Western New England Law Review

Volume 41 *41 (2019)*
Issue 3

Article 3

2019

ANTHROPOCENIC DISRUPTION IN WORLD ENERGY: RESPONSE OF INTERNATIONAL LAW

Steven Ferrey
sferrey@suffolk.edu

WESTERN NEW ENGLAND LAW REVIEW

Volume 41 2019 Issue 3

ANTHROPOCENIC DISRUPTION IN WORLD ENERGY: RESPONSE OF INTERNATIONAL LAW

Professor Steven Ferrey[*]

The earth is at a "tipping point" for climate change, according to the world's scientific community. Building on the basic structure of the Kyoto Protocol, reaffirmed at the December 2015 Paris Conference of the Parties, it remains unresolved how the framework of international law for both reducing carbon dioxide (CO_2) emissions and addressing climate change will be implemented across 200 nations.

Approximately 40% of all CO_2 emissions are attributable to the electric power sector. Currently, there is no international requirement that developed economies make any shift to zero-carbon or low-carbon renewable power, and the Kyoto Protocol's Clean Development Mechanism (CDM) program has accomplished only modest renewable energy investment, to date, accounting for less than one-third of verified CDM credits.

In order to have the world population "buy in" to the new low-carbon metric, unprecedented vigorous deployment of renewable energy generation alternatives will be required to contain runaway climate change. Even if all developed countries could achieve a dramatic reduction of 80% of their CO_2 emissions by 2050, without

* Steven Ferrey is Professor of Law at Suffolk University Law School, and was Visiting Professor of Law at Harvard Law School. Since 1993, Professor Ferrey has been a primary legal consultant to the World Bank and the United Nations on their renewable and carbon (CO_2) reduction policies in developing countries, where he has worked extensively in Asia, Africa, and Latin America. He is the author of more than one hundred articles and seven books on energy and environmental law and policy, the most recent of which are STEVEN FERREY, UNLOCKING THE GLOBAL WARMING TOOLBOX: KEY CHOICES FOR CARBON RESTRICTION AND SEQUESTRATION (2010); STEVEN FERREY, LAW OF INDEPENDENT POWER (47th ed. 2019); STEVEN FERREY, ENVIRONMENTAL LAW: EXAMPLES & EXPLANATIONS (8th ed. 2019). He thanks his research assistant Jaime Whelan for her assistance.

similar vigorous participation by developing countries, this would not achieve the Kyoto Protocol or 2015 Paris Agreement climate change goals to hold climate warming below two degrees Celsius.

Innovative program models are required to fill this void. There is now a proven model. This model is adaptable to, and has been successfully demonstrated in, Asian nations with different forms of government and reliance on different primary forms of fuel for generation of electric power, ranging from market economies to communist countries. This new model is the key to arresting irreversible Anthropocenic disruption of climate and reconfigure energy markets.

I. INTERNATIONAL POWER

A. *Anthropocenic Climate Change*

Climate change cannot be separated from energy: its production, its access, and its allocation. In the next decade, there will be an unprecedented, massive investment in the electrification of developing nations. Once installed, power production facilities will remain in place for at least forty years, and in many cases, much longer.[1]

One-quarter of the world's,[2] and approximately 30% of the U.S.'s,[3] CO_2 emissions are from fossil fuel combustion in the electric power sector.[4] This is the largest greenhouse gas (GHG) emission compared to any other sector.[5] Forty-two percent of CO_2 emissions in the Organization for Economic Coordination and Development (OECD) countries, made up of the thirty-four most-developed countries, is attributed to their electric power sectors.[6] Ninety-four percent of

1. *See Age of Electric Power Generators Varies Widely*, U.S. ENERGY INFO. ADMIN. (June 16, 2011), https://www.eia.gov/todayinenergy/detail.php?id=1830 [https://perma.cc/VPT5-CUCK]; *see also* Ray Purdy, *The Legal Implications of Carbon Capture and Storage Under the Sea*, 7 SUSTAINABLE DEV. L. & POL'Y 22, 23 (2006).

2. *See Global Greenhouse Gas Emissions Data*, U.S. ENVTL PROTECTION AGENCY, https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data [https://perma.cc/W9FK-45F6].

3. *See Sources of Greenhouse Gas Emissions*, U.S. ENVTL PROTECTION AGENCY, https://www3.epa.gov/climatechange/ghgemissions/sources.html [https://perma.cc/7LR9-VAC9].

4. *See* U.S. ENERGY INFO. ADMIN., EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2009 2, 21–22 (2011), https://www.eia.gov/environment/emissions/ghg_report/pdf/0573%282009%29.pdf [https://perma.cc/9DDP-6PSP] [hereinafter EMISSIONS OF GREENHOUSE GASES].

5. *Id.*

6. *See Decoupling of Global Emissions and Economic Growth Confirmed*, INT'L ENERGY AGENCY (Mar. 16, 2016), https://www.iea.org/newsroom/news/2016/march/

Anthropogenic CO_2 emissions in the United States are from combustion of fossil fuels in all energy-using sectors, including electric power production as the largest.[7] Fossil fuel generation results in 64% of total human-made atmospheric CO_2.[8] At current energy development rates, energy-related CO_2 emissions in 2050 would be an unsustainable 200% of their current levels and exceed the limit necessary to hold the increase in global temperatures to two degrees Celsius.[9]

The average annual growth rate in primary energy use in developing countries was projected to grow by 2.7% per year during the first quarter of the twenty-first century; while more mature industrialized countries were expected to experience growth at less than half this rate, 1.2% annually, over the same period.[10] The majority of energy and power generation expansion will occur in Asia over the next decades.[11] Asian developing countries from 2018 forward are projected to account for two-thirds of all future growth in global energy consumption.[12] The U.S. Department of Energy forecasts that energy demand in developing Asia will nearly double over the next twenty-five years.[13] Some projections estimate that by 2020, China alone will emit 40% of the world's carbon emissions.[14]

Traditional international development financing often fuels development which increases CO_2 emissions, rather than reducing

---

decoupling-of-global-emissions-and-economic-growth-confirmed.html [https://perma.cc/WC9M-KFYH]; *OECD Energy Production Hits Record High, but Consumption and CO2 Emissions Fall*, INT'L ENERGY AGENCY (May 6, 2016), https://www.iea.org/newsroom/news/2016/may/oecd-energy-production-hits-record-high-but-consumption-and-co2-emissions-fall.html [https://perma.cc/B2SZ-YENT]; *see also U.S. Energy-Related Carbon Dioxide Emissions, 2017*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/environment/emissions/carbon/ [https://perma.cc/3VT2-F57A].

7. *Energy and the Environment Explained: Where Greenhouse Gases Come From*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/index.php?page=environment_where_ghg_come_from [https://perma.cc/KL97-U4UW].

8. EMISSIONS OF GREENHOUSE GASES, *supra* note 4, at 29.

9. *See* Roger Andrews, *Global CO2 Emissions Forecast to 2100*, ENERGY MATTERS (Mar. 7, 2018), http://euanmearns.com/global-co2-emissions-forecast-to-2100/ [https://perma.cc/5LCT-NESP].

10. ENERGY INFO. ADMIN., DEP'T OF ENERGY, INTERNATIONAL ENERGY OUTLOOK 7 (2004), https://www.hsdl.org/?view&did=15903 [https://perma.cc/UQ27-BZQ2].

11. *See id.* at 32–34.

12. *See World Energy Outlook 2017*, INT'L ENERGY AGENCY, https://www.iea.org/weo2017/ [https://perma.cc/PPQ9-L5S4].

13. *See* LINDA CAPUANO, U.S. ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 4 (2018), https://www.eia.gov/pressroom/presentations/capuano_07242018.pdf [https://perma.cc/5ZAV-4BTA].

14. *See* Deborah E. Cooper, *The Kyoto Protocol and China: Global Warming's Sleeping Giant*, 11 GEO. INT'L ENVTL. L. REV. 401, 405 (1999).

emissions.[15] However, there is nothing in the international Kyoto Protocol or Paris Agreement of 2015[16] that requires that developed economies make any shift to zero-carbon or low-carbon renewable power. The CDM[17] under the Protocol accomplished only modest renewable energy investment. Even if all developed countries could dramatically reduce their current annual CO_2 emissions by 2050, this would not achieve the Kyoto Protocol's or 2015 Paris Agreement's climate change goals without similar vigorous participation by developing countries.[18] Less than 20% (37) of all (197) signatory countries were regulated by the Kyoto Protocol, and those 37 countries collectively emit much less than half of world carbon.[19]

B. *International Top-Down Protocols*

From 2005 to 2012, the period in which the Kyoto Protocol was operative international law, the developing world made only relatively modest investments in renewable energy technology. Developing countries were not required under the Protocol to reduce CO_2 emissions.[20] The Paris COP-21 Agreement perpetuated two of the most-criticized elements of the Protocol—placing no definitive obligations for

15. *See* INT'L INST. & GLOB. GOVERNANCE PROGRAM, *The Global Climate Change Regime*, COUNCIL ON FOREIGN REL. (June 19, 2013), https://www.cfr.org/report/global-climate-change-regime [https://perma.cc/3XMB-TDED].

16. *See generally Kyoto Protocol—Targets for the First Commitment Period*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/process/the-kyoto-protocol [https://perma.cc/Z4BZ-6H4A] (showing the Kyoto protocol does not require any change of any developing countries); *The Paris Agreement*, UNITED NATIONS CLIMATE CHANGE (Oct. 22, 2018), https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement [https://perma.cc/5WBG-XVPU] [hereinafter *The Paris Agreement*] (highlighting that the Paris Agreement does not require any reductions from any countries; it encourages countries to make voluntary, self-monitored reductions).

17. *See Clean Development Mechanism (CDM)*, UNITED NATIONS CLIMATE CHANGE, http://cdm.unfccc.int/index.html [https://perma.cc/CKW6-2ZES]; *infra* note 39.

18. Mohamed T. El-Ashry, *An Overview of This Issue: Framework for a Post-Kyoto Climate Change Agreement*, 8 SUSTAINABLE DEV. L. & POL'Y 2, 2 (2008).

19. *See Paris Agreement—Status of Ratification*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/process/the-paris-agreement/status-of-ratification [https://perma.cc/AS8T-E8NZ]; *The Kyoto Protocol—Status of Ratification*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/process/the-kyoto-protocol/status-of-ratification [https://perma.cc/TZN5-G5KQ].

20. *What is the Kyoto Protocol?*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/process-and-meetings/the-kyoto-protocol/what-is-the-kyoto-protocol/what-is-the-kyoto-protocol [https://perma.cc/568U-XRXW] [hereinafter *What is the Kyoto Protocol?*].

carbon reduction on any nation and remaining totally unenforceable.[21] Global temperatures are already higher today than at any other time in the past 800,000 years.[22]

The technologies to dramatically mitigate carbon emissions exist.[23] Renewable power can extend power to geographically under-served, and remote communities at a lesser cost than conventional power generation.[24] Renewable energy can improve local health by emitting fewer or no criteria air pollutants[25] than conventional fossil fuel generation.[26] It is one of the few win-win-win scenarios.

At current rates of energy development, energy-related CO_2 emissions in 2050 would be 137% of recent levels under the existing pattern of power development and expansion.[27] Life as we know it

21. *See The Paris Agreement*, *supra* note 16 (providing that all reductions are offered voluntarily by countries and self-monitored, with no enforcement mechanism, penalties, or sanctions related to the voluntary amount or its failure to be achieved).

22. *See* THE CORE WRITING TEAM, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: SYNTHESIS REPORT 4 (Katharine J. Mach et al. eds., 2014), http://www.ipcc.ch/report/ar5/syr/ [https://perma.cc/9R5D-L85T].

23. Andrea Vittorio, *Countries Could Double Global Share of Renewable Energy by 2030, Agency Says*, BLOOMBERG ENV'T (Jan. 23, 2014, 12:00 AM), https://news.bloombergenvironment.com/environment-and-energy/countries-could-double-global-share-of-renewable-energy-by-2030-agency-says.

24. Wind projects in the U.S. cost, on average, $45/MWh for capacity and energy without other subsidies, and $58/MWh for solar. *See* Jim Efstathiou Jr. & Brian Sullivan, *Smarter Wind Turbines Try to Squeeze More Power on Each Rotation*, BLOOMBERG ENV'T (May 9, 2018, 8:25 AM), https://news.bloombergenvironment.com/environment-and-energy/smarter-wind-turbines-try-to-squeeze-more-power-on-each-rotation.

25. STEVEN FERREY, ENVIRONMENTAL LAW: EXAMPLES & EXPLANATIONS 205 tbl.5.2. (8th ed. 2019) [hereinafter EXAMPLES & EXPLANATIONS] (detailing the six criteria of air pollutants).

26. STEVEN FERREY, UNLOCKING THE GLOBAL WARMING TOOLBOX: KEY CHOICES FOR CARBON RESTRICTION AND SEQUESTRATION 30–31 (2010) [hereinafter GLOBAL WARMING TOOLBOX]; Michaja Pehl et al., *Understanding Future Emissions from Low-Carbon Power Systems by Integration of Life-Cycle Assessment and Integrated Energy Modeling*, 2 NATURE ENERGY 939–45 (2017) (explaining that lifecycle carbon emissions of solar and wind power generation are many times less than power generation from coal or natural gas, even if they employ carbon capture and storage).

27. William C. Ramsey, Deputy Executive Director, Int'l Energy Agency, Presentation at OECD Tokyo Center, Energy Technology Perspectives: Scenarios and Strategies to 2050 (July 14, 2006), http://www.unece.lsu.edu/biofuels/documents/2007July/SRN_020.pdf [https://perma.cc/26WU-FCP3] (explaining that there is a direct correlation between traditional energy use and climate warming emissions, having the effect of increasing global GHG emissions when they must be drastically reduced); Holli Riebeek, *Global Warming*, NASA: EARTH OBSERVATORY (June 3, 2010), http://earthobservatory.nasa.gov/features/GlobalWarming [https://perma.cc/74DU-KXHS].

would change fundamentally as a consequence of resultant warming.[28] Without a better model implemented across the globe immediately, "the energy-related infrastructure . . . in place would generate all the CO_2 emissions allowed in the 450 Scenario up to 2035."[29]

II. TOP-DOWN, BOTTOM-UP, MIDDLE-OUT

A. *Top-Down and CDM Bottom-Up*

The Kyoto Protocol was adopted in 1997 and became effective in 2005.[30] The thirty-seven ratifying "Annex 1" countries to the Kyoto Protocol pledged to reduce GHG emissions by an average of 5% from the 1990 levels[31] to a set percentage level below historic levels by 2012.[32] During the second commitment period of the Protocol from 2012–2020, parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight years from 2013 to 2020.[33]

In 2015, a subsequent international agreement was entered into in Paris at the Conference of the Parties (COP-21), whereby all participating nations agreed to a general commitment to reduce global emissions. The Paris Agreement encourages participation by all countries in the world, including voluntary actions by countries emitting 97% of global emissions, while the Kyoto Protocol reached only 14% of global emissions.[34] However, the Paris Agreement includes no specific commitment from any nation, and there is no mechanism for enforcing the Agreement.[35] Now, almost four years and three additional

28. *See* Riebeek, *supra* note 27 (explaining that regions of the world will warm, sea levels will rise, droughts will affect food cultivation, areas amenable to crop growth will migrate further north, and diseases will spread).

29. *The World Is Locking Itself into an Unsustainable Energy Future Which Would Have Far-Reaching Consequences, IEA Warns in Its Latest World Energy Outlook*, INT'L ENERGY AGENCY (Nov. 9, 2011), https://www.iea.org/newsroomandevents/pressreleases/2011/november/the-world-is-locking-itself-into-an-unsustainable-energy-future.html [https://perma.cc/UB76-ENY8].

30. *The Kyoto Protocol—Status of Ratification*, *supra* note 19.

31. *What is the Kyoto Protocol?*, *supra* note 20.

32. *List of Parties to the Convention*, UNITED NATIONS CLIMATE CHANGE, https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states [https://perma.cc/8CS8-P8Q7] (last updated Aug. 7, 2018).

33. *See What is the Kyoto Protocol?*, *supra* note 20.

34. Robert Stavins, *Will the Paris Agreement Help or Hinder Cooperation Among Nations?*, AN ECON. VIEW ENV'T (May 16, 2018), http://www.robertstavinsblog.org/2018/05/16/will-the-paris-agreement-help-or-hinder-cooperation-among-nations/ [https://perma.cc/GFT9-PUVZ].

35. *See The Paris Agreement*, *supra* note 16; Christoph Böhringer & Michael Finus, *The Enforcement Mechanisms of the Kyoto Protocol: Flawed or Promising Concepts?*, 1 ASTA WIRTSCHAFTS- UND SOZIALSTATISTISCHES ARCHIV 253 (2008),

conferences of the parties since the Paris Agreement, deemed as a final effort to address an international climate emergency, there still are few rules or mechanisms in place to implement it. This lack of international enforcement was seen by China, India, and other developing countries as a major victory for their position, supporting a continuing lack of international limits or enforcement mechanisms that affect developing countries.[36]

The Kyoto Protocol CDM is a bottom-up GHG reduction mechanism creating tradable certified emission reduction credits (CERs) from projects that reduce greenhouse gases in developing nations.[37] CERs, once earned, are traded or sold to regulated companies in Annex I developed countries.[38] However, the CDM has not achieved substantial investment in lasting renewable energy technology, with renewable energy projects accounting for only 19% of CDM CER projects.[39] "Over 75% of registered [CDM] projects are currently being carried out in Asia,"[40] where, if carefully structured, could provide legal incentives for renewable energy projects.

A double benefit can be achieved by changing international law and programs for investment with regard to renewable energy in developing countries. First, small-scale renewable energy can be situated off-grid or on-grid to benefit previously underserved populations without access to

---

https://www.researchgate.net/publication/23691970_The_enforcement_mechanisms_of_the_Kyoto_protocol_Flawed_or_promising_concepts; Michael Gillenwater, *The Treaty Compliance Challenge: Enforcement Under the Kyoto Protocol*, GHG MGMT. INST. (Feb. 10, 2010), https://ghginstitute.org/2010/02/10/the-treaty-compliance-challenge-enforcement-under-the-kyoto-protocol [https://perma.cc/B3XB-N2SJ].

36. *See* David Hunter, *Implications of the Copenhagen Accord for Global Climate Governance*, 10 SUSTAINABLE DEV. L. & POL'Y 4, 4 (2010).

37. *See Kyoto Protocol to the United Nations Framework Convention on Climate Change*, art. 12 (Dec. 11, 1997), 2303 U.N.T.S. 224, https://unfccc.int/resource/docs/convkp/kpeng.html [https://perma.cc/7ZTX-9B6E]; GLOBAL WARMING TOOLBOX, *supra* note 26, at 52.

38. STEVEN FERREY (WITH ANIL CABRAAL), RENEWABLE POWER IN DEVELOPING COUNTRIES: WINNING THE WAR ON GLOBAL WARMING 99–105 (2006); STEVEN FERREY, SMALL POWER PURCHASE AGREEMENT APPLICATION FOR RENEWABLE ENERGY DEVELOPMENT: LESSONS FROM FIVE ASIAN COUNTRIES 29–34 (2004), http://siteresources.worldbank.org/EXTRENENERGYTK/Resources/5138246-1237906527727/5950705-1239137586151/Small0Power0Pu1e0Energy0Development.pdf [https://perma.cc/52V4-RA8Q] [hereinafter SMALL POWER PURCHASE].

39. UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, BENEFITS OF THE CLEAN DEVELOPMENT MECHANISM 2012 16–17, fig.1 (2012), https://unfccc.int/resource/docs/publications/abc_2012.pdf [https://perma.cc/HFJ8-YSL7].

40. Nhan T. Nguyen et al., *Improving the Clean Development Mechanism Post-2012: A Developing Country Perspective*, 4 CARBON & CLIMATE L. REV. 76, 78 (2010) [hereinafter *Improving the CDM*]; *CDM Projects Interactive Map*, UNITED NATIONS CLIMATE CHANGE, https://cdm.unfccc.int/Projects/MapApp/index.html (last visited Apr. 13, 2019).

the power grid[41]—electricity access is the modern denominator of developed countries.[42] Second, renewable energy emits fewer criteria pollutants than fossil fuels do, meaning that they will have a less negative impact on the health of local populations in developing countries.[43]

Demand for power in developing countries continues to increase.[44] The missing link is control of fast-accelerating carbon emissions in developing countries; it is critical that all significant world carbon emitters are appropriately and proportionately controlled. To this end, there is a proven middle-out model capable of doing so in developing countries.

B. *A Middle-Out Regulatory Model*

For a decade, countries have consistently resisted the enforceable international requirements in both the Kyoto Protocol and the Paris Agreement, with the world now at the point of losing its self-declared two-degree Centigrade climate battle.[45] Coal use is decreasing in developed Kyoto Annex I countries that have emission reductions in the Protocol.[46] Asia, with its high population growth levels and electricity consumption rates, is the key geographic focus. In Asia, there is more than triple the consumption of coal than in the U.S. and the European Union combined.[47]

---

41. GLOBAL WARMING TOOLBOX, *supra* note 26, at 37.

42. *Id.* at 6.

43. *See* GLOBAL WARMING TOOLBOX, *supra* note 26, at 32–33 (explaining that renewable energy produces fewer criteria air pollutants); Pehl et al., *supra* note 26 (explaining that lifecycle carbon emissions of solar and wind power generation are minimal).

44. GLOBAL WARMING TOOLBOX, *supra* note 26, at 32.

45. *See* Quirin Schiermeier, *G8 Leaders Fail to Agree on Carbon Cuts Before 2050*, NATURE (July 9, 2009), http://www.nature.com/news/2009/090709/full/news.2009.660.html [https://perma.cc/2QP6-2CYM]; *see also* James Kirkup, *G8 Summit: China and India Reject G8 Calls for Climate Targets*, TELEGRAPH (July 8, 2009, 7:33 PM), http://i.telegraph.co.uk/news/worldnews/g8/5780617/G8-summit-China-and-India-reject-G8-calls-for-climate-targets.html [https://perma.cc/YT2K-RVZ9].

46. *See* Silvio Marcacci, *Cheap Renewables Keep Pushing Fossil Fuels Further Away from Profitability—Despite Trump's Efforts*, FORBES (Jan. 23, 2018, 8:00 AM), https://www.forbes.com/sites/energyinnovation/2018/01/23/cheap-renewables-keep-pushing-fossil-fuels-further-away-from-profitability-despite-trumps-efforts/#46fb850a6ce9 [https://perma.cc/76R8-XX64].

47. *See Coal 2017*, INT'L ENERGY AGENCY (Dec. 18, 2017), https://www.iea.org/coal2017/ [https://perma.cc/BW67-CDY9] (showing 3,500 of 5,500 Mtce of coal in the current period being consumed in Asia, representing three-quarters of all world coal consumed in Asia, according to article's figure).

China currently depends on coal for two-thirds of its energy, more than any other "Group of 20" country, except South Africa.[48] "In China, renewable[] [technologies'] share in energy production dropped from 40 percent in 1971 to 11 percent [recently]; in 2035, it [is projected to] be [at] 9 percent."[49] China's demand for electricity will double by 2030, according to the International Energy Agency (IEA).[50] It is expected that an additional 180 gigawatts of coal-fired power will be constructed in China by 2025.[51]

In the next five years, there will be a massive investment in the electrification of developing nations.[52] Once installed, those power facilities will remain in place, often for forty years and, in many cases, longer.[53] The choices in energy technology made now during this massive increase in electrification will be the signature of the world's carbon footprint for the remainder of this century.[54]

The international top-down legal infrastructure, from the Kyoto Protocol to the Paris Agreement, has not required any enforceable shift to low-carbon renewable energy generation.[55] However, a middle-out model has been implemented, road-tested, and shown to successfully incentivize renewable power in a host of developing countries over the past quarter century—dating more than a decade before the Kyoto

48. *Id.*; Marlo Lewis, *U.S.-China Climate Deal: Who Snookered Whom?*, GLOBAL WARMING.ORG (Nov. 24, 2014), http://www.globalwarming.org/2014/11/24/u-s-china-climate-deal-who-snookered-whom/ [https://perma.cc/4GU2-FFX3].

49. Bjørn Lomborg, *Green Energy Needs to Be Cheaper*, SLATE (Aug. 25, 2013, 6:30 AM), http://www.slate.com/articles/health_and_science/project_syndicate/2013/08/green_energy_subsidies_for_solar_and_wind_power_aren_t_helping_let_s_invest.html [https://perma.cc/7QVD-TZSA].

50. Feifei Shen & Iain Wilson, *China Will Need to Build 1,000 Nuclear Plants to Meet Emissions Reduction Target*, BLOOMBERG L. (Nov. 21, 2014, 12:00 AM), https://www.bloomberglaw.com/product/blaw/document/XDB0F5PC000000?bc=W1siU2VhcmNoIFJlc3VsdHMiLCIvcHJvZHVjdC9ibGF3L3NlYXJjaC9y.

51. Michael Standaert, *China's Return to Coal Brings Rise in Carbon Emissions*, BLOOMBERG ENV'T (Sept. 11, 2018), https://news.bloombergenvironment.com/environment-and-energy/chinas-return-to-coal-brings-rise-in-carbon-emissions.

52. *See* Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, 55 UCLA L. REV. 1759, 1790–91 (2008).

53. Purdy, *supra* note 1; Todd Woody, *Most Coal-Fired Power Plants in the US Are Nearing Retirement Age*, QUARTZ (Mar. 12, 2013), https://qz.com/61423/coal-fired-power-plants-near-retirement/ [https://perma.cc/9XXW-2TDF] (depicting still-operating coal, natural gas, and hydro plants in the U.S. up to sixty years old or older, dating from the 1950s and earlier).

54. *See generally* Bill McKibben, *How Close to Catastrophe?*, N.Y. REV. BOOKS (Nov. 16, 2006), http://www.nybooks.com/articles/19596 (referencing NASA's James Lovelock on the necessity of a radical carbon transformation by 2015).

55. *See* Vittorio, *supra* note 23.

Protocol. This model, that the author first implemented through World Bank initiatives in Indonesia twenty-five years ago, has been successfully implemented in dozens of developing countries from governments that are highly market-oriented to those that are Communist.[56]

The middle-out model changes regulatory law in developing countries, modifies the utility monopoly on the production of power, and implements a balanced set of incentives for zero-carbon renewable power to supplant high-carbon traditional fossil fuels that would otherwise be chosen.[57] It develops and applies fair small power purchase agreements (PPAs) for renewable power to supplant fossil fuel power generation, and it is showcased by the World Bank as the "best practice" in developing countries for renewable energy development.[58] National laws and regulations must first be changed to modify the monopoly of the national utility to allow independent private investment in renewable power generation.

In many developing countries, the utility does not collect enough revenue from customers each year to cover the cost of its power generation.[59] This makes the utility an unbankable borrower for additional private-market lending dollars. The utility, in this position, cannot take advantage of conventional international market finance channels. Applying correctly developed PPAs in the developing world through this model is now a proven successful practice to realize sustainable electric energy development and climate change mitigation objectives.[60]

III. THE MIDDLE-OUT MODEL

This PPA model is well illustrated through World Bank-funded programs in Asia, highlighted in this section. The following explication builds on the author's prior work in these five countries and more than a

56. *See* FERREY (WITH CABRAAL), *supra* note 38. *See generally* SMALL POWER PURCHASE, *supra* note 38 (including market-driven economies like Thailand and India, and Communist countries like Vietnam).

57. *See generally* SMALL POWER PURCHASE, *supra* note 38, at 68–73.

58. *Id.*

59. *Power Purchase Agreements (PPAs) and Energy Purchase Agreements (EPAs)*, PUB.-PRIV.-PARTNERSHIP LEGAL RES. CTR., https://ppp.worldbank.org/public-private-partnership/sector/energy/energy-power-agreements/power-purchase-agreements [https://perma.cc/2LJB-JTHG] (last updated Feb. 15, 2017) (explaining that many countries subsidize retail power rates for consumers, causing utilities to not raise retail revenue sufficient to cover costs).

60. *See* SMALL POWER PURCHASE, *supra* note 38.

dozen other developing countries, documented in a World Bank study of best practices in developing country electric sectors.[61] This Part analyzes and briefly compares six examples of PPA renewable power models and best practices in developing Asian countries, each with significant distinctions: different forms of government from market economies to centrally planned economies and different applications of climate justice; reliance on different primary forms of fuel for generation of electric power; different kinds of renewable energy potential; different geography and population densities; and either centralized grids and isolated electric grids.

A. *Thailand*

Thailand was one of the first countries in Asia to adopt an independent small-power program to develop non-utility power more than two decades ago.[62] Thailand, with seventy million people, has an annual electricity consumption of approximately 168 billion kilowatt-hours (kWh), and experiences an annual rate of demand increase of 3.2%.[63] Thailand serves 100% of its populated area with electricity, with per capita annual consumption of 2,438 kWh.[64] Thailand produces power supply 63% from natural gas, 19% from coal, and 8% from renewable energy sources, including biomass, hydro, and solar, with 10% of power imported, including coal-fired power from Laos.[65]

The innovative Thai Small Power Producer (SPP) program employed competitive bidding as a means to suppress the bid price of renewable power offered for sale and to award subsidy payments.[66] National renewable energy "subsidies [were] provided on a competitive bidding basis that allows the maximum leverage of renewable SPP resources at the lowest kWh cost [bid] to the state."[67] "SPPs [were]

61. *See generally* SMALL POWER PURCHASE, *supra* note 38 (documenting the author's work to adapt power sector law and introduce PPAs to facilitate private-sector investment in country power systems).

62. *See* FERREY (WITH CABRAAL), *supra* note 38, at 85.

63. *See Energy Consumption in Thailand*, WORLDDATA.INFO, https://www.worlddata.info/asia/thailand/energy-consumption.php [https://perma.cc/V27H-X73F]; *Thailand (2014)*, REEEP (Oct. 11, 2013, 3:33 PM), https://www.reeep.org/thailand-2014 [https://perma.cc/V9F6-X6C7].

64. *See* sources cited *supra* note 63.

65. *Thailand*, ENERGY INFO. ADMIN. (Feb. 2017), https://www.eia.gov/beta/international/analysis.php?iso=THA [https://perma.cc/P8K6-SWVC].

66. FERREY (WITH CABRAAL), *supra* note 38, at 74.

67. SMALL POWER PURCHASE, *supra* note 38, at 4.

awarded subsidy in the order of the lowest SPP subsidy bid, until the gross subsidy allocation [cap wa]s exhausted."[68]

The SPP regulations allow SPPs to sell up to sixty MW of power output to the Electricity Generating Authority of Thailand (EGAT), the national Thai monopoly utility; up to 90 MW is within the discretion of EGAT to accept on a case-by-case basis. EGAT has accepted several of these larger projects.[69] The program has not restricted participation to renewable sources.[70] Most of the capacity is gas-fueled cogeneration, with some non-firm SPP bagasse, and one small hydro project of about seven MW.[71] In 2001, a Very Small Power Producer (VSPP) program was introduced in Thailand for renewable energy generating facilities with a power export delivery capacity of up to one MW net (later increased to ten MW).[72] In 2007, the government introduced a PPA "adder," a feed-in tariff (FiT)[73] premium paid for seven-to-ten years (differentiated by technology of generation) to SPPs and VSPPs for renewable energy, ranging in value by technology.[74]

As of 2012, Thailand already had approximately 8,000 MW of renewable generation projects in the development pipeline seeking renewable adders, with approximately 1,000 MW connected to the grid.[75] The combined on-grid capacity and in-the-pipeline independent amounts were about 27% of the installed power generation capacity at that time in Thailand.[76] PPA contract terms of twenty to twenty-five years are the norm for these larger cogeneration projects under firm power sale contracts.[77] What Thailand demonstrated was not only early success implementing independent power projects with generation sourced outside of the monopoly utility, but also cost control through

68. *Id.*

69. FERREY (WITH CABRAAL), *supra* note 38, at 87.

70. *See* SMALL POWER PURCHASE, *supra* note 38, at 21–22.

71. *Id.* at 24.

72. *Feed-in Tariff for Very Small Power Producers (VSPP) (excluding solar PV)*, INT'L ENERGY AGENCY, https://www.iea.org/policiesandmeasures/pams/thailand/name-146463-en.php [https://perma.cc/QNA9-QB3N] (last modified Sept. 7, 2015, 3:49 PM) [hereinafter *Very Small Power Producers*].

73. *Introduction to Feed-in Tariffs*, RENEWABLE ENERGY FOCUS.COM (Oct. 19, 2010), http://www.renewableenergyfocus.com/view/13313/introduction-to-feed-in-tariffs/ [https://perma.cc/7QRC-5EMB].

74. *Very Small Power Producers*, *supra* note 72.

75. Sopitsuda Tongsopita & Chris Greacen, *An Assessment of Thailand's Feed-in Tariff Program*, 60 RENEWABLE ENERGY 439, 439 (2013), http://www.wind-works.org/cms/fileadmin/user_upload/Files/Chabot_Files/Tongsopit_Greacen_2013_An_Assessment_of_Thailand_s_FiT_Renewable_Energy.pdf [https://perma.cc/KUQ4-WGWM].

76. *Id.*

77. *See* SMALL POWER PURCHASE, *supra* note 38, at 21–22.

competitive bidding and selective subsidies. More nations are now incorporating aspects of competitive bidding, following Thailand's lead.

B. *Sri Lanka*

While starting later than the Thailand program, the Sri Lanka model is considered one of the most successful developing country SPP standardized PPA programs to promote renewable energy in Asia and in the world. Sri Lanka is an island nation, and it implemented this model while enduring a long-lived significant civil war that attempted to divide island governance into two separate nations.[78] One distinctive feature of the Sri Lanka program is that, initially, it successfully employed a PPA avoided-cost tariff.[79] After the first decade of the program, Sri Lanka successfully switched to a technology-differentiated FiT as a means to differentially incentivize and diversify its renewable power supply from almost all hydroelectric power to more wind and solar technologies.[80] This is regarded as one of the most nuanced and successful SPP PPA programs over the past two decades, utilizing a standardized PPA to successfully attract various renewable energy technologies to make a significant contribution to power supply in a developing country.

Sri Lanka first introduced its standardized SPP PPA in 1997.[81] Fifteen-year PPAs originally were available for projects up to ten MW each in size.[82] This was altered based on initial program success and utility acceptance, so that twenty-year PPAs were later available for SPP projects up to twenty MW in size.[83]

Several important lessons came from the Sri Lanka program. In 2003, the program was modified to adopt a controlled solicitation process, with application fees and earnest money deposits from independent PPA recipient stakeholders.[84] This prevents independent SPP award recipients from attempting to prospect for valuable sites for

78. FERREY (WITH CABRAAL), *supra* note 38, at 145; WORLD BANK, PRIVATE SECTOR, SMALL-SCALE, GRID-CONNECTED RENEWABLE POWER GENERATION IN SRI LANKA (2008), http://documents.worldbank.org/curated/en/919411468302498090/pdf/700010ESW0P0990e0Sector0Small0Scale.pdf [https://perma.cc/U7UG-3EHE].

79. An avoided-cost tariff sets the wholesale power purchase price at the price at which the utility could produce or purchase a similar amount of energy and capacity. *See* 18 C.F.R. § 292.101(b)(6) (2018); STEVEN FERREY, LAW OF INDEPENDENT POWER, at §§ 7.1–7.5 (47th ed. 2019).

80. INDEPENDENT POWER, *supra* note 79, at §§ 7.1–7.5.

81. SMALL POWER PURCHASE, *supra* note 38, at 58.

82. *Id.*

83. *See id.* at 57. From the author's personal knowledge, the fifteen-year PPA term, effective when the source was published, has now been increased to a twenty-year PPA.

84. *See id.* at 57–58.

which they have no resources to develop, and once controlling these rights, trying to sell them to other independent developers.[85]

Most successful early-phase SPPs in Sri Lanka, being paid only the PPA avoided-cost rate for their power output, were dispersed, decentralized small hydroelectric projects.[86] As of 2007, after a decade of operation, the national utility grid in Sri Lanka had more than fifty operating independent SPP projects supplying more than 100 MW of power when total country power generation was 2,256 MW,[87] another twenty-five SPPs were under construction, and an additional twenty-five SPPs that were under active development.[88]

At the end of the first decade of the SPP PPA program, to attract a more diverse range of renewable energy technologies including wind, solar, and biomass projects, Sri Lanka moved to a PPA FiT for SPPs differentiated for each renewable technology (wind and biomass receive a higher tariff than small hydro projects).[89] Moving to a technology-differentiated PPA FiT increased the participating non-hydro SPPs, with renewable energy, including hydropower, constituting 47% of Sri Lanka generating capacity in 2016.[90]

By the end of 2014, total renewable energy generation reached approximately 9% of the total annual electricity output.[91] Independent wind power was a significant, growing component, along with small hydroelectric facilities, and there was more than 800 MW of renewable energy capacity in service and selling the utility independently produced power by 2011.[92]

In 2017, with its PPA model over the prior two decades having already caused the successful development of most of the small hydroelectric renewable energy potential in the country, Sri Lanka focused on other renewable energy technologies and obtained a $500

85. FERREY (WITH CABRAAL), *supra* note 38, at 150.

86. SMALL POWER PURCHASE, *supra* note 38, at 58.

87. *Id.*; M.B.S. SAMARASEKARA ET AL., CEYLON ELEC. BD., LONG TERM GENERATION EXPANSION PLAN 2013-2032 5-2 tbl.5.1 (2013), http://www.pucsl.gov.lk/english/wp-content/uploads/2013/11/LTGEP%202013-2032.pdf.

88. This is within the author's personal knowledge.

89. *See* Jayatissa de Costa, *Non Conventional Renewable Energy Tariff Announcement*, PUBLIC UTILS. COMM'N OF SRI LANKA, http://www.pucsl.gov.lk/english/notices/non-conventional-renewable-energy-tariff-announcement-purchase-of-electricity-to-the-national-grid-under-standardized-power-purchase-agreements-sppa/ [https://perma.cc/GV6K-6KEB].

90. *See* PUB. UTILS. COMM'N OF SRI LANKA, GENERATION PERFORMANCE IN SRI LANKA 2016 2 (2016) (draft version), http://www.pucsl.gov.lk/english/wp-content/uploads/2017/07/GenPerformance-2016_Draft.pdf [https://perma.cc/4267-EJRG].

91. *Id.*; M.B.S. SAMARASEKARA ET AL., *supra* note 87.

92. Tongsopit & Greacen, *supra* note 75, at 441 tbl.1.

million commitment from a multilateral development bank to develop up to 350 MW of new wind power.[93] For the first phase of this wind-development effort, the national utility, the Ceylon Electricity Board (CEB), employed a competitive solicitation process to select a wind development contractor to design, engineer, procure, construct, operate, and maintain the initial 100 MW of wind turbines to be owned by CEB.[94] For the subsequent phases of additional wind power, Sri Lanka plans to conduct competitive tenders using a PPA model, designed by the Author, to purchase the wind power output of the winning independent wind applicants for 20 years.[95] These two phases of wind power development demonstrate two variations on the models of procurement, ownership, operation, and maintenance of renewable wind energy development designed to mitigate climate warming.

C. *States in India*

While Sri Lanka is not a large country, neither in land area nor population,[96] and Thailand is relatively substantial in population, but not in land area,[97] India occupies 2.4% of the world's land surface area and is home to 16% of the world's population[98]—both significantly large percentages. With an estimated population of 1.339 billion, India is the world's second most populated country, trailing only the People's Republic of China.[99] India has confronted the challenge of keeping enough operating power generating capacity operational in light of the power demands of a very fast-growing population.

---

93. *ADB Boosting Renewable Energy in Sri Lanka with 100 MW Wind Park*, ASIAN DEV. BANK (Oct. 24, 2017), https://www.adb.org/news/adb-boosting-renewable-energy-sri-lanka-100-mw-wind-park [https://perma.cc/5PKH-LTDM]. The author also acquired this information from advising Asian Development Bank, which financed this wind project with its current first phase of 100 Mw wind project.

94. *Sri Lanka to Award Contract to Construct 100 MW Wind Power Plant to Vestas*, REVE (Oct. 18, 2018), https://www.evwind.es/2018/10/18/sri-lanka-to-award-contract-to-construct-100-mw-wind-power-plant-to-vestas/64853 [https://perma.cc/8528-9JVQ].

95. From author's information advising ADB and Sri Lanka.

96. The population of Sri Lanka is approximately 21 million people. *See Sri Lanka Population 2019*, WORLD POPULATION REV., http://worldpopulationreview.com/countries/sri-lanka-population/ [https://perma.cc/AD2R-W8PL].

97. *See Thailand Population 2019*, WORLD POPULATION REV., http://worldpopulationreview.com/countries/thailand-population/ [https://perma.cc/L7U3-VPG2].

98. *See* Pooja Mehta, *Size and Growth of Population in India*, ECON. DISCUSSION, http://www.economicsdiscussion.net/articles/size-and-growth-of-population-in-india/2241 [https://perma.cc/JW66-DYDN].

99. *Id.*; *see also Indian Population 2019*, WORLD POPULATION REV., http://worldpopulationreview.com/countries/india-population/ [https://perma.cc/CY7L-6DM8].

A 10% peak-power shortage was partly responsible for the massive grid collapse in many states causing the world's largest blackout in July 2012.[100] During typical blackouts, renewable energy plants continue operating through local community grid systems or microgrids.[101] More than 15% of India's fast-growing population has no connection to the central power grids in the Indian states.[102] Here, smaller scale SPP renewable power, operating independently off the central grid through private mini-grids, may offer the best solution, rather than extending expensive transmission infrastructure to remote areas.

Governmentally, both Thailand and Sri Lanka are structured and administered at the federal level without separate states. By contrast, India has a federalist form of government, with its thirty-five states exercising direct regulatory control over significant elements of the economy's electric sector.[103] Each state makes its own determinations about energy programs, subject to federal incentives and guidance.[104] Two of India's largest states, Andhra Pradesh and Tamil Nadu, are detailed in their SPP PPA model programs below. Each of these Indian states has a population of more than 70 million people, comparable to the population of Thailand, Germany, France, or England.[105] Both states encourage Independent Power Producer (IPP) development of renewable power.

The state of Andhra Pradesh is the most advanced in installing IPP renewable wind capacity with more than 7,000 MW of total capacity, of which 189 MW were wind capacity in operation.[106] Most of the SPP projects are wind, bagasse, cogeneration, biomass gasification, and solar.

---

100. *See* Marianne Lavelle et al., *India Power Outage Spotlights Energy Planning Failure*, NAT'L GEOGRAPHIC (Aug. 2, 2012), https://news.nationalgeographic.com/news/energy/2012/07/120731-india-power-outage-analysis/ [https://perma.cc/RN4N-85T7].

101. Benjamin Warren, *EY Renewable Energy Country Attractiveness Index—50th Issue*, GREEN MATCH (Dec. 20, 2017), https://www.greenmatch.ch/en/blog/ey-renewable-energy-country-attractiveness-index? [https://perma.cc/4ASX-Q65D].

102. *Access to Electricity (% of Population)*, WORLD BANK, https://data.worldbank.org/indicator/eg.elc.accs.zs [https://perma.cc/W8FP-CRVA] [hereinafter *Access to Electricity*] (showing that 85% of India consumers were grid-connected in 2016).

103. Pragya Bansal, *Federalism in India—Analysis of the Indian Constitution*, IPLEADERS, (Aug. 29, 2018), https://blog.ipleaders.in/federalism-in-india/ [https://perma.cc/32YK-LTYR].

104. FERREY (WITH CABRAAL), *supra* note 38, at 78.

105. *See Total Population by Country 2019*, WORLD POPULATION REV., http://worldpopulationreview.com/countries [https://perma.cc/Z9JV-QRDL].

106. *See* RENEWABLES 2017 GLOBAL STATUS REPORT, REN21 (Lisa Mastny ed., 2017), http://www.ren21.net/wp-content/uploads/2017/06/17-8399_GSR_2017_Full_Report_0621_Opt.pdf [https://perma.cc/W7X3-V5RJ].

These renewable energy projects are limited to 20 MW per facility.[107] Incentives offered for new, independently owned wind generation included 100% first-year depreciation. However, the lack of adequate revenue generated by the state utility, APTRANSCO, has frustrated some wind development.[108]

In the state of Tamil Nadu, its power supply system generates more than 7,000 MW of wind capacity.[109] Tamil Nadu state has a significant fraction of India's independent "wind turbine capacity and a significant percentage of [renewable] biomass projects."[110] An SPP PPA eligible maximum size limit of 50 MW is imposed for independent renewable energy projects.[111] The SPP PPA tariff is higher for biomass projects than for wind to reflect the former's non-intermittent, controllable power generation characteristics.[112]

Of note, in 2015, more than half of the significant wind power in Tamil Nadu was idled because its utility could no longer afford to pay the contractually-provided wind PPA FiT without losing more money.[113] "Providers . . . racked up more than 2.5 trillion rupees ($39 billion) of losses partly because they were forced to sell [retail power] below cost to keep energy affordable" for poor citizens in India.[114] The economics of infrastructure development and operation matter in developing countries.[115] For instance, in China, 15% of wind power was idled in 2015 because of a lack of sufficient transmission infrastructure.[116] And 39% was idled in one province.

---

107. FERREY (WITH CABRAAL), *supra* note 38, at 126, 128.

108. *Id.* at 129.

109. Rajesh Kumar Singh & Anindya Upadhyay, *Cheap Power or Clean Energy? India's $200 Billion Dilemma*, BLOOMBERG BUS. (July 29, 2015), https://www.bloomberg.com/news/articles/2015-07-29/cheap-power-or-clean-energy-india-s-200-billion-dilemma (last updated July 30, 2015, 1:10 AM); Sushma U.N., *How Tamil Nadu Became One of The World's Leading Renewable Energy Markets*, QUARTZ INDIA (Feb. 18, 2018), https://qz.com/india/1208222/how-tamil-nadu-became-one-of-the-worlds-leading-renewable-energy-markets/ [https://perma.cc/D6FQ-LUEK]; *see also* SMALL POWER PURCHASE, *supra* note 38, at 50.

110. SMALL POWER PURCHASE, *supra* note 38, at 50.

111. *Id.* at 51.

112. *Id.* at 3, 54.

113. Singh & Upadhyay, *supra* note 109.

114. *Id.*

115. *See More Idled Wind Turbines in China as Capacity Grows*, BLOOMBERG: ENV'T & ENERGY (July 28, 2015, 12:00 AM), https://www.bloomberglaw.com/document/XDMMG2KO000000?bc=W1siU2VhcmNoIFJlc3VsdHMiLCIvc2VhcmNoL3Jlc3VsdHMvMmIzMTZkNjlhZmE5.

116. *See China's Idled Wind Turbines Rise in 2015 After Record Installs*, BLOOMBERG (Feb. 3, 2016, 1:16 AM), https://www.bloomberg.com/news/articles/2016-02-03/china-s-idled-wind-turbines-rise-in-2015-after-record-installs; Javier C. Hernández, *It Can Power a*

India, the world's third most significant emitter of carbon, only surpassed by China and the U.S.,[117] offered to make "a sharper cut" in emissions and develop more renewable energy generation capacity only if rich nations paid it to do so.[118] Prime Minister Modi offered to develop $200 billion worth of additional renewable energy, but only if it is subsidized by developed countries.[119]

India is regarded as one of the top five countries for additional renewable energy development.[120] India is the tenth largest developer of small hydro facilities, the fifth largest developer of wind power, as well as the fifth largest producer of solar photovoltaic ("PV") systems, in the world.[121] The lessons of India are important illustrations of the PPA model in a federalist form of government with power shared by states or provinces.

D. *Indonesia*

Indonesia's 240 million inhabitants are spread across more than 6,000 inhabited islands of the more than 17,000 islands comprising the country, with 80% of the population living on Java and Bali.[122] Populations in all but four Indonesia islands (Java, Bali, Sumatra, and Sulawesi) do not have access to centralized power supplied by the state utility, Perusahaan Listrik Negara (PLN).[123] In 2016, 97% of the population was listed as having some either centralized or diesel mini-grid access to electricity.[124]

Small Nation. But This Wind Farm in China Is Mostly Idle, N.Y. TIMES (Jan. 15, 2017), https://www.nytimes.com/2017/01/15/world/asia/china-gansu-wind-farm.html [https://perma.cc/KWP3-HNQM].

117. Gopal Sharma, *India Says Is Now Third Highest Carbon Emitter*, REUTERS (Oct. 4, 2010, 8:56 AM), https://www.reuters.com/article/us-india-climate-idUSTRE6932PE20101004 [https://perma.cc/P334-6XY4].

118. Natalie Obiko Pearson & Uni Krishnan, *India Tells Developed World It Will Impose More Cuts in Exchange for Cash, Technology*, BLOOMBERG BNA: ENERGY & CLIMATE REP. 1 (2015).

119. Singh & Upadhyay, *supra* note 109.

120. *See* Nat. Res. Def. Council, *6 Countries Leading the Way in the Global Renewable Energy Boom*, EcoWatch (Feb. 28. 2017, 9:51 AM), https://www.ecowatch.com/global-renewable-energy-2290268181.html [https://perma.cc/Y3R7-GPTB] (explaining that India is one of six countries identified as leading with renewable energy); SMALL POWER PURCHASE, *supra* note 38, at 53.

121. FERREY (WITH CABRAAL), *supra* note 38, at 119.

122. U.S. DEP'T COMMERCE & INT'L TRADE ADMIN., *Renewable Energy Market Assessment Report: Indonesia*, CREDONIX (Mar. 16, 2016), http://www.credonix.com/renewable-energy-market-assessment-report-indonesia/ [https://perma.cc/B64A-P8Q8].

123. *See Access to Electricity*, supra note 102.

124. *Id.*

Indonesia has thirty-three provinces within its federal government structure.[125] To supply power to dispersed islands, it can use isolated mini-grids, which can lend themselves well to the use of modular renewable energy and independent IPP or SPP development. Indonesia now has 600 mini-grids operated by PLN outside the main Java-Bali grid, where in such mini-grids,[126] PLN maintains and operates 4,700 diesel generators.[127] Indonesia currently ranks in the top thirteen in the world, as one of the highest emitters of greenhouse gases.[128]

To fill the gap between PLN's costs of operation and revenue from operations, the government of Indonesia provides PLN with an annual subsidy. In 2012, that subsidy cost was $10 billion; however, since 2013, Indonesia has taken several successful steps to reduce cost.[129] As long as a deficit exists, the utility is not capable of raising additional private capital to augment the electric supply system.

Indonesia designed one of the first renewable energy SPP PPA programs in Asia. Indonesia began developing its program in 1993, and rolled it out in 1996.[130] It involved a standardized PPA and tariff.[131] The SPP program was designed to supply up to one-third of national new power supply capacity additions from small, renewable sources, organized into four tiers of priority for projects of up to thirty MW in size on the primary islands of Java-Bali, and half that size on smaller island grids.[132] Indonesia's power system is comprised of several separate rather than interconnected island grid systems, as well as many isolated diesel systems. Different avoided-cost tariffs, and power requirements were addressed in those PPAs on a differentiated regional island basis.[133]

---

125. *Administrative Map of the Republic of Indonesia*, ONE WORLD—NATIONS ONLINE, https://www.nationsonline.org/oneworld/map/indonesia_admin_map.htm [https://perma.cc/RJQ7-LFD7].

126. *See* WORLD BANK GROUP, *Technical and Economic Assessment of Off-Grid, Mini-Grid and Grid Electrification Technologies: Annex 1. Detailed Technology Descriptions and Cost Assumptions* (Dec. 2007), made available at https://openknowledge.worldbank.org/handle/10986/17994 [https://perma.cc/B5FF-VHKJ].

127. *Id.*

128. *Each Country's Share of CO2 Emissions*, UNION CONCERNED SCIENTISTS, https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html [https://perma.cc/G7XN-VEHL].

129. Paul Burke, *Indonesia's Electricity Subsidy Reforms Led to Improved Efficiency*, CONVERSATION (Mar. 21, 2018, 6:59 AM), http://theconversation.com/indonesias-electricity-subsidy-reforms-led-to-improved-efficiency-93546 [https://perma.cc/H7ZX-WDTA].

130. FERREY (WITH CABRAAL), *supra* note 38, at 99–100.

131. *Id.* at 107–12.

132. *Id.* at 100–01.

133. *Id.* at 77.

Those successful projects accepted for Java-Bali in the initial 1996 auction ranged from 1.5 to 30 MW in size.[134] "In the five other [Indonesia island grid] regions that actually made award selections . . . the size ranged from 1.5 to 15 MW."[135] However, the 1997 Asian financial crisis suspended the chances for implementation of the original SPP PPA program in Indonesia.[136] It was cancelled in late 1998 during the Asian financial crisis and when the Indonesian Suharto government fell.[137]

Current law permits a standardized PPA, which PLN is required to provide under the law.[138] In the past few years, Indonesia has developed a PPA program for small solar, hydroelectric, and biomass renewable energy projects, which pays a FiT for power production from these projects.[139]

As in the original 1995 program design, there are separate FiT levels for renewable power depending on the SPP location.[140] There is a base FiT rate for SPP PPA output in the primary, least-cost PLN grid of Java-Bali.[141] For less populated islands, the FiT is a multiplier of the base Java-Bali tariff: the FiT is 120% of the base amount for projects located on the major island grids on the islands of Sumatra and Sulawesi (in fall 2018 suffering from an earthquake and tsunami, with 2000 dead and 5000 missing); the FiT is 130% of the base FiT for SPP PPA projects located on the island grids of Kalimantan and Malucca; the FiT is 150% of the base FiT for eligible SPP PPA projects located on island grids on the islands of Papua New Guinea, Timur, and Nusa Tenggara.[142]

---

134. *Id.* at 103.

135. *Id.*

136. *Id.* at 104.

137. *Id.*

138. *See* Mayer Brown, *Indonesia Briefing: Latest Changes in Energy Law (Part 1)*, LEXOLOGY (Feb. 20, 2017), https://www.lexology.com/library/detail.aspx?g=be3741cb-9b3b-45cd-b8eb-4d85b17a462a [https://perma.cc/8N6A-GWKH].

139. *See Solar Feed-in Tariff of Indonesia (2016)*, INT'L ENERGY AGENCY, https://www.iea.org/policiesandmeasures/pams/indonesia/name-162230-en.php? [https://perma.cc/NA8U-93MZ] (last modified Aug. 21, 2017).

140. *See* MATTHEW HALSTEAD ET AL., MITIGATION MOMENTUM, INDONESIAN FEED-IN TARIFFS: CHALLENGES & OPTIONS (2015), https://cdkn.org/wp-content/uploads/2015/04/ECN-Policy-Brief-Indonesian-Feed-in-tariff-140304.pdf [https://perma.cc/CNL2-F9L2]. *See generally* David Jacobs, *Introduction to Feed-in Tariffs*, RENEWABLE ENERGY FOCUS.COM (Oct. 19, 2010), http://www.renewableenergyfocus.com/view/13313/introduction-to-feed-in-tariffs/ [https://perma.cc/ZJE6-F9TB] (showing the differentiated tariff by geography and island reflects variable cost of service elements).

141. Jacobs, *supra* note 140.

142. *Id.*

Although set back by the Asian financial crisis and fall of its government two decades ago, Indonesia has rehabilitated some of the most important elements of its original PPA program to standardize PPA renewable energy development across very different islands.

E. *Vietnam*

The PPA model adapted for Vietnam raises the issue of how market-based renewable energy programs are integrated into a Communist form of government and centrally managed economy. Vietnam's electric demand is expected to continue growing until 2035 at a somewhat slower rate than its GDP, with electric demand rising as a base projection at 4.7% per year while GDP is forecast to rise at a base assumed rate of 7% per year.[143] Historically, Vietnam demand for electricity increased by 14.9% per year from 1996-2000, 15.3% from 2000-2005,[144] 14.5% from 2001-2010,[145] and total demand for energy increased 9.5% from 2000-2015.[146]

Like China, Vietnam has an abundance of fossil fuel resources that it could use for power generation, as well as ample renewable energy resources as an alternative.[147] Vietnam generates 36% of its power from coal now, and is on its way to 42% coal-fired power by 2030.[148] In terms of contribution to climate change, during 2015–2035, CO_2 emissions in the Vietnam power sector are expected to quickly increase to approximately 544.4 million tons of CO_2 in 2035, which is several times the 173.2 million tons of carbon emissions emitted by the energy sector in 2015.[149]

The potential for total sustainable renewable generation in Vietnam is significant. Vietnam's rivers provide a potential hydropower

143. DANISH ENERGY AGENCY, VIETNAM ENERGY OUTLOOK REPORT 26 tbl.1-7, 29 tbl.1-8 (2017), https://ens.dk/sites/ens.dk/files/Globalcooperation/Official_docs/Vietnam/vietnam-energy-outlook-report-2017-eng.pdf [https://perma.cc/Z4BK-UWRP].

144. Nhan Thanh Nguyen & Minh Ha-Duong, *The Potential for Mitigation of Co2 Emissions in Vietnam's Power Sector* 4 (2009), made available at https://halshs.archives-ouvertes.fr/halshs-00441085/document [https://perma.cc/8R9R-4P9K].

145. Nguyen Anh Tuan, A Case Study on Power Sector Restructuring in Vietnam, Pacific Energy Summit Papers 2–5 (2012), https://www.nbr.org/wp-content/uploads/pdfs/programs/PES_2012_summitpaper_Nguyen.pdf [https://perma.cc/3Q2F-2TBV].

146. *See* DANISH ENERGY AGENCY, *supra* note 143 at 2, 12–13 & tbl.1-1.

147. *Id.* at 26.

148. Somini Sengupta, *The World Needs to Quit Coal. Why Is It So Hard?*, N.Y. TIMES (Nov. 24, 2018), https://www.nytimes.com/2018/11/24/climate/coal-global-warming.html [https://perma.cc/MSS6-7PS7].

149. DANISH ENERGY AGENCY, *supra* note 143, at 49, 59 tbls.1-20 to -21; Nguyen & Ha-Duong, *supra* note 144, at 48 tbl.10; *see Improving the CDM*, *supra* note 40, at 80.

generation of 35 Gw, with an economical potential to develop of more than half of this physical potential, of 19–21 Gw.[150] Unlike in many developing countries, in Vietnam there is a central high voltage transmission grid running the length of the country, reaching all 64 Vietnam provinces, 96% of the districts within the provinces, 78% of the communes, and 69% of the households.[151] This allows power to generation to be moved from one part of the country to a different part—such as hydropower from the less populated hills to the more populated large cities—through this central grid.

A series of regulatory reforms were enacted to make renewable energy information more transparent and to make the renewable power market more competitive and transparent to new independent entrants under the PPA model.[152] The power sector was dominated and administered by the state utility, Electricity de Vietnam (EVN).[153] To develop renewable energy, in 2009 Vietnam adopted its Non-Negotiable Standardized Power Purchase Agreement (NSPPA)[154] program to use market and other incentives to attract small renewable power producers to one of the most centrally planned and managed economies in the world. A significant barrier to international private sector participation in its NSPPA program is state bureaucracy and many layers of necessary approvals for land-use licenses to construct and to generate power. Consultant reports for the Ministry of Industry and Trade highlight the complex approval process to form a company allowed to conduct business or successfully complete a small renewable power project in Vietnam in comparison to other countries.[155] Vietnam is distinct from other countries surveyed above because of the many complex regulatory

150. *Vietnam*, INT'L HYDROPOWER ASS'N, https://www.hydropower.org/country-profiles/vietnam [https://perma.cc/EV8F-RLM5] (last updated Aug. 2014). *See generally Focus Regions of Operations*, REPDC GREEN, http://repdc-green.com/project-locations-from-the-investment-proposal/ [https://perma.cc/79AQ-F2VV].

151. FERREY (WITH CABRAAL), *supra* note 38, at 159.

152. Anh Tuan, *supra* note 145, at 4–14 (describing Vietnam power sector restructuring process from 2003 to 2010).

153. *Id.*

154. JOHN TRAN ET AL., VIET. MINISTRY INDUS. & TRADE, 2 WIND POWER INVESTMENT GUIDELINES: WIND POWER FINANCING IN VIETNAM 77, 79 (2016), https://www.giz.de/fachexpertise/downloads/giz2016-en-vietnam-wind-guidelines-financing.pdf [https://perma.cc/GER3-9NLC].

155. *See generally* STEVEN FERREY & ROBERT VERNSTROM, RESPP PLANNING AND PREPARATION: FINAL REPORT (2005) (identifying barriers to different enterprises operating in the energy sector in Vietnam); Anh Tuan, *supra* note 145, at 2–5 (making it burdensome for a non-state-affiliated company to obtain necessary permissions and approvals).

and economic factors identified.[156] Consultant reports identified the institutional impediments and needs for a viable SPP market in Vietnam.[157]

In 2017, Vietnam issued a directive to support a solar development program centered on, for the first time, allowing net metering of roof-top solar power generation.[158] Excess net metered power can earn payment of $0.091/kwh, indexed to the U.S. dollar, which is above some levels of the retail power tariff.[159] This net metering solar program is only in place for the duration of eighteen months, but can be extended.[160] What will happen to net metered facilities following the eighteen month program—as well as other details of the new Vietnam solar program—is yet to be determined.

IV. MIDDLE-OUT CLIMATE/ENERGY LESSON

There is a proven PPA regulatory model demonstrated to work for new renewable power in developing nations. The five Asian nations and six states discussed have different forms of government and different predominant fuel sources in their generation base (hydro, coal, gas, and oil). The key legal document to facilitate private sector renewable power development is a fair and neutral power purchase agreement which obligates the utility to purchase independently produced renewable power at a fair price. Both an initial avoided-cost or alternative PPA tariff concept and a standardized power purchase agreement were utilized initially in most successful SPP and renewable energy program models in each of the developing nations profiled above.[161] Even where developing nations have different forms of governance and have different predominant fuel sources in their power generation bases, there

156. FERREY & VERNSTROM, *supra* note 155, at 17–22 (explaining that it can be more difficult to get information about potential best hydro or other renewable energy development sites, to obtain environmental approval for those sites, and to obtain necessary licenses and approvals).

157. *Id.*; Anh Tuan, *supra* note 145, at 17–20.

158. *See* Emiliano Bellini, *Vietnam Releases FIT and Net Metering Scheme for Solar*, PV MAGAZINE (Apr. 19, 2017), https://www.pv-magazine.com/2017/04/19/vietnam-releases-fit-and-net-metering-scheme-for-solar/ [https://perma.cc/4ECE-LW24].

159. *See id.*

160. FED. MINISTRY FOR ECON. AFFAIRS & ENERGY, SUBSECTOR ANALYSIS: VIETNAM: SOLAR PV ROOFTOP INVESTMENT OPPORTUNITIES IN VIETNAM 18 (2016), https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Marktanalysen/2016/studie_2016_subsector-vietnam-solar.pdf?__blob=publicationFile&v=3 [https://perma.cc/GW4J-KS2A].

161. *See* FERREY (WITH CABRAAL), *supra* note 38, at 185 (concluding that the standardized PPA and avoided cost or similar tariff for the PPA were common to all five nation renewable energy programs surveyed).

are common principles for successful small renewable energy programs revealed from the experience to date.[162] These principles include:

- Transparent Regulatory Process: A transparent regulatory process is required.
- Standardized PPA: All programs employ either *de jure* or *de facto* standardized PPAs for contracts.
- Legal Dispute Resolution Mechanism: A legal framework for fair and prompt resolution of disputes.
- Allocation of Legal Risks: Commercial, sovereign, currency, and regulatory risks allocation sector.
- Interconnection Requirements: Straightforward interconnection with the utility grid for SPP projects.
- Legal Milestones and Bid Security: To eliminate the speculative risk of slow or non-development.
- Tariff Principles: Fair tariffs at least at avoided-cost.
- Renewable Set-Aside: Optional in certain countries.
- Third-Party Sales from the power generator to other retail customers.
- Net Metering and Energy Banking: Energy banking, which is in more than 75% of states in the United States.[163]

There has been a big change in the economics of renewable wind and solar photovoltaic (PV) distributed generation. "PV module prices have experienced a . . . decline from [approximately] $1.90 [per] watt in 2009 to $0.70 [per] watt (and below in some regions of the world)."[164] The current price has been half of this $0.70/watt value. "Since 2008, the price of the photovoltaic (PV) panels . . . has fallen by 75%, and solar installations have multiplied tenfold."[165] Prices for inverters, the essential equipment that is necessary to convert PV direct current power

162. SMALL POWER PURCHASE, *supra* note 38, at 11–14 (providing principles, and details of those principles, for these programs).

163. *Id.*; Steven Ferrey, *Net Legal Power*, 53 SAN DIEGO L. REV. 221, 223 n.2 (2016) (explaining that while the number of participating states has fluctuated throughout the years, forty-four states had net metering programs approximately three years ago and thirty-eight states have net-metering today); Steven Ferrey, *Nothing but Net: Renewable Energy and the Environment,* MidAmerican *Legal Fictions, and Supremacy Doctrine*, 14 DUKE ENVTL. L. & POL'Y F. 1, 52–65 (2003) (same).

164. WILSON RICKERSON, INT'L ENERGY AGENCY, RESIDENTIAL PROSUMERS—DRIVERS AND POLICY OPTIONS (RE-PROSUMERS) 9 (2014), http://iea-retd.org/wp-content/uploads/2014/06/RE-PROSUMERS_IEA-RETD_2014.pdf [https://perma.cc/WQW6-XQWQ] (citing Jade Jones, *Regional PV Module Pricing Dynamics: What You Need to Know*, GREENTECH MEDIA (Nov. 22, 2013), http://www.greentechmedia.com/articles/read/regional-pv-module-pricing-dynamics-what-you-need-to-know [https://perma.cc/8P2F-FCL9]).

165. Ker Than, *As Solar Power Grows, Dispute Flares over U.S. Utility Bills*, NAT'L GEOGRAPHIC (Dec. 25, 2013), http://news.nationalgeographic.com/news/energy/2013/12/131226-utilities-dispute-net-metering-for-solar/ [https://perma.cc/9DVP-MM6S].

to alternating current power that can be moved over utility transmission lines in world nations, have decreased by more than 60% in cost from $0.60 to $1.00 or more per watt of capacity as of 2005 to less than $0.20 per watt of capacity in 2013.[166]

The United Nations forecasts the seriousness of coming "tipping points that are irreversible within the time span of our current civilization."[167] To avoid this precipice, "the electric power sector offered the most cost-effective opportunities to reduce CO_2 emissions, compared to the transportation sector" and other sectors of the world economy.[168] The IEA notes that the "$44 trillion in additional investment [is] needed to decarbonize the energy system in line with . . . [the IEA's 2º scenario]"[169] by 2050 for temperature increase is more than offset by over $115 trillion in resultant fuel savings, and in net savings of $71 trillion.[170] There will be huge differences in Anthropocenic ecosystem damage if world temperature gains are not held to 1.5ºC rather than 2ºC.[171] Such difference in damages to the ecosystem include:

- 260% greater temperature gain;
- 1,000% increase of summers with no Arctic ice;
- 230% decline in tropical crop yields; and
- 200% greater loss of animal and crop species.[172]

The impact is significant at the margin. Economically, a successful path to less climate change and renewable energy investments that leverages power access is within reach. Meeting the increasing demands

166. RICKERSON, *supra* note 164 (citation omitted) (citing Ian Clover, *IHS Cuts Global Inverter Market Forecast in Face of Dramatic Price Drops*, PV MAGAZINE (Oct. 16, 2013), http://www.pv-magazine.com/news/details/beitrag/ihs-cuts-global-inverter-market-forecast-in-face-of-dramatic-price-drops_100013052/#axzz3o7isum1t [https://perma.cc/6587-UJ7Y]).

167. *New Science and Developments in Our Changing Environment*, 2009 UNEP Y.B. 53, U.N. Doc. UNEP/GC.25/INF/2, http://wedocs.unep.org/bitstream/handle/20.500.11822/7759/840%20-%20english.pdf?sequence=8&isAllowed=y.

168. *See* GLOBAL WARMING TOOLBOX, *supra* note 26, at 29.

169. INT'L ENERGY AGENCY, ENERGY TECHNOLOGY PERSPECTIVES 2014: HARNESSING ELECTRICITY'S POTENTIAL 2, 8 (2014).

170. *Id.* at 8 ("Even with a 10% discount rate, the net savings are more than USD 5 trillion.").

171. *See* Kelly Levin, *Half a Degree and a World Apart: The Difference in Climate Impacts Between 1.5˚C and 2˚C of Warming*, WORLD RESOURCES INST. (Oct. 7, 2018), https://www.wri.org/blog/2018/10/half-degree-and-world-apart-difference-climate-impacts-between-15-c-and-2-c-warming [https://perma.cc/6KBM-9XKZ].

172. *See id.*

of energy investment requires direct foreign investment.[173] "Richer nations need to provide $400 billion to $2 trillion a year to the developing world by 2050 to help cut greenhouse gases and fight climate change, according to [a] study by . . . the London School of Economics."[174] This would be four to twenty times the annual level pledged for developing countries to begin by 2020, and these pledged sums still need to be raised and donated.[175]

All nations of the world must be in the climate battle together. Even if all developed countries could achieve a Herculean reduction of 80% of their CO_2 emissions by 2050, this would not achieve Kyoto Protocol or 2015 Paris Agreement climate change goals unless immediately and comprehensively, the approximately 80% of world countries that are developing countries are motivated to join in vigorous GHG emission reduction.[176] By setting climate change emission reductions for only 37 of the 197 world countries that signed the Kyoto Protocol, restrictions on those Kyoto Annex I developed countries affected less than 20% of all countries, and Annex I countries collectively emit much less than half of world carbon emissions.[177] Affecting even substantially less than half, and not effectively addressing the largest nations with dramatic projected increases in GHG emissions over the next two decades is not enough to achieve a global imperative.

Even with the solution demonstration, business-as-usual does not change easily. As documented in a late 2018 *New York Times* article, Asia already accounts for three-quarters of all world coal consumption and more than three-quarters of all coal-fired plants, numbering more than one thousand, now under construction or planned.[178] The Asian

173. Doak Bishop et al., *The Breadth and Complexity of the International Energy Industry*, *in* THE GUIDE TO ENERGY ARBITRATIONS 11, 12 (J. William Rowley QC et al. eds., 2d ed. 2017).

174. Alex Morales, *At Least $400 Billion in Climate Aid Needed for Developing Nations a Year, Study Says*, BLOOMBERG ENV'T: ENERGY & CLIMATE REP. (Mar. 17, 2015, 12:00 AM), https://www.bloomberglaw.com/document/XA9FHB7C000000?bna_news_filter=environment-and-energy&jcsearch=BNA%252000000016071d7dc0fa5f0f3ffab1b0000#jcite.

175. *See How We Work*, GREEN CLIMATE FUND, https://www.greenclimate.fund/how-we-work/resource-mobilization [https://perma.cc/XFW5-BUQ8] (showing that as of March 2019, $10.2 billion had been legally committed to the Green Climate Fund, with another $0.1 billion pledged).

176. El-Ashry, *supra* note 18.

177. *See The Kyoto Protocol—Status of Ratification*, *supra* note 19 (requiring only GHG emission reductions of 37 developed Annex I countries of the 197 countries that endorsed it, which is less than 20% of these countries, with no mandatory reduction or enforcement mechanism); *The Paris Agreement*, *supra* note 19.

178. Sengupta, *supra* note 148.

countries highlighted in this article, are among the core coal-developing countries in the present:

- China consumes half the world's total coal, while adding 40% of its current coal capacity since 2002, well after ratification of the Kyoto Protocol.
- China is exporting its coal-burning technology for profit, building coal plants in 17 other countries.
- India power generation is 58% coal and totally invested in coal, building 50 more Gw under construction.
- Vietnam is advancing from 36% coal power now to 42% by 2030.
- Despite abundant untapped hydro and solar power, Indonesia is developing more coal-fired power.[179]

There is now an additional international incentive to finance small renewable power programs. A few developed countries have committed to the largest sustained international transfer of wealth in history: a commitment of an additional U.S. $100 billion/year of foreign aid continuing indefinitely for the explicit purpose of dealing with global warming risk.[180] For this to be effective, both developed country funders and developing country recipients, must control climate change through a middle-out international protocol, which will ensure the most beneficial and effective expenditure of funds.[181] What remains as the critical missing legal piece is to adapt and change the power sector laws in those 80% of world countries that will cause perhaps 80% of future world power production growth and GHG emissions in the critical next decade. This can be done.

The now proven middle-out model that must be implemented is the model that the Author and other colleagues first premiered in Indonesia in the early and mid-1990s. Since then it has been adapted in a notable number of Asian, African, and Latin American countries, which:

- Liberate restrictions on decentralized power without diminishing or altering any of the country utility's plans for power development;
- Activate economic "middle" sector forces;
- Unleash viable private power sector "actors";

179. *Id.*

180. *See* U.N. Secretary-General, *Report of the Secretary General's High-Level Advisory Group on Climate Change on Financing*, 2 (Nov. 5, 2010).

181. *See* Steven Ferrey, *The Green Climate Fund, International Governance, and Climate Justice in Developing Nations*, *in* CLIMATE JUSTICE: CASE STUDIES IN GLOBAL AND REGIONAL GOVERNANCE CHALLENGES 49, 49–53 (Randall S. Abate ed., 2016).

- Allow surplus power to be sold to the utility under a long-term PPA contract;
- Establish a fair, neutral price for the power;
- Attract international private capital; and
- Create a "win-win" outcome for the country.

This middle-out model recognizes and takes advantage of economic market forces to exploit cost-effectively the most appropriate decentralized, small, renewable, power sources for a particular nation. Effectively mitigating climate change is not a matter of awaiting new technology to be developed; the technology exists, is proven in many different countries, and the cost of renewable power now is falling dramatically. The issue is one of adapting existing law and regulations in many different countries to attract and deploy international capital to develop renewable energy, where the local utility in many developing countries lacks financial surpluses or resources to undertake this role. To effectively control accelerating Anthropocenic climate change in time, the issue is one of law and smart energy regulation implemented in developing and developed countries.