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## ABSTRACT

Since 2004, the Chinese government has been planning and building enormous petroleum reserves in China's highly industrialized port cities, located along an environmentally fragile coastline. The construction of these national oil reserves should have complied with the principle of sustainability proposed by the Chinese Communist Party in the 2003 national strategy outlined in the Scientific Outlook on Development. The Office of the Petroleum Reserve distributed the petroleum reserves to port cities based on national economic criteria, but it left the responsibility for environmental protection to the local entities. This paper examines whether and how the top-down national strategy and the bottom-up local plans were aligned to achieve the dual national goals of economic and environmental sustainability. It first provides a brief overview of the administrative levels in the Chinese planning and building processes. It then considers the first national spatial strategy, developed by the Office of the Petroleum Reserve in 2004, focusing on the decision-making process and its impact on spatial and environmental policy. Subsequently, the paper analyses plans made by local authorities from 2007 to 2015 to determine the extent to which these plans aligned with the national strategy. It finds that the port cities mostly activated the presence of the reserves to increase economic development rather than focus on sustainable practices.

# Economic Development and Environmental Protection: the planning of China's National Strategic Petroleum Reserves in port cities

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KEYWORDS
Regional planning; Port city; Petroleum reserve; Spatial strategy

# Economic Development and Environmental Protection: the planning of China's National Strategic Petroleum Reserves in port cities

## Introduction

Since 2004, China's National Development and Reform Commission (NDRC)—the macroeconomic management agency attached to the Chinese State Council with broad administrative and planning control over the national economy—has planned and built massive petroleum reserves. The project is known as the 'Nationally Strategic Petroleum Reserves' (Liu 2007). China had no strategic oil reserve in the 1990s and the significant price fluctuation of a barrel of oil represented a great risk for the national economy. In the early 2000, China's domestic oil reserves promised fewer than 20 days of use, which was far less than the 90 days standard suggested by the International Energy Agency (IEA). The central government then pushed for more strategic reserves to cope with the possible economic challenge in line with the domestic oil shortage. The NDRC issued three plans to provide for petroleum storage, respectively in 2004 (12 million tons), 2007 (28 million tons), and 2016 (28 million tons). Thus far, only the 2004 plan, which proposed 4 national reserves in the China's port cities of Ningbo, Qingdao, Zhejiang Zhenhai, and Dalian, has been completed (Li, 2017).

Due to the existing distribution network, refining facilities and storage sites, the government selected port cities as locations for the Office of Petroleum Reserve (OPR) in 2004. Port cities as traditional hubs for petroleum storage thus became the core of the national strategy. This increase of petroleum infrastructure worsened the already fragile environment of China's port cities. Petroleum, it released into the environment, takes a long time to decompose naturally; it is also lethal to most marine animals. Any oil spill might result in irreversible damage to the coastline environment with additional detrimental effects on the economy. An example is the 2010 Dalian oil spill: it cost the central government at least 30 million US dollars to clean the coastline region (State Council's Security Committee, 2011). Moreover, petroleum pollution can have an adverse impact on the health and well-being of locals and visitors. The Dalian oil spill ruined recreational opportunities provided by Dalian's waterfront, and locals had to stay away from the port to avoid the stench. The diary of an ordinary citizen shows that, as a result of the oil spill, the people of Dalian lost the beautiful port landscape of their imaginations and became afraid of the waterfront (Zhou, 2010).

The Chinese central government has identified both economic development and environmental preservation sustainability as crucial goals, but the petroleum industry by its very nature conflicts with the Communist Party of China (CPC)'s goal of environmental sustainability. This study considers whether and how the spatial plans for the national reserves are aligned with the party's dual goals of economic development and environmental preservation. The government strategically packaged the two under the broader concept of the 'Scientific Outlook on Development' (SOD) envisioning a socio-economic framework for a 'harmonious society' that emphasises a 'better relationship between human and nature' (Hu, 2007). Environmental preservation is thus included in the primary development strategy and the concept of sustainability thus officially influences national policies. The publication of the SOD in 2003 marked the moment when the concept of sustainability moved to the centre of the Chinese political stage. The current Chinese president Xi has raised the concept of the 'Chinese Dream' of which sustainable development is a core value. Before the energy transition can be fully executed in China, the CPC's goal is to make the petroleum industry as environmentally safe as possible. Within that context, this study considers whether and how the spatial plans for the national

reserves are aligned with the party's goals for economic development and environmental preservation.

To what extent spatial planning can work nationally as a complementary tool that helps the project of petroleum reserve achieve the national goal of economic development and environmental preservation, depends on the characteristics of the Chinese planning system. Specifically, since there are two parallel planning processes: one top-down and the other bottom-up. The Chinese planning system needs the synergy of them to fully implement the national strategy. Top-down describes the central government's macro-control over the economy, while bottom-up focuses on how local authorities execute the national policy to develop their economy (Wu, 2015). The bottom-up process emerged in the 1990s, accompanying the Chinese Economic Reform, in which the central government has decentralized economic power to the local municipalities. Consequently, the local municipalities have become autonomous in the field of spatial planning. But the autonomy can bring risk when it does not coincide with the central government's strategy of sustainable development. In the case of the National Strategic Petroleum Reserve, the OPR's spatial plan is a top-down process while the spatial plans by the local municipalities and the petroleum companies involve a bottom-up process. First, the paper explores the top-down planning process and raises two sub-questions: whether and how the OPR's 2004 plan can balance the economic development in the mega-regions which are interprovincial; whether and how the OPR has issued any environment regulations to restrain the local practice in order to prevent environmental hazard. Second, the paper focuses on the bottom-up local practice, questing whether and to what extent local urban plans have created synergies with the plan to achieve economic sustainability or acted as a partner in improving environmental protection.

The paper argues that both top-down and bottom-up planning as tools need to be aligned simultaneously with economic development and environmental preservation. The first national plan established in 2004 by the OPR focused more on economic development and left the responsibility of protecting environment to the local municipalities and the port authorities. However, the local leaders put more emphasis on economic development in order to advance their own careers. Environmental protection will remain a matter of words without synergy between the OPR and the local entities. Moreover, the national goal of economic development and environmental protection cannot be fully realized until both the top-down and the bottom-up planning of the national petroleum reserve involves public participation.

## Research Framework

The research on which this paper is based consisted of data investigation, data observation and data analysis. Acquisition of reliable data was a crucial part of this research, because in China collecting data on energy resources, distribution and storage is more of a challenge for researchers than in, for example, the European Union. China's government exerts tight control over any research on energy resources, especially of the dominant fuel - petroleum. Only a few economists, technologists, geographers and urban planners who have been authorized by the national government can access raw data. And it is difficult for ordinary urban scholars or planning historians to access geographic data pertaining to energy resources. This paper relies on data and on publications found in online sources and from governmental institutions, such as the National Statistical Bureau and the National Development and Reform Commission. Tracking online governmental announcements, especially those used to present the government's achievements, also provided a way to acquire geographical data. The results of this paper need to be considered in light of these limitations. For example, the Office of Petroleum Reserve and the Centre of Petroleum Reserve did not announce the exact location of each of the reserves, however, certain information was leaked on the project websites of local municipalities and port authorities and has been used here.

Additional information came from open-access geo-spatial maps. There is much governmental intervention in data production and distribution. The Chinese government may alter or abridge data for propaganda or security reasons. For this research, data on a specific case was collected and compared to recognize which part of the data was modified by the government or affiliated agencies. Though the government deliberately disguised information, the spatial impact of the already built national petroleum reserves is easy to investigate with satellite maps: the reserve sites are enormous. Chinese map producers such as Baidu Map and Gaode Map as well as other producers such as Google Maps provide convenient instruments with which to obtain geographic information regarding the national reserves.

Once gathered, the various pieces of information helped reveal the difficulties involved in combining economic and environmental strategies in formulating the 2004 spatial plans for the oil reserves.

## Economy First! The OPR's Plan of building oil storage in the port cities

In China, the government has completely monopolized planning, constructing and managing the national petroleum reserves. Such governmental dominance can be observed in the administrative structure of the governmental institutions involved with the petroleum reserves. The planning process started with the 'Request from the State Planning Commission (SPC) for the establishment of a national oil reserve implementation plan' (State Planning Commission, 2002) which was reviewed and approved by the State Council by the end of 2002. After the State Council approved the request, the State Planning Commission (SPC, NDRC)[1] proposed a three-layered hierarchy of planning, administration and operation for the national oil reserves:

1. The Office of Petroleum Reserve (OPR), founded in 2004 under the Supervision of the SPC (NDRC after 2008), is a governmental management agency responsible for top-level reserve policy and planning.
2. The Centre of Petroleum Reserve (CPR), established in 2007 by the NDRC, forms the middle layer of the management system, which exercises the rights of investors and is responsible for the construction and management of the national oil reserve.
3. The operation layer consists of local oil companies funded by the state and entrusted to state-owned oil companies. For instance, the Dalian Oil Reserve has been entrusted to the PetroChina Dalian Refinery.

There are two important actors which are invisible in the structure above: the municipalities of port cities and the port authorities. Both the OPR and the local refineries have to work with these institutions to get their spatial plans approved and finally executed.

The Chinese planning system was an obstacle for the OPR to coordinate all the spatial plans relating to the petroleum reserve since there was no comprehensive territorial planning at the national level[2]. There were four categories of functional planning: economic and social development planning, urban and rural planning, land and resources planning, and special planning (transport, hydraulic engineering, and environmental preservation). These four categories were juxtaposed and are in hands of various different ministries, such as NDRC, ex-Ministry of Land and Resource, ex-Ministry of Construction, Ministry of Transportation. In case of the national

[1] The State Planning Commission (1954-1998) was in charge of the comprehensive economic plan. The National Development and Reform Commission (NDRC) replaced the State Planning Commission in 1998 after the Ninth National People's Congress passed the 'Decision on the reforming plan of the State Council'.

[2] The Chinese government has already realized such a difficulty, and thus has given all the spatial planning power to the new Ministry of Nature Resources which was established in 2018. The new ministry is restructuring the territorial planning system in China. According to the report on the website of the Ministry of Nature Resources, it will announce the new planning system by the end of 2020.

reserve, the plan of the local refinery was a special planning while the spatial plan of the local municipality was urban and rural planning. And there were many contradictions among them. Therefore, when the OPR started to make spatial plan in 2004, the main objective was to reduce the cost of building infrastructure and to prevent economic losses. And due to its lack of experience in planning such a big project, the OPR focused more on economic and industrial purposes and ignored environmental protection.

The OPR, with its high administrative position, can push forward its spatial plans without dissent. With such an administration system, when the OPR imposes a spatial plan on a province, it does not encounter any interference from the provincial government. For instance, Guobao Zhang, the previous vice-director of the NDRC, the provincial-ministerial level in the Chinese government, held a concurrent position as the leader of the OPR in 2004. As someone working in the central government, the leader of the OPR usually has enormous political resources. Provincial leaders, who intend to form an alliance with the central government, are keen to collaborate with the OPR. Moreover, nominating such a high-level cadre as the office leader shows that the national government attaches great importance to the planning and building of the national petroleum reserves. The national will is so strong that the provincial leader would not dare to object. Finally, the provincial leaders are eager to host the national petroleum reserves because by doing so they could easily get promoted to a higher level. The State Council has approved approximately 1 billion dollars for planning and executing the national petroleum reserves (Yuan, 2003). And, as mentioned, the OPR has to collaborate with the local petroleum company or refinery company to operate the reserves. National grants are thus distributed to the local company and then become a pillar of the province's annual revenue.

The OPR chose port cities to host the national petroleum reserves for two reasons. First, using the already existing oil transport network reduced the cost of infrastructure construction. After China's opening up in the late-1970s, ports and port cities experienced the positive and negative effects of international trade, particularly those related to the oil imports that began in the mid-1990s. The central government has been investing enormously in the building of massive transport networks to facilitate international trade in port cities (Ministry of Transport, 2018), particularly oil pipelines connecting ports and hinterlands (Zhao, 2018). Second, many experienced program managers and oil industry workers were available in port cities. By relying on their labour, the OPR could save on staff education costs. Moreover, given the government cadre (Ganbu) system, in which leaders require a record of impressive achievement (and no losses) to get promoted, the choice of port cities for the national petroleum reserve was conservative and safe for the leader of the OPR. Even if projects failed or were delayed, the economic loss would be relatively small.

The closed decision-making process for the national petroleum reserves, exercised by the OPR, prevented the spatial plan from being scrutinized for its compatibility with national economic and environmental objectives. There was neither a campaign nor a public debate for the provincial governments to participate in before the OPR announced the 2004 spatial plans. Such a practice was far from the national objective of sustainability. The OPR arbitrary made decisions soon after the experts from the Chinese International Engineering Consulting Cooperation had assessed the construction conditions, the program of investment, and the safety of the producing facilities (Zhang, 2017). The decision was based only on the report from the Chinese International Engineering Consulting Cooperation as the perspectives from the international companies could have given a contradictory picture that they did not want to see. And it was irresponsible for the OPR to rely on a single estimation of a consulting company.

Provided with additional national resources, the selected port cities could further develop the local petroleum industry much easier than cities that were not part of the OPR's plan. The national government's objectives were to stimulate the development of both the host cities and the local oil

companies, and to make both more competitive in the global market. It approved national grant to upgrade the industrial facilities and building information centres to serve the retail market in the host cities. But the OPR had to select four port cities from many potential locations as the national grant was only able to finance the building of four oil reserves in 2004.

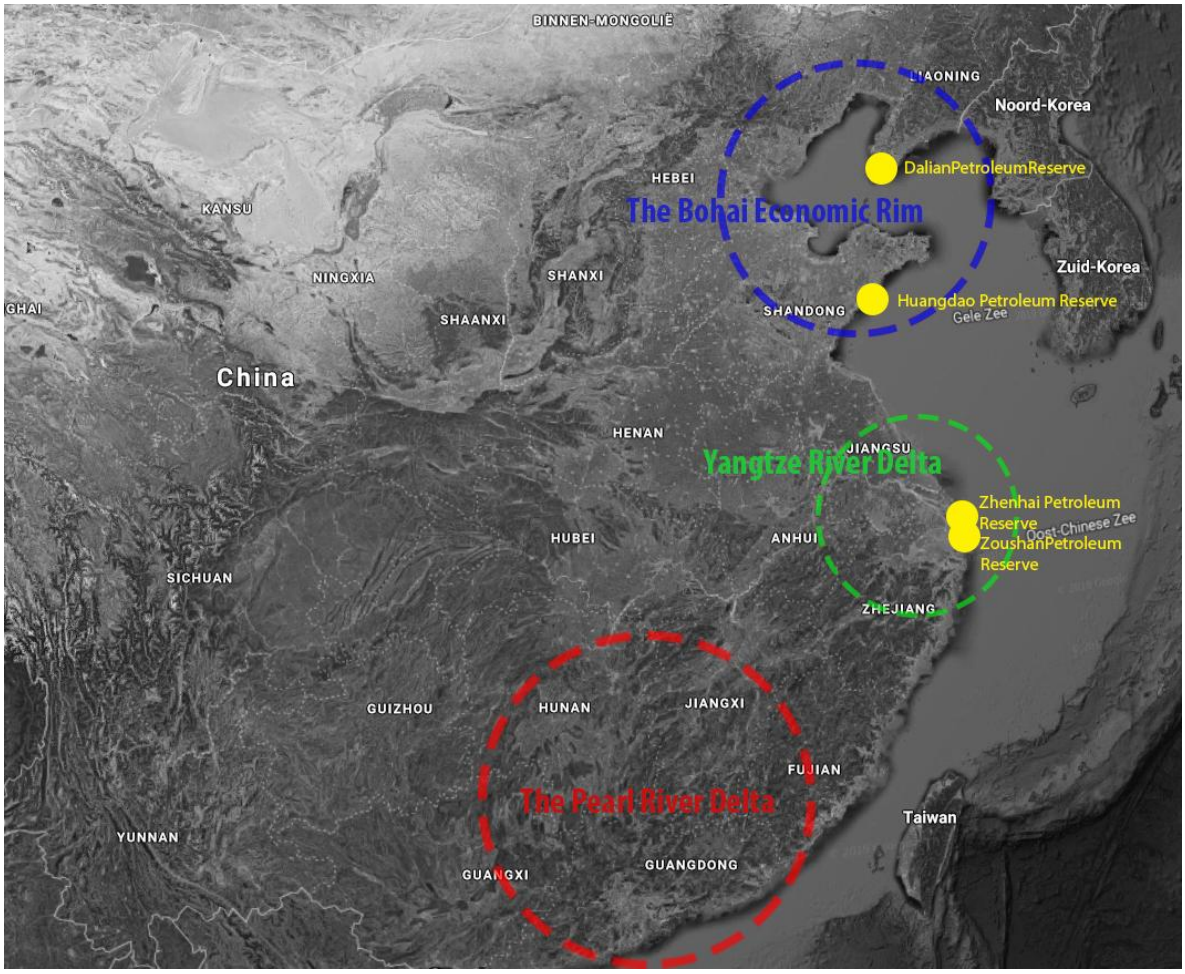


*Figure 1. The first national spatial strategy launched four petroleum reserves in the BER and YRDEZ.*
*Source: Penglin Zhu*

The location of the reserves in the port cities encouraged further unbalanced economic development in the mega-regions. The petroleum industry has long been one of the pillar industries for economic development. As shown in Figure 1, the Bohai Economic Rim (East, the Yangtze River Delta, and the Pearl River Delta form three mega-economic regions along the Chinese coastline. They are the most prosperous port regions in China with numerous refineries. But in the 2004 spatial plan, the OPR only planned to locate the first four national reserves in the Bohai and Yangtze River regions, without installing a reserve in the Pearl River Delta region which consists of Guangzhou, Hong Kong, Dongguan and Zhuhai. A clear indication of unbalance was that the OPR had to take the remedial step of designating the Huizhou area in the Guangzhou Port region to host the national oil reserve in August 2011(Ran, 2011). Moreover, the OPR did not use the opportunity to establish the national petroleum reserve as a powerful instrument to drive economic development in economically disadvantaged areas, such as the northwest part of China. For instance, with several large oil fields and leading refineries, Xinjiang Province in northwest China could have been identified as an appropriate location for the national reserve in the 2004 national plan. Due to such a lack of foresight, in subsequent years, the central government has proposed a 2800KM oil pipeline between Xinjiang and Kazakhstan and has designated Xinjiang as an important domestic oil hub especially in relation to the Belt and Road Initiative.

In the 2004 spatial plan, the OPR focused on economic development and left environmental concerns to the local municipalities and port authorities. First, the spatial plans did not include the concept of environmental preservation after the central government highlighted the SOD. The OPR long postponed issuing any comprehensive laws and regulations about the environmental security of the petroleum reserves. It was only in April 2007 that the NDRC announced the first general environmental regulation that was not pertaining directly to the oil reserves. A comprehensive law that clarifies the site selection of the national strategic oil reserve, the funding sources, the domestic distribution of petroleum, the scale of the reserve, the storage technology and the management method remains to be developed. Without a comprehensive law, meeting the national objective of environmental preservation while planning and building the oil reserves is probably impossible. The tanks pose a hidden danger for the marine environment because they can be damaged by natural disasters, such as tsunami, or by war or terrorist attacks.

In 2007 construction began on the second spatial plan of national reserves, also without attention to environmental risks in the spatial plans. And it took even longer to issue regulations, because several governmental agencies were in tension. Although NDRC finally invited comments on the draft of the National Petroleum Reserve Regulations, which was a comprehensive regulation, in May 2016 (National Energy Administration, 2016), as of publication, this regulation has not yet been approved. Moreover, the draft remained vague about environmental preservation. It neither included comprehensive requirements nor guidelines for how to protect the environment neighbouring the reserves. It only asked the local oil company to 'improve management of environmental protection and take effective measures to prevent environmental pollution caused by oil spills and waste discharges' (National Energy Administration, 2016). The message was not precise enough to ensure specific steps were taken to protect the environment by local municipalities and local oil companies. The uncertainty within the regulation has the potential to transform local actors into scapegoats.

As a tool which needs to stay in line with the national economic and environmental goals, the OPR has been gradually refining the spatial strategies for the strategic oil reserve in the subsequent plans. In regard to regional economic development, the OPR has started to select more cities in less wealthy areas, such as, in recent plans, Daqing in the northeast. It is also proposing more sites in the far-hinterlands such as in Xinjiang province. Meanwhile, the CPRs has started testing the technology of storing oil underground, which is considerably safer and cheaper than above-ground oil tanks (Baraniuk 2015). In 2009 it proposed a storage technology called 'underground storage sealed by water' to be used in Jintan, in Jiangsu Province (Hu 2009). But such a procedure has been slow to be developed and less responsible plans have been pursued for too long.

## Squeezing Economic Profit from the National Program: physical plans made by local authorities

Whether the national goal of environmental preservation can be achieved depends on how well local urban planning can complement the 2004 spatial plan made by the OPR. Executing the 2004 plan requires a successful collaboration between the OPR, the provincial government, the local municipalities and the port companies. Building the physical placement of national oil reserves could give each port city an opportunity to achieve their own objectives. An important question is whether their interests can converge. This section explores whether and how the provincial government, local municipality, and port companies have used urban planning to achieve environmental protection. If not, urban planning has not been used in this way, what is the main objective of the local actors?

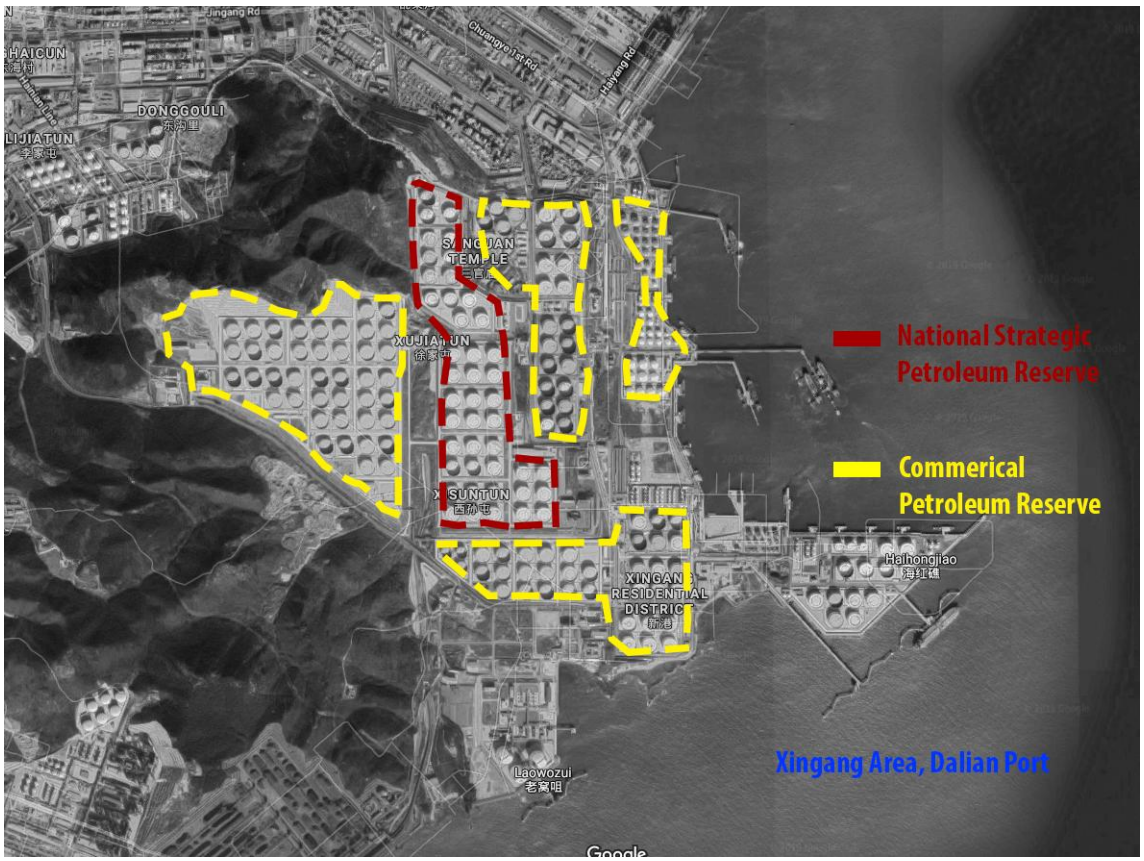


*Figure 2. A satellite image of the Xingang Area (Dalian Port) shows the spatial plan where the national petroleum reserve was built next to the commercial petroleum reserve. Source: Penglin Zhu*

When the local administrators proposed their spatial plans, their planning ideas were often not in line with those of the OPR. The provincial governments, local municipalities, and the local port companies focused more on the economic profits brought by the national reserves, attempting to use the national policy and strategy to maintain local economic growth rather than investing in environmental protection. They re-branded their port cities as petroleum business hubs based on the massive national reserve. Collaborating with the local petroleum companies, which were chosen by the OPR to operate the national reserves, the local municipalities and port companies attempted to establish regional oil trade centres. For instance, together with the local headquarters of PetroChina, in 2016 the Qingdao Port company announced a plan to build a 'crude oil cluster' in 2016 (Yu, 2018). It proposed building a trading base for international oil investors and a distribution centre for the domestic oil market. Similarly, the company of Tianjin Port announced a similar proposal to build a complete infrastructure related to the petroleum business. Investment in new infrastructure went against the OPR's intention of reducing the cost of infrastructure construction.

The three ports and port cities in the Bohai Economic Rim, Qingdao, Tianjin and Dalian respectively, proposed to build their own international oil hubs. And each of them attempted to carry out a more ambitious physical plan than the others to attract more international investors. The municipality and port authorities of the three cities have already heavily invested in port extension plans, particularly infrastructure to facilitate the oil business. To date, it is still unknown whether this competition to become the biggest oil hub in northern China will become a burden on the central government, which is attempting to balance regional economic development. A similar lack of convergence could take place on a smaller scale, involving the spatial plans made by local oil companies. The OPR's intent was to use the staff of the local oil companies to take care of both the national strategic reserves and commercial storage, as a way of reducing labour costs. But the local oil companies sometimes built national petroleum reserves next to their commercial

petroleum reserve. Figure 2 shows the spatial plans made by the Dalian Refinery: the national reserve (red) was surrounded by the commercial reserves (yellow). Economic loss may result from such a spatial composition as the local oil companies could easily divert national reserves for their own purposes since there is no regulator appointed by the CPR. This is an example of a lack of synergy between national and local spatial strategies.

In case of national petroleum reserves, without a restraint in the top-down planning process, the practice of bottom-up planning has not easily aligned for what the national government wants. Local oil companies unsurprisingly did not highlight environmental protection, given that there was not even a comprehensive environmental protection code for the petroleum reserves. But the cadres of the local municipality, the local oil company and the port company would see their careers end if a security incident were to impact the national reserve. Thus far, no oil spills or fires involving the national petroleum reserves have been reported. But that does not mean the security of the other oil facilities in the port region is guaranteed. Fires and oil spills have frequently occurred involving commercial oil reserves as well as oil pipelines and oil terminals in port cities (Yao, 2013). The contradiction between the protected national reserves and the troublesome commercial reserve is part of the satirical reality of the management of oil reserves in the coastline region. Without clear regulations, local authorities are free to take care of the two kinds of reserves differently, prioritizing the security of the national reserve.

The only means of pursuing environmental preservation with a chance of success can be found at the level of local urban planning and local plans for port development. Although the urban planning of these port cities has been addressing environmental protection since 2005, this attention has not focused particularly on the massive petroleum reserves. In general, these urban plans restrained the development of various areas in the city in order to control industry expansion, specifically involving the oil reserves and refineries. For instance, the Comprehensive Planning of the Tianjin Port (2017-2035), issued by the Tianjin Transportation Committee in 2016, restructured the function of the eight port areas, proposing to centralize oil transportation in two port areas, the Nanjiang Port Area and the Dagukou Port Area (Tianjin Transportation Committee, 2018). But these plans did not spell out how to reduce the environmental risks posed by the petroleum reserves. Thus, the efforts of the urban planning had little impact on the massive national reserves. Whether and how local authorities can work with the OPR's spatial strategies is still unknown. For example, although the Tianjin Port Company has started to collaborate with the Environmental Planning Institute under the supervision of the Ministry of Environmental Protection in various aspects—such as in port environmental protection and green port planning, port environmental monitoring, port environmental protection research and the building of a online platform for cooperation between institutions and enterprises to promote environmental preservation—these institutions have not focused on the environmental risks of the national reserves.

But no matter top-down or bottom-up, planning in China is a governmental dominance with negligible access to the public participation. Specifically, public participation was negligible in both the OPR's spatial strategies and local urban planning. Neither private oil companies nor local environmentalists were much engaged in the planning and implementing of the national oil project. As far as economic sustainability is concerned, a barrier has long been the lack of opportunity for private Chinese oil companies to host the national oil reserves. Although the State Council approved private companies' right to host the national oil reserve in 2011 (Tu, 2010), the oil companies were not treated equally in practice at the local level. The reserve ability of private companies is 200 million tons, which is ten times more than the already built national oil reserves (Liu, 2015). Meanwhile, whether the OPR would allow foreign oil companies such as Shell and Exxon to run the national strategic review is still unknown. Environmentalists and local residents have protested several times against the construction of more refineries and the 2013 protest in Dalian is one example. But there is little reporting about protests concerning the national reserves (Blanchard, 2013). Social media is not encouraging people to question environmental risks

associated with the national reserves. Meanwhile, the government's domination over the planning process discourages public participation.

## Conclusion

Both the top-down and the bottom-up spatial plans for national oil reserves in China's port city regions have not met the goals of economic development or environmental preservation. The 2004 plan of the national petroleum reserves aimed to insert oil reserves in major regions in a way that could strike a balance between economic development and environmental protection. Thus far, the OPR and CPR have constructed four of the sites proposed in the 2004 plan. So far, the goal of sustainable economic development has not been achieved, since the first oil reserves were built in two of the wealthiest mega-economic regions. The location of the reserves' risks widening the gap between China's regions. Furthermore, the 2004 spatial plan did not achieve the objective of environmental protection due to the absence of comprehensive regulation regarding the national oil reserves. But the process of building massive national reserves is still underway and the environmental assessment is being adjusted. The OPR has been working on a new spatial strategy that includes choosing sites in the hinterlands and adopting new storage technologies to reduce negative effects on the environment. However, it still takes considerable time to determine whether these actions taken will succeed in achieving the national goals.

Local execution of the national reserve plan, thus far, has not made up for the disadvantages of the national spatial strategies. On the contrary, the lower-level administrations, the port companies and other stakeholders are trying to gain profits from the building of the national reserves. They have been using spatial plans to rebrand port city regions as international oil hubs. Moreover, the local oil companies, in a search for efficiency, have used the same group of people to take care of both the national and commercial oil reserves. This managing system has encouraged a type of spatial plan that involves adjacent locations of the national reserves and the commercial reserves, in a way that it is not in line with national goals of sustainable economic development. Meanwhile, the local authorities are not addressing the challenge of environmental protection even though the OPR has left such a great challenge to them. Although the national reserves are well-secured, incidents happen constantly in the private facilities. It may take more time for local actors to both build national oil reserves and achieve the goal of reducing environmental pollution and other risks.

The national goal of economic development and environmental protection cannot be fully realized as long as the top-down and the bottom-up planning of the national petroleum reserve do not include public participation processes. The government and its representative agencies monopolize the entire planning and execution processes, though planning and executing the project of oil reserves in the coastline regions require enormous human and financial resources as well as advanced building technologies and a mature management mechanism.

To conclude, the nation's economic and environmental objectives involves inherent contradictions. Successful progress in the planning and the execution of the oil reserves depends on the synergy of both national and local actors. An efficient management system, a mature contingency mechanism, as well as advanced building technology are also important for a fast response to any incident and the improvement of national environmental security. Appropriate planning tools and steps need to be further developed. There are similarities with the spirit of the Chinese Economic Reform, which has been described as 'like a person crossing a river by feeling his way over the stones' (Wang, 2018). Planning and building the oil reserves have been a learning progress for the Chinese government as well as for individual planners and administrators: errors and disadvantages are the costs of improvement.

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