Taking a co-benefits approach in five steps : cases from Bandung and Semarang, Indonesia.

Eco Driving Training

Analysis of Pedestrianisation Programme

Awareness Programme for Students

Co-benefits are the multiple benefits of actions that mitigate climate change while addressing other development priorities. Many cities in Asia have potential to achieve co-benefits. However, urban policymakers often lack concrete demonstrations over which actions can maximize co-benefits. Since 2015, the Institute for Global Environmental Strategies (IGES) has been collaborating with local governments, researchers and other partners on projects supported by the Ministry of the Environment, Japan (MOEJ) that analyse potential climate and air quality co-benefits in the transport sector in Bandung and Semarang, Indonesia. The analysis then helped arrive at practical recommendations that the two cities could implement to reduce greenhouse gases (GHGs) and air pollutants. The research employed an evidence-based approach that could help other cities address air pollution and climate change, while achieving sustainable development goals (SDGs) .

This evidence-based approach consisted of five main steps: 1) developing an emissions inventory for air pollution and GHGs for the transport sector; 2) prioritising local policies and measures that could reduce air pollution and GHGs based on existing plans; 3) quantifying the impacts of priority policies and estimate reductions in air pollution and GHGs for selected policies; 4) building a consensus across relevant stakeholders on follow-up actions based on the quantitative analysis; and 5) translating policy recommendations into practical actions. These five steps are potentially replicable in other cities and sectors. This is particularly true given the growing emphasis on aligning nationally determined contributions (NDC) and other climate actions with other development priorities.

Taking a Co-benefits Approach in Five Steps

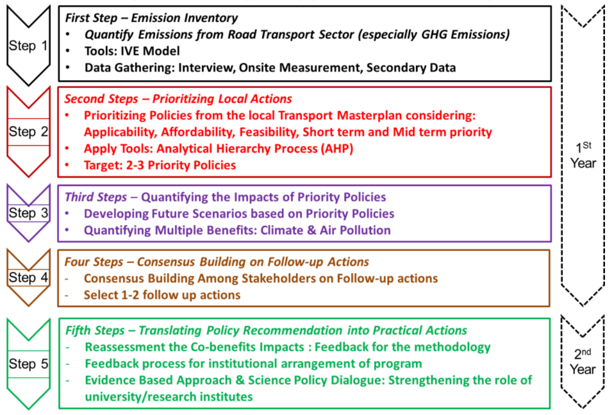


Figure 1. A Co-Benefits Approach in Five Steps

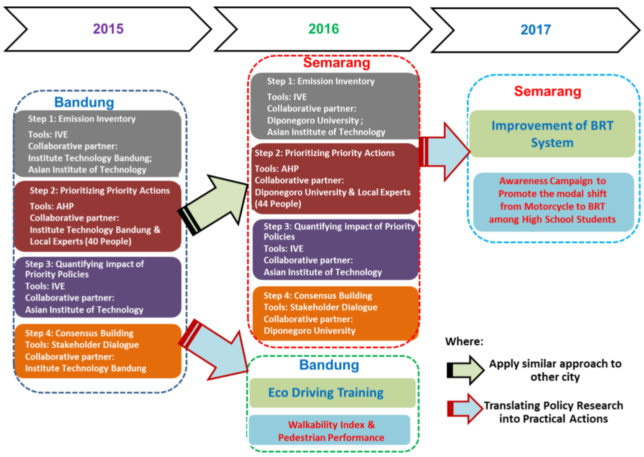


Figure 2. Implementation of the Five Steps in Indonesia

Step 1: Emission Inventory from Road Transport System

The International Vehicle Emissions (IVE) model was used to develop an emissions inventory for 15 pollutants from the road transport sector in both Bandung and Semarang. The IVE model is an open source model which was developed by the International Sustainable Research Center (ISSRC) and the University of California at Riverside (UCR). The model is designed to analyse traffic fleet and emissions from over 700 technologies of various fuel types and air/fuel control combinations.

The IVE model uses two main inputs, vehicle fleets and vehicle activity (i.e. driving behaviour), and accommodates site-specific emissions and adjustment based on the specific local context of both cities. Data was collected through a combination of primary data surveys in the two cities and neighbouring areas; and secondary data was collected through publically available sources. Outputs from the model were diverse, ranging from tailpipe emissions produce during hot-stabilised engine operations (hot running emissions), excess tailpipe emissions associated with cold engine starting (start-up emissions), and volatile organic compounds (VOC) evaporative running losses.

Bandung

Emissions for each of the 15 pollutants were defined according to their sources: passenger vehicles (PC); motorcycles (MC); public buses; taxis and paratransit. For GHG emissions, private cars were the largest contributor to CO_2 emissions and motorcycles were the largest emitter of CH_4 . For air pollution, buses emit the largest amount of particulate matter (PM) while buses, private cars and motorcycles contribute an equal share of NOx emissions in Bandung (Figure 3)

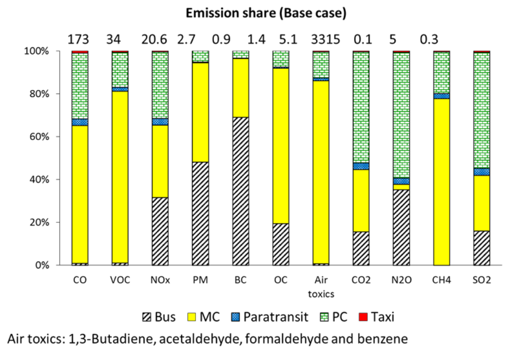


Figure 3. Emissions Inventory in Bandung (2015)

Semarang

A similar approach was applied to Semarang city in 2016. However, researchers found that motorcycles were the largest emitters for CO_2, CH_4, PM and NOx due to their large numbers in Semarang. Researchers found that the major source of GHG emissions and other air pollutant emissions were different in Bandung and Semarang due to the variation in the structure of the two cities' transport sector.

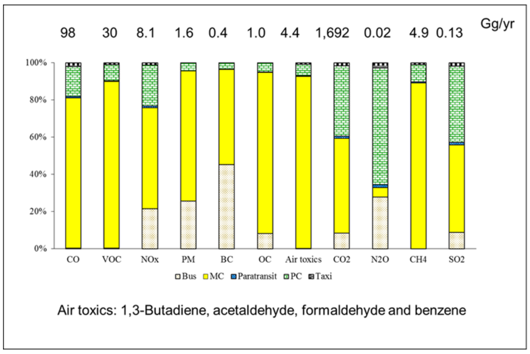


Figure 4. Emissions Inventory in Semarang (2016)

Step 2: Prioritising Local Actions

The research team applied a multi-criteria decision-making process to reflect stakeholders' priorities for improving GHG emissions and air pollutants. This approach drew upon a method known Analytical Hierarchy Process (AHP) to help local stakeholders prioritise actions based on the existing transport masterplan of Bandung city (2013) and the Urban Mobility Pillar of Semarang's Resilient Strategies (2016).

To rank the relative importance of the different policies and measures, four sets of around ten policymakers (government officers); civil society representatives; representatives from academia; and the private sector were interviewed to determine the top three possible policies and measures for the city.

Bandung

Bandung launched a masterplan for the transport sector with various policies and measures in 2013. Based on the results of the AHP, local stakeholders decided to look at the top three policies: 1) eco-driving; 2) car free days and pedestrian improvements; and 3) revitalisation of the angkot (paratransit/public transit) system (Figure 5). Based on these priorities, researchers developed scenarios: ecodriving (scenario 1); improvement of pedestrian facilities (scenario 2); and revitalisation of angkot system (scenario 3) which then were inputted into the IVE model (see previous page for description of IVE) to estimate the impacts on climate change and air pollution.

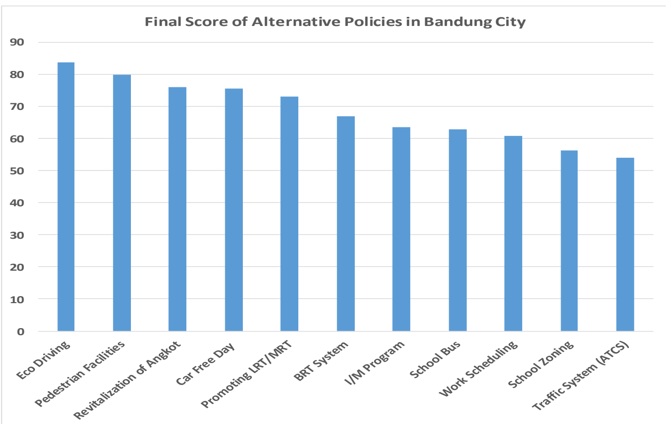


Figure 5. Priority Actions for Bandung City (2015)

Semarang

Semarang is part of the Rockefeller 100 Resilient Cities (100 RC) program. For that program, the city's developed a Resilience Strategy (2016) with components on mobility that aim to encourage residents to shift from private vehicles to public transport (BRT system). Based on the analysis from the multi-criteria decision-making process, there were three issues that should be given top priority: 1) improving inter modality; 2) universal access to transport for all citizens; and 3) pedestrian access to the public transport system (Figure 6). Drawing upon the initial results, researchers developed scenarios for a co-benefits study as follows: 1) modal shift increase riders on the BRT Trans Semarang (scenario 1); 2) changing driving behaviour (eco-driving) along the BRT corridor (scenario 2); 3) introducing low-emission vehicles for new corridors and revitalisation of old fleets in corridors 1 (scenario 3).

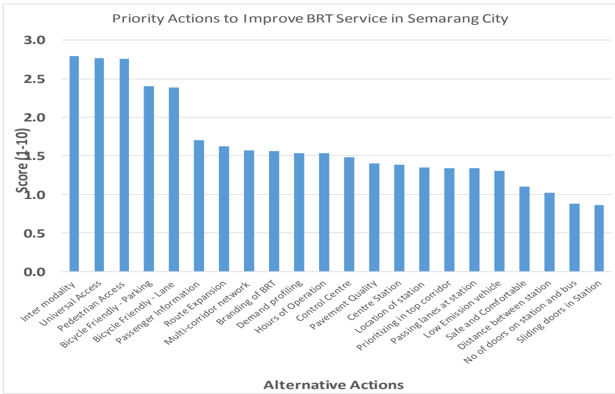


Figure 6. Priority Actions for Semarang City (2016)

Step 3: Quantifying the Impacts of Priority Policies

The three scenarios for each city were then fed into the IVE model to estimate emission reductions for different pollutants and GHGs.

The estimated results of GHG emissions and air pollution reductions from the implementation of scenarios for the three top priority actions were shown to the local stakeholders through a policy dialogue. dialogue.

Bandung

Among the three scenarios for Bandung, eco-driving (scenario 1) has the greatest potential air pollution (PM emission reductions) and climate change (CO_2 reduction) co-benefits (Figure 7). Scenario 1 (eco-driving) offered more potential benefits than other scenarios. Relatively smaller reductions were seen for scenario 2; this may be because it focused chiefly on personal cars and motorcycles in urban areas in Bandung. Scenario 3 also registered comparatively smaller reductions in pollution and GHGs as it was only applied to the small paratransit fleet. The scenarios would lead to reductions in GHGs but types of air pollutants known as short-lived climate pollutants (SLCPs) and air toxins. This result were shared with stakeholders in Bandung to help prioritise policies in the city.

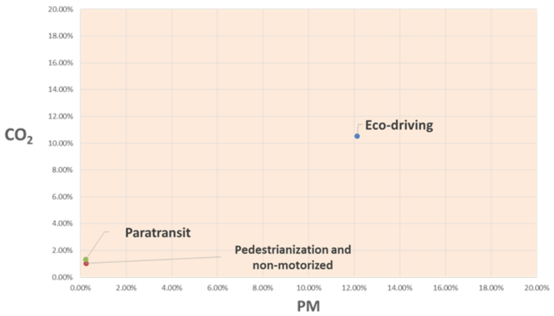


Figure 7. Co-benefits Analysis in Bandung

Semarang

Scenario 1 (modal shift from the expansion of the BRT) brought about a 3-14% reduction in emissions relative to the current BRT bus; this was only <1% of the total 2015 emissions from the bus fleet in Semarang. Scenario 1 offered considerably more emission reductions compared to other scenarios. Emission reductions from scenario 2 (eco-driving of BRT) were 16-20% of the total BRT emissions in 2015 but only 0.13-0.8% of the total bus fleet emissions. Emission reductions achieved under scenario 3 (low-emission bus for BRT fleet) were more significant, i.e. 50-99% of the current total emissions from the BRT bus fleet of corridor 1 which was 0.5-1% from the total bus fleet emissions in 2015. The latter two scenarios contributed less significantly to the total emissions because the BRT buses contributed less than 4% to the total collective emissions from passenger fleets. Under scenario 3, significant emission reductions were observed for some types while for a few others, such as for CO_2 and N2O, an increase was shown which was due to the replacement of Euro2 BRT buses by the Euro4 buses.

By introducing these scenarios, reductions were seen not only in GHG but also in the SLCPs (air toxins), meaning that overall the GWP were reduced, thus achieving co-benefits on air quality improvement and climate forcing mitigation. Notably, scenario 1 provided the highest potential for co-benefits. It is suggested that the expansion of BRT routes should be accompanied by an improved BRT system thereby attracting more users. It is also expected that more private fleet users would shift to BRT if the system were to be improved.

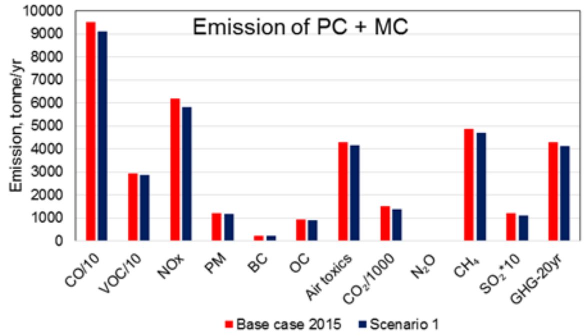


Figure 8. Co-benefits Analysis of Modal Shift due to Expansion of BRT

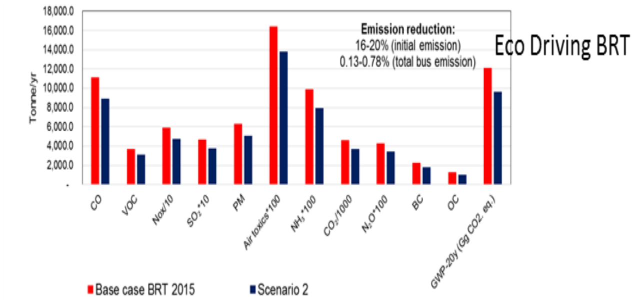


Figure 9. Co-benefits Analysis of Eco-driving of BRT Fleets

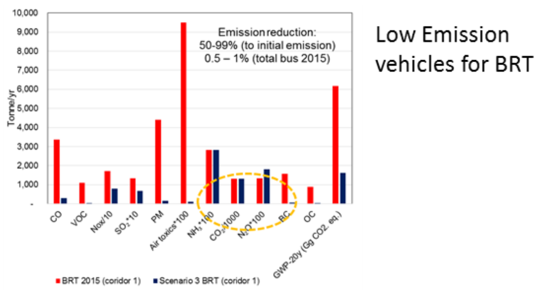


Figure 10. Co-benefits Analysis of introducing low-emissions bus for BRT

Step 4: Consensus Building on Follow-up Actions

At the end of the project, a policy dialogue was convened to share the the study's key results. The quantitative analysis gave stakeholders and policymakers insights into the benefits of simultaneously mitigating climate change and air pollution. The results were also useful to help local decision-makers to move from evidence-based research to practical actions at the city level.

Policymakers and other stakeholders play a key role in decision-making; therefore actively engaging them in several junctures of the co-benefits study was vital to the research. This continued engagement also increased the chances that policymakers would follow through with implementation of activities after the project concluded.

Bandung

Stakeholders in Bandung city agreed on the need for follow-up actions in the form of a eco-driving pliot programme and additional analysis and evaluation on the potential for expanding pedestrian zones.

Semarang

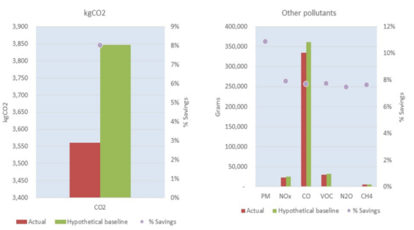
Those involved in the Semarang project agreed on the need to improve accessibility to the BRT system as well as pilots to increase the modal shift to BRT among students as the largest group of passengers of BRT in Semarang .

Step 5: Translating Policy Recommendation into Practical Action

Bandung

The pilot in Bandung was introduced to test the feasibility of building capacity for eco-driving as well as to assess the potential impacts of these activities under real-life conditions. To evaluate the impacts of the pilot, fuel consumption and vehicle kilometer data was collected before and after the training. The results showed that eco-driving can improve fuel efficiencies and save fuel (and associated costs and impacts) under actual conditions. Such results can help make a case for not only the pilot but the fuller development of a eco-driving program in Bandung. It should nonetheless be noted that a fully developed eco-driving programme will need data monitoring, provision of tools, capacity building, and other supporting mechanisms to be effective

Impact of Eco Driving Training in Bandung

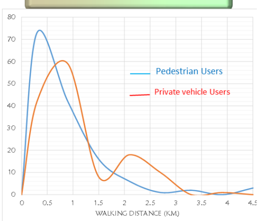


Bandung is also implementing a pedestrianisation programme called "Panca Trotoar" to provide citizens with safer, cleaner, and more visually appealing walking environments. Research on the co-benefits from this programme revealed the following important points: 1) safety and security were the most influential factors affecting the decision to walk in Bandung; 2) the decision to walk is not only determined by environmental factors but also closely related to socioeconomic status and lifestyles; 3) the attractiveness and visual appeal of pedestrian facilities received the highest score on the pedestrian index across users and non-users; 4) however, there were varying perspectives on the walkability index across different segments of society.

The microsimulation that was performed in the study shows that widening sidewalks by around 1 meter will increase traffic delays by about 5.03% and also increase average stop times of vehicles by about 1.22%. In contrast, simply widening pedestrian facilities without any other supporting programmes may reduce the pedestrian performance (average density – number of pedestrian users per m^2) by about 4.55%. A suite of policies—as opposed to any single measure—is needed to maximise the benefits of pedestrianisation. By combining the data on the acceptable walking distance and assumed influence on the shift from private vehicle to walking, the calculation reveals that the changes to pedestrian environment would yield around 1.76% drop in volatile organic compounds (VOCs) and a 1.2% drop in carbon dioxide (CO_2). These estimates are largely in line with those developed from the IVE model. In evaluating these results, it is also important to bear in mind that more significant reductions could be achieved with more significant changes to the pedestrian environment.

Changing Walking Behaviour Before & After Program

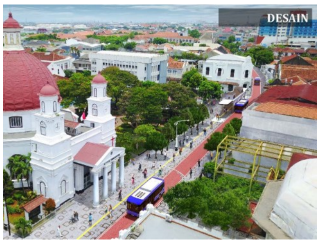
Acceptable Walking Distance User and Non-User



Semarang

In 2017, IGES is collaborating with several partners to develop guidelines for reforming the city's BRT system; to test the validity of proposed reforms (in the guidelines) on a small sample of potential riders (school children and their parents); and ultimately to increase BRT ridership. The project relies on stakeholder interviews, surveys, focus group discussions, practical pilots, and a closing workshop. The survey shows that users of BRT and other public transportation modes in Semarang are chiefly women and students. The large number of students merits careful consideration because students have a tendency to shift to private vehicles, especially motorcycles, as they get closer to 21. The flexibility and affordability of private vehicles makes it difficult for public transport to compete. Hence there is a need for BRT services to be reformed to motivate more people to shift from private to public transport.

IGES is working together with Diponegoro University (UNDIP) and the Institute for Transportation Development Policy (ITDP) to develop policy guidelines to improve the BRT system in Semarang. The guidelines are being developed through a "place making" approach. This approach could be one solution to create quality of space for residents. It relies on examining several key elements related to urban planning such as: 1) mixed-uses; 2) multiple transport options; 3) public space; 4) preservation of historic structures; 5) community engagement; 6) arts, culture and creativity; and 7) recreation.



Source: ITDP

Source: ITDP

IGES is also working with the Initiative for Urban Climate Change and Environment (IUCCE) and Save The Children (STC) to design a pilot activity that could help test/validate some of the recommendations for the BRT. In particular, these activities focus on how to make public transport safer and encourage the switch from the use of private vehicles. Rather than moving to motorcycles, the hopes are that children would have their own motivation to continue using public transport. The results of this pilot will be incorporated in the BRT guidelines. Further, to promote the participation of the young generation in the design of a future public transport system in Semarang, junior high school students were asked to develop a brief essay or illustration of what is sustainable transport system for Semarang. Two prize will be awarded to the students with the best essay or illustration.

Source: IUCCE

Source: IUCCE

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