

# Features and expansion of China's energy market

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***Abstract:** The article examines the characteristics of the energy sector in China including coal, oil, hydro-power, nuclear, renewable energy. Complementary to a general portray regarding the various sections of the Chinese energy sector, the paper also pursuits to analyze a part of the connections between energy, labor, land and the environment, as well as entities of authority, administration and decision-making. China became in the last twenty years the largest energy consumer in the world which combined with the economic progress of the country triggered not only challenges of how to ensure the supply-demand equilibrium but of what position China will have in the international landscape as it accustoms and complies to its on-going seat as an energy global force. The material wishes to show both the positive and negative consequences that energy expansion has on citizens' lives, and also conflicts of interests that in some cases are emerging from this development. It encloses a short overall presentation to topics of civil society and geopolitical concerns in China, with the scope to identify the social, political, economic and environmental context, in which China's energy emergence is taking shape, and its role in the word political and economic system. The article also takes into consideration the involvement of Chinese companies in the energy market from Romania, which is part of China's strategy to advance on the European energy market. It examines the evolution of the relationship between the China and Romania referring to energy issues and it reviews the prospects for future development of joint energetic projects.*

***Keywords:** energy demand and supply, Chinese energy market, Energy partnerships Romania-China*

## 1. Introduction on China's current energy trends

China's rise has been compared in the economics literature with that of the US or Germany in the first half of the twentieth century, or with that of Japan in the latter part of the century. At the beginning of their development, these major economic powers have invested heavily in modern infrastructure and applied economic policies that have determined the transfer of millions of citizens from agriculture to manufacturing, thus ensuring long periods of economic growth. At the moment China collects the fruits of applying a similar formula, amid the introduction of gradual reform measures meant to encourage free enterprise, expanding private property, competition and openness to the international market, the influx of foreign investment and import of advanced technologies, in parallel with the gradual and prudent limitation of centralized state control on production, trade and prices (Pencea, 2012).

Within this progress on so many layers, the Chinese government has been putting in the last decade the issue of energy development on top of its agenda and the topic has become a priority for many organizations. Nowadays China encounters an extensively growing energy demand and an analogous extension of supply. In the same time, an increased awareness of climate change pushes the country to diversify its energy supply, hence all energy sources and technologies are developing. Objectives targeting energy efficiency also represent a pivotal section of the government's strategy, and this is particularly an area where many things need improvement. The Chinese government has made important commitments to international community to reduce energy intensity by 2020. The 10<sup>th</sup>, 11<sup>th</sup> and 12<sup>th</sup> 5 Year Economic Plans have all prioritized issues relating to energy development (Xinhua, 2012).

The country's energy system must be understood within the wider process of change in China, and China's changing role within the world division of labor. On the one hand, what exists in China today could not have developed outside of the history of China, especially from its revolution and the founding of the People's Republic of China in 1949. On the other hand, as with the country in its entirety, there have been major changes in the energy sector, as the country has moved towards what it terms a socialist market economy. The energy sector has experienced major restructuring, especially since the late 1990's/early 2000's. The process of creating a market based system is being accelerated, increasingly, giving full scope to the basic role of the market in allocating resources, and encouraging various forms ownership in the energy sector.

In 1998, the petroleum sector was restructured, featuring the establishment of new vertically integrated management system of oil industry. In 2002, China's power industry went through a process of major reform, in which the generation and distribution aspects were separated from one another. In 2005, the coal industry was also restructured. Nonetheless, in spite of these changes, China's energy make-up and the relative weight of each energy source/technology are still decided upon in a coherent integrated political manner, rather than being left exclusively to the market. The Chinese government's approach to energy is based on an understanding of science and technology as the primary productive forces. The government is working to gradually establish a market-oriented system for technological innovation, in which enterprises play the leading role and which combines the efforts of enterprises, universities and research institutes. An important pillar of this approach is to develop China's capacity to manufacture energy equipment. This is often done through key state projects. Basic scientific research is key to independent innovation. In this way, China has made impressive gains in narrowing its technological gap with the developed countries in the energy sector, and great efforts have been made to both develop and popularize technologies in various fields, including energy technologies in general, energy saving, substitution, recycling and pollution control (Liu, 2009).

China's legal framework is also an important area for developing its energy sector. China has enacted and put in force the Clean Production Promotion Law and Renewable Energy Law, combined with several supporting policies and measures. At the international level, China actively participates in international energy cooperation. It is a member of the energy working group of the Asia-Pacific Economic Cooperation (APEC) and of the Association of Southeast Asian Nations (ASEAN) and while China is not a member of the International Energy Agency, as membership is currently limited to members of the OECD, China maintains close relations with it.

## **2. China's energy mix: description of national and global determinant factors and limitations**

Energy development in China (as elsewhere) is shaped and constrained by a variety of local, regional, national and international factors. Energy production and consumption is characterized by a number of features. On the one hand, throughout the country's history since 1949, there has been a very strong political commitment from the state to ensure that the bulk of the population has access to affordable electricity and other energy sources. This has always been, and still remains, a key political concern. Most (but not all) communities, including in rural areas, have access to electricity and can meet their energy requirements, but domestic consumption levels are very low in rural areas as compared to big cities, and just cover basic domestic needs. Heating and cooling are a big issue for residential use, especially in urban areas. Modern houses are electrified and have gas. However, many of the older and poorer houses still rely on coal in some cities and rural areas. Many houses have solar water heaters on their roofs, and these have been made widely available by due to their cheap pricing on the market. There is an important program to develop small scale wind use in remote off-grid areas, and rural use of biogas is important in some areas. In recent years, the massive and extremely rapid urbanization process that China has gone through (and is still experiencing), and the corresponding growth of middle class consumerism has been an extremely important driving force behind a rapidly increased energy demand and consumption. This has many aspects. In particular, the growth of consumerism and the increased use of private automobiles are all massively increasing demand for both electricity and oil (USEIA, 2013).

The country's energy matrix consists of virtually all fuels and energy technologies. The government seeks predominantly for the security of energy supply but, in the same time, climate change commitments have been taken very seriously both nationally and globally.

Energy in China						
	Capita	Primary energy	Production	Import	Electricity	CO <sub>2</sub> emissions
	million	TWh	TWh	TWh	TWh	Mt
2010	1,296	18,717	17,873	1,051	2,055	4,732
2011	1,320	22,746	21,097	1,939	3,073	6,028
2012	1,326	24,614	23,182	2,148	3,252	6,508
2013	1,331	26,250	24,248	3,197	3,503	6,832
2014	1,338	28,111	25,690	3,905	3,938	7,270
Change 2010-14	3.3%	50%	44%	272%	92%	54%
Mtoe = 11.63 TWh, exclude Hong Kong China, Prim. energy includes energy losses that are 2/3 for nuclear power						

Source: IEA Key World Energy Statistics 2014

Primary energy use in China was 28,111 TWh per million persons in 2014. According to IEA, the primary energy use grew 50% and electricity use 92% from 2010 to 2014. The energy import was almost four times bigger in 2014, compared to 2010 and the CO<sub>2</sub> emissions growth was 54% in five years (2010-2014).

The bulk of the country's electricity supply is met from coal. The overall volume of coal being consumed continues to increase, while its percentage in the total energy mix is gradually decreasing. These are somewhat contradictory trends. The government is strongly committed to reducing the overall percentage that is supplied by coal due to the different social and environmental problems it causes. This is driving the expansion of other energy sectors. In particular, recent years have seen a major expansion get underway in the use of wind energy, large hydropower, and also nuclear energy, all of which are seen as important substitutes for coal. There is also a big expansion of solar energy (especially Concentrated Solar Power) planned for the future, but this is not yet as advanced as the other branches of the sector. There is already large scale use of solar water heating used in rural and some urban areas. There is also an important role for primary biomass and biogas digestion, especially in rural areas. In addition to diversifying energy sources, energy reduction and efficiency measures are seen as an equally important part of a "clean energy strategy", and major improvements have been made (Tu, 2011).

Electricity production in China (TWh)			
	From coal	Total	%
2004	1,713	2,200	78%
2007	2,656	3,279	81%
2008	2,733	3,457	79%
2009	2,913	3,696	79%
2010	3,273	4,208	78%
2011	3,724	4,715	79%
2012	3,850	4,937	78%
2013	4,200	5,398	78%
2014	4,354	5,583	78%
<i>excluding Hong Kong</i>			

Source: IEA Key World Energy Statistics 2014

As of 2014, China leads the world in the production and use of wind power, solar photovoltaic power, and smart grid technologies, generating almost as much water, wind, and solar energy as all of France and Germany's power plants combined. In recent history, China's power industry is characterized by fast growth and an enormous installed base. In 2014, it had the largest installed electricity generation capacity in the world with 1.505 GW and generated 5.583 TWh. China also has the largest thermal power capacity, the largest hydropower capacity, the largest wind power capacity and the largest solar capacity in the world. Despite an

expected rapid increase in installed capacity scheduled in 2014 for both wind and solar, and expected increase to 60 GW in nuclear by 2020, coal will still account between 65% and 75% of capacity in 2020 (IEA, 2015).

Chinese energy experts are estimating that by 2050 the percentage of China's energy requirements that are satisfied by coal-fired plants will have declined to 30-50% of total energy consumption and that the remaining 50-70% will be provided by a combination of oil, natural gas, and renewable energy sources, including nuclear power, hydropower, biomass, solar energy, wind energy, and other renewable energy sources. Still, large hydropower, which is controversially defined by the government as a renewable energy technology, has a massive social and environmental impact, often leading to the displacement of literally millions of people and the flooding of large areas of land.

The increased use of nuclear energy presents major long-term safety concerns. In terms of nuclear power generation, China will advance from the moderate development strategy to accelerating development strategy. Nuclear power will play an even more important role in China's future power development. Especially in the developed coastal areas with heavy power load, nuclear power will become the backbone of the power structure there. China has planned to build up another 30 sets of nuclear power generator within 15 years, with total installed capacity of 80 GWs by 2020, accounting for about 4% of China's total installed capacity of the electric power industry. This percentage is expected to double every 10 years for several decades out. Plans are for 200 GWs installed by 2030, which will include a large shift to Fast Breeder reactor and 1.500 GWs by the end of this century. As of March 2016, the People's Republic of China has 33 nuclear reactors operating with a capacity of 28.8 GW and 22 under construction, with a capacity of 22.1 GW.

China's National Development and Reform Commission has indicated the intention to raise the percentage of China's electricity produced by nuclear power from the current 2% to 6% by 2020 (compared to 20% in the United States and 74% in France). Nuclear power contributed 3% of the total production in 2015 – 170 billion kWh. However, rapid nuclear expansion may lead to a shortfall of fuel, equipment, qualified plant workers, and safety inspectors (IEA, 2015). Instead, efforts are made to “clean up” the social and environmental impacts of these energy industries as best as possible, in terms of making their immediate consequence less damaging and less dangerous. There is a strong government commitment to this. Bearing this in mind, China’s commitment to renewable energy is amongst the strongest in the world. In addition to being a major consumer of energy from renewable energy source, China has also rapidly become a world leader in the manufacture of renewable energy equipment, such as both large and small wind turbines, solar photovoltaic panels and solar water heaters, and also turbines for hydropower stations (both large and small), as well as in technology development (Mastni, 2014).

The top 5 countries in 2015, based on total PV installed capacity (MW) according to IEA is:

- 1) China: 43,530 MW (22.5%);
- 2) Germany: 39,700 MW (20.6%);
- 3) Japan: 34,410 MW (17.8%);
- 4) United States: 25,620 MW (13.3%);
- 5) Italy: 18,920 MW (9.8%).

As the world's largest market for both photovoltaics and solar thermal energy, in 2015, China was also the world's leading installer of solar photovoltaics reaching a total installed capacity of 35.78GW by end-June 2015.

Photovoltaics		
Year	Capacity (MW)	Installed/yr
2010	800	500
2011	3,300	2,500
2012	8,300	5,000
2013	~17,800	~9,500
2014	28,199	10,560
2015	43,180	15,130

*Note:* Figures for 2013 were retroactively changed. Clarification TBA.  
*Source:* IEA, China National Energy Administration (2015 figures)

A major constraining factor is related to the fact that energy production in China, as in many areas of the world, is characterized by the fact that the energy rich areas are not areas where there is high energy demand (electricity or otherwise). Certain regions are important energy regions (eg Shanxi, Inner Mongolia have coal, Xinjiang, Gansu for wind (actually 7 national wind bases), Tibet will become solar and hydro region. Hydropower is important in Yunnan, Sichuan and Tibet. Several of these regions are ethnic minority regions. On the other hand, most of the energy consumption occurs in the east of the country. This means that the transportation of energy (either in the form of electricity on the grid, or fuel {especially coal} in vehicles) is an extremely important issue. Lack of infrastructure is an important concern here, eg the grid is not strong enough to integrate all wind turbines and other renewable energy. Energy storage options are also not yet as advanced as they need to be. Another key constraint at the national level is the need to ensure political stability through high economic growth and urbanization. The last thirty years of China's open economic development has led to a rapid process of urbanization, industrialization and consumerism. This economic growth based development model is heavily pushed by the government. It has brought greater wealth and higher living standards for many people, especially in cities, though has also led to great inequalities. This form of economic growth has also been based on an increased energy production and consumption, which are still for the most part based in fossil fuels. As such, energy supply is increasingly central to ensuring political stability (Lin, Purra, 2012).

### **3. Problems of ownership, direction and administration for the key actors in China's energy sector**

A number of actors operate within China's energy sector. This includes: a wide range of governmental agencies, energy companies, financial institutions, international political institution, communities and workers affected by energy production and consumption, universities, think tanks, NGOs and other civil society organizations - all both from China and from other countries. Since the early 2000s, in parallel to the restructuring of different energy sectors, a fundamental restructuring of the political institutions in the energy sector also took place. The energy companies were made independent of the main Ministry of Energy, which in turn was later dissolved. As such, the political power in the energy sector was reduced. After several restructurings in a short space of time, the main government body responsible for energy planning and decision making is the National Reform and Development Commission (NRDC), which has within it the Energy Research Institute (ERI). Central government still retains a powerful role, but much less so than when the Ministry of Energy existed. Local governments are mainly responsible for negotiating with companies about infrastructure (Fridley & co., 2012).

The restructuring of China's energy sector has mainly not involved privatization, but rather a process of corporatization. The state-owned companies which have been created operate at least somewhat autonomously from, but in close cooperation with the political structures. A fundamental change is that they are now mandated to operate according to profit logic. This presents the difficult challenge of both meeting the energy needs of the population and also industry, agriculture and other needs (not least including the military), while also ensuring that the energy companies make a profit. In the past, before restructuring, the energy sector often ran at a loss, and was heavily subsidized by other sectors of the economy.

All the powerful state-owned enterprises play a vital role in China's energy system, but they are also experiencing an important overseas expansion. In many ways the corporatization process has meant that the companies operate in quite similar ways to multinational companies, and they are becoming obliged to project themselves globally in pursuit of profits, which in turn means they have to compete in global markets with other private and state-owned companies from around the world. However, their pursuit of profits is closely guided, if not actually controlled by and subordinated to, China's domestic energy policy. Sometimes there is a strong overlap of interests, and sometimes there is a conflict.

However, as the renewable energy sector develops, this is producing some significant developments with regard to ownership. While most of the major renewable energy projects and installed infrastructures are owned by state-owned companies (mainly the electric power companies), the major manufacturing capacity of wind turbines and solar panels is being undertaken by private companies, which benefit from extensive state support. Examples of this include as Goldwind, Sinovel, or Suntech Power (which recently entered into bankruptcy). However, there is also one major state-owned enterprise that manufactures wind turbines, Dongfang Electric Corporation (DEC). As with the other branches of the energy sector, there is a significant concentration of ownership occurring in the renewable energy sector, and the companies are becoming increasingly important world leaders in the world-market (Liu, 2009).

The electrical grid, which is essentially still a monopoly, is interested to maximize profits, making the relative bargaining power of each branch of the power sector more important. This means that, despite the fact that government has an overall policy in which the targets for different energy technologies and sources is determined, economic competition between the different energy sectors nonetheless becomes important in determining the country's energy mix. This is especially so as ownership within the different branches becomes more concentrated. One important factor in this regard is the role that coal plays. Coal constitutes an important inertia factor in relation to moving towards other energy sources and industrial sectors associated with these sources. China's coal industry is incredibly economically and politically powerful compared to these other branches of the energy sector. As coal mining consolidates into larger companies due to restructuring, this gives the sector greater corporate weight with which to compete with other sectors. Another factor is that many industrial companies use coal directly, rather than using electricity. This benefits coal with respect to other energy sources. Another important concern is the inability to sell renewable energy due to companies' reluctance to purchase it, due to the (real and perceived) lack of stability of supply as compared to coal. All of this has important implications for scale.

The main thrust of the energy sector favors large technology, large corporate ownership structures and centralized decision making structures. Increased centralization and concentration is occurring in all branches of the energy sector, with a corresponding intensification of competition and global expansion of the energy companies. This is motivated mainly by profitability, efficiency and competitiveness factors. In relation to coal, this process is also driven by safety concerns. However, in the past there was a strong emphasis on smaller scale technologies as well; eg decentralized small coal mines (this was also linked to a partial privatization process), small scale dams under local government and community control; household and village level biogas digestors, often under village or individual household control. China still has the world's biggest use of small scale hydropower, biogas and solar water heaters, though its definition of small scale hydro involves a bigger scale than most other definitions. China is also an important user of small scale wind energy (especially in remote rural areas that are not served by the grid), and manufacturer of small turbines. However, these are not significant in comparison to the overall use of the large technologies.

Closely linked to the above is the question of energy prices, markets and trade. These are also important mechanisms for distributing resources in the sector, and for shaping structures of ownership and control. The need for energy companies to make a profit, instead of functioning at a loss, means that now the companies are expected to introduce "cost reflective pricing" in the energy sector, so as to reflect changes in market supply and demand, resource availability and environmental costs. This is essential for creating a functioning market. However, in order to avoid political instability, the government is implementing market-based price reforms with great caution. Energy prices for residential use are currently still heavily subsidized, regulated and, to a certain extent, also politically controlled. Consequently, energy is still largely affordable to the bulk of the population. The government faces the difficult task of introducing price reforms in such a way as to make it acceptable to all interests and social sectors. In relation to market reforms, China has made active efforts to introduce legal reforms that make joint ventures and other foreign co-operations in the energy sector easier and more attractive for foreign investors. These are based on transparency and rule based systems, and China's entry into the World Trade Organization (WTO) in 2011 had a major impact on its energy sector (Wang, Qiu, Kuang, 2009).

#### **4. The relationship between China and Romania regarding the energy field**

China has managed to be one of the big winners of the economic crisis commenced in 2008. The Chinese companies' investments in the European Union Member States have experienced an upward trend after that year, succeeding during 2010-2014 to increase from USD 6 billion to over USD 27 billion. Romania hasn't been eluded by the Chinese investors' money, although the major projects announced several years ago continue to linger or have been forgotten. However, there are signs that the Chinese investors' interest towards our country has revived lately.

The Chinese are interested in contracting large projects in Romania. Companies as China General Nuclear Power Corporation, Huadian, Huawei, ZTE, China Development Bank and others have already opened offices or subsidiaries in Romania. The Sino-Romanian cooperation is currently in a promising accelerating period.

Projects in the field of nuclear energy, hydro energy, thermal energy, highways, etc. under negotiation between the Chinese and Romanian parties reach a total value of several billion EUR. The most spectacular

arrival of the Chinese in Romania took place late 2015 when CEFC China Energy took over the Petromidia refinery and 500 fuel stations by buying the majority stake of the KMG (KazMunayGas) International group (former Rompetrol Group) from the Kazakh state company KazMunayGas. China CEFC Energy is involved in various business areas, such as transport, infrastructure, real estate, hotelier industry, logistics, sports, beverages, forestry, ranking on the sixth place among the Chinese private companies (Stoica, 2016).

Some energy projects which were made public several years ago as China's large investments in Romania, have not yet taken shape. A part of them are still under discussions, like the construction of 2 nuclear reactors with China General Nuclear Power Corp (an investment of approximately EUR 6 billion) and the building of a 600 MW in thermopower plant, with China Huadian group (about EUR 1 billion), but others are adjourned or even suspended. A few of them can be mentioned: the building of the hydroelectric plant (an investment estimated to EUR 1.1-1.3 billion), where the Chinese have stated their intention to get involved, but no company has been chosen for the project, the construction of a new thermo energy group which is on the verge of bankruptcy and the building of a 300 MW thermopower group. Another important arrival of the Chinese capital in Romania occurred with the purchase of 30% of Zeta Petroleum by Golden Meditech Holdings Limited. Zeta Petroleum was owner of a petroleum block, where the Chinese will be partners with the Russians from Gazprom, as the latter have common ownership on the block. Sino-Romanian cooperation is in line with China's and European Union's development strategies. Currently, China promotes the implementation of "The Economic belt of the Silk Road and of the Maritime Silk Road in the 21<sup>st</sup> century", expands its cooperation in international production capacity and implements new concepts of development on innovation, harmonization, openness and sharing the results of the development process.

The cooperation between China and Central and Eastern European countries has witnessed rapid development. The bridge over the Danube in Belgrade, built in cooperation by China and Serbia, has already been completed and is open to traffic, and the railroad Hungary-Serbia will be completed in two-year' time through the cooperation between China, Hungary and Serbia and will become a important component of rapid land and sea route China-Europe.

"The long-term cooperation plan between China and Central and Eastern Europe" on the direction and priorities during 2015-2020 was developed in 2015 and aims to further capitalize the cooperation potential and to boost efficiency and the quality of the '16+1 cooperation' mechanism.

## 5. Conclusion

China has grown in the last decade by becoming not only the second world's superpower (according to its GDP expressed in nominal terms) but also by consolidating its strength in the energy field. In its pursuit of development, the Chinese energy system went through a wide process of change which affected the labor, the land and the environment, as well as the entities of authority, administration and decision-making. China has arrived to be in 2016 the largest energy consumer in the world which in connection with the economic growth of the country attracted provocations regarding the supply-demand balance and about the standpoint that China will have in the international landscape as it manages its new position as an energy global force.

The paper showed the characteristics of the Chinese energy mix, the consequences that energy progress had on citizens' lives, and also the conflicts that can occur in some cases. It drew attention to problems of market, relationship between consumption and productions as well as potential for manufacturing and issues of international cooperation. A special place for future research is taken by the evolution of the relationship between the China and Romania referring to energy issues and it reviews the prospects for future development of joint energetic projects which are still to be developed and carried on.

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