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Latin America as a model for the provision of renewable energy

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RIO+20

The United Nations Conference on Sustainable Development, also referred to as Rio+20, is an important step in ongoing international efforts to accelerate progress towards achieving sustainable development globally. The conference will mark the 20th anniversary of the 1992 UN Conference on Environment and Development in Rio de Janeiro (the Earth Summit). It will also mark the 10th anniversary of the 2002 World Summit on Sustainable Development in Johannesburg.

The 1992 and 2002 summits were headline international events and key drivers of the sustainable development agenda. Similarly, Rio+20 presents an opportunity to re-direct and re-energise political commitment to the three pillars of sustainable development: economic growth, social improvement and environmental protection. The conference is expected to be attended by a significant number of Heads of State and Government.

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Abstract

This paper presents Latin America as a model for the developing world to highlight the challenges that developing countries face in providing clean, sustainable access to energy to their most isolated and deprived communities. As the host of the Rio+20 summit and the regional power of Latin America, Brazil was chosen for analysis as it presents both the progress already made in the provision of renewable energy as well as the obstacles which stand in the way of further progress.

This study shows how regional progress and challenges of renewable energy provision are applicable to the wider developing world and how institutions can learn from this to ensure a greater efficiency when working toward renewable energy targets for the future. The following recommendations are the product of this study:

- A forum for the exchange of ideas on renewable energy provision between developing nations must be established;
- The Brazilian model of using local products and innovation to develop new technology should be adopted by developing states;
- Education of local communities regarding sustainable energy access must complement the provision of new energy technology;
- Renewed financial commitment by states to render renewable energy options more competitive in the market is encouraging and essential;
- An improvement on data gathering must be made to assist developing states in sourcing sustainable energy; and

- A continued increase in the co-operation between the International Renewable Energy Agency and the UN and its member states will facilitate the reaching of global energy targets.

Introduction

Energy is one of the main agenda items of the Rio+20 conference on sustainable development and when the question about what kind of future we want is posed, universal access to clean energy is a certain ideal. The world faces a significant challenge to provide complete access to energy to the ever-expanding global population. Twenty per cent of people currently lack access to modern electricity and almost half rely on coal, wood, charcoal or animal waste for cooking and heating.¹ Furthermore, pollution from energy production is the greatest contributor to global climate change. With the current reliance globally upon non-renewable energy sources, it is imperative that a shift toward cleaner sustainable energy is put into practice. An increase in focus upon the provision of cleaner and renewable energy will revolutionise human society and this monumental shift has the potential to confront many challenges that we, as a civilisation, face today. It is a question of much more than a mere need to power the planet. In a time of worldwide economic uncertainty, with severe doubts over the viability of the status quo, and unemployment an increasing difficulty facing many countries, development and proliferation of sustainable energy would catalyse a major industry boom across the globe.

As the world moves into the future, the distinction between renewable and non-renewable energy sources becomes paramount for the sustainability of human civilisation. Society's present reliance on fossil fuels, such as petroleum and natural gas, is an unsustainable practice. Fossil fuels may be naturally renewing resources however mankind's rate of consumption far exceeds the rate at which

¹ D Spreng, T Flüeler, DL Goldblatt & J Minsch, Tackling Long Term Global Energy Problems: the contribution of social science, Springer, Switzerland, 2012, p.13.

the resources are replenished. To continue rapid development in a sustainable manner, without furthering the severe environmental degradation, a damaging by-product of fossil fuel use, a shift toward cleaner renewable energy is a must. Researching and implementing specific technologies is a difficult task given the sheer costs involved and the necessity to balance short-term expenses with long-term necessary intervention to ensure a sustainable future.

As the host region to the Rio+20 Conference, Latin America's importance to global issues of sustainable development must not be overlooked; indeed, it should be amplified. As the hosts of the discussions, Brazilians and indeed all Latin Americans must make ample use of the spotlight to present to the world the future that they want. A bastion of biodiversity and an eclectic blend of the developing and the developed world, Latin America can be a model to follow as the challenge begins of providing electricity to the ever augmenting global population. The Latin American region is particularly relevant to the developed world when it comes to the provision of renewable energy. There are examples, both positive and negative, as the success of extensive renewable energy use is evident; however this is counteracted by the failure to fulfil the vast potential for renewable energy sourcing and the reliance upon certain energy sources, which are neither the cleanest nor the most sustainable. As the dominant regional power, Brazil is furthering its established renewable energy policies and its successes in permeating the formidable interior of the Amazon rainforest to provide power to its most isolated citizens, as well as the challenges it faces in doing so, provide both lessons and encouragement for other developing countries.

Renewable Energy Potential of Latin America

Why Latin America is an appropriate model of analysis for the provision of renewable energy is evident in the region's potential and deployment of different forms of renewable energy. The International Energy Agency published in 2007 a report which showed that 29% of Latin America's

total primary energy supply is sourced from renewables.² This figure is high in contrast to data from the same year which showed that OECD states only used a 5.7% share of renewables and the Middle East only used a 0.7% share.³ However, it is important to note that despite Latin America's huge potential for the implementation of renewable energy, 62% of that which it does use comes in the form of biofuels.⁴ Almost the entire remaining share is hydroelectric power.

Given the resource rich nature of the Latin American region, such a heavy lean toward biofuels is not an environmentally healthy future and is certainly not an example for the rest of the world to follow. The conversion of biomass into energy is prevalent throughout Latin America and this must be specifically noted. Biofuels release toxic waste products, including carbon dioxide, nitric oxide, nitrogen dioxide (both nitrous oxides contribute to the destruction of the planet's ozone layer) as well as volatile compounds including methane, into the atmosphere.⁵ This example of the combustion of organic matter to produce energy highlights the need to assess each form of renewable energy on its own merits to determine whether it is worthy of any role in establishing a framework for the future provision of renewable energy. Biofuels are also highly controversial due to the risk of deforestation in order to create sugar cane plantations. Arable land is also at risk, as it can be exploited for cane plantations rather than producing food for the communities which depend upon it. Latin America, and by extension Brazil, is a bastion of positive examples for such provision; however it is also a glaring case in point when it comes to the damaging effect biofuels can wield.

Hydroelectricity is also a major issue. Hydropower is able to produce up to 90 per cent of the energy of its water into electricity, in comparison to fossil fuel's 50 per cent.⁶ In some Latin American

² P Meisen, S Krumpel, 'Renewable Energy Potential of Latin America', Global Energy Network Institute, 2009 p.19.

³ *Ibid.*

⁴ *Ibid.*

⁵ D Klass, Biomass for Renewable Energy, Fuels and Chemicals, Academic Press, United States of America, 1998, pp.194-196.

⁶ AS Draper, Hydropower of the Future: New ways of turning water into energy, The Rosen Publishing Group, United States of America, 2003, p.13.

countries, such as Brazil, Paraguay and the Central American region, total energy production from hydro power is around this 90 per cent mark.⁷ This is obviously a significant number; however this reliance on one type of energy source brings with it a unique set of problems. The most apparent issue when it comes to hydroelectric reliance is what occurs in the event of periods of low rainfall. Major hydroelectric dams have also required zones to be flooded which can displace indigenous populations of the zones in which the dams are built.⁸ The mortality rate of fish which pass through modern hydroelectric dams is approximately 15 per cent, with the target being to reduce this figure to two per cent.⁹ The risk to the prosperity of fish species as a result of the turbines, as well as the flooding of dams is a significant environmental issue to take into account. Therefore, the provision of renewable energy must take into account environmental factors and ensure that reliance upon one specific source of power is avoided. The reality is that while Latin America's renewable energy sector largely revolves around biofuels and hydroelectricity; the region also has great potential to adopt other, and in many cases cleaner, forms of renewable energy.

The renewable energy potential in Latin America is a reason why the region can be used as a model for the rest of the world, particularly developing nations. Renewables are already in vogue as demonstrated by the heavy use of biofuels. As it is a largely agricultural region, these biofuels are principally wood fuels; that is the burning of wood matter to produce energy. However, there are many alternative renewable options which could be adopted, particularly given the diversity of the terrain and the natural advantages this offers. The high usage of biofuels, such as wood fuels and cane, in Latin America highlights that photosynthetic activity across the region is abundant. Photosynthetic activity levels are an indicator of solar radiation levels, as solar energy is essential for

⁷ *Ibid*, p.20.

⁸ A Dias Leite, *Energy in Brazil: Towards a Renewable Energy Dominated System*, Earthscan, United Kingdom, 2009, p.224.

⁹ Alternative Energy Institute, KK Smith, *Powering Our Future: An Energy Sourcebook for Sustainable Living*, iiUniverse, United States of America, 2005, p.164.

photosynthesis to occur. It is therefore logical to conclude that Latin America has a high potential to harness this solar radiation and use it to forge a thriving solar energy industry.

Electromagnetic solar radiation is highest in lower latitudes and the “total solar energy received each year from the sun is 35,000 times the total energy used by modern society”.¹⁰ The northern parts of Latin America fall into a geographical belt in which solar radiation is at its highest.¹¹ Mexico, the Central American states and northern South America could find solar energy a most useful resource when seeking to power a sustainable future and provide their citizens and businesses access to a clean and reliable electricity supply. Solar photovoltaic energy is not as efficient as solar thermal energy, which harnesses the sun’s heat rather than converting solar energy directly into electricity. However, photovoltaic infrastructure is not as cost-prohibitive and technologically advanced and therefore represents a suitable option as a source of peak power. Solar energy also offers another significant advantage in comparison to some other forms of renewable energy, such as hydropower; its consistency. Solar radiation patterns are far more constant than rainfall and water levels and the risk of the electricity supply grinding to a halt with an efficient solar power system in place is very low.

Latin America, especially in the zones situated on the Pacific Rim, is blessed with a multitude of geothermal hotspots which allow for the production of geothermal energy, even if the precise potential remains undetermined.¹² This particular form of renewable energy is naturally dependent on the strategic locations where geothermal resources are available; which is usually on the boundary of tectonic plates where the thermal heat reaches closest to the surface. That geothermal energy does not require fuel to be produced is a significant factor in its potential role as a major

¹⁰ D Mulvaney, P Robbins, *The SAGE Reference Series on Green Society: Toward a Sustainable Future: Green Energy, An A-Z Guide*, SAGE Publications, United States of America, 2011, pp. 383-384.

¹¹ Meisen, Krumpel, p.22.

¹² RA Yépez-García, TM Johnson, LA Andrés, *Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean*, The World Bank, United States of America, 2011, p.95.

source of energy for a sustainable future. Such potential to utilise renewable energy sources does highlight Latin America's role as a model for the future but it also illustrates the major obstacles that are faced when seeking to implement sustainable and renewable energy solutions.

Challenges to the Provision of Renewables

A rational look at why Latin America is so heavily focused on biofuels, despite the potential use of alternative renewable energy sources, will give indications of the kinds of challenges that the renewable energy industry faces globally. The most obvious impediment to the use of renewable energy sources worldwide is, obviously, cost. With geothermal energy, for example, an approximate figure of 44 TW is transferred to the Earth's surface from its interior.¹³ This is a significant figure given the estimated electricity consumption of humans is 16 TW.¹⁴ However the cost implications only permit a small fraction of geothermal energy to be utilised. As addressed in the preceding paragraph, geothermal energy plants do not require fuel. However, the costs in establishing the drilling centres and pipelines, as well as designing and constructing the power plants are high. The United States Department of Energy cites the initial infrastructure cost of a geothermal energy facility in that country to be around \$2500 per installed kilowatt.¹⁵ The costs of renewables are also inevitably higher than established unsustainable energy sources because a significant amount of research must be conducted before infrastructure can even be planned.

This is particularly an issue in Latin America, where transmission grid mapping is patchy and incomprehensive. These grid maps can be matched up to detailed maps illustrating the locations of energy resources to determine efficient methods of supplying the renewable energy. These maps would be of particular use when it comes to geothermal energy, which is highly reliant on

¹³ EE Michaelides, *Alternative Energy Sources*, Springer, United States of America, 2012, p.257.

¹⁴ *Ibid*, p.258.

¹⁵ U.S. Department of Energy, *Geothermal Technologies Program*, published December 2011, retrieved May 2012, <<http://www1.eere.energy.gov/geothermal/faqs.html>>.

geographical data to be implemented. Studies show though, that Latin America has high potential for solar power due to the patterns of solar irradiation. In Brazil, for example, solar irradiation is high across the country and therefore in the absence of advanced transmission mapping, solar power has this edge over other renewables. A greater level of resource analysis would also assist Latin America, which has both the significant coastline access, as well as mountainous regions, to adopt plans to introduce wind turbines. Wind energy in mountainous regions would be a viable clean energy option to supply the indigenous rural population which inhabits those areas. As wind power would need a grid to be constructed, it would require a greater level of financial investment than photovoltaic power however, and this economic barrier must be taken into account. These obstacles to fulfilling Latin America's potential for the adoption of a broader range of renewable energy sources are not insurmountable but they provide important lessons, not only for the states in the region but for the developing world as a whole.

The Brazilian Experience

Renewable energy policy varies from country to country and the states of Latin America reflect this. A country-specific analysis is necessary to provide a greater insight into potential for renewable energy provision in Latin America; however space constraints prevent each country from being explored here. As the world's fifth most populous country, the dominant Latin regional power and the host of Rio+20, Brazil is an interesting point of focus for analysing renewable energy potential. The country must provide electrical access to an estimated 194 million citizens, in both urban metropolises and rural zones, as well as power a rapidly developing economy.¹⁶ With the vast potential for renewable energy as assessed in prior paragraphs, Brazil is an example for developing nations with significantly large populations. A look at Brazilian energy policy shows that it is

¹⁶ Population figure, 2010 World Bank estimate.

expanding through both its majority-state run energy providers as well as attracting foreign investors into its energy market. It is a cycle which works well for the country with a once-volatile but now booming economy. The increased privatisation of its energy sectors assists the continued development of Brazil and the foreign funds contribute toward the adoption of renewable technology.

The energy policy of Brazil is a model of problem solving; that is, the country has faced significant challenges to provide power in the face of overwhelming demand and is adopting a policy of diversifying its power sources to overcome such difficulties. The need for a broader range of electricity sources was made strikingly evident in 2009 when a power outage at Itaipu, Brazil's largest hydroelectric plant, left more than 60 million Brazilians without access to power.¹⁷ Brazil though, is pushing ahead with hydroelectric development in the face of protesters concerned with the environmental impact upon the rainforest interior as well as the risk to indigenous populations. The government is promoting the introduction of more renewable energy sources with a policy aptly titled Program of Incentives for Alternative Energy Sources (PROINFA).¹⁸ This program is designed to underwrite the provision of mainly wind and biomass energy. More than 50 long term power purchase agreements for wind energy products totalling 1,443 megawatts had been signed as of January 2009.¹⁹ The scheme extends to wave energy too. While the use of tides to produce energy is technologically distant from mainstream reality, a 100KW wave energy plant on the north eastern coast had begun.²⁰ This is a Latin American first and venturing into long-term technology indicates serious ambition.

¹⁷ C Kraul, M Soares, *Brazil's frayed wires finally short out*, Los Angeles Times, published 19 November 2009, <<http://articles.latimes.com/2009/nov/12/world/fg-brazil-blackout12>>.

¹⁸ D da Cunha D'Angelo Palacio Requejo, *The Alternative Energy Sources Incentive Program – PROINFA*, Institute of Brazilian Business and Public Management Issues – IBI, The Minerva Program 2009, The George Washington University, United States of America, 2009, pp.4-5.

¹⁹ 2010 Brazil Energy Handbook, PSI Media Inc., United States of America, 2009, p.21.

²⁰ Ibid, p.22.

The Brazilian government also passed legislation in 2007 which allows the national energy regulator to auction off renewable electricity.²¹ Linking rural zones to the national grid is also a major priority for the Brazilian government, as the large expanse of the country makes this difficult. However, given the hydro power plants are predominantly located in the remote interior, a process of connecting small hydro plants which power rural localities to the national grid has become a priority.²² Co-operation with neighbours, including Venezuela, Paraguay and Argentina is serving Brazil well in this area. Eletrobras, the state-owned power producer of Brazil, and its Venezuelan equivalent have entered into a series of agreements to supply hydroelectric power to rural Brazilians from across the border.²³ Foreign energy multinationals from countries such as Spain have even established Brazilian subsidiaries to invest in the infrastructure boom. The link with foreign countries is likely to prove vital for Brazil as it seeks to advance its renewable energy sector whilst modernising infrastructure to provide power to rural and remote areas.

Schemes such as these are making slow progress, as it is important to remember Brazil's significant reserves of oil and natural gas largely render non-renewable energy much more competitive in the market. The majority state-owned Petrobras is a world leader in the production of oil energy. Petrobras maintains activities on all continents of the globe. While Petrobras is involved in the provision of some renewable energy, its chief product is petroleum. Brazilian economic interests for the considerable future will therefore be inextricably linked to oil. However, the incentives-based encouragement of renewable energy provision is likely to ensure that Brazil will not fall behind when it comes to the development of new technologies. The state policy PROINFA is central to this. The law has been in place for a decade and from its introduction, passed quickly from the initial phase of energy subsidies, obtained via an increase in power costs applicable to all but low-income earners,

²¹ Ibid, p.20.

²² Ibid, p.24.

²³ Ibid.

to underwrite renewable projects.²⁴ The Brazilian national development bank also assisted in funding the infrastructure requirements. The first phase was scheduled to be completed by 2007 and was reached two years early. The target of 3,300MW of renewable energy consisted of 1,379MW of wind power, 1,266MW of solar and 655MW of biomass.²⁵ This policy is supplemented by *Luz para todos*, a policy that has been in effect since 2003 which aims to provide power to all of the country. According to *Sustainable Energy for All*, only one million citizens, inhabitants of the Amazon, remain without it now.²⁶ Brazilian government figures obtained via the program's official website claim that as of March 2012, it has successfully exceeded a target of providing power to 10 million Brazilians, having connected 14.4 million people with electricity.²⁷ Almost 75% of the investment was government funded.²⁸ *Luz para todos* is an innovative program which combines localised infrastructure installation with education. The state is providing solar and biogas systems to rural Brazilians. Crucially, policy co-ordinators who maintain the policy have produced a handbook providing information on how to establish local renewable energy systems and have consulted the rural locals in producing the texts. The project required an advancement in technology to produce electricity poles constructed of resin polyester reinforced with fibreglass, so as to be light enough to transport by boat. Many regions of the Amazon are impassable by truck. The Brazilian government estimates that around 439,000 jobs were created by this program.²⁹ This combination of energy programs shows how heavy state investment in renewable energy and a drive to ensure that the energy needs of citizens are met can achieve great results. Innovation is proving to be the key to

²⁴ da Cunha D'Angelo Palacio Requejo, p.6.

²⁵ F Sussman, N Helme, E Lèbre La Rovere, S Jauregui, JE Sanhueza, JA Garibaldi, J Schmidt, Center for Clean Air Policy, *Barriers to Increasing Clean Energy: Investment and Consumption in Latin America and the Caribbean*, March 2006, p.30.

²⁶ Sustainable Energy for All, *Luz Para Todos (Light for All)*, retrieved May 2012, <<http://www.sustainableenergyforall.org/progress/item/30-luz-para-todos>>.

²⁷ Ministério de Minas e Energia, *Programa Luz Para Todos*, O Programa: Resultados, retrieved May 2012, <http://luzparatodos.mme.gov.br/luzparatodos/Asp/o_programa.asp>.

²⁸ *Ibid.*

²⁹ *Ibid.*

Brazil's continued development and while it is wrong to suggest that its current consumption is sustainable, the direction is positive.

Recommendations

Brazil is therefore an exemplary state when it comes to renewable energy provision. Applying the same principles which are leading to growth in the Latin American energy sector across the developing world could assist in the global challenge to connect rural and isolated communities to greater electricity networks. The Brazilian policy of introducing electrical power to its remote Amazon communities via an innovative technological development program combined with educating the people of those communities to equip them with the knowledge to establish and maintain their own local power networks is one that could be applied across the developed world. Remote and rural communities in Asia and sub-Saharan Africa face many of the same challenges that their Brazilian counterparts did in acquiring connection to electricity grids.

The United Nations' *Sustainable Energy for All* program, which has been in place since 2010, has established clear goals in this regard. The year 2030 is earmarked as the target date by which affordable, sustainable energy should be provided to the entire global population.³⁰ An energy summit hosted in Brussels in April 2012 saw the President of the European Commission announce that the body will fund the provision of electricity to 500 million people by 2030, with the German Government pledging to increase that number by a further 100 million.³¹ This is significant, as the Brazilian example showed that financial contributions from governments and political bodies are essential.

³⁰ Secretary-General's Advisory Group on Energy and Climate Change (AGECC), *Energy for a Sustainable Future: Summary Report and Recommendations*, 2010, p.9.

³¹ A Scott, *Sustainable Energy for All: Milestone on a road to where?*, European Development Cooperation Strengthening Programme (EDCSP), published 17 April 2012.

The beneficial effect of first phase subsidies for renewable energy is also a positive model which the developing world can draw from Brazil's success. Given Brazil's specialisation in the petroleum industry and its significant business interests in the drilling of crude oil, promoting technologies such as wind and tidal energy is no small feat. The creation of jobs in these new areas is paramount as it will again offset the higher costs of providing renewable energy. The leading developing states, such as Brazil, who have already launched renewable energy programs, can export their knowledge and technology to lesser developed states. The exchange of ideas is critical. Many developing nations face similar geographical challenges as Brazil and other Latin American states do, with the isolation of rural communities and a lack of accessibility to them. Therefore, the development of new technology provides rapidly developing nations with a role as global leaders. The use of local products in each given region should be promoted, as this will assist self-sufficiency. Technology exchanges also increase education levels, another critical obstacle for rural communities which often exist far from development centres, institutions and governments. Advances in technological development are necessary to ensure that truly clean energy options, such as wind and solar power, are adopted, thus reducing the use of biofuels, which are high in carbon emissions. The *Sustainable Energy for All* program seeks to eventually create a "strengthened UN-energy framework" and a "monitoring and evaluation system" to direct and assess progress.³² Thus, it is strongly recommended that education be made a focal point.

Looking forward to the future, the roles of the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA) can also be assessed. The latter was founded following discontent regarding the former's perceived bias against the potential of renewable energy. IEA's close ties to the OECD and its role as the chief monitoring agency of oil stocks, as well as its membership base of 28 states in contrast to IRENAs 148 signatories plus the European Union

³² Secretary-General's Advisory Group on Energy and Climate Change (AGECC), p.12.

(66 of which are ratified) indicates that the latter is best poised to become the chief producer of research documents to assist states in adopting renewable energy solutions.³³ The example of Latin America shows that there are still significant gaps in key knowledge areas. The lack of detailed transmission grid mapping suitable for appraising renewable energy possibilities is an impediment to its adoption in the developing world. IRENA must therefore continue to seek a greater level of co-operation with the United Nations and given its already large number of signatories, has the potential to become an important player in the global provision of renewable energy.

Conclusion

Rio de Janeiro's hosting of the 2012 United Nations Conference on Sustainable Development presents an ideal opportunity for Brazil and the Latin American region to showcase its progress in the renewable energy field. At Rio, Brazil can demonstrate why it is a prime example to lead the developing world in adopting renewable energy and furthering the cause to provide electricity to the entire global population within the next two decades.

The global framework infrastructure is already beginning to take shape and it is a concrete direction and proven success that will catalyse further sustainable development. The United Nations has already begun co-operation with the International Renewable Energy Agency and given the challenge of establishing a consensus upon framework, a treaty organisation which the majority of states is a signatory to is a strong point of reference. This organisation is able to lead the way by filling in knowledge gaps and providing statistical data for all countries, as well as advancing the level of power grid mapping which is currently available. Latin America shows that a region with immense

³³ United Nations, *Fifth Session of the Preparatory Commission for the International Renewable Energy Agency (IRENA) and First Session of the Assembly of IRENA*, 2011, <<http://www.uncsd2012.org/rio20/index.php?page=view&type=13&nr=223&menu=46>>.

potential to harness renewable energy sources would benefit greatly from an increased level of data.

The challenge of providing energy to remote communities which do not have electricity access is prevalent across the developing world. It is a challenge which Brazil is confronting at present with a reasonable level of success and this is where such a rapidly developing state must lead the way. Technology exportation and the establishment of a forum for the free exchange of ideas must become short-term aims following the Rio+20 Conference. It is imperative that the developing world helps the developing world and while financial contributions from both the private and public sectors will be necessary to fund the provision, the developing world must be encouraged to advance itself. Education is critical to this. It will also allow for truly clean energy to be developed, rather than relying on out-dated and unclean ideas. Surmounting knowledge gaps and empowering the developing world with both education and electricity will be the building blocks of the future we want.

BIBLIOGRAPHY

Center for Clean Air Policy, *Barriers to Increasing Clean Energy: Investment and Consumption in Latin America and the Caribbean*, March 2006.

da Cunha D'Angelo Palacio Requejo, D, *The Alternative Energy Sources Incentive Program – PROINFA*, Institute of Brazilian Business and Public Management Issues – IBI, The Minerva Program 2009, The George Washington University, United States of America, 2009, pp.4-5.

Dias Leite, A, *Energy in Brazil: Towards a Renewable Energy Dominated System*, Earthscan, United Kingdom, 2009.

Draper, A, *Hydropower of the Future: New ways of turning water into energy*, The Rosen Publishing Group, United States of America, 2003.

Garibaldi, J, Helme, N, E, Jauregui, Lèbre La Rovere, S, Sanhueza J, Schmidt, J, Sussman, F, Klass, D, *Biomass for Renewable Energy, Fuels and Chemicals*, Academic Press, United States of America, 1998.

Kraul, C, Soares, M, *Brazil's frayed wires finally short out*, Los Angeles Times, published 19 November 2009, <<http://articles.latimes.com/2009/nov/12/world/fg-brazil-blackout12>>.

Meisen, P, Krumpel, S, 'Renewable Energy Potential of Latin America', Global Energy Network Institute, 2009.

Michaelides, E, *Alternative Energy Sources*, Springer, United States of America, 2012.

Ministério de Minas e Energia, *Programa Luz Para Todos*, O Programa: Resultados, retrieved May 2012, <http://luzparatodos.mme.gov.br/luzparatodos/Asp/o_programa.asp>.

Mulvaney, D, Robbins, P, *The SAGE Reference Series on Green Society: Toward a Sustainable Future: Green Energy, An A-Z Guide*, SAGE Publications, United States of America, 2011.

Scott, A, *Sustainable Energy for All: Milestone on a road to where?*, European Development Cooperation Strengthening Programme (EDCSP), published 17 April 2012.

Secretary-General's Advisory Group on Energy and Climate Change (AGECC).

Secretary-General's Advisory Group on Energy and Climate Change (AGECC), *Energy for a Sustainable Future: Summary Report and Recommendations*, 2010.

Smith, K, *Powering Our Future: An Energy Sourcebook for Sustainable Living*, Alternative Energy Institute, iiUniverse, United States of America, 2005.

Spreng, D, Flüeler, T, Goldblatt, D, Minsch, J, *Tackling Long Term Global Energy Problems: the contribution of social science*, Springer, Switzerland, 2012.

Sustainable Energy for All, *Luz Para Todos (Light for All)*, retrieved May 2012, <<http://www.sustainableenergyforall.org/progress/item/30-luz-para-todos>>.

United Nations, *Fifth Session of the Preparatory Commission for the International Renewable Energy Agency (IRENA) and First Session of the Assembly of IRENA*, 2011, <<http://www.uncsd2012.org/rio20/index.php?page=view&type=13&nr=223&menu=46>>.

U.S. Department of Energy, *Geothermal Technologies Program*, published December 2011, retrieved May 2012, <<http://www1.eere.energy.gov/geothermal/faqs.html>>.

Yépez-García, R, Johnson, T, Andrés, L, *Meeting the Balance of Electricity Supply and Demand in Latin America and the Caribbean*, The World Bank, United States of America, 2011.

2010 Brazil Energy Handbook, PSI Media Inc., United States of America, 2009, p.21.



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