

CDS: A CASE OF AUTONOMOUS WATER AND ENERGY NETWORKS

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Street light and mosque connected to the electrical grid
Source: Joan Bardeletti

I&P is a group of impact investment funds dedicated to African SMEs. I&P supports and funds entrepreneurs and growing companies with the double aim of having a social and environmental impact and reaching financial profitability. I&P helped CDS structure from 2011, allowing it to double in size since then. Within I&P, David Munnich, in charge of the CDS project with Jérémy Hajdenberg, is the Chief Operations officer for the IPDEV2 Fund.

KEYWORDS

- ACCESS TO ELECTRICITY
- ACCESS TO WATER
- UTILITY OUTSOURCING
- AUTONOMOUS NETWORKS

For almost ten years, CDS has been operating water and electricity off-grid networks in remote villages in Mauritania.

Chosen by the authorities through several calls for tender, CDS operates and maintains the infrastructure, as well as invoicing and collection from customers.

This approach will make it possible to foster rigorous and experienced national operators liable to play a growing role in the professionalization of the sector.

INTRODUCTION

Mauritania is vast but has a low population density, whose inhabitants live for the most part in remote villages. Giving access to essential services to Mauritanian citizens is a huge challenge for this country lying at the crossroads of the Maghreb region with sub-Saharan Africa. Access to water and electricity there are very limited: only 50% of inhabitants have access to safe drinking water (AFD, 2011) and the rate of electrification is 34% nationwide (IRENA, 2015), with strong geographical disparities. Only 3% of the rural population has access to electricity. The infrastructure deficit is such that several hundred villages are as yet unequipped. The context is all the more conducive to the development of a private offer, because the country's great potential for renewable energies is just beginning to be exploited. Mauritania has one of the planet's highest amounts of sunshine¹ (UNECA, 2012) and it has been identified as one of the 15 countries with the best wind resources in Africa² (UNECA, 2012).

1 Mauritania receives more than 3,000 hours of sunshine per year. Direct solar radiation for the entire country is estimated at 78%. The potential is estimated at 4-6.5 kWh/m²/day with 8 hours of sunshine on average per day. Peaks have been recorded of 9.3 kWh/m²/day in the north (Bir Moghreïn) and 7.9 kWh/m²/day in the south (Rosso).

2 By Helimax, a Canadian wind energy consultant: "With winds of 5-6 m/s in most regions, lower speeds of 4-5 m/s in the north-east and parts of the south, and a significant potential of 6-7 m/s on the west Atlantic coast."

1. THE POLITICAL CONTEXT OF MAURITANIA

For over a decade, the Mauritanian authorities have been committed to an ambitious policy of reform of the water and electricity sectors with a view to combating poverty. A legal and regulatory framework favorable to the private sector has been in place since the end of the nineties, which governs the “outsourcing of public utilities management” for electricity³ since 2001, and for water⁴ since 2005, under the responsibility and supervision of the Regulatory Authority (ARE)⁵. The Mauritanian State aims in particular to give Mauritanian companies the operation and maintenance of infrastructure that it funds in the villages, since these private operators do not bear the cost of investing in the infrastructure itself. These companies are selected through calls for tenders. The selection criteria focus on the technical quality of the tenders and the soundness of the bidding companies, and not on the energy sale price, set by the State, which subsidizes if necessary part of the cost in order to cover the expenses of the delegatee business while keeping prices affordable for the users. Several backers have assisted this policy by setting up funding to support the reform of the water and electricity sectors⁶.

2. CDS, A PRIVATE COMPANY SEEKING TO GIVE ACCESS TO ENERGY TO ALL



Entrepreneur Sidi Khalifou
Source: David Munnich

Sidi Khalifou is a Mauritanian engineer and entrepreneur trained in France. At the end of several entrepreneurial trials, in particular design offices and NGOs, Sidi Khalifou took over CDS, a family business, and developed it, focusing its activity on access for all to water and energy, particularly from renewable sources.

A strong entrepreneurial vision structures the business strategy of CDS⁷. It is possible to provide villages with a sustainable, high-quality electricity and water supply as long as three conditions are met: rigorous management, affordable pricing for the

customers and the initial investment in the infrastructure covered by the authorities.

Since 2007 CDS has won several calls for tender for the outsourcing of public utilities management (“*Délégation de Service Public*”, DSP) organized by ARE. CDS has thus become a “delegatee”, i.e. operator of electricity or water miniature networks in isolated areas. CDS is in charge of the operation and maintenance of the network and of the miniature plant, as well as of invoicing and collection from customers.

³ In particular, Law 2001-19 of 25 January 2001 relating to the Electricity Code

⁴ Law 2005-030 establishing the Water Code

⁵ Law 2001-18 of 25 January 2001 creating the Regulatory Authority (ARE), reporting to the Prime Minister, responsible for regulating activities in the water, electricity, telecommunications, and mail sectors.

⁶ For example: Project to support restructuring of the water, sanitation and energy sector (PARSEAE) funded by IDA (International Development Association); Water Priority Solidarity Fund (PSF), funded by France; support of the EIB for the Félou hydroelectric development project.

⁷ <http://www.cds.mr/>

“WATER OR ENERGY ARE AVAILABLE 24H A DAY!”

Figure 1. Location of DSPs - Source: FERDI



In the water sector, CDS has won 3 calls for tender (in the south, in the regions of Trarza, Brakna and Gorgol Guidimakha), covering some fifteen villages, approximately 20,000 people. In these “water” DSPs, a treatment station and a small water tower are used to store water need energy to operate and supply the network. The energy used is either thermal or hybrid (solar, with thermal taking over when necessary). These 3 contracts have been renewed and are still ongoing. CDS has recently been awarded a fourth contract in the same area. In the energy sector, CDS has won 4 calls for tender, covering 4 villages (Tichit, Rachid, Keur Massene, El Kaira), and has installed an off-grid network on own funds in a municipality (Blawack) near the capital Nouakchott. In these “electricity” DSPs, the authorities have chosen a thermal energy source (diesel) because of the power requested by customers. For several years CDS has thus assumed responsibility for access to energy in these municipalities. This represents approximately 1,000 households, or nearly 10,000 people, who have thus been given access to a professional electricity utility. These 4- to 8-year management contracts have now ended. After gaining nearly 10 years’ experience as DSP, and having served almost 30,000 customers

for water and energy, CDS can make a first assessment of the operation of this mechanism.

In addition, since 2011, CDS has been backed and funded by Investors & Partners⁸ (I&P), capital investor specializing in funding African SMEs, as well as by the Lundin Foundation and other Mauritanian entrepreneurs. The arrival of these new shareholders has also helped to strengthen the company strategy and governance, develop its skills and therefore accelerate its growth. The company was given structure, for instance implementing analytical accounting, an IT system, and a sales division. Today CDS has become a reference in Mauritania in the area of access to energy, both conventional and renewable, as well as to water. I&P has contributed to conduct a study of the impact on the activity of CDS, conducted by CDS and the Photographer Joan Bardeletti, the results of which are available on the website *Small is powerful*⁹ and have also been reported by the newspaper *Le Monde* and in a web-documentary¹⁰. CDS received an award from the Poweo Foundation¹¹ in 2009 and signed a partnership with Kiva in 2014.



Maintenance by the local team
Source: Joan Bardeletti

3. ENERGY AND WATER SUPPLY BY CDS

The villages where CDS supplies the electricity or water service are small, usually 2,000 to 5,000 inhabitants. In these villages, the infrastructure is comprised of a network supplying a few hundred meters in the village, and an energy source: a heat engine for an electricity DSP, and a hybrid device (solar/thermal) for a water DSP requiring lower power. Several neighboring villages are sometimes connected to the same central infrastructure (water tower or energy source). This off-grid network is autonomous: geographically remote, it is not connected to the national grid. The cost of a connection at a distance of several tens or hundreds of kilometers would be very high. To date, this village infrastructure is systematically funded on subsidy by the State or donors (for an amount estimated at approximately EUR 100,000 to 300,000, depending on the village size and extension). The delegatee operator of the infrastructure would not have the financial capacity required for this investment. The prospects for profitability of such an infrastructure in a small village are too remote to be covered by a private operator without a subsidy.

⁸ <http://www.ietp.com>

⁹ <http://www.smallispowerful.fr/cds-mauritania/>

¹⁰ <http://lesgrandsmoyens.org>

¹¹ <http://www.ivva.org/lend/691566>

However, contracting all or part of the creation of the infrastructure and network to the company to which it will ultimately be outsourced, whenever possible and if the operator has the necessary skills, is a good practice because it empowers the operator. It also gives the operator a thorough knowledge of the facility it will be managing. In addition, this gives it the incentive to choose its equipment wisely in order to avoid the future outages, instead of minimizing costs to increase its profit on the construction itself. Put briefly, the “vertical” integration of the activity incites to do things properly during construction to facilitate future management. But this method is still rare in Mauritania. CDS has not yet created the entire infrastructure but has chosen, purchased and installed the electromechanical part and the meters of a water DSP.

For both water and electricity, ARE picks the operator through a call for tender for a 5- to 10-year period, usually in order to (i) operate the network, service and maintain the infrastructure, and (ii) read the meters, invoice and collect payment from customers. For water, the tender mechanism is a reverse auction on the price of the m³ of water charged to the customer. For energy, the bidding is based on the profit and loss forecast describing the various expenditure headings. The price of the kWh is in fact set by ARE *ex ante*. In both cases, ARE’s assessment of the offers focuses on (i) the soundness of the bidding company, its experience and skills, (ii) an estimate of expenditures necessary to the activity. This mechanism aims to analyze the applicant’s ability to implement the water and energy provision service in a competitive, continuous manner, “accepting” the price set by ARE for energy or the price proposed by the bidder for water. The operator’s capability to ensure proper management and cost control is therefore decisive in this business.

However, in the energy sector, the subscribers’ consumption at the price set *ex ante* by ARE does not allow the operator to

generate sufficient turnover to cover the operational expenses of the activity. A balancing subsidy is then provided, according to the amount of energy produced and invoiced, to allow the operator to cover its expenses. This subsidy is paid directly by ARE from a dedicated fund, supplied by Mauritanian mobile and telecoms operators through a specific tax. This fund is not managed by the State budget but directly by ARE. In 8 years, CDS has practically never experienced a delay or difficulty in receiving this subsidy, which is in itself an achievement. Depending on the villages, the year and the consumption, the subsidy may rise from EUR 20,000 to 40,000 per year and per village. This balancing subsidy may in

the end fund up to 50% or even 66% of the actual cost of energy. Without these subsidies, the activity would not be possible.

By contrast, the subsidy is not necessary in the water sector. The income derived from invoicing is sufficient to cover expenses. Indeed, water requires less energy, i.e. less diesel. But on the other hand, the price charged by the delegatee must help ensure the long-term sustainability and quality of the service.

Table 1. Recap of energy consumption costs for the customer (EUR 1 = MRO 360)

Quantity of energy consumed	Fixed subscription	Variable billing	Total cost for the customer	i.e. in Euros	Type of customer
Cat. 1: 0 to 25 kWh / month	MRO 600	MRO 51 / kWh	MRO 1,875	€ 5	Family
Cat. 2: 25 to 120 kWh / month	MRO 1,700	MRO 81 / kWh	MRO 11,420	€ 32	Family +++
Cat. 3: From 120 kWh / month	MRO 7,500	MRO 90 / kWh	-	-	Business

Table 2. Recap of data of the 3 main Electricity outsourcing contracts managed by CDS

Electricity outsourcing	Keur Massene	Tichitt	Rachid
Year started	2008	2007	2007
Contract duration	4.5 years	5.5 years	8 years
Type of energy	Thermal	Thermal	Thermal
Installed power	2x65 kVA	60 kVA	60 kVA
Number of Inhabitants	2,000	3,500	2,500
Number of meters	147	205	245
Average consumption /meter	65 kWh / month	17 kWh / month	29 kWh / month
Average annual subsidy	€ 36,000	€ 21,000	€ 27,000
Nbr Cat. 1 subscribers (at end period)	117	176	205
Nbr Cat. 2 subscribers (at end period)	26	26	37
Nbr Cat. 3 subscribers (at end period)	4	3	3

Electricity DSP mini-plant at Keur Massene
Source: Joan Bardeletti



For a customer, the payment of the electricity service is very simple: one buys his meter on first connecting to the grid for about EUR 40. It is often paid in installments, and in some villages, development programs cover this initial cost. A fixed monthly subscription is then chosen: there are 3 types of subscription according to the amount of energy the customer needs. If the ceiling set for the chosen subscription category is overshoot, the customer is automatically switched to the next subscription package. Finally, variable billing depends on the subscription and the consumption registered by the meter. It may vary from to EUR 30 per meter and per month on average (between EUR 0.15 and 0.25 per kWh). The chosen pricing system is intended to make energy accessible

to smaller consumers (families) and a little more expensive for the bigger consumers (businesses, professional activities, etc).

Payment for the water service works in a similar way: a meter is purchased on connection for some EUR 40, which is sometimes covered by development programs. In the case of water,

the sole subscription package costs EUR 1.5 per month, with an added variable billing according to the amount of water consumed. The price per liter depends on the operating costs of each DSP (linked to remoteness, etc). For instance, a family of 10 consuming approximately 100L of water per day (which is low, for all purposes) will pay a water bill of approximately EUR 4.5 per month.

Table 3. Recap of data of the 3 main Water outsourcing contracts managed by CDS

Water outsourcing contract	Gorgol Guidimakha	Brakna	Trarza
Year started	2008	2009	2010
Contract duration	10 years	10 years	10 years
Type of energy	Hybrid	Hybrid	Thermal
Installed thermal power	20 kVA	10 kVA	20 kVA
Installed solar power	1,480-4,000 Wp	500-1,440 Wp	N/A
Maximum water flow	11m ³ /hour	8m ³ /hour	12m ³ /hour
Number of Inhabitants	15,600	7,500	5,000
Number of meters	757	200	254
Average consumption /meter	10m ³ /month	9m ³ /month	5m ³ /month
Cost of the liter of water	MRO 250/m ³	MRO 250/m ³	MRO 350/m ³
Monthly subscription	MRO 550	MRO 550	MRO 550

In the villages it manages, CDS usually employs two to three people full-time responsible for all tasks related to the operation of the autonomous mini-network:

- Light maintenance and servicing of machinery, starting up or shutting down the infrastructure,
- Procurement of spare parts, and diesel oil if applicable,
- Reading customer meters, invoicing, collection.

This on-site team, selected among the village inhabitants, is trained and supported by the central CDS team. It plays a strategic role in the proper provision of the service, both as regards management (use of business software) and technical aspects and first level maintenance. CDS annually gathers its field teams for training, technical upskilling and sharing experience. In addition, the central technical team travels from the CDS head office regularly to visit the various sites in order to perform routine inspections or when complex maintenance is necessary. It is not uncommon for a technical team of 3 or 4 people to have to drive 7 or 8 hours to perform a routine inspection or do repair work which will take a few hours.

The quality of the organization and management of the technical teams is the main factor in the success or failure of this activity. As in other "last mile" issues, cost control is decisive in this low-revenue business. It is what makes it possible to ensure the sustainability and quality of the energy and water provision service.

Another solution implemented by CDS is to try to make the best use of its local base and travel: around the DSPs it operates and in the big cities (Nouakchott, Nouadhibou, Kaédi), CDS started in 2011 a solar kit distribution activity with a dozen points of sale, for customers not connected to the grid or too far from the DSP network, or to supplement the installed meter. The commercial organization of this activity is based in part on the presence of the on-site DSP team, allowing them to deploy this sales activity at a lower cost. Travel between the head office and the DSPs also provide the opportunity to restock the kits and distribute them. Within a few years, CDS identified a few flagship products, purchased from major international producers (Sunking, Bbox, d.light, Barefoot) matching the population's needs: mini-kits (EUR 15, Barefoot Firefly individual lamp with mini-panel and integrated battery, 36 lumens, or stronger from SunKing), TV kits (EUR 150, more powerful solar panel - 100 to 290W and 24V), solar batteries and inverters. Solar refrigerators (130 to 225L) and solar water heaters (150 to 200L) are also distributed sometimes. As they are more expensive, they are intended for a more urban client base with more resources. In these cases, the CDS team must perform a specific installation when they travel. The development of the solar kits activity is promising and makes it possible to capitalize on the presence of CDS in remote areas. Today its sales are comparable to the DSP activity (however, with a significant part of sales made in the capital, Nouakchott). The mini-kits account for three quarters of sales volume, with approximately one thousand products sold in 2015, but they represent much less in value. The solar refrigerators, solar water heaters, TV kits and batteries account for the majority of sales by value. This product mix is necessary to ensure the profitability of a low-margin activity, specifically when the products must be routed to remote areas of the country.

4. ACHIEVEMENTS OF THIS ENERGY AND WATER ACCESS POLICY

At the end of eight years of experience, several lessons can be drawn from the operational experience of CDS in the provision of an energy and water service through autonomous networks.

In the villages where it operates, CDS has proved that the service works: energy and water are available round the clock. The current supplied conforms to the specifications requested by ARE and the water quality, audited regularly, is good. As regards electricity, the rate of outages is lower than the ceiling imposed by ARE in its Specifications: on average 20 hours of interruption of the current per year and village, in tranches of a few hours, often due to minor failures or maintenance. Keur Massene village initially experienced a few more service interruptions due to faulty equipment installed at the start (subsequently replaced). By contrast, the other villages (including Rachid) have experienced several years without interruptions. In most villages there is a secondary plant which is used during failures or maintenance. As regards water, there are one to two failures per year in each DSP, half of them requiring intervention from the head office. Overall, the service interruption rate is around 1%. The installed equipment proved to be appropriate for its use and CDS has not experienced serious malfunction of the infrastructure.

The professionalization of the delegatee activity is also a key achievement: CDS and a few other DSP operators are gradually expanding their skills in the management and maintenance of these facilities. The little institutional or external support they have received mainly concerns the management of the DSPs (software, rules and good practices, etc). On a technical plane, they have gained experience and learned on their own by grappling with the technical challenges of their activity daily.

These delegates are also grouped together at national level in an operators' association, in order to communicate more effectively with the authorities and develop common practices. This association is promising and could become a platform for support and development. Those operators who achieve a sufficient structure will truly become the strategic players of the energy sector of the future in their countries.

Finally, the balancing subsidy that the authorities were committed to pay to the electricity DSP has always been settled in accordance with the stated provisions. The reliability of this compensation mechanism is also a condition for the success of this energy access policy. The vitality and the high profitability of the mobile and telecom sectors in Africa, including in Mauritania, suggest that these subsidy amounts will be permanently available and could fund access to energy in other villages.

The quality and sustainability of this water and electricity access service is based on a strict operational requirement: long-term cost control and rigorous management. Because the delegates are all small SMEs, they are forced to control their expenditures very closely in order to survive. For Sidi Khalifou, CDS CEO, "This is a service requiring skills and regularity, and we know that this can be difficult for our States, our communities or the large public undertakings. A small private business like CDS can manage this, even if this is not always easy."

Utility consumption by the customers confirms that the offer matches a need. The quality of collection (95% on average, sometimes 100%) demonstrates customers' ability to pay and the appropriateness of the

billing method and rates. If at the start of a DSP only 70 to 80% of the inhabitants are indeed connected (mainly due to costs), subsequently CDS observed a gradual increase in the number of meters, by approximately 5% per year, as well as an increase in households' consumption, approximately 5 to 7% per year on average for all DSPs. To date, apart from a few specific events, there has been no case of interruption of subscription to the utility. CDS has managed to ensure a quality service, maintaining its costs and achieving a true financial balance, although the margin is very narrow.

In the villages managed by CDS, approximately 10,000 people have benefited from access to professional and sustainable energy and approximately 20,000 people have benefited from access to water. A qualitative assessment of the impact of the supply of water and energy in the villages served by the DSP, carried out on the basis of internal CDS data, has helped to identify three main avenues for social and sanitary progress that the service has generated, and which in turn have many and successive impacts on the economy and society in general.

First, the quantity of water consumed has increased, from an average of 100L of water per family and per day previously, to 200L/day/family today (increase not due to waste but to new uses, particularly economic). In addition, water quality improved with CDS: in several villages, the inhabitants had previously used river or well water, which caused many diseases. According to Mr. Bamba, CDS DSP Manager, "Some populations directly took water from the river or surrounding backwaters, it was too polluted and had so many microbes that it caused diarrhea and diseases of all kinds. The populations' situation improved with CDS's management." According to the elder of Dioullom village, 15km northwest of Boghé, mostly composed of livestock and crop farmers, "Tap water is healthier than the well water."

In the villages served by an electricity DSP, the use of refrigeration makes it possible to keep food longer and reduces the risk of consumption of spoiled food, which is very frequent. Ms. Zenob Mint Mohamed said as much, "during hot weather, meat did not keep very well. Now, when a villager kills a sheep, he can keep it in the freezer."

In addition, other small-scale and "professional" uses appear: the energy supply powers small mills, welding stations, bread ovens, or telecom shops: it is no longer necessary to travel several kilometers

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to recharge a mobile phone. Far from being simply an expenditure, energy is an opportunity for the creation of additional revenue within the village economy. The refrigerator is also a source of additional activity for the storekeepers, who sell ice and cold drinks in Mauritania's very warm climate.

Table 4. Economic activities supplied with power in the 3 villages

Keur Massene	Mills, tailors, electric well pumps
Tichitt	3 mills, 1 gas station, several welding stations, tire inflation stations, hair salons, tailors, telephone recharging
Rachid	Electrical well pumps, refrigerators/ice sellers, welding stations and tire inflation stations, telephone recharging

Several public or social services are also routinely connected to the energy or water network: health clinic, school, administrative services, and... the cemetery, as Sidi Khalifou explains: "In our traditions, the dead must be buried straight away and often they die at night. Before, people were afraid to go to the cemetery at night. Now, they are more comfortable during evening burials and this also gives a spiritual weight to the cemetery. "

Table 5. Public or collective services supplied with electricity and water

Keur Massene (electricity)	Police, town hall, clinic, prefecture, cemetery
Tichitt (electricity)	Elementary and middle school, town hall, clinic, radio transmitter
Rachid (electricity)	School, town hall, clinic, prefecture
Gorgol Guidimakha (water)	Four elementary schools, two middle schools, a high school, a town hall, two clinics, two prefectures, a police station, two cemeteries
Brakna (water)	School and clinic
Trarza (water)	Clinic

5. CHALLENGES AND DIFFICULTIES OF THIS APPROACH

CDS's experience also serves to identify the major challenges of this energy and water access policy that must be resolved in order to scale up and achieve a real impact on development for the inhabitants of Mauritania.

The main disadvantage of the government strategy of outsourcing management is the absence of a consistent geographical approach. The successive invitations to tender are distributed all over the country, from the south (river valley) to the east (the two Hods), and from the center to the north. The same operator may therefore find himself

delegatee for 5 sites several thousands of kilometers apart from each other. Yet one of the key parameters of service quality is the distance between the delegatee site and the operator's resources such as: skilled maintenance teams, spare parts stocks, etc. It is obviously impossible for an operator to mobilize all those skills and all those stocks for each delegation, because this would make the cost price of energy unaffordable. By contrast, mobilizing skills or stocks only a few tens of kilometers apart makes it possible to significantly reduce management costs, the operational complexity of the activity (delays, travel), as well as the loss of income related to the any service interruptions. Geographical consistency of the delegations awarded would solve this difficulty by giving the same operator several neighboring sites, or even a region.

This issue can in effect be addressed by proposing delegations of a sufficient "size", i.e. commercially viable for the operator. Supply electricity or water for a very small village of a few hundred people, several thousands of kilometers away from the operator's head office (in Nouakchott, the capital) is far more expensive, and therefore far less profitable, than to do so for a larger village (several thousands of inhabitants) just three or four hours by road from the capital. This is why for a long time CDS has been pushing the Mauritanian authorities to adopt a consistent and ambitious geographical approach to the outsourcing of utilities, as is the case in neighboring countries such as Senegal.

Such an approach of course is only meaningful for delegates that are sufficiently competent and capable of managing relatively vast areas. Strengthening delegatee skills is another crucial issue for the success or failure of this energy and water access policy. In several DSPs, ARE has had to renew the call for tenders to change operators due to poor service rates, limited maintenance skills and, ultimately, an inadequate performance from the operator chosen initially. This is hardly surprising since there was initially no professional operator in this sector, which only arose recently. A few years therefore had to pass for specialized players to emerge and structure their business.

In addition, the geographical consistency of the awarded DSPs also collides with the constancy of the Mauritanian public authorities, whose vision for the sector has sometimes varied. The frequency of calls for tender is changeable and does not match an established and published timetable. Sometimes, for contingent political reasons, a DSP may be withdrawn from a delegatee and handed to the public electricity utility, whose rates are lower, despite (or because of!) very good operating results and an increase in demand. This has already happened with some electricity DSPs managed by CDS. However, the public electricity utility is unable to operate these DSP in a sustainable and profitable manner: its cost structure is very high, its management quality is less good and income is lower. These factors often lead to a gradual degradation of service quality (frequent outages, delayed maintenance, dropping service rates) and, simultaneously, to a far greater "subsidizing" than in the DSP program, since the considerably loss-making public utility is regularly bailed out by the authorities.

In addition to geographical consistency, consistency as regards duration is also required in this approach to utility outsourcing in order to produce experienced operators and a stable and high quality service.

6. CDS INNOVATES TO GROW AND TAKE ON THESE CHALLENGES

Faced with these difficulties, CDS has implemented several concrete solutions.

CDS is trying to concentrate its activities in the south of the country, a more densely inhabited area that still has little service. Mr. Khalifou's goal is to base as many operational team assets as possible equidistant to the various DSPs which CDS operates. The closer the team to the maintenance site, the faster and more inexpensive the maintenance will be.

CDS proposes to authorities to carry out as much as possible a part of the infrastructure installation (the electrical or electromechanical part) in order to install reliable, quality hardware subject to limited failures. CDS wishes to encourage the authorities to move towards a "concession" approach where part of the infrastructure investment is borne by the concessionaire.

CDS is trying to increase network density: even restricted extensions can make it possible to reach another village or a part of the village is not served by the infrastructure. Whether this extension is funded by CDS alone or shared with the authorities, commercially and technically it represents a natural avenue for growth: without increasing operating expenses, the same equipment can often serve a greater number of people. This would help spread the fixed charges over a greater income, reduce the operating subsidy and improve the activity's sustainability.

Finally, CDS as far as possible endeavors to promote renewable energy production methods, mainly hybrid ones (solar combined with thermal). In addition to the environmental impact and the reduction of pollution (noise or air), these solutions are also economically virtuous: (i) they reduce the influence of the variation of the price of diesel on the profit and loss account, (ii) they fail less often and significantly reduce maintenance requirements (longer

"COST CONTROL AND RIGOROUS MANAGEMENT ARE KEY OPERATING REQUIREMENTS."

intervals between two technical inspections), (iii) over the long term, they reduce the cost of water or energy for customers. If the CDS case shows that it is not yet feasible to aim for renewable energy alone, the fact nevertheless remains that decisive progress can be made by promoting these energy sources. CDS has already managed to switch several water DSPs to a hybrid power source.

Over all of these challenges, the authorities must be lobbied in order to design together the best energy and water access solutions for these villages.

CONCLUSION

More widely, professionalizing and developing the delegates, as well as optimizing energy production through the use of renewable sources and increasing the density of DSP sites, will be decisive to replicate and scale up the DSP approach: decentralized electrification will be a solution for access (even partial) to energy and will be repeated only if the need for subsidized funding is limited to a minimum. If the dedicated fund supported by the mobile operators does not seem likely to dry up in the immediate future, it will not cover the financing of expensive infrastructure, often several hundreds of thousands of euros for each installation. Even on the road to a concession approach, the public authorities and donors will need to cover a part of the investment needs sustainably, and associate the DSP approach to other initiatives in order to overcome the difficulties of access to energy and water.

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A refrigerator installed in a shop
Source: Joan Bardeletti

