RENEWABLE ENERGY: THE GREAT LEVELER?

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Abstract

While trade liberalization has advanced considerably since post-WWII, emerging economies have disproportionately borne the brunt of trade inequities. However, with a growing consensus that the world must quickly and collectively combat the threat of climate change, certain unexpected phenomena in trade relations are occurring. More developed economies are experiencing a wave of nationalism and self-imposed isolation, jeopardizing the very existence of regional trading blocs and agreements and weakening the World Trade Organization's (WTO) centralist position in market liberalization (Donnan, 2016). However, as technological innovations transform clean energy into a thriving export-import item, emerging economies are discovering a new place in the world market – and buttressing the efficacy of the WTO in the process. Fossil fuel gluts and shortages, catastrophic oil spills, poisonous methane leaks, and fracking-based earthquakes have created an existential threat, eclipsed only by the grim peril of nuclear annihilation. But clean energy development, storage, and distribution have experienced significant breakthroughs. With more affordable materials, subsidized infrastructure networking, advantageous topographies, and coveted mineral deposits, historically-colonized least developed countries (LDCs)[1] may be on track to become formidable trading partners, generating revenue for their own nation-states while assuming greater leadership parity in the universal quest to de-carbonize the global economy. And with the widespread acknowledgement of planetary degradation and species extinction, 195 countries – representing developed, developing, and least developed economies alike – successfully negotiated the 2015 Paris Agreement to address greenhouse gas (GHG) emissions mitigation and adaptation (UNFCCC, 2015). Using endemic resources to generate clean energy will not only help participating countries attain their Agreement pledges, but emerging economies may now have a prime opportunity to actively participate in the global marketplace.

Introduction

The two most daunting obstacles of producing clean, renewable energy in the past have been the cost of manufacturing and the ability to store the excess. Within the last decade, however, two phenomena have occurred: (1) clean energy generation and storage technologies have rapidly advanced; and (2) the cost of installing renewable projects has declined sharply. With natural resources available to use in the manufacture of clean energy, LDCs are now emerging as new world leaders in this field. Former colonies of Western European powers, many of these nation-states – the majority located in Central and South America and throughout Africa – are now entering into clean energy agreements with more advanced economies, including their former colonizers. And they possess a unique advantage as many are leapfrogging over the Industrial Revolution and are somewhat evading the resulting consequences of fossil-fuel dependence and widespread pollution. Jumping from an absence of landlines to the proliferation of cell phones,

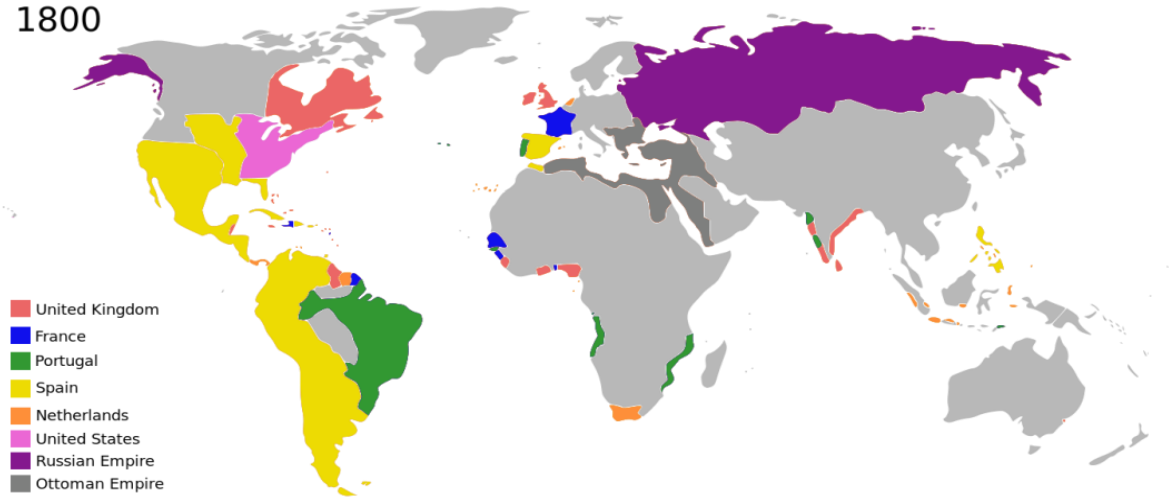
[1] WTO member nations are officially categorized as "least developed" according to the United Nations classification system to be distinguished from "developing countries" – a more generalized, self-described term in world trade.

and from frequent blackouts (and even little to no electricity capacity) to the erection of renewable-energy supported microgrids, many LDCs are largely pursuing the possibilities of meaningful world trade through clean energy development.

Predecessor Nations and the Evolution of South-South Trade

From an era dating back to the 1500s up through the middle of the 20th century, world trade was largely dominated by several Western European countries, namely, Spain, the Kingdom of England (and its successor Great Britain), the Netherlands, Portugal, and France (Rockman & Steele, 2003). These nations often transferred control of these conquered or settled lands among themselves, often as a result of armed conflict (Kohn, 2014). The Portuguese had a dominant hold over the African nations of modern-day Mozambique and Angola and its largest colony in the Western Hemisphere, Brazil; the Spanish had conquered Mexico, Central America, and most of the remainder of the South American continent (*Figure 1*); the British had maintained sovereignty over many of the Caribbean Basin islands, India, Australia, Tanzania, New Zealand,

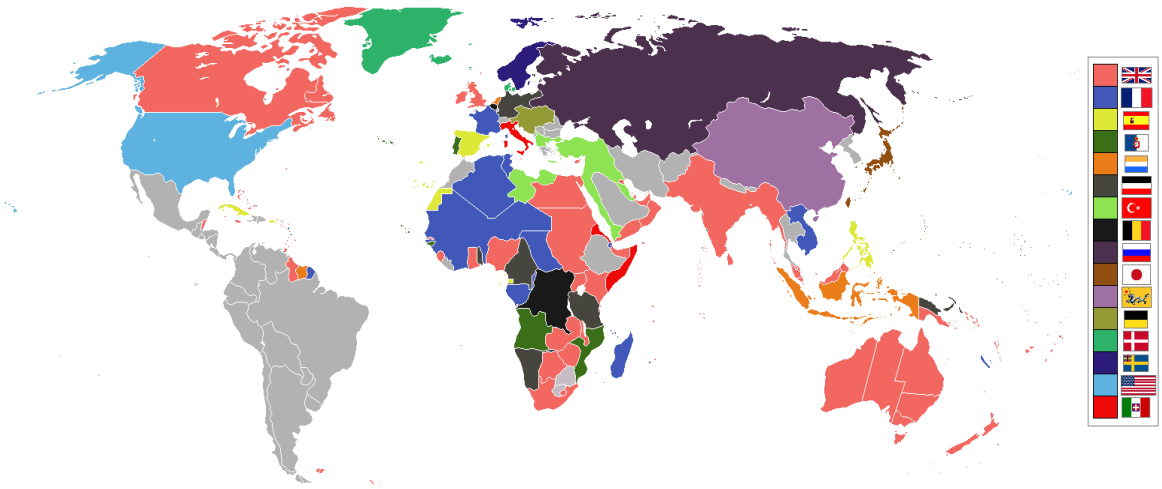
Figure 1: World colonization by 1800 (Tsiagalakis & JLUISRS) (https://commons.wikimedia.org/w/index.php?curid=36549464).



as well as South Africa, Sudan, Ghana, Kenya, and Tanzania; the French asserted rule over Morocco, Niger, Nigeria, Mali, Mauritania, Madagascar, and Rwanda; and The Netherlands – primarily through its East and West Dutch India Companies – exerted its rule over much of Indonesia as well as narrow coastal regions in Brazil and South Africa (Memmi, 1991).

The colonization of the Americas, Asia (including Oceania), and Africa (*Figure 2*) – gained either through settler migration or direct commercial control and imperialistic rule – forestalled any notion of national self-definition, self-governance, and sovereignty (Kohn, 2014). During this period of economic and political control, Western colonizers exploited both indigenous peoples and their natural resources while forging key trade routes with minimal infrastructure spending. Local populations were expelled, enslaved, or killed and resources such as mineral deposits, raw materials, pelts, lumber, rubber, ivory, precious stones, and agricultural products were confiscated and placed into the stream of cross-border trade with little to no benefits inuring to native peoples (Hoogvelt, 2001). Global trade thus had its inauspicious beginnings

Figure 2: World colonization by 1898 (https://commons.wikimedia.org/w/index.php?curid=852320



rooted in oppression, as it was a forced activity waged by vanquishers over conquered peoples.

The decolonization of these areas – Central and South America during the 1800s with much of the African continent achieving piecemeal independence post-WW II – left new sovereign states in a political vacuum, devoid of the infrastructure, technical expertise, and capital required to enter the global market as formidable players (Adelman, 2011). The territories that had made their colonizers wealthy had been left with sectarian rule, cultural degradation, and shattered economies. Furthermore, as protective tariffs were removed, these fledgling states quickly became exporters of raw materials and importers of manufactured goods (Kohn, 2014). This economic dependency, premised upon an import-export relationship, has been a theory used to explain post-colonial relations, especially with respect to African nations. While local villagers gather raw materials for trade to Europe, direct business relationships with the importing countries were not formally established. Rather, trading companies served as the middlemen – working to keep prices artificially low while inflating the costs of imported, finished goods (Ferraro, 2008). Additionally, agriculture and mineral yields continued to be achieved through threats of property loss, torture, and death (Sangeeta, 2005). Thus, in the post-colonial era, emerging economies had become the victims of dumped goods, exploited labor pools, and massive environmental degradation – well beyond political independence (Srinivasan, 1996). Western Europeans had left a nefarious, indelible mark not only on the local populations but upon trading avenues – even decades after decolonization. In the modern, post-colonial period, former subjugated nations – especially with respect to their more distant, rural regions – are still experiencing asymmetric economic relationships despite political independence. However, with newfound uses of local resources, coupled with renewable energy component manufacturing, generation, and storage capabilities, these former colonies may finally be on a path to stable international trade and successful democratization (Draper, 2013).

Since the turn of the century, the exchange of knowledge, technology, investment, and goods between emerging economies began to materialize and eventually became known as *South-South Trade* or *South-South Cooperation* (SSC) (Draper, 2013). This interaction led to the formation of alliances and the infusion of capital investment empowering formally colonized countries to take ownership and direct command of their own economic development. Throughout the last several decades, SSC has steadily consolidated member-nation influence by spearheading the technological transfer of systems and processes to where 40% of global trade today emanates

from the Global South (UN Office for South-South Cooperation, 2016).[2] This post-colonial transition has signaled a shift in the international balance of power and has significantly come to impact global economic discourse.

Influence of GATT/WTO

After WWII, tariffs were high worldwide. Within the next half a century, wealthy nations, primarily driven by North America and Western Europe liberalized trade through the establishment of the General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Organization (WTO) (Baldwin, 2006).[3] Regional Trade Agreements (RTAs) and Free Trade Agreements (FTAs) provided the forum for the liberalization of trade, opened new markets, and governed international commerce. The rules of freer trade, however, were often created at the instruction of the same Western European colonizers (with the addition of the United States and Japan) (Ashcroft, 1995).[4] While tariffs were greatly reduced among GATT member nations, those reductions were almost exclusively applied to technical, manufactured goods – leaving local protectionism in place for agricultural goods and textiles – at least in these developed economies (Sangeeta, 2005).

By the 1960s, many former colonized states were either newly-independent or in the process of casting off colonial rule. However, there was no significant trading activity within or between Latin American, African, and Asian countries during this time. Thus, they played little part in post-war tariff liberalization until the 2000s. What prior agreements had been loosely signed were subsequently ignored or had *de minimus* effect on the world stage (Baldwin, 2006). This pattern went wholly undisturbed until the turn of the century: first, with the emergence of China[5] as a predominant player in the world market (together with substantial intra-Asian trading activity), followed by Central and South American nations, and more recently, African countries.

From the beginning of the GATT, emerging economies had been given waivers or transitory periods to adapt to comprehensive tariff reduction, policy adjustment, and adherence to later WTO rules governing the protection of Intellectual Property Rights (IPRs).[6] Most-Favored Nation (MFN) status – which was geared toward reducing or eliminating tariffs on particular goods – together with national treatment, trade reciprocity, rule and regulation transparency, and comprehensive non-discrimination status had given LDCs, at least theoretically, a stake in WTO's economic rounds. The special treatment afforded to LDCs was underscored by GATT's Enabling Clause (*Decision on Differential and More Favourable Treatment, Reciprocity and Fuller Participation of Developing Countries*),[7] which expressly states that preferential treatment was to be given to, and exchanged among, developing countries, subject to stated conditions (WTO Secretariat, 1979). Such duality in foreign trade development was to continue as a resonant theme throughout subsequent economic rounds, especially during the Uruguay and Doha Rounds, up to modern-day trading.

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[2] A unit created within the United Nations Development Programme (UNEP) for the express purpose of promoting, coordinating, and supporting South-South trade and development within the United Nations system.

[3] For example, by the mid-1960s, the European Economic Community (EEC) was firmly established and the seeds of NAFTA had been planted.

[4] Often described as "neocolonialism" – a theory which refers to previous or existing economic relationships created by former colonial powers used to continue control of their former colonies even after the succession of post–World War II colonial independence movements.

[5] Entered the WTO in 2001 with an initial probationary term of 15 years.

[6] *See* Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS).

[7] Added 28 November 1979.

***Uruguay Round* (1987-1994)**

The Uruguay Round, which gave birth to the WTO as a formally-recognized intergovernmental organization, produced an agreement which incorporated – and augmented – this special treatment of LDCs and developing nations in general. Several of the Articles explicitly address this recurring theme:

> *LDCs are to be given substantially increased technical assistance to develop, strengthen and diversify their product and export bases (including services), as well as their trade promotion efforts* [Para. 2(v)].
>
> *Developed country members shall provide incentives to enterprises and institutions within their own territories to help promote the transfer of technology to LDCs* [Article 66:2].
>
> *Developed countries are to provide, upon request and on mutually agreed terms and conditions, technical and financial cooperation in favour of developing country members, and LDCs [Article 67]*. (WTO Guide to the Uruguay Round, 1999).

***Doha Round* (2001-)**

By the time the Doha Round negotiations began in 2001, many countries in Africa and Latin America had experienced lost decades in growth and development and were mired in debt, structural deficiencies, corrupt governance, armed conflicts, and chronic economic problems. The International Monetary Fund/World Bank's lending programs – with its myriad conditions – and the WTO's asymmetric trading systems have been blamed for development stagnation in these emerging economies. Moreover, the WTO's ability to correct inconsistencies has been eroding in an era of increasingly partisan and nationalistic trade agreements.[8] And as these trade negotiations have begun to incorporate more stringent environmental and labor standards, polarization along party lines has severely compromised the feasibility of successfully achieving, implementing, and/or continuing mega-regional agreements.[9]

The Geopolitics of the Modern Global Trading System

It is become universally recognized that GATT/WTO's centrality has stagnated since 2000. In sharp contrast to the 20th-century experience, regionalism and unilateralism are functioning as vehicles of liberalization while multilateralism is not. The mega RTAs – even if they did succeed – cannot ensure a harmonized global trade and investment regime nor provide an effective global enforcement tool like the WTO's dispute resolution mechanism. The influence of developing economies would ostensibly be marginalized, and those countries excluded from such RTAs would be sidelined and face further discrimination. It has become imperative that the world trade system warrants reform to enhance the interests of developing countries and to shore up the WTO's position in guiding global trade.

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[8] In the United States, for example, when trade agreements have been primarily focused on removing border barriers, politicians from import-competing states have tended to oppose them, while those from nations with strong export industries have been more inclined to favor them.

[9] Examples include the Trans-Pacific Partnership (TPP) and the United Kingdom's planned withdrawal from the EU, more commonly known as "Brexit." The TPP was originally comprised of 12 countries bordering the Pacific Ocean and included Chile, Peru, Vietnam, Malaysia, Canada, Mexico, and the US. This nascent formation represented approximately 40% of the world's economic output. It suffered substantial organizational setbacks after President Donald Trump withdrew the US from its fold in January, 2017 (TPP: What is it and why does it Matter? (23 Jan. 2017). *BBCNews*, Retrieved 30 April 30, 2017 from http://www.bbc.com/news/business-32498715). "Brexit" occurred as a result of a public referendum in June of 2016.

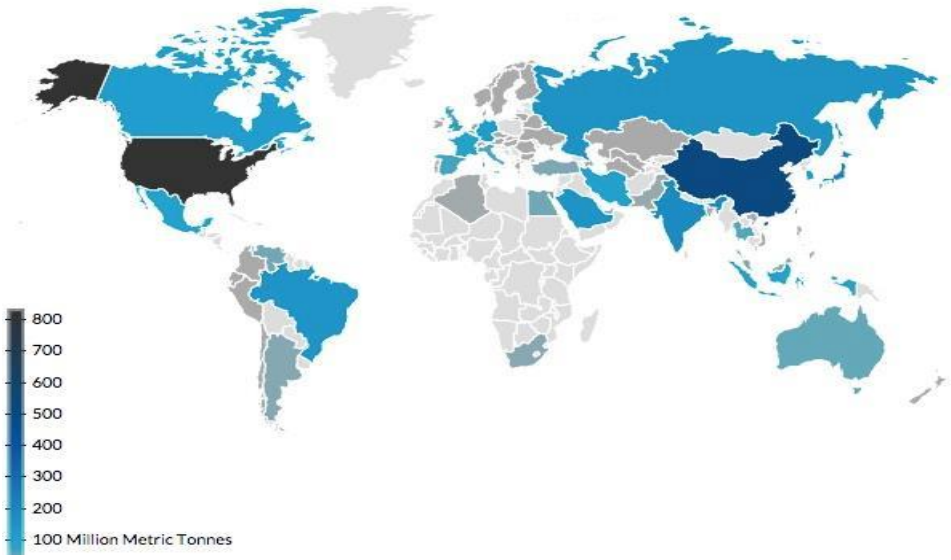
The nature of trade, however, has become radically more complex and interlinked with the internationalization of production networks. As economic growth and market competitiveness are directly shaped by international trade and investment, shifting politics, the rise of populist movements, and environmental degradation, the continued globalization of trade is in question (Donnan, 2017). However, the direction of foreign investment and trade might just be propelled by some unlikely players – LDCs – primarily due to increased demand for energy for rapidly increasing populations, attention to climate change, technological breakthroughs in clean energy generation and storage, and new opportunities to tap into local resources. Economic growth – generated through pragmatic governmental policies to create skills and linkages to global markets through trade, public-private investment, and recent technological breakthroughs – has presented developing countries unprecedented foreign market access through the development of clean, renewable forms of energy.

Climate Change and the Worldwide Demand for Clean Energy

Many LDCs, having been under involuntary tutelage of larger sovereign powers, ironically find themselves the greatest victims of climate change – largely due to the consumption practices of wealthier nations. Researchers and intergovernmental agencies have classified "more than 10% of countries as 'free riders,' ranking in the top fifth in terms of emissions and the bottom 20% in terms of vulnerability. These countries include the United States, much of Europe and Australia" (Worland, 2017). Moreover, they face the collective challenge of controlling greenhouse gas (GHG) emissions while reducing dependence on foreign sources of energy, growing their respective economies, and solidifying national security interests. Sound moral and financial government governance and incentives are ostensibly imperative. Thus, the sustainable use of a nation's resources to satisfy a rising demand for energy without causing further environmental degradation is the optimal goal. Achieving this objective in abundance – i.e., producing an excess of clean energy for subsequent storage and transportation for the global market – is becoming more than a vision; it has transcended into a working reality for many governments, particularly those of LDCs, while leaving some of the wealthiest nations behind.

***Geopolitical Power Shift*:** The world market responds to supply and demand and is currently facing an unprecedented catastrophe: CO_2 levels are greater than the last 800,000 years according to the World Data Center for Paleoclimatology, National Oceanic, and Atmospheric Administration (NOAA). Already, over 1.2 billion people out of a world population of 7.3 billion completely lack access to electrical power (*World Bank Group Report*, 2016). The more traditional and centralized grids are cost prohibitive, even to furnish power to underserved populations on a consistent basis while energy consumption is soaring in the developed countries, with the United States, much of Europe, and China carrying the dubious distinction of biggest consumers and polluters (Worland, 2017). Developing and least developed nations, especially with growing populations and rising urban growth, are in line to emulate such levels of consumerism and construction (*Figure 3*). Thus, the geopolitics of wealth distribution has historically kept those ruled in a depressed state while being the unfortunate recipients of the consequences of excess of the wealthy.

***Figure 3*: BP Statistical Review of World Energy Consumption (2015)**



But a shift may be nearing. There is a pressing need for clean energy storage as the technologies used to produce renewable energy (wind, solar, geothermal, hydro, and biomass) are taking root in almost all regions of the world and the cost of manufacturing has dropped significantly:

Developed Countries: It is estimated that energy storage will increase 40-fold in developed countries alone, with storage capacity increasing from 2 gigawatts (GW) currently to more than 80GW in less than a decade (*World Bank Group Report*, 2016). Scientists predict that about 378.1 GW of new wind and solar-generating capacity will be installed worldwide over the next 5 years (Mearian, 23 January 2017). To accomplish this, however, will necessitate reliable and robust trade relationships. This might not be readily achievable, however, as the traditional proponents of tariff reduction and universal MFN status may currently be victims of their own sectarian political infighting and entrenched fossil fuel interests. For example, while the current US administration had previously decried the outright existence of the *North American Free Trade Agreement* (NAFTA) and threatened to impose import taxes on its NAFTA neighbors,[10] global trade agreements continue to develop elsewhere. And as the United States continues to threaten to pull out of the Paris Climate Change Agreement, China has methodically signed clean energy deals with Latin American countries, forging lucrative partnerships (Halper, 2017).

***Developing Countries*:** The colloquial *BRICS* nations (Brazil, Russia, India, China, and South Africa) have taken notice of the rising potential of LDCs in world trade. PriceWaterhouse-Coopers reports that in 2015, clean energy deals nearly tripled in Latin America as a result of growing energy needs and stabilizing national policies. These transactions represent the highest growth rate in the world at an estimated 7.6 billion USD and are the result of outright asset purchases,[11] mergers and acquisitions, and public-private financing – largely driven by Chinese

[10] On April 27, 2017, President Donald Trump announced that NAFTA would not be purged after all, but certain deals renegotiated in the future (*National Public Radio* - US).

[11] For example, with the Brazilian economy in serious distress, sale of certain assets like the $3.7 billion purchase by China Three Gorges Corp. of the Jupia and Ilha Solteira hydropower plant have been appealing to foreign buyers (PwC, 2017).

buyers (Dezem, 2016). Wind, solar, and biogas projects are also being partially subsidized by China and countries such as Uruguay, Chile, Mexico, and Costa Rica are all heavily engaged in fossil-free energy development – typically in partnership with both developed and developing foreign economies.

Least Developed Countries: Emerging markets, particularly in South-South trade, are beginning to realize the untapped potential of some of the harshest climates and untillable topography in the world – for clean energy development. In 2008-2009, low energy prices undermined global, renewable energy investment. But the precipitous drop in clean energy costs over the last several years may have actually helped the industry remain competitive. In fact, renewable energy has already become cost-competitive in some markets where legislators have implemented pragmatic, effective policies. Uruguay is a leading example where its government has implemented reverse power auctions to facilitate power purchasing agreements for a certain capacity of renewable energy. This process has encouraged developers to bid the lowest price per unit of electricity (*Latin America and the Caribbean Report*, 2017). Determining which forms of renewable energy to develop may begin with a simple investigation into which regions of the world have abundant exposure to wind, sun, geothermal capacity, biogas, water flow, and certain mineral deposits. Tapping into and working with a country's natural topographic characteristics may prove to be universally beneficial. For example, *Figure 4* shows the varying levels of irradiation throughout the world, indicating, with assumed accessibility to those areas, the optimal places to harness solar power. The most intensive areas of exposure include many LDCs – especially in the Global South. Several of these countries and their current status in all forms of clean energy development are discussed, in more particularity, below.

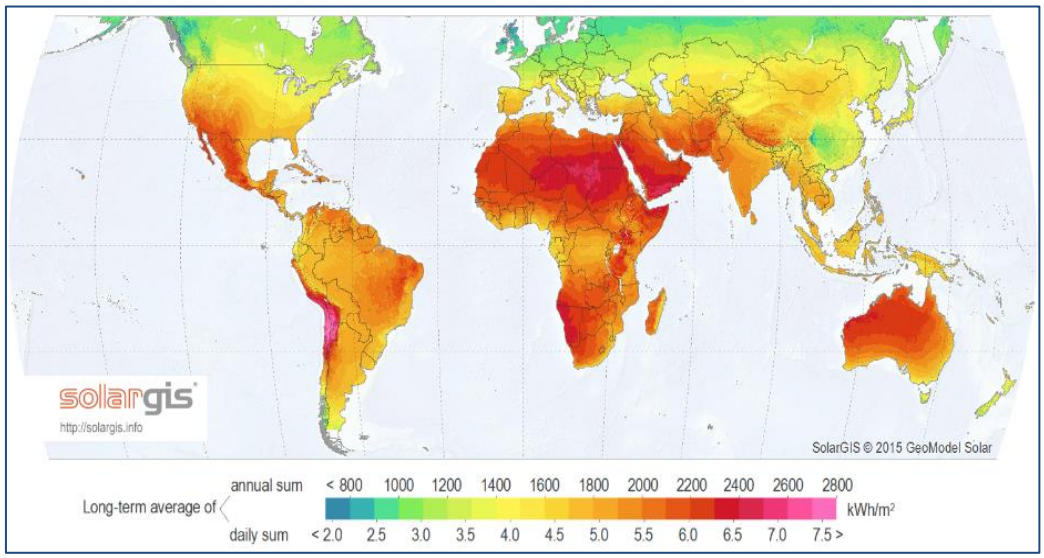


***Figure 4*: Global Horizontal Irradiation (GeoModel Solar, 2016)**

1. **<u>Costa Rica</u>**: Known for its eco-tourism, Costa Rica has already succeeded in leading the world in protecting natural habitats and is on the cusp of becoming fossil-free. In 2015, energy generation plants and projects had already weaned off fossil fuels. Like Sweden – a clean energy global powerhouse – its government subsidization is marked by a dramatic uptick in investment in both wind and solar, with massive geothermal and hydroelectric generation already established. This Central American country has adopted and implemented

basic permaculture[12] principles: examine the resources and topography of a region and use its abilities in a sustainable way. Harnessing the power of its heavy tropical rainfalls and pervasive river system, hydroelectric generation has been the most significant success. According to the Costa Rican Electricity Institute (ICE), 99% of clean energy generation was achieved by 2015 (*Costa Rica* - AFP, 18 Dec. 2015). This small country, situate in a developing, often war-ravaged region comprised of six other Central American nation-states,[13] has assumed an unforeseen position of leadership in the development of clean energy. Its government is committed to energy independence policies which have accentuated the possibilities of excess capacity production and active participation in global trade.

2. **Nicaragua:** Northern neighbor, Nicaragua, is turning its overwhelming coastal winds and earthquake-prone land masses to its advantage by working with, once again, its natural resources. By mid-2015, Nicaragua was producing more than half of its electricity needs through renewable resources. Through early governmental commitments, this country had already invested the 5th highest percentage globally of its GDP in the development of clean renewables and stands to become nearly 90% fossil-fuel free by 2020 (*Climate Reality Project*, 2016).

3. **Uruguay:** As previously discussed, without entrenched interests in fossil fuels undermining progress in clean energy development and trade, the private and public sectors of this small South American country decided, nearly a decade ago, to invest – without any special subsidies – in wind and solar. That collaboration has weaned the nation off nearly all of its fossil fuel usage in both the residential and commercial sectors.

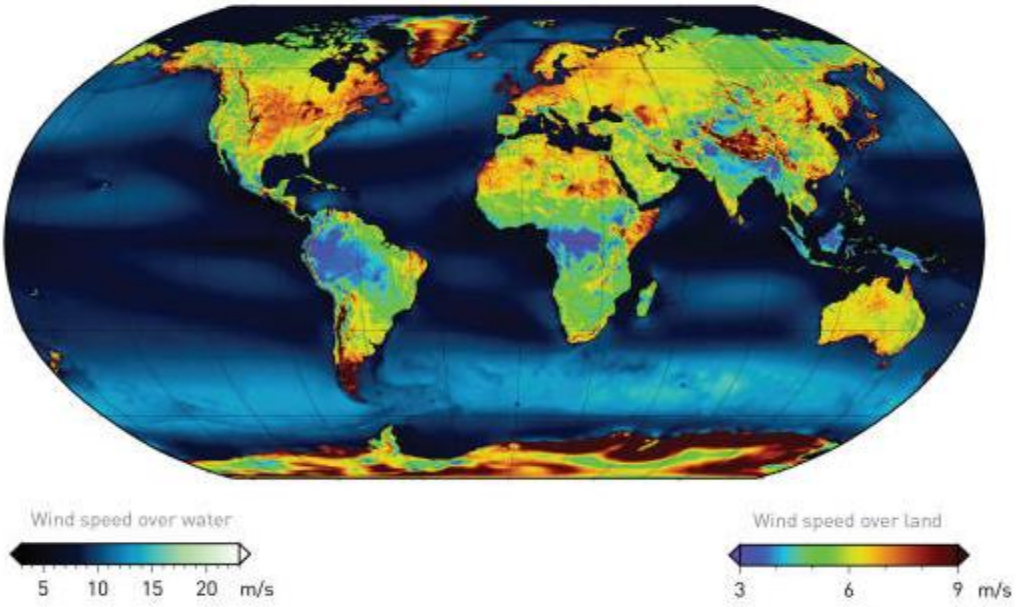
4. **Morocco**: One of the world's largest concentrated solar plant is in the final stages of construction, funded primarily by the European Union. Located on the edge of the Sahara Desert, this northern African country is taking full advantage of its perpetual sun exposure by building this plant which consists of curved mirrors totaling approximate 16 million square feet or the equivalent of 200 football fields (or soccer pitches) and will have the ability to generate 580 MW to serve almost 2 million people. It represents a model for other African nations to follow in lieu of kerosene-powered generators or rooftop solar panels – with the proper financing and governmental backing (*Vast Moroccan Solar Plant*, 2016).

5. **Kenya**: Kenya is a country currently plagued with devastating drought. It has historically been dependent upon foreign oil, but nevertheless has managed to supply over one-half of its energy mix through geothermal power. Kenya, in fact, was the first African country to use geothermal power and still maintains the largest installed capacity of this form of renewable energy in Africa at 200 MW (Singh, 2015). The Kenyan government has also added wind power as a supplementary power source as it is already home to Africa's largest onshore wind farm (*Climate Reality Project*, 2016). In fact, winds are a dominant resource throughout the east-central coast of Africa as well as within its northern countries (*Figure* 5). Topping out the mix is solar. Kenya is also a world leader in the number of solar power systems installed per capita with more than 30,000 small solar panels sold in that country annually.

[12] Design principles originally founded by Drs. Bill Mollison and David Holmgren – Australian-born scientists, researchers, and authors, of self-sustainability.
[13] Seven nations constitute Central America: Costa Rica, Honduras, Panama, El Salvador, Belize, Nicaragua, and Guatemala.

Within the last five years, Kenya's nascent renewable energy sector has attracted significant foreign investment, primarily led by 20 British companies. It is estimated that the renewable sources of energy could produce sufficient power for its own citizens with an excess to be channeled through foreign trade (Rubadiri, 2012).

***Figure 5*: World Wind Distribution, *Clean Technica* (2016).**



6. **Brazil:** While technically a developing country, the former Portuguese holding was once part of the original massive colonization efforts of Western Europe. Currently, Brazil maintains some of the world's largest hydro power plants. Hydro generates approximately two-thirds of that country's electricity, but with continued water shortages due to one of the worst droughts in history, energy expertise – needed to increase capacity – is being sought outside the country. According to Brazil's Ministry of Mines and Energy, the country has pledged to increase its hydropower capacity by 27 GW by 2024 irrespective of lingering weather patterns (*Brazil*, 2015).

Renewable Energy: Will LDCs Become Leading World Exporters?

The ability to export clean energy has been severely hampered historically; the technological means to do so simply had not yet been developed and the processes in existence were simply cost-prohibitive. With these constraints, the extraction and transportation of fossil fuels have persevered, however. As more countries focus inward to achieve "energy independence," the possibility of the poorest nations generating and exporting an excess of clean energy throughout the world is appearing increasingly feasible. This is being helped with technological breakthroughs in the next generation of storage batteries, which, when implemented, would be sufficient to elevate these countries to compete as serious players in foreign markets (Kammen, et al, 2001).

To make this transition attainable, a massive amount of long-duration energy storage (LDS) systems – compatible with all power applications and amenable to fluctuating regulatory landscapes – will be required. Energy storage refers to the collection of methods used to house

electrical energy either on or off a power grid. Electrical energy is stored during times when production (especially from plants powered by intermittent sources such as wind, sun, and tides) exceeds consumption, and returned to the grid when production falls below consumption. Currently, pumped-storage hydroelectricity is used for more than 90% of all grid-power storage worldwide (*Union of Concerned Scientists Report*, 2017). But a rise in energy demands, primarily from poorer countries, has fueled the innovation of alternative sources.

Poorer countries have been predicted to become the primary drivers of that need, but not necessarily the innovators of storage options themselves. While the *International Finance Corporation* (IFC) and the World Bank-administered *Energy Sector Management Assistance Program* (ESMAP) indicate that the largest energy storage markets are expected to be in China and India, "energy storage will play a crucial role in helping to meet demand for low-carbon electricity in developing nations. … By 2020, these countries will need to double their electricity generation, according to the International Energy Agency (IEA), and by 2035 will account for 80% of the total growth in energy generation and consumption globally" (*World Bank Group Report*, 2017). Propelling the development of these systems is US research agency, Advanced Research Projects Agency-Energy (ARPA-E). Founded in 2009 under former President Barack Obama's economic recovery plan, ARPA-E has announced the new technology they hope to become commercially viable in a predicted $50 billion energy storage market, using organic-flow technologies which include rhubarb and other waste oils as well as liquid metal cells (Martin, 2015). Technologies of this type are predicted to allow solar and wind to achieve greater parity with fossil fuels and ensure that sustainable energies quickly evolve into a prime world trade good. Even as wealthier countries like the US are attributed with the innovation and creation of the majority of these storage technologies, LDCs – with foreign direct investment – are poised for implementation. For example, Chile, Mexico, El Salvador, and Ecuador have emerged as dominant markets for solar cell imports from the US in the wake of the Paris Climate Change Agreement and China is currently looking beyond Asian markets to Africa, Central and South America for solar cell component manufacturing (Martin, 2015).

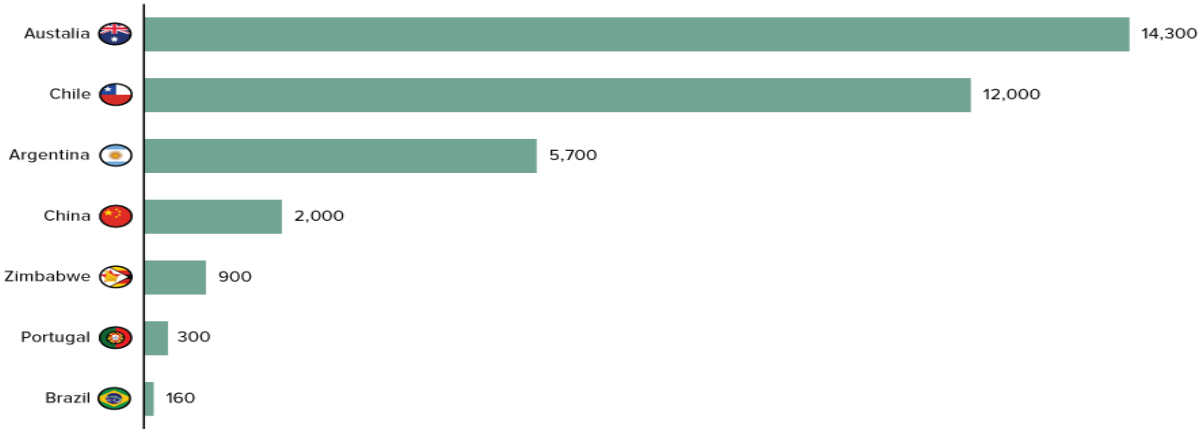
Despite technological advancements in liquid storage of excess renewable energy, the preferred method still lies with the lithium-ion battery. Exporting clean energy is thus contingent upon where lithium deposits primarily lie. Ostensibly, the lithium industry is far-reaching and is used in everything from laptop and cell phone batteries to electric-vehicles (EV) and grid storage batteries. China is the world's largest consumer of lithium primarily based on its extensive electronics manufacturing industry (*MarketWatch*, 2016). Record demand for lithium is predicted in the next decade, largely as a result of unprecedented growth in the battery-driven energy and transportation sectors. Although batteries already constitute 40% of the market for lithium, that number is projected to grow to 65% over the next ten years. The global lithium battery market is estimated to be worth $40 billion by 2020 – an increase of more than 250% (*MarketWatch*, 2016).

More than one-half of the world's lithium is extracted from South America's "Lithium Triangle" – a region encompassing three, former colonial South American countries: Argentina, Bolivia, and Chile (Chilean mines alone represent the largest confirmed lithium reserves in the world containing over 7.5 million tons) (*US Geological Survey-Mineral Commodity Summaries*, 2016). Lithium is produced in two ways – mining (which is considered labor and capital intensive and typically restricted to lithium-deposit giants, China and Australia) or by using less expensive extraction methods derived from briny aquifers and natural above-surface evaporation. The

attractive cost of the latter method is prompting the majority of global lithium producers to court South-South Trade (Tullis, 2017).

Four of the seven largest lithium-producing countries are located in former South-South colonies, with Brazil coupling with its "Lithium Triangle" neighbors to represent the top lithium producers in the world (*Figure 6*). Additionally, the African country of Zimbabwe, formerly the British colony of Rhodesia, was reported in 2014 to have produced the fifth most lithium at 1,000 metric tons in the world (WorldAtlas, 2017). One local company, privately-held corporation Bikita Minerals, is reported to control almost all of the country's lithium mining. It operates the Bikita mine, stated to hold the world's largest known lithium deposits, estimated at over 11 million tons (*Bikita Minerals*, 2017). As Bikita is slated to double its production in 2018, it is currently investing over 7 million USD to upgrade its facilities. Foreign investors are also being wooed. As one researcher notes, "foreign companies are scrambling to get a piece in the similar manner that European countries scrambled for Africa" (Musiiwa, 2016).

***Figure 6*: World's Largest Lithium Producers in 2016 by metric tons)**



With respect to emerging markets overall, projected annual stationary energy deployments, power capacity, and revenue by world regions from 2016 through 2025 are summarized in *Figure 7*. Although East Asia and the Pacific dominate throughout this period, a steady rise in LDC participation is clearly indicated.

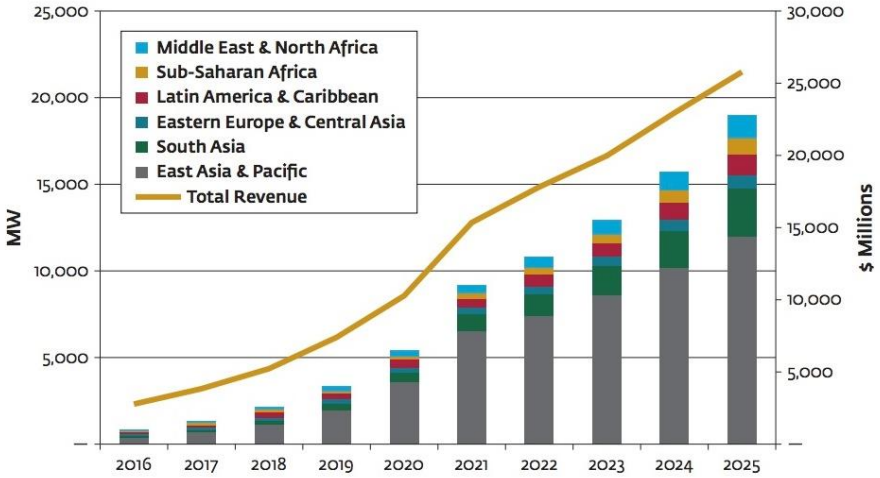


***Figure 7*: International Finance Corporation, (2017)**

LDCs and the Future of the WTO:
LDCs are predicted to provide the refocus of WTO's greatly desired centralization and to spur on the multilateralization of both entrenched and emerging regionalism throughout the world. With clean energy capacity, technological improvements in energy storage, and a willingness to enter into trade agreements, LDCs are surfacing as the new pillars of trade, threatening to surpass even their once economically-dominating colonizers.

The WTO understands the significance of this metamorphosis of LDCs from colonial nations into potential powerhouses in renewable energy by holding its 10th Ministerial Conference (MC) in Nairobi, Kenya in December, 2015 – the first time a WTO-MC has been held in an LDC. During this conference, a set of agreements known as the "Nairobi Package" was adopted. Specifically, the *Nairobi Package* calls for: (1) the immediate suspension by developed countries of export subsidies on agricultural goods; (2) the grant of special treatment to LDCs with respect to rules of origin requirements – allowing them to use up to 75% of non-originating materials in an LDC-manufactured product; and (3) unilateral, preferential trade arrangements covering both goods and services in favor of LDCs. Finally, there was the clarion call for member nations to fortify a multilateral trading system while safeguarding the environment. Actually, this integrated concept of growing national economies while bestowing special treatment to LDCs and protecting the environment was originally enshrined in the WTO's founding charter which specifically acknowledged the need to "*protect and preserve the environment and to enhance the means for doing so in a manner consistent with [nations'] respective needs and concerns at different levels of economic development* (WTO Secretariat Report, 2015). To underscore the progress made in Kenya, the next Ministerial Conference is scheduled to be held in Buenos Aires, Argentina in December 2017.

The World Intellectual Property Organization (WIPO) also respects the significance of both the increasing demand for world energy as well as the part LDCs are expected to play in the process. In 2014, WIPO introduced a new "interactive marketplace" – *WIPO Green* – which provides a network and database helping to connect innovators to service providers and products. One of its chief objectives is to highlight clean energy development, primarily in emerging economies. The *Development Agenda Recommendation No.25* of its charter includes a universal call to expedite "the transfer of technology to the benefit of developing countries" and to foster "mutually beneficial commercial transactions" (WIPO-Green, 2017).

Potential Roadblocks Ahead
While potential growth in the clean energy industry in LDCs appears very promising and lucrative, there exist substantial impediments which must be factored in to provide a more cogent forecast. The following barriers may, in combination with one another or individually applied, represent massive impediments to growth.

Poor or Failing Infrastructure: Arguably, LDCs have a certain vantage point in constructing energy infrastructure (including connecting roads and communication channels) instead of retrofitting and making costly expenditures to update existing systems – as is the case in wealthier nations. With sufficient capital investment, technical expertise, and government support, LDCs have opportunities to build infrastructure anew with an eye towards long-term sustainability and functionality. Understanding and incorporating new, clean energy technologies into less expensive grids, can conceivably propel a nation into the global spotlight. Taking inventory of a country's indigenous resources and topographical benefits can help lead an

emerging nation to satisfy both its own growing energy demands while benefitting more entrenched economies.

Obsolete and Outdated Grids: As a result of the Industrial Revolution, fossil-fuel-powered energy plants were constructed to help placate the growing needs of national populations. Today, the *United Nations Sustainable Energy for All Initiative* reports that these countries house aging grid infrastructure which are compromising the adoption, remediation, or substitution of energy storage systems and distributed grid technology. The UN has indicated that by 2030, approximately $45 billion will need to be invested to provide global access to modern electric power with energy storage accompanying a crucial role in those investments (*United Nations Sustainable Energy Report*, 2016). Clean energy generation, especially through wind and solar, has variable outputs. Energy operators must reasonable forecast patterns of energy usage and align grids with predictable changes in demand. Capturing and producing clean energy – which, depending upon the time of day and weather patterns can be unpredictable and intermittent – enables better usage of both new and existing resources while concomitantly protecting against security threats, both manmade and natural.

Intellectual Property Rights: IPRs may pose a problem for clean energy development in poorer nations. Very few of the identified generation and storage technologies are patented in the target countries (less than one per cent of all patent applications relating to Clean Energy Technology (CET) have been filed in Africa) (WIPO-Green, 2017). This may result in a situation where the technology may not require a license from the provider in order for the seeker to use the technology in target countries. But the provider may possess the technical expertise that is critical to the technology, and is likely to be unwilling to disclose the know-how to the seeker without a formal license. Thus, licensing issues are still relevant (WIPO-Green, 2017). *Figure 8* provides a global overview of renewable-energy installed capacity and generated-electricity distribution.

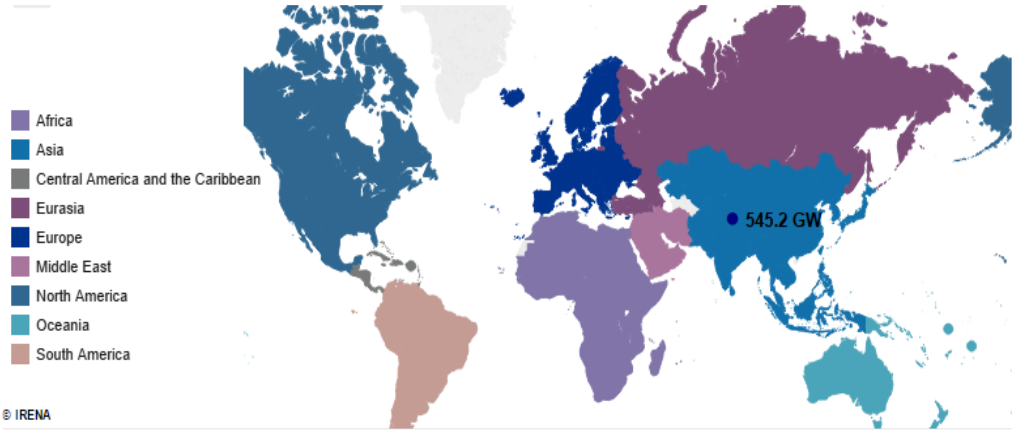


***Figure 8*: Installed renewable energy capacity (2016). International Renewable Energy Agency (IRENA).**

As intellectual property rights become more valuable in world trade, especially with respect to trading in clean-energy technologies, how trade secrets and other IPRs are processed and protected will be of fundamental importance to emerging markets. The GATT Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which became effective on January 1, 2000, applies to all WTO member countries, – including the poorest nations in the South-South Trade. Under TRIPS, universal patent protection is given at least 20 years of a virtual monopoly protection (Schaffer, et al, 2015). Such protection is currently available for "any new inventions, whether products or processes, in all fields of technology, provided they

are new, involve an inventive step and are capable of industrial application" (WTO-TRIPS). World trade is hindered without membership in the WTO and WTO members must comply with international intellectual property law if its own local laws provide either little or substandard protection. So, while developed countries have only had to make minor adjustments, emerging economies have had to begin anew and grant foreign actors full protection. With respect to clean energy development, generation, distribution, and storage patent protection, wealthier countries have maintained an advantage over poorer nations. The universal enforcement mechanisms of WTO must be adopted or world trade in goods and services could be preempted. Thus, emerging markets may very well view IPR-protected, high-technological exports as slowing the development of their own nascent economies and/or aid in the wholesale transfer of local wealth abroad.

Economic and Political Instability: As previously discussed, access to IPRs, the construction of necessary infrastructure, and pragmatic, non-corrupt rule are the main challenges for LDCs to overcome clean energy trade. But the same Climate Change forces which have produced the shift to renewables may be undermining the timing of LDC competitive entry into the world market. For instance, Venezuela, once dubbed the richest country in South America, is witnessing the depletion of its Maracaibo-based oil reserves and a stark decrease in foreign demand while former importing countries have been seeking energy independence and alternatives. While Venezuela is experiencing chronic unrest and shortages of food and medical aid, hundreds of thousands of its citizens have been fleeing to neighboring countries, with Colombia taking in the largest refugee swell (Daniels, 2017). The destabilization of the South American continent, once wholly comprised of colonial states, is also being impacted by its largest nation, Brazil. Brazil is also experiencing a deep recession and political unrest, as well as an unprecedented drought, and pandemics like the debilitating and often fatal Zika virus. With these ongoing and sometimes unpredictable challenges, whether LDCs are able to manufacture parts and components for clean energy development is still uncertain (Koop, 2016).

Emerging Oligopolies: It is reported that only 4 companies, namely Albemarle Corporation (US), Tianqi Lithium (China), SQM (Chile) and FMC (US), control nearly 90% of the world's lithium reserves. Junior companies have entered the fray including as Lithium X Energy Corp (CAN) Pure Energy Minerals, LTD (CAN) and are entering into agreements with LDC governments (*Global Lithium Report - Pacific North West Capital Corp.*, 2016*).* While private-public agreements are ostensibly critical to clean energy development in LDCs, power over resources by foreign companies has reemerged – and not necessarily for the benefit of LDCs and their populations.

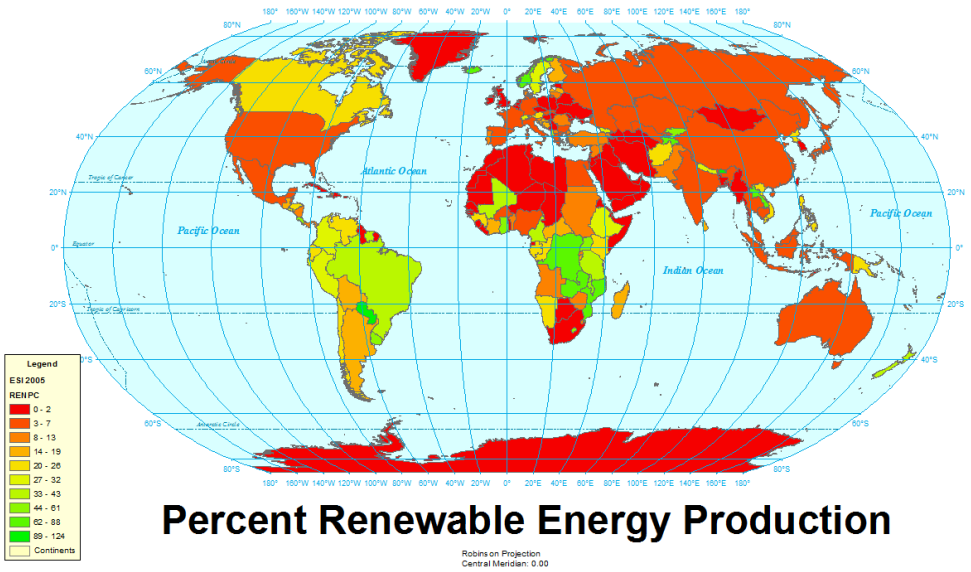
Biopiracy: When the US Supreme Court decided in 1980 that living organisms could be patentable,[14] even with natural sources and deposits forming the most desired elements for energy storage, governments in emerging economies are arguing that indigenous plants used for research are being transformed atomically to form new substances subject to new patent rights, depriving that country of a key marketable source. Hence, the host country is deprived of reasonable compensation and further denied access to the resulting inventions without forfeiting additional rights (Schaffer, et al, 2015).

[14] *Diamond v. Chakrabarty*, 447 U.S. 303 (a genetically-engineered bacterium capable of breaking down crude oil was given patent protection in a 5-4 decision).

Conclusion

Wealthier nations and emerging economies share one immediate goal: the need to answer a growing demand for clean, renewable way in a sustainable way. The *power providers* in the South-South trade disproportionately consist of formally-colonized, lower-income countries suffering the harshest effects of Climate Change. They require pragmatic, non-corrupt governmental guidance and smart public-private investment to unleash their potential as major clean energy traders. The *power consumers* – China, United States, Australia, Canada and former colonizing countries, have been the greatest GHG emitters and have driven CO2 levels to unprecedented levels. Using fossil fuels (i.e., coal, oil, gas, tar sands, and natural gas) to produce electricity to feed their power grids has produced emissions which have had a devastating effect on marginalized populations. The World Bank has assessed that GHG emissions will continue to disproportionately affect LDC populations who will continue to bear the brunt of droughts, famine, rising sea levels, deforestation, desertification, and changing animal migratory patterns.[15] However, with the proper management and development of endemic resources of LDCs, coupled with enlightened local governance and closely-monitored foreign assistance, these historically-repressed territories have already proven the potential to lead (*Figure 9*).

***Figure 9*: Clean Energy Regional Development, 2011 to 2015 (Homer, 2017, microgridnews.com)**



Hopefully, the pattern of rising electricity generation from renewable resources will progress in a manner that benefits native populations and keeps control in their own hands.

[15] Air pollution alone, exacerbated by GHG emissions, has already been pegged as the fourth largest contributor to premature deaths, "causing one in ten deaths globally" – primarily in lower-income countries (*World Bank Report*, 2017).

References

Adelman, Jeremy (2011). Independence in Latin America. *The Oxford Handbook of Latin American History*, José C. Moya, ed. New York: Oxford University Press 2011, p. 154.

Ashcroft, Bill (1995). *The Post-Colonial Studies Reader.* Routledge: London.

Baldwin, Richard E. ((2006). Multilateralising Regionalism: Spaghetti Bowls as Building Blocs on the Path to Global Free Trade, *The World Economy*, pp.1451-1518.

Bikita Minerals in $7mln capex, to double output (6 March 2017), *The Source*. Retrieved 29 April 2017 from http://source.co.zw/2017/03/bikita-minerals-7mln-capex-double-output/.

Brazil- Energy Policy, Laws and Regulations Handbook (2015). Washington, DC: International Business Publications, pp. 54-68.

Climate Reality Project (Feb. 2016). Follow the Leader: How 11 countries are shifting to renewable energy. Retrieved 28 April 2017 from https://www.climaterealityproject.org/blog/follow-leader-how-11-countries-are-shifting-renewable-energy.

Costa Rica boasts 99% renewable energy in 2015 (18 Dec. 2015). *Associated Free Press*. Retrieved 4 April 2017 from https:// www.yahoo.com/news/costa-rica-boasts-99-renewable-energy-2015-210416028.html.

Daniels, Joe (19 April 2017). Colombia militias, Venezuela's dire economy fuel border crisis, UPI. Retrieved 4 May 2017 from http://www.upi.com/Top_News/Voices/2017/04/19/Colombia-militias-Venezuelas-dire-economy-fuel-border-crisis/5521492604152/.

Dezem, Vanessa (18 February 2016). Latin America Clean Energy Deals Surge Amid Rising Power Demand, *BloombergNews*. Retrieved 27 April 2017 from https://www.bloomberg.com/news/articles/2016-02-18/latin-america-clean-energy-deals-surge-amid-rising-power-demand.

Donnan, Shawn (7 April 2016). Global economy faces fifth year of weak trade growth, *Financial Times*. Retrieved 2 May 2017 from https://www.ft.com/content/842c9f06-fc70-11e5-a31a-7930bacb3f5f.

Donnan, Shawn (21 Feb. 2017). Policy uncertainly threatens trade growth. *Financial Times*. Retrieved 3 May 2017 from https://www.ft.com/content/9d49b092-f859-11e6-9516-2d969e0d3b65.

Draper, P. (2013). The Shifting Geography of Global Value Chains: Implications for Developing Countries, Trade Policy, and the G20, *Global Summitry Journal*, 1(1).

Energy Storage Trends and Opportunities in Emerging Markets (2017), *International Finance Corporation.* Retrieved 1 May 2017 from http://www.ifc.org/wps/wcm/connect/ed6f9f7f-f197-4915-8ab6-56b92d50865d/7151-IFC-EnergyStorage-report.pdf? MOD=AJPERES.

Energy storage will increase 40-fold in developing countries (2017). *World Bank Group Report*. Retrieved 4 April 2017 from http://www.essinc.com/2017/01/23/energy-storage-will-increase-40-fold-in-developing-countries/).

Ferraro, Vincent (2008). Dependency Theory: An Introduction. *The Development Economics Reader* (1st ed.). Routledge, pp. 58–64. ISBN 9780415771573.

Global Lithium Report - Pacific North West Capital Corp. (2016). Retrieved 25 April 2017 from newagemetals.com/wp-content/.../MacquarieGlobalLithiumReport310516e245188.pdf.

Halper, Evan (27 April 2017). Republicans are Rethinking Their Disdain for the Paris Accord – Creating a Political Headache for Trump, *Los Angeles Times*. Retrieved 27 April 2017 from http://www.latimes.com/politics/la-na-pol-trump-paris-20170427-story.html.

Hoogvelt, Ankie (2001). *Globalization and the Postcolonial World: The New Political Economy of Development*. Baltimore, MD, US: Johns Hopkins University Press.

Kammen, Daniel M. Bailis, Robert, & Herzog, Antonia V. (2001). Clean Energy for Development and Economic Growth: Biomass and Other Renewable Energy Options to Meet Energy and Development Needs in Poor Nations, *Policy Discussion Paper for the United Nations Development Program, Environmentally Sustainable Development Group (ESDG) and the Climate Change Clean Development Mechanism (CDM)*.

Koop, Fermin (22 Nov. 2016). China's Impressive Stake in Latin America's Renewables, *chinadialogue*. Retrieved 27 April 2017 from https://www.chinadialogue.net/article/show/single/en/9419-China-s-impressive-stake-in-Latin-America-s-renewables.

Kohn, Margaret, (2014). Colonialism. *The Stanford Encyclopedia of Philosophy*. Edward N. Zalta (ed.). Retrieved 26 April 2-17 from https://plato.stanford.edu/archives/spr2014/entries/colonialism/.

Latin America and the Caribbean (2017). Retrieved 30 April 2017 from http://global-climatescope.org/en/country/Uruguay /#/details.

MarketWatch (25 Feb. 2016). This Emerging Lithium Producer Could Disrupt the Entire Industry. Retrieved 12 April 2017 from http://www.marketwatch.com/story/this-emerging-lithium-producer-could-disrupt-the-entire-industry-2016-02-25-920250.

Martin, Chris (13 April 2015). The $5 Billion Race to Build a Better Battery. Retrieved 30 April 2017 from https://www.bloomberg.com/news/articles/2015-04-14/gates-pritzkers-take-on-musk-in-5-billion-race-for-new-battery).

Mearian, Lucas (23 January 2017). Energy storage will increase 40-fold in developing countries, *Computerworld*. Retrieved 30 April 2017 from http://www.computerworld.com/article/3160784/sustainable-it/energy-storage-will-increase-40-fold-in-developing-countries.html.

Memmi, Albert (1991). *The Colonizer and the Colonized* (1st ed), Kansas City, KS, US: Beacon Hill Press, pp.169.

Miles, William F. S. (2014). *Scars of Partition: Postcolonial Legacies in French and British Borderlands*. University of Nebraska Press. ISBN 9780803248328.

Musiiwa, Munyaradzi (28 Sept. 2016). Fresh Lithium Deposits to Transform Zim Economy. *The Herald*. Retrieved 29 April 2017 from http://www.zimbabwesituation.com/news/zimsit-m-fresh-lithium-deposits-to-transform-zim-economy/.

Ray, Sangeeta (2005). *A companion to postcolonial studies* ([Nachdr.] ed.). Malden, MA: Blackwell Publishers, pp. 360–376.

Renewable Energy Agency Energy Distribution Overview (IRENA). Retrieved 2 May 2017 from http://resourceirena. irena.org/gateway/dashboard/?topic= 4&subTopic=17.

Rockman, Marcy and Steele, James (2003). *The Colonization of Unfamiliar Landscapes*. Routledge. ISBN 0-415-25606-2.

Rubadiri, Victoria (2012). Energy: Kenya's renewable energy sector attracts foreign interest. Retrieved 12 April 2017 from http://en.ccchina.gov.cn/Detail.aspx?newsId=38323&TId=97.

Schaffer, Richard, Agusti, Filiberto, & Dhooge, Lucien J. (2015). *International Business Law and its Environment*, (9th ed.), Stamford, CT: Cengage, pp. 467-477.

Singh, Harsha Vardhana (2015). *International Centre for Trade and Sustainable Development* (ICTSD), Retrieved 27 April 2017 from http://www3.weforum.org/docs/WEF_GAC15_ The_High_Low_ Politics_Trade_WTO_Centrality_report_2015.pdf.

Srinivasan, T. N. (1996) Trade and Human Rights. *Economic Growth Center*, Yale University, New Haven, CT, US. December 1996.

The Top Lithium Producing Countries in the World (13 March 2017). *WorldAtlas*. Retrieved 12 April 2017 from www.world atlas.com /articles/the-top-lithium-producing-countries-in-the-world.html.

TPP: What is it and why does it matter? (23 Jan. 2017). *BBCNews*. Retrieved 30 April 2017 from http://www.bbc.com /news/business-32498715.

Tullis, Paul (29 March 2017). The Great Nevada Lithium Rush to Power the New Economy, *BloombergBusinessweek*. Retrieved 29 April 2017 from https://www.bloomberg.com/news/features/2017-03-29/the-great-nevada-lithium-rush-to-fuel-the-new-economy.

Union of Concerned Scientists Report, (2017). Retrieved 30 April 2017 from https://www.google.com/#q=Currently,+pumped-storage+hydroelectricity+is+used+for+more+than+90%25+of+all+grid-power+storage+worldwide+.

United Nations Framework Convention on Climate Change Control Report (UNFCCC) (12 December 2015). Retrieved 3 March 2017 from http://newsroom.unfccc.int/unfccc-newsroom/finale-cop21/.

UN Office for South-South Cooperation Report (2016). Retrieved 27 April 2017 from http://ssc.undp.org/content/ssc/about/ Background.html.

US Geological Survey - Mineral Commodity Summaries, (2016). Retrieved 30 April 2017 from https://minerals.usgs.gov/ minerals/pubs/mcs/2016/mcs2016.pdf.

Vast Moroccan Solar Power Plant is Hard Act for Africa to Follow (5 Nov. 2016). *Fortune*. Retrieved 3 May 2017 from http://fortune.com/2016/11/05/moroccan-solar-plant-africa/.

WIPO-Green (2017). Retrieved 2 May 2017 from https//www.ctc-n.org/sites/www.ctc-n.org/files/session_6_-_network_-_wipo.pdf.

Wolfe, Patrick (2006). Settler colonialism and the elimination of the native. *Journal of Genocide Research*. *8*(4), pp. 387–409. doi:10.1080/14623520601056240.

Worland, Justin. (5 February 2016). How Climate Change Unfairly Burdens Poorer Countries, *Time*. Retrieved 3 May 2017 from http://time.com/4209510/climate-change-poor-countries/.

World Data Center for Paleoclimatology, National Oceanic, and Atmospheric Administration (NOAA). Retrieved 30 April 2017 from https://www.ncdc.noaa.gov/data-access/paleoclimatology-data.

WTO Secretariat, Escape Clause (1979). Retrieved 30 April 2017 from https://www.wto.org/english/docs_e/legal_e/enabling 1979_e.htm.

WTO Secretariat, *Guide to the Uruguay Round*, *The Hague*, Boston: Kluwer Law International, c1999 pp. 235-285.

WTO Secretariat Report (2015). Retrieved 27 April 2017 from https://www.wto.org/english/news_e/news15_e/mc10_19dec15 _e.htm.