The Impact of Greenhouse Gas Emission on Health and Economy in Asian Countries

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Abstract. This study explores the impact of greenhouse gas emissions (GHG) on the health of Asian countries as they develop economically. The study calculated how much each country would invest per person in air pollution to reduce morbidity and even mortality, given current economic conditions, by selecting countries from each of Asian five tiers of average annual PM2.5 emissions concentration. The study identifies three main causes of Asian high GHG emissions: the burning of agricultural waste, emissions from the increase in the number of vehicles, and emissions from mass production in factories. Finally, reducing fertilizer use and reprocessing agricultural waste, vehicle restrictions and promoting new energy cars, and "eliminating" the number of urban plants and the use of renewable energy to produce and meet the demand of life are the policies can government implementations that support to contain GHG emissions and slow down the greenhouse effect, improving the air quality in Asia. Through the use of VSL model, this study obtained the different investment of the people in air pollution control under the economic conditions of different Asian countries, which shows that reducing air pollution is not only what the government departments need to do, but everyone has the responsibility to maintain together.

Keywords: Value of Statistical Life; Willingness to pay; Traffic emission; Agricultural emission; Industrial emission.

1. Introduction

Air pollution is now a major environmental health problem in Asia and the world. Among them, the large amount of greenhouse gas emissions is one of the main reasons for exacerbating air pollution and the greenhouse effect. Moreover, air pollution not only affects people's health, but also reduces agricultural production everywhere. According to Statista, from 1965 to 2021, the world's carbon dioxide emissions have generally been on the rise. The Asia-Pacific region produces more emissions than any other continent, far ahead of Europe, South America and the Middle East etc. The Asia-Pacific region's carbon dioxide emissions reached an amazing proportion of 17.74 billion metric tons in 2021, which is larger than the total emissions of all other regions combined [1]. Therefore, what is the distribution of emissions among countries within Asia, what causes Asia's greenhouse gas emissions to be far higher than those of other continents, and what policies have been promulgated by governments in Asia to effectively curb the speed of air pollution? The research will manipulate the VSL model to calculate exact willingness to pay on air pollution reduction in Asian countries, and analysis cause and effect on air pollution, especially GHG emission.

The next part discusses about the environmental and economic background in Asian countries, which selected from each tier of annual PM2.5 emission concentration in Asia area. Part 4 offers the analysis about the maximum investment for each person in Asian countries on reduction of air pollution after using VSL model. Part 5 investigates causes of air pollution emission in Asian countries and policy implementation for air pollution reduction. Finally, in part 6, it concludes the research.

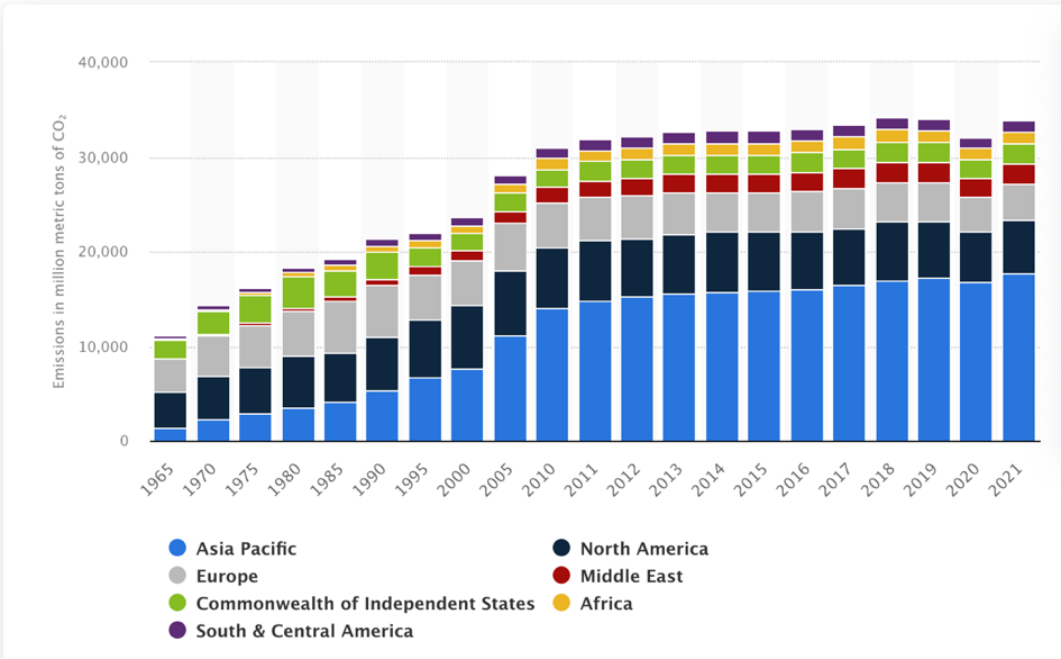

Fig 1. World's carbon dioxide emissions from 1965-2021.

2. Background

According to the WHO survey of air pollution levels across Asia, the results are shown in the chart below [2]:

Annual mean $PM_{2.5}$ concentration	WHO Air Quality Criteria	National air quality standards
40 µg/m³		India
35 µg/m³	WHO Interim Target 1	China Grade II Malaysia
25 µg/m³	WHO Interim Target 2	Mongolia Philippines Sri Lanka Thailand Viet Nam
15 µg/m³	WHO Interim Target 3	Bangladesh China Grade I Indonesia Japan Pakistan Republic of Korea Singapore
12 µg/m³		
10 µg/m³	WHO Guideline	
8 µg/m³[a]		Australia

Fig 2. Pollution levels across Asia.

Based on the table of air pollution in Asia investigated by WHO, which clearly lists India at the top of the list of Asian countries, with an annual average PM2.5 concentration of 40$\mu g/m^3$, followed by China and Malaysia at level of 35 $\mu g/m^3$. First of all, India has the highest average annual PM2.5 concentration of any Asian country, which means that the air quality in India is already in a worse status than people expected. As India faces a serious imbalance in the distribution of resources, air pollution from emissions has skyrocketed in its pursuit of productivity. Based on the statistics from

Pandey from 1990 to 2018, India's greenhouse gas emissions grew by 335%, which is a period of staggering growth [3]. In India, the bulk of its emissions come from coal-fired power. In 2017, 76% of India's electricity was generated through coal [4]. According to the graph below, the black part of India is the electricity generated by coal. Compared with other forms of electricity generation, such as oil and solar power etc., coal power generation is growing at a much faster rate than other forms of electricity generation. As we know, coal is an essential part of power generation in many countries, not just India. As a result, the burning of coal releases large amounts of exhaust gases, such as sulfur mixtures, which contribute to India's greenhouse effect and seriously pollute India's air quality. For India, what they need to pursue is how to use low-carbon energy to generate electricity, and how to use resources like solar energy properly to adapt to the current pace of rapid economic development.

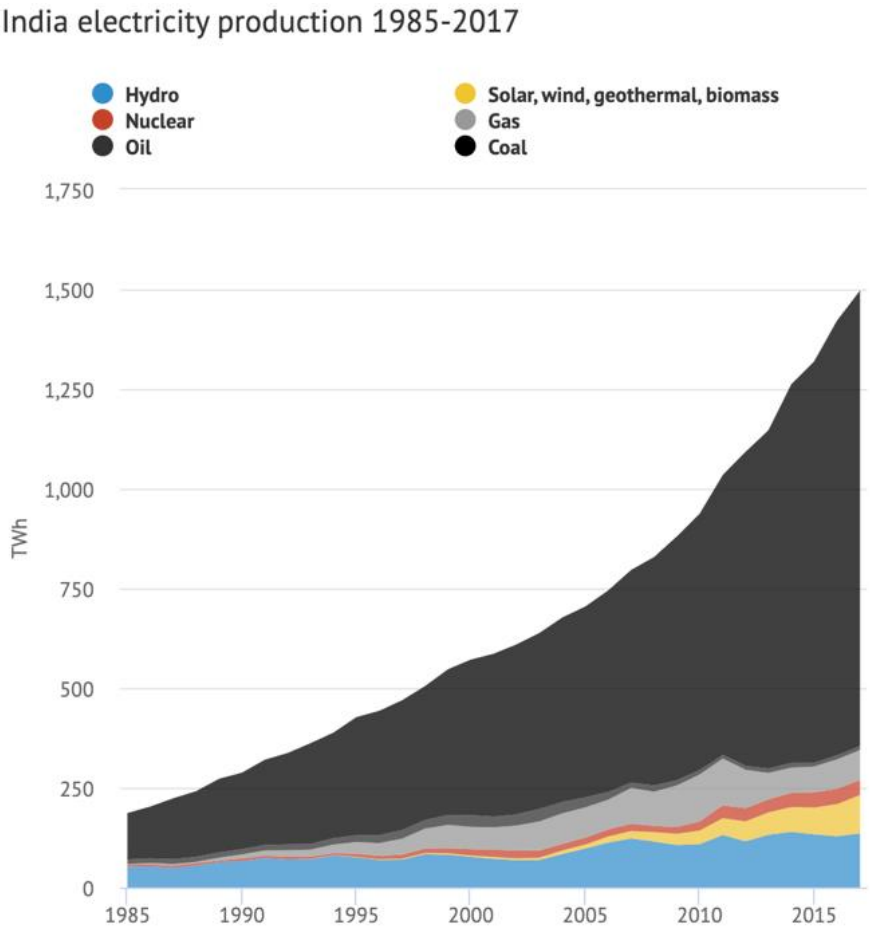

Fig 3. Indian electricity production in 1985-2017.

China is in the second tier of Asia's annual average PM2.5 emission concentration. In recent years, China, as a developing country, has witnessed rapid developing countries driven by production and consumption. However, under the economic development, it brought about by the negative externality that is deterioration of environment, such as the pollution produced by burning coal gas, and these have contributed to the greenhouse effect and to bring a lot of pollution particles in the air. According to a report by the BBC, China's total emissions now exceed those of all developed countries combined, but while total emissions far exceed those of other countries, China's per capita emissions are still lower than those of developed countries, due to its large population base [5]. Therefore, China still needs to find a balance with cleaning up its social environment without undermining economic growth.

In the third tier, Thailand is representative, because it is different that carbon dioxide emissions fell in the years after the government implemented a policy to use more renewable energy in 2016. For instance, carbon dioxide emissions were 279.31 tons in Thailand in 2018, but by 2019, its total

carbon dioxide emissions decreased slightly, accounting for 1.5 percent of total emissions [6]. While Thailand's CO2 emissions have barely fallen, they have risen overall not as dramatically as those of the top two tiers' countries. Also, the reason about emission of carbon dioxide and other air pollutants in Thailand is not as large as the first two tiers is that the greenhouse gas emission in Thailand mainly comes from the household electricity. Fortunately, the Thai government issued energy-saving strategies in time, which effectively slowed down the increase of Thailand's carbon dioxide emission.

Japan, in the fourth tier, controls emissions of greenhouse gases and other air pollution. Japan's greenhouse gas emissions fell 5.1 percent in the year to 2021, a steeper decline than any of the previous three tiers and the lowest emission since 1990 [7]. Much of the decline in Japan's emissions is due to the slowdown in energy demand and industry activity during the COVID-19 period. In the midst of the pandemic, industrial operations in Japan have declined. Nuclear power, for example, fell 2.3 percent. Also, according to the curve chart of Japan's greenhouse gas emissions from 2000 to 2020 compiled by Statista, and X-axis shows the years and Y-axis shows the emission in million tons of carbon dioxide equivalent [8]. It is not difficult to see from the line chart that Japan's greenhouse gas emissions peaked in 2013 and then showed a cliff decline, and the trend of decline was moderate from 2015 to 2017. However, when the pandemic hit in 2019-20, Japan's greenhouse gas emissions hit bottom again.

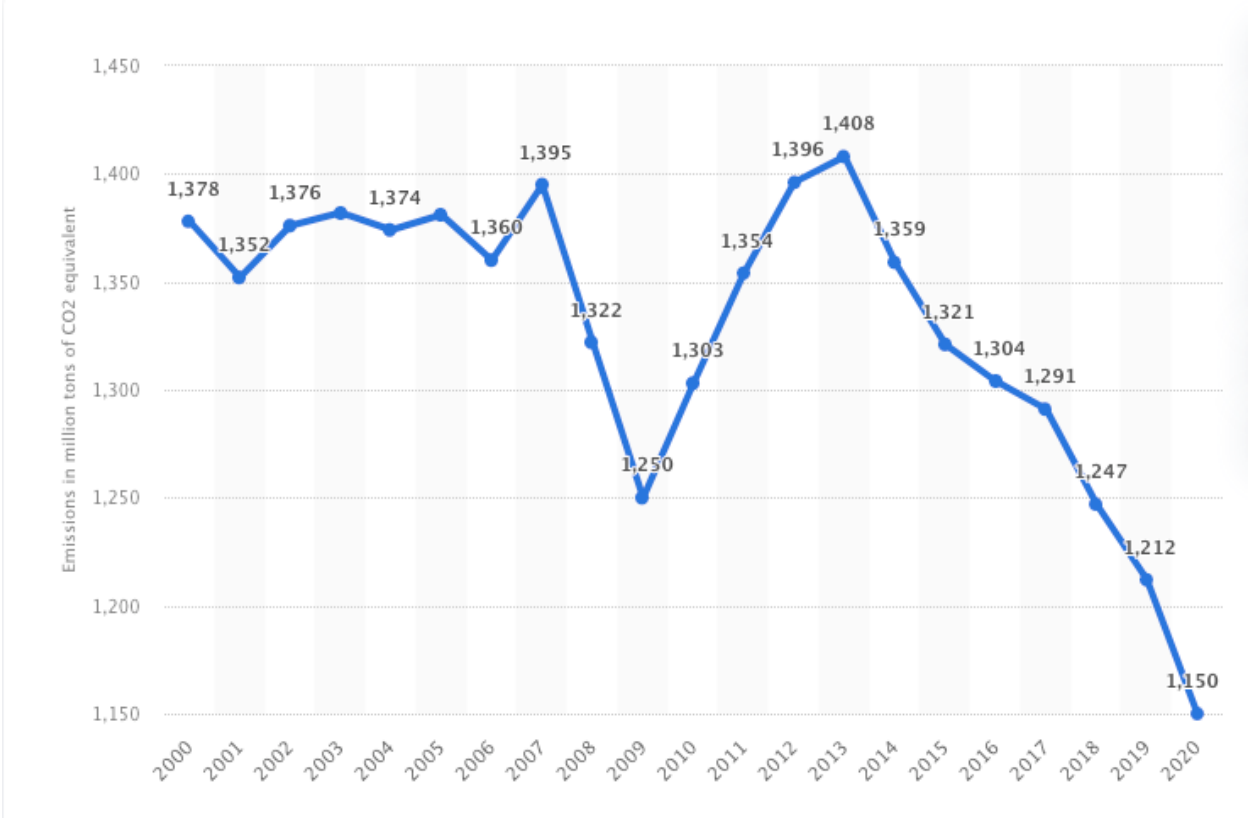

Fig 4. Trend of GHG emissions in Japan from 2000-2020.

In the Asia-Pacific region, Australia is in the bottom tier of greenhouse gas emissions. Australia is the world's largest emitter of greenhouse gases per capita because its population is sparsely populated compared to other countries. According to Ritchie, the results of Australia's per capita greenhouse gas emissions are far greater than those of the countries in the previous echelon of high greenhouse gas emissions, such as India, China, Thailand and Japan surveyed by the scholars [9]. However, the level of air pollution concentration is still at a low level. Australia's transport authorities have issued plans to regulate vehicle use and vehicle emission intensity in Australia. It plans to reduce emissions by 40% in 2030 on the basis of the original emissions [10]. Its transport department advocates the use of light commercial vehicles, which emit far less than traditional cars. Under the supervision of

Australian government departments, it has effectively curbed greenhouse gas emissions and improved air quality.

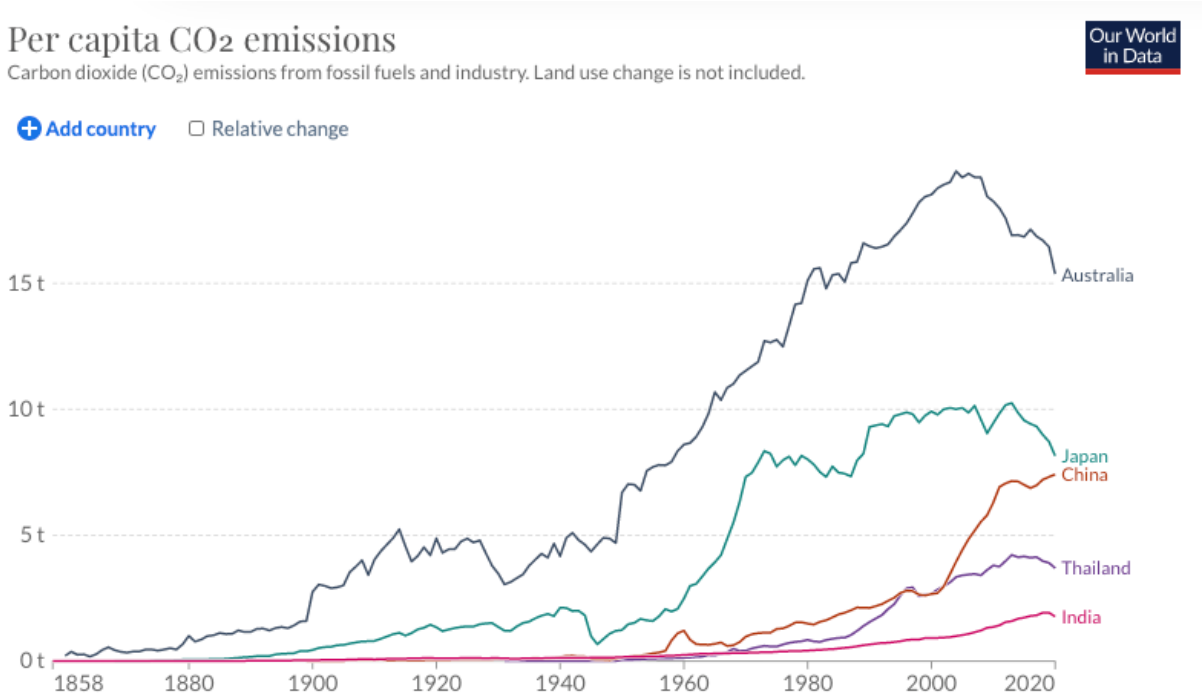

Fig 5. Per capita CO_2 emissions in Asia-Pacific region.

3. Analytical Method

3.1 Model

When Asian countries have been affected by greenhouse gases, we need to apply The Value of Statistical Life (VSL) model, which can obtain the economic benefits brought by reducing air pollution. According to Giannadaki et al., the VSL is defined as the marginal rate of substitution between wealth and mortality risk during the short time period [11]. The formula of VSL is shown:

$$VSL = \frac{WTP}{R} \tag{1}$$

Before we calculate the value of the maximum willing cost for health by reducing from air emissions, we need to know what WTP is. WTP is the abbreviation of Willingness to Pay, which means the maximum price consumers can accept to buy a product. In other words, in everyday life, if we are desire to purchase a movie ticket, assuming movie ticket is $15, we satisfy the price and purchase it. Therefore, that is the maximum price we value in mind for a movie ticket. Also, “R”, the denominator of VSL function, represents the mortality risk, which means the risk of causing death in a certain group of people in a certain period of time.

3.2 Data

In order to obtain the investment of each Asian country in reducing pollution emissions, four Asian countries were selected from each of the previously mentioned tiers of annual average PM2.5 concentration of Asian countries as a representative to measure the importance of air pollution and the health benefits. From first to the last tier, India, China, Thailand, and Pakistan were picked orderly. Also, comparing these Asian countries with other countries in East Africa and Europe, it can set up the reference countries to reveal how serious each country is about air pollution. Then, the most significant part to calculate VSL should be finding WTP of each country for reducing air pollution,

so the data from previous scholars who researched on statistics of each country's investment in air pollution in Asia was extracted. To make the data result more reliable, it is necessary to control the same number of samples in the calculation process, so let us suppose a sample of 100,000 people are willing to support and pay for pollution abatement, and the margin of death from reducing air pollution is 1/100,000 (ΔR).

3.3 Model Analysis

First of all, India is a country that has the worst air quality in Asia. According to Chattopadhyay, the estimated mean annual WTP for reduction in health risks related to air pollution is around $12 in India, so in other words, each household offers only $1 per month to invest on reduction of air pollution [12]. After calculation, the result of VSL is $100,000.

In the second tier, using the same sample data as before, China, the most populous country in the world, was found to be willing to pay 602 RMB per person per year to reduce air pollution, converting to $7.25 per person per month [13]. With the expected numbers of life saved is 1, the result of VSL is $725,000.

Then, in the third tier, according to Tantiwat et al., in Thailand, the average WTP for each person to improve air quality is 2275.163 baht per year, which translates to $61.82 per year based on the real-time exchange rate [13]. In other words, Thais are willing to pay $5.15 a month to reduce air pollution. Using the same conditions as before, the VSL result is calculated to be $515,000.

In South Asia, such as Pakistan, which is in the fourth tier of annual mean of PM2.5 concentration, it has been surveyed that the people of Pakistan are willing to pay $9.85 per month to reduce the country's air pollution by 50 percent [13]. Therefore, the total WTP is $985,000, and the expected numbers of life saved is 1. Then, combining the results of the previous two steps, the VSL should be equal to $985,000.

Outside of Asia, people in Kenya, East Africa, are willing to pay $4.67 per person per month to improve their air quality [13]. If 100,000 people are willing to pay same as before, the total WTP is $467,000. For the relatively developed European countries, the overall well-being of their residents is higher than that of the rest of the world. Thus, in Greece, to reduce the risk of premature death due to air pollution, the WTP per person per year to save a year of life is valued as €920. Based on real time exchange rates, each person in Greece would prefer paying $76 per month in maximum in order to improve air quality.

3.4 Results

Comparing the four countries represented in Asia, the VSL results in descending order are Pakistan, China, Thailand, and finally India. Then, add Kenya, which is in East Asia, and Greece in Europe into all of calculated Asian countries. We can clearly see that Pakistan, Greece and China are in the top tier, Thailand and Kenya are in the middle respectively, and India and other countries are far behind in their spending on air pollution

Although China has greater numbers of population than any other countries, the total value of VSL is less than Pakistan and Greece. That means Chinese citizens are willing to pay only a small portion of their income to support efforts to control air pollution. Low investment in regulating air pollution has also led to high rates of air pollution-related respiratory diseases and lung cancer in China. According to Chen et al., each 10 $\mu g/m^3$ increase in air pollution was associated with a 0.29 percent increase in all respiratory mortality and a 0.38 percent increase in chronic obstructive pulmonary disease (COPD) mortality [14].

India and Kenya with Greece are almost among the four countries with the lowest and highest WTP, respectively, to provide controls on greenhouse gas emissions and air pollution. The opposite extreme WTP of the three countries is due to the difference in economic development. According to the 2022 World Index of National Happiness, Greece is ranking at 67 with a happiness score of 5.723; Kenya, on the other hand, is at 119 with a happiness score of 4.607; India is ranking at 136 with a happiness score of 3.819 [15]. Therefore, for Greek residents, while enjoying their lives, they are also

willing to use their extra deposits to support the government, to improve the environment of the whole city and even the country. Also, the idea that reducing greenhouse gas emission is widely shared among the whole country. However, for the developing Kenya, East Africa's main economic hub, the economy has been steadily stabilizing since the 2008 financial crisis, but it is still lagging behind the world. Their governments do not have much experience in managing and ameliorating environmental pollution problems, focusing more on the country's infrastructure and international trade, like exporting coffee and horticultural products. Similar to Kenya, India faces many economic and social problems, gender inequality in a large population, and massive emissions of pollution while developing a large economy. Moreover, there is a wealth gap between rich area and poor areas, and for the residents living in the poor areas, they are worried about food and clothing, so they have little extra to invest in air pollution control. For some Asian countries like China and Pakistan, although their investment in improving the environment is in the middle of the world, the emission of greenhouse gases and air pollution is still a point that people cannot ignore.

4. Discussion

4.1 The Cause of Air Pollution

Greenhouse gases include carbon dioxide (CO_2), methane, ozone(CH_4), water vapor and nitrous oxide (N_2O). Among them, carbon dioxide accounts for 26 percent of greenhouse gases. Therefore, what behaviors in life lead to the emission of greenhouse gases?

Above all, countries in Southeast Asia mainly rely on agriculture to develop their economy, so a large number of crop stalks would be produced during agricultural production. In order to remove agricultural waste conveniently with low cost, farmers choose to burn those stalks directly in open fields. When these crop residues are not completely burned, the combustion process will release a large number of toxic particles and gases, and these toxic gases not only aggravate the greenhouse effect, but directly affect people's health. The table below shows the statistics of the pollutants produced by crop residue open burning (CROB) in Southeast Asian countries [16]. According to the bar chart, it is clear that the pollution gases produced by rice incineration, such as sulfur dioxide and PM2.5, also including the greenhouse gases carbon dioxide and methane, which account for a large part of the total emissions. Then, the burning of sugarcane, maize and soybean is followed by the rice incineration.

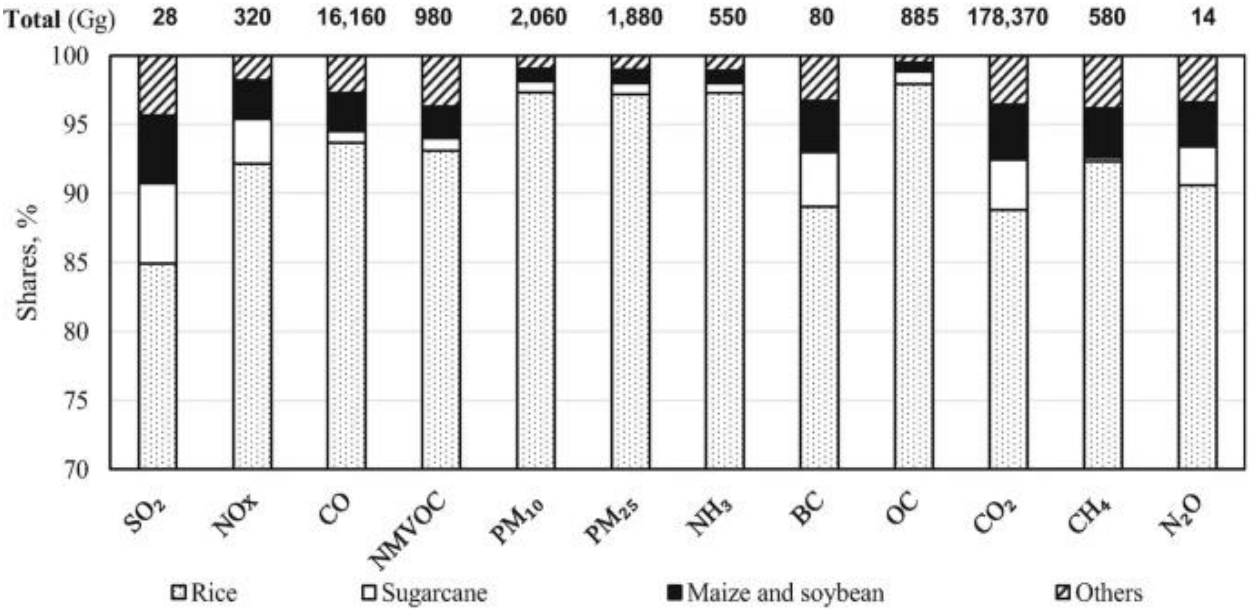

Fig 6. Statistics of the pollutants produced by crop residue open burning (CROB) in Southeast Asian countries.

Industrial operation is a crucial driving force for economic development in Asia, but it also releases pollution. As well as burning wheat straw, many factories use gas stoves to heat their components, producing carbon dioxide, the main greenhouse gas, in the process, which has led many countries to set standards for carbon dioxide emissions from factories. Moreover, for instance, in Pakistan, much of the business sector uses private generators under the insufficient electricity supply [17]. As a result, those private generators are placed in unsuitable road locations, with emissions drifting directly into the air. Such practices not only directly pollute the air, but also affect the travel of pedestrians.

Transport is the third biggest contributor to Asia's greenhouse gas emissions. With the gradual improvement of people's life quality, almost every family owns a car. India is in the top tier of Asia for annual air pollution. Among them, transportation accounts for about 11% of India's carbon emissions [18]. As more and more cars drive into the streets, traffic congestion increases in an unmistakable straight line so that emissions also increase when cars are stuck in traffic. Another country with the representation of transportation emissions is China, which is the world's largest car market nowadays. In China's Yangtze River Delta, Beijing-Tianjin-Hebei and Pearl River Delta regions are the most densely populated and vehicle-dense places. The graph below is the growth rate of vehicle sales volume from 1994-2016 [19]. As we can see from the bar chart, China's car sales have been increasing year by year since 1994. Among them, after the 2008 financial crisis, China's car sales have a significant increase, which also means the income of the middle class increased, leading car volume increasingly. Therefore, under such a trend, every car in the process of starting and running exhaust emissions are directly affecting the air quality and aggravate the greenhouse effect.

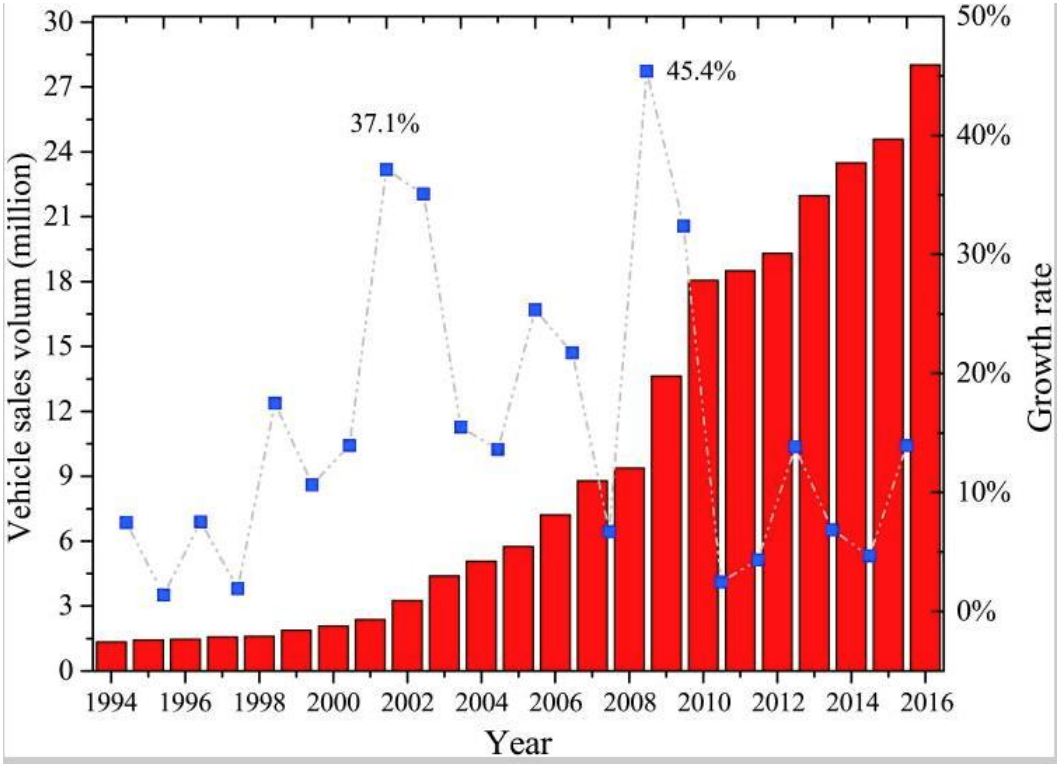

Fig 7. Vehicle sales volume in China from 1994 to 2016.

4.2 The Effect of Air Pollution

The most direct effect of air pollution caused by greenhouse gases is people's healthy issue. Pollutants in the air, including PM2.5 particles, are exposed in the air and inhaled directly by people. China and India are among the Asian countries that suffer from severe air pollution. In 2005, the total death rate in China was estimated at 1.7 million, and 1.4 millions of these deaths were due to PM2.5 exposure and 290,000 to ozone exposure; In India in the same year, the total death rate was 1.1 million, of which 730,000 were also due to PM2.5 exposure and 400,000 to ozone exposure [20]. According

to the data, it is clearly to see that a large part of the death rate is due to people's exposure to polluted air over the years. Another country, Japan, because of its aging population, the elderly is more sensitive to pollutants in the air, which is also directly responsible for the high incidence of respiratory diseases [20]. Air pollution from greenhouse gases is also having an economic impact on Asian societies. Many countries in Asia lose hours of work per person due to high rates of respiratory disease and even mortality caused by air pollution. People take time off from their workdays to recover. According to statistics, the average Asian worker lost 4.3 hours in 2005 [20]. In ageing Japan, where demand for labor is already greater than in other parts of Asia, this, combined with the loss of working hours, does not give the economy a strong enough boost.

4.3 Methods to Reduce GHG Emissions and Air Pollution

4.3.1 Agricultural policy implementation for reducing air pollution

China leads Asia in controlling agricultural emissions. The Ministry of Agriculture proposed to reduce the use of chemical fertilizers and the disposal of agricultural waste. The first is to reduce the use of chemical fertilizers, which release huge amount of greenhouse gases in the production process. Therefore, according to Joe, the government has invested nearly 8 billion RMB to help 200 million farmers cultivate 1.5 billion mu of land [21]. With government funding, fertilizer use has increased by 5 % and reduced by 10 million tons. Moreover, for agricultural waste, such as wheat straw, in the past farmers directly burned on open land, emitting GHG to pollute the air quality. However, as the government began to pay attention to this phenomenon, with financial support, the Ministry of Agriculture in China has become the focus of work to improve the utilization of wheat straw. Farmers are being funded by the government to reprocess excess wheat straw and turn it into usable biochar fertilizer to achieve greater environmental goals.

4.3.2 Industrial policy implementation for reducing air pollution

In the face of such serious air pollution in Asia, countries have also come up with measures to curb the emission of air pollutants and the worsening of the greenhouse effect. First, directly "eliminate" one of the sources of pollution----the factory. In China, the government shut down power plants in trade hubs and coastal cities such as Beijing, the Pearl areas and Yangtze River Deltas [22]. These are the cities where people flow, and where people are most welcome. If there is a factory in the city that emits waste gas all the time, it will undoubtedly affect the quality of life of the surrounding residents.

When factories cannot be closed to meet national demand and trade, they should be required to produce emissions. In five South Asian economies, namely Bangladesh, India, Pakistan, Sri Lanka and Nepal, there is a positive relationship between total energy consumption and CO2 emissions [23]. This means that its factories not only consume energy in the process of production, but also continue to emit carbon dioxide, directly deteriorate the greenhouse effect. India, as an example, relies on coal for most of its electricity. As a result, how these economies should transition to renewable energy is a problem that has long needed to be implemented. Although it is currently most beneficial for developing countries in Asia to pursue low-cost resources like fossil fuel to increase production, because the cost of generating electricity from renewable sources in the Asia-Pacific region is 16 % higher than that from fossil fuels, per capita economic growth of 1% would increase carbon emissions by about 0.244% [24][25]. Over time, developing countries in Asia have to pay more to maintain their urban environments once carbon emissions reach a certain level.

Therefore, we should reduce our sole dependence on coal, natural gas and other non-renewable resources. Some countries in Southeast Asia have developed and implemented policies in this regard. Indonesia, for example, is expected to be 20 % less dependent on oil, 30 % less dependent on gas, and 33% less dependent on coal by 2030; However, for renewable resources, such as wind, solar, biomass, etc., the increase of usage rate is 5%. Also, in Thailand, electricity generated by coal is being replaced by tidal flow.

4.3.3 Traffic policy implementation for reducing air pollution

How to curb the air pollution caused by traffic? In China, cities like Shanghai and Guangzhou have already banned cars from their roads. The license plate, that is not belong to the city, shall not go on the cities' highway, or even enter the urban area. The government's management of traffic flow has also greatly reduced the massive emission of automobile exhaust caused by congestion on the road every day. Those owners of the restricted vehicles have to choose public transport, like metro and bus, or green travel, like walking or riding bicycles. In China, where electric cars are on the public radar, the government is incentivizing manufacturers to produce electric cars as an alternative to traditional gas-powered vehicles through subsidies. However, electric cars were introduced into the car market a few years ago and were not very popular with the public. In 2015, China's top five automakers sold more than 70% of their conventional vehicles, while electric vehicles accounted for just 15% [26]. The reasons why consumers are hesitant about electric vehicles are:

Electric vehicle technology: the distance of the mile range, the length of charging time, battery life, etc.

Financial problems: the cost of maintaining electric vehicles is higher than that of traditional fuel vehicles.

Charging pile infrastructure: when electric vehicles just entered the automobile market, the ratio between charging pile and electric vehicles did not reach 1:1.

However, with the government's encouragement of electric cars, the consumer for electric cars is increasingly wide. According to statistics, in 2021, about 2.9million electric vehicles were sold, an increase of 162% compared with 2020 [27]. The craze for electric cars is also, of course, tied to enacted policies. As we all know, in Shanghai license plate is needed to queue up lottery number; therefore, it is difficult for consumers to purchase a license plate in Shanghai, but, with the enactment of the policy on electric vehicles, consumers will be given a license plate if they purchase an electric car, which has also become one of the driving forces to attract consumers buying an electric vehicle.

Except the same policies as Shanghai regarding vehicle driving restrictions, the Bangkok Metropolitan Administration supervises and promotes the frequency of road cleaning in order to prevent and control air pollution, including PM2.5. The sprinkler spray can be originally adsorbed on the road particles washed away, to avoid the re-entry into the air. Also, sprinklers use mist water to increase the humidity in the air, so as to improve air quality. This implementation would clean up as much of the pollution as possible that has already been emitted by vehicles.

5. Conclusion

This paper used VSL model to calculate people in each tier of Asian countries are willing to pay maximum on air pollution reduction. Based on the results of the investment per person in five tiers of annual PM2.5 emission concentration in Asia to reduce the morbidity rate of air pollution, we can conclude that there are still many developing countries in Asia that ignore the control of air pollution and people's quality of life in the process of production. In Asian countries under high population pressure, there is an urgent need to control carbon emissions and use renewable and green energy to meet the original production and living needs. For the government, although the process of exploring renewable energy needs to spend lots of time and money, it is the first thing to be considered in the future development of a country. The reason is that the earth's non-renewable resources are dwindling and exhausting as people use them. Asian countries need to make a gradual transition to renewable energy production with innovative technologies that can significantly reduce GHG emissions and improve the quality of life of citizens. For us, we should achieve low-carbon travel in our life and make use of energy-saving products to conform to the "green" policy as much as possible to jointly create a healthy environment. In the further study, we still need to consider about how to balance the cost and benefit for transition to usage of renewable resource society and to maximize profit when creating a better-quality environment.

References

[1] Statista. Global carbon dioxide emissions from energy 1965-2021, by region, 2022.

[2] n.d. Air pollution measures for Asia and the Pacific. Climate & Clean Air Coalition, 2022.

[3] Pandey Pooran Chandra. India Has Seen Greenhouse Gas Emissions Increase by a Staggering 335% Since 1990. ClimateScoreCard, 2020.

[4] Harrisson T. The carbon brief profile: India. Carbon Brief, 2021.

[5] BBC News. Report: China emissions exceed all developed nations combined, 2021.

[6] Banerjee Neebir. Thailand's Carbon Dioxide Emissions Have Significantly Increased Over the Past 10 Years. Climate Scorecard, 2020.

[7] Reuters. Japan's greenhouse gas emissions drop to record low in year to March 2021. Reuters. 2021.

[8] Statista. Annual greenhouse gas emissions Japan FY 2000-2020, 2022.

[9] Ritchie Hannah, Roser Max. Australia: CO2 Country Profile. Our World in Data, 2020.

[10] Sarkodie Asumadu Samuel, Strezov Vladimir, Jiang Yijiao, et al. Proximate determinants of particulate matter ($PM_{2.5}$) emission, mortality and life expectancy in Europe, Central Asia, Australia, Canada and the US. ScienceDirect, 2019, 683: 489-497.

[11] Giannadaki Despina, Giannakis Elias, Pozzer Andrea, et al. Estimating health an economic benefit of reductions in air pollution from agriculture. Science of The Environment, 2018, 622-623: 1304-1316.

[12] Chattopadhyay Mriduchhanda. Economics of clean air: Valuation of reduced health risks from Household Air Pollution – A study of rural Indian Households. WINPEC, 2021.

[13] Tantiwat, W., Gan, C., & Yang, W. The Estimation of the Willingness to Pay for Air-Quality Improvement in Thailand. *Sustainability*, 2021, *13*(21), 12313.

[14] Chen, R., Yin, P., Meng, X., et al. Chinese Air Pollution Linked to Respiratory and Cardiovascular Deaths. American Thoracic Society, 2017.

[15] n.d. Happiest countries in the world. World Population Review, 2022.

[16] Oanh, K. N. T., Permadi, D. A., Dong, N. P., et al. Emission of Toxic Air Pollutants and Greenhouse Gases from Crop Residue Open Burning in Southeast Asia. Land-Atmospheric Research Applications in South and Southeast Asia, 2018, 47-66.

[17] Munsif Rabia, Zubair Muhammad, Aziz Ayesha, et al. Industrial Air Emission Pollution: Potential Sources and Sustainable Mitigation. Environmental Emissions, 2021.

[18] FE Online. Vehicle sharing – the solution to hazardous air pollution in India? Financial Express, 2019.

[19] Wang Jin, Wu Qiuxia, Liu Juan, et al. Vehicle emission and atmospheric pollution in China: problems, progress, and prospects. PeerJ, 2019.

[20] Xie Yang, Dai Hancheng, Xu Xinghan, et al. Co-benefits of climate mitigation on air quality and human health in Asian countries. Environment International, 2018, 119: 309-318.

[21] Chen Kun, Pan Genxing. How can China cut emissions from its farms? China Dialogue, 2021.

[22] Leung Felix. How China is Winning Its Battle Against Air Pollution. Earth.Org, 2021.

[23] Murshed Muntasir, Dao N. Revisiting the CO2 emission-induced EKC hypothesis in South Asia: the role of Export Quality Improvement. GeoJournal, 2020, 535-563.

[24] Mackenzie W. Renewable power in Asia Pacific gains competitiveness amidst cost inflation. Wood Mackenzie, 2022.

[25] Hanif Imran, Aziz Babar, Chaudhry S Sharif. Carbon emissions across the spectrum of renewable and nonrenewable energy use in developing economies of Asia. Renewable Energy, 2019, 143: 586-595.

[26] Li Wenbo, Yang Muyi, Sandu Suwin, et al. Electric vehicles in China: A review of current policies. SAGE Journals, 2018, 29(8).

[27] Statista. Annual sales of new energy vehicles in China 2011-2021, by type, 2022.