

Five Small Hydro Projects in Hunan, China



Project summary

With the carbon offset project “Five Small Hydro Projects in China”, myclimate is helping to alleviate the power shortage in the province of Hunan and promotes the sustainable economic development of the local area.

The electricity generated by the five small hydropower plants is transmitted to the Central and Mid-China Power Grid and displaces parts of the electricity generated by the fossil-fuel-fired power plants, thereby reducing greenhouse gas emissions.

The project is also triggering new investment in the rural region. It not only provides financial returns for local entities, but also direct and indirect employment opportunities, which lead to the economic well-being of local residents.

Project benefits

The project is helping to reduce in CO₂ while making a significant contribution to sustainable development in the region.

- The project utilises hydropower to generate electricity, thus offsetting the equivalent amount of electricity originally generated through fossil fuel.
- The project is triggering new investment in the rural region and amongst the Chinese ethnic minorities of the Miao and Dong.
- At the Guanbaodu hydropower plant, the project has fostered entrepreneurship amongst the villagers, as they hold shares in the power plants.
- Temporary jobs are created during the construction period and permanent jobs during operation.
- The income from the project is invested in the health and education of local villagers at the Guanbaodu hydropower plant.



Facts and figures on the carbon offset project

Project location	China, region of Hunan
Project standard	Gold Standard VER
Project type	 Water
Emission reductions	185,687 t CO ₂ e (over 7 years)
Situation without project	Power from the combustion of fossil fuel
Project start	January 2009

The project country

China has had the fastest-growing major economy for the past 30 years with an average annual GDP growth rate above 10%. Chinaks per capita income has likewise grown at an average annual rate of more than 8% over the last three decades, drastically reducing poverty, but this rapid growth has been accompanied by rising income inequality.

In recent years, China has witnessed a huge increase in power consumption. Both public and private parties are struggling to meet the demand for electricity. Moreover, more than 80% of total electricity production is derived from coal-based power plants. China's electricity consumption is expected to grow by over 4% a year up to 2030, which will require more than \$2 trillion in electricity infrastructure investment to meet the demand.

The 12th Five-Year Programme (2011 - 2015) called for greater energy conservation measures, including the development of renewable energy sources and increased attention to environmental protection. Guidelines called for a 16% reduction in energy consumption per unit of GDP and an increase of non-fossil fuel to 11.4% of primary energy consumption by 2015. Moving away from coal towards cleaner energy sources such as natural gas, renewable energy and nuclear power is an important component of Chinaks development programme.



Map of China: the red circle shows the location of the project region.



Village in the project region.

Indicator	China	Switzerland
Total area (in km ²)	9,596,960	41,285
Population	1,339,724,852	7,870,134
GDP in USD per capita (2010)	4,428 USD	67,464 USD
Share of population living below the national poverty lines (2010)	13.4%	6.9%
Energy use per capita (kg of oil, 2009)	1,695 kg	3,362 kg
CO ₂ -emissions per capita (in 2008)	5.3 t	5.3 t
	Shanghai	Zurich
Min. working time to buy 1 kg of rice in min.	41	9
Min. working time to buy 1 kg of bread in min.	53	12

Table 1 – Facts & figures: China vs. Switzerland. (Source: fairunterwegs.org [2012]; World Development Indicators, web.worldbank.org; CIA World Factbook, web.cia.gov; Bundesamt für Statistik [2010])

The project region

Hunan, meaning “south of the lake”, is derived from the fact that the province is located south of the Dongting lake, which is the second-largest freshwater lake in China and a discharge lake of the Yangtze river, when there are floods. The region has many rivers and is one of the main hydroelectric powerbases of China. Hunan's climate is subtropical, with mild winters and plenty of precipitation.

The ethnic composition of the region is characterised by a majority of Han Chinese (which represent the majority in China) and ethnic minorities like the Miao, Dong and Tujia.

The project is located in the Huaihua prefecture-level city, in a mountainous region of the province. In this rural area, the heating and cooking needs of the local population are mainly met through the use of firewood. The project enables the local residents to switch from wood to electricity, thus relieving electricity shortages and ensuring industrial and civil electricity consumption in the area.

In 2008, Huaihua suffered a period of severe snowstorms and freezing weather. The destructive weather led to a brownout of electricity power from the central grid. However, the continuous operation of the project played an important role in guaranteeing the basic living and production needs of the local villagers.

Since all five hydropower stations are located in the same region and have the same characteristics, we focus only on the Guanbaodu hydro project.



Ethnic Dong women in holiday dresses.



Dong covered bridge: “Wind and Rain”



The power station seen from the dam/bridge. The far left shows where the waters flows under the bridge to the power station.



Project Site



Project focus: Guanbaodu

The “Guanbaodu Hydropower Project” is located in Huaihua City, in Jingzhou Miao and Dong Autonomous County. The county is a mountainous region where 16 ethnic minority groups live. 61% are Miao and Dong people. The local residents have their own special languages and beautiful cultures. Most of the people are farmers cultivating rice as their main crop. Other plantations include maize, tea leaves, fruit and oil trees.

How the project is implemented

The party secretary of the village of Guanbaodu and members of the village committee, which takes care of the internal affairs of the village, looked for ways to improve the energy supplies and accessibility of the village. In 2004, they came up with the idea of building a power plant and selling the electricity generated to the national grid. Unfortunately, the electricity selling tariffs were too low to recover the initial investment for the project. Some years later, the party got in contact with Climate Bridge, a project partner from myclimate. Thanks to the voluntary carbon market and the Gold Standard, it was then possible to build a small power plant with a capacity of 4.0 MW. The project also received some financial support from the local residents who hold the company shares and have also been involved in the fundraising. The plant started its full operation in 2008 when all four turbines became operational.

The power plant

The power plant has been reconstructed from an irrigation station and works as a hydropower station as well as an irrigation station. Combined, they can make the best use of local water resources. The main structure of the power plant consists of a reservoir, a powerhouse and an on-site booster station. Water from Qushui River is taken and then stored using a reservoir. It passes through four hydro turbines and generator units where the electricity is generated. After power generation, the water is discharged into the Qushui River directly from the powerhouse.

The project activity displaces power equivalent to the generated by CCPG, which is mainly dominated by fossil-fuel-fired power plants. This means CO₂ emissions are reduced.

The average operating hours for the four turbines together are around 4,000 hours/year. During the rainy season from March to August, the four turbines are permanently operating. During the dry season, from September to July, it is possible that only one turbine is operating for a few hours a day.



The back of the power station from which the water goes out.



The gates through which the water flows into the power station and to the turbines.



The four turbines inside the power station. Technical rooms can be seen on the

Hydropower comparison

The annual total electricity generation is estimated to be 16,412 MWh and the annual feed-in electricity is estimated to be 15,513 MWh. As a comparison, this power corresponds to 0.05% of the power generated by the hydroelectric installations in Switzerland in 2009¹. The electricity generated is transmitted from its booster station to Jingzhou County Grid, which is connected to the regional Central China Power Grid (CCPG). The electricity is also distributed in the local area to ensure industrial and civil consumption.

¹ Swiss national production of hydroelectric power in 2009 corresponds to 32,859 GWh (source BFE, document: “Production et consommation totales d’énergie électrique en Suisse 2009”, http://www.bfe.admin.ch/themen/00526/00541/00542/00630/index.html?lang=fr&dossier_id=00769)

In the event of floods or heavy rains, the power station cannot be used because the water levels remain very similar on both sides of the dam.

A power station company is responsible for the building and the operation of the plant. Except for one person from the local government and one living in a village nearby, the board is composed of local people from Guanbaodu: four Miao, two Dong, two Han and one Yao. The nine board members take decisions concerning the project and manage its daily operation.

Seventeen people are currently working for the power station company. They take care of the power station and of the building (dormitory, canteen and office of the company and power station staff).

Environmental aspects

The project utilises hydropower to generate electricity, which will offset the equivalent amount of electricity originally generated through fossil-fuel-based power plants, thus helping to reduce greenhouse gas emissions. As most hydropower projects, there is some limited impact on biodiversity. The numbers of some terrestrial animals such as birds, snakes and rats will decrease to some extent, due to the increase in the water level. In contrast, the relatively small increase in the reservoir area will create more inlets and discharges, such that some aquatic organisms, fish and water-loving birds and frogs may increase. However, no extinction of any animals is expected.

In order to secure approval for the project's environmental impact assessment, the project owner demonstrated that the reservoir has no considerable effect on water quantity or quality in Qushui River. In addition to these ecological motivations, because there are multiple hydropower stations further downstream, a high water flow is rigorously maintained to ensure the operability of the other hydropower plants.

A grid by the dam more than one metre in length ensures that water and fish can both pass through it. During the dry season the grid is underwater, while during the rainy season the water level rises and the water can pass above the wall of the dam, so the fish can move up and down the river.

According to the villagers, there has not been any variation in the number of fish since the project commenced operations.

The government has also built a wastewater cleaning system in the township, which has been operating since November 2009.



The back of the reservoir, where the river enters into the reservoir.



The river and the river's bank.



The water reservoir.



A closer view from the dam/bridge of the reservoir and the river.



The new gate at the entrance of Guanbaodu Village.

Socio-economic aspects

The project relieves electricity shortages and ensures industrial and civil electricity consumption in the local area. With regard to the local traffic, the dam has been modified to be a bridge so that residents on both sides can cross the river by vehicles. This is favorable for communication between local residents and fosters development.

In order to increase the efficiency and water utilisation rate, electric water pumps have been installed instead of the old rusty hydraulic pumps. The hydroelectric pumps make irrigation easier for the local people. Because of this new development, irrigation channels have been set up, which bring 100 mu (7 hectares) of farmland under irrigation.

This project is also triggering new investment in the rural region. It not only provides financial returns for local entities, but also offers direct and indirect employment opportunities, which will lead to economic well-being for local residents. 80 percent of the project costs are being covered by a bank loan made by all the villagers, 14 percent is capital raised from the village committee who also holds the company's shares, and some private villagers have invested an additional 6.4 percent. Once the bank loan has been repaid, the village committee will receive an amount of the profit in proportion to the amount invested, which it will distribute equally among all the villagers. The private villager investors will also receive an amount proportional to the initial investment.

There is real participation by the Dong and Miao minorities in the project. The Dong, Miao and Han are sharing responsibilities, investments and future profits.

The project will provide some medical subsidies to rural residents, and local college students will get scholarships from the village committee.

Farmer from a Miao-Dong family: "The project brings money to the villagers and the economic situation has improved. A good road has been built and I can easily transport my oranges to the nearby town."

Farmer from a Miao-Han family: "Electricity supply is more regular than before and we have easy access to water for irrigation."

This project is very unique. It is rare in China to see such involvement, particularly by villagers from different ethnic groups. The villagers are really keen on the project and have seen real benefits in the area since the project started. The project has a very positive impact on all levels of sustainable development (social, economic and environmental).



Company offices (first floor), the power station workers' dormitory and canteen.



Local villagers.



The bridge on the top of the dam has been built to connect 2 neighbouring villages.



People playing cards in the streets of the village close to the Guanbaodu reservoir.

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