Focus on the Development of Shale Gas Industrial Clusters in China ---- Based on SWOT Analysis

Zhengwei Ma*, Xiucheng Dong and Siyu Lin

School of Business Administration, China University of Petroleum (Beijing), 102249, China

Abstract: The worldwide energies’ price continues to rise again. More countries pay more attention to unconventional energies. Shale gas is one of a significant unconventional energy. With the successful development of shale gas in the United States, more and more countries and corporations focus on the shale gas exploitation. The large recoverable reserves of shale gas will ensure China’s energy security and diversified energy supply, and it is also an effective way for China to transform into the clean energy economy mode. However, Chinese shale gas development still has a long way to go. By using the SWOT analysis method, this paper studies the internal and external development environment of establishing shale gas industrial clusters in China, then explores development status of shale gas industrial clusters from four dimensions including strengths, weaknesses, opportunities and threats. Finally, according to the combinations of SWOT matrix analysis, the paper formulates four kinds of different development strategies to provide certain references to the development of shale gas industrial clusters in China.

Keyword: China, industrial clusters, shale gas, SWOT analysis.

1. INTRODUCTION

In the recent years, unconventional natural gas resources have attracted more and more attentions. Compared with conventional natural gas resources, unconventional natural gas resources have larger reserves and longer extraction cycle. They have considerable prospect and are valued to develop. Actually shale gas is an important unconventional natural gas. As an energy power, China has attached great attention to development of unconventional natural gas resources with huge energy demand. However, because of the late start and uncompleted technology, China shale gas industry has not made a breakthrough. In this paper, we use SWOT analysis method to analyze the feasibility of developing shale gas industrial clusters in China. At the same time, we look forward to providing reference for the study of developing model of shale gas industry.

In today’s world, natural gas is widely used, because of its clean and low-carbon characteristics. However, with a large number of conventional natural gas resources mined, reserves of natural gas are gradually reducing. Thus, the difficulty of exploitation and mining costs are gradually increasing [1]. As a result, unconventional oil and gas resources such as shale gas began revealing the value of development, originally idle due to the high cost. In the late century, the United States began to develop shale gas, and successfully achieved the industrialization of domestic shale gas, which greatly ease the energy shortage. At the same time, it also attracted many countries to follow setting off a shale gas boom.

Through the analysis, we can find that success factors in shale gas development of U.S. are policy supports, liberal market environment and the high participation of SMEs (small and medium enterprises) in promoting technological progress. The government of Chinese has already introduced policies to support the development of shale gas industries. But due to the limited strength, Chinese small and medium enterprises don't have the ability to develop shale gas independently, and the development of shale gas is still focused on three major oil companies in China. Exactly, industrial cluster development model is focused on this point, which concentrates the power of the set number of SMEs. Industrial cluster can jointly develop shale gas industry to increase the participation of SMEs, help to achieve technological breakthroughs and clear obstacles of shale gas development.

2. THE CURRENT STATUS OF CHINESE SHALE GAS INDUSTRY DEVELOPMENT

The current Chinese shale gas development has been widely appreciated and supported. But China shale gas industry has two major problems, poor foundation and the lack of core technology; it faces both opportunities and challenges.

2.1. Resource Situation

Shale gas resource in China has a very considerable development prospect. According to research, China shale gas resource is up to 100 trillion cubic meters, and the recoverable reserves are about 36 trillion cubic meters, equivalent to twice the reserves of conventional natural gas [2]. Meanwhile, shale gas also has some benefits such as a long life cycle and good environment benefits, making the development of shale gas more valuable. China government is also introducing preferential policies actively to promote the development process of shale gas. However, due to Chinese
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2.2. Development Status

At present, shale gas in China is developed mainly by China National Petroleum (CNPC), China Petroleum & Chemical Corporation (Sinopec Group), China National Offshore Oil Corporation (CNOOC) and other large energy companies. In recent years, the petroleum enterprises’ shale gas explorations mainly concentrated on Sichuan Basin, Ordos Basin, Eastern Depression of Liao He River and other regions. Through these years of painstaking efforts, China has made some achievements. However, some important factors in the progress of China’s development are still weak foundation, the lack of core technology and other issues. With the global wave of shale gas development arising and the deepening international exchanges, the development of shale gas will meet a new opportunity.

3. SWOT ANALYSIS METHOD

SWOT analysis method is an analysis method concerning competitive situation, largely used for strategic analysis process. In other words, it is an effective strategy development tool. “SWOT” is the abbreviation for the capital word of Strength, Weakness, Opportunities and Threat, in which “S” and “W” are internal factors while “O” and “T” are external factors [3]. It is commonly accepted that an industry’s strengths and weakness demonstrate the industry’s internal characteristics and are controllable; and industry’s opportunities and threats are determined by external factors on which the industry has no direct control but can react to its own advantage. SWOT analysis is a methodology allowing an industry to understand and plan to use their strengths to exploit opportunities, to recognize and repair or avoid their weakness, and to defend against or sidestep any threats. The method has been widely used as a strategic planning tool and found it was effective.

In the paper, S, W, O and T factors involved in the shale gas industry in China are proposed and analyzed with qualitative methods in the next part. We rank these factors according to their influences on the development of China’s shale gas and put the factors that are significant as well as direct prior while the factors that are indirect later. Data used in the analysis stem from multiple sources including literature review, statistical reports, government regulations and policies. These findings would provide a valuable reference to assess and evaluate the shale gas industry in China.

4. SWOT ANALYSIS OF SHALE GAS INDUSTRIAL CLUSTER IN CHINA

By means of SWOT analysis method, we analyze the development model of shale gas industrial cluster from four aspects, namely strengths, weaknesses, opportunities and threats. Then, we combine all factors and try proposing feasible suggestions.

4.1. Strengths

4.1.1. Abundant Resource Reserves

According to the Energy Information Administration (EIA), the mineable resource amount is nearly $1.87 \times 10^{12}$ m$^3$. The resource potential of shale gas is shown in the Table 1. And China has a mineable resource potential amount about $3.6 \times 10^{12}$ m$^3$ (20%), ranking first and followed by the USA (13%) [4], Argentina, Mexico and South Africa. The report from Ministry of Land and Resources shows that the resource reserves of China reach 134.42 trillion cubic meters (excluding Qinghai and Tibetan areas) and 25.08 trillion cubic meters is mineable [5]. It's obvious that the mineable resource amount of unconventional natural gas is no less than conventional natural gas. With the support of abundant resource reserve, the industrial clusters would have great development potential. Fig. (1) shows the comparison between the mineable resource of natural gas and the mineable resource of shale gas.

| Table 1. Assessment result about shale gas of EIA (Trillions of cubic meters). |
|---------------------------------|-------------------------------|-------------------------------|-----------------|
| Country                        | Mineable Resource of Natural Gas | Mineable Resource of Shale Gas | Percentage  |
| China                          | 30281                         | 360825                        | 19.25%        |
| America                        | 77118                         | 223946                        | 11.95%        |
| Argentina                      | 3792                          | 219042                        | 11.69%        |
| Mexico                         | 3396                          | 192723                        | 10.28%        |
| South Africa                   | 137255                        | 7.32%                         |
| Other Area                     | 168695                        | 39.50%                        |
| Total                          | 283282                        | 1874026                       | 100.00%       |

Fig. (1). The comparison between the mineable resource of natural gas and the mineable resource of shale gas.
4.1.2. Lower Cost and Stronger Competitive Power

The shale gas industry has a complete industry chain including processes such as exploration, mining, storage and transport and refining. If a shale gas industrial cluster is founded, there would be more specialized division of labor, more effective communication of information and more cooperation. It’s expected that the cost of shale gas would be reduced and the productive efficiency would be increased. The co-operation among the companies of clusters would lead to a reduction of the cost of transaction, transportation and pollution abatement, which helps to increase the competitive power.

4.1.3. Benefit to Local Economy

It’s expected that the foundation of shale gas industry cluster would be beneficial to local economy. And the economic progress will be helpful to the industry cluster, too. It’s obvious that the shale gas industry cluster has multiple advantages.

4.2. Weakness

4.2.1. Lack of Fund

As a kind of unconventional natural gas, shale gas has gained a lot of attention in recent years. As a result, the technology and facilities of shale gas industry has not be complete yet. Especially, there are a lot of limitations in the transportation of shale gas. It’s necessary to equip the industry with facilities, which require a large amount of fund [6]. It's the very reason why many middle and small-size enterprises have difficulties in developing shale gas industry. And the cost of exploiting is still high since the technology is incomplete. What's more, it's also a burden to purchase the land to build industry clusters. Even for industry clusters, the lack of fund is still a limitation.

4.2.2. Lack of Core Technology

The development of shale gas industry in China is at a primary stage. There is not an important breakthrough in horizontal well technology and fracturing technology, which has influenced the progress of the development of shale gas industry. Thus, the cost of mining is still high. And it may also have a native effect on development prospect. According to some reports, burying depth of shale gas in America ranges from 200 meters to 2000 meters, whereas that in China ranges from 1500 meters to 4000 meters. And part of shale gas in China is buried in areas where there is a large population and where disasters occur frequently, making it harder to mine the shale gas. Table 2 shows the distribution of the minable resource potential. To achieve the industrialization of shale gas, it's necessary to make breakthroughs in core technology.

4.2.3. Lack of Common Standard of Exploitation

Although China has a abundant shale gas resource, the element task of developing shale gas is still weak. And what we know about the storage condition of shale gas resource is not enough and there in no systematic methods to evaluate shale gas resource. These factors have a native influence on the reliability of shale gas resource evaluation and exploitation of shale gas. Thus, China has difficulty in exploiting shale gas with great resource. On the other hand, it is hard to choose the location for industry clusters if we can't evaluate the exploitation condition of shale gas.

4.2.4. Environmental Pollution

Hydrofracture is widely used in exploiting shale gas now. However, a lot of waste water would generate, resulting in serious environment pollution [7]. Though waste water would be dealt with together, it is possible that the difficult of pollution abatement would increase as the production of shale gas rise.

4.2.5. Some Problems of Industry Clusters in China

Shale gas industry cluster is a kind of resource-based industrial clusters which have some problems. As discussed above, shale gas resource is a kind of unconventional nature gas resource and the main problems of developing shale gas are that the difficulty of exploitation is great and that the cost of exploitation is high. Since there is a complete production model of conventional nature gas, the main job of shale gas industry clusters is to exploit shale gas. It's possible that there would be excessive competition in clusters. In addition, many clusters consist of middle and small-sized enterprises but technological innovation often means much input and great risk. As a result, a lack of innovation ability and innovation motivation is expectable, which would also affect the development of shale gas.

4.3. Opportunities

4.3.1. Government Policies to Guide and Support

With the strong support of our state and government, the development of the shale gas industry has been promoted well, which provides conditions for the development of shale gas industry cluster. During the 12th Five-Year-Plan period, the state will focus on shale gas as a key energy and mineral resource to strategic investigate, explore and develop, and increase channels of the investment and financing. The implementation of national policy will promote technological innovation and industrial upgrading of shale gas and provide the impetus for the rapid development of the shale gas industry clusters. At the same time, under the guidance of national policy, local governments also invest in infrastructure construction and introduce preferential policies to promote the development of shale gas industry. At present, in domestic areas rich in shale gas, the government has guided to set up several shale gas industrial parks, such as the plan to build the port area of 3750.5 acres of shale gas industrial heavy equipment park in Chongqing. It is estimated that after the completion of park, output will reach 30 billion Yuan. In October 2013, "Shale gas industrial policy" has been published to promote the development of shale gas. Table 3 shows some of these policies.

4.3.2. Huge Potential Market

China is a piece of oil consumption big country. China’s natural gas production in 2011 was 102.5×10^9 m³, while consumption is 130.7×10^9 m³. The gap between supply and demand is almost 28.2×10^9 m³ [8]. And at present, the supply pressure of domestic oil and other energy is becoming much heavier, which make domestic energy are in short supply and natural gas price on the rise as a whole. While the
natural gas prices in the U.S. market continue to fall due to the significant increase in the amount of shale gas exploration. Price of domestic gas is 50% higher than that of the United States over the same period, which provides the opportunity for the development of shale gas industry in China. Meanwhile, domestic energy structure is not reasonable. For example, clean energy, only accounting for 4% of the total energy consumption, is 20% lower than the world average. In order to reduce air pollution and alleviate the pressure of oil and other energy supply, China will focus on developing clean energy in the future, which must lead to growing demand for clean energies. Shale gas has great market potential as a kind of efficient and clean energy.

4.3.3. The Deepening of International Communication and Cooperation

Government of China is encouraging domestic enterprises to strengthen exchanges with foreign countries. For example, domestic enterprises getting the right to exploitation of shale gas can carry out international cooperation and joint development. Up to now, many domestic companies have established cooperative relationships with the US. For example, CNOOC has set up R & D center in Houston. The deepening of international communication and cooperation and learning the commercial operation pattern from the developed countries such as the United States, Canada brought opportunities for the development of China's shale gas industry model.

4.3.4. The Accumulation of Related Experience in the Domestic Oil and Gas Industries

Oil and natural gas industries in China have accumulated valuable experience not only on the conventional oil and gas but also on industrial cluster models. The accumulation of related experience in domestic oil and natural gas industry cluster will provide reference for orderly development of shale gas industry cluster.

4.4. Threats

4.4.1. The Uncertainty of Resources

According to preliminary estimates, the shale gas resource of China has considerable development potential. But up to now, the investigation and evaluation of shale gas resources in China overall system have not been completed. Under the condition that potential resource and distribution of shale gas are still not clear, there is still great uncertainty in the development of shale gas. The United States has done a large amount of resource evaluation and basic research work in the early stage, which greatly promote the development of shale gas industry. Compared to shale gas resources in the United States, shale gas resources in China are generally buried deeper in our country, therefore the strategic investigation and evaluation work of shale gas resources becomes more important. But at present our country basic research significantly lags behind the actual need of shale gas development and the lack of a comprehensive survey and evaluation work.

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Table 2. Real distribution of China’s minable shale gas resource potential.

<table>
<thead>
<tr>
<th>Area</th>
<th>Resource potential (Trillions of Cubic Meters)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Yangtze and DianQian-Gui Area</td>
<td>9.94</td>
<td>39.63</td>
</tr>
<tr>
<td>North and Northeast China</td>
<td>6.7</td>
<td>26.7</td>
</tr>
<tr>
<td>Mid-lower Yangtze and</td>
<td>4.64</td>
<td>18.49</td>
</tr>
<tr>
<td>Northwest China</td>
<td>3.81</td>
<td>15.19</td>
</tr>
</tbody>
</table>

Table 3. Chinese shale gas industrial policy list.

<table>
<thead>
<tr>
<th>General Principle</th>
<th>Industry Supervising</th>
<th>Demonstration Build</th>
<th>Industry Technological Policy</th>
<th>Market and Transportation</th>
<th>Support Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO.4 Speed up the development of shale gas, encourage enterprises (include private enterprises) to invest into the shale gas industry.</td>
<td>NO.8 Build up proper supervising mechanism to supervise the development of shale gas.</td>
<td>NO.11 Encourage to build up demonstration area, accelerate the introduction of advanced technologies and foreign enterprise.</td>
<td>NO.19 To promote the development of shale gas, make standard specification about the use of land and set market price of shale gas.</td>
<td>NO.22 Encourage to build demonstration area, support the development of shale gas industry.</td>
<td>NO.31 Give financial support to developments of shale gas industry.</td>
</tr>
<tr>
<td></td>
<td>NO.9 Encourage cooperation with foreign enterprises with advanced and information technology and experience.</td>
<td>NO.13 Encourage to build up demonstration area, to build demonstration area together.</td>
<td>NO.21 The ex-factory price of shale gas is market-set prices.</td>
<td>NO.23 Give a lot of tax incentives to shale gas enterprises.</td>
<td>NO.34 Shale gas project can import equipments and technologies which can't be made in China without tariff.</td>
</tr>
<tr>
<td></td>
<td>NO.10 The use of land in demonstration area.</td>
<td>NO.15 Support to demonstration area.</td>
<td>NO.30 Shale gas industry can be brought into strategic area of China.</td>
<td>NO.32 Give financial support to enterprises with technologies which can't be made in China.</td>
<td>NO.33 Give financial support to shale gas enterprises.</td>
</tr>
</tbody>
</table>
4.4.2. Dependence on Foreign Technology and Fierce Competition

The success of the American commercial shale gas industry led to global development of shale gas industry. Its key to the successful development of the shale gas reason lies in the mastery of the horizontal well technology, multi-stage fracturing technology, hydraulic fracturing and a series of core technologies. Shale gas industry belongs to high-tech industries, which requires high cluster innovation ability. The exploration and development of shale gas in China is still in the exploring stage. High dependence on foreign technology and weak innovation ability make the sustainable development of the cluster lack of core power.

At the same time, because of the United States has a experience of commercial operation, we will face intense competition from foreign firms and the impact of the international market in the development of shale gas cluster in China. Although shale gas industry subsidies policy has been issued, but domestic enterprises doesn't dare to enter due to its own technology gap, which would not be conducive to the independent development of shale gas independent industrial clusters in China.

4.4.3. No Perfect Market Service System

Although the government department in charge of shale gas resources is open-minded, non-oil, and gas companies as well as much private capital have entered the shale gas industry. But overall, the three major oil companies are still the main body of exploration and development and technical engineering services of shale gas. The facts that a competitive market has not yet fully formed, a competitive market and a sound market system consistent with shale gas industry have not yet fully formed, and the role of market mechanism to optimize the allocation of resources is severely affected, which is not conducive to enter of general capital, will hinder the formation of the industry cluster.

4.4.4. No Formal Specification of Management System

At present, although investment and financing system of shale gas, as well as the related management system, has been put forward, but the system that can promote the system of the construction of the industry is still under discussion. And investment and financing management system relatively lag behind. Imperfect management system and regulatory policies make the formation of gas industry cluster lack of power, so now the industrial development of shale gas stays in the exploration stage, which is mainly composed of three major oil companies. And other aspects of progress are slow, which is not conducive to the formation of healthy and orderly industry cluster. Therefore, the related management system needs to be improved and implemented.

5. DEVELOPMENT STRATEGIES OF CHINA’S SHALE GAS INDUSTRY

5.1. The Analysis of SWOT Strategic Matrix

Through the above systematic analysis about strengths, weaknesses, opportunities and threats of China’s shale gas industry, we come to the SWOT strategic matrix of Chinese shale gas, including the strength - opportunity (SO) strategy, weakness - opportunity (WO) strategy, strength - threat (ST) strategy and weakness - threat (WT) strategy. SO represents the strategy that plays industry internal strengths and takes advantage of external opportunities. WO strategy represents the strategy that uses external opportunities to compensate for internal disadvantages. ST represents the strategy that utilizes internal strengths to avoid or reduce the external threats. WT represents the strategy that circumvent external threats while to make up for internal disadvantage. The contents of strategy are displayed in Table 4.

5.2. SWOT Strategy Formulation of China’s Shale Gas Industry

5.2.1. SO Strategy

First, take the opportunity of the supportive and guiding effect of policies, make full use of the rich resources, low-cost and low-pollution of shale gas to promote developments and make progress of the shale gas industry cluster. Meanwhile, industry cluster pattern promotes the development of the local economy and in turn tilts government policies towards cluster pattern. (S1, S2, S3, O1)

Second, take opportunity of the huge market potential of shale gas, exploit the abundant shale gas resources and gradually reduce the development cost. As the surrounding areas benefit from it, they develop side by side through mutual interaction. (S1, S2, S3, O2)

Third, absorb advanced technique to reduce production cost with the deepening of international communication and cooperation so that technical progress will be promoted and the size and amount of industry cluster will be increased as well. Furthermore, with reduce of shale gas’s exploitation cost, industrial competition ability is enhanced, thus effectively attract domestic foreign investment. (S2, O3)

Forth, learn from those successful experiences of cluster pattern, combine actual situation of shale gas to exploit the abundant energy resources and actively seek ways to reduce cost. Thus shale gas could be commercially available and in turn nurturing industrial cluster and region economy. (S1, S2, S3, O4)

5.2.2. ST Strategy

First, on the basis of rich resources reserves, make effective use of the orientation function of market and the pushing effect of industry cluster on region economy to guide the exploration and research of shale gas resources, for example, a comprehensive evaluation of nationwide shale gas. (S1, S2, S3, T1)

Second, on the one hand, use huge resource reserves and indigenous advantage of competitive advantage to compete with foreign competitors. On the other hand, when we are learning the successful experience of foreign countries, the advantages of cluster, including high internal efficiency and abundant research resources, should work to promote the progress of core technique. (S1, S2, T2)

Third, rich recoverable resource provides some relaxation effect on resource competition. Compared to independent
Table 4. The SWOT strategic matrix of Chinese shale gas.

<table>
<thead>
<tr>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>S (Strengths)</td>
<td>W(Weaknesses)</td>
</tr>
<tr>
<td>P1 Take the opportunity of the supportive and guiding effect of policies, make full use of the rich resources.</td>
<td>P1 take the advantage of government policy support</td>
</tr>
<tr>
<td>P2 Make use of the huge market potential of shale gas, exploit the abundant shale gas resources and reduce the development cost.</td>
<td>P2 Attract domestic and foreign investment to promote the progress of core technique</td>
</tr>
<tr>
<td>P3 Bring into advanced technique to reduce production cost.</td>
<td>P3 Set a feasible strategy to solve the shortage of capital, the backward technology and the contamination control</td>
</tr>
<tr>
<td>P4 Combine actual situation of shale gas to exploit the resources and seek ways to reduce cost.</td>
<td>P4 Learn experience from other industry cluster to promote the development of shale gas.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>O (Opportunities)</th>
<th>SO strategy</th>
<th>WO strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 Take the opportunity of the supportive and guiding effect of policies, make full use of the rich resources.</td>
<td>P1 take the advantage of government policy support</td>
<td></td>
</tr>
<tr>
<td>P2 Attract domestic and foreign investment to promote the progress of core technique.</td>
<td>P2 Attract domestic and foreign investment to promote the progress of core technique</td>
<td></td>
</tr>
<tr>
<td>P3 Set a feasible strategy to solve the shortage of capital, the backward technology and the contamination control.</td>
<td>P3 Set a feasible strategy to solve the shortage of capital, the backward technology and the contamination control</td>
<td></td>
</tr>
<tr>
<td>P4 Learn experience from other industry cluster to promote the development of shale gas.</td>
<td>P4 Learn experience from other industry cluster to promote the development of shale gas.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T (Threats)</th>
<th>ST strategy</th>
<th>WT strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 Guide the exploration and research of shale gas resources.</td>
<td>P1 Put more effects to the evaluation work of shale gas resource.</td>
<td></td>
</tr>
<tr>
<td>P2 Learn the successful experience of foreign countries.</td>
<td>P2 Publish policies to protect domestic shale gas industry and guarantee the shale gas healthy</td>
<td></td>
</tr>
<tr>
<td>P3 Relax the effect on resource competition and enhance competitive ability.</td>
<td>P3 Improve the market mechanism and create a good market environment for shale gas industry. Encourage small and medium size companies to participate in shale gas development work</td>
<td></td>
</tr>
<tr>
<td>P4 Determine a reasonable management system to effectively manage the industrial cluster.</td>
<td>P4 Determine a reasonable management system to effectively manage the industrial cluster</td>
<td></td>
</tr>
</tbody>
</table>

For the SHOC model, the development of the shale gas industrial cluster is characterized by the following features: 

- **Small and medium-sized enterprises**: These enterprises have greater power and a more effective development environment available, enhancing their competitiveness and ensuring the cluster is competitive in the market. (S1, S2, T3)

**5.2.3. WO Strategy**

First, take the advantage of government policy support. On the one hand, government will boost relative investment; on the other hand, relevant incentive policies will also attract more foreign investment, making up for the shortage of capital, making access to a breakthrough in core techniques, to provide the sustainable development of shale gas’s industrial cluster a solid backing. (W1, W2, O1)

Second, on the basis of shale gas’s great market potential, attract domestic and foreign investment effectively to promote the progress of core technique, then push the progress of shale gas’s resource evaluation and determination of mining standard. Eventually, accelerate the speed of shale gas development progress. (W1, W2, W3, O2)

Third, by means of communicating and cooperating with countries which have successfully developed shale gas industry, introduce and absorb international shale gas development advanced techniques. According to the industry conditions, set a feasible strategy to solve present problems such as the shortage of capital, the backward technology and the contamination control. (W1, W2, W4, O3)

**5.2.4. WT Strategy**

First, more efforts should be put into the completion of shale gas’s resource evaluation work to have a comprehensive view of the status of shale gas resources in China. It will help to attract more investment, determine a unified exploitation standard, then push the development of shale gas’s follow-up work and promote the development of shale gas industry. (W1, W5, T1)

Second, increase supportive efforts for shale gas industry and publish preferential policies to protect domestic shale gas industry and guarantee the shale gas healthy and ordered development. Speed up the research of core technology to achieve breakthrough on core technology as soon as possible. Get out of the lack of core technology as soon as possible and disengage from technology dependence on foreign countries. (W1, W2, T2)

Third, improve the market mechanism, and create a good market environment for shale gas industry. Encourage small and medium size companies to participate in shale gas development work to solve the problem of funds lack and slow
pace of development so as to achieve new breakthroughs. (W1, W2, T3)

Forth, determine a reasonable management system to effectively manage the industrial cluster and effectively control the pollution generated in the development process. Meanwhile, avoid vicious competition in internal cluster, encourage innovation and efficient operation and inject vitality into the shale gas industry development process.

CONCLUSION

The shale gas industry cluster in China is still in the initial stage of exploration. On the one hand we have an advantage, we must grasp the opportunity. On the other hand, we still have disadvantages, still face threats. Using SWOT method, the development mode of industrial cluster in Chinese shale gas was analyzed. At the same time, facing the industry cluster development of shale gas, we put forward four kinds of development strategies: strength–opportunity (SO) strategy, weakness–opportunity (WO) strategy, strength–threat (ST) strategy and weakness–threat (WT) strategy. When we produce the advantages of shale gas industrial clusters, we must grasp the external opportunities at the same time. Using external opportunities to make up for self disadvantages. Use their own advantages to avoid or reduce the external threat. Finally overcome disadvantages to avoid external environment threats.

As the Five-year Development Program is promulgated and implemented, the proportion of shale gas in the China energy structure will continue to increase. At the same time, China has gained rich experience and good results in the industry cluster development pattern. Therefore, industry cluster development pattern is feasible and worthy of further consideration and research.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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