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EAST ASIAN ENERGY TRANSITION: OPPORTUNITIES, CHALLENGE, AND THE PARIS AGREEMENT

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I. Introduction

Many countries in East Asia are in a unique position in the world energy market. These nations do not face the same problems as less developed countries, where the lack of development often deprives the country of a starting point for wide-scale energy production. Additionally, many East Asian countries do not suffer as much from an engrained infrastructure like the west, where oil and gas infrastructure is so developed and invested in that it becomes a financial and societal barrier to energy switching. This paper will set out to analyze the specifics of certain East Asian countries' inevitable switch to more sustainable energy and what, if any, role the United States can play in supporting that switch. Currently, United States companies are involved in the production of oil and gas in many of these

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East Asian countries, and while the opportunities may not be as attractive as at home, overseas renewable contracting should be seen as a valuable opportunity for companies to get in on the ground floor. We need not be so rigid in pursuit of this goal, as supporting infrastructure for oil and gas production and transportation as the platform for renewable development will likely be the answer in most economies.

The world is still heavily dependent on oil, natural gas, and coal, with those sources accounting for 80% of the world's energy consumption.[1] There are two looming obstacles for most countries looking to switch from these energy sources in the electricity production sector. To switch electricity production methods a country must invest in both production and distribution. An effort to bring more renewable energy online will eventually fail if more capacity and storage are not added as well. The largest opportunity for countries in East Asia with significant coastlines will most likely be offshore wind production.

First, it is important to lay the foundation of energy sources over time and understand why renewables are a necessary switch for the world, followed by an analysis and history of the organizations working to fight climate change in East Asia. Second, this comment will examine the most important agreement in the world regarding climate change, the Paris Agreement, which implores countries to take an honest look at their current emissions and propose action to limit or eliminate emissions in the future. Finally, this paper will conclude with a look at each chosen country and its energy history, current production methods, and future considering the Paris Agreement.

This analysis will focus on four countries in the region, representing a wide variety of issues and energy sources. China is heavily reliant on coal and energy imports to support its energy infrastructure.[2] Thailand represents a current and future leader in the liquefied natural gas ("LNG") transportation industry.[3] Viet Nam is uniquely positioned to expand existing renewable infrastructure and develop new renewable technologies.[4]

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1. Humzah Yazdani, *Why transmission and distributions are the clean energy transition's secret weapons,* World Economic Forum (Jul. 16, 2020), https://www.weforum.org/agenda/2020/07/transmission-distribution-clean-energy-transition/.

2. *Country Profile: China - Coal,* International Energy Agency, https://www.iea.org/countries/china/coal (last visited Apr. 28, 2024).

3. *Thailand – Country Commercial Guide,* International Trade Administration (Jul. 25, 2022), https://www.trade.gov/country-commercial-guides/thailand-energy.

4. *See Country Profile: Viet Nam,* International Energy Agency, https://www.iea.org/countries/viet-nam (last visited Apr. 28, 2024).

Finally, Indonesia is the largest exporter of coal in the world and is still heavily reliant on traditional forms of energy.[5] Indonesia faces unique challenges in modernizing in contrast to other countries in the region who are profiting less from those traditional sources of energy.[6]

II. Energy and Pollution Background

This analysis starts with a summary of each energy source over history and its pollution to establish context around the global climate initiative. The emissions and cost data in this section is what every country will need to evaluate when making renewable energy decisions. The sweet spot for each country will differ based on the energy availability, level of development, and energy needs.

The world has changed drastically since humans began utilizing energy. First, there was human power, limiting people in energy exertion to what they themselves could output. Then, humans moved to using animals to increase energy potential, allowing for further development of society, but this source was still limited by the number of people and animals a community could support. Further, both sources were limited in their output according to energy inputs, or food. Humans then learned to use nature to their advantage, building water wheels and windmills to harness and utilize the earth's natural energy production through wind and the flow of water. However, with the invention of steam power and the discovery of oil, humans in many ways evolved beyond their predecessors.[7] For the first time, humans utilized energy stored as carbon over time to drive mechanical functions, drastically increasing the potential energy consumption and production of each individual. There was some energy production from stored carbon prior to steam power in the form of fire used for cooking and heating; however, the use was limited to non-mechanical functions.[8] The shift to long-stored, organic energy also had another effect: humans were able to store energy for long periods while in the past energy was expended without significant long-term storage.

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5. *Country Profile: Indonesia,* International Energy Agency, https://www.iea.org/countries/indonesia/coal (last visited Apr. 28, 2024).

6. *Id.; Country: Indonesia,* U.S. Energy Information Administration (Sept. 24, 2021), https://www.eia.gov/international/analysis/country/IDN.

7. Hannah Ritchie, *How have the world's energy sources changed over the last two centuries?,* Our World In Data (Dec. 1, 2021), https://ourworldindata.org/global-energy-200-years.

8. *See Id.*

This new age of stored energy, starting in the 18th century, massively increased mankind's capabilities beyond their own energy. This revolution started with the increased use of coal as a low-cost alternative to wood and charcoal; as the Industrial Revolution began, coal became prevalent as an energy source for steam powered engines.[9] In 1859, the first oil well was drilled in Pennsylvania.[10] Early on, much like coal, oil was used for heating rather than industry or transportation, although with much less frequency.[11] Coal progressed towards mechanical uses at a faster rate than oil, and by 1900 coal made up around 47.2% of the global energy mix.[12] Oil and natural gas did not become nearly as prevalent until around 1950, when it made up a combined 26.4% of the global energy mix.[13] Despite a slow start, the use of oil and gas increased rapidly, making up a combined 56.9% by 1980 while coal constituted only 23.8% of the energy mix for the same year.[14] From 2000 to 2020, the only three energy sources that had expanded, as a percentage of total energy, were coal, rising from 22.33% to 25.07%, renewables, going from 6.6% to 11.2%, and natural gas, going from 19.55% to 22.92%.[15]

Asia has a comparatively shorter history of electricity production and oil and gas utilization than the western world.[16] While the western world experienced widespread energy expansion, Asian countries took time to catch up, particularly in the realm of electrification.[17] Electrification is the number of people and regions within a given country that have readily available access to electricity. Each country has developed differently, and each country's development will be addressed individually in this analysis. It is important to note, however, that much of the earlier production of energy, and by proxy carbon dioxide emissions, was centralized in the

9. *See Id.*

10. Govind Bhutada, *The 200-year history of mankind's energy transitions,* World Economic Forum (Apr. 13, 2022), https://www.weforum.org/agenda/2022/04/visualizing-the-history-of-energy-transitions/.

11. Ritchie, *supra* note 7.

12. Bhutada, *supra* note 10.

13. *Id.*

14. *Id.*

15. *Id.*; Hannah Ritchie and Max Roser, *Energy Mix,* Our World in Data, https://ourworldindata.org/energy-mix (last visited Apr. 28, 2024).

16. *See* Hannah Ritchie and Max Roser, *Energy Production and Consumption,* Our World in Data, https://ourworldindata.org/energy-production-consumption (last visited Apr. 28, 2024).

17. *Id.*

west.[18] Think of the world's greenhouse gas budget as a glass, and when Asian countries really started pouring a significant amount in the glass, thereby benefiting the quality of life for their populations, the glass was already half full. It would be, in some sense, forgivable if those countries chose to take the same advantage of the greenhouse budget as the Western countries were permitted to. On the other hand, many of the countries in this analysis have effectively chosen to instead make significant investments in cleaner alternatives and renewable energies, thus making these countries primed for investment in their respective energy revolutions.

In terms of pollution, it is prudent to first look at science. Along with a large growth in energy use came a growth, unknown at the beginning, in greenhouse gas pollution. Below is a table representing the major energy sources, using United States emissions as a data source, and their respective pounds of carbon dioxide production per kilowatt hour as a measurement of electricity production, and production per million British Thermal Unit as an emission coefficient.[19] An emission coefficient is a base amount of carbon dioxide produced when burning the fuel to achieve a certain amount of energy production.[20]

Fuel	**Pounds of CO2 Emissions per Kwh (Electricity Generation)**	**Pounds of CO2 Emissions per Million Btu (Transportation and Industry)**
Coal	2.23	211.87
Natural Gas	0.91	116.65
Petroleum	2.13	N/A
Motor Gasoline	N/A	155.77

[21]

18. *Id.*

19. *Carbon Dioxide Emissions Coefficients,* U.S. Energy Information Administration (Oct. 5, 2022), https://www.eia.gov/environment/emissions/co2_vol_mass.php; *Frequently Asked Questions*, U.S. Energy Information Administration, https://www.eia.gov/tools/faqs/faq.php?id=74&t=11 (last visited Apr. 28, 2024).

20. *Id.*

21. *Id.*

Greenhouse gases, including carbon dioxide, warm the earth by trapping heat within the atmosphere.[22] The earth relies on this process naturally to keep the temperature stable and allow life to flourish.[23] Without greenhouse gases, heat would escape the atmosphere resulting in a colder, uninhabitable earth.[24] However, when too much of the gas accumulates in the atmosphere, the warming effect exceeds natural levels and causes excess warming.[25]

There are five major greenhouse gases, but in terms of energy, carbon dioxide is the most prevalent and accounts for 76% of the total greenhouse gases humans are responsible for emitting.[26] A warming climate will have many adverse effects on human life, particularly in poor and coastal regions.[27] First, weather events will likely become more frequent and increasingly destructive.[28] The sea will rise, which will force coastal communities to migrate inland, causing loss of life and damage for people living in those communities.[29] Increasing acidification of the sea will kill coral reefs and other ocean organisms.[30] Droughts will affect countries and regions, limiting access for already at-risk communities.[31] All of these symptoms will negatively impact food supply throughout the globe.[32]

Renewables, contrary to popular belief, are not necessarily carbon free currently, but the energy sources do represent a stark reduction in carbon dioxide output particularly once the economy shifts to full reliance on renewable sources.[33] First, manufacturing of renewable energy

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22. *What is the greenhouse effect?*, National Aeronautics and Space Administration, https://climate.nasa.gov/faq/19/what-is-the-greenhouse-effect/ (Last visited Apr. 28, 2024).

23. Melissa Denchak, *Greenhouse Effect 101*, Natural Resources Defense Council (Jul. 16, 2019), https://www.nrdc.org/stories/greenhouse-effect-101.

24. *Id.*

25. *Id.*

26. *Id.*

27. *Predictions of Future Global Climate,* Center for Science Education, https://scied.ucar.edu/learning-zone/climate-change-impacts/predictions-future-global-climate (Last visited Apr. 28, 2024).

28. *Id.*

29. *Id.*

30. *Id.*

31. *Climate Change Impacts,* National Oceanic and Atmospheric Administration (Aug. 13, 2021), https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts.

32. *Id.*

33. *See* Susan Tierney and Lori Bird, *Setting the Record Straight About Renewable Energy*, World Resources Institute (May 12, 2020), https://www.wri.org/insights/setting-record-straight-about-renewable-energy.

infrastructure in an era of environmentally unfriendly manufacturing methods means that getting the industry started will incur some environmental costs.[34] Second, battery development and production require rare metals, and batteries are often manufactured in a way that can hurt the environment.[35] However, these factors should not be something to deter future investment and reliance on renewable energy, as the environmental effects pale in comparison to continued reliance on oil, gas, and coal.[36] Additionally, future development will almost assuredly reduce the environmental impact of the production and development of renewable energies. As the world moves to renewable sources of energy, the relative carbon dioxide output of development will decrease as it no longer requires other carbon-dioxide-heavy methods for manufacturing and transportation.[37] The operation of renewable energy sources, on the other hand, does not produce carbon emissions at any substantial level.[38] Thus, once the world is converted to renewables, the theoretical output of carbon emissions will be near zero.

As of 2021, the world produced a combined 36.82 billion tons of carbon dioxide.[39] Asia produced the largest share of carbon dioxide emissions in 2021, at 21.44 billion tons, or approximately 58% of the world's total carbon dioxide emissions.[40] North America, on the other hand, represented 6.2 billion tons of carbon dioxide emissions, or around 17% of global emissions.[41] Notably, Asia represents around 60% of the global population, so its emissions per capita were actually below that of North America and Europe.[42] Historically, the difference between the regions is stark. North America is nearly tied with Asia in historical carbon dioxide emissions at approximately 29% of global emissions, or 477.77 and 480.98 billion tons respectively.[43] In fact, Europe is the largest historical producer of carbon dioxide, at 532.04 billion tons and 32.11% of total emissions.[44] The gap

34. *See Id.*
35. *Id.*
36. *See Id.*
37. *See Id.*
38. *See Id*.
39. Hannah Ritchie and Max Roser, *CO2 Emissions,* Our World in Data, https://ourworldindata.org/co2-emissions#annual-co2-emissions (Last visited Apr. 28, 2024).
40. *Id.*
41. *Id.*
42. *Id.*
43. *Id.*
44. *Id.*

between current emissions and future emissions, along with the population differences, makes the historical predominance of western nations benefiting from carbon-dioxide-emitting energy production evident.

III. Solutions and Costs

There are numerous potential solutions to reduce greenhouse gas emissions from the energy, transportation, and industry sectors. Each solution has varying potential for implementation in individual countries. The decision of which to implement is always a balance between availability and cost. Countries must look at each solution, whether renewable, natural gas, or other alternative, to determine which projects fit best into their cost analysis and renewable energy goals.

Most energy alternatives have seen a dramatic decrease in price per unit of energy produced over the last 20 years, with some decreasing in cost by more than 600%.[45] For context, coal and gas power in 2020 costed between $55 and $148 per megawatt hour in the 95th and 5th percentile of costs respectively, while the data below indicates renewables currently occupy the lower half of that range. With decreasing costs, renewables made up around 11% of global primary energy as of 2019. The world generated a total of 7,391 Terawatt hours of power from renewable energy sources in 2021.[46] The three main sources of renewable energy globally are wind, solar, and hydropower.[47]

Wind power represented 21.22% of global renewable electricity generation in 2020.[48] The cost of both onshore and offshore wind energy has reduced drastically in recent years, making it one of the most attractive forms of energy going into the future.[49] Onshore wind sources are usually wind turbines built on land, while offshore wind sources are turbines built off a coast, usually in the ocean.[50] In 2000, it would have cost around $150 per megawatt hour for both onshore and offshore wind energy.[51] Just two

45. *Mitigation of Climate Change: Summary for Policymakers*, Intergovernmental Panel on Climate Change, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf (last visited Apr. 28, 2024).

46. *Id.*

47. *Id.*

48. Hannah Ritchie, Max Roser, and Pablo Rosado, *Renewable Energy,* Our World in Data https://ourworldindata.org/renewable-energy (last visited Apr. 14, 2024).

49. *Mitigation of Climate Change: Summary for Policymakers*, *supra* note 45.

50. *See* John McCloy, *Onshore vs. Offshore Wind: What Are the Differences and Facts?*, GreenCoast (Sept. 17, 2019), https://greencoast.org/onshore-vs-offshore-wind/.

51. *Mitigation of Climate Change: Summary for Policymakers*, *supra* note 45.

decades later, in 2020, that number for onshore wind was slightly below the 95th percentile cost for coal of $55 per unit, and offshore wind was nearing that same number at around the $75 mark.[52] The global implementation of onshore wind energy increased from near 0 gigawatts in 2000 to more than 650 gigawatts in 2020.[53] Offshore wind energy has seen less widespread adoption, still totaling less than 10 gigawatts of utilization in 2020.[54]

Solar is another major potential opportunity for future renewable development. There are two main sources of solar: concentrating solar power and photovoltaics. Photovoltaics make up the lion's share of all solar power utilization.[55] From 2000 to 2020, solar power from photovoltaics rose from 0 gigawatts to around 700 gigawatts while concentrating solar power went from 0 to around 6 gigawatts.[56] Meanwhile, both fell significantly in price per Megawatt hour as photovoltaics went from above $600 to around the 95th percentile cutoff for coal of $55 and concentrating solar power started at over $300 in 2010 and dropped to nearly $75 by 2020.[57]

Nuclear energy, although not technically a renewable energy source due to its production of nuclear waste, will also be a valuable resource for many countries. Nuclear energy has remained cost competitive over the years; however, due to nuclear waste and fear of meltdowns, the technology has not seen rapid development in some Asian countries.[58] The future existence of nuclear energy in Asia is a hotly debated topic, with some claiming Asian countries should skip directly to renewables and others hailing it as a consistent low-emission energy source to compliment renewables.[59] For

52. *Id.*
53. *Id.*
54. *Id.*
55. *Id.*
56. *Id.*
57. *Id.*
58. *Economics of Nuclear Power,* World Nuclear Association (Aug. 2022), https://world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx; Tipakson Manpati, *Nuclear Power Trend in Southeast Asia and Its Contested Discourses on Climate Change,* Heinrich Boll Stiftung (Nov. 9, 2020), https://th.boell.org/en/2020/11/09/nuclear-power-trend-southeast-asia.
59. *See* Dominic Faulder, *Asia's Nuclear Power Dilemma: Ukraine War Drives Energy Turnarounds,* Nikkei Asia (Apr. 20, 2022 6:00 JST), https://asia.nikkei.com/Spotlight/The-Big-Story/Asia-s-nuclear-power-dilemma-Ukraine-war-drives-energy-turnarounds; *See* Tim Ha, *A Decade on From Fukushima, It's Time for Southeast Asia to Bury its Nuclear Dream,* Eco-Business (Mar. 12, 2021), https://www.eco-business.com/opinion/a-decade-on-from-fukushima-its-time-for-southeast-asia-to-bury-its-nuclear-dream/.

example, Viet Nam has gone back and forth on whether to implement nuclear energy while China is planning to build out an extensive nuclear infrastructure.[60] Nuclear energy continues to be a low-cost option at around $52 to $75 per megawatt hour.[61]

Realistically, renewables will only scale to the level required to curb climate change, particularly in the transportation industry, if batteries are available at a reasonable cost. Batteries serve two essential functions that allow adoption of renewables to replace oil, natural gas, and coal. First, batteries allow countries, through the implementation of electric vehicles, to centralize electricity production and force reliance on the electricity grid. Currently, cars burn fuel directly for energy, acting as a small-scale generator. However, large scale generation allows for sources of energy to be switched more readily, as it is easier to change the production method of a power plant or route renewables to the grid than it is to remove every car from the road and switch the engine. Second, with the increased reliance on the grid, batteries allow for large-scale storage of energy to equalize the potential output from the grid. Wind turbines only produce energy when it is windy and solar panels when it is sunny, but if you can store energy from peak times, saving it for lower production periods, then people will not have electrical interruptions based on conditions in nature. A good mix between wind energy, solar energy, and battery technology would stabilize the grid when the various energy sources produce energy at times contrasting consumption. Luckily, battery technology is another area that has seen cost reduction and more widespread adoption.[62] The costs of producing batteries has gone from around $1,400 per kilowatt hour to less than $200.[63] Adoption of battery technology is similarly promising, as the number of electric vehicles reached well over 6 million in 2022.[64]

60. *Nuclear Power in China,* World Nuclear Association (Jan. 2023), https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx; *Nuclear Power in Vietnam,* World Nuclear Association (Jun. 2022), https://world-nuclear.org/information-library/country-profiles/countries-t-z/vietnam.aspx,

61. *Projected Costs of Generating Electricity: 2022,* International Energy Agency (Dec. 2020), https://www.iea.org/reports/projected-costs-of-generating-electricity-2020.

62. *Mitigation of Climate Change: Summary for Policymakers*, *supra* note 45.

63. *Id.*

64. *Id.*

IV. Overview of Issues in Common

There are several issues that are common to all or most of the countries in this analysis. First, the lack of investment, trusted investment, or banking mechanisms to allow for said investment are prevalent.[65] Second, rapidly increasing demand is causing some countries to turn to simpler, more conventional forms of energy such as coal as a gap filler of sorts.[66] Third, a lack of grid upgrades, battery upgrades, and integration limits have hindered the use of renewables due to the large burden doing so would place on transmission lines and the grid.[67] Finally, the ease of use and support for conventional energy are still high in these countries even while renewable energy support is on the rise.[68]

Lack of investment is a large issue because renewable projects are not necessarily viewed as reliable in contrast to conventional methods of energy generation.[69] Additionally, the higher cost of some of these methods requires either government support or an investor with an eye for more than short-term profits.[70] The banking industries in these countries are not as supportive of these investments, and it is a high priority for international clean energy organizations to facilitate modern banking in the space.[71]

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65. *See* Michael Waldron and Lucila Arboleya, *Energy Investment in Emerging Economies – Transforming Southeast Asia's Power Sector,* International Energy Agency (Nov. 5, 2019), https://www.iea.org/commentaries/energy-investment-in-emerging-economies-transforming-southeast-asias-power-sector.

66. *See Demand From Asia is Set to Power the Growth of the Global Gas Industry Over the Next Five Years,* International Energy Agency (Jun. 7, 2019), https://www.iea.org/news/demand-from-asia-is-set-to-power-the-growth-of-the-global-gas-industry-over-the-next-five-years.; *Global Coal Demand Set to Remain at Record Levels in 2023,* International Energy Agency (Jul. 27, 2023).

67. *See Building the ASEAN Power Grid: Opportunities and Challenges,* Southeast Asia Development Solutions (Sept. 29, 2022), https://seads.adb.org/solutions/building-asean-power-grid-opportunities-and-challenges.

68. *See* Xu Chen and Denise L. Mauzerall, *The Expanding Coal Power Fleet in Southeast Asia: Implications for Future CO2 Emissions and Electricity Agreement,* American Geophysical Union (Nov. 16, 2021), https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021EF002257.

69. *See* Waldron and Arboleya, *supra* note 65.

70. *See The Cost of Capital in Clean Energy Transitions,* International Energy Agency (Dec. 2021), https://www.iea.org/articles/the-cost-of-capital-in-clean-energy-transitions.

71. *See* Waldron and Arboleya, *supra* note 65.

Rapid demand increases also plagues all of the countries in this analysis.[72] As countries modernize, they increase electricity usage, which puts pressure on the grid and generation sources.[73] For example, the amount of energy used at a per capita level in Viet Nam has increased exponentially in the past decade.[74] A lot of this comes from household conveniences such as washers and dryers or air conditioning.[75] Renewable energy projects are long-term and often more cost-intensive than other traditional generation sources such as coal and natural gas.[76] For example, China can increase generation of electricity with coal on a fairly short-term basis in response to demand increases, but their renewable projects must be deliberate and planned years in advance.[77] Additionally, the up-front cost of these projects is often higher than their conventional counterparts.[78] Finally, renewable energy puts more stress on the grid and varies depending on factors such as wind and sunlight, which can be a large problem considering the increased stress the grid is already under given higher energy usage.[79] It will take considerable effort from every developing country to balance the energy needs of today with the clean energy goals of tomorrow.

Grid upgrades are needed in order to support increased demand and renewable development.[80] The intensity of this process will vary by country and locality; however, it will likely be a challenge for all developing countries in East Asia.[81] Viet Nam is already planning a grid

72. *Southeast Asia Energy Outlook 2022: Key Findings*, International Energy Agency, https://www.iea.org/reports/southeast-asia-energy-outlook-2022/key-findings (last visited Apr. 28, 2024); *Country Profile: China – Coal, supra* note 2.

73. *See Southeast Asia Energy Outlook 2022: Key Findings, supra* note 72.

74. *Electric Power Consumption (kWh per capita) – Vietnam*, The World Bank, https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?locations=VN (last visited Apr. 28, 2024).

75. *See* Le Na Tranh, *Influence of Household Factors on Energy Use in Vietnam Based on Path Analysis,* 57, Journal of Building Engineering (Oct. 2022), https://www.sciencedirect.com/science/article/abs/pii/S2352710222008476.

76. *See The Cost of Capital in Clean Energy Transitions, supra* note 70.

77. Helen Davidson, *Chinese Premier Calls for More Coal Production as Electricity Demand Soars*, The Guardian (Jun. 24, 2022), https://www.theguardian.com/world/2022/jun/24/chinese-premier-calls-for-more-coal-production-as-electricity-demand-soars.

78. *See The Cost of Capital in Clean Energy Transitions, supra* note 70.

79. *See Variable Renewable Energy: An Introduction,* Congressional Research Service (Jun. 25, 2019), https://crsreports.congress.gov/product/pdf/IF/IF11257.

80. *See Building the ASEAN Power Grid: Opportunities and Challenges, supra* note 67.

81. *See Id.*

upgrade in order to meet these challenges.[82] Each country will likely need to develop a level of battery capacity in order to account for the variability of renewable energy sources.[83] Battery storage will be an expensive endeavor relatively unique to renewables.[84] In traditional generation, a supplier can simply increase or decrease outputs at different times of the day in order to meet demand, but with renewables that level of control is impossible without cheap battery technology.[85] Grid integration will also be a major challenge for East Asian countries moving toward a more electrified future.[86] This concern exists at local, regional, national, and international levels.[87] Having a more distributed grid, which utilizes many energy sources, helps quell issues that arise from variable consumption or production rates.[88]

Finally, opinions about conventional sources of energy remain positive in the region even if governments and policymakers acknowledge the effects. For example, China is encouraging increased domestic production of coal, while Indonesia is developing new coal-fired power plants.[89] Inaction on the part of other countries, particularly western countries, could increase this sentiment. Many Southeast Asian countries have large problems to address internally, and energy security is a high priority on this list.[90] Thus, when a country still has domestic conventional resources available, it may choose to continue to use those resources and not leave anything on the table in terms of profitability. If demand increases and quality of life improves, people are unlikely to simply abandon quality of life to hold out for renewable projects. In response to these issues the

82. *Vietnam's Power Development Plan Draft Incorporates Renewables, Reduces Coal*, Vietnam Briefing (Apr. 29, 2022), https://www.vietnam-briefing.com/news/vietnams-power-development-plan-draft-incorporates-renewables-reduces-coal.html/.

83. *See Rapid Expansion of Batteries will be Crucial to Meet Climate and Energy Security Goals Set at COP28*, International Energy Agency (Apr. 25, 2024), https://www.iea.org/reports/innovation-in-batteries-and-electricity-storage.

84. *See Id.*

85. *See Id.*

86. *See Building the ASEAN Power Grid: Opportunities and Challenges, supra* note 67.

87. *See Id.*

88. *See Id.*

89. *Despite Billions to Get Off Coal, Why is Indonesia Still Building New Coal Plants?,* NPR (Feb. 5, 2023), https://www.npr.org/2023/02/05/1152823939/despite-billions-to-get-off-coal-why-is-indonesia-still-building-new-coal-plants; Davidson, *supra* note 77.

90. *See Southeast Asian Nations Face Growing Energy Security Challenges and Need to Accelerate Their Clean Energy Transitions,* International Energy Agency (May 2022), https://www.iea.org/news/southeast-asian-nations-face-growing-energy-security-challenges-and-need-to-accelerate-their-clean-energy-transitions.

international community has a duty to assist and take the steps set out in their own Nationally Determined Contributions ("NDC"), as explained below.

V. International Laws and Treaties

When the international community needs to drive change in every country to achieve a goal, as is the case with climate change, then international treaties are often required. In addition, climate-focused collaboration is necessary at the regional level to drive change. The need for cooperation is being met under the Paris Agreement followed by international and regional organizations driving the implementation of the goals set out in the Agreement.

At the forefront of the global energy transition is the Paris Agreement. The Paris Agreement is an international treaty on climate change that arose out of the COP 21 conference in 2015.[91] The Paris Agreement was adopted by 196 countries and outlines the goals of keeping total global warming below 1.5 degrees Celsius optimally, and 2 degrees Celsius as a less favorable but still viable target outcome.[92]

China, Viet Nam, Indonesia, and Thailand have all adopted the Paris Agreement to reduce climate change.[93] In accordance with the requirements of the Agreement, all four countries have submitted a Nationally Determined Contribution ("NDC").[94] These NDCs, which are submitted to the United Nations once every five years, are meant to outline what the countries plan to do to curb climate change as compared to a business-as-usual scenario.[95] The United Nations then issues a synthesis of all the member countries' NDCs.[96] This report indicates that member countries are taking their obligations seriously and becoming more aggressive with curbing greenhouse gas pollution.[97] For example, member

91. *The Paris Agreement,* United Nations, https://unfccc.int/process-and-meetings/the-paris-agreement (last visited Apr. 28, 2024).

92. *Id.*

93. *List of Parties That Signed the Paris Agreement on 22 April,* United Nations, https://www.un.org/sustainabledevelopment/blog/2016/04/parisagreementsingatures/ (last visited Apr. 28, 2024).

94. *Nationally Determined Contributions (NDCs),* United Nations, https://unfccc.int/ndc-information/nationally-determined-contributions-ndcs (last visited Apr. 28, 2024).

95. *Id.*

96. Sharm el-Sheikh, *Nationally Determined Contributions Under the Paris Agreement – Synthesis Report by the Secretariat,* U.N. Doc. FCCC/PA/CMA/2022/4 (Oct. 26, 2022).

97. *Id.*

countries were required to submit Intended Nationally Determined Contributions ("INDCs") in 2016.[98] Compared to the INDCs' goals, the NDCs submitted in 2021 showed an increase of planned reductions in emissions.[99] The synthesis report specifically recognized a potential for emissions to peak before 2030 then decline afterward.[100] This marks a significant reduction in the timeline compared to scenarios where countries continued in a business-as-usual fashion.[101] However, the climate commitments, as a whole, are still far from sufficient to curb temperature increases in line with the Agreement, and the synthesis report states that if the estimates are not changed or outperformed, that goal will not be met.[102] The Agreement outlines a goal of maintaining the global temperature increase below 2 degrees Celsius by the year 2100 and a more ambitious goal of maintaining the increase below 1.5 degrees Celsius by 2100. The current trajectory, established by the cumulative NDCs from member countries constituting the years 2020 to 2030, would use up approximately 89% and 39% of the world's total carbon budget for a 1.5 and 2-degree goal, respectively.[103]

The Paris Agreement is not internationally binding in terms of enforcement; however, enforcement mechanisms rely on each country releasing national plans and the UN convening regular meetings to exert pressure on non-compliant parties.[104] Additionally, climate change poses a risk to all countries and the people who occupy those countries. Thus, citizens of a given country also function as a form of enforcement of the initiatives. Countries themselves also have incentives to reduce emissions because of the future climate risk faced by the whole world. Finally, international funding of renewable projects within a given country will likely be linked to that country's goals and compliance with those goals. These three pressures are central to ensure compliance with the Paris Agreement among the signatory countries.

98. *Id.*
99. *Id.* ¶ 133.
100. *Id* ¶ 12.
101. *See Id.* ¶ 64.
102. *See Id* ¶¶ 16–17.
103. *See Id* at ¶ 18.
104. Kathryn Tso and Michael Mehling, *How are countries held liable under the Paris Agreement,* MIT Climate Portal (Mar. 8, 2021), https://climate.mit.edu/ask-mit/how-are-countries-held-accountable-under-paris-agreement.

In 2021, certain member nations to the Paris Agreement signed a coal initiative called the Global Coal to Clean Power Transition Statement.[105] Viet Nam and Indonesia are signatories to the statement, which calls for four individual goals.[106] First is a call to develop clean power and assist other countries in doing the same.[107] Second, the statement calls for the phasing out of coal by the 2030s; however, it does provide that if that goal is not achievable by a particular country, then doing so by the 2040s or as soon as possible is acceptable.[108] Third, the initiative would require countries to cease issuing new permits or constructing coal-fired power generation plants.[109] Finally, the fourth section calls for global efforts to provide a framework of support for the communities that will be affected by switching to cleaner sources of energy. Indonesia accepted parts one, two, and four. Under section two, Indonesia made it clear that it will require international support to switch from coal by the 2040s.[110] Indonesia declined to sign on part three of the initiative, likely because the country still has plans to develop unabated coal-fired power plants.[111] Viet Nam signed all four portions of the statement.[112] If followed, this statement would actually cause significant change in the two countries, but more so in Viet Nam with its commitment to end new coal-fired power plants.[113] Notably, India, China, and the United States of America, the three largest consumers of coal, have not signed the agreement.[114] This demonstrates the significance of getting the larger countries on board in addition to the lower consumption countries. Viet Nam and Indonesia make up a small portion of the total global coal consumption.[115] For example, all of Southeast Asia consumed 370 million tons of coal in 2021, while China alone consumed 4.13 billion tons, the United States consumed 529 million tons, and India consumed almost 1.2 billion tons.[116]

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105. *Global Coal to Clean Power Transition Statement,* UN Climate Change Conference UK 2021 (Apr. 4, 2021), https://ukcop26.org/global-coal-to-clean-power-transition-statement/.

106. *Id.*

107. *Id.*

108. *Id.*

109. *Id.*

110. *Id.*

111. *Id.*

112. *Id.*

113. *Id.*

114. *Id.*

115. *Coal 2021: Analysis and Forecast to 2024*, International Energy Agency (Dec. 2021), https://www.iea.org/reports/coal-2021.

116. *Id.*

Additionally, Viet Nam, Thailand, Indonesia, and China are also members of the South-South Cooperation, which is a United Nations initiative to promote development and collaboration between developing countries in the global south.[117] This organization provides support to countries in the development of alternative energy sources both through direct action and collaborative efforts.

VI. Companies and Organizations

As countries strive to meet global climate goals, organizations that partner with countries and companies will become more prevalent. These organizations can be local, regional, or global. Each organization has its own goals. Some organizations strive to connect governments in a region under climate initiatives, while others partner with countries to collaborate with companies in a region. Organizations that can bridge the gap between countries and governments are invaluable for collaborating on the implementation of renewable energies.[118] This need is particularly prevalent in developing countries, where collaboration prevents unnecessary development and research costs.[119]

The Global Wind Energy Counsel is an organization for the promotion and development of global wind energy.[120] The organization's Southeast Asian task force works with the governments of Viet Nam, Thailand, and the Philippines.[121] In Viet Nam, the organization published a practical analysis of Viet Nam's energy goals, particularly in the wind sector.[122] In Thailand, the organization meets with government officials and provides

117. *About South-South and Triangular Cooperation,* United Nations: Office for South-South Cooperation, https://unsouthsouth.org/about/about-sstc/ (last visited Apr. 28, 2024).

118. *See International "Collaboration Gap" Threatens to Undermine Climate Progress and Delay Net Zero by Decades,* International Energy Agency (Sept. 20, 2022), https://www.iea.org/news/international-collaboration-gap-threatens-to-undermine-climate-progress-and-delay-net-zero-by-decades.

119. *See Id.*

120. *What We Do*, Global Wind Energy Council, https://gwec.net/global-wind-energy-council/what-is-gwec/ (last visited Apr. 28, 2024).

121. *South East Asia Task Force*, Global Wind Energy Council, https://gwec.net/south-east-asia-task-force/ (last visited Apr. 28, 2024).

122. *Route to Market for Offshore Wind Development in Vietnam,* Global Wind Energy Council, https://gwec.net/route-to-market-for-offshore-wind-development-in-VietNam-position-paper/ (last visited Apr. 28, 2024).

guidance on how the country can implement additional onshore and offshore wind production.[123]

The Energy Transition Partnership is a Southeast Asian organization attempting to help countries in the region transition to energy alternatives.[124] Indonesia, Viet Nam, and the Philippines are member nations.[125] The organization connects member countries with international donors that support training and investment.[126] Additionally, the organization supports governmental efforts to promote green energy.[127] In Indonesia, the organization has helped upgrade facilities, budget for switching to renewable sources, train people and companies on renewables, and provide credit guarantees in banking, just to name a few.[128] The organization has several projects in Viet Nam.[129] Most notably, the organization supports designing the process and requirements for renewable project opportunities. Additionally, it assists with budgeting, designing programs, and high-level analysis.[130]

The ASEAN Centre for Energy is an organization constituting ten member states in Southeast Asia working to support the region's energy sectors.[131] The organization provides members mostly with intellectual and informational support, thereby encouraging the collaborative sharing of knowledge and techniques.[132] The Centre for Energy is split into subdivisions based on focus, including energy efficiency, renewables, nuclear, petroleum, coal, and policy.[133] The organization also releases information and analysis on various topics relating to renewable initiatives

123. *South East Asia Task Force*, Global Wind Energy Council, https://gwec.net/south-east-asia-task-force/ (last visited Apr. 28, 2024).

124. *About ETP,* Energy Transition Partnership, https://www.energytransitionpartnership.org/about-etp/action/ (last visited Apr. 28, 2024).

125. *Id.*

126. *Id.*

127. *Id.*

128. *Projects: Indonesia,* Energy Transition Partnership, https://www.energytransitionpartnership.org/country/indonesia/ (last visited Apr. 28, 2024).

129. *Projects: Vietnam,* Energy Transition Partnership, https://www.energytransitionpartnership.org/country/vietnam/ (last visited Apr. 28, 2024).

130. *Id.*

131. *About: Countries,* ASEAN Centre for Energy, https://aseanenergy.org/about/countries/ (last visited Apr. 28, 2024).

132. *Introduction: Key Roles of ACE,* ASEAN Centre for Energy, https://aseanenergy.org/about/introduction/ (last visited Apr. 28, 2024).

133. *Introduction: Ace in ASEAN Energy Sector,* ASEAN Centre for Energy, https://aseanenergy.org/about/introduction/ (last visited Apr. 28, 2024).

in the region, such as impact analysis, air quality analysis, and pricing information, among many others.[134]

In terms of United States involvement, USAID Clean Power Asia worked with Southeast Asian countries from 2016 until 2021.[135] This American organization worked alongside the ASEAN Centre for Energy to promote renewable and clean power investments and provide resources to governments in the region.[136] In Thailand, Clean Power Asia helped develop guidelines for solar projects, encourage further development of wind energy, and provide technical and regulatory assistance.[137] In Viet Nam, the organization provided analysis to assist in the implementation of rooftop solar programs.[138] Additionally, Clean Power Asia assisted with financing agreements for one of the largest solar projects in Southeast Asia.[139] Overall, the organization provided technical, knowledge, and financing support for many Southeast Asian clean energy projects.[140]

Additionally, numerous branches of international organizations, such as the United Nations and the World Bank, are directing cooperation, training, and investment in the region. For example, the World Bank currently has a large loan issued to Viet Nam, over $202 million, in the repayment phase that it issued between 2010 and 2018.[141] The World Bank recognizes that renewable projects, particularly in developing economies, place a large up-front cost burden on countries. Thus, the organization has initiatives to increase financing in the region both through providing direct loans and encouraging international financing.[142]

134. *Renewable Energy: Publication,* ASEAN Centre for Energy, https://aseanenergy.org/topics/renewable-energy/ (last visited Apr. 28, 2024).

135. *Final Report,* USAID Clean Power Asia, https://www.abtglobal.com/files/insights/reports/2021/cpa-finalreport-june2021-smvert.pdf (last visited Apr. 28, 2024).

136. *Id.*

137. *Id.*

138. *Id.*

139. *Id.*

140. *Id.*

141. *Vietnam Renewable Energy Development Project,* The World Bank, https://projects.worldbank.org/en/projects-operations/project-detail/P103238 (last visited Apr. 28, 2024).

142. *Unleashing Sustainable Finance in Southeast Asia,* World Bank Group: Institute of Finance and Sustainability (Nov. 28,2022), https://www.worldbank.org/en/country/malaysia/publication/SFSEAreport.

VII. Country Specific Analysis

Each individual country in this analysis represents different opportunities and challenges. Thus, each is analyzed in its own section. Differences between the countries on a macro level include viable sources of energy, commitments under NDCs, renewable versus clean alternatives, current grid capabilities, and growth of energy needs.

The most viable sources of energy determine which energy alternatives the country will utilize to reduce emissions. Offshore wind, for example, ranks near the top for coastal countries like Viet Nam, while larger countries like China will likely have more options depending on the region of the country.[143] Some countries will fare better with implementation due to the balance between availability and cost. Other countries will rely more on neutral forms of energy, such as nuclear. Regions that need to rely on coal or natural gas for the foreseeable future will have to be balanced by higher renewables in other regions to meet NDC goals.

Countries determine their own NDCs to guide their energy decisions over the next few decades. These commitments vary from country to country. The most poignant example of this variation is the year each country plans to be carbon neutral by. For Viet Nam and Thailand, the intended year is 2050, while the goal is 2060 for China and Indonesia.[144] However, Thailand does put off commitment to net-zero emissions until 2065.[145] In order to meet climate goals laid out in the Paris Agreement, the

143. *Route to Market for Offshore Wind Development in Vietnam, supra* note 122.

144. *Enhanced Nationally Determined Contribution*, Republic of Indonesia (2022), https://unfccc.int/sites/default/files/NDC/2022-09/ENDC%20Indonesia.pdf; Fred Burke and Thanh Hai Nguyen, *Vietnam: Key Highlights of New Draft of National Power Development Plan (Draft PDP8),* Global Compliance News (Mar. 13, 2021), https://www.globalcompliancenews.com/2021/03/13/VietNam-key-highlights-of-new-draft-of-national-power-development-plan-draft-pdp8-04032021-2/; *China's Achievements, New Goals and New Measures for Nationally Determined Contributions (Unofficial Translation),* Chinese Government, https://unfccc.int/sites/default/files/NDC/2022-06/China's%20Achievements%2C%20New%20Goals%20and%20New%20Measures%20for%20Nationally%20Determined%20Contributions.pdf (last visited Apr. 28, 2024); *Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy (Revised Version),* United Nations Framework Convention on Climate Change (Nov. 2022), https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.

145. *Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy (Revised Version), supra* note 144.

world must be carbon neutral by 2050.[146] The differing commitments are due to many factors varying from cost-efficient energy availability to general climate commitment. Commitments, while not enforceable if a country doesn't meet them, are a guide for what projects each country implements in the next few decades.

The choice between renewables and clean alternatives is most prevalent in countries with a developing energy sector, such as the countries in this analysis. For most, if not all, the answer will be a mix of different sources of energy that reduce emissions, whether a cleaner alternative or fully renewable source.[147] For example, Viet Nam is currently working on wind energy projects off its coast while also initiating two projects to harness offshore natural gas.[148] Thailand is implementing a plan to increase its LNG relevancy in the international market while also opening bidding for a large number of renewable energy projects.[149] Almost all countries have been taking this approach and will likely do so at least into the mid-21st century.

Current energy grid capabilities can also impact what energy sources a country chooses. The grid capacity required to implement full electrification is not there for most countries in this analysis.[150] However, this obstacle is largely due to rising energy demand and will need to be solved regardless, although variability in energy availability will make these upgrades more necessary and extensive.

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146. *For a Livable Climate: Net-Zero Commitments Must be Backed by Credible Action,* United Nations: Climate Action, https://www.un.org/en/climatechange/net-zero-coalition (last visited Apr. 28, 2024).

147. *See The Role of Gas in Today's Energy Transitions,* International Energy Agency (Jul. 2019), https://www.iea.org/reports/the-role-of-gas-in-todays-energy-transitions.

148. *Ca Voi Xanh Project Overview*, ExxonMobil (Nov. 28, 2018), https://corporate.exxonmobil.com/locations/vietnam/ca-voi-xanh-project-overview#Projectoverview; *Top Oil and Gas Projects to Watch in Southeast Asia,* NES Fircroft (Jul. 24, 2019), https://www.nesfircroft.com/blog/2019/07/10-oil-and-gas-projects-to-watch-in-se-asia-right-now?source=google.com; *Route to Market for Offshore Wind Development in Vietnam, supra* note 122.

149. Christopher Osborne and Ramita Visavayothanan, *Thailand's 5 GW Renewable PPA Fit Scheme: 2022 – 2030,* Watson Farley & Williams (Oct. 12, 2022), https://www.wfw.com/articles/thailands-5-gw-renewable-ppa-fit-scheme-2022-2030/; *Thailand – Country Commercial Guide*, *supra* note 3.

150. .*See* Ivy Yin, *Power Grid Upgrades, Storage Expansion Critical for Renewables to go Mainstream in Asia*, S&P Global (Jun. 8, 2022), https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/060822-power-grid-upgrades-storage-expansion-critical-for-renewables-to-go-mainstream-in-asia-experts.

Growth of energy needs in a particular country can determine what projects get prioritized. Countries that need energy now are more likely to utilize natural gas or coal to facilitate said energy. Large scale renewable projects, while becoming more viable, are still longer-term, larger up-front investments, compared to natural gas and coal plants, and the energy to supply those projects can always be bought on markets to meet demand.[151] Thus, many countries are focusing their short-term needs on natural gas, and coal in some cases, while developing long-term projects for renewable energy.

A. Viet Nam

Viet Nam's regulatory and developmental goals in the energy sector are outlined in Resolution 55.[152] The resolution acknowledges the growing global importance of energy security.[153] Viet Nam currently operates its own natural gas and oil extraction, particularly offshore, with the help of both Russian and U.S. companies. Historically, Viet Nam's energy industry has relied heavily on Russia for guidance and equipment.[154] However, as ExxonMobil plans to build a natural gas platform off the coast of Viet Nam, U.S. companies are poised to provide more support within the country's energy sector.[155]

Resolution 55 has three main climate targets.[156] First, the country aims to reduce greenhouse gas emissions by 15% by 2030 and 20% by 2045 as compared to business-as-usual.[157] Second, Viet Nam projects the ratio of energy efficiency on final energy consumption to reach 7% by 2030 and

151. *See The Cost of Capital in Clean Energy Transitions, supra* note 70.

152. *Resolution of the Politburo on Orientations of the Viet Nam's National Energy Development Strategy to 2030 and Outlook to 2045,* Central Committee of the Communist Party of Vietnam (Feb. 11, 2020), http://vepg.vn/wp-content/uploads/2020/03/CPCs-Resolution-55.NQ-TW-on-Energy-Development-Strategy-to-2030-and-outlook-to-2045.pdf.

153. *Id.*

154. Thi Huyen Bui, *Vietnamese-Russian Cooperation in Exploration and Production of Oil and Gas From 1980 to The Present,* ResearchGate (Aug. 2022), https://www.researchgate.net/publication/362930070_VIETNAMESE-RUSSIAN_COOPERATION_IN_EXPLORATION_AND_PRODUCTION_OF_OIL_AND_GAS_FROM_1980_TO_THE_PRESENT.

155. Alison Williams and Jan Harvey, *ExxonMobil Continues Preparatory Work for Gas Project in Vietnam,* Reuters (Nov. 29, 2021), https://www.reuters.com/business/energy/exxonmobil-continues-preparatory-work-gas-project-vietnam-spokesperson-2021-11-29/.

156. *Resolution of the Politburo on Orientations of the Viet Nam's National Energy Development Strategy to 2030 and Outlook to 2045, supra* note 152.

157. *Id.*

14% by 2045.[158] Third, Viet Nam intends for renewables to make up 15-20% of total energy production by 2030 and 25-30% by 2045.[159] These goals are also present in the country's NDC submitted in 2021.[160] Despite such goals, the country plans to continue utilizing coal into the future, noting a preference for large-scale, highly efficient plants and affirming a commitment to decommission inefficient plants.[161] One major issue Viet Nam faces is the sheer increase in energy demand. From an electricity perspective, Viet Nam went from consuming only 6.48 terawatt-hours ("TWh") in 1990 to 223.8 TWh in 2019, a 3,353% increase.[162] Per capita energy use, as of 2019, is ten times higher than it was in 2000.[163] This rapid increase in demand makes it difficult to flexibly develop different energy sources.

The energy split for electricity production in Viet Nam is largely comprised of hydroelectric, coal, and natural gas.[164] Coal makes up around 50%, hydroelectric makes up around 28%, and natural gas makes up around 18% of total energy production.[165] Viet Nam has high potential yearly wind production off the coast, which would assist the country in increasing its energy independence and reducing carbon emissions.[166] However, the country faces obstacles in that area, including a lack of a permitting process, a lack of legislation regarding investments in facilities, and a lack of policy or pricing mechanisms for offshore power generation, which is a major reason why no wind energy facilities have been built to date.[167] Viet Nam is attempting to install 7 gigawatts of offshore wind production by 2030; however, the issues mentioned above will need to be solved in order to get the production online.[168] Additionally, Viet Nam has no nuclear energy, which is a goal for the country to develop going into the future.[169] Nuclear projects were proposed in the past, but have historically been

158. *Id.*
159. *Id.*
160. *Updated Nationally Determined Contribution (NDC)*, The Socialist Republic of Viet Nam (Jul. 2020), https://unfccc.int/sites/default/files/NDC/2022-06/Viet%20Nam_NDC_2020_Eng.pdf.
161. *Id.*
162. *Country Profile: Viet Nam, supra* note 4.
163. *Nuclear Power in Vietnam, supra* note 60.
164. *Country Profile: Viet Nam, supra* note 4.
165. *Id.*
166. *Route to Market for Offshore Wind Development in Vietnam, supra* note 122.
167. *Id.*
168. *Id.*
169. *Nuclear Power in Vietnam, supra* note 60.

passed over for coal and natural gas plants.[170] However, there are currently two finance agreements from Russia and Japan to develop nuclear power plants.[171] In 2016, the Viet Nam government postponed the plans indefinitely, but renewed interest in the projects in 2022.[172] The government planned to approve its National Power Development Plan Eight in early 2021, but the plan has been subjected to revisions, and only drafts are available as of this comment.[173] The draft outlines a focus on renewable energy, particularly solar and wind energy, and commits to reach net-zero emissions by 2050.[174] Currently, Viet Nam has the largest capacity for renewable generation in Southeast Asia at 24,519 megawatts in 2019.[175] This capacity is more than double that of the nearest country in the region – Thailand, at 11,860 megawatts.[176]

Bilateral power purchase agreements are currently in development in Viet Nam and expected to start in 2023.[177] This program would allow renewable generators to sell power directly to private entities seeking to utilize the power.[178] Historically, Viet Nam has and currently retains a monopoly in power transmission, purchase, and sale.[179]

Viet Nam is also attempting to be a global electric vehicle (EV) producer through its VinFast brand.[180] By 2022, the company intends to build around 20,000 electric cars and 1,500 buses in Viet Nam; that number is only set to grow in the coming years.[181] The government has recently issued tax and registration incentives for electric vehicles sold in the country.[182] In 2022, VinFast announced plans to open a new manufacturing facility for

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170. *Id.*
171. *Id.*
172. *Id.*
173. Burke and Nguyen*, supra* note 144.
174. *Id.*
175. Miranda McLaren, *Governments Across Southeast Asia Accelerate Renewable Energy Investment to Revive the Pandemic-Hit Economies* (Jan 21, 2021), https://www.power-technology.com/comment/south-east-asia-renewable-energy/.
176. *Id.*
177. *Vietnam Set to Open Renewable Energy Market to PPAs,* PV Magazine (Oct. 27, 2022), https://www.pv-magazine.com/2022/10/27/vietnam-set-to-open-renewable-energy-market-to-ppas/.
178. *Id.*
179. *Id.*
180. *Vietnam Electric Vehicle Industry,* U.S. International Trade Administration (Jul. 22, 2022), https://www.trade.gov/market-intelligence/vietnam-electric-vehicle-industry.
181. *Id.*
182. *Id.*

electric vehicles in North Carolina, which should open more avenues to engage in renewable sector trade between the two countries.[183]

The United States has seen geopolitical relations with Viet Nam consistently improve throughout the years, particularly in the manufacturing and energy sectors.[184] U.S. companies are poised to provide significant support for the development of oil and gas and renewables in Viet Nam. For example, because Viet Nam has never built an offshore wind energy plant, the opportunities for American companies to bid or assist on projects in the country is high. Despite these opportunities, there are geopolitical factors to monitor in the coming future. Conflict due to competition with China is less of a concern because the relationship between Viet Nam and China is strained at times; however, as we draw lines in the sand with Russia, one of Viet Nam's major allies within the industry, the United States may risk forcing Viet Nam to choose which country to do business with.[185]

B. Thailand

Thailand is 99% electrified.[186] However, energy security remains a major issue for the country.[187] In response, the government is imposing new restrictions to maximize security in a way that progresses the country into the renewable's era.[188] Currently, more than half of Thailand's energy needs are met through imported energy, which increases issues relating to volatile prices, geopolitical strife, and trade.[189]

183. Toru Takahashi, *Vietnam's VinFast Takes the EV Battle to Tesla with U.S. Push,* Nikkei Asia (Apr. 25, 2022), https://asia.nikkei.com/Business/Automobiles/VietNam-s-VinFast-takes-the-EV-battle-to-Tesla-with-U.S.-push2.

184. *U.S. Relations With Vietnam: Bilateral Relations Fact Sheet,* U.S. Department of State (Apr. 9, 2021), https://www.state.gov/u-s-relations-with-VietNam/.

185. Huong Le Thu, *Rough Waters Ahead for Vietnam-China Relations,* Carnegie Endowment for International Peace (Sept. 30, 2020), https://carnegieendowment.org/2020/09/30/rough-waters-ahead-for-VietNam-china-relations-pub-82826; Joshua Kurlantzick, *Vietnam Caught Between the U.S. and Russia on Ukraine*, Council on Foreign Relations (Apr. 21, 2022), https://www.cfr.org/blog/VietNam-caught-between-us-and-russia-ukraine.

186. *.Access to Electricity (% of Population) – Thailand,* The World Bank: Data, https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=TH (last visited Apr. 28, 2024).

187. *Thailand's Power Development Plan (PDP) 2018-2037*, Asia Pacific Energy, https://policy.asiapacificenergy.org/node/4347/portal (last visited Apr. 28, 2024).

188. *Id.*

189. *Thailand – Country Commercial Guide*, *supra* note 3.

Thailand introduced a new plan in 2018 to increase energy production, mainly through renewables.[190] By the year 2030, the country hopes to have 30% of energy needs supplied by renewables.[191] Thailand is attempting to implement an advanced grid system and plans to increase the capacity of its transmission lines to accommodate the added energy distribution.[192] However, the government also projects that, from the years 2018 to 2037, 53% of energy will come from natural gas, with much of it imported.[193] Liquified natural gas demand is projected to grow to 30 million tons per annum by 2037.[194] The country is attempting to situate itself as a regional Liquified Natural Gas ("LNG") hub and plans to have its third LNG import terminal by 2025.[195] Utilizing more LNG in its energy mix could prove beneficial for the country as it seeks to become carbon neutral due to LNG's reduced emissions and high availability.

Thailand submitted its NDC to the United Nations in October of 2020.[196] In its NDC, Thailand outlined several goals to promote environmental sustainability and brace itself for the negative effects of climate change.[197] Additionally, Thailand developed the National Adaptive Plan to protect the country from climate change effects, focusing on six sectors: water, agriculture, tourism, public health, natural resources, and human settlements.[198] Additionally, the country provides tax incentives and grants to promote renewable energy and will continue to do so into the future.[199]

The Thailand Energy Regulatory Commission is the agency responsible for renewable energy projects in Thailand.[200] Thailand has determined four areas of renewable energy that it will look to increase in the coming years.[201] The government's feed-in-tariff plan includes purchase targets for

190. *Id.*

191. *Alternative Energy Development Plan: AEDP2015,* Thailand Ministry of Energy (Sept. 2015), http://www.eppo.go.th/images/POLICY/ENG/AEDP2015ENG.pdf.

192. *Thailand – Country Commercial Guide*, *supra* note 3.

193. *Energy Resource Guide: Thailand – Oil & Gas,* International Trade Administration, https://www.trade.gov/energy-resource-guide-thailand-oil-and-gas (last visited Apr. 28, 2024).

194. *Id.*

195. *Id.*

196. *Thailand's Updated Nationally Determined Contribution*, Office of Natural Resources and Environmental Policy and Planning (Oct. 20, 2020), https://unfccc.int/sites/default/files/NDC/2022-06/Thailand%20Updated%20NDC.pdf.

197. *Id.*

198. *Id.*

199. *Id.*

200. Osborne and Visavayothanan, *supra* note 149.

201. *Id.*

these four renewable sources and a timeline for when the purchase targets should be met.[202] The four sources are biogas, ground-mounted solar with battery storage, wind, and ground-mounted solar.[203] The projected timetable for the purchase agreements begins in 2024 and goes up to 2030. Below is a table showing the timeline called for by the purchase agreements.[204] The amounts in the purchase agreements for each year are represented in megawatts.[205]

Energy Source	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Biogas			75	75	75	70	40	335
Ground-Mounted Solar with Battery Storage	100	100	100	100	200	200	200	1,000
Wind		250	250	250	250	250	250	1,500
Ground-Mounted Solar	190	290	258	440	490	310	390	2,368

[206]

This plan and its purchase agreements are only available to domestic companies for production, requiring at least 50% of shareholders to be Thai.[207] However, there is still room for international investment and cooperative efforts in the space. To qualify for these purchase agreements, there is a capital requirement and a list of technical requirements including a point of grid connection, a plan for the project's timeline and location, and a certification that the applicant has the technical expertise to carry out the project's plan.[208] Given grid capacity, the prioritization for different types of renewables the initiative will focus on, in descending order, are biogas, wind, solar with battery storage, then solar.[209] The plan is set to pay a premium for these forms of electricity, with biogas having the smallest premium and wind power having the highest.[210] Only the ground-mounted solar with battery storage will be a firm commitment, meaning that the

202. *Id.*
203. *Id.*
204. *Id.*
205. *Id.*
206. *Id.*
207. *Id.*
208. *Id.*
209. *Id.*
210. *Id.*

accepted applicant will be required to supply, within certain limits, the amount of electricity production it applied for.[211]

The Natural Gas Management Plan was released in 2018 by the National Energy Policy Council.[212] Thailand outlined a plan to increase domestic production of natural gas while also increasing LNG imports.[213] Domestic production should be 5% of total consumption by 2037, and imports of LNG should be 26 million tons in 2037, up from 5.2 million tons in 2019.[214] Additionally, Thailand will be expanding its network for the transportation of natural gas.[215] The government is making the liberalization and reformation of the gas market in Thailand a high priority to attract more business.[216]

Thailand represents opportunities for international companies in both cleaner forms of combustion energy and renewable energy. As shown in the emissions data, moving to natural gas would significantly reduce greenhouse gas emissions.[217] There will be good opportunities for international companies to export to and provide support services for LNG facilities as the country expands its LNG activities. Additionally, the country will be looking to develop more renewable energy sources in the future both to meet its obligations under the Paris Climate Agreement and increase energy independence. While many of its plans are centered around companies from Thailand getting the contracts, there is still room for support, training, cooperation, and investment in those projects from international companies.

C. Indonesia

Indonesia represents an interesting contrast to the other countries in this analysis. The country is the eighth largest producer of energy in the world.[218] In addition, Indonesia is the largest exporter of coal in the world and the seventh largest producer of LNG.[219] Indonesia has one of the fastest growing economies, which has also resulted in rapid expansion of

211. *Id.*
212. *Thailand: Natural Gas Management Plan 2018-2037*, Asia Pacific Energy, https://policy.asiapacificenergy.org/node/4349 (last visited Apr. 28, 2024).
213. *Id.*
214. *Id.*
215. *Id.*
216. *Id.*
217. *Carbon Dioxide Emissions Coefficients, supra* note 19.
218. *Country: Indonesia*, *supra* note 6.
219. *Id.*

energy production and consumption.[220] The country does not have to import as much energy as other countries in the region due to its large coal deposits and natural gas reserves.[221] Indonesia also has large oil reserves, estimated at 2.5 billion barrels; however, most of the wells require enhanced recovery techniques, and production has consistently declined in the last 10 years.[222] Due to the existence of cheap fuels, Indonesia has not seen the same historic renewable growth that other countries in the region benefit from. Indonesia relied on coal for 62% of its electricity production in 2020, with natural gas making up 18%, and renewables only constituting 18%.[223]

Indonesia is a signatory to the Paris Agreement, a member of the South-South Cooperation, and has committed to fulfilling more of its energy needs utilizing renewable sources.[224] However, because the country is more reliant on traditional sources of energy, Indonesia's commitment under the Paris Agreement is carbon neutrality by 2060 rather than 2050.[225] Additionally, the country is in line with China as it plans to peak in carbon dioxide emissions by the year 2030 as opposed to the already declining emissions in Viet Nam and Thailand.[226] Indonesia produces large amounts of natural gas but needs infrastructure in place to move the gas to processing facilities. Currently, due to the lack of transportation infrastructure, Indonesia is among the top twenty producers of flared natural gas in the world.[227] Flaring gas refers to when a company or country burns natural gas while extracting oil from a well.[228] Because of either the lack of infrastructure or the lack of a market at the wellhead, some producers will burn the natural gas that comes up with oil.[229] This is a wasteful practice and the fumes produced are needless pollution.[230]

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220. *See Id.*
221. *Id.*
222. *Id.*
223. *Id.*
224. *Enhanced Nationally Determined Contribution*, *supra* note 144.
225. *Id.*
226. *Id.*
227. *Country: Indonesia*, *supra* note 6.
228. *Global Gas Flaring Reduction Partnership: Gas Flaring Explained,* The World Bank, https://www.worldbank.org/en/programs/gasflaringreduction/gas-flaring-explained (last visited Apr. 28, 2024).
229. *Id.*
230. *Id.*

The Ministry of Investment manages Indonesia's internal renewable energy investment plan.[231] The country currently has 97 renewable energy projects in progress, constituting a 12 billion dollar investment and four gigawatts of capacity.[232] However, demand for energy is projected to increase by 80% by 2030, and electric demand is projected to triple in the same time period.[233] Thus, clean energy utilization needs to increase to meet that demand before replacing already existing non-renewable capacity. Luckily, according to a report by the Organization for Economic Co-operation and Development, Indonesia has some of the best potential for developing clean energy in the world.[234] With some of the largest geothermal deposits in the world and great opportunities for both tidal and solar generation, Indonesia still faces two main obstacles for implementing clean energy: a lack of investment and the dominance of conventional forms of energy.[235] In terms of investment, the country will need more than triple the amount of investment from 2019 every year until 2025 in order to meet its NDC goals.[236] While the country is moving in the right direction by encouraging investment, establishing regulation on clean energy, and promoting renewable energy, there is still a long way to go towards meeting its NDC obligations.[237] The government of Indonesia highlights support and investment by the international community as ways that the country can reach its goals sooner.[238]

D. China

China is still heavily reliant on coal. In terms of energy consumption, the country gets 55% from coal, 19% from petroleum, 8% from hydropower, 7% from other renewables, 9% from natural gas, and 2% from nuclear.[239] The country represents an interesting energy split, with such a

231. *Harnessing Renewable Energy Investment Sector in Indonesia*, Ministry of Investment/BKPM, https://www2.bkpm.go.id/en/publication/detail/news/harnessing-renewable-energy-investment-sector-in-indonesia (last visited Apr. 28, 2024).

232. *Id.*

233. *Id.*

234. *Clean Energy Finance and Investment Policy Review of Indonesia,* Organization for Economic Co-operation and Development, https://www.oecd-ilibrary.org/sites/0007dd9d-en/index.html?itemId=/content/publication/0007dd9d-en (last visited Apr. 28, 2024).

235. *Id.*

236. *Id.*

237. *Id.*

238. *Id.*

239. *Country: China*, U.S. Energy Information Administration (Aug. 8, 2022), https://www.eia.gov/international/analysis/country/CHN.

heavy reliance on coal, little reliance on natural gas, and above average reliance on renewables. China is currently the fifth largest oil producer in the world.[240] Most of that production, however, comes from existing infrastructure utilizing enhanced recovery techniques.[241] China is also the largest crude oil importer in the world, with a diversified list of sources.[242]

China has emphasized growth in every energy sector, in varying quantities, in response to increasing demand.[243] In particular, the country is focused on increasing its utilization of renewables and natural gas.[244] There is seemingly a large push for electric vehicles in the country as well, which should not come as a surprise given their large oil consumption deficit and potential for electric generation from other sources.[245] China released a five-year plan in 2021 outlining its objectives in many areas including industry and energy.[246] The energy aspects of this plan are more general; however, it does outline the energy objectives from a conservation standpoint.[247] China's goal is to become carbon neutral by 2060, which is less aggressive than others in the region, but taking a conservative approach makes sense with the size of their industrial economy and energy needs.[248] The five-year-plan also affirms their commitment to the Paris Agreement and South-South Cooperation on climate change.[249] In their NDC filing, China set out several goals.[250] The country plans on reaching peak emissions before the year 2030, being completely carbon neutral by 2060, reducing emissions by GDP unit by 60-65%, increasing renewables to around 25% of energy production, growing forest stock by 6 billion cubic meters, and producing 1.2 billion kilowatts of solar and wind energy by 2030.[251]

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240. *Id.*
241. *Id.*
242. *Id.*
243. *See Id.*
244. *Id.*
245. *Id.*
246. *China's 14th Five-Year-Plan*, Center for Security and Emerging Technology (May 12, 2021), https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf.
247. *Id.*
248. *Id.*
249. *Id.*
250. *China's Achievements, New Goals and New Measures for Nationally Determined Contributions (Unofficial Translation), supra* note 144.
251. *Id.*

Geopolitics will play a significant role in what opportunities are available for United States companies within China. Currently, the majority of Chinese oil imports come from the Middle East, Russia, Africa, and South America, in descending order.[252] The United States makes up only two percent of the total oil imports into China.[253] Natural gas consumption in the country has consistently increased, with production increasing but trailing consumption heavily.[254] A large and increasing portion of China's natural gas needs are being met by LNG imports; thus, the U.S. is primed to play a significant role in this sector as it is already the largest source of imports to China for short-term LNG demand.[255] China will likely look to become a model in renewable energy and carbon emissions moving into the future while also balancing its immediate need for energy development in any form. If geopolitical relations improve in the coming years, U.S. companies would be poised to provide exports and on-the-ground development in oil and gas and alternative energy.

At the time of writing, China is between locking down and opening up due to the COVID-19 pandemic in the aftermath of the Zero-COVID policy and its lifting.[256] Thus, imports are still down for coal and electricity-based energy sources relative to the expected demand increase.[257] Further, while locking down decreased consumption, there has not been much expected increase in consumption due to COVID infection increases following the country's opening.[258] Russia is currently selling coal to China at a steep discount because of a lack of buyers in the western market due to the war in Ukraine.[259] Russian coal imports hit five-year highs in August of 2022 and are likely to continue to climb if Russia remains locked out of international markets.[260] Further, China is attempting to reopen the economy following

252. *Country: China*, *supra* note 239.

253. *Id.*

254. *Id.*

255. *See id.*

256. Gavin Maguire, *Key Coal Import Hubs in China Perk Up as Economy Reboots*, Reuters (Dec. 21, 2022 4:42 PM), https://www.reuters.com/business/energy/key-coal-import-hubs-china-perk-up-economy-reboots-maguire-2022-12-21/.

257. *Id.*

258. Muyu Xu and Chen Aizhu, *China Dec Coal Imports Slip as COVID Spike Dampens Industrial Activity*, U.S. News (Jan. 12, 2023), https://money.usnews.com/investing/news/articles/2023-01-12/china-dec-coal-imports-slip-as-covid-spike-dampens-industrial-activity.

259. Reuters, *China's Russian Coal Imports Hit 5-year High as West Shuns Moscow,* CNN Business (Aug. 22, 2022), https://www.cnn.com/2022/08/21/energy/china-russia-coal-imports-july-intl-hnk/index.html.

260. *Id.*

unrest resulting from the country's Zero-COVID policy.[261] Opening the country back up means energy needs will go back to pre-COVID levels or higher eventually.[262] This return to normal will have a large impact on the global coal market as China is the largest consumer of coal in the world by a wide margin.[263] For example, in 2022 China still consumed 4.2 billion tons of coal, accounting for more than half of the global market, while second place India consumed 1.1 billion tons.[264] Thus, where China goes with its energy production, as the country reopens, will significantly impact the future of renewable initiatives and the global coal market.

The price that China is paying for coal from Russia is a stark reduction from the international market, making it a very advantageous short-term energy source.[265] While coal on the international market, namely from Australia, costs more than $210 per metric ton, Russia is charging China only $150 per metric ton.[266] The total amount of Russian imports makes up a very small portion of China's total coal imports, but this pricing scheme could encourage further trade with Russia for coal.[267] Further, cheaper prices domestically and internationally, from Russia and Indonesia, could influence whether the Chinese government chooses to follow the country's NDC objectives regarding renewable energy switching.[268] However, China is still on track to stagnate its coal consumption from 2022 through 2025 and add almost 1,000 terawatt-hours of renewable generation in that same time period.[269]

VIII. Conclusion

For East Asian countries to meet their NDC goals, extensive development will need to take place. For all countries, however, these changes can be readily integrated economically as demand continually increases. The increase in demand presents its own set of challenges and

261. Xu and Aizhu, *supra* note 259.

262. *Id.*

263. *2022 Coal Report: Executive Summary*, International Energy Agency, https://www.iea.org/reports/coal-2022/executive-summary (last visited Apr. 28, 2024).

264. *Id*.

265. *China's Russian Coal Imports Hit 5-year High as West Shuns Moscow, supra* note 259.

266. *Id.*

267. *Id.*

268. *China Imports of Coal,* Trading Economics, https://tradingeconomics.com/china/imports-of-coal.

269. *2022 Coal Report: Executive Summary*, *supra* note 263.

opportunities. First, countries will have difficulty building new renewable generation facilities while at the same time upgrading existing facilities and the grid. Second, building a framework for new sources of energy will be challenging and require substantial administrative effort. To combat this, there are organizations and companies worldwide that will seek to establish mutually beneficial relationships to develop renewable energies.

On a global scale, the Paris Agreement seems to be encouraging countries to change their outlook on energy and pollution. The responses, however, have varied. For example, while China and Indonesia anticipate a peak in carbon dioxide emissions before 2030, both Thailand and Viet Nam have seemingly already peaked.[270] China plans to be completely carbon neutral by 2060, while Viet Nam and Thailand target carbon neutrality by 2050.[271] This level of ambition is needed for the Paris Agreement to meet its temperature goals. Viet Nam is in the best position to advance in renewables out of the countries in this analysis. Its electricity grid is interconnected and can carry a considerable amount of energy. The country already has substantial renewable production from hydroelectric energy and plans to take advantage of its vast offshore wind resources. China is likely in the most difficult position to switch energy sources. It is still a developing economy in many areas with substantial amounts of rural land. With massive rural areas, the country will be more difficult to modernize in terms of renewable energy as traditional energy sources have historically been easier to distribute.

The developing world is in a precarious position with renewable energy production and will need support to fully implement renewables. Many countries, particularly western countries, have been able to utilize non-renewable energy to thrive within the last 100 years, while this progress was largely unavailable to others. Renewable energy can often be expensive to develop and take a longer period to see a return on investment than other traditional sources of energy. Thus, the international community

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270. Hannah Ritchie and Max Roser, *Vietnam: CO2 Country Profile,* Our World in Data, https://ourworldindata.org/co2/country/Vietnam?country=VNM~THA (last visited Apr. 28, 2024); Hannah Ritchie and Max Roser*, Thailand: CO2 Country Profile,* Our World in Data, https://ourworldindata.org/co2/country/thailand (last visited Apr. 28, 2024); *China's Achievements, New Goals and New Measures for Nationally Determined Contributions (Unofficial Translation), supra* note 144.

271. Burke and Nguyen*, supra* note 144; *China's Achievements, New Goals and New Measures for Nationally Determined Contributions (Unofficial Translation), supra* note 144.; *Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy (Revised Version), supra* note 144.

should have a level of understanding based on historical and current realities when analyzing contributions to the Paris Agreement, and the global community should consider subsidizing certain efforts. Surprisingly, from a data standpoint, these countries are not developing sustainable energy worse than western countries on any metric except for nuclear and coal. For example, the United States currently gets 20.1% of its energy from renewables and still relies on coal for a decreasing, but still significant, 21.8% of electricity production.[272]

International companies should see the renewable energy industry in East Asia as a prime investment and development opportunity. Countries are looking to decrease their reliance on imports while complying with their NDCs. The developing countries in East Asia are also less experienced in certain forms of renewable energy and would benefit from having foreign companies help develop the early infrastructure. Additionally, every country discussed will likely require grid upgrades, with Thailand already planning to upgrade its grid due to increased electricity production. LNG is a growing market and will be an area of opportunity for both the countries in the region and the companies looking to do business there. Thailand is currently attempting to place itself as the LNG hub of Southeast Asia, and Indonesia is one of the largest producers of LNG in the world. A current issue in the investment realm is the lack of government policies surrounding renewable energy projects, but that is rapidly changing as new energy projects navigate the legal landscape.

Further, all these countries will need significant investment, banking support, and training to meet the goals set out in their NDCs. Investment opportunities are rich, particularly in Southeast Asia, as countries are pursuing renewable projects and governments are supporting energy development in all sectors. Some countries, such as Thailand, restrict projects to mostly domestic companies; however, there is still room for many forms of collaboration. Additionally, the demand increases in these countries will mean a market already exists for additional energy production. Governments and international organizations have made reducing the risk of investments in the region a high priority, and international investors should feel more comfortable putting their money into these countries as those efforts increase.

272. *What is U.S. Electricity Generation by Energy Source?,* U.S. Energy Information Administration (Nov. 2022), https://www.eia.gov/tools/faqs/faq.php?id=427&t=3.