THE 21ST CENTURY ENERGY TRANSITION OF INDIVIDUAL COUNTRIES

An Undergraduate Research Scholars Thesis

by

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ABSTRACT

21st Century Energy Transition of Individual Countries

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Fossil fuel reserves are finite, projected to peak by mid-century and decline thereafter, yet global demand for energy is set to increase more than 50% by 2030. It is therefore crucial for all nations to transition to largely renewable energy sources by mid-century and beyond. To gauge the extent of this problem, we established three scenarios of projected energy demand throughout the 21st century. One in which only a country's population changes, a second that reaches 100% access to electricity by 2030, as proposed by the World Bank, and a third wherein countries achieve a ranking of "high" on the HDI by 2100 (i.e. using about 110 GJ of energy per capita per annum). Underdeveloped countries will struggle to provide even basic amounts of energy to their rapidly growing populations. For example, Nigeria will have to triple the amount of energy used by 2030 to provide energy for all, and increase 14-fold by 2100 to improve their HDI. Developing countries (e.g. Venezuela), already have 100% access to energy, but will still deplete their fossil fuel reserves before 2100. While many developed countries (e.g. the United States) use disproportionate amounts of energy. Here we find that renewable energy expansion will not only be critical for all countries to maintain their current levels of energy usage, but will be crucial for underdeveloped countries, such as those in sub-Saharan Africa, if they are to develop through the 21st century while facing skyrocketing population increases and insufficient fossil-fuel reserves.

NOMENCLATURE

EIA	U.S. Energy Information Administration
EJ	Exajoules ($1 * 10^{18}\ Joules$)
GJ	Gigajoules ($1 * 10^{9}\ Joules$)
IEA	International Energy Agency
HDI	Human Development Index
NRES	Non-Renewable Energy Sources
RES	Renewable Energy Sources
SE4All	Sustainable Energy for All
TPES	Total Primary Energy Supply
UN	United Nations

CHAPTER I

INTRODUCTION

The energy transition

The United Nations (UN) projects that the world's present population of 7.3 billion will increase to 10.9 billion by 2100 (Gerland et al., 2014). As population continues to increase through the 21st century most countries will face a growing demand for energy. It is projected that global energy consumption will increase by over 50% by 2030 (Suganthia &Samueal, 2011) and more than double by 2100 (Jones and Warner, 2016). However, close to a fifth of the world's population does not have access to electricity (World Bank, 2013). As underdeveloped countries strive to increase access, they will have to do so at a rate faster than their growing populations. The World Bank's Sustainable Energy for All (SE4ALL) program addresses this problem and tracks the progress being made to remedy it (Banerjee et al. 2013).

To effectively plan to not only increase energy access in underdeveloped nations, but also keep up with the growing energy demand for all countries, it is essential to understand where the energy will have to come from. Fossil fuels make up nearly 90% of the world's energy sources today, but are projected to peak globally by mid-century (Maggio and Cacciola, 2012; Jones and Warner, 2016)). To not only make up for the declining non-renewable energy sources (NRES), but also for the additional energy demand that will continue to increase along with rising population, a transition to renewable energy sources (RES) is inevitable.

This study assesses the energy transition for 100 individual countries through the 21st century based on their population growth, energy consumption, and fossil fuel reserve depletion. To do this three scenarios were established and then projected for each country's total energy consumption, per capita energy consumption, NRES reserve depletion, and RES expansion through 2100.

The low scenario

The low scenario follows the assumption that a country will maintain its current level of per capita energy consumption through 2100. This scenario is useful in understanding how much energy would have to be supplied if only population changed throughout the rest of the century; for some countries, even achieving energy levels in this scenario will be a challenge enough.

The medium scenario

The medium scenario is based on the Sustainable Energy for All (SE4All) goal of achieving 100% access to electricity by the year 2030 (World Bank, 2013). Countries that have not already achieved complete access to electricity, will be modeled to reach this objective by 2030, thereafter its per capita energy consumption will be held constant. Nations that have already achieved this goal will not have projections for this scenario. For those that have not, it will show the challenge of not only increasing energy access, but also keeping up with the increasing population rate (Banerjee et al. 2013).

The high scenario

The final scenario in this study is based on achieving an energy level at which it has been found that a society ranks highly on the human development index (HDI). The HDI is used as a measure of how a society ranks in the areas of life span and health, education, and standard of living (HDR, 2015). This scenario is used as a measure of how much energy it would require for individual countries to meet this goal by the end of the century. The amount of 110 gigajoules (GJ) per capita by 2100 was chosen as the goal for this scenario. Lambert et al.(2014) found that per capita energy levels of 100-150 GJ allowed societies to rank high on the HDI. Additionally, the SEA4All states 110 GJ per capita as being a Western European level of energy (World Bank, 2013), and Jones and Warner (2016) calculated 106 GJ as the global per capita average for 2100. We therefore use 110 GJ per capita as the level to achieve a high ranking on the HDI. Below this there is a significant decrease in the standard of living, and when a country consumes significantly more than this level there is no significant improvement in the living standard (Lambert et al., 2014).

CHAPTER II

METHODS

Historical data

To begin, historic and current data on population, energy consumption, energy access, and fuel reserves were collected. Population numbers for each of the 100 countries were taken from the *World Population Prospects: The 2015 Revision* (UN, 2015). This data set provides historical population numbers from 1950-2015, as well as high, medium, and low variants for future population projections from 2016-2100. For the purposes of this study, the historic population data was combined with the medium variant projections; no calculations were done to this data.

One of the greatest challenges in accessing total energy consumption by individual countries is finding reliable sources with data on smaller underdeveloped countries such as those in sub-Saharan Africa. The International Energy Agency (IEA) was chosen as the source for total energy consumption because it offered a dataset consisting of the most individual countries from 1990-2013. Additionally, it not only specifies how much of the consumed energy came from each source, e.g. oil products, coal, hydroelectricity, but also how much was consumed by each sector of a country's economy, e.g. agriculture, transportation, residential. To make up for a difference between this source's "Total Energy Consumption" number and similar data from the *BP Statistical Review of World Energy* (2015), the number listed as " Total Primary Energy Supply" (TPES) by the IEA was used. This discrepancy came from the inclusion of energy consumed by the energy sector itself by BP in its total energy consumption and IEA including

this data in its TPES (BP, pers. Comm. and IEA, pers. Comm). This data divided by the annual population results in the per capita energy used per annum.

In order to establish which countries need to meet the SE4All goal of 100% access to electricity by 2030, data provided by the World Bank, which gave the percent of a country's population with access to electricity, was used in combination with the calculated energy consumption per capita. This allows us to better understand the per capita consumption of those on the energy grid, rather than averaging the amount of energy used by those with energy access among a country's entire population.

Data on each country's fossil fuel reserves, i.e. oil, gas, and coal, were collected from the U.S. Energy Information Administration (EIA) database because this is the most comprehensive of the energy databases (i.e IEA, EIA, BP and Platt's). Because data for coal reserves was only available up to 2011, data from this year for both oil and gas reserves was also used. Each energy source was converted to EJ using BP conversions and combined to establish total NRES reserves for each country.

Calculations and projections

Starting at 2014, the reserves data was projected using exponential growth and logistic formulas (Hubbert, 1956 and found in Jones and Warner, 2016) to estimate how energy will be consumed and how the use of RES will have to increase for each country through 2100. Once historical per capita numbers were calculated, they were used as the basis for projecting the three scenarios.

For all countries, the low scenario uses the 2013 per capita number and holds it constant up to 2100.

For the medium scenario, countries that do not have 100% access to electricity are modeled to achieve this target by 2030. The average energy consumption per capita for countries without total access to electricity in 2013 is divided by the percent of their population that does have access, establishing a per capita goal for 2030. In order to best project estimates of how this goal could be achieved, an exponential growth formula was used with the starting amount being the average energy consumption per capita for 2013 and the end amount being the energy consumption per capita of the population with access to energy in 2013. This scenario projects a country's energy consumption to meet this per capita goal in 2030, then remain constant through the end of the century.

For the high scenario, the same values for the medium scenario are used up to 2030, but then, using the logistic formula ($f(x) = \frac{L}{1+ e^{-k(x-x_0)}}$), the per capita energy consumption is projected to continue to change through 2100 in order to reach the goal of 110 GJ. Once all projections are complete for the per capita numbers, they are multiplied with corresponding population numbers for each year to calculate projected total energy consumption for each of the scenarios. This can be divided by a billion to convert from GJ to exajoules (EJ).

To calculate the decrease of NRES reserves and the amount RES that will have to make up for the NRES decline and population increase, each country's fossil fuel reserves as of 2011 is converted to EJ using the energy conversion factors from BP (2015). The sum of these is

subtracted by the total energy consumption in 2012 to estimate how much of a country's reserves were consumed that year. This pattern is continued through 2100, subtracting each year's total energy consumption from the remaining reserves from the prior year. The inverse of these values would be the amount of energy that RES will have to offset the decrease of NRES throughout the century. A compounding interest formula ($A = P(1 + \frac{r}{n})^{nt}$) is used to find the percent change for each of the components. Data from each of the scenarios for all 100 countries was imported to Esri ArcMap 10.2 to create GIS maps. These maps allow quantitative data to be presented in a more impactful, visual manner (e.g. Figure 1 which illustrates the projected per capita energy for each country in 2030 in the high scenario).

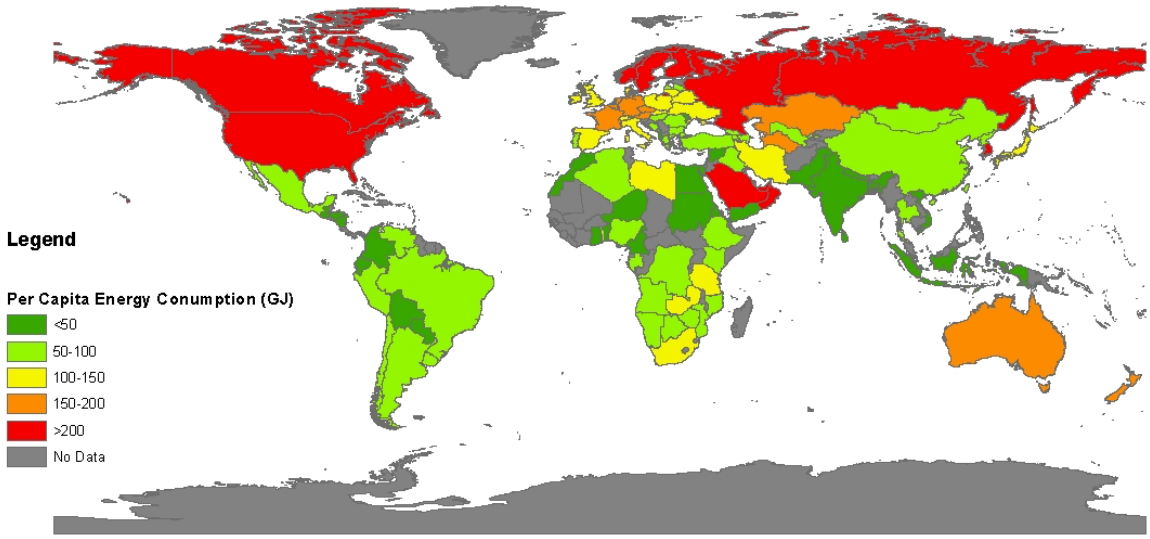

Figure 1. Projected Per Capita Energy Consumption in 2030 in the High Scenario.

CHAPTER III

RESULTS

Based on comparisons of all variables considered in this study (e.g. population trends, total energy consumption, access to electricity, and fossil fuel reserves), it is clear that countries can be grouped together based on their projected energy transition in the 21st century into one of three categories: developed, developing, and underdeveloped. For the purposes of this study, these terms refer to development only in terms of energy.

Developed countries

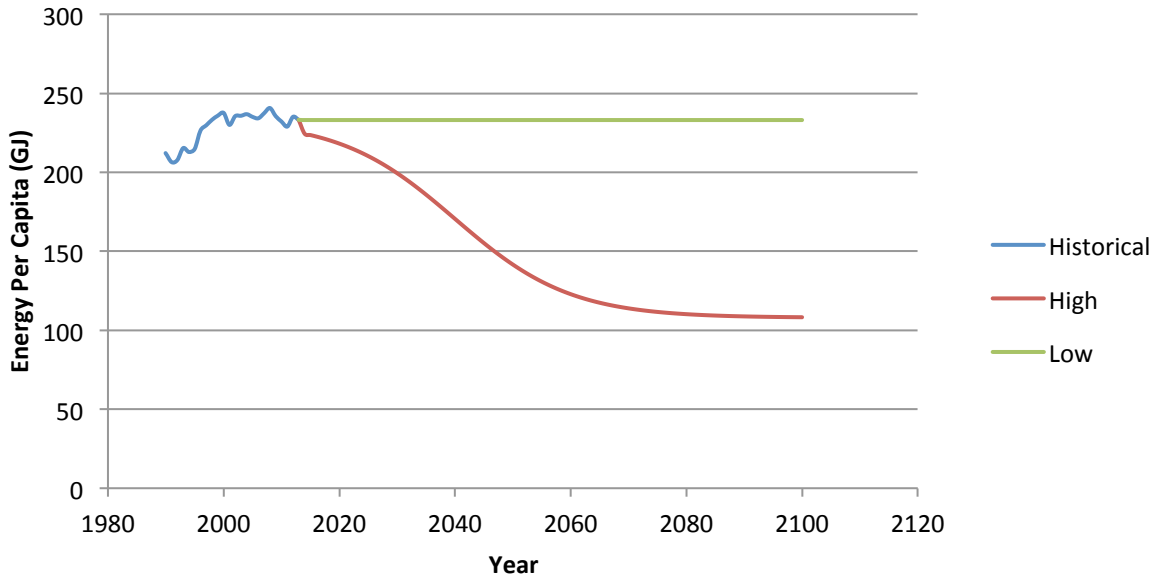

Figure 2A. Australia's Per Capita Energy Consumption from 1990 to 2100.

Our definition for the developed countries are those that have achieved 100% access to energy and generally use more than 110 GJ of energy per capita, thus the high scenario for these countries shows a decrease in energy to reach the goal of 110 GJ per capita by 2100. There are 44 countries in this category (see Table 1 in Appendix A). An example of such a country is

Australia, with a current per capita energy consumption of 233 GJ. The per capita projection in the high scenario requires Australia to gradually lower this number to 110 GJ by 2100 (red). The per capita energy consumption for developed countries in the low scenario is actually higher than in the high scenario (green) (Figure 2A). Because developed countries, such as Australia, have already met the goal of providing complete access to electricity, these countries do not have a medium scenario. Although the specific amount of energy consumed per capita currently may vary, all countries categorized as "developed" have similarly shaped per capita projections, with the low scenario line staying steady above a dipping high scenario line that eventually reaches 110 GJ.

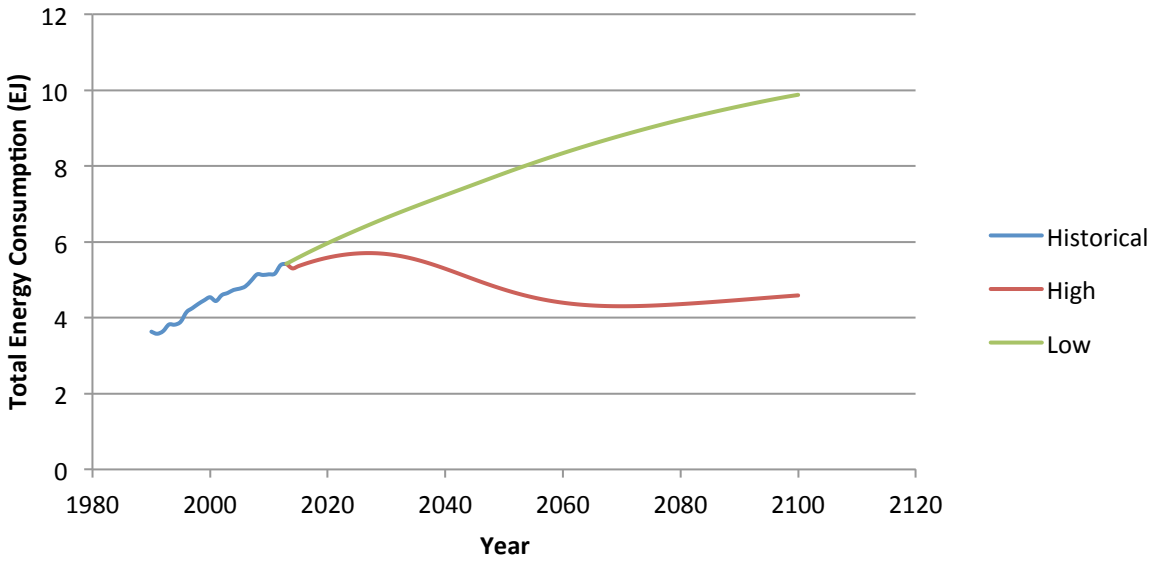

Figure 2B. Australia's Total Energy Consumption form1990-2100.

The total energy consumption figure portrays the per capita energy consumption multiplied by the country's population as it changes over the 21st century. For developed countries, this too shows the high scenario dropping below the low scenario. However, the low scenario is not

constant; while the amount of energy per capita does not change in this scenario, the total energy consumption increases and decreases with a country's population. This better shows how much energy a country will have to supply even if it's per capita energy consumption does not change.

Figures 2A and 2B show how much energy is projected to be used in the rest of this century, but just as important is where this energy will come from. The projected reserves can be used to predict, for each scenario, when a country's fossil fuels will run out, and how much RES will have to increase to make up for the lack of finite fossil fuel energy sources. For developed countries, the low scenario will use up more of a county's energy reserves than the high scenario in which the per capita energy consumption is decreasing.

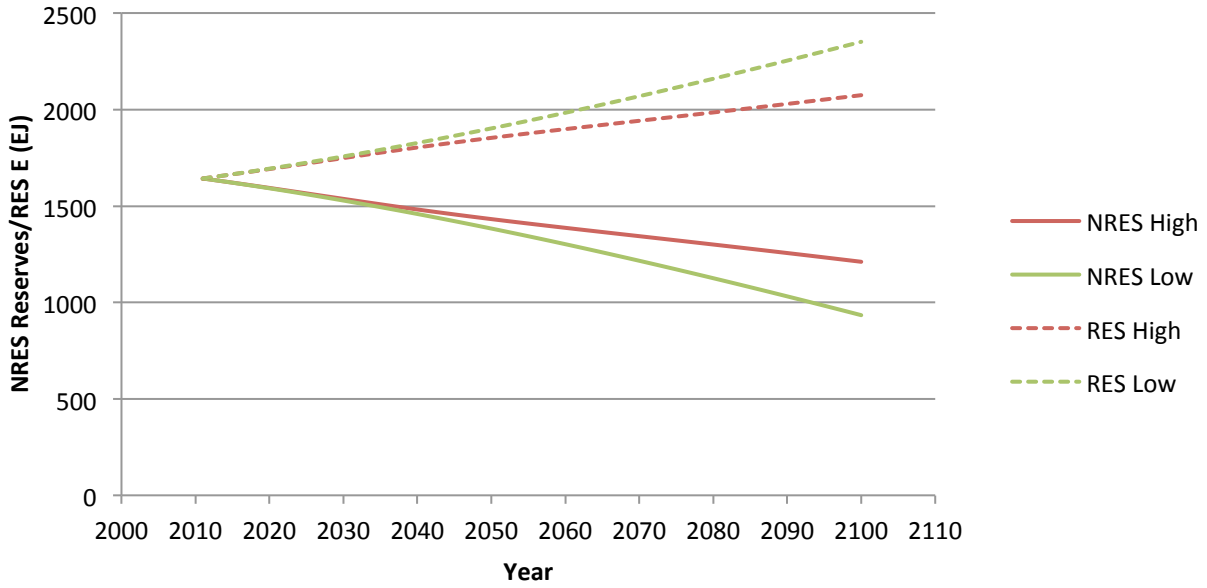

Figure 2C. Australia's Decrease in NRES vs. Increase in RES from 2011 to 2100.

Developing countries

Developing countries can be characterized as those that have, or are close to, 100% access to energy. Additionally, these countries typically have a current per capita energy consumption near 110 GJ. An example of such a country would be Venezuela, which provides 100% access to electricity and has a per capita energy consumption of 95 GJ in 2013. This example is like 11 of the 18 countries in this category in that there is no medium scenario due to the goal of complete access to electricity already being met. For all developing countries, the high scenario requires only a slight increase in per capita energy access annually.

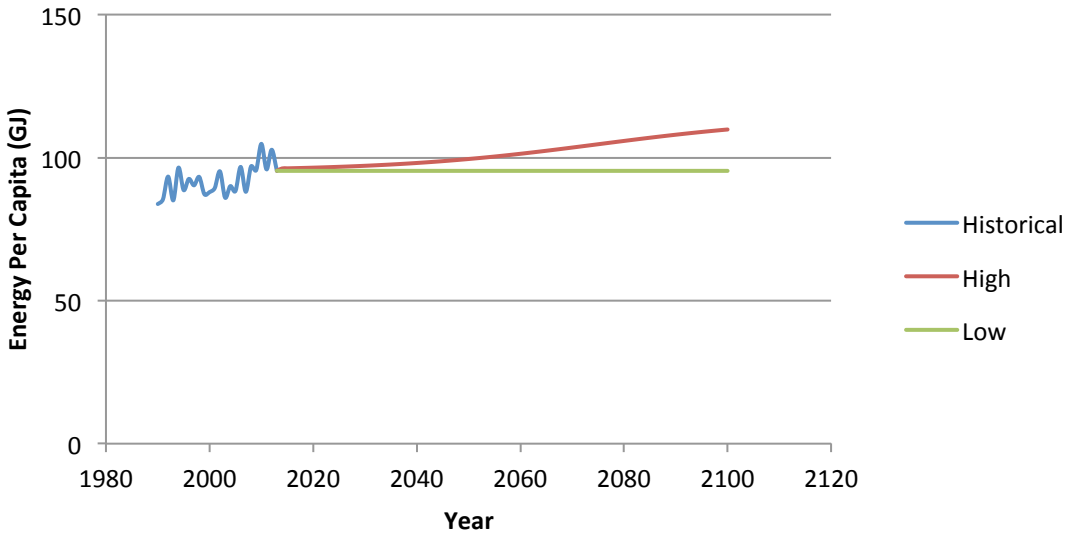

Figure 3A. Venezuela's Per Capita Energy Consumption from 1990-2100.

Developing countries generally have increasing populations that may start to decrease in the latter half of the century. These countries, like Venezuela, have total energy consumption curves that require continuously increasing amounts of energy. In the low scenario, these countries must only keep up with their populations, but when required to reach the goal of 110 GJ per capita by 2100 in the high scenario, they are facing population growth combined with the amount of

energy needed to reach this goal. For Venezuela, this would require them to nearly double their current energy consumed.

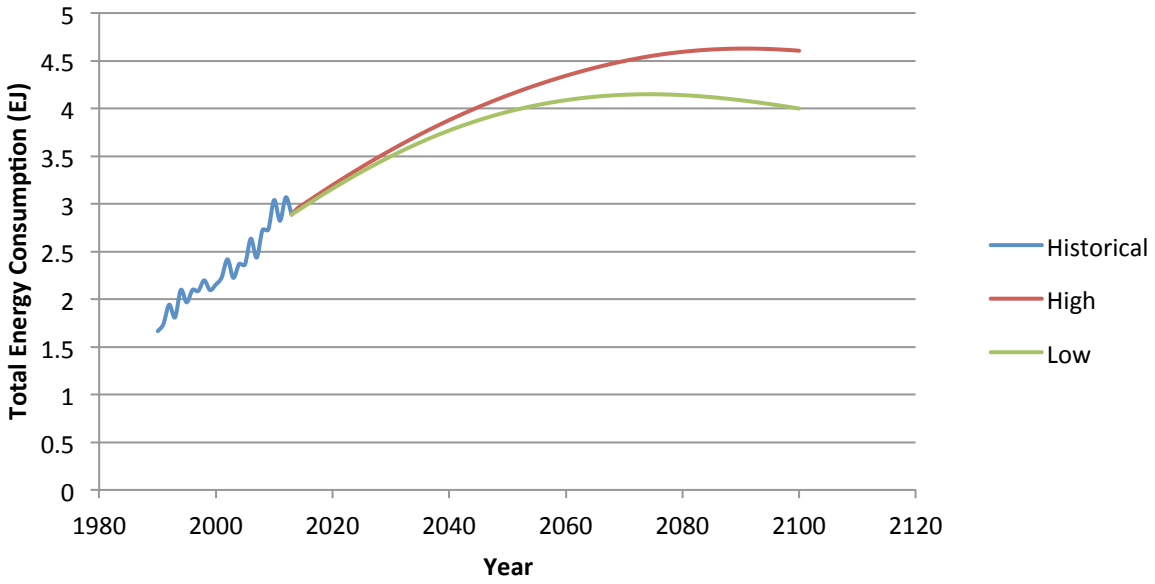

Figure 3B. Venezuela's Total Energy Consumption from 1990-2100.

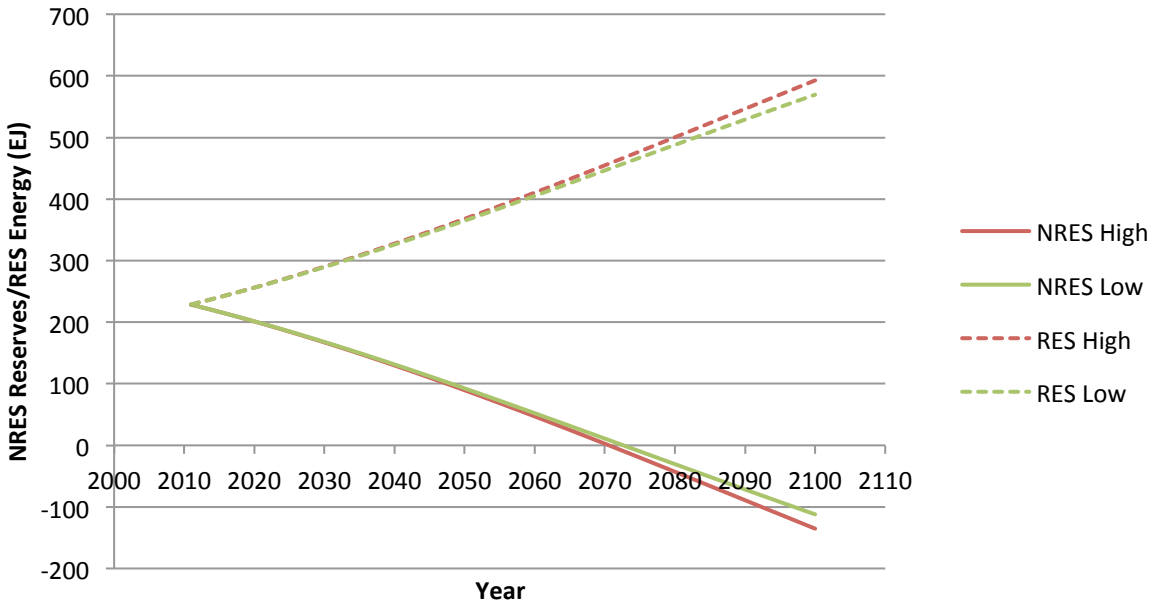

Figure 3C. Venezuela's Decrease in NRES and Increase of RES from 2011-2100.

Because developing countries will still have to increase their energy to meet the high scenario goal, and to provide 100% access to energy for those that have not already done so, the source of this energy will be crucial in the following years. These countries do have some NRES reserves currently, but not enough to last throughout the 21st century. Venezuela currently has about 230 EJ of fossil fuel reserves and will have depleted these reserves by 2070. While developing countries are not far from reaching all of the goals from these scenarios, they will still be faced with the need to increase RES (Figure 3C).

Underdeveloped countries

Countries that are considered underdeveloped are those that do not have 100% access to electricity, nor a current per capita energy consumption close to 110 GJ. The country of Nigeria represents the extreme conditions the 37 other countries in this category face when expanding energy throughout the century. Only about half of Nigeria's population has access to electricity, and those that do, only use 60 GJ per capita per annum. None of the underdeveloped countries have met the SE4All goal and thus, all have medium scenario projections.

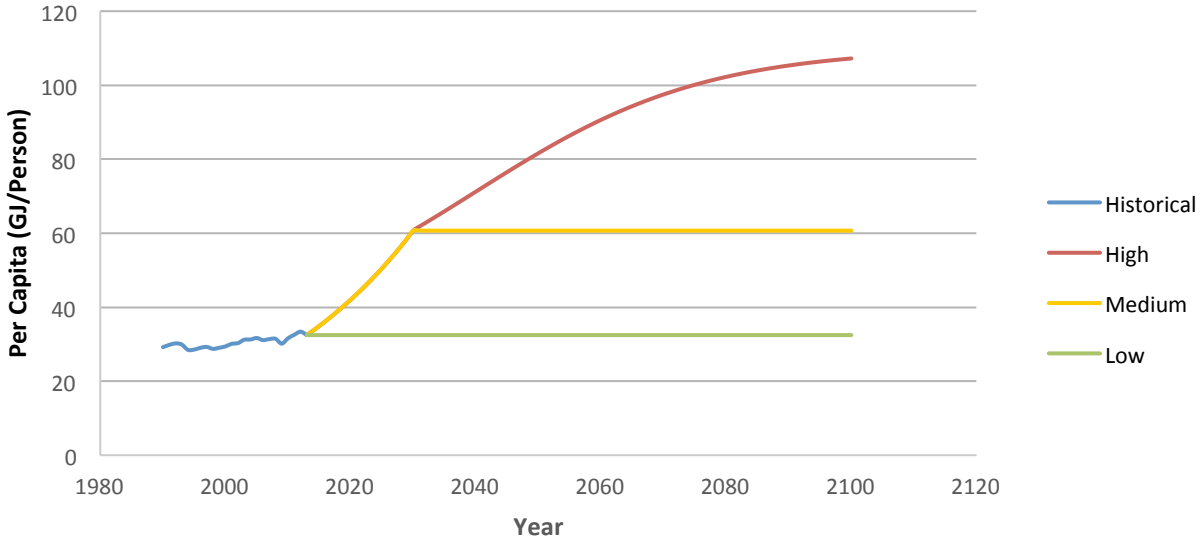

Figure 4A. Nigeria's Per Capita Energy Consumption from 1990-2100.

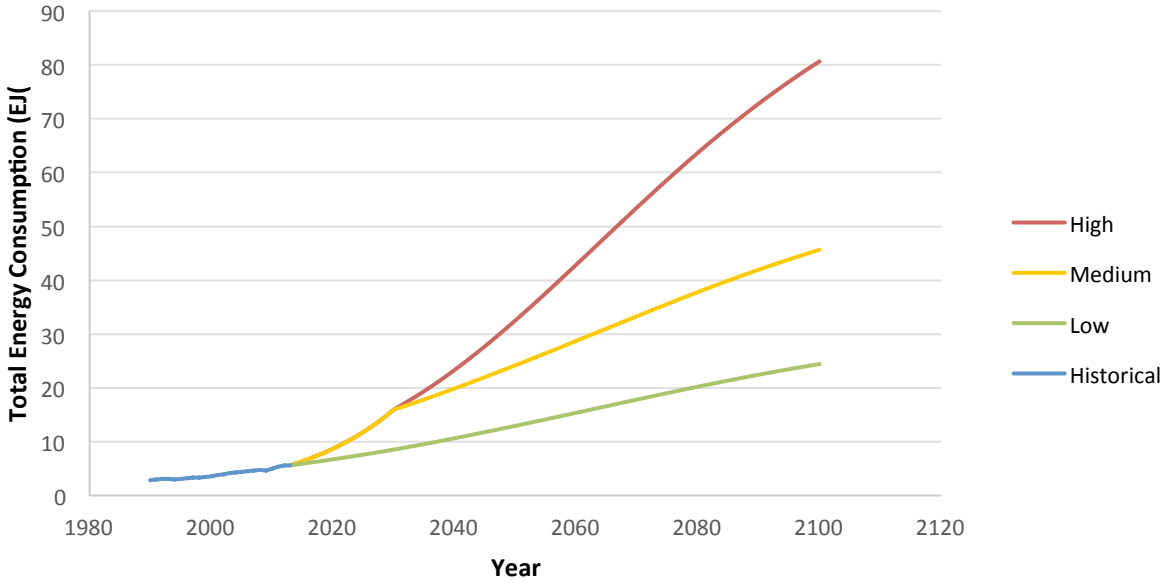

Figure 4B. Nigeria's Total Energy Consumption from 1990-2100.

Underdeveloped countries are faced with rapidly increasing populations through the end of the century. When combined with their lack of electricity access and the goal of increasing per capita energy consumption, it becomes clear how extreme the challenges for these countries are. In the

low scenario, Nigeria would have to increase its total energy by 4 times its current amount by 2100 just to provide the same amount of energy per capita as it currently does. To meet the SE4All goal by 2030, it would have to provide eight times its current amount. If Nigeria were to reach 110 GJ per capita to its total population of about 750 million in 2100, its total energy consumption would be 14 fold greater than it is today. These numbers depict the harsh futures some countries will face throughout the rest of this century.

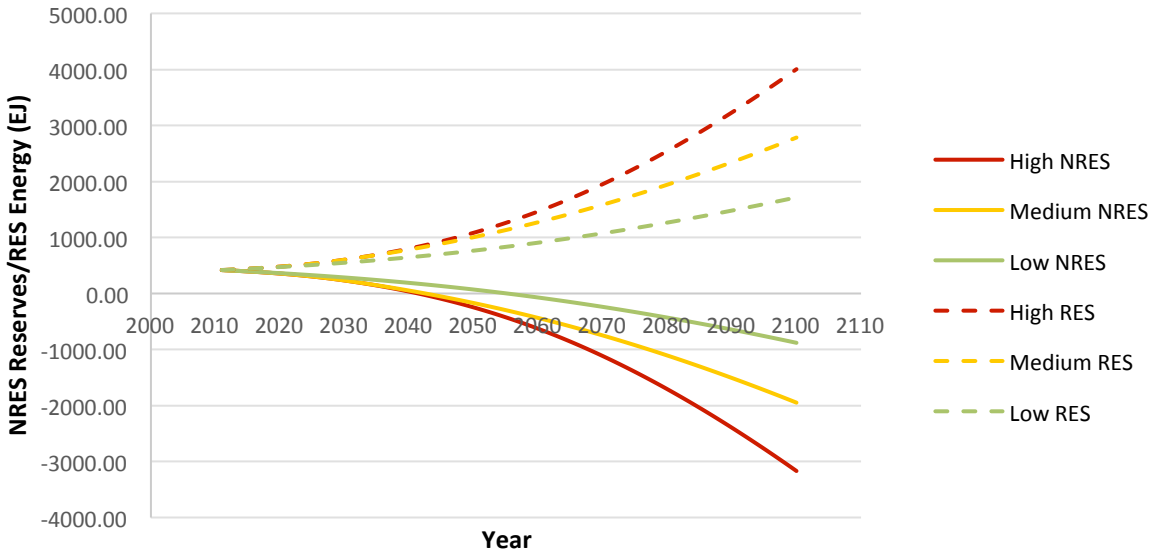

Figure 4C. Nigeria's Decrease in NRES and Increase in RES from 2011-2100.

Although underdeveloped countries will not only have to worry about the large amounts of energy they will need, but also where this energy will come from. Most underdeveloped countries do not have large amounts of fossil fuel reserves; this combined with the aim to lift their population out of poverty will increase energy consumption tremendously. Nigeria currently has 418 EJ of NRES reserves, but with its quickly increasing population, this will only last to about mid-century in any of the three scenarios.

Global perspective

When these trends for countries are mapped, clear patterns can be seen among regions. Based only on total energy consumption, the most countries categorized as underdeveloped lie within sub-Saharan Africa and South Asia, the most developing countries are in Central and South America, while Europe, North America, and Australia make up the majority of developed countries. Similarly the countries with the highest percent of their population without access to electricity are located in sub-Saharan Africa and South Asia. The same developing or underdeveloped countries also have the lowest amount of NRES reserves.

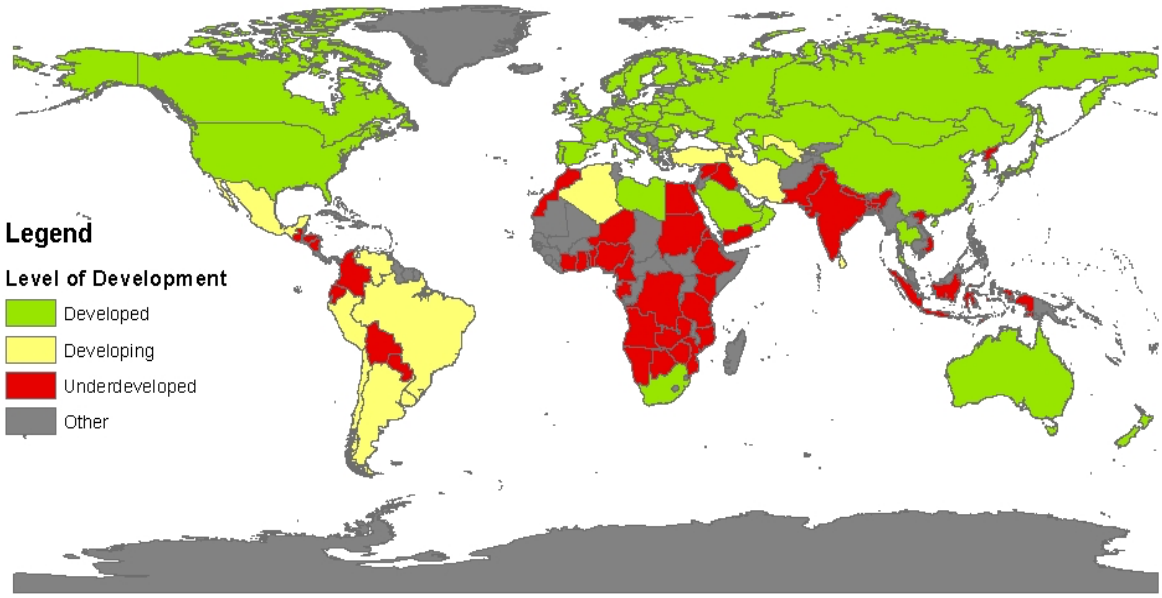

Figure 5A: Development Based on Total Energy Consumption. Note: this map describes only a country's level of energy development.

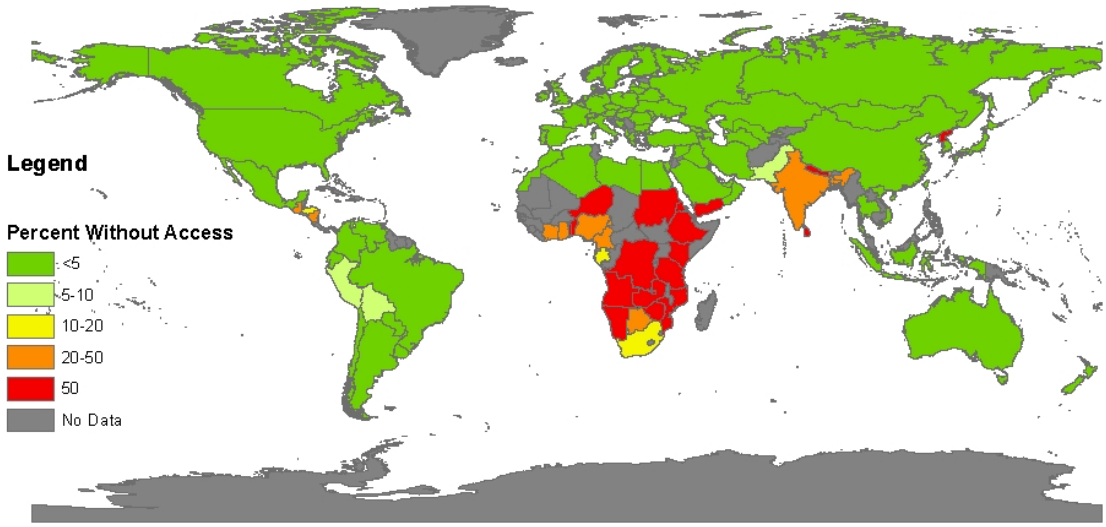

Figure 5B. Percent of Population without Access to Electricity in 2013.

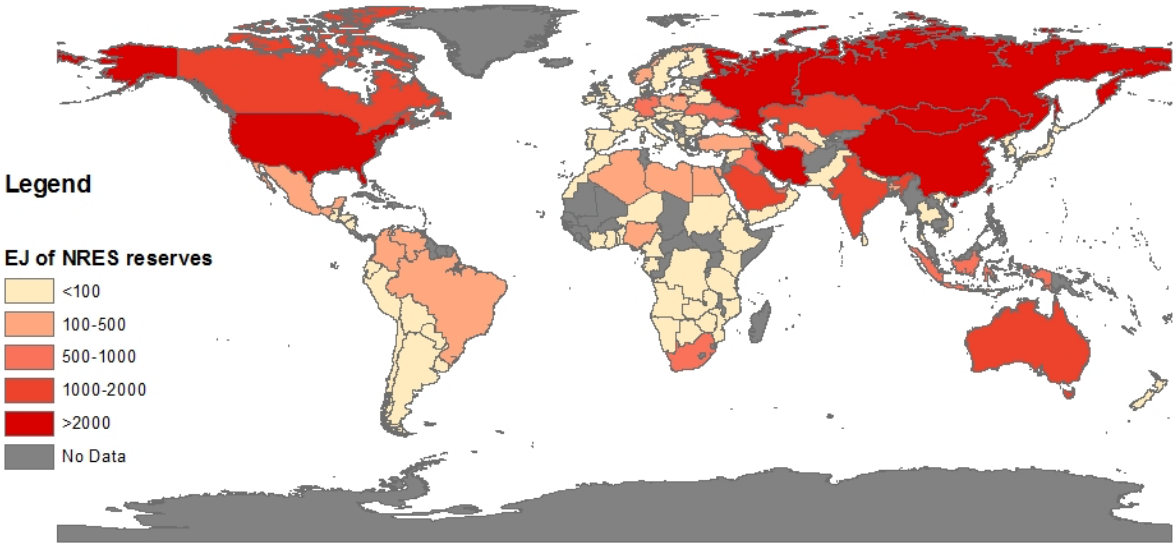

Figure 5C. The Amount of NRES Reserves in Exajoules in 2011.

Based on a global perspective of fossil fuel reserves, it is clear NRES will be the limiting factor when it comes to energy consumption through 2100. Only few countries did not have NRES reserves in 2011, they most likely rely on sources not included in this study such as nuclear energy or imported energy. However by 2100, most countries will have completely depleted their reserves. The following series of maps demonstrates the differences between the high and low scenarios. Underdeveloped and developing countries exhaust their NRES reserves more in the high scenario when compared to the low scenario. This is due to the increase in total energy consumption required for these nations to reach a per capita energy consumption of 110 GJ by 2100. This same goal makes the high scenario less taxing on developed nations because it requires them to lower their energy consumption. Ultimately, a majority of the countries in this study will be faced with depleted NRES reserves by 2100.

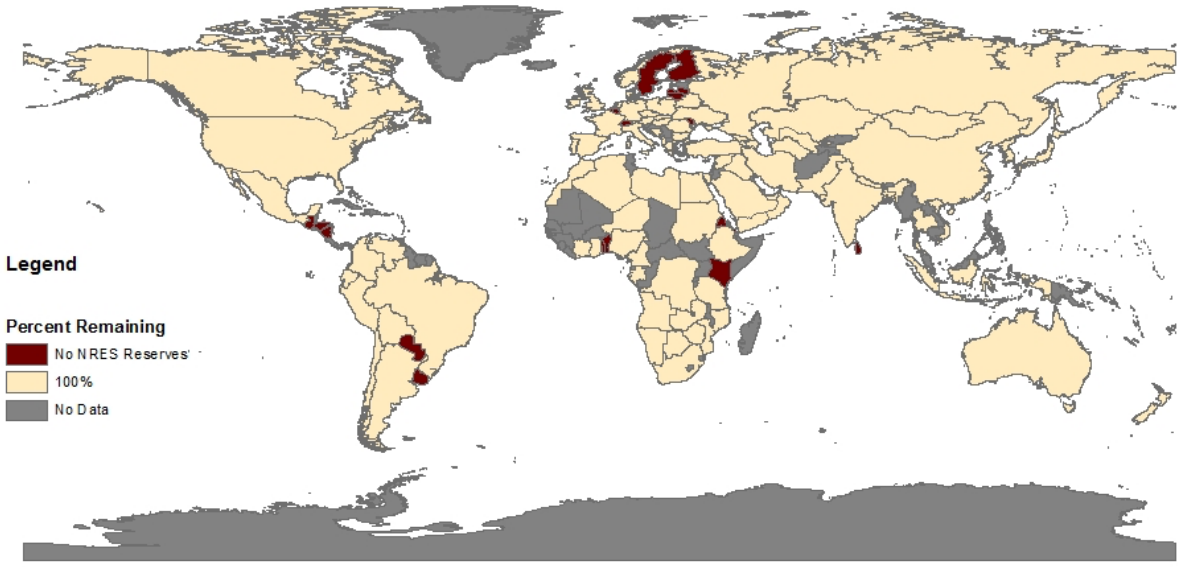

Figure 6A. The Amount of NRES Reserves Remaining in 2011.

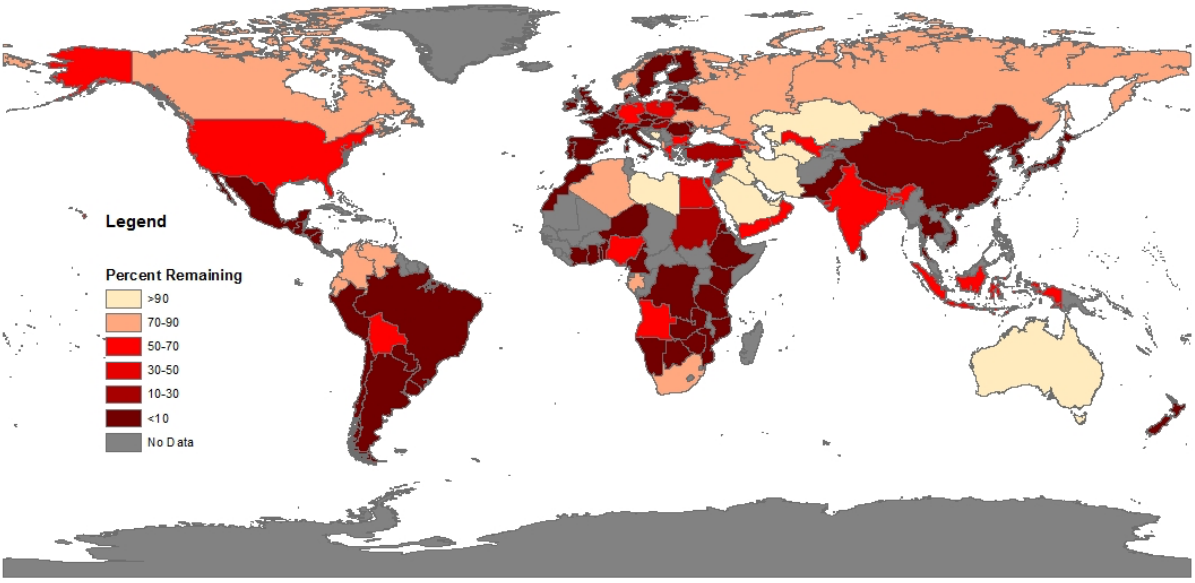

Figure 6B. Percent of NRES Reserves Remaining in 2030 in the High Scenario.

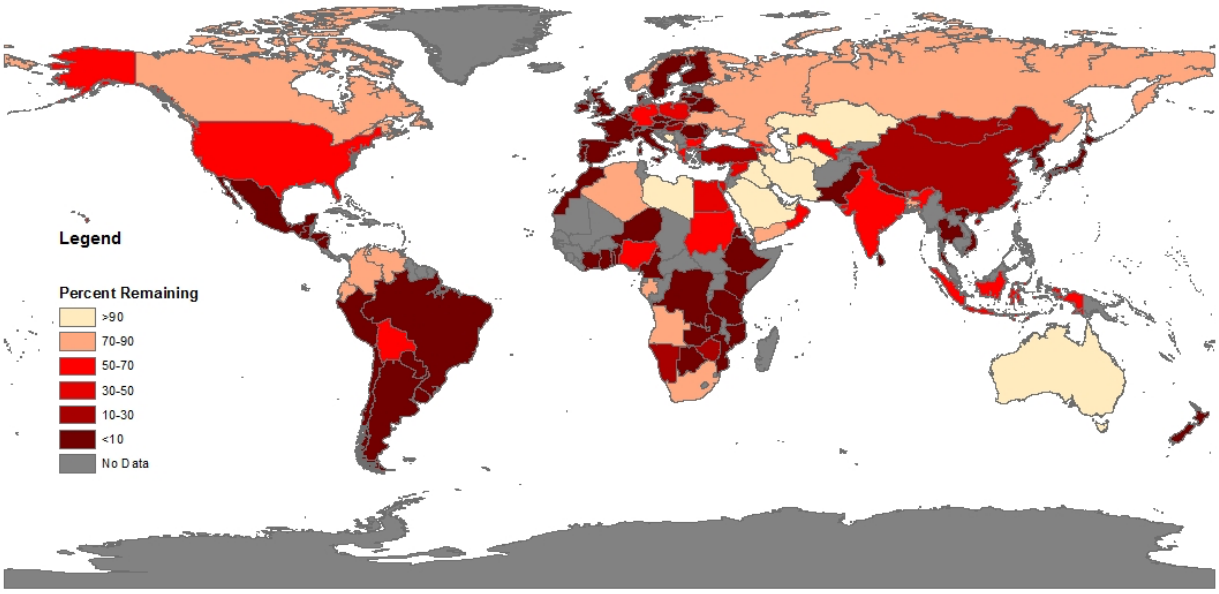

Figure 6C. Percent of NRES Reserves Remaining in 2030 in the Low Scenario.

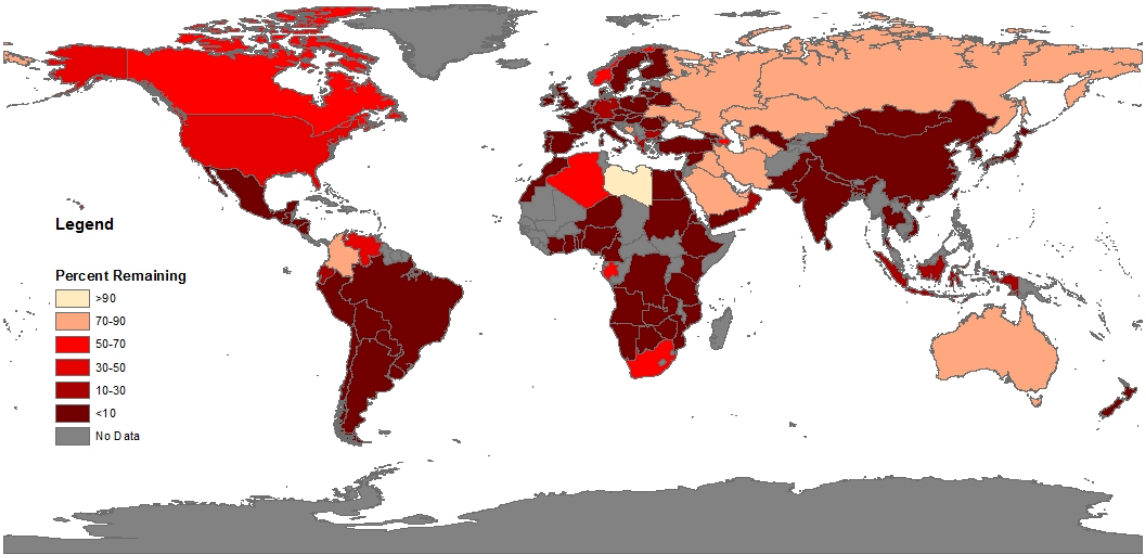

Figure 6D. Percent of NRES Reserves in 2050 in the High Scenario.

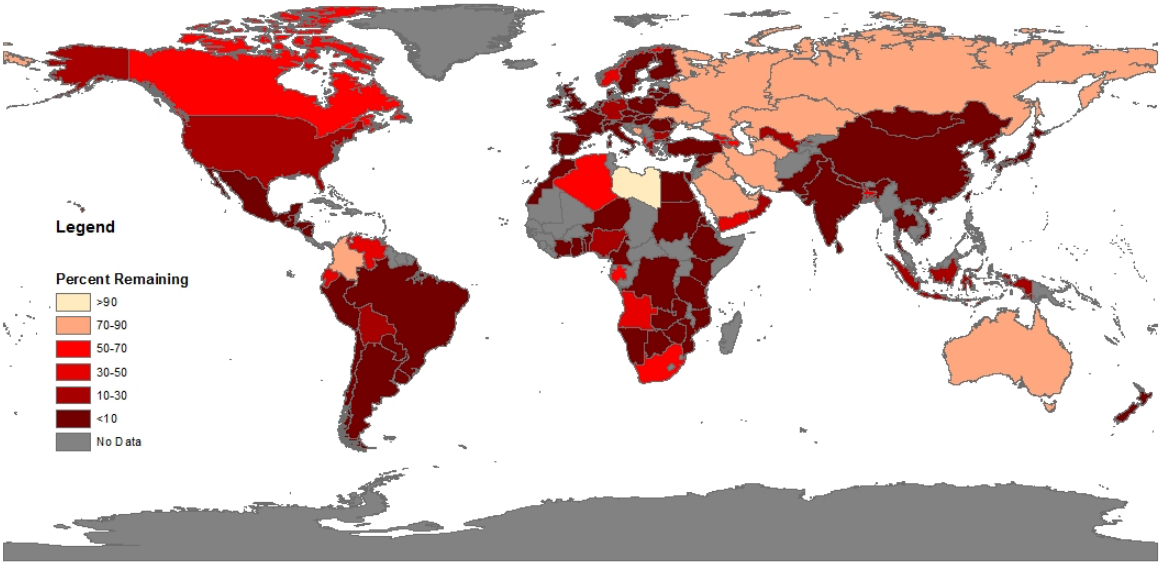

Figure 6E. Percent of NRES Reserves Remaining in 2050 in the Low Scenario.

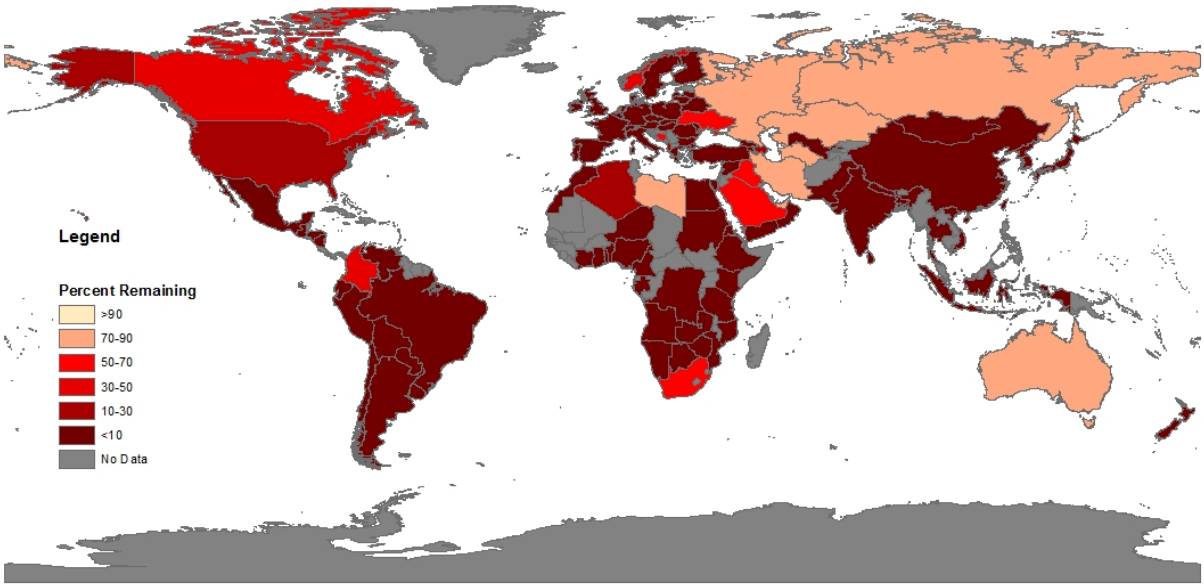

Figure 6F. Percent of NRES Reserves Remaining in 2070 in the High Scenario.

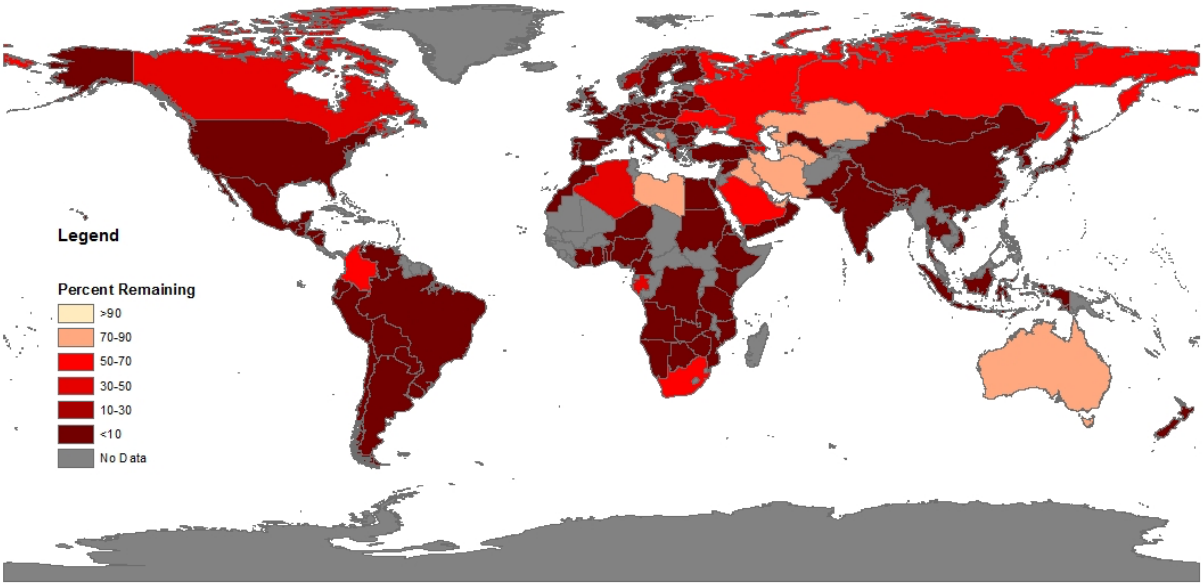

Figure 6G. Percent of NRES Reserves Remaining in 2070 in the Low Scenario.

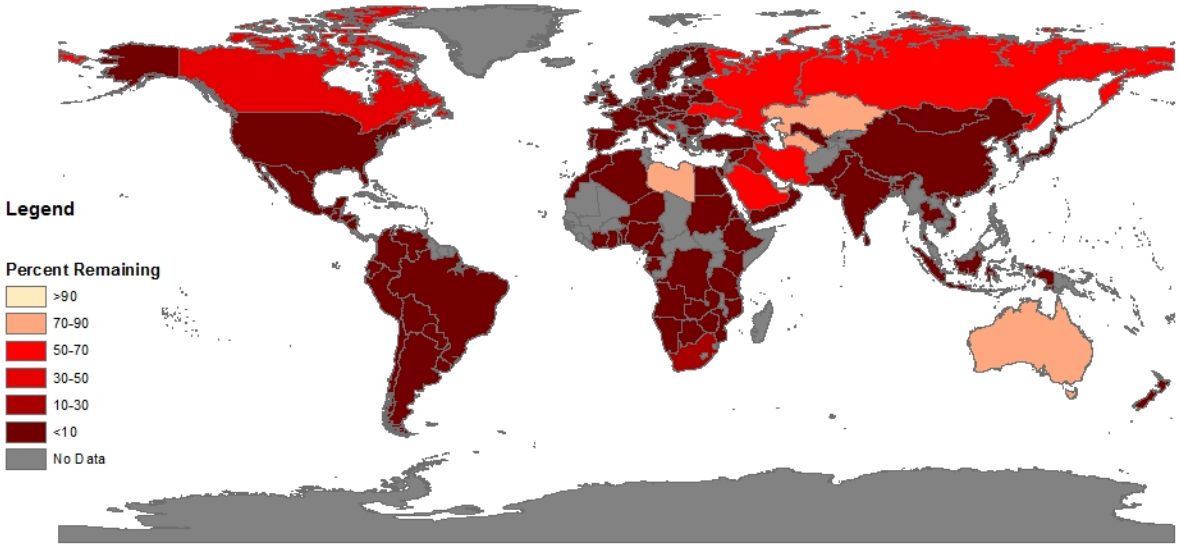

Figure 6H. Percent of NRES Reserves Remaining in 2100 in the High Scenario.

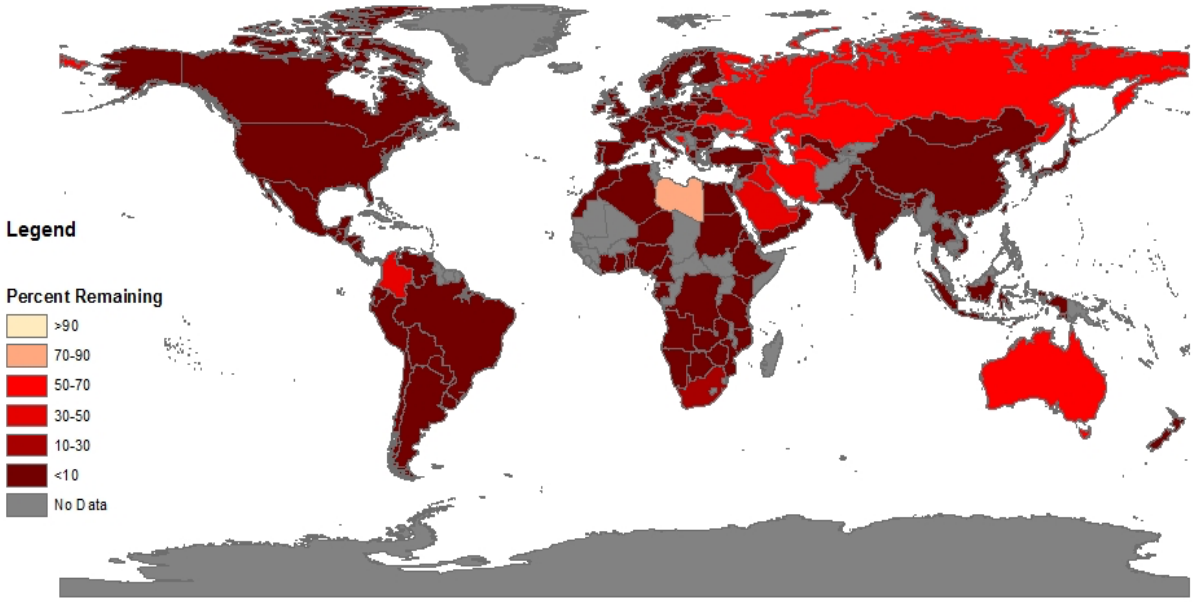

Figure 6I. Percent of NRES Reserves Remaining in 2100 in the Low Scenario.

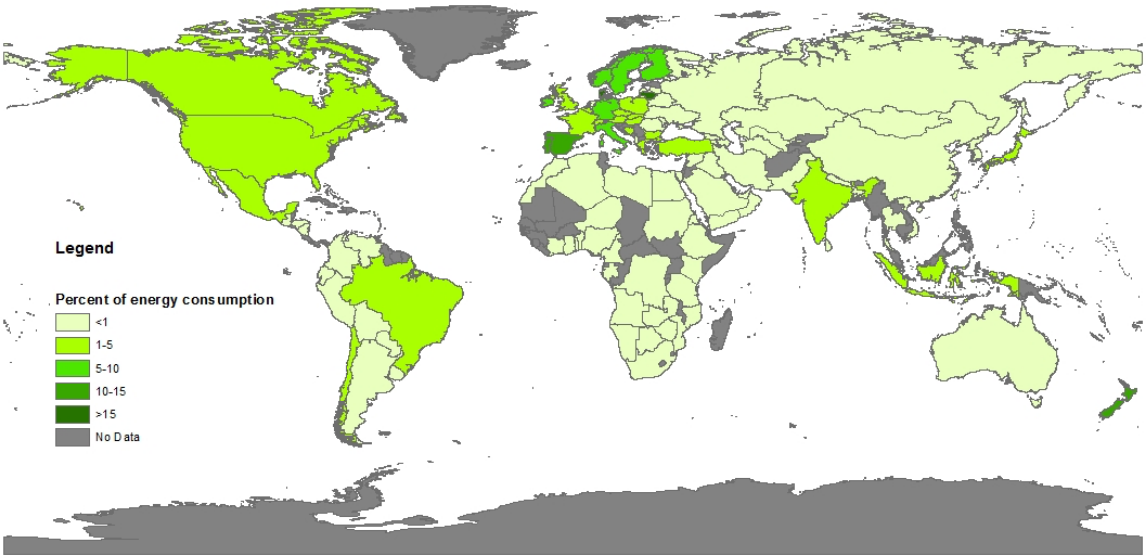

Figure 7A. Percent of Total Energy Consumption from RES in 2011

Few countries had more than 5% of their total energy consumption coming from RES in 2011. However, as the series above shows, NRES cannot be relied upon for the rest of the century. The ramp up of RES will not only be necessary to increase a country's total consumption, it will be crucial for some countries to maintain their current level of consumption. In the high scenario, developed countries will require relatively less increase in RES as they lower their energy consumption to meet 110 GJ per capita by 2100. However, for underdeveloped and developing nations, this scenario requires rapid increase in RES to not only increase consumption, but also to keep up with growing populations. In contrast, the low scenario requires greater growth in RES for developed countries as they are projected to maintain their current relatively high levels of consumption. Regardless of the scenario, it is clear, the region of sub-Saharan Africa continues to face the greatest challenge in the future energy transition.

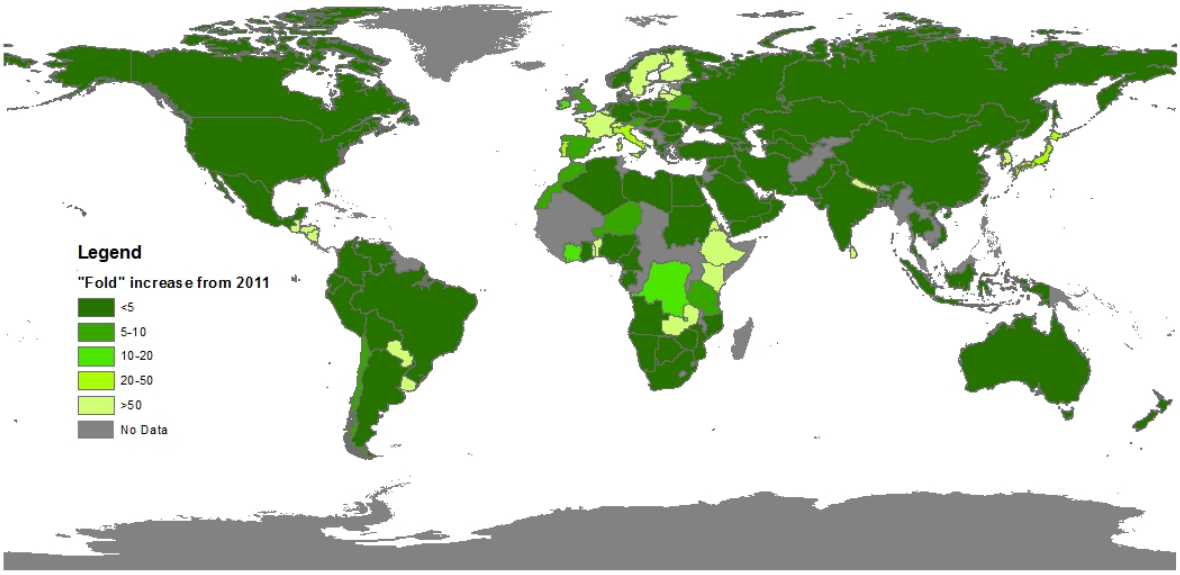

Figure 7B. Increase in RES Needed by 2030 in the High Scenario.

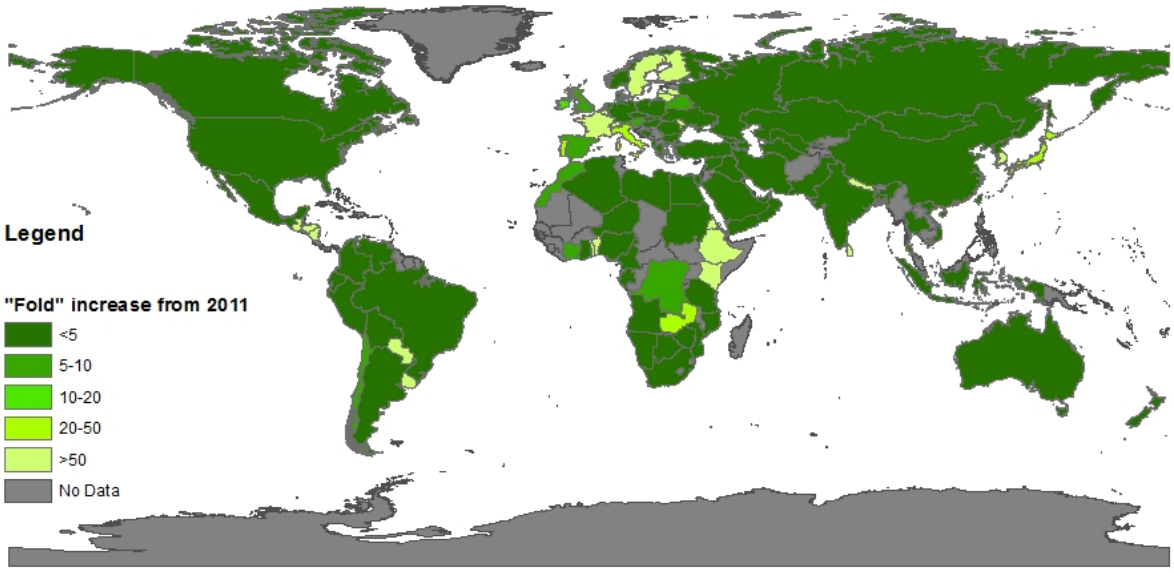

Figure 7C. Increase in RES Needed by 2030 in the Low Scenario.

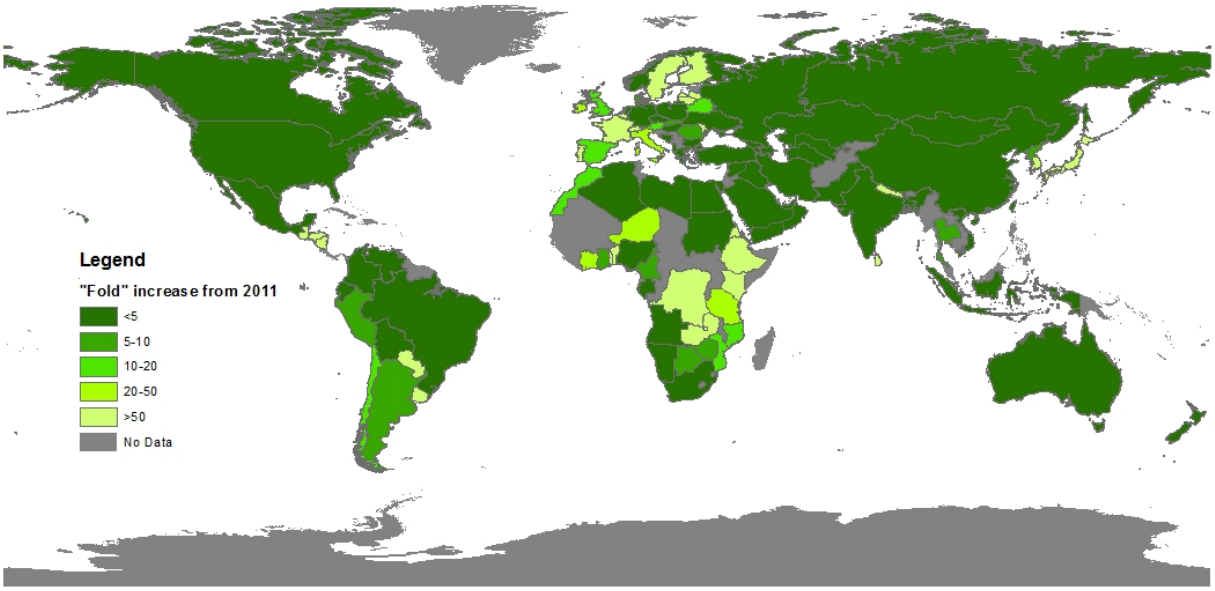

Figure 7D. Increase in RES Needed by 2050 in the High Scenario.

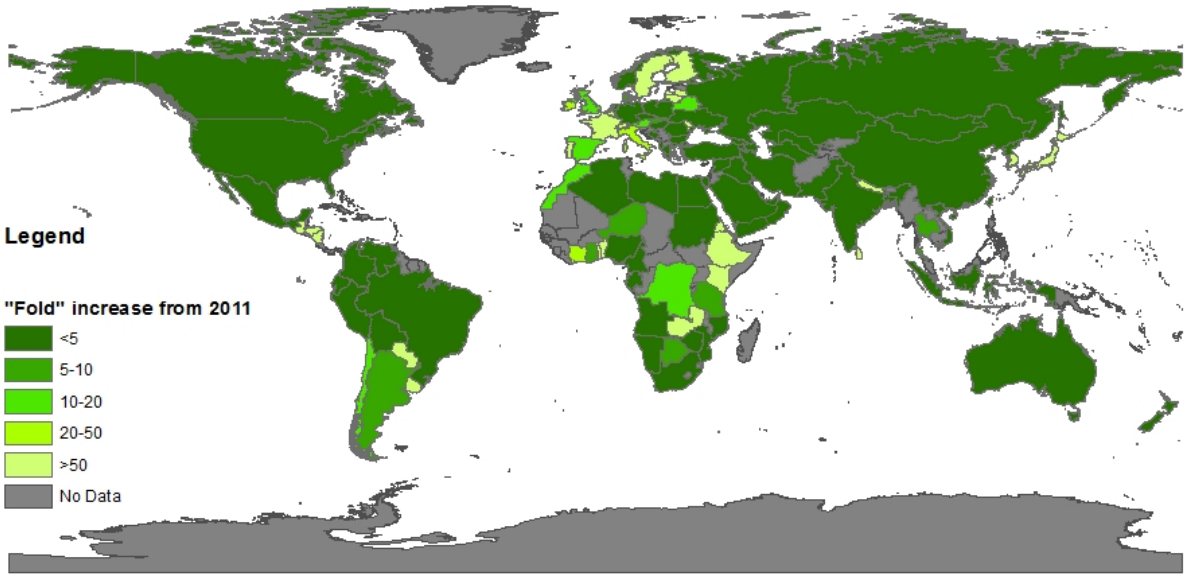

Figure 7E. Increase in RES Needed by 2050 in the Low Scenario.

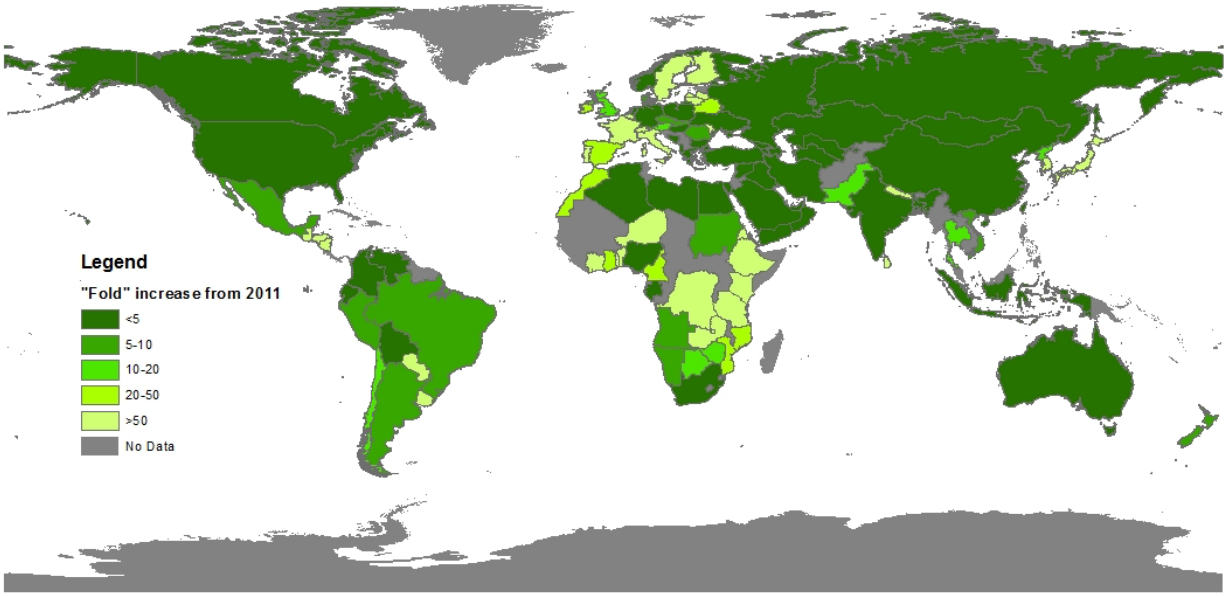

Figure 7F. Increase in RES Needed by 2070 in the High Scenario.

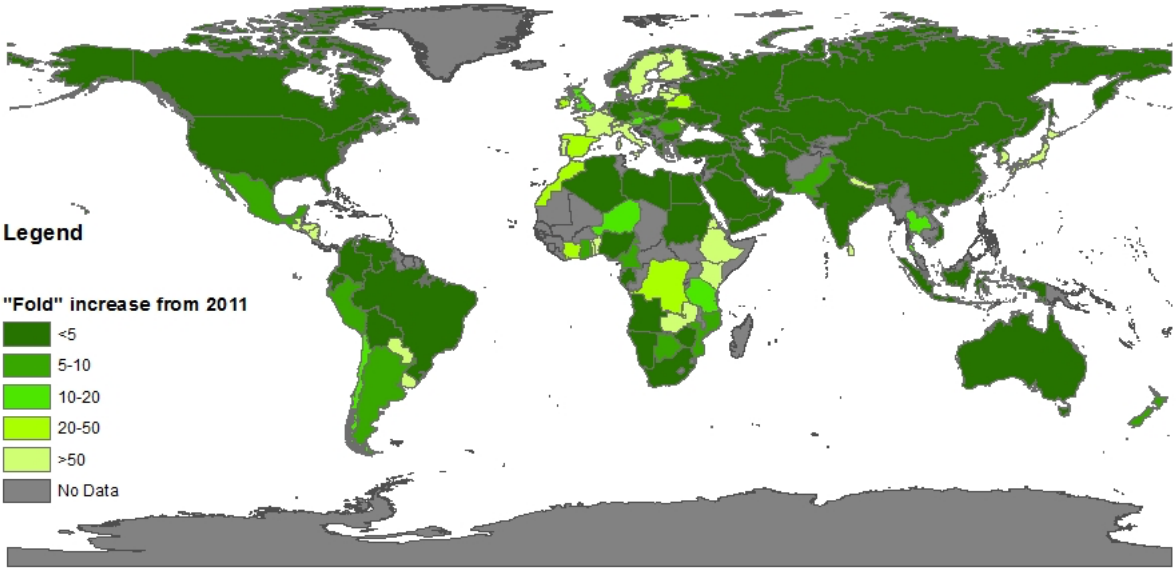

Figure 7G. Increase in RES Need by 2070 in the Low Scenario.

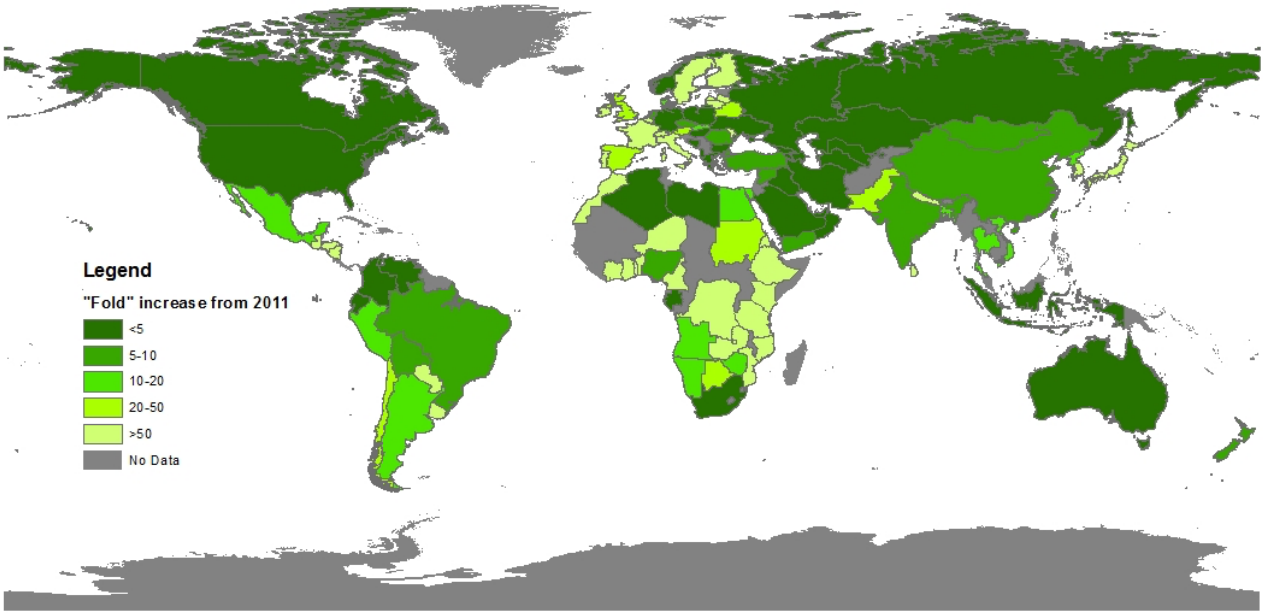

Figure 7H. Increase in RES Needed by 2100 in the High Scenario.

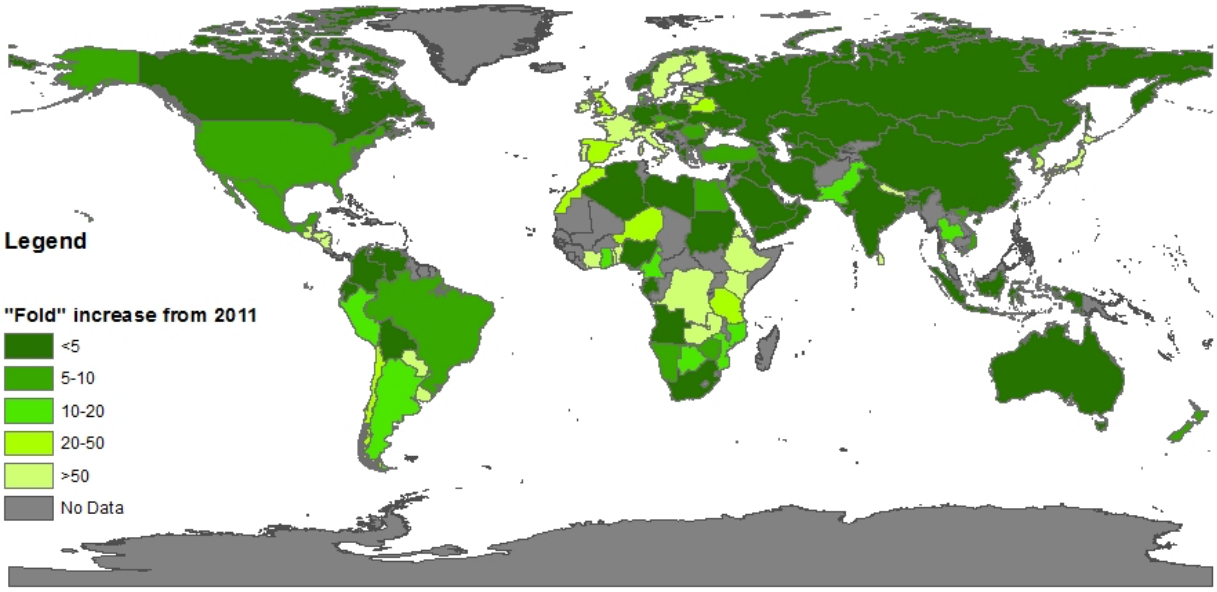

Figure 7I. Increase in RES Needed by 2100 in the Low Scenario.

CHAPTER IV

CONCLUSION

The purpose of this study was to analyze the future development of energy consumption in 100 individual countries throughout the 21st century. For this reason, there is not necessarily one all-encompassing conclusion, but rather 100 individual conclusions. The scenarios in these models depict which goals are most achievable for each country up to 2100. For some, like the underdeveloped countries, just keeping up with skyrocketing populations will be challenge enough. Developing countries might be more capable of meeting the SE4All goal of complete access to electricity if they have not already done so. While developed nations might find it more reasonable to attempt to lower their total energy consumption to 110 GJ, at which their societies will still maintain a high standard of living. However one thing is clear, almost all countries, regardless of their level of development, will deplete their NRES reserves before 2100, and thus a transition to RES, as suggested by preceding studies (e.g. Moriarty and Honnery, 2012 and Jones and Warner, 2016) will be essential.

Many factors must be considered when contemplating an increase in RES to the point of eventually replacing NRES. Each of the major NRES (i.e. coal, oil, and natural gas) took 50 to 60 years to reach their highest point as a fuel source (Smil, 2014). Because the transition to renewables may take decades as well (Davis et al., 2010, Hirsch et al., 2005, and Smil, 2014), the results of this study show that many countries' (e.g. Argentina, Netherlands, Niger) NRES will be depleted before this is possible. Additionally, the resources used to ramp up RES infrastructure may also be a limiting factor. Not only will the production of RES require

significant energy (Frizaine and Court, 2015), it will also require valuable resources such as copper and lithium that will become more limited throughout the century as well (Kerr, 2014 and Vistrom et al, 2013).

The combination of factors including population, energy consumption, access to electricity, and NRES reserves allow this study to not only analyze the development of energy consumption in individual countries in three different scenarios throughout the 21st century, but also to assess how achievable the goals of these scenarios are for each country. While analysis of these factors highlight the critical condition of energy development in underdeveloped countries, specifically those in sub-Saharan Africa, it also exposes the need to mitigate NRES depletion in all countries before the end of the century.

REFERENCES

Banerjee, S., Bhatia, M., Azuela, G., Jaques, I., Sarkar, A., Portale, E., et al. (2013). *Global Tracking Framework. Sustainable Energy for All.* Washington DC: The World Bank.

BP. (2015). BP Statistical Review of World Energy. London: British Petroleum.

Davis, S., Caldeira, K., & Matthews, H. (2010). Future CO2 Emmisions and Climate Change from Existing Energy Infrastructure. *Science , 329*, 1330-1333.

EIA. (2015). *International Energy Statisticas*. Retrieved 2016, from U.S. Energy Information

Fizaine, F., & Court, V. (2015). Renewable Electricity Producing Technologies and Metal Depletion: a Sesitivity Analysis Using the EROI. *Ecological Economics , 110*, 106-118.

Gerland, P., Raftery, A., Sevcikova, H., Li, N., Gu, D., Spoorenberg, T., et al. (2014). World Population Stabilizaiton Unlikely this Century. *Science , 346*, 234-237.

Hirsch, R., Bezdek, R., & Wendling, R. *Peaking of World Oil Production: Impacts, Mitigation, & Risk Management.* SAIC/USDOE.

Hubbert, M. (1956). *Nuclear Energy and the Fossil Fuels.* Houston: Shell Development Company.

IEA. (2015). *Statistics*. Retrieved 2015-2016, from IEA: http://www.iea.org/statistics/statisticssearch/

Jones, G., & Warner, K. (n.d.). The 21st Century Population-Energy-Climate Nexus. *Energy Policy*.

Kerr, A. (2014). The Coming Copper Peak. *Science , 323*, 722-724.

Lambert, J., Hall, C., Balogh, S., Gupta, A., & Arnold, M. (2014). Energy, EROI and Quality of LIfe. *Energy Policy , 64*, 153-167.

Maggio, G., & Cacciola, G. (2012). When Will Oil, Natural Gas, and Coal Peak. *Fuel , 98*, 111-123.

Moriarty, P., & Honnery, D. (2012). What is the Global Potential for Renewable Energy? *Renewable and Sustainable Energy Reviews , 16*, 244-252.

Smill, V. (2014). The Long Slow Rise of Solar and Wind. *Scientific American , 310*, 52-57.

Suganthia, L., & Samuel, A. A. (2011). Energy models for demand forecasting: A review. *Renewable and Sustainable Reviews , 16* (2), 1223–1240.

UN. (2015). *Human Development Reports*. Retrieved 2016, from United Nations Development Programme: http://hdr.undp.org/en/content/human-development-index-hdi

United Nations, Department of Economic and Social Affairs, Population Division (2015). World Population Prospects: The 2015 Revision, DVD Edition.

World Bank. (2013). *Sustainable Energy for All: Global Tracking Framework.* Retrieved September 18, 2015, from World Bank: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/05/28/000112742_20130528084417/Rendered/PDF/778890GTF0full0report.pdf

Vikstrom, H., Davidsson, S., & Hook, M. (2013). Lithium Availability and Future Production Outlooks. *Applied Energy , 110*, 252-266.

APPENDIX A

Table 1. List of All Countries in the Study with Level of Development based on Energy.

Country	**Level of Development**
Albania	Developing
Algeria	Developing
Angola	Underdeveloped
Argentina	Developing
Armenia	Developing
Australia	Developed
Austria	Developed
Azerbaijan	Developing
Bangladesh	Underdeveloped
Belarus	Developed
Belgium	Developed
Benin	Underdeveloped
Bolivia	Underdeveloped
Bosnia and Herzegovina	Developed
Botswana	Underdeveloped
Brazil	Developing
Bulgaria	Developed
Cameroon	Underdeveloped
Canada	Developed
Chile	Developing
China	Developed
Colombia	Developing
Congo DRC	Underdeveloped
Côte d'Ivoire	Underdeveloped
Czech Republic	Developed
Denmark	Developed
Ecuador	Underdeveloped
Egypt	Underdeveloped
Eritrea	Underdeveloped
Ethiopia	Underdeveloped
Finland	Developed
France	Developed
Gabon	Underdeveloped

Georgia	Developing
Germany	Developed
Ghana	Underdeveloped
Greece	Developed
Guatemala	Underdeveloped
Honduras	Underdeveloped
Hungary	Developed
India	Underdeveloped
Indonesia	Underdeveloped
Iran	Developing
Iraq	Underdeveloped
Ireland	Developed
Italy	Developed
Japan	Developed
Kazakhstan	Developed
Kenya	Underdeveloped
Latvia	Developed
Libya	Developed
Lithuania	Developed
Mexico	Developing
Moldova	Developing
Mongolia	Developed
Morocco	Underdeveloped
Mozambique	Underdeveloped
Namibia	Underdeveloped
Nepal	Underdeveloped
Netherlands	Developed
New Zealand	Developed
Nicaragua	Underdeveloped
Niger	Underdeveloped
Nigeria	Underdeveloped
North Korea	Underdeveloped
Norway	Developed
Oman	Developed
Pakistan	Underdeveloped
Paraguay	Underdeveloped
Peru	Developing
Poland	Developed
Portugal	Developed
Romania	Developed
Russian Federation	Developed

Saudi Arabia	Developed
Slovakia	Developed
South Africa	Developed
South Korea	Developed
Spain	Developed
Sri Lanka	Developing
Sudan	Underdeveloped
Sweden	Developed
Switzerland	Developed
Syria	Underdeveloped
Tanzania	Underdeveloped
Thailand	Developed
Togo	Underdeveloped
Turkey	Developing
Turkmenistan	Developed
Ukraine	Developed
United Arab Emirates	Developed
United Kingdom	Developed
United States	Developed
Uruguay	Developing
Uzbekistan	Developing
Venezuela	Developing
Vietnam	Underdeveloped
Yemen	Underdeveloped
Zambia	Underdeveloped
Zimbabwe	Underdeveloped