WWF

MADAGASCAR

2017

IN THE LIGHT OF RURAL MALAGASY WOMEN

Five years of learning with Barefoot College's "Women Solar Engineers"

This publication is funded by the European Union

For more information

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This publication has been prepared with the assistance of the European Union.

« Our job is to show how it is possible to take an illiterate woman and make her into an engineer in six months and show that she can solar-electrify a village. »

Bunker Roy
Founder of Barefoot College

« To these extraordinary women committed to an ever brighter tomorrow for future generations, to these thousands of looks and smiles we met, tribute to all of us who have influenced this amazing human adventure that can only help foster growth and gratefulness in us, this is somehow our memory. »

Voahirana Randriambola
Coordinator of the Barefoot College initiative
at WWF Madagascar

THEY CONTRIBUTED TO THIS HUMAN ADVENTURE...

BAREFOOT COLLEGE is an Indian organization created in 1972, whose mission is to develop basic services and solutions relating to issues facing poor rural communities with the aim of making them self-sufficient. Barefoot College has developed the “Woman Solar Engineer” program, which has provided more than 550,000 households in more than 1,300 villages worldwide with access to modern lighting and electricity, through more than 750 Woman Solar Engineers.

Worldwide Fund for Nature (WWF)'s mission is to halt the degradation of our planet and build a future where humanity can live in harmony with nature. WWF has been active in Madagascar since 1963 and is especially working to improve the well-being of communities with which the organization is committed every day for the conservation of natural ecosystems. **WWF MADAGASCAR** works with nearly 300 grassroots communities, most of whom live in remote rural areas. WWF believes that if we want to manage natural resources in a sustainable and equitable way for the sake of nature and people, it is essential to achieve socioeconomic development while reducing the vulnerability of these communities. Access to sustainable energy is one of the key requirements for improved living conditions in such circumstances.

In 2012, Barefoot College and WWF established a partnership to develop the “Woman Solar Engineer” approach with the aim of promoting access to sustainable energy for all, especially in WWF’s priority areas of intervention throughout the world. Madagascar was chosen as the first country in which to implement this global partnership, and the approach has been initiated in the country through this partnership.

The Barefoot College initiative in Madagascar was made possible thanks to the support and commitment of many people locally, nationally and internationally. WWF is particularly grateful to the Barefoot College team, the genius of its founder Bunker Roy, and the unwavering support of their CEO Meagan Carnahan. We would also like to thank the Government of India for their generosity and commitment, the Government of Madagascar, our Belgian and Swiss private donors, the Open Circle Foundation, the Small Grant Program Madagascar / UNDP, La Française des Jeux, the Indian Ocean Commission / European Union, WWF's global network and of course the communities.

This document capitalizes on the experience that WWF Madagascar team has gained working with five villages from 2012 to 2017, affecting 1,200 households and 19 Women Solar Engineers. It is presented in three parts. The first part is devoted to the implementation of the Woman Solar Engineer approach, and is then followed by a narrative on the effects and impacts at community level in Iavomanitra and Tsaratanana. Finally, we highlight the lessons learnt for scaling up which will allow us to make this approach more widespread and more effective.

Enjoy the reading.

Coffee Plantation in the Northern Highlands Landscape in Northern Madagascar

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ABSTRACT

Criteria for choosing a village

1. Not targeted by existing programs from the Rural Electrification Development Agency.
2. Small size, preferably between 100 to 200 households.
3. Remote, difficult to access, and not electrified.
4. Good social cohesion.
5. WWF interventions scheduled for at least three years after the approach starts.
6. Close to critical ecosystems to be protected.
7. Dynamic or strategic in relation to conservation efforts.

Barefoot College's approach consists in selecting women from remote rural areas to become “solar engineers” after a six-month training period in India. Upon their return to their village, the women are provided with equipment and spare parts and are able to manufacture the components of a solar system, assemble and install them, and provide maintenance and repairs to the benefit of households in their village. A local solar committee ensures the long-term management of the electricity service. The solar knowledge is thus transferred to the community, for sustainable access to electricity with reasonable costs for villagers.

This approach is relevant for a certain category of rural villages. WWF's choice fell on villages in which the organization works daily with communities for the sustainable management of natural ecosystems, which allows WWF to have a good social, economic and cultural knowledge of these villages. This means WWF can accurately judge whether the chosen villages met the criteria for the implementation of the Barefoot College approach. The five selected villages are: Iavomanitra, Tsaratanana, Andranomilolo, Ambakivao and Vorojà.

Implementing the Barefoot College approach in a village begins with a community meeting that requires good preparation to garner support from local leaders and local authorities, and win women’s trust. The meeting has eight stages; the Woman Solar Engineer approach is implemented if all eight steps have been successfully completed, as this means that the village community accepts the requirements needed to ensure sustainability of the approach:

(i) electricity service is not for free and each household that will benefit from electricity will have to pay a regular contribution on a monthly basis

(ii) women from the village will be trained at Barefoot College in India for six months, and will then manufacture, assembly, install and maintain the solar systems that will connect households to electricity

(iii) a local solar committee will ensure the long-term management of the electricity service

(iv) 200 households will be equipped with solar systems on the basis of a list of households established before the women leave for training

(v) under the leadership of the solar committee, the community will have to transport the equipment and spare parts to the village from the nearest road accessible by truck

(vi) under the leadership of the solar committee, the community will have to build a house that will accommodate the “Woman Solar Engineers” ’ workshop, a storage room and a community hall for various activities

Criteria for selecting women

- Must be a volunteer.
- Be between 35 and 50 years old; in general, in this age group, women have children and/or grandchildren.
- Not breastfeeding infants, not pregnant.
- Have received approval from their family.
- Do not occupy a particular position in the village; in general, they have little school baggage or none at all.
- Cannot be the wife of a man with a special position in the village.

During this village meeting, the whole community is made aware of the current energy situation in the village, especially with regard to the expenses associated with the use of kerosene lamps and batteries, the most commonly used items for lighting and electricity in such communities. In comparison, the use of solar systems that are sensed as the desired alternative is advantageous in terms of quality of service, as well as from an economic and environmental point of view. The approach provides three levels of service for monthly contributions ranging from Ariary 3,000 to 10,000, to use a portable solar lantern and/or a solar home system that can power four lamps as well as charge a phone and/or a small radio.

Selecting the women during the village meeting is a dynamic and transparent process designed to shortlist those who meet the necessary criteria. The solar committee members are also elected during the meeting; it ends with the sharing of experiences from other villages where the approach has already been successfully implemented.

In most cases, the selected women have very little or no formal educational background. Few of them have had the opportunity to travel beyond the district headquarters to which their village is attached, and apart from one of them, none have ever taken a plane. Taking a long journey by road and plane and staying for six months in a foreign country with an unknown language and set of customs is thus a huge challenge for all these women. As a result the psychological, administrative and material preparation of the women before their departure for training is a very important phase in the process. Throughout this period, WWF works to confront them with new situations to which they must adapt, so that they are confident about the journey that they will undertake and are in a sufficiently sound psychological state to deal with any situation calmly. They must also carry out several administrative procedures to travel to India, and WWF makes sure they are equipped to a minimum so that they can travel with confidence. The Indian Government, under its Economic and Technical Cooperation Program (ITEC), fully finances the trip, the stay and six month training, and issues the visa free of charge, once the Government of Madagascar (through the Ministry in charge of Energy, and Ministry of Foreign Affairs) issues its approval for each woman. With the blessing of their community and the encouragement of the country's authorities, the Embassy of India and WWF, the women make the trip by themselves.

Training at Barefoot College in Tilonia lasts six months, from September 16 to March 15, or from March 16 to September 15. The Malagasy women are trained with other women from different parts of the world, but with the same social status. These women who do not necessarily speak the same languages learn to identify electronic components by their shape and color, perform technical tasks by following examples, and acquire the necessary skills to manufacture, assembly, install, use, repair and maintain solar systems by following instructions. In addition to the curriculum focusing on solar systems, women have the opportunity to learn about other topics based on the training modules available onsite; Barefoot College also covers their needs during their stay in India. Upon returning from training, the women are transformed, are emancipated and more resourceful. Their return is celebrated, giving them an opportunity to share their experience with others, and to assume a position of importance and value in their community in a very public manner.

Tools and devices that the “solar engineers” need to electrify the village are provided by Barefoot College based on the list of beneficiary households drafted by the solar committee before the women leave for training in India.

The equipment arrives in the form of spare parts, and allows the manufacturing and maintenance of solar lanterns, solar home systems and a solar system for the community house. Once the materials are brought to the village, the “Woman Solar Engineers” carry out the electrification works.

The beneficiary households set up a legal association of electricity users, directed by the solar committee. The good management of the electricity service by the solar committee is essential for the households’ sustainable access to solar services. Given that this is a new activity for the community, WWF’s team provides training and ongoing support to the solar committee members to ensure this is the case. The association sets the rules on how the electricity is used and how to manage the funds from contributions, and a bank account is opened for this purpose. The sustainability of the electricity service depends on sound financial management and well-organized technical management; several tools are used by solar committee to establish such management. Manage electricity users and foster good relations with local authorities are also essential.

Central authorities have a key role in the implementation of the approach. The approval of the Ministry in charge of Energy is necessary to trigger the entire administrative process allowing women to visit India and become “solar engineers”. The Ministry in charge of Energy as well as the Ministry in charge of Women’s Promotion have demonstrated their support to the Barefoot College initiative through the development of the National Barefoot College Program (PNBC). Regional authorities appreciate the approach, although support can vary from one site to another; regional authorities are tasked with fostering a general environment conducive to the sustainability of the electrification, and are particularly important in creating a climate of security as it is necessary that district authorities are involved in monitoring, awareness and conflict resolution. A similar but more regular level of involvement from the municipal authorities is expected, and local authorities and notables also have a duty to support the management of electricity service by the solar committee. The case of Iavomanitra is a perfect illustration of the importance of local authorities, which can become obstacles when not cooperative, but also formidable levers when they collaborate actively for the sustainability of the electricity service.

Several entities have contributed to the funding of the Barefoot College initiative since 2012, to implement the “Woman Solar Engineer” approach in the five villages, and the communication efforts that the WWF team has undertaken have been instrumental in mobilizing these actors at different stages. When the expenses incurred per village in the past were capitalized, it became possible to estimate the budget required at 146,900 € to implement the “Woman Solar Engineer approach” in a village of 200 households, whilst also knowing that this budget would need to be adjusted according to geographic location of access to the village, associated coordination costs, and variations in solar services requested by households. This budget does not include the contribution of the Indian Government which covers the women’s training and travel. Once the village is chosen, there are four phases in the implementation of the Barefoot College approach.

The implementation phases of the “Woman Solar Engineer” approach are as follows:

- **Phase 1:** Training and community preparation
- **Phase 2:** Electrification of the village
- **Phase 3:** Initiation of the "Solar Lantern" value chain
- **Phase 4:** Consolidation of the "Solar Lantern" value chain

The monitoring and evaluation system developed by Barefoot College (MERL) has been improved and was used in Iavomanitra and Tsaratanana during the capitalization mission conducted by the National Barefoot College Program Steering Committee (PNBC) in November 2016. Interviews were conducted at the time with “Women Solar Engineers”, solar committees, local authorities and notables, communal authorities, gendarmerie, districts, regions, and households. These allowed WWF to highlight the effects and impacts of the approach in both villages.

The “Women Solar Engineers” have in these cases become genuinely emancipated to their benefit. They are competent in their tasks and their work is appreciated by those around them. They have gained

experience, are generally happier, and their living conditions have improved. They have no problem speaking in public, and have become leaders of change and development within their village, all whilst offering their fellows the benefits of modern electrification.

Women in the village community in these cases are given more space in society and within their families, and they are associated with developmental discussions, just like men. The example of "Women Solar Engineers" has encouraged women in the village to take on more responsibilities, and they are more assertive and are becoming members of the official organizations or associative committees. Essentially, the "Women Solar Engineers" function as engines of development for all women in the community as well as the community as whole.

Whether in Iavomanitra or Tsaratanana, users are happy that they have solar lighting; they are happy with the technology and do not want it to stop, and particularly want to have a proximity repair system available to ensure sustainability of the electrification.

Although the programs have been largely successful in the aforementioned communities, there do remain some issues that are being fixed. In Tsaratanana, users often fail to follow some basic instructions provisions such as not removing the lantern's battery, only using the solar system for authorized purposes, not trying to fix anything, and paying required contributions. In Iavomanitra, failure to pay contributions has been the greatest concern, apart from sometimes failing to respect technical instructions regarding use of equipment. Unfortunately, pursuant to propaganda by the chief of Fokontany, users expect free electricity service; however, as the recovery committee was set up in July 2017, this situation as of November 2016 should improve.

Statistics from the point of view of electricity users

- **72%** of households surveyed using solar electricity in Iavomanitra and Tsaratanana know that if their solar system breaks down, they must apply to the "Women Solar Engineers" for repairs.
- **50%** of the households surveyed insisted on the need to ensure sustainability.
- **23%** recommended continuing the capacity building of solar committees for management.
- **17%** raised the difficulty of paying their contributions
- **10%** wanted more households to benefit from access to solar electricity.
- **80%** of households surveyed not using electricity in Iavomanitra and Tsaratanana declared that they did not join because they cannot afford the contribution; non-availability of material is the second most prevalent reason given for failure to join.

Further positive elements in these communities revolve around the house built by the community, which includes a community hall, provided with solar electricity by the women technicians, both in Iavomanitra and Tsaratanana; it is usually the only communal area electrified in the village. In Tsaratanana, the solar house is used for adult literacy activities, in which the "Solar Engineers" are also involved. Video screenings are held and regulated since the community recognizes that you cannot just screen anything to all members of the village without upsetting some people. In addition, the community space addresses educational infrastructure issues that come during the rainy season by allowing classes to be held there. In Iavomanitra, the solar house is also used as a TV/video screening room, as a library and meeting room, as well as an area in which to formally welcome visitors. Other activities are scheduled in the space on an as-needed basis: interpretation and training center activities, and shop to develop income-generating activities. The space can also be used for paying guest rooms for visitors.

Following the solar electrification of the villages of Iavomanitra and Tsaratanana by the "Women Solar Engineers" and the solar committees, many of the surrounding communities requested solar lighting as well. In addition, many households in Iavomanitra and Tsaratanana were unable to benefit from first electrification. To meet this demand, the solar committees and the solar technicians have decided to work to develop the production and sale of solar lanterns. The objectives of setting up a Barefoot College solar lantern enterprise from both villages are as following:

(i) to allow communities around the village, and households in the village that did not benefit from the original equipment to have access to clean modern lighting

(ii) to optimize and promote the knowledge of solar technicians trained at Barefoot College to manufacture and maintain solar lanterns

(iii) to increase the revenue of the solar committees.

Initial financial plan for the solar lantern entrepreneurship:

- The solar lantern kit costs US $66, of which US $60 is for equipment, US $3 for solar committee costs, and US $3 for labor by "Women Solar Engineers".
- The sale price to the household is subsidized at the rate of US $25, to be paid by each household. The US $25 collected by the solar committee for each lantern makes it possible to partially subsidize the lanterns for the next households who want to purchase solar lantern.

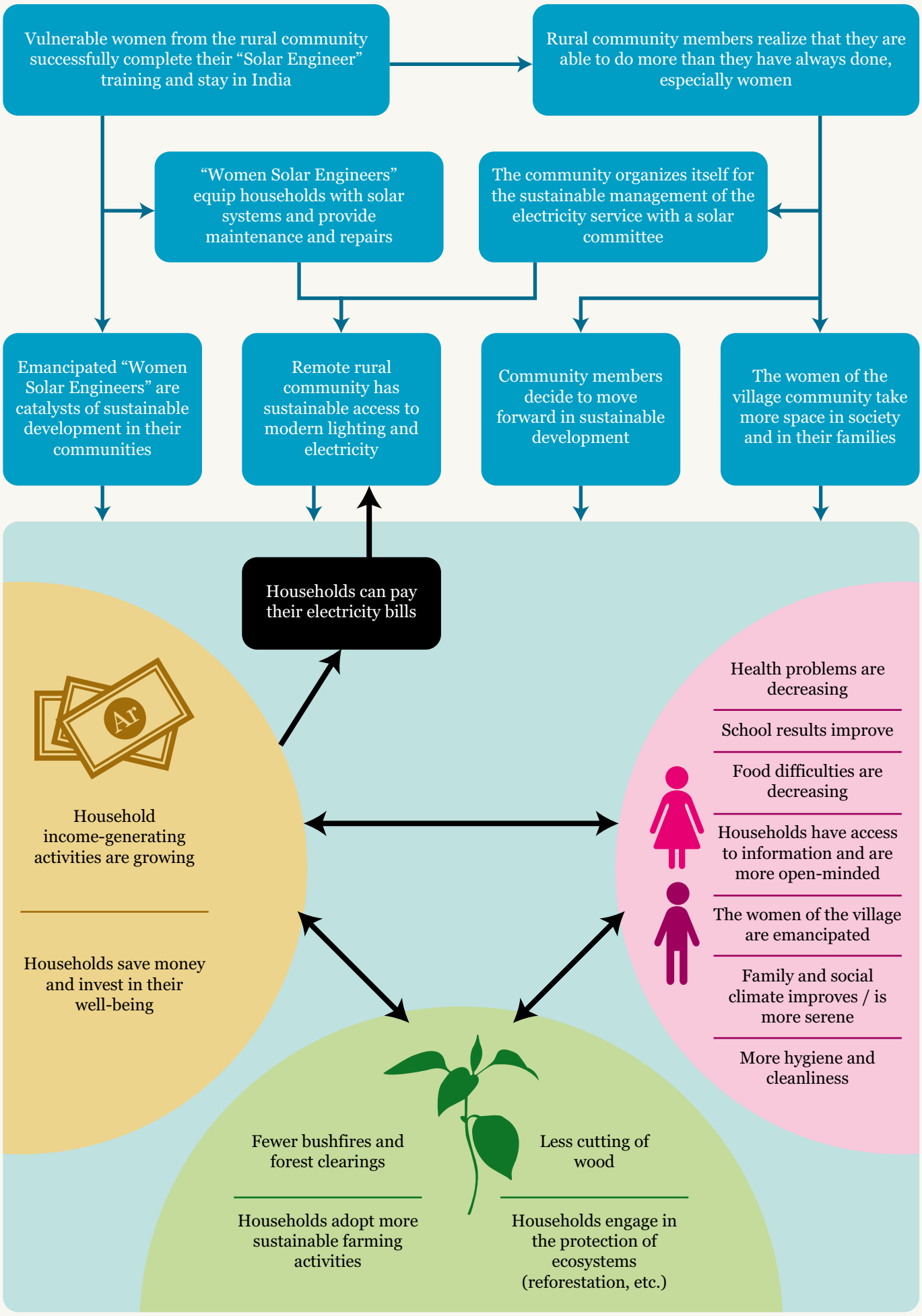
The solar lantern entrepreneurship is currently being tested for a batch of 100 lanterns from each of both villages, Iavomanitra and Tsaratanana. Final feedback is expected by June 2018. As of June 2017, 140 solar lanterns had been manufactured, and 50% of them had been sold.

One of the most important impacts of the approach is the positive psychological effect it has. For example, farmers now realize that they can do something other than farming if so desired, and this observation by farmers themselves is very important; they now have a different point of view that encourages them to adopt new development solutions. The availability of electricity is conducive to a healthy family and social atmosphere, as life changes gradually to accommodate the new possibilities that electrification brings. In Tsaratanana, households are no longer cooking inside their homes, but in a small kitchen located outside, with its positive effects on health due to the fact that kerosene smoke has been removed from the interior of the living space; solid houses also start to appear in greater numbers. It is now easier for teachers to prepare for classes and for children and young people to study at home in the evening, which in turn improves school performance, and creates a healthier community in both social and economic terms over time. Children can also spend their time differently in the evening: writing and drawing are now included in their activities. A greater openness to outsiders of the population is also noted; this comes with the ability to listen to the radio continuously and hear the latest news and information from places other than their immediate vicinity. Despite the fact that not everyone has access to solar lighting, there is no social dissension or discrimination apparent over this, as villagers help each other, with those without access to electricity benefitting from the repercussions by borrowing lanterns from their neighbors, for example. Households perceive differently the effect of lighting on security, as an advantage or a disadvantage; in 69% of households surveyed using electricity, women feel safer at night. As to the use of phones, some households have been able to buy one, although the lack of cell coverage in the village itself, whether in Tsaratanana or Iavomanitra, is still a limitation.

In addition, 60% of households surveyed using electricity reported saving money by adopting solar technology. With lighting, it becomes possible to work longer in the evening and improve one's income. For example, during the day, women tend to agricultural tasks, and in the evening they make mats. With the change of mentality and the resulting constructive dynamics that have arisen from these new habits, households are much more willing to practice new agricultural techniques such as irrigated rice farming (IRS), small livestock activities (geese, pigs, ducks as examples) or market gardening (green vegetable growth). In Tsaratanana, the lean season has been reduced and the village no longer experiences famine, despite the unforgiving climate. Moreover, as households want to maintain access to electricity and have understood that it depends on their ability to contribute to replace used equipment, the associations of electricity users are organized in the form of cooperative groups that generate income.

77% of households surveyed using solar electricity believe that the approach has had a positive impact on the environment: more involvement in the fight against bush fires, less woodcutting, dynamism in reforestation, and less forest clearing are the chief effects of the program in these areas. Improved living conditions, income and social well-being have strengthened the community's conviction and willingness to continue to protect forests, as the grassroot community's forest conservation efforts helped the village to have access to electricity in the first place.

The analysis of the effects and impacts of the "Woman Solar Engineer" approach has established the following causal effects:


Vulnerable women from the rural community successfully complete their "Solar Engineer" training and stay in India
Rural community members realize that they are able to do more than they have always done, especially women
"Women Solar Engineers" equip households with solar systems and provide maintenance and repairs
The community organizes itself for the sustainable management of the electricity service with a solar committee
Emancipated "Women Solar Engineers" are catalysts of sustainable development in their communities
Remote rural community has sustainable access to modern lighting and electricity
Community members decide to move forward in sustainable development
The women of the village community take more space in society and in their families
Households can pay their electricity bills
Household income-generating activities are growing
Households save money and invest in their well-being
Health problems are decreasing
School results improve
Food difficulties are decreasing
Households have access to information and are more open-minded
The women of the village are emancipated
Family and social climate improves / is more serene
More hygiene and cleanliness
Fewer bushfires and forest clearings
Households adopt more sustainable farming activities
Less cutting of wood
Households engage in the protection of ecosystems (reforestation, etc.)

Many actors recognize that the approach is highly relevant to many communities and needs scaling up in Madagascar. Given the growing interest generated, the Ministry in charge of Energy has decided to develop the National Barefoot College Program (PNBC) aimed at scaling up the approach throughout Madagascar. A steering committee of the PNBC has been set up and the PNBC aims to allow, by 2030, the creation of a network of 744 "Women Solar Engineers" by operationalizing a Barefoot College training center in Madagascar, and providing sustainable access to solar energy for 630,000 households. Considering these five years of experience already accrued in implementing the “Woman Solar Engineer” approach in Madagascar, here are our recommendations for developing the PNBC in the future:

(i) clearly define criteria and select the implementation bodies and the chosen villages in a transparent way

(ii) develop a standard methodology for any isolated rural villages in Madagascar

(iii) include a component on establishing a spare parts supply chain

(iv) include a component on collecting and recycling batteries at the end of their lifetime

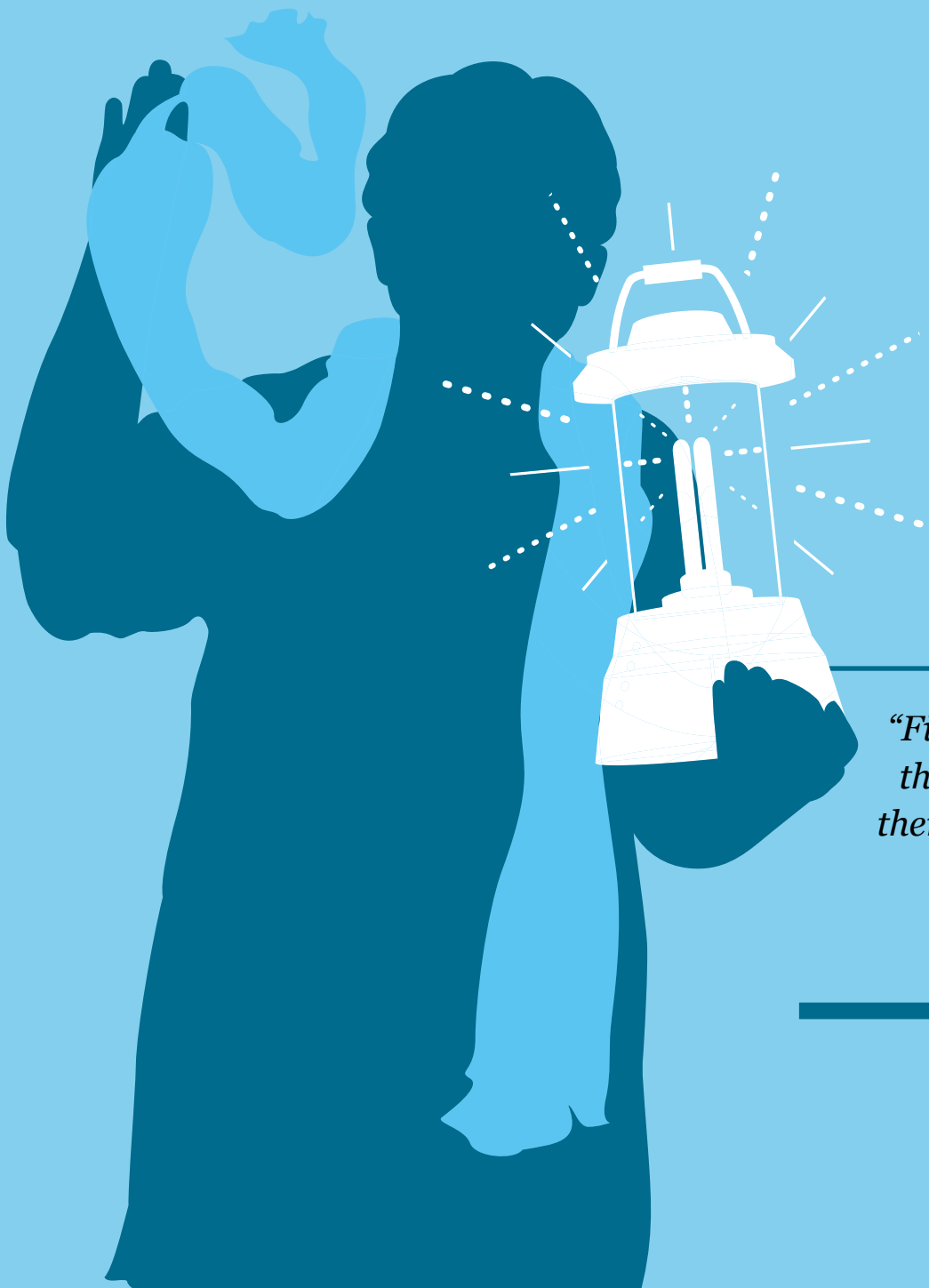
(v) engage in intersectoral collaboration, insofar as the PNBC will contribute to achieving the majority of the Sustainable Development Goals, to which Madagascar is committed

Mangroves of Manambolo Tsiribihina landscape in western Madagascar

Berthe, the dean of Women Solar Engineers, right at work

PART I

IMPLEMENTING THE BAREFOOT COLLEGE APPROACH



"First, they ignore you, then they ridicule you, then they fight you, and then you win."

Mahatma Gandhi

1. SELECTING THE INTERVENTION VILLAGES

84% of the Malagasy population does not have access to electricity, and the rate of those who do is only 4.7% in rural areas. Only those villages with a certain level of economic development could afford to raise this rate by extending the electricity grid or setting up decentralized production centers. Access to electricity in remote rural poor villages has been neglected, despite the fact that this could affect nearly 8.7 million people in Madagascar. As part of the New Energy Policy adopted in November 2015, the Malagasy State has set, amongst other objectives, access to modern lighting and electricity by 70% of households in the country by 2030. Given the high level of sunshine available in the country, promoting solar lamps and solar photovoltaic systems is part of the orientations defined, with 10% of households targeted.

The "Woman Solar Engineer" approach of Barefoot College consists in selecting women from rural areas to become "Solar Engineers" after a six-month training period in India. Upon their return to their village, the women are provided with equipment and spare parts and are able to manufacture the components of a solar system, assemble and install them, and provide maintenance and repairs to the benefit of households in their village. A local solar committee ensures the long-term management of the electricity service. The solar knowledge is thus transferred to the community, for sustainable access to electricity with reasonable costs for villagers.

This approach is relevant for a certain category of rural villages. WWF's choice fell on villages in which the organization works daily with communities for the sustainable management of natural ecosystems, which allows WWF to have a good social, economic and cultural knowledge of these villages. This means WWF can accurately judge whether the chosen villages met the criteria for the implementation of the Barefoot College approach.

1 The selected village is not targeted by the existing programs of the Rural Electrification Development Agency (ADER).

The implementation of the approach is relevant because the other more "traditional" approaches to rural electrification – subject to programming within the ADER – are difficult to achieve: decentralized electrification through a contractor hired by the Ministry in charge of Energy, or connection to the electricity grid, for example.

It would be hard for a business to envision electrifying the isolated village of Tsaratanana ▼

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Trekking for 40km through the mountains to reach Andranomilolo, in the Northern Highlands landscape ▲

To get to **Andranomilolo** from the town of Andapa, in the North East of Madagascar, you must first take a dirt track for about 1 hour and 30 minutes. The journey continues on foot to cross a "three stage" mountain, and reach the main town in the commune of Doany: an inexperienced trekker can expect to complete the journey in 8 hours. Having reached Doany, access to the community requires another 4 hours additional trekking, including a river crossing in strong currents, at which point one comes upon the main hamlet of Andranomilolo I. The village is in a vanilla production area, so quite rich compared to other rural contexts in Madagascar. Consequently, houses topped with photovoltaic solar systems are a common sight all along the way; moreover, in the main city of the commune of Doany, solar power hardware is already part of many traders' main products. In Andranomilolo, the better-off households already use solar systems, while the majority of the rest of the population uses kerosene for lighting.

2 The village or all the hamlets selected preferably have 100 to 200 households.

The village (Fokontany) is often scattered over several hamlets, and we generally consider the main hamlet or hamlets in the village. The Barefoot approach is not suitable for villages or hamlets with too large population, as community management of the electricity service must remain controllable, as explained later in this document.

However, given that the population of villages and hamlets change over time, once the first beneficiary households are equipped, it is necessary to consider a future extension of the solar activities of the village on an entrepreneurial basis.

3 The chosen village is isolated, difficult to access, and has no electricity.

This type of village is unlikely to benefit from "traditional" rural electrification projects. Meeting small electricity needs (lighting, radio, telephone charging) can transform its development. It turns out that promoting small "solar gadgets" or sometimes real solar systems is increasingly common in rural areas; and depending on the area, it may be rare to find a village without any household equipped with a solar system. One may also see, albeit more rarely, a better-off household with a power generator. The fact that some households already have solar systems or a generator set in a village is not a handicap to implementing the approach, as long as the proportion of the population affected does not make a majority; if 100 to 200 households still use kerosene or wood fires to meet their lighting needs, the Barefoot approach is worth implementing.

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In Doany, the commune in charge of Andranomilolo, solar equipment is among the more popular products sold at market ◄

Ambakivao, Commune of Delta, District of Belo sur Tsiribihina, Menabe Region, is one of the 12 WWF priority sites for the sustainable management of mangrove ecosystems within the Manambolo – Tsiribihina landscape. WWF has been working in this village since 2011 as part of its mangrove conservation actions as well as its contributions to social, cultural and economic development. Promoting local participation and building community capacity are among the most important aspects of WWF's approach there. Improvement in children's education, adult literacy, access to information – particularly on sustainable management of natural resources – are all expected positive impacts from the implementation of the Barefoot College approach, and are all effects aimed at empowering communities.

4 There is good social cohesion in the chosen village.

The Woman Solar Engineer approach is a community approach. In order for it to succeed, and for sustainability to be a given, social cohesion is important. The population as a whole must agree that the approach will be implemented in the village.

5 WWF's team plans to work with the selected village community for at least three years after the implementation of the approach starts.

The approach includes continuous support to the village community to guarantee the autonomous and sustainable management of the electricity service. Two to three years is considered enough, but it depends on the communities whether or not this period needs to be extended. Moreover, this is not WWF's only intervention in the village; the Barefoot approach is part of a synergism of different types of interventions which maximizes positive effects and impacts, especially when these other interventions focus on supporting the development of income-generating activities in the communities.

Fishing is the main activity of the village of Ambakivao ▼▲

A hamlet of the village of Iavomanitra ▲

Iavomanitra is one of the Fokontany near the Fandriana Marolambo forest corridor in the rural commune of Miarinavaratra, District of Fandriana, Amoron'i Mania Region. The two associations in the Fokontany (Fanantenana and Imaintsoanala) are among the most active ones concerning the raising of awareness of the population, forest protection and local development.

6 The chosen village is close to critical ecosystems to protect; it is dynamic or strategic in relation to the conservation efforts concerning these ecosystems.

WWF lists the implementation of the Woman Solar Engineer approach under its efforts to improve the living conditions of those communities managing natural ecosystems and that depend on these natural ecosystems for their survival. As it is not possible to satisfy everyone because of the means available, we prioritized the communities that have demonstrated a good dynamic in their sustainable development efforts, such that they can become role models for other communities. The choice of the village sometimes matches a geographical strategy, in that the village is a crossroads that can showcase sustainable development for the surrounding communities and beyond.

THE VILLAGES OF INTERVENTION FOR IMPLEMENTING THE WOMAN SOLAR ENGINEER APPROACH, FROM NOVEMBER 2012 TO JUNE 2017

Village	Iavomanitra	Tsaratanana	Andranomilolo	Ambakivao	Vorojà
Commune	Miarinavaritra	Ambohimana	Doany	Delta	Itampolo
District	Fandriana	Vondrozo	Andapa	Belo/Tsiribihina	Ampanihy
Region	Amoron'I Mania	Atsimo Atsinanana	Sava	Menabe	Atsimo Andrefana
WWF landscape	Fandriana Vondrozo corridor	Fandriana Vondrozo corridor	Northern Highlands	Manambolo Tsiribihina	Mahafaly
Critical natural ecosystems	Wet forests	Wet forests	Wet forests	Mangroves	Spiny forests
Number of hamlets	08	09	05	05	26
Total number of households	233	839	240	406	184
Number of households in the main hamlet	46	57	70	245	37
Main activities	Agriculture	Agriculture	Agriculture	Fishing	Agriculture
Access from the main city in the region	5h30 by AWD car from Ambositra, then 3 hours by motorbike	4 hours in a AWD car from Farafangana, then 2 hours on foot	130 km of road accessible by car all year round from Sambava, then 40 km on foot	3h in a AWD car from Morondava, then 6h by pirogue or 1h by speedboat	9 hours of bumpy track in AWD car from Toliara

Crossing stripped down bridges to reach Tsaratanana is perilous ▼

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2. THE VILLAGE MEETING

The implementation of the Woman Solar Engineer approach in a village begins with a community meeting that requires precise preparation.

Secure support from local leaders and authorities, and win women's trust.

The WWF team is preparing the meeting "on access to electricity in the village" with local leaders. At this stage, it is the only information and content on the project that is communicated to avoid bias and negotiations' beginning before the meeting takes place. There have been issues where even brief information on the approach was disclosed in advance; this resulted in a series of rumors, sometimes malicious, causing an a priori opposition from part of the community, or from those who did not have an interest in the approach being implemented.

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Pascal Velonarivo, mayor of the commune of Miarinavaritra in 2012 (commune of the village of Iavomanitra)

"First, the village had to agree to welcome the project and it was not easy, because while having the light at home is important, having a loved one leave for six months for an unknown destination was scary. My role was, among others, to reassure them."

Local leaders include: the ultimate village leader, the main notables, the Community Based Organization(CBO[1]) leader which reminds both us and them that the implementation of the approach in the village is tied to WWF's support for community management of natural ecosystems. The mayor of the commune in charge of the village is also invited to actively participate in the meeting, as well as the district officer. These authorities have an important role to play in implementing the Barefoot approach, as explained in the rest of the text, and it is essential to have their support from the outset.

Local leaders should inform households of the meeting beforehand, as the majority and ideally all adults from the village community should be present, men and women alike, as important decisions for community development are made during this meeting.

Since men and women are concerned, households must make the necessary arrangements to attend and take part throughout the entire meeting, which is not always easy. Keep in mind that depending on the interest and questions of the community, the meeting can easily last over four hours. Women must organize themselves in advance, their days always being filled with household activities that cannot wait; they must be able to delegate or anticipate tasks, so they can be available for the meeting. Men are usually in the fields or fishing, so it is necessary to agree with them on the appropriate time to hold the village meeting to have maximum attendance when it takes place. Date and meeting place are thus decided considering these and allow preparing all logistics requirements.

Elders and local leaders of Vorojà played a key role ▼

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During the meeting where community members are seated matters a great deal. Women are invited to come to the front, and men stay behind. This promotes women's voices during the meeting, and it allows for better observation of them for the selection of the future Solar Engineers during any discussion.

The village meeting is naturally chaired by local leaders who facilitate the debates. Administrative authorities are there to remind all that this is part of development efforts related to policies and laws in Madagascar; they are also witnesses of the measures decided on by the community.

1 Association in compliance with Order No. 60-133 of October 3, 1960, and governed by the Decree No. 2000-027 of January 13, 2000, on community based organization in charge of local management of renewable natural resources.

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Men are invited to let women sit up front in Tsaratanana ▲

Zafitsiha, Woman Solar Engineer from Tsaratanana

"I was one of the first to be selected for the training. During the morning of selection, I admit I had some concerns and questions because the project was very new and required leaving the village for a long time. I still did not have the courage to ask questions at that time, but I listened a lot to the explanations, the opinions of my friends in the village as well as my family, who all seemed motivated. It was only much later, when the group finally gathered and we were reassured about what was going to happen that I really started asking questions. There are questions that do not immediately come to mind at the moment, because we do not think about it. But I appreciated the courage I had, by immediately accepting the challenge."

The first selection of Malagasy women in Iavomanitra was made in the presence of Bunker Roy and Meagan Carnahan ▼

© WWF Madagascar / José Randriamananarivo

WWF is the main stakeholder and its role is to provide the necessary information for the community to decide; the WWF team is there to moderate and catalyze the exchanges to advance discussions, but also to observe and feel what the community's stance on the program truly is. At the first village meeting at the start of the Barefoot College initiative in Madagascar, WWF enjoyed the technical guidance of Bunker Roy and Meagan Carnahan, respectively founder and CEO of Barefoot College; thereafter, the WWF team was able to run the process by itself, with approval from Barefoot College.

During the village meeting, WWF decides whether or not it is appropriate to go through the whole Barefoot College approach in the village, based on the exchanges and the stance expressed by the community on various key points. If it turns out during the meeting that the conditions are not met to ensure the sustainability of the approach, WWF does not insist because it means that the community is not ready for it. A full meeting includes eight stages in which specific topics are dealt with; the approach is implemented if all eight steps have been successfully completed.

In **Mahasoa,** Sambava District, SAVA Region, the Barefoot College approach has not been fully completed.

In January 2016, the WWF team visited the village of Mahasoa located 1hour 30 minutes' drive and 3 days walk from the town of Andapa, in the North East of Madagascar. While there was initially a great turnout, the audience quickly thinned out. We had to postpone the meeting twice because we needed the presence of a majority of the adult community to make any decision. Through exchanges and investigations, we learned that the village was divided into 2 social categories with strained relations: the modest but non-majority category which attended the meetings was interested, unlike the other, more affluent category, which did not consider it necessary to support the other group in this opportunity. Moreover, the approach was the subject of malicious rumors well ahead of the WWF team's arrival, which did not help build trust. At the end of the third meeting, which was still at Step 4, we decided to stop and not implement the approach in the village given the lack of interest expressed and the difficult social context: this posed too many risks in terms of sustainability.

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Judicael Rakotondrazafy,
WWF Technical Officer for the Menabe Area

"As is generally the case in community development projects, local communities still expect donations. In order for the approach to be successful with lasting effects and impacts, it is important to emphasize right from the outset that the village electrification project belongs to the community, they are the ones who decide and implement it, and it is their project. "

1 A first step to explain the purpose of the meeting and break the ice.

The first step of the meeting aims to understand what the community knows about the reasons for holding the village meeting, in order to understand the level of rumors, and defuse any false ones during the discussions. It is also about understanding the expectations of the population, and explaining those that can be met, and those that will not be met.

The reasons for holding the village meeting are clarified: to consult with the population on the possibility and feasibility of having access to electricity in the village, considering the local context. It is important to consult this way because electrification, if done, needs close collaboration between WWF and the community. It is not about WWF "giving", it is a matter of working together; electrification can only happen if the community is the main actor. The community brings electricity to itself, and WWF is only there to facilitate.

The reasons for choosing the village are explained, to highlight the opportunity for the village. It is helpful at this stage to explain how and why the village was chosen from amongst many others.

2 A second step to bring together the stakes of energy practices in the village.

This step aims to understand what energy the population uses as a source of light, as access to information, and to communicate; identifying in particular what is used by the majority of community members. Monthly expenditures associated with these energy uses are assessed with the community, and this allows everyone to be aware of the economic reality of their energy practices. We then come up with a range of monthly energy expenditures, which everyone accepts to reflect their reality.

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Kerosene lamps are the most commonly used lighting source ▲

Energy practices in the village of Ambakivao

In the village of Ambakivao, the majority of households use a kerosene lamp as source of light. The average monthly expenditure on the purchase of kerosene is Ariary 15,000. Using candles is rare and occasional, and a candle costs Ariary 1,000 to 1,500. Many households use an electric torch in addition to the kerosene lamp, especially because they are fishermen, who spent about Ariary 12,000 a month on batteries. For those who use a phone, recharging it daily with those who have a solar system costs Ariary 7,500 a month, while those who want to charge a small radio must fork up Ariary 30,000 to 42,000 every month. Clearly, energy costs are high, almost 5 Euros a month for a single, low and polluting light.

3 A third step allowing the community to decide if they are interested in moving towards the solar alternative.

Discussions are held to understand what the community expect as an alternative to their energy practices, and we examine together the relevance and feasibility of the alternatives identified. The discussion easily turns to solar photovoltaic, because in all the villages chosen, there has always been at least one person who has already seen or experienced solar photovoltaic. These people are asked to explain to others what can be expected, how it works, how much it costs, the benefits, etc. WWF confirms, corrects or adds as much information as necessary: composition / operation, possible uses and limitations, conditions for proper operation (maintenance / service), and service life.

Thus, it is clear that using a solar system also means having energy expenditure as for current energy practices: it is necessary to manufacture, install, maintain, replace; technicians must be paid to maintain and replace any equipment that expires. Knowingly, the community then decides whether they are willing or not to embrace the solar alternative.

4 A fourth step allows the community to position itself in relation to the cost of the proposed solar alternative, and to decide if they want to move ahead.

We introduce the solar systems provided by the approach to the community, particularly with respect to the electricity services they provide. Three levels of services are offered, and each level of service has a monthly cost to ensure its sustainability (upkeep, maintenance, replacement). The higher the level of service,the higher the cost. Each interested household has the choice between the three levels of service, and will have to commit to paying a regular fee to a village committee; the contributions collected will be managed by this committee to ensure the sustainability of the service at the household level. Monthly contributions range from Ariary 3,000 to 10,000.

	Iavomanitra and Tsaratanana	Other villages
Service 1 **3,000 Ar/month**	1 solar lantern + 1 solar home system for 1 lamp	1 solar lantern with the ability to charge a phone
Service 2 **6,000 Ar/month**	1 solar lantern + 1 solar home system for 2 lamps	1 solar home system for 4 lamps, with the ability to charge a phone and/or listen to a small radio
Service 3 **10,000 Ar/ month**	1 solar lantern + 1 solar home system for 3 lamps with the possibility to charge a phone and/or listen to a small radio	1 solar home system for 4 lamps, with the possibility to charge a phone and/or listen to a small radio + 1 solar lantern with the possibility of recharging a phone

Progressive improvement of the services offered

The services offered to Iavomanitra and Tsaratanana are different from those offered in the villages that followed. When the village meeting took place in both villages, aside from the solar lantern, Barefoot College offered 3 types of solar home systems with different power possibilities. Afterwards, Barefoot College optimized the products taking in consideration the feedback from various countries, and in the end only one type of solar home system was selected (40Wc / 12V) and delivered. This changed nothing in the services for which households in Tsaratanana signed up (related to the authorized uses), but this led to some confusion we had to sort out: a villager who signed up for service 3 did not understand why he had the same equipment as the one who subscribed for service 1, while he was paying more. The contribution was mainly related to the cost of renewing the batteries (therefore for a lower use it would not be necessary to replace the used battery with a battery of the same power). This situation was resolved to the effect that authorized uses of the power systems were consistent with what the village had initially signed up for.

The regular contributions for the solar services offered are thus below the monthly household energy expenditure related to the "traditional" practices discussed during the meeting. Obviously, despite attempts to negotiate down the amount of contributions, in general, the community recognizes the economic relevance of the proposed solar alternative as something that must be paid for. The contributions announced are the minimum; it is explained that higher contributions would better ensure the expenses that will occur for the repair and replacement of solar components, because the community has no control over the cost of replacing the battery, for example, though this may change over time. *[See Section on "Managing the electricity service"]*

Besides, in rural areas, cash flows depend on the agricultural calendar in general. Thus, although the contributions are expressed monthly, it is always possible for households to convene with the village committee and decide on the frequency of payment that suits the availability of money in each case.

Usually, this fourth step is the most critical, and is the subject of much discussion. Before the community makes a unanimous and firm decision, we may have to incentivize villagers with the support of local leaders and authorities. They also often request further explanations from WWF. If the community decides that the conditions are acceptable, the meeting moves on.

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Women from Ambakivao attending training in Tilonia with others from Botswana, Mali, Senegal, Myanmar, Somalia, Cape Verde, Tonga, Syria, Mexico, Kiribati and Micronesia ▲

5 A fifth step allows the community to position themselves in relation to the requirements for implementing the Woman Solar Engineer approach, and decide if they want to move ahead further.

The main aspects of the approach as well as the requirements for implementing it are explained to the community, which, for each requirement, must clearly signify its agreement or lack thereof. The meeting continues if the community agrees with each of the following six requirements:

Requirement 1 The electricity service is paying, as explained in the fourth step; every household that will benefit from electricity will have to pay a regular contribution to maintain it.

Requirement 2 The manufacturing, assembly, installation and maintenance of solar systems, as well as the training of households to use them, will be conducted by women from the village, who will be chosen during the meeting. Women do not need to know how to read or write, they do not need to have any experience, and they should not have responsibilities in the village; these criteria are the essence of the Barefoot College approach that favors the most vulnerable groups by highlighting their potential and demonstrating that these groups have their place in society. These women will go to India for 6 months to become "solar engineers". They go there for the community, because when they return, they will have the responsibility to provide households in the village with solar systems.

Requirement 3 A village solar committee needs to be set up to manage the implementation of the village-level approach, and to manage the electricity service in a sustainable way once the households are equipped. The members of the solar committee will be chosen by the community during the village meeting. In particular, the solar committee must manage the contributions from households in all transparency. The solar committee will receive training and support from the WWF team. The solar committee is a subcommittee of the CBO, as there is a link between the implementation of the approach and conservation efforts. However, as this solar

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The solar house of Tsaratanana ▲

The **community house** must have the following minimum characteristics:

1. Weather resistant.
2. A lockable room that will serve as a workshop for technicians and is large enough, with worktable / chairs and storage space.
3. A lockable room that will serve as storage place for materials, without moisture, and protected from rodents.
4. A lockable room that will serve as a community hall.
5. Situated in an area without any risk of shade over the solar panels, to be set up either on the roof, or elevated on a structure near the house.
6. To easily set up the solar panels on the roof, this latter should be waterproof and made of sheet metal, if possible directed from the south to the north, with the slope directed to the north to maximize sunlight.
7. On a site where security is easy to prevent vandalism and theft; if necessary, the solar committee decides with the community whether to consider a guarding system.

committee will manage the contributions collected from households, electricity users will have to set up an association to be led by the solar committee, to have a specific bank account.

Requirement 4 200 households will be equipped, which should represent almost all households in the village/hamlet. The solar committee will need to list the 200 households and what they want as a level of service based on the amount of contributions for which each household is willing to commit to a regular payment. Those who are not on the list and have not committed will not be equipped when the Women Solar Engineers return. The costs of implementing the approach must be optimized, and this requires a total number of 200 households.

Later, if everything goes well in the management of electricity service at the village level, we can consider accommodating new members. Whilst drafting the list, if there are more than 200 requests, the solar committee must agree on prioritization criteria with the community, including:

(i) membership of the CBO, and

(ii) those still without modern lighting.

Requirement 5 The solar committee will have to mobilize the community to transport equipment for the electrification to the village, from the nearest place accessible by truck. This transport by the community is counted as beneficiaries' contribution to implementing the approach.

Requirement 6 The village community will have to build a community house for the village before the women return, under the coordination of the solar committee. It will serve as a workshop for Women Solar Engineers and as a meeting place or for housing various activities for the community. The community must support the construction of the community house, as this is also counted as a beneficiaries' contribution to implementing the approach.

The community of Tsaratanana transport the materials on foot ▼

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Women from Vorojà are reluctant to take plane ▲

The community house will be equipped with a solar photovoltaic system by the Women Solar Engineers and will be able to support – if necessary and if the means to acquire them are mobilized – the use of a TV/video, a computer, or other devices. In general, the community proposes the CBO's facility for this purpose. The community can use the community house, especially the community hall, as it sees fit and under the coordination of the solar committee and the CBO.

Since Stage 4 has already lifted Requirement 1, which is the most difficult, Requirement 2 is usually the one that is subject to many questions, doubts and concerns; it has occurred that the community asks to withdraw and discuss it in private at this point. Men generally encourage and envy women, while women worry about what can happen to them during this far-off journey to an unknown country, as well as what can happen to their children and grandchildren in their absence. For the first two villages, the community questioned the relevance of sending illiterate middle-aged women and grandmothers, because there was no Malagasy example. But in the following villages, the capacity of rural Malagasy women was no longer questioned, thanks to the existing examples.

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Vorojà, one of the poorest villages among those selected ▲

The village of **Vorojà,** in southwestern Madagascar, is unequivocally the poorest of the five WWF intervention villages chosen for the implementation of the approach. The population lives in an even more serious situation of isolation than the other communities. The area endures periods of intense drought, in a harsh climate, with limited resources of household income. Contrary to what we assumed might be a difficult sell, the community had no strong reactions to the proposed electricity services and the corresponding costs, which they considered justified and interesting compared to what they spent already. The majority was interested in Service 1, closest to their reach, and stage 4 of the meeting went well. On the other hand, when we arrived at Requirement 2 of Stage 5, on sending women to India to become village technicians, men were favorable, but women expressed their reluctance. They couldn't fathom flying on an airplane because they thought it was not respectful of the ancestors (flying over them) and would be similar to breaking a taboo, a cultural argument that never crossed our mind as an issue, but to them posed a very serious discussion point. Village elders and authorities took it upon themselves to present things differently, as they would not fly from the village of Vorojà but out of Antananarivo, so without any risk of flying over the tombs of their ancestors. Nevertheless, women were still reluctant, and finally, the community chose to meet separately to discuss in private. They agreed then to the requirement of sending women to India, albeit with some minor reservations.

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Village meeting in Vorojà ▲

The following are the **selection criteria** for women:

- Volunteer.
- Aged 35 to 50; in general, in this age group, they have children and/or grandchildren
- Not breastfeeding infants, not pregnant.
- Has family approval.
- Not holding a particular position in the village; in general, they have little or no educational background.
- Not married to a man with a special position in the village.

6 Stage 6 is about selecting the future Women Solar Engineers

The selection of women follows a well-defined and transparent, dynamic process for identifying women meeting a number of established criteria, targeting the most vulnerable and taking into account Barefoot College's experience since 1972. Indeed, in the 1990s, Barefoot College began training young and illiterate or semi-literate rural women in solar technology; the college quickly realized that the best candidates were middle-aged women (in their forties) – most of whom are grandmothers. These women show humility, are acquainted with their village and have no desire to leave.

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Armandine, among the selected women in Vorojà with some members of her family ▲

At the end of the plenary process with the community, the few remaining women eligible for the different criteria must publicly confirm their willingness and motivation, and the family must also confirm their approval. Then, local authorities, local leaders and the entire community confirm the choice of women.

In general, women have no clear idea of their age, or worse, have an incorrect idea, which does not facilitate the screening process. Consequently, the selected women are all more or less within the required age range, and local leaders step up to help as they know each member of the community. In addition, some families or husbands do not give their approval, or the families give their approval at the time of the village meeting because of social pressure, but change their mind much later. We must then make new choices that are as transparent as possible to replace those who withdrew.

At the end of this stage, the ideal is to get the exact number of women required, namely 1 woman for every 50 households (i.e. 4 women per 200 households); this was the case in Tsaratanana, Iavomanitra and Ambakivao. In the case of Vorojà and Andranomilolo, at the end of the process, there were not enough eligible women left; it was thus necessary to incentivize and encourage women to volunteer for the good of the community, or to agree on some flexibility in the criteria. So far, we have not encountered any situation where there have been more eligible women than the required quota.

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Maximiène (Andranomilolo) and Bandisa (Tsaratanana) are among the volunteer women who did not have the support of their families; Maximiène became treasurer of the solar committee ▲

Volunteer women who could not take part in the training: respect the family's position.

The village meeting in Tsaratanana was held in December 2012. At the end of the process, three women were selected: Zafitsiha, Philomène, Bandisa. Representatives of Bandisa's family gave their approval for Bandisa's participation in the training. A month later, we learned that Bandisa had to withdraw, not because of her own will but because her family changed its mind after internal consultations. The community has proposed Dotine as a replacement. The same thing happened in Vorojà: initially, a woman named Hantasoa was supposed to participate in the training, but pursuant to the meeting, her family withdrew their approval. In Iavomanitra, a woman had volunteered, but her husband did not agree; this also happened to another woman in Andranomilolo, who then became treasurer of the solar committee.

THE 19 MALAGASY "WOMEN SOLAR ENGINEERS" OF BAREFOOT COLLEGE

CLASS OF MARCH - SEPTEMBER 2013

BERTHE (Berthe Razanamahasoa)

Selected in November 2012, village of Iavomanitra

Betsileo Tribe

56 years old in June 2017 (born in November 1960)

Married - 1 children and 1 grandchildren

School level: 3 years of Primary

Farmer - family has 3 zebus, 30 hens, and 3 pigs

PHILOMÈNE

Selected in December 2012, village of Tsaratanana

Sahafatra tribe

55 years old in June 2017 (date of birth: around 1962)

Divorced - 9 children and 8 grandchildren

School level: 1 year of Primary

Farmer - family has 4 zebus, 3 hens and 2 ducks

GERMAINE (Germaine Razafindravelo)

Selected in November 2012, village of Iavomanitra

Betsileo Tribe

54 years old in June 2017 (date of birth: August 1962)

Married - 4 children and 2 grandchildren

School level: 3 years of Primary

Farmer - family has 3 zebus, 10 hens, and 3 ducks

ZAFITSIHA

Selected December 2012, village of Tsaratanana

Sahafatra tribe

47 years old in June 2017 (date of birth: around 1970)

Married - 6 children and 2 grandchildren

School level: 2 years of Primary

Farmer - family has 2 zebus, 6 hens and 3 ducks

DOTINY

Selected December 2012, village of Tsaratanana

Sahafatra tribe

46 years old in June 2017 (date of birth: around 1971)

Single - 5 children and 1 grandchildren

School level: none

Farmer - no possession

LYDIA (Saholiarisoa Lydia Razafindramanana)

Selected in November 2012, village of Iavomanitra

Betsileo Tribe

46 years old in June 2017 (date of birth: August 1970)

Married - 7 children and 5 grandchildren

School level: 5 years of Primary

Farmer - family has 1 zebu and 10 rabbits

FLORETTE (Vonjiniaina Florette Rasoamampionona)

Selected in November 2012, village of Iavomanitra

Betsileo Tribe

43 years old in June 2017 (born in October 1973)

Married - 6 children and 1 grandchildren

School level: Primary + 3 years of college

Farmer - family has 2 zebus

CLASS OF MARCH - SEPTEMBER 2016

KALOZANDRY

Selected in January 2016, village of Andranomilolo

Tsimihety tribe

52 years old in June 2017 (date of birth: May 1965)

Widow - 1 children and 3 grandchildren

School level: 9 years of Primary

Farmer - family has 2 goats and 6 hens

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MADELEINE (Madeleine Mamisoa)

Selected in January 2016, village of Andranomilolo

Tsimihety tribe

39 years old in June 2017 (born in April 1978)

Widow - 2 children and 2 grandchildren

School level: 9 years of Primary

Farmer - family has 3 goats, 4 pigs and 4 hens

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SOAVINIERA

Selected in January 2016, village of Andranomilolo

Tsimihety tribe

52 years old in June 2017 (date of birth: March 1965)

Married - without children (cannot have one)

School level: none

Farmer - family has 3 goats

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LOUISE (Louise Nary)

Selected in January 2016, village of Andranomilolo

Tsimihety tribe

41 years old in June 2017 (born in December 1975)

Divorced - 5 children

School level: 5 years of Primary

Farmer - the family has 2 goats

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CLASS OF SEPTEMBER 2016 – MARCH 2017

KINGELINE

Selected in June 2016, Ambakivao village

Vezo tribe

44 years old in June 2017 (date of birth: July 1972)

Married - 2 children and 3 grandchildren

School level: 2 years of Primary

Fisherman - the family has ducks

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REMEZA

Selected in June 2016, Ambakivao village

Sakalava tribe

35 years old in June 2017 (birthday: around 1982)

Married - 1 children and 3 grandchildren

School level: 2 years of Primary

Fisherman - the family has ducks

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YOLLANDE

(Randrianambinina Yollande)

Selected in June 2016, Ambakivao village

Mahafaly tribe

52 years old in June 2017 (born in February 1965)

Married - 2 children and 1 granchildren

School level: Primary + Secondary + 3 years of High School

Fisherman - family has ducks and hens

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HANITRA (Andrianasolo Hanitra Sylvia)

Selected in June 2016, Ambakivao village

Betsileo Tribe

38 years old in June 2017 (born in September 1979)

Married - 2 children

School level: Primary + Secondary + 3 years of High School

Housewife - family has ducks

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CLASS OF MARCH - SEPTEMBER 2017

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VOAHANGINIRINA

(Voahanginirina Raharimalala)

Selected in November 2016, village of Vorojà

Zamainte Tribe

40 years old in June 2017 (birthday: around 1977)

Married - 6 children

School level: none

Farmer - no possession

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ARMANDINE (Armandine Mahatraza)

Selected in November 2016, village of Vorojà

Zamainte Tribe

37 years old in June 2017 (born in November 1983)

Married - 7 children and 1 small children

School level: 2 years of Primary

Farmer - no possession

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VANDIDRAZA

Selected in November 2016, village of Vorojà

Zamainte Tribe

56 years old in June 2017 (born in December 1960)

Married - 1 children and 6 grandchildren

School level: none

Farmer - no possession

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AKINTSOA

Selected in November 2016, village of Vorojà

Temitonga tribe

37 years old in June 2017 (date of birth: around 1980)

Married - 2 children

School level: none

Farmer - no possession

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The solar committee of Vorojà ▲

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The solar committee of Ambakivao ▲

7 The seventh step is to set up the village solar committee.

The solar committee includes at least a chairman, a vice-chairman, a treasurer, a secretary, and sometimes advisors. It includes as many women as men if the number is even, or more women if the number of members is odd. They all must be literate and able to count. The chairman, vice-chairman and treasurer must have a reputation for integrity. The chairman and vice-chairman must also be recognized for their leadership.

These individuals are chosen from within the community, by the community. In general, they are volunteers or voluntold, then they arrange with each other and with the recommendations of the community to share the functions. The community ultimately gives its approval, as do local authorities and local leaders.

Village	IAVOMANITRA	TSARATA-NANA	ANDRANOMI-LOLO	AMBAKIVAO	VOROJÀ
Chair-man	RAZAFIMAHAFALY Ravonimanana	Venance	RAVELONANJARA Martha	RAZANAMALALA Jean De Dieu	Ralahy Flambert
Vice-chairman	RASOAFANIRY Amélie Dénise	Celme Mamico	KAMISY Jean Herley	NOARISOA Alphonsine	Zotondraza
Trea-surer	RASOAMIARANTSOA Perle	Charles	TSARATODY Maximiène	RASOANANTENAINA Clarisse	Velontsoa
Secretary	RAKOTONDRINA Donné	Tobafamelo	FIDIZANDRY Alain Stephano	ZAFINIRINA Julianah Angele	Mahazomasy
Advisors	RAZAFINDRALAMBO Rasolofo Albert RANDRIAMANANJARA Jean Alfred RAZAFIMAHATRATRA Philipson	Tovea	DOVIENNE Zandrifine RACHEL Jean	ADIZA Flaurine ALPHONSE Marcellin	Nomesoa Velontena Afemasy Lignemasy Esaodraza

The community of Ambakivao watches the adventure of the first seven women ▲

8 The eighth step is a relaxing session of sharing experiences with the community

The experience of the other Malagasy villages that implemented the approach is shared with the communities, by screening videos and photos. To reassure their families, further explanations are particularly provided on the living conditions of women while in India.

All decisions agreed on during the village meeting are recorded in minutes signed by local leaders, local authorities, the chairman of the solar committee and WWF.

3. PREPARING THE WOMEN BEFORE THEY GO FOR TRAINING

In most cases, the selected women have very little to no educational background. Hanitra, Yollande and Florette are exceptions: the first two made it to grade 12 and the second made it to the last class of secondary. Moreover, few of them had the opportunity to travel beyond the main town of the district covering their village, and except for Hanitra from Ambakivao, none have ever flown on a plane. Thus, taking a long journey by road and plane and staying for six months in a foreign country with an unknown language and set of customs is a huge challenge for all these women.

As a result the psychological, administrative and material preparation of the women before their departure for training is a very important phase in the process. Throughout this period, WWF works to confront them with new situations to which they must adapt, so that they are confident about the journey that they will undertake and are in a sufficiently sound psychological state to deal with any situation calmly. They must also carry out several administrative procedures to travel to India, and WWF makes sure they are equipped to a minimum so that they can travel with confidence.

This preparatory period has seven key steps.

The steps before departure are carefully planned.

Immediately after the village meeting, the WWF team talks with the women in the presence of the solar committee to inform them better and reassure them about what they will go through. An important and sometimes delicate point is also addressed, with each woman and her spouse: they must not become pregnant before they leave for India.

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Marie Hélène Rasoalalanirina, WWF Technical Agent in the Northern Highlands Landscape - about Madeleine, Louise, Kalozandry and Soaviniera, from the village of Andranomilolo

"The psychological preparation of the grandmothers was not easy because they came from a landlocked community, and it was the first time that they discovered a big town like Antananarivo. Their accompaniment was really a challenge and required a lot of willpower. We had to plan ahead of all the steps to take with them so they would not be surprised, and anticipate any problems. All this being said, the time I spent with these women has greatly inspired me, just thinking about their low level of literacy and what they were able to do during their journey and their stay in India."

© WWF Madagascar / José Randriamananarivo

Information on women is provided by WWF teams in Iavomanitra ▲

Eligibility of selected women is confirmed within Barefoot College

This step was not necessary when selecting the first village, Iavomanitra, because the team from Barefoot College attended their selection. For the following villages, at the end of each village meeting, the WWF team completes a descriptive form for each woman that helps Barefoot College decide whether or not the woman is eligible for the Woman Solar Engineer program. So far, all the women who had been selected by the WWF team have been confirmed as selected later.

The administrative documents necessary for the journey and their stay are constituted.

Each woman must have the following documents to be able to proceed with the administrative procedures for their trip to India:

(i) national identity card and certified copy that is less than six months old

(ii) birth certificate that is less than six months old

(iii) certificate of residence issued by the village chief

(iv) family record book for officially married women

(v) a letter of authorization from local authorities regarding women's participation in training at Barefoot College

(vi) identity photos

WWF, the village chief and the mayor facilitate the collection of these administrative documents.

When a woman does not have a national identity card, she must get one at the commune. The information on the national identity card is recorded on all the forms necessary for their journey: name and especially date of birth are considered, because the names and dates of birth declared by the women do not always match the official versions. In addition, few women have a copy of their birth certificate; they had to obtain this for the first time in their life. This requires more or less long and complicated steps depending on the case and the requirements at the court in the main town in the region. Kingeline and Remeza from Ambakivao, as well as Akintsoa and Armandine from Vorojà had to comply with these procedures.

At the end of the village meeting in Andranomilolo, Kalozandry registered on the Barefoot College form under the name Vavihita Georgine. When she had to get a national identity card, it turned out that her birth certificate had her name as Kalozandry; so we had to start the administrative steps all over again. Remeza, from the village of Ambakivao, did not have a copy of her birth certificate, and no birth certificate was available in her commune; her identity card had been issued during the electoral operations – therefore without much rigor as to the justifications required under normal times. We had to carry out investigations in her village and commune of origin to find someone who could testify and help get an excerpt of her birth certificate at the court of Morondava.

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The Ambassador of India invited the women from Ambakivao to his residence before their departure to India ▲

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Prisca Zandry, WWF socio-organizer in the Manambolo Tsiribihina landscape talks about Remeza, Hanitra, Kingeline and Yollande from the village of Ambakivao.

"The approach is very interesting and the preparation of the women's trip was a journey full of uncertainties from beginning to end; even steps/details that seem innocuous have gone for incredible spins!

There was this unfortunate candidate whose adventure stopped abruptly after the medical check-up: I was totally shaken as I did not imagine this, even in worst case scenario, but life goes on.

Preparing Remeza's birth certificate was an obstacle course during which, together with Judicael, we found out just how complex the administrative institutions of the Menabe Region truly are, from the court offices to the communes, as well as in our dealings with the region's hinterland. We went to the extremely remote village of Antevamena, looking for Remeza's origins with which to reconstruct her birth certificate, after having tried every possible and imaginable remedy elsewhere. Seeing the pride mixed with fear in her mother's eyes, having to accept that her children was heading to a distant and unknown place (in her eyes, Remeza is still a children, although already a grandmother), and meeting with her cousins and uncle was a truly memorable experience.

Accompanying the women for their trip goes beyond the "work" aspect, as it is also a human experience: I got to know these women, and share privileged moments with them. Yes, it was difficult at times, but getting past each step was a small victory and encouraged us to keep moving, and ultimately, to see them come back transformed, more assertive, stronger... as the community considers them as hope for the future, and tell myself that I chipped in... I am very proud of them and I can say it was worth it. I could write a whole book about it but in a few words: from the preparation phase for the trip, I only have good memories and lessons diamond-studded with many anecdotes."

The women are officially registered in the Indian Government's ITEC program.

Barefoot College's Woman Solar Engineer training program is registered in the Indian Government's Economic and Technical Cooperation (ITEC) program. Thus, each and every woman needed the approval of the Indian Government to take part in this program; once accepted, the Indian government fully funds the six-month trip, stay and training, and grants them free visas.

For each woman, the application document to be submitted to the Embassy of India must include:

- The completed online application form, printed and signed by the woman, with the photo and useful information required.
- The woman's commitment, signed, in which she certifies that:
  - (i) she knows the training program in which she will take part
  - (ii) she did not participate in other training programs funded by the Government of India
  - (iii) she did not apply for another training program funded by the Indian Government
  - (iv) she is in good health
  - (v) she will comply with the rules set forth by the training establishment
  - (vi) she will follow the training to completion

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Kingeline gets her yellow fever shot at the Institute Pasteur of Antananarivo ▲

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Solo Thierry Randriamanalina,
Energy Technical Assistant at WWF Madagascar.

"My role is to make sure that women go to India under the best circumstances and that materials get to their village. This includes administrative aspects such as passports, registration documents, links with ministries, visas... this also includes logistical aspects: purchasing travel supplies, and various preparation meetings.

In Antananarivo, the adventure becomes more complex for these women. They are mostly used to the calm and serenity of their village; some have never been to the capital. In Antananarivo, they see firsthand the frenzied city lifestyle with traffic jams, shops and grocery stores, and all the people milling around and jostling in the street. They also discover how the administration works, that they have rights as citizens. They move ahead despite their doubts and questions, to try to make the life better for their village, for their children."

(vii) she will submit to the required assessments during the training

(viii) she will not engage in any political or lucrative activity during the training

(ix) she will return to her country after the training

(x) she will not go to India if she is pregnant

- A medical report confirming her good health. The medical check-up report must be drafted and signed by an official doctor. The woman must be free from any mental or physical disability, any infectious disease (HIV, tuberculosis...), must have an acceptable blood sugar level, be vaccinated against yellow fever, and all treatments that she must follow need to be stated.
- A statement signed by the district chief confirming the woman's eligibility and approval of her application.
- A note signed by the Minister of Foreign Affairs (MFA) addressed to the Embassy of India in Madagascar, stating that the MFA approves the woman's application file and asks the Embassy of India to process it. In order for the MFA to draw up this note, the Minister in charge of Energy must send a letter to the Minister of Foreign Affairs, stating that the Ministry in charge of Energy supports the woman's application for the ITEC program.

WWF helps gather all these documents.

Signing the different forms has been a challenge for some women, as they are illiterate. Some of them need some practice beforehand.

Securing the authorization from the district often requires long travel because the village is so remote. The district, informed on the Barefoot approach from the beginning, is generally very cooperative, and this is also thanks to support from the mayor.

The medical check-up requires a trip to the main town in the commune or the district, depending on the health services available. The application of a woman selected in Ambakivao had to be withdrawn because she did not meet all the required health requirements; she was then replaced. During this trip, we also took identity photos needed for each woman.

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Hajaniaina Verner, WWF socio-organizer in the Mahafaly landscape talks about Armandine, Akintsoa, Voahanginirina and Vandidraza from the village of Vorojà.

"The 4 women in the village of Vorojà had a lot of fears at the beginning, about flying, going to a distant country, being there as a foreigner, unable to speak that country's language, but also having no school background. Then this fear evolved into curiosity for this new life, this new country, this new means of traveling, this new living environment, and this new experience. To this curiosity was added the desire to learn and sacrifice a little to bring new things to the village, as they say so well, "We cannot move forward unless we have the will". Moreover, the fact that they go as a team of four allowed them to know each other better and to have stronger ties, they became fused together. I have also noticed that they have totally different habits from those in the city (hygiene, clothing, culture...). They come from a very remote village."

The steps with the Ministry in charge of Energy are more or less long. Since 2012, the country has experienced at least five ministerial changes, including acting ministers. Depending on the sensitivity of the Ministers or current Secretaries-General to the approach, the time required to get their approval was more or less long; the same goes for the Ministry of Foreign Affairs.

The application file submitted to the Embassy of India in Madagascar is then processed by the Government of India. No applications filed have been rejected so far.

The women from Ambakivao visiting shopping centers in Antananarivo ▼

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Participants to the first class taking advantage of their visit to Tana to buy solid leather sandals ▲

In general for the first time in their lives, the women see the capital city of Antananarivo.

A first ever trip to the capital for the women, about one week long, allows them to get a passport, get their yellow fever shot, set up a travel kit, and get ready for what is awaiting them. This is a huge leap for them, because during their stay, they face a very different environment and many new situations.

If, for the first class, the women had been housed in a faith-based welcome center, WWF very quickly opted for housing in the city, in a hotel, thus forcing them to learn to live differently. They are chaperoned by one WWF mentor whom they know well, who works with them daily in their village to manage natural ecosystems. Strolling through the city center, visiting historical and cultural sites (Queen's Palace, Zoological Park, etc.), going shopping in various shopping centers and markets, visiting the international airport, visiting the Ministry of the Interior, at the Institut Pasteur, and visiting WWF's facilities are all part of the activities carried out during their stay.

Setting up the travel kit aims to provide them with minimum amenities to be comfortable during their trip and stay, knowing that once at Barefoot College in Tilonia, the team from Barefoot College will give them everything they need (clothing, toiletries, telephone, etc.) The purchase includes a large suitcase, a backpack, some clothing and hygiene items, leather sandals and a pharmacy kit.

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Ceremony of blessing of the first class in the commune of Miarinavaritra ▲

WWF also holds an in-depth session on their trip and stay, during which all questions are addressed to help them be as comfortable as possible with what will happen to them, while providing further instructions and recommendations. These sessions are in the form of screenings of photos and discussions/exchanges.

The procedures for securing passports have generally been fluid, and getting the yellow fever shot at Institut Pasteur has always been smooth.

Thus, little by little, these women's horizons open up and they gain more and more confidence as they face many situations that also force them to get out of their comfort zone; they also find these useful to the extent that they can project themselves into their future journey to and stay in India.

After this first stay in the capital, we can say that the women have already undergone an initial transformation, which the villagers noticed.

A ceremony of blessing is held in the village for their departure for the great trip.

Ceremony of blessing in the village of Ambakivao ▼

© WWF Madagascar / Tony Rakoto

D-Day is the day of departure from the village. The community holds a ceremony of blessing in the presence of local authorities and WWF; indeed, it is also an opportunity for said authorities and WWF to reaffirm that they will closely monitor the women's trip and that nothing bad will happen to them. The content of the ceremony may vary depending on local customs, but in general, in addition to the usual speeches, the women from the village perform a dance show to honor their peers, a zebu is killed as a sacrifice and shared with the community. This moment is very important for the

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Party at the village feast before the women from Tsaratanana left ▼▲

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The women of the first class, ready to take plane for the first time in their lives ▲

© WWF Madagascar / Jean Philippe Denruyter

Valiha Rakotomanankasina, socio-organizer of WWF in the landscape of the Fandriana Vondrozo corridor talks about Florette, Lydia, Germaine and Berthe from the village of Iavomanitra.

"We had established a good complicity despite some awkward moments with me being a young man and they being women."

women, as the village has now entrusted them with a mission. They are the representatives of their village, their commune, their region, and they must assume this role with honor, as the whole community is there to encourage them.

Once in Antananarivo, other events are organized in their honor, reminding them that they will also represent Madagascar. For the first class, a high-level ceremony was organized in the presence of the Ambassador of India and prestigious guests; a press conference also gave us an opportunity to present this first class to the public. For the second class, the ceremony was honored by the Minister of Energy and all his team, as well as the Embassy of India. For subsequent classes, we organized courtesy visits to the Indian Embassy, the Ministry of Energy and the Ministry of Population who gave them their blessing. Finally, in a more convivial and relaxed way, for each class, a meeting with WWF staff was organized.

Final preparations before departure.

For a week before leaving for India, women stayed in the capital Antananarivo for final preparations. In addition to the various ceremonies, this was the time when the Indian Embassy issued them their visa and their plane ticket, with details of the itinerary ahead.

The women travel alone, as this is part of their learning. The onward trip of the first class was quite simple, with only one stopover in Mauritius. For the second class, it was more complicated with a quick stop in Nairobi, then a stopover in Mumbai. The third class also had two stopovers, in Mauritius then in Mumbai. The fourth class has transited through the Seychelles and Mumbai. The women are generally illiterate, and only spoke their dialect. To help them, WWF has put together a set of pictorial cards containing key information about their trip and key questions they

The **second class** from Madagascar, made up of Kalozandry, Louise, Madeleine and Soaviniera from the village of Andranomilolo had a very difficult outward trip, for them but also for the WWF and Barefoot College teams. The plane from Antananarivo was over half an hour late, but the women still managed to catch their Mumbai connection from Nairobi. The difficulties began in the big airport of Mumbai. Following a misunderstanding of the instructions, after having recovered their luggage, the women missed their correspondence for Delhi. Some police officers helped them buy a ticket for Delhi with the small cash they had been given in case of problems during the trip, and so they flew much later. Aware that they arrived at the wrong time at Delhi airport, and assuming that no one would be there to pick them up, they decided to try and get to Tilonia (about 8 hours' drive from Delhi) by themselves. An airport agent helped them get aboard a night-time bus and they arrived in the early morning at the Barefoot College gate in Tilonia. For over 24 hours, the WWF team in Madagascar, Barefoot College team in India and the Embassy of India were on alert trying to locate the 4 women with the help of various consulates, airports and airlines that had been contacted. Hearing that they had arrived in Tilonia was a great relief for everyone, and taught a lot of lessons that were useful for classes that came afterwards.

will likely ask officials on the plane and at the airport. We also had a simulation of everything they have to do: from baggage checking in Antananarivo to the reception by the Barefoot College team right outside Delhi airport.

Despite some problems, the women have always done well, and have all arrived safely, both ways. For the teams from WWF and Barefoot College, these moments are particularly tense, and all are waiting for the phone call confirming that everything went well.

The Secretary General of the Ministry in charge of Women's Promotion expressing words of encouragement to the four women from Ambakivao ▼

4. THE WOMEN'S STAY DURING THEIR TRAINING

Training at Barefoot College in Tilonia lasts six months, from September 16 to March 15, or from March 16 to September 15.

The Malagasy women attended the training with other women from different parts of the world. These women who do not necessarily speak the same languages learn to identify electronic components by their shape and color, perform technical tasks by following examples, and acquire the required skills to manufacture, set up, install, use, repair and maintain solar systems by following mimed instructions.

The training usually goes without a hitch. The first month is always very difficult because of the adaptation to new things; WWF staff establishes regular contact with the women during this period to encourage them. In addition to the curriculum on solar systems, women have the opportunity to learn other topics based on the training modules available onsite. Barefoot College always add novelty to the training courses: making chalk, making candles, sewing, and marketing are only a few of the activities that can be incorporated into the solar engineer training for women.

More information on life at Barefoot College is available on the website: *http://www.barefootcollege.org*

The food is essentially vegetarian ▲

Physical exercises are essential for staying in shape ▲

Manu Singh, Enriche Facilitator at Barefoot College Tilonia, India talks about Hanitra, Yollande, Remeza and Kingeline, from the village of Ambakivao.

"The four women from Madagascar are really very beautiful people who help a lot. They are respectful and patient while understanding the courses. Without any common language with other women, they are able to discuss and sympathize with them. I spend a lot of time with the participants in the training and I observed the friendship they fostered among each of the other women. They are also very good dancers. They all have this desire to learn, including the English language, of which they learned the basics: "Hello, how are you? Fine. What's your name? Good morning. Good night. Yes. No. "

I also had the opportunity to conduct sessions on health with Malagasy women. They really have a great thirst for knowledge and I would specifically like to point out the case of Hanitra who used "Google Translate" to convey the topics they would like to learn about women's health. She raised the issue of girls in her village who do not have adequate information on reproduction and contraception, and because of this gap in knowledge, cases of early pregnancy and unsafe abortion are familiar in the village. She wanted to acquire this knowledge so as to share it with the women's association of which she is a member, as well as with the girls of her community."

© Barefoot College

Women learn how to make components using the right electronic tools and equipment ▲

Barefoot College takes care of everything: accommodation, food, clothing, medical care.... Every woman has a phone. It is therefore possible to contact them directly. In particular, families can speak with the women on a regular basis.

In addition, Barefoot College organizes outings to help them discover a bit of India and its people. The food served is vegetarian-based. If they wish, women may hold Sunday prayer sessions, according to individual religious beliefs; they appreciate the openness of the center's leaders in this regard, since they are generally quite pious.

During their stay, women receive compensation from Barefoot College for their absence from the village, for the loss of profits from not being able to contribute to their family's income and livelihood from so far away. The families receive no monetary compensation when these women leave, and each of them generally arranges with community members before leaving to prevent any financial problems, especially concerning the needs of children. Each of them is free to manage these benefits as she wishes. Many of them save part of the money and invest it in income-generating activities upon their return.

The worst that can happen to women is to get bad news from home. It happened for two of them, of the same class: they learned, with a few months apart, that their husbands had passed away. Unfortunately, one cannot do much except inform them, with the close supervision of the Barefoot College team. In both cases, the women chose to pursue the training with courage.

© WWF Madagascar

Fanomezantsoa Rasandy, WWF Technical Officer in the Northern Highlands Landscape - about Kalozandry and Madeleine in particular, from the village of Andranomilolo.

"These grandmothers have shown tremendous courage and a burning desire to see change happen in their village. Some of them have lived family dramas during their stay in India, but despite this, they each showed perseverance to achieve their dream. For the community of Andranomilolo, they have become agents of development and actively participate in community conservation activities in a society where men still hold the power of decision."

The women from Andranomilolo performing Malagasy songs during a talent show event ▲

Women learn other things in the Enriche curriculum: here, using the digital tool ▲

They have the opportunity to open up to other practices, such as using solar cooking equipment at Barefoot College in Tilonia ▲

Visiting the famous Taj Mahal ▲

They attend the training with many other women from different parts of the world ▼

5. THE RETURN OF WOMEN TO THEIR VILLAGE

The precautions taken on the outward trip still apply to the women's return trip by plane, all by themselves. Upon their return, the women are different, more emancipated and resourceful; the trip is generally eventless.

Their return is celebrated, and allows them to share their experience with the public. To welcome the return of the women from Iavomanitra, Tsaratanana and Andranomilolo, a meeting with the press in the presence of the Ministry in charge of Energy, the Ministry in charge of Women's Promotion, the Embassy of India and the WWF took place. In addition to speaking about their experience, it is also an opportunity for the women to successfully demonstrate their abilities as a Woman Solar Engineer. Their return to their region and their village is also celebrated with joy and is always full of emotion. For the women from Iavomanitra, the town hall of Miarinavaratra organized a session to present Indian customs and traditions, during which they explained their life in India to fellow citizens, in the town hall's large room. It was a very lively session, where the audience asked many questions, surprised to hear the women speak basic English.

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Unlike their outward trip, the return trip for the women from Andranomilolo went off without any issue thanks to the experience they gained ▲

© WWF Madagascar / Mialisoa Randriamampianina

The people of Miarinavaritra wanted to welcome the women from Iavomanitra with all the honor that they deserve ▲

© WWF Madagascar / Mialisoa Randriamampianina

After the women from Andranomilolo were back, a press luncheon was organized in Antananarivo in the presence of the Ministry of Energy, the Ministry for Women's Promotion, the Ambassador of India and WWF. Journalists overwhelmed them with questions ▼▲

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In Andranomilolo, it was also a time of joy ▲▼

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Words from **Hanitra,** Ambakivao's Woman Solar Engineer, at the Earth Hour 2017 ceremony in Morondava, upon returning from training.

"We were four women to attend the solar energy training in India. We hope to help our village move ahead through these solar systems, given their multiple benefits. We decided to stop using kerosene lamps, which is both costly and harmful to health. Moreover, we hope that the incoming light will scare off the bandits and restore security in our village. We are waiting for our equipment to arrive so we can get to work. It is important to point out that although our level of education is quite low, we were able to complete our entire training in producing solar systems. The systems require caution and skills to run properly, especially with regards to welding. In addition, there are several products available according to people's purchasing power: solar lanterns, solar home systems with four bulbs. Solar lanterns offer users the ability to charge their phones. We invite you to visit the village of Ambakivao to see from yourself the facilities we will set up and the changes that will follow."

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Tears flowed in Iavomanitra, it was a pleasure to meet again after six long months ▲

The women from Ambakivao were the guests of honor at the 2017 Earth Hour ceremony held in Morondava ►

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6. ELECTRIFICATION OF THE VILLAGE

Barefoot College provides the equipment for electrifying the village by the "Solar Engineers" based on the list of beneficiary households established by the solar committee before the women left for training in India. Each woman is responsible for connecting 50 households; so, 4 "Women Solar Engineers" provide service for the 200 households as generally planned. Beyond the established list, the solar technicians can develop – with the solar committee – a solar entrepreneurship as described later in this document.

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The solar lantern ▲

© WWF Madagascar / Tony Rakoto

The solar home system kit ▲

© WWF Madagascar / Mialisoa Randriamampianina

The community of Tsaratanana has transported materials on foot and on canoes ▲

The materials come in the form of spare parts.

The US $270 solar home system includes the required spare parts for: a 12V/40 Wp solar panel, a 40 Ah/12V tubular gel battery, a 10A/12V charge controller, four 12V/4W LED lamps, cables and accessories, a solar panel fixing system, a cable system for easy wiring of telephones and a small radio.

The portable solar lantern, valued at US $70, includes the necessary spare parts for: a 12V/10Wp solar panel, a solar lantern incorporating a 12V/7.2Ah battery, a 12V/3W LED lamp, the charge controller and accessories, including a cable system for easy wiring of telephones and a small radio. Note that the features of the portable solar lantern have not always been so. What is described is the latest generation developed by Barefoot College. It has been designed taking into account the necessary improvements on the previous generations after feedback from the field: more robust, more efficient, with a "phone charging" feature. Older solar lanterns last less and instead of a LED lamp, there was a compact fluorescent lamp.

The set of materials for the electronic workshop or "REW - Rural Electronic Workshop", valued at USD 5,700, for setting up, installing and maintaining solar systems for the community house and households includes:

- spare parts for a solar system composed of: a 12V/300 Wp (4x12V/75Wp) solar panel, a 12V/300 Ah (3x12V/100 Ah) battery bank, a 40A/12V charge controller, a 800 VA 12VDC/220VAC converter.
- work tools, a manual, and a stock of spare parts for 2 years.

The materials are sent to the village.

The materials are shipped by boat from India to Madagascar, to the port closest to the final destination, so far Toamasina or Vohemar.

The equipment is imported free from import duties and taxes (DTI) as they are intended for rural electrification, in accordance with the Order 16152/2007 of 21.09.07, on the exemption of import duties and taxes for rural electrification equipment, in its Chapter IV/Donations to the regions and communes.

Back to the village, the women get to work ▼

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The first class, supervised by a teacher from Barefoot College, came to Iavomanitra for a refresher course on the new generation of lanterns ▲

Shipping by boat takes about three weeks from the port in India, then clearance procedures take about fifteen days with the support of a freight forwarder. Where possible, the control of materials once cleared is done by representatives of the Women Solar Engineers in the presence of WWF. The materials are shipped from the port to the village by truck, up to the last limit accessible. Then, under the supervision of the solar committee and WWF's technical assistance, the village community covers the rest of the trip on foot, by canoe or any other means of transport adapted to the context.

As soon as the equipment arrives on site, the Women Solar Engineers take care to make the precise inventory with the solar committee, and to store the materials in the warehouse. The electrification works can then begin.

The Solar Engineers are electrifying the village.

The community house is electrified first, as it houses the Women Solar Engineers' workshop. The households are next. When it is time to set up the solar panels on the roof, young people from the village help the women. Along with the installation, the women make sure to train the beneficiary households on how to use their new tools.

For Iavomanitra and Tsaratanana, women were only able to electrify their village about six months after their return from training, because the materials arrived only then. Despite this, they were able to electrify the households without problems. The Barefoot College team came to Madagascar to follow up on what they did and could see that the women were doing well.

Women are responsible for monitoring the proper functioning of solar systems, as well as their repair in cases of breakdown. Depending on the breakdown, these repairs are done in the household's house or at the workshop.

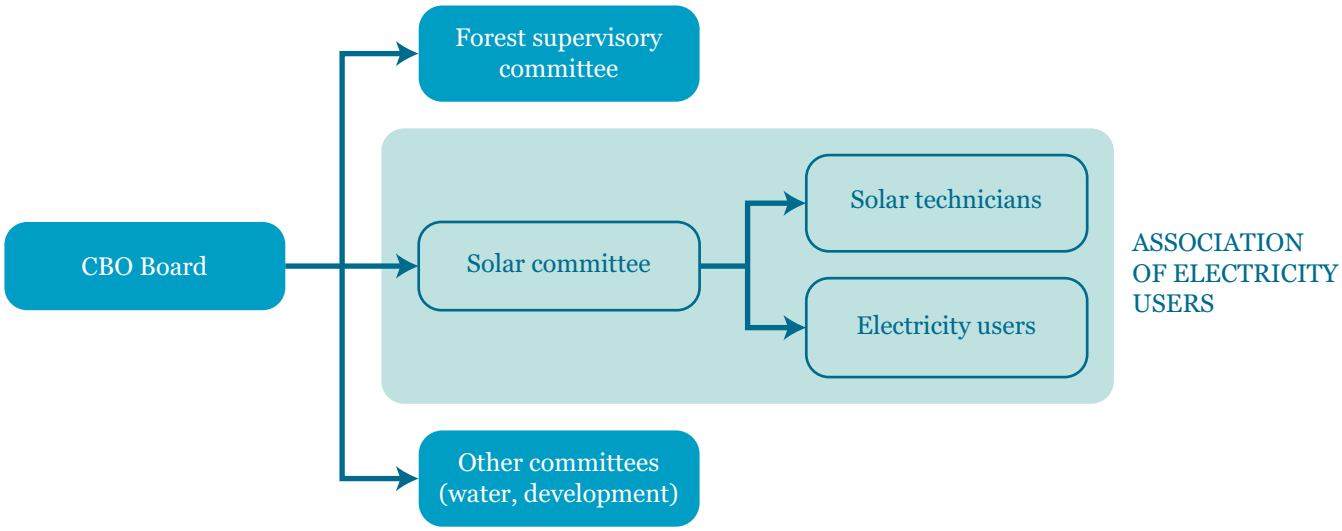
In Iavomanitra and Tsaratanana, the most frequent failures or malfunctions are those occurring on the solar lantern. This is usually due to a lack of vigilance while in use: households do not let the battery charge properly and sufficiently before using it, there are cases of misuse (going beyond the authorized use, thus draining the battery), and handling makes the lantern fragile. It is, however, important to note that the solar lanterns used in Iavomanitra and Tsaratanana are solar lanterns of the older generation. Since then, the women have been trained in the new generation of lantern, as part of the implementation of the "solar lantern" entrepreneurship. The new generations of hardware are more robust.

7. MANAGEMENT OF THE ELECTRICITY SERVICE

A legal association of the electricity users is set up

The households who benefit from the solar equipment set up a legal association, led by the village solar committee, of which the Women Solar Engineers are members. The association establishes the rules governing the electricity use and the management of the contributions from households or other income; a bank account has been opened for this purpose.

Both in Tsaratanana and Iavomanitra, which are the references in this section for being the most advanced villages in electricity service management, the association has deep ties with the existing local and social organizations. The association is tied to the CBO, because the daily collaboration with this latter brought about the electrification project. Thus, the CBO board has the right to check on the activities of the solar committee. In Tsaratanana, for instance, the FIPAJI[2] association is under the control of the CBO; if you want to join FIPAJI , you have to contribute to and join the CBO; when decisions are to be made, FIPAJI requests approval from CBO, and must report to it.



The solar committee of Andranomilolo, supervised by the COBA and the local authorities ▲

Sound management of the electricity service by the village solar committee is essential for the sustainability of households' access to solar services. As this is a new activity for the community, the WWF team provides training and ongoing support to members of the solar committee to ensure the best management. This capacity building begins during the women's stay in India, and continues until the solar committee is well-versed. This learning takes time and the solar committee assimilates the various aspects gradually, taking into account any lessons learned as they progress.

2 Fikambanana Mpampiasa Jiro - Association of Electricity Users

The composition of the solar committee evolves with practice and time, with the goal of having a sound management of the electricity service. In addition, each member needs time before they can do their job well. In Tsaratanana, for example, there was a time when members were confused as to every one's role resulting in job overlaps and frustrations; the regular meetings were considered insufficient, and some stored materials went missing because inventory management was not well organized.

When **assessing the management situation** in Iavomanitra in April 2015 (i.e. about one year after the management started), the electricity management structure had changed compared to the structure set forth during the village meeting. The existence of the solar committee reduced the prestige of the COBA (the association of electricity users includes two COBA) and the chief of the village (appointed by the administration). It was therefore better to integrate them so as to restore the balance of power within the village. In addition, there were too many members within the solar committee, especially with a view to possibly compensating them; thus the positions of "auditor" and "advisers" have been removed. The following restructuring was implemented as of February 2015:

1. Board of directors, made up of the village chief (Fokontany), the chairman of the association Fanantenana (COBA), the chairman of the association Imaintsoanala (COBA), the tangalamena (local notable). The Board of directors makes the decisions, solves the problems by talking with electricity users, sensitizes users (payment of contribution. . .), follows up on users with the support of representatives of the solar committee in each village, monitors and advises the Executive board, and plans the work to be done.
2. Executive board, includes the positions of the Chairman, the Vice-Chairman, the Secretary, and the Treasurer. Three of the Executive board members are women. The Executive board manages the funds, monitors the work of the technicians, and reports to the Board of directors.
3. Representatives of the solar committee per hamlet: 1 to 2 people per hamlet represent the committee. 8 hamlets are included. This organization is relevant given the geographical extent of the territory covered by the solar committee. The role of these representatives is to raise awareness and mobilize users (payment, use, information from the Board of directors and Executive board); they carry out monitoring/control, and act as information relays for the technicians concerning any technical issue.
4. The 4 Women Solar Engineers.
5. The security guard.

The solar electrification according to Barefoot College's approach can be likened to self-generation of electricity by the association of electricity users in the community. The only procedure required to comply with the current law on electricity is to inform the Rural Electrification Development Agency (ADER).

Indeed, the contributions paid by the households to the solar committee cannot be assimilated to the payment of an electricity bill (thus a sale of electricity by the solar committee). In fact, households entrust funds to the solar committee to ensure the sustainability of the solar systems they use. The solar committee manages this fund, for the households, at it stays within the association.

Besides this, the legislation on individual solar systems is yet to exist.

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The solar committee of Iavomanitra in action ▲

The solar committee has a specific role at each stage while implementing the approach

Before the women leave for training in India, the solar committee draws up the official list of households to be equipped with solar systems, specifying for each household the electricity service requested and the corresponding regular contribution to which the household commits. The order for equipment from Barefoot College will be based on it, because as the women learn in India, they already pre-manufacture a number of materials. Therefore, once the list is closed, there is no going back.

The solar committee makes sure that the women's pre-departure preparation is going well, and guarantees in particular that good information about the approach is circulating within the village, to avoid groundless rumors. For each of the classes, there have always been critics that sought to discourage the women with fanciful theories, the most common being that the selected women are meant to be sold and will never come back to the village.

The village ceremony organized during the departure of the women aims to represent the whole community's support to the women for their mission.

During the women's stay in India, the solar committee, with the support of local authorities and notables, mobilizes the village community to build the community house and provide it with minimum furniture. This community house must be ready before the women return, even if that was not the case in Andranomilolo, where the community fell behind. The construction of the community house is the community's responsibility, although WWF supports this construction, especially for materials that are difficult to find locally, such as sheet metal for the roof.

During these six months, the association of electricity users must set the rules for managing the electricity service and must put the entire management organization in place. They do not always meet this deadline, and this is where WWF provides specific support.

In **Iavomanitra** and **Tsaratanana,** for lack of antecedents to which to refer, the association of electricity users adjusted the level of technicians'compensation in agreement with the women as they gained practical experience. Thus, in the case of Iavomanitra, while initially they agreed on a monthly pay, in practice, the monthly basis only made sense when the women proceeded with the installation (i.e. first two months) and worked every day. Then, the association did not consider it justified to keep the monthly payment because, as to the maintenance and repair activities, women did not have to work every day. Thus, the association set the number of women's work days per month and adopted a daily wage. These adjustments were also related to difficulties in collecting contributions, which made it difficult to pay women. It is within these financial discussions that we understand the importance of the community-based approach, where decisions are made for the common good of all, and in the most equitable way possible.

When the Women Solar Engineers return, the association of electricity users must agree with the women on the amount of their compensation. The pay must be higher than the daily wage practiced in the area, because the women have acquired a certain level of technicality. It is thus necessary to make the community understand the chance and exceptional nature of having solar technicians within the village, and the need to compensate them at a fair value. In addition, they also need to understand the importance of ensuring a good financial balance in management. Thus, it is usually a compromise to be decided among the households and the technicians. Since the level of compensation is related to the socio-economic context in the village, there are differences from one village to another: the standard of living in the south-east zone is clearly lower than that of the north, so the agreed compensation is in a ratio of single to double: 5,000 Ar/day for Iavomanitra, and 13,000 Ar/day in Andranomilolo.

When the equipment arrives, the solar committee mobilizes the community to move the materials on foot or other means available from the nearest transportable point for the transport truck from Tana, in collaboration with WWF. The solar committee must make sure that this move causes no damage to the equipment.

The solar committee conducts a precise inventory of equipment and storage in the community house with the Women Solar Engineers. This is the time when the community organizes the electrification of households by the women, and the solar committee makes sure to facilitate the work of electrification, which generally takes two months. In particular, each household must help women with transporting the materials intended for them, knowing that it is sometimes necessary to travel long distances.

Once the electrification works are completed, the solar committee must manage the finances, the electricity users as well as the relations with local authorities. They also cover technical management, partly with the women, in order to ensure the sustainability of the electricity service. WWF accompanies the solar committee until it has full control over these aspects of management. Regular evaluations are carried out, and exchange visits between solar committees are organized to promote self-evaluation and the sharing of good practices and lessons learned.

The treasurer of the solar committee of Iavomanitra must be rigorous ▼

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The sustainability of the electricity service depends on good financial management.

The financial proceeds come from the annual contributions of each household for joining the association of electricity users, and the regular contributions of each household for the electricity service.

Operating expenses include salaries, travel for banking, office supplies and telephone calls. Regarding wages, apart from the solar technicians, Iavomanitra and Tsaratanana have called for the service of a security guard for the solar house, while in Iavomanitra, the

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The budget forecasts of the solar committee in Andranomilolo ▲

treasurer is compensated according to the working days set forth by the association. The other members of the solar committee work on a voluntary basis, although this situation – which they decide themselves pursuant to the financial situation – is not necessarily ideal as to their motivation.

The savings made by the difference between the proceeds and the operating expenses is devoted to renewing those end-of-life components of the solar systems at households level and in the solar house, and to purchasing small equipment, tools and components.

ESTIMATES FOR RENEWING END-OF-LIFE COMPONENT (EQUIPMENT VALUES AND LIFETIME DEPEND ON SUPPLIER AND EQUIPMENT QUALITY, HIGHLY VARIABLE ON THE MARKET)

Material to be renewed	Unit price (Ariary)	Lifetime (year)	Annual renewal fee (Ariary)	Nb.	Total annual renewal cost (Ariary)
Service 1 **Battery 7 Ah/12V (Solar lantern)**	60,000	3	20,000	1	20,000
					20,000
Service 2 **Battery 40 Ah/12V (Solar home system)**	250,000	5	50,000	1	50,000
					50,000
Service 3 **Battery 7 Ah/12V (Solar lantern)** **Battery 40 Ah/12V (Solar home system)**	60,000 250,000	3 5	20,000 50,000	1 1	20,000 50,000
					70,000
Solar house **Battery 3 * 100Ah /12V** **800 VA converter**	500,000 1,500,000	5 10	100,000 150,000	3 1	300,000 150,000
					450,000

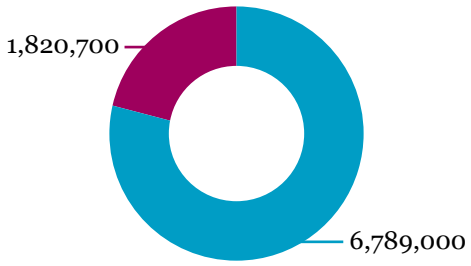
If the savings generated by a household is not enough when the batteries are at the end of their lifetime, they will have to pay an additional amount to the solar committee to get new batteries and benefit from electricity again. The solar committee must keep a strict accounting of the payments of contribution.

FINANCIAL MANAGEMENT IS GRADUALLY IMPROVING IN IAVOMANITRA AND TSARATANANA

THE CASE OF IAVOMANITRA

In April 2015, a self-assessment of the financial management of the association of electricity users in Iavomanitra was carried out and highlighted the following findings:

Collection rates for contributions as of April 2015: 21%
(amounts in Ariary)



Annual expenditure	Amount per year in Ariary
Salary of 4 women technicians	960,000
Compensation of the treasurer	120,000
Security guard's salary	960,000
Total	2,040,000

Financial proceeds

In July 2014, the facilities being recent, there was a good level of payment of contributions. Then, in August 2014, the Chief of Fokontany (head of the village appointed by the administration) of Iavomanitra began spreading rumors that people should not have to pay the contributions and that the electricity service should be free; this resulted in a drop in the payment of contributions. From November 2014 to the end of February 2015, that situation was compounded by the period of economic difficulty related to the particularly intense rainy season that year. Thus, out of a total due amount of Ariary 6,789,000 as of April 2015, only Ariary 1,820,700 had been recovered.

Financial expenditure

The women technicians are paid Ar 5,000 a day; since it was agreed with the community that they would work only 2 days a month (the first and the last monday of the month), this represents 10,000 Ar/month/woman (instead of 20,000 Ar/month/woman early into the operation), that is 40,000 Ar/month for the 4 women. In November 2016, this system was reviewed because the time allocated to the women to perform their technical tasks was insufficient; they then worked one day a week and made 20,000 Ar/month each.

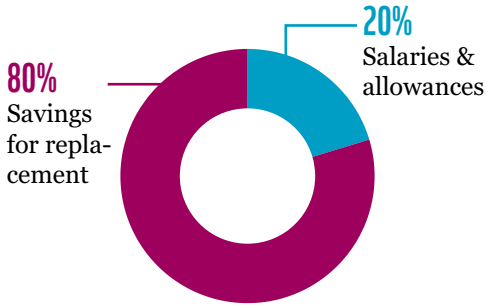
The treasurer is paid 5 000 Ar/day also, at the rate of 2 days/month, i.e. also 10,000 Ar/month (instead of 20,000 Ar/month early into the operation). The security guard, mobilized in August 2014, is paid 80,000 Ar/month (previously 100,000 Ar/month). Thus, the total monthly expenses represent 170,000 Ar/month.

Financial Equilibrium

With 222 households subscribing to service 1 (3,000 Ar/month), the solar committee should be able to recover an equivalent amount of Ar 666,000/month or Ar 7,992,000/year. Knowing that each household contributes more to the operation each year at the rate of 1,000 Ar/household, this represents additional revenue of Ar 222,000/year. As a result, the revenues should be sufficient to ensure the day-to-day operation, and with regard to the planned expenditures, there should be Ar 6,174,000 of savings per year to cover for the purchase of spare parts. However, given the level of payment of contributions, the solar committee has some trouble, if only to pay the women and the security guard.

If we take that calculation down to a household, each should contribute Ar 9,054/year to daily operating expenses. Knowing that each household is supposed to pay Ar 36,000/year in contribution and an additional Ar 1,000/year, it means that per household, a saving of Ar 27,810/year can be put side. If we assume that within 5 years, the price of a battery of

Distribution of contributions per household (in Ariary)



20 Ah/12 V, enough to use a lamp, would be Ar 130,000, we see that the savings that should be put aside per household are sufficient.

Provisions Adopted

The solar committee has decided to be stricter about paying dues.

- The solar committee has decided to remind the population of the need to pay their arrears and contributions once the harvest is effective. The majority of households was not against the payment of contributions and understood its importance for the sustainability of the materials. Therefore, it was expected that the payment of contributions would spike by May 2015, as harvests would come. The solar committee was expected to carry out a more intense awareness campaign.
- If people still fail to pay after the harvest period, the provisions of the bylaws will be applied: access to electricity would be cut off and the solar equipment removed from the user. Awareness sessions were scheduled for April 2015 before the harvest.
- When users come to request technical repairs from the women technicians, they will have to show up with their payment card and membership fee; if it turns out that they have not paid, and after an awareness phase, the repairs will not be carried out.
- Members of the solar power committee must set an example in terms of paying contributions. This is not an issue with the members, but they will have to convince the Chief of Fokontany to lead by example and to change his behavior.

AS OF APRIL 2017, THE FINANCIAL SITUATION IN IAVOMANITRA WAS AS FOLLOWS (in Ariary):

Potential total revenue	20,271,000
Actual total revenue	7,919,900
Recovery rate (in% amount to be received)	39%
Total expenditure	4,173,800
Total balance	3,746,100
Loss in profit	12,351,100
Bank savings	2,409,200

Although the situation has improved, it is not satisfactory. In July 2017, depending on the hamlet, the recovery rate ranged from 17% to 54%; on average, each household had to pay between Ariary 50,000 and Ariary 90,000.

The WWF team chose to provide a more sustained support to the solar committee in these recovery efforts. As WWF is gradually withdrawing from the Fandriana Vondrozo corridor landscape, a local civil society organization called Fanilo/SAPM NGO – already one of WWF's partners in its conservation actions – has been involved in this support work. In addition, local authorities have been mobilized.

Thus, on July 28, 2017, a recovery committee with the goal of establishing sustainability for the electricity service in Iavomanitra was set up. This committee includes: the Chief of District of Fandriana, a representative of Region Amoron'i Mania, the mayor of the commune of Miarinavaritra, the chief of the gendarmerie brigade in Fandriana and the chief of Fokontany of Iavomanitra and his deputy, the chairman of the solar committee, the chairman of the Association Fanantenana (COBA), a representative of the Women Solar Engineers, the WWF head of the area, the director of the NGO Fanilo/SAPM. This committee is chaired by the Chief of District of Fandriana.

The mission of the recovery committee is to help the solar committee apply the rules of procedure for the sustainability of the electricity service. Among other things, the following decisions were made, while considering the period of harvest between June and October:

- For users who have never paid a subscription, the solar equipment is immediately removed.
- Those who have arrears exceeding Ariary 80,000 have until the end of August 2017, to settle their situation, beyond this time, the solar equipment is removed.
- Those who have arrears between Ariary 60,000 and 80,000 have until September 15, 2017, to settle their situation, beyond this time, the solar equipment is removed.
- Those who have outstanding payments below Ariary 60,000 have until September 30, 2017, to settle their situation, beyond this period, the solar equipment is removed.

THE CASE OF TSARATANANA

In April 2015, a self-assessment of the financial management of the association of electricity users of Tsaratanana was carried out and highlighted the following findings:

Payment of contributions by households

The payment of contributions by households is dependent on the availability of income linked to harvests. Thus the following payment dates have been agreed: July, September and December. Thus, the collection of contributions is 100% for the period October to December 2014, as people started to pay in October 2014.

According to statements received from the commune of Ambohimana, which covers Tsaratanana, in the beginning, the management did not work well. People tend to always agree with what is suggested, but once in real action, they wander off. Households initially accepted the rates at Ar 3,000, Ar 6,000 and Ar 10,000 knowing that they cannot really afford this, which causes issues with payment. As a result, the solar committee lowered the amount of contribution so as to improve the recovery: Ar 2,000, Ar 3,000 and Ar 5,000. Moreover, at a certain period, the organization was unclear: some technicians asked for payment from users, a job reserved for the treasurer, which led to distrust.

Yet, households want to keep the achievements of electricity in the long term, and in this context, the association of electricity users decided to work to facilitate the payment of contributions necessary to ensure technical sustainability and fill in the loss in profit caused by the thinning proceeds. Income generating activities to be implemented by each household were decided jointly during a General Assembly: growing beans and cloves.

Financial Expenditures

Women technicians are paid at the rate of Ar 30,000/month; this payment is made at the same frequency as contributions are collected per household, therefore following the cycle July / September / December. No other expenses are planned; the compensation of the facilitator is in the works. The bulk of the revenue would therefore go to savings.

Financial Equilibrium

An account was opened within BOA Farafangana in March 2015. Only Ariary 100,000 have been deposited in the bank, though the rest should be paid when the crops arrive in July 2015.

IN APRIL 2017, THE FINANCIAL SITUATION IN TSARATANANA HAS BEEN AS FOLLOWS (IN ARIARY):

Potential total revenue	9.520.000
Actual total revenue	2 900 000
Recovery rate (in% amount to be received)	30%
Total expenditure	1.800.000
Total balance	1.100.000
Loss in profit	6.620.000
Bank savings	1.100.000

As of June 2017, the WWF team found that the solar committee has no particular difficulty in carrying out its role and all members are dynamic. It has even been able to enforce the bylaws as much as possible despite the difficult context of insecurity and socio-economic hardships, particularly in 2016.

Situation payment of contributions in June 2017	2015 contributions	2016 contributions	2017 contributions
Number of households that paid 100%	150	11	7
Number of households that paid 50%	0	34	0
Number of households that did not pay	0	105	0

As the members of the Association of electricity users were very late in standing up to their responsibilities in enforcing the rules of procedure, it was decided during the meeting of June 21, 2017, that all contributions must be paid by end of September 2017.

To do this, members must gather per 5 hamlets. The members of each hamlet must elect three people to collect the dues, and the solar committee treasurer only collects them once the full amount for a hamlet is ready. If a hamlet does not manage to collect all the dues, all materials will be moved to other hamlets. After this period, the contribution collection schedule will be set forth at a General Assembly.

It was also decided that each of the five hamlets will have to choose two women to be trained by the three technicians to help them in maintaining and controlling the use of materials.

Given the gradual withdrawal of the WWF team from the Fandriana Vondrozo corridor landscape, and in order to support the solar committee in its responsibilities, the WWF team mobilized a local civil society organization called ONG TANDAVANALA, already one of WWF's partners in its conservation actions, to support the solar power committee on a daily basis for enforcing these provisions.

The most difficult task is to foster rigor in financial management. The main difficulties usually lie in the solar committee's ability to recover contributions from households on a regular basis.

It is indeed always difficult for the solar committee to display authority in requesting regular payments, but without firm enforcement of the provisions of the rules of procedure from the outset, things quickly get out of hand: as soon as people see that others do not pay and nothing happens, they see no interest in paying either. The members of the solar committee must also lead by example: they must be the first to pay their regular contribution in time as agreed. If they encounter serious issues with some households' stance on payment, they ask the commune or the district to step forward. These authorities can come and set the record straight, and arbitrate any conflicts not settled by village authorities (COBA office, chief of village, notables).

Keeping clear accounting by the solar committee is not always easy either. It takes time for the committee members to get used to the rigor required. Close support is thus required in this matter. It is essential that the treasurer be able to read, write and count, in addition to being honest. Communities tend to choose a person with integrity first, which is understandable, but if they do, they need to be supported by someone with minimal skills.

The best way to know if the committee has full control over financial management and tools is to assess its ability to:

- Evaluate the loss in profits in terms of annual revenue (difference between expected and actual proceeds).
- Evaluate the annual balance (difference between annual proceeds and annual expenses).
- Judge the consistency between the annual balances calculated and the actual situations in the bank and the cash.
- Consider measures to ensure the sustainability of the electricity service (fundraising activities, increasing contribution, and more firmness towards users...).

The **following aspects** are important to address during a General Assembly:

- Remind people about compliance with bylaws.
- Present the financial and technical situation, tying that to the importance of users keeping their commitment. One must highlight the savings made and how they will be used. Users must see the link between the contribution they pay and how it will sustain electricity at their level.
- Announce sanctions for those reluctant to pay
- Commend those diligent users to be taken as models.

Managing electricity users and fostering good relations with local authorities are essential.

The solar committee holds regular General Assembly of electricity users, normally at least twice a year.

According to an official of the commune of Ambohimana, in the case of Tsaratanana, the solar committee lacks communication about the management situation, particularly that of the financial management. The committee would threaten users more than they would communicate, raise awareness and inform which would complicate matters. Sometimes, too, there would be delays in information because it was verbal, and it was suggested that they should keep a written record. As we can see, communication is essential, but one cannot acquire communication skills overnight, hence the importance of WWF's support for a certain period of time. On the other hand, many members of the association of electricity users, if we talk only about those in Tsaratanana, never attend the General Assemblies, which explains why they know so little about the situation.

Apart from the General Assemblies, the solar committee makes unannounced visits to users, to make sure they comply with the conditions for using the solar systems. Indeed, it often occurs that

Sanctions may occur:

- If the user does not pay regularly their contributions:
  - If there are any breakdowns on his system, the technicians will proceed with repairs only when the contributions are paid.
  - If the battery has come to the end of its life, the user will have to pay more if the contributions he has paid to date are not enough to buy the battery, knowing that 50% to 80% of the contributions are used to renew the components.
  - The solar system will be removed after exhausting the various stages before reaching this point, and as described in the bylaws. Moreover, he must always pay any contributions due up to the removal of the material.
- If the user abuses the equipment, regarding the authorized uses and required precautions (loss, breakage), apart from the measures mentioned above which remain valid, the solar committee can remove the solar system. In case of loss or breakage, the user must provide a refund.

When the removal of solar systems is necessary, the solar committee should do so in the presence of local authorities and/or notables (including the COBA office), to avoid retaliation from the user.

users tamper with or connect unauthorized devices to the solar systems. It is then helpful to remind them of the consequences and sanctions. It is important to help users understand that they can expect nothing if they violate the bylaws.

According to an official from the Commune of Ambohimana, in Tsaratanana, people need pressure: have a regulation and enforce it. They will often misunderstand and misinterpret the penalty, but it must be enforced all the same.

Beyond the initial phase of equipping the households, as the initial list established, it is to be expected that things evolve with practice and time: the list of users does not remain the same. Some people withdraw; others take advantage of the withdrawal, as some households were not there yet when the list was drafted. Some are sanctioned, others may upgrade to the next service if the equipment is available.

The solar committee must know how to secure the support of the commune and the district, because these authorities can help them with any difficulties with users, especially if a local authority at the village level abuses its power to the detriment of the sustainable management of the electricity service.

In **Iavomanitra,** during the self-evaluation in April 2015 (one year into the operation), it was clear that the board of directors of the association of electricity users was undermined by the non-constructive behavior of the chief of Fokontany (village chief designated by the District). The Chief of Fokontany wants to be seen as the almighty manager for electricity because, as it was, he had no personal interest in it; he even wanted to modify the clauses of the constitution of the association Tanamasoandro to his benefit and own advantage. He spread false rumors among the population, especially by saying that electricity is free. He does not pay his bill, and leads other people not to do so, especially those from his hamlet (Tadigna); 13/42 households in his hamlet never paid. His behavior is an issue in managing electricity and mobilizing users. All the members of the solar committee noticed this behavior and tried to address it. The committee then considered calling on the district, and even the regional authority, to settle the matter. In July 2017, a recovery committee was set up to help the solar committee address this issue; this committee included the Chief of District, the mayor of the commune of Miarinavaritra, the chief of the gendarmerie brigade in Fandriana, and a representative of the Amoron'i Mania region; the situation is being settled.

In **Iavomanitra,** during the self-evaluation in April 2015, female technicians worked 2 days/month. The association of electricity users was reluctant to make significant expenditures as compensation. However, the time allocated was not enough for them to carry out the various necessary repairs, and they are not able to make regular visits to households. Users had to wait for their turn, because they did not want to pay more to them. In November 2016, this situation was reviewed, and women now work one day a week.

In **Tsaratanana,** the women make monthly visits to each of the 150 households, and agree on a geographical division that they can follow: advice on use, control of materials, sensitization on the monthly fee, possible repairs. Users can also come to see them at the solar house in case for any technical concerns, and outside of the monthly visits.

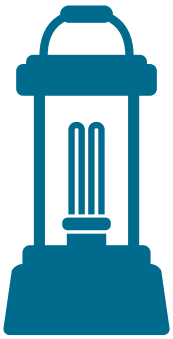
Well organized technical management is essential for the sustainability of the electricity service.

All the technical work is done by the solar technicians, but the solar committee supports them in managing the stock of tools and spare parts, in managing electricity users so these latter follow the instructions from the technicians, in the adequate organization of women in their work, and in managing know-how.

An inventory is to be carried out with the women, at least annually, in the presence of the solar committee. This helps identify any need to resupply some stock. It should be noted that the women have their own way of identifying spare parts, and that a transcription based on the document from Barefoot College is necessary for the solar committee to buy the right parts from suppliers.

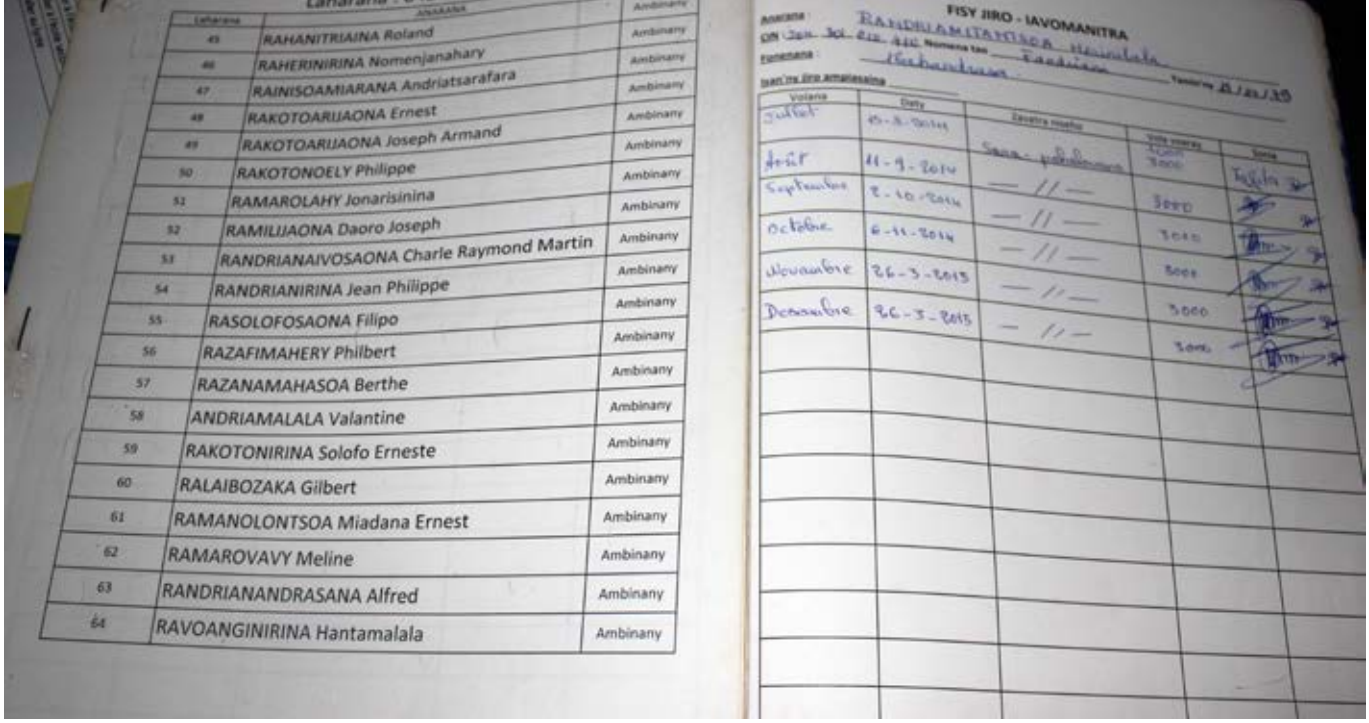
Each village organizes the women's work its own way, including the shifts for the visits to households and the duty schedule at the solar house. They organize it as it fits their needs, and according to what matches the level of compensation of the women's work. On the other hand, it is important that women can transfer their know-how little by little, so that they can get any help when they need to, and because they are older women; however, this has not happened yet.

There are few technical issues, and the women have always been able to repair any breakdowns. Such problems mainly related to the portable solar lantern: with unrestrained use or not, the batteries' performance has been somewhat variable. It is essential to provide good education to users on how to use these portable solar lanterns.



As to **solar lanterns,** it is important to:

- Allow the batteries time to charge all day long by exposing the solar panel to the north. According to the instructions from Barefoot College, when the sky is clear, it takes a day to fully charge the battery; when the sky is overcast, it may take two days.
- Not abuse their use: e.g.: solar lanterns are not supposed to be lit all night. Also according to the instructions from Barefoot College, when the battery is fully charged, we can use electricity for 5h to 6h. If the user complies with the instructions for use and maintenance, the battery will last 3 years.
- Take care of the equipment.



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Example of a management tool in Iavomanitra ▲

In Tsaratanana and Iavomanitra, the use of radio was not an obvious choice. Radios stopped picking up waves when a LED lamp was lit nearby due to interference; this issue has been reported to Barefoot College, and has been solved in the next generation of hardware. It is also important to consider what radio sets are allowed, which is those with a maximum of 12V, as this may require adapters to avoid burning them out.

Regarding phone charging, it helps to provide users with (or recommend that they purchase) multiple cable adapters. They are easily available on the local market, where people call them "rasta". Barefoot College now includes this in its new batches of materials.

For the supply of spare parts and components, the solar committee, with WWF's assistance, has to progressively built up an address book of those suppliers closest to the village who offer reasonable prices. We generally need to target hardware and electrical equipment salesmen in the region or province. For the time being, there are often delays in replacing defective parts that are out of stock due to cash flow issues, but also because of remaining difficulties in organization between the solar committee and the "Women Solar Engineers" for this type of task, all of which creates a backlog on necessary repairs.

So as to manage this problem in its different aspects, the solar committee uses various tools.

Here we draw up an inventory of the main management tools needed to solve the above issues and their usefulness. It is also important to keep in mind that in the specific contexts of the villages adaptations are often required.

Designation and main user	Use
By-Laws **[Chairman]**	Governs the electricity service within the village, and is established by the members of the association of electricity users. Includes the following information: ● Requirements for becoming an electricity user. ● Organization of General Assemblies. ● Financial terms relating of the electricity service (contributions, salaries, allowances, savings, expenditure management). ● Responsibilities of electricity users. ● Responsibilities and role of the solar committee. ● Responsibilities and role of the solar technicians. ● Process and sanctions for non-compliance with the by-laws. ● Other social, environmental or miscellaneous provisions.
Users List **[Chairman]**	Contains information about users and the service they subscribed to.
Reports Logbook **[Chairman]**	Includes all regular reports sent to the solar committee or to other entities (COBA, Ministry). The reports sent to the solar committee can include: technical reports from solar technicians, financial status reports from the treasurer It can be a binder or another document.
Journal **[Secretary]**	All minutes of solar committee meetings and general meetings are recorded in writing. transcris
Spare Parts and Tools Logbook **[Secretary and Solar Technicians]**	Includes the stock inventory and the incoming/outgoing stock items.
Technical Notebook **[Solar technicians]**	Contains information on the equipment used by each user, the issues met and the technical work of maintenance, upkeep and repair carried out.
Treasury Logbook **[Treasurer]**	Records all receipts and expenses, incoming and outgoing cash, as well as the money coming in and out of bank accounts.
Contribution Logbook **[Treasurer]**	Includes all information about the payment of regular contributions by users.
Payment Receipt **[Treasurer]**	Certifies payments by users.
Payment Invoice **[Treasurer]**	Invoice for paying regular contributions, for users.
User's Book **[User]**	Certifies payments made by users and the work done by solar technicians on their solar system. The user keeps this book.

8. SUPPORT FROM AUTHORITIES

Central authorities have a key role to play in implementing the Barefoot approach.

Despite the hesitation we noticed when the initiative was started in Madagascar, the Ministry of Energy's support has been increasingly more significant as the Woman Solar Engineer approach has evolved. The women can only go to India if approved by the authorities, and in this context, the approval of the Ministry of Energy is required to trigger the entire administrative process that allows them to go. The support of the Ministry is now obvious through the development of the national program.

The Ministry in charge of Women's Promotion joined the initiative when the national program began to be developed, and provided support during the latest classes' farewell and welcome ceremonies. The Barefoot approach was showcased during the celebrations held by this Ministry for the 2017 Women's Day, and the Ministry in charge of Women's Promotion is now a stakeholder in the Steering Committee for the National Program.

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The commune and the district representatives were present at the village meeting to select the women in Ambakivao ▲

Regional authorities appreciate the Barefoot approach and should foster a general environment conducive to the sustainability of the actions carried out.

Support from regional authorities differs from one site to the next.

Thus, while authorities of the SAVA Region and the Menabe Region wanted to show their support for the initiative by welcoming back with honors the Women Solar Engineers from training, those from the Amoron'i Mania Region are currently involved in resolving payment collection issues in Iavomanitra due to their being a stakeholder in the recovery committee.

The authorities of the Atsimo Atsinanana region have often changed since 2012, so nothing more substantive than their being made aware of the program has occurred so far, even though a regional advisor is a member of the association of electricity users in Tsaratanana. It is essential to give more responsibility to this regional adviser as a vehicle for communication with the village and the solar committee, but also as a supervisor to the solar committee on behalf of the Region. In addition, regional authorities are aware of the need to ensure security in the area so as to favor the population's sedentary lifestyle and the sustainability of the electricity service. In fact, Tsaratanana is bordering with the Ihorombe Region, an area where the "malaso" (castle rustlers) are most active, with a particular upsurge in 2016. This problem of insecurity explains the fact that the villagers of Vohimary North, intended beneficiaries for the sale of solar lanterns produced in Tsaratanana, have finally withdrawn for lack of being able to ensure the agricultural production allowing them to afford the solar materials, as insecurity has hindered their daily agricultural activity.

The ceremony to bless the women from Andranomilolo, before their departure, was attended by the Region, the District, and the Commune ▼

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The Barefoot College approach is appealing to regional authorities: not only is the solar technology adapted and access to electricity foster development, but the approach also promotes the community's autonomy since the repairs are made by people from inside the village, with no need to depend on outsiders; essentially, training people from the village is a good approach as it preserves community spirit and promotes self-sufficiency. The approach also helps restore gender balance, and gives women more recognition so that they are no longer simple "tools". Women's promotion is part of regional efforts; since women are more numerous and raise children, it is important for them to work and be able to properly educate their children.

Involvement of the district authorities in monitoring, awareness and conflict resolutions is required and is already a reality in Iavomanitra.

In Tsaratanana, district authorities are generally aware of the approach, which enjoys a good reputation in the area, but some changes in official authority have occurred without transfer of information;thus, incoming teams are not as involved as the outgoing one which saw the start of the approach implementation. Just like the Ministry of Energy, district authorities must give their approval to the women's travel, and wish to honor by their presence these latter's departure from their village (as long as their schedule permits).

Aware that rural accompaniment is necessary for the approach sustainability, district authorities advocate a regular audit of electricity service management instead of waiting for problems to arise and then reacting. District authorities see their role in incentivization as an important one, namely by raising awareness to prevent theft of solar systems which means sanctions. As they do their rounds in these regions, they can also conduct some follow-up to remind people that the State is watching and is in control in the hope that this will discourage behavior worthy of sanctions. District authorities are able to mobilize the gendarmes, as was the case during the robbery at the solar house in Tsaratanana and which was settled thanks to said gendarmes. Moreover, authorities from the district of Vondrozo, which covers Tsaratanana, are among those who wish that the Barefoot approach be extended all along the Maroteza – Vohimary corridor.

It is therefore the case that more collaboration between district officials and the solar committee in Tsaratanana would be welcome, especially when it comes to enforcing the sanctions set forth in the by-laws; the solar committee needs support to avoid reprisals from those households they punish when such behavior is justified and in accordance with sanction by-laws.

In Iavomanitra, the previous Chief of district worked to incentivize people and help them understand that it was a great privilege for the village to have solar systems. He also attempted arbitration with the Chief of Fokontany, but before that could work, the Chief of District was replaced. The current Chief of District leads the recovery committee set up to help the solar committee enforce the by-laws, particularly with respect to the collection of contributions.

A similar but more regular involvement of the municipal authorities is expected to take place in future.

Municipal authorities are involved right from the beginning of the process, especially during the first village meeting during which women are selected. For example in Iavomanitra, the mayor at that time came to raise people's awareness and help them understand that it was a great privilege for the village to have solar systems.

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Appolinaire Razafimahatratra, WWF Madagascar Technical Officer in the Fandriana Marolambo sub-landscape – about the village of Iavomanitra.

"The Chief of Fokontany of Iavomanitra holds a 2-year university degree; he is thus considered elite in the village, and does not understand why the technical management of the solar service is entrusted to a group of women with very little education. He supported the implementation of the approach in its early stages, hoping that he would then control the management and particularly the monthly contributions from solar users. He realized little by little that, instead, the elected solar committee was empowered to manage the electricity service. Seeing this, he abused his status of state representative to rebel against the solar committee and sabotage the whole approach.

The negative influence of the Chief of Fokontany was mainly obvious in his hamlet called "Tadigna", where an average of less than 20% of electricity users paid the contributions. The solar committee has relatively more authority in the other hamlets, and tries to reassure the population as to how the contributions are used, namely to replace any worn equipment.

WWF supported the solar committee by mobilizing the district authorities, to whom the Chief of Fokontany reports. The Chief of District called him to order on three occasions, but back in the village, he continued to stand against management by the solar committee. Moreover, he knows that he cannot be removed from office, under the administrative and political context of the current government.

The commitments of the newly created and operational recovery committee make up a new start for better management of the electricity service in Iavomanitra."

The relations between the solar committee and the municipal authorities have always been good. However, it is clear that beyond these good relations, the commune is not in a hurry to help the solar committee improve its management, especially in terms of recovery of payments or conflict resolutions, both of which are necessary and would be very helpful. Thus, more collaboration between the commune and the solar committee would be welcome, especially in the area of monitoring and supervision. In the case of Iavomanitra, this is now a reality, to the extent that the mayor of the commune of Miarinavaratra is involved in the recovery committee.

Municipal authorities very much appreciate the Barefoot approach, especially because there was no pressure to implement it, and it was the community itself that came up with the system now in place. The women's trip has also been a good lesson to learn.

Authorities and local notables must support the management by the solar committee.

Local authorities are not involved in the management by the solar committee, but try to arbitrate when there is a problem.

When the association FIPAJI carries out some work in Tsaratanana, they enjoy good collaboration with the Chief of Fokontany. This latter encourages the population to participate, and in case of security issues, the Chief of Fokontany and the local leaders try to address them together with the solar committee. On the other hand, local authorities and notables let the solar committee deal with payment issues. Each local entity has its responsibilities that are complementary: the village chief manages the community or "fokonolona", the chairman of the COBA manages the members of the COBA, and the solar committee manages the members of the association of electricity users.

In Iavomanitra, the Chief of Fokontany has paid only three months of contribution. He sets a bad example for the people while pursuing his crusade against the solar committee out of motivations that appear to amount to nothing more than ego and personal gain. He gets his points across because the solar committee has displayed some lack of communication, and, as previously mentioned, he enjoys an elite status as a university graduate in the community. The Chief of Fokontany wants a major role in managing the operation; however, as the recovery committee has just been set up, the situation should improve significantly by the end of 2017.

9. FINANCING AND CALENDAR

Several entities have contributed to funding of the Barefoot College initiative since 2012 in order to implement the Woman Solar Engineer approach in the five villages. Some of the funding listed herein has also contributed to the development of the national program which will be briefly described later.

CONTRIBUTORS AND CONTRIBUTIONS

Indian Government / Barefoot College	Women's travel, stay and training in India
WWF France / La Française des Jeux	€ 237,000
WWF Belgium and its private donors	€ 211,863
Indian Ocean Commission / European Union	€ 119,626
Small Grant Program / UNDP	$ 89,000
WWF Switzerland and its private donors	CHF 55,000
Open Circle Foundation	$ 39,017
WWF Norway / NORAD	Not stated
Government of Madagascar	Exemption of import duties and taxes for the equipment and materials designed to electrify the villages
Electricité de Madagascar	Moving the materials for Iavomanitra from Antananarivo
Village communities	Local materials and labor to build the solar house, moving the materials from the last point accessible by truck to the village

Youtube:
https://www.youtube.com/watch?v=-apQZePDwiM

Facebook:
https://web.facebook.com/ WWFMadagascar/

Other sites:
http://www.wwf.mg/fr/?278010/Llectrification-rurale-avance-grce-aux--Femmes-
http://www.wwf.mg/?277032/4-solar-women-from-Manambolo-Tsiribihina

Miscellaneous articles (examples):
http://www.nocomment.mg/barefoot-college-et-la-lumiere-fut/
http://www.lexpressmada.com/blog/actualites/energie-renouvelable-barefoot-college-accueille-sa-troisieme-promotion-de-malagaches/
http://www.newsmada.com/2016/09/21/energie-solaire-un-barefoot-college-a-madagascar/
http://www.zarateny.org/barefootcollege/

The communication efforts undertaken by the WWF team have been instrumental in mobilizing these institutions, at different stages, as evidenced by the various web links on this topic: videos, social networks, press coverage. The initiative has been promoted on the occasion of various conferences, both international (e.g. European Development Days, Brussels, November 2013) and national (for example: Women's Day, Antananarivo, March 2017), and a specific video in Malagasy is regularly used to inform village communities.

Through the capitalization of the expenses incurred per village, it is possible to estimate the budget required to implement the "Woman Solar Engineer" approach in a village of 200 households, knowing that this budget must be adjusted according to the geographical location of access to the village, associated coordination costs, and solar services requested by households. This budget does not include the contribution of the Indian Government that supports women's training and travel.

Specific expenditure for 4 women; supplies, administrative procedures, missions to the capital	€ 8,000
Material for 200 households	€ 74,000
Material for 1 solar house	€ 5,000
Shipping costs, forwarding agent, storage	€ 6,000
Supervision, support and follow-up missions	€ 20,000
Subtotal	**€ 113,000**
Coordination (human resources, operation) -30%	€ 33,900
Total	**€ 146,900**

Regardless of coordination costs, and taking into account training and travel to India, this amounts to investing around €650 per household for sustainable access to electricity services through knowledge transfer at the local level and in the isolated rural settings.

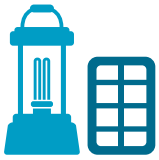
Once the village is selected, there are four clear phases that need to be completed whilst implementing the approach:

Phase 1

Training and community preparation

Phase 2

Electrification of the village



Phase 3

Initiation of the solar lantern entrepreneurship (belonging to the Women Solar Engineers / solar committee)

Phase 4

Consolidation of the solar lantern entrepreneurship

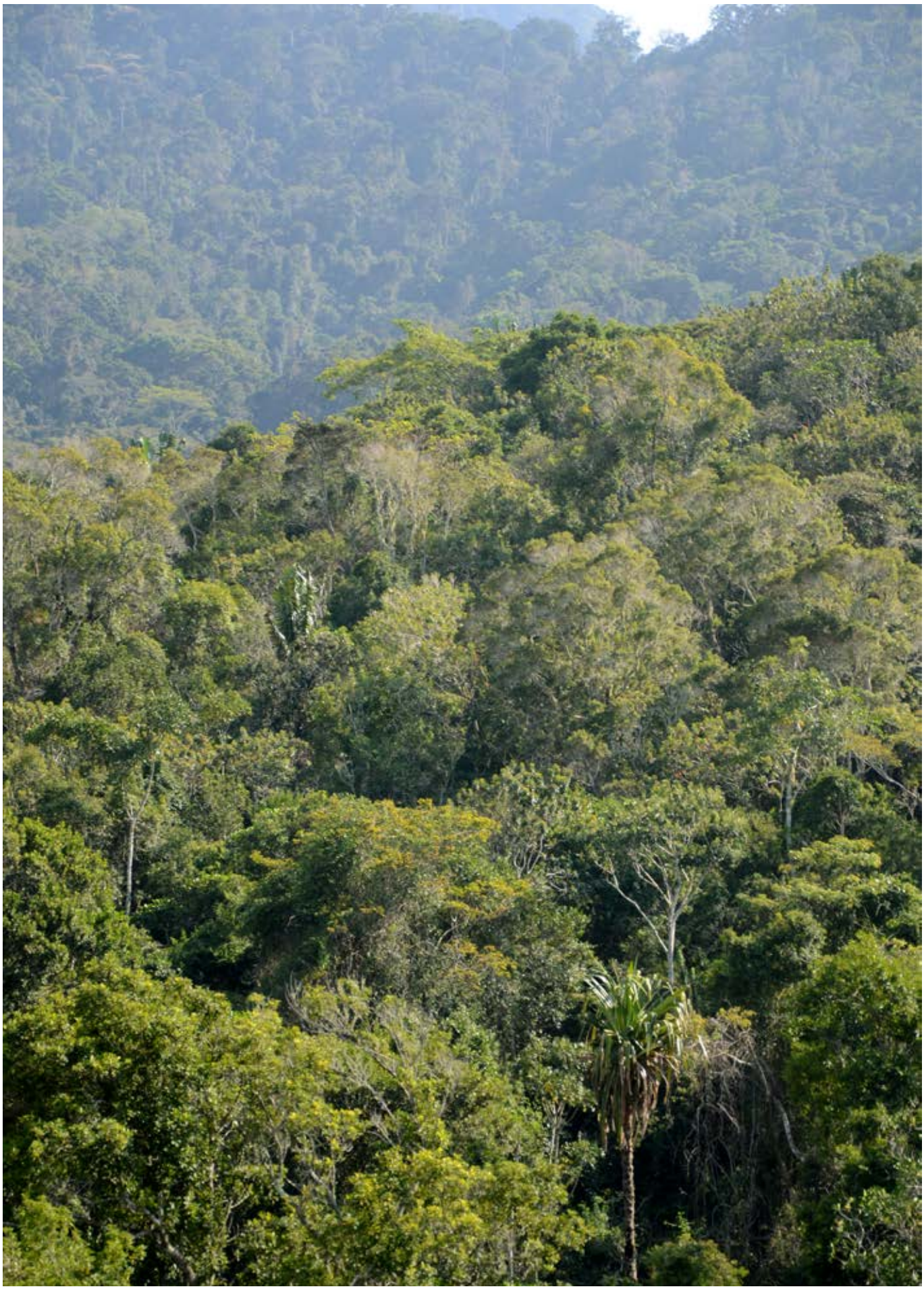
The implementation schedule for these phases is generally as follows:

Activités principales	YEAR 1		YEAR 2		YEAR 3	
	S1	S2	S1	S2	S1	S2
	June-Nov	Dec-May	June-Nov	Dec-May	June-Nov	Dec-May
	Dec-May	June-Nov	Dec-May	June-Nov	Dec-May	June-Nov
Phase 1: Training and community preparation						
Selecting the women (village meeting)						
Setting up the solar committee						
Interview with women for preparation						
Preparing the priority documents for the women's travel						
Registering the women on the ITEC program						
Preparing the women's identity documents						
Mission of the women on the capital: passport, vaccines. ..						
Obtaining the women's visas						
Ceremonies for the women's departure for training						
Training of the women in India						
Building the solar house						
Initial training of the solar committee / implementation of management systems						
Women’s return to their village						
Retour des femmes dans leur village						
Phase 2: Electrification of the village						
Consulting with the community and the women on compensation						
Ordering/manufacturing materials and equipment						
Shipping to Madagascar and customs clearance						
Community moves the materials						
Electrification of the village by the women						
Electricity service management						

Main activities	YEAR 2		YEAR 3		YEAR 4	
	S1	S2	S1	S2	S1	S2
	June-Nov	Dec-May	June-Nov	Dec-May	June-Nov	Dec-May
	Dec-May	June-Nov	Dec-May	June-Nov	Dec-May	June-Nov
Phase 3: Initiation of the "solar lantern" entrepreneurship						
Organizing the women and the solar committee						
Defining the financing mechanism						
Prospecting, marketing, information/ awareness of surrounding communities and receiving orders						
Ordering hardware from Barefoot College and shipping						
The women make the solar lanterns						
Payment by households and delivery						
Phase 4: Consolidation of the "solar lantern" entrepreneurship						
Consolidating and empowering the financial mechanism						
Empowering the organization of the solar committee						
Independent management of the solar lantern entrepreneurship						

Thus, for the five villages, the calendar is as follows:

	Phase 1 Training and preparation	Phase 2 Electrification of the village	Phase 3 Initiation of lantern entrepreneurship	Phase 4 Consolidation of lantern entrepreneurshipe
Iavomanitra	November 2012 to September 2013	From January 2014	April 2015 to June 2017	July 2017 to June 2018
Tsaratanana	December 2012 to September 2013	From January 2014	April 2015 to June 2017	July 2017 to June 2018
Andranomilolo	January 2016 to September 2016	From September 2016	January 2018 to December 2018	January 2019 to December 2019
Ambakivao	June 2016 to March 2017	From February 2017	January 2018 to December 2018	January 2019 to December 2019
Vorojà	November 2016 to September 2017	From August 2017	January 2019 to December 2019	January 2020 to December 2020



The forests of the Fandriana Vondrozo Corridor (COFAV), in eastern Madagascar.

An electrified house is shining in Iavomanitra.

PART II

THE EFFECTS AND IMPACTS OF THE BAREFOOT COLLEGE APPROACH

"Give light and people will find the way."

Ella Josephine Baker

1. MONITORING THE EFFECTS AND IMPACTS

Barefoot College has developed a monitoring and evaluation system (Monitoring, Evaluation, Reflection, and Learning (MERL) that the organization applies to all villages where the Woman Solar Engineer approach is implemented throughout the world; this system was developed after the start of the initiative in Madagascar. In the first two villages (Iavomanitra and Tsaratanana), it was not possible to implement this methodology, unlike the other sites.

Before solar electrification is effective, we need to establish a reference situation.

Baseline surveys are conducted after the women are selected and during their six month training period in India. Two focus groups of eight people are organized: one with women only, one with a balanced mix of women and men. Surveys are also conducted with 20% of households (i.e. 40 households for an approach targeting 200 households), making sure to survey those who are not part of either of the focus groups. Barefoot College has developed a questionnaire for these baseline surveys; the WWF team has translated it into Malagasy and incorporated additional issues of specific interest to WWF to achieve a greater level of precision.

After solar electrification, biannual surveys are conducted with WWF field agents, with the Solar Engineers, with members of the solar committee, and with 20% of households, with a majority of women where possible. The semi-annual monitoring helps evaluate the effects and impacts of the program.

Besides this, an evaluation is conducted every year. The follow-up targets the same people who were initially surveyed, and should not take more than three weeks to complete.

The MERL system tools were upgraded and used in Iavomanitra and Tsaratanana during the capitalization mission conducted by the National Barefoot College Program (PNBC) Steering Committee[3] in November 2016.

The team that conducted the capitalization work in Tsaratanana includes the Ministry in charge of Women's Promotion, SAF FJKM, and WWF ▼

3 The PNBC Steering Committee includes: Ministry in charge of Energy, Ministry in charge of Women's Promotion, Rural Electrification Development Agency, Barefoot College International, WWF, Madagascar National Parks and SAF FJKM

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A focus group session in the hamlet of Fenomby in Tsaratanana ▲

Interviews were conducted with Women Solar Engineers, the solar committee, local authorities and notables, communal authorities, gendarmerie, district and regional authorities, and households.

For each of the two villages, we surveyed households in two hamlets (Ambinany Morafeno and Iavomanitra, Fenomby and Tsaratanana), and conducted focus groups in two hamlets (Fenomby and Fenoarivo, Vatoromay and Tadigna).

For the focus groups, two population segments were targeted with a women's group, a men's group, and a mixed group. We interviewed 12 households per hamlet surveyed, ensuring a good distribution according to the following typology (3 interviews by typology): households using service 1, households using service 2, households using service 3, and households not using solar electricity. Thus, a total of 48 households were surveyed, and 12 focus groups were conducted.

	Service 1	Service 2	Service 3	No service	Total/Moy
Number of households surveyed	18	10	7	6	41
Average number of people per household	5	7	8	7	7
% households where the respondent is a man	44%	50%	86%	67%	56%
% households where the respondent is a Woman	56%	50%	14%	33%	44%

- The sample of households surveyed (those who use solar electricity) represents about 10% of households benefiting from the approach in both villages.
- The male-female proportion of households surveyed is almost balanced.
- Compared with households using the electricity service, we note that the more people in the household, the higher the electricity service selected by the household.

The results of these surveys and interviews are discussed in subsequent sections.

2. WOMEN'S EMPOWERMENT

Berthe was able to increase her income thanks to the salary that she received and saved through the program. She was able to improve her small restaurant. She plans to transfer her knowledge to her grandchildren, while she continues her role as a technician and wants it to continue.

"Like any farmer family, mine works the land and raises some livestock. Like so many rural women, I left school early, and as a woman I did not make decisions in my community. Today, I have gained the respect of my peers, not because I traveled to India but because I learned to become an active woman in my village. Because you have to learn that, no one is born with it!"

The Women Solar Engineers have become emancipated.

People appreciate the work done by the "Women Solar Engineers". These women are competent in their tasks. Any electricity user with technical issues does not hesitate to go to the women's workshop at the solar house.

The community - and primarily the notables - recognizes that these women have brought a lot of benefits to them: light, improved education of children and income. And although some people are jealous of their situation, the population listens to them and follows their instructions: when women go to visit households, they are always well received and respected.

Everyone agrees that they need to train other people, more women and young people, so as to perpetuate their knowledge among the community and get some help, especially as they are getting older. In Iavomanitra, for example, Florette plays a key role because she helps others remember the right techniques needed to perform maintenance. In the case of Tsaratanana, during the General Assembly in June 2017, it was decided that the three Women Solar Engineers will train two women per hamlet (five hamlets are affected) to help them with maintenance work and control the use of materials in the future. Moreover, right from start, the Women Solar Engineers have trained two people per household on appropriate use, and only these people can handle the solar systems according to the instructions that have been given in that household.

The Women Solar Engineers feel generally happier about their situation compared to before the implementation of the Barefoot approach, and their children and grandchildren are proud of them. Previously, they struggled to even sign something that constituted a binding decision; now they feel more freedom, and they no longer shy away from offices and administration. They enjoy great relations with users and among themselves.

Four years after their selection, the seven women from the first class at a meeting in Iavomanitra ▼

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Kalozandry and Louise on a demonstration for the press in Antananarivo ▲

They acquired new knowledge and skills (solar engineering, sewing, making chalk and candles), and saw many new things that opened their minds to new influences and ideas; they came back with experience. However, despite the different knowledge acquired at Barefoot College, they have for the moment been able to apply only the solar training, for lack of available equipment.

Women are now outspoken, and have the power of persuasion in community discussions. They promote hygiene (starting with themselves), children's education, and are agents of development and change by participating specifically in community sensitization. They now know how to sign their name, especially through the adult literacy classes they attended in the village. In fact, since they found that women who were already literate learned faster and easier at Barefoot College, they took it upon themselves to make personal efforts to be literate, and push their children to go to school.

They are proud of what they have achieved and brought to the village, and especially in Tsaratanana, they express it in their physical appearance: they are cleaner, better dressed, and proudly wearing shoes, which was previously not really appreciated. They have become role models and leaders in the women's association, other women look up to them as role models because they have courage. In Iavomanitra, some women regret that they did not volunteer when the approach was initiated in the village.

Germaine has made improvements to her home. She is able to educate one of her children: she has 4 children, and the last one has been able to attend school. She received training to improve her farming activities, and she gave the lantern to her child studying in Fandriana. She also wants someone to take over her business in the future. She is one of the leaders of the community, particularly through her actions to raise awareness about family planning.

Florette advises Berthe on how to make the lantern ▼

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The Barefoot College experience allowed **Lydia** to be more open-minded: she could see new things and learn new skills, and she now has better self-esteem. Upon her return from India, she was able to build a new house. She used to be able to do only so much, but now she can help at home. Lydia wants to buy more land for her offspring. Having a disabled girl (deaf and dumb) who had to drop out of school for lack of supervision in public rural schools, she wants to motivate her disabled daughter by becoming her role model and by showing her that hard work can provide personal improvement to one's circumstances. She also considers that her six months absence has helped her marriage; in fact, her husband used to be hardly involved in family life, but Lydia's absence motivated him to stand up as a father again.

"We are more concerned with the realities of our community. In Tilonia, we have been in contact with other cultures. We understand the great value of sharing and learning. Despite our educational background, we know that we have a place in our community. But we also know that training and schooling are important for us to develop. I believe our success comes from the fact that we always wanted to learn and share."

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Appolinaire Razafimahatratra, WWF Madagascar Technical Officer in the Fandriana Marolambo sub-landscape - about the Women Solar Engineers from Iavomanitra.

"As women were put at the center of the approach, people saw the importance of their role in society, but it also reshuffled the social structure that governs people's lives; indeed, women rarely hold positions of leaders and/or notables."

Florette has been able to expand the surface of the rice fields she farms. She was able to buy 2 zebus. Before, she saved kerosene and slept early. Now she can sleep later and do something else. She aims to expand the land that the family farms. Currently, they still cannot live off the crops alone. Florette was involved in incentivizing households in other villages to buy the solar lanterns. She spoke with courage and gave explanations.

In general, their living conditions have improved, even if one can wonder whether their compensation/salary is enough to motivate them, as their working conditions do not match their initial expectations. They make money as solar technicians, but this work comes with hardship, especially when they have to walk long distances to people's homes. They do not complain about their workplace, which is satisfactory to them, and the working hours are correct: the women in Iavomanitra work from 9 a.m. to 4 p.m. every Monday.

Their only livelihood used to be agriculture; now they have a new role, as a technician, and have more responsibility in the community. For example, the women in Tsaratanana have responsibilities in the church (they previously did not attend church). At the request of community health workers, they have become local bridges for health awareness actions; other women are too, but they are requested more often. They now participate in village meetings. For the future, they want to be able to increase their income, improve their living standards and ensure their retirement.

Florette handing out solar lanterns and training new beneficiaries outside her village ▼

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Marlin Andriamananjaranirina, WWF
Coordinator for the South East Zone.

"I was really impressed by the change in attitudes towards women in the village of Tsaratanana. In general, women in the area are marginalized, and the fact that the grandmothers themselves had assembled spare parts and installed the solar system for each household beneficiary to bring light in the village, changed little by little how other villagers looked at them. Therefore, during the meetings, they can now stand in front of all men and speak out. This was impossible before the implementation of the approach, and still is unthinkable in neighboring villages."

In Tsaratanana, women are supported in working the land. In fact, in the beginning, the salary of the women in Tsaratanana was Ar 60,000/month/woman, but there was not enough money left to cover the other management expenses and the savings required to renew the equipment, so they brought it down to Ar 30,000/month/woman, which they accepted. However, it was agreed that when the women work for electricity, they would get support from the solar committee and the community for the field work. However, their living conditions are not the same (some are married, others not, some have more costs than others) and so each woman does not have the same level of prestige, respect and help, depending on her personality. Things are sometimes difficult in their daily life, as they get their pay as irregularly as users pay their contributions; it is important to note that this occurs whilst these women pay their electricity bill like any other household.

In Iavomanitra, it is clear that each Woman Solar Engineer does not make enough to get by, as they make Ar 5,000/day and work one day a week, i.e. Ar 20,000/month. A salary of Ar 5,000/day is insufficient; it is equivalent to what a zebus keeper earns (Ar 2,500/day + 2 cup of rice). The Women Solar Engineers would like to raise their salary to Ar 30,000/month, and would especially like to be aligned with their colleagues in Tsaratanana. The solar activity gives them additional income, especially to purchase basic necessities, but they need to earn money elsewhere. In addition, the solar committee sometimes has to pay them on credit because of insufficient contributions collected from households. Fortunately, the women have been able to open a savings account with the remainder of their allowances after their India trip; some have invested in zebus, paddy fields, or have improved their homes. Generally speaking, the women's living conditions have improved, thanks to the remainder of their allowances and their monthly salary, although this is not high.

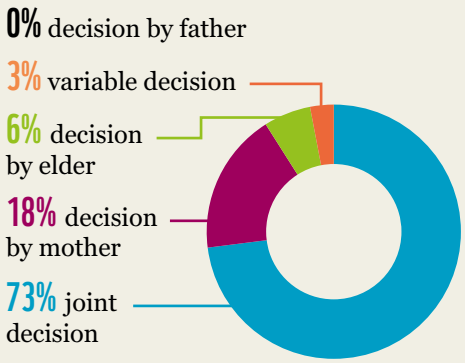
The women of the village community are given more space in society and in their families.

In Tsaratanana, the people surveyed agree that gender balance is becoming a reality, and that they have the same rights. There is no more distinction of responsibility, like in Iavomanitra, where the executive committee of the solar power committee has three women (the chairwoman, the treasurer, the vice-chairwoman) and one man (the secretary).

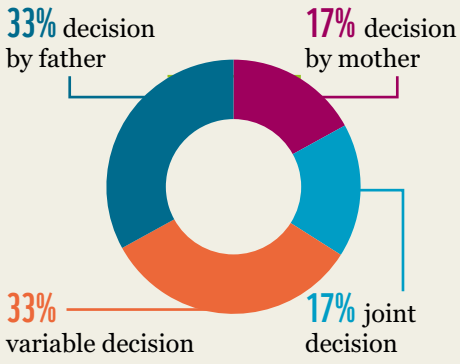
Thus, apart from the remarkable case of Women Solar Engineers, women in general are given more consideration in society, are no longer just "fanaka malemy" (weaker vessel), as we recognize that they can achieve great things. In Tsaratanana, notables agree that any development priorities must be entrusted to women; and when there are discussions on development, women and men are on the same level. Besides this, it is important to note that people pay more attention to women's ideas at home.

Surveys have shown that in households using solar electricity, joint decision-making by men and women is more common, while in those without electricity, men are more likely to make the decisions.

Decision makers in households using solar electricity



Decision makers in households not using solar electricity



In **76% of the surveyed households,** women are part of an association. For the most part, these are self-help groups or farmer associations, but there are also women's associations and COBAs for environmental protection. Some women have also joined savings groups or religious associations. Results of the survey show that when the woman is part of a farmer group, the household is doing better because they are able to choose the most expensive solar service.

In 80% of households surveyed using electricity, women participate in decision-making in a group. Only 6% of households surveyed using electricity said that women cannot participate in certain focus groups, especially when it comes to safety and theft. Note also that households that do not use electricity are more likely to exclude women from certain focus groups (this affects 33% of households that do not use electricity).

In Tsaratanana, however, people pointed out that although women bring about development, having too many women implicated makes things difficult to manage. That being said, men recognize that working with women is nice because they control their temper better than men. Women now dare more, they dare to stand up to men and are no longer afraid to meet foreigners, and they are not afraid to mingle with men. Women are stronger, as they can now lead and have more self-confidence.

The women's association is becoming a dynamic engine of development in Tsaratanana, specifically with market gardening projects. The day-to-day organization of women has changed: women take care of the home and agriculture, and in the evening they do crafts. Women now contribute to a large extent to income generation for their households. In Iavomanitra, although men are more visible and women more timid, the example of Women Solar Engineers has encouraged women in the village to take on more responsibilities, as they are more assertive and are members of associative board or committees.

According to the surveys, what women need to be emancipated is to see something else (e.g. the city) to open their minds better to the possibility of personal growth. In addition, women's training needs include agriculture (such as market gardening) and livestock farming, writing/reading/counting, sewing with sewing machines, embroidery, childbirth and family planning, cooking, income generating activities, basketry (other than weaving mats), financial management, composting, and watershed management.

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A woman from Iavomanitra who managed to develop her small grocery store ▲

In **71% of households surveyed** using electricity, women are engaged in income-generating activities. Weaving/basket making is the most common activity (61% of households), followed by gold panning, small livestock growth and agriculture. Some women bake pastries, sew or teach. They generally spend 1 to 3 hours plus a day on these activities (45% spend more than 3 hours). It is clear that for the vast majority of them (86%), access to modern light has increased the time they devote to these skills.

Moreover, in more than half of all households (59%), women spend much more time on their household activities compared to when they did not have access to solar lighting. This is because they are better at looking after the home, which they want to upkeep now that nights are brighter, and they also have more time to do so as they don't get sick as often. They are also more efficient and are able to finish their chores faster.

3. THE BEHAVIOR OF ELECTRICITY USERS

In Tsaratanana, some electricity users know the rules, but others do not, especially because some do not attend information sessions. Interviewees recommended that the by-laws be posted in the solar house. The provisions that users do not always respect include: do not remove the battery from the lantern, do not use the solar system other than as permitted (e.g. do not use for a radio-card or TV), do not do meddle with it, and pay the contribution.

Users recognize progress in the management by the solar committee, although there is still room for improvement, which is necessary to continue the efforts and foster some good habits. More particularly, members of the solar committee must learn to solve problems together, and security must be ensured. Indeed, the solar committee has shown boldness in firmly enforcing the by-laws in the case of repeated failure to pay contributions, and has removed the solar material from some users as a result. This caused some reprisals against solar committee members, who are now afraid to keep going. They need support from local authorities.

In order to facilitate community mobilization and since some hamlets are far away from the main village, the solar committee has identified facilitators to act as relay. Apart from raising awareness on electricity (fees, regulations, general assembly), the facilitators were also there to boost the development of the village after electricity arrived. The community has chosen seven facilitators that represent the different components of their society, to reach them more easily: men (2 facilitators), women (3 facilitators, actually the Women Solar Engineers themselves) and youth (1 male and 1 female facilitator). This team of facilitators designed a work program to mobilize and maintain the dynamism of development. These facilitators are volunteers for now, but the solar committee is considering compensating them like the women technicians. Through incentivization, these facilitators have led many households to join the association of electricity users and pay their dues. However, more awareness is recommended vis-à-vis those who have not adopted solar lighting, as additional equipment becomes available.

80% of households surveyed

not using electricity in Iavomanitra and Tsaratanana said they did not join because they cannot afford the contribution. Compared to households in service 1, these households have on average more dependents (average of 7 persons per household, those using service 1 have 5) and, above all, children, since all these households have children who go to school (whereas only 56% of households in service 1 have children at school). Yet, if we refer to their energy expenditure for lighting (from Ar 1,000 to 5,400/month in kerosene and electric torch), it seems that many of them could subscribe to service 1 if the solar material was available (which is the second reason for not joining), which would satisfy their desire for better education for their children (67% of households affected) and the possibility of generating more income by devoting more time to that purpose (33% of households affected).

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A household that uses electricity in Tsaratanana: more than ten people ◄

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Electricity users in Iavomanitra are happy with the solar systems ▲

In Tsaratanana, the payment of contributions varies according to the seasons. During the lean season, paying is harder; then it gets easier as they harvest coffee and rice. The payment system has been adapted to the harvests, and users are required to pay after three harvests throughout the year: two for rice, and one for coffee. It is also possible to pay with "rice", not cash. Thus, users sometimes fail to pay because of poor agricultural yield while they have many other expenses to cover; indeed, some households have ten children. Many households have given up on slash-and-burn farming and choose to farm rice fields but they say this is more problematic for those who do not have zebus. With kerosene, households can spend Ar 100/day, but unfortunately it is difficult for them to put this amount aside because they need it for something else. Thus, finding cash can be hard, depending on the household.

72% of households surveyed using solar electricity in Iavomanitra and Tsaratanana know that if their solar system breaks down, they must refer to solar technicians. However, we note that the higher the electricity service chosen (i.e. the more the household has to pay), the more the household respects the instructions in the event of a breakdown (100% of households in service 3 follow the recommended techniques). Surprisingly then, only 59% of households in service 1 (solar lantern) call the technicians for a breakdown: some said that if the system breaks down, they would sell it, or keep it at home; some people simply have no idea what they would do.

In Iavomanitra, interviewees said they did not know much about management, despite their interest. However, their answers to our questions showed good understanding of the regulations, although also a tendency for users to want everything without any effort. Failure to pay is the biggest worry. Apart from that, they do not always follow the technical instructions. Some users use other devices (television, DVD player, sound system), especially those with many young people who connect other devices than those allowed. The solar engineers cannot monitor what people are doing, and the equipment breaks down because some users do not follow the instructions they are given with the devices.

Still in Iavomanitra, the members of the solar committee are united and make decisions together. However, households do not always follow their decisions. They have issues with the Chief of Fokontany who sabotages their management. Certainly related to this sabotage, interviewees called for greater transparency in management and more information to avoid rumors (which include: material is free so no payment required, funds embezzled by the solar committee, the women do not work, privileges of committee members). They call for regular reports to the population, want the solar committee to change its attitude: they say these latter should focus more on awareness and discussions, and less on threats. It seems that a misunderstanding has crept in between the solar committee and users, exacerbated by destructive propaganda by the Chief of Fokontany but also by lack of

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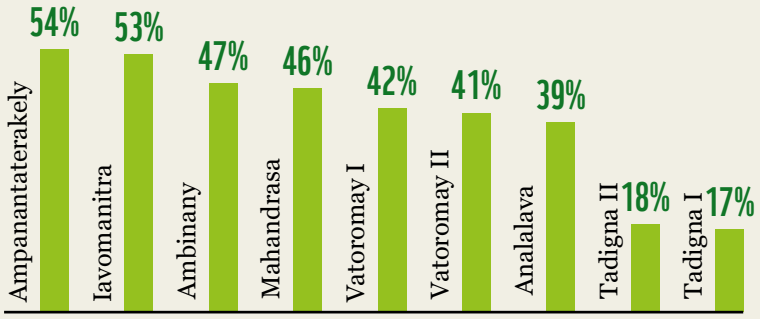
A household using electricity in Iavomanitra ▲

Percentage of amounts of contribution paid per hamlet, in Iavomanitra (as of July 2017)

The chief of Fokontany of Iavomanitra lives in Tadigna, where households are the most reluctant. Part of the focus group during the capitalization mission was carried out in Tadigna.



communication from the solar committee. These latter can no longer recover the funds by themselves as people ignore them and retaliate against sanctions. We need to restore trust, which some interviewees say could improve the situation. The political game seems to have taken over at Iavomanitra and the Chief of Fokontany's propaganda seems to have come a long way. In this political game, some even argue that members of the solar committee should be renewed on a regular basis.

Iavomanitra has low contribution recovery rates, even though everyone should be able to pay because the amount has already been agreed upon. Although some users, who are old, cannot afford the contribution, an analysis of the survey answers shows clearly that people have understood the need to pay for the sake of sustainability, but that such understanding gave way to bad faith. Because of the sabotage by the chief of Fokontany, users expect free electricity service; there is an absurd tendency to want more (e.g. use more lights) while paying less or not at all. Otherwise, according to the wishes expressed during the surveys, we would have to consider people's situation on a case-by-case basis because some households have a harder time than others at certain periods of the year; payment is much harder in winter.

The solar committee is trying to find solutions. They organized a tea party to raise funds with payments in kind or in cash. Most users took part in the festival, even those who did not pay the contribution, and they raised about Ar 200,000. In addition, they could manage to sell batteries at the end of their life at a certain price in Fandriana and Miarinavaritra, which could help buy new ones. The solar committee plans to only provide weeders to regular payers. For repairs, those who pay contributions are given priority; however, although some users do not pay regularly, the Women Solar Engineers still agree to make repairs during the agreed time so as to avoid tensions with users, despite the committee's recommendations. The women felt that not providing the repairs is counterproductive and it is better to find other payment methods for the households.

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A user paying contribution in Iavomanitra ▲

But users also wish that the regulation applies to all, namely inferring that members of the solar committee are not subjected to the same rules: enforce sanctions in case of theft (replace the material and pay), withdraw materials from non-paying households, call a bailiff/notary for the withdrawal, make the by-laws and constitution official to be able to call on public authorities.

As the Recovery Committee was set up in July 2017, the situation described above, in effect in November 2016, should evolve positively.

In any case, whether in Iavomanitra or Tsaratanana, users are happy to have solar lighting; they are happy with the technology and do not want it to stop, and particularly want what they need to on hand to conduct repairs. In Iavomanitra, villagers are proud to have light, the surrounding villages envy them; there have been concrete impacts for each household and light meets the population's needs; some people even moved into the village to benefit from the light. Respondents appreciate the approach as it focuses on sustainability, which they say is new compared to previous approaches whereby it was unclear what would happen to community infrastructure.

When we asked households if they had any specific **observations/recommendations,** 50% of respondents insisted on the need to ensure sustainability. 23% recommended continuing the capacity building of solar committees for management, 17% mentioned the difficulty of paying contributions, and 10% wanted more households to benefit from access to solar electricity.

Households use **solar home systems'lamps** for 2 to 12 hours a day, while solar lanterns are used from 1 to 7 hours a day. 20% of respondents could not use the solar lantern at the time of the survey because of breakdown; as a reminder, they have the older generation of lantern. 100% of households are happy with the solar lighting, enough to go about daily activities.

Surprisingly, 43% of households using solar electricity still use kerosene lamps at the same time, spending Ar 1,000 to 9,000/ month in doing so. 63% still use flashlights, and spend Ar 150 to 9,000/month. This assumes that if the solar equipment was available, they could decide to buy more than they already have, which justifies the creation of a solar lantern entrepreneurship (see section on solar lantern entrepreneurship).

Besides this, 69% of households using solar electricity want to have more solar energy. Those in service 1 want more lamps and want to be able to use a radio; households in service 2 also want more lamps and want to be able to use a TV/video; finally, households in service 3 want to be able to watch TV and connect more powerful devices (computer, refrigerator...).

The first generation of charge controller box made it difficult to connect anything, given the specificity of the required connector. As a result, users in Tsaratanana and Iavomanitra have rarely been able to use a telephone charger or radio. Since then, the charge controller boxes have been changed; this new generation box has a USB input and comes with a "rasta" cable. Surveys show that only 15% of respondents own a telephone.

The solar lantern is mostly used when cooking and shopping. In Iavomanitra, however, users say the solar lantern does not work well, but this is rather due to inappropriate recharge/use by users than anything else, especially as the climate in Iavomanitra is less sunny than in Tsaratanana. Some users criticize the women's skills as they could not fix some broken lanterns. In fact, at one point, they ran out of consumables to solve some breakdowns.

4. VALORIZATION OF THE COMMUNITY SOLAR HOUSE

Both in Iavomanitra and Tsaratanana, the women technicians provide solar electricity to the solar house, which has a community hall and has been built by the community. This is usually the only electrified common facility at the village level in these areas.

As these houses are each equipped with a solar system of 300 Wp/300 Ah/800 VA, various electrical uses (within reason) can be considered for when the women are not working at the solar workshop, for a maximum daily energy consumption of about 600[4] Wh/day . As an example of this, the solar house in Tsaratanana is equipped with a LED TV set and a DVD player, and in Iavomanitra this is also connected to Canal +. Both solar houses were also equipped with a computer in 2016.

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The solar house of Iavomanitra ▲

In Tsaratanana, the solar house is used for adult literacy activities in which the Women Solar Engineers also participate. Video screenings are held there; the management of video/TV screening is regulated, because the community recognizes you cannot just show anything, and so young facilitators from the village choose the programs to be shown (documentaries on agriculture, environment, leisure movies), and the screenings only take place on Friday nights, and on Saturdays and Sundays to avoid disrupting school activities. Screenings of documentaries and films at the solar house are an opportunity for all generations to get together and relax in a manner that was not possible before the advent of the solar house. However, as the solar house is located in the main hamlet, some from the community, especially those from remote hamlets, cannot make it. Therefore, some users wish to equip the community houses in other hamlets with similar features to the main ones. In addition, given the issue of educational infrastructure (the primary school is often hit by bad weather, causing problems for class organization), sometimes classes are held in the solar house.

In Iavomanitra, the solar house is used as a TV/video screening room, but also as a library and meeting room, as well as an area for welcoming visitors. The library is open Wednesday afternoon and Saturday all day, the technicians work on Mondays, the treasurer comes on Thursdays and the TV is on every night. The solar committee is in the process of training for the use of a computer and a printer. As in the case of Tsaratanana, however, those households closest to the solar house get the most out of these facilities. The people surveyed also suggested that the solar house be extended, given the activities planned; training in livestock and agriculture, interpretation and a training center (sale of local crafts and products, reading newspapers and accessing the media), provide a place that will serve as a shop to develop income-generating activities, such as setting up a hairdressing salon, and extending the building to set up paying accommodation for visitors. The solar committee could use the proceeds from these endeavours to run development activities.

Video session in Iavomanitra ▼

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4 Assumptions: 3 days of battery life, 50% battery efficiency, 12 V

5. DEVELOPING A LOCAL "SOLAR LANTERN" ENTREPRE-NEURSHIP

After the Women Solar Engineers and the solar committees brought solar energy to Iavomanitra and Tsaratanana, many surrounding communities requested the same. In addition, many households in Iavomanitra and Tsaratanana were unable to benefit from the electricity that was provided. For example, in the center of Tsaratanana, there are about 62 households, but not all of them have light; some because they could not afford the contribution, others because they are new inhabitants. In order to meet this demand, the solar committees have decided with the solar technicians to work for the development of the production and sale of solar lanterns.

The following are the goals of establishing a Solar Lantern entrepreneurship from both villages:

- Enable communities around the village and households in the village who could not enjoy the initial equipment to have access to modern, clean lighting.
- Promote the skills of solar technicians trained at Barefoot College for building and maintaining solar lanterns.
- Increase the revenue of the solar committees.

The entrepreneurship focuses for the moment on the production and sale of solar lantern kits including: (i) a 3W LED lamp, (ii) the support with a USB input for recharging a phone for instance, (iii) a 10Wp mobile solar panel, (iv) a 12V/7Ah battery. Charging time is two days under cloudy weather, and takes one day of exposure on a sunny day. This recharge is enough for 5 to 6 hours of use per day, and the battery lasts for three years. Spare parts for the production of this kit come from Barefoot College in India.

The initial financial plan for implementing this solar lantern entrepreneruship was planned as follows:

- The solar lantern kit would cost US $66, of which US $60 is for equipment, US $3 for the solar committee, and US $3 for the solar engineers' labor.
- The household sale price is subsidized, at the rate of US $25 to be paid by each household; the $25 collected by the solar committee for each lantern makes it possible to partially subsidize the lanterns for the next household in line each time.

Refresher course on the new generation of lantern in Iavomanitra ▼

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Manufacturing solar lanterns in Iavomanitra ▲

The solar lantern entrepreneurship is currently being tested for a batch of 100 lanterns from each of the two villages. Final feedback is expected by June 2018, but lessons can be already drawn from the work that has been done thus far.

Authorities in the region at the district and commune level recognize the relevance of setting up such an entrepreneurship from the villages of Tsaratanana and Iavomanitra. Indeed, depending on the quality and availability of the solar lanterns, the entrepreneurship -based approach can work and compensate for the cost of low-quality chinese solar lamps on the market. The entrepreneurship could also be interesting for rural towns as in the case of Vondrozo, or for the main town in a district, or even a bigger town like Farafangana. In all these cases, however, improved road access is needed to help extend the distribution area and enhance security while ensuring sufficient production.

100 units scheduled to be handed out to surrounding communities ▼

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The Women Solar Engineers found out that the solar lanterns that they produce are of better quality than what is found on the market, namely in Miarinavaritra - the commune covering Iavomanitra. It is therefore relevant to promote this; the lanterns the Women Solar Engineers produce are more robust, and provide a higher quality of lighting that is effective in larger spaces. The need to promote this entrepreneurship further is evidenced by the fact that surrounding villages already have placed orders for these lanterns. Solar lanterns are useful because they are practical thanks to their portability. In Iavomanitra, they are particularly very useful for gold diggers, who may work at night.

Following discussions with the various people surveyed on this subject, the most appropriate approach is to give subscribers a choice for payment, either by regular subscription for users within the solar engineers' and solar committee's follow-up area, or by payment of a lump sum that is need-based (repair, battery change). Finding cash is, however, difficult for the rural population. The entrepreneurship will provide cash to the association of electricity users. People in Iavomanitra have also recommended that the solar lanterns be promoted during winter, when people have more money.

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Berthe testing the new lantern she has just made ▲

The Women Solar Engineers have not encountered any problems while making the solar lanterns. However, when lanterns are ready well before delivery, the batteries can drain themselves and so they have had to undergo regular charge - discharge cycles, or be kept out of the lantern until delivery. Storage time affects battery performance. The batteries delivered with the lanterns are not very powerful, as those considered for the entrepreneurship have lower autonomy than those of the lanterns made when Iavomanitra was first electrified. In fact, these batteries were purchased from a supplier in Antananarivo, not imported from India like the rest of the materials.

The Women Solar Engineers are responsible for manufacturing/ assembling solar lanterns, as well as their repair and maintenance. They participate in sensitization through demonstrations. In Iavomanitra, they come along for the delivery missions so they can repair any breakdown on the way. Women feel capable and want their pay to be commensurate with the work they provide. It is a way for them to have additional income and improve their living standards.

One issue is that the delivery of lanterns has been delayed in Tsaratanana and Iavomanitra. In fact, initially, 100 households in Ambinanindrano for Iavomanitra, and 100 households in North Vohimary for Tsaratanana, had committed to buy solar lanterns. Unfortunately, these villages went through significant socio-economic hardships (poor agricultural yields related to bad weather for Ambinanindrano, and related to insecurity for Vohimary North), so all but a few households failed to pay their contributions. Thus, the solar lantern market has been opened to other nearby communities, as well as to households in the villages in the Commune of Ambohimana, which covers Tsaratanana.

In June 2017, 140 solar lanterns were manufactured, and half of them were sold to communities around Iavomanitra and Tsaratanana. This is just the beginning, and the solar committee has the following concerns related to their ability to function: managing the importation of materials from India; ability to deal with an increasing number of orders; possible saturation of the surrounding market at a certain time and limited extension given the limited road access; possible competition on the market. It is also necessary for the Women Solar Engineers to train women and young people to take over their work as the number of lanterns in use multiplies, so that the quality of products and especially the batteries can be guaranteed. If the batteries remain efficient, people will always prefer the solar lanterns from the villages to inferior ones from city markets. It's also important to work with partners to prospect new markets. The wish is for the solar committee to have independent control over the whole circuit.

6. SOCIAL, ECONOMIC AND ENVIRONMENTAL IMPACTS

Social impacts

One of the most important impacts is the psychological effect of the approach: farmers realize that they are able to do something other than grow food, and such an observation made by farmers themselves is very important. They now have a different point of view that encourages them to adopt new development solutions to problems that in the past they could do nothing about. They realize that one can always learn regardless of their current educational condition (illiterate, elderly, insufficient resources). In fact, the approach provides light in the broad sense, first degree and second degree ("fahazavana" or "light in the mind"), as it has affected psychology and mentalities, and has been followed by a constructive dynamic designed to improve life.

The house is lit, the courtyard is lit, the village is lit, life changes little by little. Information and communication technologies have shown up: television, computer, radio.

The availability of electricity means a healthier family and social climate, as part of the evening discussions. Recreation has become possible in the evening, including activities such as reading the bible, and organizing parties and balls. The atmosphere these things create is conducive to consultations and discussions on new projects and activities as part of late nights of reflection. For instance, Tsaratanana now has water supply projects underway.

Daily activities are facilitated. In Tsaratanana, households are no longer cooking inside their homes, but set up a small kitchen outside. They relocated their kitchens outside after the Women Solar Engineers instructed that the solar system (especially the battery) should be kept away from fire. There is no more fire inside, and the interior is cleaner as a result. This allows them to put an end to indoor pollution (initially from kerosene lamps and firewood), and have a cleaner and healthier atmosphere, with its positive health consequences. Indeed, as households have relocated the kitchen and ditched kerosene lamps, they have got rid of toxic fumes: there was a drop in serious coughing illnesses and the associated respiratory distress that comes with poor air quality. Health problems now relate more to malaria and bilharzia.

In the case of Tsaratanana, houses made of permanent structures are emerging, while previously, 99% were wooden. Some huts now have furniture, especially beds with mattress, while before, people squeezed on the floor at night. It should be noted that households have a competitive spirit as to improving their well-being: people try to outdo their neighbor in a constructive competition.

95% of households surveyed use firewood for cooking, the remaining 5% use charcoal and they are the ones who subscribed to service 3.

51% of households surveyed using solar electricity cook outside on a wood fire, in a specific room. We note that the more expensive the service, the more people tend to relocate the kitchen (28% of households in service 1, 60% of households in service 2 and 100% of households in service 3).

67% of households who do not use electricity cook on a wood fire inside the house.

91% of households surveyed using electricity feel an improvement in indoor air quality since the use of solar lighting.

In addition, while 33% of households surveyed who do not use electricity reported experiencing problems with eye irritation in the last two years, only 6% of households surveyed using electricity made this statement.

Photo taken inside a kitchen in Iavomanitra ▼

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Better family atmosphere that leads to serenity for children ▲

60% of households surveyed

using electricity have children going to school. The majority of children do their homework in the evening after school (80%), and most spend from 1 to 3 hours doing so (76%). Households believe that solar lighting is enough for their children to study. In addition to improving education, which is the most popular benefit for children (61%), solar electricity also helps them have more leisure (music, radio...), be more serene and calm because they are no longer afraid of the dark, and be in better health.

On the education side, access to solar systems is clearly beneficial, from teachers who can better prepare for classes in the evening at home, to students who are more motivated. In Tsaratanana, the teacher also covers adult literacy. Children and young people can calmly go to school, pushed by their parents, and school work is improved. Children also spend their time differently in the evening: their hobbies include writing and drawing. We noted the significantly improved cleanliness of young children, as guided by their parents. Young people want to go ahead and have structured desires/projects such as agricultural or computer training, sports activities. In Iavomanitra, some children go to school in Miarinavaritra and stay there for the week; they take the lantern with them, and work better with zero expense on kerosene.

We also noted a greater openness of the population, with the ability to listen to the radio continuously and hear the latest news, which is particularly important in case of bad weather or cyclones. For Iavomanitra, where the community has access to news and international news via Canal Plus, this gives them an open mind and a lot of benefits compared to surrounding villages.

Despite the fact that not everyone has access to solar lighting, there is no social dissension / discrimination related to this on a level that should cause concern. This does not lead to conflicts, because others still have light – albeit with kerosene.There is mutual help between villagers and the surrounding villages: people lend their solar lanterns in case of illness and child delivery, family celebrations, events; churches are able to borrow the solar setup for specific needs. Overall there is more social cohesion; for example, neighbors' children come to study at the houses of those who have electricity.

The most vulnerable households could not afford the electricity service and pay the contribution. However, they enjoy benefits because they can borrow their neighbors' lanterns from time to time, as long as they stay within the village.

Children can better study in the evening ▼

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© WWF Madagascar / Mialisoa Randriamampianina

Villagers provide mutual assistance, especially during events such as childbirth ▲

Households have different perceptions of the effect of lighting on security. Some think it deters thieves as the courtyard is lit. Others believe that inside lighting helps bandits locate the house and see what is inside. However, in 69% of households surveyed using electricity, women feel safe at night.

Regarding the use of a phone, some households have been able to buy one, but in any case, lack of access to cell phone coverage in the village itself, whether in Tsaratanana or Iavomanitra, is limiting. Iavomanitra is now discussing a project to set up a cell phone relay antenna nearby. The solar lantern also facilitates night travel, e.g. pregnant women who have to go to the doctor.

Economic impacts

The decrease in spending on kerosene is an important breath of fresh air for household budgets, as the money saved from kerosene can be spent on something else. Thus, in Tsaratanana, for a household who choose service 1 (solar lantern), energy expenditure went down to Ar 3,000/month, compared to Ar 9,000/month previously with kerosene. A household that does not use electricity has pointed out that access to solar electricity has been beneficial for their banana business because people save more and can afford to buy as a result.

Moreover, lighting makes it possible to work in the evening and improve one's income, e.g. for the shop-owner's accounting work or the alcohol fermentation in Iavomanitra. Farmers can stay later in their fields and not worry about the animals left in the village, which can be fed later in the evening. Women now craft mats in the evening, to improve indoor comfort but also to be sold at the market. During daytime, they tend to agricultural occupations, and in the evening, they make mats. In Tsaratanana, before electricity arrived, a woman produced 1 mat/month, but since the solar system came, one can make up to 5 to 6 mats/month.

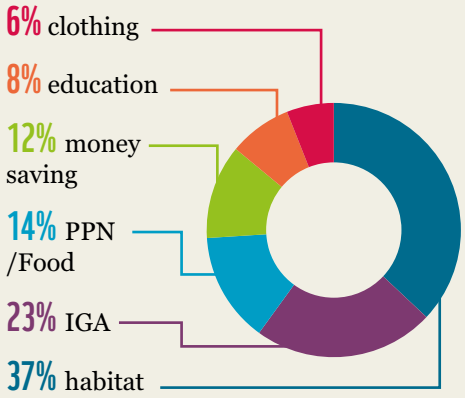
With the change of mentality and the resulting constructive dynamics, households are much more willing to practice new agricultural techniques such as irrigated rice farming (SRI), small livestock activities (geese, pigs, ducks...) or market gardens (greens). In addition, improved internal well-being, and particularly health, improves agricultural productivity; so instead of covering 1 Ha previously, it is now possible to work on 3 Ha.

In Tsaratanana, the households who adopted the SRI method significantly increased their yield. Rice is for personal consumption, and this improved production help them experience a significantly shorter lean period: from 4 to 5 months previously, the lean period now lasts one month (around April). And again, there is always something to eat (thanks to mutual help if some people had more crops/reserves than others). Therefore, the village no longer experiences famine, in spite of the inclement climate (floods etc.).

60% of households surveyed

using electricity reported saving money by adopting solar electricity. We note that the higher the service used by the households, the more they save (50% of households in service 1 saved money, compared to 60% of households in service 2 and 86% of households in service 3). We also note that households in service 3 make monetary savings.

Investment in savings from solar systems
(as percentage of households surveyed)



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Women have developed their basketry business ▲

The development of arts and crafts and small livestock activities also enables workers to improve their incomes; a woman is able to produce five times more mats per month than she did previously. This approach also includes the development of the bean and clove sectors.

© WWF Madagascar / Mialisoa Randriamampianina

Mialisoa Randriamampianina,
Communication Specialist who has closely followed the evolution of the approach in both villages.

"Berthe was able to quickly deliver my order for a mat and two small baskets. I placed my order in the evening before going to bed, and she gave them to me in the morning for breakfast, three hours of work for 5,000 Ariary for the mat and 6,000 Ariary for both baskets. The ideal outlet would be to have regular orders."

Moreover, as households want to maintain access to electricity and have understood that the key is their ability to contribute to replace used equipment, the associations of electricity users set up a cooperative to generate income. Thus, in addition to direct income for households, a bag of rice per household is for example taken and sold to fill in the association's fund. In this same spirit, they are now producing market garden produce and essential oils to buffer income.

Otherwise, villagers would like to have more power to carry out economic activities, for example enough power for carpenters to use electrical equipment, power wheels for craftsmen, and solar pumps.

Environmental impacts

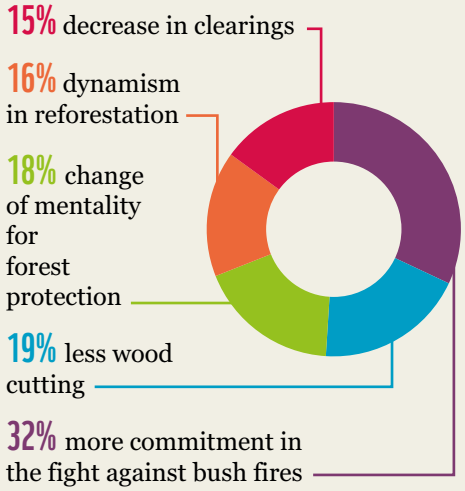
Improved living conditions, income and social well-being have strengthened the community's conviction and willingness to continue to protect forests, as it was COBA's forest conservation efforts that helped the village have access to electricity. Thus, Tsaratanana became a COBA model for the whole area; its inhabitants are proud of it and that further pushes them ahead. In Iavomanitra, bush fires have diminished, and it is easier to convince people to reforest.

© WWF Madagascar / Valiha

The community of Iavomanitra engaged in reforestation, led by the solar committee ▲

77% of households surveyed using solar electricity believe that the approach has had a positive impact on the environment.

Changes in environmental behaviors
(percentage of households surveyed feeling the change)



With lighting and the associated psychological effects, there is a heightened awareness of the importance of preserving the forest, recognizing that the future lies in improved agricultural production and no longer in forest exploitation. There is also a small decrease in wood consumption by household, since they now only use wood for cooking but no longer for lighting. Although this decrease does not seem consistent, it is already positive relative to the preservation of forest resources.

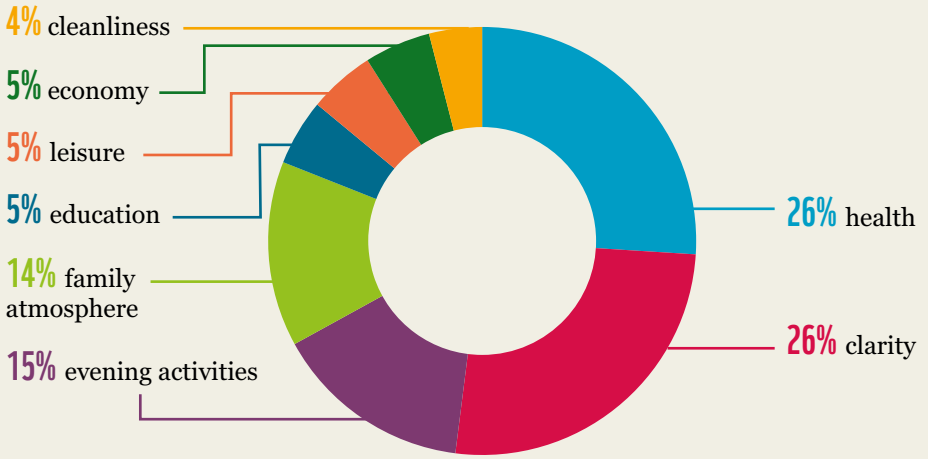
In Tsaratanana, light, which improves safety and health as well as a children's education, has pushed the people practicing slash-and-burn agriculture to settle and to stop living in the forest, with the positive consequences on the preservation of these ecosystems that are a natural result.

Causal links

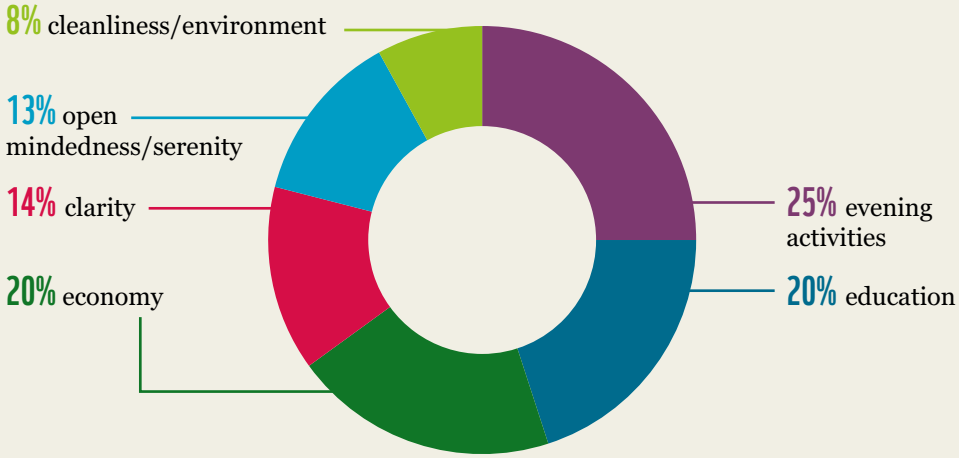
The effects and impacts analysis established the causal links as presented in the summary of this document.

In addition, we asked respondents to express the improvements they felt in terms of first, second and third place.

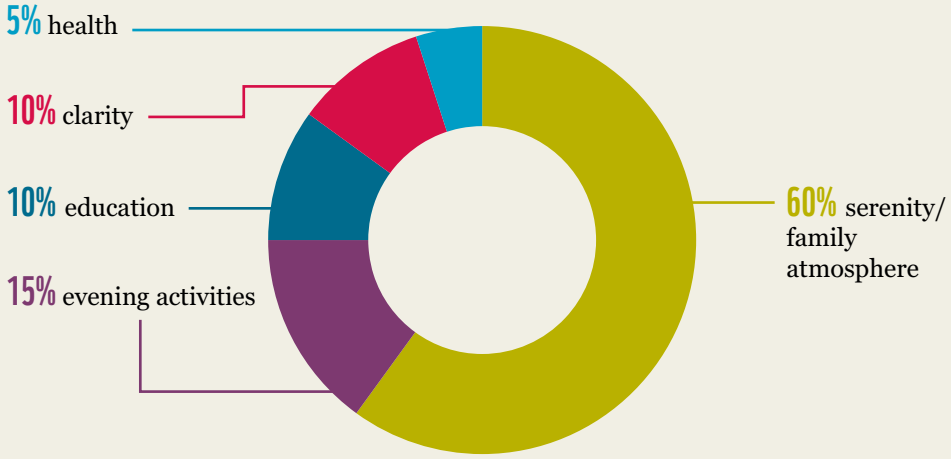
Improvements felt by households as 1st place
(percentage of households feeling the improvement)



Improvements felt by households as 2nd place
(percentage of households feeling the improvement)



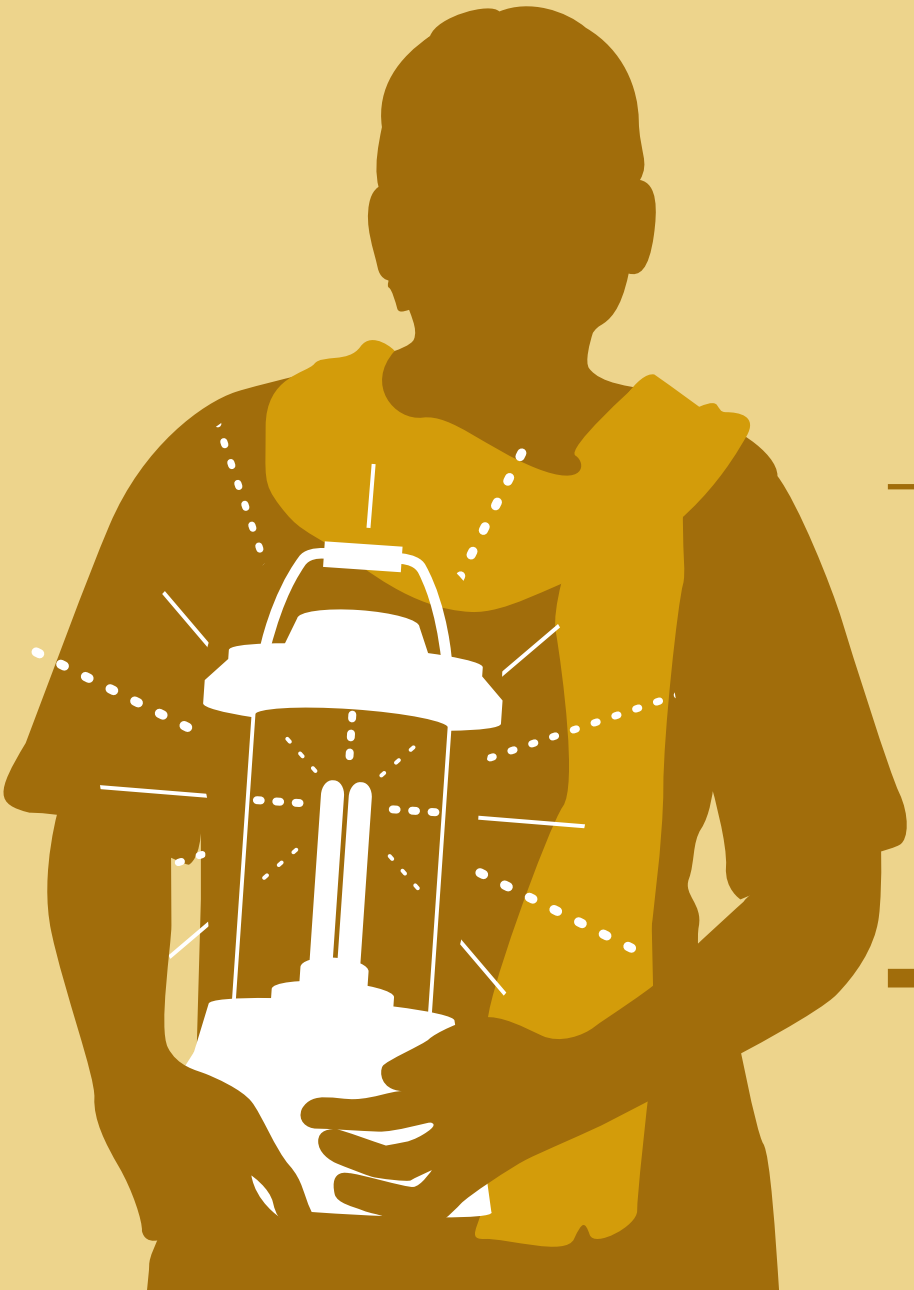
Improvements felt by households as 3rd place
(percentage of households feeling the improvement)



The training room of Barefoot College in Tilonia.

PART III

MAIN LESSONS TO BE LEARNED FOR THE NATIONAL BAREFOOT COLLEGE PROGRAM



"The lesson from the Big Mac story is that innovations that ought to be scaled won't happen everywhere but can happen anywhere."

Robert I. Sutton

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Solo Thierry Randriamanalina,
Energy Technical Assistant at WWF Madagascar.

"Whenever we introduce the Barefoot College approach, regardless of the audience, it's always been an a-ha moment! I even had to explain the project to a police officer and he did not let me go. Since I doubt that I have a particular speaking ability, I think this is due to the "human experience" aspect. It is really easy to have empathy for these women and imagine what they bring to their village. The approach also goes against what is usually done in electrification in Madagascar. Our country needs more initiatives of this kind that come off the beaten track and bring change where it is needed most."

Throughout these five years, WWF Madagascar's achievements and experience in the implementation of the Woman Solar Engineer approach have been shared with other organizations working in environmental protection and rural development. Many actors recognize the relevance of the approach and the opportunity to scale it up in Madagascar.

Madagascar National Park is the second organization to engage in its implementation. With WWF's technical assistance, a class of four women from the village of Ambararata, near the Kirinde Mite National Park, will fly to India in September 2017/March 2018 to be trained in solar technology at Barefoot College. WWF Madagascar continues to implement it in its intervention landscapes, and a class of four women from the village of Ranomay in the Mahafaly landscape will also leave in September 2017/March 2018 to join the Barefoot College in Tilonia. Internationally, inspired by WWF Madagascar's experience, WWF Myanmar is also committed to implementing the approach in partnership with Barefoot College International.

Besides these positives, in view of the growing interest generated, the Ministry in charge of Energy has decided to develop the National Barefoot College Program (PNBC) aimed at scaling up the approach throughout Madagascar. A steering committee of the PNBC was set up to do this, including: the Ministry in charge of Energy, the Ministry in charge of Women's Promotion, the Rural Electrification Development Agency, Barefoot College International, WWF Madagascar, Madagascar National Park and the NGO SAF FJKM. The PNBC aims to allow, by 2030, the creation of a network of 744 Women Solar Engineers by operationalizing a Barefoot College training center in Madagascar, and sustainable access to solar energy for 630,000 households.

A partial view of the PNBC Steering Committee during a study visit to Barefoot College in Tilonia ▼

© WWF Madagascar / Tony Rakoto

Thus, beyond sharing lessons learned, expressing the desire to promote an approach with multiple impacts on the development of isolated rural communities, this document also aims to feed the development of the national program for which we wish to offer some recommendations.

The definition of the National Barefoot College Program should be based on the definition of criteria and the selection of relevant field partners and villages.

The planning and mapping of the PNBC should be integrated into the rural electrification programming of the Rural Electrification Development Agency, being complementary to the programming of other approaches (rural electrification by a company, shop providing electricity services ...). The PNBC targets isolated rural villages, with difficult access, and can serve as a relay for businesses and shops, while seizing the opportunity of the existence of these potential relays(the businesses and shops).

The implementation of the PNBC should involve active partners in the field, in the targeted isolated villages. Indeed, the approach requires support of the community and village over time to ensure the long-term management of the electricity service. Opportunistic actors are to be excluded, since a historical background of the actor in the field with the targeted village community is necessary: the feasibility of the approach is particularly based on a relationship of trust, which does not occur overnight.

The **Enriche curriculum** at Barefoot College Tilonia is a parallel curriculum to the solar one. This means that apart from solar technology, women develop their skills and knowledge on the following topics, for a training period of 200 hours over six months:

- Leadership: self-awareness, confidence-building, public speaking.
- Women's health: reproductive health and nutrition.
- Micro enterprises: starting income-generating activities, gauging prices, customer prospecting, marketing approaches.
- Environment: environment-friendly practices or solutions (efficient cooking equipment, composting).
- Digital know-how.
- Human rights.
- Financial inclusion: budget management, savings, bank accounts.

When they return to their village, they can practice and share their knowledge with other women.

WWF's experience in implementing the Barefoot College approach since 2012 should help develop a standard methodology for any isolated rural village in Madagascar.

The process described in Part I of this document, from the village meeting to planning the activities, can be replicated regardless of the village and the implementing organization, with perhaps specific adaptations depending on local contexts.

In particular, to the extent that solar training is planned to take place in a Barefoot College training center to be established in Madagascar, the part relating to the preparation of women before the training can be reviewed. Moreover, as for the training center in India, the one in Madagascar should offer both parallel courses: Woman Solar Engineer and Enriche curriculums. The Enriche curriculum should be developed by taking into account the needs of rural Malagasy women, which will enable them to more easily practice the lessons they have learned.

The methodology could also include different models for paying for the electricity service, and for allowing each village community to decide on the model that matches its context. Indeed, the system consisting in paying a regular contribution for life is interesting because it

Sewing, one of the Enriche curriculum modules ►

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The women from Vorojà applying their marketing training in Barefoot College Tilonia, through the production and sale of small baskets for chapattis ▼

© Barefoot College

© Barefoot College

The women of Vorojà during a session on hygiene and especially on the importance of hand washing, thanks to the detection of germs ◄

matches the ability to pay on a monthly, semi-annual or other basis. However, it is difficult for the solar committees to recover such payments. On the other hand, choosing a payment equivalent to a subsidized purchase and then charging for repair/maintenance when it occurs may adversely affect the poorest households. A combination of both options is likely more appropriate.

The objective of the PNBC to provide 630,000 households with access to modern lighting and electricity was estimated by considering that each Woman Solar Engineer initially equips 50 households in her own village, then produces and sells (with the solar committee) 50 solar lanterns per quarter as part of the solar lantern entrepreneurship. Therefore, the pilot operation in Iavomanitra and Tsaratanana to set up the solar lantern entrepreneurshipwill have to be consolidated to bring out the appropriate reproducible model(s) as part of the PNBC.

Finally, we need to accurately define the role of central, regional, district, communal and local authorities. WWF's experience has identified needs, but one still needs to hone in on this by ensuring the sustainability and feasibility of the required monitoring/support from these authorities to the village solar committees.

The PNBC should include a component related to the creation of a spare parts supply chain..

So far, during village electrification, materials are imported from India via Barefoot College Tilonia. In addition, the village parts supply chain is not yet assured and the solar committees are finding solutions on a case-by-case basis with technical assistance from WWF.

The national program targets solar equipment for 630,000 households in a sustainable manner. At this level of scale, it is appropriate to create a real spare parts supply chain and relays at different levels (international, national, regional, local), optimized in terms of cost and quality of equipment.

For example, we can consider that importation will be done by the Barefoot College Madagascar training center for the national level, and that the sources of the materials will be optimized in collaboration with Barefoot College International. Indeed, although it would be desirable to rely on relay suppliers at the national level, it ultimately costs the same or even more, because these suppliers also import spare parts (none of which, to our knowledge, is yet manufactured in Madagascar), then include the import duties and taxes in their selling price. On the other hand, the training center in Madagascar could import the materials tax-free as they are designed for rural electrification. In this scenario, it would then be necessary to identify the regional and local relays that would be linked to the training center in Madagascar and which will be much closer to the targeted villages. It is in this context that the existence of "shops" would be an interesting opportunity to tap into. Some networks of "shops" are gradually being established in the country.

Otherwise, contrary to popular belief, it is not about cultivating economic dependence of the villages on India, given the purchase of materials from India. It is quite possible to consider importing spare parts from other countries (until adequate quality is manufactured in Madagascar) as long as this remains competitive. Of course, it will be easier for women to work on the materials on which they have been trained, as if they have to work on other materials, it will take some time to understand and adapt to the differences present. Once they understand that, regardless of brands, automatism is effective. Indeed, the women's learning techniques at Barefoot College in Tilonia allow them to manipulate other materials.

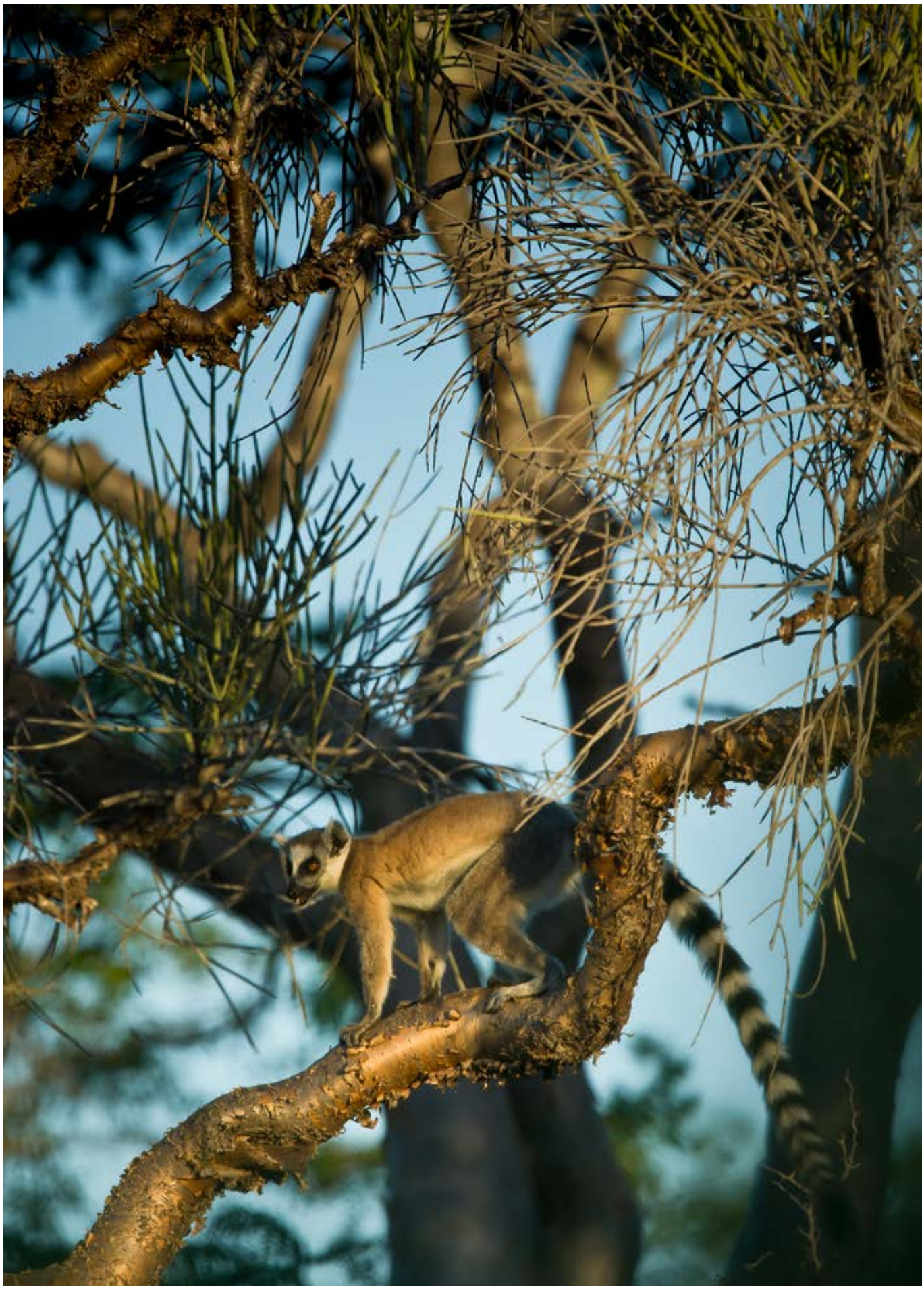
The PNBC should include a component related to the collection and recycling of end-of-life batteries.

A target of 630,000 households equipped with solar systems means at least an equivalent number of end-of-life batteries to be collected and recycled at the end of the first battery life cycle. The environmental and health issue is important and must be addressed.

Putting in place a battery collection and recycling system at the country level would affect not only the PNBC but all the actors and programs promoting solar photovoltaic with battery storage. Thus, it has to be a national approach, led by the Ministry in charge of Energy.

The implementation of the PNBC will contribute to achieving the majority of the Sustainable Development Goals to which Madagascar is committed.

As a result, cross-sectoral collaboration in the PNBC implementation will be required. This indeed affects the departments in charge of energy, population and promotion of women, education and vocational training, health and family planning, agriculture, and crafts.



A Maki catta from the terrestrial and marine landscape of Mahafaly, in the south-west of Madagascar.

© WWF Madagascar / Pauline Dame

"The arrival of electricity has caused a real revolution in the villages, a revolution in villagers' way of thinking and lives. Today, they have taken ownership of their future – actors in their own development, they also help nature benefit from it. They have turned away from clearing land, they built latrines, and they strengthened their homes, started literacy and adopted improved farming practices. The Barefoot College-WWF model is proven, and can be replicated and multiplied."

Anitry Ny Aina Ratsifandrihamanana,
Country Director, WWF Madagascar

© Varial Cedric Houin

"The time when Women Solar Engineers take their own destiny in their village and that of capacity building for village solar committees is unavoidable. It is essential to invest in both mechanisms at the community level if we want to ensure both a sustainable initiative that the community is able to pursue, and the leadership of these women in developing additional entrepreneurial activities in the community."

Meagan Carnahan,
CEO, Barefoot College International