

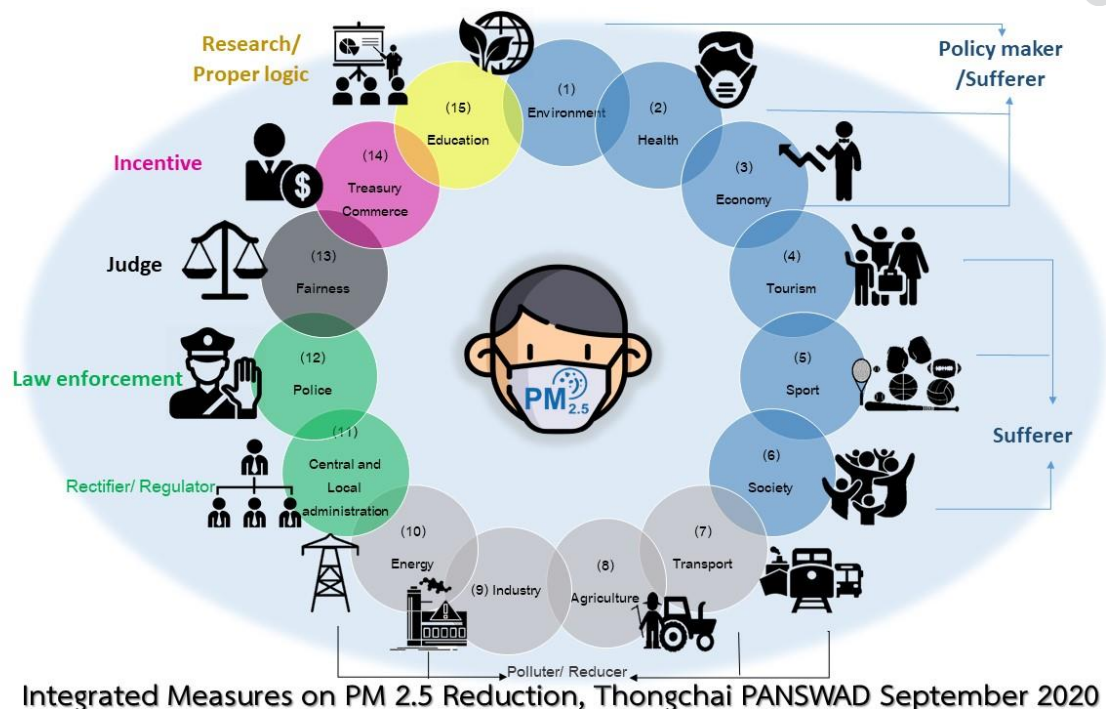
What exactly must be done to effectively solve PM2.5 situations in Thailand

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Fine inhalable particles or PM2.5 are particulate matters with a diameter of 2.5 micrometers or less. Typically, these particles are so small and can only be seen with an electron microscope. Though invisible-particle problems have blanketed Thai citizens for more than 20 years, PM2.5 have only taken the spotlight of Thai society, especially those staying in Bangkok, within the last three years. After being pressured by social netizens, the government's recommended policies and measures were issued. The authorities, however, unfortunately carry out the operations only during or after the problems occur. The inspiring and integrating solutions, on the other hand, must be done throughout the year, rather than for one season only.

It is noted that the proposed measures have been insufficiently deployed and speedy action as well as cooperation are urgently needed. Moreover, some ineffective measures which hardly reduce PM2.5 such as open-air filtration, water spraying on the roof top or from the ground or via drone (Unmanned Aerial Vehicle: UAV), should be ended and more effective measures are preferably required.

It is also noteworthy that the existing attempts to reduce the ambient PM2.5 are principally and merely those of engineering techniques. Practically, these procedures must be jointly considered together with many other key aspects such as economic, social, and health issues. The solutions will then be thoughtful, realistic and effective. The authors have identified correlated groups of different functions and responsibility who together as a team can mitigate the problems, as displayed in the figure below. The suggested players can be 1) sufferer, 2) polluter, 3) rectifier, 4) law enforcement group, 5) incentive provider, 6) researcher, 7) policy maker, and 8) public sector.



Sufferer

Many sectors are currently suffering from the invisible PM_{2.5} particles. They are (1) **Environmental** deterioration (sequencing number shown in the figure). PM_{2.5} has become a major component of air pollution which is worsening the environment. Noxious air pollution can cause breathing difficulty, respiratory problems and heart disease, respectively. These consequently affect (2) **Health** issue in which the Thai government has to pay increasingly higher medical expenses each year. Moreover, an unhealthy population with chronic respiratory problems would be ineffectively and inefficiently productive. As a result, that continuously disturbs (3) **Economic** sector with less productive labor force, hence the economy cannot consequently compete with other countries. The GDP (Gross Domestic Product) then declines. Furthermore, the level of PM_{2.5} exceeding the clean air standard would also upset (4) **Tourism**. Since travel industry is one of the country's major income sources, poor air quality will negatively affect the economy because foreign tourists are reluctant to visit Thailand. They of course will prefer to understandably travel to another cleaner air country. Besides, (5) **Sports activity and business** would also be conversely affected. With dirty air, Thai athletes are unable to fully practice and their lung as well as aerobic capacities would be lowered. Obviously, they would hardly achieve their goals in competition at any international level, thereby reducing Thailand's reputation on sports

capability. This in turn lessens Thai credibility, resulting in less bargaining power in international affairs.

The undesirable effects of PM2.5 on the environment, health and economy would lead to a social situation where inequality is more prominent and Thai society being mocked locally as (6) a **Society** of "Ignorance, Poverty, Sickness"¹. This is definitely not good for anyone, no matter what aspect of it. We are therefore left with no alternative but to come together and find a way to reduce or solve this problem as quickly as possible.

Polluter

Up to now (December, 2020), most Thai people are aware of PM2.5 through the media, that this tiny dust most probably comes from three major sources, i.e., (7) **Transportation**, (8) **Agricultural burning** and (9) **Industrial factories**. Additional sources are **haze**, dispersed from other locations (such as from the metropolitan areas of Bangkok, from Indonesia to the Southern part of Thailand, from Cambodia to the eastern part of Thailand), and those from (10) **Energy** production.

Polluter responsibility

Those who cause the problems are obviously the ones who should take the responsibility. The best way of air quality management is definitely to straightforwardly tackle the problem at the source. Although a "National roadmap to solve particulate matter pollution" has been released for in-crisis, midterm and long term operations, they are only technical issues and are not sufficient. Other subjects described below have to be addressed as well.

Rectifier/ Regulator/ Law enforcement agency/ Judge

Apart from the national policy management organization such as Thai Cabinet, National Environment Board, National Economic and Social Development Council, the local agencies closest to the problems are (11) the **Local Administration Organization (LAO)** under the

¹*It's a vicious cycle of the ignorance of basic precautions which leaves so many poor people exposed to infection. The biggest enemy of health in the developing world is poverty, and the struggle for health is part and parcel of the struggle for development.*

Ministry of Interior, including Bangkok and Pattaya. These agencies must be the main host for the local consultation and coordination and come up with various productive measures to enforce within their own jurisdiction. The LAO has the role and responsibility to study the cause of their problems, how to solve them, and what appropriate measures should be taken. Effective protocols should be done urgently without wasting time on unnecessities. More importantly, they should believe in accurate scientific data (as successfully done in the case of the COVID-19 outbreak) accumulated by the academic sector (No. 15). However, they must work in conjunction with the (12) **Royal Thai Police (RTP)** which is the first hand law enforcement agency especially in traffic matters and emissions from various sources. Frankly, the outcome of this party is not satisfactory so far. Cabinet determination and social pressures are required (this activity is likely the one that, in the context of today's Thai society, can make those measures be implemented sooner) as well as (13) the judgement of the **Court** to fairly and swiftly endorse the law enforcement.

Incentive Provider

There are two other additional measures that are likely to be taken to deal with PM2.5. They are (14) **Fiscal and Commercial** measures (this does not refer to only work in these two ministries) such as (i) the curtailment of import tax for PM2.5-reducing equipment which cannot yet be manufactured in Thailand, (ii) tax incentives to industry sectors to encourage them to produce batteries and/or electrical vehicles (road, rail, and waterway) at a price competitive to imported items, (iii) financial support to the public sector, especially local farmers to create tools and harvesting equipment using their own appropriate technology, and enable them to have their equipment replaced and repaired at lower expense.

These measures are soft power that can make a lot of change. The government has to think in theoretical "**Loss is Gain**" form, meaning that one will have to lose some of one's income now in order not to incur huge expenses related to the environment, health and social problems in the future.

Researcher

The 14 aspects explained earlier are undoubtedly interrelated. However, it is far too complex for any individual to completely comprehend. It should hence have (15) **Academic** unit including thinkers, technologists, social scientists, lawyers, economists, environmentalists,

public health workers, administrators, etc. to share their view points and take issues at least from the above (1) to (14) items for integration, not just emphasizing engineering measures as previously done. It shall then be subdivided into smaller projects, for researchers from different universities, institutes, departments, etc. to separately but collectively conduct research until they obtain enough information to be summed up together. After that, such information and recommendation should be setup as policies, plans, and measures, including standards for the relevant ministries and local authorities, to put these into practical action.

In addition, a course curriculum on this subject should be developed at high school and under graduate student level. This will help them to have a better understanding of sustainable development that the environmental, social and economic dimensions jointly form. This is to create greater public acceptance and cooperation, especially with future generations.

Policy maker

Based on the conclusions drawn from the research and synthesis to the recommendations already mentioned above, it is now the mandate of the policy sector. They should start with the upper tier Cabinet, the National Environment Board (NEB), the National Economic and Social Development Council (NESDC), the Energy Regulatory Commission (ERC) then continue to the middle level such as the Ministry of Natural Resources and Environment, Ministry of Transport, Ministry of Industry, Ministry of Public Health, Ministry of Agriculture and Cooperatives. Their jobs are to apply the recommendations turning them into national and operational policies, plans and requirements including strict regulating and monitoring of those plans. The thoughtful logic of "**Loss is Gain**" should be again emphasized as the basis of policy making.

Public sector

All of the above is a 360-degree assessment in a "top-down" route, with reference to knowledge and experts in different fields to thoughtfully formulate a plan to be implemented by the private sector and governmental units. Yet that would yield only half of the result, the other half has to originate from us, the people. We have to work together through participation to reduce this problem in a "bottom-up" style, such as social pressure to discourage everybody from open burning, the factory must exercise the EPR (Extended

Producer Responsibility) and be self-stringent not to release exhaust air over standards, and as commuters, we also could be half of the solution by using public transport, walking, or cycling as a feeder system to road, rail, or water way mass transit systems.

All this is not for just anyone, but for ourselves, our beloved children and our parents, as well as our grandparents who are at higher risk of PM2.5. We, in this context, are **the Four Parties** comprising of government official, academia, private sector, and the people themselves.
