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A Strategic Analysis for Small Hydro Power (SHP) Development in Himachal Pradesh, India

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Steven Spicer is a General Management Major in the Ricciardi School of Business. This research began in the spring of 2013 and continued with field research abroad in India the following summer under the direction of Dr. Martin Grossman (Management), and Dr. Madhu Rao (Geography). The project was funded by the Shea Fellowship for Undergraduate Research Abroad. Steven is extremely grateful to the Shea Committee, the Office of Undergraduate Research, and his mentors. He plans to continue research in the Green Technology fields of emerging markets with a trip to China planned for summer of 2014.

In addition to India currently being the second most populated country in the world, economists at Goldman Sachs have listed India as one of the five BRICS countries (Brazil, Russia, India, China, and South America) projected to be most dominant economies by 2050. In spite of the rapid growth in India's economy, there are still many serious issues affecting the majority of its people. The US Energy Information Administration reports that roughly 25% of India's 1.2 billion people are living without access to electricity; which translates to 300 million citizens without power (EIA, 2013). Various estimates put India's energy supply to just 90% of its demand (Singh, 2012). To counter this deficit, the government of India is encouraging both foreign and local investment in energy production, particularly from the development of small hydroelectric power (SHP) plants. The purpose of this paper is to provide a strategic analysis of SHP projects in India, primarily in the state of Himachal Pradesh. Two frameworks, Strengths, Weaknesses, Opportunities, and Threats (SWOT) and Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) analyses, are used to map out factors in the macro-economic and meso-economic environment surrounding SHP development in India.

Introduction

India has an estimated ten percent deficit of electricity according to reports from the Central Energy Agency (Appleyard, 2013). To combat this shortage, the CEA and the Ministry of New and Renewable Energy are focusing on efforts to increase the production of electricity from SHP plants (Appleyard, 2013). SHP plants generate electricity with a renewable energy source and have minimal environmental impacts (Colorado Energy Office, 2013). The government of India has attempted to encourage investment in SHP projects with various incentives (Government of India, 2013). Successful SHP projects can not only aid a developing country deal with its deficit but it also can generate a steady source of income for the firms that own and operate them. This paper is focused on providing a strategic analysis for SHP development in India, primarily in the state of Himachal Pradesh. SWOT and PESTLE analyses will be performed to provide insight into all of the factors involved with development of a SHP project. With these analyses tools, both the macro-environment and the meso-environment will be examined and explained.

Methods

Research for this paper includes a variety of methods. On-site research was conducted in India at cities including: Chamba, Chhatrari, Delhi, Roorkee and Shimla. Meetings were conducted with the Ministry of New and Renewable Energy (MNRE), the Agro-Economic Center at Himachal Pradesh University, the Alternative Hydro Energy Center (AHEC) at the Indian Institute of Technology (IIT) - Roorkee, and with Himachal Pradesh's Forestry Department. On-site research also included visits to SHPs located in the Chamba District, located in Himachal Pradesh. The field research was supplemented and supported by research conducted before, during and after the trip, utilizing secondary sources from academic literature as well as the web.

SWOT Framework

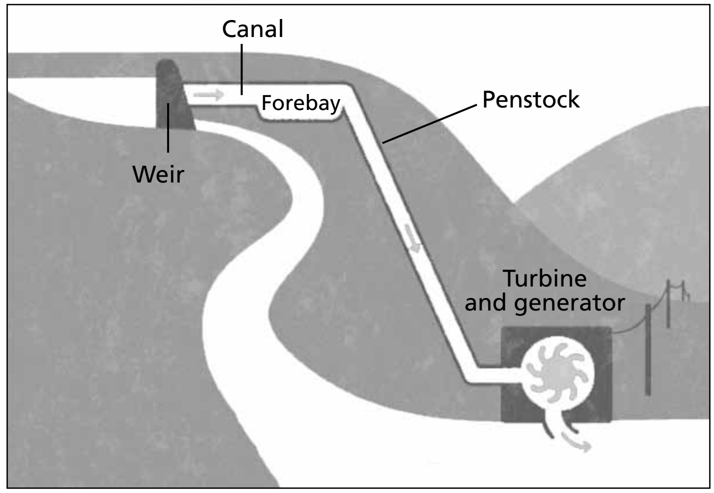
The SWOT analysis is a strategic business framework which attempts to map out the advantages and disadvantages of a particular product, investment, or industry. SWOT can be applied by firms interested in SHP projects to assess the pros and cons of investing. The 'S' and 'W' in SWOT refer to the strengths and weaknesses of a potential investment. These are the internal factors and may include everything from financial, physical, and human resources available for use, to the processes and ideology used by the firm. The 'O' and 'T' are the opportunities and threats that the company does not control. These external factors could include everything from demographics and funding to market and economic trends (Goodrich, 2013).

PESTLE

PESTLE is a similar strategic mapping technique which can supplement a SWOT analysis. It provides a 'meso-economic' and 'macro-economic' background for organizations to consult prior to their investment (CIPD, 2013) . The meso-economic environment is the organizational infrastructure which includes all procedures, policies, rules and guidelines (Shaw, 2011), and the macro-economic environment is the large scope economics trends such as interest rates, unemployment and efficiency level. PESTLE can be implemented to understand the whole picture and understand the risks that are involved in the project at hand. It can supplement a SWOT analysis by enabling a firm to maximize the opportunities while minimizing the potential threats. Additionally, most factors included in a PESTLE framework will be external to the firm. Although firms may not have control over these external factors, they must learn how to minimize the threats from such factors. That means that the external factors have no direct impacts on the profitability of the firm and planning to avoid impacts is crucial (CIPD, 2013).

Explanation of Diversion Hydroelectric Power Plant

Figure 1. Diversion Power Plant



Diversion SHP set up (Wheldon, 2013)

The primary type of project examined in this research was the diversion power plant. Sometimes referred to as a "run of the stream" power plant, this type of SHP requires no dam or storage facility. Diversion SHPs are set up on rivers and divert some of the water at the diversion weir into a settling tank (see figure 1). The water sits in the settling tank to filter out the silt and debris in the water before the water is funneled into a canal or tunnel. The canal or tunnel leads into a second settling tank, the forebay tank. The forebay tank sits above the power plant and transfers the water into the penstock (Wheldon, 2013). The penstock's design (length and pitch) adds to the natural fall and weight of the water to spin the turbine in the power house. The combined flow of water with the vertical drop is referred to as the 'head' of the SHP project (Home Power, 2013). The spinning turbine and the generator produce the electricity. From there the electricity can be transported and sold by way of typical electricity wires and towers and the water is returned to the river or stream through the outlet pipe or 'tail-race' (Wheldon, 2013). The design (See Figure 1) of the diversion SHP plants allows for the reuse of the flowing water and serves to create an efficient and green source of energy.

ANALYSIS

Investment in SHP development is extremely complex and multifaceted. This type of investment can be profitable only if set up properly. Proper analysis of the macro-environment and meso-environments are in order and firms must possess the due diligence prior to investing in such a project. Errors in the planning, constructing or maintaining of SHPs have results in many failed projects which are now abandoned or closed down (Charlton, 2011). The volatility in market costs, demand, and global economic trend (including the value of the rupee) pose risk for failure. Risk of damages includes personal injury, power failure, military conflict or environmental damages such as a flood or earth quake: these are in addition to any unforeseen risks which might delay the construction of the plant, which could increase cost and potentially cause a project failure (Chaurasiya et al, 2013). The risks are many and must be weighed against the other factors involved in SHP investment and development.

In order to minimize the risks and threats and maximize the strengths and opportunities analysis of both, the internal and external factors is necessary prior to engaging in SHP development in India. The use of strategic analysis tools and techniques are recommended. It is important to remember that analytical frameworks have pitfalls and may fail to predict market trends, successes, or outcomes. The PESTLE analysis identifies factors involved in SHP development in India. It does not attempt to create a plan for entry.

Political Factors

One factor that firms must be aware of before investing in a foreign country or industry is the political environment. The government of India offers various incentives to stimulate the growth and interest in the small-hydro industry. The Ministry of New and Renewable Energy (MNRE) is the governmental body in India responsible for monitoring and commissioning small hydro projects. MNRE offers subsidies to project developers and manufacturers of some required parts in an attempt to reduce the cost to entry. The MNRE offers programs, classes, and resources that are helpful to companies investing in SHP (Government of India, 2013). Subsidies are also offered to firms starting up SHPs as well. The MNRE offers subsidies for grid connected power for small hydro; assuming that the plans adhere to the criteria outlined in the policy regarding part types, power house capacity, and quality of transmission/development infrastructure. The size of the subsidy fluctuates with the capacity of the project and is based on Rs 2.25 crores X Megawatts^0.646 (Government of India, 2013).

A weakness that any investment in India will face is the issue of corruption. Estimates report over $400 billion being laundered out of India in just the past 10 years. That is money that could be used to fix infrastructure, help the 600 million living in poverty, or the 300 million living without electricity (Hanna, 2013). Yet corruption goes deeper than politicians lining their pockets with profits. Corruption in India has been connected to the partial cause of the energy deficit, "Transmission and distribution losses in some states are as much as 50 percent because of theft and corruption by employees in the power industry" (Nessman, 2012). Corruption appears to be rampant in India without any differentiation by industry, or state.

The Ministry of New and Renewable Energy is responsible for developing the 5 year plans. These are essentially targets for growth in the renewable energy sector. The 11th 5-year plan ran from 2007-2012 and projected an increase of 1,400 MW to the preexisting 1,976 MW of the estimated 15,000 MW potential. The actual increase in MW fell short at around 2/3rd with an addition 963MW added during the 2007-2011 span. The current plan (2012-2017) proposes an increase of 1,960 MW essentially doubling the results from the first 50 years of these plans (Ministry of New and Renewable Energy, 2011). A report funded by the World Bank found, according to current plans, 43 percent of the total small hydro potential will be harnessed by 2021 (Gaba, Cormier, & Rogers, 2011). Being aware of the policies and goals on energy and energy production presents opportunities to potential investors.

Another aspect of the political environment to consider is the issuing of no-objection certifications or NCO's. There are nine different agencies that a NCO must be granted from in order to begin building a small hydro plant: the village panchayat (village council in the project zone), public works department, forestry department, pollution control board, wild life, fishing, irrigation, and explosives licensing. Rao (2009) explains that each NCO within a board or department has various steps and engineers that it must pass before approval and filed with the state. Typically, a NCO is granted in 2 or 3 months. However, in some circumstances, it can take nearly 10 months to receive the certification. Lack of communication and misleading information given by the street-level bureaucrats in the early stages of development can cause delays in the process. Rao (2009) contends that policy change to reduce the amount of certification and bureaucratic intervention in the process would increase appeal and implementation time for small hydro projects and that NCOs present a threat to investing in small hydro in India.

Economic Factors

Before starting an investment the economic factors must be weighed to ensure financial stability and the potential for profit. One of India's attractions to international business is its highly trained yet low costing workforce. The average rate for manufacturing labor is a mere $1.26 per hour (Bureau of Labor Statistics, 2013). When visiting SHPs in Himachal Pradesh, it was noted that there was also a presence of engineers in the plants. Between 200,000 and 300,000 recent graduates of engineering colleges and universities in India are either unemployed or taking employment well below their expertise (Chaturvedi & Sachitanand, 2013). In addition to the vast human resources available in India, their financial resources promote Foreign Direct Investment (FDI) as well. FDI is defined by the Organization for Economic Cooperation and Development (OECD) as investment by a resident of one country and its economy into another country and their economy, and attributed as "...an important vehicle for development" (Organization for Economic Cooperation and Development, 2013). As mentioned previously, subsidiaries provided by the MNRE are important financial resources. Despite large startup cost and investment the cost of energy production after the initial investment is low at Rs 3.11 per kWh (Soni, 2012). SHP projects can be extremely profitable providing the demand for electricity is higher than the supply and projects have been estimated to achieve a return on equity after interest, taxes and operating expenses of 21.48% (Soni, 2012).

The global trend for investment in green technologies and energy production should be evaluated as well. Global investment in green technology has been on the rise steadily since 2004. In 2011 there was $257 billion invested globally in green technology projects including: biomass, geothermal, wind, hydro (between 1 to 50MW) wave, tidal, biofuel and solar. This is 600% of the 2004 figures and 93% higher than pre-economic crisis 2007. While these numbers look promising the investment for projects in developing countries has fallen to just 35% of the market share in 2012 (Frankfurt School of Finance and Management, 2012).

There are also inherent weaknesses in the economic environment. The initial investment in capital is extremely high. On the lower side the Chirchind II SHP (9.9MW) had an estimated project cost of $4 million (Rao, 2009) yet in other extremes, a project can total almost $27 million when factoring escalation in cost and interest (Soni, 2012). Another weakness and a possible threat to investing in India is the unpredictable value of the Rupee. The Indian Rupee or INR has an unstable past, and hit a record low this summer of 68 INR to 1 USD, thus impacting international business contracts (PTI, 2013). Another inherent weakness and cost is the Hydro Power Policy of 2006. This policy states that "1.5% of the final cost of the projects above 5 MW and 1% of the final cost of projects up to 5 MW shall be contributed to a Local Area Development Fund (LADF)" (Government of Himachal Pradesh, 2013). It goes on to say that after the commissioning of the hydro power plant, 1% of free electricity must be sold and given to LADF to provide regular income for welfare schemes. (Government of Himachal Pradesh, 2013). LADF was set up to help rehabilitation and resettlement programs and provide general improvements to the project affected zone (PAZ).

Sociological Factors

Since the implementation of the LADF, studies have been conducted by the Agro-Economic Center to monitor and review the spending on social wellness programs and projects within the PAZ.The PAZ is the immediate area around hydro projects. The locals living within these areas were surveyed to see what changes have been brought about and if they were positive. With the money that was paid into the LADF from small hydro developers, the Local area development council or LADC were able to make several investments: projects to improve the drinking water conditions at Tunan and Bhawa, construction of classrooms in Gadej and Kharga, repairing old temples in Kharga and RHEP, and 217 different projects to increase the connectivity of the project affected zone. In addition to the creation or expansion of educational buildings, the SHP developers created technical education workshops and seminars and also funded merit based scholarships to send students to continue their education. Another focus of LADF was to tend to those who may have been moved in the interest of building the power plant. These rehabilitation and resettlement (R&R) plans are directed to those immediately affected. These included creation of homes or fields for crop or livestock. In regard to crop yield only 3 percent of the locals thought these power plants were negatively affecting the agriculture industry. In fact 41% responded that it had a positive impact on agriculture (Agro-Economic Research Centre, 2013). The report is extensive. It maps out many other societal and economical projects and successes in the PAZ that were accomplished from funding by LADF. A societal opportunity that this market also possesses is that 25% of the Indian population is living without basic electricity (EIA, 2013). To provide electricity and connectivity to those 300 million Indians would have huge sociological impacts: such as connecting them to the globalized economy, opening them up to employment or educational opportunities and increase the general knowledge and welfare of the population.

Technical Factors

The current processes for harnessing and converting the hydroelectric power are universal. Other than the building and designing of the canal or penstock the actual mechanism behind small hydro has not changed. Rather, newer and more efficient machines have been built. Most parts are universal; the generators and turbines found in small hydro in the US are the same types of turbines and generators in Himachal Pradesh India.

Most of the technical factors are opportunities. The Ministry of New and Renewable Energy have extensive online resources and information available for developers for every step along the implementation and building process. They offer an approved list of suppliers for parts and have their paperwork for applying for some of the NCOs online. (Ministry of New and Renewable Energy, 2011). This is just the tip of the iceberg however in terms of information available. The Alternative Hyrdro Energy Center (AHEC) at the Indian Institute of Technology- Roorkee offers everything from three week summer courses to PhD programs all pertaining to hydroelectric power. During field research we were able to visit IIT Roorkee. Within their buildings they had several simulation rooms and programs and were in the process of building a life-size scale model of a small hydroelectric power plant. IIT Roorkee also has some of the most cutting edge research and educational techniques for hydroelectric development and brings several international students to their summer programs each year. In addition to this, they offer advisory support for developers (Alternative Hydro Energy Center, 2013).

There are some technical threats to consider with small hydro. The water must be sifted and filtered before it enters the penstock. Debris and sediment in the water can damage the turbines; further the filters for such debris must be empty and cleared on a regular basis as to prevent blockage. The Himalayan Mountains are the youngest and most delicate mountain range on earth. She soil is soft and, not properly anchoring the supports when constructing the penstock and canal can result in disaster. The last technical threat foreseen in this research is the rolling blackouts and the shortage of power. India had the largest blackout ever recorded when on July 30th 2012 a total of 670 million people were thrown into darkness. Spanning an area of 2,000 miles, and affecting roughly 10% of the total world population, this black out is an extreme example of a larger problem (Yardley & Harris, 2012). Throughout the day, energy shortages shut down traffic lights, manufacturing facilities, and restaurants.

Another technical factor to be aware of is the construction and design of the SHP plant. Once the head (drop of the water) and flow are calculated, the developer must decide which type of turbine to use. Different types are implemented based on the figures calculated. The most widely used turbines are: Pelton, Francis, Cross-flow, Propeller and the River Current turbines (Wheldon, 2013). The risk of damage to the turbine due to sediment must be addressed. Any sediment coarser than .20 mm in size can cause damage to the turbine blades and therefore should be removed from the water (Raju & Kothyari, 2004).

Legal Factors

There are a limited number of legal factors that have a role in the implementation and management of small hydro projects. However the same issue of corruption can also play a role in the legal environment. When the Foreign Corrupt Practices Act, 1977, passed it became illegal for a U.S. firm to engage in corrupt activities even outside of the scope of the states. Other policies have since been enacted in other countries and alliances. For example the Organization for Economic Co-operation and Development (OECD) has held anti-bribery conventions. More recently in the United Kingdom the UK Bribery Act was passed in 2010 (Illinois Tool Works Inc., 2013).

Environmental Factors

The main advantage of small hydroelectric power is its environmentally friendly design. Diversion power plants are considered a 'green power' source meaning that they lower carbon emission and the environmental impact of fossil fuel energy production. They also provide less economic waste and pollution than other types of power plants. The design of the diversion or run-of-the river hydro plant is also aimed at maintaining natural ecosystems. When water is diverted at the diversion weir, not all is tapped. Rather some water is left to continue the ecosystem of the river bed (ROR Power, 2012). It has been suggested that an increase in hydroelectricity in India will reduce the need to burn wood as fuel. It is this idea that supports the theory that SHPs will prevent deforestation and also reduce greenhouse emissions (Rao, 2009). The MNRE has conducted surveys and found over 5,400 potential project sites and estimates the potential for small hydro projects alone to be around 15,000MW (Ministry of New and Renewable Energy, 2011).

Silt disposition created from diversion hydro plants should be addressed. Silt and sediment are removed from the water to protect the turbine's blades. This can alter the river's ecosystem downstream, causing environmental risks. These risks were recorded in a study on the Okavango River in South Africa where erosion of the riverbed downstream and deepening of the channel bed was found to reduce the overflow into floodplains creating additional ecological impacts (Colin Christian & Associates, 2009).

Conclusion

Before any type of FDI can be made, it is imperative to conduct strategic analysis to determine factors that may impact the success or failure of the investment. Using frameworks, such as SWOT and PESTLE, makes it easier to understand the industry and the investment opportunities in a foreign market. This paper offered a holistic assessment of the market surrounding small hydroelectric projects in Himachal Pradesh. With these factors the macro-environment and meso-environment can be evaluated. Although a PESTLE and SWOT analysis may uncover many aspects of the investment, firms must go beyond these steps to do their due diligence before entering into SHP development.

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