International Journal of Energy and Environmental Research
Vol.5, No.2, pp.38-54, June 2017
Published by European Centre for Research Training and Development UK (www.eajournals.org)

LINKAGES BETWEEN GREEN ENERGY POLICIES AND CLIMATE CHANGE LAW AND CHALLENGES TOWARDS A GREATER COHERENT POLICY

Abubakar Sidiqqui Kamara

ABSTRACT: *All over the world, national governments and policy makers have been strong in their stance on the fight against global climate change due to human-made factors. Climate change law and green energy policy were critical in the movement for using green or renewable energy sources in order to reduce greenhouse gas emissions and, therefore, slowing down the process of change in the earth's climate. The aim of this study is to understand the basics of climate change and green energy and to identify and understand the relationship between the two regulatory efforts. It also aimed to identify the challenges in coming up a single, cohesive policy for the two regulatory efforts. Through scanning literature, discussion on the basics of climate change and green or renewable energy were presented. The study highlighted the aspects that established the linkages between the two regulatory efforts, which include (1) most of the green energy policies and climate change laws around the world were leaned towards the reduction of greenhouse gas emissions, and (2) the incentive-levy system to encourage the use of green energy sources. Challenges facing the establishment of a cohesive policy for the two regulatory efforts include (1) difficulty of establishing a single framework for supporting green energy technologies that addresses both clean energy generation and climate change in a wider context, (2) challenges relating to process management of energy services, and (3) compatibility of the two regulatory efforts.*

KEYWORDS: linkages, green energy policies , climate change ,law, coherent policy

INTRODUCTION

Energy generation using renewable or green resources have become a major topic in the environmental debates and discussion, as well as becoming a topic of economic and political interests. This is because of the vivid evidences that point out to the growing concern on global climate change. Though there have been small strides partaken by industries in using green energy sources, the significant changes in energy utilization and production have made its presence following policy changes as well as incentives provided by the government.

All over the world, governments have been very vocal in their support for environmental sustainability through environmental-related policies and regulations. The call of these policies have heightened because of the impending impacts of climate change that would likely affect humans from all parts of the globe, if no actions against man-made predictors or causes of climate change will be implemented. According to a comprehensive report of the Intergovernmental Panel on Climate Change or IPPC[1], energy services (e.g. production and distribution) should be safe and have low environmental impacts, considering that energy services having low environmental impacts and low greenhouse gas emissions translates to an environmentally-benign and sustainable energy services.

[1] IPCC, 'Renewable Energy Sources and Climate Change Mitigation' (*IPCC* 2012) <https://www.ipcc.ch/pdf/special-reports/srren/SRREN_FD_SPM_final.pdf> accessed 17 May 2015

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

Traditional energy generation burn fossil fuels like natural gas, coal and oil, which are very harmful to the environment. Accordingly, energy being produced from burning fossil fuels adds the amount of emissions of carbon dioxide. Contrasting to traditional energy sources, green energy sources such as solar, wind, water, geothermal heat, biomass and nuclear power[2] are clean and sustainable alternative energy sources that becoming mainstream in terms of their use across the world. These green energy sources have been widely explored by past research in helping in the mitigation of climate change. Renewable or green energy, as a matter of fact, is suggested as the most foreseeable and viable response to climate change[3].

Regulations and policy directives could be important in the use of green energy fuel sources instead of those traditional energy sources, as well as in the preparation and mitigation of climate change. Several policy approaches around the world have now shifted from national government funding and administration to research and development of technologies and infrastructures in support for the use of green energy sources and climate change mitigation. Likewise, national and local government programs and initiatives have financed R&D, as well as offering tax discounts and incentives for those individuals and companies in using green or renewable energy sources, such as the UK's Renewable Heat Incentive[4], US's Residential Renewable Energy Tax Credit[5], and many others.

In light with the growing focus on mandating policies and regulations regarding the concepts of green energy and climate change, this current paper aims to discuss on the linkages between green energy policies and climate change laws, as well as to analyze the different challenges and potential issues governing the creation of a greater cohesive policy between the two. This research will also present the basics of green energy and climate change, and discuss or cite some of the various green energy policies and climate change laws around the world, including the UK.

Green Energy Policies

To reiterate, the research will discuss on the green energy policies being mandated and implemented around the world, including the implemented policies in the UK. Before divulging into this objective, it is imperative to understand the basic of green energy, which will be discussed on the following sub-sections below.

Green Energy Sources

Unlike fossil fuels and non-renewable energy sources, green energy or also known as renewable energy, are those energy sources that are abundant in the environment. They are safe, infinite, and clean alternative energy sources that are ready to be used[6]. These alternative

[2] BBC, 'Renewable Energy Sources' (*BBC*) <http://www.bbc.co.uk/schools/gcsebitesize/geography/energy_resources/energy_rev2.shtml> accessed 17 May 2015

[3] R.E.H. Sims, 'Renewable energy: a response to climate change' [2004] 76 Solar Energy 9

[4] KPMG, 'United Kingdom Taxes and incentives for renewable energy' (*KPMG* 24 September 2014) <http://www.kpmg.com/global/en/issuesandinsights/articlespublications/taxes-and-incentives-for-renewable-energy/pages/united-kingdom.aspx> accessed 17 May 2015

[5] US DOE, 'Residential renewable energy tax credit' (*Department of Energy*) <energy.gov/savings/residential-renewable-energy-tax-credit> accessed 17 May 2015

[6] EMSD, 'Know more about renewable energy' (*Electrical and Mechanical Services Department Hong Kong*) <http://www.emsd.gov.hk/emsd/e_download/sgi/re_leaflet_eng.pdf> accessed 17 May 2015

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

energy sources could be harnessed and used to generate electricity without emitting carbon dioxide into the Earth's atmosphere[7]. There are various types of green energy sources, which includes biomass, solar, wind, water, and geothermal. The following sections will discuss these green energy sources in detail.

Types of Green Energy

Bio-energy

Bio-energy has been entrenched in the worldwide biomass systems for food, silage and fiber production, as well as for forest residues and products and in waste management. Accordingly, bio-energy plays an important function in everyday lives of the global population, especially those in the developing countries. Biomass, both low-efficiency and high efficiency bio-energy sources, have contributed about 10 per cent of the global energy supply in 2008[8]. Figure 1 shows the different types of biomass used in bio-energy production globally. Key biomass sources are categorized into two primary categories – traditional and modern biomass.

Low-efficiency traditional biomass (e.g. wood, straws, dung, etc) are those used for cooking, heating, and lighting by those in the developing countries. On the other hand, high-efficiency modern biomass sources are those more convenient solids, liquids and gasses used to generate heat, electricity, transport and combined heat and power (CHP). In particular, those biomass-derived gasses (e.g. methane) generated from the anaerobic digestion of agricultural residues and municipal solid waste (MSW) treatments are now commonly used to produce electricity as well as heat[9]. MSW could be combusted into three basic procedures in order to generate heat and electricity – thermal, biological and landfill gas utilization. The thermal process involves MSW combustion to create heat, which the heat could be used to create steam driving electric turbines. Biological process encompasses decomposition of organic elements or components of the MSW via bacterial actions caused by deficient oxygen. The decomposition will generate methane which could be used for power generation. Those MSW deposited in landfill for a long period of time would also help in the creation of gas called the landfill gas used for power production[10].

[7] FOE, 'Renewable Energy' (*Friends of the Earth* 2010) <http://www.foe.co.uk/sites/default/files/downloads/renewable_energy.pdf> 17 May 2015
[8] IPCC (n. 1, p. 46)
[9] IPCC (n. 1, p. 46)
[10] EMSD (n. 6, p. 5)

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

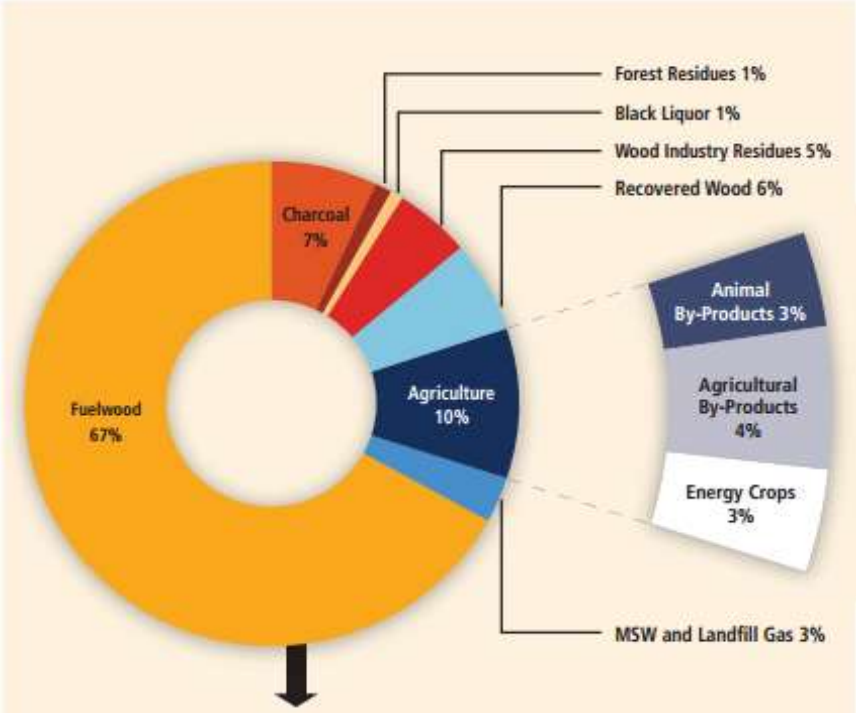


Figure 1: Types of biomass used for bio-energy

Solar Energy

The sun has already been one of most capitalized green energy sources around the world, with direct solar energy technologies were developed for energy use. Direct solar energy is the energy base that is fueled by the Sun's energy. Theoretically, solar energy makes up the thermal radiation being produce and given off by the Sun's outer layer. Before entering the Earth's atmosphere, this radiation is dubbed as the solar irradiance. More so, electromagnetic waves carry the sun's energy just outside the atmosphere and part of the solar irradiance is then contributed by rays that entering from the sun without being strewn in the atmosphere[11].

Currently, there are four basic types of direct solar energy technologies used to generate electricity, heat and fuels. These include the solar thermal, photovoltaic electricity generation, concentrating solar power electricity generation and solar fuels production methodologies, with the first two as the most common technologies. Solar thermal systems use solar collector which could be used for wide range of applications such as heating systems of buildings, solar water heating, process heat in industrial facilities and many others. On the other hand, photovoltaic electricity generation involves the use of a silicon sheet that is placed under the sun, where solar photons hitting the silicon sheet will generate electric energy. There are various photovoltaic technologies available in the market today, including wafer-based crystalline

[11] IPCC (n. 1, p. 60)

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

silicon PV, thin-film technologies of copper indinium/gallium disulfide selenide (CIGS), cadmium telluride, thin-film silicon and dye-sensitized solar cells[12].

Concentrating solar power electricity generation involves generating electricity through concentrating the Sun's rays to heat a medium which is then used to fuel heat in the steam turbine for electrical generator to run. Conversely, solar fuel production involves conversion of solar energy into chemical fuels (e.g. hydrogen, synthetic gas and liquids)[13].

Geothermal Energy

Geothermal resources comprise of thermal energy produced by the Earth's interior stored in rock and trapped steam. Geothermal resources are used to produce electric energy in a thermal power plant. This green energy resource takes form as a tapped heat from an active reservoir that is continuously restored via natural heat production, conduction and convection from surrounding hotter regions. The extracted geothermal fluids are refilled through natural recharge and through re-injection of cooled fluids[14].

Geothermal energy is extracted through various technologies and approaches. It could be hauled out through wells and other means that produce hot fluids from either hydrothermal reservoir with naturally high permeability or from enhanced or engineered geothermal systems with artificial fluid pathways[15]. Because of vast expanse of resource potentials for heat stored in rocks and trapped steam below the earth's surface, geothermal energy resources have been utilized for almost 10 decades in generating electricity. Recent statistics showed that that global geothermal industry has estimated to generate a 11,765 mega watts of installed geothermal capacity, and will reach to about 13,402 megawatts by 2017, as shown in Figure 2[16].

[12] Ibid (p. 62)
[13] IPCC (n. 1, p. 63)
[14] Ibid (p. 71)
[15] Ibid (p. 73)
[16] Geothermal Energy Association, '2013 Geothermal Power International Market: Overview' (*Geothermal Energy Association* September 2013) <http://geo-energy.org/events/2013%20International%20Report%20Final.pdf> accessed 17 May 2015

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

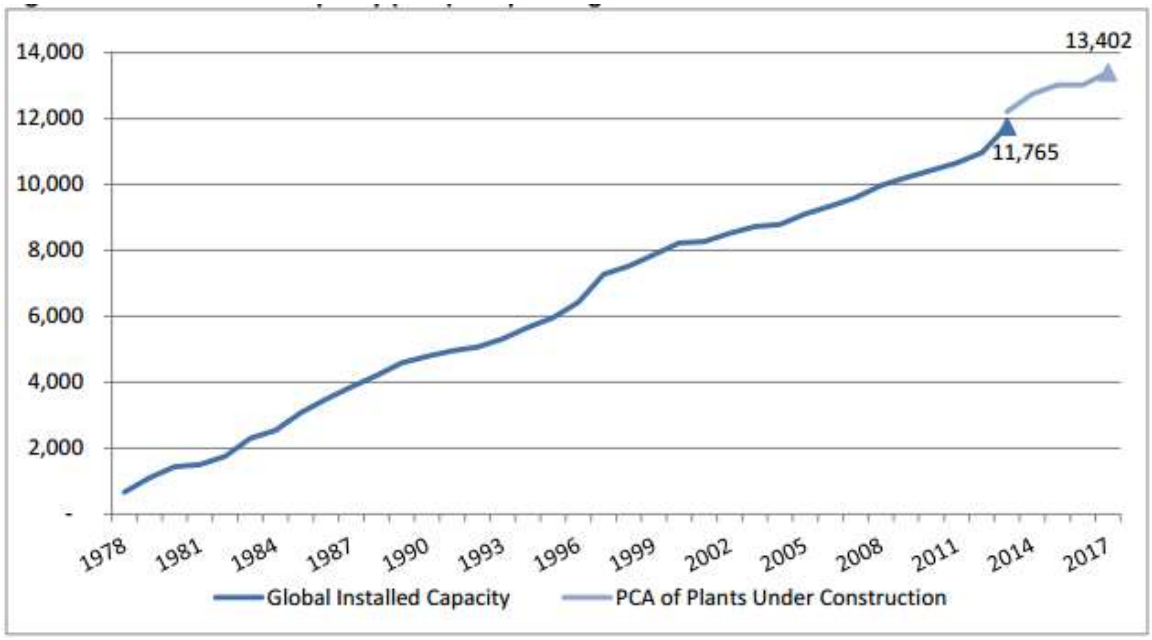


Figure 2: Global Installed Capacity of Operating Geothermal Power Plants

Hydropower

Hydropower is a green/renewable energy resource where power is generated from the energy of moving water. As a matter of fact, hydropower is already a proven, viable and cost-effective technology. Historically, the first world's hydroelectric station was located in the Appleton, Wisconsin, USA. IT produced a 12.5 kilowatt, and was established on September 1882 on the Fox River. Even though the main function of hydropower in the supply of energy globally is to provide a centralized electricity generation, it also run in isolation as well as supply independent systems in rural and remote areas in the world[17].

Hydropower plants could take forms in three key project types – run of river, storage and pumped storage. Run of river or RoR involves plants having small intake basins with no storage capacity. Power generation, therefore, is based on the hydrological cycle of the watershed. More so, the generation of power varies based on the availability of water. On the other hand, storage hydropower offers wide range of energy services including base load, peak and energy storage. These kinds of hydropower plants could also deliver services outside the energy industry, including flood control, water supply, navigation, tourism and irrigation. Pumped storage plants store water as a source for electricity generation. It involves reversing the flow of water, allowing production of electrical energy based on demand[18].

[17] IPCC (n. 1, p. 80)
[18] Ibid (p. 80-81)

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

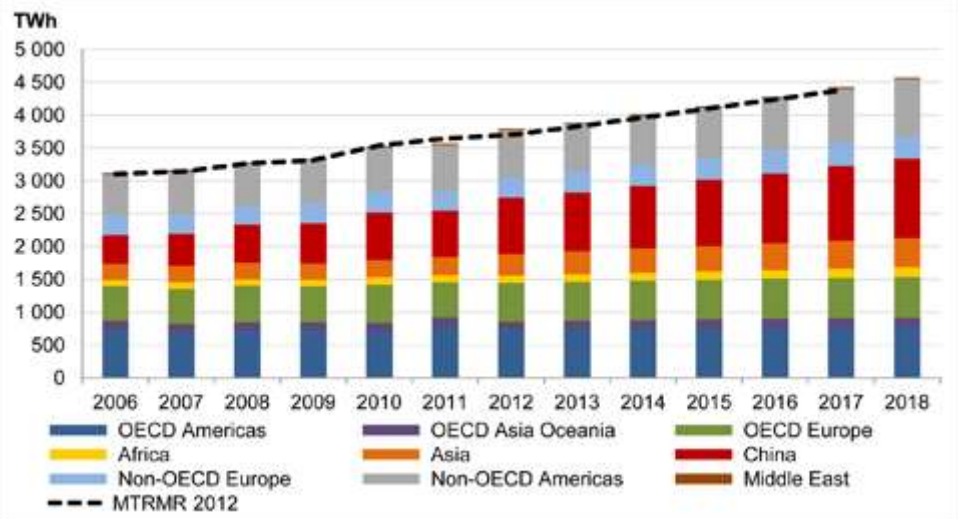


Figure 3: Hydropower electricity generation across regions in the world

Hydropower plants around the world have contributed more than 16 percent of the global electricity generation and an estimated 85 per cent of the global electricity from renewable resources. Across all regions in the world, hydropower electricity generation continues to rise since 2006, as shown in Figure 3[19].

Ocean Energy

Ocean energy has been noted to produce a great potential for continuing decrease in carbon emission. By definition, ocean energy refers to the energy generated from the use of technologies utilizing seawater as a primary source of power. Ocean-based energy sources could be either in six unique sources – wave energy, tidal range, tidal currents, ocean currents, salinity gradients and ocean thermal energy conversion. Wave energy is generated through the transfer of the kinetic energy of the wind to the upper surface of the ocean. Tidal range or the tidal rise and fall is derived from gravitational forces of the earth-Moon-Sun system. Tidal currents provides energy though water flow resulting from the filling and emptying of coastal regions associated with tides, while ocean currents involves energy generation derived from wind-driven and thermohaline ocean circulation. Ocean thermal energy conversion or OTEC encompasses energy production using the temperature differences emerging from the solar energy stored as heat in the upper ocean layers and colder seawater. Lastly, salinity gradients or the so called osmotic power is generated from the salinity differences between fresh and ocean water at river mouths[20].

Despite the vastness of the ocean and it's potential as primary energy sources, ocean energy generation technologies are still in its infancy and is not yet been widely deployed. However, there are some large-scale systems operating worldwide that harness energy from the ocean.

[19] International Energy Agency (n. 21)
[20] IPCC (n.1, pp. 87-88)

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

Examples of these include the Sihwa barrage in South Korea, La Rance barrage in France as well as other small projects in China, Canada and Russia[21].

Wind Energy

Wind energy is the most utilized green energy sources for wide range of applications. The use of wind energy to generate electricity on a commercial scale, however, became viable only in the 1970s as a result of technical advances and government support. A number of different wind energy technologies are available across a range of applications, but the primary use of wind energy of relevance to climate change mitigation is to generate electricity from larger, grid-connected wind turbines, deployed either on land ('onshore') or in sea- or freshwater ('offshore')[22].

Wind energy could pave way for opportunities for long-term greenhouse gas emissions reductions globally. As of 2009, the wind power capacity installed has able to meet about 1.8 per cent of the global electricity demand and such contribution could continue to grow in excess of 20 per cent by the next 30 years. In addition, onshore wind energy is already being installed and deployed in various countries. For the past decades, wind turbines have evolved dramatically in terms of its design and scale, generating an average of 75 kilowatts for a single turbine in 1990 to potentially 20,000 kilowatts per turbine in the future[23].

Worldwide Green Energy Policies

As noted earlier, the growing concern of global climate changed has spurted out wide range of regulations and policy mandates regarding the use of green or renewable energy sources. Across the globe, many countries have established their own green energy policies in order to push forward a more sustainable and environment-friendly energy production and distribution in their respective jurisdiction.

In the US, the federal government have designed and implemented wide range of policies with focus on the use of more renewable energy sources. For example, the Public Utility Regulatory Policies Act of 1987[24] was implemented to encourage society using more domestic renewable energy. The Energy Independence and Security Act of 2007[25] was established to set forth measures and standards seeking to support the expansion of renewable fuel production, as well as the reduction of the country's dependence on oil, increase energy security and addressing climate change.

Countries in the Asian and Pacific Regions also have implemented their own green energy policies. For example, in Australia, the Renewable Energy Act of 2000[26] was established to propose and implement a framework for the Large-scale Renewable Energy Target, as well as for the Small-scale Renewable Energy Scheme. On the other hand, the Chinese Government

[21] IEA, 'About ocean power' (*International Energy Agency*) <https://www.iea.org/topics/renewables/subtopics/ocean/> accessed 17 May 2015
[22] IPCC (n.1, p. 95)
[23] IPCC (n.1, p. 96)
[24] USBR, 'Public Utility Regulatory Policies Act' (*USBR* 9 November 1978) <http://www.usbr.gov/power/legislation/purpa.pdf> accessed 18 May 2015
[25] GPO, 'Energy Independence and Security Act of 2007' (*US Government Publishing Office* 19 December 2007) <http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf> accessed 18 May 2015
[26] ComLaw, 'Renewable Energy (Electricity) Act 2000' (*ComLaw* 21 December 2000) <http://www.comlaw.gov.au/Series/C2004A00767> accessed 18 may 2015

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

implemented their Renewable Energy Law of 2005 which aimed to assist the development and the utilization of renewable energy, facilitate in the increasing of energy supply, as well as in the improvement of energy infrastructure, ensure energy security and the protection of environment in order to meet social sustainable development[27].

In the UK, there are also multiple green energy policies enacted by the UK government. For example, the Climate Change and Sustainable energy Act of 2006[28] is an Act enacted by the UK Parliament aiming to encourage and increase the number of heat and electricity micro generation deployments in the country. Such aim would enable the country to reduce their carbon emissions and fuel poverty. The Energy Act of 2011[29] was also enacted dealing with the different barriers to energy efficiency, as well as dealing with improving energy security and enabling investment in low-carbon energy supplies. On the other hand, Bio-energy Capital Grants Scheme[30] was enacted to facilitate support on biomass-fuelled heat and CHP (combined heat and power) projects for all sectors including the industrial, commercial and community sectors.

CLIMATE CHANGE LAW

What is Climate Change?

Scientific controversy has been a major element of public discourse for the last half-century. Perhaps no issue sparks as much controversy today as global climate change, which is often referred as the global warming. Accordingly, existing literature have increasingly expressed a consensus that global climate change is basically a reality that will have detrimental impact on the lives of people around the world. Global climate change would present a huge number of challenges and risks arising from increasing warming of the temperatures around the world, which include sea level rise, expanding desertification, increasingly violent storms, changing patterns of disease vectors, decreasing agricultural output, melting glaciers and ice caps, and the resulting dislocations in societies, and ecosystems around the world spread out over the next century and beyond[31].

There are wide range of definitions of the term 'climate change' presented by climate change experts and organizations. Some of them are:

- According to US NASA, climate change is 'change in the typical or average weather of a region or city…change in Earth's overall climate[32]'.

---

[27] National People's Congress, 'The Renewable Energy Law of the People's Republic of China' (*Martinot.info* 28 February 2005) <http://www.martinot.info/China_RE_Law_Beijing_Review.pdf> accessed 18 May 2015
[28] UK Parliament, 'Climate Change and Sustainable Energy Act 2006' (*Bailii* 2006) <http://www.bailii.org/uk/legis/num_act/2006/ukpga_20060019_en_1.html> accessed 18 May 2015
[29] Energy Act [2011] <http://www.legislation.gov.uk/ukpga/2011/16/pdfs/ukpga_20110016_en.pdf> accessed 18 may 2015
[30] DEFRA, 'Bio-energy Capital Grants Scheme' (*Department of Environment Food and Rural Affairs*) < http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000IL3890W.18MIPI74LXS323 > accessed 18 May 2015
[31] Nihar Kaushik Shah, 'Climate Change and Discounting' < https://books.google.com.ph/books?id=dOLrfjSaCfAC > accessed 18 May 2015
[32] NASA, 'What are climate and climate change?' (*NASA* 26 October 2011) < https://www.nasa.gov/audience/forstudents/5-8/features/what-is-climate-change-58.html#.VVse6vmqqko > accessed 18 May 2015

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

- IPCC, in their usage, defined climate change as the 'change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer[33]'. The IPCC further noted that climate change is 'any change in climate overtime, whether due to natural variability or as a result of human activity[34]'.

- The United Nations Framework Convention on Climate Change (UNFCCC) defined climate change as ' change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods[35]'

Climate includes all the elements of weather such as temperature, precipitation and wind patterns, and refers to the average weather of a place or region. Climate change encompasses differences in climate as a whole rather than a single element, with global climate change defined as variations in all the interconnected weather elements.

Causes of climate change

Changes in climate occur because of internal variability of the system as well as external factors. Various forces can modify the retention of heat by the atmosphere - some are of human origin, some are produced solely by nature, and some are produced by feedback reactions or secondary interactions of one atmospheric component with another[36]. There are two categories of factors that influence or contribute to the changes in the Earth's climate over various time scales – natural and anthropogenic factors.

Natural Factors

Natural factors include changes in solar output, changes in the Earth's orbit, aerosols, and greenhouse effect and many others, as identified by the British Geological Survey[37].

- *Changes in solar output* - the amount of energy radiating from the sun are not constant, and evidence points to an 11-year solar cycle (variation in energy output) in the temperature of the Earth.

- *Changes in the Earth's orbit* - slow variations in the Earth's orbit around the sun affect where and when solar energy is received on Earth, and in turn the amount of energy that is reflected and absorbed.

[33] IPCC, 'Climate Change 2007: Synthesis Report' (*IPCC* 2007) < https://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html> accessed 18 May 2015
[34] Ibid (n. 36)
[35] UNFCCC, 'Climate change' (*United Nations Framework Convention on Climate Change*) < http://unfccc.int/files/documentation/text/html/list_search.php?%20zwhat=keywords&val=&valan=a&anf=0&id=10 > accessed 18 May 2015
[36] Kenneth Green, 'A Plain English Guide to Climate Change' (*Reason Foundation* 1 August 2000)< http://reason.org/news/show/a-plain-english-guide-to-clima > accessed 18 May 2015
[37] British Geological Survey, 'What causes the Earth's climate to change?' (*British Geological Survey*) < http://www.bgs.ac.uk/discoveringGeology/climateChange/general/causes.html?src=topNav > accessed 18 May 2015

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

- *Aerosols* - very fine particles and droplets that are small enough to remain suspended in the atmosphere for considerable periods of time, and both reflect and absorb incoming solar radiation

- *Greenhouse effect* - the common term for the warming function the atmosphere plays in the global ecosystem. When energy from the sun enters the Earth's atmosphere, about one-third of it is reflected back to space. Of the rest, some is absorbed by the atmosphere, but most of it is absorbed by the surface of the Earth. The Earth emits energy at longer wavelengths, some of which escapes to space with the remainder absorbed again and reemitted by clouds and greenhouse gases (GHGs)[38].

Anthropogenic Factors

Human action can affect all of the major GHGs. In addition to the natural factors discussed previously, the following are some anthropogenic factors affecting climate, as identified by the World Meteorological Organization[39].

- *Enhanced greenhouse effect* - scientific studies show that a variety of human activities release GHGs. Scientists agree that by increasing GHG concentrations in the atmosphere and by adding new GHGs such as CFCs, the greenhouse effect will be enhanced and cause additional warming.

- *Land use change* - as humans replace forests with agricultural lands or natural vegetation with concrete, the way the Earth's surface reflects sunlight and releases heat is altered and regional evaporation, runoff and rainfall patterns are affected.

- *Aerosols* - large quantities of fine particles (aerosols), both horn agricultural and industrial activities, are being added to the atmosphere. Most of these aerosols are soon removed by gravity and rainfall, but they still affect the radiation balance in the atmosphere. Whether this effect adds to or offsets any global warming trend depends on the quantity and nature of the particles, as well as on the nature of the land or ocean surface below. The regional effects, however, can be significant[40].

Worldwide Climate Change Laws

Different countries around the world have established wide range of climate change laws and legislations aiming to address the changing global climate as well as its impact on every aspect of human lives. In the US, there is no comprehensive federal legislation on climate change, especially in relation to greenhouse gas emissions. However, different States in the country have established and implemented their climate change legislations and initiatives. For example, in California State, the California Environmental Protection Agency has released Climate change law which presented wide range of strategies and approaches that could be potentially viable in reducing greenhouse gas emissions. In New York, the local government have signed and implemented the Executive Order 24 setting a goal to reduce greenhouse gas emissions in New York State by about 80 per cent below the levels emitted in 1990 by the year 2050. On the other hand, the Florida state government released a report recommending an

[38] British Geological Survey (n. 40)
[39] World Meteorological Organization, 'Causes of climate change' (*World Meteorological Organization*) < https://www.wmo.int/pages/themes/climate/causes_of_climate_change.php > accessed 18 May 2015
[40] Ibid

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

implementation of the regional cap-and-trade system, as well as recommendation on acquiring 20 per cent of its electricity from renewable sources by 2020. The report also suggested on actions aiding in the reduction of power use through encouraging energy efficiency. This report projected that the reforms would help in reducing greenhouse gas emissions by about 34 per cent by 2025 and would likely save $28 billion from 2009 to 2025[41].

In Canada, the legal action of the Canadian government took form as the National Implementation Strategy, outlining themes or priority areas in terms of actions under uncertainties. The key elements of this strategy include:

- Taking immediate action to reduce risks and to improve our understanding of dangers associated with climate change, as well as the costs and consequences of reducing emissions and adapting to a changing environment;
- Instituting a national framework that coordinates individual and joint action and recognizes jurisdictional flexibility to meet unique needs, circumstances, and opportunities;
- Adopting a phased approach which schedules future decisions and allows progressive action in response to changing domestic and international circumstances and improved knowledge;
- Furthering the science of climate change, understanding the impacts, regional variation, and the pace of change in order to take actions to reduce emissions and adapt to a changing environment;
- Understanding the interrelationship between international and national approaches; and
- Understanding the implications of emission reduction targets and options, including cross-cutting policy approaches such as emission trading and allocation[42].

On the other hand, the UK Parliament has its Climate Change Act enacted in 2008, which was established to create a framework supporting the development of an economically-credible emissions reduction path. This Act includes stipulations on 4 key domains, including the 2050 target, carbon budgets, establishment of the Committee on Climate Change and the National Adaptation Plan. It also sets out the roles of the Department for Energy and Climate Change and the Department for Environment and Rural Affairs in the development of climate change policies[43].

Relationship between green energy policy and climate change law

In order to understand or determine the linkages between green energy policy and climate change laws, it is important first to understand the relationship between greenhouse gas emissions from non-renewable energy sources and climate change. Apparently, there have

[41] EPA, 'Climate change action plans' (*Environmental Protection Agency*) < http://www.epa.gov/statelocalclimate/state/state-examples/action-plans.html > accessed 18 May 2015
[42] Government of Canada, '2001 Canada's Third National Report on Climate Change' (*UNFCCC*) <http://unfccc.int/resource/docs/natc/cannce3.pdf > accessed 18 May 2015

[43] Committee on Climate Change, 'The Climate Change Act and UK Regulations' (*Committee on Climate Change 2008*) <http://www.theccc.org.uk/tackling-climate-change/the-legal-landscape/global-action-on-climate-change/> accessed 18 May 2015

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

been a lot of research studies that contributed to the growing evidences on such relationships. For example, the study by Hegerl and Cubasch[44] attempted to present justification on the causal relationship between increasing concentration of greenhouse gasses and aerosols and climate change. Using an optimal fingerprint analysis applied to temperature trend patterns over several decades, results showed that the current warming has been caused by external influence on climate including the increasing concentrations of greenhouse gasses and aerosols.

The recent study by Shafiei and Salim[45] also supported the previous evidences, with focus on carbon dioxide emissions in OECD countries. Their research attempted to explore the various determinants of carbon dioxide emissions through the use of STIRPAT model and data from 1980 to 2011 for OECD countries. Based on their scientific results, non-renewable energy consumption likely enhance the amount of carbon dioxide emissions, while renewable energy consumption helps in decreasing carbon dioxide emissions. In addition to that, results also presented policy implications, wherein policy makers have to focus on urban planning as well as clean energy development in order to make considerable contributions to both reducing non-renewable energy use and mitigating climate change.

Therefore, the connection between the two regulatory efforts (climate change law and green energy policy) is their similarity in terms of its purpose. Most of the green energy policies and climate change laws around the world were leaned towards the reduction of greenhouse gas emissions. For example, climate change law in the UK was established to present a framework that enables the development of an economically-credible emissions reduction path. In specific, the Climate Change Act encompasses three areas of concern related to greenhouse gas emissions. These include the 2050 Target, Carbon Budgets and the Committee on Climate Change establishment. Just to reiterate, the Act obliges the UK in reducing emissions by at least 80 percent in 2050 from 1990 levels. The 80 percent target includes greenhouse gas emissions from the devolved administrations, which currently accounts for around 20% of the UK's total emissions. Likewise, the Act also required the Government to set legally binding carbon budgets which are caps on the amount of greenhouse gases emitted in the UK over a five-year period[46].

Similar stipulations of the UK's Energy Act of 2011 aimed to reduce carbon emissions. These were emphasized on the Chapter 4 of the said Act. The same goes to the Climate Change and Sustainable Energy Act of 2006, which stipulated wide range of policy mandates that aimed to reduce greenhouse gas emissions through using renewable sources in heat and electricity generation.

Another linkage between the two regulatory efforts could be seen in the incentives of using green or renewable energy sources and levies imposed for using non-renewable energy sources. The incentive-levy system to encourage the use of green energy sources represents a key mechanism for major stipulations in the two regulatory efforts. For example, one of the climate change laws implemented in the UK is the Climate Change Levy which is paid on electricity, gas and solid fuels like coal, lignite, coke and petroleum coke. Here, individuals and companies will be obliged to pay the levy when they are using electricity, gas and solid fuels, and will

[44] G C Hegerl and U Cubasch, 'Greenhouse gas induced climate change' [1996] *Environmental Science and Pollution Research International* 99
[45] Sahar SHafiei and Ruhul Salim, 'Non-renewable and renewable energy consumption and CO2 emissions in OECD countries: A comparative analysis' [2014] *Energy Policy* 547, 547
[46] Committee on Climate Change (n. 46)

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

only be exempted when the electricity is generated from renewable sources[47]. On the other hand, one of the UK's green energy policies that support the use of renewable sources using incentives is the Bio-energy Capital Grants Scheme. Just to reiterate, the Bio-energy Capital Grants Scheme was enacted to facilitate support on biomass-fuelled heat and CHP (combined heat and power) projects for all sectors including the industrial, commercial and community sectors[48].

Towards a cohesive policy: The challenges

Both the climate change law and green energy policy have been of great importance in achieving sustainable energy generation and consumption while helping in the mitigation and prevention of the impending impacts of global climate change. However, there has not been a single cohesive policy created yet for the two regulatory efforts. There are various challenges that could be seen in coming up a cohesive policy for the two regulatory efforts. One of which is the difficulty of establishing a single framework for supporting green energy technologies that addresses both clean energy generation and climate change in a wider context. Establishing a framework that involves energy generation is complex, considering the fact that renewable energy technologies are diverse and serve wide range of energy service requirements. This further imply a greater challenge on the process management of energy services addressing on the multi-step process of converting key energy sources into energy carrier and then into an energy service (see Figure 4)[49] while maintaining a low-carbon emissions.

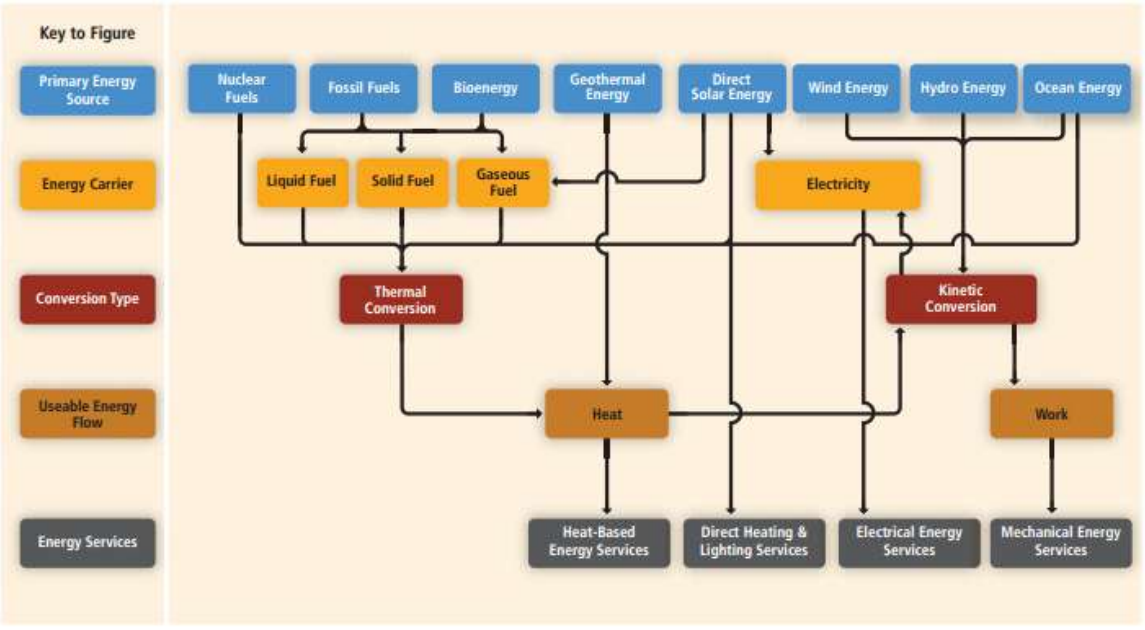
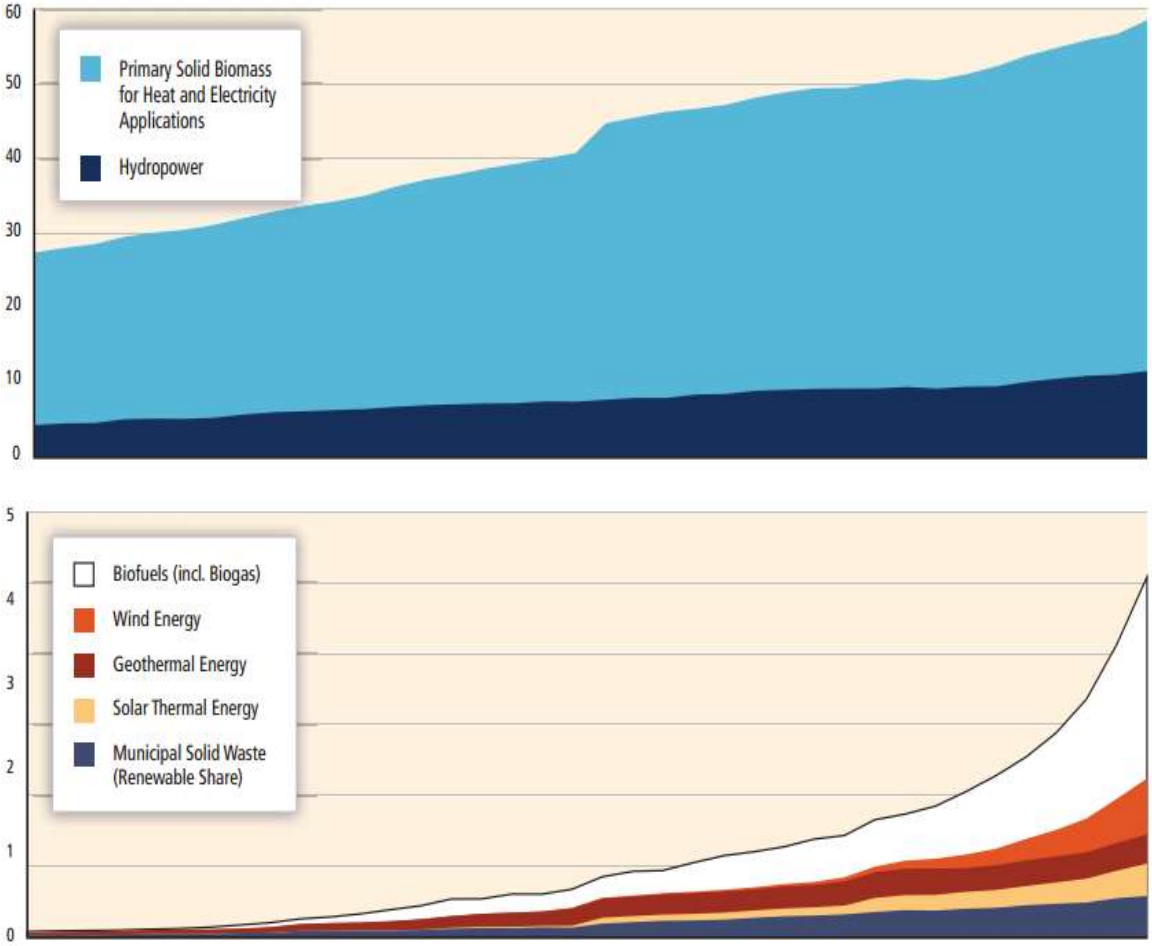


Figure 4: Process of converting energy source to service

[47] UK Gov, 'Climate Change Levy' (*UK Government Website*) < https://www.gov.uk/green-taxes-and-reliefs/climate-change-levy > accessed 18 May 2015
[48] DEFRA, (n. 33)
[49] IPCC, (n.1, p. 38)

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

Another potential challenge in establishing a cohesive policy for both climate change law and green energy policy is the compatibility of the two regulatory efforts. Technically, it could be considered that certain climate change policies such as carbon taxes, emissions trading or regulatory policies could help in reducing the relative costs of technologies that emit low carbon amounts in comparison to its effects on carbon-intensive technologies. Yet, it is still in uncertain whether or not these climate change policies, especially carbon pricing alone will be flexible and capable enough to support or promote green energy at sufficient levels that are stipulated in green energy policies in order to address and meet wide range of objectives relative to renewable energy (e.g. environmental, economic and social aims and objectives). In other words, it would take much time of aligning the stipulations of climate change law with the stipulations and regulatory mandates set forth by green energy policies that relates to the harnessing of the green or renewable resource potentials, given that for the past years, humans have already started and enjoyed harnessing renewable energy sources to generate energy such as electricity, heat and combined heat and electricity (See Figure 5 below).



ISSN 2055-0197(Print), ISSN 2055-0200(Online)

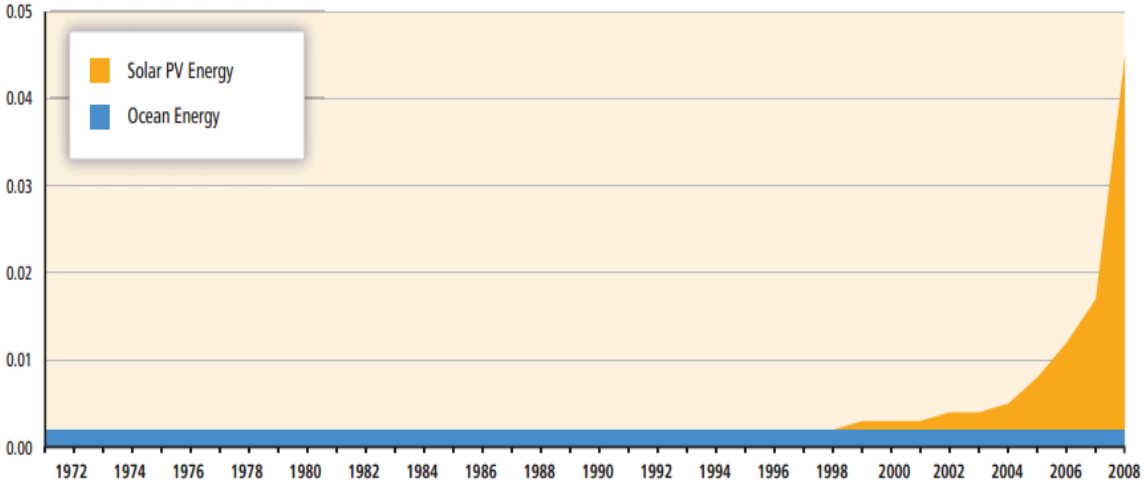


Figure 5: Historical development of global primary energy supply from renewable energy from 1971 to 2008

CONCLUSIONS

All over the world, national governments and policy makers have been strong in their stance on the fight against global climate change due to human-made factors. Such stance was clear on the various regulatory and policy mandates and initiatives to establish sustainable energy generation while preventing and mitigating the impending impacts of climate change. Climate change law and green energy policy were critical in the movement for using green or renewable energy sources in order to reduce greenhouse gas emissions and, therefore, slowing down the process of change in the earth's climate which is basically a natural event, as Earth's climate has been changing for the past millennia. Green energy policies around the world have been driven by the abundance of wide range of renewable energy sources including high-efficiency modern biomass, solar, geothermal, hydropower, ocean energy and wind. Worldwide green energy policies has established frameworks, implemented stipulations and regulatory mandates to support the use of these renewable energy sources in order to reduce the emissions of greenhouse gas in the Earth's atmosphere. Greenhouse gas is one of the factors that is influencing the changing climate of the Earth.

Global climate change is simply the change in the Earth's climate, with would present a huge number of challenges and risks arising from increasing warming of the temperatures around the world, which include sea level rise, expanding desertification, increasingly violent storms, changing patterns of disease vectors, decreasing agricultural output, melting glaciers and ice caps, and the resulting dislocations in societies, and ecosystems around the world spread out over the next century and beyond. Worldwide climate change laws have also been deployed in order to address wide range of issues relating to the global climate change.

In relation to the relationship between climate change law and green energy policy, the study could conclude that their linkages could be manifested on similarities of the two regulatory efforts. One of such similarity that links the two together is that most of the green energy policies and climate change laws around the world were leaned towards the reduction of greenhouse gas emissions. Another linkage between the two regulatory efforts could be seen in the incentives of using green or renewable energy sources and levies imposed for using non-

ISSN 2055-0197(Print), ISSN 2055-0200(Online)

renewable energy sources. The incentive-levy system to encourage the use of green energy sources represents a key mechanism for major stipulations in the two regulatory efforts.

More so, the study also concluded that various challenges and issues might arise in the move of establishing a cohesive policy for the two regulatory efforts. These include (1) difficulty of establishing a single framework for supporting green energy technologies that addresses both clean energy generation and climate change in a wider context, (2) challenges relating to process management of energy services, and (3) compatibility of the two regulatory efforts.

ISSN 2055-0197(Print), ISSN 2055-0200(Online)