Power Price Supervision in the EU, Portugal and Germany: Surveys and Enlightenments

On September 9-18, 2018, a mission formed by the Department of Price of the National Development and Reform Commission visited Portugal, Belgium and Germany, and exchanged views with them on a broad range of topics, including power transmission and distribution price supervision, power price reform and new energy price mechanism, upon the invitation from the Directorate-General for Energy, the German Federal Network Agency, Portugal's energy service and supervision commission (ERSE) and other institutions. Moreover, the mission also visited Energias de Portugal (EDP), the Council of European Energy Regulators, WindMW of Germany, Bundesverband der Energie- und Wasserwirtschaft (BDEW) and Eurex Exchange. We are hereby reporting relevant information as follows:

I. Basic Situation

i. About the uniform power market in the EU.

Since 1999, the EU has made every possible effort to open up the power market in a move to mitigate the dependence of the EU's overall energy market on external supply, promote the member states

to realize the diversification of energy supply and ensure the EU's fulfillment of safe, sustainable and affordable energy supply through opening up and integration of the internal energy market. Experiencing the evolution from single national market to multinational regional market by stage, the EU's uniform power market now covers a total of 23 countries and mainly features day-ahead market combination. So far, the EU has preliminarily forged a power trading platform optimizing resource allocation over a broad range.

In 1996, 2003 and 2009, the EU issued three energy reform acts, which define the overall framework and basic principles for the reform of the energy industry and are used to guide the reform in different member states. The EU has carried forward its reform of energy policy and power system based on three basic principles, including competition, security of energy supply and sustainability. On this basis, the EU has set the core objectives, including emission reduction, increase in the proportion of renewable energy and increase in the energy efficiency, as well as the roadmap and key time nodes to fulfill the objectives. In particular, the third energy act issued in 2009 mainly includes the following points: First, split monopoly businesses of vertically integrated companies; Second, different member states should set up independent supervisory

authorities that should mainly perform the responsibilities to supervise and certificate whether the split of generation, transmission, distribution and sales meets the requirements, supervise the effectiveness, openness and equality of the market, prevent market and price manipulation, formulate and supervise cost and price rules of monopoly businesses, supervise planning and investment access regarding monopoly businesses, and supervise the fair access, openness and power quality of grids. At the same time, the EU has launched the Agency for the Cooperation of Energy Regulators (ACER) and the European Network of Transmission System Operators for Electricity (ENTSO-E); Third, establish uniform rules governing the power market and grid operation to promote power market integration and multinational power trading; Fourth, strengthen user protection, empower power users to select power sales companies and take special measures to protect vulnerable groups.

After more than 20 years of unremitting effort, the EU has made evident progress on the way to build a uniform power market. The EU is now working to build the uniform power market and has made the following major effects, shows the report on the construction progress of the uniform energy market published by the European Commission in October 2014: (1) In 2008-2012, the

wholesale price of power fell down by 1/3, and that of natural gas kept stable; (2) Users have gained more options; (3) Multinational energy transmission infrastructures have been built; (4) Multinational power and natural gas transactions have grown, and the use of general network rules has increased the utilization efficiency of natural gas transmission pipes; (5) The EU's legislations have ensured fair opening up of the network without discrimination, assured fair competition in the market and prevented price manipulation.

ii. Basic situation in Portugal

The Portuguese power market is part of the Iberian power market. Redes Energeticas Nacionais (REN) monopolizes power transmission of Portugal and comes under rigorous income supervision of the government. Its major responsibilities are national power grid planning, building, operation and maintenance as well as scientific research and development. As to power distribution, Energias de Portugal (EDP) is the largest power distributor with a market share of 99% in Portugal, and the government implements dynamic supervision of the power distributor, and supervises its cost and net asset compensation. At the same time, the government encourages loss reduction and inspires its investment. In 1995, Portugal issued the power act and decided to deregulate the power

industry and introduce competition, based on the expectation of the first energy act of the EU. After Spain built the power wholesale market, Portugal borrowed the experience from Spain and signed an agreement in 2001 with Spain after continuous discussion with the Spanish authority. According to the agreement, Portugal would join the Spanish power market to form the Iberian power market and both parties would decide to increase the capacity of the interconnected grid in order to conduct power wholesale transactions and reduce the constraint on power distribution. In July 2007, the Iberian day-ahead power market came in operation, signifying formal start of the Iberian power market.

In the Iberian power market, power transmission assets are fully separated from generation, distribution and supply assets, where grid companies monopoly power transmission, and other power enterprises can simultaneously hold generation, distribution and supply assets and conduct corresponding businesses. To encourage power generation with renewable energy and combined heat and power generation, the market defines special power generation operators and provides special power price or compensation policy. Due to the existence of regulated users, the market sets special baseline power sellers that deliver general services, sell power to regulated users and buy power from special power generation

operators. Of power generation, transmission, distribution and supply, transaction and power supply on the generation side have fully realized liberalization, and users can select power providers at their own discretion, while special generation operators, power transmission, power distribution and baseline power sellers still come under income supervision of the government.

The Iberian power wholesale market consists of a forward market and a spot market. In particular, the spot market sets trading intervals based on hour and adopts the power pool mode, mainly including day-ahead market, intraday market and auxiliary service market. Portugal and Spain trade power in the same day-ahead market and intraday spot market, and special generation operators and baseline power sellers should also need to participate in the price bidding in the spot market. The auxiliary service market is separated, and system operators of Portugal and Spain manage the market respectively and deliver local auxiliary services. After 2014, both countries have attempted to perform tertiary standby transactions with the multinational power transmission line. The forward market mainly provides financial transactions for market players to stave off risks.

iii. Basic situation in Germany

Located in the central part of Europe, Germany has developed

manufacturing sector sectors and is the largest economy in Europe, the seventh largest power consumer in the world, and also the country with the largest installed capacity, power output and power consumption in Europe. The shares of nuclear energy, lignite and hard coal have kept falling, while renewable energies have made a rising contribution. In 2016, coal contributed about 40% of the power output, while renewable energy contributed 29% of the power output. Wind energy and solar energy are the most important renewable energies during Germany's energy transformation. Highly attentive to energy transformation, Germany aims to cut down greenhouse gas emissions by 40% from 1990 to 2020, close down all nuclear power stations prior to 2022, and provide safe, affordable and environment-friendly energies in 2050. Over past years, the country's power demand has kept growing steadily. The power consumption annually grew 0.7% on average in 1991-2010, and has kept stable since 2010. Structurally, top three power users are industry, resident and commerce. Germany has the highest power price level, which is about EUR0.194 (about RMB1.6. The unit is kWh, the same below) now, and in particular, the power price for the resident sector is about EUR0.292 (about RMB2.4), and that for large industry is EUR0.11 (about RMB0.9).

In 1998, Germany started reforming the power market by

introducing competition to power generation and sale and deregulating prices, implementing monopoly for power transmission and distribution and performing rigorous price supervision. Also in 1998, Germany issued the electricity industry law, amended the Energiewirtschaftsgesetz (Energy Economy Law) and adopted the Law against Limiting Competition. It started the power market reform by separating power stations and power grids, introducing competition to power generation and sales but still maintaining original monopoly for power transmission and distribution. In 2000, Germany successively set up two power exchanges, including Leipzig Power Exchange and European Power Exchange. In September 2007, the European Commission published a directive draft that requires effective separation of power generation and supply from business activities of the power grid, particularly in proprietorship. At the same time, the directive requires all member states reinforce the power and independence of regulators, establish the mechanism of cooperation between national regulators, set up the organization for cooperation of energy supervision and improve the transparency of the retail market.

As to market business (power generation, trading and sales): In these three segments, a few new companies have gradually risen after the former four utility operators (EON, RWE, EnBW and

Vattenfall). However, these four companies still engage in power distribution, distribution, retail and other segments and dominate the German energy market after splitting their power transmission assets. The retail market is highly competition, and final power users can select as many as 106 suppliers. The power transaction includes spot transaction and futures transaction. In detail, the spot market transaction is organized by European Power Exchange, which accounts for 89% of the day-ahead transaction volume, while the intraday transaction takes a share of 11% with a trading cycle form 15 minutes to 1 hour. Options and futures transactions are organized by Eurex Exchange and include 1-year, 2-year, 3-year, 4-year transactions as well as transactions over a longer term, and 1-year transactions account for 59% of the total transaction volume. Higher competitive level in the power market has caused the power price on the generation side to fall down from EUR0.084 in 2009 to EUR0.056 at present.

As to regulated businesses (power transmission and distribution): Germany has 4 power transmitters and more than 880 power distributors. The power transmission price and the power distribution price of power distributors (about 100) with more than 100,000 connected users are subject to supervision by the German Federal Network Agency established in 2005, while the power

distribution price of more than 780 power distributors with less than 100,000 users are subject to supervision by supervisory authorities of different states. After Germany fixed independent power transmission and distribution prices in 2008, the power transmission and distribution price fell down to some extent from EUR0.059 in 2008 to EUR0.0573 in 2009. However, extensive expansion and upgrade of the power grid aimed to connect renewable energy caused the price to rise and reached EUR0.0748 in 2017.

II. Europe's Major Practices for Reform of Power Market and Price

Except for a very few regions, the European countries have basically deregulated power generation and sales and implemented rigorous supervision of power transmission and distribution. The keys of the reform are the establishment of the power wholesale market, the access of power grid, the supervision of power transmission and distribution price, and the deregulation of the power sales market. Besides, they have also performed beneficial attempts to determine the price mechanism for renewable energy.

i. Establishment of power wholesale market. It mainly includes covers three parts. First, the spot market based on the short-term marginal cost. The market comprises the day-ahead market, the intraday market and the balance market. The day-ahead market

sequences marginal cost quotations of different generating units from low to high, defines the quotation of the last generating unit satisfying the requirement as the power price for market clearing, pays to all generating units, and determines the arrangements for power generation at different time periods of the second day. The intraday market and the balance market perform power transactions based on changes in the forecasts of load, output and other factors during the time period from 24 hours before generation to generation, adjust results of the day-ahead market to satisfy the demand. Second, the medium and long-term market based on the long-term average cost. A power supplier can sign a medium and long-term power purchase agreement to lock up the price and avoid the risk of price fluctuation in the spot market. The price is the long-term average cost with reference to the spot market price and it is an option of power generation companies to recover the fixed investment cost. The direct power purchase agreement can take the form of either a physical agreement or a financial agreement. Third, build a capacity market to offset the fixed investment cost. The spot market is the market clearing result based on the marginal cost, so some generating units with high fixed investment cost, particularly those with new energy, can’t earn adequate incomes from the spot market to keep running. To this end, some European countries have built the

capacity market to make payments for the usable capacity provided by a generating unit for the system, which is irrelevant to power output. In other words, they don't buy the power output but buy the power generation service.

ii. Access to power transmission grid. The opening up of the European power market involves splitting generation, transmission, distribution and sales and also deregulating the access to the power grid. This means other users also can pay at the open rate and obtain power transmission services, and power transmitters shouldn't simultaneously hold generation assets or shouldn't provide discriminatory services for their own generation assets that are superior to those to other power generation companies. Meanwhile, a special transaction center should be established to handle market operation affairs such as power trading, clearing and settlement after the establishment of the wholesale market. In view of physical attributes of power supply, including real-time balance and transmission constraint, the center should confirm the channel constraint with the grid operator and assure the transaction result will be safe and feasible in the system. Thus, at the early stage after market deregulation, the grid operator was responsible for operating the transaction center but came under supervision of the supervisory authority to ensure fair and equitable market transactions in

Netherlands and other countries. In many other European countries, the center is independent of the grid operator but should still closely coordinate with the latter and even maintain some equity held by the latter to assure safe market operation.

iii. Supervision of power transmission and distribution price. The supervision of power transmission and distribution price is still dominated by different member states, though the EU is now working to build a uniform power market. Germany and Portugal both separate power transmission and distribution in the power system, and implement the price management mode by defining the income ceiling for grid operators, which mainly includes the following characteristics: First, operating cost management based on performance. The asset structure and cost of the power transmission system are rather clear, so the fixed cost is estimated mainly with rigorous cost accounting with a consideration of depreciation and return on investment. The performance-based cost ceiling method is applied to the operating cost. This method determines the income ceiling not based on the actually incurred cost but inversely estimates the allowable cost of an enterprise based on its performance. The steps of the method include: First, determine major performance indicators that influence the operating cost (such as number of served consumers, provision of power and total length

of power transmission line), then, design an economic model to calculate the relationships between these factors and the operating cost, and finally, determine the operating income ceiling of the enterprise based on its performance for a given year. The method can avoid the issues of how to judge whether the operating expenditure of an enterprise is reasonable and helps inspire the enterprise to increase the operating efficiency and thus earn a higher income. Second, ask the company to reduce the cost annually during the regulatory period. Germany and Portugal both require an enterprise annually reduce the operating cost during every regulatory period for the purpose of stimulating the enterprise to continuously enhance its operating efficiency. Concrete methods include historical data comparison and enterprise benchmarking method. The former applies when there is only one grid operator. For example, Portugal requires the operator continuously reduce the income ceiling during one regulatory period and the starting point of the income ceiling during next regulatory period should be no higher than the ending point during the previous regulatory period. The latter applies to those countries having more than one grid operator. For example, Germany assesses efficiency levels of different operators by defining the benchmark, compares their cost and performance levels after deducting their uncontrollable cost influences, allows an operator

with a higher efficiency level to keep the allowable cost at a relatively fixed level during next regulatory period, and asks an operator with a low efficiency level to substantially reduce the annual income ceiling during next regulatory period. Third, multiple authorities share regulatory data. Portugal consigns third parties to collect and validate various cost and operating data of the grid operator, and these data will also serve the cost audit by the Portugal's energy service and supervision commission (ERSE) and the taxation basis for the treasury. The data sharing among different authorities can avoid repeated work. At the same time, it will also help these authorities realize joint supervision and increase data accuracy.

iv. Deregulation of power sales market. Deregulation of the power sales market can promote power sellers to integrate users, design differential services and products based on characteristics and demands of users and improve the service quality. Also, deregulation can inspire users to respond to price signals and guide power management on the user side. When deregulating the power sales market, Portugal and other countries have set up baseline power sellers to ensure the transition of power sales price from regulation to deregulation. At the early stage, users can freely select power sellers and also can select baseline power sellers providing

government-controlled power prices. After users gradually become familiar with power services and products, they will be required to shift to independent power sellers, and controlled power prices will continue to apply only to impoverished users and other special users. To help users better select power sellers, Germany has set up a special Internet platform that regularly discloses related information and data for consumers to select sellers.

v. Refine the price mechanism for renewable energy. The EU is the earliest that has defined the renewable energy development objectives. It has allocated the objectives to different member states based on variances of their power systems and resource endowments and designed corresponding framework. However, the subsidy demand has posed a growing conflict with the fiscal payment capacity and consumers' affordability as the proportion of new energies keeps rising. To this end, the EU has experienced the evolution of the policy instruments encouraging renewable energy development from unit subsidy to premium subsidy and finally to market competition. In this process, the benchmark price for renewable energy generation obviously fell down in Europe. During 10 rounds of bids of small solar photovoltaic projects in Germany in the year of 2015—2018, the benchmark price moved down from EUR0.0917/kWh to EUR0.0433/kWh. During the marine wind

power bidding in 2018, even a few projects claimed a zero subsidy to access the power grid.

III. Enlightenments for China's Power Market Reform

Compared to the mature power markets in the European countries, China has just started the power market reform, and should borrow their practices in relation to construction of market system, design of transaction rule and price mechanism, compliant market operation, application of market rules to inspire clean energy development and other aspects.

i. Accelerate the pace to establish and refine the power market system. A systemically sound power market system substantially consists of the spot market based on the short-term marginal cost (day-ahead, intraday and balance markets), the medium and long-term market based on the long-term average cost, the capacity market based on the offset of fixed investment cost, the auxiliary service market, the green certificate market and the carbon sequestration market. Financial derivatives, including financial futures contract on right of power transmission, power futures contract and contract for differences, further supplement and refine the power spot market, provide effective instruments for market players to realize price locking, arbitrage and risk avoidance, and promote safe, stable operation of the power market. At present, when

performing the power market reform, different regions of China mainly allow some generating units to participate in single medium and long-term power trading, which limits the flexibility and liquidity of the trading market. The auxiliary service and other markets have not started building, so these markets can't reflect the differences in power cost and value between different time periods, can't reflect the balance between peak and valley, and become difficult to guide optimal resource allocation both temporally and spatially with market price signals. Therefore, we should actively learn the experience of the European power market, see the building of the power market as a systematic project, elaborately design the implementation framework for a modern power market, including spot trading market, medium and long-term trading market, standby capacity market and auxiliary service market, and determine the implementation roadmap and priorities. We should build a multilevel market system to form an interest compensation mechanism between different types of power generation entities and between different regions, and employ the market mechanism to optimize the allocation of power resources.

ii. Define sound, uniform market rules. No rules, no market. Europe has vigorously promoted the construction of a uniform internal power market with uniform, sound laws governing the

power market, coordinated rules of power market and grid operation, and independent supervisory authority. At present, China builds the power market mainly by requiring different regions to initiate pilot programs, and local government authorities are the main setter of power trading rules with low level of participation by power generation enterprises and power users. During transaction, some regions frequently modify trading rules, artificially set supply-demand ratio and other indicators and even set the objective to reduce the power cost of some industries or some enterprises. Coming under a big pressure of competition and price cut, price alliance of power generation companies, market monopoly and other problems have appeared in some regions. We suggest borrowing the experience of European countries, strengthening the top-level design, accelerating the pace to establish trading rules of the power market and the supervision system, unifying market rules, designating the power market regulator, gradually eliminating market barriers between different provinces to promote a compliant and orderly development of the power market. While regulating power transmission and distribution, which are the “intermediate links” of the power market, we should also deregulate the power generation and consumption markets with good effect in order to truly make the market play a decisive role in resource allocation and better exercise

government functions.

iii. Vigorously promote development and absorption of renewable energy generation. Development of renewable energies such as photovoltaic power generation and wind power demands both financial and technical supports. The fixed unit subsidy mode doesn't work well to discover renewable energy prices and reduce the inspiration cost. Besides, it will also aggravate the fiscal burden in the context of the rising proportion of renewable energy units. Germany employs the "market competition + different subsidy" mode for renewable energy projects to discover the true cost and cut down the excessive subsidy fund demand. The country has defined penalty measures against grid scheduling to assure prioritized access of power generated with clean energy to the power grid. For example, when the wind curtailment rate of a marine wind power project is no more than 1% of the annual planned power output, the power grid shall compensate 95% of the loss arising out of the wind curtailment, and when the ratio exceeds 1%, the power grid shall compensate 100% of the loss. Besides, Germany also implements rigorous planning as the condition precedent for site selection of renewable energy power generation project and grid access work together with direction and quantity of absorbed power to avoid excessive output and abandonment of the facility. Also, the country

implements the bid bond system for construction of power stations to prevent enterprises from pursuing an “enclosure”. Its practice and experience are worth borrowing.

iv. Innovate supervision mechanism for power transmission and distribution price. Germany adheres to the principle of combining incentive and constraint for supervision of power transmission and distribution price. It classifies the cost of a power transmission enterprise into controllable cost and uncontrollable cost, implements rigorous cost accounting for controllable fixed cost, applies the performance-based cost ceiling method to the uncontrollable operating cost and inversely estimates the allowable cost of an enterprise based on its performance. Meanwhile, Germany has built the regulation model based on mass operating data of 880 power distributors, supervised these distributors by defining the benchmark, thereby inspiring them to increase the operating efficiency and thus earn a higher income. Germany and Portugal supervise power transmission and distribution prices with public enterprise supervision data of tax and other government authorities as underlying data, which both assures integrity, accuracy and integrity of data and also helps reduce the government’s supervision cost. Currently, China has completed the first phase of the power transmission and distribution price reform. Next step, we should

actively learn the experience of Germany and other countries, and establish the mechanism of linking the income ceiling and performance of a power transmission and distribution company while refining the evaluation cost, efficiency, safety and other system indicators for the provincial power grid. At the same time, we should set rules for the purpose of promoting enterprises to tap potential, increase profitability and increase the operating efficiency. When fixing the allowable cost, we should separate the controllable cost and the uncontrollable cost and introduce the benchmarking mechanism between different provincial power grids to promote an efficiency enhancement. At the same time, we should share underlying data of enterprises with finance, audit, state-owned assets administration, taxation and other authorities to achieve joint supervision.

v. Actively cultivate the retail market. At present, China has more than 6,400 registered power sales companies, and the establishment of power sales companies has stimulated the market vitality. However, how to accelerate the cultivation of market entities and market environment on the power sales side and form an effective price discovery and transmission mechanism will determine whether we can truly establish a competitive landscape of market-oriented power trading. Europe's experience in developing

the power sales subject shows that the realization of adequate, effective interaction between power sales entities and users will be equally important to cultivate the user market and the power seller market, which will promote one another and require synchronous progress. China's current power consumption system has not changed for years, and small and medium users, particularly common resident users, have already become used to the power consumption pattern. At present, while cultivating power sales market entities, we should allow small and medium users (including resident users) to select power sellers at their own discretion. We should allow power generation companies and other private capital to invest in and establish power sales companies, and allow users having distributed power sources, industries that can provide public services like water supply, gas supply and heating supply, energy saving companies and other entities to engage in market-oriented power sales so as to provide more options for users and lift the level of users' energy consumption and saving.