Published in the Russian Federation
Sochi Journal of Economy
Has been issued since 2007.
ISSN: 2541-8114
2017, 11(2): 99-106

www.vestnik.sutr.ru

UDC 33

Environmental Cost of China-Pakistan Economic Corridor

Naureen Fatima [a], Aneel Salman [b], Nedim Makarevic [c, *]

[a] Pakistan Institute of Development Economics, Pakistan
[b] COMSATS Institute of Information Technology, Pakistan
[c] Embassy of Bosnia and Herzegovina in Pakistan, Pakistan

Abstract

China Pakistan economic corridor (CPEC) is a mega project of worth $ 46 billion of which $ 34 billion are earmarked for energy projects. Concerns have been raised about the impact of carbon emissions associated with these coal fired projects and their effects on climate and air quality. This study provides carbon emissions estimates to understand environmental viability of these projects. Our estimated results of carbon emissions show that as the percentage of carbon content increases in the amount of fuel used for power generation the emissions from these power plants are also increased. It is also found that that Sub-bituminous coal has higher percentage of carbon content (71-77 %) as compare to indigenous Lignite reserves of coal (60-70 %). Therefore, indigenous lignite coal should be used to run these power projects to minimize the environmental damages. This will also soften pressure on Pakistan balance of payment as Sub-bituminous coal is an imported input.

Keywords: environmental cost, China, Pakistan.

1. Introduction

"The link between infrastructure and economic development is not a once and for all affair it is a continuous process and progress in development has to be preceded, accompanied, and followed by progress in infrastructure, if we are to full fill our declared objectives of generating a self-accelerating process of economic development" Dr. V.K.R.V. Rao.

An adequate supply of infrastructure services has been observed a vital component for economic development [2]. Calderon (2009) [4] empirically find positive relationship between infrastructure development and economic growth in 136 countries. Kamara (2006) [5] make similar findings. A landmark study by World Bank (1994) [10] shows the critical role of infrastructure in the development process. Saxena (1991) [7] highlight the role of Indian Railways in economic development and social-economic transformation over a period of almost a century-and-a-half. Communication, power and road networks are three major infrastructure pillars that are measured through different indices [8]. However, infrastructure challenges around the world have been enormous that led to the origin of economic corridors to achieve fast economic growth in both developed and developing countries.

China Pakistan economic corridor (CPEC) is a mega project of worth $46 billion with an aim to enhance economic growth, trade links among the neighboring countries through connections of highways, rail tracks [1]. The project is expected to be a game changer in uplifting socio-economic development of Pakistan in the next 15 years. However, its energy projects of $34 billion can affect

* Corresponding author
E-mail addresses: nmakarevic.science@gmail.com (N. Makarevic), aneelsalman@gmail.com (A. Salman)

the environment that is a public good by emitting carbon as majority of these projects are coal power plants. Table 1 provides the detail of energy projects expected to be completed under CPEC.

2. Main part

Table 1. Energy projects under CEPEC with their capacity and estimated cost

Sr. No	Project Name	Capacity (MW)	Estimated Cost (US$ M)
1	Port Qasim Electric Company Coal Fired, 2X660, Sindh	1320	1980
2	Sahiwal 2X660 MW Coal-fired Power Plant, Punjab	1320	1600
3	Engro Thar 4X330 MW Coal-Fired, Thar, Sindh Surface mine in black 2 of Thar Coal field, 6.5 mtpa, Thar Sindh	1320	2000 1470
4	Gwadar Coal Power Project, Gwadar	300	360
5	HUBCO Coal power plant 1X660 MW, Hub Baluchistan	660	970
6	Rahimyar Khan Coal Power Project, Punjab	1320	1600
7	SSRL Thar Coal Block 1-6.5mpta Thar, Sindh SSRL 2X660 MW Mine Mouth Power Plant,	1320	1300 2000
8	Quaid-e-Azam 1000MW Solar Park, Bahawalpur, Punjab	1000	1350
9	Dawood 50MW wind farm, Bhambore, Sindh	50	125
10	UEP 100MW Wind Farm, Jhimpur, Sindh	100	250
11	Sachal 50MW Wind Farm, Jhimpur, Sindh	50	134
12	Sunnec 50MW wind Farm, Jhimpur, Sindh	50	125
13	Suki Kinari Hydropower Station, KPK	870	1802
14	Karot Hydropower Station, AJK & Punjab	720	1420

Source: Ministry of Planning & Development, Government of Pakistan

Carbon emissions are major concerns for environmentalist as climate change has become a serious threat to the humanity. Therefore, carbon emissions among others are environmental cost of the CPEC energy projects. In order to calculate environmental damages, the amount of emissions needs to be calculated first. The current study aims to estimate the carbon emissions of these energy projects. Calculated values will help in understanding the environmental impact of CPEC coal projects and future possible adaptive and mitigation measures to control carbon emissions. Further it will help Pakistan to stand to its commitments made in COP'21 to reduce its carbon emissions by appreciable extent up-to 2025. Additionally, the study can aid the policy makers in devising environmental policies for mitigation and adaptation to control the concentrations of GHG's in the atmosphere.

What China Pakistan Economic Corridor is all about?

China Pakistan Economic Corridor (CPEC) is a mega project that links Kashgar in China with Gwadar in Pakistan through road and railway tracks around 2,442 km long channels etc. CPEC is

an outcome of deep rooted friendly relations between Pakistan and China that took off from Sino-Pak agreement[1] signed in 1963. This Sino-Pak agreement was further strengthened in 2013 to give it a pragmatic form by connecting Kashgar city of China and the Gwadar port of Pakistan through network system of roads, highways and railway tracks. This led to the origin of China Pakistan Economic Corridor (CPEC) in Asia [1]. The mega project of China –Pakistan Economic Corridor was officially launched in April, 2015 during the visit of the President of China, Mr. Xi Jinping in Islamabad, Pakistan. CPEC is a long term well-grounded project to develop a strong collaboration between the two neighboring countries of for mutual profits of China, Pakistan, Central, West & South Asia. CPEC has created intense excitement among the people of Pakistan as the mega-scale project carries huge investment that is expected to give rise to the socioeconomic development in Pakistan in the next 15 years. This project is defined on the basis of economic, historical, cultural & geo-political viewpoints of the region.

CPEC can also be linked to the formation of Karakorum Highway in the 1970s. In 2010, China announced Kashgar, a central transit point on the old Silk Route and an entrance between China and Pakistan, as Special Economic Zone (SEZ).[2] This SEZ was declared to develop Xinjiang, Chinese western province into a trade hub which will lead to energy and economic integration in Central and South Asia. In the SEZs Gwadar and Kashgar are connected through roads and railway tracks.

Overall, CPEC project of $ 46 billion expects to include nearly 17,000MW of power generation of $ 34 billion. Figure 1 provides the map of CEPEC coal power plants.

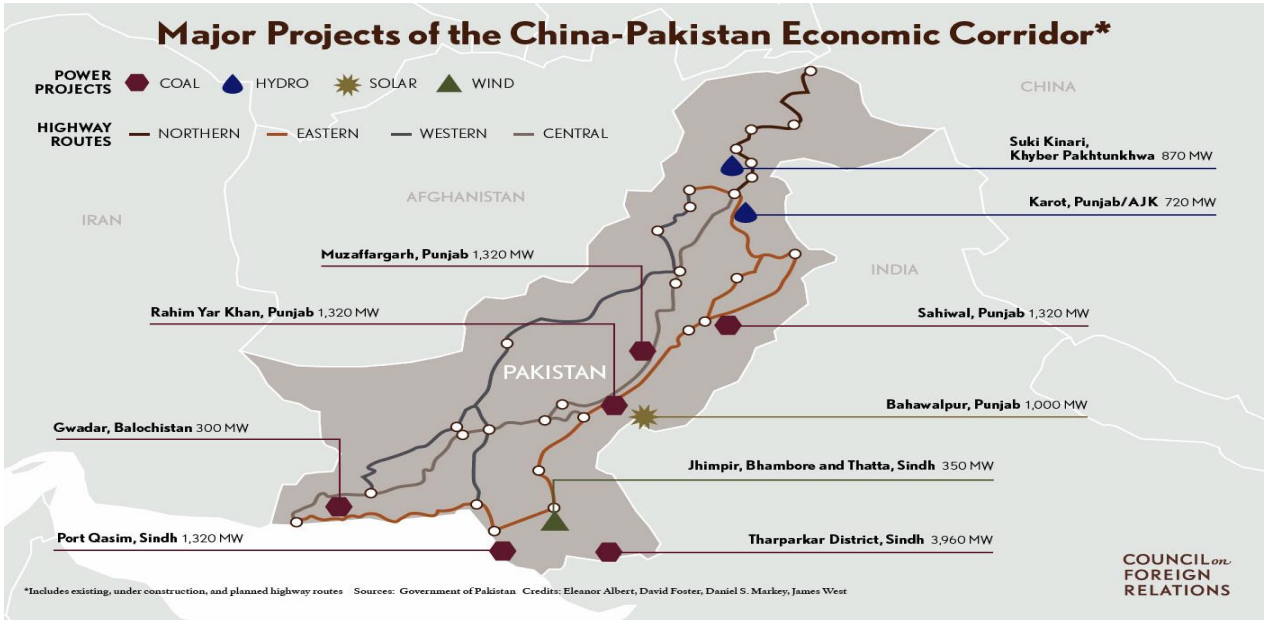

Fig. 1. Map of CPEC Coal Power Plants[3]

The rest of the investment will be spent on transport infrastructure development including re-construction of the railway tracks between the northwest city of Peshawar and the mega city of Karachi [3]. Pakistan currently faces energy deficit of over 4,500MW with regular blackout of about 12 hours per day. Therefore, the major focus of the CPEC is on energy sector of Pakistan and 10,400 MW of power plants are lined up for completion by March 2018. The energy projects in CPEC will be formulated by private Independent Power Producers (IPP) rather than the Chinese or

[1] The Sino-Pakistan Agreement was signed in 1963 between the governments of Pakistan and China establishing the border between these countries. It resulted in China ceding over 1,942 square kilometers (750 sq mi) to Pakistan and Pakistan recognizing Chinese sovereignty over hundreds of square kilometers of land in Northern Kashmir and Ladakh.

[2] A Special Economic Zone (SEZ) is a geographical area that has economic laws that are more liberal than a country's domestic economic laws. It includes: Free Trade Zones (FTZ), Export processing zones (EPZ), Free Zones (FZ), Industrial Estates (IE), Free ports, Urban Enterprise Zones and others.

[3] Source: google.com.pk/map of CPEC Coal Power Plants.

Pakistani government. These private investments will be financed by the Exim Bank of China at an interest rate of 5-6 % and the Government of Pakistan will buy electricity from these private firms at pre-set rate. The detail of CPEC investment project is presented in Figure 1.

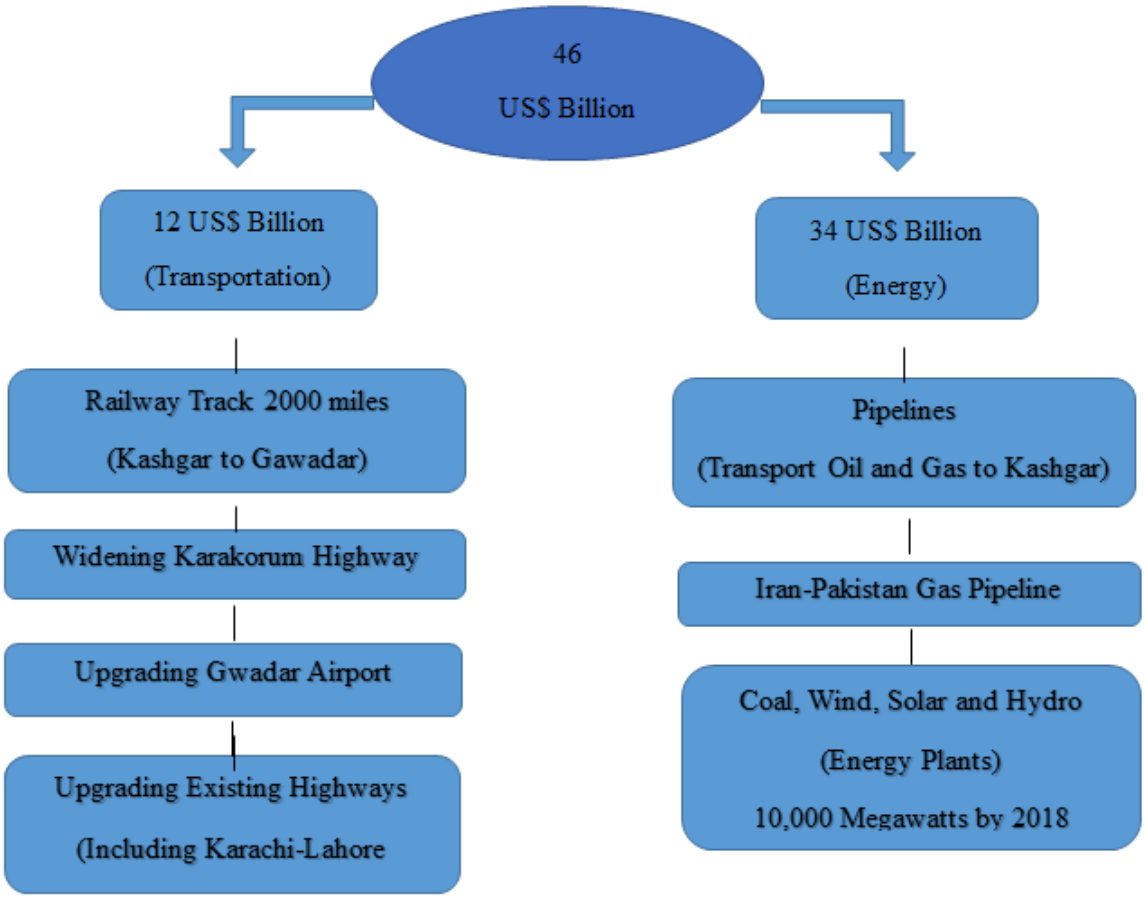

Fig. 2. CPEC Investment Tree (Irshad et al., 2015)

3. Data and Methodology

All CPEC power project come under the power generation sector, so secondary data for these coal projects has been obtained from different power sector organizations mainly Board of Investment (BOI), Ministry of Planning, Development & Reforms, Private Power Infrastructure Board (PPIB) and National Electric Power Regulation Authority (NEPRA).To achieve our proposed objectives, three parameters are required: Amount of energy released (MW), amount of coal burning (tons of coal) and amount of GHGs emitted (tons of CO2). With these parameters the carbon emissions of coal power plants can be calculated by using formula proposed by van Dijk et al. [9].

Carbon emission (eq) =Amount of Coal× $CO_{2\ emissions}$ +Amount of Coal (0.3% ×$CO_{2emissions}$×GWP for CH_4 of 21)

4. Results and discussion

The quantification of coal fire-related CO2 emissions on a micro level is a sensitive topic as it is influenced by political and economic factors, which not necessarily be in accordance with purely science-based estimates [9]. Currently coal fires plants in developing countries are receiving microscopic attention. Therefore, baseline estimation is required for coal fires. Table 1 shows the estimated amount of carbon emission equivalent from each power plant of CPEC.[4]

[4] The detail can be seen in appendix

Table 1. Calculated Carbon Emissions Equivalents of CPEC Coal Power Plants

Sr. No	Power Plant	Power Capacity(MW)	Amount of Coal required (m tons)	Type of Coal	Percentage of Carbon Content%	Carbon emission factor (tons)	CO_2 equivalents released (tons)
1	Sahiwal 2X660 MW Coal-fired Power Plant, Punjab	1320	6	Sub-bituminous	71-77	2.71	17,284.380
2	Engro Thar 4X330 MW Coal-Fired, Thar, Sindh	1320	3.8	Lignite	60-70	2.38	9,613,772
3	Port Qasim Electric Company Coal Fired, 2X660, Sindh	1320	5.61	Sub-bituminous	71-77	2.71	16,160,895.3
4	Gwadar Coal Power Project	300	1.275	Sub-bituminous	71-77	2.71	3,672,930.75
5	HUBCO Coal power plant, Hub Baluchistan	1320	5.61	Sub-Bituminous	71-77	2.71	16,160,895.3
6	Rahimyar Khan Coal Power Project, Punjab	1320	5.61	Sub-bituminous	71-77	2.71	16,160,895.3
7	SSRL Thar Coal Block 1-6.5mpta Thar, Sindh	1320	5.61	Lignite	60-70	2.38	14,192,963.4

The estimated results of carbon emissions show direct relationship of percentage of carbon content with these emissions. As the percentage of carbon content increases in the amount of fuel used for power generation, the amount of carbon emissions from these power plants are also increased. Results show that, Sub-bituminous coal that is imported for power generation of 5 plants has higher percentage of carbon content (71-77 %). While two Thar power plants are using indigenous Lignite reserves of coal which have less percentage of carbon content (60-70 %). Therefore, lignite coal has less carbon emission factor i.e. 2.38 tons as compared to imported Sub-bituminous coal, which has higher carbon emission factor i.e. 2.71 tons. Therefore, Sub-bituminous coal power plants will emit higher carbon emissions than lignite coal power plants. As table 1 shows that same amount of coal is used in Rahimyar khan power plant and in SSRL Thar Block I power plant, but there is a huge difference in their carbon emissions equivalent values i.e. 16,160,895.3 tons and 14,192,963.4 tons respectively. This difference arises due to different type of coal used in both power plants. At the end we mention that many challenges and difficulties in assessing coal fire-related CO2 emissions exist and coal fire emission quantification has to be pursued by different methods for local, regional, and country-wide scales. These results are in line with the findings of de Gouw et al, 2014 who report that coal power plants have clearly high CO2 emissions.

5. Conclusion

The present study provides estimates for carbon emissions from 7 coal fired projects under CPEC in order to understand the characteristics of the systems from the perspective of

environmental damages. The result illustrate that Sub-bituminous coal has higher percentage of carbon content (71-77 %) as compare to indigenous Lignite reserves of coal (60-70 %). This means that it is economically and environmentally judicious to use indigenous Lignite instead of Sub-bituminous to run these coal fired projects in Pakistan. We recommend that an urgent priority should be given to these coal fired projects in Pakistan because the emissions contribute to global warming and locally hazardous and contaminated situations are created. However, CO2 quantification estimates need to be based on improved methods.

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УДК 33

Экологические издержки Китайско-пакистанского экономического коридора

Наурин Фатима [a], Аниль Салман [b], Недим Макаревич [c, *]

[a] Пакистанский институт экономики развития, Пакистан
[b] Институт информационных технологий COMSATS, Пакистан
[c] Посольство Боснии и Герцеговины в Пакистане, Пакистан

Аннотация. Китайско-пакистанский экономический коридор (КПЭК) – это мегапроект стоимостью 46 млрд. долл., из которых 34 млрд. долл. выделены на энергетические проекты. Высказывались опасения о влиянии выбросов углекислого газа, связанных с этим угольными проектами и их влиянии на климат и качество воздуха. В этом исследовании представлены оценки выбросов углерода для лучшего понимания экологической жизнеспособности этих проектов. Авторские подсчеты выбросов углерода показывают, что по мере увеличения доли углерода в количестве топлива, используемого для выработки электроэнергии, также увеличиваются выбросы от этих электростанций. Также установлено, что суббитуминозный уголь имеет более высокий процент содержания углерода (71-77 %) по сравнению с местными запасами угля лигнита (60-70 %). Поэтому уголь лигнит следует использовать для запуска этих энергетических проектов с целью

* Корреспондирующий автор
Адреса электронной почты: nmakarevic.science@gmail.com (Н. Макаревич), aneelsalman@gmail.com (А. Салман)

минимизации ущерба окружающей среде. Это также смягчит давление на платежный баланс Пакистана, поскольку суббитуминозный уголь является импортным.

Ключевые слова: экологические затраты, Китай, Пакистан.

Appendix

The detail of estimated carbon emissions of 7 coal power projects under CPEC separately.

1) Sahiwal 2X660 MW Coal-fired Power Plant, Punjab
Amount of Coal required=6million tons (Board of Investment Report)
Type of Coal=Sub-bituminous
Percentage carbon content=71-77%
Carbon emission factor=2.71 tons

=6,000,000×2.71+6,000,000(0.003×2.71×21)
=16260000+1024380
=17,284.380 tons of CO_2 equivalents

2) Engro Thar 4X330 MW Coal-Fired, Thar, Sindh
Amount of Coal required=3.8 million tons (Thar Coal Energy Board, Government of Sindh)[5]
Type of Coal=Lignite
Percentage carbon content=60-70%
Carbon emission factor=2.38 tons

=3,800,000×2.38+3,800,000(0.003×2.38×21)
= 9044000+569772
=9,613,772 tons of CO_2 equivalents

3) Port Qasim Electric Company Coal Fired, 2X660, Sindh
Amount of Coal required=5.61 million tons (PPIB)
Type of Coal=Sub-bituminous
Percentage carbon content=71-7%
Carbon emission factor=2.71 tons

=5,610,000×2.71+5,610,000(0.003×2.71×21)
=15203100+957795.3
=16,160,895.3 tons of CO_2 equivalents

4) Gwadar Coal Power Project, Gwadar 300MW
Amount of Coal required=1.275million tons (PPIB)[6]
Type of Coal=Sub-bituminous
Percentage carbon content=71-7%
Carbon emission factor=2.71 tons

=1,275,000×2.71+1,275,000(0.003×2.71×21)
=3455250+217680.75
=3,672,930.75 tons of CO_2 equivalents

5) HUBCO Coal power plant, Hub Baluchistan, 1320 MW
Amount of Coal required=5.61 million tons (PPIB)
Type of Coal=Sub-bituminous
Percentage carbon content=71-7%
Carbon emission factor=2.71 tons

=5,610,000×2.71+5,610,000(0.003×2.71×21)
=15203100+957795.3
=16,160,895.3 tons of CO_2 equivalents

6) Rahimyar Khan Coal Power Project, Punjab 1320MW
Amount of Coal required=5.61 million tons (PPIB)
Type of Coal=Sub-bituminous

[5] http://sindhcoal.gos.pk/
[6] http://www.ppib.gov.pk/N_upcoming_coal.htm

Percentage carbon content=71-7%
Carbon emission factor=2.71 tons
=5,610,000×2.71+5,610,000(0.003×2.71×21)
=15203100+957795.3
=16,160,895.3 tons of CO_2 equivalents
7) SSRL Thar Coal Block 1-6.5mpta Thar, Sindh, 1320MW
Amount of Coal required=5.61 million tons (PPIB)
Type of Coal=Lignite
Percentage carbon content=60-70%
Carbon emission factor=2.38 tons
=5,610,000×2.38+5,610,000(0.003×2.38×21)
=13351800+841163.4
= 14,192,963.4tons of CO_2 equivalent