

## The dilemma of growth: pollution and health impacts in the BRICS countries (Brazil, Russia, India, China, South Africa)

*O dilema do crescimento: poluição e impactos na saúde nos países do BRICS (Brasil, Rússia, Índia, China, África do Sul)*

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**RESUMO:** Uma das maiores ameaças de nossa era é a poluição, principalmente a poluição do ar, devido ao seu impacto negativo nas mudanças climáticas, que influenciou muito a morbidade, a mortalidade e tem um efeito devastador na saúde. A poluição e seu impacto na saúde é um importante substrato do crescimento econômico porque tende a ter um efeito incapacitante na economia de países que abusam de atividades causadoras de poluição. Os países propensos à poluição são países conhecidos por dominar a fabricação e o fornecimento de bens, serviços e matérias-primas e países cujos modelos de crescimento são baseados na disponibilidade de recursos naturais e seus produtos. Um exemplo perfeito desses tipos de países é o grupo chamado BRICS (Brasil, Rússia, Índia, China e África do Sul). Neste estudo, a metodologia de método misto foi utilizada na aquisição e análise de dados secundários sobre o crescimento econômico e a poluição nos países BRICS, e estudos de caso sobre o impacto da poluição em certas partes desses países foram explorados. O resultado de todas as investigações mostrou que a criação do NDB ajudou a evitar o “estado de dependência” descrito por André Gunder Frank. Descobrimos que a alta taxa de crescimento dos países do BRICS teve um impacto negativo na qualidade ambiental ao longo dos anos, sendo a industrialização e a urbanização os principais fatores que influenciam a taxa de crescimento.

**PALAVRAS-CHAVE:** Poluição do ar; BRICS.

**ABSTRACT:** One of our era's greatest menaces is pollution, particularly air pollution, on account of its negative impact on climate change which has greatly influenced morbidity, mortality, and has a devastating effect on health. Pollution and its impact on health is a major substratum of economic growth because it tends to have a crippling effect on the economy of countries that have overindulged in pollution-causing activities. Pollution-prone countries are countries that are known to dominate the manufacture and supply of goods,

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services, and raw materials and countries whose growth models are based on the availability of natural resources and their products. A perfect example of these types of countries is the group called the BRICS (Brazil, Russia, India, China, and South Africa). In this study, the mixed-method methodology was utilized in acquiring and analyzing secondary data on the economic growth and pollution in the BRICS countries, and case studies on the impact of pollution in certain parts of these countries were explored. The result of all the investigations showed that the creation of the NDB helped to preclude the “state of dependency” described by Andre Gunder Frank. We discovered that the high growth rate of the BRICS countries has had a negative impact on environmental quality over the years, industrialization and urbanization being the major factors influencing the growth rate.

KEYWORDS: Air pollution; BRICS.

JEL Classification: F10.

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## I – INTRODUCTION: BRICS COUNTRIES (BRAZIL, RUSSIA, INDIA, CHINA AND SOUTH AFRICA)

Jim O’Neill, chairman of Goldman Sachs Asset Management, coined the term ‘BRICS’ in 2001, the notion behind the coinage was that the nations’ economies would come to collectively dominate global growth by 2050. He noticed that the economic growth rate of these four developed countries excluding South Africa at the time of the study was higher than the average growth rate of other developed countries such as the United States, Japan, and Germany. The alliance between these five countries has been met with mixed feelings by economists, critics, and basically anyone that has an opinion about the political amalgamation. Some people, majorly economists, predicted that these five nations will dominate the supply of goods, services, and raw materials in the near future, while critics argue that the BRICS base their growth model on heavily used non-renewable resources, therefore doomed to fail. Although these five countries have in common a high economic growth rate, high growth potential, and a belief that the multilateral institutions, such as the International Monetary Fund and World Bank have not evolved quickly enough to reflect the increasing economic and political influence of large emerging nations, they are not allies naturally. Relations between China and India have not been easy due to a border dispute. Brazil, Russia, and South Africa are known to be net resource exporters, while China and India are importers.

History seems to be repeating itself because these institutions still bear the imprint of their origins in the 1940s when European nations represented a larger share of the global economy. For example, as of 2020 Belgium accounts for around 3.42% of the global economy and has a voting quota of 5.59% at the International Monetary Fund (IMF). By contrast, China alone accounts for around 18.34% of global GDP, yet has a 6.40% voting quota at the IMF. To address this, the BRICS nations have sought to influence change, and even set up their own financial institutions, establishing the New Development Bank (NDB), which provides loans and

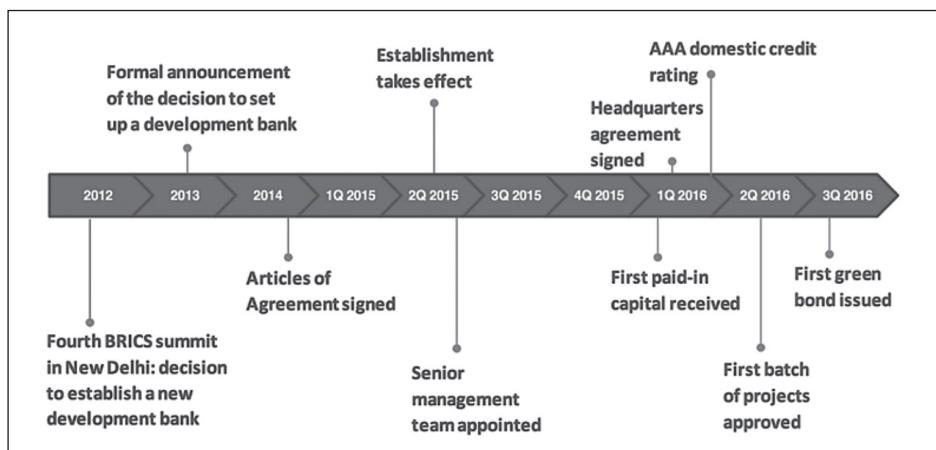
rivals the World Bank, and the Contingent Reserve Arrangement (CRA), providing emergency liquidity much like the IMF does.

## NEW DEVELOPMENT BANK (NDB)

In 1971, Andre Gunder Frank argued that developing countries should find a way to emancipate themselves from global capitalism and be independent. In 2014 Brazil, Russia, India, China, and South Africa, known as the BRICS, took this advice and created the New Development Bank (NDB) and Contingent Reserve Arrangement (CRA). These financial institutions were promoted as an alternative to the World Bank and the International Monetary Fund respectively, both of which have basically been controlled by the United States, Europe, and Japan. The main purpose of the NDB is to fund infrastructure and long-lasting development in the burgeoning markets and developing countries.

A set of projects were approved in the NDB's first year, one in each of its five-member countries, totaling \$911 million. The projects focused on energy, and include the following: India's Canara Bank was awarded a \$250 million loan for 500 megawatts of renewable-energy projects in India; an \$81 million loan for 100 megawatts of rooftop solar power in China; Brazil's national development bank (BNDES) was awarded a \$300 million loan to develop 600 megawatts of renewable energy capacity in Brazil; Eskom, a South African public electricity company got a \$180 million loan to investment in transmission lines and the connection of renewable electricity capacity to the national grid; The Eurasian Development Bank (EDB) and the International Investment Bank (IIB) got a \$100 million loan for a small-scale hydropower project in the region of Karelia, Russia. Thus far, the NDB has been known to only lend money to public sector entities, but there are plans to expand to the private sector.

Figure 1: NBD Creation Milestone

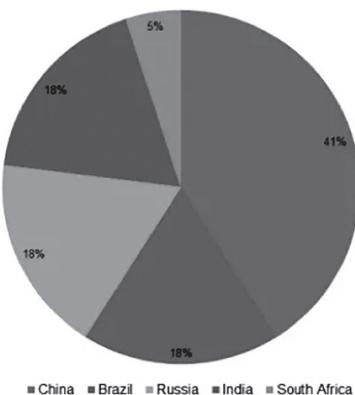


Source: [https://en.wikipedia.org/wiki/New\\_Development\\_Bank#/media/File:NDB\\_Creation\\_Milestones.png](https://en.wikipedia.org/wiki/New_Development_Bank#/media/File:NDB_Creation_Milestones.png)

## CONTINGENT RESERVE ARRANGEMENT (CRA)

In 2014, the BRICS countries established the Contingent Reserve Arrangement (CRA) purposely to make amends for the BRICS' frustration caused by the dearth of equity exhibited by the International Monetary Fund (IMF). Redress had long been promised but blocked by the US until late 2015. A prescribed evaluation of the CRA reveals that though all BRICS countries enjoy equality for strategic decisions, the CRA strongly has a lot in common with the IMF's quota-based voting distribution where operational decisions are taken. It however provides a more balanced electoral system because the veto position is not granted to just one single party. Like its own staff or macroeconomic research facilities, the CRA also lacks legal personality and other fundamental features. Funding approvals are then traced to IMF on-track arrangements, which compromises the CRA's significance. The CRA however holds the potential to be developed into a viable BRICS alternative to the IMF in the long run.

Figure 2: Contribution of each member to BRICS  
Contingent Reserves Arrangement



Source: Sixth BRICS Summit – Fortaleza Declaration

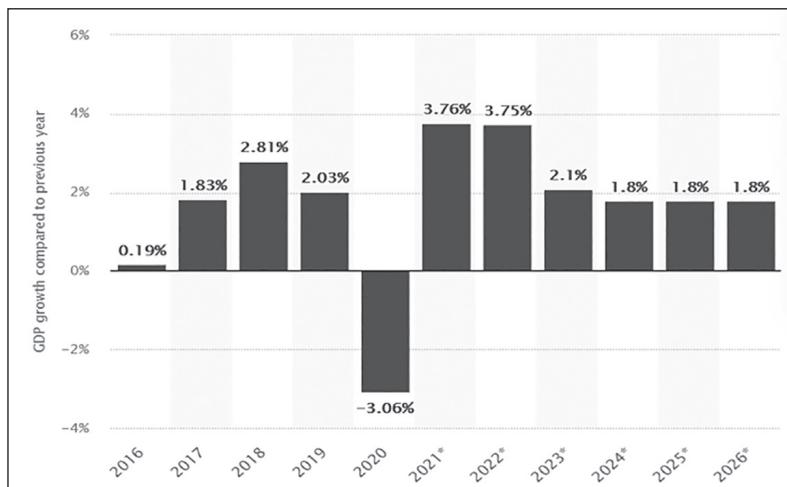
The BRICS countries are known to be dominant suppliers of manufactured goods, services, and raw materials due to low labor and production costs. This means that alternatives to human labor are leveraged in the production process, and these activities have led to an increase in the emission of pollutants like carbon monoxide which can lead to a series of health issues. The aim of this work is to provide a detailed answer to the different health impacts from air pollution due to the economic growth in the BRICS countries.

The paper is structured as follows; in section II we examine the economies of the five nations that make up the BRICS. In section III, we will investigate how the high economic growth of the BRICS countries contributes to the emission of pollutants and its impact on health. Measures put in place to reduce air pollution by the BRICS will be discussed in section IV, and the conclusion.

## II – REVIEW OF LITERATURE: THE ECONOMIES OF THE BRICS COUNTRIES

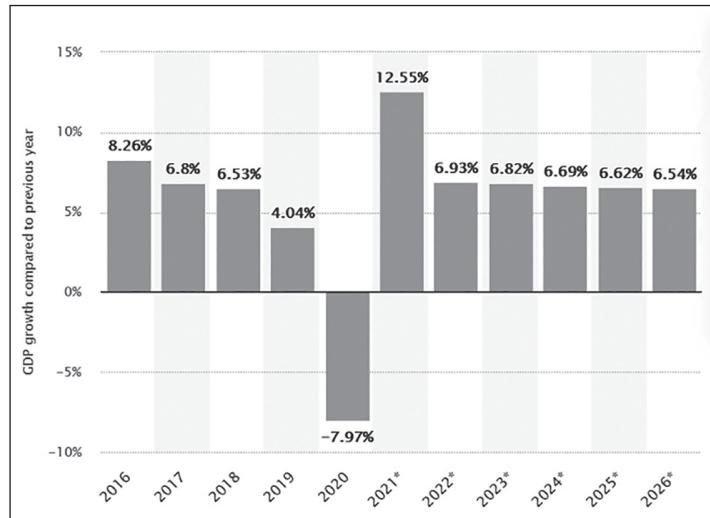
The increase in globalization in the BRICS countries has made the group of countries a vital contributor to global growth and political influence. BRICS economies have grown rapidly with their share of global GDP rising from 25.6% in 2015 to a projected increase of 33.3% in 2020. The IMF also estimated that the BRICS countries will account for over 50% of the world's GDP by 2030, because of the high growth potential of the nations. BRICS account for 41.53% of the world population, foreign currency reserves of \$4.4 trillion, and 16% of global trade. The growth of the financial market in the BRICS countries has been exponential. For example, from 2000 to 2020, Brazil's market capitalization increased from less than 40% of GDP to 69.98%, India from 34.15% to 98.95%, Russia and China from almost zero to 46.8% and 82.96% respectively, South Africa from over 150% to 358.95%. In the S&P Global Market Intelligence global bank rankings, banks from these five countries are among the top 100 banks in the world, with the top 4 banks having their headquarters in China. It is not surprising that these economies are the new propellers of global demand. The BRICS countries have been known to be victims of the global financial crisis and suffering the effect of large and volatile capital flows and the BRICS countries converge into a common objective of transforming the international financial and monetary system, with a strong desire to build an international order driven by equity and fairness, that reflects the changes in today's global economy and serves the interests of all. Thus, the five countries in the BRICS community play a vital role in the G20, in reforming global economic policy and aiding financial stability.

Figure 3: GDP Growth Chart for Russia



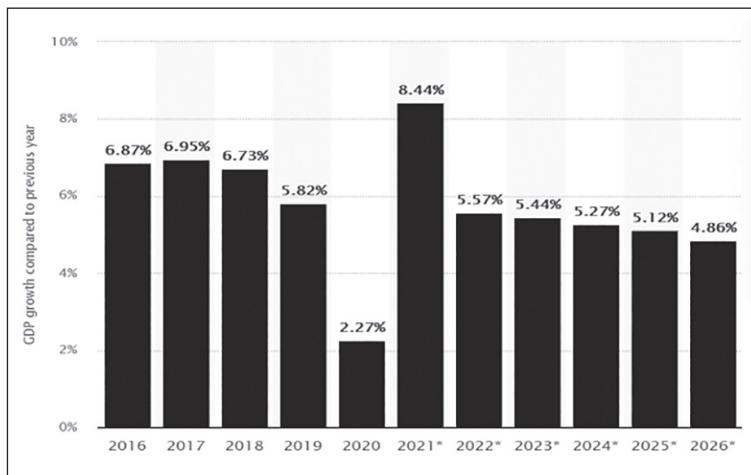
Source: <https://www.statista.com/statistics/741729/gross-domestic-product-gdp-growth-rate-in-the-bric-countries/>.

Figure 4: GDP growth chart for India



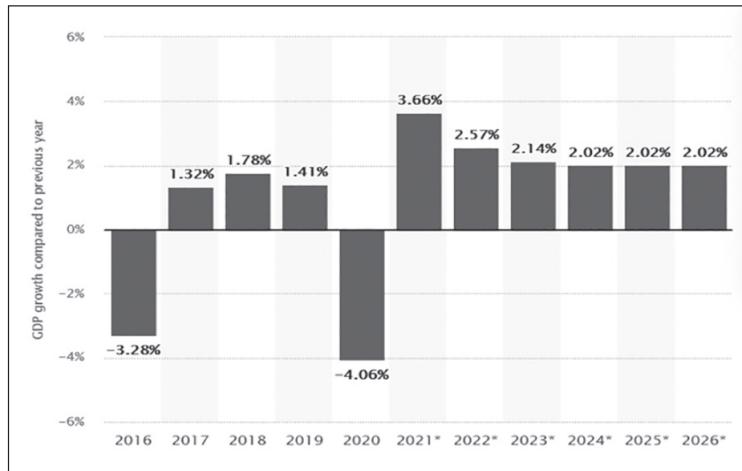
Source: <https://www.statista.com/statistics/741729/gross-domestic-product-gdp-growth-rate-in-the-bric-countries/>.

Figure 5: GDP growth chart for China



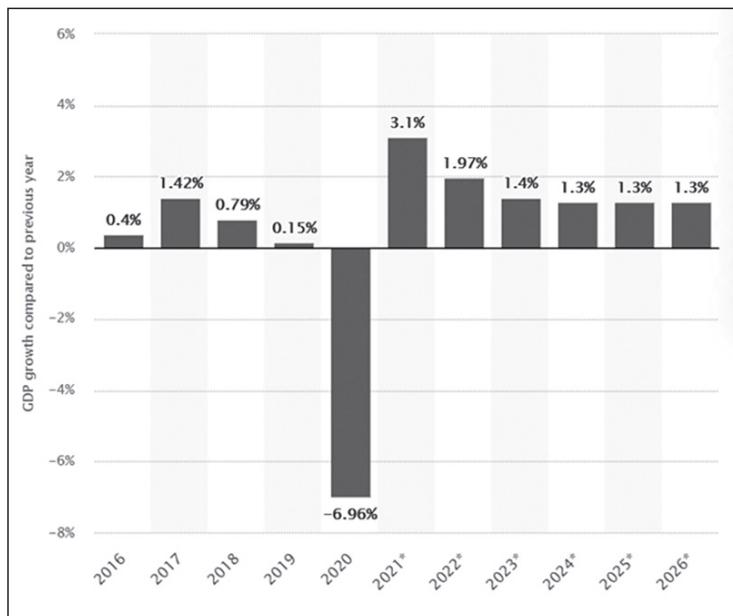
Source: <https://www.statista.com/statistics/741729/gross-domestic-product-gdp-growth-rate-in-the-bric-countries/>.

Figure 6: GDP growth chart for Brazil



Source: <https://www.statista.com/statistics/741729/gross-domestic-product-gdp-growth-rate-in-the-bric-countries/>.

Figure 7: GDP growth chart for South Africa



Source: <https://www.statista.com/statistics/370514/gross-domestic-product-gdp-growth-rate-in-south-africa/>.

Renata Vidart Klafke, Rudy de Barros Ahrens, Ruy Gomes da Silva, Luiz Alberto Pilatti, and Antonio Carlos de Francisco (2015) worked on the clarification and exploration of the changes of some of the atmospheric indicators of the BRICS

countries, measures taken to reduce the rate at which pollutants are being emitted by investing heavily in research and development of renewable energies, and the deleterious effect of oxides of carbon emission. They concluded that the connection among economic growth, utilization of energy, and the environment cannot be denied. These factors majorly affect the sustainability of a country and can be measured by the quality of life, natural resource usage, and the air quality of the country. This study also supports the inference that major pollutants such as carbon dioxide, are clearly increasing the incidence of respiratory diseases in young children. Certainly, the BRICS countries still must combat a great challenge as they continue to expand their sustainable development strategies.

Viviana Tedino (2017) aim was to attest to the existence of the Environmental Kuznets Curve (EKC) in developing economies using the panel data analysis. The EKC states that pollution is directly proportional to income, and after reaching a turning point, it starts to decrease. By accessing the connection between GDPs per capita and greenhouse gas emissions, an inference was arrived at that the EKC curve holds true for China, India, and South Africa, which will continue to pollute, while Brazil and Russia are the exceptions to the rule.

Tamazian et al. (2009) studied the relationship between income and the emission of pollutants in developed countries like the BRICS countries, they also considered the financial development of these countries. After controlling the diversity of the countries, it was discovered that economic and financial development are important determinants of environmental quality in the countries observed during the study. The evaluation suggested that financial freedom and openness are important factors for the reduction of CO<sub>2</sub> emissions. They also tested their results using the economies of the United States and Japan.

Pao and Tsai (2010), like Tamazian et al. (2009) discussed the influence of financial and economic growth on the deterioration of the environment over the period of 1980-2007 in BRIC countries. The results of this study support the EKC, which states that pollution is directly proportional to income, and after reaching a turning point, it starts to decrease. During this study, evidence was achieved that shows that in the long run CO<sub>2</sub> emissions are found to be FDI inelastic and energy consumption elastic.

Xu Tian et al. (2015) dissected the relationship among BRICS countries' economic development, emission of pollutants and resource consumption from a decoupling analysis standpoint. They evaluated the implications of the economic gains of the BRICS countries on the environment and resources. The major aim of the study is to shed more light on the shift in equilibrium in relationships among economic development, environmental emissions, and resource usage issues methodically from a consumption-based point of view. The results obtained made developing countries' future sustainable development more understandable.

### III – METHODOLOGY

In this paper, economic growth and its contribution to pollution of the BRICS

were analyzed. The effect of pollution on health in these countries, and measures put in place to preclude the increase in pollution without sabotaging the economic growth of the country were also investigated and juxtaposed to see which is more effective in the fight against pollution in the BRICS. Secondary data on the qualitative and quantitative analysis of air pollutants in Brazil, Russia, India, China and South Africa were obtained using the mixed methodology method. The information gathered using this method coupled with the theory postulated by Andre Gunder Frank, was leveraged in arriving at a conclusion on how the economic growth of the BRICS contributes to pollution, and eventually the health of the citizens.

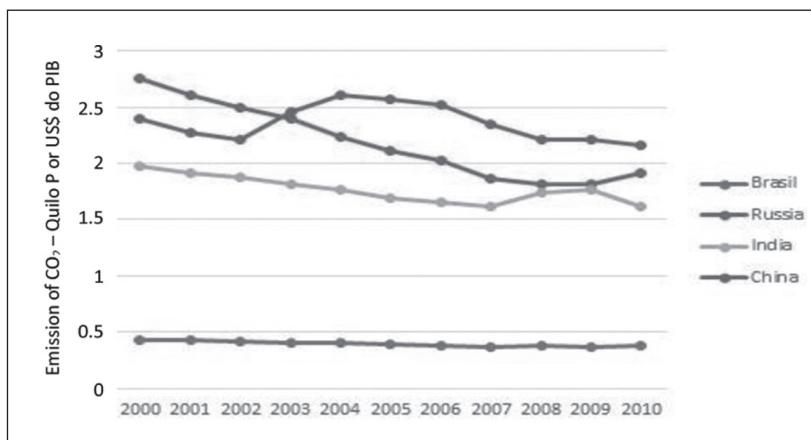
## FINDINGS

### **Effect of Economic Growth on Pollution**

As a result of the growth of their political and economic strength, an informal union was formed between the BRICS countries. The economic cooperation of these countries has engendered incentives for foreign, direct investment and these in turn reinforce their economies. Economic growth of the BRICS countries is a very contentious subject that elicits debate. Some people believe that the economic growth of the BRICS is detrimental to the environment and will increase pollution and emission of greenhouse gasses. Also, it would not be beneficial to the less privileged percentage of the demographics and ultimately increase the crime rate and reduce the standard of living. On the other hand, most economists believe that economic growth will prosper societies and increase their standard of living. Advocates of economic growth also believe strongly that it will lead to a reduction in unemployment and surely reduce poverty. Moreover, government accounting books will look better, and more money can be used by the government to fund programs such as education and health care.

Industrial growth has been known to have a major positive influence on economic growth. The ramification of the BRICs' high economic growth and development rate have been a source of concern to environmentalists that are distressed over the alarmingly high rate at which pollutants are being emitted into the atmosphere, owing to the increased number of industries and the aggravated consumption of more products that are non-biodegradable, which requires a long time or extensive recycling process to break down, and it can also negatively alter natural resources. The consequences of this lack of environmental awareness have been known to be really devastating. If a thorough analysis of sustainable activities is not taken, the environmental prognosis for the generations to come is not optimistic.

Figure 8: Emission of CO<sub>2</sub> in the BRICS countries



Source:<https://www.semanticscholar.org/paper/Air-pollution-indicators-in-Brazil%2C-Russia%2C-India-Renata-Rudy/aa2103009c70a8977da5ff4be3f80a053e3aed99>

POPULATION PER COUNTRY (BRAZIL:214,000,000

RUSSIA: 1.434,000,000 INDIA: 1.393,000,000 CHINA: 1.412,000,000

### Air Pollution In China

China, the country with the largest population and second-largest economy in the world, plays an important role in the ongoing scientific and policy deliberations on how to control and manage air pollution. After years of fast industrial growth caused by manufacturing products that are highly demanded outside the country, increasing domestic energy consumption, and an increase in automobile traffic and other economic activities that lead to emissions, many parts of the country face extreme, unhealthy levels of air pollution. Chinese citizens have been forced to tolerate occasional red alerts caused by the air quality index (AQI) increasing beyond the World Health Organization Guidelines for multiple days in a row. Air pollution has been known to traverse the country of origin, thus China's air pollution problem, which is connected to the world's highest emissions of greenhouse gasses, has immense consequences for the global crisis of climate change. Currently, China is the world's largest energy consumer using up to 145.46 exajoules in 2020, followed by the United States with a total consumption of 87.79 exajoules and then India with a total consumption of 31.98 exajoules. This is likely due to China's remarkable economic growth since economic reform in the late 1970s. Energy and industry sectors contribute mainly to air pollution in rural areas, while transportation is the major source of pollutants in urban areas. Automobiles emit substances such as oxides of Nitrogen (NO<sub>x</sub>), carbon dioxide (CO<sub>2</sub>) and some other particulate

matter which are major pollutants that can impair health. Although the Chinese government enacted some policies to curtail emissions, the situation still got worse. According to WHO, “Air pollution is responsible for about 2 million deaths in China per year. Of those deaths, ambient air pollution alone caused more than 1 million deaths, while household air pollution from cooking with polluting fuels and technologies caused another million deaths in the same period in China”.

### Air Pollution in India

India, the second most populous country in the world with a total population of 1.2 billion people, is the third highest energy consumer in the world with a total consumption of 31.98 exajoules. The major causes of air pollution in India are domestic and industrial biomass burning, windblown mineral dust, coal burning for the generation of energy, industrial emissions, agricultural waste burning, burning of fossil fuels, construction activities, brick kilns, emissions from automobiles, and diesel generators. The main cause of domestic air is using solid fuels for cooking, such as wood, dung, agricultural residues, coal, and charcoal. Currently, Ghaziabad city in India, is the second most polluted city in the world after Hotan in China, and other cities in India occupied the third to the fourteenth position and beyond. In 2017, schools were shut down in Delhi when air pollution hit a hazardous level a day after doctors declared a “public health emergency”. This shows how high pollution is in India, and how devastating the effect has been and will continue to be if not curtailed.

### Air Pollution in Russia

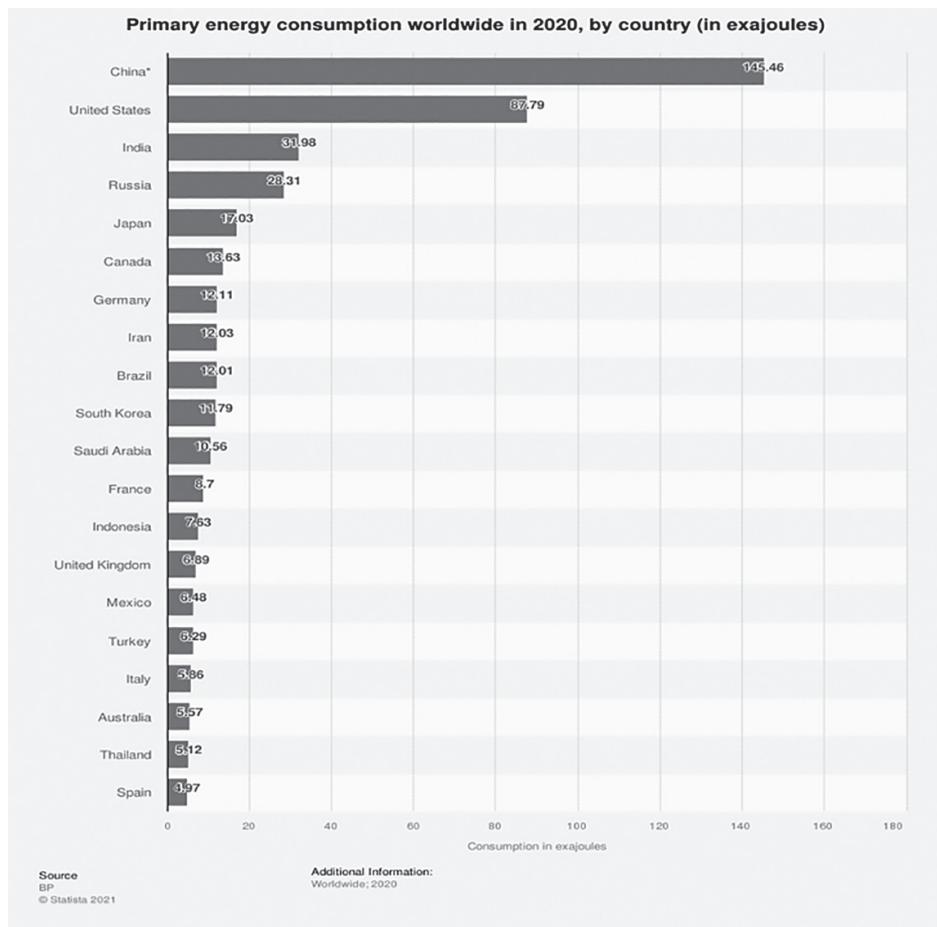
Russia is the third largest energy consuming country, with a total consumption of 28.31 exajoules in 2020. Most of the cities in Russia with the highest emissions are industrial areas. Some people have the idea that sustainable economic development can only be achieved through continuous augmentation of production technology, but sadly most of the innovative ideas coupled with technological designs were only implemented to increase economic growth potential, most at the cost of the citizen’s health. Some of Russia’s well-known industries include the steel industry, heavy machinery, petrochemistry, and these enterprises are geographically localized with clusters of urban areas. Clear examples of such clusters in Russia are in Ural and Kuzbass. Also, in 2018 residents of Chelyabinsk, Russia protested over air pollution caused by industries after heavy smog engulfed the Ural Mountains city. Certainly, in recent years Russia has done a lot to improve the situation in the environment in these industrialized areas. Industries that are into mining and processing, and metallurgical production, are equipped with filters and systems for getting rid of emissions. Recently, emission of pollutants into the atmosphere in Russian cities has decreased significantly. However, the problem is yet to be resolved completely. Emissions of pollutants into the atmosphere in most of the industrial

areas in Russia remain relatively high. And in the cities, where there are not a lot of industries, transportation is the main source of pollution.

## Air Pollution in Brazil

In Brazil, about 61 thousand people die each year from air pollution and 43,600 from airborne material and 3,700 from environmental ozone. 14,000 of which are from domestic pollution, caused by cooking with firewood, coal and from household air pollution caused by cooking with wood and other solid fuels, making emission of pollutants the ninth largest cause of mortality in the country after dietary risks, high blood pressure, physical overweight, tobacco smoking, high fasting plasma glucose, alcohol and drugs, physical inactivity and low physical activity, high cholesterol, among dozens of other factors.

Figure 9: Primary Energy Consumption Worldwide



Source: <https://www.statista.com/statistics/263455/primary-energy-consumption-of-selected-countries/>.

## EFFECT OF AIR POLLUTION ON HEALTH IN THE BRICS COUNTRIES

Industrialization, transportation, and some anthropogenic activities that utilize important fossil fuels are responsible for the emission of pollutants into the atmosphere, reducing air quality and impairing the health of people in Brazil, Russia, India, China, and South Africa. Some major pollutants released into the atmosphere that has major negative impacts on health include Oxides of Nitrogen (NOX), Oxides of Sulfur (SOX), Carbon monoxide (CO), Particulate Matter (Smoke and Dust), Volatile organic compounds, Oxides of metals (lead, mercury, cadmium, and greenhouse gasses that are the major cause of global warming.

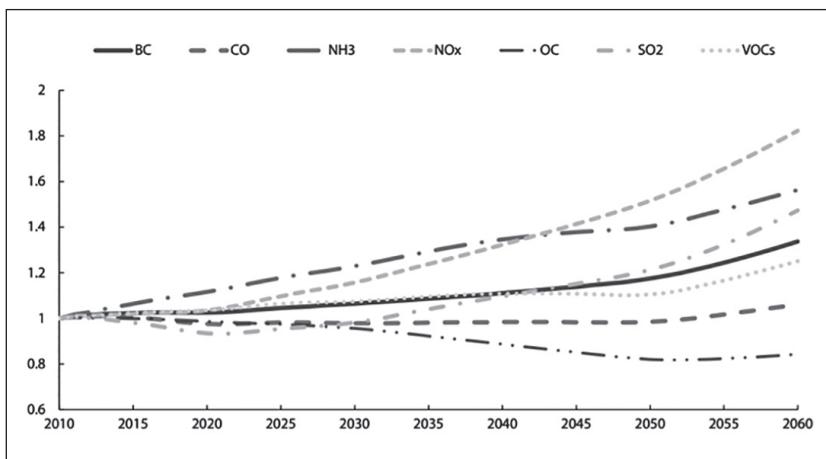
Various studies have discovered a connection between air pollution and several adverse health effects in the general population. These effects range from not easily detectable effects to premature death, and include primarily the following effects:

1. Increased respiratory ailments (bronchiolitis, rhinopharyngitis, bronchial hypersecretions)
2. Eye irritation
3. Increased cardiovascular morbidity.
4. Compromised immune system
5. Impact on short-term mortality as a result of respiratory and cardiovascular diseases.
6. Impact on long-term mortality attributed to the carcinogenic effect of pollutants.

Air pollution is a major cause of a lot of diseases that are non-communicable. Approximately 3% of deaths caused by cardiopulmonary and 5% of deaths caused by lung cancer deaths are ascribable globally to Particulate Matter.

If the rate of emissions in the BRICS countries continue to grow unchecked, the concentration of pollutants in the atmosphere can increase rapidly and lead to possibly even more extreme consequences on human health. Way back to the 1900s, the London Smog of 1952 was the first tragic pollution incident in Western Europe, causing the death of thousands and wreaking havoc on the city's transport system for days. concentrations of PM2.5 in Mumbai increased to the extreme level of 1,010  $\mu\text{g.m}^{-3}$  during a smog crisis that lasted for days also, in November 2017. As the concentration of pollutants are predicted to rise globally in the future, the occurrence of high-concentration events could increase, especially in association with global warming, continued urbanization and globalization of industrial production.

Figure 10: Emission projections over time (Index with respect to 2010)



Source: ENV-Linkages model, based on projections of emission factors from the GAINS model.

## SUSTAINABLE DEVELOPMENT STRATEGIES BY THE BRICS COUNTRIES TO REDUCE AIR POLLUTION

As earlier mentioned in this paper, one major move taken by the BRICS countries to combat air pollution is the funding of projects focused on energy. The BRICS New Development Bank ascribes importance to projects created to develop renewable energy sources. In 2016, at the Boao Forum for Asia, Leslie Maasdorp commented that “The mandate of the Bank as set out in our Articles of Agreement is to be an establishment that is focused on accelerating the pace towards the transition to the ‘green economy’.”.

The NDB Vice President emphasized the fact that preference will be given to renewable energy projects. The bank is also seeking alliances with other institutions in quickening ‘green’ financing growth and augmenting the protection of the environment.

In 2015, Brazil generated close to 74% of its electricity from non-fossil energy sources. Brazil is working towards a 63.15% increase in total stationed renewable energy by 2024 from 106.4 gigawatts (GW) in 2014. Therefore, a total funding of \$121 billion will be required over the course of Brazil’s 2024 Energy plan, or a sum of \$12 billion raised annually to meet the renewable capacity addition targets. In 2015, Brazil was able to amass committed funding of \$7 billion for the development of renewable energy projects. In Russia, only 16% of its electricity was generated from renewable sources in 2015. Non-renewable energy still contributed to 66%

of its generation of energy. However, over time they have been able to drastically reduce emissions from 2233.9 million metric tons of CO<sub>2</sub> in 1990 to 1482.2 million tons in 2020. India's generation of electricity was estimated at 17% in 2015 and predicted to spike by 40% by 2030. India had a target to reduce the rate of emissions from 2005 by 35% in 2030. To achieve this a total funding of \$128 billion is required. In 2015, China being the most polluted country in the group when it comes to emissions, needed a total funding of \$254 billion to achieve its renewable power targets by 2020.

Figure 11: Renewable Energy Resources Additional Target

Country	Renewable Energy Capacity Target (GW)	Renewable Energy Investment Required (US\$ Bn)	Target Year	Remarks
Brazil	173.6	121.3	2024	As per 10 year energy plan 2024; Includes proportional transmission
Russia	73.5	44.0	2020	Plans to increase renewable energy share to 4.5%
India	225.3	157.7	2022	Includes US\$ 30 Bn for smart grids till 2022
China	761.0	622.0	2020	Includes US\$ 368 Bn for smart grids
South Africa	17.8	30.0	2030	As per South Africa's INDC
<b>Total</b>	<b>1251.2</b>	<b>975.0</b>		

Source: IEEFA Research.

#### IV – CONCLUSION

In this study, we discovered that the high growth rate of the BRICS countries has had a negative impact on environmental quality over the years, industrialization and urbanization being the major factors influencing the growth rate. China is currently known as the world's largest energy consumer, while India and Russia occupy the third and fourth position on the list of the world's energy consumption. China is the world's largest energy consumer using up to 145.46 exajoules in 2020. According to WHO there have been 2 million deaths per year attributed to pollution yearly. Brazil recorded 61,000 deaths yearly from air pollution. Protests from citizens in the BRICS countries brought significant pressure on the government to start creating change. They are now intentionally taking actions to reduce emissions, by investing heavily in renewable energy sources. A recommendation is to form alliances with other environmentally conscious countries or organizations so that innovative ideas that can help reduce air pollution will be shared amongst these countries and organizations, leading to maximum implementation that will benefit the world.

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