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# Brazil's Energy Lifeblood: Hydro

## Hydropower: A Renewable Source of Energy for the Developing World:

Brazil, as well as the rest of the developing world is highly dependant on hydroelectricity as a high initial investment but long-term, low-cost energy source (see Appendix, Figure 3). Recent research has indicated that hydro may not be as environmentally friendly as it was once thought. This paper seeks to understand the positive and negative effects of Brazil's energy history and reliance on hydropower.

## The History of Brazil's Search for Energy Self-Sufficiency:

Brazil is unique in that it is currently the one of the world's only self-sufficient energy nations. The history of Brazilian energy diverged widely from that of the rest of the world beginning in October of 1973 when the worldwide oil crisis spurred by OPEC resulted in a severe energy shortage due to exorbitantly high oil prices. Uniquely, Brazil quickly instituted a plan called Proalcool which sought to improve technology and increase the production of sugar cane for the creation of ethanol for use in 'flex' vehicles[1]. This was the first time that the country made a major concerted effort to cut its ties from dependency on other nations' energy resources.

In 1986, Petrobras, Brazil's national oil company, launched a plan called PROCAP 3000 to access deep sea oil reserves, known as deepwater fields[2]. The country has prided itself on being able to pursue new technologies ahead of the United States and other world superpowers. In 2006, Brazil officially achieved oil self-sufficiency when it reached the benchmark of garnering over 70% of its oil reserves from ultra-deep oil sources, by far more than any other country. Brazil is now a net exporter of oil.

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[1] http://www.csmonitor.com/2005/1007/p05s01-woam.html
[2] http://www2.petrobras.com.br/tecnologia/ing/areadeatuacao_exploracaoaguas.asp

Brazil also made huge strides in hydropower starting in 1975, resulting in a current yearly production of 70 GigaWatts which provided the country with 93% of its energy requirement in 2002[3]. Even though critics claim that Brazil is overly dependant on essentially one source of renewable energy, the country is trying to innovate yet again to harness the power of the Amazon's many slower-moving rivers with non-impacting hydroelectric technology. Ironically, from June to December 2001, Brazil had a severe electrical energy crisis, known as the Apagão, due to a lack of rain in the country, resulting in the very situation they intended to avoid by becoming ever reliant on internal sources for energy.

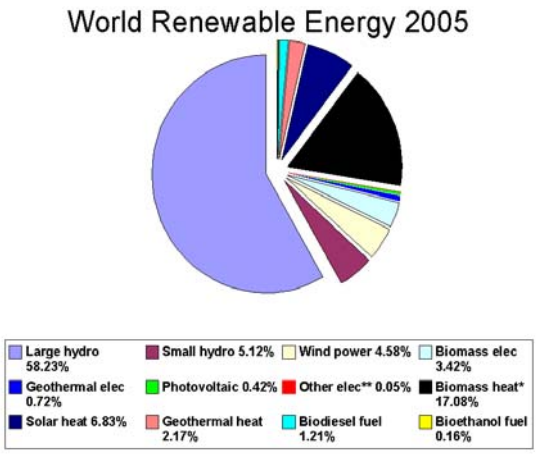
Going forward, Brazil has promised investment in wind energy, partnering with Pacific Hydro for a project called the 'Millennium Wind Farm' which will generate 10.2MW of clean energy. Electrobras has stated that it intends to create up to 300MW of wind energy capacity through partnerships with multinationals[4].

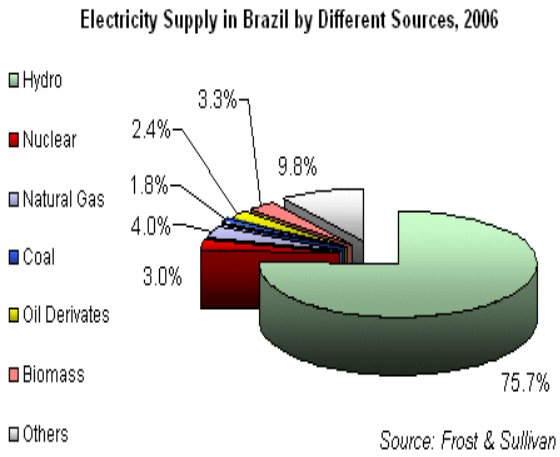
Brazil and Hydropower:

Brazil's relative lack of natural gas and coal led the country to hydroelectricity early in its energy history. Looking at Brazil's energy profile in 2007, the nation ranks 32nd in coal (fossil fuel required for steam turbines) and 41st in natural gas production (fuel gas required for gas turbines)[5]. As in other cases around the world, necessity forced the country to fill its needs in other ways. The table below shows that Brazil has outperformed the rest of the world in terms of electricity from hydropower by becoming 76% reliant on that form of renewable energy whereas the renewable share of the world's electricity is a paltry 19%[6] (breakdown of sources below):

[3] Brazil Information Center. *Brazil's Energy Crisis is Over. Now What?* Brazil News, Volume 3, Issue 2. June 2002. Page 1.
[4] http://www.pacifichydro.com.au/Default.aspx?tabid=214
[5] Energy Information Administration. Official Energy Statistics from the US Government. http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=BR
[6] EIA. *International Electricity Analysis to 2030*. Chapter 6: Electricity. Page 63.

*Figure 1: Comparative World vs. Brazil Renewable Energy:*




[7] [8]

If you consider that the world's use of hydro power only accounts for 58% of 19% of the world's production of renewable energy, the fact that Brazil has been able to harness 76% of its energy from hydro is staggering.

Over the last two decades, Brazil has privatized much of the energy sector in an effort to increase efficiency and diversification. Even so, in 2006, of the $100 million the government has spent on infrastructural issues, $31.6 million was allocated to energy initiatives, leading to the belief that the private sector is not investing enough[9]. Unfortunately, in the past five years, the Brazilian government has promoted gas-fired power plants to offset the risk of power failure to due single-source reliance, thus the reducing the overall country usage in hydropower from 93% in 2002 to 83% in 2004 to 76% in 2006[10].

[7] REN21. *Renewables: Global Status Report 2006*. Renewable Energy Policy Network for the 21st Century. Eric Martinot. Page 20.
[8] Jorge De Rosa. *Brazilian Energy Blackout 2010-2012*. Frost & Sullivan. 23 October 2007.
[9] Brazil Information Center. *Brazil's Energy Crisis is Over. Now What?* Brazil News, Volume 3, Issue 2. June 2002. Page 1.
[10] EIA. *International Electricity Analysis to 2030*. Chapter 6: Electricity. Page 63.

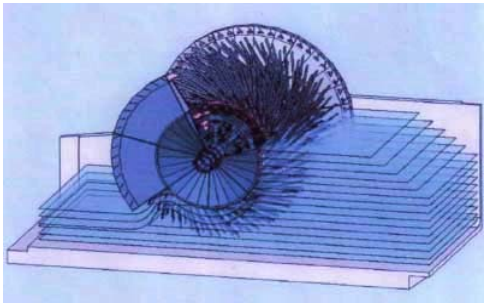
Brazil's Latest Technological Hope:

The 'Floating Turbine' could be the answer to Brazil's dependence on its more than 600 dams and subsequent reservoirs by allowing power to be harnessed from rivers all over the country for local production[11]. It is estimated that 12 million people in Brazil have no access to electricity, most of who live in remote areas or the Amazon[12].

In addition, this technology does not require the damming of water resources, which severely damages entire ecological areas through flooding. The initial flooding of reservoirs causes large releases of carbon dioxide as trees rot. In the long term, methane is produced and released into the atmosphere when plants spring up during drawdown periods only to decay again when the reservoir is re-filled; creating a form of dissolved methane on the reservoir floor that is released when the water is pushed through the turbines[13].

The half-submerged turbine (30m diameter and 160m length), designed by EcoHydro Energy Ltd., dams water locally and forces it underneath the blades, making it functional in slow-moving, gradient-free water sources for 240 MegaWatts per hour (at a very cheap cost of $450,000 per MegaWatt capacity). This would supply enough power for a city of nearly 2 million.[14]

*Figure 2: The Floating Turbine*



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[11] http://www.dams.org/news_events/press309.htm
[12] http://www.usaid.gov/stories/brazil/cs_br_hydropower.html
[13] New Scientist. *Hydroelectric Power's Dirty Secret Revealed*. Duncan Graham-Rowe. 24 February 2005.
[14] IPS. *Brazil: An Energy Source Both Cheap and Eco-Friendly*. Mario Osava. 18 January 2006.
[15] http://bandua.net/info/040908_alg-a/modules.php?op=modload&name=News&file=article&sid=915&mode=thread

Brazil's Energy Control:

Energy capacity is not keeping up with demand in Brazil and this has caused blackouts in the past and a rising potential for additional failures in the future. A study by energy consultants, Instituto Acende, shows that the risk of rationing rises from 5% in 2009, to 8% in 2010, 14% in 2011 but could rise as much as 23.5% in 2010 and 30% in 2011 if the economy continues to grow at over 5% annual GDP growth rates[16].

Hydroelectric Power - A Success for Brazil?:

Arguably, yes; yet there have been some serious issues created by the massive investment in one technology over time. Brazil has been able to provide renewable energy to the nation as a result of focusing on hydropower.

The drawbacks are many. Brazil relies on foreign producers for wind, steam and gas turbine technologies. Brazil looks to Bolivia for the majority of its natural gas and Petrobras fields in the country were recently nationalized by Bolivia's President, Evo Morales. Without national fields, Brazil has no other alternative. Even so, ethanol development and deep-sea oil exploration has given Brazil economic and political independence from Venezuela and OPEC nations. Brazil's sole reliance on hydro has caused massive risk of blackout failure which could leave millions without power, forcing rationing as experienced in 2001. That blackout caused an extreme economic slowdown. Currently, the majority of hydropower generated is for use in the large industrial, urban areas of the country, leaving millions in more obscure areas without electricity and that needs to be addressed.

Brazil will inevitably need to find new sources of energy that are renewable and scalable given its current deficiency outlook. Brazil's only current plan is to cut public spending and hope that the private sector steps in, which is a seriously flawed approach to a massive problem[17].

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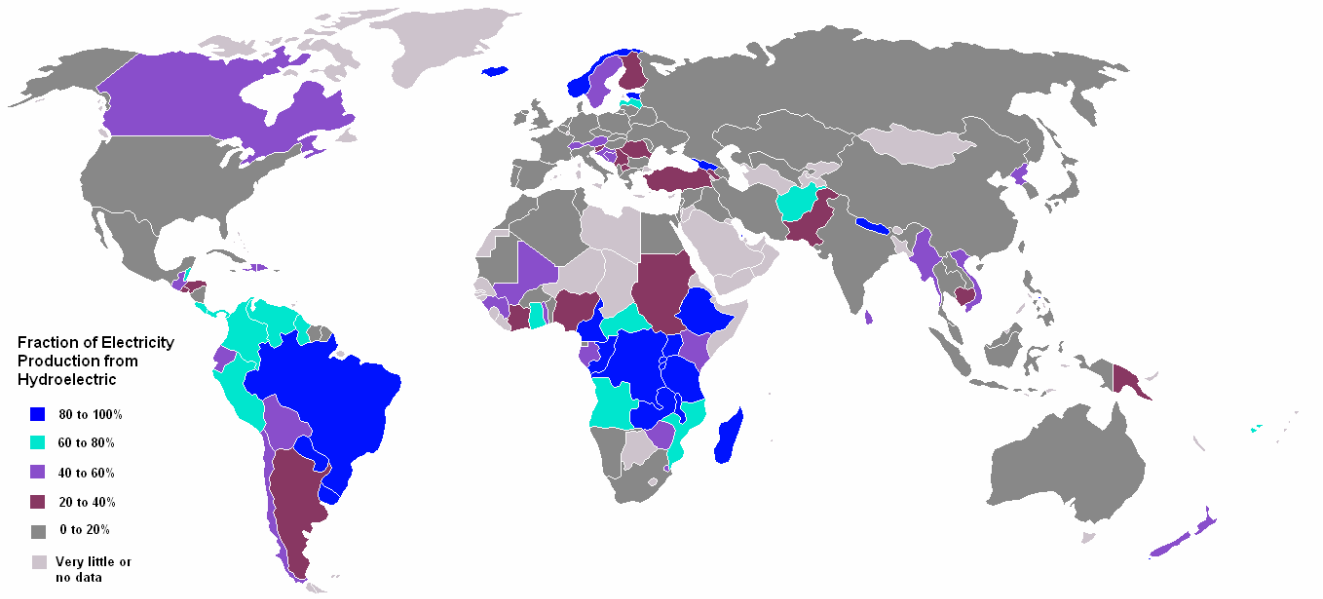
[16] Reuters. *Brazil at Risk of Energy Rationing from 2010 Study.* Reese Ewing. 13 April 2007.
[17] Executive Intelligence Review. There is Nothing 'Natural' About Brazil's Energy Crisis, Either. 6 July 2001.

## APPENDIX:

*Figure 3: Developing World is Reliant on Hydropower*

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[18] EIA: Energy Information Administration. Official Energy Statistics from the US Government. http://www.eia.doe.gov/emeu/international/electricitygeneration.html