

On Sustainable Development of Coal Industry against the Background of Climate Change

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Abstract

Coal industry is producing not only economic wealth, but also pollutants to the world. The atmospheric accumulation of greenhouse gases with fossil fuel combustion as the major source has been proved to be a threat to the well-beings of human beings. In the face of the problems caused by the nature of coal industry and under the pressure from both governmental regulations and demand of the new market, it is necessary for coal enterprises to move on the road of sustainable development. Therefore, in order to survive, the whole industry is ready to make transformation in the production mode and make structural reform.

Keywords

Climate change; global warming; dual pressure; sustainable development.

1. Introduction

Coal has been used as one of the major energy sources especially since the industrial revolution. After the tremendous rise in coal use in the early 2000s, which was primarily driven by the growth of world economy, coal use worldwide peaked in 2012. Since then coal use has experienced a steady decline, offset largely by increases in natural gas use. However, the world never ceases exploiting coal, the most abundant fossil fuel on the earth. As a matter of fact, the demand for coal worldwide is constantly on the increase. With an increase in the coal consumption comes the problems with regard to the negative impact on the environment. There has been presented more and more disturbing scientific evidence regarding the disastrous consequences of the exploitation of fossil fuels, in particular, the potential consequences of climate change. Under the circumstances, the requirement to reform coal industry has become more than urgent and necessary with a foreseeable dystopia of either the exhaustion of the supplies at its origin or destruction of the world human beings inhabit someday. Evidently, coal industry has to work out solutions on the way to its sustainable development in case it becomes an ancient history in time once it rejects to change.

2. Problems caused by coal industry against the background of climate change

The booming coal industry has not only brought about colossal economic gains but also serious problems, among which climate change is the most disturbing and worrying. Without doubt, the ceaseless supply of greenhouse gases has left and will leave a tremendous impact on the global weather pattern, thus intensifying the severity of the climate change.

2.1 Severity of climate change

The climate of this planet we inhabit is undergoing tremendous changes in many ways that are obvious in our life, like the noticeable rising temperature even in winter, the time that is supposedly the coldest days in a year. Actually, the planet's average surface temperature has risen about 2.12 degrees Fahrenheit (1.18 degrees Celsius) since the late 19th century. Most of the warming occurred

in the past 40 years, with the seven most recent years being the warmest. The years 2016 and 2020 are tied for the warmest year on record. [1].

Constant rising temperature has brought with it grave consequences, such as less snowpack in mountain ranges and polar areas, likewise, faster melting rate of glaciers. Consequently, the sea levels are rising, threatening coastal communities and estuarine ecosystems. Statistics show that global sea level rose about 8 inches (20 centimeters) in the last century. The rate in the last two decades, however, is nearly double that of the last century and accelerating slightly every year. [2] Evidently, with the rising temperature, there comes numerous consequences of disruption in the weather pattern which is more alarming and typical signs of climate change, such as prolonged droughts in the dry season, dreadful sandstorms over wider range of the land, increasing number of extreme weathers every year, thick swarms of locusts hovering over the fields, more severe wind and snow storms around the world.

2.2 Contribution of coal industry to global warming

Scientists attribute the global warming trend observed since the mid-20th century to the human expansion of the "greenhouse effect" — warming that results when the atmosphere traps heat radiating from Earth toward space. [3] Carbon dioxide (CO₂) makes up the biggest percentage of the total volume of greenhouse gas as is shown from the pie diagram 1 and its rising trend can be very explicitly demonstrated from the following graph.

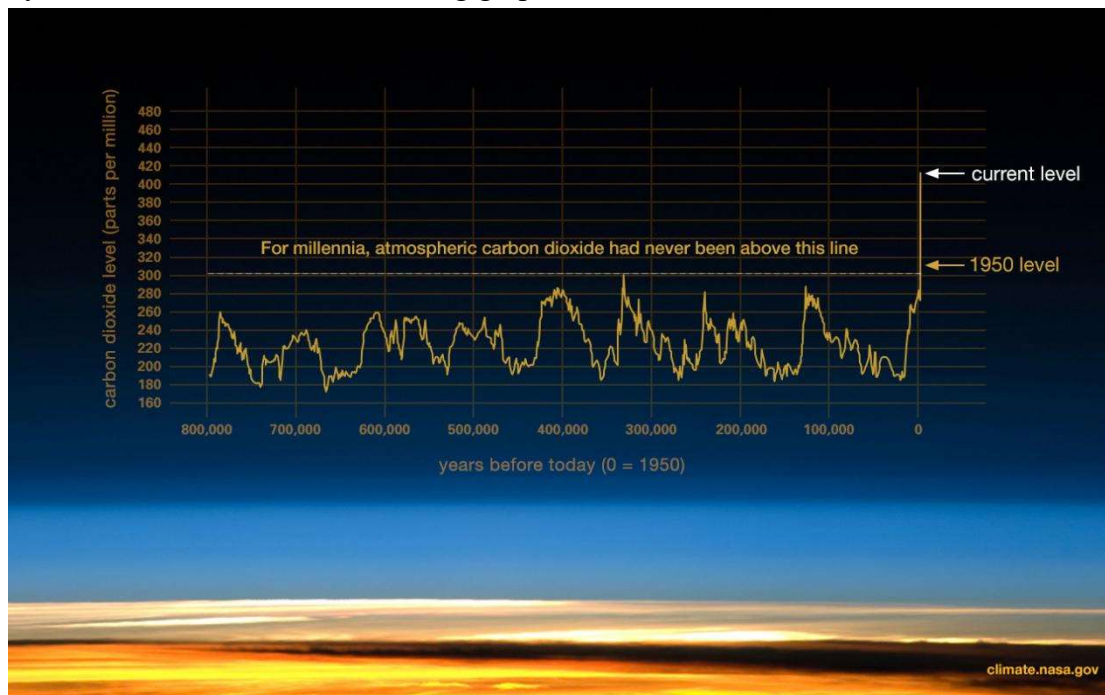


Fig.1 This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO₂ has increased since the Industrial Revolution. (Credit: Luthi, D., et al. 2008; Etheridge, D.M., et al. 2010; Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO₂ record.)

As pie diagram 1 shows, the source of carbon dioxide (CO₂) ranges from fossil fuel and industrial processes which accounts for 65% the total to forestry and other land use of 11% the total. Because of a variety of human activities especially since the Industrial Revolution began, atmospheric CO₂ concentration has been increasing, leading to the higher and higher temperature of this planet. Among all the activities entailing emission of greenhouse gases including CO₂, the combining forces of electricity and heat production, agriculture, forestry and other land use as well as industry are playing the significant role. (based on pie diagram 2) Obviously, all of these activities involve the burning of the fossil fuels, hence directly or indirectly related to the coal industry. Therefore, coal industry has become a major contributor to climate change, in particular, global warming.

To make the matters worse, statistics show that global carbon emissions from fossil fuels have significantly increased since 1900. Since 1970, CO₂ emissions have increased by about 90%, with emissions from fossil fuel combustion and industrial processes contributing about 78% of the total greenhouse gas emissions increase from 1970 to 2011. [3] Evidently, it is the time for the coal industry to address the emission issue as soon as possible.

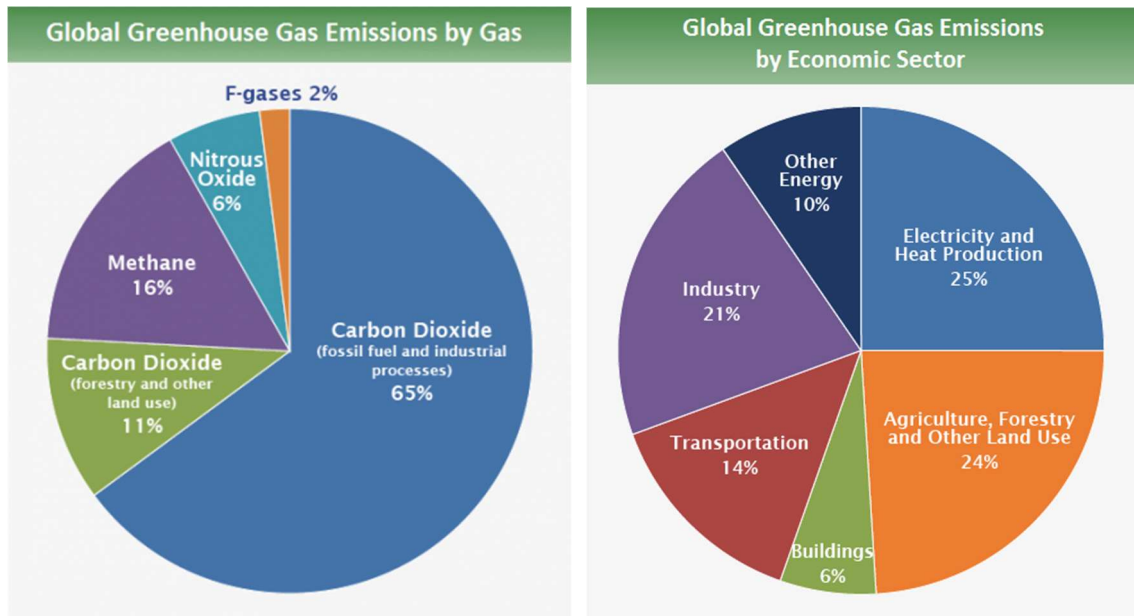


Fig. 2. Source: IPCC (2014) based on global emission from 2010.

3. Dual pressure faced by coal enterprises

The scientific figures the consequences of coal exploitation has exhibited have grabbed attention of more and more countries and aroused their ecological consciousness. Thus, governments issue corresponding policies and regulations with regard to carbon emission reduction. At the same time, the demand side of the coal market has been undergoing changes. Therefore, coal industry has to find ways to deal with the dual pressure.

3.1 Pressure from government

Confronted with the problems combustion of fossil fuels has given rise to, most of the governments in the world realize by now that global warming poses a serious threat to the future well-being of all people. The governments agree that it is necessary and urgent to reduce the concentration of CO₂ in the atmosphere by lowering carbon emission. This consensus was expressed by governmental agreements starting from the Kyoto Protocol, signed in 1997 and put into place in 2005, which set targets for emission reductions by the countries of the world (the US, Canada, Andorra, Afghanistan, and South Sudan are the only holdouts) to Paris Agreement, adopted in December 2015, which aimed to reduce the emission of gases that contribute to global warming. The Paris Agreement set out to improve upon and replace the Kyoto Protocol and it entered into force on November 4, 2016, and has been signed by 195 countries and ratified by 190 as of January 2021. [4].

Accordingly, the whole globe has to meet the emission reduction requirement set by scientific bodies. The Intergovernmental Panel on Climate Change (IPCC) proposes that global greenhouse gas emissions should decrease by 50% to 85% by 2050. Therefore, all countries are allocated corresponding emission decrease task for the sake of curbing of global warming rate. Furthermore, the IPCC 4th assessment report and the famous footnote in the Bali roadmap put forward that by 2050 emissions in developed countries should decrease by 80-95%, while emissions in developing countries should "deviate substantially from baseline," compared to 1990 levels. This is necessary to restrict the temperature increase to about 2oC above pre-industrial level. [5].

Those specific regulations have naturally put coal industry under huge pressure to make structural transformation. Every coal enterprise has to take steps to cut emission to meet the goals set by the governmental agreements as well as international organizations.

3.2 Pressure from the market

Besides the pressure from the government which has allocated carbon emission task to each coal enterprise, the coal industry is facing other challenges too, in particular, challenges it has to approach against the backdrop of the demand-driven economy. The dilemma coal enterprises are trapped in is the oversupply of traditional coal products and its dwindling market demand. Therefore, the key to coping with the pressure from the market is that the enterprises can firmly lock and capture the exact demand from the market. Successful companies will often devote a lifetime of effort and resources to the search of the current industry demands, potential demands and new demands, which applies to coal industry too.

The way to finding out the market demands can be made even harder with the development of international coal chemical industry, growing competition in the industry, more frequent integration, acquisition and capital operation of large coal chemical enterprises. Under the complex circumstances, no wonder more emphasis of coal industry is focused on market research on the industrial development environment and in-depth study of customer demands, both of which are believed to play a significant role for the survival and flourishing of the coal industry.

4. Sustainable development strategy of the coal industry

Being aware of the problems caused by its outdated production mode and faced with the pressure imposed by both governments and market, coal industry needs to transform itself in order to find a way out. Therefore, the sustainable development of coal enterprises has inevitably become the most pressing issue among others. The reform requires structural transformation of coal industry and other relevant changes as follows.

4.1 Constructing coal base

To deal with the multiple challenges, coal industry needs to build a solid coal base, the bottom line of survival of the whole industry. Coal base, an integrated space concept, is composed of several coal mines, hence enjoys manifold advantages over a single mine.

The most two prominent advantages of constructing coal base are to slow down the excessive exploitation of the old mines through production adjustment of the new and old mines to its utmost extent, and to enhance the economic gains of the coal enterprises by extending the advantages of low cost and high benefit to the full. Furthermore, with the conscious integration of various resources, the coal base enjoys the privilege of developing more secure and efficient coal mines as well as applying innovation to the production engineering and method through upgrading technological equipment standard.

Given the advantages born with the establishment of coal base, the outdated production mode of the coal enterprises can be reformed with greater ease. In order to develop fully mechanized mining, light carving and automatic development, the coal base is able to readily improve the collective production standard. It can also be ready to promote the upgrading and development of traditional industry by gradually abandoning blasting mining, high-grade traditional mining. The coal base should adhere to the idea that science and technology constitute the primary productive force and take science and technological progress and innovation as the core competitive advantage of coal industry. Evidently, the existence of the coal base stands a better chance to fully integrate specialized managing advantage as well as coordinate comprehensive functions of different branches including technological, dispatch, ventilation, mechatronics innovation and geological survey, etc. for the purpose of instructing and supervising the development of the whole industry.

In a word, the coal base plays a crucial role in realizing coal transfer, power supply, coal chemical industry and comprehensive utilization of resources. The conviction of coal base construction is in

consistency with the coordinated development path, which is believed to be an effective way to reduce air pollution, waste water and solid waste, as well as to increase the development scale and guarantee the steady growth. Only in this way will the coal enterprises be able to realize mechanized, large-scale and collective production by fully exerting their own advantages in line with their very sustainable strategy.

4.2 Sustainable development of coal chemical industry

To cater to the government requirement and market needs, coal chemical industry has to endeavor to make structural transformation with a view to decreasing energy waste and emission production in the first place. To address huge energy waste at its origin, the chemical industry needs to expand its capability in the processing sector, in particular, in coal washing. Depending on its quality, coal needs to be “washed” with water and chemicals to remove sulfur and impurities before it can be burned in a power plant. Coal washing, or coal beneficiation, is widely seen as an efficient method for getting the most from run-of-mine coal. On the other hand, it is a water-intensive process: typically, washing one ton of coal consumes about 45 m³ liters of water. [6] This is why coal industry has to urgently develop technology to use less water and chemicals in the process to reduce operating cost. As a result, the more energy-saving technology in coal washing paves the way for the whole industry to turn onto a more sustainably developing track.

Besides, coal chemical industry must attach an equally great significance to technology innovation with respect to coal gasification, a thermo-chemical process in which heat and pressure break down coal into its basic chemical constituents. [7] Gasification avoids burning coal altogether. With integrated gasification combined cycle (IGCC) systems, steam and hot pressurized air or oxygen combine with coal in a reaction that forces carbon molecules apart. The resulting syngas, a mixture of carbon monoxide and hydrogen, is then cleaned and burned in a gas turbine to make electricity. The heat energy from the gas turbine also powers a steam turbine. Since IGCC power plants create two forms of energy, they have the potential to reach a fuel efficiency of 50 percent [8]. Therefore, it is very necessary for the coal chemical industry to upgrade its gasification technology for the sake of its production efficiency and its long-run development.

4.3 Development of modern logistics

Logistics with efficiency as the lifeline has been proved to be increasingly important in the current society which values efficiency with unprecedented enthusiasm. Given the circumstances, coal industry cannot afford to neglect logistics industry development as long as it intends to develop further. It is no wonder that many coal enterprises have already organized branch logistics companies across the world and pitched in on the international logistics with limited liability. Obviously, those enterprises must carry on investing in this sector in the succeeding years.

As a matter of fact, the coal industry has established its marketing company, materials company and international logistics company in response to the actual demands. The operating network of the international logistics company is scattered in Northeast China, North China, South China, Northwest China and Hong Kong district. This network covers the service from coal supply chain management including the domestic and overseas coal circulation and processing, sorting; strategic reserve management including port warehousing and transfer; to market dealing management including delivering materials to railway and road transportation, import and export trade. The service reaches the upstream and downstream customers in the supply chain including coal production, coal washing and processing, coal dispenser manufacture, metallurgy, coking, electric power and chemical industry, etc.

Consequently, the best way to develop logistics for the sustainable development of the whole coal industry is to adopt trinity as the paradigm, which is comprised of the management of coal supply chain, strategic reserve and market dealing. In this way, the well-managed modern logistics has and will make its contribution to the sustainable development of coal industry.

4.4 Development of coal cultural tourism industry

Corporate culture, as a unique means of identifying an enterprise, must take up an important position in the sustainable development of coal industry. Among many likely attempts to promote the corporate culture to the ever-changing market, the development of coal cultural tourism, with its considerable potential to integrate different elements together, such as ecological, economic and social gains must be an advisable alternative in the strategic structure of the coal industry.

Development of the coal cultural tourism industry will help to finally realize its faithfulness in the sustainable development via effective integration of different but related projects. The industry can be operated over a wide range of scope from industrial cultural tourism, commercial shopping, entertainment to catering and accommodation. Generally speaking, coal cultural tourism industry will provide a new-style venue for promotion of corporate culture through the channel of both recreation and tourism. It will form an industrial tourism chain which makes the best of all the possible resources, which is what sustainability ultimately means.

In the meanwhile, tourism development will almost necessarily facilitate the development of residential real estate in the adjacent areas for industrial purposes and as commercial complex. In this way the coal industry will have accomplished a significant transformation in its economic development pattern from the only coal sale to the coal-based industrial chain expansion. The transformation is an important channel to develop a modern and new-style enterprise as well as a remarkable signal of enhancing the scientific and sustainable development.

4.5 Development of energy-saving and environment-friendly industry

To build a sustainable industry, the coal industry must keep the energy-saving and environmental-friendly development top of its agenda because sustainable industry means green industry ultimately. In order to satisfy the environmental protection requirement, coal enterprises should not only voluntarily accomplish the designated tasks by the central government to cut down emissions, but undertake the environment-friendly responsibility in earnest as a long-term mission.

Given the perpetual nature of the environmental protection, coal industry must endeavor to pragmatically carry out the energy saving and emission reduction missions in all of its key units, projects and areas. Take recycling strategy which ranks high in importance among the targeted endeavors for instance, it should be implemented in all the possible fields including manufacture, building materials, land resources, etc. Furthermore, effective recycling methods can play significant roles in areas managing mine water, which as a result can be made available for production and daily life usage after being processed. Equally importantly, the coal chemical projects are the sectors where recycling has been and will be proved to be crucial with the application of dry quenching technique. The dry quenching technique is capable of recycling the remaining heat of coke which is not only conducive to realizing zero emission of pollutants but also producing steam and generating power through the use of the remaining heat. Consequently, a certain amount of standard coal is annually recycled as the yearly profit.

Evidently, as long as the coal industry actively responds to the new norm of the air and environmental protection, it will spontaneously and thoroughly carry out the new Environmental Protection Law as well as the requirements for energy saving and emission reduction formulated by governments of different levels. In this way the coal industry will accomplish the immediate tasks of comprehensively managing the coal chemical industry, additionally, it will be able to strengthen the supervision of pollution sources as well as the function of the environmental equipment with ease to a certain extent. As a result, the emission of the pollutants will meet the demand of the standard and the whole industry will have made the necessary contribution to the containment of global warming.

5. Conclusion

Coal industry, because of its high emission of carbon, is highly responsible for the global climate change which needs to be dealt with as soon as possible owing to its current as well as the potential consequences on the planet we inhabit. Furthermore, coal enterprises have to positively respond to the increasingly

fierce competition in the home and foreign markets, to approach the grave challenges presented by the industry itself. Consequently, coal industry has to restructure itself not only for the purpose of the environmental protection need, the need for the well-being of humanity but also for the sake of its own survival. In response to this, coal industry has to transform and innovate the out-of-date manufacture approaches, explore and expand new functions of traditional sectors, etc. in order to be more sustainable in its development paradigm. In a word, coal industry needs to adjust and regroup the overall structure, clarify its development orientation, accommodate to the turn of the market, move on to the road of enterprise transfer, strengthen risk resistance capability, on top of that, manage the energy-saving and environment-friendly development.

Acknowledgments

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Appendix

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