

Case study summary

GIZ and INTEGRATION, Afghanistan/Germany

2012 Ashden Award winner

GIZ and INTEGRATION were joint winners of a 2012 Ashden Award for their contribution to bringing hydro-electricity to remote off-grid areas of Afghanistan – improving quality of life, encouraging economic activity and reducing communal tensions.

Badakhshan is a remote, mountainous rural province in the far north east of Afghanistan. Lack of electricity has hampered development and added to ethnic tensions. It has also hindered efforts to stop opium production, because other sources of income are limited.

GIZ and INTEGRATION are working with the Afghan government to improve rural electricity supply. This includes constructing mini-hydro schemes in Badakhshan and neighbouring provinces. The programme works with local communities to gain support and share benefits, and provides intensive training to operators and users to ensure that systems continue operating long-term.

Key information

- At a potential hydro site there is extensive community consultation, then an Energy Committee is set up, made from members of local Shura (council of elders).
- Communities are actively involved in the hydro development, through both in-kind contributions and paid work.
- Local men are identified and trained as operating crew for the scheme, one of whom becomes the leaseholder for an initial period of three years.
- Capital costs are paid by grants. Electricity fees cover all operating costs, including wages, maintenance and a leasehold fee retained centrally for major repairs.
- By March 2012, six off-grid mini-hydro schemes in operation with a total capacity of 1.3 MW, producing about 2.5 GWh of electricity per year.
- Over 7,565 households (63,000 people) electrified, also 110 public organisations (government buildings, schools and hospitals), and 645 small businesses.
- Homes use electricity for lights, radio, TV, mobile phones, kettles, water heaters, small refrigerators and washing machines.
- Replacement of kerosene for lighting cuts CO₂ emissions by 3,200 tonnes/year.
- Better light helps with chores, study, productive work. Reduced smoke and better medical facilities improve health. TV and radio offer information and entertainment.
- Benefits are particularly important for women, who spend much of their time within the home. Separate training in electricity use is provided for women and men.
- The programme has supported the development of small enterprises using electricity. People have come back to set up businesses, and poppy cultivation has decreased.

Future plans

- Two more mini-hydro schemes and a decentralised solar scheme are under construction, which will serve 3,400 more households and 450 more businesses.
- Five further potential hydro sites are under assessment by different organisations.

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) is a federal enterprise that supports the German government in international development. INTEGRATION environment & energy is a German consulting firm, with specialist expertise in rural electrification and productive uses of energy. GIZ and INTEGRATION work in partnership with the government of Afghanistan on the rural electrification programme, which had funding of US\$6 million from the German government in 2011.

Afghanistan statistics 2007 -11

(World Bank)

GDP: US\$501/year per person

84% of people lack grid electricity

Location



“If there’s a security problem, people can live with it. If there’s a problem with water, they can live with it. But if people find they don’t have power for just one night, they all come hammering on my door!”

Dawlat Mohammad, Jurm District Governor



Fargahmbowl village with micro-hydro powerhouse on the left

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Case study

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Background

Badakhshan is a remote, mountainous rural province in the far north east of Afghanistan. Development has been slow and infrastructure is extremely limited: the one major tarred road was completed only three years ago, so most transport is by donkey and horse. Badakhshan has never been controlled by the Taliban, but there is some insurgent activity and also tension between different ethnic groups (mainly Tajik and Uzbek) and between rival militias. The region was formerly a major source of opium, although poppy production has declined in recent years.

The services that electricity provides can decrease communal tensions and provide alternative sources of income to opium production. But in 2005 only 3% of rural Badakhshan homes had access to electricity. The German government therefore started to work with the government of Afghanistan to improve rural electricity supplies, including the construction of mini-hydro schemes in Badakhshan and neighbouring provinces including Takhar.

The organisation

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) is a federal enterprise that supports the German government in the field of international co-operation for sustainable development. GIZ was formed in 2011 from the merger of three previous agencies (GTZ, DED and InWent) and has 17,000 staff members across the globe, 70% of whom are employed locally. In 2007 GIZ was commissioned by the German Ministry for Economic Co-operation and Development (BMZ) to assist Afghanistan with the Renewable Energy Supply for Rural Areas (ESRA) programme.

For this purpose GIZ subcontracted INTEGRATION environment & energy, a German consulting firm, to make use of their specialist expertise in rural electrification and the promotion of productive uses of energy. INTEGRATION was founded in 1998 and has 30 full-time and 10 part-time employees.

The Afghan partners of ESRA are the Ministry of Energy and Water and DABS, the state-owned electricity utility. In 2011 ESRA had 65 full-time and 5 part-time project staff and funding of US\$6 million from BMZ.

The programme

The ESRA programme works at a number of levels. At national level, it provides advice and capacity building on energy planning, institutional strengthening and the development of standards for electro-technical equipment. At provincial level it assists in the planning of rural electrification through the development of 'Provincial Electrification Concepts'. These are used by ESRA and its partners on the ground to identify and develop sites for rural electrification schemes. The schemes provide off-grid electricity and act as demonstrations for future developments.

Sites are chosen by first identifying places where there could be significant demand for electricity. These are usually district centres with a substantial population and also a large bazaar with potential for developing productive uses of electricity. Centres are ranked through a socio-economic appraisal, and suitable sources for electricity are then surveyed. Local mini-hydro generation is preferred, because it is reliable, relatively low-cost and quick to install, and provides sufficient power for productive uses. In addition, technically skilled local people can be trained to manage, operate and maintain hydro plants. If there is no hydro potential, alternative power solutions such as PV-diesel hybrids are explored.

Given the troubled history of the region, it is essential that any scheme has the support of all sections of the local community. Extensive community surveys and consultations are therefore carried out with both traditional and official authorities, including religious leaders, to confirm local support and to avoid potential conflicts. The traditional local councils of elders or Shuras are key players in this process, and are responsible for most of



The blacksmith's apprentice no longer has to operate the bellows now that there is electricity.

What is electricity used for and how is demand controlled?

Appliances commonly used in the home include lights, radio, TV, mobile phones, kettles, water heaters, small refrigerators and washing machines. Businesses use power tools, sewing machines, computers, chill cabinets, and electrically-driven mills

Electricity customers have to agree not to use excessive power and to balance use, so that power-hungry appliances are used in the daytime and not the evening, when demand is at its peak. Leaseholders of individual plants can cut people off if they persistently refuse to comply with the terms of use. This has happened occasionally, for example in Jurm, where the whole bazaar was cut off because power tools were being used at peak load time, despite warnings.

"Now we have lights, the TV, an iron, a kettle.... There's a code of conduct that says we musn't use too much power or we deprive our neighbours. And we respect that. We're all part of the same community."

Ghulam Rabbani

the formal agreements associated with providing electricity. The most important agreements are that poppy cultivation stops; that the community makes an agreed in-kind contribution to the scheme; and that paid construction work is shared fairly among the local community.

Once local support is secured, an Energy Committee made up of local Shura members is established for each plant. The committee organises workers for the construction and, together with DABS and ESRA, identifies a group of talented and motivated men who will form the operating crew for the plant, and selects the most able as the plant's leaseholder.

When the plant is commissioned and fully operational its ownership is formally transferred by the Ministry of Energy and Water to DABS. The plant is operated and managed by the leaseholder, who holds the lease from DABS for an initial period of three years. The local Energy Committee is responsible for monitoring his performance: leases will not be renewed or can even be lost if the committee is not satisfied. Refinement of operation and maintenance models is an on-going activity of the programme.

The technology

How does it work?

Water is diverted from a river by a weir. It is channelled along a contour line via a sediment basin, to prevent damage from the turbine, until sufficient head is achieved. It is then diverted down a steep penstock into the power house, where it rotates the turbines that drive the electrical generators.

Electricity is distributed through 20 kV medium voltage lines, and stepped down via transformers to a 400 V distribution network in villages. Apart from service down-times, customers are supplied for 24 hours per day, and seven days per week. The plants and their distribution infrastructure are designed so that they could be interlinked and possibly even connected to the national grid at a future date.

How much does it cost and how do users pay?

US\$1 = 49 AFN (Afghani) [March 2012]

The capital costs of plants range from about US\$3,700 to US\$5,300 per kW installed: cost depends on a number of factors including topography, distribution distances and population. Cash costs are covered by funding from BMZ: for the first three hydro plants the Counter Narcotics Trust Fund contributed the major share. In-kind contributions come from local communities, who provide the land, supply the stones required for the construction, and build or improve the roads for access to all villages and the power house site.

The main customers are households, small businesses, district administration and other institutions such as schools, hospitals and police stations. Each customer has a digital meter on their wall which is read bi-monthly by one of the plant operators, who also collects payments. The leaseholder and user both have record books. Customers are charged US\$0.1/kWh (5 AFN), plus a one-off connection fee of US\$10 (500 AFN) for domestic households, with a higher connection fee for the three-phase meters that are used to connect productive machinery.

The revenue from electricity sales must cover all running costs of the plant, and the leasehold agreement specifies how this is apportioned. 60% is income for the leaseholder, from which he must pay the salaries of all other operators. 10% goes into a maintenance fund, and 30% is the leasing cost, paid by the leaseholder to DABS and saved for the replacement of major components (e.g turbine blades) at a later date. This clarity in how revenue is used is one factor that has contributed to the generally good track record of customer payment.

How is it manufactured, promoted and maintained?

Most plants use Francis turbines. An international tender process is used to select providers and so far all turbines were manufactured in China. Construction of the plant uses as little heavy machinery as possible in order to maximise the use of paid local labour. The Energy Committee organises 14-day rotating work shifts, thus spreading employment amongst the local communities. Materials and tools are sourced and procured locally where possible.

Gender-specific training on electricity use

For cultural reasons, men and women receive separate training on the use of electricity. Men attend a morning session on issues such as product selection and installation. In the afternoon, and with approval from community leaders, women attend a session on efficiency of appliances and electrical safety. Trainers emphasise the importance of using electricity fairly so that the whole community can benefit, and also the need to pay so that the plant will stay in operation. These sessions are also used to explain more about the nature of renewable energy and its environmental aspects. The role of women in energy management is strengthened. Users are made aware of the new opportunities that electricity will offer for farms and businesses, and that support will be available to help them take up these opportunities. Plant operators are involved in the training and advisory sessions so that they can continue to offer them in future.



Adjusting the turbine blade angle, Feyzabad

"Ask people here what is the single most important project for them and they will always say electricity. One night there was a flood – some sediment had blocked the channel. And a hundred people came from the bazaar with shovels to clear it."

Dawlat Mohammad, Jurm District Governor

At all stages of the programme, skills and responsibility are transferred to local people to ensure operational sustainability in the long term. Plant operators are trained in all aspects of plant operation and maintenance, electricity distribution, and business management. Larger technical problems, for example a channel breach, are referred to DABS. ESRA plans to set up a Central Maintenance Service in the North of Afghanistan for major repairs and renewals of plant.

Both male and female household heads receive training on practical issues of electrification (see box p2). Customers are made aware early on of the opportunities that electricity will bring for their farms and businesses, and later are offered business training and support.

Achievements

By early 2012, the programme had installed six mini hydro schemes ranging in capacity from 112 to 480 kW, with a total capacity of 1.3 MW. These plants produce about 2.5 GWh of electricity per year and supply over 7,565 households, together representing some 63,000 individuals. A similar number of people benefit indirectly through the 110 public organisations and buildings and 645 small businesses that are supplied.

Environmental benefits

Electricity from the plants replaces fossil fuels and therefore cuts greenhouse gas emissions. The main fuels replaced are diesel, used in engines and generators in markets, bottled gas for cooking, and kerosene for lighting (mostly in households). ESRA estimates that the overall reduction in emissions for lighting alone is about 3,200 tonnes/year CO₂e.

The hydro schemes have reduced pressure on forests due to the substitution of brush and firewood, traditionally used for hot water and cooking: this also cuts greenhouse gas emissions, although the amounts have not been quantified. Use of dry cell batteries has also declined.

Social benefits

With the elimination of kerosene lamps and reduced burning of firewood, homes are less smoky and cleaner, which significantly improves the health of women and children who spend most time indoors. Furthermore there are fewer accidents resulting in burns. Extra hours of light for household chores during the evening, make it easier for women to get to the clinic or market during the day. Light in the evening can be used for embroidery and other income-earning activities in the home, and makes it safer to move around outdoors. Water-heaters free up time that was previously spent collecting fuel. The use of electric space-heating, although not officially sanctioned, probably saved lives in the exceptionally cold winter of 2011.

Electricity has allowed access to TV and radio and given people, particularly women, a window on the world. A wide variety of programmes are available covering education, religion and health (including family planning) as well as entertainment. Lighting for schools, teachers' and learners' homes has further increased the opportunities for education. Clinics now have light, and power for refrigerators that keep vaccines and medicines effective by storing them at the correct temperature.

ESRA has used socio-economic surveys to quantify some of these benefits. Baseline surveys were carried out before electricity was introduced, and are followed up annually. Villages without power are also surveyed as a control group. Results indicate improved health in 70% of households, improved education in 70%, and an improved feeling of security in 45%.

Economic and employment benefits

During construction, over US\$4.2m was spent on local procurement and employment, with more than 27,000 local people employed. Long-term employment has been directly created for 32 leaseholder and operators. ESRA has actively supported the establishment of new jobs in a wide range of small enterprises, including carpentry, milling, TV and mobile phone repair, business services and processing of local gemstones. Some young people have returned to the area because with electricity they are now able to start businesses.

The ESRA surveys show that people in electrified areas have improved livelihoods, with 90% of households now above subsistence level compared to only 32% in 2007. Cash incomes have improved in 17.5% of households, along with a 14% reduction in household



“It used to take me five days to make a door; now with power tools it’s just one day.”

Mohammed Amir, carpenter, Farghambowl



“Now I can do a lot of the detailed work on the windows that people like.”

Mohammed Amir, carpenter, Farghambowl



Although now made using electricity, the window frame is still delivered in the traditional way

spending on fuel. There is evidence that opium cultivation has declined sharply, due in part to the requirement that poppy growing must stop, but also to the availability of other earning opportunities.

Potential for growth and replication

The current phase of the ESRA programme will be completed by 2013, with the commissioning of two more mini-hydro schemes (250 kW and 140 kW) and one 240 kWp decentralised solar scheme, that will bring electricity to about 3,400 more households and 450 more businesses. The overall programme is planned to finish in 2018, with all planning and management of plants transferred to Afghan partners.

Others are interested in replicating the ESRA approach. Five sites are currently under pre-feasibility assessments by different organisations including the Asian Development Bank. These sites could supply electricity to over 60,000 additional customers.

There is considerable potential for further mini-hydro, solar and wind power plants in the north of Afghanistan at sites close to population centres. Mini-hydro is likely to remain a popular choice, because of the high cost of other electricity sources in rural areas.

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This report is based on information provided to Ashden judges by GIZ and INTEGRATION and findings from a visit by a member of the judging team to see their work in Afghanistan.

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Tailor Abdullah and his son

"I learnt how to be a tailor in the refugee camp in Pakistan, where my family fled from the fighting. I came back seven years ago, and set up the shop then. I've had electricity for the last year, and it's made a big difference."

Abdullah, tailor, Nalan



Electricity distribution system, installed by ESRA. Poles are made on-site from concrete because they would be too heavy to carry to the site.

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