CENTER FOR ENERGY, ECOLOGY, AND DEVELOPMENT

POLICY BRIEF ON

VOLCANIC ASH, COAL ASH, AND AIR QUALITY AND EMISSION STANDARDS IN THE PHILIPPINES

February 2020

Following the recent phreatic eruption of the Taal Volcano which led to the displacement of more than 20,000 families,[i] there has been growing concerns on the harmful impacts of volcanic ash to public health. This has also l ed to greater awareness of another toxic and polluted emission from which many communities have long been suffering–coal ash.

This policy brief takes a comparative look at the harmful impacts of volcanic ash and coal ash, the country's existing guidelines and standards on ambient air quality and emissions of stationary sources, and the system for monitoring compliance.

A comparative look at the harmful impacts of volcanic ash and coal ash

Table 1. Physical and chemical characteristics of volcanic ash and coal ash[ii]

Particle Size	Volcanic Ash	Coal Ash
Size Distribution	<2 mm[iii]	<0.045 mm (45 micron)[iv]
Density	700-3200 kg/m^3([v])	1120-1500 kg/m^3([vi])

Ash Components	Volcanic Ash		Coal Ash	
Material components	Quartz Feldspar *Micas*	*Amphiboles* *Olivine* *Clinopyroxene*[vii]	Quartz Feldspar *Shale* *Clays*	*Aluminosilicate glass* *Unburned Carbon*[viii]
Chemical components	Silica; Aluminum; Potassium; Sodium; Calcium; Magnesium;	Iron; Sulfur; *Chloride;* *Fluoride;* *Sulfide*.[ix]	Silica Aluminum Potassium Sodium Calcium Magnesium Iron Sulfur *Phosphorous* *Chromium*	*Nickel* *Zinc* *Arsenic* *Selenium* *Cadmium* *Antimony* *Mercury* *Lead* *Uranium*[x]
Notable By-products	Carbon Dioxide Sulfur Dioxide *Hydrochloric acid*	*Hydrofluoric acid* *Sulfuric Acid*.[xi]	Carbon Dioxide Sulfur Dioxide *Trace Heavy Metals*	*Nitrogen Oxide*[xii]

Prolonged exposure to the harmful components volcanic and coal ash can increase the risk of developing severe illnesses. The severity of health impacts is highly dependent on existing health conditions and level of exposure. Children and the elderly are more prone to health impacts without proper precautions.

Compared to volcanic activities, coal emissions have a higher potential to cause harmful impacts to public health since it has a broader range of possibly harmful components and at a higher concentration. It also impacts a larger portion of the population since the country has significant coal power plant operations with 28 existing coal power plants and 27 more in the pipeline. On the other hand, volcanic activity is rare, with emissions occurring on rare occasions.

Table 2. Summary of harmful impacts

Ash Components	Volcanic activities	Coal power plant operations
Trace heavy metals Trace heavy metals are metallic elements that are deemed toxic even at low concentrations.	Volcanic activities emit heavy metals such as Iron, but are less varied compared to coal power plant operations. Presence and concentration of some of these elements vary depending on the location, source material, and type of volcanic activity.	Coal power plant operations emit an even wider range of elements and compounds, with the addition of more trace heavy metals such as Arsenic, Mercury, and Lead that are harmful to human and ecological health even in very small amounts. Toxicity from trace heavy metals can accumulate within the body. Presence of radioactive metals in coal ash can also result to the development of lung cancer.
Notable by-products Notable by-products are incidental or secondary products that are worth stressing.	Notable by-products include the presence of Hydrochloric acid, Hydrofluoric acid, and Sulfur Dioxide, an intermediate to Sulfuric Acid. These can react further to form Acid rain, a corrosive solution that is harmful to humans and ecological health.	Notable by-products include the presence of trace heavy metals and some radioactive elements. Even in trace amounts, these metals can be harmful and they can accumulate to dangerous amounts. Nitrogen Dioxide and Sulfur Dioxide are also produced. These can react to form smog and acid rain.
Silica A compound most commonly found in the Earth's crust.	Inhalation of volcanic ash can irritate the upper airways as well as worsen pre-existing asthma and bronchitis among others. Risks are only high during volcanic activity.	Inhalation of coal ash can also irritate the upper airways as well as worsen pre-existing asthma and bronchitis among others. Developing chronic Silicosis is more common. The risks are higher due to continuous operations by several coal plants throughout the year.

	The risk of developing Silicosis is also present due to the presence of Silica.	
Carbon dioxide (CO_2) emission CO_2 is a greenhouse gas, which is the primary driver of climate change.	CO_2 emissions from global volcanic activities, even when consolidated, pale in comparison to CO_2 emissions from coal power generation.	Human activities combined *in just 2.9 days* can have the same level of emissions of volcanic activity *in a year*.[xiii] It requires a little over 2% of the world's coal power generation to match the CO_2 emissions of global volcanic activities.[xiv]

Outdated Ambient Air Quality Guideline Values and Standards and Emission Standards

Air quality in affected areas following the Taal Volcano eruption is being monitored based on the existing Air Quality Guideline Values and Standards[xv]. On the other hand, coal power plants are classified as "stationary sources" under the Philippine Clean Air Act. In addition to the monitoring of ambient air quality in their operational areas, coal plants' emissions must also comply with the Emission Standards for Stationary Sources[xvi].

Except for particulate matter, these Guideline and Standards have not been updated by the Department of Environment and Natural Resources (DENR) through the Environmental Management Bureau (EMB) since the Philippine Clean Air Act took effect in 1999. It is important that these are routinely updated to reflect the most recent scientific understanding of how air pollution affects human health. The more than two decade-old Guideline and Standards are way below the standards of the United States Environmental Protection Agency (US EPA) and the World Health Organization (WHO), and merit urgent review and updating.

Table 3. Comparison of Ambient Air Quality Standards

Pollutants	**EMB**	**US EPA[xvii]**	**WHO[xviii]**
Particulate Matter 2.5 (PM 2.5)	75 µg/m3 24-hour mean	35 µg/m3 24-hour mean	25 µg/m3 24-hour mean
	35 µg/m3 annual mean	12 µg/m3 annual mean	10 µg/m3 annual mean
Lead	1.5 µg/m3 three-month mean	0.15 µg/m3 three-month mean	
	1.0 µg/m3 annual mean		0.5 µg/m3 annual mean
Sulfur Dioxide (SO_2)	70 ppb 24-hour mean	75 ppb 1-hour mean	7.63 ppb 24-hour mean
Nitrogen Dioxide (NO_2)	80 ppb 24-hour mean	100 ppb 1-hour mean	187.5 ppb 1-hour mean

Figure 1. Comparison of PM 2.5 Ambient Air Quality Standards

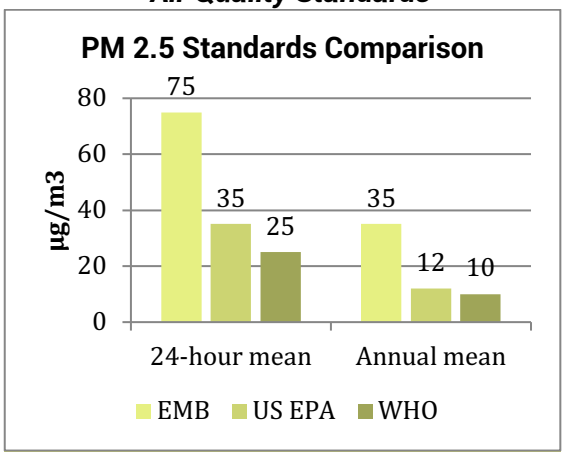
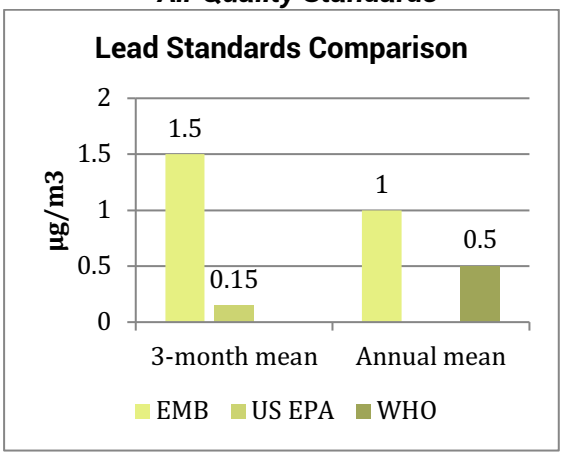


Figure 2. Comparison of Lead Ambient Air Quality Standards



Under EMB's standards (75 µg/m3), there can be twice as much PM 2.5 present in the ambient air than what the US EPA considers safe (35 µg/m3), and thrice as much than what the WHO considers safe (25 µg/m3). The EMB has worse standards for lead, allowing 10 times more lead in the ambient air (1.5 µg/m3) than what the US EPA considers safe (0.15 µg/m3).

Table 4. Comparison of Emission Standards for Coal-fired Power Plants

Pollutants	EMB[xix] (mg/Nm3)	US EPA[xx] (mg/Nm3)[xxi]	World Bank[xxii] (mg/Nm3)
Particulate Matter (PM)	150	8	50
Sulfur Dioxide (SO_2)	700	65	900-1,500[1]
Nitrogen Dioxide (NO_2)	100		510

Figure 3. Comparison of PM Emission Standards

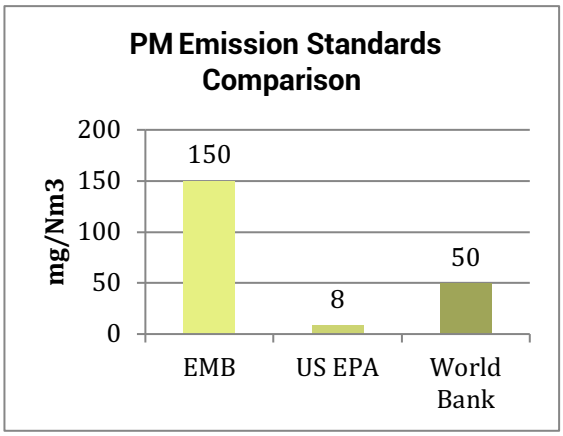
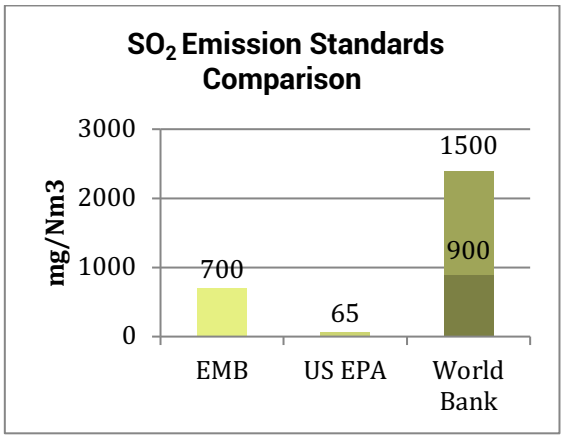


Figure 4. Comparison of SO_2 Emission Standards



[1] Targeting the lower guidelines values and recognizing issues related to quality of available fuel, cost effectiveness of controls on smaller units, and the potential for higher energy conversion efficiencies.

Box 1. Sample Scenarios for Monitoring of Sulfur Dioxide

As for SO_2 and NO_2, the EMB, US EPA, and WHO use different sampling methodologies. The EMB uses a 24-hour mean sampling methodology, where measurements are taken on an hourly basis then averaged after 24 hours. Meanwhile, the US EPA and WHO (except for SO_2) use a 1-hour mean methodology, where measurements are taken more than once every hour then averaged every hour.

Figures 5 and 6 show the implications of different sampling methodologies through sample scenarios of monitoring of Sulfur Dioxide by the EMB and US EPA.

Figure 5. Sample EMB Ambient Air Quality Monitoring of Sulfur Dioxide (24-hour mean)

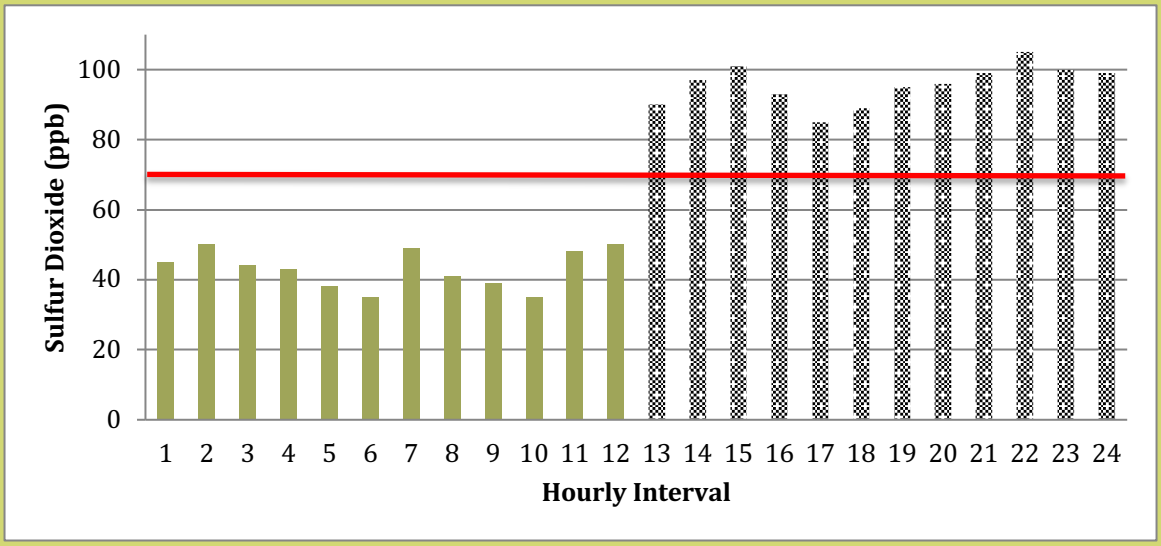


Figure 6. Sample US EPA Ambient Air Quality Monitoring of Sulfur Dioxide (1-hour mean)

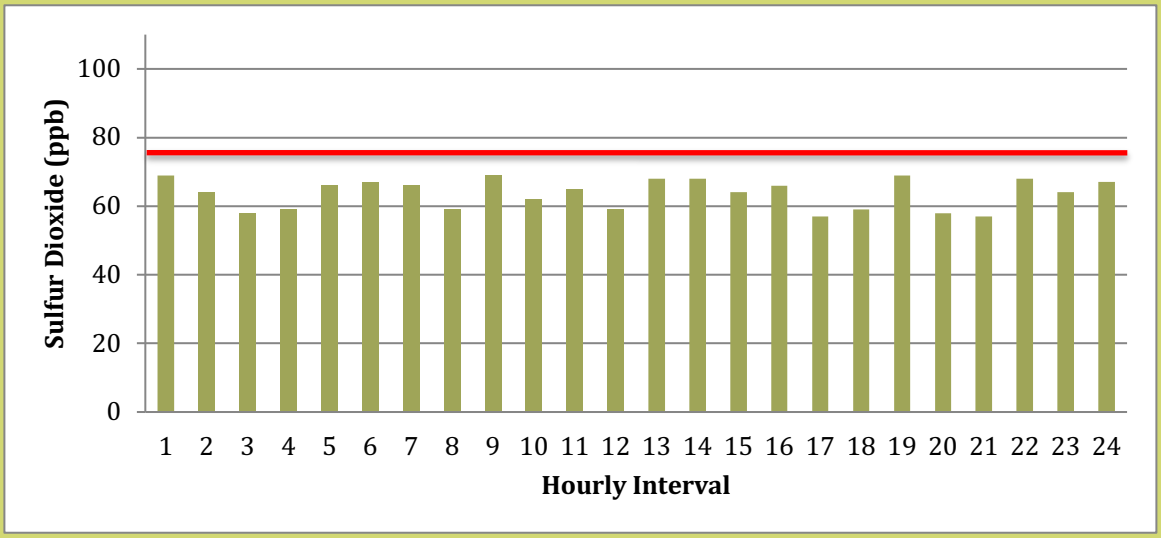


Figure 5 shows a sample scenario using EMB's 24-hour mean sampling methodology for SO_2, where on hours 13-24, or for 12 hours in a day, SO_2 in the ambient air measured well beyond the

EMB standards (70 ppb). However, when averaged after 24 hours, SO_2 still rounded-up to 69 ppb, well within EMB standards.

In comparison, Figure 6 shows a sampling scenario using US EPA's 1-hour mean methodology, where the average presence of SO_2 in every hour of the day has to be within the limits of 75 ppb.

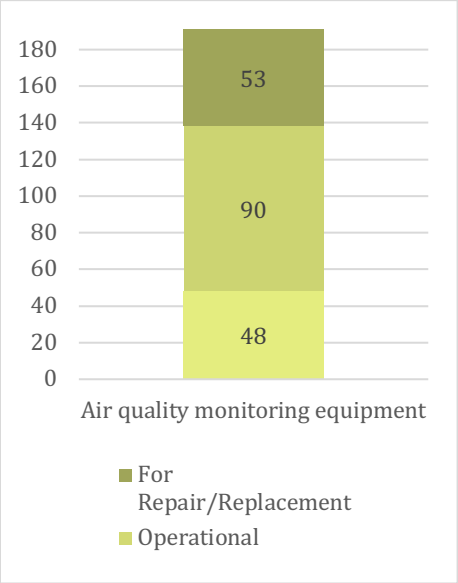
In EMB's methodology, communities can be exposed to harmful concentrations of SO_2 for extended periods of time in a day, and ambient air quality can still be deemed compliant to current standards. If a more stringent 1-hour mean standard is used, communities will not be exposed to high concentration of pollutants for extended periods of time.

It should also be noted that current Guidelines and Standards do not include all possible harmful emissions from coal power plants such as Iron, Chromium, and Uranium, which can have detrimental impacts on human health and ecology once they accumulate.

Broken and uncalibrated air quality monitoring equipment

The strict monitoring of air quality is also a cause of concern. According to the EMB's latest Status of Air Quality Monitoring Equipment Nationwide, only a quarter of its air quality monitoring equipment nationwide is functional. The rest, over 143 equipment, are either "operational" only (has not been calibrated) or are due for repair/replacement. Some of these equipment are located in regions with existing coal power plants such as Regions 3, 4A, and 7.[xxiii]

Figure 7. Status of Monitoring Equipment Nationwide



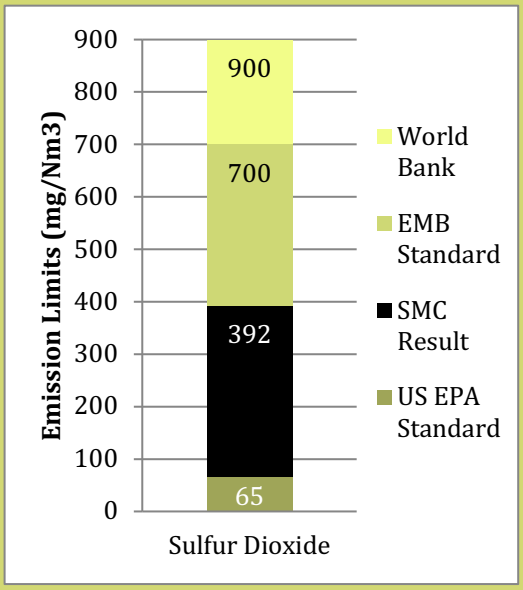
Unvalidated self-monitoring emissions reports

In terms of monitoring emission charges, the responsibility of demonstrating compliance with Emission Standards lies mainly on the coal plant proponents, which are mandated to install their own emissions monitoring devices and to submit quarterly self-monitoring reports of their emission rates among other compliance requirements The DENR is simply required to evaluate the quarterly self-monitoring reports for completeness and conformance as required in the DENR's Procedural and Reference Manual for DAO 2003-27.[xxiv]

There is currently no system that ensures that these emissions monitoring devices have been installed properly and are functioning and well-calibrated; and that the submitted self-monitoring reports are accurate. In fact, the DENR's Procedural and Reference Manual states that **"self-monitoring, self-recordkeeping, and self-reporting rely on the integrity and capability of the facility to provide accurate data. The data will be misleading if the facility either deliberately falsifies the information or lacks the technical capability to provide accurate data."**[xxv] Considering that non-compliance with emission standards will result to the payment of a fine for every day of violation on the part of coal power plant proponents, this places serious questions on the integrity and credibility of these self-monitoring reports, and warrants a stringent validation system on the part of the DENR.

Box 2. A look at SMC's 600MW Coal Plant Self-monitoring Emissions Report

Figure 8. SMC's Coal Plant SO_2 Emission Results



San Miguel Corporation (SMC) published the Self-monitoring Emissions Report of its 600 MW coal-fired power plant in Limay, Bataan in their website last 2 September 2018. The results show that though all measured parameters fall within the standards of EMB and World Bank, not all of them subscribe to the more stringent standard of US EPA. The sulfur dioxide monitoring result of the coal plant is 6 times more than the standard (65 mg/Nm3)[xxvi] set by US EPA.

US EPA standards has always been a primary reference material for most of the country's environmental standards and its sampling and analytical methods. Though highly regarded, its stringent standards are not fully adopted in Philippine emission standards. If the more stringent standards are used, more of the harmful emissions such as sulfur dioxide will be filtered-out and the adoption of advanced cleaning technology for coal plants will be standardized.

Lack of a national plan for the reduction of GHG

A comparative assessment of CO_2 emissions from global volcanic activities and coal power plants would reveal that CO_2 emissions from anthropogenic activities significantly outweigh volcanic emissions. Global volcanic carbon dioxide emissions release less than 1% of the carbon dioxide released by anthropogenic activities.[xxvii] It takes just 2% of the world's coal-fired power generating capacity to match global volcanic CO_2 emissions. Very rarely does a catastrophic volcanic eruption occur in the Philippines. The Taal volcano eruption, the most recent and major volcanic eruption in the Philippines, occurred on January 2018. The most notorious eruption in the Philippines however is the Mt. Pinatubo eruption; in 1991 the volcano emitted an estimated 42 megatons of CO_2 emissions.[xxviii] The emissions of such a rare eruption still pales in comparison to the combined CO_2 emissions of the Philippine economic sectors. In 2018, said sectors combined for 123 megatons of CO_2 equivalent.[xxix] Annual emissions from anthropogenic activities in the country far outweigh rare emissions from volcanic activities.

Under Section 31 of the Philippine Clean Air Act, the DENR is mandated to prepare and fully implement a national plan consistent with the United Nations Framework Convention on Climate Change and other international agreements, conventions and protocols on the reduction of greenhouse gas emissions in the country. The DENR has not released any national plan as of date.

Recommendations to the DENR

1. Enhance transparency and expedite the review process of Ambient Air Quality Guideline Values and Standards for Source Specific Pollutants, and Emission Standards for Stationary Sources.
2. Ensure that all air quality monitoring equipment are operational.

3. Issue a moratorium on all Permits to Operate Air Pollutant Installations to proposed coal power plants until the Ambient Air Quality Guideline Values and Standards and Emission Standards are updated.
4. Install its own emissions monitoring devices in existing coal power plants and, in the meantime, adopt a stringent process for validating self-monitoring reports of emissions rates.
5. Fully prepare and implement a National Plan on the Reduction of GHG, as mandated by Section 31 of the Philippine Clean Air Act.

ABOUT CEED

The Center for Energy, Ecology, and Development is a think-do institution that conducts research and advocacy, and partners with communities in promoting transformative energy, ecological justice, and people-centered development.

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Endnotes

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[ii] Different components are emphasized in italics.
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[xv] *See* Republic Act No. 8749, An Act Providing for a Comprehensive Air Pollution Control Policy and for Other Purposes, [PHILIPPINE CLEAN AIR ACT OF 1999], 23 June 1999, sec. 12.
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