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Tackling Air Pollution Using Public Transport – A Study from the Philippines

Particulate pollution from diesel engines is a major problem in many towns and cities around the world. In the Philippines, one of the most polluted urban locations is the central business district (CBD) of Baguio, a city located on the north of Luzon. To help highlight and address the problem, a new EEPSEA study has assessed the health costs of the air pollution in this district. It has also looked at the costs and benefits of a potential solution to this problem—an electric-powered public transport system.

The study is the work of a team led by Achilles Costales and Maria Angeles Catelo from the University of the Philippines Baguio and the University of the Philippines Los Baños, respectively. The study finds that long-term particulate pollution in the CBD is over four times the World Health Organization limits. This pollution is causing death and illness among the local residents, costing around PHP 77.4 million per annum. Meanwhile, the proposed public transport system would reduce pollution, illness, and mortality; it will also provide overall economic gains to society. It is hoped that this study will spur action to significantly reduce the air pollution concentration levels in the Baguio CBD.



A summary of EEPSEA Research Report “Clean Air In, Bad Fumes Out: An Evaluation of the Benefits and Costs of an Alternative Mode of Public Transportation System to Reduce Air Pollution in the Baguio City CBD, Philippines,” by Achilles Costales, Maria Angeles Catelo, Harvey Baldovino, Winona Bolisli, and Dorothy Bantasan.

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Baguio and its pollution problem

Baguio is popularly known as the Philippines’ “Summer Capital” and the “City of Pines.” For years, the city has had a reputation as a tourist destination, owing to its pristine pine-scented air. However, over the last two decades, the town has lost its title of the “Cleanest and Greenest” city as pollution levels have substantially risen.

Today, the Baguio Central Business District (CBD) has one of the highest air pollution concentrations in the country. Over the six-year period between 2007 to 2012, the CBD experienced an annual mean concentration of PM₁₀ of 83.2 µg per m³, more than four times the WHO air quality guideline of 20 µg per m³, and about 40% above the national standard set by the Philippine Clean Air Act of 1999 at 60 µg per m³ (Figure 1). The main source of PM₁₀ in the CBD is the 7,300 diesel-powered public utility jeepneys (PUJ) and taxi cabs that throng the area on a daily basis.

Particulate matter (PM₁₀) is a type of air pollutant made up of a complex mixture of solid and liquid particles suspended in the air (≤ 10 micrometers in diameter). It consists of chemicals such as sulfates, nitrates, ammonia, sodium chloride, black carbon, and mineral

dust. Exposure to such small particulates has been linked to illnesses such as heart disease and strokes, respiratory diseases, and lung cancer. This type of pollution has a particularly bad effect on infants, children, and the elderly.

Pollution clean-up in the CBD has been insufficient

In 2008, the local government of Baguio City enacted a Clean Air Ordinance that set out measures to regulate the flow of motor vehicles into the CBD and to reduce the pollution they emitted. Initially, this was a success; however, the levels of PM₁₀ have been rising again since 2011.

It is clear that the PM₁₀ concentration levels in the Baguio CBD cannot be substantially brought down without a radical change in the type of transport system available to the general public. Various options, including electric jeepneys, have been proposed but have not been taken up. In early 2014, the Philippine Department of Science and Technology (DOST) proposed an electric-powered Automated Guideway Transit (AGT) system for the CBD. This has been deemed to be a feasible project.

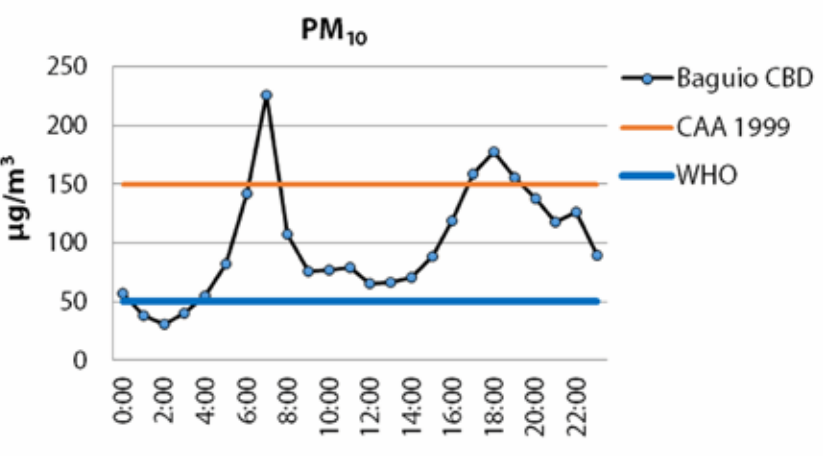


Figure 1. Mean hourly PM₁₀ levels in the Baguio CBD on 14–20 December 2012 relative to the respective standards of the Philippines CAA of 1999 and WHO

Assessing the cost of pollution and the cost and impact of the proposed AGT sytem

The study looked at the health costs that particulate air pollution is imposing on the people who live, study, and work in the CBD. It also evaluated the economic merits of the AGT public transportation system to see if it could offer a financially viable solution.

The research team used a literature review and key informant interviews to establish the link between air pollution and illness in Baguio. This research highlighted two key categories of “attributable” diseases, namely, upper respiratory tract infections (e.g., allergic rhinitis and sinusitis) and lower respiratory tract infections (e.g., chronic obstructive pulmonary diseases, asthma, and pneumonia).

The study used the cost of illness (COI) approach to value the economic burden that households bear due to (1) a household member falling ill with an air pollution-related disease and (2) a household member dying of such a disease. Direct and indirect costs of pollution-related illnesses were assessed. The direct costs included expenses for hospitalization, doctor’s fees, and medications. The indirect costs included the value of reduced activity days during which a patient was confined to a hospital or was recuperating at home. The cost of premature death was estimated using the loss of productivity approach.

Likewise, household-specific information was gathered using a random survey of 398 households living within a 1.5-kilometer radius from the Baguio CBD PM₁₀ monitoring station. Most households in this area were found to have members that are exposed on a daily basis to the high concentrations of PM₁₀ in the CBD, while at work, or while at school.

Meanwhile, the costs of building, operating, and maintaining the proposed AGT system in Baguio were obtained from DOST. The proposed AGT system would follow a four-kilometer-long circumferential route traversing the main public transport road network within the CBD (Figure 2).

The size of the potential impact of the proposed AGT system on traffic was estimated using key informant interviews with representatives of each of the 40 PUJ Operators and Drivers Associations whose routes pass through the road network that would be affected by the AGT system. To work out the impact of the AGT system on air quality in the CBD, the study estimated the number of PUJ services that it would remove and replace.

Pollution has significant effect on health

The study found that residents in the CBD were being exposed to PM₁₀ concentration levels that were bout four times the WHO air

quality guideline for PM₁₀ (this is set at 20 µg per m³). This pollution is having a significant adverse impact on the health of the exposed population.

Around 157 annual cases of premature non-traumatic adult mortality were found to be attributable to exposure to particulate pollution. This accounted for around 14% of the total number of premature non-traumatic mortalities in Baguio in 2013. In addition, particulate pollution was found to be responsible for around 4,758 cases of cardiovascular and respiratory illness per year. This accounted for about 22% of all cases of cardiovascular and respiratory morbidity in Baguio in 2013.

The aggregate direct cost of premature mortality and illness attributable to PM₁₀ exposure in Baguio City was found to be about PHP 77.37 million per year. Around PHP 53.3 million of these annual costs (69% of the total) was due to lost productivity.

The remaining 31% of costs (PHP 24.04 million per year) was attributed to the costs of hospital admission, outpatient consultations, and medication.

The cost of the AGT system

The cost of the proposed AGT system was estimated at PHP 778 million over a 10-year operating period. The bulk of this investment cost would go toward the construction and operation of the four-kilometer elevated track, 60 train coaches, 20 AGT system stations, and a depot.

The most conservative estimate of the impact of the AGT system on air quality in the CBD was that it would lower PM₁₀ levels to 60 µg/m³. In other words, investment in the AGT system would achieve at least the long-term PM₁₀ standard set out by the Philippine Clean Air Act of 1999. The study also made a more optimistic estimate that showed that the AGT system has the potential to reduce pollution to 50 µg/m³.

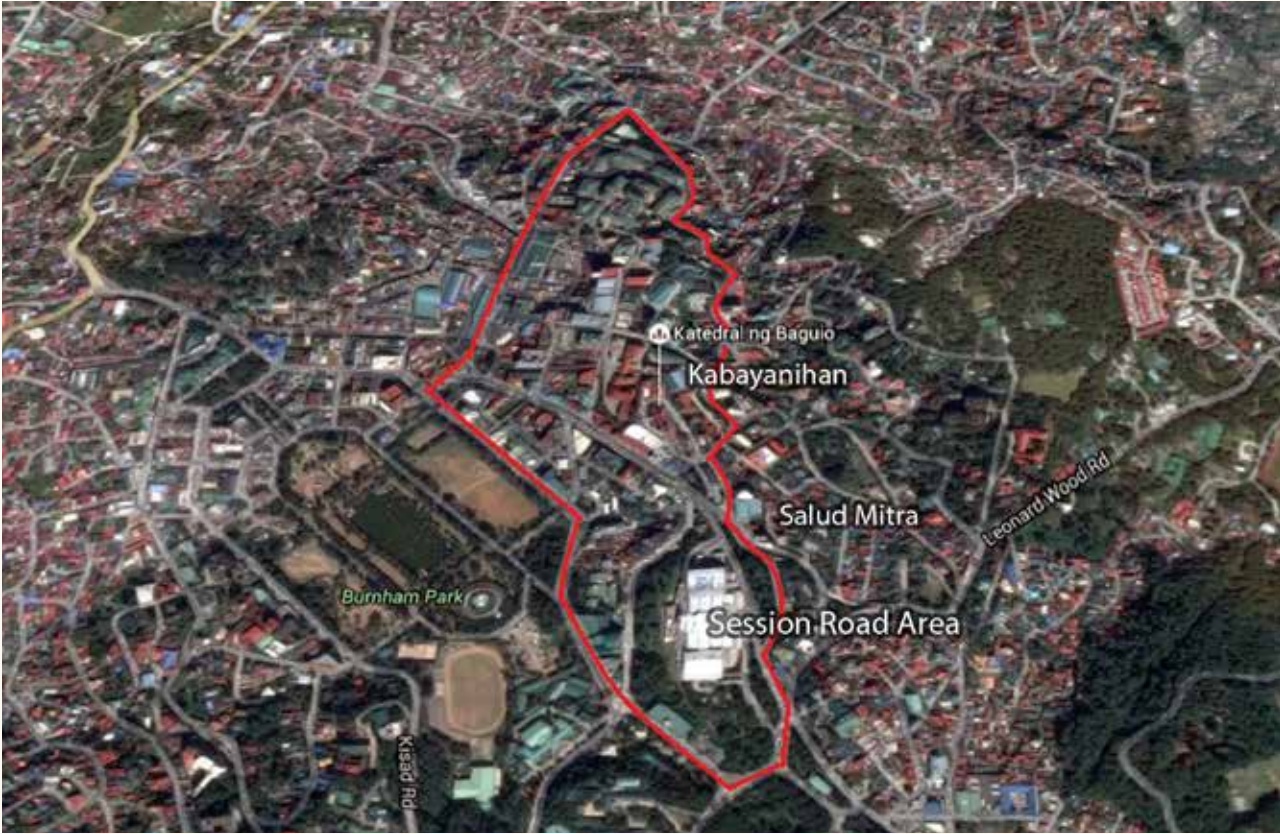


Figure 2. The Baguio CBD link of the AGTS

Table 1. Comparative NPVs and IRRs of introducing the AGT system in Baguio CBD at alternative reductions in PM₁₀ concentrations

PM ₁₀ Reduction Scenario (µg/m ³)	Net Present Value at 12% (PHP million)	Internal Rate of Return
60 (PCAA 1999)	251	19%
50 (WHO IT-2)	238	18%

Lowering the PM₁₀ concentration levels in the Baguio CBD to the more conservative level (60 µg/m³) would result in reducing the attributable cases of premature non-traumatic mortality by about 40%, and attributable cases of cardiovascular and respiratory illnesses by about 47%. This would significantly reduce COI due to the current PM₁₀ pollution in the Baguio CBD.

The AGT system makes economic sense

The most conservative estimate of the impact of the AGT system on pollution and illness was used in the cost-benefit analysis of the proposed system. This found that for a 10-year operation period the net present value (NPV) of the system (using a 12% discount rate) would be PHP 250.8 million, with a respectable internal rate of return (IRR) of 19% (Table 1). It is therefore clear that the proposed AGT system is economically viable, as it has a positive value for its NPV and an IRR above the assumed opportunity cost of funds. In other words, the proposed investment would generate substantial positive social benefits.

The AGT system could have an even greater positive impact

The actual impact of the AGT system would actually be higher than that calculated as many of its benefits were not included in the cost-benefit analysis. These benefits include (1) the convenience and comfort of riding the air-conditioned coaches instead of smog-filled open PUJ motor vehicles; (2) lower public health expenditures in public hospital and public health centers for the treatment of air pollution-related morbidity and mortality cases; and (3) the value of improving the reputation and image of Baguio as a tourist destination.

In addition, if the more optimistic reduction in PM₁₀ would be achieved, the estimated net benefit that the AGT system would provide to society as a whole would be even higher. Likewise, the net social benefits would even be much higher if a social discount rate of 6% was used instead of the 12% discount rate adopted in the study. This would be the case if the AGT system were funded using public funds.

Overall, on economic efficiency grounds, it is worthwhile for the Baguio City local government and its residents to pursue and support this novel proposal.

More research necessary

A new Continuous Air Monitoring System at the Baguio City Burnham Park area is now generating real data on PM_{2.5}. As a result, the long-term mean value of PM_{2.5} exposure of the population could soon be determined (PM_{2.5} is particulate pollution with a smaller diameter than PM₁₀). It is recommended that this new information should be used to obtain new estimates of attributable cases of mortality and morbidity, as this will provide a more accurate impact assessment.

Although the study focused on analyzing the impact of the proposed AGT system only, there could be a number of other complementary policy and investment measures that could help bring down the PM₁₀ concentration levels in the Baguio CBD. It is recommended that such measures should be highlighted and their feasibility studied.

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