

Public acceptance of constructing coastal/inland nuclear power plants in post-Fukushima China

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ABSTRACT

Risk perception and public involvement have become more and more important in post-Fukushima accident era. A survey had been carried out about public acceptance of constructing coastal/inland Nuclear Power Plants (NPPs) in China. We examined impact factors of public acceptance of nuclear energy and also carried out a comparison between China and OECD. The study revealed that the public still took relatively optimistic attitude although there was a slight decrease just after Fukushima and the public's confidence recovered four years later. The ratio of inland NPPs opponents reached to quite a high level and “not-in-my-back-yard” still reflected an obvious syndrome. We also found public acceptance is mainly affected by benefit and, to a lesser extent, by knowledge, education and age. Moreover, the study suggested government is still a creditable information resource due to its authority but most of respondents felt little or no well-informed about nuclear safety, which means a significant communication gap exists between government and the public. As China is the most ambitious country to develop nuclear energy, it is proposed to introduce a transparent and open system of third-party evaluation, which mainly consists of scientists and non-profit research institutions, to ensure the healthy and sustainable development of nuclear energy.

1. Introduction

The Japanese Fukushima-Daiichi Nuclear Accident (FDNA) has affected the nuclear energy policy of many countries. Germany declared to shut down nuclear power plants permanently. Italy voted overwhelmingly to keep non-nuclear. Not surprisingly, the situation differs from country to country. China, India and other countries stick to develop nuclear energy. However, FDNA has greatly influenced public attitude and risk perception of nuclear energy. Technology Roadmap Nuclear Energy (2015) points out public acceptance is one of the key challenges for China. This study focused on public attitude of coastal or inland nuclear power plants (NPPs) in China and explored the factor of public acceptance of nuclear energy.

1.1. Energy demand and low-carbon policy

Although FDNA had an obvious effect on China's nuclear energy (Wu, 2011) and the government suspended its new NPPs' approvals during March 2011 and October 2012, it doesn't change the long-term policy priority to develop nuclear energy in order to cut carbon emissions and keep sustainable increase of Chinese economy. President Jinping Xi and Premier Keqiang Li in 2015 have announced that China would work hard to make carbon emissions to peak before

2030 and aim at increasing the share of non-fossil fuels in its primary energy consumption to about 20% by 2030, meanwhile, reducing carbon emissions per unit of gross domestic product by 60–65% from 2005 levels. These targets seem ambitious and challenging. It can be also expected that nuclear energy will play an even more important role in low-carbon policy because of its scale application compared with the renewable energy, for example solar energy, hydro energy, biomass energy, etc.

1.2. China's nuclear energy and policy in post-Fukushima era

Nuclear energy accounts for 2.39%, about 130,580 GWh, in China's total electricity production nowadays. As of January 2016, 30 NPPs in 12 sites are in operation and 24 NPPs are also under construction as shown in Fig. 1. Notably all the operational and constructing NPPs are located in coastal sites.

On the basis of 13th Five-Year Plan (2016–2020), China should have 58 Gigawatts (GW) nuclear energy capacity in operation and still 30 GW nuclear energy capacity under construction until 2020. In other words, China will approve about 600–800 MW NPPs in construction per year during 13th Five-Year period. According to International Atomic Energy Agency (IAEA) Power Reactor Information System (PRIS), there are now totally 66 NPPs under construction worldwide,

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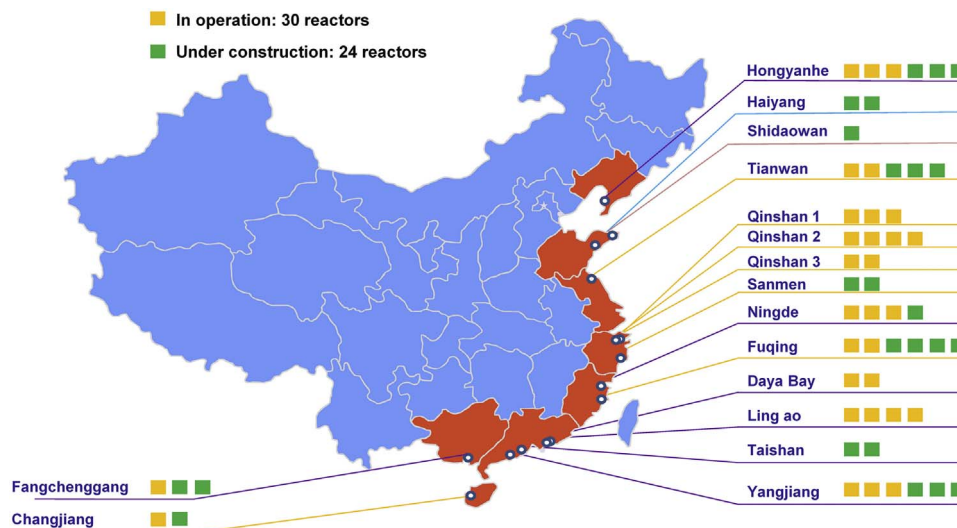


Fig. 1. Distribution of NPPs in operation and under construction.

among which 24 reactors are located in China (IAEA, 2015). China accounts for 36% of the world's new NPPs and is the most ambitious country to develop nuclear energy. Moreover China has been also seeking to export native NPPs technology with self-intellectual property rights to other countries, for example to Pakistan, United Kingdom, Argentina, Romania, and has raised nuclear power “going-out” as a national level strategy.

In brief, China adopts nuclear energy as a priority strategy in energy policy due to economic development, population growth, energy security and low-carbon emission (Lin and Ouyang, 2014).

1.3. Importance of risk perception

Inland NPPs become a hot but controversial topic, because government suspended approvals of inland NPPs in 12th Five-Year period (2011–2015). However, it is not clear whether government will ratify the construction of inland NPPs in the following 13th Five-Year period. Whether and when to approve the inland NPPs have attracted the attentions not only from the public but also from the industry. Several inland NPPs sites have been accepted by the government and billions of money have been invested on the preliminary work by the industries, which makes stakeholders eager to recoup their investment. In contrast to the industry's aggressive push of nuclear energy, the public become more and more cautious about nuclear safety especially in post-Fukushima era. Risk perception and public involvement have become the influential, sometimes predominant, factor in decision- and policy- making processes.

In fact, there exist gaps between the industry and general public. One of the striking examples may be anti-nuclear protest against Jiangmen Uranium plant which happened in Guangdong province in July 2013. The project, which would bring about 40 billion RMB investment to the local economics (amount to about 5.89 billion dollar), was strongly supported by local government and the industry. But this project has been canceled ultimately because local residents who lived in the city only 30 km away from the planned site strongly disapproved and they felt fully uninformed about the plan in advance. The abortion of this nuclear project may be the first time that government's decision-making has been affected and changed by the public's strong opposition in China. What's more, public involvement will be further emphasized in the upcoming *Nuclear Safety Law* scheduled to be approved by the supreme legislative in 2016, which means public involvement will be protected and guaranteed by national legislation.

So the following questions must be investigated and consulted

before the final decision is made:

- 1) What is the public attitude about developing nuclear energy in China?
- 2) What is the public attitude about developing nuclear energy in the inland sites?
- 3) Which is most creditable information source in public opinion when regulator, industry, scientists and non-government organization (NGO) have different even opposite viewpoints and voices?

2. Literature review

2.1. Public attitude

Organization for Economic Co-operation and Development (OECD) issued a report *Public Attitude to Nuclear Power* (OECD/NEA, 2010) providing a number of insights into public attitude towards nuclear power before FDNA. OECD/NEA (2010) was mainly based on 4 separate surveys by Eurobarometer in European Commission (2005), European Commission (2007a), European Commission (2007b) and IAEA's survey. Eurobarometer's surveys covered 25 countries, most of which are developed. IAEA's survey covered 18 countries, only 4 of which are the members of European Union. A comparison between two datasets was studied. This research introduced a consistent methodology which made comparison between different countries possible.

There are also longitudinal studies which focused mainly on the stability of attitudes within individuals. Ipsos MORI (MORI Ipsos /Nuclear Industry Association, 2005, 2009, 2010, 2011a, 2011b) carried out a continuous survey on public attitude in Britain. Mulder (2012) reconstructed public opinion on the nuclear power issue between 1974 and 2006 in Netherland and analyzed the dynamics of public opinion. Liu et al. (2008) established a method of quantifying public attitudes to nuclear power in China and derived four indicators including interests, risk, knowledge and trust. In post-Fukushima era, many countries have adjusted energy policy and risk perception becomes a hot research topic. A series of public acceptance literature reflecting different countries' policy selection have been published. A research conducted in Switzerland found public attitudes towards nuclear power were rather stable and the prior beliefs and attitudes are crucial for the interpretation of a new event (Siegrist and Visschers, 2013). Ertör-Akyazi et al. (2012) analyzed public preference on nuclear and renewable energy in Turkey and the factors shaping them. The result demonstrated knowledge of climate change is a common factor. Song et al. (2013) examined the effects of perceived efficacy, risk

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