

LESSONS FROM BEIJING: A LOOK AT THE ENVIRONMENTAL CHALLENGES FACED BY CHINA AND BRAZIL AS HOSTS OF THE OLYMPIC GAMES

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ABSTRACT: The Olympics Committee, in requiring that the environment be a consideration in hosting the Games, has propelled the implementation of several needed projects in the countries of China and Brazil. The Olympics has therefore become the catalyst for the realization of environmental and sustainable projects. China has already completed the bulk of their environmental commitment and several of the lessons learned can be transferred to Brazil as they prepare for the 2016 Olympics. A comparison of the environmental preparations of Beijing and Rio de Janeiro is discussed in this note. As a summary, listed below are nine actions that were taken that contributed to Beijing's success.

1. Build on Prior Successes – China focused on prior Olympic events to determine what went right (in Sydney) and to shy away from what went wrong (in Atlanta).
2. Conduct a Realistic Assessment and Have Attainable Solutions – China was extremely forthright in their assessment of the causes of their environmental degradation.
3. Involve Everyone – Beijing's environmental efforts brought together Chinese government agencies, multinational corporations, environmental inventors, environmental nongovernmental organizations, United Nations organizations and community leaders to plan and execute the solutions to Beijing's environmental problem.
4. Have Strong Leadership – One of the reasons projects were pushed through to completion even though there were tough obstacles to overcome was the support and active participation of high level government officials.

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5. Provide and Find Financial Support – Even though the environmental improvements in Beijing were US\$5 billion more than the original estimates, China met their environmental goals.
6. Promote Environmental Education and Sponsorship – China made a conscious effort to promote environmental education.
7. Measure Environmental and Sustainable Actions – Beijing has been an open book by working with the IOC and the UNEP experts on assessing Beijing’s Olympic environmental performance.
8. Expect the Unexpected – China saw a couple of unexpected events which threatened to derail their environmental and infrastructure development and had to step up their responses.
9. Think Beyond the Olympics – Beijing in their Sustainable Development Plan will continue to implement projects and action items well into 2015 (five years after the conclusion of the Beijing Olympic Games).

For a \$17 billion investment in the environment, the Olympic city of Beijing received a significant improvement in air quality; over 90 percent of their wastewater is now treated; coal driven facilities were replaced with natural gas, geothermal technology and wind; and the city has set up 20 natural reserves. Rio has initiated its own seven year journey to an environmentally sound Olympics and can learn from the successes and failures of previous host cities.

KEYWORDS: China, Brazil, Environment.

INTRODUCTION

Large events, such as the Olympics, present many challenges and benefits for a host city or country (Beyer 2006, 424). Challenges such as resource depletion, environmental degradation and transportation limitations can overshadow the economic and social benefits years after an event concludes (Beyer 2006, 424). The Olympics and other major sporting events have begun to recognize their role as not only promoting the development of mankind via sports but also as developing “a peaceful society concerned with the preservation of human dignity” (International Olympic Committee 2010, 12). Therefore, included in the vision of the International Olympic Committee (“IOC”), is a

growing environmental consciousness and a push towards social responsibility (Beyer 2006, 425).

After the destruction of woodlands and mountains in the French Savoy Region in preparation for the 1992 Winter Olympics, the IOC recognized the need for an explicit environmental policy in their guidelines (Beyer 2006, 427). In 1994, the IOC recommended that the Olympic Charter be amended to include environmental responsibility as the third pillar of the Olympics alongside sports and culture (The Olympic Movement 2010) (Hildebrandt 2003). The amendments were adopted in 1996 and the Charter now instructs the IOC “to encourage and support a reasonable concern for environmental issues, to promote sustainable development in sport and to require that the Olympic Games are held accordingly” (International Olympic Committee 2010, 15). In addition, the IOC adopted the *Olympic Movement's Agenda 21*¹ (United Nations 2009) (McMullen 2001, 120) in 1999 where member countries were encouraged to focus on sustainable development and the protection of the environment (China Daily 2002).

The implementation of the IOC’s environmental vision first began with Sydney – the first hosting city to have a set of environmental measures in its plan (Beyer 2006, 423). The Beijing Olympic preparations also included a comprehensive plan on sustainable development and the environment with focus areas of “construction, transportation, pollution control and waste management” (Beyer 2006, 426). The Rio de Janeiro’s (“Rio”) Olympic environmental and sustainability plan highlights four areas: water conservation, renewable energy, carbon neutrality and waste management and social responsibility to ensure that Brazil executes an “all-green” Olympics (Rio 2016 Executive Summary 2009). This note looks at the environmental challenges faced by both the Beijing Olympics and the Rio Olympics and discusses the solutions and implementation process.

Part I of the Note will discuss the background and environmental status within China and Brazil before the preparations for the Olympics began. Part II will focus on the root causes of environmental/infrastructure problems and the solutions developed to address the challenges in both Beijing and Rio. Part III will compare the solutions and

¹ Agenda 21 has three objectives: “(1) to improve socio-economic conditions; (2) to promote the conservation and management of resources for sustainable development; and (3) to strengthen the role of women, young people, and indigenous populations in sustainable development.

implementation of the Beijing plan to what is currently being undertaken in Rio and highlight the lessons learned from Beijing. This Note concludes by recognizing the relative success of Beijing's Olympic Games and the potential of the Rio Olympics.

PART I. BACKGROUND AND ENVIRONMENTAL STATUS

Introduction to China and Brazil

Over the past two decades, China and Brazil have entered the world stage as forces of mega economic growth and industrialization but with notable environmental challenges (O'Neill 2006). China and Brazil are the fourth and fifth largest countries in the world respectively (CIA Factbook 2010). China has large amounts of “coal, iron ore, petroleum, natural gas, mercury, tin, tungsten, antimony, manganese, molybdenum, vanadium, magnetite, aluminum, lead, zinc, rare earth elements, uranium, and hydropower potential (the world's largest)” (CIA Factbook China 2010) while Brazil similarly boasts huge reserves of “bauxite, gold, iron ore, manganese, nickel, phosphates, platinum, tin, rare earth elements, uranium, petroleum, hydropower, timber” (CIA Factbook Brazil 2010). Both countries have experienced such high levels of development, with China's Gross Domestic Product increasing ten times since 1978 (CIA Factbook Economy: China 2010) and Brazil currently at a 7.5% Gross Domestic Product growth rate (The Goldman Sachs Group 2007, 152), that natural resources were being stripped to fuel the growth (Crawford 2007, 14). In addition to the depletion of natural resources, the necessary infrastructure (sanitation, clean water, housing and transportation) has not kept pace with the population growth and the transition from a more rural to urban populous (Sands 2008) (R. A. Hudson 1997).

The opportunity to host the Olympic Games has focused world attention on the challenges these two emerging countries face in readying heavily populated, factory laden and traffic congested cities for the main event. China not only had to prepare for the Olympics but also the Asian Games in 2010² (Guangzhou Asian Games Organising Committee 2010) (Sands 2008). Brazil in turn will welcome the world again to the 2016

² Olympic events were held in cities throughout China including Beijing, Hong Kong; Qingdao, Shandong; Qinhuangdao, Hebei; Shanghai; Shenyang, Liaoning; and Tianjin. The Asian Games were held in Guangzhou, a south port city in China.

Olympics after hosting the World Cup in 2014 (FIFA 2010). Having to undertake back to back international events, support the notion that the changes made to the pre-Olympic environmental situation should be sustainable as recommended in the IOC's *Agenda 21* and the Olympic Charter.

Even before the IOC adopted the *Olympics Movement's Agenda 21*, both China and Brazil had already agreed to adopt the *Agenda 21* program and the Rio Declaration during the 1992 Earth Summit in Rio (United Nations 2009). The principles of the Rio Declaration tied environmental protection to development efforts and called on all nations to assume responsibilities to prevent environmental degradation (Rio Declaration on Environment and Development 1992).³ In 1994 China rolled out its *Agenda 21* which included a focus on sustainability and the protection of the environment (Tubilewicz 2006, 8-9).⁴ Brazil had its *Action 21* in the works as well as other international agreements (Federal Republic of Brazil 2010).⁵ Even so, both China and Brazil continue to struggle to balance between environmental protection and development. In reality, the economic development portion of China's *Agenda 21* took the highest priority (Tubilewicz 2006, 9). In 2003, Beijing graded their progress on implementing *Agenda 21* and found prevalent environmental issues and ecological problems that persisted throughout China (Tubilewicz 2006). Brazil's *Agenda 21* is in various stages of implementation but with slow success (National Sustainable Development Strategies Status Report: Brazil 2004) (Orlando Sentinel 2002, A11). Even the Brazilian Minister of the Environment, Izabella Teixeira voiced her recognition of environmental challenges especially in the face of urbanization and industrialization in a country with vastly differing ecosystems and diverse economies (Teixeira 2010). She did however note that some progress had been made but recognized that more broad based plans and

³ For example, Principle 4 states that "[i]n order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it."

⁴ China's *Agenda 21*: White Paper on China's Population, Environment and Development in the 21st Century focused on "sustainable development; social development; economic development and the protection of resources and the environment."

⁵ Brazil participates in other international environmental agreements such as the Conference of Parties (COP); 2002 World Conference on Sustainable Development (Rio+10) and the Bali Conference.

regulations needed to be put in place to tackle the environmental challenge (Teixeira 2010).⁶

The Environment and Pre-Olympic China

Pre-Olympic China faced challenges of renewing and preserving their air, water and land in addition to establishing a sustainable use of their natural resources. There has been constant deterioration in China's environment, especially in the northern part of the country which includes the Olympic City of Beijing (Beijing Olympic Action Plan Present Environmental Status 2008). Just a decade before the 2010 Games were to begin, the World Health Organization ("WHO") listed seven of the ten most polluted cities in the world as being in China (McMullen 2001, 120).

In addition to the seven cities singled out by the WHO, many of China's larger cities also suffered from pollution. In particular several cities faced tremendous air pollution (excessive greenhouse gas emissions, sulfur dioxide and particulate matter) (CIA Factbook China 2010). There was a continuous decline in the water table level and an increase in water shortages in other cities and rural areas (Beijing Olympic Action Plan Present Environmental Status 2008). Water pollution remained widespread due to the lack of treatment facilities to handle industrial and sewage wastes (Beijing Olympic Action Plan Environmental Protection 2008) (CIA Factbook China 2010). Soil erosion due to vegetation clearing and deforestation for economic development continued to reduce arable lands (CIA Factbook China 2010). Desertification of once viable lands became prevalent and in addition, the illegal trade of endangered species continued to impact the ecosystem life cycle (CIA Factbook China 2010). With these incessant challenges as a back drop, China prepared its bid for the Olympic Games after conducting an honest assessment to identify the root causes and provide solutions to each environmental issue that impeded the air, water and land preservation.

⁶ A one-size-fits-all type plan does not work in Brazil where the ecosystem, local economies and population is considerably different.

The Environment and Pre-Olympic Brazil

Brazil is a land where environmental legislation and agreements abound on paper and to a lesser extent in practice (McAllister 2008, 12). The Brazilian legislators passed the first overarching environmental law in 1981 known as the National Environmental Policy Act (*Lei da Política Nacional do Meio Ambiente*) which included language on criminal prosecution, strict liability, a process for establishing environmental standards and zoning requirements (McAllister 2008, 12). In addition, the 1988 Brazilian Constitution acknowledged that “[a]ll have the right to an ecologically balanced environment . . . and both the Government and the community shall have the duty to defend and preserve it for present and future generations”. The Brazilian governing body also created several agencies (for example the Special Secretariat for the Environment “*Secretaria Especial do Meio Ambiente*” and the Brazilian Institute for the Environment and Renewable Natural Resources “*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*”) to manage environmental programs, issue permits and develop standards (McAllister 2008, 23). But even with strong Constitutional language and new laws which criminalize environmental violations, regulations, and governing bodies, environmental protection is lacking and environmental degradation persists in this ecologically rich country (R. A. Hudson 1997).

The Brazilian landscape was one that transforms from one spectacular biome to another and was recognized as having as much as twenty percent of the world’s species as well as vast varieties of flora and fauna (Crawford 2007, 5). But in the midst of this biological splendor, lies the destructive force of deforestation in areas such as the well known Amazon Basin or the Atlantic Forest (Crawford 2007, 6). Multiple plant and animal species are being eliminated due to construction, farming, logging and ranching (CIA Factbook Brazil 2010). The land is also subject to desertification and waste issues due to mining and industrial activities (CIA Factbook Brazil 2010). In addition, severe oil and chemical spills have negatively impacted the land, wetlands and bodies of water (CIA Factbook Brazil 2010). In general, water pollution remains prevalent in major cities such as Rio de Janeiro and Sao Paulo due to sewage and industrial waste treatment problems (R. A. Hudson 1997). Similarly, air pollution is also affecting the major cities within Brazil (CIA Factbook Brazil 2010).

Both China and Brazil recognized their respective environmental challenges in the face of development when they submitted their bids to host the Olympic Games (Building4Change 2009) (Beijing Olympic Action Plan Guidelines and Objectives 2008). The two countries both had to deal with water pollution in their primary Olympic City - Beijing more so than Rio de Janeiro (Beijing Olympic Action Plan Guidelines and Objectives 2008) (Federal Republic of Brazil 2010). China and Brazil also had to deal with urban growth and the impact their industries were having on nearby waterways and lands within their major cities (Beijing Olympic Action Plan Guidelines and Objectives 2008) (Federal Republic of Brazil 2010). They also had to determine how to be energy efficient during the games (Beijing Olympic Action Plan Guidelines and Objectives 2008) (Federal Republic of Brazil 2010). But once China and Brazil won the opportunity to host the 2008 and 2016 respectively, they began instating plans to overcome those challenges.

PART II. ENVIRONMENTAL SOLUTIONS IN THE OLYMPIC CITIES OF BEIJING AND RIO DE JANEIRO.

Beijing

When China conducted an assessment of their environmental challenges, they decided to focus on areas of “construction, transportation, pollution control and waste management” (Beyer 2006, 426). The Beijing Sustainable Development Plan became part of the Beijing Olympic Action Plan and parallels China's implementation of Agenda 21 (Hildebrandt 2003, 16). The Beijing Organizing Committee for the Games of the XXIX Olympiad (BOCOG) then began to clearly identify sources of the environmental challenges and in concert with a host of experts and participants, decided on a plan to tackle the environmental problems (Hildebrandt 2003, 16). Below is a summary of what caused the environmental issue and what BOCOG did to solve those issues.

1. Air

There were multiple sources of air pollution in Beijing and multiple solutions were needed to reduce the pollution to acceptable levels. High levels of sulphur dioxide

and nitrogen oxide in the air were derived from coal use (for industrial production, electricity generation, cooking, and heating) while carbon monoxide and lead came from the large number of vehicles (3-4 million) being used in Beijing (Aflala-Calderon 2008, 26) (Beyer 2006, 426). Another source of air pollution was the desertification of northeast China (Beyer 2006, 426). Because of the lack of vegetation, solid particulates remained suspended in ambient air at levels that were higher than China's national standard (Beyer 2006, 426). In addition, there are dust storms to contend with when the winds begin to gust in the spring (Beyer 2006, 430).

To deal with the air pollution, the Beijing Action Plan called for a reduction in coal consumption by almost 50 percent by 2007 and the adoption of the European Union emission limits for vehicles by 2005 (Sands 2008, 43). Factories that once used coal were to be converted to natural gas or moved outside of the city limits (industries like iron, steel, and cement producers) (Beijing Olympic Action Plan Environmental Protection 2008) (McMullen 2001, 120-21). Lower sulphur coal was also being promoted as an alternative to help reduce the level of sulphur dioxide produced when the coal is burned (Beyer 2006, 426). Electricity production would move towards being from wind, geothermal and natural gas sources as opposed to coal generation (Beyer 2006, 430). In addition, more environmental controls would be added to the remaining coal fleet (Beijing Olympic Action Plan Environmental Protection 2008). Natural gas will be used to power up to 48,000 newer buses and taxis (Hildebrandt 2003, 17). BOCOG determined that with these measures, during the Olympics, the sulfur dioxide, nitrogen dioxide, and ozone in Beijing should meet the WHO guidelines and the other air pollutants should be at levels comparable to that experienced in major developed cities (Beijing Olympic Action Plan Environmental Protection 2008).

2. Water

The problem of water pollution and water shortage was also addressed in the Olympic Action Plan (Beijing Olympic Action Plan Environmental Protection 2008). Beijing lacked the proper amount of water resources and with less water, the more acute the water pollution problem becomes (Beijing Olympic Action Plan Environmental Protection 2008). The pollution was to the extent that many urban rivers cannot be used

as a watering source for irrigation or naturally occurring foliage (Beijing Olympic Action Plan Environmental Protection 2008). The flooding in recent years, also impacted Beijing's already stressed water systems (Beyer 2006, 431). The Olympic Games would require an additional 5% of water usage (Wall Street Journal 2008). This supply of water would have to be diverted from farming and continue to reduce the already shrinking groundwater supplies (Wall Street Journal 2008).

Beijing's plan to resolve these issues focused on strictly enforcing environmental laws and protecting drinking water sources in Beijing's reservoirs (Beijing Olympic Action Plan Guidelines and Objectives 2008). Therefore, the Miyun and Huairou reservoir should meet the national drinking water standards, and the Guanting reservoir should start back being used as a drinking water source (Beijing Olympic Action Plan Guidelines and Objectives 2008). There were also plans for water conservation "through higher water prices, cuts in water consumption, and increase of water reuse rates to 50 percent by 2008" (Beijing Olympic Action Plan Guidelines and Objectives 2008).

3. Land

The lack of green space has been prevalent in the industrialized parts of China (Sands 2008, 40). In the pre-Olympics era, there was little greenery throughout Beijing causing increased heat areas (Sands 2008, 40). The surrounding mountains had portions of bare land and soil erosion which led to dust storms and also impacted the air quality (Beijing Olympic Action Plan Guidelines and Objectives 2008). The reforestation solutions proposed in the Olympic Action Plan would lead to "over 70% of the soil erosion in the mountainous area and 100% of sandy bare land" being controlled (Beijing Olympic Action Plan Guidelines and Objectives 2008). In addition, Beijing is setting aside about 10% of the city area for greenery (Beijing Olympic Action Plan Guidelines and Objectives 2008).

The improper disposal of waste was also a challenge for Beijing to correct before the advent of the Olympics (Beyer 2006, 431). In the area of sanitation, because of the lack of sewage treatment facilities, little treatment was being done in the urban areas and waste would be placed in open air storage areas (Beyer 2006, 431). However, the city planned to increase the treatment rate so 90% of sewage would be treated and 50% of the

wastewater would be reclaimed (Beijing Olympic Action Plan Environmental Protection 2008). Solid waste challenges also include refuse collection and proper disposal. The Olympic Plan called for a 30% recycling of domestic waste and an 80% recycling or reuse of industrial waste (Beijing Olympic Action Plan Guidelines and Objectives 2008). In addition, all hazardous wastes were to be dealt with according to environmental requirements (Beijing Olympic Action Plan Guidelines and Objectives 2008).

The infrastructure challenges were to be met by a wide sweeping enforcement of the law. Illegal buildings were to be dismantled and approximately 200 factories were to be relocated outside the “fourth ring road” of the city by 2008 (Beyer 2006, 431). There were also plans to control noise, electric-magnetic radiation and improve radiological safety (Beijing Olympic Action Plan Environmental Protection 2008).

With these visionary changes to the environmental norms, the BOCOG hoped to achieve the proper level of environmental compliance especially within the WHO standards (Beijing Olympic Action Plan Environmental Protection 2008). In addition, the United Nations Environmental Program (“UNEP”) would also be used to evaluate whether Beijing was successful in achieving the desired target (Carmichael, et al. 2009, 15).

Rio de Janeiro

Rio is the second largest city in Brazil with a population exceeding 16 million (Rio de Janeiro City Information 2009). The city comprises an area of 486 sq. miles and is mainly metropolitan (Rio de Janeiro City Geography 2009). The uniqueness of Rio is that an amazing biodiversity exists right in the midst of a city because Rio is made up of mainly mountains, seas and forest (Rio de Janeiro City Geography 2009). The city is essentially intertwined with the Tijuca National Forest which is part of the Atlantic Forest (Cleary 2009). To deal with the environmental challenges, Rio’s Olympic environmental and sustainability plan focuses primarily on an all-green Olympics and thus the areas of water conservation, renewable energy, carbon neutrality and waste management and social responsibility (Rio 2016 Executive Summary 2009, 31-32).

1. Water and Water Conservation

Rio faces several challenges in ensuring the cleanliness of the various bodies of water that surround or run through the city as well as the sufficiency of its water supply. The city of Rio has the Atlantic Ocean to its south, Guanabara Bay to its east and Sepetiba Bay to the west (Rio de Janeiro City Information 2009). The main rivers through Rio are the Cabuçu and the Piraquê (Rio de Janeiro City Geography 2009). Some of the larger lagoons include the Jacarepaguá, the Marapendi, the Lagoinha and the Rodrigo de Freitas (Rio de Janeiro City Geography 2009). Each body of water has its own set of environmental and ecological problems.

The first body of water to greet visitors when they arrive at Rio's international airport is Guanabara Bay which will host the sailing competitions (Cleary 2009). The Bay has been and is still being used by the chemical plants and oil refineries that grew up along its banks (Cleary 2009). As tankers come in from the Atlantic Ocean to unload or receive cargo, some use Guanabara Bay as a washing basin to rinse out their cargo bays (Echeverria 2010). This mixture of chemicals and petroleum residue flow back into the Bay turning a once vital source of aquatic sustenance into a lingering time bomb (Echeverria 2010). Another major problem facing Guanabara Bay is the pollution from raw sewage from the thousands of residences in the Zona Norte (Cleary 2009). Refuse dumped into tributaries, such as the Cunha, flow into Guanabara Bay and add to the unsavory character of the Bay (Phillips 2007). Sepetiba Bay is another example of a bay laden with high concentrations of heavy metals in its sands and a declining fishing resource (Campos, Moraes and Borges n.d.). Industrial development (petrochemical factories and smelters) near to Sepetiba has had its toll on the aquatic life cycle (Molisani, et al. 2003). The once thriving tourist stop and commercial fishing ground, has shriveled to an environmental challenge (Molisani, et al. 2003). The lagoons have also experienced environmental decline due to refuse dumping (which added excessive nutrients to the water body causing extreme algae growth and low levels of dissolved oxygen) (Riberio 2010). This led to an unsuitable ecological system and tons of fish died within the past decade as a result (Riberio 2010).

In response to these environmental hazards, the Rio Olympic Committee has already started work on reducing the environmental impact. The new Alegria water

treatment plant, can handle up to 2,500 gallons of sewage per second and will help in the cleanup of Guanabara Bay (Rio 2016 Environmental Initiatives 2009). A US\$87 million dollar project is in progress to remediate the damage done to the ecosystem of the Jacarepaguá lagoon and to control flooding (Projetos Reabilitação Ambiental da Baixada de Jacarepagua 2010). Efforts were already underway to clean up the Rodrigo de Freitas lagoon (which is slated to host the rowing, kayaking and canoeing competitions) and to bring that ecosystem back into balance even before the Olympic bidding process (Riberio 2010). Currently, Rodrigo de Freitas lagoon “has never been so clean” (Rio 2016 Environmental Initiatives 2009). The Brazilian State Environmental Institute has noted that the lagoon is now up to swimming standards with a 92% improvement in water quality since 2006 (Rio 2016 Environmental Initiatives 2009). Similarly, Sepetiba Bay is experiencing a face lift with the sea front being rebuilt. However, the existence of heavy metals in the sand still needs to be addressed (Porto 2010). In addition, the city water and sewage systems will be treated and conservation measures put in place to support the greening aspects of the Games (Building4Change 2009).

2. Energy

Rio plans on being green in the area of energy. It is one of Brazil’s strength that is being utilized during the Olympics is its Energy Matrix (Building4Change 2009). The Brazilian Energy Matrix has 85% of electrical generation from renewables (mainly hydro power with some wind and biomass), 12% from fossil fuels and 3% from nuclear (International Energy Agency Energy 2008). Compared to similarly sized countries (America and China), Brazil has less emissions per capita GDP (Tolmasquim 2002, 21). Also, less than 5% of greenhouse gases come from energy emissions in Brazil (Tolmasquim 2002, 21). Therefore, the Rio Olympic Committee has promised that the electricity for the Games will come from renewable sources hence emissions that can be attributed to the Olympic Games will be negligible. Also, in the transportation section, Rio is proposing the use of bio-fuels to reduce the amount of emissions from Olympic vehicles (Building4Change 2009).

3. Carbon Neutrality

With an aim towards having the first all-green Olympics, Rio has placed a significant emphasis on offsetting any carbon dioxide emissions. Rio officially rolled out its “Carbon Zero 2016” program soon after winning the bid to host the Olympics (Du Bois 2009). Planting trees seems to be the primary mechanism used by Rio to accomplish its carbon neutrality goal (Rio 2016 Carbon Offsets 2009). Trees were planted in Pedro Branca National Park to even offset the calculated emissions from Rio’s Bid team’s travel, energy use etc. (Du Bois 2009). Rio has committed in their bid documents to planting three million trees before 2016 in strategic locations of the Tijuca Forest (Rio 2016 Carbon Offsets 2009). Brazil also has a successful carbon trade market which will also be useful in reaching Rio’s Carbon Zero 2016 goal (Building4Change 2009).

4. Land & Waste Management

Challenges with the land in Rio include deforestation, unplanned settlements, flooding, improper waste management, and congestion. Even though the Olympic bid materials focused primarily on waste management and social responsibility, other projects are being funded to provide a more pleasant environmental reality of the city.

The surrounding neighborhoods (favelas) along the hillsides of Rio have continued to expand and erode away the shrinking Atlantic Forest (Cleary 2009). However, balancing between environmental protection and displacing long time inhabitants in these unplanned settlements is a complicated and seemingly difficult choice. As stated by Minister of the Environment for Brazil, Izabella Teixeira, forest codes apply even in urban areas. Therefore, it is technically against the law to have the favelas encroach on the protected forest (Teixeira 2010). But as Minister Teixeira noted, one cannot just uproot hundreds of thousands of people, some of which have lived in the protected areas for 30 or 40 years, to a new area that is 50 or 60 kilometers away from that region – “it’s impossible” (Teixeira 2010). The hillside communities are also more susceptible to flooding. At the beginning of 2010, Rio experienced flooding which claimed over 105 lives and highlighted the infrastructure gap that needs to be filled

before the world pours in for the World Cup and the Olympics (Philips, Rio Floods 2010).

Rio is now trying to address both issues of protecting the forest while recognizing the need for housing with two planned projects – Reforestation and the “Living Carioca”⁷ Project. Reforestation not only helps achieve the carbon neutral goal, but it also provides stability for barren soil and it is central to having an all-green Olympics (Projetos Reflorestamento 2010). Plans are underway to remediate hillsides and even marshes to prevent landslides and flooding (Projetos Reflorestamento 2010). In addition, more focus will be given to the management of public parks (Projetos Reflorestamento 2010). The “Living Carioca” project has a goal of introducing standards of land use so that expansions impacting protected forests can be controlled (Projetos Morar Carioca 2010). The project would also aid in urbanizing disadvantaged neighborhoods and would provide a mapping of those neighborhoods via aerial photos and satellite on an annual basis (Projetos Morar Carioca 2010).

Recycling has been a strength in Rio’s overall solid waste management sector, but problems still exist in the areas of proper sewage infrastructure and treatment (Cernansky 2010) (Philips, Rio Floods 2010). Even before welcoming the Olympics, Rio has to prepare for the World Cup since it is one of the 12 hosting cities in Brazil (Bland 2010). According to Marcelo Cortes Neri who heads the center for social research at Fundação Getúlio Vargas, proper sanitation is lacking and the current sewage system will not be adequate to support such a large sporting event (Bland 2010). Rio has an 85% sewage system coverage and is undergoing a US\$358 upgrade and expansion under the Complexo do Alemão initiative (Bland 2010). The project which was 40% complete at the beginning of 2010 will add sanitation services in the northern part of Rio (Bland 2010). The Lagoa Rodrigo de Freitas lagoon project discussed in the water section above, not only included the remediation of the waters in the lagoon, but also an upgrade of eight sewage lift stations that are located around the shoreline. (Rio 2016 Environmental Initiatives 2009) The Caiçaras sewage lift project was completed in May 2010 and benefits the neighborhoods of Ipanema and Leblon (Rio 2016 Environmental Initiatives 2009). In June 2010, the Barra da Tijuca sewage treatment plant came online

⁷ Residents of Rio refer to themselves as Cariocas.

and will serve the Olympic and Paralympic Villages, the Press Center and 19 sports competitions (Rio 2016 Environmental Initiatives 2009). All these projects should ensure that Rio's sewage nightmare will end.

The currently overloaded transportation sector in Rio will be expanding for both the World Cup and Olympics (Projetos BRT Av Brasil 2010). In an effort to minimize emissions by reducing the amount of traffic on the roads, Rio is encouraging biking, revitalizing the bus system and extending the metro rails (Projetos Expansao da Rede Ciclovitaria 2010). The cycling network project is a program that provides incentives to construct bicycle lanes, links bicycle lanes to the public transport system, and educates the citizenry on the environmental need to reduce greenhouse gas emissions (Projetos Expansao da Rede Ciclovitaria 2010). Rio 2016 is also constructing bicycle lanes at all Olympic venues and linking those bike lanes to the new Bus Rapid Transit ("BRT") system (Projetos Expansao da Rede Ciclovitaria 2010). The BRT will revamp the current public transport system by providing four connecting terminals and bus lanes (Projetos BRT Av Brasil 2010). The BRT will be able to accommodate up to 40,000 riders per hour and will use efficient, environmentally friendly buses (Projetos BRT Av Brasil 2010). Finally, new metro lines are being laid to provide quick access to all parts of the city. Work has already started on the Metro Line 4 tunnel which will connect the West and South Zones of the city making it easier to move from one Olympic event to another (Rio 2016 Metro Expansion 2010). The organizers of these projects hope to realize an 8% reduction in greenhouse gas emissions by 2012 (Projetos Expansao da Rede Ciclovitaria 2010). So, even though air pollution is not listed as a primary focus, several projects are planned that will help elevate air borne environmental problems.

PART III. COMPARING THE PLANS AND IMPLEMENTATION PROCESS

Both Beijing and Rio had already assessed their environmental challenges to varying extents even before bidding on the Olympic Games. Both cities also had some proposed solution and had begun projects to improve their environmental degradation before being selected as host cities. The Olympics seem to pull all the cities' current and future environmental projects under one umbrella and prompted the host city to expand its environmental goals and consider sustainable development. This section compares the

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solutions to pollution problems, energy sources, land management and governance presented by Beijing and Rio.

The pollution to the air, water and land were addressed in varying degrees by both host countries. The Beijing approach was to identify the pollution source, enforce the environmental laws, and either remove, reduce or convert the source. For example, a factory using coal in its process would have to meet environmental standards according to the law or move to the outskirts of the city or reduce its production or convert to another energy source such as natural gas. The same method applied to vehicles where EU standards had to be met per the law, certain cars were only allowed to be driven on certain days (removal and reduction), and numerous buses and taxis were converted from high sulfur fuel. This approach does not seem to be being followed in Rio. For instance, the sources of pollution are not being engaged at the moment. The factories are still in full swing operation, there are no current plans to limit vehicular use and the urban zoning solutions may not address whether a building connects to the sewage system or not (leaving the newly built wastewater stations useless). There has also been no move to tighten the enforcement of environmental regulations in Rio. Thus even if 3 million trees are planted, there may be no enforcement mechanism to keep those trees from being harvested in 20 years. Rio is however focused on the removal of the pollutant especially from its waterways. The difference between the methods used by the two cities may determine if pollution reduction and prevention can be sustained beyond the Olympics. The success in Rio may be limited if the sources of pollution are not confronted and Brazil's already paper-strong environmental laws not enforced.

The second area of comparison is how the energy demand for the Olympics would be met to reduce emissions. One of Brazil's strength is its low emissions energy matrix which contains little fossil fuel sources. So it was not a surprise for the goals for the Rio Olympics to include an all green Games where renewable energy sources are used and carbon emissions are zeroed out. To accomplish this, Rio has already begun carefully computing every pre-Olympic use of energy and then offsetting any of those emissions with tree planting. In this respect, the Rio games have already gone a step further than the Beijing games. Beijing did not track all their emissions related to the Olympics even though they did focus on switching from coal dependence to using more

natural gas, geothermal and wind power. In addition, Beijing fueled their vehicular fleet with natural gas whereas Rio is raising the ante by going towards all bio-fuels in their vehicles. Both cities also had a heavy focus on reforestation which results in not only erosion, dust, and flooding control but also in a carbon offset. In this energy arena, Brazil seems to be pushing forward beyond the Beijing green efforts.

The third area of comparison is land management which includes infrastructure and transportation. It is a bit difficult to draw conclusions in this area since Beijing and Rio face a range of differing challenges. For example, Beijing focused on the legality of certain infrastructures like illegal buildings and solved the issue by removing such buildings. However in Rio where hundreds of thousands live in illegal settlements on the hillsides, the Beijing solution would not work. In the area of transportation, both cities did road and rail expansion projects but where biking is routinely seen in Beijing, in Rio it is an anomaly and it would be interesting to see how many Cariocas adopt this alternative style of transport. Both cities looked at waste treatment and have brought online many wastewater treatment facilities. Even though right now it seems that Beijing also considered industrial wastewater in addition to sewage in their infrastructure planning, time will tell if Rio also considers this aspect.

The final comparison considers governance and execution of the environmental goals for the two Olympic Cities. Most of this section focuses on Beijing because Rio is still in the initial execution stage and some plans are still being developed. China pursued 20 environmental goals to improve Beijing's environment and meet those goals (Carmichael, et al. 2009, 13-14). Listed below are nine actions that were taken that contributed to Beijing's success.

10. Build on Prior Successes

China focused on prior Olympic events to determine what went right (in Sydney) and to shy away from what went wrong (in Atlanta) (Sands 2008). China sent a group of delegates from the Beijing Environment Protection Bureau to the Australian Capital Territory to learn about waste management, pollution reduction, and environmental protection (Landon 2001, C9). The good news for Rio is that preparations for the World Cup were already on the way when Rio was selected to host the 2016 Olympics and any

faux pas committed during the World Cup can be remedied for the Olympics (Cushman 2009). In addition, lessons have been learned from Rio hosting the Pan American games in 2007 (Cushman 2009). Rio 2016 has also signed agreements to monitor and engage in the preparations for the London games (Rio 2016 Olympic Cooperation Agreement 2010).

11. Conduct a Realistic Assessment and Have Attainable Solutions

Beijing was extremely forthright in their assessment of the causes of their environmental degradation. In the early 1990s, Beijing had already developed an Environmental Master Plan which was being funded by the World Bank (Carmichael, et al. 2009, 13). Several actions items from that plan were added to Beijing's Olympic environmental plan but with completion dates that coincided with the commencement of the Olympics (Carmichael, et al. 2009, 13).

12. Involve Everyone

Beijing's environmental efforts brought together Chinese government agencies, multinational corporations (for expertise and sponsorship), environmental inventors, environmental nongovernmental organizations, United Nations organizations and community leaders to plan and execute the solutions to Beijing's environmental problem (Aflala-Calderon 2008) (Brody and Zachold 2008). However, Beijing also got communities at large and their children involved. The Beijing children produced over 2,000 drawings on ways to save the environment and made speeches in their schools and communities (Aflala-Calderon 2008).

13. Have Strong Leadership

One of the reasons projects were pushed through to completion even though there were tough obstacles to overcome was the support and active participation of high level government officials. Executive Vice Premier Li Lanqing and PRC vice president Xi Jinping were instrumental in ensuring that central government ministries, the Beijing Municipal Government, and BOCOG, worked together (Sands 2008). Even the Chinese People's Political Consultative Conference, China's top political advisory body, included

Olympic officials and environmental experts as members (China Daily 2008). In addition there was a policy change in China to allow non-Chinese companies and nongovernmental organizations to get involved in resolving environmental issues (Hildebrandt 2003, 18). One explanation is that “[t]his departure from past policies banning such independent organizations was not, however, an indication of an increasingly liberal power structure in Beijing, nor was it done to release pent-up citizen discontent. More simply, the government was acknowledging its need for help in dealing with pressing environmental issues. The government, in effect, took a political risk to ensure that it could meet its environmental goals” (Hildebrandt 2003, 18). For Brazil, governance has meant thus far the proper integration of the three levels of government (city, state and federal) as well as the IOC and Rio 2016 Olympic Games Organizing Committee into what is known as the Rio 2016 Institute (Rio 2016 Institute 2010).

14. Provide and Find Financial Support

The actual amount spent on environmental improvements in Beijing was US\$17.4 billion which was US\$5 billion more than original estimates (Carmichael, et al. 2009, 19). But that extra US\$5 billion had to be provided to meet the environmental goals of the 2010 Beijing Olympics.

During the bidding process to host the Olympics, Rio presented a budget of US\$11.6 billion (Cushman 2009). The large part of Rio’s budget was carved from the Growth Acceleration Program (Kingstone 2007). This economic program is now a US\$878 billion federal government plan that was originally launched in 2007 and focuses on infrastructure upgrades in transportation, housing, sanitation and energy development in Brazil (Thomas White Global Investing 2010). So, 70 percent of the road and rail upgrades in Rio and the construction of some sports venues would have been built whether Rio was hosting the Olympics or not (Cushman 2009). Therefore, Rio 2016 should have solid funding to execute their plans.

15. Promote Environmental Education and Sponsorship

The BOCOG made a conscious effort to promote environmental education. They scored big using four of their five Olympic mascots (Fuwas) to represent the elements of

the earth – water, land, air, and vegetation (Aflala-Calderon 2008). These Fuwas were on display everywhere. Sponsors also got involved under the premise that environmental promotion has a longer term benefit and boosts a company's brand (Brody and Zachold 2008). Conoco Phillips initiated "Search for Solutions" where Chinese youths could receive updates on their local environmental conditions, participate in field trips and express environmental concern via the theater (Brody and Zachold 2008), while Coca-Cola recycled the steel left over from the construction of Beijing's Olympic stadium into Olympic pins (Aflala-Calderon 2008). International artist presented exhibits with environmental themes according to the public arts project "the Olympic Spirit" (Brody and Zachold 2008). Brazil recently launched a green city action forum to help government formulate green policy and encourage public awareness of environmental issues (Building4Change 2009).

16. Measure Environmental and Sustainable Actions

Beijing has been an open book by working with the IOC and the UNEP experts on assessing Beijing's Olympic environmental performance. The UNEP first got involved in evaluating Beijing in 2005 and published the first independent assessment in 2007 which concluded that Beijing was on schedule to meet its goals (Carmichael, et al. 2009, 17). The final assessment took place in 2009 to ensure that the environmental performance had some permanency and did not just shift environmental problems elsewhere (Carmichael, et al. 2009, 14). Brazil on the other hand has created the Environmental Indicators Games Observatory which will gauge the success of Rio's environmental progress (Building4Change 2009). But an independent observer may add to the credibility of Rio's efforts.

17. Expect the Unexpected

China saw a couple of unexpected events which threatened to derail their environmental and infrastructure development. The heavy snow fall in early 2008 impacted the transportation and electrical infrastructure (Sands 2008, 45). Then just weeks before the Olympics were to begin, an algal bloom almost crippled Qingdao, the site of the Olympic sailing event (Yardley 2008). The entire region had to mobilize to

get the algae out of the sea (Yardley 2008). BOCOG may not have been prepared for these two events but the response was successful. BOCOG was however, prepared for reducing air pollution even more if necessary by having a contingency plan where factories would be shut down (Yardley 2008). Brazil has seen recent floods cause landslides, traffic pains and the loss of life (Philips, Rio Floods 2010). Therefore, plans should include contingency measures to deal with environmental hiccups.

18. Think Beyond the Olympics

Beijing in their Sustainable Development Plan will continue to implement projects and action items well into 2015 (five years after the conclusion of the Beijing Olympic Games) (Interfax International Information Group 2008). According to Du Shaozhong, deputy director general of the Beijing Municipal Environmental Protection Bureau, even “[a]fter the Olympics, we will be able to build on the success we have achieved and continue to implement measures to improve the environment in Beijing” (Interfax International Information Group 2008).⁸ The lessons learned in infrastructure development and revitalizing the environment will be applied to other cities in China according to the Ministry of Housing and Urban-Rural Construction and the Ministry of Environmental Protection (China Daily 2008). This method of adopting proven solutions to environmental challenges at a nationwide level improves the rate at which environmental problems can be addressed in other cities.

After the Pan American Games in Rio, some Cariocas felt that there were “virtually no long-term benefits to the city, despite the budget ballooning from R\$500m . . . to R\$5bn”. (Philips, Rio de Janeiro Captures 2016 Olympics 2009) In essence, the equipment, resources and sports projects were not redirected towards the community (Philips, Rio de Janeiro Captures 2016 Olympics – But Now the Work Begins 2009). The games ended and everything went back to the norm. Therefore, the Olympics and the World Cup are opportunities to make infrastructure and environmental changes permanent in Rio and even to transplant successful programs to other parts of Brazil.

⁸ Beijing recognizes that there is still significant room for improvement in the areas of "particle matter, water resources management and water quality", and "air quality is always going to be the most significant challenge."

CONCLUSION

The Olympics has strategically expanded its reach from inspiring young athletes to changing the environmental landscape for millions of people. The Olympics in requiring that the environment to be a consideration in hosting the Games has propelled the implementation of several needed projects in the countries of China and Brazil. The Olympics has therefore become the catalyst for the realization of environmental and sustainable projects almost 20 years after the Earth Summit took place in Rio. With the Olympics comes the necessary funding, sponsorship, focus, alignment of layers of government, participation by NGOs, multinational corporations and citizens to accomplish what can be known as an environmental miracle in less than a decade.

For a \$17 billion investment in the environment, Beijing received a significant improvement in air quality with carbon dioxide emissions decreasing by 47percent, nitrogen dioxide down by 38 percent, volatile organic compounds by 30 percent, particulate matter (PM10) by 20 percent, and sulphur dioxide by 14 percent (Carmichael, et al. 2009, 36). The waters are cleaner with over 90 percent of wastewater being treated (Interfax International Information Group 2008). Natural gas, geothermal technology and wind are replacing coal and over 60 percent of electrical energy is being generated by natural gas (Sands 2008, 44). In the transportation sector, “50,000 out-of-date taxis and 10,000 buses have been scrapped and replaced with new ones, and 4000 buses are powered by natural gas, the largest fleet of its kind in the world” (Sands 2008, 44). In addition, vehicle emissions must meet the European Union’s standards (Carmichael, et al. 2009, 40). Half of the city is now forested or covered with bushes and lawns and the city has set up 20 natural reserves (Sands 2008, 44).

Rio has initiated its own seven year journey to an environmentally sound Olympics and can learn from the successes and failures of previous host cities (Building4Change 2009). As noted by Marcio Santa Rosa, who helped create the environmental and sustainable portion of the Rio's bid documents, “Rio’s landscape is like nowhere else in the world and sport is a way of life for our people. The benefits of hosting the Olympics have to be shared by the whole population before, during and after the Games” (Building4Change 2009). Therefore, now it is time for Brazil to shoot for the gold and break some records in the environmental protection, remediation and

sustainable development arena. Rio's environmental miracle is still to be written and the world is now watching.

REFERENCES

- Aflala-Calderon, B. 2008. "The Greening of Beijing." *Faces: People, Places and Culture*, 26-28.
- Beyer, S. 2006. "The Green Olympic Movement: Beijing 2008." *Chinese Journal of International Law*, 423-440.
- Bland, D. 2010. "Brazil, Rio de Janeiro: Needs Sanitation Improvements for 2014 World Cup, says Specialist." *Sanitation Updates*. January 29. Accessed December 22, 2010. <http://sanitationupdates.wordpress.com/2010/01/29/brazil-rio-de-janeiro-needs-sanitation-improvements-for-2014-world-cup-says-speciali>.
- Beijing Olympic Action Plan*. 2008. "Environmental Protection - Guidelines and Objectives." Accessed September 14, 2010. <http://en.beijing2008.cn/56/92/article211929256.shtml>.
- Beijing Olympic Action Plan*. 2008. "Environmental Protection - Present Environmental Status." Accessed January 3, 2011. <http://en.beijing2008.cn/56/92/article211929256.shtml>.
- Beijing Olympic Action Plan*. 2008. "Environmental Protection." Accessed January 3, 2011). <http://en.beijing2008.cn/56/92/article211929256.shtml>.
- Brazil - The Environment*. Accessed July 29, 2010. <http://countrystudies.us/brazil/25.htm>.
- Brody, M. and C. Zachold. 2008. "The Green Olympics and CSR." *China Business Review*, 26-28.

LESSONS FROM BEIJING: A LOOK AT THE ENVIRONMENTAL CHALLENGES FACED BY CHINA AND BRAZIL AS HOSTS OF THE OLYMPIC GAMES

Building4Change. 2009. "Márcio Santa Rosa: Going for Gold in Rio's 2016 Olympic Bid," September 29. Accessed July 29, 2010. <http://www.building4change.com/page.jsp?id=110>.

Campos, A. N., R. B. Moraes, and A. L. N. Borges. "Sepetiba Bay: Contamination or Pollution?" *CPRM*. Accessed December 22, 2010. <http://www.cprm.gov.br/pgagem/Manuscripts/camposasepetiba.htm>.

Carmichael, G. R., S. C. Yoon, C. Jones, C. Hochfeld, and T. Oben. 2009. *Independent Environmental Assessment Beijing 2008 Olympic Games*. Nairobi: United Nations Environmental Programme.

Cernansky, R. 2010. *Brazil: Model Recycling Nation*. August 4. Accessed December 22, 2010. <http://planetgreen.discovery.com/tech-transport/brazil-model-recycling-nation.html>.

China Daily. 2002. "China: IOC Hails 'Green Olympics'," November 4.

China Daily. 2008. "Games Experience Can Aid City Building Ideas," August 22.

China Daily. 2008. "New Advisors on the Nation's Political Horizon," February 28.

CIA Factbook Brazil. 2010. *The CIA Factbook: Brazil Geography*. July 22. Accessed July 29, 2010. <https://www.cia.gov/library/publications/the-world-factbook/geos/br.html>.

CIA Factbook China. 2010. *The CIA Factbook: China Geography*. July 22. Accessed July 29, 2010. <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>.

CIA Factbook China Economy. 2010. *The CIA Factbook: China Economy*. July 22. Accessed July 29, 2010. <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>.

CIA Factbook. 2010 *The CIA Factbook: Country Comparison*. July 22. Accessed July 29, 2010. <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2147rank.html?countryName=China&countryCode=ch®ionCode=eas&rank=4#ch>.

CIA Factbook Brazil Economy. 2010. *The CIA Factbook: Brazil Economy*. July 22. Accessed July 29, 2010. <https://www.cia.gov/library/publications/the-world-factbook/geos/br.html>.

Cleary, D. 2009. "What Do the Olympics Mean for Rio's Environment." *Nature*, November 3. Accessed June 5, 2010. <http://blog.nature.org/2009/11/what-do-the-olympics-mean-for-rios-environment/>.

Crawford, C. 2007. "The Insistent (and Unrelenting) Challenges of Protecting Biodiversity in Brazil: Finding 'The Law That Sticks'." *University of Miami Inter-American Law Review* 39:1-65.

Cushman, D. 2009. "2016 Olympic City Bid Report: Rio de Janeiro." *Sports Pro*, July 20. Accessed July 27, 2010. http://www.sportspromedia.com/notes_and_insights/2016_olympic_city_bid_reports_rio_de_janeiro/.

Du Bois, D. 2009. "Rio De Janeiro to Host All Green Olympic Summer Games in 2016." *Energy Priorities*, October 2. Accessed July 27, 2010. http://energypriorities.com/entries/2009/10/rio_dejaneiro_green_2016.php.

Echeverria, C. A. 2010. *Lecture: Land Use and Rio's Physical and Built Environment - The Case of Guanabara Bay*. July 12.

Federal Constitution of Brazil. 1988. Title VIII, chap. VI, art. 225.

Federal Republic of Brazil. 2010. "About: Environment." Accessed July 29. <http://www.brasil.gov.br/sobre/meio-ambiente/programas-e-iniciativas/acordos-e-iniciativas-globais>.

LESSONS FROM BEIJING: A LOOK AT THE ENVIRONMENTAL CHALLENGES FACED BY CHINA AND BRAZIL AS HOSTS OF THE OLYMPIC GAMES

FIFA. 2010. "2014 FIFA World Cup Brazil." Accessed December 5. <http://www.fifa.com/worldcup/index.html>.

Guangzhou Asian Games Organising Committee. 2010. "The 16th Asian Games." Accessed June 5. www.gz2010.cn/special/0078002F/enindex.html.

Hildebrandt, T. 2003. "Making Green in Beijing." *China Business Review*, 16-18.

Hudson, R. A. 1997. "Brazil: A Country Study." *Country Studies*. Accessed May 29, 2010. <http://countrystudies.us/brazil/>.

Hudson, R. A. 1997. "Brazil: Environment." *Country Studies*. Accessed May 29, 2010. <http://countrystudies.us/brazil/25.htm>.

Inter-American Development Bank. 1996. "Basic Sanitation Program for the Guanabara Bay Basin: Phase I." *IADB Project*. October 26. Accessed June 24, 2010. <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=438723>.

Interfax International Information Group. 2008. *China Learns Environmental Protection Lessons from Olympic Preparation*. Weekly Report, China: Interfax China Ltd.

International Energy Agency Energy. 2008. *Electricity in Brazil 2008*. Accessed July 28, 2010. http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=BR.

International Olympic Committee. 2010. "Olympic Charter." *Official Web Site of the Olympic Movement*. Accessed June 4, 2010. http://www.olympic.org/Documents/Olympic%20Charter/Charter_en_2010.pdf.

Kingstone, S. 2007. "Lula Pins Hopes on Economic Plan." *BBC News*, January 23. Accessed December 22, 2010. <http://news.bbc.co.uk/2/hi/americas/6289943.stm>.

Landon, D. 2001. "Chinese Look at Canberra for Olympic Help." *Canberra Times*, C9.

McAllister, L. K. 2008. *Making Law Matter: Environmental Protection & Legal Institutions in Brazil*. Stanford: Stanford University Press.

- McMullen, M. 2001. "The Green Olympics: Boom or Farce?" *Colorado Journal of International Environmental Law & Policy*, 119-127.
- Molisani, M. M., R. V. Marins, W. Machado, H. H. M. Paraquetti, E. D. Bidone, and L. D. Lacerda. 2003. "Environmental Changes in Sepetiba Bay, SE Brazil." *Regional Environmental Change*, October 21, 4:17-27.
- "National Sustainable Development Strategies Status Report: Brazil." 2004. *United Nations Department of Economic and Social Affairs*. Accessed July 29, 2010. http://www.un.org/esa/agenda21/natinfo/countr/brazil/2004statusreport_Brazil.pdf.
- Olympic Movement. 2010. *Olympic Charter*. Accessed May 4, 2010. http://www.olympic.org/Documents/Olympic%20Charter/Charter_en_2010.pdf.
- O'Neill, Jim. 2006. "Ask the Expert: BRICs and Investor Strategy." *Financial Times*, November 2. Accessed December 22, 2010. http://us.ft.com/ftgateway/superpage.ft?news_id=fto110620061008293518.
- Orlando Sentinel. 2002 "Environmental Progress Slow." *Orlando Sentinel*, A11.
- Philips, T. 2009. "Rio de Janeiro Captures 2016 Olympics – But Now the Work Begins." *The Guardian*, October 2. Accessed July 28, 2010. <http://www.guardian.co.uk/sport/2009/oct/02/rio-de-janeiro-2016-olympics>.
- Philips, T. 2010. "Rio Floods: Why Did More Than 100 People Die?" *The Christian Science Monitor*, April 7. Accessed July 28, 2010. <http://www.csmonitor.com/World/Americas/2010/0407/Rio-floods-Why-did-more-than-100-people-die>.
- Phillips, Tom. 2007. "Sewage, Algae and Rubbish Stain the Once-Pristine White Beaches of Rio." *The Guardian*, April 28. Accessed July 28, 2010. <http://www.guardian.co.uk/environment/2007/apr/28/brazil.pollution>.

LESSONS FROM BEIJING: A LOOK AT THE ENVIRONMENTAL CHALLENGES FACED BY CHINA AND BRAZIL AS HOSTS OF THE OLYMPIC GAMES

Porto, Gisele. 2010. *Lecture on the State of the Environment in Sepetiba and Legal Efforts to Protect It*, July 14.

Press & Sun-Bulletin. 2008. "An Olympic Fete - Will Hosting the Games Spur Change in China?" August 6, B1.

Projetos BRT Av Brasil. 2010. Accessed January 3, 2010.
<http://www.transparenciaolimpica.com.br/projetos/brt-av-brasil/>.

Projetos Expansão da Rede Cicloviária. 2010. Accessed January 6, 2011.
<http://www.transparenciaolimpica.com.br/projetos/expansao-da-rede-cicloviaria/>.

Projetos Morar Carioca. 2010. Accessed January 3, 2011.
<http://www.transparenciaolimpica.com.br/projetos/morar-carioca/>.

Projetos Reabilitação Ambiental da Baixada de Jacarepagua. 2010. Accessed January 3, 2011. <http://www.transparenciaolimpica.com.br/projetos/Reabilitação-ambiental-da-Baixada-de-Jacarepagua/>.

Projetos Reflorestamento. 2010. Accessed January 3, 2011.
<http://www.transparenciaolimpica.com.br/projetos/Reflorestamento/>.

Riberio, Patricia. 2010. "Cleaning Lagoa." *Go Brazil Web Site*. Accessed December 22, 2010). <http://gobrazil.about.com/od/riodejaneiro/ss/cleanlagoon.htm>.

"Rio 2016 Offset Carbon Emitted During Olympic Bid by Planting 3,580 trees." *Rio 2016 Now*, September 22, 2009. Accessed December 22, 2010.
<http://www.rio2016.com/en/rio-2016-now/rio-2016-offsets-carbon-emitted-during-olympic-bid-by-planting-3580-trees>.

Rio 2016. 2009. "Rio de Janeiro Environmental Initiatives in Place Ahead of 2016 Games." *Rio 2016 Now*, May 25. Accessed December 18, 2010.
<http://www.rio2016.com/en/rio-2016-now/rio-de-janeiro-environmental-initiatives-in-place-ahead-of-2016-games..>

Rio 2016 Executive Summary. 2009. Accessed June 5, 2010.
http://www.rio2016.org.br/sumarioexecutivo/default_en.asp.

"Rio 2016 Institute to Make the Relation Between the City Council and 2016 Rio Committee Even Closer." *Rio 2016*, May 12, 2010. Accessed December 5, 2010.
<http://www.rio2016.com/en/rio-2016-now/rio-2016-institute-to-make-the-relation-between-the-city-council-and-rio-2016-committee>.

Rio 2016. 2010. "Metro Expansion Started for the Rio 2016 Games." June 28. Accessed December 22, 2010. <http://www.rio2016.com/en/rio-2016-now/metro-expansion-started-for-the-rio-2016-games>.

Rio 2016. 2010. "Brazil and Great Britain Sign an Olympic Cooperation Agreement." November 9. Accessed December 22, 2010. <http://www.rio2016.com.br/en/rio-2016-now/brazil-and-great-britain-sign-an-olympic-cooperation-agreement>.

"Rio Declaration on Environment and Development." 1992. *United Nations Conference on Environment and Development*. August 12. Accessed December 18, 2010.
<http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>.

"Rio Presents Plans to be the Center of the 2014 FIFA World Cup." *Rio 2016 Now*. June 4, 2009. <http://www.rio2016.com/en/rio-2016-now/rio-presents-plans-to-be-the-center-of-the-2014-fifa-world-cup> (accessed December 22, 2010).

Rio de Janeiro City Geography. 2009. Accessed July 28, 2010.
<http://www.riodejaneiro.com/v/geography/>.

Rio de Janeiro City Information. 2009. Accessed July 28, 2010.
http://www.riodejaneiro.com/v/city_info/.

Sands, L. 2008. "The 2008 Olympics' Impact on China." *China Business Review*, 40-46.

Teixeira, I. 2010. "Video Recording of 'A Review of Brazil's Environmental Policies and Challenges Ahead'." *Wilson Center*, October 20. Accessed December 27, 2010.

LESSONS FROM BEIJING: A LOOK AT THE ENVIRONMENTAL CHALLENGES FACED BY CHINA AND BRAZIL AS HOSTS OF THE OLYMPIC GAMES

<http://wilsoncenter.org/ondemand/index.cfm?fuseaction=Media.play&mediaid=4D50CBCD-BAD9-8CA8-08A2F6B3BAB635C8>.

The Goldman Sachs Group. 2007. *BRICS and Beyond*. Australia: The Goldman Sachs Group, 2007.

The Olympic Movement. 2010. *For A Green Sport*, June 4. Accessed October 23, 2010. <http://www.olympic.org/en/content/Olympism-in-Action/Environment/For-a-Green-Sport-/>.

Thomas White Global Investing. 2010. "A Postcard from the Americas: A \$878 Billion Bonanza From Lula," April 16. Accessed December 22, 2010. <http://www.thomaswhite.com/explore-the-world/postcard/2010/brazil-investment.aspx>.

Tolmasquim, M. T. 2002. "The Brazilian Energy Matrix and Greenhouse Gas Emissions." *Rio 2002*. Accessed July 28, 2010. http://www.rio02.com/proceedings/pdf/021_Tolmasquim.pdf.

Tubilewicz, C. 2006. *Critical Issues in Contemporary China*. Abingdon Oxon: Routledge.

United Nations. 2009. "Agenda 21." *United Nations Division for Sustainable Development*. Accessed January 3, 2011. <http://www.un.org/esa/dsd/agenda21/>.

Wall Street Journal. 2008. "Olympics Add to China Water Crisis," June 27, A8.

Yardley, J. 2008. "To Save Olympic Sailing Races, China Fights Algae." *The New York Times*, July 1. Accessed July 1, 2010. <http://www.nytimes.com/2008/07/01/world/asia/01algae.html>.