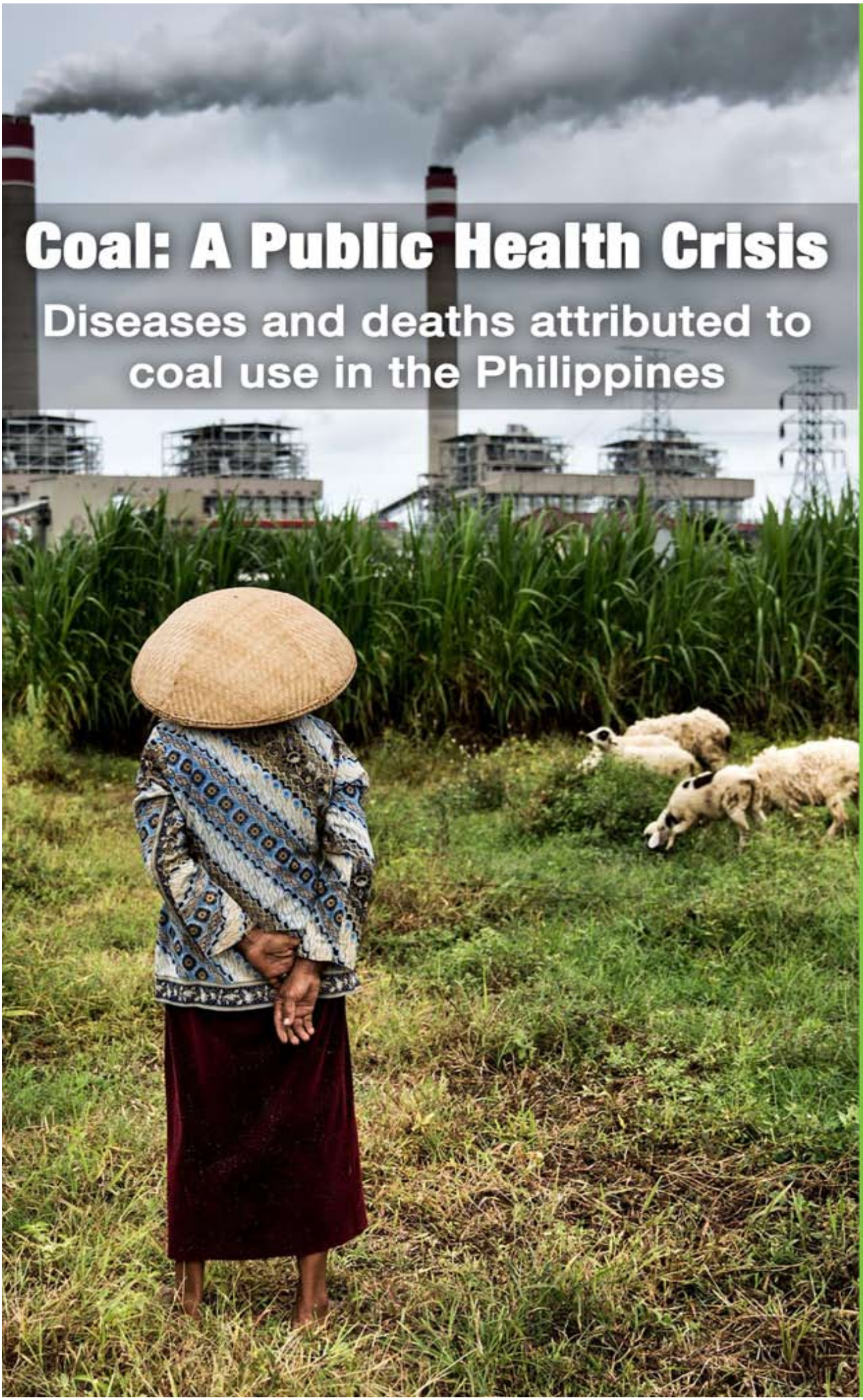

Coal: A Public Health Crisis

Diseases and deaths attributed to coal use in the Philippines

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Table of Contents

Acronyms and Abbreviations

μm	Micrometers
CALPUFF	California Puff
CARMA	Carbon Monitoring for Action
CCAH	Climate Change Adaptation for Health
CO_2	Carbon Dioxide
COC	Coal Operating Contracts
COP21	21st session of the Conference of Parties to UN Framework on Climate Change
COPD	Chronic Obstructive Pulmonary Disease
CWP	Coal Worker's Pneumoconiosis
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DOE	Department of Energy
DOH	Department of Health
EIA	Environmental Impact Assessment
ERC	Energy Regulatory Commission
FIT	Feed-in-Tariff
GHG	Greenhouse Gases
HIA	Health Impact Assessment
HiAP	Health in All Policies
Km	Kilometers
LGU	Local Government Unit
m^3	Cubic Meters
MW	Megawatts
NASA	National Aeronautics and Space Administration
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxide
PM	Particulate Matter
PAB	Pollution Adjudication Board
PMCJ	Philippine Movement for Climate Justice
RE	Renewable Energy
REAS	Regional Emissions Inventory in Asia
RA	Republic Act
SO_2	Sulfur Dioxide
USD	United States Dollar
USEPA	United States Environmental Protection Agency
VAT	Value-Added Tax
WHO	World Health Organization

Executive Summary

Coal is a major public health hazard. Each stage of the coal life cycle – mining, transportation, washing, combustion, and disposing of post-combustion wastes – carries health risks that lead to lung, heart and brain diseases, as well as work-related injuries. Burning coal affects the environment, human health and wildlife, and is a major contributor to climate change.

The Philippines, which ranked 1st in the world for countries most affected by climate change in 2013, is particularly vulnerable to the health risks posed by coal use. Yet, the country continues to be heavily dependent on coal energy. More than one-third of the energy used to generate electricity in the Philippines comes from burning coal, and several new coal plants are expected to start commercial operations by 2020. The Department of Energy (DOE) continues to award new Coal Operating Contracts (COC) for exploration, with at least 39 new COCs awarded in 2015 alone.

This report reveals for the first time the current health impacts of existing coal-fired power plants as well as projected health impacts of operating and planned power plants in the Philippines. The data shows an estimated 960 premature deaths each year due to stroke, ischemic heart disease, other cardiovascular diseases and respiratory diseases. If the new power plants are to be developed, premature deaths may rise up to 2,410 or more than double the current number of people dying from coal-related pollution in the Philippines.

Another case study was conducted in the Visayas to estimate premature deaths attributable to operating coal-fired power plants and the projected premature deaths from the combined emissions of existing and new plants. The data shows that the current 240 estimated coal-related deaths might reach as high as 650 deaths per year if the new power plants are constructed.

Considering the Philippines' rising population, poor health outcomes, and the scarcity of resources needed to adapt to the worst effects of climate change, the country should end its heavy dependence on coal as an energy source and accelerate initiatives involving renewable energy (RE) resources to meet its energy demands. RE is emerging as the energy of choice for an increasing number of communities and local government units (LGU). It is therefore recommended that the government phases out of coal and fully embrace RE sources in the Philippines based on public health considerations.

INTRODUCTION

This report is the result of the collaboration between Greenpeace and Harvard University. In 2015, Greenpeace commissioned Harvard University to do a research on the impacts of emissions coming from coal-fired power plants on the air quality of selected countries in Asia, including the Philippines. Greenpeace funded the research and the publication of the results of the research contained in this report. In the Philippines, Greenpeace collaborated with HealthJustice to write the report, with support from Health Care Without Harm – Asia and the Philippine Movement for Climate Justice.

Links between energy, the environment, and health

Energy has been described as the "engine of development"[i] because of its significant role in economic and social progress, including improved health outcomes, a higher standard of living and an increased life expectancy. The link between energy, the environment and our health was acknowledged as early as 1992, when the issue of energy in the context of climate change was first addressed at the intergovernmental level during the United Nations (UN) Conference on Environment and Development in Rio de Janeiro. UN Agenda 21 states that "all energy sources will need to be used in ways that respect the atmosphere, human health and the environment as a whole." More than two decades later, the issue of energy remains as critical as ever. During the 21st session of the Conference of Parties (COP21) to UN Framework on Climate Change, world leaders were called upon to seriously reevaluate how nations are being powered in the shadow of our shared climate and public health crisis.[ii]

It is now widely accepted that universal access to energy is essential to defeating poverty.[iii] In recent years, the legal dimension of energy access has been recognized at the international level[iv] and is recognized as an enforceable right in some jurisdictions.[v] However, the issue of access to energy is multi-faceted. Not all sources of energy stand on equal footing. Specifically, traditional means of generating energy that involves the burning of polluting fossil fuels, such as coal, natural gas, and oil, have been scientifically proven to be extremely hazardous to the environment and to human health. Of the three types of fossil fuels, coal has inflicted, and continues to inflict, the biggest blows to public health.[vi]

Coal's massive contributions to global warming

Of all energy sources, coal releases the most carbon dioxide (CO_2) per unit of energy.[vii] Coal accounts for 43% of global emissions released annually from fossil-fuel combustion, with 28% emitted from coal-fired power plants.[viii] Coal-fired power plants, which are the largest producers of man-made CO_2 emissions,[ix] contribute to the increase of greenhouse gases (GHG) building up in the atmosphere. These gases trap heat in the earth's lower atmosphere, causing the average global temperatures to rise.

According to the Intergovernmental Panel on Climate Change, global temperatures increased roughly to 0.85ºC over the period 1880 to 2012.[x] Experts predict that the rising global temperatures will continue to increase overall health burdens, [xi] which disproportionately affects the poorest and most vulnerable communities, resulting in the widening of current unacceptable gaps in health outcomes.[xii]

Coal's negative health impacts are costly

Common environmental exposure hazards associated with rising temperatures include heat waves, flooding, storm surges, prevalence of insect- and water-borne diseases, and degraded air, water and food quality.[xiii] The World Health Organization (WHO) predicts that by 2030, climate change will be causing an additional 250,000 deaths each year from malaria, diarrheal disease, coastal flooding, heat exposure and undernutrition.[xiv] Burning coal is a leading cause of smog, acid rain, and toxic air pollution.[xv] Air pollutants produced by coal combustion have been linked to serious damage to the human respiratory, cardiovascular and nervous systems.[xvi] The WHO estimates that more than 7 million people die each year from diseases related to air pollution, making it the world's largest single environmental risk to health.[xvii]

Moreover, each stage of the coal life cycle – mining, transportation, washing, combustion, and disposing of post-combustion wastes – negatively affects health.[xviii] Coal's undeniable contributions to global warming and the dangers it poses to human health represent the hidden costs of coal use that the coal industry and their allies attempt to conceal.[xix]

THE PHILIPPINES' DEADLY ADDICTION TO COAL

More than one-third of the energy used to generate electricity in the Philippines comes from burning coal. Coal-fired power plants continue to be the country's top producer of electricity since 2012, accounting for approximately 39% of the country's power generation mix.[xx]

As of May 2015, the Philippines has 17 operating coal plants (30 boiler units), with 29 more (59 boiler units) approved by the Department of Energy (DOE) to begin commercial operations by 2020. Coal Operating Contracts (COC) for exploration have likewise been awarded to at least 39 companies in 2015.[xxi] It should be noted that this number does not state which among them are already in operation, with some of them having been awarded with contracts as early as 2005. In official statements released by a high-ranking DOE official, the Philippines is looking at a dramatically increased 70% dependence on coal for electricity from 2030 to 2050.[xxii]

These statistics are alarming in view of the latest data from the Climate Risk Index 2015, where the Philippines ranks 1st in the world for countries most affected by climate change in 2013, with a 5th overall ranking between 1994 to 2013.[xxiii]

TABLE 1: Philippine Country Profile

DEMOGRAPHIC ESTIMATES[1]	
Population (2013)	98 million
Population growth rate (2013)	1.6%
Population living in urban areas (2013)	44.6%
Population under five (2013)	11.3%
Population aged 65 or older (2013)	4.4%
ECONOMIC AND DEVELOPMENT INDICATORS[2]	
GDP per capita (current US$, 2013)	2788 USD
Total expenditure on health as % of GDP (2013)	4.4%
Percentage share of income for lowest 20% of population (2012)	5.9%
HDI (2013, +/- 0.01 change from 2005 is indicated with arrow)	0.660
HEALTH ESTIMATES[3]	
Life expectancy at birth (2013)	69 years
Under-5 mortality per 1000 live births (2013)	30
CLIMATE CHANGE RISKS[4]	
Rank among countries affected most in 2013	1st
Rank among countries affected most in the period 1994–2013*	5th
Extreme weather events incidents; overall ranking in the period 1994–2013	328; 1st
COAL STATISTICS[5]	
Overall coal production (2012)	74.534**
Overall coal importation (2012)	132.93
Overall coal consumption (2012)	194.308
Overall coal exportation (2012)	14.355
Power generated from coal (2012)[6]	39%
Coal Operating Contracts (COC) holders for exploration (2015)[7]	39
* based on annual averages ** in million metric tons	

SOURCE: 1-3. World Health Organization/United Nations Framework Convention on Climate Change (2015) *Climate and Health Country Profile.* **4.** Kreft, S et al. (2014) *Global Climate Risk Index 2015*. Bonn Germany: Germanwatch e.V.; **5.** Department of Energy (2012) *Overall Coal Statistics in the Philippines.* **6.** Department of Energy (2012) *Philippine Power Statistics 2012*; **7.** Department of Energy (2015) *List of Coal Operating Contract (COC) holders for exploration as of 2015.*

The Philippines' rankings also raise red flags that underscore the need to urgently end dependence on coal-fired power plants, and fast-track RE policies and projects. Considering the country's rising population, poor health outcomes and the scarcity of resources needed to adapt to the worst effects of climate change, the country cannot afford to continue its deadly dependence on coal.

The national government must embrace renewable resources to effectively meet energy demands while ensuring the right to a healthy and balanced ecology. RE is emerging as the energy of choice for an increasing number of Filipino communities and local government units (LGU). The challenge, therefore, is for the national government to speak favorably of renewables and embrace RE the same way communities and LGUs have. A strong government stance in support of RE initiatives will increase market confidence and send strong signals that public health is a key issue in energy policy.

COAL'S IMPACT ON PUBLIC HEALTH

Coal use pollutes the environment and poses detrimental effects on human health. From the mines to the power plants, coal's life cycle carries with it various health risks that lead to lung, heart and brain diseases, as well as work-related injuries.[xxiv]

Table 2 shows how coal use harms the environment and public health at every stage of its life cycle.

TABLE 2: Impact of coal's life cycle on the environment and health

Coal's life cycle	Effects on environment	Effects on human health
Coal mining	1. Air pollution 2. Destruction of local habitat and biodiversity 3. Methane emissions from coal that can contribute to climate change	• Work-related fatalities and injuries of miners • Black lung disease and silicosis among miners due to exposure to coal dust • Illnesses due to increased air pollution in the nearby community
Coal washing (Removal of soil and rock impurities from the coal which creates as a byproduct a liquid waste called slurry)	1. Contamination of water sources from runoff and waste spills 2. Sludge and slurry ponds 3. Loss and contamination of streams and aquatic life	• Health impacts of heavy metals from coal slurry • Health impacts of water contamination
Coal transportation	1. Air pollution from coal dust released by transport trucks and trains 2. Greenhouse gas emissions from the vehicles	Health impacts due to coal dust inhalation during transport
Coal combustion	1. Release of toxic chemicals such as sulfur dioxide, particulate matter, nitrogen oxides and others 2. Air pollution 3. Climate change due to power plant emissions 4. Environmental contamination as a result of heavy metal pollution (mercury, arsenic, selenium)	Increased prevalence from lung, heart, and brain diseases due to particulate pollution (*See* **Table 2**)
Waste disposal	1. Water pollution from runoff and fly ash spills 2. Impacts on surrounding ecosystem of coal ash and other wastes	Health impacts of contaminants from coal ash and other wastes

SOURCE: Epstein et al. (2011) **"**Full cost accounting for the life cycle of coal." *Ecological Economics Reviews*. Robert Costanza, Karin Limburg & Ida Kubiszewski, Eds. Ann. N.Y. Acad. Sci. 1219: 73–98. doi: 10.1111/j.1749-6632.2010.05890.x. Retrieved from http://www.chgeharvard.org/sites/default/files/epstein_full%20cost%20of%20coal.pdf

Health effects of coal burning

Coal combustion is a major threat to public health because it releases particulate matter (PM), or a complex mixture of extremely small particles and liquid droplets,[xxv] in the air. The size of the particles is directly linked to their health effects, with particles 10 micrometers (μm) or smaller in diameter considered as more harmful because these can pass through the throat and nose and enter the lungs.

Figure 1: Comparison of fine particle matter size

SOURCE: Greenpeace (2015). *Human Cost of Coal Power: How coal-fired power plants threaten the health of Indonesians.*

Coal-fired power plants emit sulfur dioxide (SO_2), nitrogen oxide (NO_2) and other gaseous pollutants in the air that can react chemically to form particulate matter that is 2.5 μm in diameter. $PM_{2.5}$ is categorized as a fine particle and is smaller than 1/25th of the diameter of human hair.[xxvi] These particles are small enough to penetrate the lungs and bloodstream, and cause a wide range of diseases.

Table 3 shows the health effects associated with exposure to particulate matter emitted from coal-fired power plants, as well as the current burden of disease in the Philippines.

TABLE 3: Coal's contributions to major health effects

	Disease or condition*	Symptom or result	Most vulnerable populations	Reported disease burden in the PH**	Coal pollutants that may contribute to the disease
Respiratory	Asthma exacerbations	Coughing, wheezing, shortness of breath, and breathlessness with a range of severity from mild to requiring hospitalization	Children, Adults	Age-standardized asthma mortality rates for all ages between 2001-2010: 105 per million population.[1] Overall prevalence of adult asthma in 2014: 8.7%.[2]	NO_2 Ozone PM
	Asthma development	New cases of asthma resulting in coughing, wheezing, shortness of breath, and breathlessness with a range of severity from mild to requiring hospitalization	Children		Suspected but not confirmed: NO_2 Ozone $PM_{2.5}$
	Chronic Obstructive Pulmonary	Emphysema with chronic obstructive bronchitis; permanent narrowing of	Smokers, Adults	COPD ranks as the 6th leading cause of death in the Philippines as of	NO_2 Ozone PM

	Disease (COPD)	airways; breathlessness; chronic cough		2010 with 22,877 deaths recorded nationwide.[3] The mortality trend for COPD has increased from 12.3 deaths per 100,000 population in 1980 to 24.6 deaths per 100,000 in 2005.[4,5,6]	
	Stunted lung development	Reductions in lung capacity; risk factor for development of asthma and other respiratory diseases	Children	No Philippine data available	NO_2 $PM_{2.5}$
	Infant mortality (relevant organ system uncertain; may be respiratory)	Death among infants age <1 year	Infants	Overall deaths in 2013: 24 per 1,000 live births.[7]	NO_2 $PM_{2.5}$
	Lung cancer	Shortness of breath, wheezing, chronic cough, coughing up blood, pain, weight loss	Smokers, Adults	The most common sites for cancer in the Philippines are the lung, trachea and bronchus which accounted for 8.5 deaths per 100,000 population in 2005.[8]	PM
	Coal worker's pneumoconiosis (CWP), commonly called "Black Lung"[9]	No symptoms in early stages in some cases; cough, with or without mucus production, or chest tightness; shortness of breath[10]	Coal miners, workers, adults[11]	No Philippine data available.	PM
Cardiovascular	Cardiac arrhythmias	Abnormal rate or rhythm of the heart; palpitation or fluttering; may cause fatigue, dizziness, lightheadedness, fainting, rapid heartbeat, shortness of breath, and chest pain	Adults, hypertensives, diabetics, those with cardiovascular disease	Heart diseases ranked no. 1 in the leading causes of death from 1985 to 2009.[12] It represents 21% of total deaths in the country with 102,396 recorded deaths in 2010.[13] The mortality rate from heart disease has been increasing throughout the years from 60 deaths per 100,000 population in 1980 to 90.4 deaths per	NO_2 $PM_{2.5}$
	Congestive heart failure	Shortness of breath, fatigue, edema (swelling) due to impaired ability of heart to pump blood; can result from narrowed arteries, past heart attack, and high blood pressure; can lead to death	Adults, hypertensives, diabetics, those with cardiovascular disease		$PM_{2.5}$

	Acute myocardial infarction	Chest pain or discomfort; heart attack	Adults, diabetics, hypertensives	100,000 population in 2005. The prevalence of hypertension has also increased 20 percent from 1998 to 2008.[14]	$PM_{2.5}$
Neurological	Ischemic stroke	Artery supplying blood to the brain becomes blocked due to blood clot or narrowing; may cause sudden numbness or weakness, especially on one side of body, confusion, trouble speaking or seeing, trouble walking, dizziness, severe headache; effects can be transitory or persistent	Elderly, hypertensives, diabetics	Stroke prevalence of 0·9%; ischemic stroke comprises 70% while hemorrhagic stroke comprises 30%.[15]	NO_2 $PM_{2.5}$ PM_{10} SO_2
	Developmental delay	Reduced intelligence; mental retardation; clinical impairment on neurodevelopmental scales; permanent loss of intelligence	Fetuses, infants, children	No Philippine data available.	Mercury and other heavy metals

* not an exhaustive list

**coal is a suspected contributing factor in an unknown number of health cases

SOURCES: Unless otherwise stated, Lockwood, AH, Welker-Hood, K, Rauch, M, Gottlieb, B (2009) *Coal's Assault on Human Health*, Physicians For Social Responsibility. Retrieved from www.psr.org/coalreport. **1**. The Global Asthma Network (2014) *The Global Asthma Report 2014.* Auckland, New Zealand: Global Asthma Network; **2.** Varona et al. (2014) "Prevalence of Asthma Among Filipino Adults Based on the National Nutrition and Health Survey." *Philippine Journal of Internal Medicine*, 54(4), 1-7; **3-4.** Department of Health (2012) *National Objectives for Health Philippines 2011 to 2016*, p. 82; **5.** National Statistics Office (2014) *Philippines in Figures 2014*. Available online. **6.** Trinidad, T.S. (2013) *National Strategy for COPD*. Philippine College of Chest Physicians; **7**. UN Inter-agency Group for Child Mortality Estimation (2014) *Levels & Trends in Child Mortality.* United Nations Children's Fund. Retrieved from http://www.unicef.org/media/files/Levels_and_Trends_in_Child_Mortality_2014.pdf; **8.** Department of Health (2012) *National Objectives for Health Philippines 2011 to 2016*, p. 82; **9**. Newman, LM (2014) "Coal Workers' Pneumoconiosis (Anthracosis; Black Lung Disease; Coal Miner's Pneumoconiosis)," *Merck Manual Professional Version.* Available online; **10-11.** World Health Organization (2013) *Health Effects of Particulate Matter.* Copenhhagen, Denmark: WHO Regional Office for Europe; **12.** Department of Health (2009) *Ten Leading Cause of Mortality in the Philippines.* Retrieved from http://www.doh.gov.ph/node/2573; **13.** Philippines in Figures 2014. National Statistics Office. Retrieved from https://psa.gov.ph/sites/default/files/2014%20PIF.pdf; **14.** Department of Health (2012) *National Objectives for Health Philippines 2011 to 2016*, pp. 80-81; **15.** Navarro JC, Baroque AC, Lokin JK, Venketasubramanian N (2014) "The real stroke burden in the Philippines." *Int J Stroke*, 9(5). 640-1.

It should be noted that his table presents the current burden of disease in the Philippines that coal may be contributing to, as already documented in epidemiological studies from other countries, and may be further exacerbated if the country will continue to pursue the use of coal in electricity generation.

Health effects of climate change

Aside from generating particulate matter, coal combustion also affects health indirectly by contributing to greenhouse gas emissions. Climate change can bring extreme heat, lead to natural disasters, and eventually increase diseases transmitted through insects such as malaria and dengue. According to the WHO, climate change is expected to cause 250,000 additional deaths per year from 2030 to 2050.[xxvii] The WHO also estimates direct damage costs to health to be between USD 2 to 4 billion by 2030.[xxviii] Table 4 shows the predicted health effects of climate change.

TABLE 4: Impact of climate change on human health

Examples of human health effects*	Exposure hazards**	Global warming mechanisms	Most vulnerable populations
Cardiovascular diseases	Air pollution; smoke exposure from wildfires; heat waves	• Increasing CO_2 levels • Rising temperatures • Particulate emissions from fossil fuel combustion	Adults, diabetics, elderly, those carrying out physically demanding work
Food and waterborne diarrheal disease	Flooding; infrastructure damage; heavy rainfall; mold contamination; algal blooms; degraded water quality	• Rising sea levels • Rising temperatures • Precipitation extremes • Extreme weather events	Children, the developing world
Drowning	Flash floods and flooding associated with tropical storms	• Rising sea levels • Precipitation extremes • Extreme weather events	Children, elderly, coastal dwellers
Heat cramps, heat exhaustion, heat stroke	Heat waves	• Rising sea levels • Increasing CO_2 levels • Rising temperatures	Children, elderly, urban poor
Hunger, malnutrition, starvation, famine	Droughts; reduced crop yields; crop damage; disruptions in forestry, livestock, fisheries; wildfires; dust storms; flooding; reduced water; degraded water quality	• Rising temperatures • Extreme weather events • Rising sea levels resulting in loss of agricultural land • Ecological changes • Changes in water cycle	Children, rural poor, the developing world
Neurological diseases; including stroke, developmental delay, brain tumors	Degraded air, water, and food quality; algal blooms releasing neurotoxins in seafood; exposure to biotoxins	• Rising temperatures • Rising sea levels • Precipitation extremes • Extreme weather events • Ecological changes	Elderly, diabetics, hypertensives
Red tide and other harmful algal blooms	Degraded water quality; excess nutrient inputs	• Rising temperatures • Rising sea levels	Poor, children, coastal communities
Respiratory diseases; including asthma, COPD, coal worker's	Degraded air quality; heat waves; smoke exposure from wildfires	• Increasing CO_2 levels • Rising temperatures • Particulate emissions	Children, elderly, those with pre-existing medical conditions

pneumoconiosis		from fossil fuel combustion • Airborne allergens	
Vector-borne diseases, including insect-borne (malaria, dengue); rodent-borne (hantavirus infections, tick-borne encephalitis)	Seasonal shifts boost parasite development, expands geographic range of insect and rodent vectors, increase bite frequency	• Rising temperatures • Rising sea levels • Precipitation extremes • Extreme weather events	Children, those with impaired immune systems, the developing world
Mental health and stress-related disorders	Stress resulting from environmental and social changes cited above.	All of the above	Varied

* predicted health effects of global warming
** not an exhaustive list

SOURCES: Based on the framework in Lockwood, AH, Welker-Hood, K, Rauch, M, Gottlieb, B (2009) *Coal's Assault on Human Health*, Physicians For Social Responsibility. Retrieved from www.psr.org/coalreport.; Additional information from Luber, GK et al. (2014) "Chapter 9: Human Health." *Climate Change Impacts in the United States: The Third National Climate Assessment*, JM Melillo, TC Richmond, and GW Yohe, Eds., U.S. Global Change Research Program, 220-256. doi:10.7930/J0PN93H5. Retrieved from http://nca2014.globalchange.gov/; De Blois, J et al. (2015) "The Effects of Climate Change on Cardiac Health." *Cardiology.* 131(4), 209-217. Doi: 10.1159/000398787. Retrieved from https://www.karger.com/Article/FullText/398787; Kreft, S et al. (2014) *Global Climate Risk Index 2015*. Bonn Germany: Germanwatch e.V. Retrieved from https://germanwatch.org/en/download/10333.pdf; Veenema, TG (2013) *Disaster Nursing and Emergency Preparedness* . New York, NY: Springer Publishing Company, pp. 308-310. The Interagency Working Group on Climate Change and Health (2010) *A Human Health Perspective on Climate Change.* Environmental Health Perspectives and the National Institute of Environmental Health Sciences.

HEALTH IMPACTS OF COAL-FIRED POWER PLANTS IN THE PHILIPPINES

According to the 2014 WHO ambient air pollution database,[xxix] the annual mean of $PM_{2.5}$ concentration in cities with monitoring data in the Philippines is at 23 $\mu g/m^3$.

Table 5 shows that this level is still within the national guidelines set by the Department of Environment and Natural Resources (DENR)[xxx] but exceeds WHO guidelines for PM2.5 levels. [xxxi]

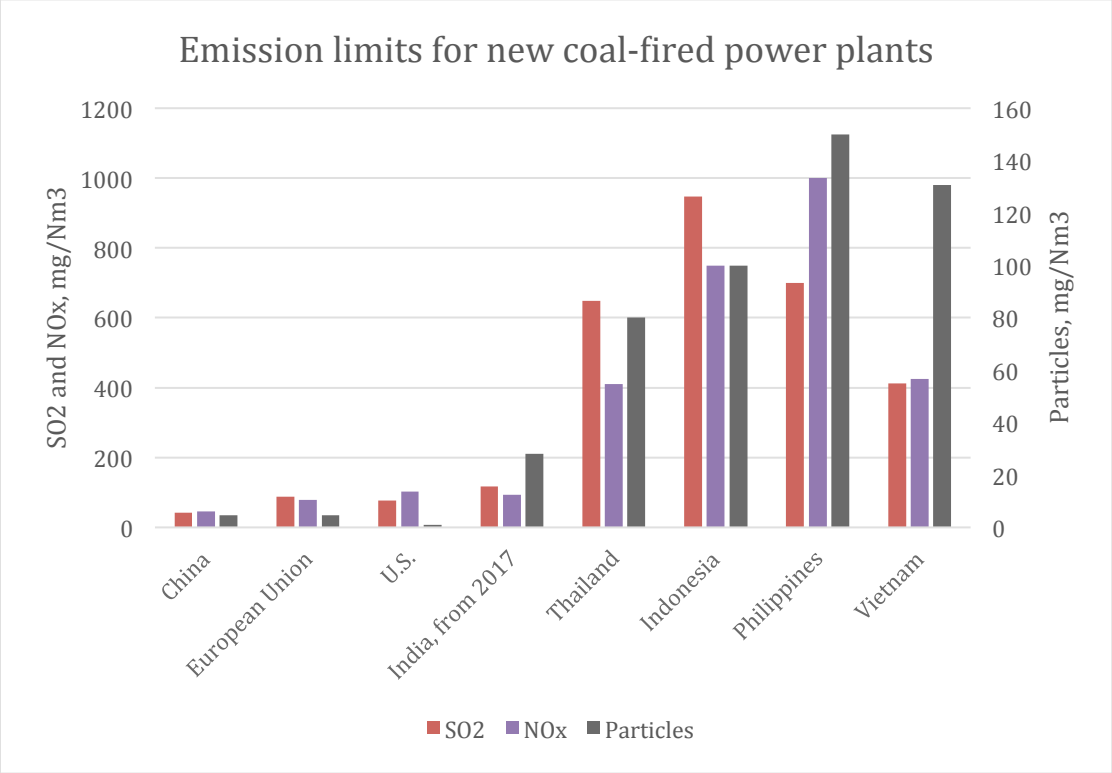
Table 5: $PM_{2.5}$ concentration in the Philippines compared to national and international guidelines

	WHO Guidelines ($\mu g/m^3$)	National Ambient Air Quality Guidelines ($\mu g/m^3$)	PM2.5 level in the Philippines ($\mu g/m^3$)
Annual mean	10	25	23
24-Hour mean	25	50	-

Exposure to $PM_{2.5}$ increases the risk of diseases and can reduce life expectancy. Long-term exposure to $PM_{2.5}$ has been associated with an increased risk of cardiopulmonary mortality by 6 to 13 percent per 10 $\mu g/m^3$ of $PM_{2.5}$.[xxxii] A WHO study also showed that exposure to $PM_{2.5}$ reduces life expectancy in Europe by an average of 8.6 months. The same study revealed that in the most polluted European cities, bringing down the levels of $PM_{2.5}$ to the WHO guideline of 10 $\mu g/m^3$ could increase life expectancy by approximately 20 months.[xxxiii]

Aside from $PM_{2.5}$, coal-fired power plants also release other pollutants that are harmful to public health. Therefore, it is important to establish strong emission standards to effectively limit the amount of pollutants these power plants emit. Figure 2 shows a comparison of emission limits for new coal-fired power plants in different countries, where the Philippines clearly lags behind in implementing stringent limits on power plant emissions.

Figure 2: Comparison of emission limits for new coal-fired power plants in different countries



Methodology of Philippine Health Impact Study

The Harvard University Atmospheric Chemistry Modeling Group carried out a state-of-the-art study to assess the health impact of coal-fired power plants in the Philippines. The study utilized the impact pathway approach which follows air pollution from emissions to the total health impacts on the population. Table 6 shows the detailed methodology used in conducting the study.

Table 6: Steps, information sources and processes used to assess health impacts of coal-fired power plants in the Philippines

Steps in Impact Pathway Approach	Information Sources	Process
1. Estimate emissions of air pollutants from coal-fired power plants	- Coal power plant database - Emission rates from official statistics, companies and academic studies	• The emission estimates were based on a detailed listing of coal-fired power plants and their technical data compiled by the Philippine Movement for Climate Justice (PMCJ) • The operating data, such as thermal efficiency and capacity factor, for most operating plants

	- National emission standards - Fuel use from the International Energy Agency (IEA)	was obtained from the Carbon Monitoring for Action (CARMA) database • National emission standards, power plant specific information, company average emissions performance and Regional Emissions Inventory in Asia (REAS) 2.1 estimates of emissions were used to calculate emission rates • New power plants were assumed to operate at the same average capacity factor as existing plants
2. Describe dispersion and chemical evolution of air pollutants in the atmosphere	- Atmospheric model GEOS-Chem at Harvard University	• Atmospheric modeling was done by the research group of Professor Daniel Jacobs at Harvard University using the GEOS-Chem global model of atmospheric composition (www.geos-chem.org). The model quantifies surface area concentrations of particulate matter and ozone resulting from present and future scenarios of emissions from coal-fired power plants • The model is first run with all air pollution emissions from different sources included • The emissions from operating coal-fired power plants are then removed and the model is run again • The difference in pollution levels in the results of these two model runs is the share of pollution attributable to coal-fired power plants • For new power plants that are not yet operating, another model is run with projected emissions added to the model
3. Assess population exposure to PM2.5	- High resolution population density maps from the National Aeronautics and Space Administration (NASA)	• The research team used high- resolution population data together with the modeling results, to evaluate population exposure to power plant emissions.
4. Estimate health impacts of coal-fired power plants	- Results of large epidemiological studies - Death rates from lung cancer, stroke, heart disease, chronic respiratory disease and lower respiratory infections in the country	• The team based the assessment of health impacts on the findings of the American Cancer Society study that tracked medical histories and residence records of 1.2 million Americans for 18 years. This is the largest study ever carried out on the chronic health impacts of air pollution and showed significant differences in health risks between cities with different pollution levels[xxxiv] • For the projection of future health impacts, the results took into account projected population growth and changes in death rates based on the WHO Global Burden of the Disease for 2030[xxxv] • To take into account changes in geographical distribution of the population, the researchers used World Bank projections of urbanization[xxxvi]

Results of the Study

The study evaluated 13 operational coal-fired power plants in the Philippines with a combined installed capacity of 3,799.10 megawatts (MW), as well as the potential impacts of plans to build 29 new coal-fired power plants with a total capacity of 11700MW, which could dramatically increase levels of sulfur dioxide (SO_2), nitrogen oxide (NO_x) and $PM_{2.5}$ emissions.

Table 7 shows emission estimates from targeted operational coal-fired power plants and planned power plants. Results indicate that the additional power plants will increase SO_2, NO_x and $PM_{2.5}$ levels by 123%, 174% and 197% respectively. Carbon dioxide (CO_2) emissions are also estimated to increase by 254%.

Table 7: Emission estimates from operating and new coal-fired power plants in the Philippines (kt per year)

	SO_2	NO_x	PM_{10}	$PM_{2.5}$	CO_2 (Mt)
Operating	74	78	6.5	2.9	21.5
New projects	91	136	13.0	5.6	54.7
Increase	123%	174%	201%	197%	254%

The data from these emission estimates were then used as the basis for modeling the power plants' air quality impacts through the atmospheric chemistry-transport model GEOS-Chem at the Harvard University. Figures 3 and 4 show models of annual average $PM_{2.5}$ concentration for both existing and planned power plants.

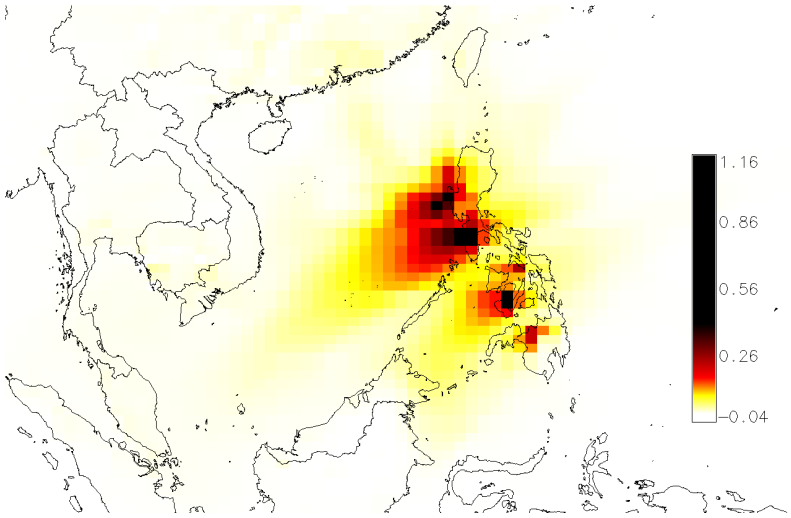


Figure 3: Estimated annual average $PM_{2.5}$ concentration attributable to emissions from operating coal-fired power plants in the Philippines ($\mu g/m^3$)

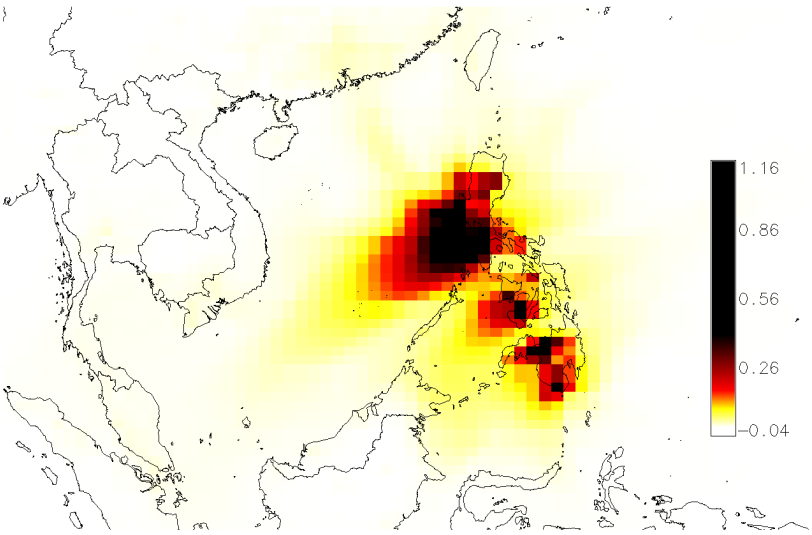


Figure 4: Projected increase in annual average $PM_{2.5}$ concentrations caused by the operating coal-fired power plants and new projects in the Philippines ($\mu g/m^3$)

The study also assessed current health impacts of existing coal-fired power plants as well as projected health impacts of operating and planned power plants. Table 8 shows that air pollutants from currently operating coal-fired power plants cause an estimated 960 premature deaths each year. The main causes of these deaths in adults include stroke, ischemic heart disease, other cardiovascular diseases and respiratory diseases. Among children, current power plants cause an estimated 20 deaths due to increased risk of lower respiratory infections. If the new power plants are to be developed, premature deaths may rise up to 2,410, or more than double the current number of people dying from coal-related pollution in the Philippines.

Table 8: Estimated current and projected health impacts of coal-fired power plants

Health Impact	Current Impacts	Projected Impact
$PM_{2.5}$ exposure to adults		
Stroke	200	380
Ischemic Heart Disease	420	1050
Lung Cancer	40	100
Other cardiovascular diseases	80	200
Respiratory Diseases	110	190
$PM_{2.5}$ exposure to children		
Lower respiratory infections	20	30
Ozone exposure to adults		
Respiratory diseases	90	450
TOTAL	Central: 960 Low: 540 High: 1420	Central: 2410 Low: 1270 High: 3600

CASE STUDY IN VISAYAS, PHILIPPINES

Aside from estimating the health impacts of 13 operational coal-fired power plants in the Philippines, a case study was also conducted in the Visayas region to provide a more detailed analysis of coal's health impacts. The impacts were modeled over a 1,500 kilometers (km) X 1,500 km domain covering the areas of Southern Luzon, Visayas and Mindanao, where approximately 97 million people live.

The case study followed the methodology of the Harvard study for emission estimates and health impact assessment, but used the CALPUFF (California Puff Model) version 7 system for pollutant dispersion modeling. CALPUFF is an advanced meteorological and air quality modeling system adopted by the U.S. Environmental Protection Agency (US EPA) and is the preferred method for assessing long range transport of pollutants and their impacts.[xxxvii]

The Visayas is host to several coal-fired power plants in the country. It is also the most severely impacted region when Super Typhoon Haiyan hit the country in November 2013.

Coal's impact on air quality and health

The operating coal-fired power plants in the study area have a total capacity of 830 MW. Eleven power plants are however in the pipeline with an estimated capacity of 1670 MW. Tables 9 and 10 show the estimated annual emissions for SO_2, NO_X and PM_{10} for the currently operating and planned power plants.

Table 9: Estimated annual emissions from the operating power plants (t/a)

Power station name	SO_2	NO_X	PM_{10}
Iloilo City PEDC	1491	5485	318
Naga City	5040	3635	401
Toledo Sangi	7621	14492	1745

Table 10: Projected annual emissions from the new projects (t/a)

Power station name	SO_2	NO_X	PM_{10}
Cadiz City Power Station	1994	3399	285
Concepcion Power Station	3589	6118	512
Danao Coal	266	453	38
Iloilo City PEDC	3485	6962	602

Isabel Copper Plant	2659	4532	380
Naga City	9029	6589	970
Pulupandan	711	527	102
Therma Visayas Energy Project	3988	6798	569

The data from these emission estimates were then used as the basis for modeling the air quality impacts of power plants using the CALPUFF modeling system. Figures 5 to 8 show models of annual average $PM_{2.5}$ concentration and 24-hour maximum $PM_{2.5}$ concentration for both existing and planned power plants.

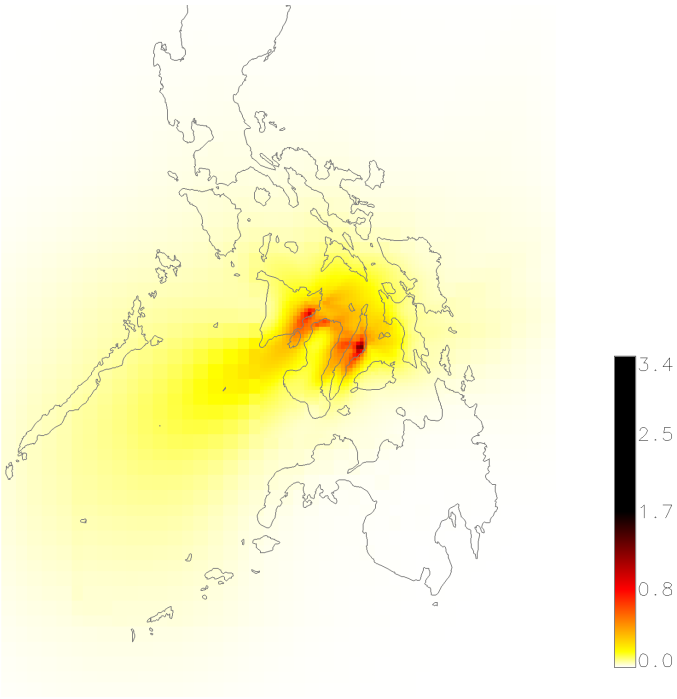


Figure 5: Estimated annual average $PM_{2.5}$ concentration attributable to emissions from the operating coal-fired power plants in Visayas (µg/m^3)

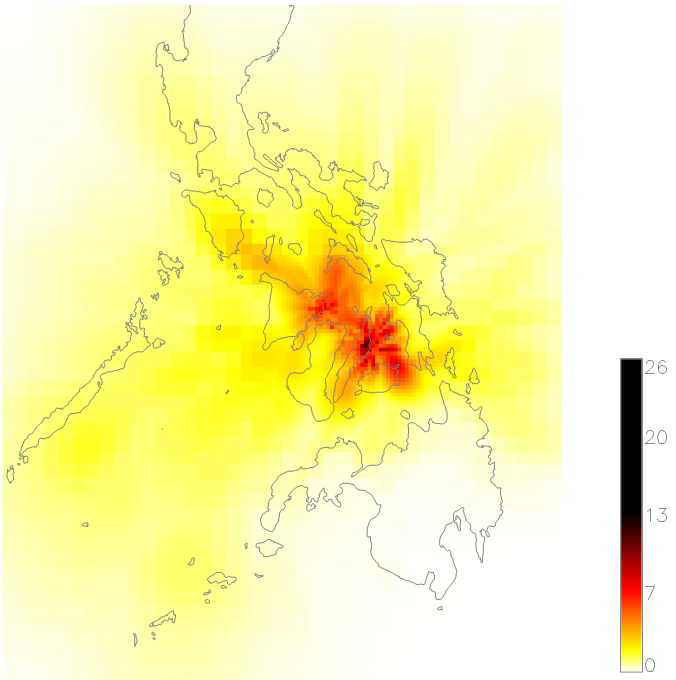


Figure 6: Estimated 24-hour maximum $PM_{2.5}$ concentration attributable to emissions from operating coal-fired power plants in Visayas (µg/m^3)

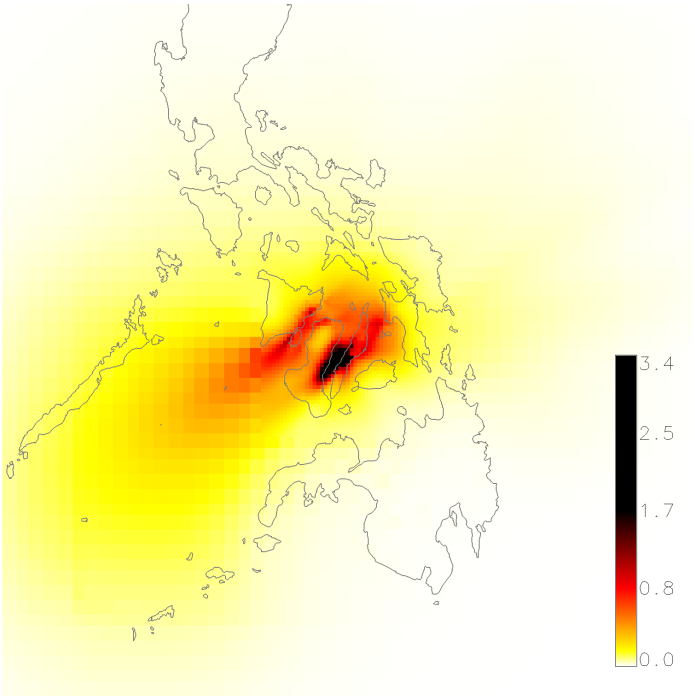


Figure 7: Projected increase in annual average $PM_{2.5}$ concentrations caused by the operating coal-fired power plants and new projects in Visayas ($\mu g/m^3$)

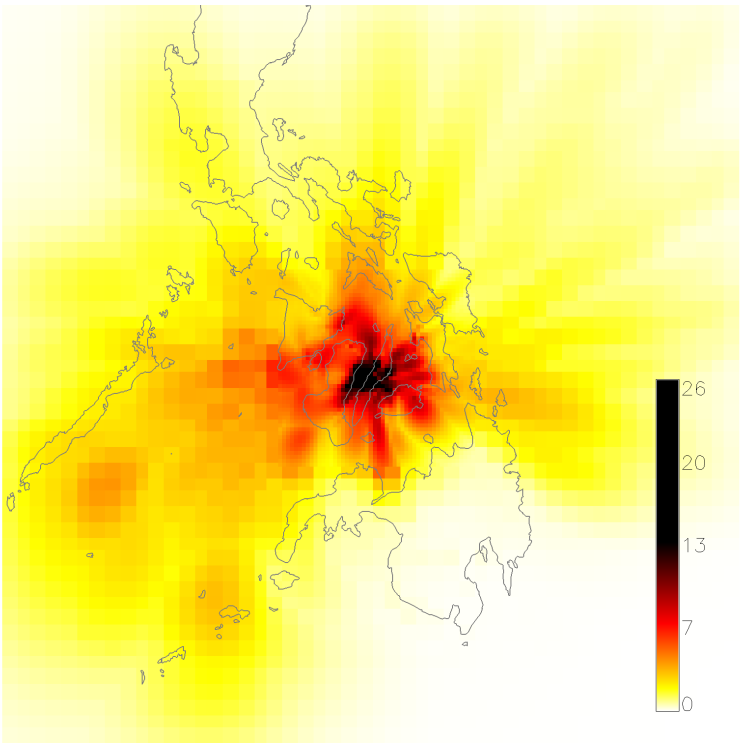


Figure 8: Projected 24-hour maximum $PM_{2.5}$ concentration caused by the operating coal-fired power plants and new projects in Visayas ($\mu g/m^3$)

The emissions from the three operating power plants affect pollution levels most significantly in the cities of Cebu and Danao, and the rest of the Cebu province, as well

as the east coast of the Panay Island. The province of Bohol and Cadiz City in the province of Negros Occidental were also strongly affected. Based on the study, Danao City would be the most affected by the adverse health effects of coal-fired powered plants due to its large population and high levels of pollution.

In terms of short-term air quality effects, the power plants can raise the daily $PM_{2.5}$ level in Danao City to up to 50% of the yearly national average level.[xxxviii] It can also raise $PM_{2.5}$ levels in other heavily affected cities by up to 25%.

Table 11 shows the estimated premature deaths attributable to operating coal-fired power plants and the projected premature deaths from the combined emissions of existing and new plants. The data shows that the current 240 estimated coal-related deaths may reach as high as 650 deaths per year if the new power plants are developed.

Table 11: Estimated premature deaths attributable to currently operating power plants and projected premature deaths from existing and new power plants in Visayas, per year

Diseases attributable to coal-fired power plants	**Current impact of existing power plants**		**Projected impact of existing and new power plants**	
	Best estimate	95% confidence interval	Best estimate	95% confidence interval
Cerebrovascular disease	40	30-60	130	80-180
Ischemic heart disease	130	80-180	360	230-490
Chronic obstructive pulmonary disease	10	7-16	60	36-81
Trachea, bronchus, and lung cancers	10	3-12	50	20-75
Other chronic cardiopulmonary diseases	30	20-46	60	35-79
Lower respiratory infections <5yrs	10	2-20	2	0-4
TOTAL	240	140-330	650	400-910

Toxic fallout

Emissions from coal-fired power plants may also lead to the deposition of heavy metals and fly ash. Deposition mainly occurs during the southwestern monsoon season. Total direct fly ash deposition on the eastern coast of Cebu is projected to be approximately 600 kg per square kilometer. Acid deposition at the most affected locations is also projected at 3,000 kg of SO_2 equivalent per square kilometer.

Based on a U.S. Geological Survey analysis,[xxxix] 600 kilograms of fly ash from coal could be expected to contain around 20-60 grams of toxic arsenic, around 60-140 grams of chromium, 20-80 grams of copper, 20-160 grams of manganese, 80-160 grams of nickel and 8-20 grams of lead.[xl] Figures 9 and 10 show projected fly ash and acid deposition in the region.

Table 12. Toxic heavy metals in coal ash and their health and environmental effects

Heavy Metal	Human Health Hazards	Environmental Hazards
Mercury	Damage to brain, nervous system, kidneys and liver. Causes neurological and developmental birth defects.	Taken up by fish and wildlife. Accumulates in the food chain.
Lead	Damages the developing nervous system, may adversely affect learning, memory, and behavior. May cause cardiovascular and kidney effects, anemia, and weakness of ankles, wrists and fingers.	Harms plants and wildlife; accumulates in soils and sediments. May adversely affect land and water ecosystems.
Other Heavy Metals (Arsenic, Beryllium, Cadmium, Chromium, Nickel, Selenium, manganese)	Carcinogens: lung, bladder, kidney, skin. May adversely affect nervous, cardiovascular, dermal, respiratory and immune systems.	Accumulates in soil and sediments. Soluble forms may contaminate water systems.

Source: https://www.csu.edu/cerc/researchreports/documents/EmissionsOfHazardousAirPollutantsFromCoal-FiredPowerPlants2011.pdf

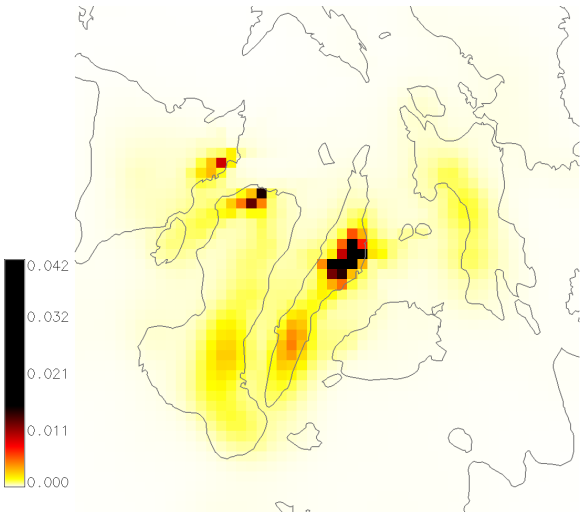
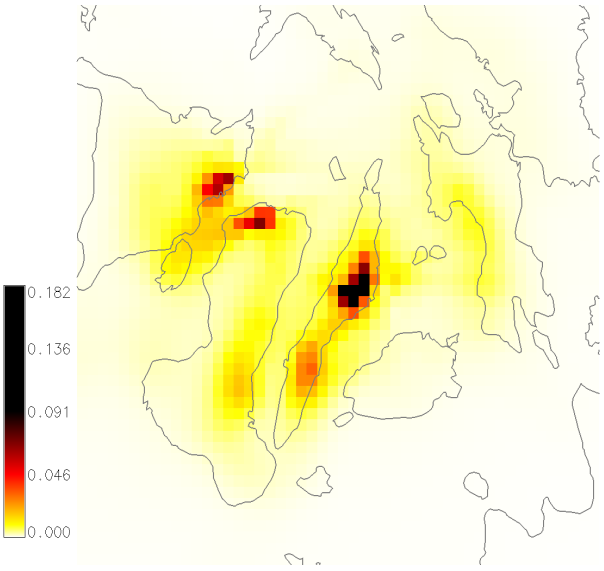


Figure 9: Projected fly ash deposition from the operating coal-fired power plants (µg/m^2/s, average)

Figure 10: Projected acid deposition (SO_2 equivalent) from the operating coal-fired power plants (µg/m^2/s, average)



RECOMMENDATIONS

It is the policy of the state to protect and promote the right to health of the people[xli] and to protect and advance the right of the people to a balanced and healthful ecology in accordance with the rhythm and harmony of nature.[xlii] Pursuant to these constitutional mandates, the following action points are recommended:

A. Moratorium on coal

As supported by evidenced-based studies, the Philippines should adopt a strict moratorium on the issuance of new Coal Operating Contracts (COC) for the exploration of coal and the construction of new coal plants. For contracts that have already been approved and set to begin commercial operations by 2020, review, amend and re-negotiate the contract and permit terms to incorporate health and environmental safeguards. This could be done through an Executive Order issued by the President of the Philippines that will suspend the grant of new COCs until a new law on coal is passed, similar to what was done with the mining industry.[xliii] Simultaneously, advocates should lobby for the passage of a new law banning coal use in the Philippines and provide initiatives that will accelerate the promotion, development and utilization of RE sources.

To improve the capacity of the Philippines to quit coal dependence, embrace renewables, and mitigate climate change impacts, there must be greater participation and engagement by different government agencies.

Table 12 shows the list of different government agencies that should be involved in mitigating and addressing the health effects of coal.

Table 12: Government agencies and their primary responsibilities

Government Agency	Primary Mandate/Responsibilities
Department of Health (DOH)	Formulation, planning, implementation and coordination of policies and programs in the field of health [xliv]
Department of Energy (DOE)	Policy-making body mandated to supervise and control all government activities pertaining to energy projects.[xlv]
Department of Environment and Natural Resources (DENR)	Control and supervise the exploration, development, utilization, and conservation of the country's natural resources. [xlvi]
Department of Interior and Local Government (DILG)	Mandated to establish and formulate plans, policies and programs to strengthen the technical, fiscal and administrative capabilities of local governments.[xlvii]
Climate Change Commission (CCC)	Coordinate, monitor and evaluate the programs and action plans of the government in order to ensure the mainstreaming of climate change into the national, sectoral and local development plans.[xlviii]

B. The Department of Health as national focal point in the health impact assessment of energy policies and projects

The Department of Health (DOH) should be the national focal point in forging public health arguments for climate mitigation and acceleration of RE initiatives, in accordance with the "Health in All Policies" (HiAP) approach promoted by the WHO.

Pending the complete phase-out of coal, the Philippines should adopt a national health adaptation strategy under the leadership of the DOH. In 2012, the DOH adopted the National Policy on Climate Change Adaptation for the Health Sector through DOH Administrative Order No. 05-12 (DAO 05-12). The strategies developed by DOH are summarized in Table 13.

While the DOH has already put in place policies and strategies to enhance adaptation of the health sector to the health impacts of climate change, such as the CCAH Strategy, the role of DOH in addressing climate change must be expanded to include using the evidence on public health co-benefits to influence other sectors (such as the energy sector) to adopt climate mitigation strategies.

Table 13: DOH Strategies for the Implementation of Climate Change Adaptation for the Health Sector (CCAH)

Policy, Plans and Partnerships	
Health Policy, Plans and Programs	Develop appropriate implementing instruments for local adaptation of the national climate change and health response initiatives.
Standards and Regulation	Ensure effective and efficient intervention measures, such as, but not limited to preparedness and response to health emergencies, appropriate standards, regulations and accreditation mechanisms shall be established.
Resource Mobilization/Financing	Develop mechanisms to generate resources; optimize resource allocation and guarantee equitable distribution; encourage investments for the development of climate change adaptation for health technologies.
Networking and Partnership-Building	Undertake collaborative efforts through inter-sectoral response and community participation for advocating and implementing the Philippine Climate Change Adaptation Plan for Health.
Service Provision, Capacity and Infrastructure Enhancement	
Service Delivery	Appropriate adaptation response and services related to, but not limited to, managing the health effects of climate change.
Capability-Building	This includes CCAH-responsive human resource development and training.
Facilities Enhancement	This includes upgrading of hospitals and other health facilities to make them climate change-proof, in adherence to infrastructural and service standards.
Health Promotion, Research, Surveillance and Monitoring	
Health Promotion and Advocacy	Develop communication interventions to influence societal and community actions toward climate change adaptation and health.
Research and Development	Utilize high-quality studies for evidence-based decision-making. Emphasize on establishing links connecting climate change and adverse health.
Information Management System and Surveillance	Generate reliable, relevant and up-to-date information is essential to respond to the negative health effects of climate change. Surveillance systems shall be developed for climate change-sensitive diseases.
Monitoring and Evaluation	Document events and progress in implementation, lessons learned, and share of good practices.
Strengthening Organizational Structure for Climate Change at Different Levels of Governance.	
National Level	The Inter-Agency Committee on Environmental Health, chaired by the

	Secretary of Health, shall be the main coordinating body with secretariat support from the Climate Change Unit under the National Center for Disease Prevention and Control.
Regional Level	The Regional Inter-Agency Committee for Environmental Health chaired by the CHD Director shall manage the CCAH sub-sector.
Local Government Unit (LGU) Level	The composition and organizational arrangements shall correspond to the structure at the regional level to be headed by the local chief executive.

C. Review and revise current emission standards

In the discussion earlier, Figure 2 showed that the Philippines lagged behind in implementing stringent limits on emissions from new coal-fired power plants compared to other countries. The weak emission standards allow new power plants to emit more pollutants that are detrimental to public health. There is therefore a need to review and revise current emission standards in the country to make it at par with the guidelines set by WHO.

D. Investigate and conduct a full accounting of health impacts of coal

The Philippines should conduct a full accounting and assessment, both at the national and local levels, of coal's contribution to climate change and the vulnerability and health impacts of coal use. The assessment process includes both the lived experiences of communities hosting coal-fired power plants and the national impacts of long-range pollution where most of the health impacts take place due to the large amount of people exposed. Evidence-based studies are vital in influencing coal energy policy from a public health perspective.

Efforts towards stronger implementation of DOH's CCAH strategy shown in Table 13 should be made. In addition to DOH's CCAH strategy, there should be a requirement for conducting health impact assessments (HIA), alongside environmental impact assessments (EIA) required by DENR under Presidential Decree No. 1586 (PD 1586), as part of the process for the approval of future energy projects.

The HIA should involve predicting and evaluating the likely impact of a project (including cumulative impact) on the health of host communities and the impacts of long-range pollution during construction, commissioning, operation and abandonment of a coal plant. It should also include designing appropriate preventive, mitigating and enhancement measures addressing these consequences to protect the community's health. The HIA should apply to all companies involved throughout a coal's life cycle: coal mining, coal washing, coal transportation, coal combustion and waste disposal.

There should also be a full accounting of the health costs of coal as well as the benefits of RE, including the implementation of CCAH, which will be used to allocate domestic funds and obtain financing from both international and domestic sources. Pursuant to Republic Act No. 9729, otherwise known as the "Philippine Climate Change Act" and Republic Act No. 10121, otherwise known as the "Disaster Risk Reduction and Management Act", the DOH should allocate a corresponding budget based on the implementation plan of the CCAH. LGUs should be encouraged to fund their local CCAH plans and programs with necessary technical assistance.

Based on the evidence generated from studies, advocates can define a clear statement calling for the phase out of coal and increase the number of renewable energy (RE) sources in the Philippines in accordance with public health considerations.

E. Respond to the needs of communities affected by coal's health impacts

Once the health situation in communities hosting coal plants has been assessed, patients suffering from diseases associated with exposure to coal plant emissions should be provided immediate medical assistance, as well as other forms of support to protect them from further health damage. Coal companies should be held accountable and required to cover the costs of hospitalization and other forms of medical help, in addition to health coverage already provided by PhilHealth. Rural health units in host communities should continue to extend needed health services to coal-affected individuals. To prevent further harm in communities, local governments should also immediately put in place preventive public health measures and enforce environmental laws governing coal-related emissions. In addition, local health systems should be strengthened, not just to be resilient to climate-related health impacts, but also responsive to health effects of energy options due to both direct pollution and indirect climate change.

F. Increase RE ambition of the Philippines to at least 50% by 2020

The DOE's recent announcement that the country is looking at a 70% dependence on coal for electricity generation from 2030-2050 is an indication that the Philippine government had already put RE in the back burner. This alarming outlook overlooks the fact that as early as 2011 the DOE had already indicated in the Philippine Energy Plan 2012-2030 that in terms of primary energy supply, RE already provides of up to 40.7% and 53% for the fuel input mix for power generation, with about 28.4% for the over-all power generation mix. The same document states that as part of its Energy

Reform Agenda, the DOE will triple the RE capacity by 2030 as part of its efforts to ensure energy security. However, this strategy seems to be the least favored option by the current Aquino government as actual power generation from RE fell starting in 2012 while coal is now on track to have the lion's share of the country's energy mix.

The Philippine Energy [R]evolution Roadmap to 2020, produced by Greenpeace Philippines in June 2011, provides a practical blueprint on how the country can dramatically increase its share in renewable energy while providing a secure and affordable energy supply and stimulating economic development. It also demonstrates how the country can get from where we are now to where we need to be in terms of ensuring energy security, phasing out fossil fuels, and contributing to global efforts in combatting climate change. To achieve this, we need to set an ambitious but realistic target of at least 50% renewable energy generation by 2020. The Philippines can lead Southeast Asia, especially within the context of the new ASEAN Economic Community, in RE development and provide a prime example of national development powered by sustainable energy.

The same *Roadmap* also recommends that RE generation should steadily increase to 45.15% by 2017 and should provide more than half of our energy needs by 2020. Established RE technologies like geothermal and hydro will take the lead. But rapidly emerging technologies such as solar and wind, will increasingly contribute to the energy mix leading up to 2020.

The latest *Energy [R]evolution* report by Greenpeace International, released in September 2015, sends a strong message to policy makers and leaders around the world: "there are no major economic or technical barriers to moving towards 100% renewable energy by 2050. It just requires the political will to make the change." In the same report, it is stated that renewables contributed 60% of new power generation worldwide in 2014. This expansion has meant huge falls in costs, so that solar PV and wind power is now cost-competitive with new coal in most regions.

These global trends will have a significant impact on how RE will pave the way for a new level of energy security and independence in the Philippines, reducing its greenhouse gas emissions as part of its efforts to adapt and mitigate climate change impacts and ultimately wean away from its dependence on coal for electricity generation.

G. Policy and law review and evaluation

Currently, as shown in Table 14, there are a number of laws and regulations that appear to address air pollution, water pollution and hazardous wastes. These laws focus on the regulation of emissions, effluents and hazardous wastes generated to comply with the standards and procedures imposed by law or by the DENR, and may therefore serve as basis to manage and mitigate the environmental and health impacts of existing coal plants. However, these laws also demonstrate the insufficiency of the current regulatory framework in terms of mitigating coal use. In fact, these laws sanction the emission or discharge of effluents and pollutants and the generation of hazardous waste, subject only to compliance with applicable regulatory standards.

Table 14: Philippine laws addressing air pollution, water pollution and hazardous wastes

Pertinent Laws	Provisions of the law
Republic Act (RA) No. 8749 Philippine Clean Air Act of 1999	• Mandates that all sources of air pollution have a valid permit to operate.[xlix] • Companies violating air quality standards shall pay a fine computed by the Pollution Adjudication Board (PAB)[l] The PAB can also order the closure, suspension of development, construction, or operations of the violating companies.[li]
RA 9275 Philippine Clean Water Act of 2004	• Requires all owners or operators of facilities that will discharge regulated effluent to secure a permit which will specify the quantity and quality of effluent allowed to be discharged into a particular body of water.[lii] • Any person who causes pollution in or pollutes water bodies in excess of the applicable and prevailing standards is responsible to contain, remove and clean up any pollution incident at his own expense to the extent that the same water bodies have been rendered unfit for utilization and beneficial use.[liii]
RA 6969 Toxic Substances and Nuclear Wastes Control Act of 1990	• Governs the importation, manufacturing, processing, handling, storage, transportation, sale, distribution, use and disposal of hazardous and nuclear wastes in the country.[liv]

On the other hand, Republic Act (RA) No. 9513, otherwise known as the "Renewable Energy Act of 2008", declares the policy of the State to accelerate the exploration, development, and utilization of RE resources and to minimize dependence on fossil fuels such as coal. To encourage participation in the exploration and development of RE resources, the law provides for various fiscal incentives for RE developers. Considering, however, the health risks posed by coal throughout its life cycle, it is simply not sufficient to merely regulate or minimize the environmental hazards of coal use or even to incentivize the construction and operation of RE plants.

Review of policies are needed in all relevant sectors – for the DENR to enhance regulation of pollution most particularly policies that impact energy policy decisions; for the DOE to recommend relevant amendments to the Electric Power Industry Reform Act (EPIRA) and other electricity-related laws to veer away from technology-neutral "least cost" approaches and instead consider the inclusion of external costs of energy such as health costs; and, for the DOH to play a more aggressive role in assessing health impacts of energy, both occurring and projected.

Furthermore, there is also a need to strengthen the monitoring and enforcement of penalties and fines for violations of PD 1586, RA 8749, RA 9275 and RA 6969.

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