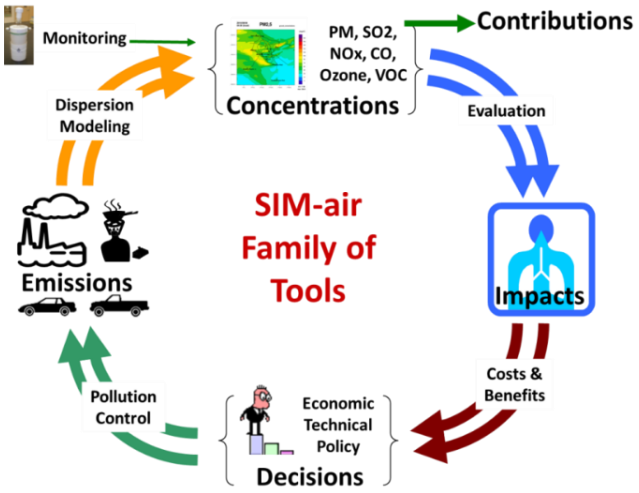
# JAKARTA EMISSIONS INVENTORY

## DEVELOPING AN EMISSIONS INVENTORY FOR DKI JAKARTA

The Special Capital Region of Jakarta, locally known as Daerah Khasus Ibukota (DKI Jakarta), covers an area of 660 km2 and is home to 9.6 million people, which reaches up to 12 million during day time, including the commuters from the surrounding cities. The capital city has the largest and most modern airport in the country, the most important harbor in Indonesia, and is well-connected by rail of good roads to other destinations in Java, Sumatra, and Bali. Over the last several decades, Jakarta has proudly developed into one of Asia's most prominent metropolitan centers, has undergone dramatic growth, and consequently resulting in growing air pollution in the city.

A prerequisite to an air quality management plan for a city is some idea of the main sources of pollution and their contributions. In 2013, the new and updated emissions inventory for the Greater Jakarta region was developed for total particulate matter (PM) in two size fractions (PM10 and PM2.5), sulfur dioxide ($SO_2$), nitrogen oxides (NOx), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), and carbon dioxide ($CO_2$). All the databases, calculations, and interfaces are available as spreadsheets for easy access and model transparency. The total emissions were then projected to 2030, with assumed growth rates based on inputs from environment, transport, and industrial authorities.




| *Emission sources* | *Approach* |
|---|---|
| *Transport sector* | Based on past source apportionment studies and inventories, a large share of increase in air pollution was attributed to the growing vehicle population in the city. Of the total registered fleet, two-wheelers (including mopeds, scooters, and motorcycles) and passenger four-wheelers are the dominant, followed by heavy duty (HDV) and light duty (LDV).<br>The total vehicle exhaust emissions are also adjusted for the likely congestion levels in the city and includes landing and take-off emissions at the airport and the port activity. The total gridded road dust emissions are estimated based on assumed vehicle density data and fractions assigned for each vehicle type to two road categories (main and arterial). The total re-suspended dust emissions are also corrected for the rainy hours, assuming that under the wet conditions, there will be little or no resuspension of dust possible on the roads.[1] |
| *Industrial sector* | The industrial emissions data is also supplemented from the surveys conducted to develop the national $CO_2$ emissions inventory, which included information of fuel consumption and industry |

[1] The meteorological data used for this correction is presented in the previous section, with the precipitation data available at 1-hour temporal resolution

| Emission sources | Approach |
|---|---|
| | type.[2] The industrial types ranged from metal processing to textiles, paper, agricultural processing, and pharmaceuticals, to paint manufacturing. While most of the industries rely on the grid electricity for their energy needs, there are frequent power outages, which force them to use in-situ diesel generators and other supplementary sources. |
| *Domestic sector* | The domestic sector emissions are based on fuel consumption estimates for cooking and waste burning.<br><br>Using census statistics, household total energy consumed in the form of solid (coal and wood), liquid (kerosene), and gaseous (LPG) fuels was estimated at the grid level. In slum areas, construction sites, some restaurants, and areas outside the urban boundary, are listed as using coal, biomass, and agricultural waste. Garbage burning in the residential areas emit substantial amount of pollutants and toxins. While this is limited to the urban parts of the city, it is assumed that at least once a week, the uncollected garbage is put to fire at makeshift collection sites in the city. |

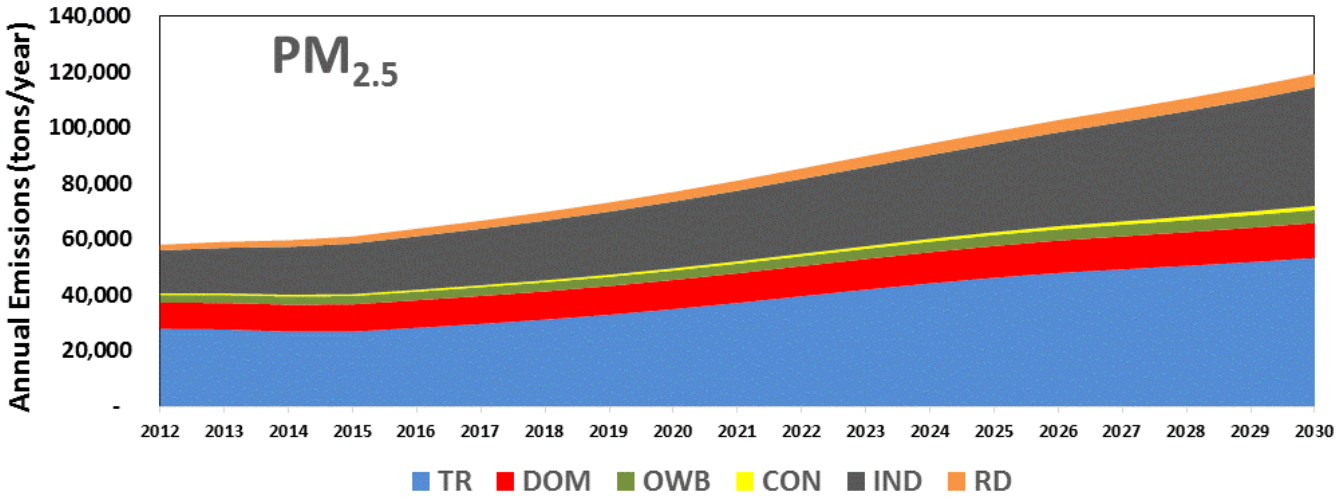
## $PM_{2.5}$ TOTAL EMISSIONS AND PERCENTAGE SHARES FOR THE GREATER JAKARTA REGION

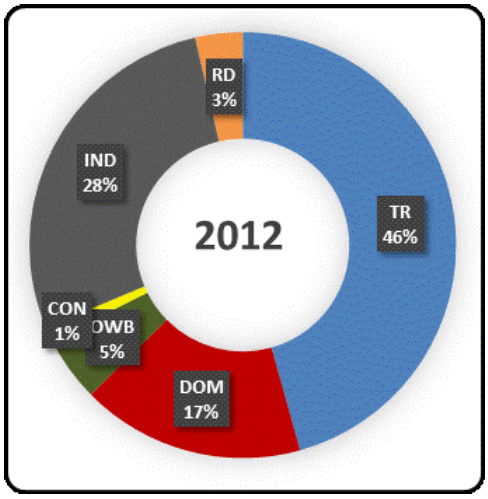
In the following figures, we present total emissions for the study domain for the period of 2012 to 2030. Since, there are many factors which influence the changes in a city's economic, land use, and industrial layout, the growth rates assumed should be considered as an estimate only. We used these estimates to evaluate the likely trend in the total emissions in the city, their likely impact on the ambient PM2.5 concentrations, and health impacts through 2030.

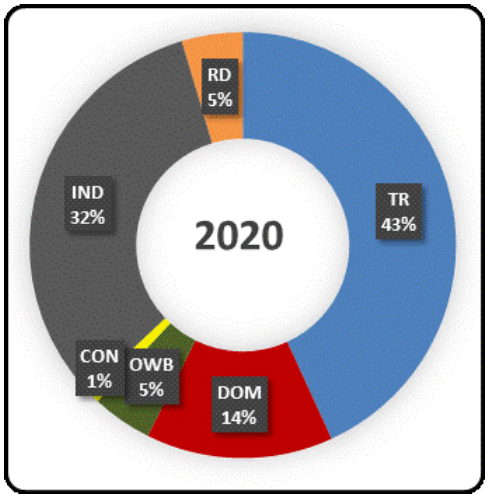
BOX – major highlights from the updated emissions inventory

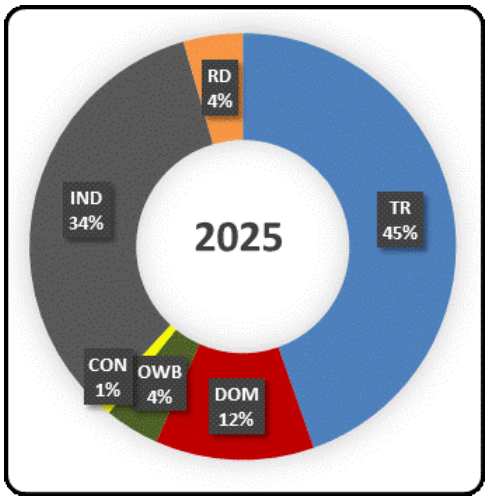
- For PM emissions, the vehicle exhaust, road dust, and industries are the major contributors. The vehicle exhaust emission rates (per vehicle number) is expected to improve over the coming years, with the inclusion of newer vehicles. However, with an increase in the overall number of vehicles, the overall emissions are expected to go up
- The re-suspended dust emissions are lower in Jakarta, compared to their counterparts and equally big cities in Asia, like Delhi and Beijing, primarily due to prevalent wet conditions
- The sulfur emissions from the transport sector are still higher in Jakarta, compared to those observed in Delhi and Beijing, due to higher diesel sulfur content. It is assumed that the sulfur content is minimum 1000ppm, and can be as high as 2000ppm. This is expected to drop over the coming years, if the high fuel standards are introduced for diesel
- A majority of the CO emissions in the transport sector are coming from the motorcycles and the 3-wheeler rickshaws
- A majority of the $CO_2$ emissions are originating from the transport sector
- With no additional controls assigned to the current trends in total emissions, the total emissions are expected to at least double through 2030
- The transport sector remains the dominant source of emissions, along with the on-road resuspension as the primary contributor (to PM10), followed by the industries

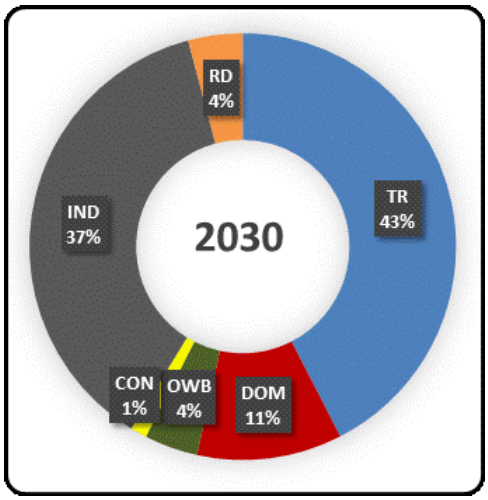
[2] This database is collated and documented by Swiss Contacts (Indonesia)



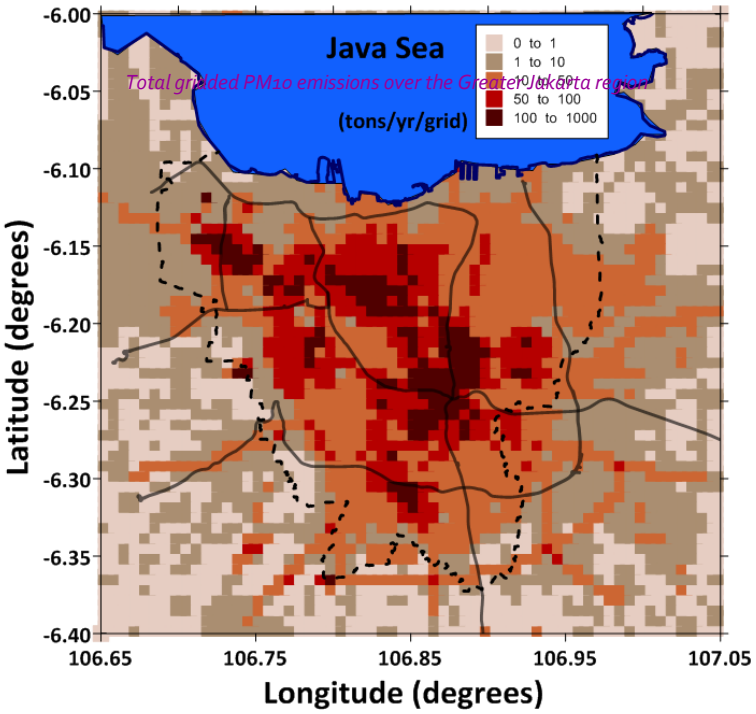




Notes: Base year for all the emission calculations is 2012. TR = transport (including road, rail, and air); RD = road dust; DOM = domestic (including household and kiosks); OWB = open waste burning; IND = manufacturing industries CON = construction activities.

While the urban parts of the city are expected to experience most of the changes, the highest percentage changes are expected in the peri-urban areas, outside the Jakarta municipal boundaries, where the urban expansion plans are already underway. For the business as usual scenario, we assumed a growth rate parallel to population for the domestic and construction sector emissions, which is an underestimate and their shares could double, and further worsen the ambient pollution levels in the city. Since, the inventory is based on bottom-up activity data in the city and secondary information on emission factors, there is some uncertainty associated with our estimates, the emissions inventory estimation has an uncertainty of ±20-30%.




Overall, based on the data available from various departments (e.g. transport, industry, census, and monitoring) for various activities in the city, this is considered as a representative emissions inventory. All the calculations and databases presented in this Chapter are maintained in MS Excel workbooks for easy portal of the calculator and use. , The emissions inventory is also maintained on a GIS platform and spatially segregated at a finer resolution of 0.01° in longitudes and latitudes (equivalent of 1km) and for further use in atmospheric modeling, currently available with the staff of Ministry of Environment. A summary of the emissions inventory and instructional videos will be hosted @ http://www.breatheeasyjakarta.org .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