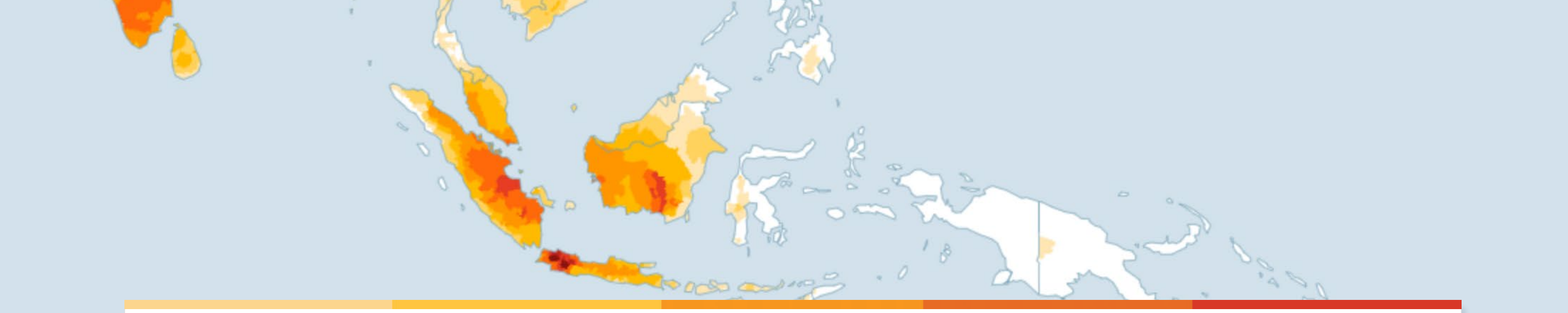
AQLI Air Quality Life Index®

AIR QUALITY LIFE INDEX® | UPDATE SEPTEMBER 2021

Indonesia's Air Pollution and its Impact on Life Expectancy

By Ken Lee and Michael Greenstone



SUMMARY

The average Indonesian can expect to lose 2.5 years of life expectancy at current pollution levels, according to the Air Quality Life Index (AQLI), because air quality fails to meet the World Health Organization (WHO) guideline for concentrations of fine particulate matter (PM2.5). The pollution index, developed by Michael Greenstone and his colleagues at the Energy Policy Institute at the University of Chicago (EPIC), shows that the health impacts of particulate pollution are the greatest in Depok, Bandung, and Jakarta, where particulate pollution concentrations are the highest.

Satellite data show that air pollution was mainly concentrated in Java, and specifically the Jakarta metropolitan area, and some parts of Sumatra. However, residents of Kalimantan and Sulawesi have also shared the burden of air pollution in recent years. In Indonesia's capital city of Jakarta, the average person can expect to lose 5.5 years of life expectancy if 2019 pollution levels are sustained over their lifetime. In some regions, the loss of life expectancy is even greater, with residents potentially losing more than six years of their lives.

For two decades, Indonesia's average air pollution level has been three times the WHO threshold. Today, Indonesians are beginning to recognize the threat of PM2.5 on human health. The AQLI highlights the tremendous benefits that could be achieved by cleaning the air. Other countries in the Asia-Pacific region provide a useful benchmark. If, for example, Indonesia achieved a reduction in air pollution comparable to what China achieved in the last six years, the average Indonesian could expect to live a year longer. In the country's most polluted areas, the gains would be an even larger 2.4 years.

Note: The WHO changed its particulate pollution guidance on September 22, 2021. The data here reflects the previous guidance.

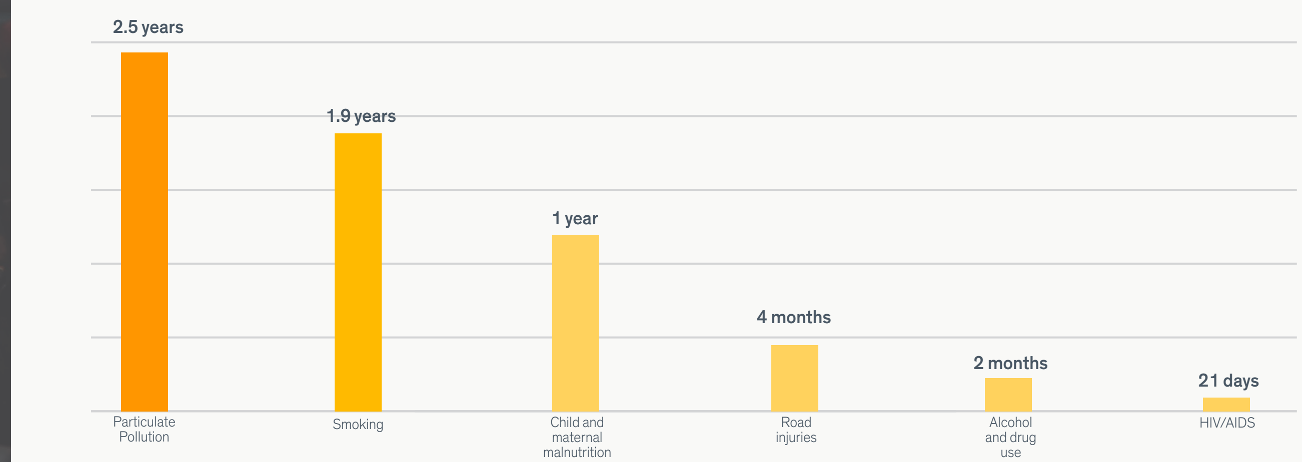
Indonesia's Pollution Challenge

Over the past decade, Indonesia has witnessed a rise in particulate pollution. Today, more than 93 percent of the country's 262 million people live in areas where the annual average $PM_{2.5}$ level exceeds the WHO guideline. If current particulate concentrations were to persist, average life expectancy would be reduced by 2.5 years, relative to what it would be if the WHO guideline of 10 µg/m³ ($PM_{2.5}$) was met[1].

Some parts of Indonesia fare much worse than the national average. In Jakarta, a city that is home to more than 11 million people, the average resident will live 5.5 years less if $PM_{2.5}$ levels remain at current levels, relative to if the WHO guideline was met. On the islands of Sumatra and Kalimantan, the average loss is roughly four years of life expectancy. South Sumatra, city-dwellers in Palembang will lose 4.5 years on average, and residents of the regency of Ogan Komering Ilir will lose three years on average (see Figures 4 and 5 and the Appendix Table for more cities and regencies).

Measured in terms of life expectancy, ambient particulate pollution is the greatest risk to human health in Indonesia. First-hand cigarette smoke, for instance, reduces average Indonesian life expectancy by about 1.9 years, while child and maternal malnutrition reduces life expectancy by 1 year (see Figure 1). In total, the current Indonesia population will lose about 643 million life-years to particulate pollution, if 2019 concentrations are sustained. Indonesia is facing one of the highest population-weighted health burdens of air pollution in the world, trailing behind only India, China, Bangladesh and Pakistan (see Figure 6).

Figure 1 · Life Expectancy Impact of PM2.5 and Unassociated Causes/Risks of Death in Indonesia



METHODOLOGY

The life expectancy calculations made by the AQLI are based on a pair of peer-reviewed studies, Chen et al. (2013) and Ebenstein et al. (2017), co-authored by Michael Greenstone, that exploits a unique natural experiment in China. By comparing two subgroups of the population that experienced prolonged exposure to different levels of particulate air pollution, the studies were able to plausibly isolate the effect of particulate air pollution from other factors that affect health. The more recent of the two studies found that sustained exposure to an additional 10 µg/m³ of PM10 reduces life expectancy by 0.64 years. In terms of $PM_{2.5}$, this translates to the relationship that an additional 10 µg/m³ of $PM_{2.5}$ reduces life expectancy by 0.98 years. The AQLI applied this finding to Indonesia's $PM_{2.5}$ concentrations, taken from satellite-derived $PM_{2.5}$ measurements, to determine the current life expectancy impacts of air pollution in Indonesia and the potential impacts of air pollution reduction.

To learn more about the AQLI and its methodology, refer to the back of this report or visit: aqli.epic.uchicago.edu/about/methodology

1 Since the publication of our previous report on Indonesia in 2019, the AQLI has updated its data. The present satellite-derived PM2.5 data is aggregated from the grid-level dataset constructed by Hammer et al. (2020). This is a revision of the raw data that the AQLI used from 2018 to 2020, which was constructed by van Donkelaar et al. (2016) and spanned 1998-2016. The present raw dataset retroactively re-vised PM2.5 estimates for all previous years. For more information, see https://aqli.epic.uchicago.edu/about/methodology/.

The impacts of air pollution are concentrated in Java and Banten

The provinces of West Java and Banten, home to Jakarta and other large cities, have been air pollution hotspots for the past two decades. The average person in these provinces continues to breathe air that is four times the WHO safe limit, resulting in a three-year reduction in life expectancy. Although the reduction in life expectancy for an average person in Jakarta is higher, Java as a whole stands to lose a total of 250 million person years as opposed to the 50 million person years in Jakarta due to the latter's significantly larger population size (see Figure 5).

The connection between climate change and air pollution

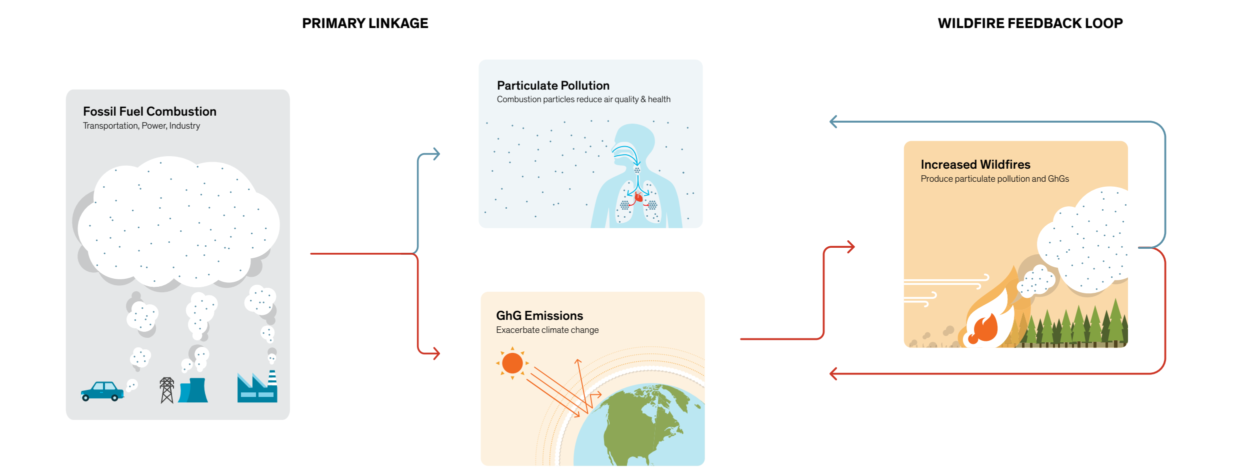
Particulate pollution is primarily caused by the burning of fossil fuels. According to some estimates, fossil fuels account for 60% of urban ambient $PM_{2.5}$, with the remaining sources being attributed to natural sources and other human activities. At the same time, fossil fuel combustion is also the primary cause of climate change, which is already causing temperatures to rise, winter snowpacks to melt earlier, droughts to become more severe, and wildfire seasons to become longer.

As the planet becomes hotter, drier soil and vegetation conditions will expose even more areas to the risk of wildfires, many of which are triggered by human activities. Indeed, rampant wildfires have been witnessed across the globe in recent years. As is revealed in satellite $PM_{2.5}$ data, surges in air pollution levels are noticeable in years with a particularly high number of fire events, not just in California, but also in the Amazon, the islands of Kalimantan and Sumatra in Indonesia, Northern Thailand, and the Congo Basin, among others.

In 2015 in Indonesia, there were over 100,000 fires, making it one of the worst fire seasons on record[1]. Compared to 2013, the population weighted average $PM_{2.5}$ in Indonesia was over 30% higher in 2015, reaching nearly 40 µg/m³. If this were a permanent increase, there would be a 0.9 year decline in average life expectancy in Indonesia, according to the AQLI data. And since air pollution from fires typically travels across national boundaries, they produce spillover effects affecting the health of people in neighboring countries and regions.

Thus, fossil fuel combustion not only directly contributes to $PM_{2.5}$, it also indirectly causes air pollution through its effect on climate change (see Figure 2). In addition, if adaptation to rising temperatures results in increased energy consumption, for instance through the mass adoption of air conditioners in the developing world, then the feedback loop will only worsen. Given the role that climate change will play in exacerbating air pollution, it is imperative that policies are introduced today to reduce our dependence on fossil fuels.

Figure 2 · The Link Between Fossil Fuels, Particulate Pollution, and Climate Change



* https://www.bbc.com/news/business-35770490

Major causes of particulate pollution include emissions from vehicles and coal-fired power plants. In Jakarta, one of the most congested cities in the world, motor vehicles accounted for 31.5 percent of the city's $PM_{2.5}$ in 2008-2009 and 70 percent of the city's PM10 — particulate pollution in which the diameter of each particle is 10 micrometers or smaller[2]. Since 2010, there have been sharp increases in electricity generation from coal-fired power plants, as well as gasoline and diesel consumption, which have both contributed to particulate pollution. An issue is that Indonesia's coal-fired power plants — of which there are around ten within a 100 km radius of Jakarta[3] — are currently allowed to emit 3 to 7.5 times more particulate matter, NOx, and SO2 than China's coal plants, and 2 to 4 times more than the Indian coal plants installed between 2003 and 2016[4]. NOx and SO2, once emitted into the atmosphere, can also form particulate matter pollution.

The air quality in Bandung, the capital city of West Java, is even worse than in Jakarta. If Bandung's 2019 pollution levels were sustained a lifetime, the average person would live 6.5 years less. In Kota Bogor, Indonesia's most polluted city, the average person is expected to lose roughly seven years of life expectancy.

Figure 3 · Differences in $PM_{2.5}$ (µg/m³) Concentrations Across Indonesia's Regions (2010-2019)

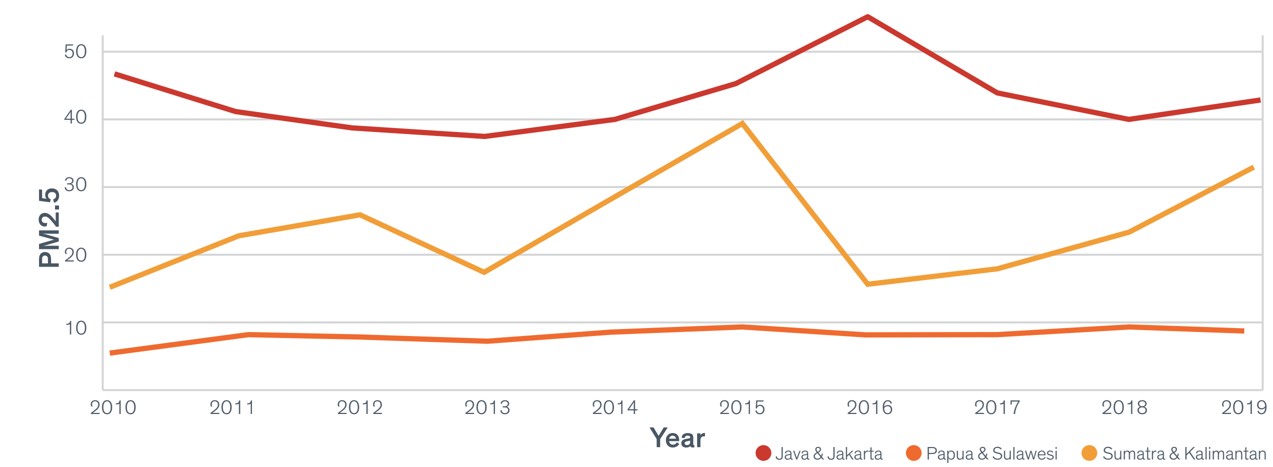
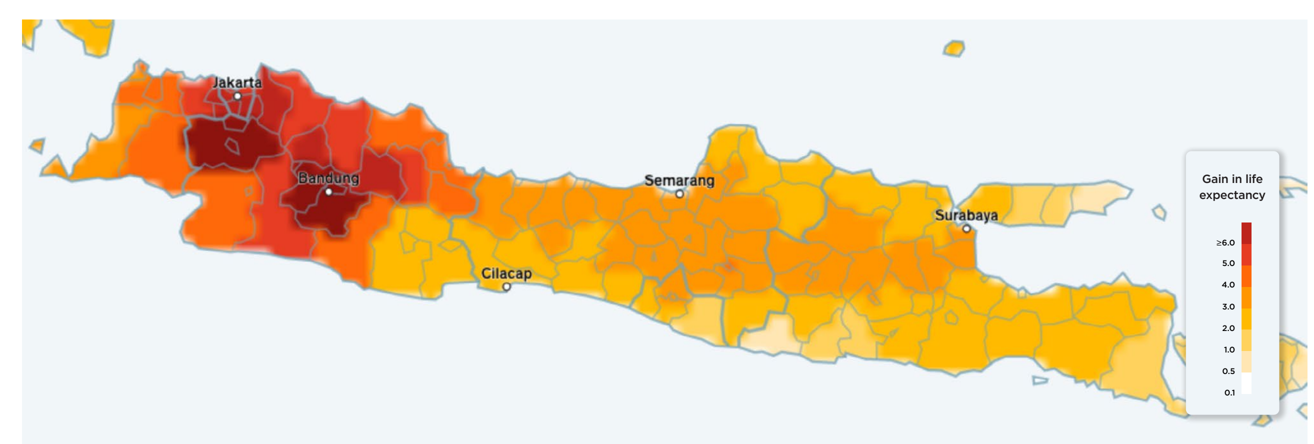


Figure 4 · Life Expectancy Gain in Java from Reducing $PM_{2.5}$ from 2019 Concentrations to WHO Guideline



2 Santoso, M., Lestiani, D.D., and Markwitz, A. (2013). Characterization of airborne particulate matter collected at Jakarta roadside of an arterial road. Journal of Radioanalytical and Nuclear Chemistry, 297, 165-169.
3 Taylor, M.(2019). Asia's coal addiction puts a chokehold on its air-polluted cities. Reuters. https://www.reuters.com/article/us-asia-pollution-coal/asias-coal-addiction-puts-chokehold-on-its-air-polluted-cities-idUSKCN1R103U
4 Zhang, X. (July 2016). Emission standards and control of PM2.5 from coal-fired power plants. Retrieved from https://www.iea-coal.org/emission-standards-and-control-of-pm2-5-from-coal-fired-power-plant-ccc-267/

Gradually declining air quality in Sumatra and Kalimantan

In more agricultural areas, particularly Sumatra and Kalimantan, forest and peatland fires — which are often associated with illegal deforestation, oil palm plantations, and slash-and-burn agriculture — are significant contributors to air pollution. Much of Indonesia's forests lie atop peatlands, which are swampy areas of decomposed carbon-rich plant matter. After forest land has been logged for commercial purposes, the peatlands are drained to accommodate agriculture, making the land highly combustible. In a fire, peatlands release not only CO^2 but also black carbon, a form of particulate matter. The rise in the demand for palm oil has further exacerbated matters. Today, very little fire-resistant forest is understood to remain in Indonesia's peatlands, suggesting that the annual haze events that have plagued the past will become more frequent and dangerous in the future.

Biomass burning affects air quality not only in local population centers, but also in regions further away, due to the wind. For example, in one estimate, biomass burning is blamed for about 31 percent of Jakarta's particulate pollution[5]. In the El Nino drought years of 1997, 2015, and 2019, the fires were so intense that they not only emitted more CO^2 per day than the European Union, but also created air pollution haze events across Southeast Asia, affecting human health and economic activities in Indonesia, Singapore, Malaysia, and beyond.

Over the past two decades, particulate pollution in Sumatra has doubled, causing the impact of air pollution on life expectancy to rise drastically, from 0.7 to 2.4 years. Likewise, Kalimantan's air quality has gone from meeting the WHO standard in 1998 to reaching nearly three times the WHO safe limit, resulting in 1.9 years of lost life years, if 2019 levels were to persist.

Figure 5 · Life Expectancy Gain in Sumatra and Kalimantan from Reducing $PM_{2.5}$ from 2019 Concentrations to WHO Guideline

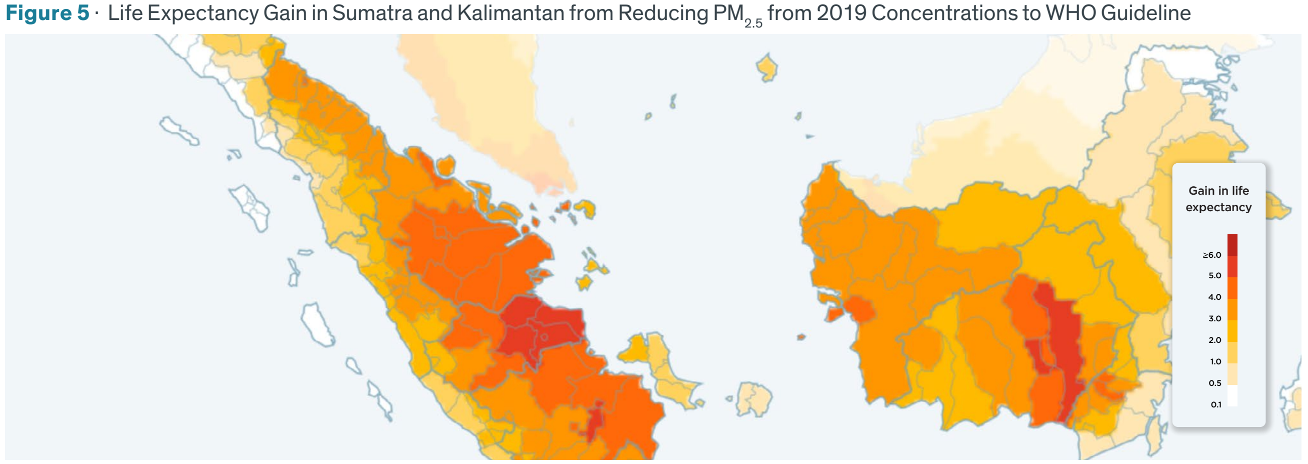
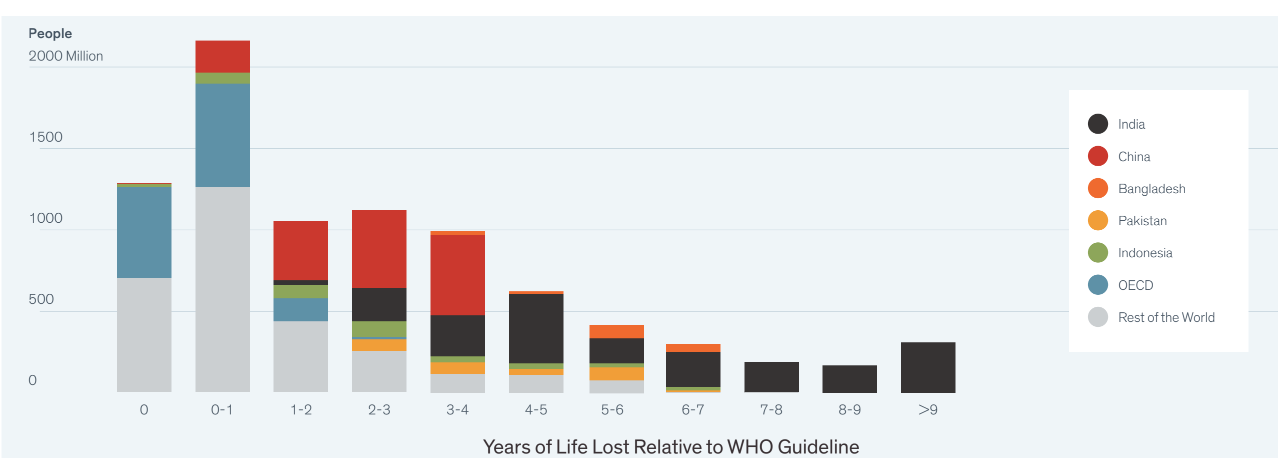
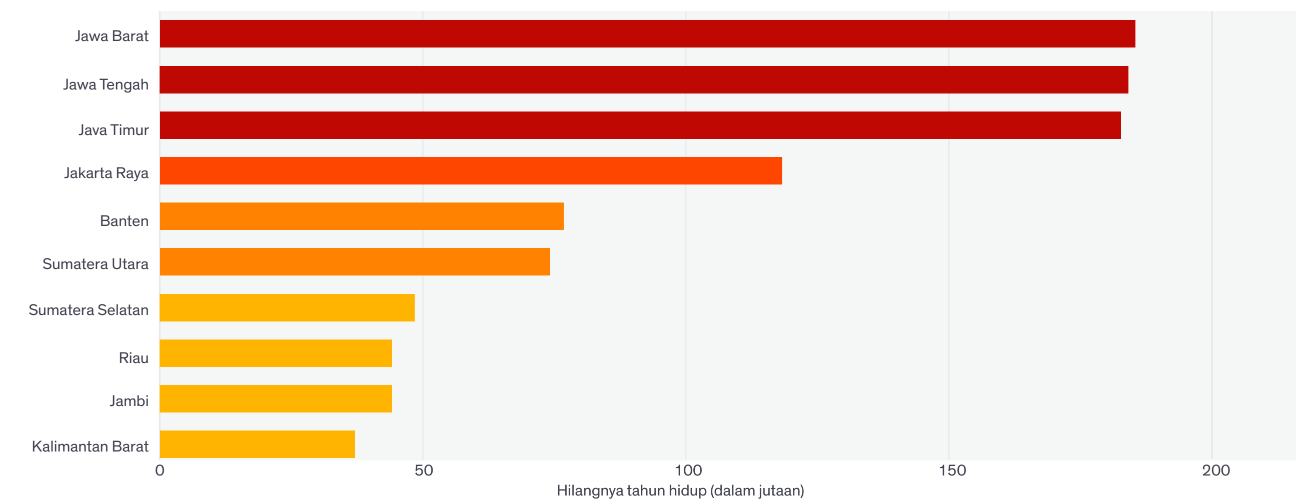


Figure 6 · Global Distribution of Life Expectancy Lost to Particulate Pollution



5 Supra, and Reddington, C.L. et al. (2014). Contribution of vegetation and peat fires to particulate air pollution in Southeast Asia. Environmental Research Letters, 9(9).

Figure 7 · Top 10 Provinces with the Largest Gain in Person-years if $PM_{2.5}$ is Reduced to WHO Guideline



More gasoline vehicles on Indonesian roads

The share of Indonesian energy consumption attributed to transportation has been steadily rising due to the drastic increase in motorized transport, which in turn has been caused by generous subsidies for fuel and low interest rates on vehicle loans. In 2019, Indonesia had more than 15 million cars and 112 million motorcycles on its roads, according to data from Indonesia's Automotive Industries Association. Some estimate that the transportation sector currently accounts for 70 to 80 percent of outdoor air pollution in megacities like Jakarta[6].

In Jakarta, drivers spend more than a quarter of their travel time idling, averaging 33,000 stops and starts per year, the highest in the world. The result of this congestion is high fuel consumption, leading to increased levels of ambient air pollution as well as increased exposure to this air pollution for anyone spending time outdoors. Indonesian law now requires that all new gasoline vehicles meet Euro-4 emissions standards. Diesel vehicles, however, are only required to meet the obsolete Euro-2 standards.

Recently, plans have been unveiled to implement an Electronic Road Pricing (ERP) system in Jakarta, similar to the one used in Singapore. In the past, Jakarta has experimented with odd-even traffic control policies.

Across Indonesia, the issue of vehicular emissions is being tackled by expanding the public transport system and replacing the current fleet of motor vehicles with electric and hybrid vehicles. Hosting the 2018 Asian Games gave Jakarta a major incentive to rapidly improve and expand its public transport infrastructure. Over the past few years, Transjakarta has revolutionized the city's public transit by integrating with, and formalizing, the popular, private bus network. In doing so, Transjakarta has grown its ridership to 950,000 people per day, and continues to add riders as its routes expand.

To make the transportation sector more sustainable, Indonesia is moving towards electric and hybrid vehicles through tax and non-tax incentive schemes. For example, a non-fiscal incentive includes exempting electric vehicles from certain driving restrictions, such as the odd-even license plate policy currently implemented in Jakarta.

6 Indonesia's Transport Assessment, ADB 2016

Indonesia's heavy reliance on coal, despite abundant potential for clean energy

Indonesian energy policy places a strong focus on energy security and independence. Once a large crude oil exporter, Indonesia became a net importer in 2004, following a decline in domestic crude oil reserves and an increase in general demand. The National Energy Policy 2014 (Kebijakan Energi National, or KEN) calls for re-establishing Indonesia's energy self-sufficiency by reducing the share of oil in total primary energy supply to 25 percent by 2025, and sourcing at least 30 percent of energy supply from coal, 22 percent from natural gas, and 23 percent from renewable energy (GoI 2014)[7].

Presently, Indonesia has among the world's highest carbon intensity in its electricity generation. Electricity production relies almost exclusively on fossil fuels. In 2016, 87 percent of generated power was sourced from coal, oil, and gas. While the share of oil in power plant installed capacity declined between 2013 and 2018 from 12 percent to 7 percent, the gap was mainly bridged by coal, and not renewable energy.

In fact, the use of coal has more than doubled since 2005 in absolute terms, with its share in total power generation increasing to 54 percent in 2016. The problem is that most of Indonesia's coal-fired power plants use subpar technologies that are inefficient and highly polluting. Despite these qualities, their use is often justified by citing the need to provide affordable electricity for all.

Although the share of electricity in final energy consumption has risen and the share of polluting fuels has declined, the latter remains the dominant source of Indonesia's energy[8]. And as long as Indonesian electricity production remains carbon intensive, the shift in energy generation from fuel towards electricity only serves to relocate pollution emissions from households and industries to power plants (see Figures 8(a) and 8(b)).

Since more than 90 percent of Indonesia's coal-fired power stations are located in the Java region (Centra, West, and East), as well as in Sumatra and Banten, $PM_{2.5}$ concentrations are highest in these areas, deeply affecting the local populations. For example, in Tangerang, a large regency in Banten with more than 3.5 million residents where one such coal-fired power plant exists, particulate pollution is shaving 4.4 years off of the average life expectancy, based on 2019 pollution levels.

On a positive note, Indonesia holds some of the world's greatest potential for geothermal energy and hydropower, as well as abundant biofuel, tidal, solar and wind power resources. Currently, less than 2 percent of this renewables potential has been developed. However, in July 2018, the president inaugurated the country's first large-scale wind farm (75 MW) in South Sulawesi.

Figure 8(a) · Share of Fuel and Electricity in Indonesia's Final Energy Demand (%)

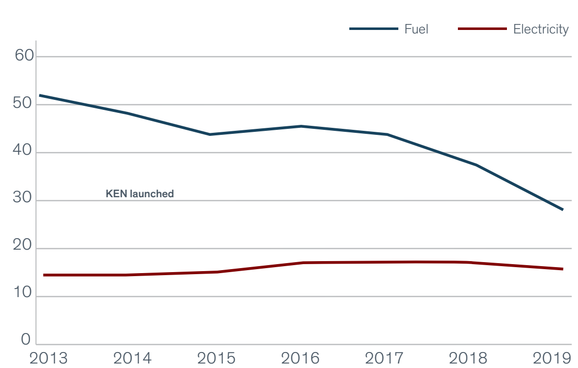
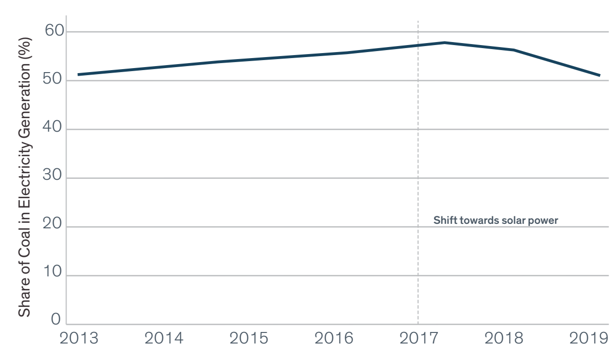


Figure 8(b) · Share of Coal in Electricity Generation (%)



Note: Other sources of energy in Indonesia's final energy demand include biofuel, coal, natural gas, LPG, and biogas.

7 In line with this policy, coal production increased nearly 52 percent between 2015 and 2019, while the production of crude oil has declined marginally (Statistical Yearbook of Indonesia 2021).

8 Handbook of Energy and Economic Statistics of Indonesia, 2019

Government efforts to confront air pollution

The Government of Indonesia has begun to take some initial steps to confront the particulate pollution problem. To date, much of the focus has been concentrated on the transportation sector. For example, in 2017, the Government of Indonesia required that all gasoline-fueled vehicles adopt Euro-4 fuel standards by September 2018. An internationally-recognized fuel standard, initially adopted in the European Union and now widely adopted across the world, Euro-4 demands the use of high-quality, cleaner fuels with a sulfur content that is no higher than 50 parts per million (ppm). This is ten times more stringent than the Euro-2 fuel standards that had previously been used in Indonesia.

The Government of Indonesia has also stepped up its efforts to combat air pollution from peat and forest fires. After the 2015 Southeast Asian Haze caused international health and economic damages, Indonesian President Joko Widodo enacted a moratorium on new peatland development and established the Peatland Restoration Agency (BRG). The BRG's efforts to rewet degraded peatlands have been cited as one possible reason why Indonesia has since experienced fewer fires recently. In 2018, the land area experiencing fires was just 7 percent of the land experiencing fires in 2015. However, since some of the land catching fire in 2018 was prioritized for peat restoration or protected from drainage, it is unclear whether the recent decrease in fires are due to government efforts or to milder weather conditions

One source of particulate pollution where stricter regulation may be possible is coal. Coal combustion emits black carbon, a form of particulate matter, and sulfur dioxide (SO2) and nitrogen oxides (NOx), which in turn react with other substances in the atmosphere to become particulate matter. Although electricity generation from coal has more than doubled since 2010 to meet rising energy demand, regulations on coal plant emissions remain significantly less stringent than those of other countries in Asia. As stated above, limits on the concentrations of PM, SO2, and NOx in Indonesian coal plant emissions are 3 to 7.5 times higher than the limits that China has in place, and 2 to 4 times higher than India's limits for plants installed between 2003 and 2016. Though the government has attempted to strengthen these limits that have been in place since 2008, conflicting criticisms of the proposed revisions have hindered their efforts[9]. In addition, if the rules were enacted, the proposed new limits would have been less stringent than those in China and India.

The AQLI highlights the enormous benefits that could be obtained through effective clean air policies. In the meantime, the health implications of breathing polluted air underscore the importance of taking on individual actions to reduce personal exposure. For instance, the residents of highly polluted countries like Indonesia could gain from better access to widespread, real-time data on air pollution levels. For example, data from low-cost air pollution sensor networks, like the data generated by Nafas Indonesia, can provide people with valuable information on where and when it is safe to exercise outside, wear a pollution mask, or stay in close proximity to an air purifier, if possible.

Figure 9 · Life Expectancy Gain from Reducing $PM_{2.5}$ from 2019 Concentrations by 30%

9 Proposed revision of coal plant emissions limits from https://www.thejakartapost.com/news/2018/02/12/ngo-planned-new-coal-emission-standards-not-strict-enough.html

Demonstrated success from air pollution policies

The dual challenges of economic growth and environmental quality faced by Indonesia today are no different from those once confronted by London, England, Los Angeles, California, or Osaka, Japan — once respectively known as "the big smoke," "the smog capital of the world," and the "smoke capital" — during their periods of industrialization. That legacy of environmental improvement is evidence that Indonesia's pollution challenges are solvable.

In fact, China has seen tremendous progress in improving air quality in the last few years. In 2014, the government declared a "war against pollution" and instituted a nationwide plan to confront it. According to satellite data, particulate pollution in China's cities has been reduced by about 30 percent on average since the "war against pollution" was announced. India, having declared its own war against pollution in January 2019, would be on a similar path if it succeeds in meeting its stated pollution reduction target of 20 to 30 percent.

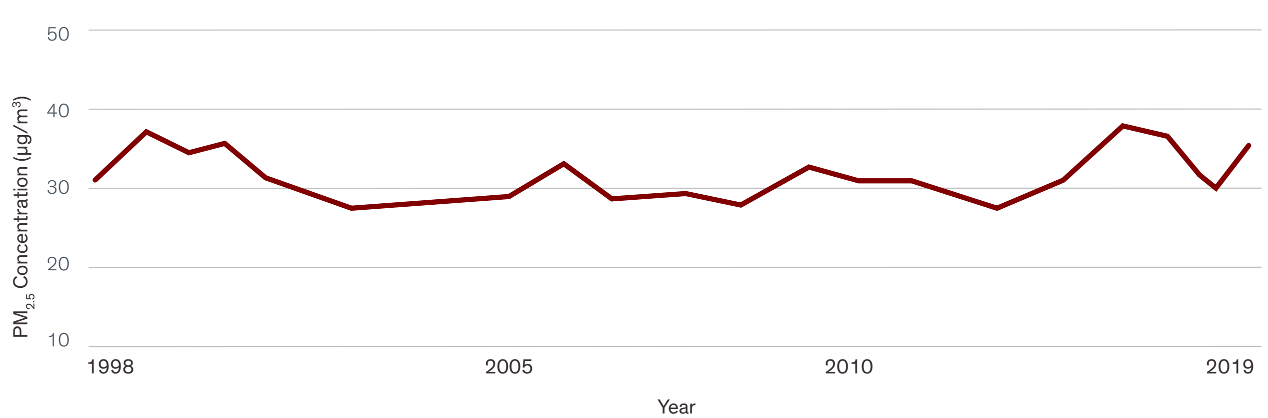
Indonesia has the opportunity to experience similar progress. If Indonesia were to achieve and sustain the same 30 percent pollution reduction experienced in China, its residents would live another year longer, on average. Those in the most polluted areas of Indonesia would live 2.5 to 3 years longer (See Figure 9 and the Appendix Table for the impacts on the 50 most populous regencies).

Conclusion

Four out of five Indonesians are exposed to annual average pollution concentrations that exceed the WHO safe limit. As a result, Indonesia ranks thirteenth in the world in lost life-years due to particulate pollution levels. The average Indonesian stands to gain 2.5 years of life expectancy if particulate pollution were permanently reduced to the WHO limit. In Jakarta, the average resident stands to gain 5.5 years, and in Palembang, the gain is 3 years.

Over the last several decades, other countries — including Japan, the United States, and the United Kingdom — have enacted and successfully enforced policies to reduce air pollution. This underscores the fact that today's air pollution need not be tomorrow's fate. More recently, China has greatly reduced $PM_{2.5}$ concentrations after declaring a "war against pollution." While clean air policies may come at a cost to industries, the AQLI makes it clear that the benefits of clean air policy, namely longer and healthier lives, are vast.

Figure 10 · Indonesia's Annual Average PM2.5 Concentration, 1998-2019 (µg/m³)



Note: The $PM_{2.5}$ concentrations shown in this figure are satellite-derived, and net of dust and sea salt to focus on human-caused pollution. Source: Hammer et al. (2020)

Current and Potential PM2.5 Concentration and Life Expectancy Impact in 50 Most Populous Regencies

			$PM_{2.5}$ Concentration (µg/m3)		Life Expectancy (Years) Gained by Reducing $PM_{2.5}$ from 2016 Concentration	
Province	Regency	Population (millions)	2019	After 30% reduction	To WHO Guideline of 10 µg/m3	After 30% reduction
Jawa Barat	Bogor	4.2	78	55	6.7	2.3
Banten	Tangerang	3.5	55	38	4.4	1.6
Jawa Barat	Bandung	3.3	76	53	6.4	2.2
Sumatera Utara	Kota Medan	3.3	43	30	3.2	1.3
Jakarta Raya	Jakarta Timur	3	70	49	5.8	2.1
Jawa Timur	Surabaya	2.9	31	22	2.1	0.9
Jawa Barat	Sukabumi	2.8	43	30	3.2	1.3
Jawa Barat	Garut	2.8	41	29	3.1	1.2
Jawa Barat	Kota Bandung	2.7	77	54	6.6	2.3
Jawa Barat	Karawang	2.7	54	38	4.3	1.6
Jawa Barat	Cianjur	2.6	52	36	4.1	1.5
Jawa Barat	Cirebon	2.6	45	31	3.4	1.3
Jawa Barat	Bekasi	2.5	61	43	5	1.8
Jawa Timur	Jember	2.5	20	14	1	0.6
Jakarta Raya	Jakarta Barat	2.4	62	43	5.1	1.8
Jawa Timur	Malang	2.3	23	16	1.2	0.7
Jawa Barat	Kota Bekasi	2.2	68	48	5.7	2.0
Jakarta Raya	Jakarta Selatan	2.2	71	50	6	2.1
Jawa Barat	Indramayu	2.2	41	28	3	1.2
Jawa Barat	Tasikmalaya	2.1	29	20	1.9	0.9
Jawa Barat	Bandung Barat	2.1	78	54	6.7	2.3
Banten	Kota Tangerang	2	61	43	5	1.8
Sumatera Selatan	Palembang	2	56	39	4.5	1.6
Jawa Barat	Ciamis	2	25	18	1.5	0.7
Banten	Serang	2	44	31	3.4	1.3
Jawa Tengah	Brebes	1.9	39	27	2.8	1.1
Jawa Timur	Sidoarjo	1.8	34	24	2.3	1.0
Jawa Barat	Subang	1.8	52	37	4.2	1.5
Jawa Tengah	Cilacap	1.8	22	15	1.1	0.6
Sumatera Utara	Deli Serdang	1.8	39	28	2.9	1.1
Lampung	Lampung Tengah	1.7	23	16	1.3	0.7
Jakarta Raya	Jakarta Utara	1.7	60	42	4.8	1.8
Jawa Timur	Banyuwangi	1.7	16	11	0.6	0.5
Jawa Barat	Depok	1.7	80	56	6.9	2.4
Jawa Tengah	Banyumas	1.6	26	18	1.6	0.8
Jawa Timur	Kediri	1.6	29	21	1.9	0.9
Jawa Barat	Majalengka	1.5	54	38	4.3	1.6
Banten	Pandeglang	1.5	32	22	2.1	0.9
Jawa Timur	Pasuruan	1.5	29	20	1.9	0.9
Jawa Tengah	Tegal	1.5	38	27	2.8	1.1
Jawa Tengah	Kota Semarang	1.5	40	28	3	1.2
Jawa Tengah	Grobogan	1.5	36	25	2.6	1.1
Jawa Barat	Sumedang	1.4	62	44	5.1	1.8
Sulawesi Selatan	Makassar	1.4	15	11	0.5	0.4
Jawa Tengah	Pemalang	1.4	34	24	2.4	1.0
Banten	Lebak	1.4	43	30	3.3	1.3
Riau	Indragiri Hilir	1.3	44	31	3.4	1.3
Jawa Timur	Lamongan	1.3	27	19	1.7	0.8
Jawa Timur	Bojonegoro	1.3	31	22	2.1	0.9
Nusa Tenggara Barat	Lombok Timur	1.3	15	10	0.5	0.4

ABOUT THE AIR QUALITY LIFE INDEX

The AQLI is a pollution index that translates particulate air pollution into perhaps the most important metric that exists: its impact on life expectancy. Developed by the University of Chicago's Milton Friedman Distinguished Service Professor in Economics Michael Greenstone and his team at the Energy Policy Institute at the University of Chicago (EPIC), the AQLI is rooted in recent research that quantifies the causal relationship between long-term human exposure to air pollution and life expectancy. The Index then combines this research with hyper-localized, global particulate measurements, yielding unprecedented insight into the true cost of particulate pollution in communities around the world. The Index also illustrates how air pollution policies can increase life expectancy when they meet the World Health Organization's guideline for what is considered a safe level of exposure, existing national air quality standards, or user-defined air quality levels. This information can help to inform local communities and policymakers about the importance of air pollution policies in concrete terms.

aqli.epic.uchicago.edu @UChiAir #AQLI

ABOUT EPIC

The Energy Policy Institute at the University of Chicago (EPIC) is confronting the global energy challenge by working to ensure that energy markets provide access to reliable, affordable energy, while limiting environmental and social damages. We do this using a unique interdisciplinary approach that translates robust, data-driven research into real-world impacts through strategic outreach and training for the next generation of global energy leaders.

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