

A Reconciliation Consideration of the Energy Policy Adapting to Abolishing Nuclear Power in Taiwan ^{*)}

Chien-Te Fan ^{**)}
Ruay-Nan Wu ^{***)}
Jui-Chu Lin ^{****)}

Abstract

Fukushima nuclear disaster in Japan has triggered a global nuclear power reflection. Now abolishing the nuclear power seems to be a trend, and with no exception in Taiwan. In post-Fukushima, not to mention Japan and Germany, Taiwan, incompetent to bear any nuclear disaster, more firmly makes a choice to develop clean energy to substitute nuclear and meet the reduction target simultaneously. However, how to reduce nuclear energy while ensuring a stable power supply system and achieving the goal of carbon reduction are the common problems for us, which moreover turn out to be the most challenging issues for Taiwan in the near future.

It is convincible that Taiwan must focus on the existing legal system alignment so as to promote sufficient renewable energy. It is arguable that,

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**) Corresponding author; Professor of law, Institute of Law for Science & Technology, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan 30013, R.O.C.. Email: ctfan@mx.nthu.edu.tw.

***) Associate Professor, Department of Electrical Engineering, National Taiwan University of Science and Technology, #43,Sec.4,Keelung Rd.,Taipei,106,Taiwan,R.O.C.. Email: rrwu@mail.ntust.edu.tw.

****) Professor of Law, College of Arts & Humanities, National Taiwan University of Science and Technology, #43,Sec.4,Keelung Rd.,Taipei,106,Taiwan,R.O.C.. Email: 1030@mail.ntust.edu.tw.

trying to harmonize the anticipatory conflict, both technical and legal issues shall be solved coherently.

This article will firstly provide some historical review of nuclear development since it is hard for Taiwan to reach Nuclear-Free Homeland. Then this article will cover the technical side and legal side of Taiwan's energy policy, and finally, point out the problems with Taiwan and some possible and feasible solutions.

Keywords:

Nuclear energy substitute, stable power supply system, promote renewable energy in Taiwan, Nuclear-Free Homeland, Taiwan's energy policy

The Pursuit of Nuclear-Free Homeland Policy in Taiwan

A Historical Perspective

After energy crisis in 1973, Taiwan government has decided to develop nuclear power as other countries do, and made it the main project of energy policies at that time. At present, there are three nuclear power plants in operation in Taiwan. Nuclear power plant No.1 was part of the “Ten Major National Economic Developments” founded in 1970s, which is equipped with two reactors. The reactors were completed and in operation respectively in 1977 and 1979, and will be decommissioned latterly in 2018 and 2019. Plant No.2 and No.3 were the achievements of another major national development project: “The Twelve Major Public Constructions” in 1980s. The former one was completed in 1981 and equipped with two reactors capable of 985MW power generation, which will be decommissioned in 2021 and 2023 separately.¹⁾ The latter one is also a plant of two reactors whose capacity is 951MW.²⁾ The power plant was completed and in operation in 1984, and the reactors will be decommissioned individually in 2024 and 2025.³⁾

Now, Plant No.4, which is under debate for years, has not yet to be completed. Again, the plant is equipped with two reactors whose capacity is 1,350MW and aimed to adapt to the anticipatory challenge incurred from the development of the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol in 1997. Before the Fukushima nuclear disaster, the commercial operation time of reactors were scheduled for December 2011 and December 2012 separately. However, the government turns conservative now by saying not until the design and operation plan of the plant are certified by international regulations, the operation shall be left

1) Taiwan Power Company, The introduction of nuclear power plant No.2, <http://wapp4.taipower.com.tw/nsis/option0-2.asp> (visited on December 5, 2011).

2) Taiwan Power Company, The introduction of nuclear power plant No.3, <http://wapp4.taipower.com.tw/nsis/option0-3.asp> (visited on December 5, 2011).

3) Republic of China Nuclear Energy Association, The status of nuclear power plants in Taiwan, <http://www.chns.org/s.php?id=48> (visited on December 5, 2011). Also Ten Major National Economic Development, <http://zh.wikipedia.org/wiki/%E5%8D%81%E5%A4%A7%E5%BB%BA%E8%A8%AD> (visited on December 5, 2011).

with no schedule.

A Stumbling Policy of Nuclear-Free Homeland in Taiwan?

It has been more than 20 year that nuclear power policy has been under heating debate in society. The main reasons addressed in support of so called "Nuclear-Free Homeland Policy" include; in Taiwan, the nuclear power plants are all located on the earthquake belts; it is difficult to get landfill sites for nuclear waste; and that Taiwan is too small and incompetent to bear any nuclear disasters. Finally, after the first transfer of government occurred in 2000, the main ruling parties of Taiwan had reached the consensus in taking the Nuclear-Free Homeland Policy as a long term goal to achieve. Nuclear-Free Homeland Policy was also codified into "Environmental Basic Law" as part of the fundamental policy of Taiwan. The same policy was reaffirmed after the Kuomintang (KMT) won back its presidency. As indicated in the executive summary of the 2009 National Energy Conference, several nuclear power development topics are deleted and only those blessed with the consensus are kept therein.

However, strictly limited by the nature geological conditions and badly in wanting of energy resources, it's not an easy job for Taiwan to mention nuclear-free. Listed below are some of the major points which have been so emphasized:

a. Taiwan has an isolated power system.

Unlike European countries, where they may share each other's power supply through the European power grid and import electricity from neighboring countries when any power shortage occurs, Taiwan can only count on her isolated power system for its survival. Further, restricted by the technology availability and the cost, renewable energy can hardly become alternative source of Taiwan's power generation in substitute of the decommissioned nuclear power. The reality has been that, without new power generation plant of sufficient capacity being constructed, the reserve margin will be inclined to be low until 2017 and incurs the problem of energy security.⁴⁾

4) Cau, Yi-Wun, "Ministry of Economic: Taiwan can surly be nuclear-free with certain conditions", Nownews, <http://www.nownews.com/2011/08/30/320-2739160.htm> (visited on December 5, 2011).

b. The irrational low price of electricity is another problem.⁵⁾

The energy consumption mix of nuclear power in Taiwan is about 20%.⁶⁾ It makes Nuclear-Free Homeland Policy looks un-convincible when increasing the fossil fuel power plant as substitute becomes necessary and, in turns, will cost the country of GHG emission increase. Therefore, it has been suggested that the most feasible solution for Taiwan has been the raising of the electricity price so as to facilitate the dissemination of the renewable energy technology, and to foster the required industry structure transformation into low energy intensity type.⁷⁾

c. The developing limits of other clean energy

The third issue that causes the problem has been the limitation of environmental resources to enable the development of sufficient renewable energy; e.g., the land areas are not broad enough to support wind and/or solar power installations.

Nuclear power generation has long been a solution to solve the power shortage problem in Taiwan. According to the statistics released by Bureau of Energy, Ministry of Economic Affairs, the total electricity generated in 2010 was 247TW. The nuclear power contributed to 41,628TW, accounted for one-fifth of the total electricity generated or so,⁸⁾ which can be beneficial to Taiwan in reducing the carbon emission by 24,497,748 tons a year of carbon reduction equivalences.⁹⁾ In other words, the carbon reduction potential of applying nuclear power cannot be ignored, and neither the diminished carbon neutrality effect derived from the nuclear abolishment accordingly.

It is estimated that all the three nuclear power plants in operation, together the

5) Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), Comparison sheet of electricity price, http://www.moeaboe.gov.tw/opengovinfo/Plan/electronic/PEIecMain.aspx?PageId=p_elec_03 (visited on December 5, 2011).

6) Taiwan Power Company (Taipower), Annual Report 2010 (2011), http://www.taipower.com.tw/TaipowerWeb/upload/files/32/TPC_2010_Annual_Report.pdf, at 11-12 (visited on December 5, 2011), (in Chinese)

7) ChinaTimes, "Short comment: Germany can, why Taiwan can't", <http://blog.udn.com/michalle77/5605009> (visited on December 5, 2011).

8) Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), *Energy Statistics Handbook 2010 (2011)*, pp. 82, 83. Also, *Taipower, 2010 The performance of nuclear power modules*, <http://wapp4.taipower.com.tw/NSIS/Manage/99%E5%B9%B4%E6%A0%B8%E8%83%BD%E7%87%9F%E9%81%8B%E7%B8%BE%E6%95%88-%E8%B3%87%E8%A8%8A%E9%80%8F%E6%98%8E%E5%8C%96.pdf>, p. 2 (visited on December 5, 2011).

9) Taipower, Carbon Equivalences of Nuclear Power, <http://wapp4.taipower.com.tw/nsis/CO2lessen.asp> (visited on December 5, 2011).

incoming the fourth one, are able to reduce up to 33 million tons of GHG in Taiwan, which is beneficial to the fulfillment of the country's emission reduction target.¹⁰ Should the nuclear be all abolished, looking for an alternative substitute yielding 33 million tons carbon cut shall be another serious challenge.

Rethinking of the Nuclear-Free Homeland Policy after Fukushima Nuclear Crisis

Keep Nuclear Power Plant No.4 in Operation after Completing the Construction?

After the Fukushima nuclear crisis, most of the countries in the world started to re-examine their nuclear power generation policy, and inspect all the nuclear power plants as well. So does Taiwan. In the meanwhile, public voices against nuclear power are flooding, too.

The main issue in debate has been whether or not the nuclear power plant No.4 should be admitted for commercial operation after completing its construction disregard of the increasing opposition attitude expressed by the general public. Indeed, subject to the premise of Nuclear-Free Homeland Policy, the fourth power plant has been counted in as part of Taiwan Power Company's (Taipower) power development plan, aiming to be a main power supply source for the northern Taiwan. The abolishment of the original plan might cause serious problem to stable power supply in the region.

Trying to solve the dilemma, the premier of Executive Yuan, Mr. WU Den-Yih stated that, concerning with people's well-being in refraining from the shadow of

10) So far, according to the official documents, the total carbon reduction equivalence in one year of Plant No.1 to Plant No.3 is about 24,497,748 tons. In addition, according to China Technical Consultants, Inc.(CTCI), the carbon reduction equivalence of Plant No.4 is estimated 19.2 million tons. Therefore, the overall total carbon reduction after the completion of plant No.4 can reach up to 33 million tons. See Taipower, Carbon Equivalences of Nuclear Power, <http://wapp4.taipower.com.tw/nsis/CO2lessen.asp> (visited on December 5 ,2011). Also, CTCI, Choices for Taiwan's energy policy in post-Fukushima, <http://www.ctci.org.tw/public/Attachment/18515173071.pdf> (visited on December 9 ,2011).

power restriction and/or power failure, the plant will be in operation, provided that the safety condition is diagnosed and assured by the experts from domestic and overseas. For the purpose, Premier WU mentioned further, once the new plant can be performed normally, it's possible to retire Plant No.1 earlier than it should be. The same opinion was also highlighted by President MA in his "Golden Ten Years" campaign statements. In addition, the statements reassure the retirement of old nuclear power plants on schedule, and emphasize the promotion of renewable energy so as to enhance the energy efficiency and carbon mitigation, and the collection of carbon tax as well.

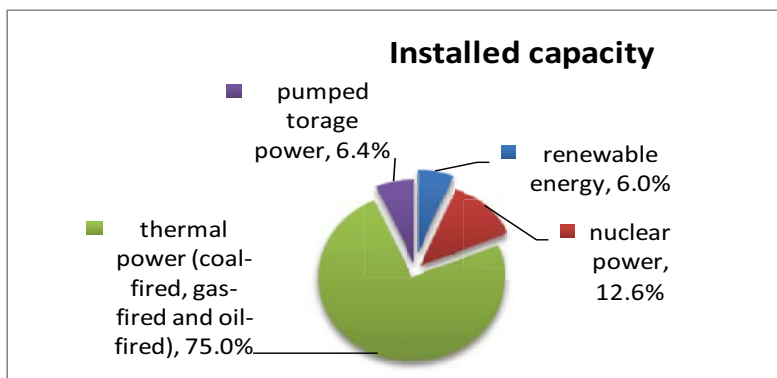
However, taking into consideration of the time requirements for economic transmission and renewable energy development, the early retirement of the old plants might cause electricity shortage and/or restriction problem. This is why the government decides to wait until the stable operation of the new plant before the re-evaluation of old plants retirement. Besides, Ministry of Economic Affairs will review the progress of technology and renewable energy development conditions routinely so as to find out the best time schedule set for the implementation of Nuclear-Free Homeland Policy.

Obviously, it's been Taiwan's policy that, subject to the Nuclear-Free Homeland Policy, the government keens to put the new plant in operation after completing its construction so that we may delay the threat of power shortage, and save the time needed for new energy development. After that, the old nuclear power plants will be closed down gradually.

According to the statistics of the installed capacity of Taiwan's power system by 2010,¹¹⁾ thermal power (including coal-fired, gas-fired and oil-fired) accounted for about 75%, nuclear power accounted for 12.6%, pumped storage power accounted for 6.4% and renewable energy accounted for about 6% (conventional hydro 4.8%, wind 1.1%, PV 0.05%), as shown in chart 1. However, among the total power generated, thermal power accounted for 76.7%, nuclear power accounted for 19.3%, pumped storage power accounted for 1.5% and renewable energy accounted for 2.5%, as shown in chart 2.

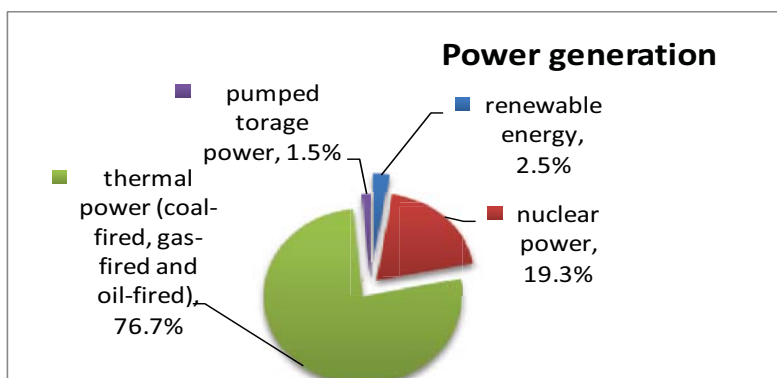
11) Taipower, *Annual Report 2010 (2011)*, http://www.taipower.com.tw/TaipowerWeb/upload/files/32/TPC_2010_Annual_Report.pdf, pp. 11-12 (visited on December 5, 2011).

Chart 1: The installed capacity share of energy in 2010 in Taiwan



Source: Arranged and made by the author in accordance with the data above.

Chart 2: The power generation share of energy in 2010 in Taiwan



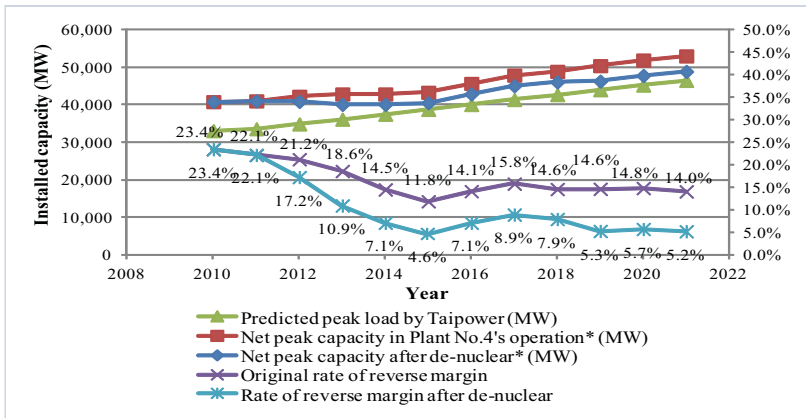
Source: Arranged and made by the author in accordance with the data above.

Obviously, sudden closing of the old nuclear power plants is impossible for renewable energy, which accounted for only 2.5% in the mix, to function as a substitute to cover the 19.3% electricity shortage originally generated from the nuclear power. Therefore, the importance of on-schedule operation of the new plant was emphasized by the Ministry of Economic Affairs. The reason is a straightforward one, assuming the national economic growth is marked at 5%, coefficient of elasticity of electricity demand growth is 0.75:1 and the electricity growth per annual is about 3.75%, without

the power supply back up by the new plant, the reserve margin of 2014 would be only 4.5%, which would trigger out the power shortage risk. This is especially true in the year 2015, wherein the reverse margin would be even lower as that of 2%. In such a case, the Northern Taiwan is the area of highest risk facing the threat of electricity restriction. Following the trend like this, the most serious circumstance will occur in the next 3 years.

Also, according to the executive summary of 2010 Power Development Plan of Taipower, from 2011 to 2021, the peak load is estimated to increase from 33,528MW to 46,406MW.¹²⁾ If the Plant No.4 can be in operation on schedule and the other three plants are closed in an appropriate way, the net peaking capacity will rise from 40,950MW to 52,922MW. However, without all nuclear power plants, including Plant No.4, reserve margin will decrease annually, even lower than 10% in 2014, as shown in chart 3. It is foreseeable that the shortage problem would occur much faster than we think.

Chart 3: The analysis of variation on installed capacity of nuclear power in Taiwan



Source: Analyzed and arranged by the author in accordance with the Summary of 2010 Power development plan issued by Taipower, available at http://www.taipower.com.tw/TaipowerWeb//upload/files/26/Power_development_plan_01.pdf (visited on December 13, 2011).

12) Taipower, *Executive Summary of 2010 Power Development Plan* (2010), http://www.taipower.com.tw/TaipowerWeb//upload/files/26/Power_development_plan_01.pdf (visited on December 7, 2011).

The Response to Abolishing Nuclear Policy

In June 2008, Executive Yuan of Taiwan passed "Sustainable Energy Policy Guidance", which hopes to establish a low-carbon society through various energy conservation and carbon reduction measures. Due to insufficient environmental resources, Taiwan's sustainable energy policy should start from the supply-side "clean energy" and the demand-side "efficiency".

Governance by the "Sustainable Energy Policy Guidance," in the newly released energy policy issued by Ministry of Economic Affairs, "Increasing Power Supply" and "Repelling Demand" are further included. Also, the low-carbon gas-fired power will be taken as a substitute for nuclear power; the off-shore wind power, solar power, ocean power. The government budget will subsidize those who purchase energy-saving appliances, such as the air conditioner, and together the industry structure adjustment will be illustrated therein.

On the level of expanding the power supply and the coverage of clean energy, it has been estimated that the new installations will be reached 20,000MW¹³⁾ by the year 2030, while the gas storages and pipelines required for the newly installed gas-fired power will be ready in 2018.¹⁴⁾ However, before that, power shortage may already occur in 2015, should there be no Plant No.4 available. That's why Taiwan government emphasizes the importance of Plant No.4, which plays a critical role for Taiwan in tackling with the power shortage problem.

Although traditional coal-fired power generation is a more stable power supply than others, taking the carbon mitigation requirement into account, gas-fired power turns out to be a better choice for its half of the carbon emission, less than that of the coal-fired one. Then, starting from this year, the capacity of gas-fired power would rise from 15,000MW up to 25,000MW of 2030,¹⁵⁾ which will be accounted for nearly 30% of the energy consumption anticipated. That might ease the threat of energy shortage in

13) Natural gas is predicted to be raised up to 10GW by 2030, and so is renewable energy. Thus, the total is 20,000MW.

14) Chinese Petroleum Corporation (CPC), 100th anniversary celebration of state founded, the 100th gas boat came in, http://www.cpc.com.tw/big5/news/index01_pda.asp?sno=3372&pno=158 (visited on December 7, 2011).

15) Lin, Shu-Yuan, "Post-nuclear era Raising gas-fired in renewable energy", October 6, 2011, <http://forum.cute.edu.tw/stu/viewtopic.php?f=32&t=2026> (visited on December 13, 2011).

the next 30 years even though the increasing power demand in the next 30 years will continue. Recently, Council for Economic Planning and Development of Executive Yuan has approved a 185-million-NT-Dollar project aiming to establish three onshore gas storage sites accompanying with gasification facilities nearby the west of Taichung Harbor, with the capacity of producing 160 thousands kilolitre HCG, and planned to set up pipelines for gas transportation. The construction will start from July 2012 and will complete by 2018.¹⁶⁾

In regard to the energy efficiency, the goal was lowering the peak load, compressing power demand, facilitating industry structure transformation, downsizing the high energy-consuming and/or high pollution industries, certifying energy efficiency, and encouraging energy-saving products. Further, the market mechanism and related legislation are promoted to develop energy efficiency market, including but not limited to the rationalization of electricity price, liberalization of power industry, enactment of Greenhouse Gas (GHG) Reduction Act (Bill) and Energy Tax Act (Bill), and so on. In terms of the price rationalization, market mechanism will be implanted to reflect the fair market price, including the application of time-of-use rate, green electricity price and drought season water fee tariff, while related enforcement time schedule and methods are still under discussion. In regard to the legislative efforts, among so called energy related four legislations, Energy Regulation Law and Renewable Energy Development Act are in position; GHG Reduction Act (Bill) is waiting for the final approval of the Congress (Legislative Yuan); and Energy Tax Act (Bill) has yet to be adopted by the Congress agenda.

As mentioned above, no matter Plant No.4 will be commercially in operation or not, the other three plants will still be decommissioned step by step. Therefore, it is predictable that the electricity price shall go up as a result of applying substitute energy, especially the costly renewable energy. However, it has also been expected that the rising price by itself may benefit us on the promotion of energy efficiency and renewable energy development; further, the fruits of the earlier implementation in

16) Cao, Yi-Wun, "Council for Economic Planning and Development passed an NT 18.5 billion-dollar investment on the second period plan in Taichung of CPC natural gas storage", Nownews, September 5, 2011, <http://www.nownews.com/2011/09/05/320-2740517.htm> (visited on December 7, 2011).

this regard can be taken as reference to adjust the policies stated above, and to meet Nuclear-Free Homeland vision more closely.

Promotion of Renewable Energy

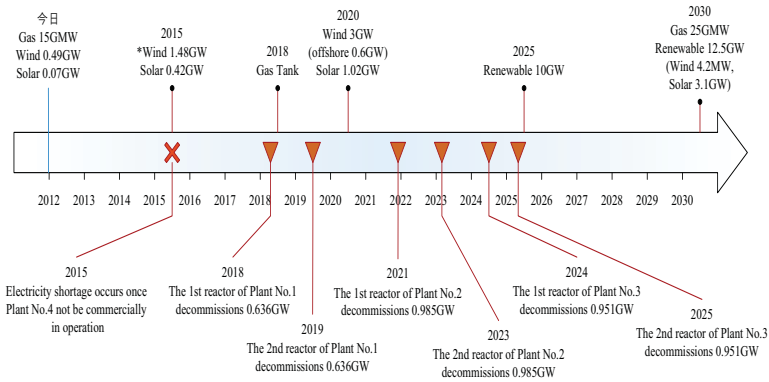
In regard to the promotion of renewable energy, a new plan adopted by the Ministry of Economic Affairs tries to achieve the original goal of 2030 earlier in 2025, viz., installed capacity of 12,500MW. This effort represents Taiwan's ambition to raise the contribution of renewable energy from 3% to 16%. The project is titled as "Thousands of Onshore and Offshore Wind Turbines, Millions of Rooftop PVs." Through the implementation of the new plan, extra 8,200MW of new installed capacity can be expected and both onshore and offshore wind power installation are included. Those are 600 of the onshore wind turbines accounted for 1,200MW, 800 of the offshore ones constructed in the 50-meter-deep ocean and accounted for 4,000MW power generation. Totally, the new wind power installations will generate 5,200 MW in power.¹⁷⁾ However, several problems remain, for instances, the technical issues concerning the typhoon resistance capacity of offshore wind turbine installations, environment protection, fishery operation and military conservation zones. On the other hand, on the rooftop PVs side, should every unit of rooftop PV module installed may create 3kW of the power, one million installations may accumulate 3,000MW installed capacity in total.

To sum up, trying to alleviate the impacts of nuclear abolishment, Taiwan government is inclined to accelerate the renewable energy generation target being achieved by 2025, vis-à-vis 2030 as the original planning and begins to establish the related equipment required for gas-fired power generation. As shown in the chart listed below, we can see the rescheduled time table set for the 2050 target, in comparison with the progress of nuclear decommissioned. Right now, the installed capacity of gas-fired power is 15GW and 0.49GW for wind power, 0.07GW for PVs only. According

17) Pan, Yi-Jing, "Ministry of Economic Affairs: Renewable energy will be twice growth 20 years later", Industry and Commerce Times, October 07, 2011, <http://money.chinatimes.com/news/news-content.aspx?id=20111007000047&cid=1206> (visited on December 7, 2011).

to Ministry of Economic Affairs, without Plant No.4, Taiwan would face too low reserve margin in 2025 and a possible crisis of power shortage. It was believed by the government that there might be other solutions than a new nuclear power plant, such as renewable energy mentioned above; however, all these alternatives should face critical uncertainty reading the obstacles in achieving the goal, which might turn the hope into hopeless.

Chart 4: Timeline of solution for decommission of nuclear power plants for the 2050 target in Taiwan



Source: Arranged and made by the author.

New Challenge Derived out of NAMAs Development

The Convergence of Energy Policy and Carbon Reduction Policy in Taiwan

After Taiwan introduced the Nationally Appropriate Mitigation Actions (NAMAs), public sectors are trying to come up measures aiming to achieve national goal. In addition, President Ma also pointed out that even if Taiwan is not yet the formal

member of international Conventions, it should still actively consider how to internalize the international norm.¹⁸⁾ In 2008, Executive Yuan has approved *Sustainable Energy Policy* with the fundamental principles to establish principle of *high efficiency, high value, low emission and low dependence* to achieve triple-win in energy, environmental protection and economy.¹⁹⁾ Because fuel combustion is the main source of greenhouse gas emission in Taiwan as high as 99%, energy policy is always the most essential part of Taiwan's measures for energy demand and supply as well as greenhouse gas reduction. The principle lays down the blueprint for Taiwan's mid-term energy policy up to the year 2025 and paves the road for a low-carbon society.

In order to implement domestic measures to strengthen the integration of carbon reduction, Executive Yuan further founded *Energy Saving and Carbon Reduction Promotion Commission* in January 2010, publishing the national energy saving and carbon reduction plan. This plan includes building a sound regulatory system, transforming low-carbon energy system, creating a low-carbon community and society, creating a low-carbon industrial structure, constructing green transportation networks, constructing green landscape and promoting new green buildings, expanding energy saving and carbon reduction technical capacity, promoting energy saving and carbon reduction in public works, deepening energy saving and carbon reduction education and strengthening energy saving propaganda and communication²⁰⁾.

The Legal Framework of GHG Reduction in Taiwan

With regard to GHG reduction, the legal system includes *Greenhouse Gas Reduction Act (Bill)*, *Renewable Energy Development Act*, *Energy Management Act and Energy Tax Act (Bill)*, among which *Renewable Energy Development Act* and

18) Ministry of Economic Affairs, R.O.C (Taiwan), The Target of Sustainable Energy Policy Convention (2008). (in Chinese)

19) Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), GHG Reeducation Website, <http://iggic.estc.tw/feature/content.asp?id=1041> (visited on October 13, 2011).

20) Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), Committee for promoting the low carbon community, <http://210.69.152.10/Policy/ReduceCO2Emission/ReCO2Main.aspx?pageid=reason> (visited on October 13, 2011).

Energy Management Act were passed in June 2009.²¹⁾ Before the legal framework completed, each government department has responsibility to implement its policies and programs to support carbon reduction, mitigation and adaptation. Followings are the sectors to point out: ²²⁾

- A. In energy sector, it is to promote the use of natural gas, renewable energy, energy price rationalization, and to improve energy efficiency and implement measures for energy saving, greenhouse gas inventory audit and voluntary reduction by energy industry.
- B. In manufacturing industry sector, the reduction measures executed by six industrial associations include 2,237 items, which contribute accumulative reduction of 5.345 million tons of carbon dioxide equivalents.
- C. In transportation sector, it is to build a green transportation system with seamless highways, a rapid and convenient public rail transport network and intelligent road services, establish an urban traffic environment based on people-oriented green vehicles, and improve personal vehicle efficiency level.
- D. In residential and commercial sector, it is to subsidize citizens to buy products with energy saving labels. An estimated 25,000 tons of carbon dioxide emission will be saved every year. It is also to promote voluntary energy saving and signing intention of cooperation among 65 business groups such as hospitals, hotels, department stores, and seven convenience store franchises.
- E. In manufacturing industry sector, the Ministry of Economic Affairs conducts greenhouse gas inventory audit for each type of industry and provides assistance in verification and registration. It established audit methodology, techniques and software in accordance with the 1996 IPCC Guideline and ISO/CNS 14064-1 and 14064-2 international standards.
- F. In the area of promoting industrial voluntary reduction, the Environmental Protection Administration (EPA) signed with the Taiwan TFT-LCD Association (TTLA)

21) Ministry of Economic Affairs, R.O.C (Taiwan), *The Target of Sustainable Energy Policy* Convention (2008). (in Chinese)

22) Environmental Protection Administration, R.O.C (Taiwan), Second National Communication of the Republic of China (Taiwan) under the United Nations Framework Convention on Climate Change, pp. 8-12. (2011) (in English)

and Taiwan Semiconductor Industry Association (TSIA) in 2004 and 2005 the memorandum for voluntary perfluorocarbons (PFCs) emission reduction to commit to total PFCs emission in year 2010 to be 90% below the average emissions of 1997 and 1999. Since the implementation of industrial energy resources integration in 2009, industrial areas are moving toward the goal of “zero waste.” It is estimated that GHG emission can be reduced by more than 50,000 tons of carbon dioxide equivalents every year. By the end of 2008, 33 companies in Taiwan had been invited to participate in an international carbon disclosure project.

To achieve the goal of Taiwan’s NAMA, which is to reduce total GHG emission below baseline by at least 30%, the measures are introduced, such as energy saving measures, clean source measures and carbon sequestration and carbon right management.²³⁾ The purpose of these measures are: increasing efficiency at energy consumption end and realizing energy intensity reduction by 2% every year, expanding the use of natural gas, developing renewable energy, using nuclear power generation, increasing power generation efficiency, strengthening renewable energy, levying energy tax, applying new low-carbon technology and engineering measures, and increasing energy utilization efficiency.

Nuclear-Free Homeland Policy vs. NAMAs

Obviously, the political decision of Nuclear-Free Homeland Policy shall face a big challenge derived out from the newly released implementation of Taiwan’s NAMAs. Subject to the context of NAMAs, it is explicitly indicated that: “Taiwan’s support of the Copenhagen Accord with a voluntary commitment to the target of at least 30% deduction based on business-as-usual (BAU) of the total GHG emission volume by 2020.” All the efforts articulated in NAMAs to cut down the carbon emission include: lowering the energy intensity ratio (accounted for 46.7%), developing carbon-free renewable energy (accounted for 32.2%), applying the carbon sink (accounted for 0.7%) and carbon offset (accounted for 19.9% and with a 0.5% in shortage). Among the

23) Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), <http://210.69.152.10/Policy/PoMain.aspx?PageId=polist> (visited on October 13).

variable sources of renewable energy developed for the purposes, the nuclear power is highly expected to contribute substantially to the carbon reductions; viz., 17.6%. It is about the scale of national power reserve for security, 18% of the total energy supply. Obviously, Taiwan's evolving nuclear diminishment policy is strictly in conflict with the national carbon mitigation actions.

As indicated previously, how to reduce nuclear energy while ensuring a stable power supply power system has been very challenging issue. Now, further embodied with the NAMAs carbon reduction goal, the Nuclear-Free Homeland Policy turns out to be the most challenging issue which Taiwan should face in the near future.

After the Fukushima incident, international society- Japan²⁴⁾ and Germany²⁵⁾ - might be the leading countries in demonstrating their will in reducing the reliance on and even abolishing the nuclear power. Although they both count on a substantial proportion of renewable energy under development to make up for the power supply shortfall, there are many background and policy differences laid between the two countries which are

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- 24) Japan is ranked the third of nuclear power developing country, only behind the U.S and France. There are 55 reactors, which supply 30% energy consumption. It is well known that Japan was a victim of nuclear crisis during Second World War, but Japan still wanted to develop nuclear power because of the shortage of nature resources. There is over 90% of fossil fuel imported every year. For Japan, developing nuclear power is the vital way to solve its energy shortage problem. However, after the crisis, the former prime minister, Naoto Kan, has clearly declared his position of stopping the development of nuclear power and abolished the projects based on nuclear power. From this day on, they are going to focus on new energy such as solar and wind power, and subsequently make the new energy become the basic power supply resources. Unluckily, Fukushima crisis strongly intensified the difficulty to reach 2020 target without new nuclear plants, which also made Japan government reject to make any commitment to the second period of Kyoto Protocol. See "Japan announced to halt nuclear policy", SoundofHope.org, May 11, 2011, <http://big5.soundofhope.org/programs/162/188471-1.asp> (visited on October 10, 2011).
- 25) The Germany government re-inspect in September 2010 and found that Germany could not merely rely on renewable energy such as solar and wind power to assure domestic power supply; therefore, they decided to extend nuclear plan, and based on the agreement day on 2010, plants constructed before 1980 could extend eight years; those after 1980 could extend 14 years. But everything changed rapidly just after Fukushima crisis this year. German Chancellor Angela Merkel's coalition government announced to close all the nuclear plants constructed before 1980, which accounting for 8,336MW in capacity and 6.4% in all nuclear production. At the end of March 2011, the government further announced that all nuclear power plants will be closed down by 2022, and supported the development of wind power, new coal-fired and gas-fired power. See World Nuclear Association, Nuclear Power in Germany, <http://world-nuclear.org/info/inf43.html> (visited on October 10, 2011). Also, World Nuclear News, New nuclear policy voted through, October 29, 2010, <http://www.world-nuclear-news.org/newsarticle.aspx?id=28719> (visited on October 10, 2011).

worthy for Taiwan's legislative and policy references.²⁶⁾

At least, it becomes convincible that Taiwan must focus on the existing legal system alignment so as to promote sufficient renewable energy development. It is arguable that, trying to harmonize the anticipatory conflict, both technical and legal issues shall be solved coherently. For the technical side, it is necessary to figure out the alternative sources of energy in a more innovative way to fix the gap created from the nuclear power retirement, without jeopardize the energy security of Taiwan, nor the national goal to rationalize the energy intensity ratio. In regards to the legal side, on the other hand, learning from the most recent Germany and Japan experiences, Taiwan should revise its contemporary legal policy and/or the legal rules to harmonize the conflict national goals and, hopefully, to optimize the whole system in pursuing the carbon mitigation goal with diminishing nuclear power supply.

Conclusion

Envisioning the challenge of climate change, since early 2001, Taiwan government has established series of approach to promote energy reutilization, renewable energy, and energy saving technology R&D in compliance with the energy strategy requirement Market Allocation (MARKAL). The policies improve the aspects in energy saving, energy supply and related industrial development. According to the statistics, energy saving has reached 5.3 million kiloliters of oil equivalents and carbon dioxide pollution reduction has reached 15.55 million tons. Moreover, in the case of transferable technologies, it covers three major areas: development and utilization of renewable energy, energy reutilization and advanced research, and energy saving

26) Nuclear power in Japan offered about 30% power generation, while the development of renewable energy is just at the beginning, which makes it much harder to cover the gap from closing down all the nuclear power plants. Unlike Germany, nuclear power is about 30% in power generation, too, almost the same situation with Japan. However, Germany has developed renewable energy for a long time, which already accounted for 20% in the first half of 2011, and is one of the most successful countries developing clean energy including related legislations. Germany has more stable technical conditions and legal systems than Japan has. Therefore, it can be predicted that giving up nuclear power is a very big challenge for Japan to overcome.

technology R&D. Until 2009, there were 367 transferable technologies in accordance with Sustainable Energy Policy in the areas of solar photovoltaic, LED lighting, wind power, biofuel, hydrogen and fuel cells, energy information and communication, and electric vehicles.

Obviously, these technology developments provide Taiwan with precious resources to combat with the threat and/or risks occurred accompanying with the pursuit of Nuclear-Free Homeland Policy and NAMAs implementation. However, politically isolated situation, together with the fragile geological conditions of Taiwan make us difficult to complement the ideology fairly.

References

- Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), <http://210.69.152.10/Policy/PoMain.aspx?PageId=polist> (visited on October 13).
- Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), *Comparison sheet of electricity price*, http://www.moeaboe.gov.tw/opengovinfo/Plan/electronic/PElecMain.aspx?PageId=p_elec_03 (visited on December 5, 2011). (in Chinese)
- Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), *Energy Statistics Handbook 2010*. (2011)
- Bureau of Energy, Ministry of Economic Affairs ,R.O.C (Taiwan), GHG Reeducation Website, <http://iggic.estc.tw/feature/content.asp?id=1041> (visited on October 13, 2011).
- Bureau of Energy, Ministry of Economic Affairs, R.O.C (Taiwan), Committee for promoting the low carbon community, <http://210.69.152.10/Policy/ReduceCO2Emission/ReCO2Main.aspx?pageid=reason> (visited on October 13, 2011). (in Chinese)
- Cau, Yi-Wun, "Ministry of Economic: Taiwan can surly be nuclear-free with certain conditions", Nownews, <http://www.nownews.com/2011/08/30/320-2739160.htm> (visited on December 5, 2011).
- Cao, Yi-Wun, "Council for Economic Planning and Development passed an NT 18.5 billion-dollar investment on the second period plan in Taichung of CPC natural gas storage", Nownews, September 5, 2011, <http://www.nownews.com/2011/09/05/320-2740517.htm> (visited on December 7, 2011).
- ChinaTimes, "Short comment: Germany can, why Taiwan can't", <http://blog.udn.com/michalle77/5605009> (visited on December 5, 2011).
- Chinese Petroleum Corporation (CPC), 100th anniversary celebration of state founded, the 100th gas boat came in, http://www.cpc.com.tw/big5/news/index01_pda.asp?sno=3372&pno=158 (visited on December 7, 2011).
- CTCI, Choices for Taiwan's energy policy in post-Fukushima, <http://www.ctci.org.tw/public/Attachment/18515173071.pdf> (visited on December 9, 2011).

- Environmental Protection Administration, R.O.C (Taiwan), *Second National Communication of the Republic of China (Taiwan) under the United Nations Framework Convention on Climate Change*. (2011) (in English)
- Japan announced to halt nuclear policy", SoundofHope.org, May 11, 2011, <http://big5.soundofhope.org/programs/162/188471-1.asp> (visited on October 10, 2011).
- Lin, Shu-Yuan, "Post-nuclear era Raising gas-fired in renewable energy", October 6, 2011, <http://forum.cute.edu.tw/stu/viewtopic.php?f=32&t=2026> (visited on December 13, 2011).
- Ministry of Economic Affairs, R.O.C (Taiwan), *The Target of Sustainable Energy Policy Convention* (2008). (in Chinese)
- Pan, Yi-Jing, "Ministry of Economic Affairs: Renewable energy will be twice growth 20 years later", Industry and Commerce Times, October 07, 2011, <http://money.chinatimes.com/news/news-content.aspx?id=20111007000047&cid=1206> (visited on December 7, 2011).
- Republic of China Nuclear Energy Association, The status of nuclear power plants in Taiwan, <http://www.chns.org/s.php?id=48> (visited on December 5, 2011). (in Chinese)
- Taiwan Power Company, The introduction of nuclear power plant No.2, <http://wapp4.taipower.com.tw/nsis/option0-2.asp> (visited on December 5, 2011)
- Taiwan Power Company, The introduction of nuclear power plant No.3, <http://wapp4.taipower.com.tw/nsis/option0-3.asp> (visited on December 5, 2011).
- Taiwan Power Company (Taipower), *Annual Report 2010* (2011), http://www.taipower.com.tw/TaipowerWeb/upload/files/32/TPC_2010_Annual_Report.pdf, at 11-12 (visited on December 5, 2011). (in Chinese)
- Taiwan Power Company, *2010 The performance of nuclear power modules*, <http://wapp4.taipower.com.tw/NSIS/Manage/99%E5%B9%B4%E6%A0%B8%E8%83%BD%E7%87%9F%E9%81%8B%E7%B8%BE%E6%95%88-%E8%B3%87%E8%A8%8A%E9%80%8F%E6%98%8E%E5%8C%96.pdf> (visited on December 5, 2011).
- Taiwan Power Company, Carbon Equivalences of Nuclear Power, <http://wapp4.taipower.com.tw/nsis/CO2lessen.asp> (visited on December 5, 2011).

- Taiwan Power Company, Carbon Equivalences of Nuclear Power, <http://wapp4.taipower.com.tw/nsis/CO2lessen.asp> (visited on December 5, 2011).
- Taiwan Power Company, *Annual Report 2010* (2011), http://www.taipower.com.tw/TaipowerWeb//upload/files/32/TPC_2010_Annual_Report.pdf (visited on December 5, 2011).
- Taiwan Power Company, *Executive Summary of 2010 Power Development Plan* (2010), http://www.taipower.com.tw/TaipowerWeb//upload/files/26/Power_development_plan_01.pdf (visited on December 7, 2011).
- Ten Major National Economic Development, <http://zh.wikipedia.org/wiki/%E5%8D%81%E5%A4%A7%E5%BB%BA%E8%A8%AD> (visited on December 5, 2011).
- World Nuclear Association, Nuclear Power in Germany, <http://world-nuclear.org/info/inf43.html> (visited on October 10, 2011).
- World Nuclear News, New nuclear policy voted through, October 29, 2010, <http://www.world-nuclear-news.org/newsarticle.aspx?id=28719> (visited on October 10, 2011).