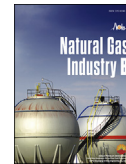




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Research Article

China's gas market under new situations: Trends and countermeasures – Taking Sichuan and Chongqing gas provinces as an example

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Abstract

The world oil and gas market has entered a new period of low oil prices, which has inevitably affected the natural gas market in China. So, it is urgent to timely study the market trends and to actively seek for appropriate countermeasures. In this paper, the development trends of China's gas market under the situations of New Normal and low oil prices were analyzed from the perspective of sustainable development of the natural gas industrial chain and market, by taking the Sichuan and Chongqing gas provinces as an example, which are of representative and of great significance to China in its natural gas market. The following trends were identified. First, the gas market reform will be deepened. Second, the competition among major market players will be intensified. Third, supply will exceed demand. Fourth, export tasks will be difficult. Fifth, higher demand of “guarantees of the minimum GDP, tax and profit” will be raised for local government. And sixth, low-cost strategy will be indispensable to oil and gas enterprises. In order to cater to these trends, some countermeasures were presented during the 13th Five-Year Plan. First, to improve the natural gas market system, to strengthen the supply-side reform, to complete market development modes, and to promote the introduction of governmental policies for relevant industries. Second, to develop the efficient gas-consuming clusters such as industrial parks, LNG-fueled vehicles and vessels, and distributed energy sources system, to establish innovative marketing strategy systems, and to boost the localization of resource consumption, through the establishment of strategic alliances for natural gas terminal markets in partnership with local governments and competitive enterprises, while the Chinese government is intensifying efforts in promoting energy conservation and pollution reduction and haze control. Third, to improve the cobweb pipeline network system, and to establish the strategic reserve system. And fourth, to make greater efforts to deepen internal reforms, to cut costs in a sustainable way through technological and managerial innovation, so as to respond to any changes in the natural gas market as a result of low oil prices.

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Keywords: New Normal; Low oil prices; China; Natural gas market; Industrial chain; Market changes; Countermeasures; Sichuan and Chongqing gas provinces

Now, the world oil and gas market has entered a new period of low oil prices, which has inevitably affected the natural gas market in China. In this paper, the development trends of

China's gas market under the situations of New Normal and low oil prices were analyzed from the perspective of sustainable development of the natural gas industrial chain and market, by taking the Sichuan and Chongqing gas provinces as an example which are of representative and of great significance to China in its natural gas market, and appropriate countermeasures were actively sought for in order to build confidence and to overcome difficulties.

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1. Characteristics and position of the natural gas industrial chain and market of Sichuan and Chongqing

1.1. As China's natural gas industrial bases, they own rich resources and complete industrial chains

The Sichuan and Chongqing gas provinces have a long history of natural gas industry and have the most complete natural gas industrial chain in China. They take a leading position in domestic natural gas output and sales, and have complete supporting elements of an industrial base, such as storage and transportation facilities, consuming markets, science & technology base, policies, co-construction between local governments and enterprises, and skill training [1]. Firstly, the Sichuan Basin is one of the regions with the richest natural gas and shale gas resources in China, and has become an indispensable support for regional economic development since China's first 10-million-ton-level large oil & gas field mainly for natural gas production was built in 2006. Secondly, Sichuan and Chongqing are regions with the most developed regional natural gas pipeline networks in China, which have laid a solid basis for their resource supply diversification and market development. Thirdly, Sichuan and Chongqing have the most mature natural gas consumption markets in China. During the “12th Five-Year Plan”, natural gas consumption in Sichuan and Chongqing increased by nearly $48 \times 10^8 \text{ m}^3$ from $185.3 \times 10^8 \text{ m}^3$ in 2011 to $233.22 \times 10^8 \text{ m}^3$ in 2015. As of the end of 2015, totally 159 counties (cities) in Sichuan and Chongqing had used natural gas, and gas coverage rate of these counties (cities) had reached 72%.

1.2. As one of China's natural gas storage and transportation hubs, they own perfect cobweb pipeline network systems and underground gas storages

Through continuous development and construction and market development for over 50 years, PetroChina and Sinopec have established their own gas transmission and distribution pipeline network in Sichuan and Chongqing respectively, forming the most complete regional cobweb pipeline network within China. With gas transmission trunk lines in the south and north as the main part and with gas source development areas as the support, the network provides a circular transmission pipeline network. Moreover, it has such features as complete high pressure transmission and low pressure transmission, support by underground gas storages (such as Xiangguosi gas storage) and strong deployment capability.

PetroChina Southwest Oil & Gas Field Company has established a pipeline production system which integrates natural gas production, transportation and sales, covers main gas-producing areas, connects main cities in Sichuan and Chongqing, and is connected with main pipelines in China through Zhongwei–Guiyang Connecting Line and Zhongxian–Wuhan Pipeline. It is the southwestern storage and transportation hub in China's oil & gas strategy channels. As of the end of 2015, PetroChina Southwest Oil & Gas Field

Company had built gas pipelines of totally about 9000 km with annual gas transmission capacity of $250 \times 10^8 \text{ m}^3$. Sinopec Southwest Oil & Gas Field, Puguang and Fuling Shale gas fields own gas pipelines of about 1100 km in Sichuan and Chongqing. These pipelines are mainly distributed in the west of Sichuan, the northeast of Sichuan and Fuling District of Chongqing. Sinopec's Sichuan-to-East Gas Pipeline is mainly used for transmitting natural gas produced by Puguang Gas Field to the eastern part of China.

1.3. As China's natural gas utilization demonstration areas, they own developed utilization industrial clusters

Through cultivation and exploitation for over 50 years, natural gas has occupied an important position in energy structure of Sichuan and Chongqing, and contribution of comprehensive utilization of natural gas to regional economy has reached domestic leading level. As natural gas has been widely used as main raw materials and fuel of various industries, industrial clusters developed by relying on natural gas utilization have been formed, mainly including urban gas industrial cluster, chemical fertilizer industrial cluster, chemical industrial cluster, metallurgical industrial cluster and building materials industrial cluster [2].

During the “12th Five-Year Plan”, PetroChina Southwest Oil & Gas Field Company sold about $809 \times 10^8 \text{ m}^3$ natural gas cumulatively in Sichuan and Chongqing, and Sinopec Southwest Oil & Gas Company sold $273 \times 10^8 \text{ m}^3$ natural gas cumulatively. Natural gas was supplied to over 1000 large and medium-sized industrial users, over 12 million residents and over 10000 public utility users in Sichuan and Chongqing. In 2015, natural gas consumption in Sichuan and Chongqing accounted for 12.9% of China's total consumption, and scale of natural gas utilization industrial clusters was the highest in China.

1.4. As China's natural gas policy drivers, they own industrial reform policy experimental areas

China's natural gas industry started in Sichuan and Chongqing. Many policies were promoted nationwide after pilot implementation in Sichuan and Chongqing first and after summarization and refining. In particular, pilot implementation of natural gas price reform and shale gas industry reform in recent years has played an important demonstration and leading role in domestic natural gas policy reform.

Under the background that self-produced gas output declined and China started to introduce foreign gas sources, Sichuan and Chongqing firstly explored rationalizing price policy on purchased gas in 2011. In 2012, Sichuan and Chongqing conducted pilot implementation of comprehensive gate station price reform first as main natural gas consuming regions, which directly promoted nationwide price reform. In 2013, Sichuan and Chongqing firstly conducted pilot implementation of settlement mode based on comprehensive price on the basis of incremental gas and existing gas price reform. In September 2015, the Sichuan

provincial government pricing catalogue made it clear that the government's natural gas pricing scope is “pipeline gas distribution price and sales price of gas for residential use”; that is to say, “sales price of pipeline gas” will not be determined by the government. Obviously, Sichuan and Chongqing have always taken the lead in pilot implementation of price reform and have deeply influenced the state's formulation of natural gas price policy.

Sichuan and Chongqing have actively promoted the development of shale gas industry reform. In 2009, the Changning–Weiyuan Shale Gas Industrialization Demonstration Area was built by PetroChina. In 2012, it was upgraded to be the Sichuan Changning–Weiyuan National Shale Gas Demonstration Area. In 2015, the Fuling National Shale Gas Demonstration Area was officially built under the leadership of Sinopec. These two industrial demonstration areas have formed four major development modes – domestic cooperation, international cooperation, risk development and self-support development, directly promoted the issuance of relevant policies such as shale gas subsidy, standard and industry planning, and led the industry's development.

2. Six major development trends of natural gas market of Sichuan and Chongqing during the “13th Five-Year Plan”

2.1. Natural gas price reform will continue to keep ahead domestically and regional natural gas trading centers will emerge

2.1.1. Governments of Sichuan and Chongqing will actively promote the establishment of reasonable price mechanism

Relevant governmental departments of Sichuan and Chongqing will actively promote the establishment of reasonable price mechanism, deeply study and promote natural gas energy valuation, natural gas pipeline transmission price mechanism under independent operation of regional pipeline networks, separate charging of pipelines and gas storages, tiered gas price reform, natural gas peak regulation price, and price integration of gas for industrial use and for residential use, and promote continuous improvement of natural gas price mechanism in Sichuan and Chongqing. In April 2015, Sichuan Province issued the *Notice on Strengthening Resource Factors Price Management and Stabilizing Industrial Economic Growth* (People's Government's General Office of Sichuan Province [2015] No. 30) with the aim to fully implement cost supervision and examination of natural gas pipeline operation enterprises and urban gas enterprises, promote urban gas companies to reasonably determine price difference of supply transfer of gas for non-residential use, and strive to increase sales of directly-supplied gas.

2.1.2. Sichuan and Chongqing will be the first to conduct pilot implementation of energy metering and valuation and to establish regional trading centers for demonstration

With pipeline interconnection and mixed sales of various gas sources into pipelines, it is urgent to implement natural

gas energy metering and valuation reform. As a pilot region for comprehensive innovation and reform, Sichuan will firstly conduct pilot implementation of energy valuation to provide demonstration for natural gas reform and also to lay a solid foundation for the establishment of regional trading centers in Sichuan and Chongqing. At present, natural gas metering technology of Sichuan and Chongqing reaches the domestic leading level, so no technical obstacle exists in natural gas energy metering.

In 2015, Shanghai Oil & Gas Trading Center was established and firstly carried out pipeline natural gas spot trading in China. The Sichuan provincial competent department for energy has completed research on issues regarding the establishment of natural gas spot trading market in Sichuan and has achieved obvious progress. Chongqing also plans to cooperate with the French company ENGIE to establish a regional natural gas trading center in Chongqing. Regional trading centers in Sichuan and Chongqing will complement each other with Shanghai natural gas trading market, and show the position and importance of natural gas markets of Sichuan and Chongqing in China. This is favorable for forming natural gas benchmark price in southwestern China and for accelerating the establishment of regional natural gas market system.

2.2. Competition in system reform and alternative energy will intensify and major market players will compete to achieve strategic shares

2.2.1. Competition in oil & gas system reform will intensify in the industry and major market players will compete for market shares

Oil & gas system reform will promote the opening of upstream and downstream and the independence of midstream backbone pipeline network, which will intensify competition in natural gas market. Operation of natural gas spot trading will impact the existing sales modes, break through the existing regional sales limits, challenge integrated transportation & sales mode, and impact planned sales mode.

Under the New Normal, market competition will intensify. To increase market shares, PetroChina and Sinopec have rapidly expanded natural gas market in Sichuan and Chongqing in recent years, and competed and cooperated by adopting such market strategies as price, joint venture, shale gas market-oriented pricing, “one-to-one” negotiation, and accelerating pipeline network arrangement and construction, and made great efforts to strive for strategic shares of natural gas market.

2.2.2. Competition between natural gas and alternative energy sources will keep intensifying and reverse replacement will occur in some gas-consuming industries

In recent years, price of alternative energy sources to natural gas such as coal and oil has kept dropping, competition between natural gas and alternative energy sources has kept intensifying, and price competition between energy sources has brought the effect of reverse replacement. For example, the gas company

under PetroChina Southwest Oil & Gas Field Company has faced the problem of water gas reverse replacement. Natural gas demand of a ceramics company within its market scope was $2400 \times 10^4 \text{ m}^3$ in 2013. As the ceramics market was stagnant, the company tried to replace natural gas with water gas for two production lines. In 2015, its natural gas demand was just $250 \times 10^4 \text{ m}^3$. Moreover, the development of new energy vehicles (mainly electric vehicles) will have a great influence on the development of the gas-fueled vehicles industry and restrict the growth of natural gas demand.

2.3. Natural gas supply exceeding demand and Sichuan gas export will become the New Normal, and cultivation of high-efficient utilization market will be a long way to go

2.3.1. Downstream demand will still keep at a low growth rate, and strong market supply capacity and gas export will be the New Normal

Although environmental protection and urbanization have promoted natural gas demand, under new situations, the overall growth rate of natural gas demand in Sichuan and Chongqing is still low, natural gas consumption structure shows a new trend, and natural gas power generation and natural gas distributed energy sources become the main growth points of future natural gas consumption.

In recent years, the natural gas supply capacity of Sichuan and Chongqing has improved significantly, output of such main gas fields as PetroChina Anyue Gas Field (Longwangmiao Fm gas reservoir) and CDB High Sour Gas Field has increased greatly. Sinopec has actively promoted the construction of “double ten billion” gas fields in Sichuan and Chongqing. Based on natural gas production plans of PetroChina and Sinopec, natural gas output in Sichuan and Chongqing will reach $600 \times 10^8 \text{ m}^3/\text{a}$ in 2020, and supply surplus will reach $200 \times 10^8 \text{ m}^3$; there will still be about $130 \times 10^8 \text{ m}^3/\text{a}$ natural gas resources difficult to be utilized in Sichuan and Chongqing after natural gas consumption demand in Yunnan and Guizhou has been satisfied. The pattern of supply exceeding demand will continue during the “13th Five-Year Plan”. On the basis of further expansion of local market, Sichuan gas export will become the New Normal.

2.3.2. Economic growth will slow down, and cultivation of new utilization industries in new markets will be a long way to go

According to the *New-Type Urbanization Plan of Sichuan Province (2014–2020)* and the *New-Type Urbanization Plan of Chongqing during the “13th Five-Year Plan”*, it is possible that urbanization in Sichuan and Chongqing will make gas consumption of the urban gas industry realize a rigid growth of 2.5%, but overall growth of natural gas market demand will slow down as the real estate industry enters the stage of long-term adjustment, investment demand will decline and gas consumption demand growth of such industries as urban gas, metallurgy, ceramics and glass will slow down due to the decline of economic growth.

Under the situation of low oil prices, advantage of natural gas price is not obvious, cost of LNG-fueled complete vehicles remains high, and cost of natural gas power generation is much higher than cost of coal-fired power generation and lacks relevant policy support, so new market cultivation is still a long-term, arduous task.

2.4. Third-party access will strengthen the construction of branch pipeline networks, and the construction of gas storage clusters will become the New Normal

2.4.1. Opening of national oil and gas pipelines will be inevitable, and natural gas pipeline networks of diversified investment subjects will increase

In 2014, the *Management Measures for Natural Gas Infrastructure Construction and Operation* and the *Measures for Supervision on Fair Opening of Oil & Gas Pipeline Facilities* were issued, which marks that opening of national oil and gas pipelines will be inevitable during the “13th Five-Year Plan”. In recent years, Sinopec has established such companies as Sichuan Natural Gas Investment Co., Ltd., Sichuan Natural Gas Chuandong Energy Co., Ltd. and Sinopec Chongqing Natural Gas Pipeline Co., Ltd. through cooperation with main local gas companies, local governments and other relevant enterprises in the energy industry in Sichuan and Chongqing. On March 1, 2016, PetroChina and Chongqing Gas Group established a joint venture – Chongqing Natural Gas Pipeline Co., Ltd., which is the first joint venture about natural gas pipelines established by PetroChina nationwide together with a local gas company. The joint venture will vigorously promote natural gas pipeline construction in Chongqing and accelerate natural gas “coverage of all counties” and supporting projects construction.

2.4.2. Construction of natural gas reserve facilities will be accelerated and gas storage clusters will become growing industries in Sichuan and Chongqing

Natural gas reserve facilities are one of the main means which ensure the security of natural gas supply. After diversification of natural gas supply and third-party access to pipelines, peak regulation and supply guarantee responsibilities of gas supply enterprises in Sichuan and Chongqing will be gradually reduced, which will promote them to strengthen the construction of gas storage facilities [3]. More importantly, five major gas-producing areas, eight major regional markets and four major strategic channels for natural gas import have been formed in China. Once one or several of transnational natural gas pipelines, such as Central Asia–China Gas Pipeline, Myanmar–China Gas Pipeline and Russia–China Gas Pipeline, stop gas supply due to such factors as political and economic contradictions and natural disasters, it is far from enough to just rely on the existing gas storage resources [4]. Natural gas storage resources are the richest in Sichuan and Chongqing. For example, large gas fields (e.g. Anyue Gas Field and Gaoshiti Gas Field) in central Sichuan Basin, large gas fields (e.g. Datianchi, Puguang, Tongluoxia and Shapingchang gas fields) in northeastern

Sichuan Basin, and gas fields (e.g. Yanggaosi Gas Field) in southern Sichuan Basin, which are sites selected for gas storage clusters can constitute a strategic reserve network with LNG peak-regulation reserves in the east. Their reasonable arrangement can meet the demand on strategic reserve and emergency peak regulation of Central Asia–China and Myanmar–China pipeline gas [5].

2.5. Economic development speed of Sichuan and Chongqing will be among the highest in China, and local governments will raise higher demands on “guarantees of the minimum GDP, tax and profit” for gas supply enterprises

2.5.1. Economic growth rate of Sichuan and Chongqing will still be higher than China's average, and local governments will have growing demand on “guarantees of the minimum GDP, tax and profit”

It is predicted that in the period of 2015–2020, Sichuan's regional GDP growth rate will gradually decline from 7.5% to 6.5% and Chongqing's regional GDP growth rate will decline from 9.5% to 8.5%. However, due to such factors as low growth base, industrial transfer, urbanization acceleration and big space of industrialization demand during the “13th Five-Year Plan”, and especially more national policy support to central and western regions for promoting sustainable and healthy economic development under the New Normal, economic growth rate of Sichuan and Chongqing will still be higher than China's average.

As large gas fields including Pugang and Anyue gas fields have been successively discovered in recent years, local governments have raised higher demand on “guarantees of the minimum GDP, tax and profit” for gas enterprises. For example, governments of some regions have required that gas supply enterprises should not reduce output even under the situation of low oil price, should attract investment through cheap natural gas resources even though the local natural gas market is not mature, and leave low natural gas amount indexes, and establish terminal gas companies through mixed ownership to jointly develop natural gas.

2.5.2. Safety and environmental risks and policy supervision environment will be stricter and tougher, and the task of realizing harmony between local governments and enterprises during natural gas development will be arduous

National financial and taxation policies and legislation supervision will be stricter. Such preferential policies as shale gas subsidy policy will be reduced or hardly be kept. Official implementation of “two new laws” (namely, new versions of the Production Safety Law of the People's Republic of China and the Environmental Protection Law of the People's Republic of China) will increase the pressure of constraints on safety and environment protection. Contradiction and communication difficulties between local governments and enterprises in such aspects as land acquisition and demolition, ecological compensation and collection of

taxes and fees will increase. The task of coordinating relations between local governments and enterprises will be more arduous.

2.6. Oil price will be low, meager profit of natural gas market will fluctuate, and enterprises' low cost strategy will promote quality and efficiency

2.6.1. Market will be sluggish and gas price will be low under low oil price, and profit space of sales enterprises will narrow

Under the situation of low oil prices, the advantage in natural gas price is no longer obvious. Due to the impact of macroeconomic downturn, overall growth rate of gas consumption by industries, businesses and collectives will show a decline trend. International market and national policy will cause a slight decline of gas demand of the chemical fertilizer industry whose gas consumption scale is relatively big; new energy vehicles will restrict CNG/LNG consumption amount and coverage; gas demand of such industries as traditional chemical industry, glass, ceramics, steel and non-ferrous metals will possibly decline or almost not grow. Market sluggishness and low gas price will affect the profit of gas supply enterprises.

2.6.2. Low cost and low oil price have become the New Normal, and low cost strategy is a must for oil and gas enterprises to enhance quality and efficiency

Since 2015, international oil price has fluctuated at a low level, market sluggishness and low gas price have accelerated the formation of meager profit in natural gas market, the situation of rigid rise of exploration and development cost has become increasingly serious, the market has been more open, competition has become more intense, price fluctuation has become more frequent, and the number of factors restricting natural gas industry chain and market has increased. But these have forced relevant enterprises to transfer mode, adjust structure, lower cost and enhance benefit, thereby accelerating transformation and upgrading and realizing low-cost development [6].

Transportation of natural gas from Sichuan and Chongqing to eastern markets will cause benefit losses to suppliers. For example, PetroChina Southwest Oil & Gas Field Company transports natural gas to Shanghai, and its sales price is close to gas supply cost, so its profit is meager or almost zero. As to importing natural gas resources according to “take or pay” agreement, its proportion is high, price is high, resource allocation lacks elasticity and flexibility, and long-term trade contract on import restricts enterprises' benefit increase and causes negative impact on the development and utilization of tight gas and shale gas in Sichuan and Chongqing. Thus, gas supply enterprises, storage and transportation enterprises and sales and utilization enterprises should strengthen cost decreasing and benefit increasing and take the route of low-cost development — this is the need under the objective situation of market competition and the necessary choice for sustainable development.

3. Countermeasures for natural gas market in Sichuan and Chongqing

3.1. Strengthen top-level design of modern natural gas market and promote natural gas market-oriented reform

3.1.1. Accelerate the establishment of modern natural gas market system and strengthen supply-side structural reform

In the Third Plenary Session of the Eighteenth CPC Central Committee, it was required that markets should play a decisive role in resource allocation which must need a perfect modern market system. Governments of Sichuan and Chongqing required in the “13th Five-Year Plan” that a unified and open modern energy market system with orderly competition should be established. So, Sichuan and Chongqing should accelerate the establishment of modern natural gas market system which is comprised of such markets as natural gas industry chain (producer, supplier, sales and utilization businesses) market, reserve market, science & technology and equipment market, trading market, finance market and information market and guarantee basis relevant to natural gas market.

Under the new situation, supply-side structural reform of the natural gas industry in Sichuan and Chongqing should be promoted. Industry and market structure adjustment is realized mainly through reforms. IT means should be actively adopted. Connotation of natural gas product supply shall be enriched through services. Adaptability of natural gas supply should be enhanced. Excess and low-efficient capacity in Sichuan and Chongqing should be strictly controlled. Quality and benefit of natural gas production and supply in Sichuan and Chongqing should be highlighted.

3.1.2. Accelerate the promotion of natural gas pricing mechanism and price market-oriented reform

Market-oriented reform of natural gas gate station price should be actively promoted, and linkage mechanism on natural gas price and alternative energy price should be further improved. Detailed rules for the implementation of fair opening of regional pipeline infrastructure and gas storages should be promoted, to promote pipeline interconnection construction of pipeline companies in the region. Independent operation mechanism on gas storage facilities should be established, and pilot implementation of peak regulation gas price should be carried out. Gas transmission and distribution price system and short-distance pipeline transmission expense system should be established, and tiered price policy on natural gas should be implemented and deepened.

3.2. Establish strategic alliances for natural gas terminal markets, and create reasonable and high-efficient utilization industry clusters

3.2.1. Explore the potential of industrial park market based on action plans on air pollution treatment of Sichuan and Chongqing

In both the *Detailed Rules for the Implementation of Action Plan on Air Pollution Prevention and Treatment of Sichuan*

Province and the *Opinions on the Implementation of Action Plan on Air Pollution Prevention and Treatment of Chongqing*, the goal of coal ban in 2017 was put forward and such measures as increasing natural gas supply, the project of changing from coal-burning to gas-burning, and cogeneration or centralized heat supply transformation in industrial parks and industrial concentration areas were also put forward. These measures will provide bigger space for the industrial layout optimization in Sichuan and Chongqing during the “13th Five-Year Plan”, especially gas utilization in industrial parks. It is predicted that gas demand of existing and new industrial parks (economic development zones) will be $60 \times 10^8 \text{ m}^3$ and newly increased gas demand will be $25 \times 10^8 \text{ m}^3$ in 2020. Thus, gas supply enterprises should actively communicate with the management committees of industrial parks, cooperate with local governments on energy (gas) development planning and actively assist local governments with investment attraction; actively promote the development of new area market, link urban gas demand in Sichuan and Chongqing, and focus on such work as the development of pipeline natural gas in Sichuan and Chongqing and in remote and border areas of Yunnan and Guizhou, regional market demonstration and pipeline planning.

3.2.2. Actively develop markets of LNG-fueled vehicles and LNG-fueled vessels, and jointly promote the development of natural gas distributed energy sources through strategic alliances

The Sichuan Development and Reform Commission and the Department of Transportation of Sichuan Province distributed the *Layout Plan on LNG-fueled Vehicles Filling Stations in Expressway Service Areas of Sichuan Province (2015–2018)*. Based on the plan, 153 LNG filling stations will be built to preliminarily form a service area filling station system which covers expressway networks throughout the province in 2018. It is predicted that in 2020, the number of LNG vehicle filling stations newly increased in Sichuan and Chongqing will be 250 and the amount of gas consumption newly increased will be $20 \times 10^8 \text{ m}^3/\text{a}$. In 2013, Chongqing issued the *Plan on High-efficient LNG Utilization of Chongqing*, which indicated that the number of LNG-fueled vehicles should reach 50000, that of LNG-fueled vessels should reach 300 and “all-in-one” comprehensive utilization of LNG reserve, peak regulation, power generation, cooling and heating in Chongqing should be realized in 2020. Thus, formation of strategic alliances between gas supply enterprises and downstream transportation enterprises should be promoted to actively push the arrangement and construction of LNG stations and to promote the development of natural gas market in transportation field. Natural gas terminal companies should carry out the construction and operation of LNG filling stations in an orderly manner, accelerate promoting the formation of LNG terminal and diesel price linkage mechanism, extend LNG industry chain and increase its value.

Action plan on energy Internet will greatly promote the development of gas power generation and distributed energy market. According to incomplete statistics, based on the

preliminary plan, there will be 61 natural gas distributed energy projects in Sichuan and Chongqing during the “13th Five-Year Plan”, total installed capacity of gas turbines will be nearly 5000 MW and potential natural gas demand will be up to $68 \times 10^8 \text{ m}^3/\text{a}$. Thus, gas supply enterprises should establish strategic cooperative relations with distributed energy enterprises, local governments and local investors, establish strategic alliances with main power grid companies, power companies, important real estate enterprises and hotel groups, or invest into construction of distributed energy projects, so as to jointly promote the development of natural gas distributed energy sources.

3.3. Improve the cobweb pipeline network structure in Sichuan and Chongqing, and accelerate the establishment of strategic reserve system for natural gas

3.3.1. Establish cobweb storage and transportation network system and promote market opening and optimization

Improvement of internal and external transportation pipeline networks of Sichuan and Chongqing should be accelerated. Based on the principle of coordinated development of production, transportation and sales and based on comprehensive consideration of resources and market distribution, pushing role of third-party access should be further enhanced on the basis of the existing “three horizontal, three vertical and three circular” pipeline network structure, construction of pipeline facilities and optimal resource allocation should be promoted, and full coverage of branch pipeline networks in main cities above the county level and key industrial parks in Sichuan and Chongqing should be realized, to form a cobweb pipeline network pattern leading to all directions and featuring flexible deployment with backbone channels and gas storage clusters as adjustment center and with regional branch pipeline networks as market support which meet the demand on market opening, gas amount deployment, emergency guarantee and fair pipeline opening. Moreover, economy and efficiency of centralized or decentralized construction of natural gas emergency reserve facilities should be valued and strengthened, and a lesson should be learned from “gas shortage” problem which occurred in such regions as Beijing, Shaanxi, Jiangsu, Sichuan and Chongqing in previous years.

3.3.2. Establish a strategic natural gas reserve system as soon as possible, and promote steady market development

Reserve market is an important part of modern natural gas market. Sichuan and Chongqing have rich available gas storages and large gas fields. Site selection and arrangement of strategic reserves of large gas fields should be strengthened, resource reserve should be done in advance, and regional strategic natural gas reserve system should be established first.

Diversification of import channels of Sichuan and Chongqing should be promoted. Interconnection with such national backbone pipelines as Zhongwei–Guiyang Gas Pipeline, Zhongxian–Wuhan Gas Pipeline and Myanmar–China Gas Pipeline should be promoted. Deep integration between pipeline markets nationwide and pipeline

markets of Sichuan and Chongqing should be promoted. Market-oriented operation systems and mechanisms should be established. National unconventional gas development industrial demonstration areas should be established in Sichuan and Chongqing. Preferential policies of “national industrial demonstration areas” should be enjoyed. International cooperation should be carried out actively. Development benefit and market competitiveness of unconventional gas should be enhanced through technological innovation. Development of unconventional gas cleaning scale benefit should be motivated. So natural gas reserve systems of Sichuan and Chongqing and nationwide reserve system will rely on and support each other.

3.4. Continuously deepen enterprises' internal reform, and actively implement low cost strategy to enhance quality and efficiency

3.4.1. Deepen internal reform and fine management, and implement natural gas strategic marketing to expand profit space

Low-cost development should be upheld. Unproductive expenditure should be reduced. Reform of personnel and labor allocation system should be deepened. Growth of labor cost should be controlled. Wages and benefits linkage appraisal mechanism should be improved. Multiple contracting forms should be adopted. Internal adjustment, transfer and exit mechanism should be established.

Strategic marketing of natural gas should be implemented and linkage mechanism on enterprises, governments and users should be established to expand profit space. Communication and coordination with local governments and customers should be actively done. Multiple means for strengthening sales management should be adopted [7]. Marketing concept should be changed, marketing strategy analysis should be strengthened, and marketing mix strategy (namely price strategy, market development strategy, contract management strategy, market competition strategy, terminal marketing strategy and customer service strategy) should be implemented. Capital operation should be strengthened. Social capital should be introduced actively. Diversified setting of shares proportion should be explored. Excellent customers should be cultivated. Diversified marketing modes should be explored. User management system should be established. High-end user groups should be cultivated actively. Determining sales based on benefit, determining output based on sales and arranging production based on benefit should be adhered to. Advantages of integrated production, transportation, sales and storage management should be given into full play.

3.4.2. Establish natural gas science & technology innovation system to drive industrial development and upgrading through innovation

Under the new situation, Sichuan and Chongqing should further deepen the reform of science & technology system and incentive mechanism with natural gas production enterprises as the center, and establish a science & technology innovation

system suitable for natural gas development in Sichuan and Chongqing. Natural gas industrial technology research institutes should be built by relying on the backbone oil and gas enterprises in Sichuan and Chongqing. Talent incentive, application and promotion of scientific and technological achievements and benefit sharing mechanisms should be improved. Innovation capability of enterprises relevant to natural gas should be enhanced. Efforts should be made to promote the development of technologies about natural gas exploration, development, storage, transportation, utilization and economic management. Focus should be put on cultivating ecological natural gas industry chain technologies. The natural gas industry should be led to realize low carbon development. Tangibility and commercialization of scientific and technological achievements should be promoted.

Natural gas market network and think tank should be built. Decision-making capability of governments and enterprises about market development should be improved. To actively adapt to “Internet+” natural gas situation, new operation modes including E-commerce, online direct sales, mobile marketing and remote services should be explored and developed. Construction of digitized gas fields should be further strengthened. The goal of intelligent gas fields should be achieved. Efforts should be made to enhance modernized management level and value creation capability of oil and gas enterprises.

In conclusion, Sichuan and Chongqing are the most typical representatives of China's natural gas market and the epitome of China's natural gas industry. Development trends of their

natural gas markets and countermeasures under the New Normal have reference significance for other regions. We firmly believe that the new situation will bring severe challenges and also new opportunities. With the deepening of market reform during the “13th Five-Year Plan”, China will definitely create new low carbon social and economic values in the continuous market reform as long as we are based on global energy market, strengthen management, control and risk early warning of natural gas market strategies, and accelerate the change of development mode of the natural gas industry.

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