

Fact Sheet

University of Stellenbosch
The BOP Learning Lab

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A market-driven solution for energy needs at the BOP – is solar energy an option in Southern Africa ?

The economic and environmental issues revolving around energy have perhaps never been quite as prominent as today. Global climate change, and its potentially devastating effects on our planet's environment, have indeed injected an unprecedented sense of urgency in the search for clean, sustainable and renewable sources of energy. From an economic standpoint, wild price fluctuations, especially for oil, and disruptions in the supply chain (as witnessed, for example, by power cuts and load-shedding in South Africa in 2008), are just two examples demonstrating the importance of a reliable source of energy in ensuring economic stability and securing investment. Against this background, the question of how to satisfy the growing and largely unmet energy needs at the bottom of the pyramid (BOP), especially electricity, is the subject of many debates and studies.

There is no doubt that access to energy is an important element towards poverty relief and improved living standards at the bottom of the pyramid : it makes a crucial difference to the proper functioning of schools, clinics, public buildings and, of course, households. Furthermore, and just as importantly, a reliable source of energy facilitates the creation and management of businesses and micro-entreprises, making it an indispensable tool for the creation of employment and economic value. Energy poverty is, clearly also a factor of economic poverty. The big question is, therefore, what is the most efficient, cost-effective and environmentally friendly way to provide this energy ? There is, of course, no one-size-fits-all answer, but solar energy has become increasingly prominent as a viable solution compared to alternatives such as hydro-electricity, nuclear energy, wind power and fossil fuels. The idea that solar power will

become increasingly important, including for Southern Africa, is highlighted by the planned Solar World Congress planned for October 2009 in Johannesburg, to be hosted jointly by the International Solar Energy Society (ISES) and the Sustainable Energy Society of Southern Africa (SESSA).¹

This factsheet will look at one small example of how solar energy panels have transformed life in Nachengue, a village in rural Mozambique, bringing clean and efficient energy to power homes, businesses, and public buildings. The project involves a public-private partnership between Advantage Management International, a French distributor of solar panels, and FUNAE, the national Electricity fund for Mozambique.

While many challenges remain, as we will see, solar energy seems to provide a way forward in many places in Southern Africa and is becoming increasingly credible as a result of changing cost structures and technological advances.

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¹ <http://www.swc2009.co.za/>

Electricity : some key figures for South Africa, Africa and the world

• Worldwide

Number of people on the planet with no access to electricity :	1.6 billion
Amount spent by these people on fuel-based lighting :	38 billion
USD/year	

Source : International Finance Corporation (World Bank)

• Sub-Saharan Africa

Proportion of people with access to grid electricity :	25%
Proportion of rural people with access to grid electricity:	10%
Number of people outside grid connectivity	500 million

Source : UNEP

• South Africa – breakdown per user category ²

Private consumers :	12%
Industry :	84%
Mining industry :	36%

1. Background – the global and regional context

a. Available sources of energy and their significance for Southern Africa

In Africa as a whole, demand for energy is growing at a rate of about 8% per annum. This is almost three times as fast as the continent's population growth, and despite the global economic crisis, this growth rate is unlikely to fall significantly. While the demand for energy can be seen as a welcome indicator of economic dynamism, it also poses the question of environmental sustainability, especially in the context of global climate change. How can these energy needs be met while remaining as clean, cost-effective and reliable as possible? Six main sources of electricity are available at present :

Water power
Fossil fuels
Nuclear energy
Geothermal energy
Wind power
Solar power

Fossil fuels, mainly coal, still by far

constitute the main source of electricity generation in the world, with a global share of about 27%, going up to 71% for example in coal-rich South Africa⁴. Elsewhere in Southern Africa, hydro-electric power is more common, as evidenced by the Cabora Bassa dam in Mozambique, Kariba on the Zambia/Zimbabwe border and Ruacana on the Cunene river between Namibia and Angola. The main factors determining how electricity is generated in a given country are the availability of natural resources (coal, major waterways), technical and financial resources (especially in the case of nuclear power plants) and the relative financial and environmental cost of each form of electricity generation.

Global trends, in this regard, are changing. Traditional forms of electricity generation are increasingly controversial, especially with regards to coal plants, considered the most polluting, and hydroelectricity, which involves building expensive and environmentally damaging dams. This leaves nuclear power, but also geothermal, wind and solar power as possible « clean » alternatives. For the African continent, solar power and geothermal power seem to hold most theoretical promise, as it has abundant sunshine and geothermal resources.⁵

b. The increasing appeal of solar power as a viable source of energy

More and more studies confirm the idea of solar power as an increasingly viable source of energy globally, especially thanks to technological advances and lowering costs. McKinsey, a consultancy, has calculated that in at least 10 markets in the world, solar energy will have reached « grid parity » of 10 US cents per Kilowatt-hour (kWh) by 2020⁶. According to some calculations, the technology needed is 90% cheaper than 30 years ago⁷, and this rate of decrease is set to continue thanks to economies of scale and the use of thinner layers of silicone in panels. For the African continent in particular, the relative abundance of sunshine further increase its potential : « With an average daily dose of five-to-seven kilowatt hours (kWh) for every square metre, Africa has more potential for producing energy from the sun than almost anywhere on Earth, with the possible exception of northern Australia or the Arabian peninsula”..⁸⁹

Furthermore, there is no doubt that as part of the global drive towards the use of renewable energies, momentum is gathering for solar energy to be a preferred solution for context of rural communities and the poor, especially in Africa, where less than 10% of the population in rural areas have access to national grids.¹⁰

c. The local mozambican context : off-grid rural electrification in a post-conflict environment

Mozambique is perhaps one of Southern Africa's most inspiring turn-around stories. Devastated at the beginning of the nineties by 15 years of armed conflict, the country was on its knees, and its people among the poorest of the continent. Since then, the return of peace, political stability and steady economic growth have transformed the country's image and drastically improved the daily lives of people. As a country with few exportable commodities, in contrast to several of its neighbors, Mozambique has had to rely on

2 SHARIFE Khadija, « Solar energy = energy democracy », Mail & Guardian, 26 November 2008. <http://www.thoughtleader.co.za/khadijasharife/2008/11/27/solar-energy-energy-democracy-p1/>

3 X, «Continental Rift, A hot new proposal for ending electricity shortages”, The Economist, 8 December 2008. http://www.economist.com/world/mideast-africa/displaystory.cfm?story_id=12821590

4 LAFOSE Jacques, BOP presentation, Bellville, November 13, 2008

5 X, «Continental Rift, A hot new proposal for ending electricity shortages”, op. cit.6 “Solar PV, a reliable, cost effective climate solution », Factsheet prepared for the United Nations Environmental Programme (UNEP), December 2008. <http://www.unep.org/pdf/factsheet-Poznan.pdf>

7 http://www.bbc.co.uk/climate/adaptation/solar_power.shtml

8 X. “Africa awash in sunshine, but not solar energy”, Mail & Guardian, 28 September 2008.

9 KOLTERMANN Ulrike & KRUEGER Ralf, « Plenty of sunshine but little solar power », Mail & Guardian, 1 June 2004. <http://www.mg.co.za/article/2004-06-01-plenty-of-sunshine-but-little-solar-power>.

10 United Nations Environmental Programme (UNEP)

agriculture and the development of tourism for economic growth. Yet despite remarkable progress over the last decade and a half, there is still huge work to be done in terms of general infrastructure, including access to clean, sustainable and affordable sources of energy. Mozambique's relatively large land area of 800,000 square km, with many isolated and scattered rural communities, means that installing and maintaining a national power grid is a daunting task involving costs which the country is not able to bear. It is in this context that solar panels, which don't need to be connected to a national grid, make particular sense.

2. Nachengue – photovoltaic solar energy in action

The village of Nachengue is situated in the central Mozambican province of Inhambane, about 700 km north of the capital Maputo. With 2000 inhabitants, it is a typical medium-sized community. Like many other such villages, Nachengue is not connected to the national power grid of Mozambique. Private households and public buildings either had no electricity whatsoever or had to rely on generators.

Partnering with the National Mozambican Fund for Energy (FUNAE), Advantage Management International is implementing a two-phase project to equip the village with photovoltaic solar energy panels. The photovoltaic process refers to the direct generation of electricity from the sun using solar cells. A solar cell is a device in the form of thin sheet that generates electricity when exposed to light. It's a passive device and there are no moving parts or any other input or output of matter. 90 % of the cells are made of silicon.¹¹

The first phase, which was to equip Nachengue's main public buildings with solar panels, is now completed, and provided the school, the clinic, the police station and the village's administrative centre with electrical power. The second phase involves equipping as many individual households as possible, enabling people to use clean energy for lighting and cooking purposes.

The impact on people's lives is substantial, and goes far beyond the

mere additional comfort of being able to use light bulbs or kettles. In economic terms, the availability of electricity is an incentive for the creation of micro-enterprises and employment, as retailers, for example are able to use fridges to store more produce and limit wastage.

Crucial government support

The project in Nachengue is just one example among many similar small-scale rural electrification projects in Mozambique. One of the main features of these projects is the public-private partnerships between government (through FUNAE) and private sector manufacturers and distributors of solar panels. The success of the model is therefore partly based on the impulse of strategic policy choices made at government level, within the framework of national economic development plans. The promotion of solar energy has been adopted as one of the objectives in FUNAE's 5-year strategic plan to expand electrification in rural areas, with a specific focus on providing access to energy for the poor. The objective is to have provided access to electricity for at least 400.000 additional people between 2008 and 2010¹². Given the particular context and environment, it is unlikely that private sector companies would be incentivised to implement rural electrification programmes without this strategic support received from government.

3. Benefits and challenges of the Nachengue programme

a. Benefits

In Nachengue as in many other similar rural settings in Mozambique, the benefits of off-grid, solar panel energy are confirming the long-term potential of this source of power across African rural settings.

From an economic perspective, solar panels are clearly competitive where grid connection or fuel transport is difficult, costly or impossible, as is most often the case in rural areas. In addition, self-standing solar power is reliable and not subject to power cuts, which can be costly in terms of lost business, or perishable products such as food and medical supplies.

From an environmental point of view, solar power is also pollution-free during use. Product end wastes and emissions (for example by batteries) are manageable using existing pollution controls.

Operationally, the solar powering system requires minimal maintenance, another important consideration for remote areas.

b. Challenges

From a purely technical standpoint, one of the biggest drawbacks of solar panels is intermittency : electricity is generated during sunlight hours, when the need for lighting is at its lowest. Energy therefore has to be stored for use at a later point.¹³ The issue is partially solved through the use of batteries, but these need to be maintained on a regular basis. It also means that for the time being, solar power can be used only on a relatively limited scale for low-intensity use by households and smaller sized-buildings.

This relative limitation of capacity leads some development economists to question the idea that off-grid power is a viable solution, partly because of negative perceptions, and suspicions that solar energy is a substitute for failure to connect whole areas to national grids : "some rural areas continue to resist solar energy out of fear that it will preclude later access to national or regional electricity networks".¹⁴

Another obstacle, perhaps especially in very poor areas, is the risk of damage and theft. Solar panels contain expensive parts such as silicone and are fairly easy to remove and transport.

Useful resources :

1. Solar world congress 2009, Johannesburg
<http://www.swc2009.co.za/>
2. Lighting Africa (World Bank-sponsored programme) :
www.lightingafrica.org
3. International Solar Energy Agency
<http://www.ises.org/>

11 LAFOSSE Jacques, BOP presentation, Bellville, November 13, 2008

12 FUNAE, Strategic plan summary 2008-2010, <http://www.funae.co.mz/lib/pdf/Strategic%20plan.pdf>, Maputo, November 2007, p7

13 WORLD BANK, Asia sustainable and alternative energy program

14 X. "Africa awash in sunshine, but not solar energy", Mail & Guardian, 28 September 2008.

15 "Actually, there is an alternative", The World in 2009, The Economist, November 19th, 2008.

None of these challenges, however, disqualify the fundamental viability of solar energy and cell-based technology. In fact cell-based technology is growing at a pace of 60% per annum, the fastest growth for any form of electricity generation.

4. Conclusion

While no one is arguing at this point that solar energy will soon have the generating capacity to supply electricity to the industrial sector, it definitely is emerging as one of the most credible long-term sustainable and renewable sources of energy for three key market segments : public buildings, small businesses, and households, especially at the Bottom of the Pyramid. As can be extrapolated from the example of Nachengue, sourcing energy from the sun is particularly adapted to conditions in many rural areas of Africa. But even high-density housing in urban areas can benefit from a large-scale deployment

of solar panels. In South Africa, for example, the authorities are looking at the potential of solar energy to equip low-cost housing, making them « energy smart ». Fuel savings in the order of 65% are possible in this area, not to mention the environmental benefits of this energy-efficient approach.¹⁶

The biggest condition of success, perhaps, will be the building of efficient strategic partnerships between government and the solar panel industry. Government support, including through financial and tax incentives, will be crucial to unlock the potential of solar power. Mozambique is showing the way in this regard for the Southern African region with the active participation of the National Energy Fund in solar panel projects, but there are examples elsewhere on the continent, such as Burkina Faso, where local authorities offer micro-loans to families to purchase solar panels.¹⁷ The long-term return on investment is amply justified, and is another demonstration of the leverage that state

and private enterprise can achieve together when focusing on a common objective with reciprocal benefits.

Pierre Coetzer, Reciprocity

¹⁶ GOVERNMENT COMMUNICATION and INFORMATION System, South Africa Yearbook 2007/2008, Chapter 15. Pretoria, 2007, p419

¹⁷ X. "Africa awash in sunshine, but not solar energy", Mail & Guardian, 28 September 2008.

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