

*BRI Benefits Series*

# AIR QUALITY AND PUBLIC HEALTH

*This analysis is part of a series of policy briefs on a high-quality, sustainable low-carbon transition in the BRI countries. To view the other briefs, please visit our webpage. Technical background information regarding the model and scenario(s) used in this analysis are provided in methodological appendix.*


## Summary

Belt and Road Initiative (BRI) partner countries not only face challenges in reducing greenhouse gas (GHG) emissions and decarbonizing the economy, but also public health issues, including air pollution. While these two policy outcomes are often approached as separate issues, research suggests that measures targeting GHG emissions reduction may also improve air quality.[1] To evaluate air quality and health co-benefits from a low-carbon transition, we assessed public health impacts attributable to ambient air pollution in BRI countries under a 1.5°C aligned scenario. **Our results suggest that a low-carbon transition could significantly reduce air pollutant concentrations and premature mortalities attributable to air pollution in BRI countries.** Under a 1.5°C aligned scenario, the average $PM_{2.5}$ and $O_3$ concentrations in the BRI region decrease by about 35% and 20%, respectively, in 2050 compared to 2020. Given improvements in air quality from decarbonization under a 1.5°C scenario, total premature deaths attributable to $PM_{2.5}$ and $O_3$ decline by about 20% from 2020 to 2050. In 2050, premature deaths from air pollution in the BRI region will be reduced by about 30%, and about 950,000 premature deaths will be avoided under a 1.5°C scenario compared to the Reference scenario, which assumes no enhanced climate ambition policies are introduced after 2020. **To achieve these improvements in air quality and reduced premature mortality, the BRI region should: integrate climate and air quality goals, develop regional and local policies, and strengthen cooperation among BRI countries.**



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## 1. Current levels of air pollution in BRI countries

Air pollution is a global problem, but can vary significantly across regions,[2] as Belt and Road Initiative (BRI) countries have some of the highest concentrations of $PM_{2.5}$ globally.[3] Air pollution levels in low- and middle-income countries remain at dangerous levels,[4] with countries in Asia, Africa and the Middle East having higher levels of $PM_{2.5}$ and $O_3$ concentration than other parts of the world. In 2019, the ten countries with the population-weighted average and $O_3$ concentrations were all BRI member countries or countries along the Belt and Road routes (Table 1). Concentrations in these countries vastly exceed the global average and WHO standard, with $PM_{2.5}$ concentrations in 2019 over 10 times higher than the WHO standard and 50-95% higher than the global average.

**Table 1: Top ten countries with the highest population-weighted average $PM_{2.5}$ and $O_3$ concentrations in 2019 with global average[4] and WHO recommended standards.[5] All countries are BRI countries, except for India, which is along the Belt and Road routes. Data is from the 2020 State of Air Report, a collaboration between the Health Effects Institute and the Institute for Health Metrics and Evaluation's Global Burden of Disease project.**

| Country | $PM_{2.5}$ Concentration(μg/m3) |
|---|---|
| India | 83.2 |
| Nepal | 83.1 |
| Niger | 80.1 |
| Qatar | 76.0 |
| Nigeria | 70.4 |
| Egypt | 67.9 |
| Mauritania | 66.8 |
| Cameroon | 64.5 |
| Bangladesh | 63.4 |
| Pakistan | 62.6 |
| *Global Average* | 42.6 |
| *WHO Standard* | 5.0 |

| Country | $O_3$ Concentration(ppb) |
|---|---|
| Qatar | 67.2 |
| Nepal | 67.0 |
| India | 66.2 |
| Bangladesh | 64.6 |
| Bahrain | 64.0 |
| Pakistan | 63.3 |
| Kuwait | 62.1 |
| Iran | 59.5 |
| South Korea | 57.9 |
| Saudi Arabia | 58.2 |
| *Global Average* | 49.5 |
| *WHO Standard* | 60.0 |

Air pollution presents a serious health hazard to people in BRI countries. According to the Global Burden of Disease analysis, an estimated 6.67 million people died globally from air pollution in 2019, which is higher than the number of deaths caused by obesity, high cholesterol, malnutrition and other chronic diseases.[4] Other research suggests the number may be even higher, estimating almost 9 million ambient air pollution related deaths in 2015.[6] In 2019, the ten countries with the highest number of deaths and the number of deaths per 100,000 people caused by air pollution were all BRI countries or countries along the Belt and Road routes (Table 2). The total number of deaths in these ten countries accounted for around 68% of the global total premature deaths, and the number of deaths per 100,000 people is much higher than the global average.[4]

**Table 2: Top ten countries with the highest number of premature mortalities attributable to air pollution in 2019.[4]** **All countries are BRI countries, except for India, which is along the Belt and Road routes. Data is from the 2020 State of Air Report, a collaboration between the Health Effects Institute and the Institute for Health Metrics and Evaluation's Global Burden of Disease project.**

| Countries | Premature mortalities (thousands) |
|---|---|
| China | 1850 |
| India | 1670 |
| Pakistan | 236 |
| Nigeria | 198 |
| Indonesia | 186 |
| Egypt | 91.7 |
| Russia | 77.5 |
| Ethiopia | 77 |
| Myanmar | 74.5 |
| Vietnam | 71.7 |

| Countries | Premature mortalities per 100,000 of the population |
|---|---|
| Central African Republic | 287 |
| Somalia | 280 |
| Papua New Guinea | 254 |
| Guinea-Bissau | 244 |
| Afghanistan | 238 |
| Chad | 225 |
| Niger | 223 |
| Nepal | 222 |
| Guinea | 220 |
| Burundi | 206 |

## 2. Low-carbon transition co-benefits in BRI regions

Public health co-benefits can offer a strong motivation for governments when considering climate change mitigation strategies. Understanding these co-benefits in regions with high current levels of air pollution that are also simultaneously facing pressure to decarbonize, such as the BRI region, is critical. Our results suggest that the low-carbon transition presents opportunities for reducing air pollution and premature mortality. Compared to current and projected levels under a scenario without climate mitigation, air pollution concentration and associated premature deaths under a decarbonization scenario in 2050 are reduced, highlighting the potential public health co-benefits that can be realized from a low-carbon transition in the BRI.

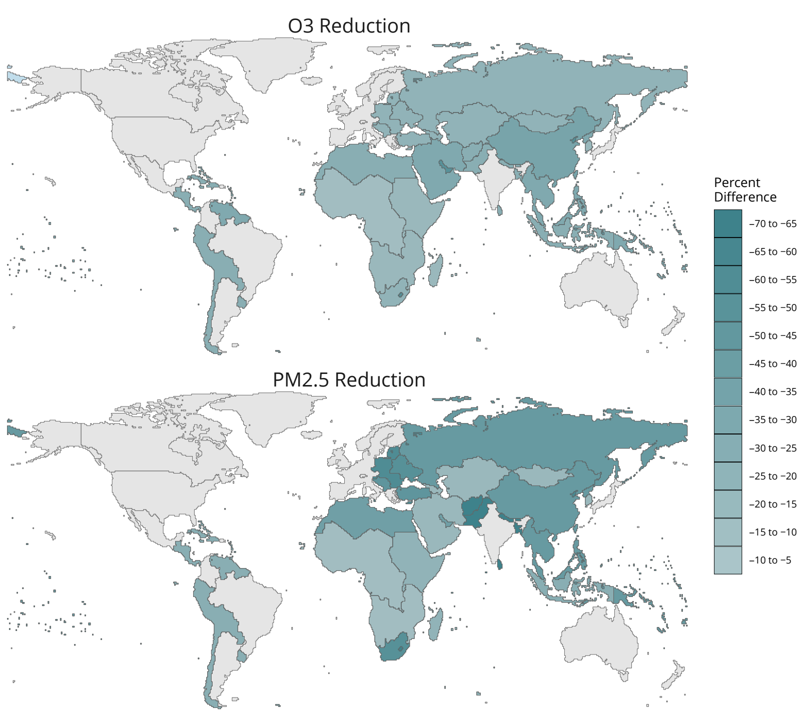
To evaluate health co-benefits in the BRI region under a low-carbon pathway, we developed several scenarios, including a 1.5°C scenario, in which global net zero $CO_2$ emissions are reached in 2050 and a Reference scenario, in which climate ambition continues as reflected in current policies without enhanced ambition. Both scenarios used an integrated assessment model, Global Change Analysis Model (GCAM),[7] and a tool that replicates the calculations of the Fast Scenario Screening Tool (TM5-FASST)[8] air quality model, rfasst, to evaluate air quality implications from the energy transition.

### *2.1 Air quality improvements*

Air quality in the BRI region significantly improves by 2050 compared to current levels, under the 1.5°C scenario (Figure 1), but the level of reduction depends on region and air pollutant. The average $PM_{2.5}$ concentration of the BRI region decreases around 36% by 2050 compared to 2020, with higher reductions in some regions, such as Pakistan and South Asia, which decrease by more than 60%, and China, Southeast Asia, Russia, South Africa, and parts of the EU, which also reduce by more than 40%. The average $O_3$ concentration in the BRI region, compared with 2020, declines by 22% by 2050, with some regions exceeding 25%, including China, the Middle East, and Southeast Asia. Some regions only see a small reduction (<10%) in air pollutant concentration from 2020, which suggests that in addition to energy system transition, these regions will need to investigate additional policies, such as end-of-pipe control, for enhanced air quality improvement.

Air quality also improves significantly across entire region when comparing the 1.5°C and the Reference scenario, but levels of reduction vary across BRI regions. In 2050, the entire BRI region averages around 27% reduction in $O_3$ and 35% in $PM_{2.5}$ reduction, with some regions reaching over 50% reduction greater reduction in 1.5C compared to reference for $PM_{2.5}$ (South Africa, Eastern Europe, South Asia, Northern Africa, Pakistan) and $O_3$ (Northern Africa).

**Figure 1: Percent change in $O_3$ and $PM_{2.5}$ concentration in BRI regions under 1.5°C scenario between 2020 and 2050.** Air pollutant concentration results from rfasst[9] are downscaled from TM5 regions to the country-level a weighted population average, then aggregated by the 32 regions available in GCAM.

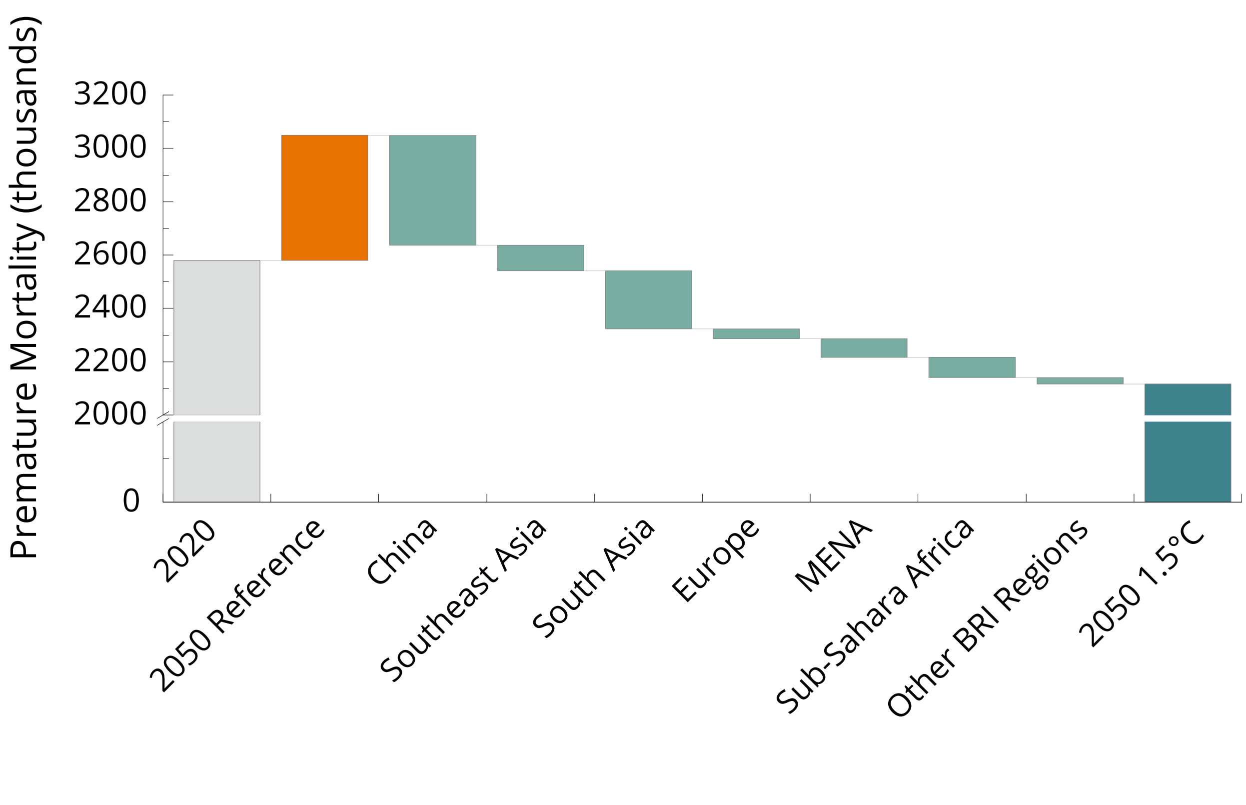


### 2.2 *Reduction of ambient air pollution-induced premature mortality*

Without an energy transition, premature deaths across the BRI region will increase. Under the Reference scenario, premature mortality attributed to air pollution will increase by 18%, or around 450,000 people, across the BRI region by 2050 compared with 2020 (Figure 2).

A low-carbon transition in the BRI region can reduce premature deaths caused by air pollution across the BRI region (Figure 2). With an energy transition, total premature deaths decline by about 20% in 2050 from 2020. Compared to the Reference scenario, total premature deaths attributed to air pollution in the region in 2050 will be reduced by about 30%, and about 950,000 premature deaths will be avoided. The regions with the largest reductions in premature deaths are China and South Asia, in which premature deaths are reduced by 29% and 50%, respectively, in 2050 under a 1.5°C scenario compared to Reference.

**Figure 2: Reduction of premature mortality in 2050 in bri regions under the 1.5°c scenario compared to a reference scenario.** **Premature mortality is downscaled from TM5 regions to the country-level using historical shares of premature mortality across countries within a region,[10] then aggregated by the 32 regions available in the GCAM, and to the regions listed in this figure.**



## 3. Policy implications

A low-carbon transition in the BRI region will improve air quality in member countries and countries along the Belt and Road routes, helping the region to achieve SDGs such as renewable energy (SDG 7), climate action (SDG 13), and good health (SDG 3) simultaneously. Based on our findings and the current development status of the BRI region, we make the following policy recommendations:

- **Integrate climate and air quality goals**. Our results support the finding that there are synergies between air pollution control and greenhouse gas reductions. Not only may climate mitigation reduce air pollution, but also, measures to improve air quality may contribute to GHG reduction.[9] Coordinated management of the low-carbon transition and air pollution control can help BRI regions achieve the dual purpose of mitigating climate change and improving air quality. For example, end-of-pipe control policies are an effective near-term mechanism for reducing air pollution. However, in the long-term, improving air quality requires reducing the source of air pollutant emissions,[10] which can be achieved, in part, through the reduction of fossil fuel use as part of a low-carbon transition. Making policy decisions with both of these outcomes in mind can help to achieve multiple objectives simultaneously.

- **Develop sector-specific, local policies.** Air quality is both a global and local issue, with sources of emissions varying across and within countries. Our results aggregate emissions to the regional level, and can be useful for indicating trends within the BRI region, but additional, more granular, air pollutant concentration analyses are needed to better understand the relationship between climate mitigation and public health. Additionally, there are different drivers of air pollution emissions across BRI member countries, which require different mitigation strategies.[13] Developing approaches to decarbonization that account for sources of greenhouse gas and air pollutant emissions at the subnational level is critical for meeting national and regional climate and air quality targets. Identifying inter-sectoral and sector-specific approaches to decarbonization and air quality improvement can help to prioritize low-hanging fruit measures and integrate actions across sectors.

- **Strengthen international cooperation and governance among BRI countries.** Countries in the BRI region should establish methods to share best practices and enhance collaboration in greenhouse gas emission and air quality data accounting and monitoring. Sharing information on governance of the low-carbon transition and air pollution across different actors including businesses, industries and regions can be beneficial. The BRI, as an existing network, presents an opportunity for enhanced coordination and support across member countries. Strengthening the exchange and cooperation among researchers, government officials, research institutions and universities, can improve the level of collaborative governance for the BRI low-carbon transition and air pollution improvement.

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