

Grid Interconnection and Renewables Deployment related Air Quality and Human Health Benefits in Southeast Asia

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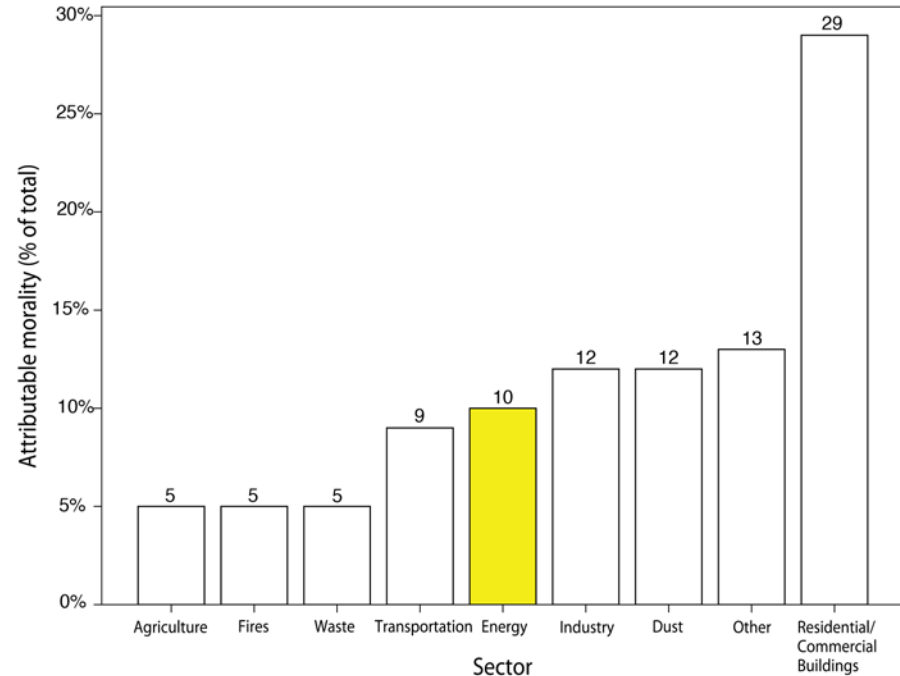
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Introduction

Air Pollution in Southeast Asia

- Energy sector contribution to air pollution caused mortality is 5th highest (~10%) in SE Asia, including:
 - 6% from coal-fired power generation and
 - 4% from other power generation sources
- 10,000–40,000 cases of excess mortality each year from PM_{2.5} exposure
 - More than the excess deaths from transportation-related pollution



Adapted from McDuffie et al. (2021)

Geographic and Sectoral Scope of Analysis



- Our analysis focuses on power sector-related emissions.
 - Only direct emissions from combustion of fossil fuels are considered
 - Emissions from any upstream and downstream processing are not accounted for

ASEAN Interconnection Masterplan Study (AIMS) III Scenarios

Scenario Name	Description
Base Case	Each country's existing PDP* is respected but extended beyond PDP period to 2040, without new interconnection considered
Optimum RE	Co-optimization of interconnection capacity and VRE & conventional generation expansion
ASEAN RE Target	Renewables target of 23% is fixed in the plan, the remaining generation and interconnection capacity are optimized
Higher VRE	Explore the potential of having higher VRE for advancing multilateral power trade
Updated PDP	Updating the study with the latest PDPs

*PDP: Power Development Plan

*Note: Many countries have updated their Power Development Plans (PDPs) since AIMS III, and these updates are not included in our analyses.

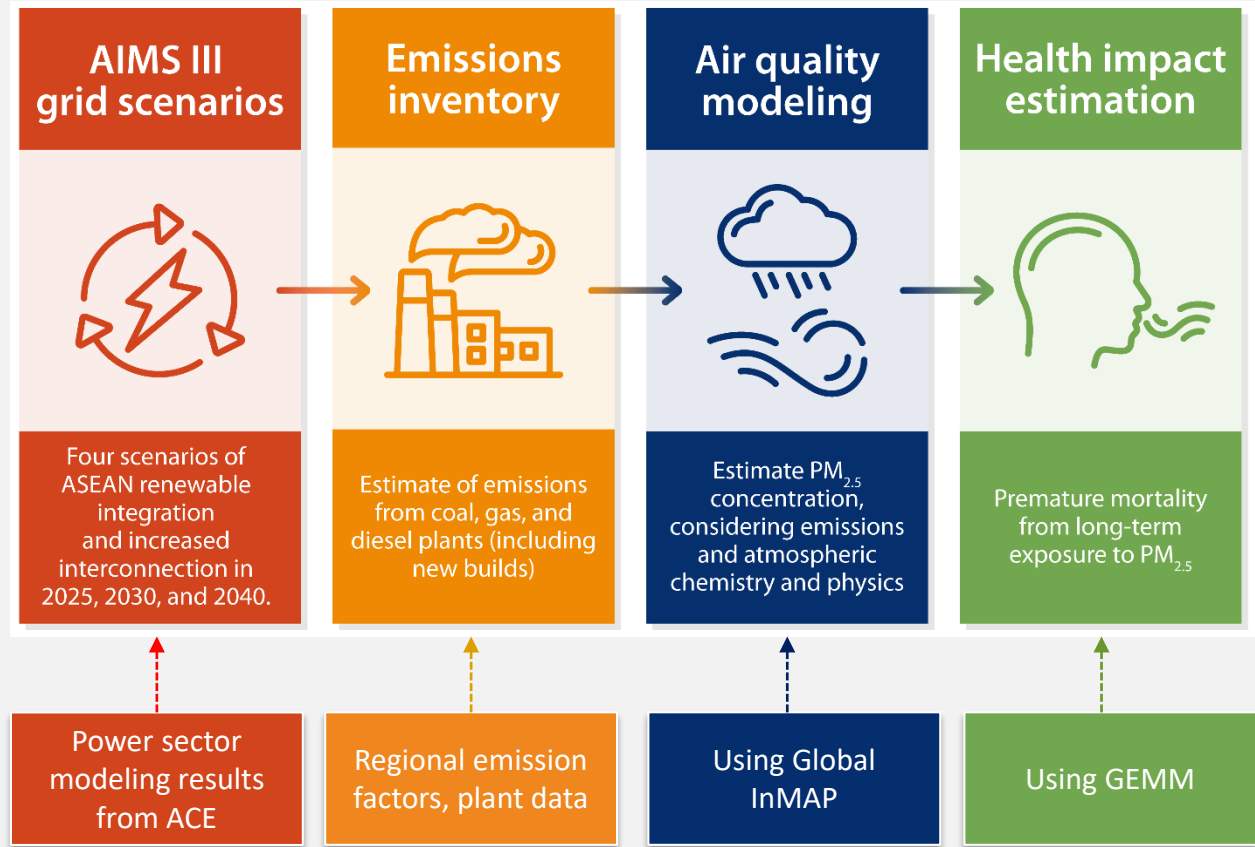


Source

Coal Diesel Gas-CC Gas-OC Geothermal Hydro Solar Wind

Models and Methods

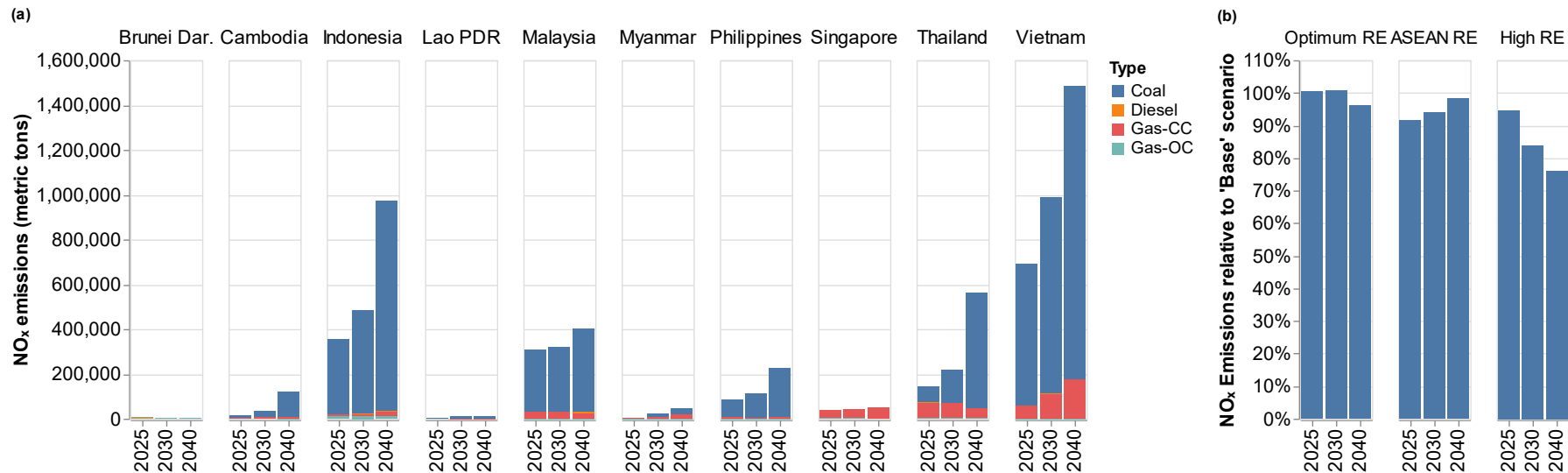
Analysis Methodology



Global InMAP is described in Thakrar et al. (2022)

Air quality and health impact results

Emissions Inventory Reflecting AIMS III Scenarios



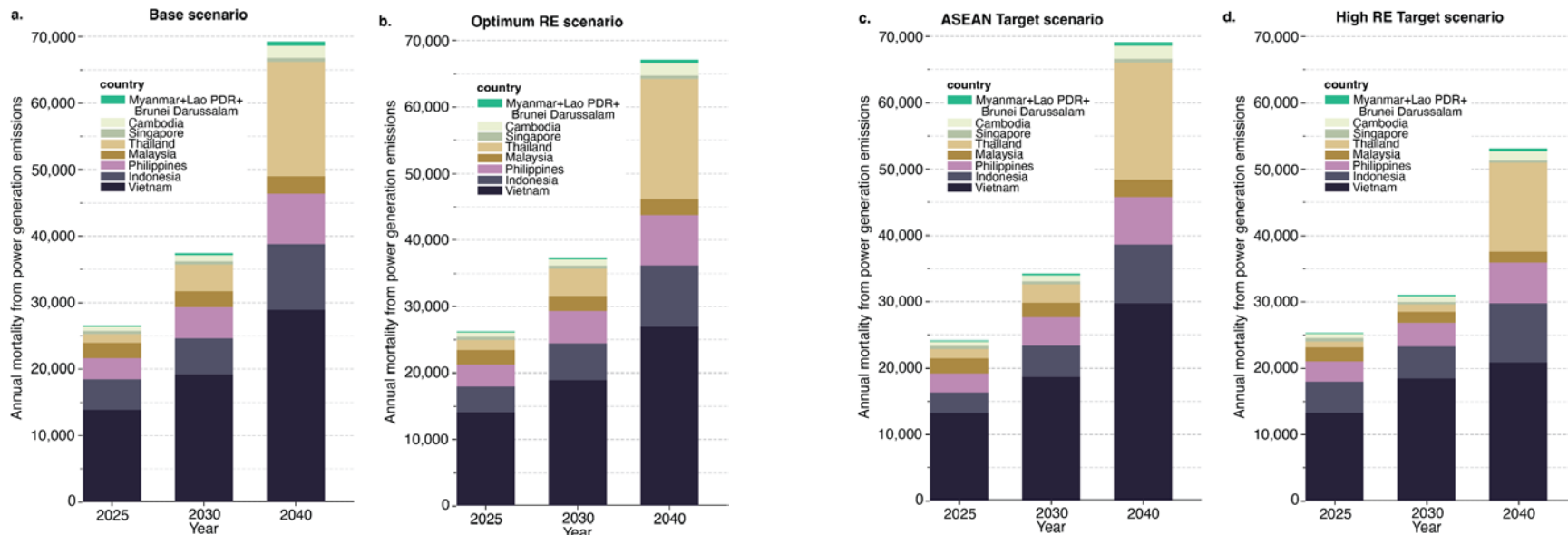
Estimated emissions of NO_x by country and unit types in the three AIMS III modeling years for the Base scenario (Frame a) and for the ASEAN region as a whole (relative to the Base scenario) for the three AIMS III scenarios (Frame b)

Results: Changes in Annual Average PM_{2.5} Concentration

Scenario	Year	Change in Population-weighted PM _{2.5} Concentration Relative to Base Scenario ($\mu\text{g m}^{-3}$)	% of Population Breathing Cleaner Air (Relative to Base scenario)
Optimum RE	2040	-0.08	91%
ASEAN RE Target	2040	-0.01	34%
High RE Target	2040	-0.50	99%

In Optimum RE and High RE Target scenarios, the vast majority of citizens in ASEAN countries would breathe cleaner air

Results: Changes in Mortality Over Time

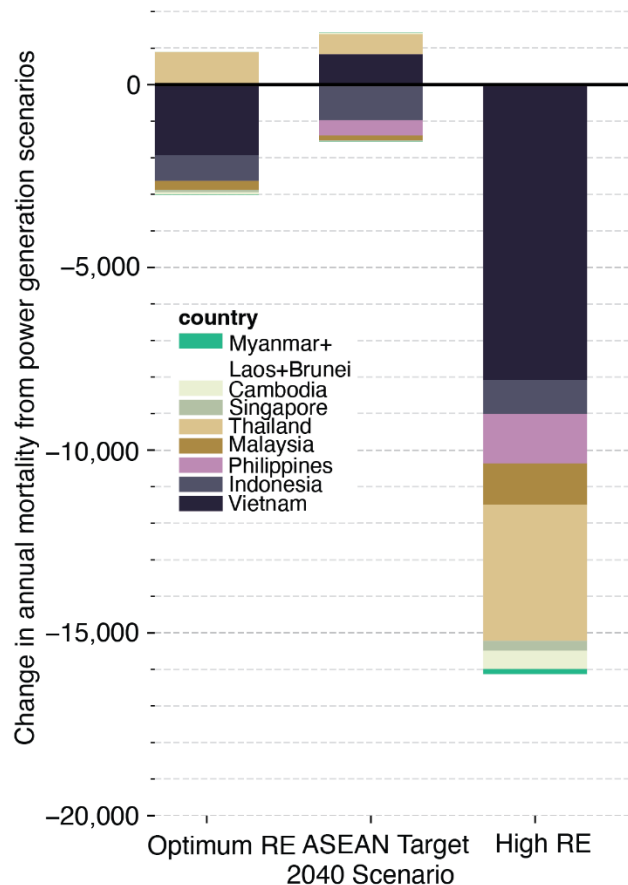


- All scenarios lead to projected increases in PM_{2.5}-caused mortality
- Distribution of projected increases in excess mortality reflects the spatial distribution of emissions increases across ASEAN countries, with the greatest increases in countries such as: Vietnam, Thailand, Indonesia, and the Philippines

Results: Changes in Projected Mortality Relative to “Base” in 2040

- All alternative AIMS III scenarios lead to decrease in regional, net PM_{2.5}-caused annual mortality relative to the Base scenario in 2040
- In the High RE Target scenario, PM_{2.5}-caused mortality declines in all countries relative to the Base scenario
- Other scenarios indicate a few countries experience an increase in mortality relative to the Base scenario in 2040

Change in mortality relative to 2040 Base Scenario



Limitations and Opportunities

Limitations & Opportunities for Improvement

- AIMS III scenarios reflect 2018-2019 power development plans.
 - Incorporating recent changes to PDPs would increase the relevance of this analysis.
- Country-level analysis
 - Power sector modeling was at country level (2 countries represented with 3 nodes)
 - Results should only be viewed at country or regional level
- Population, economic growth, and health status assumed static with 10,000–40,000 cases of excess mortality each year from PM_{2.5} exposure
 - Incorporating these factors and resultant changes could further improve the analysis
- Biomass-based power excluded in AIMS III
 - In some countries, this could lead to large underestimation of emissions from power sector, but in others, relatively small underestimation of emissions
- Power sector considered in isolation
 - Electrification of transportation represents just one cross-sectoral linkage
 - Thus, this study doesn't attempt to estimate absolute magnitude of concentrations and health in the future; the focus is relative differences in power sector emissions and health impacts between scenarios

Conclusions

- **Power sector is (and is expected to remain) a prominent source of air pollution in SE Asia.**
 - Mortality and other health effects from the power sector in SE Asia will only become more pressing in a region already with some of the highest air pollution levels in the world
- **Alternative AIMS III scenarios yield net reductions in mortality compared to Base scenario**
 - A few countries have increased estimated mortality in Optimum RE and ASEAN RE Target scenarios
 - All countries have decreased estimated mortality in High RE Target scenario (16,000 total avoided mortality annually in 2040)
- **Study points to potential benefits of regional coordination of strategic power sector investments that could start to consider air quality and health**
 - Air pollution is transboundary; changes in one country will affect others
 - Strategic utilization of renewable power; partnerships to locate emitting plants in lower mortality intensity regions; and the prioritization of emissions control equipment for certain units



Thank you

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Thank You

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