



Annual Planning 2018 Update

Energising Development – Phase 2



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A. Introduction

The Governing Board of EnDev approved the Annual Planning 2018 during its 17th meeting on November 21st and 22nd 2017. Since then, it has become apparent that several EnDev projects will reach a critical financial situation (underfunding) if no changes to the project budgets are possible. As a result of the current external strategic evaluation of EnDev, it is expected that during the meeting in autumn 2018 the Governing Board will decide on EnDev's new strategy and the future strategic development of EnDev's country and project portfolio. To avoid that projects are required to be closed due to lack of funds before strategic decisions on EnDev's country portfolio development can be taken by the Governing Board six up-scaling proposals are presented.

To strengthen the performance-based approach of the programme, the EnDev management applied a structured screening process for the assessment of up-scaling concepts and proposals. The screening process is described in detail in chapter B.

Chapter C summarizes the key data of planned country activities in 2018.

Chapter D comprises the up-scaling proposals of the different country activities.

Chapter E provides information about the changes in RBF components in order to optimally steer for results of the portfolio.

B. Screening procedure for up-scaling country projects

B.1 General description of the screening procedure

As a result of the discussion during the 15th board meeting in Bonn (November 2016) EnDev management revised the screening process for up-scaling of country measures giving more weight to those activities which facilitate access to modern energy at higher tiers and where energy is used for economic activities or for providing social services via a dedicated up-scaling criterion. Although outcomes and cost-efficiency remain the most important indicators, compared to previous (regular) up-scaling rounds projects are required to provide more information on the level of access, on the way they envisage to reach scale in the (sub-) sectors, i.e. concrete strategies for market/sector development, and ways to cooperate with other key actors in the sector. Projects are also invited to elaborate on the evidence base of claims on for instance market/sector development, economic and social impacts, and sustainability. In addition, the format takes into account the indicators that have been agreed with the Governing Board for EnDev phase 3, and introduces an additional bonus criterion for concrete gender strategies.

EnDev is not abandoning its basic philosophies or outcome orientation. Coming to scale, however, requires continuously evaluating and tuning the programme's role in the market. Appreciating differences between markets and countries, EnDev's role in some countries remains that of a market initiator whereas in others EnDev needs to take – in cooperation with other actors – a much more facilitating role. By describing this in the proposal, EnDev management aims to further strengthen the performance of the programme.

Seven projects have project periods that would end in 2018. Their financial situation allows cost neutral extensions until March, April, June or December 2019 (Burkina Faso, Central America, Ghana, Indonesia (biogas), Madagascar, Mali, Senegal). Additional for one project (Nepal) a cost neutral extension is proposed from June to December 2019. All cost neutral extensions are proposed for these projects to overcome the mismatch in timing of the expected/anticipated additional financial commitments of donors (end of the year) and contractual requirements of the projects to stay operational. Another reason for these extensions is the expected decision about the future strategy and country portfolio to take place in the Governing Board meeting in autumn 2018. Without extending these projects now, they might be required to be substantially scale down operations or even phase out prematurely, i.e. before strategic decisions can be taken.

The available funds for up-scaling projects are limited. Hence, this semester only projects in urgent need of additional funds are invited by EnDev management to submit short proposals (7-10 pages each). The financial need of projects is defined as the ability of projects to continue implementation until EnDev's country portfolio has been reviewed and strategic decisions on EnDev's country portfolio development can be taken by the Governing Board. For six projects, an extension in project duration and a budget increase is required.

In the short proposals, projects are requested to explain their views and plans for the up-scaling taking the up-scaling criteria duly into account. The projects receive support from their respective country managers at EnDev head office (GIZ and RVO). EnDev head office (management and country managers) jointly evaluates all short proposals and provides feedback and recommendations to the projects that are either selected or not to submit a full proposal for the EnDev Governing Board. EnDev head office financially balances its recommendations according the available funding. On the basis of the recommendations the project prepares a full up-scaling proposal to be included in the (updated) annual planning for approval by the Governing Board. Country managers assist in the process, assuring that major recommendations are taken into account. Responsibility for the proposals lies nevertheless with the country projects.

B.2 Up-scaling criteria

For the proposals, the following up-scaling criteria are applied:

Up-scaling criteria
Cost efficiency (current and anticipated)
Sustainability (proven/expected)
Impact (with special emphasis on economic activities and social services)
Degree of market/sector development & scalability
Conditional criteria
Administrative & financial clean track record (per GIZ standards)
Bonus criteria
Least developed countries
Strategic importance for (individual) EnDev donors
Electrification activities
Higher service level access
Remote areas
Concrete gender strategy

B.3 Assessment of up-scaling concepts of country projects

Six projects were invited to submit a short proposal for evaluation because of limited uncommitted funds related to EnDev’s current programme end.

Assessing the short proposals in an early phase of the up-scaling process proved to be valuable as it offered the opportunity to provide feedback and guidance to the projects on the basis of a coherent and transparent comparison between all submitted proposals.

EnDev management capped the overall budget for this up-scaling round at EUR 6.8 million. The cap resulted in detailed discussions about each project. Based on the quality of the proposal and the project’s performance the budget of one proposal was reduced by 100,000 EUR and the project duration of four proposals was changed.

Three proposals (Bangladesh, Bolivia, Vietnam) were presented with a convincing concept to the evaluation meeting and were accepted. One (Vietnam) of these three projects presented an exit strategy and will close its EnDev activities after this phase. Of the remaining three, one proposal (Indonesia) was accepted with recommendations slightly to adjust the concept. One more proposal (Liberia) also is required to include some adjustments to the concept and to use the proposed funds over a longer project period. Finally, one project (Liberia) was asked to adjust the proposal in term of concept, duration and reduce the budget. The total amount of the full proposals amounts to EUR 6.7 million.

B.4 Review of RBF projects

In December 2017, the Results Based Financing (RBF) Facility reached the important milestone of providing clean energy access to more than 1.5 million people. Most of the 17 projects have started to

pick up pace. The delivery of results is expected to further accelerate in 2018, although progress remains slower than originally anticipated. This is due to challenges and delays in project implementation primarily related to the innovative character of the approach. At the same time, these challenges provide a considerable amount of learning and knowledge EnDev is gaining through the implementation of the RBF Facility. These are of increasing value for other stakeholders using RBF approaches in the energy and other sectors and EnDev is regularly being asked to share them. These experiences have therefore been summarized in EnDev's most recent publication titled "Results-based Financing for Energy Access" and can serve as a guide on how to design and implement RBF projects.

In March 2018, DFID together with EnDev management evaluated the progress of the RBF Facility. This entailed the detailed review of sixteen RBF projects in regards to their achievements so far, their potential for market transformation as well targets still to be achieved in the remaining duration of the Facility, which is to close by the end of 2019. A special focus was put on projects that can phase-out this year due to DFID's interest in a consolidation of the overall in 2018. The only project that was not part of the review, was the RBF project for promotion of ICS in Ethiopia, as the project is to close in June 2018 already. In addition, RBF projects that will definitely phase out by the end of 2018 are Bangladesh, Vietnam, and Peru.

For most projects in the review, adjustments of their Key Performance Indicators (KPIs) are proposed to better reflect the actual developments of the respective markets, and therefore the projects, over time. In addition, time extensions are proposed for the RBF projects in Bangladesh, Tanzania and Vietnam (all within 2018), as well as the Grid Challenge and the solar appliance project (implemented by CLASP) from the third round of the RBF Facility until June 2019. Budgets of the RBF projects in Benin and Peru were reduced. No project budgets were up-scaled during this review round.

Furthermore, the decisions on the East Africa biogas project implemented by HIVOS and the Mekong stove project implemented by SNV have been postponed. Budgets of both projects will definitely be downscaled, however, as more thorough analyses of the detailed circumstances are required the exact downscaling of budgets and activities will be defined in a subsequent meeting between DFID and EnDev in April 2018. Review proposals will subsequently be included in a final version of this document.

The proposed budget and timeline changes, as well as adjusted KPIs are provided and briefly commented in the chapters C and E below.

C. Overview of planned country activities in 2018 under EnDev 2

The total budget of the second phase is currently EUR 329 million. Below, an overview of country activities is provided. Table C.1 gives an overview of ongoing and unchanged projects (compared to the previous Annual Planning 2017 document), including regional RBF projects. Country activities that are foreseen to be extended without up-scaling are presented in table C.2. Table C.3 presents the country activities that are proposed to be scaled up and table C.4 presents country activities in which only the RBF component is intended to be scaled down or the target is adjusted. Table C.5 presents ongoing regional sector support initiatives and table C.6 activities to facilitate access to modern energy for refugees.

Table C.1: Ongoing country activities under EnDev 2 *without changes*

Country	Activities	Project duration		Funding	Planned outcomes on HH level
		start	end	in EUR 1,000	in persons
Cambodia	Biogas	12/12	06/19	2,550	34,000
Ethiopia	solar, grid stoves, hydro	01/10	12/20	34,086	1,872,500
Malawi	solar, stoves	12/12	06/19	4,190	1,094,500
Rwanda (with Burundi, DRC)	solar, hydro, biogas, stoves	10/09	12/20 ¹	21,240 ²	1,479,618
Uganda	stoves, solar, grid	04/09	02/19	12,250 ³	707,800

¹ With project periods of Burundi, DRC until June 2019 and Rwanda until December 2020.

² Including up-scaling of EUR 1,700,000 depending on final approval of USAID funds.

³ Of which EUR 11,750,000 is guaranteed; EUR 500,000 is subject to availability of EnDev Global funds.

Table C.2: Country activities intended to **be extended** without up-scaling

Country	Activities	Project Duration			Funding	Planned outcomes on HH level
		Start	Old end	New end	in EUR 1,000	in persons
Burkina Faso	solar, stoves	10/09	12/18	03/19	7,597 ⁴	1,600,000
Central America	solar, stoves, hydro, grid	09/09	12/18	04/19	17,590	475,370
Ghana	solar, stoves, grid	01/10	12/18	06/19	3,675	mainly SME
Indonesia	biogas	12/12	12/18	03/19	2,500	61,750
Madagascar	stoves	12/12	06/18	12/19	800	130,000
Nepal	stoves, hydro, grid	05/09	06/19	12/19	7,915	502,755 ⁵
Mali	solar, mini-grids, energy kiosks	01/13	12/18	06/19	4,500	140,000
Senegal	solar, grid, stoves	04/09	12/18	03/19	16,701 ⁶	1,765,000

Table C.3: Country activities with **change of the budget, target and project duration** (details in chapter D)

Country	Activities	Project duration			Funding in EUR 1,000		Planned outcomes on HH level in persons	
		start	old end	new end	old funding	new funding	old target	new target
Bangladesh	solar, stoves	06/09	05/19	06/19	24,069	25,069	6,870,330	7,100,000
Bolivia	solar, stoves, grid, PU	10/09	08/18	08/19	15,000	16,000	886,100	926,600
Indonesia	solar, hydro	05/09	07/18	08/19	11,960	12,760	172,000	228,000
Liberia	solar, mini-grids, solar dryers, stove	05/12	11/18	06/19	4,428	5,428	45,000	97,500
Mozambique	solar, stoves, grid	10/09	06/19	08/19	14,500	15,900	549,000	615,000
Vietnam	biogas	07/13	06/18	12/20	3,740	5,240	275,000	375,000 ⁷

⁴ This includes EUR 947,000 from EU for ProCEAO regional management and implementation in Burkina Faso.

⁵ As defined in the Annual Planning 2017 update

⁶ Including EU Cofinancing budget: PASES up to EUR 2,370,000, ProCEAO Senegal up to EUR 531,354.

⁷ Result of DFID-RBF in 06/2018 estimated at 225,000. Target for extension under EnDev-RBF is 150,000 additional people. Total target will be 375,000 (225,000 achieved under DFID + 150,000 new). This is an increase of 100,000 over the old target. The actual estimation or result is 470,000, but that would only work if the pig meat crises is overcome fast. Therefore, a reduction has been applied.

Table C.4: Country activities in which the RBF component is intended to be **changed**

Country	Activities	Project duration			Funding in EUR 1,000		Planned outcomes on HH level in persons	
		start	old end	new end	old funding	new funding	old target	new target
Benin	solar, stoves, grid, picoPV	10/09	06/21	06/21	16,028 ⁸	15,808	1,816,987	1,675,000
Kenya	stoves, picoPV, SHS, mini-grids	04/09	06/19	06/19	22,515	22,515	7,284,000	7,574,945
Peru	solar, stoves, grid, SWH	06/09	06/19	06/19	17,520	17,257	2,053,851	1,976,161
Tanzania	stoves, solar	12/12	12/18	03/19	5,660	5,660	560,000	590,000
RBF BD, KE, RW, TZ, UG	off-grid solar	03/15	02/19	06/19	4,110	4,110	1,111,200	1,071,546 ⁹
RBF MOZ, UG SSA	grid densification	03/15	02/19	06/19	4,421	4,421	200,000	290,000
RBF KY, TZ, UG	biogas	03/15	02/19	06/19	3,870	2,140	128,940	47,262
RBF Mekong (CM, LS, VT)	stoves	03/15	02/19	12/18	4,096	2,436	600,726	128,000

Table C.5: Ongoing EnDev sector development activities **without changes**

Countries	Title	Budget EUR in 1,000
Bangladesh, Ghana, Kenya, Uganda	Cooking sector support and coordination	2,000

⁸ Including up to EUR 468,041 contribution of EU to ProCEAO Benin.

⁹ 546,488 persons will be considered as gaining new access, while 525,058 are expected to obtain improved access.

Table C.6: Special country activities in the context of refugees and stabilisation in fragile environments without changes

Countries	Activities	Budget EUR in 1,000
Kenya, Somalia		985
Kenya	stoves, picoPV	approx. 550
Somalia	grid, solar street light	approx. 350
Uganda	stoves, picoPV	300 ¹⁰
Uganda	stoves, picoPV	300
Mali	solar street light	255
Tanzania	stoves, picoPV	1,600 ¹¹

¹⁰ planned under bilateral BMZ programme

¹¹ planned under bilateral BMZ project

D. Up-scaling proposals

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Bolivia..... 17

Indonesia 26

Liberia and Sierra Leone (with side activities in Guinea) 37

Mozambique..... 47

Vietnam 56

Bangladesh

1. Summary

Promoted technologies		solar, stoves,nano grid			
Project period	old	06/2009 – 05/2019	Budget (EUR)	old	24,069,000
	new	06/2009 – 06/2019		new	25,069,000
		old targets	new targets		
Energy for lighting / electrical appliances in households		2,300,000	2,300,000	people	
Cooking / thermal energy for households		4,570,330	4,800,000	people	
Electricity and/or cooking / thermal energy for social infrastructure		0	50	institutions	
Energy for productive use / income generation		100	750	SMEs	
Lead political partner		Bangladesh Ministry of Power, Energy and Mineral Resources			
Implementing organisation		GIZ			
Implementing partner		Solar: Infrastructure Development Company Limited (IDCOL), solar companies; stoves: Bangladesh Bondhu Foundation (BBF), Ministry of Environment and Forests			
Coordination with other programmes		REEEP (BMZ), GEF, KfW, IDA, GPOBA (DFID), GPOBA (SIDA), ADB, WB, IFC, GFA and UNDP.			
Key interventions		<ul style="list-style-type: none"> • picoPV (< 10 Wp and 1200 lumen hours/solar day) RBF component with solar companies • Support of sales and installation of improved cookstoves that are suitable for indoor cooking and promotion of clean kitchen environment through BBF • Support of sector coordination for cooking appliances and fuels through the national household energy platform (HEP) 			
Main strategic changes introduced with up-scaling		The main strategy so far has been very successful and consequently will not be changed. EnDev will pilot the introduction of new stoves if they fulfil the established health and clean kitchen standards.			
Project manager		Gerard Hendriksen, gerard.hendriksen@giz.de			

2. State of sector and market development

2.1 General energy situation in the country

Bangladesh is currently ranked 139th out of 188 countries in the Global Human Development Index (HDI) 2016. Although Bangladesh has made significant progress regarding several development indicators like health, education and economic growth in recent years, it is still the largest least developed country (LDC) in terms of population and economic size. It is expected by the UN that Bangladesh will leave officially the LDC status by 2024.

Lack of access to modern energy services is still one of the main barriers for eliminating poverty and enhance economic development. According to a recent Government report (Feb 2018) 90% of the population has access to electricity. However, the electricity supply is not reliable and supply does not meet the demand. Load shedding occurs up to 14 hours a day. Households without access to electricity generally use inefficient, kerosene lamps as sources of light. The kerosene price has almost doubled in the last five years.

Only about 8% of the entire population has access to natural gas for cooking, primarily in urban areas. Biomass such as wood, cow dung and agricultural residues are the dominating fuel for cooking. In rural areas, they are collected mainly from the local environment. In urban and peri-urban areas they have become a traded commodity with increasing prices as access to biomass becomes continuously more difficult.

2.2 State of market development

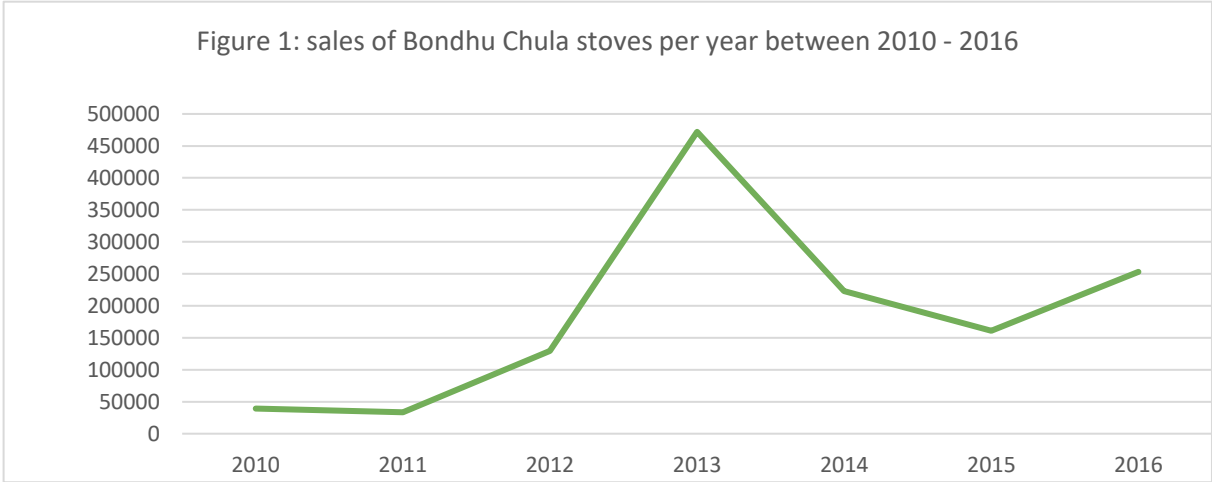
2.2.1 Stoves

Over 90% of the 35 million households of Bangladesh use biomass for cooking (60% of the urban households and almost all rural households), whereas only 8% use natural gas, primarily in urban areas. 76% of households use some form of leafy biomass to cook, while 55% of households use dung cakes and sticks. Many households use both biomass and dung cakes. Agricultural residues, leaves, and grass account for 39% of cooking energy, while animal dung makes up around 17% of the cooking energy. Most people relying on solid fuels for cooking use traditional cookstoves, which consist of a hole in the ground with three raised clay lips to rest the pot, with a separate fuel entry hole. Stoves are often fed with bigger pieces of wood or dung sticks. Households are unaccustomed and/or unwilling to chop wood into small pieces. In addition, traditional stoves are constructed in a way that the fuel naturally slides further into the combustion chamber as it burns. This allows multi-tasking during cooking. The traditional clay stoves are inefficient and used in poorly ventilated kitchens so that they produce smoke and soot. Women are exposed to high levels of air pollutants between three and seven hours a day. The World Health Organisation (WHO) estimates for Bangladesh that women and children are affected by premature death each year as a direct result of exposure to indoor air pollution, with more than 30 million households impacted by exposure to household air pollution each year. These 30 million households form the market potential for ICS. As 67% of households use more than one stove, the total number of stoves that could be sold would be over 50 million. With varying and unreliable availability of natural gas in urban areas, the use of stoves other than gas stoves will increase also in urban areas. This represents an opportunity for fuel-efficient stoves to enter the cookstove market in urban areas. That would have to be advanced biofuel stoves since electric stoves are not considered an option by the government to avoid an overload of the grid.

The market for fuels is changing, too. Due to rising fuel demand, deforestation and forest degradation is proceeding and fuelwood is becoming increasingly scarce. In rural areas, household members, mainly women and children, collect biomass fuels from the local surroundings, spending more and more time due to increased scarcity of biomass. About 40% of the needed fuelwood is purchased from local markets. The price of dry woody biomass is EUR 0.08 - 0.11 per kg, depending on the quality, while the price of rice husk briquettes is EUR 0.14 – 0.16 per kg. In urban areas, most of the biomass fuel is purchased. However, natural gas plays a much larger role although current supply is unreliable and many are still not connected to the gas grid, hence commercial operations (hotels, food shops, bakeries etc.) mostly use rice husk and some sawdust briquettes. Street food vendors use twigs, cow dung, leafy biomass and briquettes. Fuelwood traders sell wood in bundles (50-60 kg) costing around EUR 2.74 – 4.39.

The GIZ-EnDev programme started to introduce high quality energy efficient stoves with chimney (so-called Bondhu Chula stoves) in Bangladesh in 2010. As stove manufacturing is not very common in Bangladesh, because households themselves make most of the traditional stoves, the EnDev programme supported artisans and small enterprises experienced with the production of cement products (such as water pipes, toilet slabs etc.) to manufacture the new type of stoves. Figure 1 shows

the sales figures of the stove per year. Around 5,000 trained manufacturers produced in total 1.8 million improved cookstoves showing that the stove could be established successfully in the local market. End of 2013 IDCOL started a parallel programme with the aim to promote another 1 million



cookstoves until 2018. The World Bank supported improved cookstoves programme of Infrastructure Development Company Limited (IDCOL) is using to a large extent the structure of the solar home system programme with more than 60 partner organisations (POs), most of them NGOs, to disseminate improved cookstoves. By January 2017, the target of one million was achieved. Both programmes, EnDev and IDCOL, are responsible for more than 95% of the current sales of energy efficient biomass stoves. Based on an estimated life span of 5 years for the high quality stoves around 2 to 2.5 million households (6-8%) use currently energy efficient cookstoves benefitting 8-9 million people. The still unserved market for energy efficient cookstoves is around 26 to 27 million households as only a small number of households will shift to cooking with biogas (currently 30,000 households) or LPG (currently 0.5 million households).

Despite these successes the market development is still in a pioneering state with average sales figures of around 10,000 – 15,000 improved cookstoves per month by EnDev and another few hundreds by the IDCOL programme.

The main limiting factors for wide spread dissemination of ICS are, among others:

- i. ignorance of the people about the health hazards of indoor air pollution and other negative effects of using traditional stoves and benefits of ICS;
- ii. unreadiness to pay for ICS given the low purchasing power;
- iii. adherence to traditional stove by habit;
- iv. lacking social recognition of ICS;
- v. lack of after-sales services;
- vi. insufficient accessibility in the market distribution network ,
- vii. ignorance of different government agencies about ICS and the potential to reduce biomass consumption;

Nevertheless, the opportunities for a significant increase of the demand for energy efficient biomass cookstoves in the coming years are high. The main challenges will be on the one hand to increase consumer awareness about the harmful effects of the traditional cooking systems and the knowledge about the clean cooking systems. On the other hand, it will be essential to develop the supply side in a way that manufacturers and retailers provide a sufficient number of high-quality stoves at affordable prices, which are convenient, adjusted to the cooking habit and meet the specific needs of the different customer groups. This will require buy-down grants for a limited period so that stoves are in a price range of EUR 10. Sales of products of a higher cost range of EUR 17-30 are possible as shown by stoves produced by five local companies, but the sales figures are low and unstable. Only, if households are

convinced that the new stove will greatly improve their cooking system they will be willing to pay a higher price for the stove.

2.3 Relevant activities of other donors and implementers

The World Bank is supporting cooking activities as part of the Rural Electrification and Renewable Energy Development project (RERED II). The improved cookstoves programme is managed by IDCOL and implemented by 42 POs. The stove activities started in 2013 with the installation target of 1 million ICS in Bangladesh until December 2018. Key element of the project concept is the provision of EUR 5.54 per ICS as grant to the POs. The programme achieved the 1 million ICS installation target within January 2017, almost two years ahead of the project completion period. However, IDCOL and World Bank admit that more than 80% of the stoves sold, were simple one-pot stoves without chimney, which had production costs below the subsidy of EUR 5.54. Given the achievement of the set target in the first phase of the IDCOL programme, the Government of Bangladesh in cooperation with the World Bank plans to expand the programme in a second phase. The World Bank has submitted a proposal to the GCF for a USD 20 million grant in addition to USD 20 million loan from IDA. The project aims to scale up the number of ICS disseminated by 4 million (in addition to the 1 million disseminated under the first phase) over the next five years. The proposal has been formally approved by the GCF Board in February 2018.

The Global Alliance for Clean Cookstoves (GACC) started working in Bangladesh in 2011/2012 and assisted in developing a Country Action Plan. In collaboration with Accenture Development Partnerships and USAID, GACC has conducted a larger ICS market sector study and carried out business training for stove producers. GACC supports the strengthening of industrial (national and international) production of portable gasifier stoves and subsequent distribution channels, and the development of national policies, standards and regulations. GACC also supports the establishment of reliable testing methods and facilities in the country as well as raising awareness, while building the evidence base for a comprehensive clean cooking agenda. GACC also initiated the idea of the Household Energy Platform, which was launched by SREDA in May 2016. The HEP provides a forum for relevant ministries, development partners, private sector and academia to coordinate and align better and plan activities jointly.

The Korean company, Ecoeye, agreed recently to support the development of a CDM / Programme of Activities (PoA) for cookstoves and to buy carbon credits from the Bangladesh Bondhu Foundation (BBF) for 500,000 stoves after successful completion of a pilot project. There will be an increasing focus on repair and maintenance of the installed stoves to ensure their continuing and effective operation and maintain lower carbon emission levels.

3. Intervention strategy

3.1 Market development vision

The project expects that the demand for improved cookstoves will increase in the coming years due to growing consumer awareness about the harmful effects of the traditional cooking systems. The main challenges will be to develop the supply side in a way that poor rural households even in remote areas get access to high-quality stoves at affordable prices, which are convenient and meet their specific demands. So far, the project has focused its activities on the Bondhu Chula stove, a fixed stove with chimney made with concrete that is relatively cheap and significantly reduces indoor air pollution. Currently no other stove type on the Bangladesh market has similar benefits at comparable, affordable prices. The project aims at strengthening production and marketing resulting in an annual growth of sales figures for the Bondhu Chula stove by roughly



Bondhu Chula stove

15% on average (from currently 12,000 to 13,500 per month). It will be important for medium to long-term stability of the market that the profitability of the Bondhu Chula business is comparable to other products of sanitary shops.

The Bondhu Chula stove is especially suitable for rural markets. In densely populated urban and peri-urban areas, advanced biomass stoves that emit almost no smoke may be an interesting option to traditional and improved cookstoves and an alternative to LPG stoves. EnDev will explore the potential of this market and pilot support of the advanced biomass stoves.

3.2 Fit with policy ambitions and plans for energy access and climate change, in particular with SDG7/SEforAll country plan and NDC

The Government of Bangladesh has the ambition to achieve universal access to modern energy technologies and services by 2030. To reach this goal the government has defined the following targets:

Grid extension: between 2016 and 2020 the percentage of households connected to the grid shall increase to 96% according to the five year plan of the government.

The total accumulated number of SHS sold including picoPV and small systems shall reach 6 million, with an estimated generation capacity of 220 MW of electricity.

In the Country Action Plan for Clean Cookstoves (CAP) the government defined the target to disseminate cookstoves to over 30 million households by 2030.

3.3 EnDev conceptual approach and intervention strategies per (sub)sector

EnDev will continue to support around 3,000 sanitary shops to build, promote and sell improved cookstoves with chimney. EnDev's support is mainly channelled through the Bangladesh Bondhu Foundation (BBF). BBF provides technical training to the stove builders to promote high-quality stoves at affordable prices. BBF will also support the stove manufacturers (sanitary shops) in marketing their products through sales and marketing staff (roughly 480 people) employed by BBF. These so-called promoters have the task to approach local governments, provide trainings to users and create awareness amongst the population in community meetings and in similar settings. In addition, female volunteers receiving allowances do promotional work in their home villages and assist families in using the new stove. EnDev's strategy for market development aims at strengthening the nationwide network of small-scale manufacturers each serving a certain number of communities comparable to the network of different craftsmen which provided basic services in rural areas in Europe for decades. In parallel, EnDev will explore whether an industrial mass production of stoves is feasible so that the role of the local stove fitters would be focused on installation and repair work. Other cooking system and biomass fuel technologies (other stove types, hot bag, briquettes etc.) have been piloted and will continue to receive support to scale up their businesses.

EnDev's activities in the coming year will be largely built on results achieved so far. Thus far, EnDev has facilitated total sales of 1.44 million stoves since 2009. Out of these 966,000 are assumed to be still operational, based on an estimated life span of five years, benefitting 3.93 million people. To date, market development is still in an unsustainable state, where sales are supported by awareness campaigns and buy-down grants so that stoves are in a price range of EUR 9-14. Sales of products of a higher cost range of 1,500 - 2,500 taka (EUR 17-30), produced by 5 local companies have begun to take up over the last year, yet the sales figures of the organisations involved are still low and unstable. EnDev is cooperating closely with the MoEF and SREDA. The MoEF provides a stove subsidy of BDT 250 (EUR 2.75) for every installed stove to producers to make stoves more affordable and the stove business more profitable.

3.4 Cooperation with others

EnDev together with its partner organization Bangladesh Bondhu Foundation are in regular exchange with the Ministry of Environment (Department of Environment), the Sustainable and Renewable Energy Development Authority (SREDA) of the Ministry of Energy's Power Division, IDCOL, partner organisations of IDCOL (such as Grameen Shakti), UNICEF, Winrock, GACC, SNV, and USAID. It is

planned to intensify cooperation with these organisations, especially to strengthen the “Household Energy Platform” and to support the CAP. EnDev is currently already providing staff to the platform and is engaged in strengthening the capacity of local laboratories to become acknowledged test laboratories for stoves and cooking technologies.

Very recently, BBF signed an agreement with the Korean company Ecoeye. Ecoeye will finance the development and registration of a CDM /PoA and buy carbon credits of 500,000 stoves installed by BBF. Thus, the activities of EnDev have created the base for additional market development activities funded by other organisations. Despite this additional support from Korea, BBF will still need strong support regarding the management of the 500,000 stove programme and for providing evidence to the Korean company of the efficiency of the stoves in a pilot phase.

4. Sustainability

In 2015, EnDev had to reduce its stove activities due to financial limitations, and the government (MoEF) stopped their contribution to the stove programme (EUR 2.75 per stove). For several months, the sanitary shops continued to produce and sell stoves, however at a lower scale (roughly 50% of previous sales). It means that a certain degree of sustainability has already been achieved. Project activities mainly help make the stove known to a broad number of households. Thus, the marketing and promotion activities of EnDev are an add-on for the stove producers and retailers to stimulate market growth but not necessarily to ensure a self-sustainable market at a lower level. A significant push to the market is expected through the planned GCF project, which shall start in 2019, if the application is successful.

Apart from the production and installation of new Bondhu Chula stoves, there is also a growing market for repair and maintenance of the installed stoves, which involves producers of chimneys, metal grids and other wearing parts and technicians in the villages to replace these parts. However, so far little information is available in this increasingly important aspect of the stove market.

Another key role of EnDev is to assure a high quality of stoves. EnDev has established a quality check system and is providing training to the manufacturers. It is expected that both measure contribute to ensure that low quality products get no chance to spoil the market.

EnDev has supported the development of the Bangladesh Bondhu Foundation (BBF) as a key player in the cooking sector of Bangladesh promoting modern indoor cooking systems and healthy kitchen environments and developing innovations in the sector. BBF has got a lot of recognition for its work from national entities and recently also from international organisations. As a result, BBF has received national as well as international grants. Therefore, EnDev's target that BBF does not depend on EnDev financing or any other single donor is gradually achieved.

5. Expected impacts of the project intervention and related indicators

Impact	Possible indicators
Environment	Reduction of the use of (non-renewable) biomass in households will benefit the local biodiversity by reducing the pressure on natural resources and forests.
Health	Less diseases caused by indoor air pollution; customers of improved cookstoves and solar lanterns will be less exposed to harmful fumes and particles from fires and kerosene and benefit from improved health.
Poverty/livelihood	<ul style="list-style-type: none"> • Less expenditures through fuel saving • Less fuel collection work and picoPV offers extra hours for income generating activities • Creation of 50 jobs along the value chain
Education	<ul style="list-style-type: none"> • Better environment for learning, saving of time for learning
Governance	The project will contribute to a better coordination of activities among organizations active in the cooking and renewable energy sector.
Climate change	Annual reduction of CO ₂ emissions by 4,000 t CO ₂ e
Gender	Gender balanced access to modern cooking, gender balanced job creation; especially women and children in households will benefit from the improved cooking conditions, on the one hand through less exposure to smoke and pollutants, on the other hand by reduction of labour required procuring cooking fuels.
Market development	<ul style="list-style-type: none"> • Increase of sales figures of 15% per year • Profit margin in the stove business is comparable to those of other products on sale in the sanitary shops • At least one additional stove or other cooking system component has been thoroughly tested and introduced

6. Budget

Estimated additional budget until 30.06.2019 : **EUR 1,000,000.**

		EUR
1	Human resources and travelling	165,000
2	Equipment and supplies	7,000
3	Funding financing agreements/local subsidies	700,000
4	Other direct costs	54,730
5	Total direct costs (sub-total)	926,730
6	Mark up costs/administrative overheads/imputed profit	73,270
7	Cost price	1,000,000

Bolivia

1. Summary

Promoted technologies		Grid densification, solar PV, stoves, productive use			
Project period	old	10/2009-08/2018	Budget (EUR)	old	15,000,000
	new	10/2009-08/2019		new	16,000,000
		old targets	new targets		
Energy for lighting / electrical appliances in households		501,500	541,000	people	
Cooking / thermal energy for households		384,600	385,600	people	
Electricity and/or cooking / thermal energy for social infrastructure		2,700	2,950	institutions	
Energy for productive use / income generation		11,680	15,000	SMEs	
Lead political partner		Vice-Ministry of Electricity and Alternative Energy (VMEEA) of the Ministry of Energy (ME)			
Implementing organisation		GIZ			
Implementing partner/s		Inter-American Institute for Cooperation on Agriculture (IICA); private sector companies and small-scale entrepreneurs; “Electricity to live with dignity (PEVD)” programme of the VMEEA; NGOs; local governments; communities; electricity utilities; cooperatives and associations.			
Coordination with other programmes		ITDR II (World Bank), Ministry of Rural Development and Land through its programmes EMPODERAR, CRIAR, PAR, and DETI.			
Key interventions		<ul style="list-style-type: none"> • Financial and technical support for grid connections for households, social infrastructure and SMEs • Creation of a Fund for Sustainable Access to Renewable Energies and Efficient Technologies (FASERTE) at IICA • Financial support and technical training to promote productive use of energy • Fostering market development for picoPV products along the value and distribution chain • Phase-out strategy for selected ICS technologies by transferring know-how to local partner institutions • Implementation of gender approach including technical training (picoPV, ICS, productive uses), job creation, and improvement of living conditions 			
Main strategic changes introduced with up-scaling		<ul style="list-style-type: none"> • Creation of Fund for Sustainable Access to Renewable Energies and Efficient Technologies (FASERTE) to stimulate private sector activities • Phase-out strategy for selected ICS technologies • Strengthening capacity development for local and national partners on managerial and technical aspects 			
Project manager		Rafael Wiese, rafael.wiese@giz.de			

2. State of market/(sub-) sector development

Bolivia has a population of more than 11 million inhabitants and is one of the poorest countries in Latin America. Bolivia's 2016 HDI value ranks the country in the medium human development category, positioning it at 118 out of 188 countries and territories. In spite of advances made in recent years to reduce rural poverty, there are still regions, which have limited access to markets, basic public services and energy. Currently, the electrification rate is estimated to be 67% of the rural population and 90% of the urban population. Seven out of ten rural households use biomass for cooking every day.

Because of the challenging topography of Bolivia, energy, communication and transport infrastructure face severe barriers with some regions being completely isolated during rainy season. This situation is gradually worsening due to the impacts of climate change with severe flooding and drought affecting the whole country and becoming increasingly unpredictable, especially for people living in rural areas, who lack appropriate adaptation and resilience strategies.

The government is portraying itself as socialist and has nationalised several strategic sectors and businesses since coming into power in 2006. The political situation is tense and government decisions and plans are not favouring private sector development. The vision of the government has been strongly influenced by the ideas of a socialist economy, with focus on mega-projects for electricity supply such as large hydroelectric power plants, thermoelectric power plants, etc. with little regard for environmental, social and cultural consequences. When targeting small-scale technologies, the government acts in a paternalistic way through its various programmes. In many cases, it hands out equipment (including picoPV and productive uses machinery) for free to rural communities.

It is estimated that more than 55,000 small and medium-sized companies were forced to close down during the last three years due to measures introduced by the government. Significant annual salary increases on presidential decree and an increase in minimum salaries had a serious impact on staff costs and formerly sound business plans. These measures have aggravated the economic situation of the entire private sector and have added to the cost of living.

2.1 Grid densification and picoPV systems

Within the national development agenda, universal access to electricity (100% by 2025) is a priority for the Bolivian government (Patriotic Agenda 2025). The government has nationalised the entire electricity sector and has embarked on large public programmes for rural electrification. The electricity tariffs in Bolivia are far lower than average tariffs in Latin America. The average residential tariff in 2017 was 0.09 USD per kWh (compared to 0.185 USD per kWh-weighted average in LAC). In 2006, the Bolivian government approved the *Tarifa Dignidad* ("Dignity Tariff") by Supreme Decree 28653. This tariff grants a 25% discount on the electricity bill to those consumers whose monthly consumption is below 70 kWh in urban and rural areas.

To achieve its universal electricity access target, the government implements various interventions ranging from grid extension and densification, to off-grid solutions promoting renewable energy for rural people's access to energy. The Ministry of Energy has been financing programmes for the extension of the national electricity grid in rural areas. The National Enterprise for Energy (ENDE) is in charge of providing the electricity services through regional branches and rural cooperatives. Recently, several rural cooperatives have been established or approved by the National Electricity Authority. The objective is to provide electricity to the more distant communities; however, the cooperatives often lack the financial and managerial capacities to fulfil the goal.

Two years ago, the Ministry of Energy started the implementation of a pilot project to provide picoPV systems to various municipalities in the lowlands (east region of Bolivia, with a low electrification rate). Although it is still a pilot experience, these activities lack sustainability, end user training, and after-sales-services. Nevertheless, rural municipalities lacking electricity access throughout the country are highly interested in investing in picoPV in order to provide lighting for dispersed households that will not be connected to the grid, including areas reached by the grid where, however, the government could not connect all households.

This offers a window of opportunity for EnDev, and at the same time, presents a challenge to the development of viable markets and sustainable energy access. The successful promotion of the sector will require technical assistance and advice to the choice of technologies, to the development of implementation strategies and to the mitigation of the government's socialist policies' effects on the market. From private sector side, the market for picoPV products is in an early stage of development with only five established suppliers offering Lighting Global certified products. Some smaller providers offer picoPV systems for lighting as part of a variety of products in urban or peri-urban areas of the main three cities of the country (La Paz, Cochabamba and Santa Cruz) but it is not their core business. There is one provider working in rural areas of the so-called valleys working closely with municipalities. Companies perceive rural areas as unattractive and challenging markets since the purchasing power there is low and distribution networks are not in place. Products reaching rural areas are often low quality cheap picoPV products with a short lifespan. Capacity development for the private sector offering off-grid solutions is needed in terms of installation, operation and maintenance as well as developing new business models and distribution chains to foster market development.

EnDev's approach supports the private sector to overcome these barriers and to develop a market based on both private and public demand.

2.2 Improved cookstoves (ICS)

In 2005, when EnDev Bolivia started, there was only a small number of local stove manufacturers, which sold different models of metallic stoves near larger towns and cities. The stoves were relatively expensive and had a low energy efficiency. The concept of ICS and its positive effects on health and the environment were still unknown. Rising metal prices in 2007 and the following years have constituted a barrier to the growth of these businesses. In reaction to the changing business environment, EnDev supported the introduction of the so-called *Malena* stove, an improved adobe-based biomass stove. The stove is highly valued by beneficiaries for its functionality, durability, technical characteristics, and cultural acceptability. Parallel to the introduction and dissemination of the *Malena* stove, EnDev increased awareness about the technology and its benefits on community and the government level.

The *Malena* stove has a higher local content and is therefore cheaper than the metal stoves. Logistic costs are low as it is constructed on-site in the household with the assistance of the family. Since its introduction, the *Malena* has evolved with regard to design, material, and dissemination strategy. Today, local stove promoters, trained by EnDev, have frequent income from constructing stoves. Their clients are either the beneficiaries directly or municipalities investing in ICS to improve the lives of the inhabitants. Today, the *Malena* stove has reached a high level of acceptance and is well known by beneficiaries. For increased market development in the cooking sector, the supply side needs to be further diversified by promoting related/comparable products and alternatives as e.g. portable cookstove like the so-called *Augusta* cookstove.

At least 30 institutions (NGOs, associations, foundations) and more than 50 local entrepreneurs have built up the technical capacity to construct and/or sell ICS since 2007. At least 20 local entrepreneurs are still active constructing *Malena* and four sell the *Augusta* stove. Most suppliers work with municipalities, and international (development) cooperation programmes targeting e.g. climate change or health impacts.

However, low ability to pay and challenging logistics in rural markets limit the attractiveness of these market segments for companies, especially for the *Augusta* stove since it is a metallic portable stove and it costs around EUR 40. But there is high interest in the rural communities to improve their cooking situation since forest degradation significantly affects wood supply and prices for firewood are increasing.

2.3 Productive Use

Many private companies across Bolivia offer agricultural machinery and equipment to improve farmers' productivity and to process goods. The market penetration rate is overall good although limited to rural towns and not reaching into remote rural communities. The main barriers to increased

and/or sustained use of energy for productive uses are (1) little demand from and low purchasing capacity of rural producers, (2) the low-tension electricity available from the grid, (3) lack of electricity transformers, (4) lack of skills and knowledge by rural producers on how to operate and maintain electricity-driven agricultural machinery and equipment. Another market barrier is the lack of access to finance for rural farmers.

The national ministries (agriculture, productive development) manage large programmes in support of rural farmers, rural associations, and cooperatives. These programmes – as is the case for PV systems – disseminate a variety of agricultural machinery and equipment on grant basis or highly subsidised. The programmes' focus is on dissemination and often lacks end user training on operation and maintenance. Respective energy access requirements to run the machinery are often not considered. Hence, without adequate energy access the provision of productive use equipment is not sustainable. EnDev strives to close that gap working closely with government programmes to overcome the lack of training, energy access and increase sustainability.

3. Intervention strategy

3.1 Market development vision

The Bolivian government has successfully increased the electrification rate in rural areas and continues its efforts to reach the goal of universal electricity access for all (as stated in the Patriotic Agenda 2025). New electricity access enables small-scale farmers and cooperatives to use agricultural machinery to increase productivity and process goods. The market for improved cookstoves is characterised by product variety and a solid basis of actors from the private and public sector. The Fund for Sustainable Access to Renewable Energies and Efficient Technologies (FASERTE) managed by IICA (Inter-American Institute for Cooperation on Agriculture) is channelling international funds to private sector companies and other partners implementing projects in the field of energy access with a special focus on productive use and portable cookstoves. FASERTE is recognised as a reliable fund that supports modern energy access in rural communities.

Solar PV subsector: In five years, the share of rural and remote areas linked to the distribution chain for electricity access technologies has increased. Solar companies are offering an effective product warranty and after-sales services to their clients.

Cooking energy subsector: Three national institutions are actively promoting the *Malena* cookstove models (including ovens) and portable cookstoves. Small-scale entrepreneurs continue to construct *Malena* stoves for households and small businesses in rural areas. Individual beneficiaries either contact the entrepreneurs directly or via community groups, associations and governmental institutions (municipalities or national programmes). The fund (FASERTE) incentivizes technology development and new business models to match the cooking and financing needs of rural clients.

Productive use of energy: Coffee, cocoa, potato and producers of other agricultural products have adequate access to energy to run machinery, process goods, use energy productively and solar pumps for irrigation purposes. The fund (FASERTE) incentivizes product diversification for productive use and technology development.

3.2 Fit with policy ambitions and plans for energy access and climate change, in particular with SDG7/SEforAll country plan and NDC

The Rapid Assessment and Gap Analysis for Bolivia conducted by SEforAll highlighted the following goals¹²:

Access to electricity: The “Plan for Universal Energy Access 2010 - 2025” launched by the VMEEA end of 2010 states the overarching objective to reach 100% of Bolivian households with electricity access by 2025. This objective has been integrated into the “Patriotic Agenda 2025”, which constitutes the plan for reaching Bolivia’s development goals by 2025. The plan foresees investment in grid

¹² Source: Sustainable Energy for All, Rapid Assessment and Gap Analysis for Bolivia. Enrique Gómez, IDB, January 2016.

densification (mostly urban), grid extension, and renewable energies combined with off-grid solutions to reach isolated communities. An investment of roughly 1.4 billion USD is foreseen to be implemented by the electricity utilities in the various regions of the country.

Energy Efficiency: Recently the topic of energy efficiency has been included in the National Agenda by the government. Aspects highlighted in the agenda are substitution of diesel, isolated systems integration, hybrid systems, energy efficiency, etc. The government plans to invest about 900 million USD in hydroelectric and geothermal power plants to substitute the use of natural gas and diesel in electricity generation. By 2020, the government expects to generate 50 MW based on biomass, 136 MW wind, and 220 MW solar energy, totalling 406 MW installed generation capacity based on renewable energies.

National Plan for Economic and Social Development: In November 2014, the Vice Ministry of Electricity and Alternative Energies finalised the National Plan for Development of Alternative Energies 2025. Recently, its goals have been re-confirmed in the Plan for Economic and Social Development (PDES) – a 5-year development master plan.

3.3 EnDev conceptual approach and intervention strategies per (sub-)sector

The project will follow two complementary implementation strategies and modalities, which reinforce each other:

Continuation of proven and successful approaches for grid densification, productive use, and strengthening market development for solar PV and ICS technologies. The highly cost efficient and sustainable approach for grid densification working closely with local electric installation companies will be continued without major changes. In the field of productive use of energy, the focus is on upgrading transformer capacity to allow for three-phase connections required to run larger machinery and solar pumps for irrigation purposes.

Complementary to the above mentioned implementation track, the Fund for Sustainable Access to Renewable Energies and Efficient Technology (FASERTE) will be established at IICA to trigger market development in selected market segments. Financial support will be offered on a competitive basis to the private sector and other eligible stakeholders to foster productive use (e.g. grain mills, dehydrators, dryers) and strengthen distribution chains for solar PV and ICS technologies. Targeting market development via a fund takes into consideration the relatively strong private sector and stakeholders having the capacity to develop individual new business models and project ideas.

3.3.1 Solar PV and ICS subsector

Government programmes offering fully subsidized solar PV systems for selected municipalities in the so-called lowlands have changed the market situation for last mile distributors supported by EnDev in the same areas. In response to this development, some distributors have changed their sales strategy from addressing the clients directly to working more closely with municipalities. Due to the limited extent of the government support with less than 2,000 picoPV systems disseminated in five municipalities, there remains a large market potential for private sector activities with 51 municipalities in the lowlands not targeted by government. EnDev will continue to support last mile distributors to diversify their client structure and target direct sales as well as making best use of upcoming opportunities from the public sector.

EnDev's focus will be to strengthen last mile entrepreneurs with both fixed and mobile sales points in the communities. Support and training will be offered for marketing (e.g. radio spots) and business skills. On the other hand, EnDev will support suppliers in their marketing and sales strategies as well as by linking them to local rural actors. Thereby, EnDev targets the whole value chain from importers and wholesalers, to distribution companies and last mile entrepreneurs. EnDev will especially focus on successful female entrepreneurs by supporting them with tailor-made training and market matchmaking.

3.3.2 Phase-out strategy for Malena cookstoves

The overall objective is to stabilize the market and scale down direct support offered by EnDev. The *Malena* cookstove is an internationally quality certified product (*Cocina Malena*) adapted to the beneficiaries' needs. The *Malena* product family (cookstove with and without oven, baking oven) is highly appreciated by beneficiaries. The approach has fostered a solid structure of successful local artisans working in alliances with NGOs and municipalities. EnDev will withdraw step-by-step its direct support and continue to observe how the market segment will develop.

EnDev will strengthen and hand over the knowledge on the Malena cookstove products to institutions and partners from the public and private sector as well as civil society which have already played an active role in the past or are newly identified .

During the phasing out of this component, EnDev will support local artisans to make strong linkages with NGOs and municipalities where the main demand for *Malena* stoves comes from. Municipalities already familiar with the stove will be targeted to trigger additional demand. Artisans will be provided with limited marketing support and targeted business and technical training to ensure a sound base for a long-term business engagement. Particular focus will be on product diversification and offering additional services for maintenance and repair of existing *Malena* stoves and ovens. Besides improving the business model of the individual artisan, this has a positive impact on the sustainability of the intervention.

3.3.3 Productive use of energy

Following the proven approach, financial and technical support is provided to agricultural associations/cooperatives to access electricity via three-phase transformer connections and using solar PV pumps for irrigation to foster productive use of energy and open up opportunities for generating additional income. Capacity development on use and maintenance of machinery and equipment as well as financial implications will be offered, aiming particularly at the empowerment of women.

3.3.4 Grid densification

EnDev will continue working closely with the Vice-Ministry of Energy, through its investment programme for electricity (PEVD). Over the past years, the project has significantly reduced the required subsidy to facilitate grid connections and the objective is to reach a subsidy level of EUR 11-18 per household. Contracts with installation companies will include training and awareness raising of rural beneficiaries with regard to safe and correct use of electricity and possibilities for productive use on household level.

EnDev will extend its support to newly formed, small electricity cooperatives located in remote areas, which have recently been approved by the electricity authority. These cooperatives consist of up to 80 households and often lack administrative and technical capacity to fulfil their new role.

3.3.5 Fund for Sustainable Access to Renewable Energy and Efficient Technologies (FASERTE)

The objective of the Fund for Sustainable Access to Renewable Energy and Efficient Technologies (FASERTE) is to increase market development for renewable energy technologies. The experience with establishing a fund will be transferred from EnDev-Peru, where the scheme was established and successfully implemented for five years. The fund manager will be the same regional organisation IICA. IICA Peru has extensive experience in the development of regional projects, the most emblematic are the following: The Sustainable Forest Management (SFM) and Energy and Environment Alliance (EEA) which has been implemented in the Andean region in partnership with the Government of Finland and included in the Regional Fund for Innovative Projects; the Fund for Sustainable Access to Thermal Renewable Energies (FASERT) currently implemented in Peru and financed by EnDev. Funds will be allocated on a competitive basis or directly awarded to eligible project developers depending on the respective case. A steering committee will evaluate the project proposals. IICA periodically monitors projects through its own computer system, the Monitoring and Information System (SMI). It also carries out external audits of the fund in general, and specific audits of each project it executes.

The fund will be established as an open basket fund right from the beginning to attract financing from other donors and financial sources to ensure its existence once EnDev might be phased out. Based on the experience from EnDev-Peru, the establishment and operationalization of FASERTE will be feasible in a short period allowing launching the first call for proposals at the end of 2018. EnDev will grant approximately EUR 200,000 for the initial phase to establish the fund and launch a first call for proposals. The fund aims to trigger the development of markets for portable ICS, productive uses and PV systems (mainly picoPV, but also larger systems).

3.3.6 Gender approach:

Pilot on safe use and maintenance services: Due to the high rate of rural job migration (mainly male), women remain alone in their homes. They often lack the knowledge and training to maintain electricity installations properly or to change spare parts. To increase the number of women with technical skills in the communities, technicians, of whom at least 50% have to be women, will be trained to carry out these activities.

Pilot on in-house wiring: The low payment capacity of some communities constitutes a barrier for the in-house wiring. Even though some families have the possibility to be connected, they do not have the resource to pay a technician for the internal connection. As in the case above, technicians, of whom at least 25% have to be women, will be trained to carry out these activities.

Pilot on smart metering: EnDev, the Vice-Ministry of Energy and the World Bank will jointly implement a pilot project on smart metering. The objective is to analyse data about the possible reduction of expenses and possibilities to improve the service in rural areas. Electricity cooperatives managed by women will be prioritized and every cooperative asked to hire a certain share of women for meter reading. Awareness creation will focus on the correct use of electricity and showing women as active, capable users of electricity.

Technical advisory services on productive use will be provided as support to government programmes and projects (Ministry of Productive Development, Ministry of Agriculture) and will prioritize working with female staff, as far as the institutional conditions allow for this. Women are involved in the productive activities and can be trained for the use and maintenance of the machinery, for women empowerment and possible generation of extra income.

3.4 Cooperation with others

EnDev will continue strengthening and building up its network of partners from civil society, the private and public sector and extend its cooperation where new opportunities arise.

Civil society: NGOs with a focus on health, gender, education, environment or economic development (e.g. Practical Action, Engineers Without Borders (EWB), SODIS Foundation, women's associations).

Private sector: last mile entrepreneurs, local manufacturers, wholesalers and importers of solar PV and ICS technologies (e.g. SIE.SA, Energetica; agricultural machinery and equipment importers/distributors).

Public sector: local governments, electricity utilities, universities, ministries and government programmes.

Development partners and their programmes: IICA, IDB, WB.

4. Sustainability

By establishing, the Fund for Sustainable Access to Renewable Energies (FASERTE) a flexible financial mechanism open for other funding sources is introduced which can continue its work even after EnDev phases out its support. The managing authority IICA is a regional organization with a long term perspective and own staff and office in Bolivia. Through the fund, incentives can be introduced to the market to offer financing for proven and innovative technologies and business models in future. Transferring the knowledge on fund management built up within IICA in Peru to Bolivia is a first step of regionalization of energy access funds managed by IICA.

EnDev's support focuses on high quality products which either have an international certification (e.g. Lighting Global) or have local/regional certificates e.g. for cookstoves from Bolivia or Peru.

Working closely with partners and developing tailor-made business models and approaches ensures that successful approaches are continued e.g. by the private sector and integrated into business models. The key to sustainability is partner orientation and ownership.

Essential part of the exit strategy for cookstoves is the transfer of knowledge to various local partners with a special focus on ensuring a solid supply and demand side. Endevo-Bolivia will withdraw its support step-by-step and continue to observe how the market develops.

5. Expected impacts of the project intervention and related indicators

Impact	Possible indicators
Environment	<ul style="list-style-type: none"> • Reduced emissions and noxious fumes due to reduced firewood and kerosene consumption • Reduced consumption of firewood • Reduced contamination from battery waste
Health	<ul style="list-style-type: none"> • Reduced exposure to kitchen smoke, reduced exposure to kerosene lantern smoke, better ergonomics
Poverty/livelihood	<ul style="list-style-type: none"> • Job creation for stove promoters, importing and regional energy companies • Reduced workload for women in firewood collection and cooking • Reduction of household expenditures due to reduced firewood consumption (in cases where firewood is bought) • Energy solutions and modern machinery offered to producers fostering agricultural value chain to process agricultural products and income generation
Education	<ul style="list-style-type: none"> • More time for studies and homework, and increased access to information (TV, radio)
Climate change	<ul style="list-style-type: none"> • Reduction of CO₂ emissions • Reduction of forest degradation
Gender	<ul style="list-style-type: none"> • Women empowerment with capacity development and technical training • Job creation and income generation for women related with energy services and productive uses • Reduction of negative health impacts caused by traditional cooking situation and lighting solutions
Market development	<ul style="list-style-type: none"> • PicoPV suppliers offer warranty schemes and after-sales services in rural markets • Access to capital improved and suitable business models for rural areas supported • ICS manufacturers gain access to capital to invest in production and distribution chains • Last mile distributors supported with sale strategies, business models and marketing

6. Budget

Estimated additional budget until 08.2019: **EUR 1,000,000**

		EUR
1	Human resources and travelling	419,361
2	Equipment and supplies	61,218
3	Funding financing agreements/local subsidies	368,000
4	Other direct costs	26,747
5	Total direct costs (sub-total)	875,326
6	Mark up costs/administrative overheads/imputed profit	192,572
7	Cost price	1,067,898

Note: EUR 68.000 balance in favour from previous budget

Indonesia

1. Summary

Promoted technologies		PV mini-grid			
Project period	old	05/2009 – 07/2018	Budget (EUR)	old	11,960,000 Euro
	new	05/2009 – 08/2019		new	12,760,000 Euro
		old targets	new targets		
Energy for lighting / electrical appliances in households		172,000 (17/12 achieved 198,113)	228,000	people	
Cooking / thermal energy for households		---	---	people	
Electricity and/or cooking / thermal energy for social infrastructure		900 (17/12 achieved 1,546)	1,650	Institutions	
Energy for productive use / income generation		1,000 (17/12 achieved 2,241)	2,350	SMEs	
Lead political partner		DG New and Renewable Energy and Energy Conservation, MEMR			
Implementing organisation		DG New and Renewable Energy and Energy Conservation, MEMR			
Implementing partner		Ministry of Cooperative and SME, Ministry of Marine and Fisheries, relevant local government, universities, vocational schools, EPCs, local technicians, NGOs			
Coordination with other programmes		Other GIZ projects such as LCORE, Green Chillers, REEP, ELREN			
Key interventions		<ul style="list-style-type: none"> • Capacity development on productive uses of energy for the community and the local enterprises. This will be conducted through pilot in up to five sites. • Implementation of a remote monitoring mechanism, which allows automatic evaluation on the mini-grid's technical performance. This will be conducted through pilot in up to 30 sites. • Introduction of electricity tariff payment system by using digital technology, will be implemented in trial basis in up to two sites. • Facilitation on the development of maintenance and repair service structure for PV mini-grids to be available locally. This will be conducted through pilot in two provinces. • Policy recommendation and capacity development measures for the implementing organisation and partners focusing on productive uses of energy, monitoring and evaluation, and technical service providers. 			
Main strategic changes introduced with up-scaling		<ul style="list-style-type: none"> • Utilisation of electricity for productive activities both in processing and in provision of services. • Innovation in technology and mechanism to monitor remotely mini-grid performance. • Pursuing innovation in business setup and processes of technical service providers to be accessible locally. 			
Project manager		Amalia Suryani, amalia.suryani@giz.de			

2. State of market/(sub-)sector development

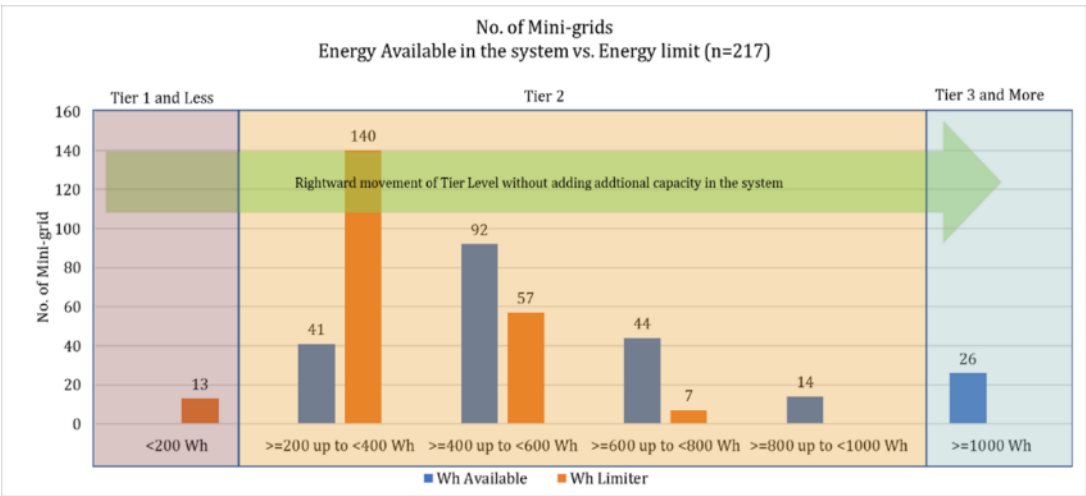
Geographically endowed as an archipelagic state, Indonesia consists of around 17,000 islands of which 30% are inhabited. With a population of approximately 260 million and an electrification rate of 92%, there are over 18 million people still without access to electricity. This remaining population resides in the most remote villages; from the heart of jungles to the small outer islands spread across the country. In such villages, electricity is sporadically generated from diesel-fuelled power plants or small private generators with high operational costs and bad impact on the environment.

Since 2012, the Indonesian government has been deploying over 800 mini-grids using photovoltaic (PV) battery technology to supply electricity in remote villages, on top of more than a thousand micro hydropower (MHP) systems which have been flourishing since decades ago and remain as favourable energy access solutions in remote villages with hydro potential. Meanwhile, the PV-battery technology is most effective to address electricity access in the small outer islands where hydro potential and electricity grid are lacking, also because it can be rapidly deployed due to its uniform design. Most of these mini-grid systems are financed by grant funding from various initiatives, which are restricted to physical infrastructures only and not extended to operational and maintenance setup as well as productive utilisation.

Limited electricity demand/supply management

Generally, users are not fully aware of the potential as well as limitation of the electricity supply. They also do not have yet the capacity to manage their electricity demand. Tariff collection and system maintenance are being administered by the communities despite their limited technical skills and without proper assistance. Especially in PV mini-grid schemes, productive uses are limited due to the use of energy limiter device which allows only small daily allocation of electricity for each household. Such allocation is only sufficient for lighting and maybe one additional appliance. It therefore may hinder the community to undertake some value-adding process to leverage local income.

According to a study which evaluated the energy access of PV mini-grids using the Multi-Tier Framework¹³, it appeared that 90% of 217 PV mini-grids analysed showed a positive energy balance, meaning there is energy available beyond the current demand load. The graph below illustrates the notion that reaching higher level of energy access is possible without adding additional capacity in the existing system, but instead by adjusting the energy allocation per household. Tier of energy services can be optimised by introducing demand/load management.

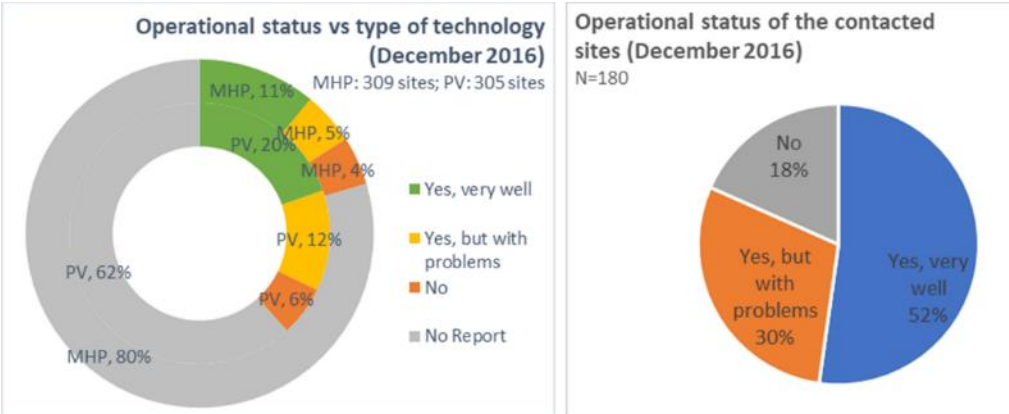


Source: Evaluation of Energy Access at RE Powered Mini-grid in Indonesia (Master thesis, 2017)

¹³ Evaluation of Energy Access at Renewable Energy Powered Mini-grid in Indonesia “A Multi-Tier Framework Approach” (Hasan, 2017)

Limited local technical support

Maintaining sustainability of the mini-grids is hindered by limited skills of local operators. Additionally, technical support for maintenance and repair services are not widely accessible. Skilful local technicians hardly exist and the sector still highly depends on the expertise from companies that are situated on Java. This geographical barrier has caused difficulties and delay in addressing technical problems that arose. In the absence of long-term support to the users, many systems are vulnerable to hasty deterioration. Based on the operational status survey conducted in January 2017, around 18% of a sample of 180 mini-grids surveyed were not operational. This year, the Ministry of Energy and Mineral Resources (MEMR) will rehabilitate around 47 PV mini-grid systems. EnDev provides support in conducting technical review of the proposals for this revitalisation initiative.

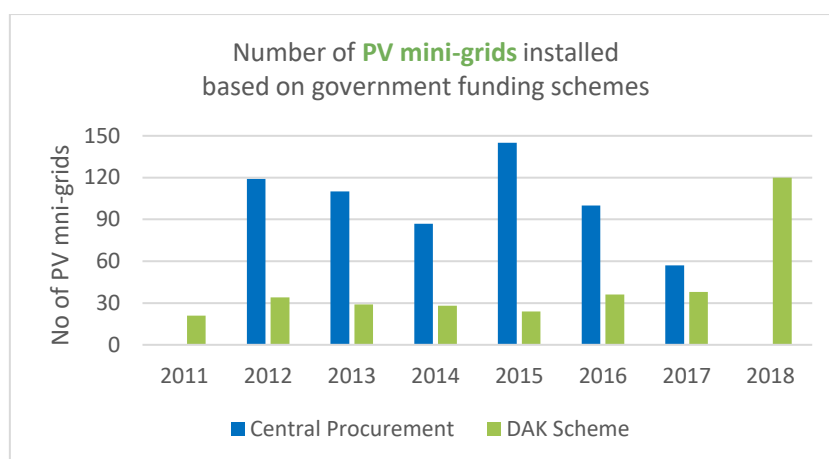


Source: Report on Operational Status of Micro-grid 2016 (GIZ, 2017)

Alternatives to ensure long-term technical support exist but are not yet applied, such as maintenance contracts with local technical service providers. Such contract shall include monitoring measures, simple troubleshooting, and repair works. In the meantime, complex corrective maintenance service can be conducted by service providers with advanced engineering skills which might be more costly. Unfortunately, revenue collection on electricity sales is generally insufficient to refinance repair or replace the key components, while the external funding is inaccessible. Therefore, the existing village management team (VMT) shall be transformed into a legal entity, such as cooperative or village-owned enterprise, to be able to access funding for more complex maintenance services.

Shift in the national policy strategy

Since 2017, the MEMR shifted much of its infrastructures budget to reach more households through the pico-PV programme for around 95,000 households in six provinces in eastern Indonesia. However, the mini-grid budget remains available and this year will significantly be disbursed more through the Specific Allocation Fund (DAK) scheme directly managed and supervised by the local governments. Over 50 PV mini-grids were commissioned by the MEMR in budget year 2017 and approximately 120 new additional PV mini-grids in 27 provinces are planned to be installed in 2018 through DAK. DAK scheme has been implemented since 2011 which covers installation and rehabilitation of MHP plants, installation of PV mini-grids and solar home systems.



Funding allocation for PV mini-grids.

In 2018, the Central Procurement will only be allocated for revitalisation programme of 47 PV mini-grid systems.

Despite the fast-changing policy within rural electrification sector in Indonesia, we foresee the local governments will play a much bigger role in securing rural electrification efforts and ensuring the sustainability of the systems in the future. This becomes a serious challenge since most of the local officials are still lacking of competence in regards to renewable energy technology and application. With this background, we propose to scale up our current activities to support the local government by implementing a replicable pilot approach in selected regions.

The current national energy plan sets ambitious targets for the electrification ratio to reach 99% of all households by 2025. In order to achieve the target, the MEMR has enacted several regulations with the aim to increase private sector participation in rural electrification programme. A number of MEMR Regulations (among others: 38/2016; 39/2016; 50/2017) have been issued to expedite this. Electricity generated from the mini-grid systems built using the state budget can be sold with special (i.e. lower) feed-in tariff compared to the tariff for typical Independent Power Producers (IPPs). This arrangement is to accommodate the situation when the grid comes after the mini-grid system is constructed, so that the mini-grids will continue to operate and gain income from electricity sales to the grid.

3. Intervention strategy

3.1 Market development vision

The share of mini-grid development by the local government will increase and be distributed evenly throughout the country, specifically in the provinces with lower electrification ratio compared to the national figure. Micro hydropower technology will remain relevant for villages with good hydro potential, while PV mini-grids will become a favourable solution for other villages especially those areas with abundant solar irradiance.

In five years, with the expanding market, awareness on the benefits of PV technology will rise considerably. The users of PV mini-grids will be better aware about their energy demand and how to better utilise the electricity. There will be more products and services for different needs and purposes. The users will be exposed to information about and access to energy-efficient electrical appliances such as LED lamps, low-wattage TV, or larger production equipment like the solar ice machine. They will also be familiar with the technical services, for example: new connection installation, repair, and replacement of spare parts and big components.

In the developed market, electricity users and suppliers will have access to reliable market information at reasonable cost. Users will know where to buy LED lamps, spare parts, etc. as well as where to get technical support. They would also know where such mini-grid systems have been installed in their neighbourhood. This will allow them to peer-learn from the other villages on how to operate, utilise, and maintain the mini-grid. Transparency on information about mini-grid development would be vital where monitoring measures become the major driver.

With the increasing awareness about mini-grid technology, the infrastructure for maintenance and repair services will be widely available and more easily accessible for the users. This will include business expansion by the private sector (such as solar companies, local technicians) to provide services for mini-grid facilities, both for off-grid and on-grid applications. There will be more companies and skilful human resources to provide technical services to the mini-grid owners. These owners, either the community or the local government, shall have access to funding for such expenses. Funding could come from both income through electricity sales and external funding, such as from the government, especially for the big repair or component replacement.

3.2 Fit with policy ambitions and plans for energy access and climate change, in particular with SDG7/SEforAll country plan and NDC

In 2010, the Indonesian government pledged to reduce emissions by 26% (41% with international support) against the business as usual (BAU) scenario by 2020. The Indonesian government considers climate mitigation and adaptation efforts as an integrated concept that is essential for building resilience in safeguarding food, water, and energy resources¹⁴. Within the first Nationally Determined Contribution (NDC) submitted in 2016, the Indonesian government committed to include renewable energy in electricity production of 19.6% (7.4 GW) with the BAU scenario of coal power plant. The share of mini-grids, however, is relatively low compared to the overall commitment.

The intervention strategy will perfectly fit to both international commitments and the national development plans. The Indonesian government has a target to electrify all population by 2025 with the energy mix of 23% renewable energy, contributing mainly to SDG 7. Considering that the majority of remaining un-electrified population are living isolated from the grid, off-grid and mini-grid infrastructure becomes the most effective and cost-efficient solution. Massive deployment of mini-grids funded by the government is ongoing, while supporting regulations to allow private investment in mini-grids have been introduced. On average at least 100 mini-grids are estimated to be installed annually by the national government, local government, and through other non-governmental initiatives.

3.3 EnDev conceptual approach and intervention strategies per (sub)sector

Even though the national electrification ratio has reached 92%, there are provinces with low electrification ratio below 70%. The up-scaling proposal will focus its intervention through pilots in two provinces, namely Nusa Tenggara Timur (NTT) and Sulawesi Selatan. NTT is selected as a pilot area for two main reasons: 1) low electrification ratio of 59% and 2) part of the six priority focus areas of MEMR in electrification. Meanwhile, Sulawesi Selatan is selected because the province has the most PV mini-grid systems installed thus far, which means there is a big market potential for PV maintenance and repair to be developed.

The up-scaling proposal has the central goal to stimulate productive activities by utilising the renewable energy based rural power plants. It fulfils the ultimate purpose to improve economic development in typical isolated villages. This target will be achieved by incorporating four aspects of intervention, which will be the strategy to support the market to get further scale. These intervention strategies were designed to serve as an exit strategy through working examples before handing over to local stakeholders.

3.3.1 Pilot A: Increasing productive use of energy (PUE) through rural businesses

The concept of PUE has initially been introduced through training activities on entrepreneurship for particular sites supported in the current phase. Such training programmes have changed the mind-set to utilise electricity for productive activities. However, that has not yet convinced the community to shift their electricity use to leverage economic activities. There are not enough successful examples of

¹⁴ First Nationally Determined Contribution Republic of Indonesia (2016)

PUE applications in the PV mini-grid sector. Pilot A aims to increase productive uses of energy through facilitation and capacity development of rural businesses.

The performance analysis of PV mini-grids¹⁵ in Central Java and Maluku show that beyond battery re-charging, only 40% of available energy was used during day-time as demand is too low. Much of the potential solar energy remains unused; the batteries are quickly fully charged since there is not enough demand. By assisting the users to manage their demand and supply, there are opportunities to improve the current situation by piloting PUE applications such as for agriculture and food processing, as well as services such as for tourism and telecommunication infrastructures. Additionally, the electricity can be used also to improve education and health facilities which would create positive impact on the quality of life. This will also create opportunities for more job creation through employment or entrepreneurial activities.

Pilot A will be implemented in five sites located in the two pilot provinces, including the pilot on solar ice machine. The activities are defined as follows:

- Facilitating the development of rural businesses to showcase the benefit of electricity for productive uses. This will include awareness raising of the users to manage electricity demand and supply, training and coaching of new and/or existing entrepreneurs.
- Implementing special tariff for PUE activities that utilise extra electricity. The PUE tariff shall be applied in the sites where the available electricity of the PV mini-grid allows day-time use for productive activities. The introduction of such a tariff and the resulting payments will directly increase the mini-grid revenue.
- Facilitating access to finance or programme targeted at productive activities in rural areas by either private or government initiative.
- Pilot on solar ice machine. In 2017, EnDev joined a cooperation project on solar ice machine in a small island. The fisher community in that small island is struggling to maintain the freshness of their catches which results in low price and wasted catches. Lack of basic infrastructure such as energy supply and fresh water contributes to this situation. Therefore, EnDev and partners have been working on the idea of a solar powered ice machine to solve the problem. Together with the partners, EnDev is working on a solution for a more efficient solar energy use, an environmentally-friendly refrigerant¹⁶, without any use of plastic for packaging. This machine will produce approximately 1-ton ice blocks per day, providing approx. 2,700 fisher with ice for a better cold chain. The current use of ice packs (in 700 ml plastic) is not efficient as the ice cannot last long and has caused plastic waste problem in the area. The pilot was initiated since 2016 with the design developed through the Green Chillers¹⁷ and LCORE¹⁸ projects, with the support of Institut für Luft- und Kältetechnik (ILK) Dresden. Currently manufacturing is ongoing, including collaboration with various companies in terms of providing components. In parallel, the support also focuses on setting up a business scheme in the pilot area¹⁹. The latter is managed together with a social venture which operate as privately run water vendor business. The system is expected to be installed and operational in the fourth quarter of 2018.

¹⁵ Measuring System Performance of Isolated Photovoltaic Mini-grid in Rural Indonesia (GIZ, 2016)

¹⁶ The solar ice machine will use propane, which does not deplete the ozone layer and make a negligible contribution to global warming.

¹⁷ GIZ project on green chillers and industrial energy efficiency.

¹⁸ GIZ project on promotion of least cost renewables in Indonesia.

¹⁹ Promotional video for fundraising <https://www.youtube.com/watch?v=B8D2AKyVqVI>.

3.3.2 Pilot B: Optimising the quality of energy services based on monitoring and evaluation

Previously, the quality assurance measures comprised of technical inspection and evaluation of MHP and PV mini-grids which provided recommendations for the partners for further improvement. These activities led to the development of tools and practical guidelines that are being adopted by the partners both on national and local level.

The up-scaling proposal aims at optimising the quality of energy services based on monitoring and evaluation measures, which will be implemented through the following activities:

- Enabling an effective and efficient remote monitoring mechanism to allow technical data being obtained by the responsible institution to oversee the performance of up to 30 PV mini-grids. Innovation on monitoring technology and analysis application, installation of monitoring device, and remote evaluation will be covered in this activity.
- Introducing digital payment system in two sites, which will allow the users to choose the service level based on the needs. It is expected that the users' willingness to pay will increase due to more transparency and fairness induced. Accordingly, the management of tariff payment will be more efficient and accountable, and more savings to sustain the mini-grid operation is expected.
- Through better understanding on the energy production and load behaviour, EnDev will facilitate the process to upgrade the daily energy allocation per household. As a result, it is expected that the community to be able to utilise more electricity, ideally for productive activities.

3.3.3 Pilot C: Developing locally accessible technical service providers

In the current phase, EnDev has been pioneering a partnership model which is expected to enter trial period in one region. Transferring and/or up-scaling this initiative in different regions will require repetition of steps with different stakeholders active in different regions. The up-scaling proposal focuses on two provinces, i.e. Nusa Tenggara Timur (NTT) and Sulawesi Selatan.

EnDev aims at strengthening the surrounding structures required to ensure that the mini-grids will have a reliable support system in case technical problem arises. This will be achieved by:

- Establishing and/or strengthening the partnership between national solar companies and local technicians in providing technical services for PV mini-grids. This initiative will be transferred and, when possible, scaled up to the other regions where PV mini-grids are dense but lacking necessary support.
- Implement a business plan of maintenance and repair by launching the services to the potential customers. In this setup, local technicians will deliver the service under a partnership agreement with the national solar company who will ensure the service quality and supply of the required components.

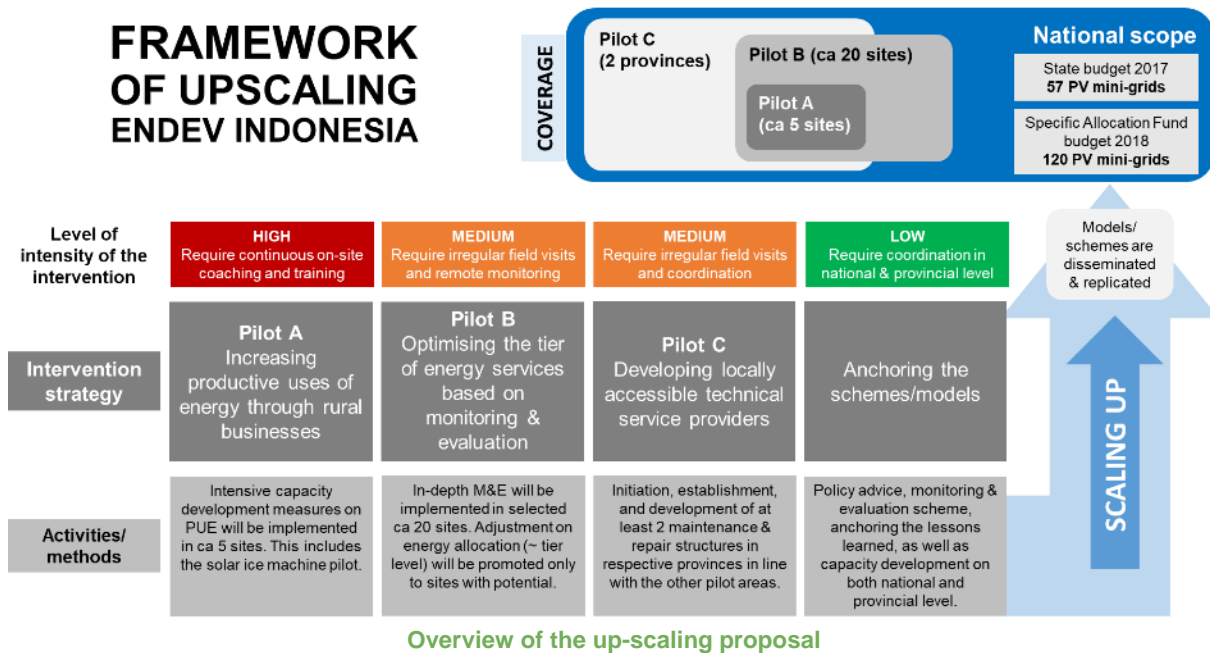
3.3.4 Anchoring the schemes/models with national and local implementing partners

While EnDev will focus on selected sites in two provinces, there is a bulk of mini-grids constructed in the remaining provinces which EnDev intends to indirectly support through policy advice, monitoring and evaluation scheme, dissemination of lessons learned and best practices, as well as capacity development on both national and the selected provincial level. The local government will play a prominent role as the mini-grid asset owner. Therefore, capacity development measures, through training and workshop, are needed in order to raise the awareness about mini-grid technology and prepare them once the system is handed over.

With the expanding market and more working examples available on PV mini-grid implementation, it is anticipated that the awareness on benefits of PV mini-grid technology shall rise considerably. This can be achieved by making available best practices on the productive use of energy, transparent and

reliable monitoring and evaluation scheme, as well as the effective operation and maintenance service structure.

Acknowledging the increasing pressure on MEMR to strengthen its monitoring and evaluation role, EnDev will be supporting the establishment of a Monitoring Dashboard, which will be centralised in the MEMR office to allow faster response when a technical problem occurs. Initial discussions and concept development have been conducted. Results of Pilot B will greatly contribute to this initiative.



3.4 Cooperation with others

Introducing a shift in livelihood (for instance, from farming to processing) will require some resources on the side of the household including financial capital. There is a need to open the access to such financial support where the project will work on. EnDev will establish partnerships with local banks and/or MFIs to make available access to financing (e.g. soft loans) for rural entrepreneurs to start and/or expand businesses. Such partnerships will be applied in the selected pilot regions, aiming to create a replicable model for a typical mini-grid community in initiating a business. There are several MFIs who have been working on financial inclusion that are ready for collaboration.

In the topic of monitoring and evaluation, EnDev will closely cooperate with the BMZ-funded project ELREN (Electrification through Renewable Energy), which has the mandate to institutionalise the best practices in rural electrification through capacity building and standardisation measures. This partnership will overcome the barriers on the sparsely available knowledge that is not yet nationally standardised for easy adoption by the local actors. The partnership will also address the monitoring and evaluation system, which will provide a unified tool or mechanism for all actors in the sector to join forces to improve data quality and reliability toward better transparency in the sector. The latter will include a partnership with a telecommunication provider to conduct a pilot on monitoring and tariff payment modes.

The third component of the proposed activities will require partnership with private companies, by establishing a technical service structure, which caters preventive and corrective maintenance. The activities will be about forming a business partnership with local technicians, closer to the mini-grid facilities. This partnership shall enable access to higher quality of service and components replacement as well as facilitating technology transfer to local technicians.

Leverage will be increased through cooperation with local NGOs that have strong network that can be used for multiplication of the approaches. Partnership with social enterprises is also pursued to accelerate the implementation of activities.

4. Sustainability

- **For the on-going project**

From 2013 - 2015, EnDev supported quality assurance efforts through the Mini-grid Service Package which covers technical inspection, socio-economic survey, and hands-on training for local operators and managers. From this intervention, EnDev developed various tools and knowledge products which are widely used and adopted by local actors. The Inspection Guide for PV Mini-grids which comprises checklists, forms, and questionnaire, has become a key tool for government staff, engineers, and academia in conducting technical inspections. A set of methodologies to analyse PV mini-grid performance is already transferred to a selected MEMR staff who are now capable to independently reviewing field survey results. Additionally, the Inspection Guide has been used by contractors when checking the installation quality of newly build mini-grid sites. This lead to better understanding in key parameters to ensure good operation of PV mini-grids.

A geo-information in the form of map called RE-Map Indonesia (<http://remap-indonesia.org/>) will continue to serve as the first general information available publicly to give a glance on where mini-grid facilities are located. The map is useful in planning since it gives a good overview on the distribution of mini-grid systems. This might also avoid the risk of double electrification initiative.

An Operation and Maintenance Guide Book for PV mini-grid, which adopted much of the tools developed by the project, was published by MEMR early in 2018. A book of good and bad practices in PV mini-grid installation, based on the long-term technical inspection, is scheduled to be launched in the second quarter of 2018. This practical guide book is highly anticipated by the PV mini-grid actors. These two publications are expected to help the operators to maintain their mini-grid and the installers to follow the good examples and avoid installation mistakes in the past.

From the recent pilot on a mini-grid management model in Nusa Tenggara Barat (NTB) province, EnDev accomplished four main goals, namely: (a) establishment of two Various Business Cooperatives in two villages, (b) commitment by the local government to regularly allocate budget for field monitoring and rehabilitation for PV and MHP systems, (c) leveraging a follow-up support activity from a national bank on local business development in the targeted village, (d) technical service catalogue could be offered by a solar company to the PV mini-grid owners.

- **For the newly proposed activities**

There are three main channels which EnDev will pursue to ensure sustainability of the mini-grids.

First, with regard to the mini-grid system and its quality assurance, EnDev will be supporting MEMR through the monitoring tool which will be developed under Pilot B. EnDev will work closely with MEMR in building a monitoring application to acquire data from (up to 30) pilot sites installed with remote monitoring devices. This will be implemented in line with MEMR's plan to strengthen its data acquisition activity, answering the public demand on transparent information. It is foreseen that within a year, MEMR will obtain more technical data acquired from the sites through remote monitoring system. The data will be analysed and displayed in a centralised dashboard in MEMR office for them to oversee the mini-grids' technical performance. Such monitoring dashboard will allow fast response and immediate action in case a technical problem occurs. Based on the results of pilot in up to 30 sites, it is expected that MEMR will gradually expand the monitoring tools to the other 600+ mini-grids.

Second, in terms of sustainability of the market and sector development, EnDev intends to anchor technical service structures within the private sector. The private sector will significantly amplify the sustainability of PV mini-grids since they have better technical capacity, local presence, as well as interest to expand their business lines. Through implementing Pilot C on Developing Local Technical Service Providers, we expect that the demand on maintenance and service works will occur and can be tapped by the local private actors. The objective is to have two technical service structures developed in two provinces, serving at least 70 existing PV mini-grids as well as around 100 PV mini-grids in the nearby provinces. The maintenance and service repair performed by the private actors shall be compensated against certain fees. Subsequently, EnDev will link the supply of such services to

the local government as one of the main potential clients. EnDev aims at channelling part of the provincial government budget and/or village budget to earmark regular funding for field monitoring and maintenance of PV mini-grids. It is estimated that the entire process will require around one year. Such government funding, however, might only be available in the next annual budget.

Third, in terms of long term ability to develop innovation, EnDev aims at building the local- or village-owned enterprises to trigger innovation in new business types or processes; for example, shifting manual processing into using power tools. Through Pilot A, the sustainability is also ensured by encouraging formal structure of mini-grid management team to foster access to funding and local business development in the area. PUE applications will create higher income of the villagers through value addition of their economic activities. With the increasing ability of the village to fund operation, maintenance and repair, the sustainability of the mini-grids will be strengthened.

5. Expected impacts of the project intervention and related indicators

Impact	Possible indicators
Climate change	Reduction or avoidance of CO ₂ emission: 22,000 t CO ₂ e annually
Environment	<ul style="list-style-type: none"> Reduction or avoidance of non-renewable fuels (diesel, kerosene) for lighting and generate electricity Less air pollution from the burning of kerosene and diesel Less sound pollution from diesel generator, more quite neighborhood Renewable electrical power generation capacity installed: approximately 2,000 kWp PV mini-grids will be installed by the government, coming from around 100 systems.
Education	Increased awareness of the communities about renewable energy based electrification as well as the skills in managing electricity demand and supply. (Surveys pre- and post intervention)
Gender	Both women and men share equal roles and work together in the management of mini-grid, including in the leading position (at least 20 % of the management position are women which is a significant increase to the current situation) <ul style="list-style-type: none"> Women play their active role in managing the electricity uses in household, becoming better aware of electricity demand and supply management.
Governance	<ul style="list-style-type: none"> The Ministry is well informed about the performance of the mini-grids, which will lead to a better planning and execution strategy that will raise the quality of the future mini-grid installation. Improved transparency through a publicly available platform on installed mini-grid systems
Health	<ul style="list-style-type: none"> Better and longer services provided by the community health centers through electricity supply (health centres use at least one electrical equipment beyond lighting) Reduced indoor air pollution from the burning of kerosene and diesel, hence less negative health effects from air pollution
Market development	Expected impacts reached through the Pilot A on increasing productive uses of energy through rural businesses: <ul style="list-style-type: none"> Double the household income as well as business revenue from the higher value addition of electricity for productive activities Double the income of the fisher because of better quality of fish/sea products (specific in regards to solar ice machine pilot)

Impact	Possible indicators
	<p>Expected impacts reached through the Pilot B on optimising the quality of energy access through monitoring and evaluation:</p> <ul style="list-style-type: none"> Improved reliability of mini-grid services as the monitoring system will allow fast response in case of technical problems (cut the time needed to respond on technical problems by half) Optimised daily energy allocation to allow more utilisation (reduced the energy curtailment (energy wasted/unused) by at least 20% from the baseline situation)
	<p>Expected impacts reached through the Pilot C on developing locally accessible technical service providers:</p> <ul style="list-style-type: none"> At least two maintenance and repair works occur, supplied by the local technical service providers. Replacement of components occurs, depending on necessity.
Poverty/livelihood	<ul style="list-style-type: none"> Job creation for local operators and managers Reduction of household expenditures for diesel generator operational costs Improved revenue of businesses due to longer operational time and/or higher quality products
	No of jobs created along the value chain: 300 jobs for operators and managers; 100 jobs in rural businesses; 1,000 jobs for construction

6. Budget

Estimated additional budget until 31.08.19: **EUR 800.000.**

No	Budget lines	EUR
1	Human resources and travelling	275,000
2	Equipment and supplies	159,800
3	Funding financing agreements/local subsidies	258,000
4	Other direct costs	15,000
5	Total direct costs (sub-total)	708,800
6	Mark up costs/administrative overheads/imputed profit	92,200
7	Cost price	800,000

Liberia and Sierra Leone (with side activities in Guinea)

1. Summary

Promoted technologies		Solar lanterns, SHS, mini-grids, solar dryers and modern cooking			
Project period	old	05/2012 – 11/2018	Budget (EUR)	old	EUR 4,428,000
	new	05/2012 – 06/2019		new	EUR 5,428,000
		old targets	new targets		
Energy for lighting / electrical appliances in households		35,000	75,000		People
Cooking / thermal energy for households		10,000	22,500		People
Electricity and/or cooking / thermal energy for social infrastructure		400	1000		Institutions
Energy for productive use / income generation		2,300	2,500		SMEs
Lead political partner		Liberia: Ministry of Lands, Mines and Energy; Sierra Leone: Ministry of Energy			
Implementing organisation		GIZ			
Implementing partner		<p>Liberia: Rural Renewable Energy Agency (RREA), Ministry of Health and Min. of Education, Welthungerhilfe (WHH), Lighting Lives in Liberia (LLL/World Bank), several local NGOs, local companies, Mercy Corps, Plan Int., We Care Solar, Total, Mary's Meals, Partners in Health, Africare;</p> <p>Sierra Leone: Local offices of the Ministry of Health, Renewable Energy Association of Sierra Leone, several local NGOs and companies, Barefoot Women College, Playhouse Foundation, Oxfam, Welthungerhilfe (WHH), Government Technical Institute, UNDP;</p> <p>Guinea: Min. of Health and Min. of Energy, F.PROSMI, GIZ Health, Education Project, Office of the President</p>			
Coordination with other programmes		Different Energy Programmes funded by USAID, the EU, the World Bank, DFID and others, especially Liberia Electricity Enhancement Project (WB), Light up Liberia (EU), Power for All (DFID), Promoting Renewable Energy Services for Social Development (EU), We Care Solar; ECREE; AfDB; KfW: USAID; MCC			
Key interventions		Trainings for active and new solar and stove technicians, retailers, solar system planners and sales agents. Improve marketing and sales activities; facilitate consumer finance; increase knowledge exchange and learning, market information, networking, communication, establish maintenance and repair systems. Up-scaling (sizes, quantity, and quality). Assist with logistics (Import, storage, installation, quality control, tracking, follow-up) and memory on market participants and installations (IT).			
Main strategic changes introduced with up-scaling		The current project strategy will not be substantially changed. The project will put more emphasis on establishing sustainable maintenance and repair systems for solar installations in public institutions, partially through IT solutions, and on increased qualification of RE technicians and officials.			
Project manager		Hartlieb Euler, hartlieb.euler@giz.de			

2. State of market/sector development

Liberia and Sierra Leone are not conventional EnDev countries where usual market development indicators and cost efficiencies can be applied. The purpose of the project is to contribute to the reconstruction and stabilisation of these countries. Therefore, interventions and performance indicators show different characteristics than in other country contexts. The medium and long-term effects of the Ebola crisis, which hit the countries heavily in 2016, still hamper market development in Liberia, Sierra Leone, and Guinea. Consequently, EnDev is investing a significant part of its resources in the improvement of social services through electrifying health centres and schools.

2.1 State of the market for solar lanterns and plug-and-play systems in Liberia and Sierra Leone

In both countries, the market for high quality picoPV products is still in an early stage. Over 90% of people in rural Liberia and Sierra Leone do not have access to electricity, but become more and more aware of solar lamps and picoPV systems. There is not yet much availability of high quality solar lamps, and only few persons sell them in rural and remote areas. However, a market for low-quality small solar products like LED solar lamps is thriving, showing that a demand for low-cost lighting exists. Relevant portions of products currently on the market come from China, often imported through Guinea or Ivory Coast. These are of poor quality, which can destroy the reputation of solar lamps, but is as well a chance for quality products.

Through the Ebola crisis in mid-2014, a portion of the up to then built-up market deteriorated again. EnDev received solar lamp donations (>12,000) for emergency relief in three countries and gradually shifted its interventions back again from a grant-driven to a market-oriented approach.

In Liberia, the Rural Renewable Energy Agency (RREA), a government agency, imports and stores quality picoPV lamps duty free in the context of a World Bank programme *Lighting Lives in Liberia* (LLL). EnDev identifies and empowers solar lamp retailers, sales agents and solar lamp producers and helps those with lower starting capital to get into the market. In 2017, there were about 20 retailers who bought solar lamps in larger quantities, many of whom are based in Monrovia and provide their sales agents in various counties with solar lamps on commission. This way several tens of thousands solar lanterns were sold.

Many retailers as well as sales agents are family businesses or individuals. Often they sell various other merchandise, e.g. electrical products, stationary or rubber ware. Some retailers are NGOs that entered the solar lamp business to generate funding for their projects or to have it run in parallel to their NGO. Many perceive the selling of solar lamps as a way to improve living conditions in rural areas. They thus combine a social motivation with business interest.

In Sierra Leone, there is no government agency importing picoPV products. Since the ratification of the 2017 Finance Act, the import of products that fulfil IEC standard is duty free by law. In practice, private companies struggle with the duty free process. There is an active private sector. In early 2016, the Renewable Energy Association of Sierra Leone (REASL) was founded, which was supported by SOBA, a UK-funded private sector development programme. EnDev has supported the association and became the host of the secretariat, after SOBA left the country in 2017. There are currently about 30 registered REASL members of which approximately 15 are actively selling picoPV and SHS products.

In 2016, TOTAL has started to sell d.light products at their filling stations first in Liberia and later in Sierra Leone, too. EnDev has trained their sales agents in Liberia in the basic technology of lanterns, the marketing, customer information and repair. EnDev is asked to do the same in Sierra Leone.

Most of the sales persons in Liberia and Sierra Leone use direct marketing strategies, thus presenting their lamps, talking to people. Few had leaflets that they distribute. The promotion of solar lamps on the radio and through road shows, including EnDev's outreach vehicles with solar cinema, projector and solar popcorn (often done in cooperation with RREA, EnDev, Mercy Corps and REASL) is perceived as helping to create interest and improve sales. Many of the retailers who do over-the-counter sales also travel to remote areas to reach out to rural costumers. They either collaborate with local agents

or have their own sales agents, who mostly receive the lamps on commission. One promising sales strategy is targeting people with a regular income, so that monthly instalments can be deducted from salaries or contractual payments. This includes amongst others farmer cooperatives, mining companies or agricultural business centres. Some persons collaborate with NGOs to carry the lamps along to project areas.

Due to the lack of cash, many agents sell their products in instalments, especially to close and trusted communities. The collection of the money is often a problem since there is no strong mobile money platform in place and a lot of money has to be paid on transportation/fuel to reach the customers and collect the money back. Easy Solar and Western Africa Off-Grid are two of the first companies which started to use a PAYGO model in 2017 for solar installations for households in rural areas of Sierra Leone.

As well, as of end of 2017, there are now several projects (largely promoted by PRESSD-SL, REAL, SL-GEF Biodiversity Conservation Project, ENFO), to implement rural charging stations, where people can charge their phones, lamps or radios or buy picoPV products in instalments. Cooperation on website and other IT solutions in both countries starts to improve considerably market transparency and access, since products, events, retailers, locations and markets can slowly be made more publicly known.

2.2 State of the cookstove market in Liberia and Sierra Leone

In Liberia, households in rural areas use mainly three-stone fires for cooking that are not fuel-efficient. Households in Monrovia and urban centres use non-improved charcoal stoves that are not different from those commonly found in other West African countries. The “coal pots” are available in all major markets in different sizes to match the pots used. Extremely inefficient and unhealthy, sometimes dangerous traditional coal production is heavily encroaching on last forest reserves and the biomass fuel base of the country – however, it is a relevant employment factor for unskilled rural workers.

Electric, LPG and kerosene stoves are available on the market, but are only bought by wealthy families due to the high costs of the energy carriers. The cost of delivering one MJ of energy into the cooking vessel is six times higher by using electricity compared to charcoal purchased in small quantities; LPG is 2.5 times more expensive, and kerosene 1.9 times.

Even though charcoal prices in Liberia are relatively cheap, charcoal is still an important budget factor for many households. Liberia has a total population of 4 million (in 2016) and many families are in need of improved cookstoves. 60% of these families live in urban or semi-urban centres where charcoal is the primary cooking fuel. The need for charcoal is further increasing as the migration from rural to urban centres intensifies. Households in the countryside collect firewood from the surrounding areas. Thus, generally rural households have no direct costs to cover their energy consumption for cooking. However, costs for firewood play a relevant role for institutions such as schools, prisons or hospitals that use three-stone fires to prepare food in bigger amounts.

In 2012, EnDev introduced a new energy-efficient charcoal stove (Red Fire Pot) that meets cooking needs in Liberia. The stove design changed over the time to increase its attractiveness for costumers. EnDev has trained whitesmiths to fabricate the stove and assisted them to market it. EnDev also supports the sales of imported Envirofit stoves, in cooperation with the local NGO Sjedi, and develops an institutional stove for schools.

In Sierra Leone, according to the 2015 Population and Housing Census, 96.8 % of the population uses firewood or charcoal for cooking. Gas, kerosene or electricity account for the remaining 3.2%. Different from other West African Countries, the use of clay stoves is very common in urban centres of the country. Clay stoves and metal coal pots gradually replace the three-stone fires. The use of either clay stoves or metal coal pots can differ from community to community, depending on the proximity of the different stove producers or retailers. The stove quality varies a lot since different villages and families produce the stoves. EnDev supports the local stove producers with further trainings, testing and marketing, in particular of the “Wonder Stove”, which produce presently the most efficient clay and metal stoves alike.

Governments in both Liberia and Sierra Leone focus their renewable energy policy on electrification and pay relatively low attention to the cooking sector. However, UNDP, in partnership with the Ministry of Energy in Sierra Leone, is implementing a project that targets as well disseminating improved cookstoves for institutions and SMEs. EnDev is assisting in developing criteria and conduct trainings. Both, in Liberia and Sierra Leone, EnDev is more and more esteemed and consulted for technical advice on improved cookstoves, for example from Mary's Meals to give guidance for their school feeding programmes.

2.3 Solar electrification of health posts, clinics, schools and other social institutions

Before the Ebola pandemic, there have been only few relevant solar installations in clinics and schools. In 2015, EnDev adapted its strategy to Ebola and post-Ebola recovery and supplied several hundreds of health facilities in Liberia, Sierra Leone and Guinea with solar fridges and with solar home systems for light and other electric appliances. The project also installed solar systems in more than 100 schools and other institutions and almost 100 solar fridges for medicine and vaccination. In Liberia, the EU via Save the Children had already provided health facilities with solar systems, which EnDev followed up upon. Thus, a 50-60% of all health facilities in Liberia have by now received some access to electric lighting based on PV technology. In cooperation with the We Care programme, WHH and others, EnDev installed over 150 additional solar systems in health facilities in Liberia alone in 2017. The share of electrified health facilities in Sierra Leone is still lower. In the case of schools, it is estimated that roughly 10% of the schools in rural areas have access to electricity, which is used to provide light for night schools and basic services for teachers. In cooperation with Playhouse Foundation, EnDev provided here over 150 SHS for schools and health centres in Sierra Leone. Moreover, EnDev assists the Ministry of Health in Sierra Leone to monitor the implementation of UNICEF-funded solar fridges for a vaccination programme.

In Guinea, EnDev installed over 200 small solar home systems and fridges for health facilities and schools.

The installation of solar systems is highly appreciated by almost all related institutions and in particular the Ministries of Health, Ministries of Education and Ministries of Energies in Liberia, Sierra Leone and Guinea. However, neither the ministries nor the institutions are investing into solar systems themselves, since they basically do not have any investment funds. In addition, they have not identified other local resources for financing electrification measures. Therefore, there is no private market for this segment. Against this background, EnDev also started to promote the use of solar systems for other public institutions and businesses. To demonstrate the benefits of solar system for public buildings EnDev powered its own office in Monrovia with 100% solar power since 2015. GIZ EPP in Sierra Leone and GIZ Health Project in Liberia will now as well power their offices with solar energy as of 2018. In addition, governmental institutions, international NGOs (MOE, UNICEF, Forestry Department, other UN organisations), and even Total filling stations and supermarkets get sometimes technical assistance to assess, install, monitor or repair solar systems with the support from EnDev. All this helps to increase the visibility of solar technologies. The purpose is to avoid failed systems on the market to destroy the reputation of the technology and use them as multiplier for the solar option in the energy debate. Every installation is a training ground for maintenance and repair. In cooperation with the Mano River Union, an Action Plan is being developed, to electrify more border posts, police stations and prisons with solar technologies.

2.4 State of the adaptation and dissemination of solar cocoa dryers

Cocoa is one of the most important cash crops in Liberia and Sierra Leone. However, the quality of cocoa is low; farmers dry the cocoa on the ground, which leads to contamination with dirt, loss due to animals and damages by rain. However, efforts to introduce improved drying techniques are successful but seen by farmers and cooperatives as a somehow public task where only local inputs are to be invested but the external share to be contributed by government, NGOs, procurement companies or donors.

2.5 State of dissemination and market for mini-grids in Liberia and Sierra Leone

Liberia and Sierra Leone have limited experience with PV and micro hydropower plants up to a capacity of a few hundred kW. Only around 10 mini-grids exist. Both governments and donors in both countries plan to increase the number of mini-grids considerably. Under the DFID-funded Rural Renewable Energy Programme, implemented by UNOPS, 50 solar-based mini-grids with a capacity between 6-36kW are being installed at health facilities, providing electricity to the neighbouring communities. Three private sector companies have been selected to operate the mini-grids and install another 40 bigger mini-grids (>36kW). Under the PRESSD-SL project, three solar-based mini-grids (60-130kW) have been installed.

In Liberia, USAID financed three solar, biomass respectively hydro mini-grids and the EU has financed the installation of five solar village mini-grids (Plan International) and some DC grids (Mercy Corps) as well. An investor forum organized by EU and the Swedish Embassy to attract private capital into some segments of the market and a regulator recently appointed starts to organize the sectors. So far, a market for private investors into solar mini-grids did not exist partly due to missing licensing and tariff regulations; however, there is a broad experience with urban diesel mini-grids to be built upon. In the hydropower sector, Liberia has only little know-how so far, so that technical assistance is a key requirement to develop the sector. All hardware such as turbines, generators and electricity equipment has to be imported, and maintenance is a serious issue for small hydro plants.

3. Intervention strategy

3.1 Vision

EnDev long-term targets are:

A basic, self-sustainable market for solar lanterns and solar home systems in Liberia and Sierra Leone is established. The supply chain of importers, wholesalers, retailers, spare parts and sales agents becomes functional with lower need for external support. At least 10,000 customers per year buy quality certified PV products in each country. At the same time, the sector is ready to grow significantly in the context of favourable conditions.

A small, but self-sustained market for energy efficient charcoal stoves is established. The market chain of manufacturers, retailers and sales agents is functional with limited further need of external support. At least 5,000 customers per year buy improved cookstoves in Liberia and Sierra Leone and the sector grows under favourable conditions.

80% of the health centres and 20% of schools are electrified in Liberia and Sierra Leone. A maintenance system is established that monitors (technical) problems. Human resources, structures and a financial mechanism exists that can support maintenance and repair including costs.

The use of solar dryers is well known among farmers and agricultural institutions and cooperatives. Farmers and their associations are able to pay fully for the construction of a solar dryer including the high quality, UV-resistant plastic foil. A local market for the solar dryers is established as well as a maintenance system, which identifies problems regularly. A financial mechanism exists that can support costs of maintenance and repair.

Different business concepts for mini-grids have been tested under practical conditions and are taken into account in the mini-grid policy of the Liberian and Sierra Leonean government and by the donor community investing into this sector.

Curricula for solar PV technicians are developed and courses are offered by different training institutions to create local knowledge and ensure sustainability of solar systems.

An internet network of market information and news on renewables is functional and maintained in Liberia and Sierra Leone.

3.2 EnDev's conceptual approach and intervention strategies

SHS and picoPV

EnDev is promoting sales and installation of SHS and picoPV products through existing distribution chains for electric products or other supply chains. In Liberia, most partners are retailers that are part of the RREA/World Bank programme. In Sierra Leone, the majority of businesses are REASL members. EnDev will implement the following activity lines in the coming period:

Empower more people to sell and use solar lamps and continue capacity building measures with those that are already active. EnDev will invite business partners as well as NGOs and school representatives to suggest target groups and sales strategies for their area(s) of operation.

EnDev applies and further develops marketing and outreach strategies in collaboration with solar lamp retailers and NGOs, e.g. flyers with contact information, a radio show featuring solar lamps, supporting road shows and energy fairs, show movies and solar product publicity in rural communities to increase awareness on high quality products. EnDev created solar outreach and installation vehicles: cars equipped with solar panels that reach rural communities to install solar systems where no electricity is available and show movies and inform about solar energy and solar products. When not on installation but on outreach mission, it carries along applications, such as a projector for presentations and films but also fan, lights, sometimes a small solar fridge and a popcorn machine to demonstrate the use of solar energy.

Facilitate consumer finance by connecting solar retailers and sales agents with microfinance institutions such as Credit Unions and by promoting different ways of instalment payment. In addition, a result-based financing scheme will be considered to cushion higher transaction costs (e.g. transportation cost) in rural areas. EnDev supports PAYGO business models where companies are interested and willing to invest and carry out pilots.

Increase knowledge, skills and synergies to improve solar sales and repairs. EnDev focuses on gathering, generating, sharing and distributing information and knowledge, connecting product or service providers with customers, enhancing quality and facilitating market development. This is done by institutionalising a solar technician qualification, developing a smartphone app to gather relevant information and a renewables website to accommodate for needs and wishes of solar retailers.

Promoting "Renewable Energy Associations". In Liberia, the Liberia Energy Access Practitioners Network (LEAP) was founded, which is supported by Mercy Corps, EnDev and RREA. In Sierra Leone, EnDev supports the Renewable Energy Association of Sierra Leone (REASL). EnDev hosts their secretariat, helps with data collection, information sharing and outreach campaigns. The associations could gradually take over some activities that are currently implemented by RREA and EnDev.

Improved cookstoves

EnDev is promoting stove sales and technical improvements in Liberia and in Sierra Leone. EnDev will implement four activity lines in the coming period to strengthen market development for improved stoves:

Empower more producers to manufacture and sell improved stoves and continue capacity-building measures with those that are already active.

Support further technical improvements to make the stoves more robust, durable and possibly cheaper.

Pilot the introduction of firewood stoves that cost maximum USD 5 for private households and USD 50 for institutions. The technology considered is also already sold in Sierra Leone in limited numbers and might have the potential for bringing it to scale.

Carry out awareness campaigns about the advantage of improved stoves and kitchens and risks of excessive charcoal and wood consumption. Improve marketing and sales activities. As well, EnDev will continue to organize flyers, posters, cook shows and radio jingles.

Electrification of health centres and schools

EnDev will continue to assist the installation of solar systems in health centres, schools and other public buildings. However, the number of newly installed systems could be lower than during the post-Ebola recovery period, even though demand seems to be rather growing. Activities of this component will as well focus on establishing a surveillance, maintenance and repair system for already installed systems. For this purpose, relevant data about different solar installations and institutions are to be regularly collected through an app by different partners, documented in a database and visualized in a map accessible for all stakeholders. Problems and solar system failures are monitored and evaluated. Repairs of failed solar systems are to be organized. A routine for repairing solar systems (including a clear responsibility for financing the repairs) is meant to be agreed upon and established with different stakeholders.

Solar cocoa dryers

Building on a GIZ project that had strengthened a cocoa farmer cooperative, EnDev Liberia started to support cocoa farmers to construct solar dryers in 2012. In total, EnDev supported the construction of over 200 solar dryers. The main contribution is the UV-resistant plastic foil, which is not easily available on the local market. EnDev imported the foil and now helps to establish business contacts between local importers and foil companies. EnDev also provides technical advice in the construction of the dryers. Farmers provide labour and the wood material for the construction of dryers, but have low financial capacity to invest into the thermoplastic. EnDev trains farmers in maintenance and has started to establish systems for maintenance and repair. EnDev plans to partially merge its activities here with those in Sierra Leone and to look into other construction techniques and drying of other crops as well. In addition, EnDev wants to look into some gender issue of this approach, since the solar cocoa dryers are mostly controlled by men and thus only allow limited use for other crops.

Mini-grids

EnDev provides some technical and logistical support for organisations or individuals who install and operate solar-based mini-grids on a small level so far. EnDev plans not to be directly responsible for the installation and operation of mini-grids in Liberia and Sierra Leone, even though donors are approaching EnDev increasingly to do so and to manage mini-grids for them. EnDev so far gives advice and assistance on request only. Some organisations get funding from international donors, but face problems to implement projects in such a way that a sustainable operation of the mini-grids can be assured. EnDev is increasingly supporting partners here through logistic help, networking and targeted advice regarding selection of appropriate technologies, technicians, assistance to tariff setting and realistic management of mini-grids. There is cooperation with PLAN, Mercy Corps, USAID, UNOPS, WHH, RREA, PRESSD-SL, EU and private operators. A GIZ managed PPP fund for the Mano River Union selected a new mini-grid project in Liberia to be supervised by EnDev and constructed by HELOG. An extensive monitoring programme has been started in one mini-grid. EnDev will use experience gained and data collected through its networks and some additional smart meters in the mini-grid sector to help to develop realistic and more productive concepts for a more sustainable mini-grid approach in Liberia and Sierra Leone; if results become relevant lessons learnt for Ministries of Energies, Donors (EU, USAID, DfID and Sweden) and regulation authorities.

3.3 Cooperation with others

EnDev is cooperating with government, local and international organisations in all components. In the picoPV sector in Liberia, the World Bank is financing the importation of large quantities of solar systems through the Rural Renewable Energy Agency (RREA), whereas EnDev helps RREA to identify and capacitate retailers and the Liberia Energy Access Practitioners Network (LEAP). In Sierra Leone, EnDev cooperates with the Energy Task Force lead by the Ministry of Energy and with the members of the Renewable Energy Association of Sierra Leone (REASL). Major international stakeholders in the picoPV sector are DFID and the Power for All initiative. In addition, EnDev can build on the cooperation with the Barefoot Women Solar College, Oxfam, WHH, Total and SOBA amongst others.

The electrification of health facilities and schools in Liberia is done in cooperation with the Ministries of Health and Education, Office of the President, UNICEF, Mary's Meals, WHH, We Care Solar, Partners

in Health, AfriCare, UN-WOMEN. In Sierra Leone, EnDev cooperates here with Playhouse Foundation, the Ministry of Health EPI programme, PRESSD-SL project, Alfred Gbla and ENFO. In Guinea, EnDev installed SHS for health facilities jointly with PROSMI and the Ministries of Health and Education, the Office of the President and the GIZ Health and Educations Projects.

Activities of international organisations to promote improved cooking technologies are scarce. In Liberia, the European Union carried out some studies about the charcoal value chain, but did not follow up on these activities. EnDev is cooperating with the Ministry of Sport and Gender, vocational training schools, SOS-Children villages, Welthungerhilfe, and Mary's Meals to further promote the private sector. In Sierra Leone, a workshop StovePlus by GERES with conducted and EnDev cooperates with UNDP, the Ministry of Energy, Environmental Foundation for Africa, Catholic Relief Services, supports the Governmental Technical Institute and Wonder Stove producer Westwind Energy.

Regarding cocoa processing, EnDev cooperates and networks closely with several local cocoa farmers cooperatives, some buying and exporting companies (LAADCO, WIENCO, Africa Venture Liberia), the Ministry of Agriculture, the International Fund for Agricultural Development (IFAD), the International Cocoa Organization (ICCO) and several Non-Governmental organisations (ACDI/VOCA, GROW, WHH). EnDev supported a cocoa sector meeting with the Ministry of Agriculture in a joined effort to professionalize cultivation and processing of cocoa.

4. Sustainability

Liberia and Sierra are among the poorest countries in the world, with the majority of households living on very low incomes, and public institutions often lacking adequate funding. Thus, the sustainability of any device that has to be maintained, repaired or replaced over time is a great challenge. EnDev is fully aware that the project has to invest a considerable part of its resources to increase the chances for a sustainable use of the promoted technologies and disseminated systems.

Throughout its work in all components, EnDev trains women and men – from artisans to engineers – to properly use, maintain, and repair solar systems and improved cookstoves.

In the picoPV sector, solar lamps promoted by EnDev have a two years warranty. However, many households face problems to invest USD 25 or more to buy certified solar lamps. Therefore, many households prefer cheap Chinese lamps operated by batteries. Continuous marketing activities are necessary to make people aware of advantage of picoPV products and thus keep the number of households low that move back from high quality to cheap low quality lamps. In addition, the warranty based repairing or replacing of the lanterns needs to be ensured and mechanisms established to repair and replace broken parts (e.g. the front plastic). PAYGO systems start to overcome the financial access issue for poor and medium level households.

Concerning solar installations in schools and health facilities, EnDev works towards a system of monitoring, surveillance, maintenance and repair. National funding for such a system is not very realistic in the near future, yet EnDev lobbies towards establishing some sustainable funding mechanisms. EnDev has already established a hotline in case of problems and increases its telephone monitoring.

For solar cocoa dryers, EnDev made the experience that many dryers in Foya district had broken down or were severely damaged. Most problems were with the planks in the legs due to termites; floor and the roof were often broken. Sometimes, other buildings or a road construction had led to a total breakdown of the structures. Many still had the plastic intact, but others had holes in it from rats or from rubbing on the wood. Some plastics were damaged due to a storm; some got stuck on the nails. Often, the wood or tree material was not selected well enough and not protected against termites. In some communities, farmers had repaired the dryers by replacing broken planks. However, in many communities the farmers had reverted to drying on the ground. They appealed towards having the dryers repaired, as they highly valued that their income increased due to solar drying. EnDev reconstructed the dryers but now insists on clear responsibilities and a maintenance system, e.g., a fee system, where users of the dryer make a small contribution either in cash or cocoa for repairs and

purchasing new thermoplastics. Caretakers are nominated for each dryer to ensure a proper use of the dryer and any necessary repair. EnDev trains these caretakers in good maintenance practices. EnDev will introduce an app to monitor the performance of the dryers.

An important instrument for sustainability for solar systems is the traceability, since preferably all installations (including those of other organisations) are to be documented with their technical specifications and locations and can thus be mapped and their history of maintenance be better documented. EnDev is introducing and testing a system, which will allow for better monitoring, follow-up and repair.

5. Impact

EnDev Liberia has not carried out any impact study. However, there is plenty of evidence based on the feedback of the customers and clients that interventions produce tangible benefits. The promoted picoPV systems replace either kerosene lamps or battery operated lamps whose end-consumer price is low but which are expensive to use. Customers generally appreciate the robustness of the certified lamps, the good quality of the light and the low operation costs.

Employees of several health facilities report positive impact: deliveries during the nights can now be done with bright light, vaccines can be cooled in solar fridges, and health services can be offered during dawn and night-time. In some cases, health facilities presented statistics showing that the number of vaccinations and deliveries doubled after the electrification of the health centre. Mother and child death are claimed to have decreased, however sufficient trustworthy quantification here is still difficult.

Electrification of schools improves not only the working conditions of teachers, but also allows night classes. Farmers, who had started adult literacy classes taught by volunteer teachers, reported increased confidence, being now able to prevent cheating when selling their products. Some also said, they now better understand the importance of education and send more of their children to school, also being models to their children who had been unwilling to go to school.

The improved stoves reduce fuel consumption by at least 30%. Households confirm that they save money spent for charcoal. In addition, the exposure to smoke is reduced, which decreases likelihood of diseases.

Cocoa farmers report that they received higher prices for cocoa beans that had been dried in the solar dryer. The higher price is not the result of the better drying alone, but also caused by a general improvement of the cocoa processing and increasing cocoa prices on the world market. However, the solar drying besides fermentation is an important component in the professionalization of the cocoa processing of Liberian farmers.

EnDev attempts to mainstream gender aspects in all activities. EnDev emphasizes training women as sheet metal workers and manufacturers of the Red Fire Pot. In addition, electrification of health facilities, partially done by women as well, benefits mostly women. Nurses are often in charge to support deliveries during night and women feel safer to go the health facility. In addition, EnDev especially encourages women to sell solar lanterns and become some solar installers. There is an increasing demand for solar installation by social institutions and private homes. Training for larger solar system design pushes the SHS market forward, too.

Impact	Possible indicators
Climate change	Annual emission reduction: 2,000 t CO ₂ e
Environment	Renewable electrical power generation capacity installed (in W): 5,000
Health	No of households gaining access to at least level 2 cooking systems: 1,500
Poverty/livelihood	No of jobs created along the value chain: 50
Market development	<ul style="list-style-type: none"> • The overall turnover of stove producers and retailers as well as retailers with picoPV products increases by 10% per year on average. • The number of sales agents for PicoPV products increases by 10% per year on average. • Business models for solar dryer construction, maintenance and repair are developed.

6. Budget

Estimated additional budget until 30.06.2019: **EUR 1,000,000**

	EUR
1 Human resources and travelling	737,000
2 Equipment and supplies	38,000
3 Funding financing agreements/local subsidies	0
4 Other direct costs	96,000
5 Total direct costs (sub-total)	871,000
6 Mark up costs/administrative overheads/imputed profit	129,000
7 Cost price	1,000,000

Mozambique

1. Summary

Promoted technologies	Grid, Stoves, Solar PV				
Project period	old	10/2009 – 06/2019	Budget (EUR)	old	EUR 14,500,000
	new	10/2009 – 08/2019		new	EUR 15,900,000
		old targets		new targets	
Energy for lighting / electrical appliances in households		139,000		185,000	people
Cooking / thermal energy for households		410,000		430,000	people
Electricity and/or cooking / thermal energy for social infrastructure		15		15	institutions
Energy for productive use / income generation		75		75	SMEs
Lead political partner	Ministry of Mineral Resources and Energy (MIREME)				
Implementing organisation	GIZ				
Implementing partner	Electricidade de Moçambique (EdM), Fundo Nacional de Energia (FUNAE), NGOs (SNV, AVSI, ADEL, Kulima, Magariro), FDC (Fundo de Desenvolvimento Comunitario), universities, colleges and private sector.				
Coordination with other programmes	GIZ: Education (ProEducação), Economic Development (ProEcon), Adaptation to Climate Change, Project Development Programme (PDP); DFID, World Bank, Belgian Technical Cooperation (BTC).				
Key interventions	<ul style="list-style-type: none"> • Grid densification • ICS • Solar 				
Main strategic changes introduced with up-scaling	<ul style="list-style-type: none"> • National energy access monitoring platform • Sustainable Renewable Energy Access Fund (FAES) • Multi-level financial and technical support • Access to 'end-consumer finance' through the EdM pre-paid platform (Credelec) • Improving affordability of clean cooking fuel • Gender strategy 				
Project manager	Rosario Loayza, rosario.loayza@giz.de				

2. Introduction

In the Annual Planning 2018 the duration of EnDev Mozambique was extended from 12/2018 until 06/2019 because of the establishment of the regional RBF SSA on grid densification. However, the budget of the non-RBF part of EnDev Mozambique was not up-scaled at that time. Hence, without additional funding for the EnDev core project, interventions would need to be phased out until 12/2018. This up-scaling shall allow EnDev Mozambique to continue both programme components (RBF and EnDev classic) to operate until mid-2019.

3. State of market/(sub-)sector development

Mozambique is among the bottom eight countries in the Human Development Index (HDI), ranking 181st in the 2016 UNDP Human Development Report. The country has the lowest HDI among the Southern African Development Community members. The concomitantly high poverty, low income and low ability to pay, present severe challenges for private sector market development. Therefore, at the current stage of market development, donor support is crucial in order to trigger/accelerate market development with the aim of achieving the SEforAll goal of universal access to modern energy services by 2030. So far, the government relies on on-grid energy access data to derive policies and action on energy access which is a misconception of the real situation and leaves out information on off-grid technologies and cooking energy solutions. More recently, the government has shown considerable interest in reaching a more realistic energy access monitoring database to assist in the planning processes.

Mozambique's Renewable Energy Atlas (2015) proves that the country is endowed with an extraordinary mix of renewable energy sources. The least cost electricity generation projects that could be developed in the short term add up to 7 GW. This potential could satisfy both Mozambique's internal electricity demand and the current deficit of the Southern African Power Pool (SAPP) – making Mozambique a key player in the SADC region. At the same time, the current national electrification rate is amongst the lowest in the region with only 26% connected to the grid and an estimated 10% using off-grid solutions.

In addition to the National Five Year Plan (PQG 2015-2019), the Government of Mozambique has embarked on the elaboration of a National Electrification Master Plan and a new National Energy Strategy, a review of the role of FUNAE with regard to off-grid solutions and the creation of an independent Energy Regulator (ARENE) to tackle the challenges described above. Mozambique has subscribed both the SEforAll objectives and the targets of SDG 7 with the main objective of providing universal access to energy services by 2030. The signature of the Joint Declaration on Renewable Energy between the Government of Mozambique and the European Commission (EC) and various EU member states (2016) is an indication of commitment to renewable energy sector development and contribution to reducing human-induced climate change.

The Mozambican government has acknowledged the need to take into consideration on- and off-grid solutions to achieve universal access until 2030 and recognizes the lack of available information and energy access data on donor programmes and private sector activities. Currently, the government has only access to data related to on-grid electricity connections. One key consequence of the lack of data is a limited ability of the government to coordinate and steer ongoing and upcoming donor and public programmes to complement each other and coherently contribute to the goal of universal access.

3.1 Solar PV Market

The market for off-grid electrification in Mozambique offers a potential customer basis of almost 4.1 million households. Despite the size of the theoretic demand, Mozambique's off-grid solar PV market is still small and in an early stage of development, with only a handful of companies active in the country. One reason being the unfavourable business environment, primarily caused by policy inconsistencies, lack of access to financial resources and a continuous deteriorating macroeconomic situation over the past years. Since the solar PV sector is strongly dependent on imported products and components, barriers to enter the Mozambican market as well as its weak integration with international markets are severely constraining the sector (e.g. currency risks).

Product diversity of small solar PV systems is low in the Mozambican market and most products lack independent quality certification by e.g. Lighting Global. The situation is worsened by the fact that end-consumer sales prices are high compared to neighbouring countries. To date, only four relatively large importers of Lighting Africa (LA) certified picoPV and solar home systems are active in the country. New donor-funded programmes targeting energy access (e.g. the recently launched BRILHO programme financed by DFID), have attracted considerable interest by companies to enter the market.

Those new market players introduce new products and business models including instalment-based payment mechanisms through mobile money and fee-based (PAYGO) electricity services.

3.2 Improved Cookstove (ICS) Market

Firewood and charcoal remain the primary sources of energy for cooking, heating and illumination in Mozambique. Wood fuel collection and charcoal production is one of the driving forces of forest degradation, 80% of urban households rely on biomass to satisfy their energy needs (87% charcoal and 13% a combination of wood and charcoal). In rural households, almost 98% use wood fuel for energy while only 2% use charcoal. 14.8 million tons of woody biomass is used for cooking and other energy services in urban and rural areas per year.

In urban and peri-urban areas, the predominant choice of cooking fuel is charcoal, which has to be bought by households. In the past years, the charcoal price has increased with an annual rate of 15%. Apart from scarce resources nearby urban centres, the economic crisis and high inflation rate impact charcoal prices. Reducing energy related expenditures with ICS technologies is a key to alleviate the financial burden of poor households. EnDev's socioeconomic surveys indicate that about 30% of the family income in Maputo is used to purchase charcoal. In the urban and peri-urban areas of Mozambique, charcoal is the most expensive source of energy in comparison with electricity and LPG. However, poor families only have the available income to cover their basic necessities on a daily basis. Charcoal is the predominant fuel for cooking in urban and peri-urban areas because of its availability in financially accessible small amounts. Demand for ICS technologies is high especially in urban areas to reduce energy related costs.

In rural areas, the economic situation has a reversed effect where households collect firewood. In other words – where fuel has no price, the demand for ICS technologies is low. For both market segments, it is key to achieve product diversity with artisanal, semi-industrial and industrially produced cookstoves to address different price segments and customers.

As a result of the project's activities in the past local production groups and SMEs produce artisanal and semi-industrial ICS to a limited extent which can be found on the Mozambican market, but product diversity, production capacity and market penetration are not sufficient to respond to the current and potential demand. Higher tier industrially produced ICS exist in the market and are imported as completely assembled products or flat-packed solutions. There is no local industrial production in Mozambique at the moment. Compared to the solar market, upcoming new donor-funded programmes targeting energy access, have led to an increasing interest in the Mozambican ICS market with new players introducing new products and business models.

3.3 Grid

Electricidade de Moçambique (EdM) is the state-owned electric utility providing power to over 1.5 million customers throughout the country. EDM is the only utility in the country, there is therefore no competitive market as such for grid densification. The utility's performance has been negatively affected given that 24% of electricity is lost each year due to non-technical losses, low management capacity, and an underperforming distribution meter system. As a result, the utility loses significant revenue each year and households and businesses are dissatisfied with the quality of service delivery. EDM is currently undertaking an internal reform process to reach a more commercial oriented management, reduce electricity losses, improve service orientation, and achieve the target to connect over 300,000 new customers a year.

4. Intervention strategy

4.1 Market development vision

Five years from now, the benefits of the use of ICS and household solar PV products will be well known by Mozambicans living in urban, peri-urban and rural areas near to the main province capitals. In addition, a functioning supply chain in those urban and rural areas, for high quality off-grid technologies offered at competitive price is in place. The Mozambican Government acknowledges the

need for a balanced approach across all tiers, to achieve universal access by 2030. Measures have been undertaken to support the market development of ICS and household solar PV technologies by reducing fiscal weight and import duties on high quality products. Access to financing for investors, importers, retailers as well as consumers is significantly improved.

The sector's accelerating market will change the funding dynamics for renewable energy projects, making them transition from a traditional focus on donor aid to an approach with a greater participation of the private sector where donor funding will be channelled to overcome market barriers. The increasing private sector investment and a targeted financial donor support enhances affordability for low-income households due to a more competitive market environment.

As a result of the EdM administrative and technical restructuring process, the company is performing on a commercially and financially viable level being able to effectively serve its customers, reach financial sustainability and guarantee cost-coverage not only for operation, but as well for maintenance and repairs.

4.2 Fit with policy ambitions and plans for energy access and climate change, in particular with SDG7/SEforAll country plan and NDC

One of the major drivers of forest degradation in Mozambique is the unsustainable extraction of wood for domestic energy uses such as fuelwood and charcoal. In its Nationally Determined Contribution (NDC) presented to UNFCCC in 2015, Mozambique intends to reduce 23 MtCO₂ from 2020 to 2024 and 53.4 MtCO₂ from 2025 to 2030. Mozambique has significant potential to contribute to these targets through forest-related climate change mitigation. Land use change and forest degradation account for over 80% of Mozambique's GHG emissions²⁰, offering a significant potential to reduce emissions and enhance forest carbon stocks. This ambition will be reached through the combined objectives of several national programmes and strategies, providing the strategic direction towards net emissions reductions in the long term. Access to safe and clean fuels for cooking and heating is much lower than access to electricity in Mozambique; the country has not included access to energy for cooking energy specifically as a mitigation action related to the development objective of access to modern energy services.

The EnDev interventions in access to clean cooking will provide reductions in the use of wood fuel and will directly contribute to emission savings – and is hence well aligned with the government strategy.

4.3 EnDev conceptual approach and intervention strategies per (sub)sector

EnDev Mozambique will continue to maintain its leading role in the energy access sector, by promoting a common vision between government, donors and implementers oriented towards universal access based on a multi-tier approach.

Three main new instruments and modalities with impact on the implementation of all components will be introduced:

4.3.1 National monitoring platform on energy access

Based on its extensive experience in outcome monitoring, EnDev will support the Ministry of Energy in creating a national monitoring platform to measure energy access on-grid and off-grid, using a multi-tier approach. The platform will help the government to improve the quality of the data collected, thereby getting a real picture of the state of energy access in Mozambique and assist in making future plans more efficient to achieve the target of universal access by 2030. The platform will foster the cooperation between partners in the energy sector leading to a more efficient use of resources. EnDev will continue to actively support the creation of synergies and coordination on sector level.

²⁰ Sustainable Financing of Protected Areas in Mozambique. (Melissa Moye and Sean Nazereli 2010)

4.3.2 Sustainable Renewable Energy Access Fund and Multi-level financial and technical support

EnDev will set up a Sustainable Renewable Energy Access Fund managed by the Foundation for Community Development (FDC) to address one of the biggest challenges in the development of the sustainable energy market, which is access to finance.

FDC is a private, non-profit institution, working to build the capacity of communities with the objective to overcome poverty and promoting social justice in Mozambique. FDC establishes strategic and implementation partnerships with communities, civil society organizations, private sector, governmental, academic and research institutions. Due to its reputation, since June 2015 FDC is managing a 22 million USD fund of the *Global Fund to Fight AIDS, Tuberculosis and Malaria* for its interventions in Mozambique. Hence, FDC has a proven track record and experience in managing funds channelling significant financial resources into projects worth more than 220 million USD in all 11 provinces of Mozambique. FDC mobilises and manages on average 10 Million USD per year and is subject yearly to international audits.

The Sustainable Renewable Energy Access Fund, which will be set up by the end of 2018, will launch open calls by the beginning of 2019. A steering committee, with representation from EnDev, will evaluate the presented proposals. Contracting of partners will be done by FDC. Eligible partners will be assessed based on pre-defined criteria including aspects of financial management, experience and track record. The objective is to establish a financing mechanism to significantly scale up activities.

EnDev will continue to act as a business accelerator offering financing, technical advice and targeted support according to the respective financial and technical capacities of partners. Managerially and financially strong partners promoting improved cooking technologies and solar quality products will be motivated through the fund based on Results-based Financing (RBF) schemes to extend their business to less favourable market environments such as remote rural areas where operational costs are high. ICS and solar PV entrepreneurs characterized by a lower level of capacities will receive technical assistance in product development and/or selection, business models and financing for selected activities (e.g. cash advances for start-up, stock or distribution).

The Sustainable Renewable Energy Access Fund will be designed as a potential basket fund to attract additional funding from donors, companies, foundations, etc.

In addition, FDC will also allow for more flexibility and ensure more transparency in channelling and allocating funds. This new implementation scheme will accelerate project implementation due to a reduced timeframe from proposal presentation to implementation launch. EnDev is aware of the challenges associated with the establishment of such a mechanism and the time required hence EnDev will continue to work in the current set-up until the fund is fully functional.

4.3.3 Access to 'end-consumer finance' through the EdM pre-paid platform (Credelec)

The so-called Credelec is an integrated prepaid energy sales system available 24 hours a day throughout Mozambique managed by EdM. Currently, the Credelec system covers about 1.2 million grid-connected customers across the country, representing about 86% of electricity consumers. Payments are processed in real time, offering increased and diversified payment options. The customer can buy energy via bank, ATM, mobile money, physical sales-points or mobile street vendors. Currently the Credelec platform is also used for paying for waste removal charges and radio licence fees. EdM has agreed to open the system to be used for payments for decentralized energy solutions such as ICS, energy saving lamps etc., offering an option to pay in instalments. EnDev will support a study, which will analyse the financial and fiscal risks for EdM. Based on the result a pilot phase will be designed and launched. The objective is to improve affordability of renewable energy technologies and energy efficient appliances for low-income households. Improving energy efficiency is one of the major concerns that EdM wishes to address in the short term on corporate and consumer level.

The approaches for the three technical components are described below:

- **Grid densification**

EnDev will concentrate most of the resources on financing grid densification activities due to the high cost-efficiency of the grid densification component. The programme supports household connections through assistance to the national electricity utility EdM in acquisition of prepaid meters. The cooperation with EdM is based on a grant agreement which includes specified connection targets. In previous contracts, EdM has proven an increasing capability to deliver both technically and financially in a short period. Hence, EnDev will facilitate tier 5 energy access to the target group and maximise the number of beneficiaries. Furthermore, this approach will assist the Mozambican government in achieving its ambitious target (300,000 connections per year) to provide universal access by 2030.

- **Improved cookstoves (ICS)**

EnDev will increase its focus on artisanal and semi-industrial production on local level to respond to the high demand, low purchasing power and the increasing prices of charcoal in urban and semi-urban areas. Support will be offered in terms of training for new market players on production and distribution. Furthermore, EnDev will continue with the assistance in awareness creation and marketing campaigns. EnDev will concentrate activities in areas where fuel is purchased. A stronger focus on local production will require the set-up of a replacement strategy for the stoves not linked to a carbon credit scheme to ensure sustained access to ICS due to the conservative estimated lifespan set up for the local production. The replacement strategy entails setting up and strengthening an after-sales service scheme with a range of stove spare parts affordable and available in the market, especially ceramic linings for the current locally produced technologies.

In order to increase ICS higher tier cookstove affordability for low-income households, EnDev has successfully linked carbon credit trading companies with project implementers in Mozambique since 2013. Partners like the AVSI Foundation and the MOZCARBON combine the commercialisation of ICS with the generation and trade of Certified Emission Reductions (CER's) under the Clean Development Mechanism (CDM) and the Gold Standard mechanism. Revenues from the carbon market flow back into the project and are used to bring down the cost of higher tier cookstoves for the poor market segment. Tapping into carbon finance is a strategy to promote the development of a sustainable market for cleaner and more efficient cookstoves, with the objective to change the funding dynamic from a focus on direct donor aid to a more sustainable one attracting investments from the private sector.

Considering the actual cost of fuel, cooking with LPG is cheaper than charcoal for urban households in Mozambique. And still, the majority of households prefer to use charcoal. One of the reasons for this is the investment barrier. LPG has to be bought in bulk (one gas bottle filling), while charcoal is usually bought in quantities of the daily needs. The investment for charcoal is therefore much smaller at any given time, while LPG would be cheaper if households would be able to mobilise money for bulk purchase. This is a major limitation for the role-out of LPG. EnDev will support and explore the market development of the first PAY AS YOU COOK company in Mozambique by piloting a project aimed to provide access to LPG in combination with the possibility to pay with mobile money on a daily basis. This will allow households to pay for LPG the same way as they currently pay for charcoal. Looking at the lower fuel costs of LPG, this model has the potential to convert households into using a cleaner and cheaper fuel by removing the investment barrier. The business model behind the PAY AS YOU COOK approach (similar to PAY AS YOU GO for solar PV), is based on paying for the actual energy consumption. Therefore, the success of this pilot will be linked to the set-up of a new and currently non-existent door-to-door LPG distribution channel, which will serve both low income and upper tiers in the Maputo City market. The objective of the pilot project is to learn more about the LPG cooking market segment and derive valuable insights and lessons learnt not only for Mozambique, but also for the EnDev programme as a whole.

- **Solar Home Systems (SHS) and picoPV**

Over time, EnDev has adapted its intervention strategy from awareness creation for consumers as well as technical/business training for distributors and retailers towards focusing on facilitating end-consumer finance addressing specific market development barriers identified. Companies are

supported and incentivized to expand their business to less favorable market environments. To increase ownership and sustainability, new business models are developed jointly with the private sector according to the individual experience, needs and market segments the companies work in.

EnDev for example supported SolarWorks! (Mozambique's first PAYGG company) from the very beginning by financing the development of a credit score tool which helps SolarWorks! sustain its business model. The tool is used to assess the financial credibility of potential customers comparable to a check of creditworthiness done by commercial banks before issuing a loan. After a successful pilot phase in the Maputo area, EnDev and SolarWorks! will expand activities to more remote areas.

Applying the same model, EnDev will support additional companies focused on end-consumer finance through the promotion of PAYGO mechanisms for solar technologies and appliances at the same time giving support to smaller partners using business models. This will make products more affordable to a large part of the population, improve product diversity and enable reaching scale for sustainable business activities.

- **Gender strategy**

To address gender inequality and support access to energy for women, EnDev will pilot an incentive for providing energy access to women living in vulnerable conditions for the different technologies supported (ICS, solar PV and grid). In Mozambique, 36% of the children live in a single-parent household, most often headed by single mothers. EnDev has developed a consolidated monitoring system that permits tracking all the implementing partners' activities and the verification of the beneficiaries. Poverty certificates are issued by local leaders in the communities, nominated by the local administration; the implementer will receive the gender incentive by presenting formal documentation as proof of having provided access to single mothers living in poverty.

4.4 Cooperation with others

EnDev works together with its partners to access larger funding from programmes like the future DFID programme BRILHO, the EU-funded MESAP project, and the Italian project Ilumina, which will enable EnDev partners to scale up their activities. Thereby, related interventions of other donor's programmes are geared towards EnDev goals. In case of the BRILHO programme, EnDev has been invited to be part of the evaluation committee.

Furthermore, EnDev cooperates with GET.pro/invest, a multi-donor programme implemented by GIZ, with the objective to increase public institutions' capacity, support an enabling environment to facilitate investments in renewable energy, and prepare a series of public and privately developed investment projects. EnDev will share offices with GET.pro/invest and will also host the Mozambican Association of Renewable Energies (AMER), created with GET. pro/invest's support.

EnDev also cooperates with the WB, the BTC (rural electrification mainly through support to FUNAE), GIZ-ProEcon (promoting mobile money / introduction PAYGO), GIZ-ProEducação (vocational training on solar PV), and the GIZ-E4D Programme (Employment for Development). EnDev collaborates with the PDP (Project Development Programme), which contributes to improve the overall investment environment for foreign investors. EnDev will intensify cooperation with other donors and create a stakeholder platform on household energy and to support the country's action plan for clean cookstoves and rural electrification.

5. Sustainability

EnDev puts a strong emphasis on establishing self-sustaining structures and does not play an active role in the value chain besides to support its public and private sector partners. EnDev seeks to create synergies between the various market players and stakeholders as a fundamental backbone of market development.

The production and distribution structures strengthened through the support of EnDev are independently managed by local stove and solar companies and NGO's. Thus, production and distribution capacities are sustainably increased.

Through capacity building in technical and business skills, local stove producers/distributors as well as solar distributors are empowered to deliver quality services and products in the long term.

Through capacity building in UEM (Universidade Eduardo Mondlane), INNOQ (Instituto Nacional de Normalização), BECT (Biomass Energy Certification & Testing Center), FUNAE, Ministry of Energy and AMER, EnDev is laying the basis for a solid knowledge and awareness in various institutions from academia and public sector.

Setting up a national monitoring platform for energy access has the potential to enable the Mozambican government to better fulfil its role in steering and coordinating sector policies and programmes (publicly or donor funded).

The Sustainable Renewable Energy Access Fund will continue to act as a finance mechanism for market development in the sector in the long-term (find more details in chapter 4.3). Capacity building for a local institution to manage such a national fund for renewable energy will ensure a consolidated and transparent financing mechanism for the energy sector. EnDev has been supporting partners in gaining access to carbon credit financing for their projects. This strategy allows EnDev to promote higher tier improved cookstoves at an affordable price. Furthermore, for continued gold-standard carbon credit financing an effective replacement strategy needs to be established which will be monitored by an independent third party, leading to a self-sustained project design.

6. Expected impacts of the project intervention and related indicators

Impact	Possible indicators
Climate change	Annual reduction in CO ₂ emission (in t CO ₂ e): 2,122
Environment	<p>Increased use of solar PV for lighting and small appliances / efficient ICS contributes to reducing the use of dry-cell batteries, kerosene and/or woody biomass and has a positive impact on reducing pollution through waste and emissions, as well as forest degradation.</p> <ul style="list-style-type: none"> Renewable electrical power generation capacity installed (in W): 48,000
Education	<ul style="list-style-type: none"> Experts on solar PV technology have been trained for the work in solar laboratories on quality testing (baseline: 2 experts) Increased share of picoPV users using evening time for studies: 2019: 15% (baseline: 10%, source: EnDev user surveys)
Gender	<ul style="list-style-type: none"> At least 50% of the jobs created are benefiting women along ICS and solar PV value chains. (Source: EnDev surveys)
Governance	<ul style="list-style-type: none"> Increased coordination and use of synergies between different donor-funded programmes and improved steering and coordination by the Government of Mozambique through the new national monitoring platform on energy access in the middle- to long-term
Health	<ul style="list-style-type: none"> Reduced exposure to harmful emissions for at least 9,500 women and girls No of households gaining access to at least level 2 cooking systems: 3,846
Market development	<p>Target indicator 1: at least 2 additional established companies distributing quality household solar PV products and ICS as their core business</p> <p>Target indicator 2: at least 50% increased sales figures for solar PV and 10% for ICS</p> <p>Target indicator 3: at least one additional end-consumer finance mechanism such as mobile money instalment based payment or fee-4-service introduced (baseline: 1)</p>
Leverage	Investments by households, private and public sector (in EUR): 1,300,000
Poverty/livelihood	<ul style="list-style-type: none"> ICS user households save at least 40% in energy for cooking (Source: user survey); picoPV user households save at least 20% in energy for lighting (Source: user survey) <p>No of jobs created along the value chain: ICS: 13; solar PV: 12; grid densification: 40 (total 65 new jobs)</p>

7. Budget

Estimated additional budget until 31.08.2019: **EUR 1,400,000**

		EUR
1	Human resources and travelling	538,000
2	Equipment and supplies	21,000
3	Funding financing agreements/local subsidies	648,000
4	Other direct costs	64,000
5	Total direct costs (sub-total)	1,271,000
6	Mark up costs/administrative overheads/imputed profit	129,000
7	Cost price	1,400,000

Vietnam

8. Summary

Promoted technologies		Biodigester			
Project period	old	07/2013-06/2018	Budget (EUR)	old	RBF: 3,740,000
	new	07/2013-12/2020		new	RBF: 3,740,000 EnDev: 1,500,000
		old targets	new targets		
Energy for lighting / electrical appliances in households		0	0		people
Cooking / thermal energy for households		275,000	375,000 ²¹		people
Electricity and/or cooking / thermal energy for social infrastructure		0	0		institutions
Energy for productive use / income generation		0	30,000 ²²		SMEs
Lead political partner		Ministry of Agriculture and Rural Development (MARD)			
Implementing organisation		SNV			
Implementing partner		PMU for the Biogas Programme in Vietnam under the MARD			
Coordination with other programmes		Non formal coordination			
Key interventions		<ul style="list-style-type: none"> • (a) strengthen business character of suppliers, (b) stimulate demand for biodigesters, (c) support enterprise-based technical innovation in the sector, (d) support coordination in the sector 			
Main strategic changes introduced with up-scaling		<ul style="list-style-type: none"> • Re-integration of a government financed RBF-subsidy to clients • Strengthening enterprise-based innovation in the sector 			
Project manager		Bastiaan Teune			

9. Introduction – Phasing out sector support

For over 15 years, the Biogas Programme in Vietnam has developed the market for biodigesters in the country through demand and supply side interventions. Government entities played an important role in the facilitation of the process. EnDev advanced since 2014 the commercialisation of the sector, leading to the emergence of the first strong biogas enterprises. The requested programme extension until December 2020 is the final phase for the biogas programme. It will establish that more companies reach maturity stage for an independent and self-sustaining future. These companies form the backbone of the private sector, assuring access to biodigesters in all relevant provinces of the country.

²¹ Result of DFID-RBF in 06/2018 estimated at 225,000. Target for extension under EnDev-RBF is 150,000 additional people. Total target will be 375,000 (225,000 achieved under DFID + 150,000 new). This is an increase of 100,000 over the old target.

²² This target is based on counting the pig farms using a co-benefit of the biodigester – the slurry – to replace mineral fertilizer for growing their crops. This is a key factor for making investments into a biodigester economically viable. Additionally, some pig farms use biogas for the preparation of the pig feed. In annual monitoring, at least 50% of the pig farms use the slurry for their agricultural production.

The Government of Vietnam considers biodigesters as an important technology for the future. In order to boost the use of biodigesters in the livestock sector, the MARDC issued Decree No 50/2014/QDD-TTg, which serves as a supporting policy over the period 2015 - 2020 that stipulates mandatory treatment approaches of livestock manure. It renders the permission for biodigester subsidies up to a maximum of VND 5,000,000 (= approx. EUR 180) per household.

By promoting the establishment of efficient and effective commercial suppliers of biodigesters in all relevant markets of Vietnam, EnDev is preparing the private sector for playing the role that the Government of Vietnam is requesting of them beyond 2020.

10.State of market/(sub) sector development

The Government of Vietnam has indicated in its Nationally Determined Contribution ([NDCs](#)) that biogas digesters shall be widely replicated (Mitigation measure 5.3 of the Action Plan for Implementing GHG Emission Reduction dated 25 August 2016). Under this plan, it has set an ambitious target that between 2020 and 2030, a total of 800,000 biodigesters shall be installed cumulatively, out of which 500,000 are conditional to NDC funding.

On the demand side, the current number of pig farming households with a sufficient number of pigs in Vietnam is unknown as the census data available is out of date and recent data does not drill down to the aggregation level of smallholders. Combining figures of the census from 2006 and an estimated number of 2 - 4 million pig farms at that time, a market potential of 950,000 can be assumed. Since then, the pig market first experienced a growth, followed by a drastic shock after China closed its borders for pig meat from Vietnam in 2016. It is therefore estimated that a third of the domestic pig farms actually closed due to the price decline of pig meat by 50% or more in 2016/17. Taking the market estimation of 2013 with 950,000 households, there is still a demand for 630,000 biodigesters. In the meantime however 260,000 biodigesters have already been sold through EnDev and other projects; so the unserved market would be around 370,000 biodigesters. So, even in the context of a drop in livestock holders, it seems still a substantial number of smallholders are left and viable for a biodigester for the years up to 2020. The non-conditional NDC target (300,000 biodigesters sold in 2020 - 2030) would reach 80% of the estimated remaining market after the pig-meat-price crisis (though markets may grow again once the meat price has recovered).

10.1 Development of the biodigester sector under DGIS funding (2003-2013)

Together with the Ministry of Agriculture and Rural Development, SNV started the national Biogas Programme (BP) in 2003 to build a commercially viable biogas sector. Until 2013, this DGIS funded programme managed to establish a broad base of skilled masons who construct digesters in a market that initially was organised by government agents and supported by a post-construction subsidy to the end client. The masons built more than 100,000 digesters in total, with a peak of 25,000 digesters in 2009. However, these successes were mainly dependent on the availability of donor funding and not driven by domestic market development of the sector. Most of the artisans were only working on directives of the government agents and constructed digesters close to their own homes. Encouragingly, there were also first small signs that some masons started to develop more initiative to search for clients and to sell digesters outside the programme which paved the way to the next phase.

DGIS phase 2003-2013: Tasks and finance of stakeholders in the digester supply chain

	Provincial govt. bodies	Enterprises	Households
Tasks	<ul style="list-style-type: none"> Promotion Awareness Client identification Household training Extension After sales service Quality control 	Construction on demand of Govt extension workers	
Finance	Receive subsidy of approx. EUR 29 per digester from ODA for services provided	Receive payment from household	<ul style="list-style-type: none"> Pay for materials Pay for mason services Receive subsidy of approx. EUR 33 for their digester from ODA

10.2 Development of the biodigester sector under EnDev funding (2013-today)

In 2013, EnDev started a Results Based Financing (RBF) approach to support the transition of the biogas sector towards a fully commercial market. This means that financial support is given *after* a sale has taken place and the result has been verified (in this case the construction/installation and commissioning of a biodigester). In a wider sense, the household subsidy under DGIS-funding was already a kind of RBF. However, in the EnDev phase the focus was shifted from “increasing the demand for digesters (pull)” with a household subsidy towards “increasing the supply (push)” from commercially operating enterprises. Under this approach, the supplying company receives an RBF cash incentive payment for each installed digester sold, after a successful verification. The companies use the cash to offer free appliances (gas-stove) or offer price reductions to farmers, or they invest in more staff, better marketing of tools and machines for faster digester construction (e.g. for excavation). The new approach has a significant impact on the awareness, empowerment and strengthening of biogas enterprises.

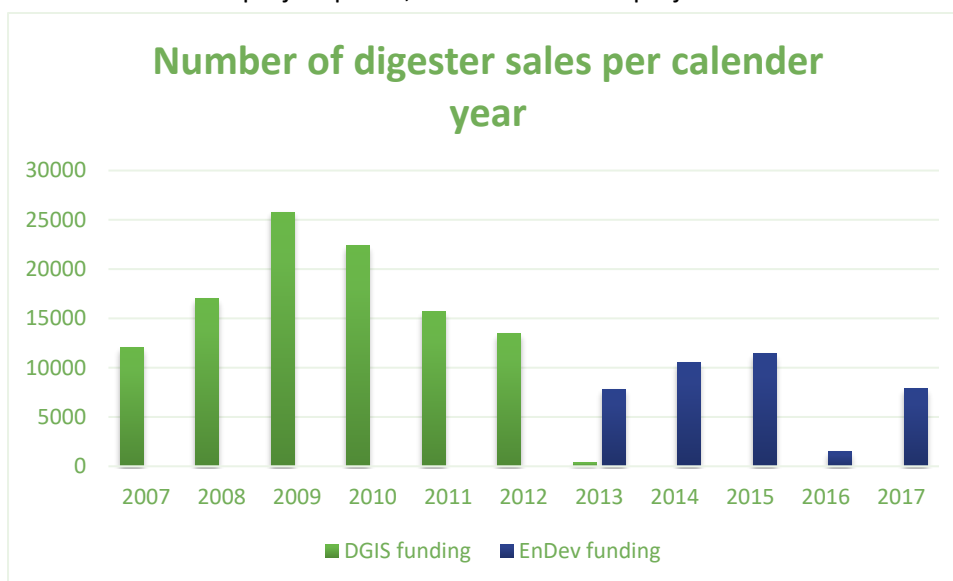
After some time for preparation, the first six provinces changed to the full RBF approach in the 2014/15 digester installation season. The next 12 provinces followed in the 2015/16 season. The remaining 27 provinces were supposed to join the full RBF in the 2016/17 season. Administrative and political problems at the implementing Biogas Programme (BP) resulted in a shutdown of project implementation in 2016. For this reason, BP started the shift to the RBF-incentive to the companies in the current 2017/18 season. Today, the majority of the provinces, and most of the biogas companies have not yet had enough time to fully transform towards a market driven sector.

EnDev phase 2013-2018: Tasks and finance of stakeholders in the digester supply chain

	Provincial govt. bodies	Enterprises	Households
Tasks	Quality control	<ul style="list-style-type: none"> Construction/Installation Promotion Awareness Client identification Household training Extension After sales service 	
Finance	Receive approx. EUR 6 per digester from carbon finance	Receive payment from household Receive payment of approx. EUR 35 /digester RBF incentive from ODA	HH pay enterprise for installed digester NO subsidy

10.3 Current situation of the sector – Did the RBF work?

Close to the end of the RBF project phase, the results of this project are mixed.



The average annual sales went down from about 18,000 digesters under the old approach to close to 8,000 digesters under EnDev. At first glance, this may suggest that the old approach was more effective. However, that conclusion would be premature:

Interruption of project implementation in 2016:

In 2016, the project could not operate in the field due to administrative hurdles with the renewal of BP under MARD. When discounting 2016, the average annual sales rise to 10,000 biodigester/year under RBF.

Pig meat price crisis since 2016:

Between December 2015 and June 2017, the price almost halved²³ due to China closing its border for (illegal) import of pig meat from Vietnam. Being cut off from this export market, the production exceeded the local demand, which resulted in a sharp drop in market prices for pig meat. This external shock to the sector discouraged potential clients from investing in a digester, as approximately a third of the larger pig raising farms filed for bankruptcy.

However, after the consolidation of 2017, the [ipsos report](#) on the Vietnam Swine Market from 2017 (see page 11) predicts a slow growth path from 2018 onwards.

There are provinces with booming biodigester markets:

Most of the six provinces where EnDev piloted the full RBF approach in 2014 developed a mature market for biodigesters. Today, they register annual sales of 500 to more than 1,000 digesters even in the pig meat price crisis. The provinces which joined the full RBF later are mostly still at a sales level of below 500 digester per year.

There are biodigester enterprises which have grown to scale:

A team of three masons can construct one brick biodigester within two weeks. This is limiting their annual production to a maximum of 20-25 digesters (full-time artisanal production). When working with two or more teams or investing into machines and mobility, they can increase their productivity to higher levels. Installers of factory-made digesters are not hampered by the lengthy construction and drying time of conventional brick digesters. Hence, the annual production is a good indicator for the maturity of a biodigester company.

²³(https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Grain%20and%20Feed%20Update%20Quarterly_Hanoi_Vietnam_10-12-2017.pdf), page 4.

Level	Description (not obligatory)	Range of annual sales	# of companies
5	Business Class of biogas enterprises <ul style="list-style-type: none"> several teams of masons in different provinces large machines, vehicles etc. often also installation of factory made digesters 	200 and more	7
4	Professional biogas enterprises <ul style="list-style-type: none"> several teams of masons, active in a few provinces investment in small machines chief becomes a full time manager 	100 - < 200	23
3	Emerging biogas enterprises <ul style="list-style-type: none"> still artisanal production style, mostly 1 province working in parallel with more than 1 team of masons chief is still active mason overseeing other teams 	25 - < 100	51
2	Full time artisanal production with 1 team of masons, main occupation	15 - < 25	14
1	Occasional artisanal production with 1 team of masons, part time occupation	< 15	28

By the end of 2017, 123 enterprises were active under the RBF scheme, the table above shows that 7 reached the highest level. This proves that we have a very dynamic uptake of the business idea by about 15% of the companies that are selling half of all the digesters, whereas the other 85% have not (yet) developed this dynamic. One reason for the others to grow slowly is the pig meat price crisis, which was making it difficult to grow the business.

Factory-made ‘composite digester’ accelerated market development:

Factory-made digesters offer the opportunity to reduce significantly the time between contracting and the first use of gas. Conventional brick digesters take about two weeks for construction (including waiting time) and another four weeks for drying of the cement, filling of biomass and the raising of the gas levels until the gas is usable. In a composite digester, installation takes only one day, and after a week the first gas can be used.

EnDev/SNV started integrating this digester type into the technology mix since 2014. By now, enterprises have installed close to 5,000 digesters of this type, half of them in 2017. It is a very dynamically developing sub-market with a high potential to further boost overall sales.

Some of the Enterprises are now even offering both the construction of brick digesters and the installation services of composite digesters, depending on the choice of the client.

Biodigester enterprises have shown that they are embracing the opportunity to grow their business and become national players with multiple technologies. However, there are still many enterprises who did not yet have enough time and support to follow the example of the market leaders. Equally, there are some striving provinces with mature markets, while others are lagging behind.

11. Intervention strategy

11.1 Market development vision

The Government of Vietnam is able to scale the market of biodigesters to the required level to achieve its NDC targets using government funds including income from the Voluntary Gold Standard (VGS). A larger group of regionally operating enterprises of biodigester companies compete in this growing market and provide a range of quality digesters. Factory made digesters of different sizes allow fast delivery and installation complementary to the traditional brick digesters. This private sector is

investment-ready and can adapt to market demands for scale. ODA is no longer a condition for the functioning of the market.

11.2 Fit with policy ambitions and plans for energy access and climate change, in particular with SDG7/SEforAll country plan and NDC

The Government of Vietnam has ratified the endorsement of the BP phase III (2016-2020). This phase explicitly aims at developing a commercial and private sector driven biogas market through RBF as well as to support the sales of 100,000 digesters by 2020. The government approved the usage of funds from carbon finance/VGS to support the BP in January 2018. Additionally, the government approved a pro-poor scheme that will support the construction of biodigesters in remote areas by a EUR 180 household subsidy, for households living in 64 poor districts. All this is aiming at growing the market for achieving the objectives formulated by MARD in response to the objectives set in the frame conditions of the NDC.

11.3 EnDev conceptual approach and intervention strategies per (sub)sector

All activities of EnDev under this last funding are geared to prepare the phasing out of ODA support to the sector. The focus of the implementation concept is to bring more biodigester companies to a sustainable business level through a targeted phasing out of the RBF-incentives of the current phase (see 4.3.1).

To overcome the negative implications of the pig meat price crisis and to boost the sector towards the NDC targets, the Government of Vietnam is planning to use its own funds (right now based on VGS income) to finance household subsidies. BP is implementing this intervention complementary to EnDev activities, but outside of the EnDev funding (see 4.3.2).

Long-term development of the sector depends on continued innovations. New digester designs, materials, appliances and uses are important for developing the attractiveness of the sector (see 4.3.3).

The biogas sector of Vietnam hosts a number of different programmes and initiatives. EnDev will support MARD in the coordination of the sector development (see 4.3.4).

With the support of EnDev, BP will prepare other aspects of sector development (beyond the actual production and distribution of biodigesters) for the phasing out. One example is the promotion of the use of bio-slurry for commercial farming (see section 4.3.5).

11.3.1 Strengthen the business character of suppliers in the market of biodigester

In the current phase, seven companies have used the RBF incentive scheme to grow their business to unprecedented levels ("business class"). They are no longer in need of premium payments to co-finance future investments. All other companies will be eligible for an RBF incentive for all of their verified digesters in the 2018/19 installation season except for digesters that are built in provinces that are phased out. The phasing out of provinces is following the same order as the provinces joined the RBF, starting with the six pilot provinces in the 2018/19 season.

Based on the observed performance of the 2018/19 season, EnDev/SNV will determine again which companies and which provinces will be eligible for RBF payments in the 2019/20 season. The amount of the RBF incentive will be reduced to prepare the companies for the phasing out of this instrument. In that last season, EnDev will focus its support on the emerging producers that are not yet at top level 5. EnDev will offer all level 5 enterprises a small monitoring fee for them to provide a simplified data set of all their installed digesters. This monitoring fee will be phased out during this programme phase.

Installation-season	RBF-eligible companies	Incentive levels
2018/19	All companies except the top 7 of 12/2017 monitoring. Payments restricted to digesters that are built in provinces that are not phased out.	EUR 36 per digester
2019/20	All companies which have sold in the 2018/19 season < 200 digester. Payments restricted to digesters that are built in provinces that are not phased out.	To be determined in 6/2019 EnDev/SNV
Second semester 2020	RBF incentive and monitoring incentive payments will close down in an organised fashion, yet aim to capturing as much of the production of the last months of 2020. To allow one month time for verification and acceptance, the last biodigesters to be considered will be built in the third quarter of 2020.	

11.3.2 Government support to accelerate the demand for biodigesters (outside EnDev funding)

This up-scaling intends to prepare the sector to be ready for an ODA-free future. While this usually would call for a consolidation phase ('winding up'), the government of Vietnam has a strong interest for a fast acceleration of the market. Subsequently, EnDev needs to integrate both ambitions into the same conceptual approach.

This will lead to a situation where there might be both a subsidy to a household (from government or carbon funds) and an incentive payment to the supplier (from EnDev) for the same digester installation. Usually this is not a favoured set-up. However, in this particular situation it is a good compromise:

In the current phase, all incentive money goes to the enterprises, of which the majority chooses to use the incentive money to finance a price reduction to the client. This limits their investment into production and marketing.

The Government of Vietnam (GoV) has now decided to support the growth of the biodigester sector (using the VGS funds) in their quest to achieve their NDC targets. In EnDev projections, there will be enough VGS finance to allow household subsidy for every interested farmer. Hence, there is no more need for the enterprises to use a share of their enterprise RBF incentive from EnDev for price reductions. This makes the RBF incentive much more effective for investments into the production and distribution infrastructure of the biodigester enterprise.

At the end of the proposed extension phase, the RBF incentive can be withdrawn from the sector without risking that end customer prices increase as their price reduction is stemming from another funding source that can be provided as long as there is the commitment of the GoV.

All payments (household subsidy and RBF incentive to the company) are post-paid based on verified results. The verification-app developed by EnDev/SNV in the current phase will be the basis for the monitoring throughout the requested programme extension.

The GoV will offer a result-based subsidy for all household biodigesters built (regardless of the province), likely to be of about EUR 70. The final level has yet to be determined.

To address poor and remote areas, 64 poor districts (as defined under Resolution 30a of the Government), will be offered a household results based incentive of EUR 180. BP will manage and disperse all VGS funds controlled by government including these incentives.

The RBF financed by the government is required to satisfy the need of the government of growing the demand of the market towards the desired level of 30,000 digester per year. The RBF financed by EnDev ensures that there will be enough strong enterprises supplying quality digesters countrywide to fulfil that same goal. Hence, both interventions are complementary and create synergies.

EnDev phase 7/2018-12/2020: Tasks and finance of stakeholders in the digester supply chain

	Provincial govt. bodies	Enterprises	Households
Tasks	Quality control	<ul style="list-style-type: none"> • Construction/installation • Promotion • Awareness • Client identification • Household training • Extension • After-sales service 	
Finance	Receive approx. EUR 6 per digester from carbon finance	<ul style="list-style-type: none"> • Receive payment from household • Receive payment of app. EUR 35 (digressive) /digester RBF incentive from ODA 	<ul style="list-style-type: none"> • Payment for installed digester • Receive a subsidy of EUR 43 (or EUR 200 in poor districts) from VGS funds

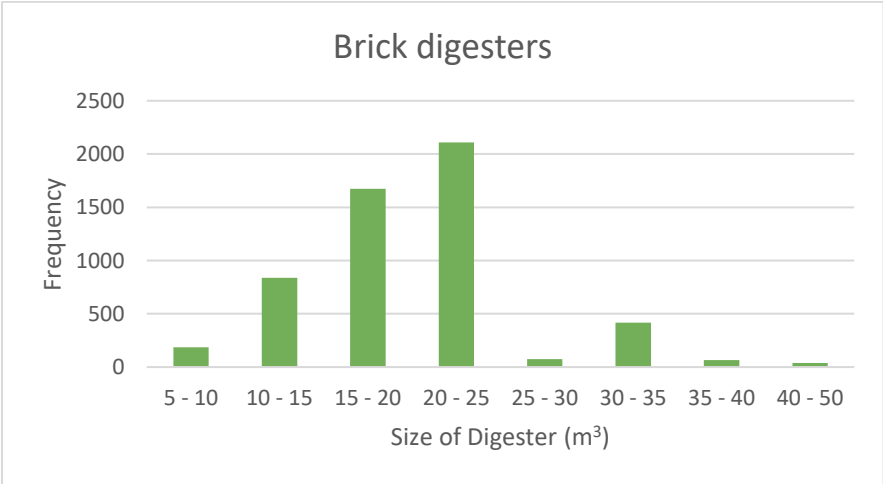
This is NOT a “going back to the old system” implemented in phase 1, since in both finance structures; the main share of tasks lies in the hands of the enterprises.

11.3.3 Support enterprise-based innovation in the sector

Vietnam has a strong culture of innovation in the business sector. One biodigester enterprise has already developed a biogas filter that is now on the market. For the long-term transformation, EnDev will encourage and strengthen this capacity particularly with the larger enterprises of the sector. The main innovation lines are:

Larger factory made digesters which correspond to the most preferred size on the market;

Composite digesters come with a pre-defined volume. Currently, there are only small digesters of 6-10m³ available. The most frequent brick digester size is around 20m³ and therefore twice or three times as big (see graph below).



In order to make factory-produced biodigesters a solution for the acceleration of the supply for the majority of the clients, larger digesters have to be developed and field-tested. If proven successful, EnDev and BP can integrate this model into the other programme activities for market development.

Secondary biogas connections from large digester to neighbouring households

A conventional domestic biodigester ranges from 6 to 10 cubic meters and serves the cooking needs of one household, including the cooking of feedstock for the animals. For larger digesters (as the most popular 20m³ model), there is a surplus of gas that so far has been underutilised, and risks to be flared or even worse, released into the atmosphere. Another option is to pipe this gas to a neighbouring household for their cooking needs. There are some first examples on the feasibility of this solution that

require further fostering. If found feasible, this would offer an additional mechanism for scaling access to biogas for more households, at a low cost.

New appliances that are increasing the attractiveness of biogas usage (e.g. cooling)

Innovative appliances can increase the usage of surplus biogas in existing digesters and increase the attractiveness of the technology (e.g. cooling or heating) for new clients.

Within this project extension, EnDev will create an innovation fund through which companies can apply for market-oriented research projects from product development up to field testing and market introduction. EnDev will link the enterprises to research institutes, where appropriate, to ensure the quality of the product. EnDev will reserve the participation in the innovation fund for the professional biodigester enterprises²⁴ (level 5 with > 200 digester per year) as they are best suited for this kind of investment. It also serves as a motivation for other companies to reach this level and compensates the larger companies for no longer being eligible for the RBF incentive.

For the case of secondary biogas connections through gas piping, a small RBF type of intervention will be tested to further enhance implementation of this approach if it was found technically feasible. Additionally connected households will be reported in EnDev monitoring if gas supply is found to be satisfactory.

11.3.4 Support coordination in the biogas sector of Vietnam

The BP, previously supported by DGIS and now by EnDev, is the largest programme to support the sector of biodigesters in Vietnam (cumulative 166,385 biodigesters until 12/2017). The ADB supported programmes QSEAP and ALCASP constructed jointly (until 01/2017) app. 67,000 biodigesters and the World Bank financed LISAP programme 26,000 biodigesters (until 01/2017). However, the WB and ADB financed biogas projects in Vietnam will close their activities by the end of 2018. The VGS funds generated through BP digesters will co-finance the costs of the BP III budget. This will ensure harmonisation and synergies with EnDev investments (see section 4.3.2).

Provincial authorities, however, manage own funds earmarked for biogas and these are usually earmarked for traditional household subsidies. These initiatives will be coordinated with the provinces to avoid overlap. In fact one high potential province offers so many subsidies that the BP will not engage in RBF there.

Today, the ADB funded Low Carbon Agriculture Support Programme LCAP is still working under MARD. EnDev/SNV will continue to support MARD to develop LCAP and any potential new biogas programme in Vietnam to promote maximum synergies towards achieving the NDC objective on biodigesters. Implementers will be invited to workshops and training sessions and lessons learnt will be shared, especially around R&D and pilots of new technologies.

11.3.5 Other activities for the development of the sector

The clients that buy biodigesters in Vietnam are households with commercial pig farms. The households use the biogas mainly for domestic cooking. However, some of the users also prepare the pig feed on the gas stove.

Many of the commercial pig farms also have fields to grow the feed for their pigs, but also other crops they can sell. They commonly apply chemical fertilizers to increase their yields. The fertilizer costs constitute an important expenditure of the farms. The biodigesters offer an important co-benefit that helps to make the commercial crop growing more profitable: the bio-slurry. The savings on chemical fertiliser ranges from EUR 18 to 37 per year, and smaller amounts are saved on pesticides. (The slurry induces stronger plant growth, which would be limiting the need for pesticides). The impact on yield through better quality and more harvests differs per crop and variety, and on how the treatment takes place. On average however, surveys report an average of EUR 200 per year, and in the case of tea farmers in Northern Vietnam, this can go up to EUR 1,000 per year. In tea areas, the farmers buy

²⁴ This includes also external companies with professional size operations who want to invest into Vietnam.

digesters with the prime purpose of substituting chemical fertilizer, and not so much for the gas. For a substantial number of farmers the bioslurry plays an important role in their agri-business.

Based on the annual biogas user surveys 2017, across 350 sampled biogas households, more than 50% of the pig farms are using the slurry on their fields. MARD is very interested that BP is further promoting this application of slurry including vermiculture and composting. So far, EnDev has not yet reported back on the productive use of the co-benefit of biogas. However, looking at its economic importance (higher than the avoided fuel costs) and the environmental impact (avoided emission and energy in the fertiliser production and distribution), we suggest that we report the pig farms using bio-slurry on their fields as productive use of a biogas-energy by-product.

Another important work to be done before closure of the programme is the development of standards for the new composite digesters and a standard for the use of recycled materials in the construction of a biodigester.

11.4 Cooperation between the Biogas Programme and EnDev

The combination of different funding sources (ODA and carbon finance) offers promising opportunities for the strengthening and scaling of the sector. The anticipated contribution of VGS funds to this programme will be EUR 3.3 million. The cooperation between EnDev and BP forms the basis for these synergies between the EnDev development objectives and the NDC-based objectives of the government.

Already in the current phase, the original plan was anticipating this kind of co-financing. However, the implementation was not as easy as initially anticipated:

With the integration of VGS funds into the national budget of the Government of Vietnam, a number of structural costs of the BP office had to be taken over by EnDev (which was not budgeted for);

Budget approval processes in MARD resulted in delays of implementation even for interventions based on EnDev budget;

Problems with the renewal or extension of the BP project phase led to a suspension of project field work in most of 2016 and parts of 2017.

The distribution of roles between SNV (as advisor) and MARD/BP (as decider/implementer) has been challenged since the ministerial decision making processes proved to have negative impacts and inefficiencies on EnDev implementation. For the new phase, the arrangement needs to be modified to ensure the following:

As long as BP is operational, all project activities are implemented jointly between BP and SNV. However, it is SNV to decide upon programme interventions financed by EnDev (and not MARD/BP);

If BP is not operational, SNV will implement directly all activities which are financed through EnDev funds (without the need for any permission);

If BP is not operational, EnDev will reconsider the financing of the structural costs of the BP office.

With these arrangements, EnDev is assured that operations can continue (except for subsidy funds) even if BP faces similar difficulties as in 2015/16/17.

In a letter dated March 19th, 2018, the director of BP has agreed to the concept of the programme extension as outlined above and the use of EnDev funds for these purposes.

11.5 Cooperation with others

See under 4.3.4.

12.Sustainability

Biogas digesters have a high durability. Evaluation (under the biogas user survey 2017) of oldest brick (10 years) and composite (3 years) digesters have shown no significant levels of malfunction and a very high level of usage. Replacement is not yet an issue for the next 5-10 years. With the introduction of larger composite sizes, this technology will also be available for the largest share of the market.

The introduction of the verification App has helped to make before, during and after-construction information available for every digester built in the programme. The masons confirmed that the use of the App actually reminds them of the various quality criteria to be considered, and thus sharpened their attention.

The current RBF phase has demonstrated that biogas masons can evolve into economically sound biogas enterprises. Despite the pig meat price crisis that resulted in the closure of about a third of all pig farms in Vietnam, these enterprises managed to find clients and sell their products. In the additional project phase, more producers will manage to evolve to mature levels.

Half of the total digester sales under EnDev were recorded in six out of the 45 provinces in the EnDev programme. Every year, an average of 500 to 1,000 digesters are sold in these provinces. This is a solid market level, which also prevailed in the 2016/17 season hit by the pig-meat-price crises. Further stimulation of the demand through VGS funded subsidies in provinces with less developed biogas markets, will motivate more provinces to higher sales levels (out of non-ODA sources).

The private sector in Vietnam has already demonstrated its power for innovation, also in the biogas sector. With the innovation fund and the collaboration with university, EnDev will strengthen the link between business and research for developing market-ready innovations in the sector. This is needed to address the challenges to make larger composite biodigesters and provide solutions or appliances of gas beyond cooking needs.

As for sector management, different options are possible from 2021 onwards. If there is strong donor support to even aim at the conditional target for biogas digesters (additional 500,000 digesters until 2030), the BP office would continue to manage the biogas sector at large. Otherwise it might well be possible to continue the stimulation of the demand through the continued investment of VGS income into RBF-subsidies to the household. For this purpose, BP could be integrated into MARD and be operated from there by civil servants.

13.Expected impacts of the project intervention and related indicators

The externally conducted biogas user surveys assess annually the impact of biodigesters through interviews, focal group discussions and observations. A summarised list of the benefits of biodigesters are:

Lower environmental pollution. If untreated, animal waste is malodorous and acts as a constraint to the expansion of small pig farms (which are often opposed by neighbours because of the smell).

Untreated animal waste directly harms the environment, notably by polluting groundwater and causing eutrophication of water bodies. Biodigesters therefore help small farmers to expand their businesses, while reducing environment pollution.

Lower cost of cooking. A digester produces sufficient gas for household cooking, thereby reducing or eliminating the need to purchase fuels or to collect firewood.

Fuel use	Baseline HH	Biogas using HH	Reduction	Reduction %
	(kg/day/hh)	(kg/day/hh)	(kg/day/hh)	
Firewood	10.87	0.54	10.33	95%
Agricultural Residues	1.69	0.19	1.5	89%
LPG	0.12	0.04	0.08	67%
Electricity	Not surveyed	Not surveyed	NA	NA

Time savings. Households (and this almost always means women) using biodigesters save 83 minutes per day on cooking, fuel collection and also on the cleaning of pots.

Bioslurry use and lower fertiliser cost. Bioslurry can be used to replace chemical fertilisers. Bioslurry reportedly also results in higher agricultural yields than chemical fertiliser does.

Improved health. Biogas user feedback and surveys indicate that biogas has resulted in noticeable reductions in respiratory health and eye problems, because cooking with biogas does not release emissions and soot (as is the case with firewood, the most common alternative to biogas).

Better hygienic conditions are also achieved in situations where open defecation was abandoned after attaching a toilet to the biodigester. The number of digesters that include a hygienic toilet has rapidly increased in recent years, and now account for over 65% under the largest biogas project in Vietnam.

Impact	Possible indicators
Climate change	Annual reduction in CO ₂ equivalents (CO ₂ e) emission (in t CO ₂ e): 150,000
Health	No of households gaining access to at least level 2 cooking systems: 30,000
Market development	<u>target indicator 1</u> : number of provinces with >500 annual biodigester sales in 2020: 10 (baseline 2017: 4) <u>target indicator 2</u> : Number of producers that sell biodigesters in > 1 province in 2020: 75 (baseline 2017: 41) <u>target indicator 3</u> : Number of producers in the 2019/2020 season at level 5: 15 (baseline 12/2017: 7) and at level 4: 30 (baseline 12/2017: 23)
Leverage	Investments by households, private and public sector (in EUR): 12,000,000
Poverty/livelihoods	No of jobs created along the value chain: 800 jobs (165 companies with on average 5 staff/ informal co-workers).

14. Budget

Estimated additional budget until 31.12.2020: **EUR 1,500,000**

	Overall additional budget	EUR
1	Human resources and travelling	30,000
2	Equipment and supplies	0
3	Funding financing agreements/local subsidies	1,350,000
4	Other direct costs	40,000
5	Total direct costs (sub-total)	1,420,000
6	Mark up costs/administrative overheads/imputed profit	80,000
7	Cost price	1,500,000

E. RBF project revision documents

- Regional RBF: Kenya, Uganda & Tanzania - Biogas Business Boost Benefitting Farmers (4BF) 69
- Regional RBF: Market Acceleration of Advanced Clean Cookstoves in the Greater Mekong Sub-region 70
- RBF: Accelerate the uptake of off-grid solar technologies with Results-Based Financing 71
- RBF: Bangladesh energy efficient cookstoves 72
- RBF: Building sustainable and affordable credit lines for small solar systems in rural areas (picoPV), Kenya 73
- RBF: Getting to universal access in thermal energy services in Peru 74
- RBF: Lifting up 3 off-grid PV market segments to the next level in Benin 75
- RBF: Market Creation for Private Sector Operated Mini-Grids in Kenya 76
- RBF: Rural Market Development of PicoPV Solar, Lake & Central Zones Tanzania 77
- RBF: Sub-Saharan Grid Densification Challenge Fund 78

Regional RBF: Kenya, Uganda & Tanzania - Biogas Business Boost Benefitting Farmers (4BF)

1. RBF project revision

In the RBF review meeting, it was recommended that the project will be:

- Extended time wise until: **06.2019**
- Downscaled budget wise to: **EUR 1,989,989** (total budget including GIZ costs: EUR 2,140,000)²⁵

The project introduced significant adjustments to the incentive structure end of 2017. To allow the new structure to yield results, it is proposed to **extend the project until June 2019**. However, since the original target was based on an entirely different market setting (including high end-consumer subsidies), the overall **target will be significantly reduced** with a respective **budget reduction**. In addition, project activities in Tanzania were put on hold in 2017 due to detection of a fraudulent incident in previous years. Following a forensic audit, it was decided not to resume the activities in Tanzania for the remaining duration of the project and **continue in Kenya and Uganda only**.

The most important change introduced is a new **Sales Incentive (SI)** that will substitute the Credit Sanction Incentive (CSI) rewarding sales rather than credit provision. While affordability of the technology is still a significant challenge, the real bottleneck for market actors to accelerate biodigester uptake is the weakness of the sales infrastructure of BCEs and Financial Institutions (FIs). Their sales capacity is low, both in terms of available time to dedicate to sales and to communicate and customise the business case to the household. As the SI will reward sales on cash and on credit by any registered cooperative, any registered BCE, farmers' group or association, community organization, SACCO, MFI or bank, pro-active FIs promoting biodigester sales on credit will continue to benefit as they qualify for the SI. The new **Quality Plant Incentive (QPI)** will involve a Service Relationship Contract between the mason/BCE and the client instead of a contract between BCEs and the project: The first year of after sales service (AfSS) after the biodigester is commissioned, is paid by the project against responsibilities from both BCEs and clients. There will be only one QPI payment disbursed to the mason/BCE after the AfSS visit, instead of two separate payments as it was done under the previous incentive structure.

2. Adjustment of KPIs

Due to the slow uptake of the incentives resulting from changes in the market setting as described above the KPIs are suggest to be adjusted as follows:

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	128,940	47,262
EUR per person gaining access	28.23	42.11
t CO _{2e} emissions avoided (over the lifetime of the products sold during project)	1,719,200	617,691
EUR per t CO _{2e} emissions avoided	2.12	3.22
Private sector leverage ratio	5.1	2.7
Jobs created	1,504	596
Thereof jobs for females	/	17
Enterprises created / improved	30	61
Technologies deployed	21,490	8,706

²⁵ Previous total budget including GIZ cost: EUR 3,870,000

Regional RBF: Market Acceleration of Advanced Clean Cookstoves in the Greater Mekong Sub-region

3. RBF project revision

In the RBF review meeting, it was recommended that the project will be:

- Shortened time wise until: **12.2018**
- Downscaled budget wise to: **EUR 2,258,000** (total budget including GIZ costs: EUR 2,436,000)²⁶

As part of the annual RBF review process, DFID requested EnDev to develop different scenarios for an early exit of the regional RBF project. Based on this, DFID opted for the exit scenario with a project period until end of 2018, i.e. closing only two months earlier than initially foreseen. In Lao, the exit in December would provide enough time to establish a linkage of the producers with the more viable markets in the North of the country. This would increase the chance for a continuation of the distribution chain at the end of the project. In Vietnam, the auction would run until end of July 2018, i.e. 2 months less than in the initial project design. However, this should only minimally affect the target achievement and leave sufficient time to strengthen market participants. In Cambodia, the phasing-out of the EnDev support is somewhat more complex than in Lao and Vietnam. Due to the importation of internationally produced stoves and the physical auctioning of stoves to retailers, a larger number of stakeholders are involved and an important challenge consist in already imported stoves yet to be auctioned and stoves auctioned but yet to be sold. The auction will be stopped at the end of September, which should allow selling a large share of the imported stock at the Stove Auction with only few stoves to be returned to producers.

4. Adjustment of KPIs

The setting-up of the project has taken much longer than initially anticipated and market uptake of the promoted technologies has not been in line with expectations. With an additional earlier closing, the targets have been reduced from 120,255 to 50,000 deployed stoves. Accordingly, the other KPI values as well as the budget have been adjusted downwards.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	600,726	128,000
EUR per person gaining access	6.37	17.62
t CO ₂ e emissions avoided (over the lifetime of the products sold during project)	541,013	32,493
EUR per t CO ₂ e emissions avoided	7.08	69.49
Private sector leverage ratio	1.26	0,3
Jobs created	300	300
Thereof jobs for females	Not quantified	30
Enterprises created / improved	100	15
Technologies deployed	120,255	50,000

²⁶ Previous total budget including GIZ cost: EUR 4,096,000

RBF: Accelerate the uptake of off-grid solar technologies with Results-Based Financing

5. RBF project revision

In the RBF review meeting, it was recommended that the project will be:

- Extended time-wise until: **06.2019**

The current end date for the project is January 2019. Due to unexpected and prolonged contracting delays with various components of the project's co-funding in 2016 and 2017, CLASP had to delay the launch of the second round of incentives substantially. The delay, combined with the scale of the uptake of the second round, necessitate the provision of additional time to ensure 1) participating companies can sell all products to end users, and 2) CLASP can complete all stages of the verification process. Therefore, a cost-neutral **extension of the end date to June 2019** is suggested.

6. Adjustment of KPIs

In consultations with leading off-grid market players regarding the percentage of SHSs sold with TVs to new customers versus TV sales as upgrades to existing customers, CLASP found that the majority of PAYGO companies require 12-36 months of repayments before extension of further credit to a customer for assets beyond lighting and mobile phone charging. Consequently, the KPIs for the number of beneficiaries has been revised where:

- New access is defined as any sale of an appliance directly together with a SHS where a household did not have access to electricity before
- Enhanced access is defined as any sale of an appliance to an end consumer that already has access to a SHS

The overall number of technologies deployed now includes an accurate number of TV and fan products procured through the second round of the project and an estimate of the number of refrigerators that are yet to procure with the recent opening of the incentive window. The job target was significantly reduced to a more realistic figure due to previous overambitious assumptions.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	1,111,200 ²⁷	1,071,546 ²⁸
EUR per person gaining access	3.70	3.59
t CO _{2e} emissions avoided (over the lifetime of the products sold during project)	61,786	148,214
EUR per t CO _{2e} emissions avoided	66.52	25.98
Private sector leverage ratio	4.1	2.6
Jobs created	1.900	137
Thereof jobs for females	-	34
Enterprises created / improved	-	45
Technologies deployed	300,000	237,370

²⁷ The original target was exclusive of an additional 268,920 people with improved access.

²⁸ 546,488 people will be considered as gaining new access, while 525,058 are expected to obtain improved access.

RBF: Bangladesh energy efficient cookstoves

1. RBF project revision

In the RBF progress meeting, it was recommended that the project will be

- Extended time-wise until: **12.2018**
- Budget: **EUR 577,500 (no change)**

As reported in the Annual Planning 2018 document, the original approach to promote picoPV systems through the IDCOL programme was discontinued. Instead, it was decided to support sales of energy efficient cookstoves to contribute to the market development of these cooking devices. The project is part of the second phase of the IDCOL cookstove programme that started in 2013. In the first phase of the programme mainly (>90%) simple portable stoves without chimney were sold. In the RBF project, the focus is on single and double mouth chimney stoves including cement stoves and metallic stoves. It was originally planned to promote sales of 33,100 stoves within a period of 6 months. However, after 4 months it became obvious that sales figures develop much slower than expected. Under these conditions, IDCOL will not be able to achieve the dissemination target within the planned time. IDCOL has the following explanation for the slow development of the sales figures: "The stove models selected under the agreement were developed just prior to signing of the contract and we did not have the experience of disseminating these models in the field. As a result, we could not project the installation well and the installation number did not pick up as we projected. Also, after start of the dissemination, we had to take care of some design issues of the stoves based on the feedbacks from the users."

The above mentioned factors require an extension of the project period to be able to meet the defined target of 33,100 disseminated stoves.

2. Adjustment of KPIs

No adjustment of targets as funding remains the same.

RBF Key Performance Indicators (KPI)	Targets
People gaining access (EnDev counting method)	142,330
EUR per person gaining access	4.06
t CO ₂ e emissions avoided (over the lifetime of the products sold during project)	88,372
EUR per t CO ₂ e emissions avoided	6.53
Private sector leverage ratio	0.70
Jobs created	27
Thereof jobs for females	14
Enterprises created / improved	30
Technologies deployed	33,100 stoves

RBF: Building sustainable and affordable credit lines for small solar systems in rural areas (picoPV), Kenya

1. RBF project revision

In the RBF review meeting, it was recommended that the project will not be adjusted time-wise or in terms of budget. The RBF project is progressing well. The uptake of the incentives is generally in line with the original expectations considering the time the beneficiary companies/organisations (BOs) have been active. The amount of incentives paid was expected to be a function of time and the number of BOs enrolled, with the incentive payment starting slowly and peaking towards the end of the second year after enrolment. The first batch of the BOs was enrolled in the first quarter of 2016 and by mid-2017, incentive claims totalling to EUR 611,695 had been disbursed in the first round. A further EUR 362,581 of incentive claims for the second round (for 2017 results), which have just been verified, will be paid within the first quarter of 2018. This brings the total committed/paid incentives to EUR 974,276, which is 34% of the up-scaled (EUR 2.86 million) incentives budget.

In November 2017, EnDev revised the incentive structure. The key changes included introduction of incentive cap per product and reserving a percentage (30%) of remaining balance of incentives for marginalised or underserved areas, to increase the challenge. The maximum amount of incentives per BO will be EUR 500,000 over the project period.

2. Adjustment of KPIs

An increase of targets and respective KPIs, as shown in the KPI table was recommended, as per the results achieved. The market is picking up and the systems are being sold, especially systems of larger size than anticipated. The KPIs have been adjusted to account for the market tendency towards larger system categories.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	400,000	700,000
No. of social institutions gaining access		
No. of productive uses gaining access		
EUR per person gaining access	9.70	5.50
t CO _{2e} emissions avoided (over the lifetime of the products sold during project)	33,387	27,594
EUR per t CO _{2e} emissions avoided	116.21	139.42
Private sector leverage ratio	2.20	4.90
Jobs created	Not quantified	2,000
Thereof jobs for females	-	600
Enterprises created / improved	600	8*
Technologies deployed	150,000	150,000

* The original entry (600 enterprises) is related to number of last mile entrepreneurs, which are now shifted to jobs created.

RBF: Getting to universal access in thermal energy services in Peru

1. RBF project revision

In the RBF review meeting, it was recommended that the project will be:

- Shortened time-wise until: **12.2018**
- Scaled down budget-wise to: **EUR 1,776,505** ²⁹

A shortening of the project until 12.2018 is recommended to align the project's duration with the interest of DFID and the overall phasing out of EnDev Peru. As the component for portable improved cookstoves (PICS) implemented by Practical Action was closed end of 2017, this change in duration primarily affects the solar water heater (SWH) component of the project. The reduction in the budget is therefore largely due to the incentives that will not be disbursed in time.

2. Adjustment of KPIs

The suggested adjustments of the KPIs result from changes in both technical components. While in the PICS component the expected 2,000 incentivised retail sales were achieved in time, a large part of the expected impact sales will go through a social programme to schools (approx. 13,000). Therefore, the number of beneficiaries in terms of persons will be significantly reduced, and in turn, the number of social institutions increased. At the same time, there is need to reduce the target sales for the SWH component. This is due to the shortening of the project duration as well as a slower uptake of incentives than originally expected.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	135,000	57,310
No. of social institutions gaining access	-	12,288
No. of productive uses gaining access	700	375
EUR per person gaining access	15.11	31.01
t CO _{2e} emissions avoided (over the lifetime of the products sold during project)	209,438	102,046
EUR per t CO _{2e} emissions avoided	9.74	17.42
Private sector leverage ratio	3.65	3.10
Jobs created	9	145
Thereof jobs for females	-	55
Enterprises created / improved	45	45
Technologies deployed	7,000 solar water heater 20,000 PICS	3,750 solar water heater 20,000 PICS

²⁹ Previous timeline was until 06.2019 and budget was EUR 2,040,000.

RBF: Lifting up 3 off-grid PV market segments to the next level in Benin

1. RBF project revision

In the RBF review meeting, it was recommended that the project will be:

- Scaled down budget wise to: **EUR 2,840,000**

For all PV technologies, the market uptake is on a positive trend. However, it has not been in line with the expectations. Reasons for this include the still weak retail networks, the lack of regional distribution hubs as well as the lack of consumer financing schemes. However, EnDev expects a steady increase of sales during the remaining project period with a few companies covering the largest market shares. EnDev plans to introduce the following changes in 2018: the incentive structure of picoPV and SHS will be further streamlined to reach a common “household solar” approach. This includes basing the incentive value on the service quality rather than on FOB prices.

2. Adjustment of KPIs

EnDev proposes to maintain the sales number for all active technologies. However, the number of beneficiaries needs to be adapted due to the following reasons: The picoPV systems sold are smaller than originally anticipated, therefore reaching less persons per system. In addition, the number of people reached by SHS is lower than initially thought. Finally, a number of systems are also installed in social institutions or businesses, therefore not contributing to the number of people gaining access.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	333,987	192,000
No. of social institutions gaining access	Not quantified	140
No. of productive uses gaining access	Not quantified	100
EUR per person gaining access	9.16	14.79
t CO ₂ e emissions avoided (over the lifetime of the products sold during project)	25,971*	47,312*
EUR per t CO ₂ e emissions avoided	117.82*	60.03*
Private sector leverage ratio	1.8	1.8
Jobs created	Not quantified	30
Thereof jobs for females	Not quantified	6
Enterprises created / improved	15	15
Technologies deployed	68,000 solar home systems 747 streetlights 125 solar pumps	68,000 solar home systems 740 streetlights 125 solar pumps

* Please note that these figures only reflect the picoPV and SHS systems. Neither pumps nor solar streetlights are included in the calculation. The EnDev calculation method is currently being revised to include these technologies in the future.

RBF: Market Creation for Private Sector Operated Mini-Grids in Kenya

3. RBF project revision

In the RBF review meeting, it was recommended that the project will remain the same in terms of duration and budget. The uptake of incentives has been slower than expected. Based on the first Call for Proposal (CfP), two mini-grid projects are under construction and will be commissioned by end of May 2018 and the first tranche of incentives paid in June 2018. In the second CfP, five sites have been awarded to two developers in clusters of two and three projects respectively. The third CfP for seven sites will be done at the start of Q2 of 2018 (no later than 06.04.2018) and incentive contracts concluded in the same quarter.

The combination of several parallel developments in the mini-grid sector – the launch of KOSAP by MOEP and WB in 2017, targeting at implementation of 120 mini-grids of larger capacities in 14 underserved counties, the slow progress in mini-grid regulations by Energy Regulatory Commission (ERC), and the national electrification strategy of the MoE, which envisages mini-grids as a solution in electrifying off-grid centres – have challenged the RBF mini-grid project and slowed progress significantly.

The assumptions of the EnDev RBF mini-grids proposal therefore have changed. Nevertheless, the uniqueness of RBF is that it targets lower scale mini-grids, demonstrating the viability of long-term private sector investment in remote areas, where the grid nor commercially more attractive mini-grids are possible.

4. Adjustment of KPIs

To account for the changing conditions, a) enterprises created, b) technologies deployed and c) number of people gaining access have to be reduced. Due to the small size of target villages, bundling of sites has been adopted to increase attractiveness and viability to the private sector. This will therefore mean implementation of less than seven bundles for 14 mini-grid projects, therefore less firms supported.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	22,500	13,445
EUR per person gaining access	92.22	154.40
t CO _{2e} emissions avoided (over the lifetime of the products sold during project)	5,106	3,524
EUR per t CO _{2e} emissions avoided	406.38	589.01
Private sector leverage ratio	1.00	0.60
Jobs created	-	60
There of jobs for females	-	12
Enterprises created / improved	10	5
Technologies deployed	20	14

RBF: Rural Market Development of PicoPV Solar, Lake & Central Zones Tanzania

1. RBF project revision

In the RBF review meeting, it was recommended that the project will be:

- Extended time-wise until: **12.2018**

An extension of the programme of four months until 12.2018 is recommended to enable full depletion of the RBF Fund. It is expected that approximately EUR 300,000 incentives will remain (from the total of EUR 2.2 million incentives fund available) by June 2018. This extension would allow companies - especially Round 3 firms, which only entered the project in 2017 - to consolidate their businesses in the Lake and Central Zone. Practically, the incentive window would remain open for companies until end of October 2018.

2. Adjustment of KPIs

Despite the budget remaining unchanged, the KPIs in terms of people reached and cost efficiency per person can be increased. This is because two firms has reached the incentive limit per company set at EUR 550,000 in 2017, but continued to reported additional sales in excess of their incentivised sales limits, which now contribute to the project's target achievement. Furthermore, sales of firms active in tailored market segments such as productive use lighting applications with clear kerosene replacement effects (night fishing lights, etc.) have been included. They will receive 50% of the regular incentive value and are reported additionally as productive uses gaining access.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	360,000	390,000
No. of social institutions gaining access	-	-
No. of productive uses gaining access	-	200
EUR per person gaining access	9.44	8.71
t CO ₂ e emissions avoided (over the lifetime of the products sold during project)	29,000	17,597
EUR per t CO ₂ e emissions avoided	117.24	193.22
Private sector leverage ratio	2.2	7.0
Jobs created	800	800
Thereof jobs for females	-	175
Enterprises created / improved	400	14
Technologies deployed	105,000	75,000

RBF: Sub-Saharan Grid Densification Challenge Fund

1. RBF project revision

In the RBF review meeting, it was recommended that the project will be:

- Extended time-wise until: **06.2019**

Extension of the project until June 2019 is suggested. This has previously been discussed with DFID and communicated to the participating utilities during the second call, which was launched in August 2017. As all round two projects were given a project duration of 18 months with an intended start date in January 2018, the official timeline should be extended accordingly.

2. Adjustment of KPIs

Despite the budget remaining unchanged, the KPIs in terms of people reached and cost efficiency per person can be significantly increased by almost 45%. This is due to competitive incentives per connection achieved during the reverse auction process especially in the second call. While the original KPIs were estimated based on an incentive of EUR 100 per connection. The winning incentive during the first round was EUR 90 and in the second round went down to EUR 67.5 and EUR 58 respectively, allowing the project to reach significantly more people than planned.

Figures for enterprise creation are also to be adjusted. Previous assumptions for enterprise creation rested on households opening up a business or shop after electrification. However, these enterprises are not directly evolving from the interaction with the project, but rather as an impact from the electrification. Therefore, these figures will be reported under productive use in the future.

RBF Key Performance Indicators (KPI)	Old targets	New targets
No. of people gaining access	200,000	290,000
No. of social institutions gaining access	0	0
No. of productive uses gaining access	0	5,000
EUR per person gaining access	23.00	15.24
t CO _{2e} emissions avoided (over the lifetime of the products sold during project)	160,000	73,791
EUR per t CO _{2e} emissions avoided	28.00	59.91
Private sector leverage ratio	8.0	1.0
Jobs created	6,000	6,000
Thereof jobs for females	-	1,800
Enterprises created / improved	4,000	0
Technologies deployed	40,000 connections	56,300 connections

Abbreviations

ADEL	Agenda de Desenvolvimento Econômico Local
ADES	Association pour le Développement de l'Energie Solaire, Switzerland
ALCASP	ADB supported programme in Vietnam, Biogas
ASS	After Sales Service
AVSI	Associazione Volontari per il Servizio Internazionale, NGO
BAU	Business as usual
BBF	Bangladesh Bondhu Foundation
BECT	Biomass and Energy Certification and Test Center, Mozambique
BMZ	the German Federal Ministry for Economic Cooperation and Development
BOs	Beneficiary companies/organisations
BP	Biogas programme in Vietnam
BTC	Belgian Technical Cooperation
CAP	Country Action Plan for Clean Cookstoves
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CfP	Call for Proposals
CLASP	Collaborative Labeling and Appliance Standard Program
CLASP	Collaborative Labelling and Appliance Standard Programme
CRRF	Comprehensive Refugee Response Framework
DAK	Specific Allocation Fund, Indonesia
DELAPAZ	Electricity Distribution Company of the Department of La Paz, Bolivia
DEZA / SDC	the Swiss Agency for Development and Cooperation
DFID	the UK Department for International Development
EC	European Commission
EDM	Electricidade de Moçambique/ Energy Public Utility, Mozambique
ELREN	Electrification through Renewable Energy
ENDE	National Enterprise for Energy, Bolivia
EnDev	Energising Development programme
ERC	Energy Regulatory Authority, Kenya
ERC	Energy Reserach Centre of the Eduardo Mondlande University, Mozambique
ESMAP	Energy Sector Management Assistance Program
FASERTE	Fund for Sustainable Access to Renewable Energies and Efficient Technologies
FDC	Foundation for Community
FONCODES	National Cooperation Fund for Development, Peru
FUNAE	Fundo de Energia, Mozambique
GACC	Global Alliance for Clean Cookstoves
GCF	Green Climate Fund

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GOM	Government of Mozambique
GoV	Government of Vietnam
HDI	Global Human Development Index
HEP	National household energy platform, Bangladesh
HH	Households
HIVOS	Humanistisch Instituut voor Ontwikkelingssamenwerking
ICS	Improved cookstove
IDCOL	Infrastructure Development Company Limited
IICA	Inter-American Institute for Cooperation on Agriculture
KPI	Key performance indicator
KPT	Kitchen performance test
LA	Lighting Africa
LAC	Latin America and Caribbean
LDC	Least developed countries
LISAP	World Bank financed programme in Vietnam, Biogas
LLL	Lighting Lives in Liberia, World Bank
LPG	Liquefied Petroleum Gas
MARD	Ministry of the Agriculture and Rural Development, Vietnam
MEMR	Ministry of Energy and Mineral Resources, Indonesia
MFA / DGIS	the Netherlands Ministry of Foreign Affairs Directorate-General for International Cooperation
MFA-NOR	the Norwegian Ministry of Foreign Affairs
MFI	Micro finance institution
MHP	Micro hydropower
MoEF	Ministry of Environments and Forests, Bangladesh
MoF	Ministry of Finance, Vietnam
MoU	Memorandum of Understanding
MTE	mid-term evaluation
MTF	Multi-Tier Framework
MZM	Mozambican Metical
NDCs	Nationally Determined Contributions
NIS	Nordic International Support Foundation
NTB	a province in Indonesia: Nusa Tenggara Barat
NTT	a province in Indonesia: Nusa Tenggara Timur
O&M	Operation and maintainance
ODA	Official Development Assistance
PAYC	Pay-As-You-Cook
PAYGO	Pay-As-You-Go

PDES	Plan for Economic and Social Development, Bolivia
PDP	Project Development Programme, BMWi/GIZ, Mozambique
PEVD	Electricity to live with dignity programme in Bolivia
PHC	Primary Health Centres
picoPV	Pico photo voltaic
PICS	Portable improved coostoves
PO	Partner organisations
PPP	Public private partnership
ProEcon	Economic Development Programme, GIZ/BMZ, Mozambique
ProEducaçao	Education Programme, Mozambique
PU	productive use of energy
PUE	productive use of energy
QSEAP	ADB supported programme in Vietnam, Biogas
RBF	Results-based finance
REASL	Renewable Energy Association of Sierra Leone
REEEP	Renewable Energy and Energy Efficiency Programme
RISE	Regulatory Indicators for Sustainable Energy
RREA	Rural Renewable Energy Agency, Liberia
RVO	Rijksdienst voor Ondernemend Nederland
SAFE	Safe Access to Fuels and Energy
SAPP	Southern African Power Pool
SDG	Sustainable development goals
SEforALL	Sustainable Energy for All initiative
SHS	Solar home system
SI	Social institutions
SIDA	the Swedish International Development Cooperation Agency
SIF	Special Initiative for Refugees (GIZ)
SME	small and medium enterprise
SNV	Stichting Nederlandse Vrijwilligers / Netherlands Development Organisation
SREDA	Sustainable and Renewable Energy Development Authority
SSHS	Small solar home systems
SWH	Solar water heaters
UEM	Eduardo Mondlane University, Mozambique
UNEP	United Nations Environment Program
UNHCR	United Nations High Commissioner for Human Rights
VGS	voluntary gold standard emission reduction certificates
VMEEA	Vice Ministry for Electricity and Renewable Energy, Bolivia
VMT	Village management team, Indonesia

WHH

Welthungerhilfe

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