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Political Economy of Energy Transition in Developing Countries: a Comparative Case Study of Indonesia and the Philippines

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Master in Political Economy

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Abstract:

Since the turn of the millennium, there has been an increased international focus on global development. In 2015, the focus shifted to a sustainable based one, which includes ideas such as "energy transition". What exactly "energy transition" is and how to measure it has been heavily debated. Nevertheless, it has become the standard that all countries are being held to by organizations such as the United Nations. The influence of this standard affects countries with developing economies differently than those considered developed. This dissertation will show why developing countries decide to partake or not in the energy transition. Through a comparative case study analysis of two developing countries, Indonesia and the Philippines, this dissertation will highlight the factors that create differences in the amount of renewable energy that is used per country. Public policy is the guiding force of a country's power production. Therefore, the ideas and institutions that policymakers face are crucial to understand how the different countries end up with vastly different energy systems. By examining all the factors at play, including technological limitations of the different energy sources, one can see that partaking in the United Nation's energy transition may be more harmful than helpful for developing countries.

JEL Classification:

Q48 - Government Policy

O10 - General Economic Development

Keywords: energy, public policy, economic development, Indonesia, the Philippines

Resumo:

Desde a viragem do milénio, tem havido uma maior atenção internacional ao desenvolvimento global. Em 2015, o foco mudou para uma base sustentável, que inclui ideias como a “transição energética”. O que é exatamente a “transição energética” e como medi-la tem sido muito debatido. No entanto, tornou-se o padrão a que todos os países estão a ser obrigados por organizações como as Nações Unidas. A influência deste padrão afecta os países com economias em desenvolvimento de forma diferente dos países considerados desenvolvidos. Esta dissertação irá mostrar porque é que os países em desenvolvimento decidem participar ou não na transição energética. Através de um estudo de caso comparativo de dois países em desenvolvimento, a Indonésia e as Filipinas, esta dissertação destacará os factores que criam diferenças na quantidade de energia renovável que é utilizada por cada país. A política pública é a força orientadora da produção de energia de um país. Por conseguinte, as ideias e as instituições com que os decisores políticos se deparam são cruciais para compreender como é que os diferentes países acabam por ter sistemas energéticos muito diferentes. Ao examinar todos os factores em jogo, incluindo as limitações tecnológicas das diferentes fontes de energia, é possível ver que a participação na transição energética das Nações Unidas pode ser mais prejudicial do que útil para os países em desenvolvimento.

JEL Classification:

Q48 - Política governament
O10 - Desenvolvimento económico geral

Palavras-Chave: energia, políticas públicas, desenvolvimento económico, Indonésia, Filipinas.

Index of Tables and Charts:

Index of Abbreviations:

ACE - ASEAN Centre for Energy
AMS - ASEAN Member States
APAEC - ASEAN Plan of Action for Energy Cooperation
ASEAN - Association of Southeast Nations
CCS/CCUS - Carbon Capture and Storage/Carbon Capture, Utilization, and Storage
CO2 - Carbon Emissions
DER - Distributed Energy Resources
DOE - Philippine Department of Energy
EC - Energy Consumption
ECC - Electricity Consumption per Capita
EG - Economic Growth
EIA – United States Energy Information Administration
EKC - Environmental Kuznet’s Curve
ESCAP – United Nation’s Economic and Social Commission for Asia and the Pacific
EU - European Union
GDP - Gross Domestic Product
GNI - Gross Net Income
GW - Gigawatt
HDI - Human Development Index
IEA - International Energy Agency
IMF - International Monetary Fund
LCOE - Levelized Cost of Electricity
LNG - Liquefied Natural Gas
MDG - Millennium Development Goals
Mtoes - Million Tonnes of Oil Equivalent
NDC - Indonesia’s First Nationally Determined Contribution
NGO - Non-Governmental Organizations
NIMBY - Not in My Backyard (idea that people don’t want certain things near where they live)
SDG - Sustainable Development Goals
R&D - Research and Development
RE - Renewable Energy
REE - Rare Earth Minerals and Elements
RUPTL - Rencana Umum Penyediaan Tenaga Listrik (one of Indonesia’s energy policies)
SO2 – Sulfur Dioxide
TFEC - Total Final Energy Consumption
TPES - Total Primary Energy Supply

TWh and KWh - Terawatt-hour and Kilowatt-hour

UN - United Nations

UNDP - United Nations Development Programme

UNSD - United Nations Statistical Division

WEC - World Energy Council

Chapter One: Introduction

Countries worldwide can be divided into different categories based on their level of economic development, those being “developed”, “developing”, or “underdeveloped” with different sub-levels within each category. Those outside the ‘developed’ category will strive to reach it because with higher levels of development comes a higher standard of living for its citizens. In order to grow the economy and reach the next level of economic development, the countries need more power generation to fuel the growth. Even if they are not actively making the move up to the next level they need steady and affordable electricity access for their people in order to maintain their current levels. Unstable or unaffordable energy comes with more problems which pushes policymakers to develop well-rounded energy policy.

With a well-rounded energy policy it provides citizens access to be able to run their businesses, develop energy-intensive industry, keep hospitals running, have cooling when it is hot or heating when it is cold, be able to preserve food longer, and a long list of other much needed benefits. Countries that have resources to harvest energy also have an added advantage of potential economic benefits that can be rolled into other industries or infrastructure. Even if these sources are harvested for one’s own country, they can provide more security and independence for the country, which relying on imports does not provide. The type of energy sources chosen to fuel the power generation is important because a top all the economic consequences there are lasting environmental ones as well.

Many countries relied on the most accessible and cheapest forms of energy as the main source of their economic development throughout history. In recent years the focus has changed as there has been a worldwide growing awareness of environmental concerns which has increased the scope of considerations in making energy policy. Many developing countries have stated that they aim for cleaner forms of energy by certain dates; straying from the old ways of simply using whatever source cost the least. This is where the idea of energy transition has gained major traction globally, as even the United Nations (UN) has made it a major discussion in their gatherings.

Energy transition is a highly debated topic with few countries and international organizations agreeing on exactly what it is the majority loosely define it as the move from ‘dirtier’ energy sources to ‘cleaner’ ones, usually measured by carbon emissions (CO2). Using this loose definition, it is easy to see why so many are focused on making some form of energy transition occur, as each step away from dirtier energy can have significant effects on the environment. However, debates begin when delving into the details of energy transition. Those debates range from how to measure a transition through percentages or raw numbers, and should it be supply side or demand side based. It could also be that one doesn’t simply say ‘cleaner’ energy but has a specific set of energy in mind, such as renewable energy but what is “renewable energy” gets debated heavily. Should it be sustainable energy instead? Where do sources such as nuclear fall in all of this? All of these have created rifts in the international community in defining the term.

There is also an increased focused on energy security ensuring countries don't end up too reliant on other countries to provide their crucial energy supply. Some countries have grouped this with energy transition as an important multi-pillared foundation of better energy policy. Thus, this thesis will seek to answer the following question: *How do domestic and international political economic factors affect developing countries´ energy sourcing and power generation?*

Conceptually, discussing energy security, energy access (or equity), and environmental sustainability pushes policymakers to have more well-rounded energy policy. If conversations die out then it becomes easier to take the simple way out and neglect one or two of the trio. Energy is needed for economic development and development is needed for a higher standard of living for people. All of it is connected and therefore all aspects are highly important. These points are talked about often on the international stage but if they actually go into effect on the domestic level is another question altogether. Even if they do, what does that look like? Looking at the worldwide, then regional, then country level is one of the best ways to understand energy policy. Southeast Asia is considered one of, if not the most, important developing regions in the world at the current time. In the attempt to answer the question, this thesis will look with more detail into the case of Southeast Asia.

The region of Southeast Asia encompasses a larger population than the entire European Union (EU), and there are only 11 countries compared to the EU's 27. Southeast Asia's population is continually increasing larger and the economy is one of the fastest growing in the world. This economic growth and large population mean that in the future Southeast Asia could be a very important region with the power to drastically impact the world economy and the environment.

The region of Southeast Asia has created a political and economic union that covers many different areas of public policy including the energy sector. The organization has set out goals and deadlines, including increasing renewable energy by certain amounts by 2030. The goals aren't the only aspect of energy it is involved in. It also helps propose and coordinate different projects to help alleviate the pressures of handling all three energy challenges for the individual states. Even with the regional organization, the countries still maintain sovereignty, allowing them to carve out their own energy futures, which has led to countries with varying energy transition results.

Methodologically, through a comparative case study of two Southeast Asian countries on the two ends of the energy transition scale, this dissertation will show how political economic factors lead countries to differing results when it comes to energy policy. The concepts and definitions guiding policymakers will be established first, along with the grand consequences of slight differences in definitions and metrics. The region will be examined on the whole, since geography also plays a role in energy supply and demand, before the case studies themselves are discussed. Through secondary data and literature published by different sources, such as international energy monitoring organizations, academic articles, the international organizations publications, and the countries themselves own words, the answers to the questions shall come forth. The different sources of energy shall have their merits and downsides discussed along with the challenges countries face when trying to establish their power generation system. By having a technical understanding of energy, a wide view of the international pressures exerted, and a deeper dive into the structures of individual countries, the goal is to have the reader understand what policymakers in developing countries have to be aware of when creating energy policy which may or may not align with goals set out for them by the UN and/or other organizations.

The thesis is structured in the following way. After this Introduction,

Chapter 2 discusses the important concepts and theories for energy policy in developing countries along with making definitions more clear and going through the controversies surrounding them. A technical understanding of many energy terms will be established to show the complexity and to remove confusion that often comes for those who do not have an energy background. The international energy goals will be shown specifically alongside alternative choices to measure the successfulness of energy policy for developing countries.

In Chapter 3, Southeast Asia, as a region, will be examined from the economic situation, to the political and economic union, to the energy situation. The human development and energy access relationship will be developed in the regional context to further highlight the importance of good energy policy. The environmental concerns surrounding the economic growth shall be discussed afterwards showing the non-financial costs of the quick expansion. Then why the situation is occurring will be examined through a breakdown of the current energy sourcing. Which leads to the future trajectory and alternatives to the current state of power generation along with the challenges involved with each option. The chapter will be wrapped up with a political economy analysis to understand what pressures Southeast Asian countries face on the whole and how they can aim to be successful in their energy planning.

In Chapter 4, a comparative case study of the two countries going in the most opposite directions of renewable energy growth will be conducted. First the importance of the countries will be established as Indonesia and the Philippines both have the potential to be significant world players. Then it will follow a similar pattern as Chapter 3 by discussing the human development and energy access relationship specific to the cases and followed by the environmental costs of the growing energy access. The energy scene will be shown to have a general understanding of the two along with how each energy source appears or doesn’t within their borders. Then the energy transition or lack thereof will lead up to the finale of the chapter, the political economy analysis of the cases’ to understand how they got to this point, and where they will must go from here.

Chapter Two: Energy Policy and Human Development

2.1 Human Development and Energy Access

There are a number of important ideas and theories that guide policymakers all around the world when it comes to energy policy and development of their countries. Human development has become a very important topic in many internationals' discussions as a goal to achieve. What does this goal even mean? Is it measured in economic numbers such as GDP or is there more to it? What does it mean in practice for the citizens receiving the higher levels of human development? This can involve raising the living standards of their citizens, increasing the number of jobs, raising more money for important projects such as infrastructure or increasing incomes for majority of the people. It shouldn't be measured solely on a country's gross domestic product (GDP) numbers because it has been seen that population increases can bring this number up without any positive effects for the people. It is best measured based off the effects of how the citizens are affected. True development means more than just a larger economy, but one of improvement for the whole of the country; underdeveloped reaching developing and developing reaching developed classification would have long and deep lasting changes for all those involved. Therefore economic development can generally be seen as the pursuit of moving from one stage of development to another but these goals cannot be realized without defining what exactly it means to be developed or developing.

The definition of what a developing country is varies from organization to organization with some, such as the United Nations Statistical Division (UNSD) taking a stance that there is no established convention of designation of developed and developing within the UN system. One way to remedy this lack of a clear definition is to cross reference different standards from different organizations such as "high income" from the World Bank based off gross net income (GNI) per capita, purchasing power parity for the International Monetary Fund (IMF), and Human Development Index (HDI) established by the United Nations Development Programme (UNDP). The crossing point of "high income", "advanced economy" and "very high" HDI can be used as a way of dividing developed countries and developing or underdeveloped countries. When applying this to Southeast Asian countries, Singapore and Brunei, fall under the developed categorization. Two others countries that meet the standards in one or two categories but not all three are Thailand and Malaysia, categorizing them "developing" countries but on the upper end. Vietnam and Indonesia fall in the next category below that categorizing them as "developing" countries but in the middle end, Philippines lag a bit behind them while Cambodia, Laos, and Myanmar are considered to be a category below categorizing them as "developing" but on the low end. The "underdeveloped" category is not given out lightly as the economic situation has to be considered quite dire to be in that category. While none of the Southeast Asian countries have situations considered as dire as much of Sub-Saharan Africa, or war-torn countries like Yemen or Afghanistan, it is still far from ideal for the living standards of their people.

In 2020, over 750 million people worldwide did not have access to electricity with nearly 80% of that population (589 million) living in Sub-Saharan Africa. The region with the second highest population is developing Asia at 126 million (IEA, 2023a). While numbers may seem staggering, it is important to compare it to 10 years prior where the world had approximately 1.4 billion people without energy access and the developing Asian population was at six times what it was in 2020, 760 million, thus showing major progress[1]. The most significant division occurs between the upper income countries and the those in the lower income brackets as upper income has 100% energy access or very close to it and even the upper-middle income countries sit at 99% while much of the low-income countries have urban rates of 73.5% urban and an astonishing 31.4% rural electrification rate (World Bank, 2024a). This highlights the other big division in electrification rates, the urban/rural divide. When looking at the world average, those living in urban settings have a 97.67% electrification rate even with the struggling Sub-Saharan countries dragging the average down. However, the world average of the rural population is 84.48%, a number that has come a long way since 2000 (66.5%), and made progress since 2010 (72.9%). The urban population has experienced a smaller increase since 2000 with the number going up nearly 3% from 94.84%.

Electricity availability is directly linked to increases in the HDI, made up of three indicators: GDP growth, life expectancy, and education, which is often considered a better metric for standard of living than GDP (Leung and Meisen 2005).

Much like the electrification access rate, possibly *because* of it, the HDI rate of the World average has been on the rise. Moving from 0.645 in the year 2000 up to 0.736 in 2020 with 1 being the highest score achievable and 0 being the lowest (UNDP, 2024). Leung and Meisen demonstrated that the HDI index accounts for a broader view than GDP numbers do with examples of Russia, Saudi Arabia, and South Africa (2005). Each in the late 1990s/early 2000s had good economic scores of GDP but GDP didn't account for the high suicide rates and poor healthcare access of Russia, AIDS epidemic that plagued South Africa, and the poor education system of Saudi Arabia. The authors concluded that using HDI should be used when determining the overall condition of a country to not miss the full story especially in developing nations. In the paper, Leung and Meisen measure the correlation between different factors in 19 low and middle income countries compared to electricity consumption per capita to assess the level of correlation (2005). Electricity consumption per capita (ECC) had a 95% correlation with GDP per capita which supports the idea of an extremely high correlation between the two. The ECC had a 64.83% correlation with HDI directly which is considered significant indicating higher levels would rise the level of HDI as well. ECC and life expectancy at birth, infant mortality, and maternal mortality were correlated at rates of

1 Sub-Saharan Africa has not progressed in this field from 2010 to 2020 in fact the number without access went up slightly. It is the only region in the world to not be advancing in this timeframe

47.69%, 58.61%, and 45.76% respectively further supporting the connection to higher HDI levels. Increasing the electricity per capita consumption can directly stimulate faster economic growth and indirectly achieve enhanced social development especially for lower income countries. The threshold for moving from low to medium HDI transitions occurs when 500kwh per capita is attained, which is the amount needed for pumping water, providing light, refrigerating food and medicines. The authors believed the greatest task at hand is to educate the public about the link between the factors to garner support and possibly resources for expanding electricity in developing countries (Leung and Meisen, 2005). Even if the support and resources are found, the policymakers of the low and middle income countries need to make choices about how they source the energy to make the vital electricity. Each source of energy comes with inherent pros and cons which will have economic, societal, and environmental impacts.

> *“There is no economic activity that can sustain itself without direct or indirect use of electricity” (Kabeyi and Olanrewaju, 2021).*

Human development cannot improve or continue to improve without more power and electricity since economic activities overall strongly depend on sourcing to keep running. There is a strong correlation of change in income and change in electricity demand with higher income leading to more housing space and more equipment in house (Kabeyi and Olanrewaju, 2021). The word “electricity demand” is highly important here because it refers to the availability of affordable electricity for the masses. In the cases that electricity is produced, but the majority of citizens cannot afford it, makes all the benefits near obsolete. This is important for policymakers to take into account. The electricity demand to supply in developing countries becomes an endless cycle of limited resources needing to spread to different important areas such as medical centers and better transit systems but the hospitals and public transport can’t run properly if there is no power. This relationship means that economic growth can increase electricity demand. The relationship also works the other way where reliable, affordable, abundant electricity access can lead to increases in investment leading to higher economic growth. Therefore economic growth and electricity use can have a push-pull relationship as one grows so does the other. The relationship between GDP growth and electricity use becomes less important as economies advance due to the rise of service industry, a lessened importance of manufacturing, and the increase of more efficient technology (Kabeyi and Olanrewaju, 2021). It is not enough for there to be plentiful electricity but there has to be also good capacity to channel it to reach all and to be affordable otherwise the necessary effects can’t occur for the economy.

The idea that energy consumption and economic growth are linked was initially developed by Kraft and Kraft in the energy-growth nexus hypothesis (1978). The general theory is that energy consumption and economic growth are strongly linked so it is important for developing countries to manage energy policy in a way that doesn’t inhibit the economy. However, from the energy-growth nexus hypothesis came four branches of thought divided into growth, conservation, feedback, and neutrality. The growth theory is that energy consumption (EC) pulls the economic growth (EG) meaning higher levels of energy usage will lead to more economic activity. The conservation approach believes the reverse; that EG will pull EC as the economy grows it will demand more energy. The Feedback view believes that as the two variables play into each other more EC equates to more EG and more EG means more EC which is opposed by the neutrality theory in which that neither affects the other. Deang, Dispo, and Pizarro-Uy found that when applying the energy-growth nexus to specific countries the results can vary greatly on which variables are used (2022). They found that it might be impossible for there to be a truly universal relationship between energy consumption and economic growth among all countries. Regardless if EC pulls EG or vice versa having good energy policy and improving energy efficiency are two crucial steps for developing countries.

The energy-growth nexus theory was examined in a more detailed way in 2014 by Karanfil and Li to see if it could be applied to 160 different countries. The authors point out that the economic importance of electricity has been widely recognized by economists, businessmen, engineering, energy, and government agencies which implies that the energy-growth nexus is accepted as the common theory among important policy makers and influencers. This is seen in the US Energy Information Administration's (EIA) following quote "a country's economy and its energy use, particularly electricity use, are linked. Short term changes in electricity use are positively correlated with changes in economic output (2013)". They then changed the theory focus from energy-growth to electricity-growth because electricity cannot be stored therefore making it have higher urgency and needing better planning. The paper focused more on dependency and supply vulnerability than previous papers on the topic, and in doing so they found that the less integrated a regional electricity market is in emerging markets the more likely they are to have a bigger reliance on net electricity imports. They also found that the electricity-growth nexus is highly sensitive to a number of factors ranging from country income levels, regional differences, urbanization rates, and electricity dependency. The biggest variable is the country's income level with high-income countries GDP and electricity consumption only having short-run or little causality whereas in low and lower-middle countries that relationship is very strong. Then diving deeper into the lower-income countries, the authors found that urbanization or electricity imports play an important role in the GDP-electricity consumption relationship, how this plays out depends on the region. Electricity dependency was found to be crucial for the lower income countries. This is why the paper advised that policymakers truly understand the effects of providing electricity that is reliable and affordable. They also strongly advise against energy conservation policies due to the drastic negative effects this will have on a growing economy. This has been a common theme among those who research the energy-economic relationship.

2.2 Energy Supply and Environmental Impact

2.2.1 Energy Supply

There has been a general acceptance or understanding in the world of the previous ideas that economic growth is linked to human development and to push this forward there needs to be electricity available for the masses. Therefore, policymakers have the difficult task of understanding the energy industry and economies of their countries because some types of electricity will have more positive impacts on the economy than others (World Bank, 2008). There is no universal policy that can be enacted due to the global context being so complex and different from country to country. Some things that can be done for almost all is to expand the transmission systems and have more regional interconnections. This is especially useful in the lower income countries. The countries should also aim to secure supply of energy which often requires diversification of energy imports particularly from different geographic regions to reduce energy vulnerability and supply risks (European Commission, 2013).

These tasks of expanded grids, regional connections, and supply security are all ones that the Southeast Asian political and economic union, ASEAN, is working on which, if done well, will allow Southeast Asia's growing economies to continue the march forward. In some of Southeast Asia it was found that any hampering of energy consumption will hurt the economy and for most of them this is especially true of non-renewable traditional sources and while true for Renewable Energy (RE) it wasn't as important for economic growth (Destek and Aslan, 2017). That said, in Indonesia, Thailand, and Malaysia, adding renewable energy had a neutral effect on the economy and non renewable energy increases had a positive effect. In the Philippines it was found that renewable energy hurt the economy because it often meant taking away resources from affordable and reliable traditional sources (Destek and Aslan, 2017). Another study focusing on the Asian Pacific region (the insular south-east Asian region) from 2000-2015 found a direct negative correlation between RE and economic growth due to the energy taking away investment from more efficient alternatives (Titalessy, 2021). Not only does it take away direct investment but RE uses a different energy system so it requires even higher investment in the power grid, complementary infrastructure, and energy flexibility than traditional sources require. This negative effect on economic growth only leads to greater inequality and more social issues. These studies highlight the previous point that not all senergy sources are equal when it comes to energy policy.

Understanding land use intensity, capacity factor, and challenges of energy sources paints a fuller picture when it comes to the limitations of RE. Table 2.1 below lists these factors out to highlight why many developing countries have a negative correlation between adding RE and economic growth. The factors included for each source are land use intensity (how much land is required for each source to produce one Megawatt-hour of electricity), capacity factor (the ratio of actual electrical energy output over a given period of time to the theoretical maximum electrical energy output over that period), what affects the power production, and what are the challengers involved with each source. The negative RE additions to economic growth is due to the need for reliable, affordable access to power a growing economy. The reliable portion and land usage are strong setbacks for RE seen in how the high end of the RE's capacity factors tends to be below the average lows of the traditional sources.

Nuclear energy is also included in the table because many countries include it as part of ET. Even though this is debated having it included shows its big appeal, low land use, highly dependable, and it produces significantly less CO2 emissions than coal. Coal, both open-cast and underground, is also included to highlight why so many developing countries rely on it to provide a reliable, affordable source. The numbers indicate that oil and natural gas have even more favorable capacity factors and land use intensity than coal does (Ritchie, 2022). Natural gas in particular is less ecologically harmful than coal based on CO2 emissions. The main problem is, depending on the region, it can often times end up being more costly since it has to be imported and that often requires Liquefied Natural Gas (LNG) ports. This makes it more clear why developing countries with limited resources have built so much infrastructure around coal since it provided a desperately needed reliability in energy production.

Table 2.1: Energy Sources Statistics and Limitations (Harjanne and Korhonen, 2019)

Energy Source	Land Use Intensity [m2/MWh]	Capacity Factor	Power fluctuation	Challenges
Solar (photovoltaic)	10	16-30%	Weather and often seasonal dependent	High volatility, low energy density, high material and land requirements
Solar (concentrated)	15	25-80%	Weather dependent unless backed by heat storage	High volatility, low energy density, high material and land requirements
Wind Power	1	26-52%	Weather and often seasonal dependent	High volatility, low energy density, high material and land requirements
Hydropower	10	12-62%	Precipitation dependent and accumulating Sedimentation	Negative environmental impacts on aquatic populations. Displaces local populations
Wave Power	4.6	26%	Weather and tide dependent	Costly, far from demand centers, and volatile
Geothermal	2.5	72-98%	Local rate of depletion dependent	Limited in the possible locations it can be harvested

				from and doesn’t always replenish
Nuclear	0.1	85-90%	Fuel and plant properties dependent	Requires advanced expertise and the most detailed planning and monitoring
Coal (underground)	0.2	75-93%	Fully controllable	Long term environmental and health consequences especially if used without carbon capture and storage technology
Coal (open-cast)	5	75-93%	Fully controllable	Long term environmental and health consequences especially if used without carbon capture and storage technology
Biomass	500	70-90%	Fuel properties dependent	Can lead to increased food costs, soil degradation, groundwater pollution, and has considerable net emissions in short term

The electricity use and GDP growth in developing countries greatly outpaces the rate in developed ones making it even more of a challenge for the policymakers to enact good practice. The industrial sector requires large amounts of electricity and within it manufacturing, mining, and utilities are largest sources of this demand (Kabeyi and Olanrewaju, 2021). The governments will need to have detailed planning of how to keep satisfying the unquenchable thirst for energy as the economy rises which is no small feature to accomplish. Since electricity can’t be stored, systematic planning and investment are needed to avoid undesirable over or under capacity both of which can be very costly to a growing economy. To make the challenges even more difficult for those forming the energy policy, they cannot simply go with the most affordable and reliable options because, as is often the case, coal and biomass which can have very large environmental impacts when left unchecked.

2.2.2 Environmental Concerns and Damage from Energy Supply

Theoretical perspective states casual link between RE, economic growth, and environmental degradation (Vo, Vo and Le, 2019). Higher income means higher energy demand which leads to more environmental degradation. This leads to higher concerns for environment and energy security which leads to more demand for RE. This is the general trend often seen in developed countries, less so in developing ones which need to fulfill their energy demand with more limited resources than the former. In developing countries the increase in energy demand generally leads to higher CO2 emissions and environmental degradation: this idea is known as the Environmental Kuznet's Curve (EKC) hypothesis (Grossman and Krueger, 1994). The theory was based off the original Kuznet's Curve which found economic development lead to an inverted U shaped curve when it came to income inequality and applied it to environmental damage. The measures of environmental damage were based off air and water quality, important to mention it did not include CO2 emissions which the authors list as a limitation but it does include many others such as Sulfur Dioxide (SO2) to give a more all-encompassing view. It was examined through GDP per capita and environmental quality which can end up neglecting rural and other small scale communities. The poorer rural areas often take on disproportional adverse environmental problems without the economic benefits that are often reaped by the more dense urban centers. This is often a problem with renewable energy seen in wind, solar, biomass, and hydropower with the adverse effects such as flooding, health issues, deforestation being placed on the rural communities while the benefits of power generation are sent to the urban centers. In their results they did find that national income is an important determinant of water and air quality showing how environmental degradation doesn't continually rise with income but instead peaks out and then starts declining with the peak for most having occurred before $8,000 USD GDP per capita in 1985 dollars (approximately $23,000 USD in 2020 dollars).

By the time countries reach middle income the environmental degradation appears to only go down (this level is $10,000 USD GDP per capita in 1985 dollars (approximately $29,000 USD in 2020 dollars)). The authors believed this decline to come from induced policy response from the people as they could afford to focus attentions outside economic survival ones. They also believed that there was better technology available which will lead to cleaner technology that has the same outputs. This idea is also complimented to Syrquin's findings that development gives rise to structural transformation which leads to an economy's production moving away from heavy manufacturing and more towards service-based trade (1989). They do not believe all countries are doomed to make the same mistakes of the past nor do they believe this is a predetermined path that automatically corrects itself. With better technology and a better understanding of what is required to prevent environmental damage low-income countries can lessen the blow and instead demand better conditions from earlier on. This theory was introduced 30 years ago but it is still widely discussed today in a variety of ways such as how to improve it or make it more applicable to the modern era.

There have been attempts to show that the EKC hypothesis does not hold through observations of some cases of different relationships using CO2 emissions as the metric of environmental damage (Maneejuk *et al.*, 2020). This however is a failed approach that found 9 out of 44 had lower CO2 emissions as the other economic variables increased. It remains failed because while it is true that CO2 emissions cause environmental damage, such as playing a large role in climate change (Cairoli, 2024), using it as the singular measure to discredit the hypothesis that covered many different aspects of water and air quality seems too limited in scope to write it off. Even those who support the hypothesis and accept it as is, or simply want to modify it to make it more modern, have their concerns with it such as believing that policymakers and other people may believe that if the EKC is true the environmental concerns will naturally just take care of themselves as the economy continues to grow (Leal and Marques, 2022). This concern requires emphasizing very clearly that the hypothesis itself states that a big part of the reason the environmental damage decreases is through induced policy regulations as citizens become more focused on preserving the environment around them. Therefore, if one truly adheres to the idea, they would push for more environmental reforms to minimize the damages done during the development phase and to help reach the peak sooner. The last way that the theory is discussed is through application to various regions or countries, especially the developing ones, to see if holds true in specific cases such as Southeast Asia, ASEAN or the individual member states.

2.3 Discussing Energy Transition and Infrastructure Challenges

There is much international debate over the pressure and need for countries to partake in an energy transition which must be defined before it can be properly discussed. Energy transition is the move from certain energy sources (traditional aka fossil fuels) to other ones (renewables). This is the generally accepted definition, however, when it comes to measuring it this is where the disagreements grow. What is commonly used as the indicator is a country's energy share or energy profile. This is the percentage breakdown of when all the sources of energy are compared to each other. However, not every country or organization uses this, and instead prefer raw numbers of energy production. When using the energy share measure it can be further divided into two major components Total Primary Energy Supply (TPES) and Total Final Energy Consumption (TFEC). The former, TPES, being used to describe the amount of energy that can be withdrawn from the sources and the latter, TFEC, being used to describe how much of the sourcing will be needed to meet the current consumption levels. Generally higher TPES from one source will lead to higher levels of TFEC but this is not a one to one ratio which is the source of debate as to which is a better measure of an energy mix. Some have pushed that TFEC be the measure of whether energy transition is occurring but developing countries tend to object to this and use TPES instead because renewable energy tends to be very volatile so higher shares of renewable in consumption equates to less electricity which equates to less economic growth and more poverty. A growth in TFEC positively impacts growing economy but if renewable energy has a larger share of TFEC it will hurt economies in growth (Namahoro, Nzabanita and Wu, 2021). Energy intensity is the measure of how efficient the energy supply is being used relative to the economic activities measured in (TPES/GDP), this alone can bring down carbon emissions significantly if the number is improved.

For those involved in energy policy creation it is also important to know when discussing energy, especially renewable energy, is power generation the process of turning energy into electricity. Installed power capacity indicates how much can be generated if all working power generation sources are running without issue. Base-load and base-load capacity tells what the minimum level of electricity demand is and what the minimum level of normal power generation is. While peak-load and peak-load capacity is the highest time of electricity demand and the power generation abilities to meet this. This is where energy sources such as solar and wind often struggle due to their volatility which isn't aligned with demand and the reason many developing countries don't use TFEC as a measure of energy transition. This volatility is what can be attributed for the rise of coal in many developing countries. As coal began to grow in usage and/or harvesting more infrastructure was built around it including the transportation of harvested coal to new coal fire power plants to the electrical connections to the population centers from said power plants. As more infrastructure was built around the energy source the more costly it becomes to use new energy sources and the cheaper it becomes to continue to expand coal. There is also the environmental costs associated with building the new infrastructure needed for a change in energy sourcing. New land has to be cleared to build the new harvesting area, new connections from harvesting to power plant, the new power plants, and to connect those to the population centers: New materials are also needed for that entire beginning to end journey which each come with environmental costs of acquiring them. Any increases in financial cost would make energy more expensive possibly passed down to the consumers which is detrimental to a growing economy. When looking at the reliability of RE it makes it even less appealing to these countries because of the even higher costs to invest an energy that is less reliable. On top of that, many developing countries still have abundant natural resources that could be oil or coal but to harvest RE the materials have to be imported since the rare earth minerals needed are only harvested in a small number of countries thus weakening the developing country's energy security too. Providing cleaner energy is not the only important goal for countries as energy independence, energy security, and affordable energy all remain largely important as well.

Lower energy intensity or not, there are nine major energy sources, some with further divisions. They are solar (photovoltaic and concentrated), wind, hydropower (traditional and wave), geothermal, nuclear, coal (underground and open cast), oil, natural gas, and biomass. There has been a common dividing line into fossil fuels and renewable energy but these names carry problems and lead to misunderstanding of the true nature of the sources. "Fossil" fuel often includes coal, oil, and natural gas but using a word such as fossil has created confusion as to the processes that create these sources therefore it would generally be more accurate to refer to them as "old" or "traditional" or "historical" sources. Renewable or clean energy as a definition also causes controversy due to neither word being inherently a given fact, this often includes hydropower, wind, solar, geothermal, and biomass. In the international context there is a largely agreed upon definition, the IEA says it is energy derived from natural processes that are replenished at faster rate than they are consumed (mentioning specifically solar, wind, geothermal, hydro, and biomass). The EU agrees and adds tidal power and the renewable part of waste with the UN Environmental Programme following this same logic. It is also important to note that biomass creates problems with classifying because biomass can be listed as source far more pollutant than coal and also as a renewable energy depending on the type. Traditionally it is used to be the source that many individuals in undeveloped countries would use by chopping down trees and making charcoal or other unprocessed sources but now the term also includes big state run highly monitored processed sources. This is the reason the numbers often show a country that have biomass decrease as they develop more but then rise again when they gain more wealth. It is almost as if two entirely different sources share the same name. Even along the fossil fuel and renewable classification lines there is no consensus on where nuclear energy falls this is due to some components of it acting as the former but other components acting as the latter paired with having the lowest required spacing, one of least volatile power production, and one of lowest beginning to end emissions. To discuss energy transition nuclear will not count as either category and instead be its own.

To make the real lasting differences in the fight against climate change there needs to be an idea of how to use sustainable energy that doesn't leave billions of people behind in poverty. The definitions began to vary as sustainability has no one overarching meaning. Since all energy production will cause some societal and environmental impact, some have suggested that sustainable energy should be defined as "enables societal development that is largely, even if not entirely, decoupled from increasing environmental degradation for the foreseeable future" (Harjanne and Korhonen, 2019). With this definition it can have renewable energy be in direct opposition to sustainable energy depending on the time and place. There are a number of key factors to look for to determine how sustainable energy truly is such as the land required to start harvesting the energy, what materials are required to make the technology for harvesting, where they will have to be located versus where the energy demand is, how it affects the environment around it, how it affects society, how much energy is retrieved from it, and how volatile the source is (Iddrisu and Bhattacharyya, 2015).

Finding a common measurement has been one roadblock to universal agreement on energy transition but the other technological challenges remain an even larger problem. The volatile nature of RE is one of them and the other big issue the technology faces is the materials needed to build them, especially solar and wind, namely the rare earth minerals. The rare earth mineral harvesting is highly damaging to the environment as it is often occurred with strip mining, this along with the relatively short life span of the wind and solar farm technology equates to a process that seems far from renewable. In creating the solar panels or wind turbines one needs rare earth minerals and elements (REE) at their current technological state which is troubling for a number of reasons. For one the mining of the REE has major environmental concerns such as Gangue (waste material mixed with wanted material) being used as a loophole for waste disposal. Since if something is classified as waste it must be disposed of immediately and have clear plan for disposal but if it classified as gangue then it could be used later legally. In this case it oftentimes means that these REE mine operations are leaving radioactive material in the open for prolonged periods of time with no plans to safely dispose of them all in an effort to save money (Ali, 2014). If the gangue loophole is closed the costs of retrieving REE will increase significantly which will then make the costs of RE such as solar and wind rise in turn.

The recycling process of REE also raises major concerns as it only sits around 1% of total supply. If the number goes up, the environmental impacts would be lessened but would also make embedded costs for RE go up (Ali, 2014). The economic cost has already been a concern with its low energy return on investment and volatility which gives less power per dollar spent compared to tradition sources. REE minerals also face a major problem of scarcity which is more due to the fact that they come in low concentrations in the earths crust, it is not to say they are truly rare but more so that they are not economically feasible to obtain large quantities that can create major supply problems. Four elements, cerium, indium, lanthanum, and tellurium, are considered in near critical levels of supply (Ali, 2014). Another five, dysprosium, terbium, europium, neodymium and yttrium, also run risk of long run supply issues (these are used in magnets for wind turbines and electric vehicles). The lack of a stable supply of crucial REE makes RE not full under sustainable energy definition of a country having strong energy security since the ability to add, repair, or replace the technology for energy harvesting is in jeopardy. At the current stage of mining and recycling is not environmentally friendly to rely on technology involved with REE but it isn’t a viable long term plan due to the increasingly scarce levels of supply. It is also costly to open new mines (in the $500 million range) along with 6-10 year timeline (de Boer and Lammersma, 2013). Due to these costs, high maintenance costs, and big environmental concerns, China is the number one producer of the REE in the world and has been putting stricter export quotas on the materials. This would make energy sources like solar and wind fall out of energy independence as options because they would still have to import the technology and materials from China further decreasing the sustainable nature of the sources. It is important to acknowledge that treating a complete energy transition to RE as sustainable energy policy is not always the correct answer. RE can play an important role for minimizing environmental damage and providing electricity to those who otherwise wouldn't have it but this is something that must be decided after looking at the whole picture instead of jumping to conclusions without understanding the full depth of the issue as Germany and others have done.

2.4 A Political Economy Analysis of Energy Transition in Developing Countries

2.4.1 Global Development Agenda

All of the previously mentioned ideas have been largely driving the policymakers' decisions in shaping their countries' energy profile. Each country has a number of actors involved in the decision making process that will assert pressures to guide it towards what they believe the ideal energy policy to be, the biggest of which are the international actors such as the UN, the multi-country agreements, and multinational political and economic unions. The UN themselves have had two separate energy policy agreements emerge, the first of which is the Millennium Development Goals (MDG) which was subsequently replaced by the Sustainable Development Goals (SDG). These two both discuss development and some form of environmental sustainability, both set of goals acting as a form of pressure for countries to dictate decisions to meet these objectives. The MDG set forth eight objectives meant to be completed by 2015 (starting in 2000) while the SDG kicked in at the end of the MDG and continues until 2030 increasing the number of objectives to seventeen. When comparing the eight MDG objectives with the seventeen SDG objectives, it starts to paint more of the picture of what the UN valued at the time of their creation. There were two MDG objectives directly related to economic development, MDG 1 (to eradicate extreme poverty and hunger) and 8 (to develop a global partnership for development), and this number didn't change with the SDG seen in SDG 1 (no poverty) and 8 (decent work and economic growth). There are arguments that the numbers could be higher but many of the objectives tend to be more of a byproduct of economic development rather than the process itself, therefore, outside getting rid of poverty (raising incomes for the most vulnerable) and economic growth, they aren't counted here. The big separation between the SDG from the MDG is the large focus on the environment going from 1 goal, MDG 7 (to ensure environmental sustainability) to a total of 6 goals, SDG 7, 11, 12, 13, 14, and 15[2]. This has led to environmental focused policy being valued above all others as it becomes weighted more than the other focuses, leading to developing countries to be put in uncomfortable situations as the UN policy suggestions end up being more strict than even the Paris Agreement.

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at the UN Climate Change Conference in Paris, France on 12 December 2015 and entered into force on 4 November 2016. Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels" (UNFCCC, 2015). This conflict has led some to question the point of the SDG since the Paris Agreement already covers much of the environment and was decided at a UN meeting of nations. This has led to some developing countries choosing to more or less ignore the SDG when deciding energy policy and instead leaning closer to the Paris Agreement, if they choose to follow that one either.

2 SDG 7 Affordable and clean energy, SDG 11Sustainable cities and communities, SDG 12 Responsible consumption and production, SDG 13 Climate action, SDG 14 Life below water, SDG 15 Life on land

Why do these international agreements even arise. It comes down to the growth of electricity and CO2 emissions that generally come with it. Electricity demand in 2002-2012 increased 3.6% annually outpacing annual population growth despite that 1.6 billion people are still without electricity (Handayani, Krozer and Filatova, 2017). At that rate of growth, the IEA predicts that from 2013-2040 electricity demand will have increased by more than 70%. At the same time from 2000-2010 GHG emissions increased 2.4% a year reaching 49GtCO2 eq in 2010 comprised of 25% coming from electricity and heating (Handayani, Krozer and Filatova, 2017). The Paris Agreement demands that countries account for this in national energy planning, yet the Paris Agreement also has a goal for developing countries to hit 100% electrification rate. So one can see that it does try to account for multiple dimensions instead of simply an increase of RE as others have (Handayani, Krozer and Filatova, 2017). This has made the Paris Agreement seem more favorable than the SDG which tend to place higher demands and a more cookie-cutter policy as opposed to a more flexible country by country approach one. This will be addressed further in the case studies.

2.4.2 Limitations of Development Agenda and Alternatives

Some have believed that the world players such as the UN and those involved in the writing of the Paris Agreement have focused too heavily on CO2 emissions and environmental sustainability instead of looking at the full picture. These are important but they are only part of good energy policy. If one neglects energy security and energy equity then their own citizens would suffer from what would not be considered by energy policy. That is why the World Energy Council (WEC) gives rankings to 101 countries based off the Energy Trilemma, being energy security, energy equity, and environmental sustainability. The energy profile mix is the result of a country balancing the energy trilemma with what their natural resources basis is and their geographic situation. This is a better system of measuring a countries energy policy than how other organizations do it where they only focus on one (and, even within that, only one aspect of it). Each country is given a grade of A, B, C, or D in each of the three categories. Based on their scores they then are ranked against each other. Overall, there are 101 countries included, with many excluded due to there not being enough data for an accurate ranking. Only nine countries have an AAA score[3] and its very possible Germany will lose that status due to poor policy that has damaged the affordability and reliability of their energy. Everyone else generally has to make sacrifices or evaluate opportunity costs and decide which aspects of energy policy they value more. Another important note when examining the top performers on the list is that every single one that has improved their environmental sustainability scores from 2000-2020 has had a negative impact on energy equity. While this may not have the biggest impact on advanced economies citizens, it could very well be the difference between poverty and a dignified life of security for thousands or

3 The 9 AAA rated countries are Sweden, Switzerland, Denmark, United Kingdom, Finland, France, Austria, Germany, and New Zealand

even millions of people in a developing country especially those with massive growing populations. Only two developing countries prioritized environmental sustainability scores over the other categories, Vietnam and Sri Lanka. The latter went into a complete economic crash with major power supply problems starting in 2019 that is still ongoing today (Gupta, 2022).

If it's possible to balance economic development and creating sustainable environmental policy has been a highly debated topic divided among those who believe it can be achieved and those who don't. The starting point for many of the debates came from the Environmental Kuznet's Curve hypothesis that as countries begin expanding their economies they will cause more environmental damage until they reach a tipping point and the damage starts decreasing with every unit of economic growth. If the hypothesis is true then it's possible there is no balancing act to be had because it is inevitable that economic development will come at a cost of environmental sustainability until the country can be more advanced then it can return focus back to the environment. Some, especially those in developing countries, have said that is a price to pay for a higher standard of living, but others, predominately in developed countries, have stated developing countries should have to aim to minimize the environmental damage through sustainable energy policy. What sustainable energy is, is an even more highly debated topic than many of the other previous ideas mentioned in this chapter. Some have claimed that it must be fully environmentally sustainable with no regards for the economy, while others have claimed it must not rely on imports as the country must have access to the energy no matter what (World Energy Council, 2022). Those two ideas have led to many using sustainable energy interchangeably with energy transition, claiming that if a country relies solely on RE than that should be considered sustainable. This is narrow in scope and often neglects the differences within countries so one should always proceed with caution when hearing the word 'sustainable' thrown around. Sustainable energy should be defined as one that enables societal development that is decoupled from increasing environmental degradation for the foreseeable future (Harjanne and Korhonen, 2019). This definition accounts for the increase in standard of living for those currently alive and the well being of the those to come making it the most all encompassing of the ones presented. This would mean that RE or non RE could be the best choice depending on what the actual impacts are, requiring a deeper dive and more thought process behind every decision. It could also mean that countries on their own may not be able to afford or use the best technologies to achieve this and need outside help to bridge the gap until they have developed enough to be able to afford and have the expertise for these systems. The sustainable answer could be for complete or more RE. Some countries have been held as prime examples of being able to have complete or near complete levels of energy come from RE sources such as Iceland, Norway, and Costa Rica. This is deceptive however because this has not worked anywhere else and can only work under the current technologies because majority of their energy comes from plentiful geothermal sources which is not widely available and therefore isn't a sustainable prospect worldwide. In Germany, they have made it part of their country's policy to aim for zero carbon emissions done through a heavy reliance on RE such as solar and wind. If looking at the level of greenhouse gas emissions and affordability of electricity for the German people this policy has been a failure (Harjanne and Korhonen, 2019). This shows, under current technologies, it isn't an environmentally or economically sustainable outlet to simply commit to RE without having the favorable geographic conditions. This all too important separation of sustainable and renewable is shown again in Finland which vowed to get off traditional sources by waning off coal and instead going for renewable biomass which has led to emissions not going down despite the switch (Harjanne and Korhonen, 2019).

The World Energy Trilemma Index is more understanding than the UN goals and agreements in that each country's policymakers have a wider range of political and economic actors involved in the creation of energy policy than just environmentalists. Each country is different in who the extra actors involved are and what consequences they have. In almost every developing country the economic development actors exert huge pressures whether directly or indirectly hence variation occurs. This is due to the fact that those without economic security tend to make up the majority of the population in developing countries and, regardless if the country is democratic or not, the consequences of ignoring their demands can have drastic effects on the nation. After this is taken into account, that's when the political economy actors and their pressures vary from country to country even when they sit in the same region with similar structures. Divisions occur when it comes to whether the power generation companies are public or private and, even if they are private, how many of them are there. Questions such as how strong are the green parties, how much protest is allowed for the people to voice their opinions, how integrated in the region is the country that policy. That is only the tip of the iceberg, as every system is a complex interconnected one that requires careful examination.

2.4.3 Politics and Interests Shaping Energy Transition

Different actors will have different ways they want to shape ideas and with such a wide range of actors in such a large scale idea such as ET it will create many conflicting interests. There are green parties, environmentalists, international organizations (on global or regional scales), national governments, regional governments, local governments, trade unions, energy companies, non-governmental organizations (NGO), and general local interests all with their own desires pushing ET in different directions (Sovacool *et al.,* 2022). This can be specific to each country so some generalizations have to be used to apply it to a global scale. A country with heavy coal extraction that has many local and regional economies reliant on coal mining is likely to push back with great strength against any national policy that involves phasing out coal production since it means the loss of their jobs and economies. Environmentalists and green parties[4] may push back against the coal miners and their trade unions in an effort to get the world to have lower CO2 emissions.

4 It is worth noting that generally the environmentalists are usually from the Global North or far away from the economies that rely on coal. While the pro-coal parties tend to be local and often from the Global South

Environmentalists are also divided into different camps with some wanting zero CO_2 emissions from every country, 100% RE on one extreme and the other to have sustainable development based ET that includes nuclear energy and carbon capture technology on traditional sources. The companies that produce the more traditional sources are likely to also push back against a move to RE unless they themselves are well positioned to take advantage of the move. Industrialist companies also tend to offer resistance to ET because RE is not as capable of supporting large scale industry as traditional sources are. On the other hand companies that produce RE will push for an energy transition to increase their own profits as is the logical choice. National governments may push to align with international goals, whatever they may be, for a number of reasons such as political moves or to help increase the chance to access international financing. National governments may attempt to balance between the two opposing sides to keep peace and not upset their own populations or the international pressures as is often the case in developing countries. Countries that produce excess energy or materials for harvesting energy may try to guide international goals towards what benefits them. A prime example is that China produces majority of the world's rare earth minerals which are needed for solar and wind energy so for them it is largely beneficial to have countries switch to RE as it improves their economy and their position in the world. Those involved with economic development in the developing world will support what helps with a long term sustainable economic progression which is often a mix of RE and traditional sources. Energy plays a vital role for the economy therefore energy policy can have significant effects on the well-being of a country and that makes it crucial for the policymakers to listen to all sides and know the consequences of any actions taken. The generalizations will be examined in depth in the following chapters with real world case studies.

Chapter Three: Southeast Asia and Energy Transition:

Southeast Asia is increasingly attracting the world attention due to its fast and dynamic economic growth. According to most updated world economic data, Southeast Asia is the fastest growing region in the world. The region of Southeast Asia does not have perfectly defined lines due to close proximity to Oceania. The most common defined countries are Cambodia, Laos, Vietnam, Myanmar, Malaysia, Singapore, Brunei, Indonesia, Philippines, Thailand, and East Timor (World Atlas, 2024). Geographically, the Southeast Asian countries can be divided into two subdivisions of Mainland Southeast Asia and Maritime (or Insular) Southeast Asia, which again has difficulties being precise as Malaysia and Singapore are categorized as Maritime despite being fully or partially physically attached to the mainland section. The other countries follow the more logically pattern with Myanmar, Thailand, Cambodia, Laos, and Vietnam considered mainland and Indonesia, Philippines, East Timor, and Brunei being considered Maritime. Ten of the eleven countries banded together to form a political and economic union called the Association of Southeast Asian Nations (ASEAN). East Timor is the only remaining country in the region that has to yet to join ASEAN but the regional group has already accepted “in principle” in 2022 to admit her as a member.

According to the regional group´s website, “ASEAN is a regional organization of Southeast Asian countries that aims to achieve a just, democratic, and harmonious environment, a well-integrated and connected regional economy, and a quality of life for its citizens” (ASEAN.org, 2024). The region holds a combined population of over 650 million people compared to the European Union’s 450 million or the United States’ 330 million (O’Neill, 2024). This significant population is paired with the seventh largest economy in the world and is on pace to become the fourth largest by 2050 (ASEAN, 2020). The entire region faces very high population density and an increasing urbanization draw. While half (50.1 percent) of the ASEAN region’s population were urban in 2020, this figure is projected to rise to 55.6 per cent in 2030, a total of almost 405 million people (ASEAN, 2022). With such a large population and one that is ever-growing, it is of extreme importance that they plan well to ensure a high quality of life for all its people, both the current ones and the future ones.

3.1 Human Development and Energy Access in Southeast Asia

In Southeast Asia, the urbanization levels drive consumption, meaning higher numbers in cities equates to higher consumption. Those who do not partake in the urban pull can be found far away from these centers in mountains, far away islands, or through difficult to traverse terrain. The seasons fall under dry and wet seasons with temperatures reaching high levels in some areas and, outside mountain areas, it is rare for very lower temperatures to occur. These geographic features didn’t stop the industrial sector from becoming the largest energy-intensive sector followed by transportation. They accounted for approximately 39.1% and 34.8%, respectively, of ASEAN TFEC in 2020 (ACE, 2022). However, the geography has contributed to the findings of the IEA's study on "The Future of Cooling in ASEAN" that cooling will become the single largest driver of energy demand growth in ASEAN to 2040. In a region where the average low tempature on the year is approximately 20°C and the average high can go up to 40°C, cooling units have become increasingly popular with rising incomes. In regions such as this, air conditioning and refrigeration are two important pillars of a rising standard of living. This higher standard of living is reflected in the HDI numbers for the region where it used to be below the world average in 2000 at a 0.594 but then moved above it by 2020 to reach 0.760 (UNDP, 2024). The increased HDI can be attributed to the increase in electrification rate with the region going from 68.8% in 2000 to 96.9% in 2020 (IEA, 2023b). This rate started below the world average but in 2009 crossed above it and has only continued to increase the distance from the world average since then. When going country by country, only Singapore has a rate at 100% and only Brunei and Malaysia were included above the 90% threshold (IEA, 2023b). By 2020 Malaysia, Indonesia, and Thailand joined Singapore at complete electrification and the Philippines, Laos, Cambodia, and Vietnam joined the above 90% grouping making Myanmar[5] the only ASEAN member not to have reached this milestone.

The geography has also played a large role in the energy sector with some countries having access to the Mekong delta and its tributaries in their lands, others have access to the waves of the ocean or geothermal energy of the volcanoes while some have abundant natural gas and oil reservoirs. All of these play factors in how countries decide to create power and distribute it to their citizens. In order to ease the efforts for all ASEAN countries the organization has created a regional energy integration plan called the ASEAN Plan of Action for Energy Cooperation (APAEC). If successful, the plan will assist the growth of the energy sector to ensure the human and economic development of the region can continue to expand. With the large and ever-growing economy all of these sources will need to be utilized to satisfy the ever increasing demand.

The regional GDP growth rate more than doubled in 2020 from 2000 and is expected to triple by 2030, even with COVID regulations negative impact, which will cause huge growth in energy demand (ASEAN, 2020). This is evident in primary energy demand which rose over 80% from 2000-2019 at a rate of 3.4% per year well above the global average of 2.0% (IEA, 2022). It is also seen when examining TFEC in 2020 with 385 Mtoe (ACE, 2022) having over 1.5 times increase compared to 2000. The main reason the final energy consumption didn't double like the economy did is because the countries have put a major emphasis on increasing energy efficiency, as mentioned in the APAEC. These goals of higher energy efficiency and lower energy intensity, calculated by dividing TPES by GDP, are two of the stated goals that ASEAN is actually ahead of schedule on before their self set 2030 deadlines. The ASEAN goal of improved energy efficiency aligns with SDG 7.3 (by 2030, double the global rate of improvement in energy efficiency). By continually working towards this, they shall also be working towards this portion of the UN goals.

5 Myanmar has also made significant improvements moving from 5% in 2000 to 56.20% in 2020 (IEA, 2023b)

Southeast Asian countries have been working tirelessly to provide the necessary energy access for the continual economic growth that they have had and hope to continue, so how have their results been? Charts 3.1.1, 3.1.2, and 3.1.3 show the continually upwards trajectory of the economic states of the ten ASEAN members. Only Brunei and Singapore sit above the world average GDP per Capita and are generally considered developed. The other eight are considered below the average and hold the developing categorization. With the rate in which their economies are growing, most of them are on track to join the two more advanced member states in the foreseeable future. If they manage to maintain close to these numbers Southeast Asia will become an important world player similar to how their East Asian neighbors have done.

Chart 3.1.1: Total GDP of ASEAN Member States from Years 2000 to 2019 (World Bank, 2024b)

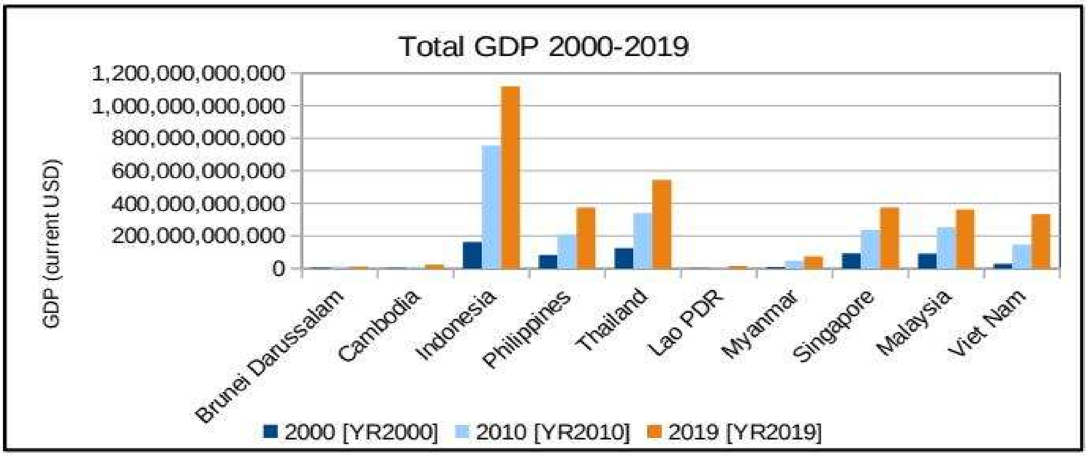


Chart 3.1.2: GDP per Capita of ASEAN Member States from Years 2000 to 2019 (World Bank, 2024b)

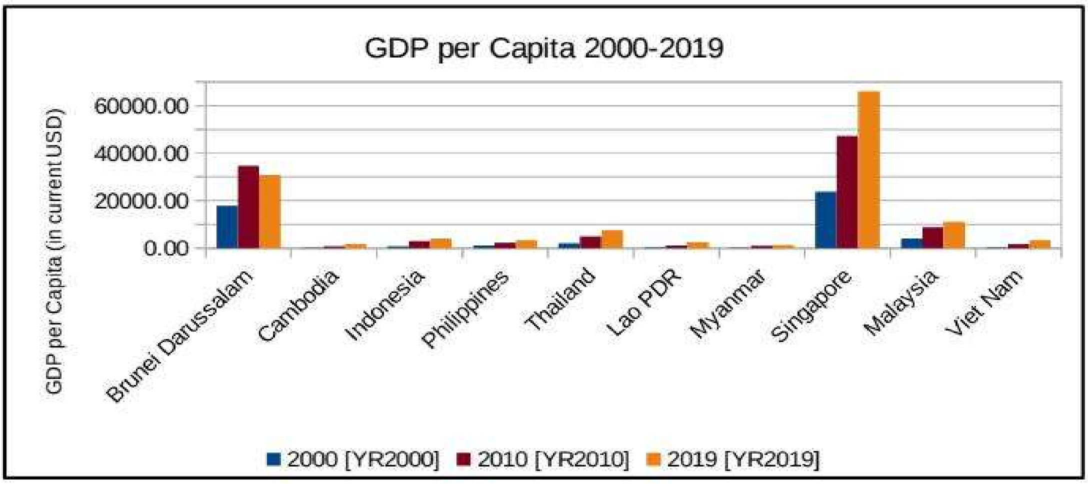
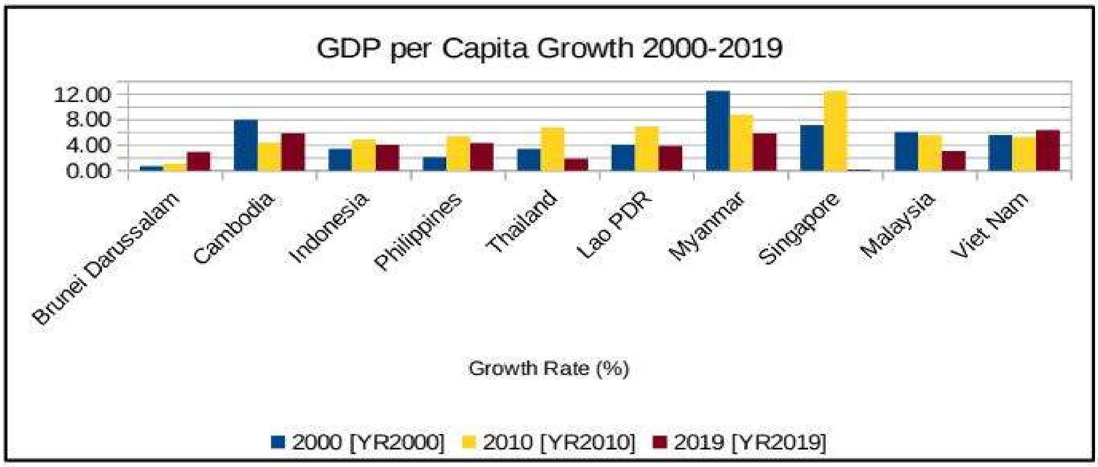


Chart 3.1.3: GDP per Capita Growth of ASEAN Member States from Years 2000 to 2019 (World Bank, 2024b)



3.2 Energy Supply and Environmental Damage in Southeast Asia:

3.2.1 Energy Supply in Southeast Asia

Coal is the dominant source of energy in the region and it only continues to grow creating the cycle of more infrastructure being expanded which drives down the marginal costs of adding more coal power continually making it the cheapest option. It is not because coal is the only option that it became the top source of the region. There are natural alternatives to coal which the Southeast Asian countries heavily rely on, seen in the fact that 7 of the 10 countries (not Singapore, Brunei or Cambodia) have annual rainfall exceeding 200cm/79 inches per year. This, factored with plentiful rivers, lead to a great hydropower system. Some of the island states, such as Indonesia and Philippines, have access to large reserves of geothermal energy as well, but, as the EKC theory states, the countries will only start moving towards greater environmental concerns once the economy develops more.

Another alternative that has been becoming increasingly attractive for the ASEAN member states is to start the process of adding nuclear power in the energy profile. As it stands there is currently none. This would address the base-load electricity supply that can often times be a major issue when relaying on RE. It can also be easier to integrate into the existing grids, has great intermittency abilities, and requires little space unlike RE. Pair these benefits with the recently advanced nuclear reactor technologies especially in the small modular reactors (part of Gen IV Tech) have drawn renewed interest in the energy source. Unfortunately, few Southeast Asian countries have any experience with nuclear energy in a commercial sense adding another major roadblock to developing the energy source in the region. The power plant safety and security needs to be very developed before implementing more nuclear due to the dangers associated with poor expertise and handling as seen with the Chernobyl incident. The lack of experienced citizens in the field means that the countries will have to cooperate with other countries outside the region to gain the necessary expertise and knowledge needed to efficiently and safely run nuclear power plants. As it stands, only four countries have the realistic potential to utilize this energy form in a region with no existing nuclear plants. Indoensia, the Phillipines, Vietnam, and Malaysia are the four best geared for creating this power but only Indonesia has wide public support for it and all of the four are still a long way away from starting up. The big reason for the lack of support is the traditional NIMBY (Not in My Backyard) argument which encroaches many people's backyards, so to speak, because the entire region tends to be densely populated (Lau *et al.*, 2022).

Many of the previously mentioned issues that lead to the reliance of coal to address the ever growing energy demand could be alleviated or solved with the regional integration goals of ASEAN. Along with the financing and technology deficiencies for expanding RE, there is also a gap between where the resources can be "extracted" and the demand centers (Li *et al*., 2019). Despite all of the alternative resources available there is still a dominance of coal which continually grows in not only raw power generation but its share of energy profiles continues to balloon to larger amounts. Some of this can be attributed to pure financial decisions, others have to do with the nature of power providers either as state-run enterprises or socially embedded private companies, or another variety of reasons. Ultimately there is no blanket reasoning that applies to all ten AMS so the answers have been discussed in more depth in the case studies of Indonesia and the Philippines in the next chapter. Having all this in mind is important for then taking a deeper look at the countries and the changes in their energy profiles.

Table 3.2: Energy Profiles of ASEAN countries with Percentage Change from 2000-2020 (International Energy Agency Database, 2024)

	Coal	**Natural gas**	**Hydro**	**Biofuels and waste**	**Oil**	**Wind, solar, etc.**
Brunei	13.74%	-18.34%	0.00%	0.00%	4.60%	0.00%
Cambodia	13.48%	0.00%	4.27%	-37.54%	19.47%	0.32%
Indonesia	21.58%	-2.44%	0.34%	-17.75%	-7.85%	6.12%
Laos	37.34%	0.00%	15.00%	-48.31%	-4.07%	0.05%
Malaysia	18.70%	-12.29%	1.20%	-1.38%	-6.44%	0.22%
Myanmar	3.45%	4.04%	2.70%	-24.06%	13.85%	0.02%
Philippines	17.85%	5.69%	-0.65%	-1.09%	-12.44%	-9.35%
Singapore	1.35%	21.75%	0.00%	0.87%	-24.11%	0.13%

Thailand	2.46%	2.40%	-0.41%	-2.59%	-2.41%	0.55%
Vietnam	37.08%	3.72%	2.10%	-41.66%	-2.19%	0.94%
Average	**16.70%**	**0.45%**	**2.46%**	**-17.35%**	**-2.16%**	**-0.10%**

As shown in Table 3.2 not only is the country average of wind and solar not increasing but coal is the largest growing energy source from 2000-2020. Every single ASEAN member state had their share of coal increase in this time period, the only source to have an increase by every one, while only one had a significant (greater than 5%) increase in wind and solar as shown in Table 3.2. The country by country average has coal making a 16.7% increase in the energy share. This clearly indicates that the countries on the whole are not partaking in UN defined energy transition. The country by country average gives a better picture into how the countries themselves are acting because raw regional numbers becomes skewed very quickly due to Indonesia and Philippines making up a population the size of the other eight ASEAN members combined. However, when examining the region on the whole there is an 8.6% share of RE, the world average was an 11.9% share in 2019 so ASEAN still lags behind despite ASEAN's advancements. That's not to say there isn't growth as over the last fifteen years it went up 0.5% in ASEAN and over the next ten it is on pace to increase by 5%. This still puts ASEAN behind their APAEC goals except in total installed power capacity of RE which has been part of the massive wave of increased electricity capacity. These increases stand at 2.2 times electricity generation from 2020 compared to 2005 with the installed power capacity being 2.7 times in the same time-frame. The reason for the mismatch between installed power capacity and electricity generation is due to the high volatility of solar and wind energy. For this reason ASEAN has been looking to alternatives such as biomass, hydro-power, nuclear, and geothermal that could more easily combat these moments that the wind isn't blowing or sun isn't shining (Safrina and Utama, 2023). The latter is particularly important to mitigate due to Southeast Asia being known for having wet and dry seasons which can lead to long spells of time without any solar power generation. Despite this, there has been a focus in more remote regions to expand solar to quickly get at least some form of power generation to the people and achieve the 100% electrification rates they've set out to achieve. Wind energy in the region has viability issues due to their only being a few spots of even non-low levels of wind. Indonesia, the Philippines, Vietnam, and Thailand are the only four AMS that utilize wind. Even with the more favorable conditions for these countries there is still the 15-40% capacity factor problem (Lau *et al.*, 2022).

Biomass is third largest of RE in ASEAN with Thailand, Malaysia, Indonesia, and Philippines having the highest bioenergy potential. In 2020 8.35 GW was the total installed capacity. Thailand 53%, Indonesia 23%, and Malaysia 11% making up the majority of that. Most of ASEAN's bioenergy comes from first-generation biocrops such as palm oil, sugarcane, coconut, and cassava. This creates many issues such as competition for land and water resources, food scarcity, loss of biodiversity, deforestation, destruction of peatland, GHG, soil erosion, rural development, social conflicts, public health, and more. Indonesia mostly produces biodiesel made from palm oil. The world's largest palm oil producer and second largest exporter, 66% of Indonesia's produced biocrop is exported mostly to India, China, and the EU. Philippines produces biodiesel from coconut oil and bioethanol from sugarcane. Due to these issues, the Philippines government is promoting third-generation biocrops such as algae and seaweed which are in early stage of R&D. (Lau *et al.*, 2022),

Even with the setbacks of seasonality that affects the RE available, the region still has abundance of natural resources especially oil. Despite this, oil actually has a negative energy share rate over the last twenty years. Power generation by oil has been mainly constant throughout the last two decades in terms of raw numbers, this consistency has led to the negative energy share because other sources have continued to grow (Lau, Zhang, Bokka, and Ramakrishna, 2022). When the oil is extracted for export purposes, the oil rents can be used to invest in other infrastructure if the government chooses to do. If done well this will have a net positive on the economy. If done poorly, or not at all, this can damage the economy in the long run. Wahyudi and Palupi found that Southeast Asian countries have a positive effect on economic growth from the oil rents (2023). These exports of oil create monetary inflows which are then invested into cheaper energy sources such as coal or ones that require less import such as hydro-power. Since most of ASEAN shares similar characteristics: densely populated, located near equator, developing economies, and heavily rely on coal for power generation the latter two indicate the region is acting in the way that Grossman and Krueger theorized it would (1995).

3.2.2 Environmental Concerns and Damage from Energy Supply

To fuel this massive economic growth the policymakers of Southeast Asia have predominately relied on coal, as seen in Table 3.2, which is often the most affordable source in the region. This heavy reliance on coal is not without its environmental costs. In 2020, ASEAN emitted 1.65 Gt CO_2 from burning of fossil fuels and cement production (Lau *et al.*, 2022). CO_2 emissions in 2019 has 1.759 Gt of energy related CO_2. 38% from power sector, 24% from transport, 23% from industry, and 5% from building. The levels of emissions are only suspected to continue to rise mainly contributed to the extremely high expansion of coal energy. Coal made up 12% of TPES in 2015 but is projected to reach 23% by 2040 with a tripled amount from 116 Mtoe to 329 mtoe in 2040 (IEA, 2022). Largely due to this, ASEAN carbon emissions are projected to go from 1446 million tons (Mt) in 2015 to 3460Mt in 2040. These additions alone would match the fifth biggest emitter country (Japan) of 2014 (Li *et al.*, 2019). The largest city in all of ASEAN by population, Jakarta, has suffered environmental and health problems due to this coal dominance (Li *et al.*, 2019). Indonesia has increased coal's energy share by over 21% in the 2000-2020 timeframe which has been stated as the main cause of its capital's environmental and health problems. The countries all have made statements about environmental sustainability and invested in RE which has left some puzzled why they would continue to prioritize coal and all the problems that come with it over other sources. It isn't for a lack of resources that keeps the region on coal. There are massive oil and natural gas reserves in Southeast Asia but there is also potential for many other energy sources with hydro-power, geothermal, biomass, solar, and wind all occurring with high frequency (Wahyudi and Palupi, 2023).

3.3 Discussing Energy Transition and Infrastructure Challenges in Southeast Asia

If Grossman and Krueger's 1995 EKC theory is indeed applied to Southeast Asia then countries should be partaking in switch to energy sources of less CO2 emissions than coal. As seen before, there have been roadblocks on the world stage of making those replacement energy sources be RE. How to measure and define what it means to partake in an energy transition is the first of these roadblocks. Fortunately, in Southeast Asia, since ASEAN covers most all the countries this isn't a problem on the regional scale, but it still remains a problem when comparing to the international organizations standards. Due to the numerous different factors that can cause changes in energy supply profiles, such as population or economic growth, the main way ASEAN reports the profiles is in percentage breakdowns. How much does that particular energy source provide to the power production of the country out of all the differing ones. For ASEAN to count an energy transition as occurring it requires the renewable energy to take a larger percentage while oil, coal, and/or natural gas end up with a lower percentage.

At the current rate of progression, the numbers indicate that to reach the RE goals stated by ASEAN, the 20.5 billion USD spent over last twenty years on RE would need to increase eight-fold. This number needs to be higher than the other energy sources to start gaining ground on their total share but also needs to be higher by a lot in order to make up the ground that coal has been gaining. This won't be achieved at the current rate considering that 25.4 billion USD was spent on coal in the same time frame, nearly 5 billion USD more than RE, 12.9 billion USD on hydro, and 3.8 billion USD on natural gas (Safrina and Utama, 2023). These invested dollars are how countries advance their energy sector but in such a complicated system it needs to be standardized to compare nations and different points of time. All countries finance nuclear in one way or another whether its actual hard investment in the infrastructure or soft investment on research and personnel training. Indonesia and Philippines received majority of geothermal finance which is only logical given that only a handful of countries have any access to that type of energy in the region anyways.

The international energy transition and RE goals have already been established but these are not one to one the same as the Southeast Asian goals such as the ASEAN APAEC 2016-2025. The APAEC 2016-2025 provides very tangible energy policy targets. It aims for 23% TPES from RE and RE share in installed capacity at 35% by 2025. Seen through 2020 installed power capacity hit a 33.5% RE share. That mostly came from hydro and bioenergy. Even with high levels of installed capacity due to the volatile nature of renewable the TPES was not near the goals of the UN or ASEAN, and, if measured by TFEC, it is even further off. Regardless of which end is measured, the idea that there should be more renewable energy has taken strong root worldwide particularly seen in SDG 7 as one of the ways to combat climate change. ASEAN has put a strong emphasis on energy intensity as well, possibly even more so than energy transition, to help lower carbon emissions as the region keeps increasing its power production. Based off the levels of the year 2000 aimed for 20% energy intensity improvement by 2020 and 30% by 2025, in just a ten year span of 2005-2015 they had a 19% energy intensity reduction (Li *et al.*, 2019). Yet despite setting out objectives of the international organizations the individual member states have their own visions of what their energy and economic goals should be. Most of them have at least partially a green future publicly stated. Two cases will be examined in further depth in the next chapter but one should remember that all AMS will create their own strategies with differing goals in mind. A prime example how two countries can seemingly have similar goals but end with drastically different results is how Indonesia has listed an energy share goal for RE while the Philippines set an installed capacity goal (Vo, Vo and Le, 2019). This could mean that the Philippines are able to install as much power as they want of any source of energy as long as RE is also being installed while Indonesia has to strategically plan out their energy sources in order to keep RE from getting overrun by the other sources percentage wise. Meaning Indonesia may have to stop future power plants from being built if they do not have the capacity to increase RE at the time, while the Philippines is not limited by this. Eight of ten AMS are traditionally considered developing. Those have prioritized affordable energy and economic development over green technology, making the Philippines more of the norm and Indonesia more of the outlier as seen in Table 3.4 on World Energy Trilemma Index.

3.4 A Political Economy Analysis of Energy Transition in Southeast Asia

3.4.1 Global Development Agenda in Southeast Asia

Trying to achieve international goals set out by the UN itself or agreed upon by a majority of all countries is no easy task but organizations such as ASEAN can help developing countries try to achieve it despite the lack of financing and resources. This issue of lack of financing was examined and evidence was found that all 17 SDGs proposed by the 2030 agenda need financial resources to be achieved (Govindan, Shankar and Kannan, 2020). When this was applied to ASEAN it was also found to be true, however, by working towards shared goals and sharing economy across the ten countries this will alleviate some of the burdens and barriers to reaching the 17 SDGs (Huang, 2023). ASEAN as an organization has indicated that they would like to accomplish the 2030 SDG though this appears to be more of a side thought to their APAEC goals and general economic development goals as opposed to the main focus as evidenced by the absence of any mention thereof in the ASEAN 2023 Energy Outlook. Even in the fields that ASEAN countries are making progress towards, especially in the SDG 7, they still aren't on pace to accomplish these by 2030 at their current rate (UNESCAP, 2020). SDG 7 Target 7.2 is to increase the global percentage of RE defined as modern renewables based on TFEC excluding sources such as household biofuel, nuclear, hydrogen, coal bed methane, gasified coal, and liquidified coal. This is important to note because ASEAN's stated goals and the individual countries themselves define the energy share percentages based of TPES and not TFEC as some developed countries push for more. Also, ASEAN include some energy sources not counted by the UN towards what is considered a successful ET. Having these differences means that even as ASEAN and the AMS work towards more sustainable energy policies it won't be seen as a success by the UN SDG. Each of the ten countries faces external pressures from the UN with their SDG, the large international agreement called the Paris Agreement to cut down CO2 emissions, and ASEAN with their own ideas and missions. This makes it difficult on countries planning their own energy future when these conflict with their own domestic efforts or even the international goals conflict against each other.

3.4.2 Limitations of Development Agenda and Alternatives in Southeast Asia

If the countries choose to follow the regional organization, they will at least know that it considers most of their developing statuses as ASEAN has stated through different statements and publications that they are focused on three factors in regards to energy. They aim to achieve energy security by having majority, if not all, energy sourced from within their ten member states. They aim to have energy equity that all their citizens have access to electricity and in an affordable manner. The final goal is to have energy sustainability by not having their supply destroy their environment and potentially run out in the future. The ASEAN Plan of Action for Energy Cooperation (APAEC) is the organization's plan to integrate the energy systems of their member states and meet the previously mentioned goals of energy security, equity, and sustainability. The plan has seven programs involved which are the Power Grid, Trans-ASEAN Gas Pipeline, Coal and Clean Coal Technology, Energy Efficiency and Conservation, Renewable Energy, Regional Energy Policy and Planning, and Civilian Nuclear Energy. This is all-encompassing from government policies to academic research to private partnerships and even intergovernmental agreements outside the region. If ASEAN succeeds at these plans they will be able to create greater efficiency in the regional energy system and should be able to achieve energy independence which is listed as a regional view meaning that even if one member has 100% energy imports it will still be considered independent if the imports only come from other ASEAN member states. Not only are they attempting to integrate the power grid, they also have plans to build pipelines across the region and build a LNG port for the entire region to ease the transportation of natural gas.

The regionalization of energy extends from the physical products to information, with plans to build a regional database and information sharing system. Even with a heavily internal regional view, the plan directly mentions the UN SDGs, indicating they still listen to the international opinions while focusing on their own internal policy. The plan runs from 2016 to 2030 divided into different timelines with different goals including how and who will be responsible for measuring the progress on each program. The organization takes stances that are pro-coal and pro-nuclear paired with an expansion of renewable energy. This is all in an effort to put economic development and energy independence as the highest priorities. This is done while still considering environmental impacts shown through the investment into research and development (R&D) of carbon capture technology to lower those negative impacts of burning coal. The ASEAN Member States (AMS) all understand that as their economies and population keep growing the demand for energy will keep ballooning and they will have to continue to be ahead of this or they risk causing major problems for their citizens. They've shown this understanding through their representation and commitment to ASEAN's APAEC and through their own internal plans. That is why in the grand plan involves governments, private, academia, and others to all be brought together and used in order to not inhibit the growing standard of living that is being seen for their people. The commitment to economic growth is at such a high level that ASEAN even puts the energy independence to the side occasionally to make agreements with foreign governments such as China and Japan to gain information on developing energy systems or to have power sharing agreements and projects. While ASEAN is on pace to meet a majority of their own goals, most of East and SE Asia need stronger interventions to meet SDGs (Li *et al.*, 2019).

The ASEAN countries have differences in key economic indicators, development priorities, political make-ups, political affiliations, and national interests causing additional barriers to full integration. These are not the only barriers to the completely integrated regional grid. Things such as technical challenges of physical access and grid compatibility, barriers to cooperation and contractual arrangements, and other institutional challenges will cause major issues if not solved. However if they do overcome these barriers, a regional grid for all ten members can help with the coal issue since some places like Laos have access to the Mekong river but they don't always have demand matching energy output. Connecting them to the grid could allow them to sell off the excess power generated to other countries. Even with the current challenges, they have been making significant progress in this task as the regional power grid went from 3,489 megawatt in 2015 to 5,300 megawatt in 2017 along with 14 cross border interconnections already established at eight planned locations with eight more new locations to come in that same year. Due to these advancements in the grid, power trading was approximately 2.5% of total regional installed capacity. Power exchange and purchase was 3.5 GW in 2014 and expected to triple to 10.8 GW in 2020 with plans to go to 16 GW (Li *et al.*, 2019). These are significant amounts that are only increasing as ASEAN continues advancing their regional independence plans. Yet, even with ASEAN's efforts, the countries still make their own policies including energy ones so in order to fully understand why these trends are occurring it requires a deeper dive into the country with the greatest increase in solar and wind, Indonesia, and the one with the biggest decrease, the Philippines.

The 2021 World Energy Trilemma Index not only examined countries but focused on regional groupings as well. Interconnections can help to beat difficult energy challenges and often times geography can play a huge role in a country's energy profile. Asia is defined by poor regional interconnection and heavy reliance on energy imports. There are more regional organizations and agreements than there were in the past, but, despite being founded in 1967, ASEAN only in more recent times began expanding towards energy. ASEAN also only covers one section of Asia whereas the others lack strong regional integration organizations to help smooth out the challenges involved. These factors heavily affect energy security which in general the region struggles with. ASEAN generally tends to outperform the rest of Asia in regional integration especially compared to the other developing ones. East and Southeast Asia have generally been doing well at energy equity but will need more collaborations for better results in environmental sustainability and energy security. In regards to environmental sustainability, the authors believe RE is getting cheaper and therefore these scores should improve as countries often tend to go for the cheapest option. This is a point that has already been proven to be faulted with their unreliable and volatile nature of power production alongside the rare earth mineral limitations.

Table 3.4: 2021 World Energy Trilemma Index (World Energy Council, 2022)
Italics indicates ASEAN member, underlined indicates case studies

Country	**World Ranking**	**Energy Security**	**Energy Equity**	**Environmental Sustainability**
Iceland	15th	C	A	B
Japan	16th	B	A	A
Malta	21st	D	A	A
Malaysia	*25th*	*B*	*B*	*C*
Greece	39th	C	B	A
Cyprus	42nd	D	A	B
Mauritius	50th	D	B	B
Trinidad & Tobago	53rd	C	A	D
Thailand	*53rd*	*B*	*B*	*D*
Indonesia	*58th*	*A*	*C*	*C*
Sri Lanka	60th	C	C	B

Vietnam	*61st*	*C*	*C*	*B*
The Philippines	*70th*	*B*	*D*	*C*
Myanmar	*83rd*	*B*	*D*	*C*
Cambodia	*84th*	*C*	*D*	*D*

3.4.3 Politics and Interests Shaping Energy Transition in Southeast Asia

Regional interests and politics could position Southeast Asia in a much better spot than it would have been at if the ten ASEAN members attempted to traverse the energy scene alone. Taking a regional view, it is all the same pressures as the generalized ones from the last chapter but divided more along the lines of international and national. The international community, particularly the developed countries, will push the developing countries towards what they believe is best for the developed countries but often end up overlooking the effects on the developing countries. The 'Green New Deal' has the EU countries looking to be less reliant on China's rare earth minerals needed for solar and wind energy, and has effectively turned to Southeast Asia which will lead to increasing amounts of environmental devastation and human rights violations to meet the demands on such toxic and dangerous mining (Hertanti and Anderl 2024). These actions that seem paradoxical if one cares about the environment are not done out of poor intentions. There are well meaning aspects because the CO2 emissions from ASEAN alone in the next 30 years have the potential to be extremely high and leaving that unregulated could have worldwide negative effects. One of the main problems is that other countries that are pushing Southeast Asia towards ET are not offering to pay for it so the demands are that the developing countries themselves pay more for energy sources that provide less electricity. To this the national interests apply pressure to the regional ones seen through the organization representing them, ASEAN. ASEAN has the potential to smooth out many of the energy issues without the countries having to partake in ET such as the inter-regional pipelines, LNG ports, and standardization of energy grids. It also brings better positioning to the international stage by presenting a united front of a larger population than the European Union to make it more difficult to pressure the countries into less favorable movements. ASEAN also allows the region to set its own goals that account for the local situations ranging from consideration for the economy with the benefits coal has brought to an acceptance of sources that produce less CO2 emissions but are not necessarily RE. It isn't to say that Southeast Asia wants to pollute unlimited amounts of emissions without any sort of plan or slowing down. The APAEC 2016-2025 specifically addresses this in a number of different ways. Having lower CO2 emission based energy is even beneficial to improving the World Energy Trilemma Index score in the categoris of energy security and environmental sustainability. If Southeast Asia focuses on the sources that provide the biggest benefit to their unique geography and situation such as more reliable RE, geothermal and hydropower, it will end up better off than if it just follows blanket energy policy prescriptions handed to them from the outside (Safrina, 2024). Since ASEAN is an organization solely made up of Southeast Asian countries and their representatives it listens more to the needs and interests of the nations that make it up making it partake less in the balancing act that countries have to. The collective interests on the international stage appear almost as one sort of pressure and the collective interests on the national stage make up the other one sort of pressure. This is a generalization because on every level there will be conflicting interests even within ASEAN. Among its members it is possible that some countries favor some aspects of the APAEC 2016-2025 while others don’t. The internal pressures are not always visible from the outside and that is one of the main points of ASEAN’s existence to provide that unified front that helps prevent outside powers from exploiting each of its member states.

Chapter Four:

A Comparative Analysis of Energy Transition in Indonesia and the Philippines

While Southeast Asia may fall under the political and economic union of ASEAN, that doesn't mean the countries themselves aren't guiding their own paths. That it is why it is important to do a comparative analysis of two countries within the same region, of similar geographic and economic profiles that ended up going in opposite directions when it comes to RE. Not only do the two countries have the largest swings in the region of RE energy share going up in Indonesia's case and going down in the Philippines case. The Philippines and Indonesia are both island states with large numbers of inhibited islands with one or two islands holding significant amounts of their large populations. Indonesia is estimated to have 277 million people within its borders and the Philippines sit at approximately 113 million. These two combined make up 57% of ASEAN's entire 680 million people (Statista.com, 2024). Indonesia's Java island has a higher population than all of Russia at 151 million people (setkab.go.id, 2021) and the Philippines' Luzon island having more than South Africa at 62 million (philatlas.com, 2021). As is often the case with archipelago countries the exact number of islands is unknown with estimates for Indonesia ranging from 13,000-18,000 range depending on which authority is asked (Blakemore, 2017), and of these it is estimated that approximately 6,000 are inhibited (Conrad, 2020). In the Philippines case, they have similar geography as Indonesia does but in smaller numbers with the estimated islands landing in mid 7,000 range with about 2,000 being inhibited (Barile, 2017).

4.1 Energy Access and Human Development in Indonesia and the Philippines:

The challenge of being a multi-island state is providing electricity to all the people that can often times be far away from any electric grid. Yet despite this both countries remain committed to a 100% electrification rate. This will offer the chance for all their citizens to achieve a higher standard of living and not just those living on the main island. Indonesia successfully reached the 100% electrification rate in 2020, achieving this remarkable feature through yearly trends upwards from a 53.39% rate in 2000. Indonesia had managed to provide electricity for 46.61% of the population that was without in it in a span of twenty years. In the Philippines case they have also successfully been moving towards the 100% rate sitting at 97.39% in 2020 with a trend to achieve it by 2023. They came from a rate of 73.69% in 2000 which equates to nearly 1/4th of the country receiving electricity when they didn't just a generation ago. This electrification rate growth is reflected in higher standards of living. The HDI numbers have increased for both countries since going from 0.635 in the Philippines and 0.597 in Indonesia up to 0.705 in 2020 for the Philippines and 0.712 for Indonesia (UNDP, 2024).

Not only have both countries improved their numbers of electrification but the energy intensity rates have greatly improved as well. Energy Intensity is measured through MJ of energy per unit of GDP (2015 USD PPP) and has remained an important goal for many developing countries. This is because Energy Intensity is a measure of how much energy is needed for each advancement of economy and having a better rate of this means one is using less electricity to achieve the same economic result. Indonesia in the year 2000 had a TES/GDP PPP of 5.41 which, the same as the Philippines, has steadily come down every year up to 2020 with a score of 3.12. This lower score shows that the country has been getting more efficient and requiring less electricity per unit of economy due to a number of factors. It is not fair to compare this number to developed countries but any time a country can bring their own number down it is considered a positive outcome. This is a very significant change leaving 2020 at 58% of what 2000 required energy-wise. The Philippines had a similar rate of decline going from 4.69 in 2000 to 2.78 in 2020 requiring only 59% of what it had needed twenty years prior. Both have been committed to reducing energy intensity which has been seen as majorly successful efforts with the Philippines leading the way in ASEAN (Li *et al.*, 2019). One of the stated subsections for the SDG is to have the world double their energy efficiency by 2030 meaning the number is cut in half, both of the countries would be considered very successful by this measure.

Economically speaking when examining the triangulation approach to defining a developed or developing country both of these cases are considered developing with a continuous growth towards developed status. They can both be argued to be in the third tier of development compared to the other AMS led by Singapore and Brunei then Malaysia and Thailand then comes these two countries along with Vietnam. From 2000 to 2019 they've both steadily increased the GDP per capita and held the GDP per capita growth rate above the global average indicating a move in the right direction as seen in Charts 3.1.2 and 3.1.3. If they are both considered developing at a steady rate then the EKC hypothesis needs to be examined for the validity here in order to know how they should plan their energy policy.

4.2 Energy Supply and Environmental Damage in Indonesia and the Philippines

4.2.1 Energy Supply in Indonesia and the Philippines

Due to the geographic proximity of the Philippines and Indonesia there is significant overlap as to the energy sources available to them. Their proximity to their fellow ASEAN members also generally gives them similar profiles and options, however there are a few differences that are mainly unique to these two. Examining source by source gives policymakers and readers a better understanding of what is occurring and what the options are for the country's energy future. Both countries heavily rely on coal which has remained the largest growing source for both countries. Indonesia is both the largest consumer and exporter of coal (though it still imports large quantities). This heavy reliance on coal comes with a large environmental cost because it admits the most

CO_2 when combusted, the amount of emisssions depends on the coal rank (the quality of the coal being used). A short ton (2000lbs) of bituminous coal will produce 206lb of CO_2 compared to diesel at 161lb and natural gas at 117lb. If coal is replaced by natural gas CO_2 emissions would drop 40-50%. Both countries produce significant amounts of natural gas alongside Malaysia. Much like most of the energy sources, natural gas capacity has grown steadily over the last twenty years but at a much slower rate than coal. The Levelized Cost of Electricity (LCOE) of natural gas combined cycle power plant is similar to pulverized coal power plant. The downside is even with the high production levels it still requires import and negotiation of long-term gas contracts which can be costly and volatile in price. Once those contracts are negotiated there will then need to be LNG ports to be able to receive the imports from anywhere that doesn't have already established pipeline connections. LNG ports exist in Indonesia and they do not in the Philippines making it easier for Indonesia to make the switch to natural gas (Lau *et al.*, 2022). Those are the traditional sources, but what is unique for the case studies' RE?

Of the RE, both countries have hydropower making up the main share of it at 59% of all RE in Indonesia and 44% in Philippines (Lau *et al.*, 2022). Most of the wind energy harvesting occurs offshore. The immense amount of offshore that the countries have certainly helps them find suitable locations to try and receive at least some energy from this low capacity energy. The geothermal is particularly strong in these two countries with their location of the Ring of Fire, a location of increased tectonic activity which causes hot magma to rise closer to the surface than it would in other regions. Geothermal is used by 26 countries worldwide for electricity putting Indonesia and Philippines in an exclusive group to be lucky enough to have access to the source. It is predicted that increases in this energy source worldwide will prevent approximately 195 million tonnes of CO_2 emissions by 2030 (Idroes *et al.*, 2023). In 2020 there was 4.06 GW of geothermal energy produced between the two countries, roughly half and half between the two countries, though new geothermal has been very limited (Lau *et al.*, 2022). Despite all of these advantages, Indonesia and Philippines don't have clear plans to expand it. The following charts show what the 2020 state of energy based off the TPES numbers was and how they compare to the 2000 numbers.

Chart 4.2.1: Indonesia's Energy Share Profile in the Year 2000 (IEA, 2022)

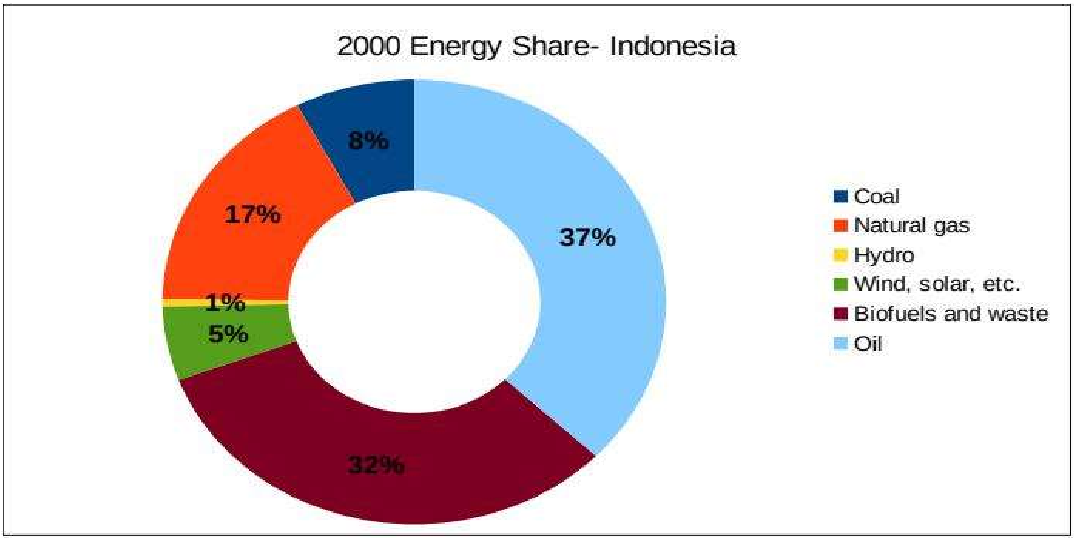


Chart 4.2.2: Indonesia's Energy Share Profile in the Year 2020 (IEA, 2022)

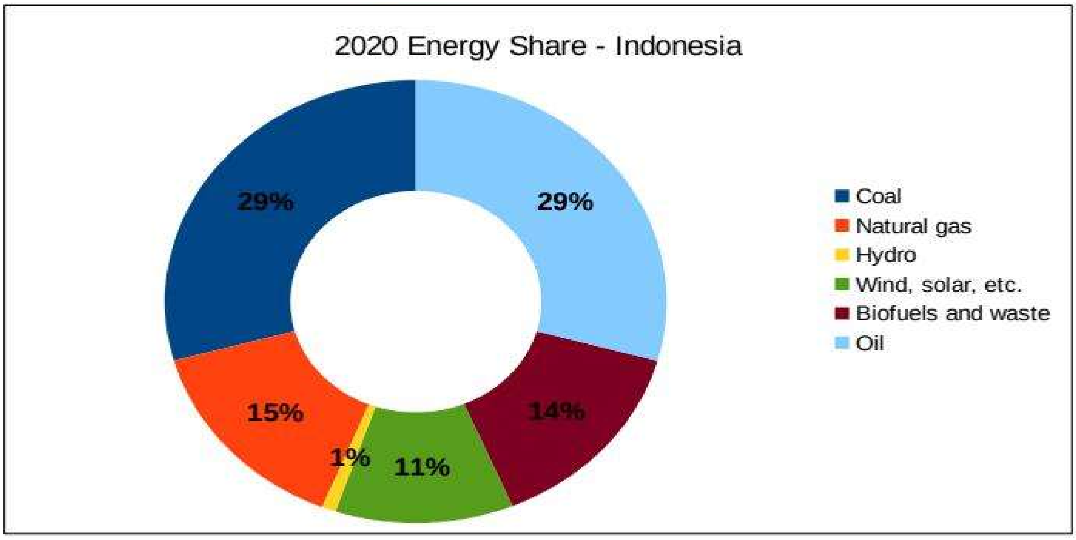


Chart 4.2.3: Change in Indonesia's Energy Share Profile in Years 2000 to 2020 (IEA, 2022)

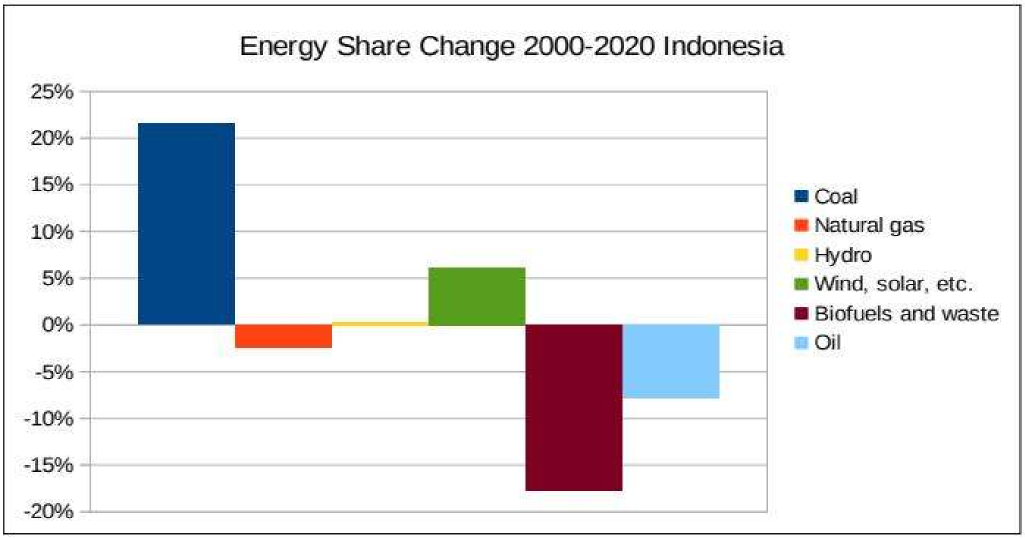


Chart 4.2.4: The Philippines' Energy Share Profile in the Year 2000 (IEA, 2022)

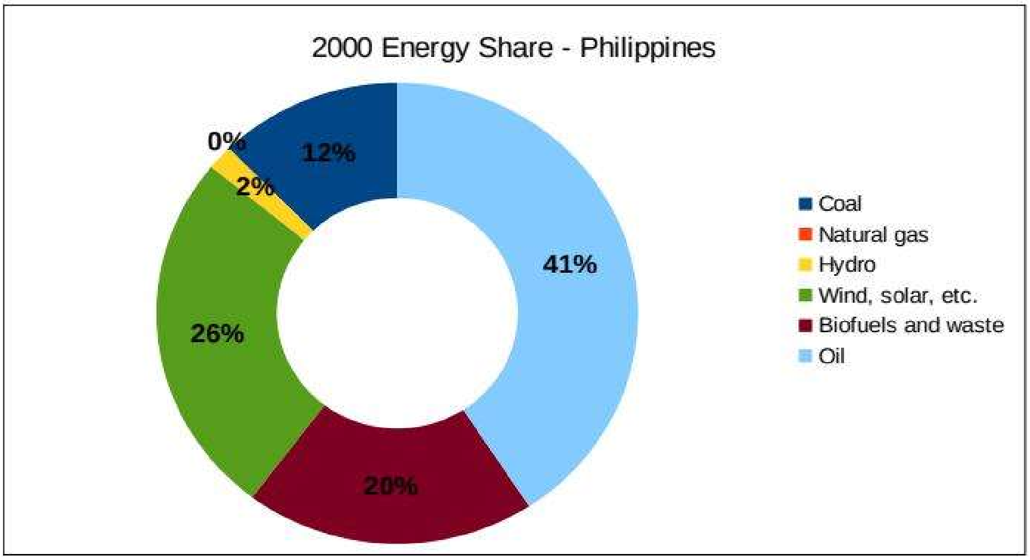


Chart 4.2.5: The Philippines' Energy Share Profile in the Year 2020 (IEA, 2022)

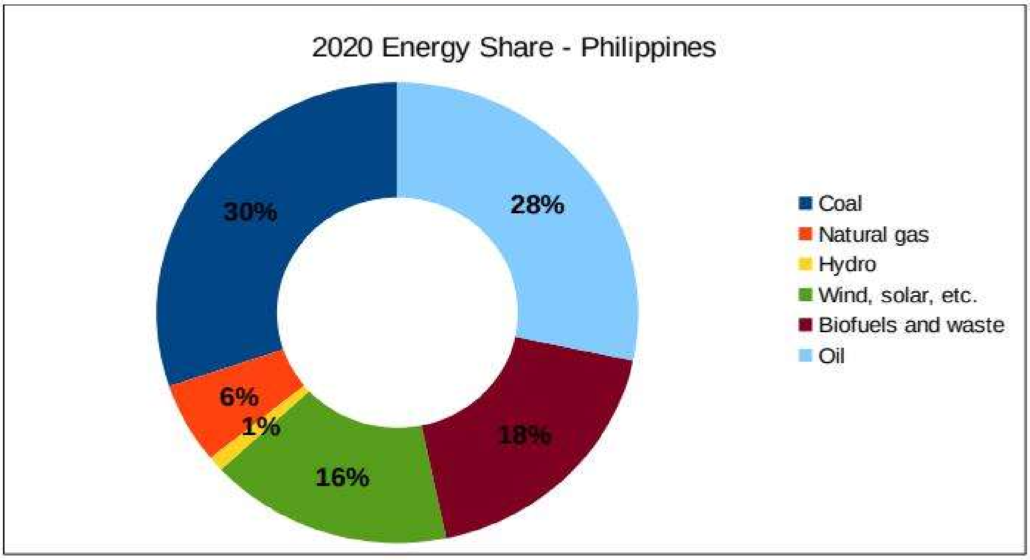
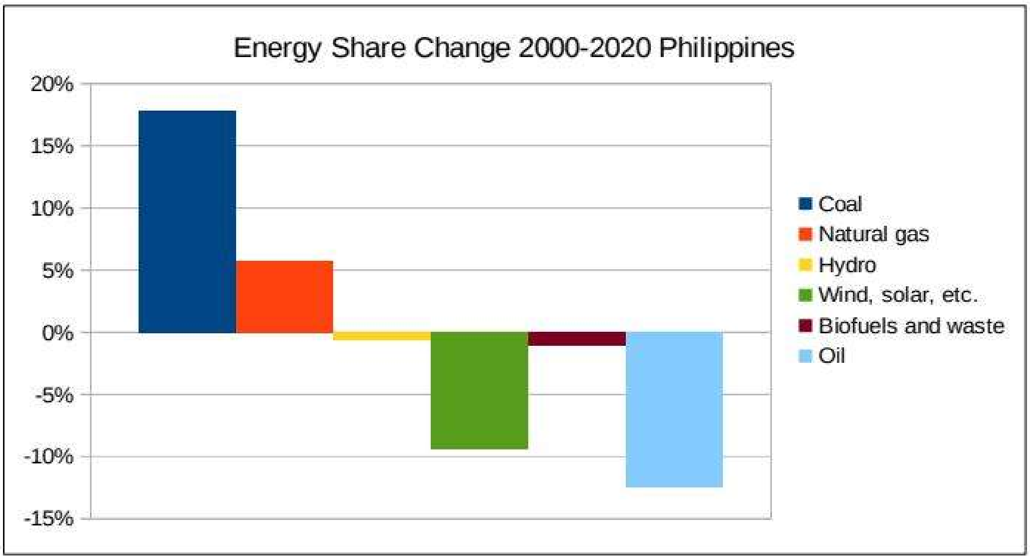


Chart 4.2.6: Change in the Philippines' Energy Share Profile in Years 2000 to 2020 (IEA, 2022)



Examining the supply side, total primary energy supply (TPES), gives a generally clearer view of how countries have been allocating their resources because there is more control for those in charge than there is when examining consumption. Indonesia in the year 2000 had over 2/3rds of their entire energy supply come from oil and biofuels with wind, solar, geothermal, and hydro only making up 6% combined. In the twenty years that followed oil and biofuels fell 25% combined, predominately a decline in biofuels more so than oil, while hydro, wind, solar, and geothermal collectively have doubled their position up to 12%. The largest change for Indonesian energy has undoubtedly been coal blooming from 8% up to 29% which is over three times as much growth as RE had in the same period.

The Philippines on the other hand has some overlap but some major differences as well from Indonesia such as oil and biofuels making up slightly less than 2/3rds of the energy share in 2000 and also having a decline in 2020 but less drastically at 15% decline with oil not biofuels being the main source of the reduction. Unlike Indonesia, Philippines had a large share of energy coming from RE at 28% in 2000 but the trend actually went the other direction decreasing to 17% in 2020. However, the main story remains the same for both countries with coal going from 12% all the way up to 30% making up by far the largest growth of any source for the Philippines as well as Indonesia. This is of great concern for the environmentally focused groups because as previously mentioned in the prior chapters a switch from coal to natural gas would decrease ASEAN's CO2 emissions by 40-50% and these two countries are the two largest in the organization. These energy supply share numbers however don't account for energy efficiency, for CCS technology, for improvements in technology such as the underground coal power production or long-stack replacing short stack coal plants. These are all points that can give environmentalists the peace of mind that just because there is an increase in coal does not necessarily mean there is the same environmental damage being done as twenty years ago.

4.2.2 Environmental Concerns and Damage from Energy Supply in Indonesia and the Philippines

Population growth has to be accounted for because generally any growth will cause environmental damage in many different aspects beyond just CO2 emissions. It is important to note that when researchers input different variables such as CO2 emissions in the air versus other damaging emissions it can lead to some refuting the EKC hypothesis while others confirm it for the same country and period of time. This is why it is generally better to look at the relationships of different variables rather than trying to refute or confirm the hypothesis. Looking at the work of Vo, Vo, and Le in 2019 they found that for Indonesia, GDP growth plays a key role in energy consumption, CO2 emissions, and RE use. Economic growth and population growth cause each other and GDP growth directly causes carbon emissions increase in the short and long run. Authors found GDP growth leads to growth of RE use. All of these connections agree with what Grossman and Krueger had stated before (1995). When Vo, Vo and Le examined the Philippines they found that the connection was there when looking at economic growth which pushes CO2 emissions and energy consumption to increase with it (2019). The same could be found in population growth which causes both energy consumption and RE use to increase as it goes up. It may be due to the lag of the economy that the Philippines has compared to Indonesia but essentially Vo, Vo, and Le did not find that inverted U shape relationship between the factors here (2019). If the EKC hypothesis is to be believed it means with further economic growth the Philippines will begin following the trend that Indonesia has and have their variables match theirs more.

The Philippines have had a smaller share of RE while Indonesia has had a larger one but how have the two actually fared on a CO2 emissions ratio when compared to their growing economies. To the surprise of some, both have improved in this category from 2000 to 2020 when examining CO2 emissions per GDP unit seen in the decrease of this ratio. Measured in Kg of CO2 for the emissions and USD in 2015, Indonesia was at a rate of 0.656 in 2000 but declined by 0.138 in 2020 to a rate of 0.518. This aligns very well with the improved rate of energy intensity and better technologies which is promising that developing countries are able to cause less environmental damage as they continually advance their economy. In the Philippines there is a similar downwards trend from 0.463 in 2000 down 0.118 to 0.345 in 2020 this occurs for similar reasons as Indonesia, the lower levels indicate that a higher share of RE in the TFEC isn’t necessarily going to solve all a developing countries CO2 emission problems (IEA, 2022). If the main task is to reduce carbon emissions than CCS (or CCUS) is one of quickest answers. 98% of CO2 storage occurs at saline aquifers. Even just the storage capacity of the sedimentary basins of Indonesia, Malaysia, and Thailand can hold 282 years of CO2 emissions from all of ASEAN (based of 2020 emission numbers) (Lau *et al.*, 2022).

4.3 Discussing Energy Transition and Infrastructure Challenges in Indonesia and the Philippines

Even with these similar prospects overall, we see divergences in how their energy mixes have gone. There are two main ways to examine a country's energy mix, demand side or supply side. Looking at the demand side, total final energy consumption (TFEC), of the two shows different paths for RE despite the major similarities the country's share. In Indonesia the percentage share in 2020 is 13.03% versus 8.98% in 2000 for an increase of 4.05% share. From 2000 up until 2015 the percentage was actually trending downwards but then it made a switch to upwards trend passing the 2000 level in 2018 and only going up from there. In the Philippines this was not the case as the 2020 level of 10.33% is lower than the 2000 share of 10.34% at a smaller share of 0.01%. While this change may not seem significant one needs to understand that from 2000 to 2012 the share was increasing and peaked at 12.23% over the following eight years it has only trended downwards indicating that the disparity between 2020 and 2000 will only grow larger. This is a result of the Indonesian-Filipino difference in what the RE target is, Indonesia targets final energy consumption energy share while the Philippines targets primary energy production installation capacity (Vo, Vo and Le, 2019). This will also be examined further in the next subchapter as it goes beyond just differences in goals.

The difference in how the RE goals are defined isn't the only reason for the split between the two. Indonesia has a larger economy and therefore more resources which is part of the reason they began to build more infrastructure for RE to power the country's electricity needs. Yet, the current infrastructure continually advances the cycle around coal with it being an easy to obtain and cheap resource the marginal cost of expanding it keeps decreasing. This is a similar case as what is seen in the rest of the ASEAN countries with the Philippines also being the same. The big difference in the two is differing goals have led them to different results when it comes to RE in the energy share mix.

Indonesia:

Indonesia's energy share breakdown is coal (59.9%), gas (22.3%), oil (6%), with RE (11.8%) rounding out the rest. The RE includes biomass and geothermal. Biomass and geothermal both have significant costs associated with them on the operating side such as infrastructure, machinery, and workforce. However, they both have the ability to alleviate CO2 emissions if done well and increase energy security. Geothermal compared to fossil fuels of similar capacity produce 97% less sulfur compounds and 99% less carbon dioxide (Idroes *et al.*, 2023), making it an attractive option that plays an important role for the future of the country's energy. With Indonesia's National Energy Plan the government estimates the country's potential capacity for RE could reach 418 Gw and has targets to increase RE share by 23% in 2025 and 31% in 2050. Technical and economic limitations make it unlikely that RE will fully replace fossil fuels in country's energy mix in the near future but it doesn't mean they can't expand their RE base.

Philippines:

The irony of the Philippines having the largest decline of RE in their energy mix share is that they were the first country in ASEAN to pass a RE Act. RE has functioned as an important form of domestic energy as the TPES has geothermal at 32.4% of indigenous energy and 17.9% of total, hydro at 6.9% indigenous and 3.8% of total. These two have long been the pillars of RE in country yet they remain at a relative standstill since the RE Act went into law. In fact, hydro has even declined since 2013 in share (Altomonte, 2021). The government made intentions clear with a target of 20,000 MW installed RE by 2040. This has been sluggish in progress and contrasts with Indonesia's RE goals to have RE make up a percentage of the entire energy share instead of a total amount of installed power generation.

4.4 A Political Economy Analysis of Indonesia´s Energy Transition Policy

The political economy that comes from outside and within the countries has created what seems to be such a wide chasm between the two case studies' energy policies. Each one must be examined separately and in depth, so that afterwards other country's decision-makers may be able to see what their own options are. First the country with a growing RE energy share, Indonesia, will be examined then afterwards the one with the declining share, the Philippines, to see how the deviations occurred.

4.4.1 Global Development Agenda in Indonesia

With global goals sometimes countries will integrate them into their own national plans. This is the case with the Paris Agreement and Indonesia's national energy plan. Even with the expansion of coal, Indonesian First Nationally Determined Contribution (NDC) states the country is committed to reduce GHG by 29% by 2030 (from 2015) as agreed in the Paris Agreement. The number goes up to 41% if they receive outside support from developed countries as opposed to taking on the challenge by themselves. Examining the energy sector alone it breaks down to 11% without support and 14% with support (Handayani, Krozer and Filatova, 2017). At the current trajectory the energy sector is projected to produce up to 1669 million tons of CO_2e in 2030 and in addition would fall short of the Paris Agreement goals in terms of energy share. Handayani, Krozer, and Filatova ran scenarios on how Indonesia's energy sector would look in the future on its current path versus different possibilities on reaching the international goals (2017). In the reference scenario, how the country is currently advancing, coal more than triples from 2015 to 2030 (108 TWh to 350 TWh) at 75% of the energy mix with natural gas at 18% and 7% in RE (for power generation). CO_2 emissions in 2030 would be 339 million tons of CO_2 or nearly three times base year. They then ran the scenario that most efficiently, in both costs and energy production, reaches the desired rates of GHG emissions set out in the Paris Agreement. What they found would require less coal and an increase of gas and RE. RE capacity would amount to 12.8 GW compared to reference's 7.2 GW measured as hydro 5.1, geo 5.5, and biomass 2.2. Wind, solar, and nuclear are not included because at present technology they are lacking in different ways (either cost, consistency, overall CO2 reduction, and so on). Gas would increase from 31.3 GW in reference to 33.7 GW (up 8%) here while coal decreases from 51.8 GW to 50.8 GW (down 2%). Ending with 66% coal, 17% gas, and 17% RE showing coal remains so cheap and the systems are still in place that Indonesia will most likely be locked in on coal for the foreseeable future. They ran scenarios where it was focused solely on increasing natural gas and another focused on increasing RE only. They found that in the optimization scenario the RE capacity is lower than it is in the RE scenario but actual electricity generation is higher. This is due to hydro, geothermal, and biomass having higher capacity factors than solar or wind which make the majority of the makeup in the RE scenario. The RE scenario also had the highest costs of the scenarios while optimization had the lowest, making the latter the most cost efficient method of lowering CO2 emissions. This is hugely important because any added costs will likely increase electricity production costs which often get added to the price paid by the consumer and also government subsidies which would both in turn hurt those most vulnerable in the country. While there is some overlap it is important to remember the UN SDG are not the Paris Agreement and follow a different pathway which leads countries to have to follow different international goals set out for them.

4.4.2 Limitations of Development Agenda and Alternatives in Indonesia

Reality is not always aligned with idealized goals and when goals don't allow for flexibility, especially for those with more limited resources, it creates policy prescriptions that can be more detrimental than helpful. The UN's ESCAP (Economic and Social Commission for Asia and the Pacific) wrote a 2020 report on what Indonesia should do to achieve the SDG 7. This report highlighted that the SDG is out of touch with reality and created controversy as the UN goals and ways to accomplish those goals ask too much without understanding the complete picture of what the countries have and are working towards (Nugroho, 2021). The report claims that Indonesia should not focus as much on city gas networks and instead expand electric cooking stoves especially on the Java-Madura-Bali islands to achieve an expansion of clean cooking for its people. The UN ESCAP also wants Indonesia to reduce GHG by 18% which is higher than the NDC (nationally determined contribution to the Paris Agreement of 2015 by over 7% without any international assistance). Also no more new coal plants as they claim are no longer more cost-efficient than RE. The final proposal was that there should be no more fossil fuel subsidies and instead an expansion of green financing. Every single one of these points comes with controversy and misunderstanding of the situation. The first point ignores that a switch to electric stoves requires major investment and long term planning which in turn would also strain electric production even more. This is also only feasible on Java island because its the only one with true surplus of power and would also probably increase coal as the country would need more power generation (Nugroho, 2021). The second recommendation to reduce GHG is not an issue because the other international and even domestic goals align with this but they still ignore that country also has other priorities such as increasing energy access and energy security. Developing RE may not be correct answer to widespread energy access challenge for the islands especially at the rate that the UN is asking for. The third point isn't just a lack of understanding but it is factually not true as Indonesia still has abundant amounts of coal which remain the cheapest option as Handayani, Krozer, and Filatovahave previously shown through many scenarios (2017). This doesn't even account for RE especially solar and wind being unreliable and volatile compared to the more traditional sources. The final point about financing ignores a lot of the realities of Indonesia's situation because removing the fossil fuel subsidies would directly harm those most vulnerable citizens. The subsidies are in place to ease the burden on the consumers. One could argue that Indonesia can keep the fossil fuel subsidies but expand "green financing" towards RE but this doesn't work without the strong institutional capacity. That strong financial institutional structure does not currently exist in Indonesia, this would require relying on outside institutions further weakening the energy security. For all these reasons Nugroho and others have argued that country's should outright ignore any UN recommendations and not follow the SDG but instead focus on their own internal goals (2021).

The World Energy Trilemma gives a better measure of how a country's energy policy is going which helps focus in on what can be improved. Indonesia had a score of A in energy security, C in energy equity, and C in environmental sustainability making it finish only behind Thailand and Malaysia of the developing Southeast Asian countries. Indonesia's big push to electrify the entire country and the continual expansion of different energy sources helped it reach that high ranking with decent to great grades (World Energy Council, 2022). The big increase in coal is one of the main reasons Indonesia doesn't have higher grades because the CO2 emissions that comes with that come at a high cost. The grades can go up with CCUS technology and/or better energy intensity which are accounted for on a fairer scale than they would be with UN SDG metrics. The World Energy Trilemma gives a clearer picture of what can be improved and what is going well but sometimes politics and different groups interests will impede what can be done this is the crucial last point to examine to understand developing countries energy policy.

4.4.3 Politics and Interests Shaping Energy Transition in Indonesia

One of the main factors keeping Indonesia from truly waning off coal usage is the economic importance it plays. Indonesia has abundant coal along with natural gas, oil, geothermal, solar, and hydro. At the current rate of use and export, oil is expected to be exhausted in 12 years, 33 years for natural gas, and coal in 82 years (Handayani, Krozer and Filatova, 2017). In fact there is such abundant levels of coal within the country that Indonesia is the world's third largest coal producer

(Sinaga and Soekarno, 2023). The massive levels of coal extracted play a vital role to the country's economy along with electricity generation. This runs a risk because the coal price has been declining recently and the demand for it has been in decline as other alternatives have become more available and cheaper too (Sinaga and Soekarno, 2023). Yet, despite this, coal production continue to rise and demand is still there so Indonesia and PLN, the national power company, have no plans to slow the extraction of the energy source. The answer to this goes beyond just coal being the cheapest reliable option.

Coal is predominately a state run enterprise in the country so waning off of it could cost hundreds of thousands of jobs (with ripple waves too) and economic damage (Li *et al.*, 2019). Some believe Indonesia should slow their exports of oil, gas, and coal and instead keep these sources for the country itself as there are still significant levels of imports of them despite the high indigenous production. The Indonesian government's plan doesn't align with that vision though, known as "Rencana Umum Penyediaan Tenaga Listrik" (RUPTL), as they aim to replace fossil fuels with RE by 2030 as a share, not in a complete entirety, and by 2060 have zero carbon emissions (Sinaga and Soekarno, 2023). That leaves little room for coal often known as one of the dirtiest sources in terms of CO2 emissions to be involved in the country's energy future. As for the present, coal continues to grow due to the availability and the current infrastructure mainly being geared towards it and oil. The energy supply required to meet the country's poverty rate goal of under 4% in 2025 is nearly double the amount of 2015 (Handayani, Krozer and Filatova, 2017) which will allow for coal to continue to expand for the time-being. The economic ambitions and goals of the country do not align with a future of coal-less energy supply and production. The positive side of the importance of the state-run power production enterprise is that when the country does hit the economic goals it sets out, it can begin to shift towards other sources and while doing so train the current employees for the new energy fields. This should save jobs and provide less push back than if the country and only a handful of strong oligarchies in the energy sector.

Even with the importance of coal, the country has made it clear through action that it doesn't want to be totally reliant on coal and that it does want to comply with some international pressures for less GHG emissions. Similar to almost every developing country there are multiple interests pulling it in different directions which requires a balancing act from the policymakers. It is usually international pressures, strong internal institutions, and ground-level citizens' desires that require careful consideration. Luckily for Indonesia the strong internal institutions can be guided or already closely align with the visions of the future that the country has. The ground-level citizens shouldn't be overlooked. They fall into two major groupings, the Java island residents especially the urban living ones and the rural community especially the far islanders. With Jakarta, the capital and main hub of Java island, hitting such high levels of pollution the cries for less pollution have been growing there. The city has already received a well established electrical grid, with consistent reliable energy so that is no longer the main concern. The rural islands on the other hand only recently received electricity access so having reliable and affordable energy is a higher priority. These two major groupings tend to fall in line with either the country's own development plans or lean more towards the international ones in the case of the urban Java population. With the growth of RE energy and the growth of coal the balancing act has chosen the path of more energy in general, this will cause Indonesia to hit a crossroads in the future but for now this is path they've chosen to satisfy all parties.

4.5 A Political Economy Analysis of the Philippines´s Energy Transition

4.5.1 Global Development Agenda in the Philippines

If Indonesia, the country that has a growing share of RE and a larger budget than the Philippines, is still off from the Paris Agreement and UN SDG than the Philippines doesn't have much off a chance of reaching these goals either. The UN SDG 7 in particular is broken down into five parts; access to energy services, share of RE, energy efficiency, international cooperation on energy, and investing in energy infrastructure. The Philippines has already stated they are working towards higher energy efficiency, 100% electrification rate, and ASEAN international projects. When looking at the smaller parts as opposed to the whole of the SDG 7, the Philippines is certainly on the right track towards some of the global development agenda.

4.5.2 Limitations of Development Agenda and Alternatives in the Philippines

The World Energy Trilemma has been established as a seemingly better measure of successful energy policy compared to the UN measures. How has the Philippines done in this category? They received a grade of B in energy security, D in energy equity, and C in environmental sustainability. Each of the categories is broken down into anywhere from 5 to 8 parts that make the country receive the score that it does so even when a country like the Philippines does have a higher reliance on energy imports than others do it doesn't mean they will end up with a lower grade if they succeed at the other portions. In the Philippines case they have been attempting to expand the energy source options for the smaller islands and rural communities, while also trying to improve energy efficiency and stability. The two things that have truly hurt the energy equity is the reliance on diesel in rural communities which causes high prices and the failure to hit 100% electrification (World Energy Council, 2022). This discussion is why alternatives to the SDG are so important because it forces a deeper dive into a country's situation which leads to more realistic solutions that encompass more than just one aspect of energy policy.

Every country has a unique blend of geography, infrastructure, and historical trends overlooking this can lead to policy prescriptions that ultimately cause more harm than good. The World Energy Council tried to bring attention to the more multidimensional aspects of energy policy to show that a country can focus their efforts outside environmental sustainability and still have success by their own measures. Whether or not they have successful energy policy depends on what metrics one uses, in the end of the day the most important ones are the ones they set out for themselves.

4.5.3 Politics and Interests Shaping Energy Transition in the Philippines

Taking into account the World Energy Trilemma view and the UN SDG 7 sub-parts it becomes easier to breakdown the interests and politics at play that are keeping the country from fully investing into an ET. The Philippines is a net energy importer despite producing coal, oil, and gas which leaves it vulnerable to price shocks through weakened energy security. Sitting at a rate of 474,000 barrels of oil per day being consumed while production was only 37,000 barrel per day with coal and natural gas also requiring imports to fulfill the demand (Deang, Dispo and Pizarro-Uy, 2022). In 2020, the TPES of imported oil was 28.4% and of imported coal was 18.6% while the remaining portion was domestically extracted (Altomonte and Guinto, 2022). There was even a major setback of indigenous coal at a 5.8% decline in 2020 due to water build up issues in the largest coal mine making the Philippines even more reliant on foreign energy sources (Altomonte and Guinto, 2022). Even natural gas which is more abundant in the country, has had issues with variability in production and have been on the decline, leading to development of import LNG terminals. The Philippine Department of Energy (DOE) believes there will be a large increase in natural gas, particularly LNG imports, standing in line with ASEAN stated objectives but not helping with the domestic energy security issue.

On the energy equity and energy access front, the Philippines by 2020 had yet to reach their 100% electrification rate which indicates even more power generation will be needed than their current level even if the economy doesn't grow and population stays flat, neither one is true, so the demand should only continue to increase. It's not to say they aren't close to reaching the 100% though. In 2019, electrification was 95%, even despite the problems and setbacks, the country still marches on to 100% goal (Altomonte and Guinto, 2022). A way to alleviate this issue of the rural populations lack of electricity is to create microgrids. With this it becomes easier to have isolated circuits that can use any form of energy accessible, most likely solar due to the lack of import needed after the initial set up. The isolated communities wouldn't need to be connected to Luzon's power grid anymore (Altomonte and Guinto, 2022). The DOE (2019) defines micro-grids as "a group of interconnected loads and Distributed Energy Resources (DERs) within clearly defined electrical boundaries that act as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the [main] grid which enables it to operate both in grid-connected or in island." If Micro-grids are paired with solar it can help expand the electricity to those rural, isolated populations that lack access to energy. Even those with access to electricity don't have it great because Philippines on average have a household electricity cost that's almost twice that in Malaysia, Vietnam, and Thailand (Altomonte and Guinto, 2022). Diesel may account for 97% of power generation in off-grid areas and small islands. The country hopes to replace this with biofuels as seen with 2006 Biofuels Act because this plays into the lack of reliable energy and higher electricity costs (Altomonte and Guinto, 2022). This indicates major changes are needed to keep growing the economy and raising the standard of living for those most in need.

Although they have their variability problems, wind and solar have had prices drop significantly to become the cheapest option for the electricity[6] yet they combine for 0.3% of TPES (Altomonte, 2021). Island, rural, and indigenous communities in remote areas typically lack access to energy, relying primarily on harvested biomass as a source of fuel. When looking at the price of solar and wind, the electrification goal, the RE act of 2008, and the fact that 16 million people don't have reliable electricity access in country especially in rural areas (Altomonte and Guinto, 2022), it doesn't make sense on the surface why coal keeps growing despite being an imported source but RE has gone in the opposite direction. A deep dive into country's political structure shows that there is an influential national oligarchy where the private sector exploits close relationships with government. In the case of energy it is the incumbent utilities showing the strong embeddedness that can exert pressure on energy policy with over 50% of power generation is owned by just three corporations (Altomonte, 2021). Different interests will attempt to guide public energy policy towards what they believe is the ideal state.

The power distribution also has a similar structure as the power generation companies with over a quarter of the population covered by one company. The country suffers from a strong social embeddedness between the large energy companies and the government where those with favorable ties are able to shift things their way. A prime example is how fossil fuels, especially coal, were supposed to be subject to more difficult requirements for permitting but those with ties to government are able to bypass them (usually large incumbents) and/or receive confidential information long before it is publicly announced allowing for adjustments that give an advantage (Altomonte, 2021). Thus coal keeps growing without issue so much so that the amount of wind and solar have actually increased in total production but decreased in energy share due to the massive growth of coal. Solar could have grown faster but large solar suppliers with strong ties to government have been able to raise barriers to entry for new players making it so that only large players can build instead of anyone with even a bit of capital. The expansion of RE can still occur even in this less ideal business environment if the government partakes more through reducing financial burdens, initial fixed costs, and medium-term low rate of return on RE investments to help energy sector kick this off (Deang, Dispo and Pizarro-Uy, 2022).

This internal pressure seems to be applied in the opposite direction of the international one. This puts the country at crossroads forcing it to prioritize what goals are the most important and try to work towards those because if no goals are worked towards it ends up with all people and interest groups upset. Complete electrification with continuous expansion to feed the growing

6 This price doesn't account for the marginal increase in infrastructure needed which still leaves coal as the cheapest option

energy appetite and better energy efficiency have come out on top. This is because the internal and external pressures could be content with this option because it satisfies portions of the UN SDG and the energy equity portions of the World Energy Trilemma while at the same time allowing the national power oligarchies to hold their position and make more money all while making their citizens receive a tangible important thing, accessible electricity. This balancing act is often what is required of developing countries when developing energy policy because ignoring any of the extorted pressures can create large problems now and into the future.

Chapter Five:

Conclusion

Developing countries design energy policy through a balancing act between international pressures and domestic interests. This leads to national energy goals that can use different definitions of what energy transition and renewable energy are compared to what organizations such as the UN define them as. This way the developing countries can still succeed at undergoing their energy transition while also still growing their economies and effectively their citizens' standard of living. By building the common concepts that policymakers worldwide have followed it is clear to see how the countries and international agencies reach the conclusions that they do. Understanding the importance of energy access to the economy, the potential environmental damage that comes with it, how to mitigate that potential damage, and why it may not be as straightforward as policymakers would like it to be are all vitally important towards the creation of energy policy.

This conclusion was found through examination of what international organizations had stated as their goals and how they defined their metrics then comparing that to the national goals of Indonesia and the Philippines and the regional ones of their organization, ASEAN. This point already shows a divide, in particular the SDG and the ASEAN, Indonesia, and the Philippines. To understand the division it was examined what needs to be done for the countries to achieve the UN goals and what would happen if they did. This showed that the UN SDG recommendations are not what is best for the developing countries as many recommendations could harm economic growth through unreliable, unaffordable energy and may even cause significant environmental damage with rare earth mineral mining being extremely harmful to the environment. Examining every energy source with their benefits and downsides gives a fuller picture as to what the options are for these countries along with additional opportunities that may come from themselves or from cooperation with ASEAN. Statistical evidence of where the countries used to be with their energy situations, what is occurring currently, and where they seem to be heading needed to be established as well. With this data and comparing it between the two case studies it showed how the two had seemingly headed in opposite directions when it came to renewable energy if it was measured as a percentage. From here the differences that caused the gap were evaluated and the answer came out to be a complex mixture of different factors. These different factors helped to highlight how the national policymakers end up facing many different pressures from different actors on all levels from local to domestic to regional organizations all the way up to globally spanning ones. The domestic factors range from a number of different things such as the private/public nature of power generation, the levels of regional integration on the energy grids, the resources domestically available to them, the current infrastructure, the physical geography, the cost of import on energy sources and/or harvesting materials for energy sources, the financing available for projects, and the reliability of different technologies. All of these were seen through the mix of government statements, statistical data, and academic papers building up how the two countries in similar situations with similar geography in the same economic and political union ended up on different paths. Even Indonesia's increase in energy share of RE hasn't been considered good enough by UN SDG standards but by providing an alternative evaluation method, the World Energy Trilemma Index, it becomes clearer that both countries have been making progress on a holistic approach to their energy. This new metric allows for the countries to work towards economic progression for all by expanding reliable energy at affordable rates without being poorly graded for it because they chose sources such as coal or natural gas to provide the electricity. It also accounts for reductions in CO_2 emissions as opposed to switching to RE which comes with its own issues. Knowledge of the technical terms of energy along with having a beginning to end approach also were needed to reach an understanding of sustainable energy policy.

Even with all the layering of knowledge there is still more to cover and research in the future if this is to be applied to other countries. There is a lack of direct statements from those involved in the national energy policies including those who write legislation, the Department of Energy's of the case studies, and the ACE. Interviews directly with them could contribute important knowledge to the paper to potentially cover factors not included thus far. The voices of the citizens of the countries both rural and urban are secondhand mentioned but the lack of firsthand discussions could also provide information as to what grassroots pressures the countries' leaders face. There was a lack of conversation around the structures of the governments, this is a topic that should receive extensive research to see if/how government types affect energy policy. Some more comparisons that could should be made to fully understand the extent of how energy policy can be shaped are ones such as the Global South versus the Global North to see how much influence wealth can have. Comparing the countries who seem to be on track for the UN SDG to those who aren't to see what they have done and what the effects have been so far. Comparing more island based nations to those that are landlocked to the coastal adjacent ones to see how much geography has an impact. A comparison of Southeast Asia against the East Asia countries, the most recent group to be considered developed, to see the effects that becoming developed has on energy policy versus those on the pathway of development. Having ASEAN members be compared to Latin America is the final comparison that would add depth to see the extent that a strong political and economic union could have on developing countries against those without one. The last factors to explore are what extent does foreign direct investment have on what energy sources are chosen. This paper did not explore this topic much because the two case studies do not receive much of this towards their energy industry, but countries like Vietnam do. This last factor is particularly important to research further in depth because it could be the key for the developed countries attempting to guide developing countries energy policy to have that achieve what they hope for the developing countries to achieve.

Many of the points to research further require either immense amounts of time and/or resources, especially interviews with high end government officials and energy companies, but they are all important topics. Energy policy and the systems that follow them are complex and vast involving many moving parts and understanding how these parts influence each other is crucial for policy recommendations. Evaluating the levelized cost of electricity of each energy source for the two countries was something that requires insights into each country which is not public information. Having that information is also something that could add important depth to the research that was not accessible. Even with these setbacks the research presented gives the basis for building up depth to the field of energy policy in developing nations.

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