

Power plants in Southeast Asia - a necessary evil?

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The energy demands of Southeast Asia



All Southeast Asian (SEA) countries have signed the Paris Agreement to keep global average temperatures below 2°C above pre-industrial levels (IPCC, 2013). However, thermal power plants (coal and natural gas) still remains to be responsible for a majority of the region's electricity production (77.8%) despite its carbon

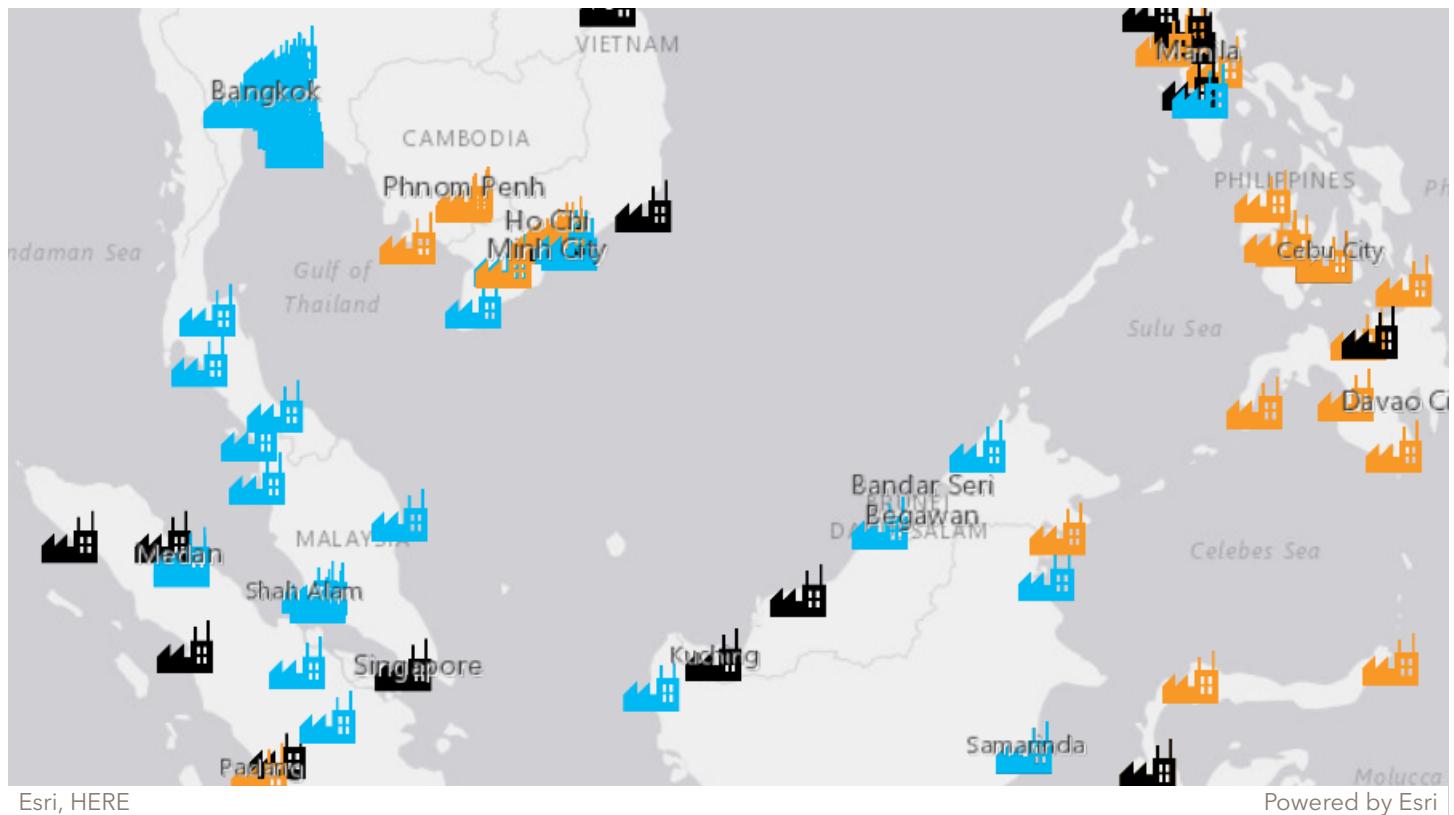
emissions being a leading contributor to climate change (UNESCAP, 2016).



The number of power plants across SEA has been observed to be increasing significantly since 2000 to cater to the energy demands of a growing population.

While there has been diversification in the power supply industry in recent years (such as with the introduction of renewable energy), thermal power plants still remains to be the main energy source due to it having the highest capacity (Tan, 2019).

The question is, is it feasible for these developing countries to fulfil their commitments to the treaty by eliminating thermal power plants or is this energy source a necessary evil?

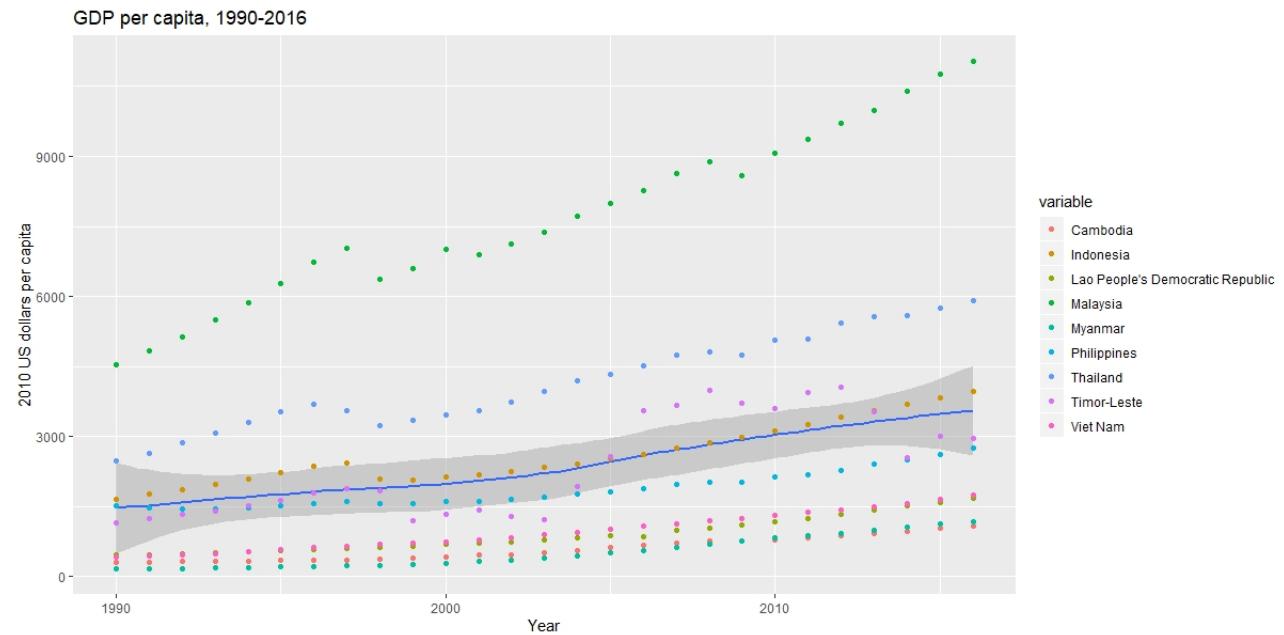


A map of the different types of power plants type in SEA (click bottom left for legend). Thermal power plants (coal and natural gas) are responsible for a majority of SEA's electricity production (77.8%), followed by hydro (14.1%), oil/diesel (2.69%), bio fuels and waste (2.49%) and lastly, solar/wind (0.69%).

COUNTRIES UNDER THE POWERING PAST COAL ALLIANCE

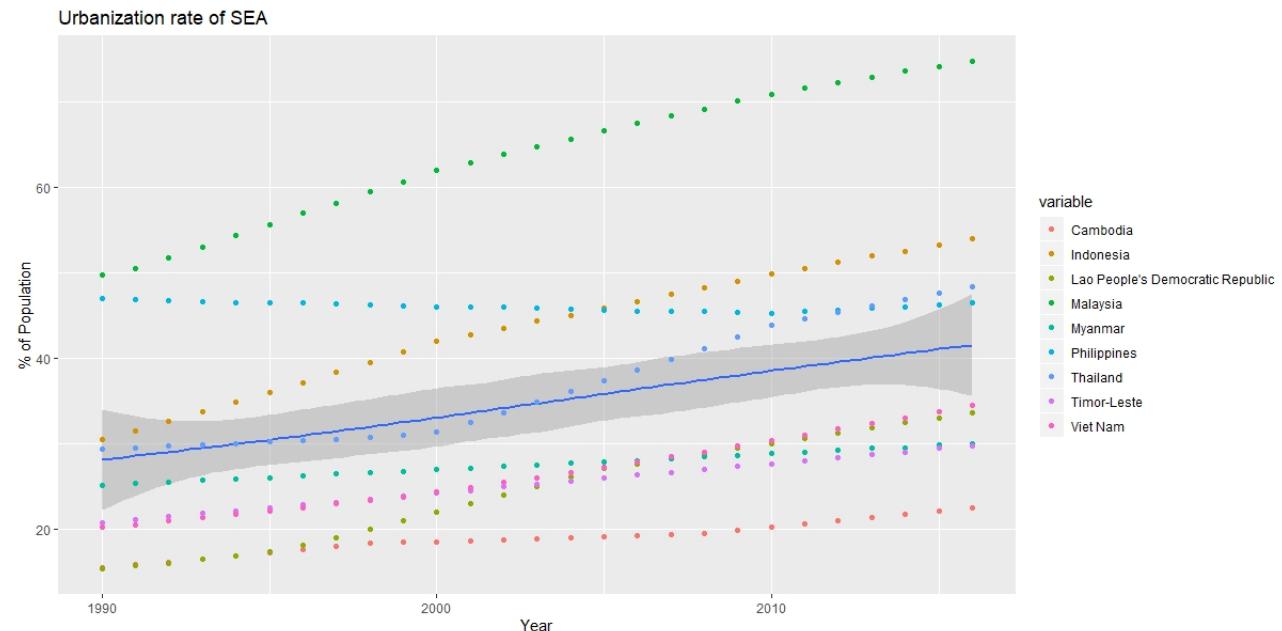
- | | | | |
|--------------------------|--------------------|-----------------------------|------------------------|
| 1. Canada | 9. Ethiopia | 17. Latvia | 25. Niue |
| 2. United Kingdom | 10. Fiji | 18. Liechtenstein | 26. Portugal |
| 3. Austria | 11. Finland | 19. Lithuania | 27. Senegal |
| 4. Angola | 12. France | 20. Luxembourg | 28. Slovakia |
| 5. Belgium | 13. Germany | 21. Marshall Islands | 29. Sweden |
| 6. Costa Rica | 14. Ireland | 22. Mexico | 20. Switzerland |
| 7. Denmark | 15. Israel | 23. Netherlands | 21. Tuvalu |
| 8. El Salvador | 16. Italy | 24. New Zealand | 32. Vanuatu |

The Powering Past Coal Alliance comprises of 32 countries which have pledged to phase out traditional or unabated coal power. No SEA countries are a part of this group (PPCA, 2017). It is not feasible for SEA to rely on renewable energy sources such as wind, solar and tide because supply is intermittent and the technology is still in its infancy (Tan, 2019).



Locally weighted smoothing was done for the GDP per capita, urbanization rate and final energy consumption per capita on the SEA countries.

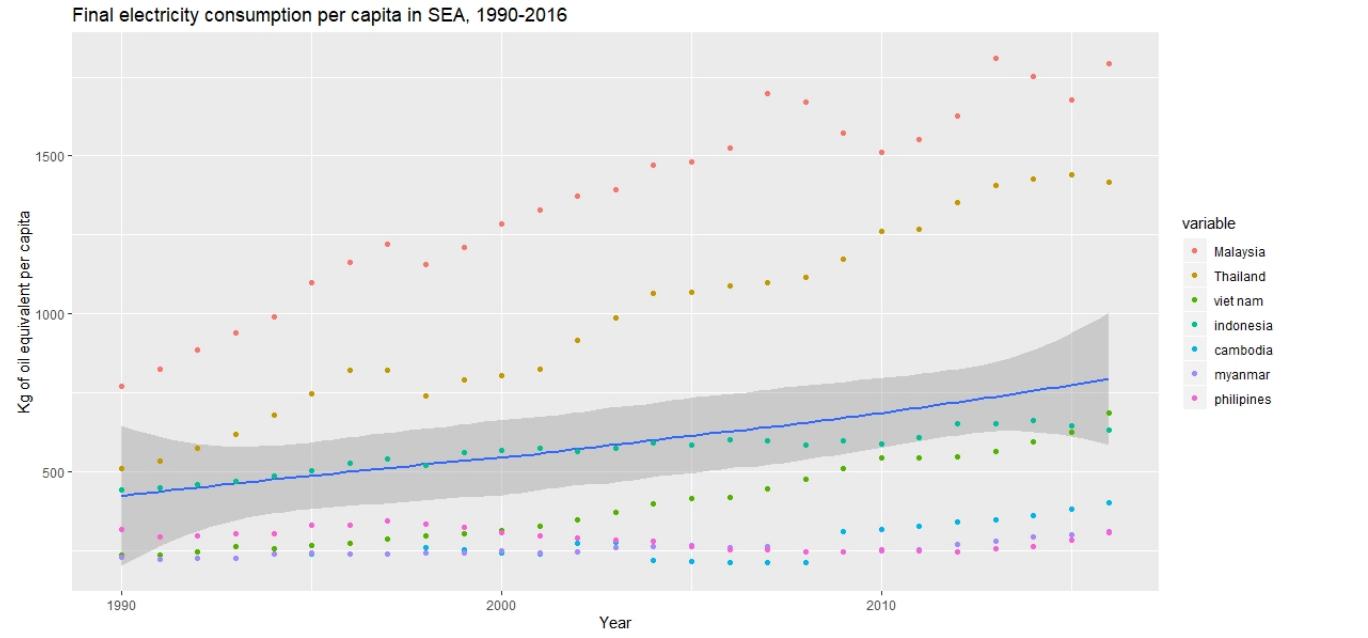
The regression analysis showed an increasing trend in the economy, urbanization and energy consumption rate.



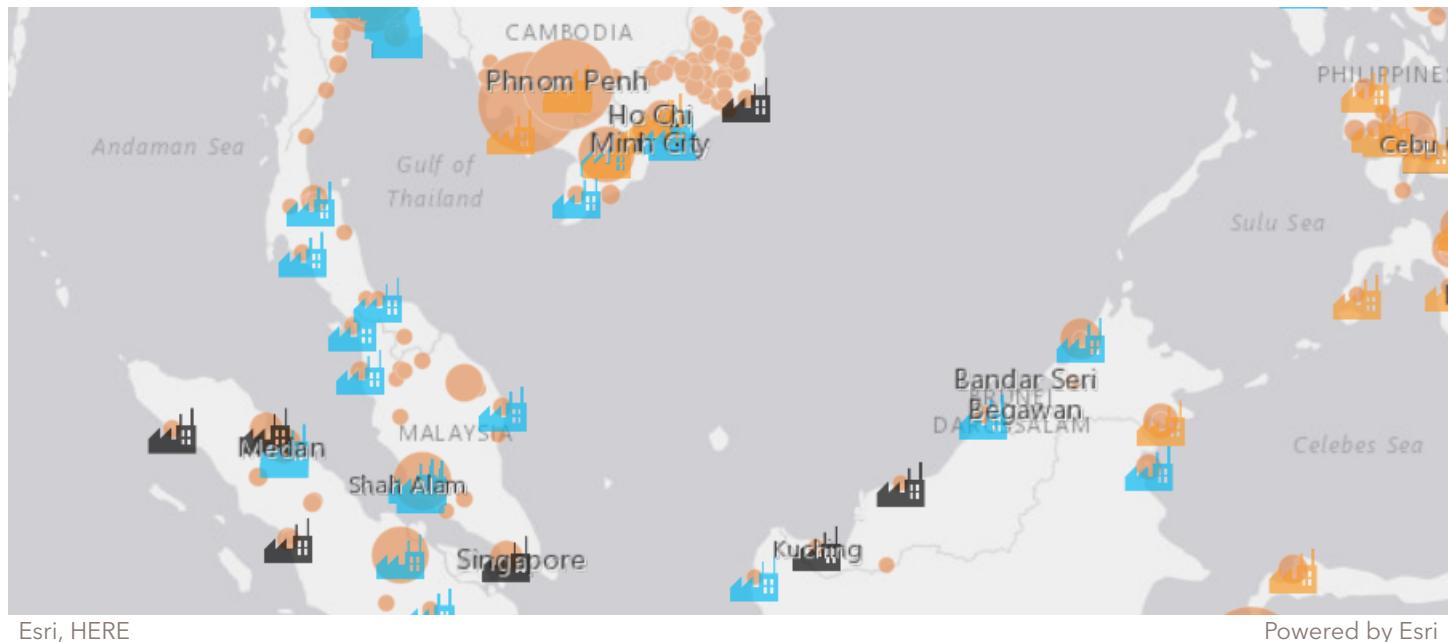
Thermal power plants are a very efficient source of energy relative to its renewable counterparts.

Because most SEA countries are still in the process of achieving

economic advancements and stability, they are unwilling to make the switch from thermal to renewable energy, despite the environmental benefits.



Location of power plants in SEA



Most power plants in SEA are located within close proximity to densely populated areas. The population count is represented by the orange buffers.

Power plants in SEA

Fuel type



Gas

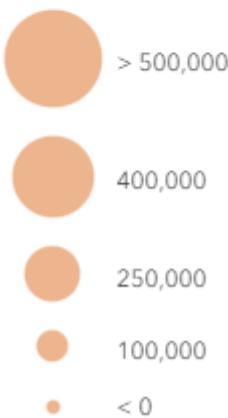


Coal



Oil

Population



Earthstar Geographics | Esri, HERE, Garmin

Powered by Esri

For example, there are three gas power plants in Cilegon, Indonesia - all of which are located in areas with high population numbers.

The populations residing closest to the power plants are those that are most vulnerable to the negative impacts of its activities.

Feel free to click on the power plant icons and population buffers to find out more information about these sites.

If the power plants aren't located in populated areas, they are found within forested ones.

For example, the Na Duong coal power plant is surrounded by dense vegetation; approximately 175,000 ha of forest can be found within a 20km radius.

Environmental and Health Impacts



Aquatic life

Coal and gas power plants are often located near water bodies because large quantities of water are required to cool down the facility during operations (Pan, 2018).

Improper management and regulation of water use would significantly decrease the water source's stream base flow and affect stream morphology (Rolls, 2012).

Mercury emissions also tends to get biomagnified across the food

chain. Humans are most likely to obtain mercury poisoning from eating contaminated fish (WHO, 2017).



Human health

Some examples of harmful emissions include **particulate matter (PM)** which are small enough to enter human lungs and bloodstream, causing a multitude of diseases such as heart attacks and asthma (EPA, 2003).



Natural and built environments

When emissions of sulfur dioxide comes into contact with water and air, it forms sulfuric acid, a component of acid rain.

Acid rain corrodes the built environment and causes natural environments to become overly acidic and not conducive to support life (Yocom, 1979).



Soil health

Soil acidification due to acid rain will cause nutrient and water

depletion. This damages vegetation and renders affected lands to become infertile (Liang, 2017).

Would you let your child live near a coal and natural gas plant or a nuclear plant? Let's hear what Bill Gates has to say.



Video

Methodology

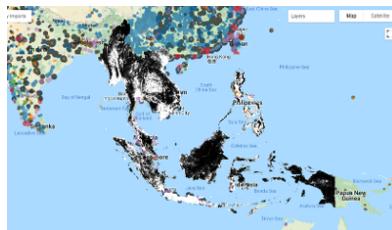


"Worldpop Global Project Population Data: Estimated Residential Population per 100x100m Grid

"Square" and "Global Power Plant Database" are obtained using Google Earth's Engine's (GEE) "view all datasets" search function. The code is then run in GEE code editor. Next, image collection function is then used to clip to the region of interest – Southeast Asia (SEA).



Global power plant data base was extracted with “Export.table.toDrive” code.



Population in SEA image was then exported to drive using “Export.image.toDrive” code.

SEA population data was in TIFF file format and separated into four parts. “Mosaic to New raster” tool was used to merge the four images into a single image.



Medium scale data, 1:50m raster of the world map was downloaded from naturalearthdata.com. Polygons of SEA was selected and exported as a

new layer in ArcGIS pro. To show only power plant database in SEA, “Clip” tool was used to clip the power plant database with the newly exported SEA layer

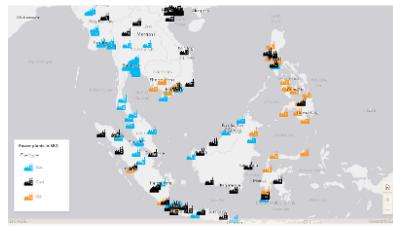
Owner	
Country	MYS
Commission year	0.00
Capacity (MW)	330.00
Longitude	100.31
Latitude	5.38
source	Peninsular Malaysia Electricity Supply Company
url	More info
Fuel type	Gas
Power plant name	Gelugor
Country	Malaysia
GW h	1,827.90
Forest (ha)	11,005.79
Water (ha)	2,894.11
Mangrove (ha)	1,239
Urban (ha)	12,709.65
plantation (ha)	20,103.90
Population (5km)	21,490.67
Population (20km)	40,612.52

Next, Miettinen’s (2016) land cover map of SEA was used to display the different land classes in the region. The classes are grouped into water, forest, mangrove, urban and oil palm. To calculate amount of land cover around the power plants. “Buffer” tool was first used to create a buffer of 20km. Then, “tabulate area” tool was

used to determine the amount of vegetation around the power plants.

Moving on, “Zonal statistics as table” tool was used to calculate the population number count around the power plant at 5km and 20km radius.

“Tabulate area” and “Zonal statistics as table” results were exported into excel, cleaned up, then imported back into ArcGIS. Join and relates function was used to add vegetation and population data into a single layer.



Then, export features function was used to export the layer as a shape file to be uploaded onto the webmap. And aesthetics of the map was edited on Arcgis online web map.

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