Analysis of Low-Carbon Contribution Pathways for Resource-Based Cities under the Dual Carbon Goals: The Case of Tangshan, China

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Abstract. China is still the biggest carbon emission entity at present, which is mostly produced by resource-based cities. It means that actions to control carbon emissions in order to mitigate the greenhouse effect are urgently needed. The purpose of this study is to examine resource-based cities' low-carbon development strategies after the dual carbon regulations were put into place. Using a literature review as the research technique, this paper uses Tangshan as an example to explore the current condition, difficulties that exist, and Policy recommendations for resource-based cities looking to improve in a low-carbon manner. The result shows that there are now some clear issues with resource-based cities' low-carbon growth routes: high reliance on high-emission industries, the incomplete top-level design, and "the intensifying competitive pressure from surrounding cities. The following optimization suggestions have been proposed for the above-mentioned issues. The optimization direction of resource-based areas should be to clarify the top-level design, increase competitiveness, and continue to increase industrial carbon emission reduction. In other words, this kind of cities should reduce the dependence of urban development on high-polluting industries and attract talent to cope with external competitive pressures requires the government to coordinate and cooperate across departments, so that under the dual carbon goals they can achieve carbon reduction in resource-based cities which are under the dual carbon goals.

Keywords: Carbon Reduction, Resource-Based Cities, the Dual Carbon Goals.

1. Introduction

The greenhouse effect caused by human activities is becoming increasingly severe. The stability of the Earth's ecosystem has been severely disrupted. What' more, the sustainable development and survival of humanity are also under threat. China is the biggest emission entity at present, and the processes of urbanization and industrialization are still rapidly advancing. Considering the current national development context and the global problem that the massive emission of greenhouse gases hinders global sustainable development, China has proposed the 'dual carbon' goals that China will achieve peak carbon emissions before 2030 and carbon neutrality before 2060.

Carbon emissions of urban areas in China accounted for more than 70% of that volume, which are main emission entity, relying on significant energy consumption to develop economy rapidly. Under the dual pressures of both international and domestic demands, China first proposed the construction of low-carbon cities in 2010, and advanced the first roll of low-carbon city pilot program that confirms the urban development path that is the one of green economy and sustainable, high-quality growth. The government divided the pilot cities into three batches that will implement batch-by-batch in 2010, 2012 and 2017. China has been extending the strength and range of carbon emission reduction. In the wave of national carbon reduction, the approaches of different types of cities vary greatly. Especially resource-based cities have more blocks due to history, geography, policy and other reasons, which is most focused type of cities in Chinese carbon emission reduction program.

Nowadays researches on resource-based areas are primarily in areas such as the economy and industrial structure, whiles in most of the resource-based cities there is still a lack of an operational strategy for reducing carbon emission in cities dependent on resources. The author analyzes the carbon reduction issues and policy recommendations in resource-based cities taking Tangshan as a

case, and summarizes the experiences and challenges of carbon emission reduction in cities dependent on resources, so that resource-based communities can achieve both the dual carbon targets and superior economic development with the aid of this research.

2. Policies Backgroud

China formally started its first set of low-carbon pilot programs in 2010. 'Notice on Carrying Out Pilot Work for Low-Carbon Provinces and Low-Carbon Cities' was published. And then in 2012 and 2017, the projects' second and third batches were introduced, respectively. Pilot area expanded from the provincial level and the larger central cities to the city and county, which made this experience expand further. China advanced in 2020 that China aims to reach carbon neutrality by 2060 and carbon peaking by 2030. These two goals are called 'the dual carbon' policy.

Tangshan is the one of the first batch of pilot provinces for low-carbon cities, and is the traditional heavy industry cities that relies on coal. Before the issuance of the central document, Tangshan had embarked on a carbon tax policy. And after low-carbon policies were taken out, Tangshan made more carbon reduction policies on coals, such as 'Notice on the Implementation of Production Restrictions for Steel Enterprises Due to Excessive Carbon Monoxide Emissions from Sintering Machine Heads', Tangshan steel, 'Implementation Plan for Ultra-low Emissions in Coking and Deep Emission Reductions in Coal-fired Power Plants' and so on. After the dual carbon goals, Tangshan overall planned some restrictions on industrial emissions in purpose, such as 'Implementation Plan for Carbon Monoxide Emission Reduction Control in Tangshan Steel Enterprises', 'Notice on Carrying Out Deep Governance Work for Engineering Emission Reduction in Steel Enterprises' and other policies.

3. Status of Implementation

In 2013, a transformation has already been completed in Tangshan, which means Tangshan turned from a single-resource city that relies on coal to an industrial resource city with the largest iron output in China. However, industries and coals are still the indicators that account for the highest proportion of consumption in Tangshan. According to Tangshan Statistical Yearbook in 2023, total energy consumption is steadily decreasing, and the proportion of the second sector in total energy consumption decrease from 93% to 90% from 2024 to 2022, and coals consumption in the proportion of it drops from 93.7% from 91.8%. When the consumption of energy drops, the gross domestic product increase steadily, which increases from 63000.34 million 89007.4 million from 2018 to 2022. The improvement is significant. This shows that the utilization rate of energy in Tangshan has greatly improved, and the carbon reduction improves a lot. However, it is still a big problem that gas emission of industries is large, and high-carbon and high-polluting enterprises still leads the industries of Tangshan [1].

4. Status of Implementation

4.1. Green Transformation of Key Industries

Government accelerates to implement the energy-saving renovation and upgrading and in-depth treatment of pollutants of the key trade such as iron and steel, coal power, coking, cement, building materials, chemicals, flat glass, ceramics, non-ferrous metals and so on. And they obey strictly the laws about energy consumption, environmental protection, water consumption, quality, safety, technology.

4.2. The Improving Energy Conservation and Environmental Protection of the Industrial Park

Tangshan government constructs the scientific parks, and improve the utilization of resource in the zone. They build healthy park industrial chain to make full use of resource, and share the environmental so that this zone comprehensively improves the resource output rate and recycling level of high-energy-consuming industries.

4.3. Energy-saving Retrodiction of Civil Establishment

Tangshan government implements the green building standard totally, accelerates the energy-saving renovation of buildings for what their local conditions are, and extends ultra-low energy consumption buildings.

4.4. Emission Reduction in Transportation and Logistics

The traffic base facilities of highway port run through the concept of green and low-carbon, for example, power infrastructures are accelerated such as charging and hydrogen energy, and hydrogen electric vehicles and solar energy facilities are extended. Government continues to advance electrified and clean construction of public traffic system and area.

4.5. Transformation of Civil Installation

The use of renewable energy sources, including air source heat, biomass, wind, and solar energy, is being expedited by the government, and then put these technologies into agriculture to build a green and environmentally friendly economic agriculture system.

4.6. Clean and Efficient Use of Coals

The government strictly controls coal consumption and increases carbon reduction and weight loss efforts in heavy industries such as steel, coking, cement, and electricity. And they promote the clean use of coal to make sure that total coal consumption has been steadily declining in total city. What is more, they carry out in-depth ultra-low emission transformation of coal-fired power machines, and encourage industries to innovate technologies or they will be obsoleted.

4.7. The Improving Level of Environmental Base Installation

The government has established and improved environmental base installation that combines the disposal of sewage, garbage and solid hazardous medical waste with monitoring and supervision capabilities, and accelerate a full coverage network of urban and rural environmental infrastructure in both city and countryside. Government promoted the creation of a sponge city demonstration city in Tangshan, and completed the transformation of rain and sewage diversion of the municipal combined drainage pipe network, and enhanced the centralized sewage treatment capacity of new urban areas. Domestic sewage collection facilities are being built at a faster pace in urban villages, older urban districts, and urban-rural interfaces. Additionally, the collection pipe network's blank area is being cancelled, sewage resource utilization is being implemented, and sludge is being treated in a harmless manner.

5. Problems

5.1. High Dependence on Industries with High Emissions

Tangshan's carbon emissions in 2017 were 140,425,200 tons, which rank highly in China. In 2021, Tangshan’s dual carbon index of traditional industries cities ranks low [2]. Heavy industry is still the largest part of Tangshan's GDP. According to Tangshan 2023 Statistical Yearbook, the proportion of industry in the GDP of the region is 50.6%, and the contribution rate to economic growth reach 48.8%,

comparing to service sector which accounts for 48.8%. It follows that Tangshan's dependence on heavy industries did not decrease significantly.

5.2. Uncomprehensive Entire Management and Top-level Design

Holistic theory emphasizes the harmonization among departments to avoid isolation [3]. If the top-level is undefined, the government will spend attention on too much programs. For example, in America, they use up and down linkage as the top-level design, and effectively control pollution by top-down mode [4]. According to the Tangshan's implementation methods, the government pay the most attention on too many areas instead of the key areas. Without entire goal, the apartments are difficult to work in phase.

5.3. Intensifying Competitive Pressure from Cities Surrounding

From 2017, the State Department decided to build Xiong'an New Area, which develop together with Beijing as the sub-center and the "two wings" of Xiong'an New Area. This situation brought some opportunities but also challenges. The absorption of resources from surrounding cities will marginalize the city of Tangshan [5]. In recent years, the economy of Baoding and other areas developed so fast that the gap with Tangshan is getting smaller and smaller gradually. Intra-provincial competition has adversely affected Tangshan City [6].

6. Optimization Suggestions

6.1. Government Defining Top-level Design, Overall Planning and Coordination Work

Government should establish the overall framework for reducing carbon emissions. to make sure the work of the various departments is coordinated to achieve the overall development goals. Under this leading, the government should make a comprehensive policies system, which includes economy, society, environment and so on, to promote the orderly development of various fields. Meanwhile, government should lead every apartment works under top-level by making interrelated laws to ensure apartments can work together.

6.2. Adjusting Social Transformation, Attracting Talents and Enhance Competitiveness

Affected by the establishment of the "Xiong'an New Area", Tangshan City has lost talent and its scientific and technological innovation has declined. Therefore, although overall economic efficiency is generally on the rise before 2017, Tangshan kept a low level after 2017. Unemployment rate reached 4% in Tangshan [1]. In order to enhance Tangshan's own competitiveness to overcome the external shocks, Tangshan should first optimize the industrial structure and promote the development of high-tech, green energy and modern service industries, so that it can bring more employment opportunities. In addition, Tangshan needs to improve the urban living environment and installation, and increase the attractiveness of the city, so that more talented people are willing to settle and develop here. Furthermore, the government should strengthen education and vocational training, improve the overall quality of the local labor force and reduce structural unemployment caused by backward technology.

6.3. Achieving Promoting Green Economic Growth and the Transition to a Low-carbon Economy

When economic development is realized, the government must encourage the low-carbon transformation of Tangshan's industry in order to meet objectives for sustainable development and environmental preservation. Tangshan's government should reduce the negative impact of industrial activities on the environment through green technology and energy-saving and emission reduction measures, such as improving energy efficiency, promoting cleaner production technology, strengthening the resource utilization of industrial waste and other technologies. The low-carbon

transformation can improve the structure of Tangshan's industries, and develop the green level of industries development. So that Tangshan can promote the alteration of green economy and realize the positive interaction of economic, environmental and social benefits

7. Literature References

7.1. Low-carbon Cities

7.1.1. Technological innovation

A research by Limei Ma and colleagues discovered that low-carbon city development may successfully foster urban renewable energy technical innovation and that low-carbon city construction policies have geographical spillover effects on renewable energy technology innovation[7]. Yi Qiu study found that the growing level of urban green technology innovation do more help on energy conservation and waste management sector than agroforestry. What is more, it affects non-resource-based cities most [8]. On the other side, around the concept of low-carbon cities, green innovation technologies have improved in both quality and quantity [9]. And government intervention affects the quality of green finance more than the quantity, while the public participation is comparable to the impact on both [10].

7.1.2. Industries structure

Xiaoyu Zhang study find that low-carbon policy significantly improves the quantity of industries structure, but restricts the quality and rationalization of industries structure [11]. The low-carbon policy is impact on employment in the tertiary sector exhibits significant heterogeneity, which is positive to secondary and tertiary industries, comparing to primary [12]. The urban green transition, in addition to green technological innovation, can improve employment effect through the concept of green consumption for residents [13], so that it can develop the industries' structure.

From another point of view, the study on carbon reduction includes factors. The energy structure and energy intensity promote carbon emissions [14]. Yan Xu and others confirmed that there is a positive correlation between the digital economic spatial correlation network and carbon emissions [15]. The economic output effect and urbanization effect will increase agricultural carbon emissions [16]. This shows that the factors influencing carbon emissions reduction involve multiple dimensions and sectors.

7.2. Reasource-Based Cities

7.2.1. Economy

According to research by Li, H., and others, Chinese resource-based cities are now experiencing comparatively slow economic development, which is required to encourage the change in the economy of resource-based cities by reducing polluting projects and reasonably allocating transfer payments [17]. The impact of creative development of resource-based societies' green economic growth is mitigated by resource endowment, and the degree of affinity decreases as resource endowment increases [18].

7.2.2. Industries structure

The study shows that the mutual inhibition between renewable energy and the industrial structure's rationalization hinders the promotion of the green economy, which means there is a mutual exclusivity effect between the two [19].

What is more, researchers found that the implementation of environmental regulations has a significant promoting effect on the industrial structure of resource-based cities, with the mediating factors being the stimulation of consumer demand and investment demand [20].

7.2.3. Market development

The most significant influence on the green evolution of resource-based cities comes from market advancement, whereas the improvement of resource-based cities' low-carbon infrastructure benefits from the expansion of the internet [4,21]. Wei-xiang and colleagues discovered that there is a considerable degree of variation in the way that various resource-based cities operate when it comes to reducing carbon emissions [22]. Furthermore, one effective policy tool for lowering urban carbon emissions is the establishment of high-tech industrial development zones and demonstration zones for industrial transformation and upgrading [23].

8. Conclusion

Fist, Tangshan's urban development is still highly dependent on high-emission industries, and there is great potential for industrial emission reduction. Second, the overall governance and top-level governance are not comprehensive, and different apartment will do things in their own ways. Third, competition in surrounding cities intensifies due to the policies. Accordingly, the following optimization suggestions are proposed: government have to clarify what is the top-level design and coordinate the work of various departments; Social transformation should be adjusted, and government should attract talent and enhance competitiveness; government should spend more effort on conducting low-carbon industries to develop green economy. This research only analyzes Tangshan as an example, but it does not have a high degree of universality. In the future, resource cities can achieve significant carbon reductions through diversified means such as innovative technology and industrial upgrading, and promote the transition to a green economy, so that China can be out on the path of sustainable development.

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