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Research article

Beyond high carbon society

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Abstract: In the past two decades, despite seemingly violating its policy of sustainable development, the government of Taiwan has continued to develop its petrochemical industry. As a result of which public resistance has emerged. This study examines the social robustness and sub-politics capacity of the movement against Kuo Kuang Petrochemical Corp. from 2010 to 2011. Among the various civil groups engaged in the movement, the anti-expert coalition was formed by local environmental, literary and medical groups as well as universities and university professors. These groups mobilized independently, while supporting one another; leading to a multi-risk movement coalition. One significant difference between this anti-expert coalition and past environmental movements was that it not only constructed systematic risk knowledge and resisted official discourse from a professional perspective, but also developed perceptual literary thought, triggering a response from the general public. Therefore, no matter whether it be through systematic, rational participation in the environmental assessment process, proposing socio-economic assessment and health risk paths or their more perceptual initiation of green thought processes (generation justice, land subsidence, good and agriculture safety and the sustainability of villages) and methods of promoting civil trust, the sub-political pluralism has been able to break through authoritative expert politics, and seek for a dynamic reflexive governance of social sustainable development.

Keywords: sub-politics; socially robust knowledge; high carbon emission; reflexive governance; participatory paths

1. Introduction

The concept of a low carbon society is in fact a response from countries worldwide to the dramatic collapse impact global warming has had on the world's environment, economy, society and

survival [1]. In response to such problems, many countries are striving to transform from a traditional industrial society characterized by high energy intensity, carbon emissions and pollution, into a green economy society, also known as a low-carbon society. However, newly industrialized societies attempting such a transition face great challenges as it involves structural reform of not only the economy but also environmental and social paragons. Many developing countries regard high energy consumption and high carbon emission industries as the engine which drives the economy. However the reality is that in Taiwan for example, while the petrochemical industry made great contributions to economic growth during the 1980s, later in the 2000s its low GDP contribution and high carbon emission have been severely criticized by green thoughts both domestically and internationally.

Between 1990 and 2007 greenhouse gas emissions of CO_2 in Taiwan severely increased; from 110 million tons in 1990 to 262 million tons in 2007. And while this figure reduced to 239 million tons in 2009 mainly as a result of the global economic crisis, in the past two decades, CO_2 emissions have increased from 116% to 137%, with an average annual growth rate exceeding 4.9% [2]. In 2011, emission levels increased again to 251 million MT, accounting for more than 1% of the world's total. In 2010 Taiwan's per-capita emissions of CO_2 increased to 11.53 MT, ranking it the 16^{th} greatest CO_2 emitter in the world, and sixth amongst countries with a population of over five million [3]. The petrochemical industry was the main contributor [2].

In an attempt to transform from a brown economy to a green economy, after the Rio+20 Conference, the government of Taiwan founded a green economy promotion team [4]. However, with regards to environmental governance, the government still relies heavily on scientific positivism, and tends to neglect risk communication with its society. While the high degree of integration between technocrats and the technological elite has formed a kind of expert politics, which tends to have a monopoly on knowledge and scientific related information, hiding risk data and slowing down risk controls. Despite this, since the mid-1990s Taiwan has seen the gradual emergence of a climate risk consciousness within its civil society, with the environmental movement paradigm moving from an anti-pollution movement to one focussed on climate change risk [7].

This study aims to explore the social robustness of the movement against Kuo Kuang Petrochemical Project (eighth petrochemical construction) between 2010 and 2011 and argues that during this period sub-politics involving local environmental, medical and literary groups, anti-expert coalition and universities were able to overturn authoritative expert politics and bring about dynamic reflexive governance of sustainability social development. Strategic mobilization in areas, such as proposing socio-economic assessment, methods of promoting civil trust and assessment of health risk or more perceptual initiation of green thought processes such as generation justice, land subsidence, good and agriculture safety and the sustainability of villages.

2. Research method

2.1. Risk and reflexive governance

In recent years many academics have pointed out that climate change governance involves complicated policies, regulations, social values and selections which move towards the grand meta-change involved in transitioning to a low-carbon economy society. Such a transition demands greater emphasis on risk communication, risk awareness and the innovative governance of public

participation; a process which must begin with a self-critical reflexive governance approach to the decision-making and governance structures embedded within local society, in order to reconstruct the relationship between the nation, industry, market, society, and scientific assessment [8-11]. This process includes two main levels of institutions and agents: through institutional systematic innovation, the relationship between society and technology (risk) leads to a new dynamic governance relationship. For instance, stakeholders such as the government, industry and civil society, can gradually develop multi-risk communication. As for agents, they (including the public) can move away from old passive roles, becoming active participants in related decision-making processes and the construction of risk knowledge [8,11].

In other words, the complicated technological and social systems involving health, ecology, agriculture, energy, economy, and social distribution which are involved in reconstructing and building on the transition process to a low carbon society, encourages greater input from local knowledge and social value selection of public participatory knowledge. This can not only supplement limited climate science knowledge and resist against the complicated manipulation of scientific knowledge and expert politics within risk society, but also provide a balance to potential conflicts between various stakeholders [8,11].

In fact, the reflexive governance paradigm has not only been valued in the areas of technology and social transition, but has also been seen as the reflective path and methodology of developing states in their governments and social decision-making processes [12]. That is to say that the modernization of authoritative technocracy and expert politics valued by developing states has been challenged by the private sector. The brown economy, which is characterized by top down technology bureaucracy for the purpose of achieving GDP growth, is being forced to change. Instead, social development, demand trends in the economy and technology as well as the planning and implementation of energy usage and demand, increasingly depend on the needs of the end user. Therefore, green economy, low-carbon society, low-carbon energy, the rise of environmental consciousness, or concern for climate change, are to a great extent a product of social demand.

2.2. Sub-politics and socially robust knowledge

This kind of bottom up, socially instigated reflexive governance is fundamentally a form of immediate grassroot sub-politics [13]. That is to say that in the face of wave after wave of global disaster risk, the patriarchal government's governance of industrial society has been declared ineffective, while the rise of individual consciousness, post-risk self-action along with the political process of self-organization have become the keys to current politics. Selbstpolitik (self-politics) refers to people responding to risk by engaging in reflection, participation and decision-making risk; uniting to form a civil society [14]. As such, sub-politics not only refers to traditional civil movements in an industrial society, but also the different levels of organizations formed by individuals directly responding to their experience of risk, implementing various multivariate movement strategies.

Sub-politics is also reflected in the knowledge force of a civil society. When a country encounters significant controversial transformation, and if that society wants to implement strict controls and successful resistance, it needs to change its position of passive knowledge production, constructing participatory knowledge intervention, in order to challenge and monitor the inappropriate actions of government and industry [15-18]. In fact, it is necessary that they possess

the capacity to scrutinize the increasingly complicated technology decision-making of governments, markets, technology, and social relations. Therefore, producing systematic socially robust knowledge can determine the success of attempts to resist the manipulation and ignorance of complicated scientific knowledge and expert politics within risk society [8,19].

In other words, in contrast to traditional environmental movements, sub-politics is manifested in various kinds of mobilization at different dimensions and levels, through multivariate agents. Noticeably, regarding authoritative expert politics, the agents attempt to construct risk knowledge and discourse from their positions. They form meaningful and multiple socially robust systems, and establish complete and innovative resistance and social participation.

Therefore, in the face of the complicated and ambiguous scientific boundaries and general uncertainty surrounding climate change, as well as the social value disputes and elastification of regulations, it is necessary we re-examine the definition of sub-politic elements within this movement. On the one hand sub-politic refers to the mobilization, alliance and multiple strategies adopted by various civil groups; while on the other, it is the way a series of events, enabled the mobilization of the anti-expert position, which strengthened citizen knowledge to the extent it was able to pose a challenge to the official scientific discourse [20,21]. The sub-politics capacity developed within this society shows a sign of the significant transformation to a form of reflexive governance in newly industrialized countries; a move from a dependency on authoritative expert politics towards a social path of citizen participation.

3. Empirical study

3.1. Event decision-making on Anti-Kuo Kuang petrochemical project

The petrochemical industry has played an important role as a key manufacturing industry in Taiwan's development as a newly industrialized nation, attracting enormous private investment ever since the 1980s. In 1995, the government planned the Pinnan Industrial Complex as a means for expanding on petrochemical production but this plan was halted in 2006 due to severe civil resistance. However, a new project known as the Eighth Naphtha Cracker was quickly proposed, intended to replace the Fifth Naphtha Cracker with petrochemical production shortage after its closure in 2015. In early 2000, the Eighth Naphtha Cracker was listed by the Ministry of Economic Affairs (MOEA) as an important construction project. In 2006, Kuo Kuang Petrochemical Corp. was founded, with China Petroleum Corporation (CPC) as the primary investor. Cities in ChangHwa County of central Taiwan were reserved as locations to develop the plants.

Despite the change in ruling party in 2008, the Kuo Kuang Petrochemical Project continued to be supported by the government. In 2006, under the ruling of the Democratic Progressive Party (DPP), the premier announced that it was one of its national projects—'Warm and Great Investment'. After the KMT retrieved political power in August 2008, the project was re-launched. Despite the 1998 and 2005 National Energy Conferences, as well as the 2006 National Economic and Sustainable Development Conference, resolving to avoid the development of industries with high pollution, high energy consumption, and high carbon emission, the Kuo Kuang Petrochemical Project was still treated by the government as a major industrial investment plan. The plan was dominated by the government, while the details of the policy and planning were not disclosed. It was not until after the decision-making entered the stage of environmental assessment that the

environmental, economic and social impact of the plan started to see backlash at numerous levels, including for example the fact that the site is located in the wetlands of Jhuoshuei River, and the development may affect the ecology of the wetlands and tidal flats, as well as the migration routes of Chinese white dolphins, the survival of the aquaculture industry and the residents' health, not to mention the landscape and cultural assets. This has therefore become an important issue for Taiwan.

3.2. Sub-politics: multiple self-mobilization

In the decision-making model of authoritative expert politics, the scientific network of the industry, government and academia in Taiwan, particularly the government's control of academic resources, is characterized by techno-corporatism, which differs greatly from the western model, with scholars remaining silent or showing their support in different levels of expert committees. As a result, in order to prevent the approval of secret development projects within the administrative procedures of hidden hierarchies [20,22,23], environmental groups must find new mobilization strategies that go beyond environmental assessment, namely the sub-politics.

Environmental groups must work around environmental assessment meetings controlled by government-designated experts, and carry out a direct conversation with society; once the awakening of the public risk consciousness forms a powerful enough political pressure, the environmental groups are then able to return to participation in the environmental assessment through traditional institutions. In the process, the movement against the Kuo Kuang Petrochemical Project launched multiple sub-politics and witnessed the self-mobilization of Taiwan's citizens.

Risk discourses draw the public's attention through a snowballing effect. In March 2010, the Matsu Fish Conservation Union and the ChangHwa Environment Protection Union made an appeal to protect the Matzu fish (white dolphins) because white dolphins often surface when the sea god, Matzu, tours. Their attempt was to draw the public's attention to the issue by making use of religious symbolism. In May 2010 they launched a wetland adoption project on the internet at a price of 199 NTD per ping (3.3 square meters). This was the first National Trust in Taiwan. More than 40,000 people responded, and it successfully became a national issue that resulted in the rippling effect of citizen self-mobilization. In the same month, several scholars cooperated to successfully manipulate a headline on the Business Weekly magazine, indicating that all citizens in Taiwan will have their lifespan reduced by 23 days, thus becoming a national focus of controversy. In early August, more than 1300 university professors signed petition in opposition to the project, holding a press conference and making the headlines of national newspapers the next day. In October, the anti-expert coalition established the systematic Statement of Academia against Kuo Kuang Petrochemical Project, providing the sub-politics with a means of mobilizing risk knowledge and discourse (Figure 1).

Besides the academia, literary groups also participated in knowledge mobilization by advocating for their alternative sustainable values. At the invitation of local poets, numerous artists visited the Dacheng Wetland, and presented their appreciation and respect for the land through forms of art, songs or music. This use of soft rational knowledge by the anti-expert coalition formed by such literary groups and university professors to appeal against such plans was also able to touch the public's heart. Sub-politics began to blossom and grow and became more diverse in nature. In early January 2011, university students across Taiwan formed the National Youth Alliance Against the Kuo Kuang Petrochemical Project. On January 27, one day before the last important environmental

assessment meeting, they mobilized hundreds of members through the internet to stage a sit in overnight in front of the office building of the Environmental Protection Administration. At the same time, students from National ChangHwa Senior High School launched a flash sit-in for ten minutes, and elementary students wrote cards to the President urging him to protect the wetlands and white dolphins.

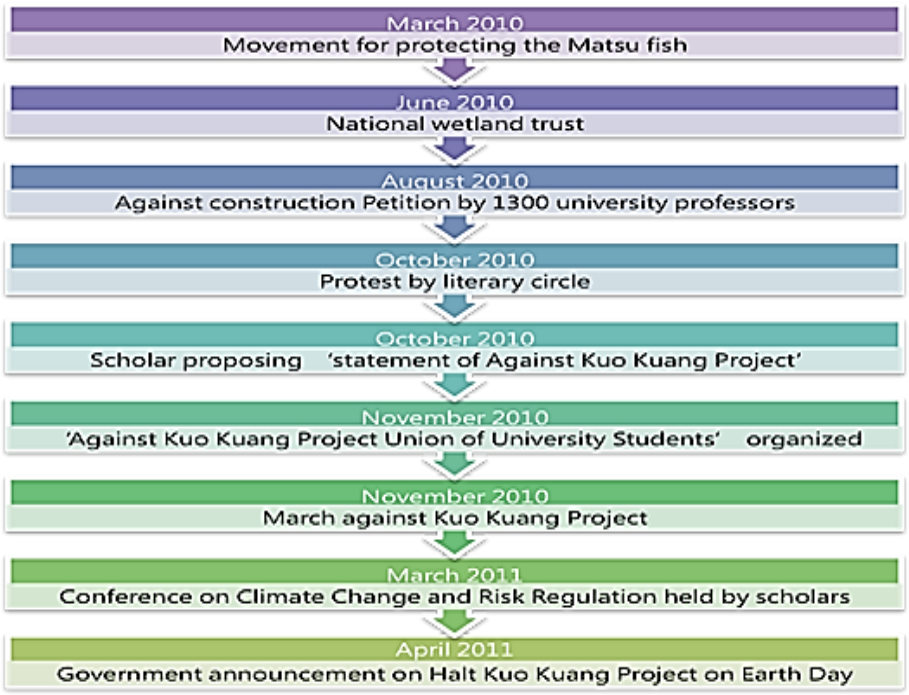

Figure 1. The development of anti- Kuo Kuang Petrochemical movement.

The ChangHwa Medical Alliance for Public Affairs (ChangHwa MAPA) from central Taiwan was founded in early 2011 as part of the above movement. From a medical perspective, the potential air pollution the site would produce would lead to health hazards. The alliance made an appeal to the government to halt construction projects that would lead to high-energy consumption and high pollution. The group listed the hazards of PM2.5 particulate matters and demanded the government to halt the Kuo Kuang Petrochemical Project, in the process becoming an important civil group monitoring the implementation of PM2.5 air pollution regulations.

In early November 2010, some environmental groups held regular strikes in Taipei. In early March 2011, the anti-expert coalition held a conference on climate change and risk control, with an attempt to strengthen the legitimacy of risk discourse and knowledge. On April 21, 2011, one day before the final environmental assessment on the Kuo Kuang Petrochemical Project (and the eve of Earth Day), the Youth Group published imitations of four major national newspapers, using exaggerated headlines to claim that the Kuo Kuang Petrochemical Project would be completely rejected in the next day's meeting[1].

[1] That is culture jamming: Hoaxes come true. The Liberal Time became 'Liberal Oyster Times'. United Daily became 'Untied Oyster Daily'. China Times became 'China Oyster Times' and Apple Daily became 'Apple Oyster Daily'. The headlines were virtually set as 'Big change! People Power finally wins Kuo Kuang Petrochemical!', 'Wetland and White Dolphins make big Triumph over Kuo Kuang'.

This series of sub-politic mobilization, beginning under the banner of environmental groups and gradually spreading with a rippling effect which in turn initiated the mobilization of different systems of self-mobilization. Moreover, in order to distinguish the subjective nature of the movement, the groups at first did not form an alliance, and they intentionally kept a distance from party politics. By the end of 2010, as the capacity of the movement declined, they started to cooperate.

3.3. Sub-politics and civil knowledge mobilization

Besides the self-mobilization of multiple sub-politics, the key point of this movement was to construct risk knowledge and aesthetics through the work of groups from various levels mentioned earlier. Through the promotion of various activities, a robust and mutually supportive risk discourse coalition was formed. In comparison to the governmental and industrial knowledge discourse based upon government or bureaucracy, a civil risk discourse coalition should construct knowledge to challenge official perspectives and fight for public support [24]. The characteristic of this knowledge mobilization is that voluntary civil groups are not limited to academic or professional knowledge, rather they make use of their profession to create a discourse coalition of both perceptual and rational risk aesthetics and risk knowledge.

3.3.1. Local knowledge vs detour of white dolphins

Risk is a subjective and open social construction. Risk perception is embedded in experiences of daily lives in local society, and it includes perceptual and rational things that form the public's risk aesthetic [13,25].

In order to capture people's attention, during the early stages of the movement, local environmental groups referred to white dolphins, which often surface every March during the tour of Matzu (the goddess of Taoism), as the Matzu fish to trigger people's religious affection and concern for the habitat of white dolphins. Nevertheless, perceptual appeals were not sufficient. Chia-yang Tsai, a PhD in Ecology and the President of the ChangHwa Environment Protection Union, depicted the risk knowledge of white dolphins migrating along the west coast of Taiwan and resting on coastal wetlands. He said: 'The reason that the south sea shore of ChangHwa, stretching from the Hanbao Wetland to Fangyuan, as well as the Dacheng Wetland, is listed as an important national wetland is to protect ChangHwa. This area is the last section of natural argillaceous intertidal beach in Taiwan.' He went on to say: 'In recent years, the white dolphins of Taiwan, a popular issue, have used the sea shore of ChangHwa as an important habitat and migrating path. This should be seen as an ecological asset for the sea shore of ChangHwa rather than a debt of economic development!' [26]

The academia supported the movement by stating that the wetland is the 'habitat of Chinese white dolphins…an important biological gene base. It can purify water and dust in the air absorb and save natural carbon credit of carbon dioxide' [27]. It also extended the risk knowledge to challenge official assessments and political discourse. Chao-lun Chen, the associate research fellow at the Academia Sinica's Biodiversity Research Center, strongly criticized the researchers who were simultaneously invited by the government to participate in the environmental assessment and Kuo Kuang Petroleum on its projects. He argued that there was not only a serious conflict of interests [28], but the report also neglected the research base of international academic journals, and it wrongly

interpreted the distribution hotspots of white dolphins. It resulted in a series of errors of policy assessment and wrongful statements by political figures: 'as a result, Kuo Kuang Petrochemical Corp. mistakenly believed that white dolphins can be trained to take detours, and be guided by bait or sound. That statement misled the premier, who suggested that white dolphins are capable of taking detours'.

In addition to triggering people's risk consciousness by challenging official policy discourse, local environmental groups treated the environmental trust case of the well-known Totoro Forest in Japan as an example to launch the first national trust movement in Taiwan. The movement, known as the 'National Subscription for the Protection of White Dolphins' [29], aimed to enhance people's risk consciousness and encourage direct participation. Local environmental groups adopted a wide range of action knowledge that led people to experience first handed grassroots participation of sub-politics mobilization, as well as enhanced the robustness of local knowledge and the public's risk aesthetic thoughts and participation.

3.3.2. Risk aesthetic and literary circle knowledge

The construction of risk knowledge is not only academic and rational; it can also be intuitional. Another important sub-politics group was launched by the literary circle, which used soft, nostalgic and poetic appeals that directly touched the public. Famous local writer Sheng Wu launched the action. In October 2010, he organized the petition of 'Guarding the mouth of Jhuoshuei River, ensuring the health of Taiwan' [30]. Poets, prose writers, fiction writers and music workers visited the wetlands of ChangHwa. They published their works in supplements of newspapers and magazines to draw the attention of different circles, particularly the middle class and students. Some are cited below:

The Young band sang, 'The situation of Jhuoshuei River is serious. A great amount of water was sent to Miliao Industrial Park. In the future, the toxic water of the science park will be released into the mouth of the river. New plants will be constructed and the sands will be gone' [31]. The poet Sheng Wu wrote: 'the petrochemical plant named Kuo Kuang is approaching the sorrowful west coast. The last argillaceous intertidal beach remaining. The flag in the name of construction waved violently to the wind of the mouth of the river' [32]. The writer Tse-lai Sung accused: 'will the ruins of Taiwan come soon?' The writer Fang-hua Chuang stated: 'are regular disasters in Taiwan unrelated to the development attitude of the Taiwanese and the environmental cost paid in the name of development over the past 50 years? Disasters caused by development projects without concern for the outcome will always be managed by the following development plans…the government spends money to allow white dolphins to take detours. However, will our opinions change the politicians' minds' [33]. The poet Min-yung Li wrote: 'in order to maintain the great chimney, anti-riot police blocked the whole village. The smoke covered the sky, and turned the rice field black. The web of power constrained the brain with thoughts and mind with feelings in the name of development' [30].

Dozens of creative works, vastly different from numerical figures and professional statements, incited people's concerns on social development and great development projects. In the environmental movement, literary groups wrote and edited the *Wetlands, Petrochemical Industry and Island Imagination* at the end of 2010 as an important knowledge base for the expansion and framing of the anti-Kuo Kuang Petrochemical Project. The construction of the risk aesthetic was one

of the strategies of mobilization. Through rational and perceptive creations, the literary circle established an intuitional risk discourse, and strived to acquire the ethical legitimacy to denounce the development project, thus ensuring the ethical superiority of the risk discourse coalition.

3.3.3. Anti-expert knowledge

In resistance to the Industry-Academic-Government discourse alliance formed by the MOEA and Kuo Kuang Petrochemical Corp., besides the social robustness demonstrated by the environmental groups' local knowledge and the perceptual elements of the literary circle, in joining with anti-expert knowledge, they were able to complete the formation of a systematic risk discourse coalition.

An organization formed by university professors, named 'Academic Resistance Group to Kuo Kuang Petrochemical Project (the Eighth Naphtha Cracker) of ChangHwa' was established in mid-July 2010 [34]. Through professional appeals, they obtained a petition containing the names of more than 1300 colleagues from universities across Taiwan, quickly establishing the beachhead of anti-expert knowledge. In the history of Taiwan's environmental movement, university professors have mostly been mobilized by environmental groups, proposing various critical knowledge perspectives, but with a lack of systematicness. In contrast to this the self-directed sub-political mobilization of university professors' in this case is vital to the development of a knowledge subject within the environmental movement. In order to maintain their legitimacy and go beyond the political spectrum, they initially maintained independent operation without any aid from political parties, and later became a national academic movement.

Noticeably, their reflective criticism and examination of governmental industrial policy differed from past occasional statements. They were active and systematic. Through TV and print media, they enhanced the content of risk discourse. In addition, they referred the discourse to the risk of climate change and turned the traditional mobilization of the environmental movement to one based on knowledge and reason, thus resulting in a national movement against climate change[2]. A number of scholars made the following statements: 'When the national per-capita income is under 10,000 USD, economic growth matches energy consumption and the continuous growth of carbon dioxide. Nevertheless, when it is above the threshold of 10,000 USD, it will become efficient growth…economic growth will be separated from the increase of energy emissions'[35]. 'In 2010, CO_2 per-capita emission in Taiwan increased to 11.53 MT, ranking top 16th in the world. Among the countries with a population of over five million, Taiwan is ranked in the top six. Therefore…in the demands for decrease in CO_2 production amongst newly industrialized countries, Taiwan will without a doubt be a priority' [36]. 'In 2008, industry accounted for 48% of total CO_2 emissions in Taiwan (255 million MT), of which 35% were attributed to chemical industries, yet this industry's product value output only accounted for 18.67% of Taiwan's overall industry (Press conference on the academic resistance to development project of Kuo Kuang Petrochemical Project 20100730) [37].

In order to provide a more systematic argument to convince the public and senior government officials of its position, the risk discourse coalition reorganized and published 12 pages of 'Script of

[2] It includes more than 20 letters from university professors of different fields. Regarding wetlands, water resources, carbon dioxide, energy consumption, high pollution industry, low-carbon sustainability and BAU estimation, they suggest the significant correlation between national industrial competition and global climate change.

resistance to Kuo Kuang Petrochemical Project (the Eighth Naphtha Cracker) of ChangHwa'[3]. They submitted the script to the President, and published risk knowledge on the internet. Hence, for the first time in Taiwan, in political and social movements, professional and rational knowledge was transformed into vernacular language, for the purpose of constructing and reinforcing the paradigm of reflective and robust knowledge in society. It became the key to changing the public's attitude towards development projects.

This rapidly brought about a direct confrontation with the Industry-Academic-Government discourse alliance formed by the MOEA and Kuo Kuang Petrochemical Corp. On October 4, 2010, the latter released 'Industrial Development, Environmental Protection, and Public Benefits are Concerns of the MOEA: Policy Description to Implement Kuo Kuang Petrochemical Project', [38] in order to criticize the academic perspective. The risk discourse coalition responded immediately. On October 22, it held a press conference entitled: 'Revoke the statements of the MOEA, Truth Told by the Academia', which stated the points of disagreement in the evaluation results provided by the two parties. Table 1 illustrates the competition and confronting positions of the official knowledge discourse and the risk knowledge discourse. As one can see, the discourse groups on both sides focus on climate change and industrial development, while also debating the ecology of the wetlands, the preservation of white dolphins, land subsidence, air pollution, health risk, agricultural safety, social and economic assessment, greenhouse gas, impact on the coast, and the sustainability of villages.

Table 1. Competing risk discourses.

Discourse camp	Governmental and industrial discourse	Risk discourse coalition
Wetland ecology	Area of usage of Kuo Kuang Petrochemical Project will use only 13% of the wetlands of ChangHwa	Loss of ecological diversity and service functions of wetlands
Preservation of white dolphins	Construction of passages for the migration of white dolphins	Extinction of white dolphins in the Straits of eastern Taiwan
Water resources	Water supply of the Dadu River weir	Water use of Kuo Kuang Petrochemical Project exceeds the capacity of the water resources in ChangHwa
Land subsidence	Caused by long term extraction of groundwater	Supply-demand imbalance of water resources will accelerate land subsidence
Air pollution	The latest technology is adopted to lower air pollution PM2.5 is not listed in the air quality of EPA	Pollutant dispersion to southern and northern Taiwan PM2.5 dispersion

[3] The script directly indicates the effects of the foundation on six public goods in Taiwan, including: (1) wetland ecology and the preservation of white dolphins; (2) national land planning of water resources; (3) health risk and air quality; (4) external cost of society; (5) greenhouse gas and climate change; and (6) impact of coastal landscape of the mouth of Jhuoshuei River.

Health risk	Environmental scholars adopt the wrong assessment.	An increase of hospitalized and deceased individuals to 339–515 people/year, as a result of respiratory tract and cardiovascular diseases. Average loss of 23 days/per person in lifespan for citizens of Taiwan
Food and agriculture safety	According to the risk assessment of agricultural products, it is an acceptable risk	The Taichung Thermal Power Plant and the Sixth Naphtha Cracker are the top two emission sources of dioxin among six counties and cities in central Taiwan, and will cause dual effect in pollution.
Social economy	Percentage of the output of the petrochemical industry is 10% of the GDP Annual average net benefit is 169 billion NTD Annual external cost 31.2–49.9 billion NTD	Annual average net benefit is lower than 50 billion NTD External cost can be 53.98–148.215 billion NTD GDP contribution is lower than 0.4% Contribution of the petrochemical industry to employment is low Upstream ethylene products of the petrochemical industry do not match internal demand
Greenhouse gas and climate change	Adoption of technology for low energy consumption CO_2 emission is estimated to be 1229 metric tons	According to academic estimation, emission will be 12 to 23 million metric tons Its CO_2 emission and the Sixth Naphtha Cracker will be 1/3 of the total in Taiwan
Impact on coastal landscapes	Compensation by 4 billion NTD	Impact on the fishery base of the west coast in Taiwan High potential area for floods
Sustainability of villages	Reduction of development and lowering the impact of pollution on agriculture and fishery	It will damage the sustainability of agriculture and fishery

Sources: The academic resistance group of Kuo Kuang Petrochemical Project of ChangHwa (2010.10.03), script of resistance to Kuo Kuang Petrochemical Project of ChangHwa; MOEA (2010.10.04) industrial development, environmental protection and the public benefit of Ministry of Economic Affairs: policy description to implement Kuo Kuang Petrochemical Project; The academic resistance group to Kuo Kuang Petrochemical Project of ChangHwa (2010.10.22) press conference 'retort to statements of Ministry of Economic Affairs. Truth (Shi Hua, petrochemical) from academia'.

The two sides had relatively competing perspectives of the above issues. However, air pollution, the cost benefit of the petrochemical industry, social and economic evaluation, greenhouse air emission, and water resources were particularly valued. Although the EPA criticized the scholars' methodology on PM2.5 dispersion, the risk discourse coalition suggested that the construction project would reduce life expectancies, that there would be a double effect caused by the Sixth Naphtha Cracker and thermal power plant, and that this would cause the public to panic. In addition, as to the evaluation on cost benefit, the two sides saw a significant gap. For the risk discourse coalition, the industry accounted for at least 1/3 of the Taiwan's greenhouse gas emissions, as well as consuming a significant amount of water resources. It not only had an impact on agricultural safety with its demand for water, but was also associated with economic competition for sustainable

industries within the context of global climate change.

As for greenhouse gas emissions, according to the governmental and industrial discourse: 'based on the estimation of Kuo Kuang Petrochemical Corp., the adoption of the most advanced and usable low-energy consumption production technology of the EU and low-carbon fuel instead of fire coal can reduce the total CO_2 emissions at the plant to 12.29 million MT per year'.

The risk discourse coalition responded: 'currently, in Taiwan, the average emission per capita is 12.08 MT/person/year, which is higher than the global average of 4.38 MT/year, higher than the 10.97 MT/year of OECD countries, and higher than its neighbouring competitors, such as Japan (9.68 MT/years and Korea (10.09 MT/year)…according to the estimation of Kuo Kuang Petrochemical Corp., annual emissions are 12 million MT, which would mean individual emissions increasing by 0.55 MT/year'.

As for the safety of agricultural products, according to the governmental and industrial discourse: 'the development units have authorized experts and scholars of health risk in Taiwan to conduct assessments…and according to the assessment results, the planned area is close to neighbouring villages and the health risk is acceptable. It means that local agricultural products will not become health hazards to consumers.'

The response of the risk discourse coalition was as follows: 'the air pollution emission of Kuo Kuang Petrochemical Project is equal to the Sixth Naphtha Cracker. Besides, the electricity to be used by the plant requires more generators, and the problem will worsen. PAH, heavy metal, dioxin and organic compounds of carbon in the emission are mostly carcinogenic materials. After the pollutants are emitted by the plant, they will settle in the food chain through air, water, soil and crops, and enter the food chain through milk, eggs, vegetables, oysters, and breast milk.'

As to the conflict on water resources, according to the governmental and industrial discourse: 'the main water source of the Kuo Kuang Petrochemical Project is the surface water of Da Tu Weir. Domestic water supply is from the tap-water system instead of an underground water source. It will not deteriorate the current land subsidence of the ChangHwa and Yunlin area.'

The risk discourse coalition responded by stating: 'the daily water volume of Kuo Kuang Petrochemical Project is estimated to be 400,000 MT, which is more than the daily water volume of 366,000 MT in the entire ChangHwa area. The supply-demand imbalance of water resources will deteriorate the land subsidence.'

Regarding the analysis of cost benefits, the governmental and industrial discourse stated: 'as to the calculation analysis of the social, economic and environmental resource external cost…according to current research findings show that after accounting for the overall economic effect of initial development costs (internal and external costs), the annual average net benefit (2010~2050) will be 169 billion NTD and will be a positive benefit.'

The risk discourse coalition responded by stating: 'the net profit of Kuo Kuang Petrochemical Project is less than 51.6 billion NTD…according to the previous external cost, the cost calculated by the petition group is 58.8 to 114 billion NTD. Based on the statistics of the Directorate General of Budget, Accounting and Statistics, the GDP contribution of the upstream, downstream and midstream of the petrochemical industry in Taiwan is less than 4%. The contribution of the foundation of Kuo Kuang Petrochemical Corp. to the national GDP is less than 0.4%..'

The university professors' statements on national industrial development created the sub-politics of a new social participation path. Their professional knowledge broke through Taiwan's long-term techno-corporatism expert politics while at the same time aggressively promoting the climate change risk

knowledge struggle, which shifted the public focus to sustainability and the threat of climate change.

3.3.4. Medical knowledge

Besides academia, which argued that air pollution increases health risk, the medical circle was also mobilized, and a local medical coalition in ChangHwa County was formed immediately. By comparing lung adenocarcinoma data in central, southern and northern Taiwan, the coalition analysed the risk of particulate matter PM2.5 in human body. The local anti-expert coalition was founded by the movement against Kuo Kuang Petrochemical Project in early 2011, and later became an important group to extend the PM2.5 issue and implement environmental controls.

In early 2011, physicians of ChangHwa Show-Chwan Memorial Hospital and ChangHwa Christian Hospital established the MAPA of ChangHwa, representing an alliance of ChangHwa's medical profession's medical knowledge. It not only launched the 'Medical Petition against the Development of the Petrochemical Industry' but also held press conferences. By focusing on 'the increase of cancer occurrence rate, including lung cancer and malignant tumor', it criticized national economic policy emphasizing the petrochemical industry.

'According to the health risk assessment report of Kuo Kuang Petrochemical Corp., before the operation of the petrochemical plant, people's exposure and health risk were not acceptable…the percentage of oral cancer, cancer of the esophagus in the neighbouring six towns…in recent years, have been significantly higher than that in other regions of Taiwan'.

'Because of the petrochemical industry, people are exposed to risky environments with a high degree of disease occurrences and carcinogenic possibilities. It is not the situation we expected…' [39].

By a professional medical review, the MAPA ChangHwa became another important example of anti-expert self-mobilization, holding lectures and press conferences, making promotional documents, and hosted a dinner for ten thousand participants at the final resolution of the Kuo Kuang Petrochemical Project. It thoroughly dispersed risk knowledge from a medical perspective in term of responding to academic risk discourse.

For the first time in the environmental movement history of Taiwan, medical groups were willing to stand up, and provide systematic and professional knowledge. Their opinions were valued by the public as they displayed numerical figures, disease history and views on pollution from the plant, including carcinogenic related data. Their efforts not only enhanced the anti-expert knowledge of risk discourse coalition but also strengthened the health risk of air pollution PM2.5. In addition, although the Kuo Kuang Petrochemical Project was halted, the group continued expanding the environmental control movement of PM2.5. With their specialty, they examined the industries, energy, and air pollution policy, and continued monitoring the EPA through press conferences and academic forums.

4. Discussion and Conclusion

With local environmental knowledge, literary creations, academic and medical knowledge, perceptual expression and relational analysis, many professional groups voluntarily formed risk discourse coalitions, which continued to grow producing a snowball effect which saw the scale of mobilization build upon itself and leading to new mobilization. However, analysing this process with

reference to the resource mobilization theory, it is clear that Taiwan's environmental movement, with its long-term structural restrictions, has yet to demonstrate the significant paradigm shift which the theory describes. On the one hand the professional knowledge formed through various perceptual and rational organizations highlight the increasing maturity of social robustness. Under the claim of professionalism, the groups created robust social perceptual thoughts and rational knowledge to ponder on social development. While on the other hand, the diverse, voluntary and new social participation sub-politics deconstructed the long-term solid power of the governmental and industrial discourse coalition. In the past the latter's powerful expert politics had formed an iron cage, monopolizing with its superior knowledge and dominance. However, the legitimacy of this non-transparent decision-making system has increasingly been brought into question.

The society of Taiwan has experienced long-term manipulation by the firm authoritative industry-government-academic alliance, and its environmental movements, has as a result tended to be passive and weak, limited to local resistance. Although occasionally related participatory knowledge was supported, it lacked a formal system [7]. In contrast, the diversity and scale of this recent movement has developed and shaped the system's social capacity; with its rich citizen knowledge it could even surpass the scope of western industrial advanced society experience[4]. In the past, western society's environmental movements have tended to show resistance through rational knowledge. Civil groups propose a clear risk viewpoint and discourse to challenge the government, mobilizing the public to gain legitimacy for their cause. While this type of mobilization is no doubt established on the basis of scientific assessment, with civil society experts opposing expert government officials, it remains within the scope of rational knowledge. In contrast, during this recent movement in Taiwan, the risk knowledge developed by different sub-political groups was not limited to rational and academic professionals; rather literary and local groups revealed a more perceptual or emotional way of thinking, and this along with the rational element was even more appealing to the public. Moreover, this true totality has led society as a whole to thoroughly rethink its perspective. In contrast to many societies, this grassroots self-mobilization, with its local historic knowledge, homeland affection and anti-expert knowledge, resulted in combining intuitive and rational citizen participation and systematic social robustness. In other words, Taiwan society, which had been dominated by an entangled expert politics of government and industry, simultaneously was able to produce both rational anti-expert knowledge and perceptual literary knowledge and homeland affection. In the process this movement not only constructed a reflexive governance paradigm switch but also developed a unique means of citizen participation.

However, as a whole, the groups that truly resisted authoritative expert politics mainly formed by university professors and medical groups. This sub-political movement both self-organized and professionally based, significantly challenged and deconstructed the official knowledge discourse and enabled a once fragile and passive civil society to produce a capacity for systematic civil knowledge, resulting in the collective deliberation of the whole society. No matter whether it be with regards to wetland ecology, water resources, white dolphin conservation, air pollution, agricultural security, socio-economy, CO_2 emissions or lung cancer statistics, this recent movement was in all respects the first time that such a movement was able to incite the publics' reflection on and

[4] The experience should be beyond the statement of Wynne & Dreyer (2001) [40], who emphasized people's bounded knowledge between the known and unknown regarding risk. Moreover, it criticized Beck's reflective knowledge which was limited to rational knowledge. From the perspective of the author, the two neglected the fact that reflective risk knowledge can be constructed by local affection, local knowledge and rational knowledge.

perception of the overall impact of climate change, industrial transformation and sustainable development. In addition, the social robust knowledge systems constructed during this movement has become a model for future political and social movements.

In fact, authoritative expert politics has become the last mile for Taiwan democratization; the last obstacle[5] [6]. In the past, the government's decision-making in relation to large scale industry policy was unsatisfactory whether in terms of participation or transparency, tending to trigger local resistance and result in circular delays and a hidden risk society. In the early days, an authoritative regulatory science regime could suppress social mobilization. Now, with the rise of the public's environmental consciousness and the lessons of severe climate change, the legitimacy of this type of decision-making has been questioned. And while the regime attracts scholars by using public resources and forms complicated governmental, industry and academic relationships, with the robust citizen knowledge system, the base of governance power has grown fragile.

Despite the success of this environmental movement in halting the development project, the sub-political mobilization formed by robust citizen knowledge, was unable to fully review the relationship between industry, market, society and the environment or achieve a complete form of reflexive governance[6]. In other words, social reflexive governance based on risk knowledge can seriously challenge the outcomes of the authoritative expert politics structure, while the government and civil society continue to confront each other and distrust each other. From the perspective of

[5] In fact, expert politics occurs in many countries, bringing about a revolution in technology democracy. Take the EU for example, after experiencing BSE, GMO, antibiotics abuse, toxic chemical materials and other risk controversies, beginning in 2000 the EU initiated a series of science and technology governance reforms, including encouraging public participation in a series of interactions between science and society. Through this series of reforms in technology democracy, the EU was able to gradually restore the public's trust in government's ability to govern [41]. However, in East Asia, whenever expert politics combines with a culture of authoritative governance, the situation is sadly not so optimistic. From past research into Japan, South Korea and Taiwan with regards to the risk policymaking and social disputes caused by issues such as GMO, BSE and nuclear power, it is not hard to see that authoritative governance culture and the technocrat elite to some degree still possess a knowledge hegemony in these three East Asian countries, firmly controlling technology related policy. In Japan, there exists something of a nuclear complex made up of government officials, nuclear industry and academics; while in Taiwan and South Korea a similar GMO complex or BSE complex exists. This form of authoritarian expert politics has become something of an obstacle for East Asian countries' democratization. While at the same time, when researching these cases one can see that these three societies have all experienced serious technology risk controversies and conflicts, with civil society initiating a strong challenge against government policies (see Chou (2015)) [42].

[6] Having faced resistance from academics, the literary world, medical circles, student groups and environmental groups, on the 22nd April 2011's Global Day, President Ma-Ying Jeou openly announced his administration would not support the Kuo Kuang Petroluem Project, and in the May of the same year the project was rejected by the environmental impact assessment meeting. After such a long battle this result for environmental resistance demonstrates that the public have already grown impatient with elite expert politics, especially their disregard for high-energy, high CO2, high pollution economic driven policies. That is to say that such authoritarian technocrat elite lose policy legitimacy because they neglect risk communication with stakeholders. At the same time, with a severe awareness of climate risk, the public opinion has already moved towards a pursuit of a socio-economic development towards a low carbon society paradigm, while those who remain fixed on the old fossil fuel based high carbon society face sublation. In terms of Taiwan's public's discourse on climate change risk paradigm shift, please refer to Chou (2013) Public Risk Perception Survey Results Analysis [43] and Beck (2015) discussion on the Public's Catastrophic Aesthetics [44].

democratic transformation, this leads to newly industrialized nations coming into a deadlock of hung risk governance, with government's various policies and initiatives being boycotted, civil society and the government lacking a commitment to or means of communication, making it even more difficult for the country to face the challenges of economic competition under globalization and climate change.

Conflict of interest

The author declares no conflict of interest in this paper.

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