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Energy Poverty and Justice: Using Renewable Energy in Marginalized Countries to Overcome Climate Change and Support Human Development

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ABSTRACT

Energy Poverty and Justice: Using Renewable Energy in Marginalized Countries to Overcome Climate Change and Support Human Development

Drema Khraibani

Energy poverty is limited to no access to affordable, reliable, and efficient form of energy. Currently, there are 1.3 billion people living in energy poverty, being deprived of their basic need. Providing access to a billion people has become a global goal and movement for energy justice. With IPCC warning about global fossil fuel consumption, energy development has moved towards renewable options.

Renewable energy provides those previously without access an ability to meet rudimentary needs. It can uplift communities and families from extreme poverty by easing their labor and extending the time they have to work after dark. Renewable energy can empower women by providing them a chance to work and trade. It powers electricity that provides children opportunities to study at night. Renewable energy powers a movement of development when the source is installed in needed locations and with governmental support.

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DEDICATION

"*My thanksgiving is small*

before Thy great boons,

and my praise and news-spreading shrink

beside Thy generosity toward me!

Thy favors have wrapped me

in the robes of the lights of faith,

and the gentlenesses of Thy goodness have let down over me

delicate curtains of might!"

Excerpt from *The Whispered Prayers* of Imam Zain Al-Abideen (as)

To the most amazing four parents I could be blessed with, to my brothers, cousins, friends and family around the world, and to everyone that never stopped believing in me,

Thank you for everything!

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Introduction:

As the global population increases, the demand for electricity will increase, which may cause more people to live under circumstances of limited or no access to energy. Currently, there are approximately 1.3 billion people without access to electricity. Another billion are without reliable energy access (Casillas, 2010). Future projections do not look much different from the current state. In the next 15 years, projections indicate that one billion people will still not have access to electricity (Association, 2012). Even with the growing world population, energy would continue to be limited to billions.

Poverty is a broad term that not only means limited monetary income; the term can include alternative forms of poverty. The United Nations Development Program's Human Development report has explained poverty to be a multi-dimensional concept including literacy, housing quality, access to energy and other factors (Drupady, 2012). One of the alternative forms and dimensions of poverty is energy access. The inability to have access to energy is defined by the International Energy Agency as "energy poverty" (I. E. Agency, 2011; Casillas, 2010). To further elaborate on the definition, the World Energy Assessment has stated,

> "energy poverty - may be defined as the absence of sufficient choice in accessing adequate, affordable, reliable, quality, safe and environmentally benign energy services to support economic and human development" (Cecelski, 2000).

Humans living in conditions which do not provide affordable, consistent, and safe energy services are in energy poverty; and access to reliable energy sources has been mentioned as part of the process to reduce poverty. Global goals have been set to reduce poverty such as the Millennium Development Goals (MDG). Part of the MDG's aim is to reduce the amount of people who live on less than a dollar per day. In order for that goal to be met, access to affordable energy is a must (Pachauri, 2004). Access to energy to meet the goals and improve lives has become an environmental movement.

Energy poverty and the lack of reliable energy to billions of people has become a social justice issue. Social justice is concerned with the distribution of equal opportunity to acquire basic goods that will provide the chance for a productive life (Benjamin K. Sovacool, 2014). Assuming this concept of social justice is accepted, global distribution of energy services would become critically important across societies (Benjamin K. Sovacool, 2014). A new concept arises from the equal distribution of energy, termed *energy justice*. Research on energy justice is limited and circumscribed in theoretical and empirical concerns (Karen Bickerstaff, 2013). A variety of definitions for energy justice have recently been introduced in literature. While each definition is slightly different, based on the individual perspectives of scholars, such as; Bickerstaff, Sovacool and others, at the core of every definition is equal distribution and fair access to reliable energy (Martins, 2005).

Access to energy can be a life changing experience for families. Once families are able to access a consistent and efficient form of energy, children are able to study and mothers

are able to cook (Cecelski, 2000; Kammen, 2008; Martins, 2005). With energy, families will stay in their houses longer where they are protected and crime rates will decrease (Kammen, 2008; Martins, 2005). With clean energy access, families are not exposed to health effects from wood or biomass usage (Drupady, 2012). The discussion of energy and justice is crucial because of the improvements to living conditions that access to energy provides. Another significant reason to focus on energy justice is,

> "Energy makes available for human use historically unprecedented amounts of power, and this power, like all forms of power, harbors a potential for domination. The most basic form this domination takes is the instrumental domination of energy as a means over the ends it serves" (Benjamin K. Sovacool, 2014).

Energy is not only a chance for families to move out of poverty but also a source of power for families, communities, and nations.

The energy sources that should provide for billions of people and protect the environment are forms of renewable energy; if energy access is met by fossil fuel systems, then the climate will be drastically affected. The expected increase in demand for energy access from the 1.3 billion people that are currently without, may well cause dire climate impact (Casillas, 2010). Additionally, the effects of climate change exacerbate the levels of poverty. Casillas et al., has identified that "alleviating poverty is hindered by two interlinked phenomena: lack of access to improved energy services and worsening environmental shocks due to climate change" (2010). However, renewable energy can alleviate poverty by providing access to energy services and expand income-generation activates, not impact

climate change, and diversify the economy of marginalized countries who will face increased fossil fuel shocks (Drupady, 2012).

Background:

Vocabulary in academic papers can carry different meanings either due to context, education, or references. The following sections provide an insight into different definitions of terms that will be used during the paper. Additionally, the section provides a deeper understanding of data and historical information.

Electrification Data:

Currently in the world, there are 1,258 million people without access to electricity. The following is a breakdown of regions and countries' accessibility to energy. The global electricity rate is eighty-two percent. Urban electrification is the highest at ninety-four percent compared with rural electrification rate of sixty-eight percent. Africa has an average forty-three percent electrification rate; North Africa with ninety-nine percent and sub-Saharan Africa with thirty-two percent. India's rate is seventy-five percent, China's rate is hundred percent and the average of the rest of developing Asia is at eighty-three percent. Latin America has the highest average of ninety-five percent and the Middle East is ninety-two percent. In comparison, transition economics and OECD have a hundred percent electrification rate, however, that still would leave one million people without access to

electricity. For both China and OECD countries the percentage electrified is hundred, however, there still are people without electricity. The millions of people without electricity is a small percentage compared to the total population of OECD countries and China, which is less than 0.001 percent. For this reason, the percentage is calculated to be hundred. This data comes from the most recent 2014 publication by the IEA in their World Energy Outlook report, as seen in table 1.

In the earliest report about energy access in 2002, IEA included projections for 2015 and 2030. Figure 1 compares the most recent electrification rates with the projections from 2002. There is only one region that failed to meet their electrification rates and that region was the Middle East. There is a five percent difference between projected and current rates. We cannot compare information for Asia because of the development and changes in reports over time. Reports have developed over the past decade, and as such, there are slight differences in the tables produced by the IEA. In the WEO 2002 report there were only two projections: South Asia and East Asia/China. The current data separates India and China from the rest of developing Asia.

Traditional Use of Biomass

Currently, in the world there are 2,679 million people relying on traditional use of biomass for cooking. The following is a breakdown of regions and countries with regards to traditional use of biomass. The percent of the world relying on traditional use of biomass is

four percent. There are 728 million people in Africa using biomass with the majority of the population in Sub-Saharan Africa at 727, leaving one million in Northern Africa. Developing Asia has the largest population relying on the use of biomass with 1,875 million people. China comprises of 448 million and India with 815 million. Southeast Asia has 280 million and the rest of developing Asia is at 332 million. Latin America has sixty-eight million with Brazil at highest of thirteen million. The Middle East has eight million with the majority in Yemen. This data comes from the most recent 2014 World Energy Outlook publication by IEA, as seen in table 2.

Millennium Development Goals:

In September of 2000, the Millennium Summit was held to discuss a two-year consultancy process. The birth of the United Nations Millennium Declaration came out of the summit. This declaration declares certain fundamental values to be essential for the twenty-first century: freedom- men and women have the right to raise a family from hunger, fear of violence, oppression, or injustice; equality- no nation can be denied an opportunity for development; solidarity- distribution of costs and burdens should be fair in accordance with basic principles of equity and social justice; tolerance- humans must respect one another within regards to their diversity in belief, culture, and language; respect for nature- prudence should be shown to all living species and natural resources in accordance to sustainable development; and shared responsibility- responsibility for managing global

economic, social development and international peace and security must be shared amongst nations (Assembly, 2000). These values are incorporated into the essence of the Millennium Development Goals.

The declaration inspired 189 nations to come together to form the Millennium Development Goals (MDGs), a pledge to aid people in poverty and other deprivations by 2015. Eight goals were created after the Millennium Summit of the United Nations. These goals are; 1) to eradicate extreme poverty and hunger, 2) to achieve universal primary education, 3) to promote gender equality, 4) to reduce child mortality, 5) to improve maternal health, 6) to combat HIV/AIDS, malaria, and other diseases, 7) to ensure environmental sustainability, and 8) to develop a global partnership for development. Each of the eight goals has specific aims and dates to reach the stated targets.

As of 2013, several MDG targets were achieved. Global poverty levels have declined by twenty-two percent from the 1990 level of half of the population in developing regions to 700 million. Drinking water has become available to 2.3 billion people. There is little to no gender disparity at primary education levels. Other goals have been achieved but there is still more that must be done. The deadline has approached for the MDGs and the secretary general is planning a post-2015 development agenda. The post-2015 agenda will incorporate the outcomes from Rio+20 in 2012 with the creation of the Sustainable Development Goals and current MDG goals. UN hopes to create a global development agenda that reduces poverty and maintains sustainable development at its core (Affairs, 2014).

Energy Poverty:

The IEA has defined energy poverty as the lack of access to modern energy services. Modern energy services are defined as household access to electricity and clean cooking facilities (I. E. Agency). In addition, the World Energy Assessment has identified that energy poverty could also entail the absence of choice to affordable, reliable, and safe energy services (Cecelski, 2000). Energy poverty includes the limited access to a variety of energy services. It is important to include affordability for energy access because of the disproportionately large amounts the poor pay for energy in comparison to higher economic statuses.

There are three ways to measure energy poverty. The first way is identifying the energy poverty line or fuel poverty line. This can be found either through income calculations or expenditure poverty measure. Calculations are done by determining energy use as a poverty function of income or expenditure and by calculating the average level of energy use corresponding to an amount of income or expenditure specified by the official or expenditure poverty line. The expenditure poverty line is the level at which the minimum amount of income is needed to meet basic needs. An alternate method of obtaining the energy poverty line can be achieved by looking at energy use at the aggregate national level in relation to other broader measures of poverty (Pachauri, 2004). The first method is a simple math calculation, however, the product is also simplistic in its meaning. The resulting number only shows a single energy or fuel poverty line, which shows little to no insight.

The second method to measuring energy poverty uses engineering estimates to determine direct energy required to meet basic needs. An area is considered impoverished if energy does not meet basic needs. In order to make these estimates they need to assume different aspects of the energy sources, because of this, there are several issues that are faced when making those calculations. They require certain assumptions for the calculations to be conducted, such as: the type of energy consuming equipment, their size, efficiencies, and intensity of use. Additionally, basic needs are coherent to various climates, regions, period in time, age and sex. This approach does have a benefit, in that it allows for specification between rural and urban basic needs (Pachauri, 2004).

The final method measures poverty in terms of access to energy services. This method measures the energy options available for electricity usage by a household. In this measurement, a household with fewer choices of energy services for access is in energy poverty. This measurement could be used as a consumption-based measure of poverty. The consumption measures would show levels of energy usage at different poverty levels, providing an index of opportunities (Pachauri, 2004).

Social Justice

The term social justice dates back to different philosophical eras but was not explicitly used until the 1840s. John Rawls derived the current term of use from the philosophy of the social contract. His definition of social justice states that "[it] provide a way of assigning rights

and duties in the basic institutions of society and they define the appropriate distribution of benefits and burdens of social cooperation" (Rawls, 1971). To simplify the definition, social justice is about the distribution of benefits and burdens in society.

Environmental Justice

Rawls' definition of justice can be applied and used when defining other forms of justice. His theories are what defined justice studies, mainly the focus on distribution of goods in society and the best principles to distribute those goods (Scholsberg, 2007). Environmental justice is relatively a new term in comparison with social justice. Academics have been discussing the meaning of environmental justice for two decades (Scholsberg, 2007). Most of the literature on environmental justice revolves around the distribution of burdens unequally on minorities of race, color, gender, and social economics. The US Environmental Protection Agency has a definition on environmental justice:

> Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (E. P. Agency, 2012).

Environmental justice first became a movement in the USA during the 1980s. During this time, the definition of environmental justice was an issue of distributional inequity of ills (Scholsberg, 2007). Since then, the terminology of environmental justice has incorporated

and developed to include other forms of justice: equity, distribution, procedural, recognition and others.

Energy Justice

Energy justice is one of the new concepts branched off from environmental justice. It separates energy issues from the much larger concerns of environmental justice. However, it is not used regularly and consequently, research on it is underdeveloped. Energy justice is a critical concept for low-carbon transitions and a sustainable energy future. Work on the topic has formed around the social and spatial distribution of energy poverty. There are a few definitions related to energy justice, depending on region and application. These definitions hold a wide range of meanings from domestic energy prices and fuel poverty in the developed countries to the impact of fossil fuel extraction on indigenous people (Karen Bickerstaff, 2013). However, in this paper I define energy justice as people that are deprived of reliable, efficient and affordable energy sources because distributional access is not available or they are in energy poverty.

Even though energy justice sprouted from the environmental movement, the importance of a new movement revolving around justice of energy services is because energy provides power to people that have no resources or opportunities to better themselves. It is also important because energy justice incorporates social, economic, and environmental equity including past, present, and future generations (Karen Bickerstaff,

2013). Social justice, environmental justice, and ecological justice are tied together in these critiques, as the poor suffer both social and environmental inequity and nature is drained of resources for economic gain (Scholsberg, 2007). Renewable energy can provide power and resources to the most vulnerable.

Analysis

To effectively understand the need for energy, specifically renewable energy, a literature analysis was conducted on the ways renewable energy alleviated energy poverty and provided energy justice to people in marginalized countries. In addition, the analysis draws from case studies of renewable energy projects in those areas. It addresses the concerns of human need, poverty, gender, education, health equality, economic, development, and climate.

Climate Change and Sustainability

As the 1.3 billion people without access to energy connect to the grid, the energy source to which they are connected could drastically affect the globe. Emission are expected to grow as populations connect to traditional fossil fuel sources (Casillas, 2010). The most recent International Panel on Climate Change report has identified energy as the largest contributor of greenhouse gas (GHG) emissions in the decade. From 2000 to 2010 greenhouse gas (GHG) emissions have increased by ten gigatons of carbon dioxide equivalence, and the highest cause of this increase was energy supply at a substantial forty-seven percent. They also found that economic and population growth continues to be the most important drivers of increases in carbon dioxide emissions from fossil fuel combustion. Between 2000 and 2010, both drivers outpaced emission reductions from improvements in energy intensity. IPCC has identified that in order to keep global temperatures from rising

below two degree Celsius, then substantial cuts in GHG emissions need to be made through large scale changes in energy systems and potentially land use.

To prevent temperatures from increasing with the addition of 1.3 billion people or more to the grid, renewable energy must be tapped. To draw further attention to the importance of renewable energy, research has shown that climate mitigation policies could increase the number of poor households that go into energy poverty (Ottmar Edenhofer, 2014). There is another issue that arises with climate change and energy discussions. Developing countries argue that there is more of an importance to addressing poverty via economic growth than future generation's hazard of a warming climate (Benjamin K. Sovacool, 2014). This is a large concern when addressed in the context of energy justice. Investing in energy infrastructure in marginalized countries will help alleviate the current issues of billions of people. However, if the business as usual trend continues, the IEA and IPCC projections state that the threshold of two degree Celsius can be reached in a few years (Benjamin K. Sovacool, 2014). In which case, the poor will feel the impact of climate change the most (Scholsberg, 2007). However, installation of renewable energy sources, in place of fossil fuel base sources, could prevent such a dilemma.

Basic Needs

Humans have a right to be able to access fundamental human needs. Economist Manfred Max-Neef classified fundamental human needs as subsistence, protection,

affection, understanding, participation, leisure, creation, identity and freedom (Manfred Max-Neef, 1991). Energy can provide and meet some of those human needs. Specifically, renewable energy can provide billions of people access to rudimentary human needs. Renewable energy can provide three basic direct energy needs: cooking, lighting, and heating. Research conducted by Goldemberg and other scholars have tried estimating basic human energy needs. Their calculations concluded that the requirement of direct primary energy per time is 500 watt per person (Pachauri, 2004). In a similar finding, the United Nations identified the basic level of energy would be 100 kWh of electricity and 1200 kWh of modern fuels per person per year (Programme, 2010). Both calculations show the importance of energy. They both are examples of the second method of calculating energy poverty discussed in the background section.

In Mongolia, one-third of the population lacks access to electricity and almost half lack access to central heating (Drupady, 2012). Mongolia has a large population of nomadic herders who live off-grid in *gers* or *soum* centers. A *ger* is a collapsible tent that can accommodate about four people to sleep in with no form of access to electricity. *Soum* centers are permanent living spaces that include hospitals, schools and banks that serve the herders. These nomads live off of coal and fuelwood as a form of energy. An international program, Renewable Energy and Rural Electricity Access Project (REAP) was designed to improve their standard of living by providing lighting, refrigeration, communication, television, radio and cooking. The program utilized small-scale solar home systems and wind

turbine systems for the form of energy services. In 2010, the program had distributed about 41,800 solar systems and a few hundred wind systems. They also rehabilitated 15 mini-grids and installed 11 renewable-diesel hybrid systems in *soums*. Research found that the herders were using the electricity for lighting, television, and radio. If the systems were bigger then herders were also using them for cooking and refrigeration.

These systems provided herders a chance to access basic human necessities that were inaccessible before because of their consistent traveling. Families that were interviewed in the program spoke about solar systems enabling them to keep their meat and milk cold during the summer and improve their livelihood by making reading available at night (Drupady, 2012). Not only are humans entitled to access such fundamental needs, but they are also needed to help remove poverty and spark economic growth as was seen in Mongolia.

Poverty

With the creation of the millennium development goals, poverty has seen a decline by twenty-two percent since 2010. There are still areas living in extreme poverty. Energy can be a means out of poverty for these families and communities. Providing them access to affordable energy services will be required (Pachauri, 2004; Action, 2014). Energy can reduce poverty, create jobs and spark economic growth. IEA has identified energy sources as a necessity for economic and social development. Electricity to impoverished areas would

provide lights, heating, and potentially appliances. However, it is important to realize that to improve the lives of the poor it is necessary to improve access to energy efficient resources and an adequate supply of energy at an affordable rate (Pachauri, 2004).

One area within which renewable energy can be used to provide an economic boost is the agriculture sector. In developing countries, the agriculture sector generates about twenty-nine percent of gross domestic product. It provides work to sixty-five percent of the labor force, whom are also income and energy poor. If agriculture productivity could be increased via an alternative energy source, then food security, income generation, development and poverty reduction could simultaneously occur (Action, 2014). Nepal is one country that has greatly benefited from installation of renewable energy. Nepal's population is about thirty million people. One-third of that population is officially poor. Nepal also is burdened with low levels of access and electricity consumption. Only forty percent of the rural population has access to electricity (Drupady, 2012).

To alleviate such poverty in Nepal, the Rural Energy Development Program installed small and medium scaled micro-hydro energy units in 2003. The program has covered more than fifty thousand homes in all of fifty-one target districts as of 2010. There were a total of more than ninety projects with 1.5 MW capacity providing energy access to seventeen thousand homes. By the end of 2012, expectations were to have operations in all 75 districts reaching more than one million people (Drupady, 2012).

Citizens were interviewed on the changes that have occurred. One response was that the micro-hydro units did not just provide lighting but also mechanical energy to millions. The services in which energy provided access to or increased yields or productivity were in: husking, grinding, carpentry, spinning and pumps for irrigation. Citizens noticed that the unit has paid off with higher local incomes. One study found that the units have increased income by eleven percent. The units also reached remote locations in the mountains that were unreachable through other energy services (Drupady, 2012).

This case study also noticed a decline of women and children suffering from respiratory problems and incidences of disease because of the switch from wood and charcoal to the micro-hydro units. In addition, communities with micro-hydro units had more equal gender equity. Poor families, predominately the women, face issues when there is lack of a reliable source of energy. In the case of Nepal, these issues dimensioned with the installation of the micro-hydro units.

Gender

Gender plays a part in access to energy services. Women are the major collectors, users and managers of energy in rural households. They are impacted the most when there is a lack of energy or a safe energy source. Women face health issues, safety problems, and economic strain when energy is not easily accessible at an affordable rate, because they collect and manage biomass fuels for their homes in rural areas. These fuels have several

health consequences on women. The World Bank estimates that 780 million women and children inhale kerosene fumes while they perform their daily tasks (Drupady, 2012). Not only do women face health issues from the use of these fuels, but there is also impending danger in the collection of these resources. Women are vulnerable to environmental damage and scarcity of fuels (Misana, 2001). Additionally, women will have to devote longer hours to collecting these fuels.

Poverty has a greater effect on women than men. Approximately seventy percent of the 1.3 billion people who are poor are women (Misana, 2001). Providing women access to safe and reliable energy seems important. Renewable energy sources can improve the lives of women in many different ways. The United Nations Developmental Program project on "Energy and Women" has found that: "Small-scale manufacturing, food processing industries, trading and marketing opportunities are all greatly expanded when energy services are available and have direct positive influences on women and their communities" (Misana, 2001). Not only are lives improved, but also economic benefits are tied with access to energy services. One case study conducted by the United Nations Development Programme (UNDP) project looked into overcoming financial, social and institutional barriers to the use of solar energy in Uganda. The project focused on rural areas, especially areas that do not have access to the electric grid or will not have access for another five years.

The project has led to the installation of 576 homes and forty-two institutional solar systems. Solar systems have increased quality and effectiveness of income generation work,

reduced drudgery in daily tasks, improved health conditions, increased opportunities for income generation and increased conservation of natural resources (Misana, 2001). In rural areas, the projects were geared toward the needs of household lighting which increased hours of work and reading capability for children. In the urban areas, the needs were different. In these cases, the systems were used for income generation and were used to provide electricity to refrigeration, lights, and recreation. In addition, the project empowered women by teaching them new skills. Women were trained as technicians or managers at a local institute (Misana, 2001). Solar energy did not only provide women and men economic benefit but also helped improve the lives of children.

Education

Education is one topic that is often overlooked when talking about energy access. It is important to realize that poor children do not have adequate time to focus on their studies when there is limited source of lighting. Kerosene lamps can be used but they are dimmer and can be more expensive than an electric light. Evidence in studies showed that electricity and lighting can significantly increase the time poor children spend reading and studying (Shahidur R. Khandker, 2009; Martins, 2005). One such location, where renewable energy provided children with electricity to study, was Bangladesh.

Bangladesh established a Rural Electrification Board (REB) in 1977 to expand electrification and provide reliable, sustainable and affordable electricity to rural people.

Since the establishment of REB, rural electrification has increased significantly. In 1977, less than ten percent of people were connected to the grid, while by 2007 more that 61 percent have received electricity. REB conducted a survey in 2004 to evaluate the implementation of the sustainable systems (Shahidur R. Khandker, 2009).

The case study of Bangladesh provides evidence that access to electricity improves rural economics, well-being, and education. An earlier study of Bangladesh residents found that the major use of electricity was for children's education at eighty-three percent. The findings were also conclusive in the more recent case study. In fact, families that were able to access an energy source had improved school completion rates as well as study time for both boys and girls. Girls had higher improvement in villages with electricity access than boys (Shahidur R. Khandker, 2009). Not only did electricity improve education for children and education completion rates, but it also provided empowerment for female children.

Health

The health of the poor is drastically affected when there is no form of electricity or energy service available. The poor are prone to inadequate health, lack of health services, respiratory issues, increase cases of fire accidents, and incidents of women being violated. The World Health Organization (WHO) noted that thermal comfort, which can be attained through access to an energy service, "is inextricably linked to health." In one finding by the WHO, they found that forty percent of winter deaths, which amounted to 278,409 people,

were caused by housing conditions (Sovacool, 2013). Use of traditional biomass for a fuel to cook and heat homes causes respiratory issues in women and children. Another report by WHO found that approximately two million deaths per year and forty million disability adjusted life years are caused by biomass use in marginalized countries (Bhattacharyya, 2012). Traditional fuels for cooking and heating are disadvantageous to the poor's health.

There is an additional health concern that isn't always addressed in energy justice case studies: women being physically assaulted. A case study that was conducted in South Africa on the impact of energy sources on the quality of life of poor communities found an alarming concern for women. Without access to a form of energy, women have to venture out into far distances to obtain biomass to use for cooking or other common household work. During their trips, women are physically attacked. Installing a form of electricity or lighting in communities decreases the occurrence of crimes in the dark. "There is evidence that the number of accidents in electrified areas is lower than those for non-electrified areas" (Martins, 2005). Lighting provides safer streets for the community and electricity also provides women with fuel for which they no longer have to travel far distances to obtain.

The study also found that there are significant improvements to well-being because of access to electricity. The study also found significant safety concerns associated with limited to no access to electricity. There is a a high incidence of fires in houses and burns to individuals. From approximately 2,750 individuals studied, eight people died from burns and six children died from drinking paraffin. Additionally, the study found that cases of fires

decreased drastically with increased access to electricity (Martins, 2005). Electricity removes the safety concerns for women, children, and the poor.

Equality

Inherent to the notion of energy justice is equity. Within that notion resides evidence for the need of renewable energy to meet the inequality of the current system. Individuals that are deprived of access to energy services will typically have limited education opportunities, terrible health, and limited economic growth (Benjamin K. Sovacool, 2014). These individuals and families also face another limitation that further adds a burden to their lives. As the energy poor are deprived of those basic needs they also spend most of their income and time on unreliable and inefficient energy sources (Benjamin K. Sovacool, 2014; Kammen, 2008; Karen Bickerstaff, 2013; Satterthwaite, 2013; Sovacool, 2013).

Surveys conducted in different marginalized countries found that the poor pay more for energy based on their income than they use when compared to higher income classes. One survey found that approximately thirty-three percent of people with the poorest incomes were in energy poverty and those with the highest income had less than one percent in energy poverty (Sovacool, 2013). Another study found that within the countries analyzed, the poor households consumed less energy but used more of their income to pay for it than other households (Sovacool, 2013). Sovacool found that middle and upper incomes pay three to four percent of their incomes on energy, while the poorest incomes

pay twenty to thirty percent of it on energy. In addition, they spend another twenty to thirty percent on indirect costs associated with collecting and using energy (2013). Survey after survey and analysis after analysis come up with the same findings that the poor pay more for energy, but yet the energy that they pay for is harmful to their health, stability, and growth. The issue may not be entirely that more energy is needed, but that the type of energy, it's manner of distribution of energy, and who has the privilege to receive access to energy must be addressed as well.

Socio-economically poor areas are treated unjustly because of their economic standings. A personal study in Lebanon (by the author) found that areas of religious or economic difference were given less access to electricity. According to the most recent world outlook report, Lebanon is hundred percent electrified with zero million without electricity (because of the way statistic are calculated this means that there are less than one million people with electricity). However, the distribution of electricity access proves otherwise. Lebanon faces demand issues and a weak electric grid, thus Lebanon must schedule power distribution. In the capital Beirut, cities with higher political and economic power are only deprived of electricity for three hours. In comparison, areas of religious differences and lower economic standings could be deprived of more than six hours of electricity. In rural Lebanon, distribution is more profound. Smaller villages with little political or economic standing could go days without receiving access to electricity. Renewable energy could

relieve the strain on the electrical grid. Lebanon is only one example of many other countries that have similar distribution inequalities (Personal recollections of the author).

Economics

Affordable renewable energy can help alleviate poverty and help improve economics of marginalized countries. Energy services are a powerful driver of economic and social development. Countries cannot grow without ensuring minimum access to energy services for a majority of its populations (Fatema, 2005). Ensuring energy to populations is one form of development. Economic development also grows when energy consumption increases (Benjamin K. Sovacool, 2014). An analysis of GDP and electricity production data at country level was done to visualize the growth of economic development. Data for figures 2, 3, and 4 came from the World Bank. Data collected was from 2002 to 2012 for the Middle East in GDP and electricity production.

Figure 3 is change in gross domestic product in US dollars from 2002 to 2012. The darker colors represent higher GDP than the lighter colors. The largest changes in percent were Qatar at 883%, Kuwait at 356% and Iran with 332%. There was missing data for Iraq and Syria because of political unrest and thus there could be no analysis of GDP.

Figure 4 is percent change in electricity production kWh from 2002 to 2012. The darker colors represent a higher change than lighter colors. The largest changes in percent

were Qatar at 181%, Oman at 112% and United Arab Emirates at 112%. Drivers of this economic growth do have a correlation with electricity production.

Figure 2 is a scatter plot of data from figures 3 and 4. The scatter plot shows a strong positive correlation between gross domestic product and electricity production for countries in the Middle East. The countries with large GDP change between 2002 and 2012 also had large change in electricity production. The R^2 for the analysis was quite high at 0.697, signifying a strong positive correlation. However, electricity is not the sole reason for an increase in GDP, as seen in Iran and Kuwait data. They had large increases in GDP but electricity production increase was small.

Data analysis found a strong correlation at the national level of electricity and GDP for most countries. Renewable energy could also improve local economics. Providing access to energy for women workers in the agriculture sector and communities has an economic affect.

> "Improved access to energy services has multidimensional economic impacts in general and impacts on economic poverty reduction specifically. There are a handful of innovative projects that demonstrate the potential of using energy as a medium for reducing time spent performing existing economic activities while providing opportunities for new productive activities" (Fatema, 2005).

Energy is a source of economic growth for countries, regions, communities, and individuals. UNIFEM has recognized the importance of energy in providing economic empowerment to women. One of the major lessons they have learned throughout their work is that the lack

of reliable, affordable, and locally-available energy supplies, women's productivity is limited (Misana, 2001). For this reason, UNIFEM created a project on "Energy for Sustainable Women's Livelihoods: Gender Responsive Renewable Energy Systems Development Application" (GRESDA). The focus of this project is to "demonstrate selected marketable and appropriate renewable energy equipment and energy efficient appliances that can be used to create sustainable rural industries" (Misana, 2001). Their products focus primarily on food-related activities.

UNIFEM conducted research on existing renewable energy alternatives and their feasibility for application in Western Africa. A case study highlighted in their report focuses on women in Ghana. These women struggle with optimizing efficiency of their food process activities because they were using wood as fuel. The case study of Ghana introduced efficient and sustainable fuel-saving stoves, fish smokers, and other equipment to enterprises. Traditional shea butter extraction is a significant source of income for women in northern Ghana. Approximately, thirty-two thousand metric tons of shea nuts have been exported from Ghana since 1998. Women primarily do the extraction and harvesting of the shea nuts. The average extraction efficiency in the production process is sixty-two percent. The process consists of seven steps: grinding, roasting, milling, kneading, washing, cream boiling, and clarification. This traditional process is used for about eighty percent of total shea butter production in Ghana (Misana, 2001).

Women's groups in northern Ghana appealed to UNIFEM for assistance in finding technology that would increase output, reduce fuel use, and eliminate the middlemen. The GRESDA shea butter processing project came about after the women reached out. The project was focused on introducing and testing an improved bridge press. The new bridge press would reduce fuel and water use and reduce exposure to smoke and heat. To eliminate the middlemen, whom were men marketing the products, the project was to be promoted as women's products and link women processors with international markets. In collaboration with Ghana's Technology Consultancy Centre, they developed a simple processing method to help improve the traditional extraction process for the women, the Intermediate Moisture Content method. The shea butter extraction project in northern Ghana was a success. There was a five percent increase in extraction efficiency and a two hundred percent increase in daily production. There was a decline in firewood consumption from seventy-two kilograms to eight kilograms. These was also a decrease in the amount of water used in the process (Misana, 2001). Such programs help improve economic growth for communities and empower women to make an impact, both of which are development goals.

United Nation's development goals

The United Nations has recognized the importance of energy to the Millennium Development goals. Energy was not specifically mentioned in the declaration in year 2000,

however, they have published reports on the importance of energy to the goals that were in the declaration. Additionally, the UN has recognized the importance of renewable energy to their goals.

> "Clean, reliable and affordable energy services are indispensable for global prosperity and the achievement of the MDGs. Energy makes a profound impact on multiple aspects of human development, from poverty to gender equality, health, food security and climate change" (Programme, 2010).

According to United Nations Development Programme (UNDP), energy is linked to all the MDGs. They recognize that increasing access to modern energy services has a dominos affect. Energy can reduce poverty and create jobs for the poor by sparking income generation, reducing hunger, increasing agriculture yields and entrepreneurial opportunities, goal one. Energy also empowers women by releasing women and girls from time-consuming tasks of collecting fuel. It also allows women and girls to reinvest in education and income generating activities, goals two and three. Energy also improves health conditions by decreasing drudgery for women and children, goals four and five. Modern energy services promote clean energy solutions that contribute to low-carbon growth and a climate resilient future, goal seven. Lastly, increasing access fosters global partnership to promote universal access to modern energy services as a vehicle to achieving the MDGs, goal eight (Programme, 2010). All the goals can be addressed by providing modern energy sources to those that are deprived.

The UNDP energy portfolio has focused on off-grid energy solutions for the poor. There have been over 1500 off-grid decentralized energy initiatives in over a hundred marginalized countries that have reached at least one million recipients per year. Between 2001 and 2007, there were approximately seven million individuals whom benefited directly from UNDP's support to expand access of modern energy services to the poor (Programme, 2010). Figure 5 shows the percentage of regions that received those benefits.

Challenges

Issues, concerns and challenges are bound to occur during projects and case studies. Majority of the issues addressed in the texts are technical, economic or political. A case study in Malaysia faced such challenges. The Malaysian Small Renewable Energy Power Program attempted to install 500 MW of a variety of renewable energy technologies from 2001 to 2005 (Drupady, 2012). However, they only achieved 12 MW of capacity by the end of 2005. Malaysia is a great case study to explore the dynamics and challenges of expanding renewable energy access. The case study faced technical, economic, and institutional failures. An example of a technical problem faced, was the lack of experience in technology. In the biomass project, the engineers did not have experience with advanced boiler technology. The projects had to proceed with a lot of expensive trial and error. Another technical issue was the lack of skills, education, and training. One of the individuals interviewed said that "there was no centralized training institution, no place to learn about

how to innovate technology, instead we had to do our research on an ad hoc basis" (Drupady, 2012). There was even a site that was closed down due to lack of maintenance skills.

The second issue faced in Malaysia was economics. One of the economic issues faced was insufficient tariffs for the providers. The tariffs were set very low and were not based on any economic principles. Developers found other uses from the renewable energy fuels that would pay them more money. Another economic roadblock was the unfamiliarity of Malaysian banks with renewable energy projects. Banks had no idea what the different forms of renewable technology were and project developers had to seek outside funding, such as from Chinese and Japanese financiers. The last challenge was political and institutional driven. Such issues concerned policy obstacles, like low capacity cap, lack of scientific consultation, and other political issues with licenses and technology (Drupady, 2012).

Other case studies faced very similar challenges and road blocks to the success of renewable projects. The important focus and question should be "how such transformations are divided, managed, and implanted raise a number of challenges with regard to just processes and outcomes" (Karen Bickerstaff, 2013). In order for renewable energy to meet the growing demand and provide access to billions of energy poor people, challenges need to be addressed and resolved.

Conclusion

Renewable energy is the best way to improve lives of marginalized people and save the planet. The 1.3 billion people who are deprived of their human basic needs are more than just a social injustice. These people have become a movement for environmental and energy justice forums. The United Nations has recognized that for any form of development to take place, access to affordable, reliable, and efficient energy sources is the key.

Millions of people are suffering from health issues due to the use of traditional forms of fuels. Children are being deprived of education because there is no lighting to study at night or they must sacrifice school for the betterment of their family. Women are a majority of the voiceless energy impoverished. They lack opportunities to raise money for their families, to be educated, or to be safe. The system is currently unbalanced with the poor receiving the brunt of the problems. The poor are in this negative feedback loop that cannot be broken without energy. Yet, “as long as the global economy remains dependent on fossil fuels, the poorest people in developed countries will continue to pay a disproportionate share of their income to keep their homes warm and their cars running” (Benjamin K. Sovacool, 2014). It is unfair to continue to burden the energy poor with the inability to develop. In order for this energy injustice to be removed, reliable and affordable energy sources are required. It has been concluded in many studies that the economy grows with an increase in energy production, especially for the energy poor. However, the growth of energy can prove dire to the climate. The IPCC has predicted that there needs to be

substantial changes to the energy sector, otherwise we will go over the threshold. In order to meet the dilemma of economic growth and climate change catastrophe, renewable energy needs to be an investment in our future and in bringing about energy justice.

Appendix

Table 1. Electricity access rates in 2012.

Electricity access in 2012 - Regional aggregates				
Region	**Population without electricity** millions	**Electrification rate** %	**Urban electrification rate** %	**Rural electrification rate** %
Developing countries	**1,283**	**76%**	**91%**	**64%**
Africa	622	43%	68%	26%
North Africa	*1*	*99%*	*100%*	*99%*
Sub-Saharan Africa	*621*	*32%*	*59%*	*16%*
Developing Asia	620	83%	95%	74%
China	*3*	*100%*	*100%*	*100%*
India	*304*	*75%*	*94%*	*67%*
Latin America	23	95%	99%	82%
Middle East	18	92%	98%	78%
Transition economies & OECD	**1**	**100%**	**100%**	**100%**
WORLD	**1,285**	**82%**	**94%**	**68%**

Table 2. Traditional Use of Biomass in 2012

Population relying on traditional use of biomass for cooking in 2012- Regional Aggregates	
Region	**Population relying on traditional use of biomass** millions
Developing countries	**2,679**
Africa	728
North Africa	*727*
Sub-Saharan Africa	*1*
Developing Asia	1875
China	*448*
India	*815*
Southeast Asia	*280*
Rest of Developing Asia	*332*
Latin America	68
Brazil	13
Middle East	8
Yemen	7.8
WORLD	**2,679**

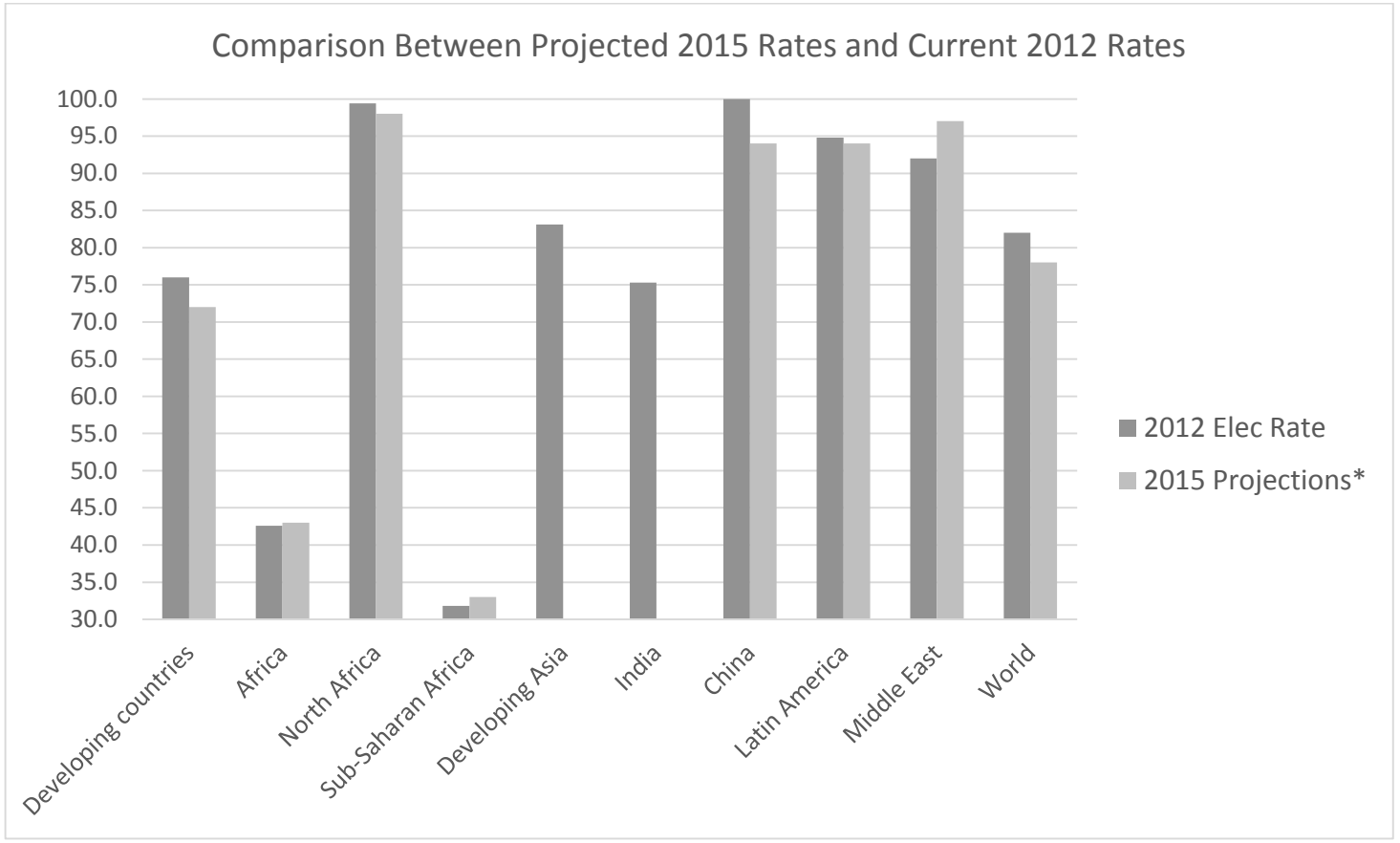

Figure 1. Comparison between projected 2015 electrification rates with most up to date 2012 rates.

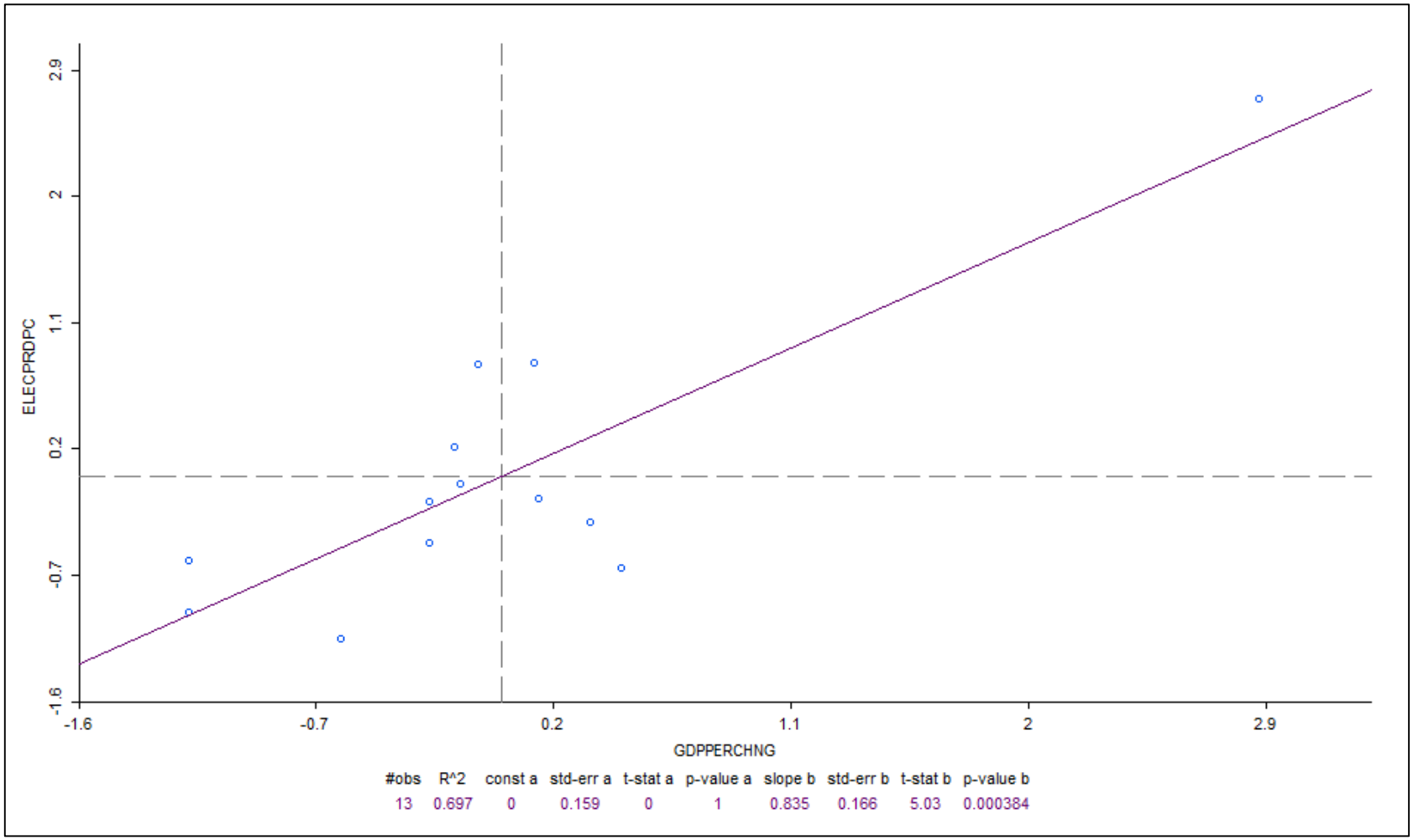

Figure 2. Scatter Plot produced in GeoDa graphing GDP percent change vs. electricity production percent change.

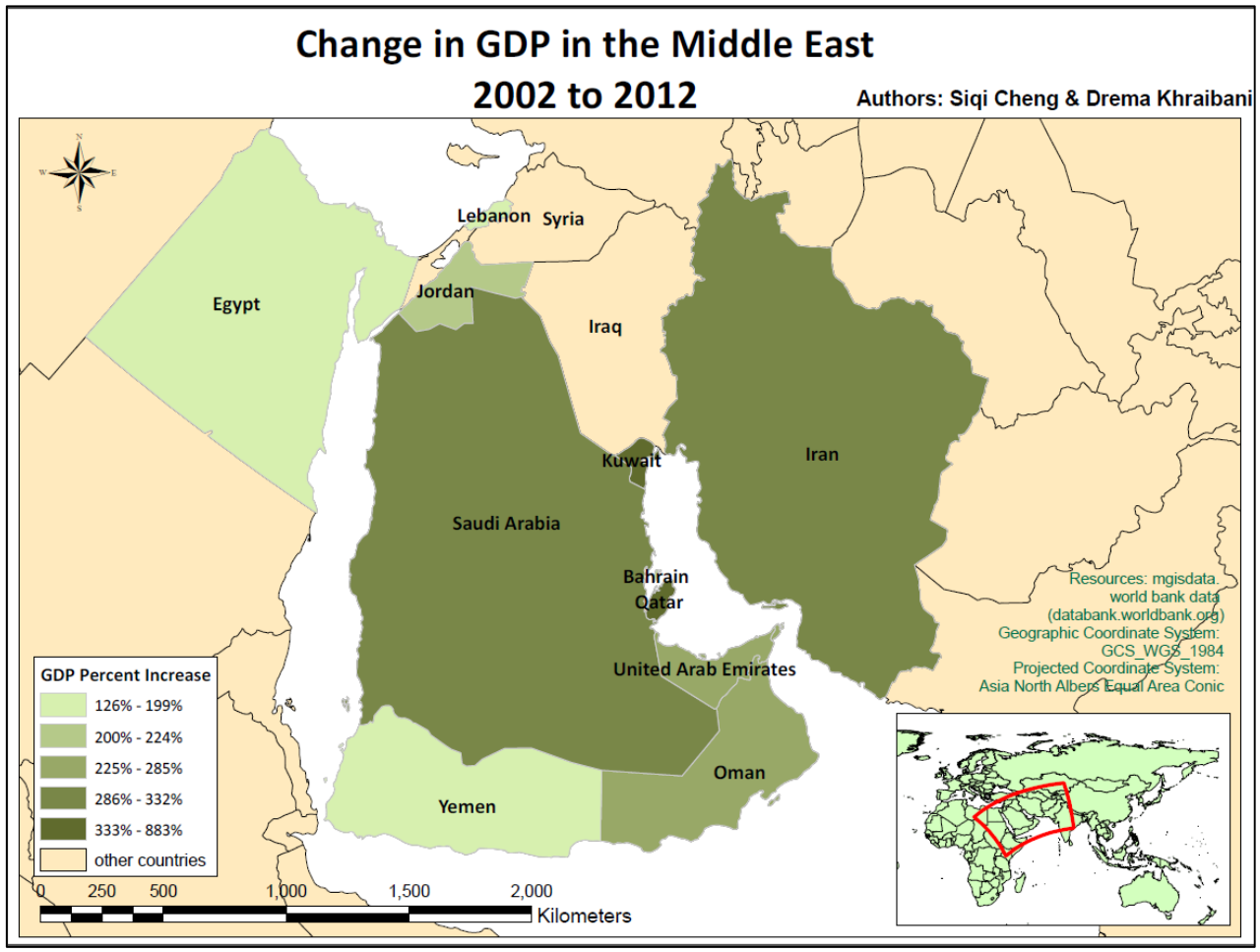

Figure 3. Chane in Gross Domestic Prodcut in current dollar for the Middle East between 2002 and 2012.

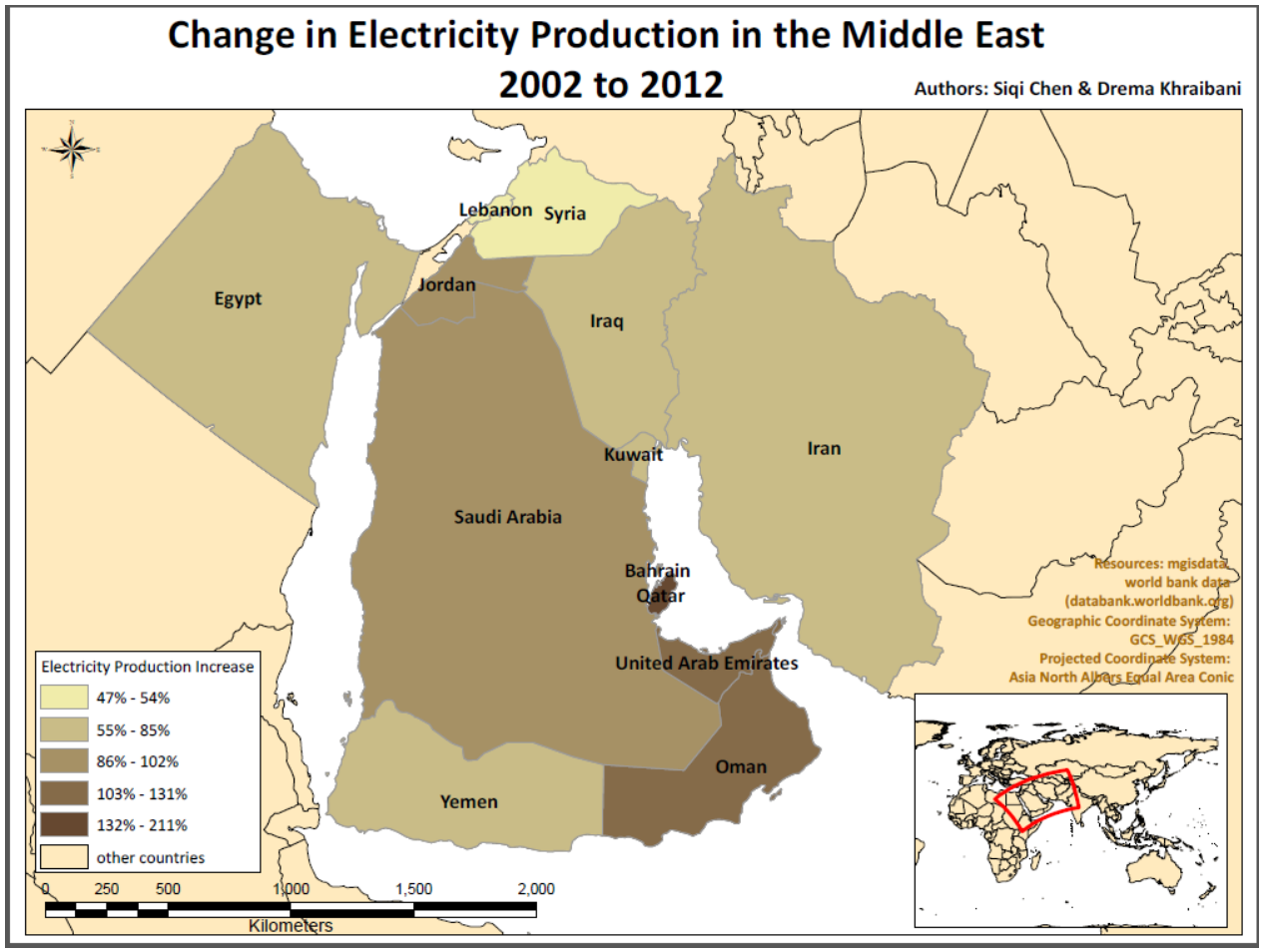

Figure 4. Electricity production change in the Middle East between 2002 and 2012.

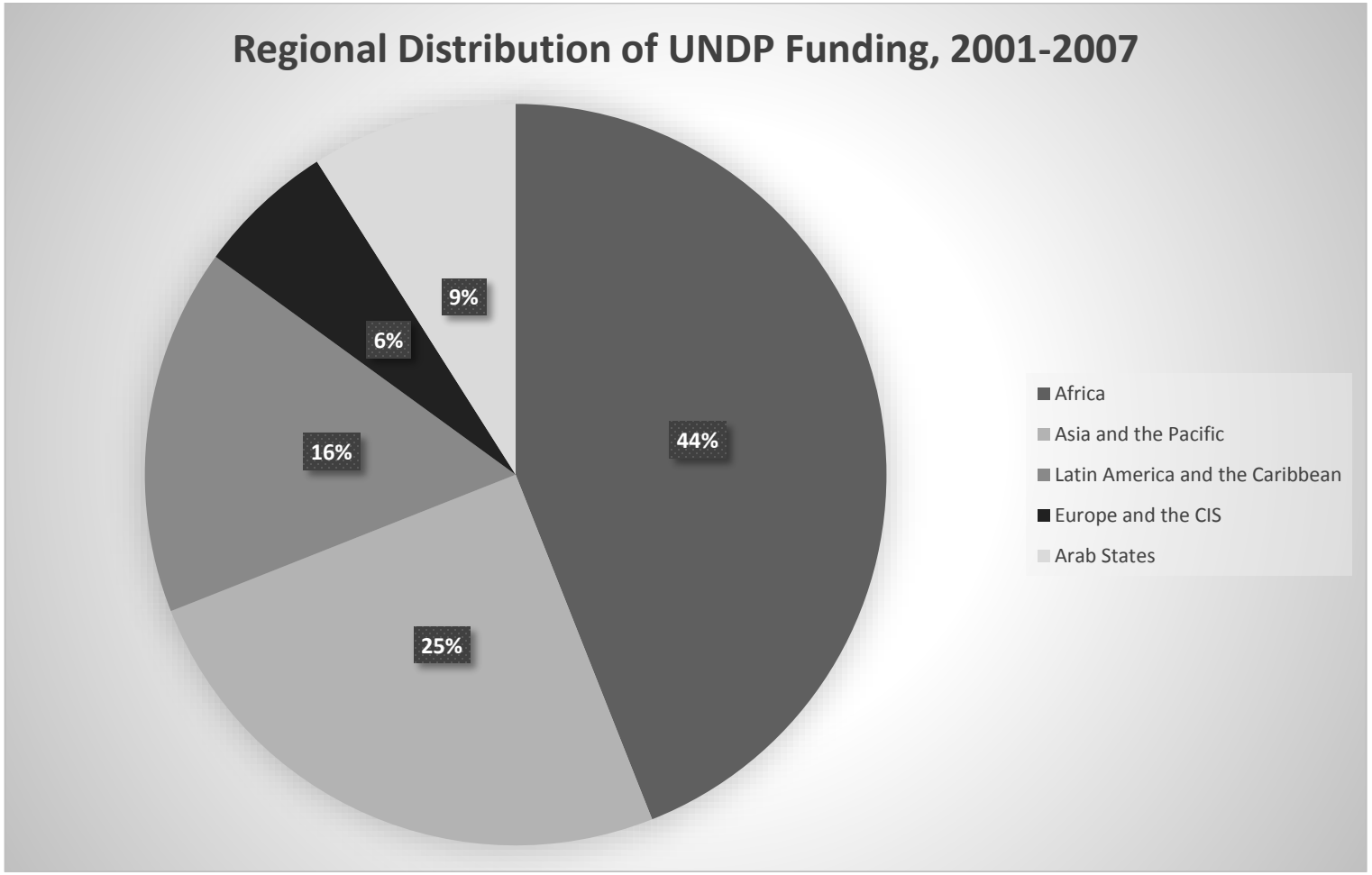

Figure 5. Breakdown of regional distribution of UNDP funded programmes from 2001 to 2007.

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