Rural Electrification in Afghanistan

How do we electrify the villages of Afghanistan?

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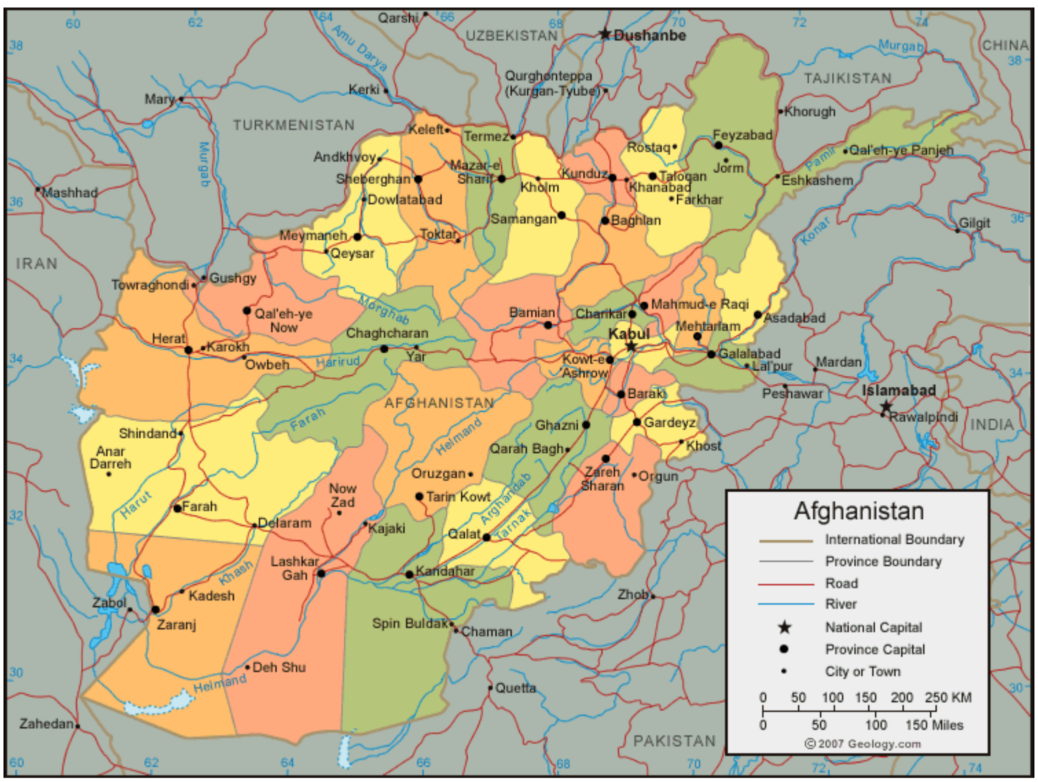
Table of Contents

Introduction

This project focuses on micro-level village sustainable energy, specifically on electricity. The main question is, "how do we electrify villages in Afghanistan using renewable energy?" The paper shows that most problems that exist in rural areas of Afghanistan, such as poverty, healthcare, drug trade, and deforestation, are linked to the lack of access to electricity. The challenge is to find and describe different ways of solving these problems. This project is based on questions like: What problems do villagers face? How important is rural electrification in Afghanistan? Is renewable energy a viable solution or can renewable energy be used as an alternative? Who can help them and how can they support the villages of Afghanistan? By using examples from past projects, this paper shows possible solutions to address the lack of access to electricity in Afghanistan.

1. Afghanistan-Facts and Figures



The population of Afghanistan is 29.8 million (2005) with an annual growth rate of 3.0 percent. Fertility rates are high, at 6.8 children per woman, and the maternal mortality ratio is 1,900 deaths per 100,000 live births - one of the highest in the world.

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http://ochaonline.un.org/Default.aspx?tabid=1719

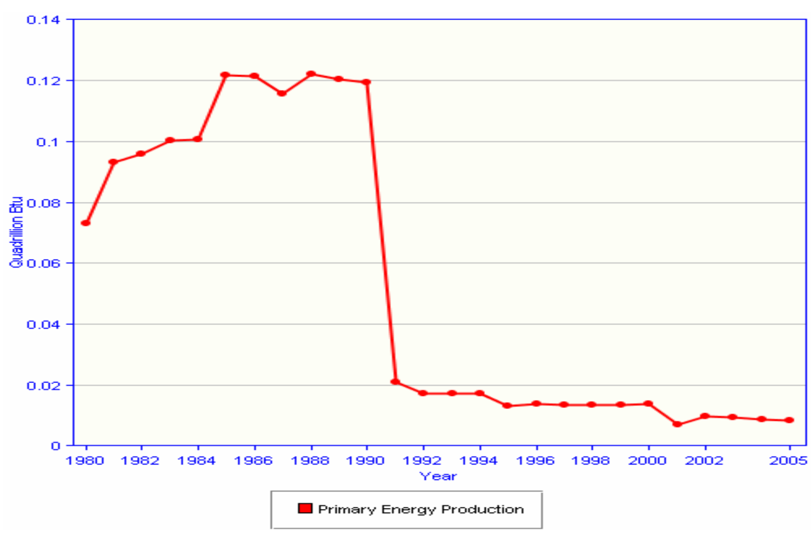
Half of the population lives below the poverty line, and Afghanistan's health status is among the poorest in the world. Much of the population lacks access to basic healthcare.

In 2006, reported polio cases rose a massive six-fold over 2005. Afghanistan's infant and under-five mortality rates are among the highest in the world with diarrhea, respiratory infections, malaria and malnutrition the most common deadly threats.

Afghanistan faces several humanitarian challenges: assisting returning refugees; dealing with land-mines; healthcare and education; protection of human rights, water and sanitation, food aid and nutrition.

1.1 Primary Energy

The first graph shows the production of petroleum (crude oil and natural gas plant liquids), dry natural gas and coal and net generation of hydroelectric, nuclear and geothermal, solar wind and waste electric power during the last 15 years up to 2005. In the year 1992/3, the energy production fell rapidly from 0.12 quadrillion Btu* to 0.02, and since then, the production has never returned. In 2005, Afghanistan's primary Energy production was only 0.008 quadrillion Btu. In comparison, the Energy consumption also fell rapidly in 1992/3, but there was more need for energy than what was produced by the country itself. There was a gap of about 0.011 quadrillion Btu in 2005, and that gap still exits today. There is clearly a need for more primary energy, especially electricity, in Afghanistan.



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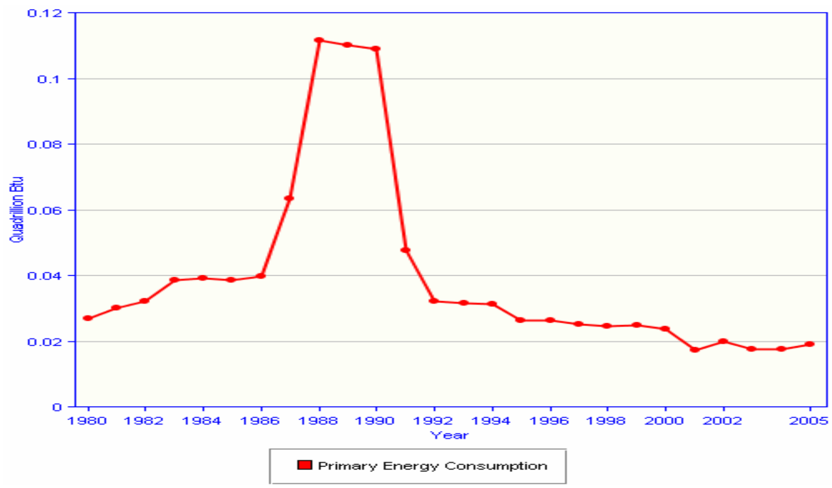
[1] http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=AF

*BTU stands for British thermal unit, a measure of energy, one BTU is about equal to the amount of energy in 45 million tons of coal.

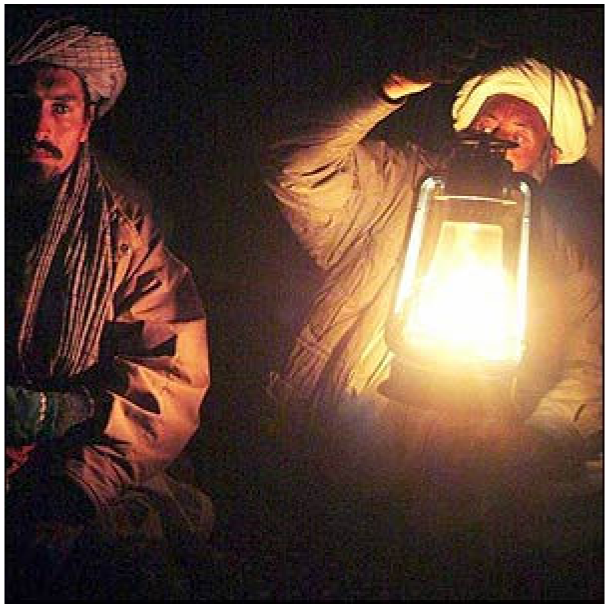


"Less than 10 percent of Afghanistan's population currently has access to electricity"[1]

2. Importance of rural electrification in Afghanistan

Most of Afghanistan's 25 million people have no access to modern forms of energy, such as electricity, gas, and liquid fuels. Traditional fuels meet more than 85% of energy needs, while commercial energy sources, such as oil, gas, coal, and hydropower, meet the remaining requirements. Fuel wood accounts for about 75% of total energy supplies. More than 80% of the population live in rural areas and depend on traditional fuels (fuel wood and crop residues) for cooking, heating water and kerosene for lighting. This is having an adverse impact on forests and watersheds. In addition, burning these fuels increases indoor air pollution, which adversely affects the health of women and children in particular. Rural electrification is the only way that the majority of the rural populace can move toward attaining energy security and enhancing social well being.

No electricity



Poverty in the province of Ghor is extreme. There is no electricity, no running water, and no sewage system.[2]

2.1. Poverty

Extreme poverty in rural areas is partially due to the lack of income earning opportunities. The productive use of electricity would help reduce poverty by enabling alternative sources of livelihoods. At present, the Afghan power infrastructure consists primarily of three isolated power systems. Electricity networks are located around major urban centers. The remoteness of rural locations and the country's topography would make it difficult to expand the electricity supply in these areas through a centralized grid system, and such an expansion might not be economically feasible. Therefore, an exploration of renewable, sustainable energy sources that can be maintained in a decentralized approach, and that the poor can afford, is urgently needed. The Government's program for environmental preservation and regeneration envisages promoting renewable energy in the private sector. This approach of increasing the use of renewable and more efficient energy resources would result in less reliance on conventional sources of energy, such as coal, oil, kerosene and gas.

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[1] *http://www.eia.doe.gov/cabs/Afghanistan/Background.html*
[2] http://news.bbc.co.uk/2/shared/spl/hi/pop_ups/05/south_asia_snow_engulfs_central_afghanistan/html/4.stm

Up to 8 million people face severe food shortages or starvation. The UN Development Index ranks Afghanistan 169 out of 174 poorest countries in the world

2.2. Deforestation

Before After

Deforestation and overgrazing have contributed to serious soil erosion at this site near Qala-i-Nau. Left-hand photo shows intact but degraded pistachio woodlands. Right-hand photo shows complete deforestation.[4]

[4] http://www.adb.org/Documents/TARs/AFG/tar-afg-38044.pdf

Firewood costs $0.08 per kilogram in Kabul and $10 a donkey-load in Faizabad. Kerosene costs $0.39 per liter. It is estimated that the average family burns four to seven kilograms of firewood daily for cooking. In this case, they will spend $10 to $17 a month on fuel. This is a heavy burden for many who earn $30 a month (a teacher's salary) and for many who are unemployed.

However, the country enjoys a sunny climate, so conditions for using solar energy for cooking food and boiling water are quite ideal. Afghanistan averages 300 solar cooking days a year. Even in the winter months, many days have clear skies and solar cooking can be used. In addition to saving money, solar cookers reduce the amount of smoke in the women's eyes and lungs. Air pollution and respiratory problems are reduced whenever solar cookers are used in place of wood or fossil fuels.[5]

The solar cooker consists of a parabolic reflector, in which a cooking pot device is situated for heating various dishes. By focusing the sunbeams, the meal or cooking foods can be heated to high temperatures. For this reason, the solar cooker is suitable for baking, roasting, deep frying, and sterilizing.[6]

2.3 The Drug Trade

As much as one-third of Afghanistan's GDP comes from growing poppy and illicit drugs including opium and its two derivatives, morphine and heroin, as well as from hashish production.[7]

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[5]http://solarcooking.org/newsletters/scrnov04.htm#Pilot_project_in_Afghanistan

[6]http://www.afghan-solar.com/e/products/solar_cooker.html

[7] http://www.solarnavigator.net/geography/afghanistan.htm

Afghanistan's top business is the drug trade. The World Bank and Great Britain argue in a report that this illicit business can only be combated if impoverished farmers have other means of making a living.[8]

This graphic presents the 2007 World Drug Report data on potential opium production in Afghanistan for the years 1990 through 2006.

When agricultural productivity declined or was monopolized by certain warlords, the cultivation of opium became another cheap and accessible alternative for the poor farmers. That was mainly encouraged by the growing international drug market. This resulted in further degradation of Afghanistan's environment.[9]

"Electricity is in serious shortage all over Afghanistan, in particular in the remote rural areas."[10]

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[8] http://www.iht.com/articles/ap/2008/02/05/asia/AS-GEN-Japan-Afghan-Opium.php

[9] http://dark-wraith.com/index.php?itemid=43

[10] http://www.mindfully.org/Energy/2004/Afghanistan-Geothermal-Energy1feb04.htm

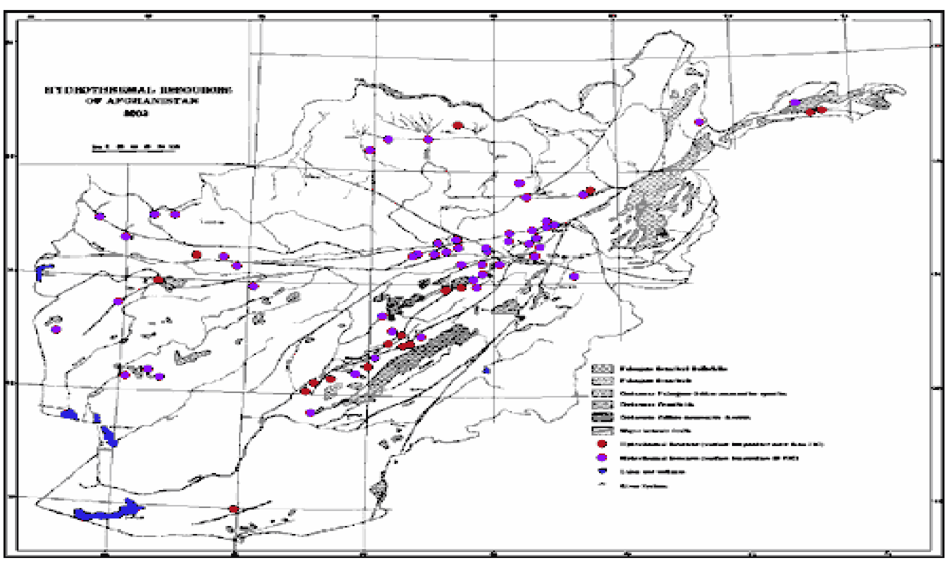
3. Potentials for Renewable Energy

3.1. Geothermal Energy

Afghanistan has been an energy-deprived country. Anecdotal evidence suggests that per capita energy use in this country is substantially lower than international standards. As the reconstruction process advances further, the demand for energy will increase. As the World Energy Commission puts it, “energy affects all aspects of modern life and human development” (WEC, 1993). For Afghans to successfully rebuild their country, new initiatives have to be undertaken to satisfy these increasing energy needs of the country. Given this circumstance, there is urgent need to deploy sustainable and environmentally clean energy sources, such as geothermal energy, which is abundantly available in Afghanistan.

Potential geothermal energy reserves in Afghanistan could provide part of the electricity needs required to satisfy the growth in demand. Electrical power production is the most profitable use of geothermal energy and worldwide has grown the most, compared to other geothermal applications.

To generate electricity from geothermal hot water, two prerequisites must be fulfilled: adequate technology and abundant high-temperature water or steam. At present, efficient and durable technology is readily available to Afghanistan to produce this low-cost electricity from its geothermal resources. Also, the tectonic structure of Afghanistan suggests the presence of vast hot water circulation systems underground. But only under certain conditions of depth, temperature, and chemistry does it pay to drill into these systems, and such conditions that would require further explorations.[1]



Surface Indications of Geothermal Prospects of Afghanistan. (Map shows thermal waters with a surface Temperature of more than 20ºC)

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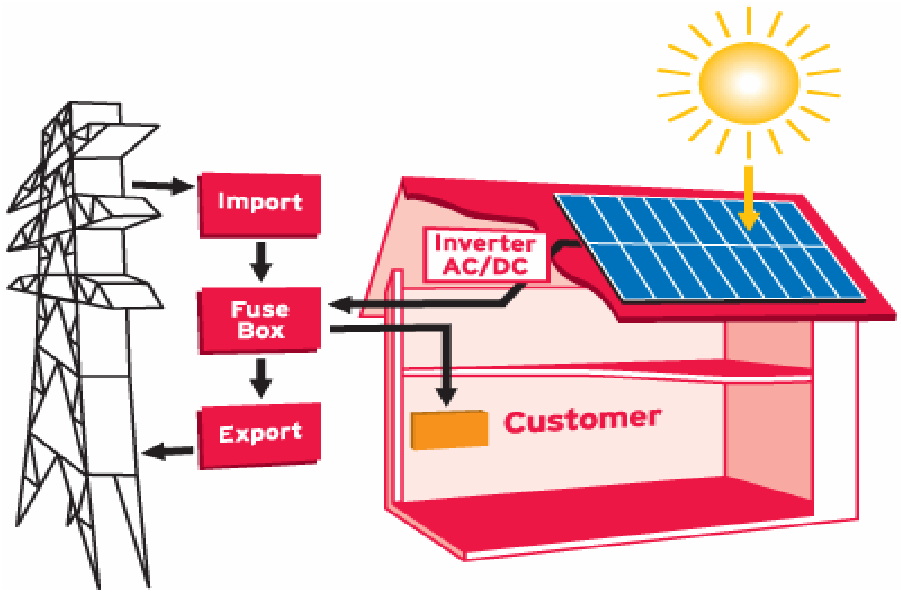
[1] http://www.mindfully.org/Energy/2004/Afghanistan-Geothermal-Energy1feb04.htm

3.2. Solar Power

Solar energy is energy directly from the Sun. This energy drives the climate and weather and supports virtually all life on Earth. Solar energy is considered the most abundant renewable energy source. Estimates indicate that in Afghanistan, solar radiation averages about 6.5 kilowatt-hours per square meter per day, **and the skies are sunny for about 300 days a year. Consequently, the potential for solar energy development is huge**, not only for solar water heaters for homes, hospitals, and other buildings, but also for generating electricity.

Solar power can be installed on homes and buildings that are already connected to the grid, allowing solar power to flow to all customers on that grid. Distributed solar power can also be installed in non-grid connected rural villages and homes.



[2]http://solarcooking.wikia.com/wiki/Afghanistan

[3]www.adb.org/Documents/TARs/AFG/tar-afg-38044.pdf

3.3. Wind Power

Wind energy is plentiful in Afghanistan and wind turbines capture the energy of the wind and convert it directly to electricity. This can displace fossil-fuel derived electricity. [4] In fact, an American wind & solar hybrid power system could electrify an Afghan village in 4 hours. [5] (See Appendix for full article….)

3.4. Hydro power

Some 125 sites have been identified in Afghanistan for micro hydro resources, with the potential to generate about 100 megawatts of electricity.[3] Hydro power captures the energy from flowing water to power machinery and produce electricity [6]

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[4]http://en.wikipedia.org/wiki/Wind_power

[5] www.bergey.com/Examples/Afghan.Hybrids2.doc,

[6] http://www.nrel.gov/learning

4. An example of village development in Afghanistan based on renewable energy

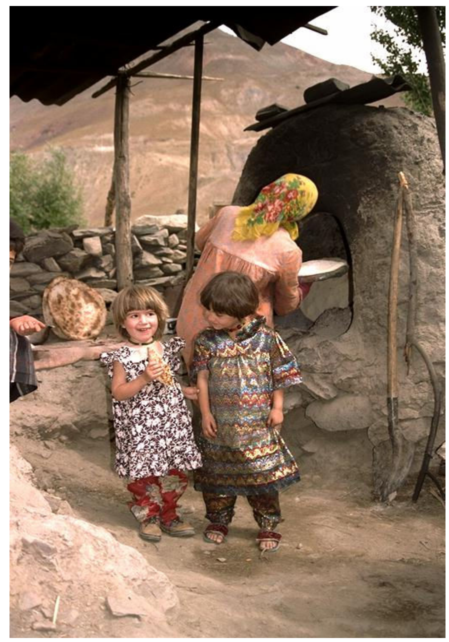
A model of village development based entirely on education and renewable energy is being implemented in the Afghan village of Bedmoschk. Solar lamps, butter making machine, solar dryers, Scheffler reflectors, energy stations and small wind turbines are being developed or adapted to the local situation by the NGO Afghan Renewable Energy Center e.V. (ABS). The principal purpose**:** to create a model of village development that will spread over the neighboring municipalities and beyond.

The village

The village of Bedmoschk lies in a high valley on the edge of the Hindu Kush in the province of Wardak, approx. 100 km southwest of Kabul. Bedmoschk has approx. 600 inhabitants. The landscape around the village is barren. The weather over four seasons is similar to central Europe, only much dryer. The intensive sunshine during 250 to 300 days a year provides excellent radiation for the use of solar energy. People get water for their daily needs from a spring and transport it in plastic canisters and wheel barrels. The water supply is thus limited. Due to the lack of rainfall in the last 15 years, the ground-water level sank considerably.

How do people cook?

In a roofed side area of each house within the fort, is the cooking place, or Tandor. It consists of a large, open clay vessel submerged in the ground, approx. 80 cm deep (largest diameter is 70 cm). A hole in the roof of the kitchen serves as a chimney for the smoke. In a second room, another Tandor is built, which operates in winter as the floor heating system of the house. The warm air of the fire place passes through a duct system and heats the floors. Women prepare the dough for bread the evening before, allowing time for the yeast to rise. The Tandor is used for cooking in the morning. Once the meals are cooked and the fire has burned down, the pots are taken away and the Tandor is cleaned. The bread is then baked on the hot inner walls of the oven. This is arduous and also dangerous work, since the women must bend down deeply into the Tandor. In the summer, temperatures of 114 -118° C prevail. Above the remaining glowing coal, temperatures are approx. 180° C, and the inner wall of the Tandor is around 220° C.



Right: A woman bakes bread in clay, wood-fired oven assisted by her children

Women suffer from respiratory illnesses and eye irritation from the smoke of open fires employed for cooking and baking, and made worse by using kerosene lamps for light. Cow dung is used for cooking on a daily basis. Burns are very common.

People live on agriculture and sell the surplus. As a primary grain, wheat is cultivated, and to a lesser extent, potatoes and onions are grown. Almost no machinery is available for agriculture: ploughs are drawn by cows. In the recent years, many families in the valley have changed to growing fruit, as this provides a better income. Often the fruit is sold directly off the trees, however for a lower price than for harvested fruit. People try to make use of the short fruit surplus during harvest time by drying apples and apricots on their roofs. Except for drying, no other methods of conservation are used. Selling the agricultural products (fruit) results in very meager incomes.

Solar Drying

Cupboard type solar dryer

Afghanistan is famous for its delicious apples and apricots. Since storage of fresh fruit is difficult, they must be dried. The drying process takes place traditionally on roofs or other free surfaces. The cut fruit is simply spread out on a cloth or plastic sheet, which can lead to contamination of the fruit with dirt and dust. Therefore, farmers obtain only a low price for their otherwise excellent product. ABS built the first solar dryer in its Centre for Renewable Energy in Bedmoschk in 2004 with the purpose of adapting existing know-how in solar drying to the Afghan situation. The first dryer was of the cupboard type. It became clear that its construction is too complicated for its relatively little capacity. Handling of the dryer was not convincing to people.

In August 2005, a different solar dryer, of the tunnel type, was built. Like the first solar dryer, it uses direct solar radiation to create hot air in the collector part of the equipment. With this design, a solar PV-driven fan provides the necessary air flow over the fruit. It was tested in the drying of apricots. Handling of the dryer is very similar to the traditional methods, as the fruit is simply spread on a flat surface. In this dryer, 7 kg of apricots are dried within 3 to 4 days. This is very similar to the method of spreading the fruit in the open air. But the quality is much better in a much more hygienic drying process: the fruit is protected against dirt, dust and animals. In the example, the village started with small dryers of 2m x 1m. This way the device could easily be carried and placed on roof tops. If more drying surface is needed, further dryer modules of the same size could be added. A small ventilator bought on the local market is used to force the air through the dryer. The 9 Watt PV panels used for the solar lanterns produced by ABS were enough to run 4 solar dryers of that size. Five more dryers have been built for the second phase of the project, which includes packing the dried fruit in an attractive, sealed bag and finding ways to sell the product. In Bedmoschk, a fruit grower’s cooperative now exists. After the first tunnel dryer was tested by ABS, the cooperative showed interest and took the dryer for their own tests. By introducing the solar dryers, ABS is addressing three aims:

- Creation of jobs and income in the village
- Possibility to reduce migration as villagers now have local employment
- Making women's work easier by this new equipment (as the dryers protect fruit from dust and sand)

By autumn 2006, ABS offered the solar dryer to the farmers for a reasonable price. If farmers showed interest, a larger version of the tunnel dryer was also offered.

Solar tunnel dryer, 2m x 1m

Scheffler Reflector

In summer 2005, one reflector of 10m² was built in the Centre for Renewable Energies in Bedmoschk and was installed there for demonstration purposes. Advantages of the system: environmental protection and alleviation of women's work. Since firewood is scarce; women have to walk many kilometers to collect it. Inhalation of smoke from open wood fires and burning cow dung are prevented. Local co-workers learn methods and procedures of manufacturing. The aim is to put production and sales into local hands at a later stage.

Scheffler Reflector at the Center for Renewable Energy in Bedmoschk.
A traditional Tandor oven is heated with solar power.

After a lot of experience with "modern" type baking ovens for Scheffler Reflectors, for the first time a traditional Tandor oven is combined with a Scheffler Reflector. In September 2005, Solare Brücke e.V. conducted tests in their centre in Aislingen, Germany, to find out which way allowed most features of the traditional Tandor to be kept when adapting it for solar use. To simulate a Tandor, two big flower pots of a total weight of 24kg were used. Different pieces of iron were added as thermal mass, but a real Tandor weighs around 70kg. A test was done with around 35kg of oven weight. An 8m² Reflector was used to heat the Tandor.

Two flower pots to simulate a Tandor oven

Results of the test:

- The Tandor needs to be well insulated with around 10cm of mineral fibre
- Ideal temperature for baking Nan is between 360 and 450 C°
- The oven needs around 2.5 hours to preheat to 450 C°
- Nan takes between 2 and 3 minutes to be done (just like in a conventional Tandor)
- On its own, the Tandor cools by 60C° per hour; this means that with this setup, heat can not be stored over a longer time.
- 6.5kg of Nan can be baked in 50 minutes
- The opening of the Tandor needs to be covered with a heat resistant glass lid (for example a Pyrex pallid) during preheating, to prevent hot air from escaping.
- Whilst Nan is baking, it was highly recommended to close the glass lid.
- Handling: it is uncomfortable to use the solar Tandor whilst heating it with the reflector.

The recommended mode of use is to preheat it and then turn the reflector out of focus. This way the cook can operate without getting in contact with the concentrated sunlight. When the first Scheffler Reflector in Bemoschk was inaugurated, it was used to heat a traditional Tandor that was built on site. Nan and Chapatti (thin flat bread, without yeast) were baked. The Tandor was preheated for about 2.5 hours, and the result was a success. The oven weighs 70kg and is built into the ground. 10cm of glass fiber insulation surround the clay vessel. The complete oven area has a clay finish. As glass lid, a flat plate of Borofloat (heat resistant, high transmission) was used. It cracked after some days of use, probably due to thermal expansion of its metal frame. Now a different glass type (Robax), usually used for chimney doors, is being tested. The social structure in Afghan villages will make it very difficult for families to share one reflector with a Tandor.
For an individual rural family, a 10m² Scheffler Reflector will be too costly, the manufacturing cost comes to $1,500. At this price, it is only feasible for institutions.
For institutional baking, a different type of baking oven has been tested. Christoph Müller (www.hc-solar.de) developed one for use in Argentina. ABS is installing a demonstration unit in Kabul.

Manufacturing of 10m² Scheffler Reflectors started in winter 05/06 in Kabul. At the moment (May 06) the second series of 5 reflectors is being built. Training for construction of 2.7m² Scheffler Reflectors was started in April 06 and will be completed in August 06.

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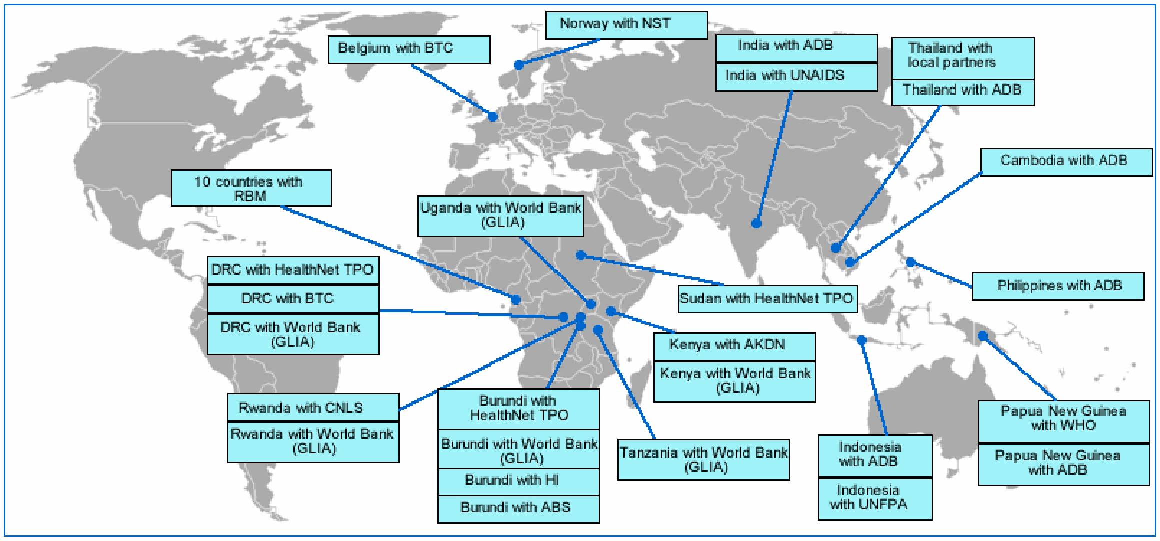
http://www.afghan-solar.org/

"Access to electricity is essential for economic growth," says Sohail Hasnie, an ADB Senior Energy Specialist.

5. ADB Project to Bring Electricity to Poor in Rural Towns of Afghanistan

The Asian Development Bank (ADB) is dedicated to poverty reduction in Asia and the Pacific, a region that is home to two thirds of the world's poor. ADB extends loans and provides technical assistance to its developing member countries for a broad range of development projects and programs. It also promotes and facilitates investment of public and private capital for economic and social development.[1] The ADB presents one of the possible ways to make rural business for big projects, that is not only focused on making profits but can also help people in poor countries to increase their life standards. There are a couple of projects which were done by the ADB for Afghanistan's rural villages. In the text below you can find one of the ADB projects for Afghanistan.



The map shows all the ADB member countries and all the banks and organizations with which ADB is working together.[2]

The ADB has approved a US$50 million loan and grant assistance package for a **power supply improvement project** [Appendix] that will help improve the living conditions of about 1.2 million poor people in rural **Afghanistan**.

A highly concessional $26.5 million loan will finance the construction of 206 kilometers of an 110kV transmission network, while a $23.5 million grant will finance the construction and rehabilitation of associated substations and low-voltage distribution systems.

The project will cover 11 rural towns - Breshna Kot, Imam Sahib, Jalalabad, Khan Abad, Mehtarlam, Muhammad Agha, Puli Alam, Qarghayi, Sarepul, Surobi, and Taluqan - as well as adjacent rural areas in the northern, eastern, and southern provinces of Afghanistan.

More than 90,000 households, most of which are poor, will be connected to the grid once the project is completed. The project will also offer about 18,000 electricity connection kits with affordable and flexible payment options.

"Access to electricity is essential for economic growth," says Sohail Hasnie, an ADB Senior Energy Specialist. "It will also help improve learning opportunities for children, allow home-based businesses to expand into small-scale commercial or industrial operations, and result in net savings to customers as electricity is cheaper than kerosene and fuel wood."

The project's components are the most critical ones in the Government's power master plan. The project also complements an earlier ADB project that is rehabilitating and reconstructing damaged transmission lines and substations in the north for importing power from neighboring countries.

A $750,000 technical assistance grant accompanies the project to strengthen project management, planning, design, implementation, and operation and maintenance of the Ministry of Energy and Water, the executing agency for the project.

As one of the poorest post-conflict countries in the Asia and Pacific region, Afghanistan is eligible for grants from ADB's concessional Asian Development Fund. ADB's loan and grant, both from ADF, will therefore finance the entire project cost of $50 million. Special terms will also be applied to the loan. It carries a 40-year term, including a 10-year grace period with 1% interest charge throughout the term, to be capitalized during the grace period and charged to the loan account.

The project is due for completion in June 2008.

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[1] http://www.adb.org/default.asp

[2] http://www.aidscompetence.org/content/images/world_map.png

[3] http://www.adb.org/Documents/News/2005/nr2005063.asp

6. The Art of Doing Rural Business

"*If you can conceptualize the world's 4 billion poor as a market, rather than a burden, they must be considered the biggest source of growth left in the world," says C.K. Prahalad, "assuming that if this market is well understood, it can be served profitably."*[1]

Rural electrification is a rapidly developing field. Electric grids in poor countries grow so slowly that they will not reach many young villagers in their lifetime. Yet wind turbines and photovoltaic systems already generate electricity in thousands of remote places. These systems are likely to become more common as oil and gas prices soar and the next generation of renewable energy systems rolls out.

All this is well known, and the course of rural electrification seems predictable. Yet, innovation will change the scene. Already, new information and communication technologies, as well as new services for finance and insurance, health and education are impacting rural markets. Many of these seem unrelated to rural electrification - but will push it forward nonetheless.

Rural Electrification is in transition, pushed on by a variety of innovations which interact and reinforce each other.

Greater things lie ahead because innovation is about much more than technology and products. It is about applications, business models and entirely new markets - far different from those in the industrialized urban world. The combined force of these innovations can speed-up rural 'evolution' and help meet the untapped energy needs of two billion rural customers.

Micro credit for the rural poor is an innovation made in Bangladesh. When Grameen began village banking thirty years ago, it was not about adapting commercial banking to some new, still underserved clientele. Rather, it was about doing business in a radical new way - a change of paradigm. Before, banking simply could not be done profitably in a poor rural environment. The Grameen Bank could - thanks to an ingenious business model. The Grameen model has been researched in depth and absorbed by areas other than banking. It has also inspired researchers to find strategies on how to do business at the bottom of the social pyramid. That the rural poor should have a business and make a profit is one of the basic principles.[2]

Grameen Shakti, under its Managing Director Dipal Barua, has installed more than 110,000 solar home systems in rural Bangladesh. It has shown that solar energy applications can be scaled up massively and rapidly to provide an affordable and climate-friendly energy option for the rural poor.[2]

The goal of Grameen Shakti is to promote and supply renewable energy technology at an affordable rate to rural households of Bangladesh. Thus, their work not only focuses on the technical and capacity-building sides of renewable energy promotion. They have also adopted the Grameen Bank's experience in micro financing to make renewable energy applications affordable for poor rural people.

Muhammad Yunus, Founder / Managing Director of the Grameen Bank and 2006 Nobel Peace Prize Laureate

[1] http://www.businessweek.com/magazine/content/04_26/b3889003.htm
[2] Renewable Energy World, January-February 2007 Vol. 10 No. 1

Grameen Shakti employs 1500 field staff and has trained 1000 engineers and 1000 local technicians in renewable energy technology. They either work for Grameen Shakti or have started their own renewable energy businesses. The Managing Director of Grameen Shakti is Dipal Barua, born in 1954, who holds BA and MA degrees in economics from the University of Chittagong. Barua has been working closely with Muhammad Yunus since 1976, and was a co-founder of the Grameen Bank. In addition to his position as the Managing Director of Grameen Shakti, he is also Deputy Managing Director of Grameen Bank. Yunus and the Grameen Bank received the Nobel Peace Prize in 2006.

Grameen Shakti has built up a network of 390 village unit offices, in all of Bangladesh's 64 districts, reaching out to the rural areas where 70% of the country's 135 million inhabitants live. In these areas, there is no electricity grid, and the population, therefore, seldom have access to electricity. Through the village unit offices, Grameen Shakti promotes renewable energy technologies - especially solar home systems, which typically consist of a small 30-100 W photovoltaic panel connected to a battery for storage. By June 2007, Grameen Shakti had installed more than 110,000 solar home systems, with a capacity of about 5MW peak, covering 30,000 villages. The installation rate is growing exponentially, with plans to reach 1 million installations by 2015. Currently, more than 4000 solar home systems are being installed per month. In addition, 4 wind energy plants, 1000 biogas plants and 3 solar thermal projects have been installed, and 9 solar-powered computer training centers have been created. The biogas programme is linked to the emerging poultry and livestock industry in Bangladesh with a focus on market slurry as a replacement for chemical fertilizer.

Grameen Shakti has always sought to involve the local community in the planning, implementation and maintenance of solar home systems and has started a network of technology centers. These centers are managed mainly by women engineers, who train women as solar technicians. The women are equipped with tools to service and repair the systems in their areas, and to manufacture solar home system accessories. Seven technology centers are already in operation, and there are plans to expand to 30 centers and to train 2000 women technicians.

A woman engineer demonstrating a Solar Home System

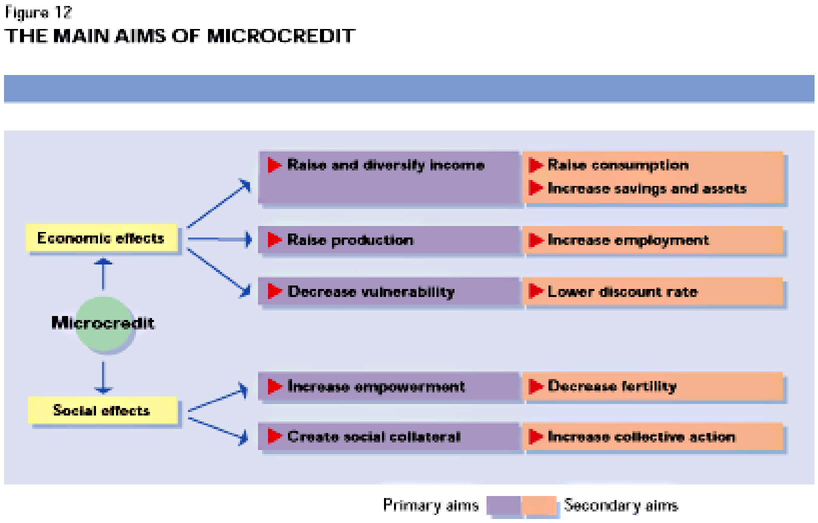
Grameen Shakti also trains entrepreneurs to go into business. A small scale entrepreneur can buy a solar home system on easy credit terms, install it in a village market, and rent solar powered lights to neighboring shops for a fee. Ownership and increased income have made renewable so attractive to rural entrepreneurs that they now number over 1000 and serve even more rural customers too poor to buy solar home systems.

The art of doing rural business is a bottom up approach. It's as much about enabling the poor to gain leverage with new technology to raise their income and social status as it is about trust. Grameen has learned not to underestimate the poor. They pay their loans back reliably - the Bank's recovery rate is 98 % - far above the banking industry's average. They easily embrace new technologies.

Carrying a solar panel through a tea plantation. Organizations like Grameen Shakti have allowed PV to become part of everyday life.

The financing

Grameen Shakti has developed four different credit schemes to make the solar home systems affordable. Customers pay different proportions of down-payment and monthly installment according to their circumstances, supported by low-interest loans that Grameen Shakti receives from the Dutch Stichting Gilles Foundation and from the World Bank through the Bangladesh Ministry of Finance's Infrastructure Development Company Limited (IDCOL). Grameen Shakti has also received grants from USAID to cover their overhead costs, which has made it possible for them to deliver less expensive services. The company is widely recognized to comprise a strong business model based on vertical integration of solar home system technology and micro-finance. Grameen Shakti got its initial funds from the Grameen Trust and Grameen Fund. But the current massive scale-up is part of a World Bank and Global Environment Facility (GEF)-supported government programme, which was launched in 2003.[3]



Source: http://www.fao.org/docrep/x4400e/x4400e06.htm

"It is a fact that the future belongs to Renewable Energy Technologies. But unless this technology can reach the millions of rural people who suffer most from the energy crisis, it will not reach its full potential, and neither will the economic and social problems of the world be solved."
Dipal Barua

[3] http://www.rightlivelihood.org/grameen_shakti.html

Conclusion

If you look at the international climate of awareness of global warming and other environmental impacts, this is the right time for the development of a long term program to extend renewable energy to rural villages which have little or no prospect of grid electrification.

The goal of a renewable energy village electrification plan should not just be to electrify the village, but also to achieve measurable results to reduce poverty and to build trainee centers to teach villagers how to use renewable energy.

Solar energy technologies have been demonstrated successfully; and a few examples are highlighted in this paper. There are many different ways to electrify a village. The paper includes big projects, in which the government realized the problem and asked the ADB for support to electrify many villages. This is one of the solutions which I see as a collective solution. But there are also individual solutions, as the example of the Badmaschk village shows, which was done by a non-profit organization and with the help of donations.

One of the best solutions, in my opinion, is the “Grameen Shakti” model in Bangladesh. I think this is a long term solution and the most effective one, by giving the villagers credit to build or buy their own solar products. This appears to be the best solution, because not only do the villagers make a profit but also the bank which offers microcredit. This offers a two-way-benefit and by looking at the success of the Grameen Shakti, every development bank and social investor can be interested in these kinds of projects.

Considering that nearly two billion people lack access to electricity, there is an enormous market gap that needs to be bridged. This market gap exists not only in Afghanistan but all over the developing countries. The development of renewable energy sources will not only help reduce poverty but will also increase the economy of that country.