision by industry in 2015. Secretary of Energy Spencer Abraham said. “If we achieve our technical objectives, the automotive and energy industries will be in a position to begin to mass market availability of both vehicles and refueling infrastructure by 2020.”

The Bush administration’s fiscal year 2005 budget request includes USD $227 million for research to support the Hydrogen Fuel Initiative. The federal government will play a key role in accelerating the transition toward the hydrogen economy by pursuing research to overcome technical challenges. The Posture Plan integrates research, development, and demonstration activities from the DOE renewable energy, nuclear energy, fossil fuel, and science offices. An integrated hydrogen program will improve the effectiveness and accountability of DOE’s research

[9] http://www.hydrogen.or.kr/

[10] Seok Yeol Yoon, Future Prospect of Mobile Fuel Cell, www.fair-pr.com/hm05/conference/seok_yeol_yoon.php

activities and increase the probability of success in achieving technical milestones on the road to a hydrogen economy. DOE has also coordinated its work on codes and standards with the Department of Transportation and other agencies.[11]

Our second challenge is lack of advanced technology. The use of hydrogen as an energy carrier can surely enhance energy security while reducing air pollution and greenhouse-gas emissions. But every coin has two sides. Hydrogen economy needs a stronger technical support than other economic patterns. Research should be increased in the areas of distributed hydrogen production systems, hydrogen storage, and solar energy for hydrogen production. Korea remains about four to five years behind in the technology compared to industry leaders like the United States and Japan.[12]

Our third challenge is lack of human resources. We really have many first-class experts in hydrogen energy research in China and Korea. What we lack the most is a pond of human resources that have the combination of knowledge and skills in the fields of technology, economics and public administration. These talents can make it possible that innovation and diffusion of hydrogen energy technologies changes the pattern of economic developing at the level of both national and regional with the help from public policies.

4.Suggestions for Cooperation

In order to push forward hydrogen economy both in China and Korea, we suggest a roadmap with a topic of bilateral cooperation. The cooperation should consist of three parts:

First, China and Korea can build a technology network for hydrogen energy research with national labs of each country playing the key role and universities working as the main partners. Complementary between the two countries would make it possible for them to catch up with the leading countries.

Second, China and Korea can found a bilateral hydrogen economy park in Harbin, a metropolitan with advantages in technology, human resources, natural resources and location. Another choice should be Songdo New City in Incheon Metropolitan City who is the first national development zone of Korea.

Third, China and Korea should play a more important role in some regional cooperation system. There is a Senior Officials Meeting on Energy (SOME) + the Ministry of Economy, Trade, and Industry (METI) of Japan, the State Planning and Development Commission (SPDC) of China and the Ministry of Commerce, Industry and Energy (MOCIE) of Korea (SOME+3) Consultations for the ASEAN+ 3 energy cooperation from 2002[13]. Also we have some forums and meetings in APEC system to cooperate in hydrogen energy technology and related economic aspects.

5.Concluding Remarks

Hydrogen Economy is a good opportunity for both China and Korea to make an economic transformation in the first decade of the 21st century. Although these two countries have some different aspects in this process such as energy necessity growth, government function and

---

[11] DOE Releases Long-Term Hydrogen Research Plan, Science policy, www.mrs.org/publications/bulletin

[12] Yonhap, South Korea to Set Hydrogen Economy Policy This Year, 03 March 2005, Asia Pulse Pte Ltd

[13] www.aseanenergy.org

regional policy making, they truly share several common challenges waiting for us to meet with. The best way for China and Korea today is to cooperate and build a bilateral development zone of hydrogen economy.