Low Carbon Innovation: The Construction of Green Patent Pools in Guangdong-Hong Kong-Macao Greater Bay Area

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Abstract. In view of the features of technology transfer and patent licensing of low carbon technologies, it is necessary to explore a new green patent system, focusing on solving the problems of excessive licensing fees and complicated implementation conditions. Based on the analysis of the industrial foundation and technical reserves of low carbon industry in Guangdong-Hong Kong-Macao Greater Bay Area, this paper proposes a concept of constructing green patent pools in the region. First, to construct enterprise-shared green patent pools, break through the traditional competition pattern by sharing innovative technologies, and promote the overall development of low carbon industry. Second, to construct public green patent pools, which are funded by government totally or partially, promote the innovation and application of low carbon technologies, and promote to take the road of low-carbon development in the Greater Bay Area.

1. Introduction

As environmental issues become more prominent, low carbon has become one of the most concerned topics in the world, and the upsurge of low carbon technology, low carbon industry and low carbon economy also followed.

The fundamental goal of low carbon technology is to reduce carbon emissions, which belongs to environmentally sound technology. In 2017 report of United Nations Environment Programme (UNEP), low-carbon technology refers to a wide array of technologies used to reduce greenhouse gas emission of energy supply and/or use [1].

The concepts of green economy and green economic priority sectors are often appear in the documents of the UNEP and the United Nations Department of Economic and Social Affairs (UNDESA). Green economy refers to the economy that takes into account the vital linkages among economy, society and environment. In 2008, the UNEP launched the Green Economy Initiative, which aims to encourage countries to invest in improving the environment and use green development as a new engine of economic growth.

In the report of Trade and Climate Change, which jointly issued by the World Trade Organization (WTO) and the UNEP, low carbon technology is called climate friendly technology. This report points out that technology innovation, technology transfer and implementation are essential to solve the problem of climate change. Global emission reduction depends on the ability of developing countries...
to acquire, diffuse and use low carbon technologies, and this can be facilitated through trade and technology transfer [2].

2. Green Patent System

International transfer of low carbon technology may involve two aspects. On the one hand, it relates to the transfer of technology in physical tangible assets or goods, such as industrial plants and equipment, machinery, components, and devices. On the other hand, it relates to intangible knowledge and information associated with the technology, such as patent rights, technical secrets, and royalties [2].

In order to facilitate patent licensing and technology transfer of low carbon technologies, the World Intellectual Property Organization (WIPO) and countries seeking institutional innovation in environmental protection (such as China, the United States and some European countries, etc.) are exploring to establish a green patent system. Green patents are mainly based on inventions, and they are not different from ordinary patents in terms of granting terms of patent rights, duration of protection, content of rights, and infringement judgments. Their particularity is mainly reflected in the procedure of patent authorization and patented technology licensing [3].

In order to speed up low carbon patents licensing and accelerate the launch of environmentally friendly products and services, some countries have designed special application procedures. China implemented the *Administrative Measures for Priority Examination of Invention Patent Applications* from August 1, 2012, and established a fast-track patent approval process for low carbon technology applications. Patent applications involving energy conservation and environmental protection, new energy, new energy vehicles, as well as other low carbon technologies, can be subject to priority review procedure.

Within one year after the request for priority examination is approved, patent application procedure for low carbon technologies should be completed. This priority examination procedure greatly speeds up the approval process for green patent applications. On August 1, 2017, the *Administrative Measures for Priority Examination of Invention Patent Applications* was abolished, and the new *Administrative Measures for Priority Examination of Patents* began to be implemented. The new Measures still retains the priority examination of patent applications in key national development industries such as energy conservation and environmental protection, new energy, new materials, and new energy vehicles.

The United States began applying a new Accelerated Examination Procedure in 2006. This procedure applies to technologies that have an impact on improving environmental quality, saving energy, and developing alternative energy sources. According to this procedure, the patent examination must be completed within 12 months, and the examination period can be shortened by up to three quarters compared with the past.

Since 2009, the United Kingdom Intellectual Property Office (UKIPO) applied accelerated examination procedure. The applications of low carbon technologies enter the so-called Green Channel. Patent applications in Green Channel can be authorized as quickly as in 9 months, which usually takes an average of 2 to 3 years. The European Patent Office (EPO) added a new classification scheme Y02, indicating *climate change mitigation technologies*, which provides easy access to general public to low carbon technologies.

China Science and Technology Innovation Board (STIB) officially launched on 13 June, 2019, in Shanghai. The launch of the STIB has attracted more attention to low carbon technologies. The *Interim Provisions on the Application and Recommendation of Enterprises for Issuance and Listing on Shanghai Stock Exchange STIB* details the scope of the industries and sectors that STIB focuses on, covering companies in high-tech industries and strategic emerging industries. Half of them belong to low carbon industry, including new materials, new energy, energy conservation and environmental protection. The *Guidelines for Evaluating the Attributes of Science and Technology Innovation (for Trial Implementation)* provides a system of specific indicators for evaluating the attributes of sci-tech innovation, which mainly includes three parts: R & D investment, number of invention patents and operating income. So the issues of green patent system and low carbon technology licensing are also important to STIB.
3. New Attempts at Green Patent Licensing

The intellectual property system, especially the patent system, not only provides an incentive for technological innovation, but also an institutional guarantee for technology transfer and technology commercialization. According to the joint Survey of Licensing Activities in Selected Fields of Environmentally Sound Technologies (ESTs) by the UNEP, the EPO and the International Centre for Trade and Sustainable Development (ICTSD), technology licensing is an important instrument in the transfer of and utilization of ESTs. And there seems to be a growing support towards the use of licensing over time [4].

Some scholars have pointed out that in order to address the challenge of climate change, the international system adopts two complementary approaches: active transfer by developed country governments (so called “push factors”) and creating favourable conditions in developing countries to attract technology through trade and investment (so called “pull factors”). For example, the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) is concerned, almost exclusively, with pull factors, by creating favourable trade and investment environment for patent rights holders. However, the minimum standards of patent protection stipulated by the TRIPS Agreement may impede the development and transfer of technology in developing countries, and there is no clear evidence that developing countries can obtain significant benefits from technology licensing or foreign direct investment [5].

Patent rights lead to technology monopolies and excessive transaction costs, which become barriers to market access for investors and producers and may pose a threat to subsequent technological innovation. In order to solve the problems encountered in green patent licensing, especially the problems of excessive licensing fees and complicated implementation conditions in technology transfer, some entities with vision and leadership attempt to share and open their patents.

3.1. Eco Patent Commons

In January 2008, IBM and the World Business Council for Sustainable Development (WBCSD), cooperated with Nokia, Sony and other companies, established the Eco-Patent Commons. The Eco-Patent Commons is an initiative to create a collection of patents which belong to low carbon technology. This project aims to promote the use, implementation and subsequent development of low carbon technologies; provide a platform for technology sharing; and encourage the cooperative utilization and development of environmental protection technology solutions among enterprises. The project is operated by the Geneva-based WBCSD. More than 10 companies representing different industries in the world have joined the Eco-sharing Commons, including Bosch, Dow Chemical, Fuji Xerox, HP, Nokia, Ricoh, Sony and Xerox, etc. They provided about 100 patents, which open to the public and free of charge.

The Eco-Patent Commons project is open to all companies or organizations around the world, regardless of industry, as long as their patents may provide environmental benefits; at the same time, the patents in the Commons are open to anyone, any company and organization. To a certain extent, the Eco-Patent Commons project inherits the idea of Creative Commons. Creative Commons is dedicated to supporting an open and accessible platform that is enriched with free knowledge and creative resources for people around the world to use, to share and to cultivate. Eco-Patent Commons provides a unique leadership opportunity for global business to sharing their innovations in support of sustainable development.

The World Intellectual Property Organization launched a new online trading platform WIPO GREEN in November 2013, which aims to promote and accelerate green technology innovation and its transfer, expand the adoption and use of environmentally friendly technologies. WIPO GREEN is composed of two parts: The first part, the WIPO GREEN database, provides information on related inventions, technologies, technical secrets and services, and a category of requirements. The database can be consulted publicly, and some specific information is only available after registration. The second part, the WIPO GREEN network, provides global forums, builds contact channels for users, and provides trading venues for green inventions, technologies, technical secrets, and services.

According to Ms. Dietterich, Director of the Global Challenges Division of WIPO, as of March 2020, the WIPO GREEN database includes more than 3,000 technologies and needs. The platform
serves nearly 1,500 international users from 63 countries, including small and medium-sized enterprises, universities and research institutions, and multinational companies. Any company or entity with technology that has the potential to support the transition to a low carbon future can join the WIPO GREEN system by signing an agreement [6].

3.2. Open Patent Framework
After the Eco-Patents Commons, there emerged a new trend of patent opening in the field of new energy vehicles. In June 2014, Tesla, the world’s most famous electric vehicle design and manufacturer, announced that it would open its patented technology. For companies that use Tesla’s patented technology, Tesla will not file patent infringement lawsuits. Elon Musk, the Chief Executive Officer (CEO) of Tesla, posted on the company’s official website that motivated by the spirit of the open source movement, the wall of Tesla patents has been removed, and the patents are open to the whole electric vehicle industry, for the advancement of electric vehicle technology.

Among the patents opened by Tesla include the battery power system patent and the patent on how to integrate the battery system with the rest parts of the car. These patents have helped Tesla reduce battery costs, increase battery safety, and improve battery charging speed. Opening these patents means giving up the competitive advantages. This approach breaks through the original intention of companies to develop and obtain patents, that is, to use patents to set obstacles for opponents and improve their own competitiveness. But Musk said that, technological leadership is not defined by patents, but by the company’s ability to attract and motivate the world’s most talented engineers. This also shows that, Tesla positioned its competitors as traditional gasoline vehicle manufacturers which have the vast majority of market share, rather than other electric vehicle manufacturers.

Tesla’s announcement of opening patents has caused controversy in new energy vehicles industry. Some researchers analysed from the perspective of commercial competition strategies. They believe that opening patents can promote the development of the entire new energy vehicle industry. At the same time, opening patents will improve the universality of technical standards and thus control the future development of the industry [7]. Some researchers analysed Tesla’s patents, and then believe that Tesla and other auto companies (such as Toyota, Panasonic, GM, Ford) have a lot of mutual citations in patents, and the technical correlation between those companies is very strong. That means other electric vehicle companies conducting R&D on the basis of Tesla’s open patents may also face the risk of infringing on the patent rights of other automobile companies [8].

Therefore, no matter from which point of view, Tesla’s approach of promoting the overall development of the new energy vehicle industry with opening patents is a new exploration for the low carbon industry. It can be considered that patent opening is not only a market competition strategy of Tesla, but also an attempt of the leader of the green economy to break the original competition pattern by updating the competition rules.

4. Construction of Green Patent Pools in the Guangdong-Hong Kong-Macao Greater Bay Area
Since the new century, the innovation of low carbon technology in China has been very active, and the innovation is dominated by domestic entities. According to the patent statistics of the National Intellectual Property Administration (NIPA) [9], from 2014 to 2017, the total amount of green patent applications in China reached 249,000, with an average annual growth rate of 21.5%. Low carbon technological innovation activities are mainly active in the four technical fields of pollution control and governance, environmental materials, alternative energy, and energy conservation and emission reduction. The applications in these four fields accounted for nearly 90% of the total number of green patent applications. According to regional surveys, from 2014 to 2017, the Guangdong-Hong Kong-Macao Greater Bay Area had nearly 20,000 green patent applications, with an average annual growth rate of 39.4%, higher than the domestic average annual growth rate of green patents of 14.9%.

In order to build a world-class bay area, the Guangdong-Hong Kong-Macao Greater Bay Area needs to take the road of green and low carbon development. The Framework Agreement on Deepening Guangdong-Hong Kong-Macao Cooperation to Promote the Construction of the Greater Bay Area, jointly formulated by the National Development and Reform Commission, the People’s Government of Guangdong Province, the Government of the Hong Kong Special Administrative
Region (SAR) and the Government of the Macao Special Administrative Region, put forward “ecological priority, green development” and build “green, low carbon, open and innovative industrial system”. To build an international technology innovation centre with global influence is a core task for the construction of the Guangdong-Hong Kong-Macao Greater Bay Area. There are currently more than 18,900 state-level high-tech enterprises in the Greater Bay Area. International patent applications account for 56% of the country each year. The innovation elements are concentrated and there is a good foundation for building an international scientific and technological innovation centre [10]. Therefore, the Guangdong-Hong Kong-Macao Greater Bay Area has the practical needs and foundation to build green patent pools.

4.1. Constructing Enterprise-shared Green Patent Pools

As one of the most dynamic regions in China’s economy, the enterprises in Guangdong-Hong Kong-Macao Greater Bay Area have always been leading the country in the field of technological innovation. Half of the eight strategic emerging industries in Guangdong Province are low carbon industries. The Guangdong Intellectual Property Research and Development Centre has conducted statistics on patent applications and authorization data of the Guangdong new energy vehicle industry [11], energy conservation and environmental protection industry, new energy industry and new material Industry [12] from 1985 to 2015.

Table 1. Patent Application and Authorization of the Four Low Carbon Industries in Guangdong Province from 1985 to 2015 [11] [12].

| Industry Category                  | Patent Application     | Patent Authorization                             | Main Applicants                      |
|------------------------------------|------------------------|--------------------------------------------------|--------------------------------------|
|                                    | Amount of applications | National share | National ranking | Amount of Authorization | National share | National ranking |                      |
| New Energy Vehicle                 | 28,381                 | 14.57%         | 1               | 17,939                 | 15.61%         | 1               | BYD, Dongguan New Energy Technology, and SCUT |
| Energy Conservation and Environmental Protection | 109,936              | 16.75%         | 1               | 80,415                 | 18.56%         | 1               | Midea Group, Gree Electric, and SCUT |
| New Energy                         | 27,080                 | 9.49%          | 4               | 18,834                 | 10.42%         | 4               | Midea Group, China Guangdong Nuclear Power Group, and Gree Electric |
| New Material                       | 24,675                 | 11.32%         | 2               | 13,196                 | 12.97%         | 2               | Ocean King Lighting Technology, SCUT, and BYD |

As shown in Table 1, after summarizing the relevant data, it can be found that Guangdong has strong technical strength in the field of low carbon industries: the number of patent applications and patent authorizations in new energy vehicle industry and energy conservation and environmental...
protection industry rank first in the country, new materials industry ranks second in the country, and the new energy industry ranks fourth in the country. Analysing the proportion of patent applications and patent authorizations, it can also be found that the proportion of patent authorizations in all four green industries is higher than the proportion of applications, which shows that the quality of patent applications in Guangdong is better than the national average.

In addition, among the main patent applicants, Guangdong enterprises and universities have demonstrated strong R&D capabilities. South China University of Technology (SCUT), BYD Company, Midea Group, Gree Electric rank among the top three in the amount of applications in several industries, as shown in Table 1.

This shows that enterprises in the Guangdong-Hong Kong-Macao Greater Bay Area have strong patent reserves in the field of low carbon technology. Based on this, it is recommended to build a unique green patent licensing model among enterprises in the Greater Bay Area. The new licensing model will promote the overall development of the low carbon industry by sharing innovative technologies and solutions, and also enable enterprises to obtain distinctive leadership and provide an opportunity for enterprises to establish new partnerships for in-depth development of low carbon technologies.

The goal of the enterprise-shared green patent pools is to create a platform for the exchange and sharing of knowledge and technology among low carbon enterprises in the Greater Bay Area, and will not require enterprises that join the plan to give up their core patents and the technical advantages. The enterprise-shared green patent pools can combine technological innovation with social innovation to help more companies, especially start-ups, develop in a more sustainable way.

4.2. Constructing Government-funded Green Patent Pools

The cooperation in intellectual property issues among the governments of Guangdong, Hong Kong SAR and Macao SAR has a long history. Guangdong Intellectual Property Administration, Guangdong Administration for Industry and Commerce, Guangdong Copyright Administration, Hong Kong Intellectual Property Department and the Intellectual Property Department of the Macau Economic Bureau jointly developed the Guangdong-Hong Kong-Macao Intellectual Property Database. In the field of low carbon technology, it can be considered to construct green patent pools through government funding.

The cooperation in the low carbon technology not only depends on policy support, but also requires continuous improvement of the cooperation mechanism and expansion of cooperation areas. Based on this, it is recommended that to construct public green patent pools, which are funded by government totally or partially. The government-funded green patent pools are constructed to promote the innovation and application of low carbon technologies. The proportion of capital contribution can be determined by agreement according to the target of specific project.

As the global economic situation changes, the economic development model needs to gradually shift from factor-driven and investment-driven to innovation-driven. Therefore, it is necessary to establish a green and innovation development pattern in the Greater Bay Area. Researchers of the Guangdong Academy of Social Sciences, after a comprehensive calculation of Guangdong’s green development practices, point out that in the 40 years of reform and opening up, although the level of resource utilization and ecological protection in Guangdong have generally increased, the green development level has not increased significantly in Guangdong. In particular, the overall level of environmental governance is relatively low, which seriously restricts the further improvement of the competitiveness of the region [13]. Therefore, under the new development situation, whether Guangdong can continue to be the frontrunner of the Chinese economy, the key is to take the road of low-carbon development.

5. Conclusions

Green patent system introduces a new mechanism in technology licensing. Guangdong-Hong Kong-Macao Greater Bay Area plans to establish a low-carbon, open and innovative industrial system. Based on the analysis of the industrial foundation and technical reserves of low carbon industry in the Greater Bay Area, this paper proposes a concept of constructing green patent pools in the region.
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