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The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 10 member countries: Cambodia, China, Indonesia, Laos, Malaysia, Papua New Guinea, the Philippines, Sri Lanka, Thailand, and Viet Nam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to policymakers.

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Pollution Clean Up At What Prise?: A Cost-Benefit Study From Thailand

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Across Southeast Asia, there has been a massive increase in electricity consumption over the last decade. This trend looks set to continue as industry develops and the region's population rises. Although renewable sources of energy production such as wind and solar have a role in supplying the region's electricity, large-scale →

A summary of EEPSEA research report 2006-RR4, *Costs and Benefits of Flue Gas Desulfurization for Pollution Control at the Mae Moh Power Plant, Thailand* by Varaporn Punyawadee, Ratana Phothisuwan, Numpet Winichakule, and Kanitta Satienerakul - Faculty of Economics, Maejo University, Chiang Mai, 50290, Thailand. Email: nong@mju.ac.th

“Reducing emissions to 5% ...

→ fossil-fuel-fired power stations will provide the bulk of the region's power needs for the foreseeable future. Such power stations can have massive environmental and social impacts. The need for cost-effective pollution control technologies and approaches for such plants is therefore vital.

A new study from Thailand (where energy use has gone up by 70% in the last ten years) highlights this in a compelling way. It looked at the costs and benefits of pollution clean up at one of the country's most important power stations. It found that the pollution cleanup systems at the plant were not cost-effective – in other words they were an economic burden, rather than benefit, to society. While the study acknowledges that the pollution clean up has had many positive benefits, it argues that cheaper options could have been considered. It concludes by advising that careful environmental cost-benefit analysis must be central to any decision-making process linked to pollution control policy and electricity generation.

Before And After

The study assessed the economic effectiveness of the investment in pollution clean-up technology at the Mae Moh power plant, in the northern region of Thailand. This plant was an excellent candidate for such an investigation as it provided a text-book 'before and after' case study of one of the most important types of pollution abatement technologies – flue-gas desulfurization (FGD). The Mae Moh power plant, with its 2,625

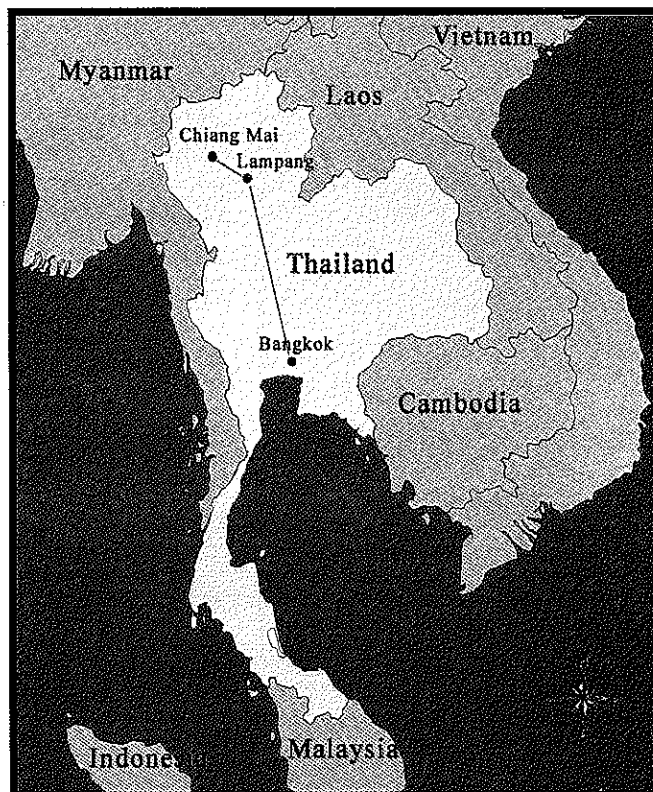
megawatt (MW) installation capacity, is the largest thermal lignite-fired power plant in Thailand and in Southeast Asia and meets about 18 per cent of the national power demand. Approximately 17.5 million tons of lignite, is supplied to the generating units annually when they operate at full capacity.

Before emission controls were fitted to this power station, it emitted over 500,000 tons of sulfur dioxide annually when operating at full capacity. This led to levels of ambient sulfur dioxide (SO₂) concentration in surrounding areas over four times the Thai national pollution control standard. This caused many people near the power plant to suffer from respiratory problems such as coughs

and asthmatic attacks. The pollution also damaged crops, trees and livestock – the leaves of many trees withered and dropped overnight. In response to public pressure, FGD systems were fitted to the plant's power generation units between 1994 and 2000. These now absorb 92–97% of SO₂ prior to discharge into the atmosphere. Since the strict implementation of FGD technology, sulfur dioxide emissions have been controlled at rates far below the levels demanded by environmental legislation and local air quality has improved significantly.

Costs And Benefits

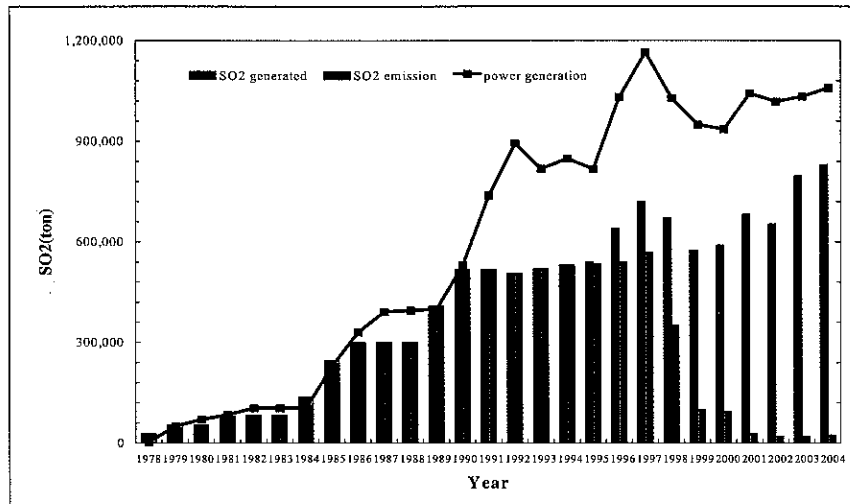
The study was carried out by Varaporn Punyawadee and her team from the Faculty of Economics at



Map of Thailand, showing the location of Lampang

was bound to be costly”

Sulfur dioxide generated and emitted from the Mae Moh Power Plant



Maejo University, Chiang Mai. The researchers identified and valued the costs and benefits of the FGD equipment installed at Mae Moh. The direct benefits they looked at included the impact the systems had on human health and on agricultural and forest productivity in the area surrounding the plant. Gypsum is produced as by-product of the FGD process and the value of this was also assessed. The costs the team looked into included the direct costs of the FGD systems and their operating, maintenance and input costs (e.g., limestone, energy, raw and processed water, etc.). The indirect costs associated with the carbon dioxide emissions produced by the FGD process (which contribute to global warming) were also investigated.

To determine the impact of pollution from the power plant, it was necessary to find out how big an area was affected and how many people lived in this zone. The larger the area, the greater the values of potential damages. An investigation of meteorological data showed just

how concentrations of ambient SO₂ were affected by the area's geography and climate. In light of this research, the impact of pollution on health and agricultural productivity was limited to the local districts of Mae Moh and Mae Tha. The impact on timber and non-timber products was considered for a wider region encompassing the three provinces of Lampang, Phrae and Phayao. To calculate the costs and benefits of the FGD system it was assumed that it would have a lifespan of twenty-five years.

The Benefits Of Avoiding Pollution

The study's assessment of the value of health improvements produced by FGD drew on results of a recent study from the College of Public Health at Chulalongkorn University. This estimated the short-term and long-term effects of air pollution from the Mae Moh power plant on children and adults living in Mae Moh District. Health problems assessed included coughs, chronic coughs, phlegm, chronic phlegm, wheezing, asthma and bronchitis. Using the

results of this study and actual pollution records, the health impacts of annual ambient sulfur dioxide levels were calculated. This was done for the periods before and after FGD had been installed at the power station. The financial costs of these health impacts were then calculated by investigating related medical costs and the value of the work and leisure time lost by the people who got ill. The other main benefit assessed – the production of gypsum by the FGD equipment – was valued at its commercial price.

Impacts on agriculture and non-timber forest products were assessed using 'dose response functions' calculated by the Organisation for Economic Co-operation and Development (OECD). These set out the relationship between pollution exposure and productivity loss. These functions made it possible to work out how the improvements in air quality produced by FGD had improved the productivity of local farms and forests. Changes in the productivity of teak forest plantations were assessed using the Forest Industrial Organization's database. The value of the impact of the carbon dioxide produced by the FGD equipment was estimated by calculating how much tax would have to be paid under an 'optimal' carbon tax system. The level of tax was taken from a previous study, which calculated the amount that would have to be levied to effectively control carbon dioxide emissions. The value of all the benefits (and costs) associated with the FGD systems were calculated for the twenty-five year

lifespan of the pollution cleanup technology.

Was It Worth It?

It was found that the costs associated with the installation of FGDs at the Mae Moh power plant significantly exceeded the benefits that this pollution clean up could produce over its twenty-five year lifespan. Specifically, the present value of benefits (calculated in 1994 prices) was calculated at approximately 4,700 million baht. This is about a third of the present value of total costs, which were calculated at about 13,800 million baht. From a benefit-cost perspective, this is obviously a disappointing result as the costs incurred outweigh the benefits.

The initial capital costs of setting up the FGD equipment accounted for about half of the total FGD abatement costs, while the operation and input costs made up 15% and 27% of the total, respectively. Carbon dioxide emissions from the FGD equipment amounted to about 7% of the total costs.

Of the benefits linked to the installation of the FGD technology, health impacts accounted for almost

80%. The increase in forest productivity contributed about 18%, while benefits associated with agriculture and gypsum made up the rest.

Some Qualifications

The study's main conclusion is not surprising, given the degree of pollution reduction provided by FGD. Reducing emissions to less than 5% of their previous level - to the point that air quality standards were substantially exceeded - was bound to be costly. A smaller reduction might have been more affordable while providing an acceptable level of air quality. Or cheaper options, such as dry FGD, could have been considered.

On the other hand, the study did not include all the possible benefits of air quality improvement. For example, the risk of premature mortality was not taken into account because of a lack of scientific evidence that it is linked to exposure to ambient SO₂ concentrations. If this factor had been included, it is possible that the FGD investment would be justified.

Furthermore, while the analysis

shows that society paid too much for pollution reduction, the decision may well have been rational from the firm's point of view. Given the level of compensation payments provided to local people who suffered illnesses or crop losses, pollution prevention through FGD would probably have been cheaper than continued compensation payments.

Installing FGD at Mae Moh has also helped establish public trust in the Mae Moh power plant. And even with expensive FGD technology at the lignite-fired power plant, the cost of the electricity it produces is still cheap, compared with electricity from natural gas or fuel oil.

The overall lesson from Mae Moh is that cost-benefit analysis should play a greater role in choosing environmental protection measures for future electricity development projects.

38 Baht = 1 USD (September 2006)

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