Systemiq supported by the ClimateWorks Foundation presents report

BETTER AIR, BETTER INDONESIA

The Economic and Political Case for Urgent And Coordinated Action For Jakarta's Clean Air

SYSTEMIQ

climateworks FOUNDATION

EXECUTIVE SUMMARY

The science is clear: air pollution is one of the deadliest environmental health risks in the world, estimated to cause 8.1 million deaths worldwide in 2021.[1] Indonesia is no exception to this risk — Jakarta's air pollution has significantly worsened, ranking among the world's top 10 most polluted cities in the world.[2] In 2023, annual mean $PM_{2.5}$ concentration amounted to 39.6 µg/m^3, which is more than 2 times of the national standard (15 µg/m^3) and more than 6x of the World Health Organization (WHO) guidelines at (5 µg/m^3).[3]

The repercussions on Jakarta's health and economy are severe, as residents bear the profound toll on their lives and well-being. The World Bank estimated that in 2019, the economic burden of air pollution in Indonesia totalled $220 billion in health costs, equivalent to 6.6% of Indonesia's GDP PPP.[4] University of Chicago's Air Quality Life Index study reported that an average Jakarta resident loses 2.2 years of their life expectancy compared to what it would be if Jakarta pollution level met the WHO guideline.[4]

To dive deeper, this report's 2023 Emissions Inventory of activities within Jakarta reveals that the primary sources of air pollution are road transport, industry, power, waste burning, and construction. Road transport dominates across all pollutants, except for SO_2 whereby the industry sector is the most significant contributor. Open burning of household waste has emerged as a growing source of emissions. If current trends persist, projections for 2035 under a Business-as-Usual (BAU) scenario indicate a sharp rise in emissions across all sectors, driven by increasing vehicle ownership, inadequate public transit, urban expansion, and growing energy demands. Urgent and coordinated action is critical to reverse this trend at the speed and scale needed.

This report's Emissions Inventory was calculated using the Greenhouse Gas - Air Pollution Interactions and Synergies (GAINS) model to quantify emissions load of activities within Jakarta from 2023 to 2035. Notably ambient air pollution in Jakarta is impacted by emissions produced within the Jakarta city limits and outside the city limits from transboundary sources, such as industrial zones, power plants, and road transport exhaust from surrounding regions. Due to the methodology, the scope of the Emissions Inventory provided in the report focuses solely on activities within Jakarta's administrative boundaries, excluding transboundary pollution sources. This underscores the need for further research for a more integrated approach to air quality management that considers the broader airshed affecting the city.[6]

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1 Health Effects Institute & Global Burden of Disease. (2024). State of Global Air Report 2024. https://www.stateofglobalair.org/resources/report/state-global-air-report-2024

2 For more information on rankings and their respective methodologies, please see: IQAir, Air Quality Life Index (AQLI).

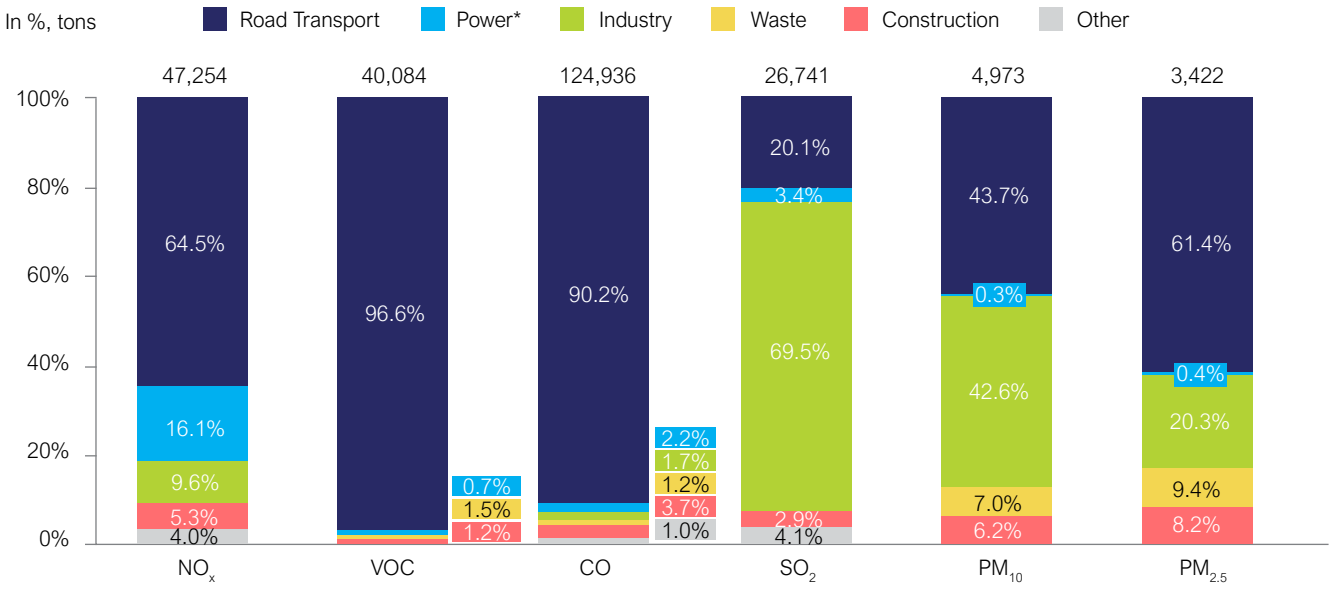
3 Environmental Agency Jakarta. (2023). Annual report on air quality monitoring activities for the DKI Jakarta Province in 2023. https://lingkunganhidup.jakarta.go.id/files/laporan_udara/LAPORAN_KUALITAS_UDARA_2023.pdf

4 World Bank. (2022). The global health cost of PM2.5 air pollution: A case for action beyond 2021. https://doi.org/10.1596/978-1-4648-1816-5

5 Air Quality Life Index. (2024). Annual update. https://aqli.epic.uchicago.edu/wp-content/uploads/2024/08/AQLI-2024-Report_English.pdf

6 For more information on emissions inventory for Greater Jakarta area, see forthcoming report: ITB & ViriyaENB. (forthcoming). Emission inventory in Jabodetabek.

FIGURE ES1: SOURCES OF AIR POLLUTANT EMISSIONS WITHIN JAKARTA



Source: ITB. Emissions Inventory calculated using GAINS model.
Note: (*) Power emissions only cover CCGT power plants in Jakarta: Tanjung Priok and Muara Karang

***The Better Air, Better Indonesia* report provides a multi-action roadmap for Jakarta to improve air pollution by 2030.** It identifies key levers (see Figure ES2), evaluated based on their impact on air pollution, health costs, economic effects on government and private sectors, and the political feasibility of regulatory reforms and governance models.

Compared to the emissions load of 2030 Business-as-Usual projections, these measures could reduce the emissions of $PM_{2.5}$ by 92%, carbon monoxide (CO) by 64%, nitrogen oxides (NO_x) by 51%, sulfur dioxide (SO_2) by 41%, volatile organic compounds (VOCs) by 64%, and PM_{10} by 89%. Beyond environmental benefits, the levers have potential to contribute to a $40.7 billion electric vehicle (EV) market and save the government $1.2 billion in reduced fuel subsidies.

The health benefits of proposed levers far outweigh the cost to implement levers: from 2025-2030 an estimated 32,747 pre-mature deaths would be prevented, resulting in an economic impact of $27 billion, equivalent to 1–2% of Jakarta's Gross Regional Domestic Product (GRDP).[7,8] The cause-specific diseases included in this study include Chronic Obstructive Pulmonary Disease, Ischemic Heart Disease, Lung Cancer, and Stroke, based on Global Burden of Diseases 2019 methodology. Prolonged exposure to pollutants such as fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), and sulfur dioxide (SO_2) lead to chronic diseases, exacerbating pre-existing conditions, and contributing to thousands of pre-mature deaths nationally each year. Vulnerable populations, such as children, the elderly, and individuals with underlying health issues, bear the brunt of these impacts. In addition to the human toll, the economic consequences—ranging from increased healthcare costs to lost productivity—are staggering.

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[7] GDP projection numbers are based on projected nominal GDP with 2015 as the base year, assuming Indonesian GDP is expected to grow at 5% per annum from baseline until 2028 and 8% per annum from 2029 onwards, based on an optimistic scenario aligned with government targets. Jakarta's projected GRDP is calculated assuming a consistent proportion of 16% of nominal GDP, based on historical trends. Sources include Systemiq analysis for Indonesia Climate Growth Dialogue (ICGD), World Bank, CEIC, and BPS.

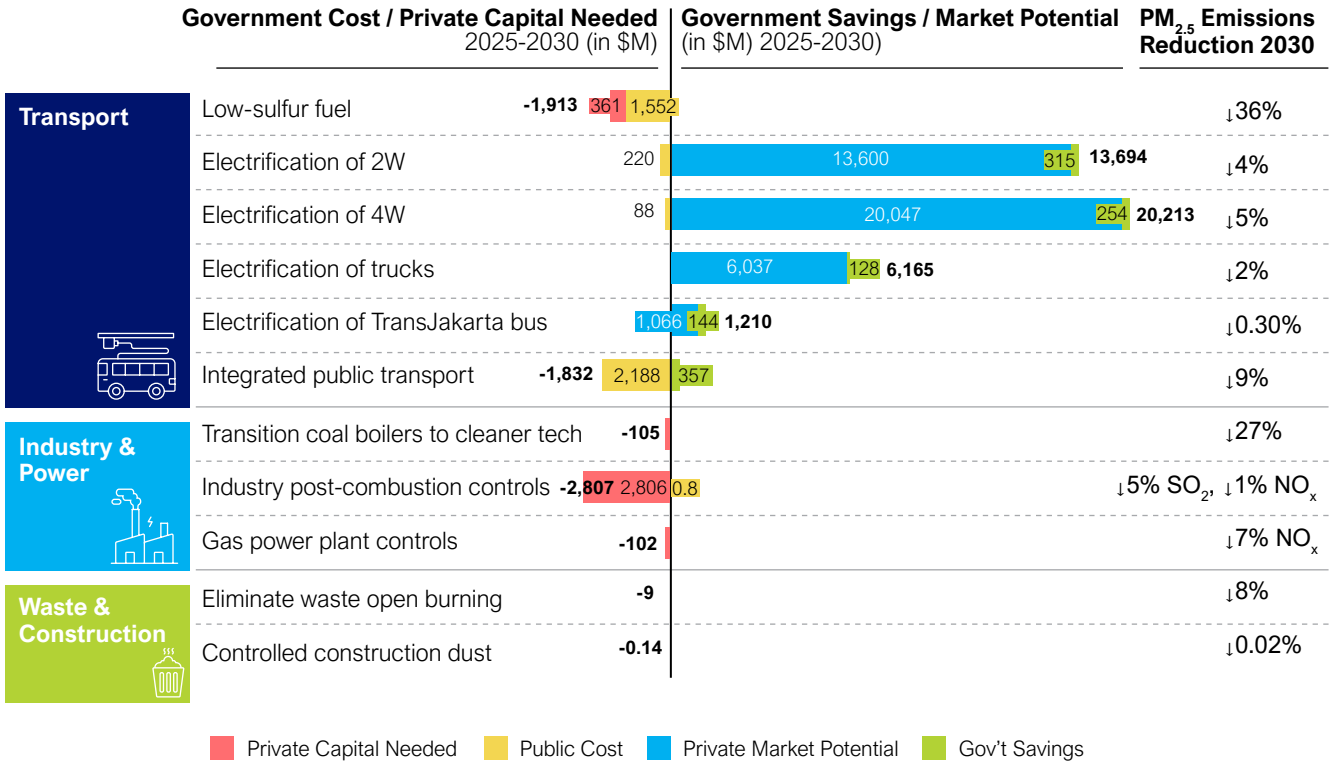
[8] Health impact is calculated with the Air Quality for Urban Action (AQUA) Model by C40 and AirQ+ model by WHO. The economic value of premature deaths is based on Value of Statistical Life (VSL) calculation. Due to data limitations, the estimated health impact may be undervalued as the analysis does not take into account (1) impact on diabetes and lower respiratory infection (LRI), and (2) the impacts on illness and morbidity, including hospitalization costs, years lived with disability, children's health (e.g. stunting), and adverse birth effects (e.g. pre-term births). For more information, please see appendix on Health Methodology and Assumptions. For more information, please see appendix on Health Methodology and Assumptions.

FIGURE ES2: 12 KEY LEVERS

	Levers	2030 Targets
Transport	1 Low-sulfur fuel	100% Euro IV fuel adoption in Jakarta
	2 Electrification of 2W	45% electrification (5.5M E2W) of 2W in Jakarta*
	3 Electrification of 4W	23% electrification (887k E4W) of 4W in Jakarta*
	4 Electrification of trucks	15% electrification (115k E-Trucks) of trucks in Jakarta
	5 Electrification of TransJakarta bus	100% electrification (10k E-Buses) of Transjakarta
	6 Integrated public transport	60% Public Transport ridership
Industry & Power	7 Transition coal boilers to cleaner tech	0% coal usage in industrial boilers
	8 Industry post-combustion controls	50% of highest-emitting industries install NO_x and SO_2 controls
	9 Gas power plant controls	100% NO_x controls at combined-cycle gas turbines (CCGT)
	10 CFPP controls & retirement**	100% CFPPs compliance to post-2019 emission standards
Waste & Construction	11 Eliminate waste open burning	100% waste handling (zero waste open burning)
	12 Controlled construction dust	100% construction dust control

*Electrification targets extrapolated based on national 2030 targets: 13M E2W, 2M E4W
** CFPPs have been included as a notable lever as a key source of transboundary pollution. However, due to data limitations, the emissions inventory of this report is limited to the administrative boundary of Jakarta. As CFPPs are located outside of Jakarta, assessment of CFPP lever impact to air pollution is not included in report.

FIGURE ES3: IMPACT SUMMARY



THREE STRATEGIC APPROACHES ARE RECOMMENDED:

1. **Prioritize Highest-Impact Levers:** Focus on the four most effective levers: (1) Low sulfur fuel adoption, (2) Transition coal boilers to cleaner technology, (3) Public transport expansion, and (4) Eliminating waste open burning. Collectively, these four levers alone can deliver an 80% reduction in $PM_{2.5}$ emissions by 2030, providing the greatest immediate impact.

2. **Enable Market Growth:** Leverage the economic potential of emerging electric vehicles (EVs) industry which encompasses E2Ws, E4Ws and e-trucks, representing a $40 billion market. Government incentives, such as subsidies, VAT exemptions, and non-financial incentives, like Low-Emission Zone allowances, can accelerate adoption. Further reduction of CO and VOC can be achieved if EV adoption rates surpass proposed targets.[9]

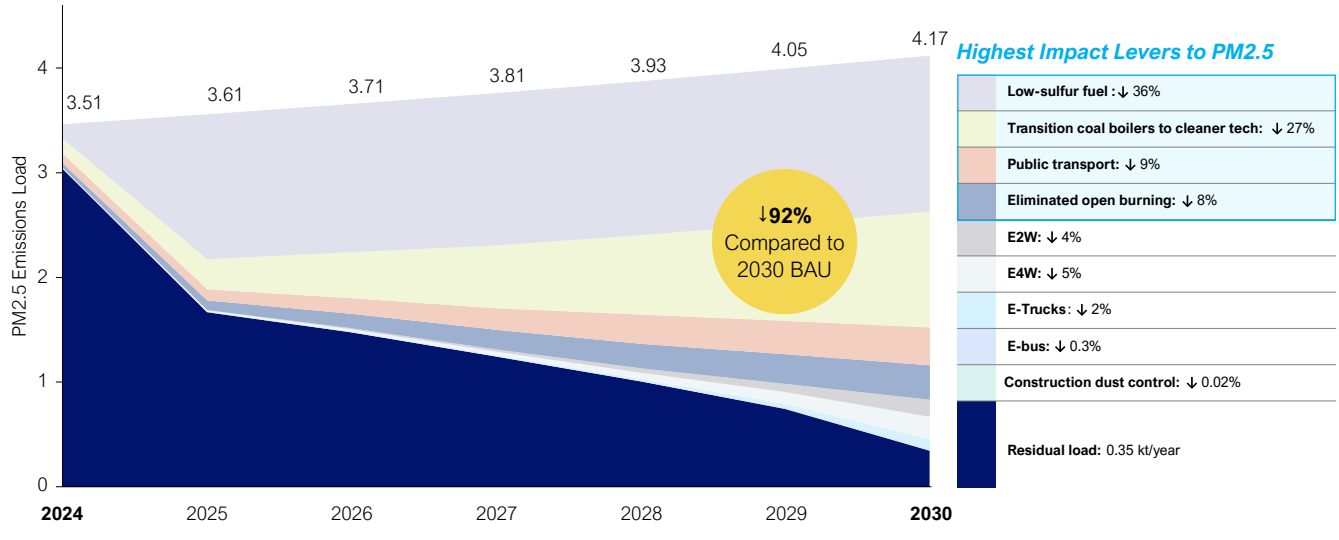
3. **Strengthen Enforcement:** While their impact on $PM_{2.5}$ is less significant, remaining levers of industrial pollution controls, e-bus and construction dust can be implemented for comprehensive pollution control of other pollutants.
   a. Issuance and continued enforcement of stringent emission standards for industry is crucial to encourage the installation of industrial post-combustion technologies, selective catalytic reduction (SCR) and wet flue gas desulfurization (WFGD) which target pollutants NO_x and SO_2 that pose serious health risks.[10]
   b. The electrification of Transjakarta buses supports long-term national electrification goals. However, with Transjakarta buses making up only 15% of Jakarta's total bus fleet, their impact on $PM_{2.5}$ reduction remains relatively limited compared to other levers. Leveraging this momentum could encourage other bus companies to transition to cleaner public transport for greater impact.
   c. Construction is the 5th largest sectoral contributor to air pollution and will expand with Jakarta's urbanization. Controlling construction dust and issuing standards will become increasingly important – as can be seen in the case of Beijing, which included construction measures as part of its air pollution program.

Infrastructure development is critical for the achievement of recommended strategies. Implementing the four highest-impact levers—low-sulfur fuel adoption, coal boiler conversion, public transport expansion, and waste burning elimination—requires major infrastructure planning and investment, including fuel processing and distribution networks, grid upgrades, transport infrastructure systems, and waste processing facilities. The success of emerging sectors like electric vehicles also hinges on supporting infrastructure such as charging stations and urban mobility planning. Strengthening enforcement efforts, including industrial emission controls and construction dust standards, similarly depends on built systems and planning.

FIGURE ES4: LEVERS IMPACT TO PM2.5

PM2.5 Projections: BAU vs. Impact

Kilotons/year



[9] ITB & ViriyaENB. (forthcoming). *Emission inventory in Jabodetabek.*

[10] Note that $PM_{2.5}$ pollution controls, such as Electrostatic Precipitators (ESP) or fabric filters, were not included in the analysis, as cleaner technology for industrial boilers is recommended as it provides a more cost-effective way to reduce particulate matter. For more information on impact of all air pollution controls, see: ITB & ViriyaENB. (forthcoming). *Emission inventory in Jabodetabek.*

TO ACHIEVE PROPOSED LEVERS, CERTAIN ENABLING CONDITIONS ARE CRUCIAL:

- **Improved data system** are is essential for enhancing air quality management.
    - **Air quality monitoring stations:** Jakarta currently has twelve high-quality Air Quality Monitoring Stations (AQMS). Expanding this network is essential for accurately tracking daily and monthly Air Quality Index (AQI) readings.
    - **Regularly conducted emission inventories and source apportionment:** Establishing an official government-owned national emissions inventory, with local Environmental Agencies supplying data to Ministries, would create a reliable data source. Strengthening air quality and health data infrastructure is critical for monitoring, policymaking, responding to high-risk events, and increasing public engagement.
    - **Advanced modeling techniques:** such as source apportionment, atmospheric transport and dispersion modeling, and satellite remote sensing are essential for accurately identifying air pollution sources. Given the significant role of coal-fired power plants, industrial activities, regional transport, agricultural burning, and waste burning in transboundary pollution, further research on pollutants from Jakarta's surrounding regions is crucial to understanding their impact on the city's air quality.
- **Public education and behavior change campaigns** play a critical role in increasing awareness of the health risks associated with air pollution and influencing behavioral shifts, such as increased public transport ridership, promoting EVs over ICE vehicles, discouraging household open burning of waste, and informed consumer choices on cleaner fuel quality.
- **Continuous assessment of air pollution policies and emission standards** aligned with the latest science and global benchmarks is essential to driving and sustaining long-term improvements in air quality. Achieving proposed targets requires embedding them within a broader policy framework of regularly upgrading regulations, ensuring strict monitoring and enforcement, including appropriate penalties to discourage non-compliance.
- **Enabling market conditions** to make cleaner technologies and practices more widely available, accessible and affordable. The government can issue comprehensive financial incentive packages—stimulating market growth on the supply side and alleviating potential financial burden for adoption on the demand side. Once market tipping points are achieved for cleaner technologies, it will be easier for an uptake in adoption.[11]

For more information on tipping points for low-carbon technologies, please see: Systemiq. (2023). *The Breakthrough Effect in ASEAN: How to Trigger A Cascade Of Tipping Points to Accelerate ASEAN's Green Growth*; Systemiq. (2023). *The Breakthrough Effect: How Tipping Points Can Accelerate Net Zero*

CENTRALIZED, COLLABORATIVE GOVERNANCE IS KEY TO DRIVE IMPLEMENTATION:

Individual efforts have already been made in many of these levers, but a true step change in action will require collective coordination across national and sub-national governments. Co-developed with and informed by extensive government engagement, a centralized Coordinating Team for Greater Jakarta Air Pollution is proposed to oversee implementation of levers. The taskforce would be led by a Steering Committee comprised of ministries or agencies accountable for achieving specific air pollution targets, supported by a Secretariat responsible for day-to-day coordination with the Implementing Team. Ten workstreams would be assigned to specific ministries or agencies, each responsible for driving policy reforms (e.g., emission standards) and accelerating program implementation (e.g., EV charging infrastructure, low-sulfur fuel roll-out) in collaboration with other stakeholders. The proposed taskforce would elevate air pollution as a national priority, strengthen coordination, enforce accountability, and direct resources more effectively. The Coordinating Minister for Infrastructure and Regional Development could serve as a potential lead for the Steering Committee and house the Secretariat, given the critical role of infrastructure development in achieving the recommended strategies. The proposed governance model remains high-level and flexible, designed to strengthen cross-agency coordination over time.

Case studies from other emerging markets that have successfully reduced air pollution, Beijing and Mexico City, show that integrating national and local governance is crucial to drive successful implementation. China launched a 'War on Air Pollution' in 2013 with the launch of Beijing's Coordination Group for Air Pollution Prevention and Control in the Beijing-Tianjin-Hebei Region.[12] Between 2013-2023 when the Group existed, the region achieved a 59% reduction in $PM_{2.5}$, from 106 to 43 μg/m³, respectively.[13] Similarly, Mexico City, once deemed the world's most polluted city by the UN in 1992 and doubly burdened by a valley geography that trap pollutants, launched the Metropolitan Environmental Commission and ProAire program,[14] reducing SO_2 by 89% and PM_{10} by 66%.[15] Key lessons from top-performing cities show that a centralized, coordinated framework across national and local governments, focused on high-polluting sectors like transport, industry, and power, can effectively reduce air pollution, drive economic growth, and improve public health.

[12] UNEP. (2019). A review of 20 years' air pollution control in Beijing.; Wang, J., Zhang, L., & Liu, Y. (2018). Taking action on air pollution control in the Beijing-Tianjin-Hebei (BTH) region: Progress, challenges, and opportunities.
[13] Latest data from Beijing Ecology and Environment Bureau (March 2025).
[14] Center for Public Impact. (2016). Mexico City's ProAire Programme.
[15] The Nature Conservancy. Planting healthy air case study: Mexico City

FIGURE ES5: HIGH-LEVEL PROPOSAL FOR A CENTRALIZED COORDINATING TEAM

STEERING COMMITTEE
MoE, MoI, MSOE, MEMR, MoF, MoH, MoPW, MoT, MoHA, Provincial Governments Jabodetabek

Expert Body

Academics and experts
to provide scenario analysis, advise on roadmap, and support with Monitoring and Evaluation

DAILY COORDINATOR

Implementing Team

	Workstreams	Priority Focus	Main Stakeholders
Pillar 1: Energy Transition-Related	1 **Workstream 1:** Electric Vehicles	Accelerate adoption of electric vehicles (E2W, E4W, E-bus, E-truck) and expand city-wide charging infrastructure	Jakarta Provincial Government, PLN, MEMR
	2 **Workstream 2:** Power	Develop stringent emissions standards aligned with global benchmarks, enforce controls and encourage transition	MEMR, PLN, MSOE, MoE
Pillar 2: Policy Enforcement & Issuance	3 **Workstream 3:** Industry	Develop stringent emission standards and enforce cleaner technologies, inc. PCC, CEMS, and e-heating solutions	MoE, MoF, MoI
	4 **Workstream 4:** Fuel Quality	Accelerate adoption of EURO IV fuel through policy and implementation of timeline	MEMR, Pertamina
	5 **Workstream 5:** Waste Open Burning	Expand waste mgmt. infrastructure and improve monitoring and enforcement against open burning	Jakarta Provincial Government, MoE
	6 **Workstream 6:** Construction	Issue emission standards for construction dust and enforce monitoring	Jakarta Provincial Government, MoE, MoPW
	7 **Workstream 7:** Public Transport & LEZ	Accelerate public transport infrastructure and development of Low Emission Zone	Jakarta Provincial Government, MoT
	8 **Workstream 8:** Financing	Develop financing mechanisms to support air pollution program and policy implementation	MoF
Pillar 3: Data & Health	9 **Workstream 9:** Data & Monitoring	Develop national and regional emissions inventories, enforce AQI aligned with global standard, oversee AQM	MoE
	10 **Workstream 10:** Public Awareness	Develop public awareness and education campaigns on health impact of air pollution	MoH

MoE (Ministry of Environment), MoI (Ministry of Industry, MSOE (Ministry of State-Owned Enterprise), MEMR (Ministry of Energy and Mineral Resources), MoF (Ministry of Finance), MoH (Ministry of Health), MoPW (Ministry of Public Works), MoT (Minisry of Transportation), MoHA (Ministry of Home Affairs), Jabodetabek (Jakarta, Banten, West Java)

Proposed sectoral levers provide significant co-benefits for national climate goals, especially when integrated into a broader energy transition. Electrification technologies, EVs and clean tech for industrial boilers, reduce emissions but are most effective when paired with a greener electrical grid powered by renewable energy sources. Expanding public transport ridership will reduce private vehicle trips and cut per capita carbon emissions. Eliminating open waste burning and improving waste management facilities, such as landfill upgrades and composting, can reduce black carbon and methane emissions—key climate pollutants. Addressing air pollution and climate mitigation together creates a win-win solution for Jakarta.

Achieving Better Air in Jakarta ensures a Better Indonesia — for our environment, health, and economy.

The following sections will deep dive into the four priority highest-impact levers: (1) Low-sulfur fuel, (2) Transition coal boilers to cleaner technology, (3) Integrated public transport (MRT and LRT), and (4) Eliminated waste open burning.

LOW-SULFUR FUEL

Investment needs

$816M (IDR 13T)
Cost of achieving 100% low sulfur gasoline and diesel

Impact to Pollution in 2030

↓ 36%
reduction in **$PM_{2.5}$ emissions load**

- **The GoI has set a target of achieving full adoption of EURO IV in Jakarta, diesel by 2025 and gasoline by 2027.** National target is for 100% adoption of EURO IV fuel by 2028 for both gasoline and diesel.
- **Achieving 100% EURO IV fuel in Jakarta will require $816 million investment –** which would need to be allocated through a combination of government cost, Pertamina and fuel supplier cost, and/or passed through consumers through fuel price and potential subsidy adjustments
- **Additional costs for recommended enablers include:** emissions testing ($713 million), Low Emissions Zone ($24 million) and truck retrofits ($361 million)
- **Adoption of EURO IV fuel is the highest-impact lever** across all levers proposed, resulting in 36% reduction in PM2.5 emissions by 2030 compared to BAU.

CONTEXT

As the first step towards achieving higher quality fuel, the GoI has set a target for achieving full adoption of EURO IV in Jakarta, diesel by 2025 and gasoline by 2027. The national target is to achieve 100% adoption of EURO IV by 2028. MOEF Regulation 20/2017 was issued mandating that the production of all new vehicles must comply with EURO IV standards, starting with gasoline vehicles in 2018 and diesel vehicles in 2022. Further impact can be achieved if standards are raised to become more stringent towards EURO V or higher, similar to other peer countries.

Low sulfur fuel is the highest impact lever for air pollution, with the potential to reduce 36% of PM2.5 by 2030. EURO IV is significantly cleaner than the current fuel standards, as EURO IV contains less than 50 parts per million (ppm) of sulfur compared to over 500 ppm in EURO II fuel, the currently widely used fuel in Indonesia.

[Challenges] To achieve adoption of EURO IV in Jakarta, the priority is to increase the supply of EURO IV fuel which face capital and distribution challenges:

1. **Additional investments are needed throughout the supply chain to make EURO IV fuel supply available.** For processing, additional treating units of Diesel Hydrotreating Unit (DHU) and Gasoline Sulfur Hydrotreater (GSH) are needed in refineries, including all six Pertamina refineries.

2. **Distribution logistics must be adjusted and prepared** including blending process in tanks at Fuel Terminals (TBBM) and pipeline flushing for supply. In addition, there may be an increased need to import EURO IV compliant fuel if fuel supply does not match demand. In 2023, 60% of gasoline (about 20 million KL) and 13% of diesel (about 5.15 million KL) were imported.

3. **Lack of urgency and lack of consumer awareness:** Including low price point of subsidized fuel make it more attractive to the public – resulting in low demand and consumption of existing EUROIV fuel (Pertamax Green and Pertamax Turbo for gasoline, and Pertamax Dex for diesel) available to the market.

4. **Devising policy package and financial mechanism to address additional investment needs–** either through increased government subsidy, passed to consumer through increased fuel costs, and/or increased costs to fuel suppliers. The policy package will need to consider potential changes to national fuel subsidy policy, government financial mechanism to support Pertamina (e.g. through product subsidy, PSO, tax incentives or state capital injection), and long-term macroeconomic impact (e.g. inflation, national budget and deficit)

INTERVENTION

To achieve the roll out of EURO IV according to timeline, the main intervention is government support for Pertamina and other fuel suppliers to account for the additional production costs to desulfurize current fuel, pending discussions with the company. Other interventions include:

1. **Relevant ministries to coordinate for the harmonization and issuance of key regulations,** to enforce EURO IV. Strong commitment from ministries, through the issuance of a regulation mandating a strict timeline, is crucial to prompt market players to accelerate the necessary capital and infrastructure preparation to provide EURO IV-compliant fuel. Key regulation should also include a comprehensive financial and investment plan outlining potential change to consumer fuel subsidy, costs to state budget and Pertamina financial sustainability.

2. **Increased enforcement of EURO IV usage** through enabling policies including implementation of emissions testing and the establishment of Low Emission Zones.

3. **EURO IV truck retrofitting to make truck engine compliant with EURO IV.** Procurement of new EURO IV compliant trucks or early retirement of fleets could create a big barrier for truck owners to adopt a cleaner fuel. Retrofitting offers a lower cost option with significant benefits to air pollution.

TRANSITION COAL-BASED INDUSTRIAL BOILERS TO CLEANER TECHNOLOGY

Private Sector Cost

$105M (IDR 1.7T)
From the cost of transitioning coal boilers to industrial e-heating

Impact to Pollution in 2030

↓ 27%
reduction in **$PM_{2.5}$ emissions load**

- **Switching to cleaner technology for industrial boilers** via e-heating solutions would require $57.2 million investment for CAPEX and OPEX to achieve 0% coal usage in industrial boilers by 2030.
- **Eliminating industrial coal combustion from boilers is the second highest-impact lever towards $PM_{2.5}$ reduction,** as coal combustion has a high emissions factor and emits high amounts of pollutants
- **Industries have the opportunity to leapfrog coal-fired boilers and adopt best-available technology (BAT) for e-heating solutions,** which represent the end-state low-carbon and low-pollutant alternative

CONTEXT

Eliminating coal-based industrial boilers can lead to a significant reduction in PM emissions. In 2023, coal accounted for only 3.8% of total industrial energy consumption but contributes to a significant share of PM10 and $PM_{2.5}$ emissions, due to the high emissions factor of coal to particulate matter (0.33 kt/PJ).[16,17]

Industries have the opportunity to leapfrog coal-fired boilers and adopt best-available technology (BAT) for e-heating solutions, which represent the end-state low-carbon and low-pollutant alternative. There are various e-heating solutions available in the market depending on heating temperature and energy needs. This analysis examines the use of heat pumps for industries relying on low temperature processes (<200°C), such as textiles, food & beverage, and pulp & paper, and e-boilers for medium to high-temperature processes (>200°C) in energy-intensive industries like chemicals, steel, and cement.[18]

INTERVENTIONS

To support the adoption of industrial heat pumps, strong policy and support are required:

1. **Explore policy options to establish more stringent industrial emission standards and timeline to transition down from coal-based boilers,** especially for low-temperature processes that can more easily switch to heat pumps. These regulations are also aligned with government's long-term climate strategy. To achieve compliance, regulations should be supported by strong monitoring and enforcement, including strict punitive measures such as fines and penalties.

2. **Issue financial incentives to support suppliers and industries.** Mainstreaming technology through collaboration with OEM will be key to accelerating the availability of technologies, in line with Indonesia's industrialization strategy. Currently, major industrial heat pump suppliers and

[16] Environmental Agency Jakarta. See annex for more information.
[17] To note, this report does not cover coal used as industrial feedstock or raw material. The government may consider establishing standards for coal feedstock in alignment with global benchmarks. Additionally, this report does not address coal stockpiles in the Jakarta area which may also have an impact air pollution. The government and industry stakeholders could explore implementing measures to manage coal stockpiles, such as utilizing warehouses and avoiding open stockpiles.
[18] For more information regarding electrification of industrial heat, please see: Systemiq. (2023). *The Breakthrough Effect in ASEAN: How to Trigger A Cascade Of Tipping Points to Accelerate ASEAN's Green Growth*; Systemiq. (2024). *Catalysing the Global Opportunity for Electrothermal Energy Storage*; Systemiq (2025), *A Lightning Moment for Industry: How to Reach Positive Tipping Points in Electrification of Industrial Heat*

manufacturers are based in Japan, Europe, and North America, with China leading the largest share (39%) of heat pump manufacturing globally.[19] Creating market conditions for OEMs to supply the technology in Indonesia market is crucial to make technologies readily available. On the demand side, the government may provide subsidies or corporate tax incentives for factories to incentivize technology adoption of e-heating.

3. **Coupling e-heating buildout with on-site and grid-scale variable renewable energy (VRE):** The emission reduction potential of e-heating solutions is capped if Indonesian grids stay the same. There is a need to balance out the increase in electricity demand with clean electricity generation as well.

[19] 39% of global heat pump manufacturing (by GW) is in China. European Commission. (2024). The future of European competitiveness

INTEGRATED PUBLIC TRANSPORT

Government Cost

$1.8B (IDR 29T)
Net government cost of fuel subsidy savings and PSO subsidy for MRT and LRT and infrastructure CAPEX

Impact to Pollution in 2030

↓ 9%
reduction in **$PM_{2.5}$ emissions load**
(↓ 15% CO, ↓ 37% VOC)

- **Government of Jakarta targets to increase public transport ridership to 60% by 2030** under Jakarta Governor's Decree 576/2023
- **$1.8 billion net government cost:** when combined $357 million of fuel subsidy savings offset from $2.2 billion capital required for infrastructure expansion and PSO
- **Public transport is considered a high-priority impact lever as it has the third highest impact potential to $PM_{2.5}$,** with potential to reduce PM2.5 emissions load by 9% by 2030

CONTEXT

The Government of Jakarta has set a target to increase public transport ridership to 60% by 2030, as established in Governor's Decree 576/2023. Jakarta's public transportation network comprises of four primary modes — Bus Rapid Transit (BRT), Mass Rapid Transit (MRT), Light Rapid Transit (LRT), and the Commuter Line (KRL) — together covering 54% of the city. This research explores the impact of increasing ridership of public transport on the annual distance travelled by private vehicles following government plans to expand LRT and MRT.

CHALLENGES

Despite the efforts by government to advance public transportation, some challenges remain:

1. **High reliance on private and ride-hailing vehicles** – Private vehicle ownership continues to grow, due to an increasing middle class with higher purchasing power. In addition, there is high ridership of ride-hailing services (e.g. Gojek, Grab), as opposed to public transport, due to its low prices and accessibility.

2. **Insufficient integrated public transport infrastructure,** such as pedestrian facilities. Limited pedestrian facilities and uneven public transport connectivity hinder accessibility, making private vehicles or ride-hailing necessary for first- and last-mile transit. The current public transport network has limited coverage, with the MRT primarily serving areas from South to Central Jakarta.

3. **Expanding and enhancing this network requires substantial investment**, as the CAPEX for infrastructure development is high.

INTERVENTIONS

This research proposes several interventions to address the challenges:

1. **The expansion of MRT and LRT routes,** including Transjakarta as feeder route, to increase the accessibility and coverage of public transportation across the city.

2. **Complementing these expansions, the development of pedestrian infrastructure,** such as park-and-ride facilities, will further support ease of access to transit stations, encouraging more residents to use public transportation.

3. **Disincentivize the use of private vehicles through push policies,** such as electronic road pricing (ERP), reducing fuel subsidy, increasing parking fee, and reducing areas for parking.

4. **Complete physical, service and tariff integration to provide integrated option for riders that is cheaper than using private vehicles.** Physical integration could include building sky walks or pedestrian paths between MRT and LRT stations. Whereas service integration includes partnering feeders or buses to expand the coverage of MRT and LRT. Lastly, tariff integration between all public transport could result in a lower commuting cost compared to using private vehicles.

ELIMINATED OPEN WASTE BURNING

Government Cost

$9M (IDR 144B)
from expanding municipal waste service, public awareness campaign, monitoring & enforcement cost

Impact to Pollution in 2030

↓ 8%
reduction in **NO_x emissions load**

- **To eliminate waste open burning** estimated cost is $9 million, including expansion of municipal waste collection, campaigns and monitoring & enforcement
- **Waste open burning is considered a priority lever as it is the fourth highest impact lever to** $PM_{2.5}$, with potential to reduce emissions load by 8% by 2030

CONTEXT

Open burning of municipal solid waste contributes 8% $PM_{2.5}$ in Jakarta. In 2023, approximately 40,000 tons of solid waste were openly burned, equivalent to 1.2% of Jakarta's total waste generation.[20,21] The open burning of waste is already prohibited under Law 18/2008, and Jakarta Regional Regulation 4/2019 in the context of Jakarta city, but it remains prevalent today. Open burning is harmful to public health: studies show that open burning releases toxic and carcinogenic chemicals and is a leading cause of black carbon.

CHALLENGES

There are multiple factors as to why people resort to open burning:

1. **Lack of access to proper waste collection service.**
   At the most upstream, open burning typically occurs because there is a lack of collection, eventually leading to burning due to a limitation on space/disposal site. In some cases, it also leads to utilization of informal waste collectors that burns waste after they recover the recyclable (valuable) materials.

2. **Lack of waste transportation and disposal sites.**
   Even in areas that have a community waste collection, the waste may still end up being burned at the temporary waste disposal site (TPS) if there is no means (and space) to transport it to the landfill.

3. **Lack of awareness and understanding of open burning's negative impacts.**
   Burning of waste is also often done out of norm and convenience to eliminate waste, without proper understanding of its negative health impacts.

4. **Lack of enforcement on open burning activities.**
   When the enforcement is weak, perpetrators will not hesitate to burn their waste as there is no direct consequences. Jakarta Regional Regulation 4/2019 already imposes fine sanctions to open burning perpetrators of up to Rp500,000.

[20] Ministry of Health, Riset Kesehatan Dasar (Riskesdas) 2023
[21] Ministry of Environment and Forestry, National Waste Management Information System (SIPSN). https://sipsn.menlhk.go.id/sipsn/

INTERVENTIONS

To eliminate open burning activities, the following interventions are proposed:

1. **Expansion of municipal waste management services,** especially for the unserved households and populated areas. This includes both expansion of waste collection and transportation to temporary shelter (TPS) and eventually to landfill (TPA). In addition, additional sortation and composting at either community-level or at TPS, depending on community needs and organic composition, can reduce waste sent to the landfill. The majority of waste burned will be comprised of non-valuable waste, comprised of residue and organics, that cannot be utilized by waste-pickers to sell to recyclers. To reduce waste sent to the landfill, the TPS workers can conduct additional processing, sortation of organics and composting. This will limit the residual waste transferred to the landfill given that landfill Bantar Gebang is currently in over-capacity. Other waste management solutions such as waste-to-energy (WtE) or refuse-derived fuel (RDF) can also be explored.

2. **Increasing public awareness & behavior change campaign on open burning.** A public campaign on the environmental and health impacts of open burning in hotspot neighborhoods can help shift community behavior. Additionally, implementing a public reporting mechanism can provide a dedicated channel for citizens to report violations or file complaints, enhancing community accountability and applying social pressure to discourage open burning.

3. **Stricter monitoring & enforcement on open burning activities.**
   Along with public campaign and socialization, it must also be followed with strict monitoring and enforcement by the local authorities, administering warnings and fines to prevent open burning.