

EUROPEAN DEVELOPMENT FUND

Mid-term evaluation of the “Up-scaling Energising Development (EnDev) Ethiopia – Access to energy through off-grid renewable energy solutions”. FED/2017/382-191

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Specific Contract 300011258 — SIEA-2018-1364

FINAL EVALUATION REPORT

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TiEG & FCG Germany

Mid-term evaluation of the “Up-scaling Energising Development (EnDev) Ethiopia – Access to energy through off-grid renewable energy solutions” FED/2017/382-191

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ABBREVIATIONS

CDM	Clean Development Mechanism - Market mechanism set up under the UNFCCC Kyoto Protocol (cdm.unfccc.int)
CER	Certified Emission Reduction - Carbon credits from emission reductions achieved by CDM projects
CPA	Component Project Activities
CRGE	Climate Resilient Green Economy– a macro-economic development strategy designed by the Government of Ethiopia
DBE	Development Bank of Ethiopia
EC	European Commission (the operating arm of the EU)
ECCA	Ethiopian Clean Cooking Alliance - http://pmgsy.nic.in/nrrda.asp
EEA	Ethiopian Energy Authority – the energy regulator
EFCCC	Environment, Forest and Climate Change Commission – a nodal agency of the Government of Ethiopia: efccc.gov.et
EnDev	Energising Development - a partnership providing access to modern energy that works in more than 20 countries: endev.info
ESA	Ethiopia Standards Agency - https://www.ethiostandards.org
ESEDA	Ethiopian Solar Energy Development Association - an independent non-profit association facilitating the growth and development of solar energy businesses in Ethiopia
EREDPC	Ethiopian Rural Energy Development and Promotion Center - established to carry out national energy resources studies, data collection and analysis, rural energy policy formulation, technology research and development and to promote appropriate energy technologies in rural areas
EU	European Union
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH - https://www.giz.de/en
GoE	Government of Ethiopia
GTP	Growth and Transformation Plan - developed by the Government of Ethiopia
ICS	Improved Cookstoves
IMS	Institutional <i>Mirt</i> Stove
IRR	Internal Rate of Return - a measure used to gauge the attractiveness of an investment; the discount rate at which the present value of cash-flows is equal to the initial investment made
IRS	Institutional Rocket Stove
MFI	Micro Finance Institutions
MoWIE	Ministry of Water, Irrigation and Energy - mowie.gov.et
M & E	Monitoring & Evaluation
NEP 2.0	National Electrification Plan 2.0
NICSP	National Improved Cook Stove Program
PRED	Public Renewable Energy Demonstrations
PV	Photovoltaics – also called solar PV
RET	Rural Energy Technologies
RBF	Result based financing
SDG	[The United Nations] Sustainable Development Goals
SEC	Socio-economic Classification - developed to help with Market Research and incorporates education of the lead wage-earner and the household's ownership of consumer durables in addition to traditional variables such as land, and electricity connections, etc.]
SNNPR	Southern Nations, Nationalities and Peoples' Region - a province in the south-west of Ethiopia
WTP	Willingness-to-pay - for an asset where actual purchase price data may be unavailable

FISCAL YEAR

08 July – 07 July

CONVERSION RATES

01 May 2021

Currency: 1USD = ETB 41.8528

Currency: 1Euro = ETB 50.5264

<https://www1.oanda.com/currency/converter/>

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1. INTRODUCTION AND CONTEXT

The assignment objective was to conduct the Mid Term Evaluation (MTE) of the “Up-scaling Energising Development (EnDev) Ethiopia – Access to energy through off-grid renewable energy solutions” (the Project). The financing agreement was signed by the EU and the Federal Republic of Ethiopia (Ethiopia) in February 2016 (CRIS number: ET/FED/38370 financed under the 11th European Development Fund (EDF)) with an EU budget of €9 million. Implementation began in 2017 and is ongoing. The ToR (Annex 6) sets out the scope for this evaluation. This mid-term evaluation provides an independent assessment of the use of resources along with the results (outputs, outcomes, and impacts) delivered by the constituent project components¹.

This assignment was implemented by TiEG (Transport & Infrastructures Expertise Group) under FWC SIEA 2018 – Lot 2 using a team of two key experts (KEs) (see Annex 5). Evaluation work began on March 9th, 2021. The field phase took place in May 2021 when in-person interviews were held with project beneficiaries, the EUD and EnDev Ethiopia. COVID-related movement restrictions had confined Implementing Agency personnel to work-from-home arrangements overlapping with the duration of the evaluation, and as a consequence, interactions with the respective province in-charge personnel and others concerned were only able to be undertaken online, by telephone and by email communication, with one in person meeting only on the last day of the field phase work.

Remote / online interviews were also undertaken with key stakeholders concerned to the extent that such stakeholders responded to KE requests for interviews. The evaluation was hindered by the global Covid-19 pandemic and ongoing security and election related challenges in Ethiopia, which meant that field visits remote from driving distance from Addis Ababa were not advised, and there were delays in obtaining feedback also caused by Covid restrictions. Given the uncertainties highlighted by the Implementing Agency, given the limitations imposed upon the movement of Implementing Agency personnel, and given the need for the evaluation team to make their own necessary arrangements for translation / interpretation and logistics, and in the best interest of enhancing time and cost efficiencies while keeping safe in the limited time ex-quarantine (on arrival) that was then still available to the evaluation team, the field survey was organized one-round-trip-out-of-Addis Ababa at a time covering a maximum one-way road-length distance of about 200km out of Addis Ababa. The field survey covered as many as possible of the locations recommended by the Implementing Agency with suitable modifications in the routes and schedules to gather as much data from each round-trip as possible, while also alternating between longer drives and shorter ones.

As recommended by the Implementing Agency, the field survey team visited and inspected the installation quality of Implementing Agency supplied social institution’s solar system hardware and discussed service arrangements with site personnel at the Health Center in Jarso (1200Wp) and the Health Post in Dumburii (600Wp). In response to specific requests for information, the Implementing Agency had advised the field survey team *against* visits to social institutions equipped with solar PV systems that were funded by other donors including by the Korea Foundation for International Health Care (KOFIH) in the Jimma Zone, and *against* interacting with solar PV installers in Sebeta town [enroute to other sites visited]

¹The evaluation of the MHP project is not included in the present Mid Term Evaluation report as it has not yet made substantial implementation progress.

reported to have worked under a Norwegian Agency for Development Cooperation (NORAD) funded solar PV project².

This Introduction and Context section is followed by the Findings by each evaluation criterion and question with ratings for each component (Section 2), an Overall Assessment (Section 3), and Conclusions and Recommendations (see Section 4). Besides the annexes already mentioned, there are several more, mentioned at the relevant points in this report.

1.1. Background to the Project

Development assistance under the Energising Development Partnership Programme (EnDev) in the Federal Democratic Republic of Ethiopia (Ethiopia) has been underway since 2005/2006. The project implemented agency was the EnDev/GIZ Ethiopia programme, which at the inception of the project, had a total budget of more than €18 million and around 70 employees. The overall objective of EnDev/GIZ Ethiopia activities is to increase access to modern energy supply through off-grid renewable energy technologies and energy efficient solutions.

1.1.1. Improved Cook Stove component

Since its inception in 2006, EnDev/GIZ Ethiopia has reportedly trained over 490 small-scale producers of ICS spread across 310 districts and seven regions of the country³. These stove producers have reportedly sold more than 1 million ICS including *Mirt* (= Amharic for “best”) for baking *injera* (a staple main course food item in many parts of the country), *Tikikil* for cooking and “institutional rocket stoves” (IRS) for cooking at institutions. More than 700,000 people were reported to be benefitting from these technologies amounting to a combined claimed household fuel savings of more than 570,000 tons of biomass⁴. EnDev/GIZ Ethiopia’s Phase I of 2006-2009 was reported to have disseminated 261,626 ICS, while Phase II of 2010 to June 2014 was reported to have disseminated 545,881 ICS, with an estimated 486,207 of the 807,507 ICS reported to still be in use⁵ as of September 2014.

The National Improved Cook-Stove Programme (NICSP) had reported that more than 15 million ICS were disseminated between 2005 and 2016. Of these stoves that were reported to have been brought to market, 27% were apparently closed- mud-stoves such as the *Awramba*, while 21% were *Mirt* Stoves, 14% *Lakech*, 6% *Tikikil*, 5% *Upesi* and 1% other stoves⁶.

² [REDACTED]

³ As per the TOR for the Mid-Term Evaluation, p 4 of 27.

⁴ This figure is apparently based on assumptions relating to substitution of stoves and to cooking patterns

⁵ ICS in Ethiopia (EnDev) Results 2006-2014, EnDev Ethiopia, September 2014

⁶ EnDev / GIZ (2020) *Final Consolidated Report to Irish Aid*, EnDev Project Document, p. 9 of 40.

1.1.2. Solar PV component

From 2009 to 2014, EnDev/GIZ electrified 160 social institutions with large discrete component PV systems ranging between 2.0 to 4.0kWp⁷ and was reported to benefit over three million people with improved health, education and other community services⁸. Numerous capacity building measures for installation companies, service technicians and end users have been conducted to ensure the sustainable operation of the SI solar systems. In addition to the installation of larger PV technologies with a direct benefit for the rural population, the project promoted and supported smaller PV systems.

Beginning in 2010, EnDev/GIZ started promoting solar lantern and solar home system (SHS) PV systems. Until the end of 2015, more than 180,000 solar lanterns and 7,000 SHS were reported to have been disseminated by EnDev/GIZ trained retailers during prior EnDev phases. In addition, over 100 retailers were reported to have been trained in installation, servicing, and maintenance of these systems. In all, prior to the present project, more than 350,000 persons were reported to have benefitted from access to lighting and to basic electrical appliances powered by small PV systems.

At the start of the EU funded project, it was reported that 85% of rural households still relied on fuel based light sources, and that solar PV alternatives were often *unaffordable, inaccessible, and of poor or unknown quality*. For larger discrete component non “plug and play” solar PV systems, there was reported to be a lack of suitable local trained technicians, and a lack of suitable budgets/or funding mechanisms for service and maintenance, especially for the replacement of battery banks at the end of their life.

1.2. The Project

In February 2016 the EC and the Federal Republic of Ethiopia (Ethiopia) signed a financing agreement (FA) that would support the third phase of EnDev activities in Ethiopia (“the project”) with €9.0 million financing under the 11th European Development Fund (EDF), in parallel with co-financing from *Irish Aid* with a €600,000 budget, and the erstwhile UK-DfID (now FCDO) with a €900,000 budget. The project activities were to mainly take place in the four provinces (used interchangeably with “regions” in this report) of Amhara, Oromia, Tigray and the Southern Nations, Nationalities and Peoples Region (SNNPR including Sidama) which then accounted for 86% of Ethiopia’s population. The Minister of Finance and Economic Development signed the FA for Ethiopia.

While the specific activities to be undertaken were not spelt out in detail in the FA, the principal objectives of the project in the FA had three components: (1) to support the promotion and market development of improved cook stoves (ICS), (2) to support pico (0.3 Wp to 12 Wp) solar photovoltaic (PV) systems and “high quality” solar home systems (SHS); and (3) to support off-grid electrification through micro hydropower (MHP) and mini grids⁹. The MHP component of the project was subsequently amended to instead provide for solar photovoltaic

⁷ EnDev Ethiopia 20210521 SI Overview for 267 Other Funded Sites 2009-2019 & 113 EU Funded Sites 2018-2020

⁸ EnDev Ethiopia 20160219 Annex I Description of the Action

⁹ The MHP and mini grid component’s implementation has been significantly delayed, and as such this component is not included in this MTE.

system (PV-) powered mini-grid networks, which component has not yet been substantially implemented and is planned for implementation over the years 2022 – 2023.

Through these initiatives, the project sought to provide people residing in rural areas of Ethiopia with cleaner renewable energy (RE) for: lighting, phone charging, radios etc: and through improved stoves and fuels to promote more efficient cooking. In addition to individual households, Social Institutions (SI) were to be equipped with larger solar PV systems to help them provide improved services to their communities. In the context of ICS (also referred to as “efficient cook stoves”, or “fuel-efficient cook stoves”) in addition to helping improve stove-designs, the project sought to distribute stove and chimney moulds, and to help build briquetting plants to streamline the supply of cleaner fuels. Additionally, the project sought to identify financing options through the clean development mechanism (CDM) and through partnering with micro-finance institutions (MFI) to facilitate the acquisition of solar PV and ICS hardware.

The project budget was elaborated in the FA related documents¹⁰ by component/initiative and by outputs/deliverables. The *indicative* budgets within the €9 million EU Funding total were: (1) €1,437,155 for ICS – Bioenergy; (2) €1,229,600 for Solar; and (3) €2,093,000 for Micro Hydropower; plus, Human Resources, Technical/Admin Services, Travel, Procurement of Equipment and Materials, Admin Costs, Visibility, Contingency and Overhead costs. Some of these amounts were later re-allocated to reflect the modifications in the design of the third project component from small-hydro powered mini-grids to solar PV powered mini-grids.

A Logical Framework for the project was elaborated in the FA related documents¹¹ and constitutes the intervention logic for the project.

1.2.1. ICS component

It is estimated that since *circa* year 2017, an average of around 100,000 ICS units have been sold per year¹². However, it was reported that awareness among end-use consumers of the health and economic benefits flowing from the use of the fuel-efficient ICS was still low, and that this might have continued to serve as a deterrent to the acquisition and sustained use of ICS in the [desired] large numbers¹³. On the supply side, the marginal presence of the private sector and low levels of investible surpluses, combined with the absence of organized retail networks had reportedly impeded growth in ICS sales volumes.

1.2.2. Solar PV component

The solar PV component’s intervention logic in the EU funded project FA of February 2016 stated that the pico PV market in Ethiopia had been growing significantly in the years to 2016. The FA identified inaccessible and “low quality” or “counterfeit” solar PV products as key barriers, followed by a lack of access to credit to buy such solar PV systems. The main project mechanisms to deal with these issues were stated in the FA to be: (1) creating financing options (€221,600 budget); (2) quality and warranty (€84,500 budget); (3) capacity building (€266,000 budget); (4) electrifying vital rural social institutions (€612,000 budget); and (5)

¹⁰ EnDev Ethiopia 20160219 Annex III Budget

¹¹ EnDev Ethiopia 20160219 Annex I Description of the Action

¹² Terms of Reference for the present assignment, p. 4 of 27.

¹³ GIZ / EnDev, Final Consolidated Report to Irish Aid, August 2020, p. 9 of 40.

initiating solar battery recycling (€45,500 budget). The relative budget amounts can be taken as the expected relative importance of the different activities in the intervention logic at the FA stage¹⁴. It is notable that activities¹⁵ 3, 4 and 5 as above were implicitly focussed on larger separate discrete component solar PV systems. Such systems are only relevant to larger/higher income) rural households and social institutions such as schools, health centres or health posts, and productive uses such as remote rural water pumping.

The project design did not provide any explicit mention of support to the largest solar PV market, the pico solar lantern and packaged or plug-and-play SHSs. These systems did not require systems testing (if such systems are Lighting Africa/Global certified), installation, technician and retailer¹⁶ training, or Solar Association support. In addition, the Lighting Africa/Global list of “quality” solar PV products already included pico solar lanterns (including many models of solar lanterns with built in mobile phone charging ports), and packaged SHS were already well established at the project design phase, yet this was not referenced as a definition of “quality”. And there was no link to undertaking any suitable market study of what “low quality” or “counterfeit” or “legal markets” was or was understood to mean in the intervention logic, although the project apparently later adopted Lighting Africa/Global certification of solar PV products to be a suitable indicator of quality.

The issue of how social institutions (SI) were actually going to fund maintenance¹⁷ and especially how the significant recurring high battery replacement cost was actually going to be addressed (beyond MOUs that stated that the recipient organisations were responsible for O&M) was not mentioned in the intervention logic. So, in the intervention logic there was no direct link from the relevant project activities to the desired outcome which would have been the actual likelihood for ongoing sustainable operation of the supported discrete component solar PV SI systems. And without sustainable operations, the activities and their outputs would not lead to significant impacts¹⁸. For the pico solar PV packaged systems, it was reported that quality¹⁹ and price/financing²⁰ were major constraints. A loan guarantee fund mechanism,

¹⁴ The budgets were apparently subsequently changed but given that actual expenditures are not available by component or by activity, all one can say is that these were the original indicative amount by activities, which may or may not represent relative or actual final expenditure rates by component or by activity.

¹⁵ Activity 3 included the training of retailers and technicians as well.

¹⁶ All these systems have been promoted by the project. The retailer's sell these products and the project has supported them with broad awareness and marketing.

¹⁷ The project implemented agency are now apparently focusing on quality and the wider dissemination for larger solar PV systems through plug and play solar PV systems to social institutions.

¹⁸ The project implemented agency advise that there have been discussions with the Ministries of Health, Education and Energy to maintain the solar PV systems in Health Centers, Schools, etc through a sustainability strategy. The project implemented agency has stated that it has sourced additional resources to focus on solar PV sustainability issues in their upcoming Stage IV programme (2021-2024).

¹⁹ The project implemented agency advise that there have been close discussions with the Ethiopian Energy Authority (EEA), ESA (Ethiopian Standards Association) and supporting the solar industry association (ESEDA) as well as with regional associations in order for the solar industry to be able to regulate itself through a disciplined membership, this includes quality brand membership and exclusive support on both technical issues and marketing, with the FSD to focus on quality promotion. It is also stated that there has been work undertaken on a warranty system by the project implemented agency

²⁰ The project implemented agency advised that there have been discussions with microfinance institutions and the government to supply consumer loan for renewable energy users, but without

support for the formation and consolidation of the industry associations as well the introduction of a data management system at the regional energy bureaus aimed at improving quality of services and transparency of prices were to address these issues.

Another issue that was identified was the high-end user value in having a mobile phone charging facility in pico solar PV systems. There were low cost but still good quality Lighting Africa/Global certified solar lanterns available in 2016 that provided mobile phone charging through a USB port, but this was not explicitly mentioned in project literature. Similarly, there were Lighting Africa/Global certified packaged and/or plug-and-play SHS in 2016 that could support multiple low power LED lamps, multiple USB ports, and built-in radios along with replaceable Lithium-Ion batteries. So, the link was unclear from project activities and their outputs to outcomes such as Lighting Africa/Global certified solar lanterns and packaged and/or plug and play SHS being increasingly available - and then being further linked to impacts such as sustainably increased pico solar PV and SHS sales and sustainable ongoing operations through more than one battery replacement cycle for solar PV systems.

1.3. Evaluation Methodology

This evaluation is based on the six standard evaluation criteria introduced by the Development Assistance Committee (DAC) of the Organisation for Economic Cooperation and Development (OECD). This is supplemented by a further specific EU evaluation criterion. The seven evaluation criteria and their related agreed evaluation questions were:

1. Relevance - is the intervention doing the right things?

- 1.1 Alignment with Ethiopia's Priorities
- 1.2 Linkage with SDGs et al

2. Coherence - how well does the intervention fit?

- 2.1 GoE; EU; and other Donors Alignment and Complementarity
- 2.2 Private Sector Implementation Focus

3. Efficiency - how well are resources being used?

- 3.1 Turning Inputs into Outputs

4. Effectiveness – is the intervention achieving its objectives?

- 4.1 Achievement of Planned Results
- 4.2 Adaptive Management for Results

5. Impact - what difference does the intervention make?

- 5.1 Tangible Outputs/Results

6. Sustainability- will the benefits last?

concrete results yet. It is stated that the project implemented agency will have a Financial Systems Development component in its upcoming stage IV.

6.1 Likely Post-Programme Results

6.2 Project Exit/Continuation Strategies

7.EU Added Value

7.1 EU versus EU Member State

Within the seven (7) evaluation criteria, eleven (11) evaluation questions (EGs) were formulated (as above). Please refer to Annex 2 for a more detailed elaboration of the EQs and their judgement indicators.

Each project was evaluated for each EQ on a 6-point scale as per Table 1 below. For maximum transparency and given the apparently minimal overlap between the two streams of the intervention, the ICS and solar PV components were separately rated for each of the 11 evaluation questions, along with a *summary* rationale and appropriate data sources referred to by the independent evaluation team in the derivation of each rating. The full rationale for each rating can be found in the wider discussion of the ICS and solar PV components in this evaluation report, as to provide a full rationale and justification for each individual rating would lead to an extremely long report with significant repetition and major challenges in reading the report.

Table 1: Evaluation Rating Scale Used

Score		Definition*	Category
6	Highly satisfactory	Level of achievement presents no shortcomings (90% - 100% achievement rate of planned expectations and targets).	SATISFACTORY
5	Satisfactory	Level of achievement presents minor shortcomings (70% - 89% achievement rate of planned expectations and targets).	
4	Moderately satisfactory	Level of achievement presents moderate shortcomings (50% - 69% achievement rate of planned expectations and targets).	
3	Moderately unsatisfactory	Level of achievement presents some significant shortcomings (30% - 49% achievement rate of planned expectations and targets).	UNSATISFACTORY
2	Unsatisfactory	Level of achievement presents major shortcomings (10% - 29% achievement rate of planned expectations and targets).	
1	Highly unsatisfactory	Level of achievement presents severe shortcomings (0% - 9% achievement rate of planned expectations and targets).	

Note: * For impact, the assessment will be based on the level of *likely* achievement, as it is often too early to assess the long-term impacts of the project at the project completion point.

The evaluation team obtained more than 300 individual documents from the project implementing agency and from open sources (see Annex 5). The evaluators checked and documented evaluation report findings and conclusions from verifiable and/or independent sources where these could be found, to avoid relying solely upon the assertions of the project

implementing agency (see Section 3.6 and Annex 2 for a more detailed elaboration of the evaluation methodology used). The evaluators sought necessary clarifications from the implementing agency. The sources of information cited in this report are listed among the footnotes.

1.4. Data Gaps and Evaluation Challenges

The focus for the overall project and its ICS and solar PV components was on a mix of: ICS and Pico Solar PV capacity building, training and facilitation; and SI solar PV implementation.

For ICS and Pico Solar, the data gap limitation is that no usable baseline data has yet been sighted. The number of Pico solar systems sold in Ethiopia data has been provided, but there was no meaningful link in the data provided to project activities, and the logical connection between the activities undertaken and the desired outcomes and impacts is weak. For instance, *Access to Modern Energy Services in Ethiopia (AMES-E), A Baseline Study* prepared by Entec Consulting & Engineering back in 2008 was available to the MTE team but was obviously not an appropriate benchmark for an intervention spanning years 2017 – 2020 / 21.

No meaningful data has yet been sighted that would underpin the selection of the Mirt stove as the primary ICS supported, and also for its claimed firewood savings.

In addition, unfortunately all the Mirt stove producers visited by the evaluation team had stopped production due to the lack of access to affordable cement supplies, and it is difficult to predict timelines for the resumption of Mirt stove production.

For the Pico Solar support activities, no evidence has yet been sighted of an awareness that the project supported “official” systems only comprise a small fraction of around 10% of the Pico solar supply in Ethiopia. In addition, the support of “official” suppliers constitutes supporting essentially local monopolies of supplier with higher prices and backed by similar warranties (and sometimes even shorter warranties) to the much larger “unofficial/informal” sector’s supply of Pico solar systems.

For the scheduled 100 SI solar PV projects the post implementation sustainability is essentially unknown as there have apparently²¹ been no post-handover site visits or follow up calls by the implementing agency²². In addition, evidence was requested but was not provided by the Implementing Agency on any hard data basis for the SI systems sizing, on the factual basis of the critical 60% Depth of Discharge (DoD) assumption behind battery sizing and battery lifetime estimates, or on any implementing agency data on actual battery lifetimes or replacement rates.

²¹Personal communication from EnDev

²² Ideally the evaluation would have done this physical SI systems status checking, but the limited time in the field available made this impractical. In any case, the Implementing Agency should have done this already as part of good M&E practice for both the EU funded SI systems and for the 267 SI systems provided via other donor’s funding – no such data was available from the Implementing Agency.

1.5. Field Visit/Interview Approach and Limitations

The field mission in Ethiopia was conducted under a confluence of challenging circumstances.

- a. Since late 2020, Ethiopia has experienced significant military conflict in the Tigray region. There was also unrest threatening to spread to other regions as well – with proposed street demonstrations projected to disrupt peace and order across some of the cities – especially in the north and east of the country.
- b. At the time of the commencement of the field survey phase, Ethiopia was scheduled to go to the polls on the 5th of June 2021 to elect a new parliament. The campaigns in the weeks preceding the elections were projected to lead to blockades in Addis Ababa and in other places, and to the diversion of traffic and to other disruptions in people’s routines.
- c. All of this was unravelling in the backdrop of the global COVID–19 pandemic which disrupted travel, work, and other aspects of the daily lives of people across the world.

The evaluation team’s KE2 was able to travel to Ethiopia for the field mission in April 2021 as the border was open from India and the KE2 had already been vaccinated for Covid-19. The KE1 was unable to travel to Ethiopia as he had not yet received a Covid-19 vaccine, his risk profile was higher, and on account of ongoing flight availability constraints from New Zealand. In addition, there was extremely scarce booking availability for the mandatory and costly extremely strict 14-day government MIQ (Managed Isolation and Quarantine) Covid-19 control requirements on return to New Zealand.

The project implementing agency team, including their M&E specialist, provincial in-charge personnel and administrative personnel provided raw data, background information for the survey, field visit suggestions and supported the evaluation team’s field visits despite the COVID-related restrictions imposed upon their own movement.

With the invaluable assistance of the evaluation team’s locally recruited driver/translator, Mr. [REDACTED] the wide range of site visits as detailed in Annex 1 were undertaken. Mr. [REDACTED] provided the necessary logistic support, was strongly involved in the field work, helped identify the sites to be surveyed, established contact with the persons concerned on the ground, drove the vehicle an average of about 200km per day - of which around half was on unpaved roads –served to translate between the evaluation team and the respondents, and accompanied the evaluation team to the field and back to Addis Ababa each day. In designing and undertaking the field survey, precautionary measures were put in place to ensure the safety of the survey team, and given the uncertainty associated with the emerging circumstances, each day of fieldwork was planned in detail and in close consultation with the persons located at the various destinations.

The Mirt-stove producers and the PV retailers generously granted interviews (sometimes at short notice), and the general public living across the towns and provinces covered actively participated in the survey and helped the evaluation team gain a grasp of the prevailing ICS, solar PV, and related circumstances. The evaluation team greatly appreciates the extremely helpful responses received despite the potentially unfavourable circumstances involving the rains, the Covid-19 pandemic, the forthcoming elections, etc. Residents from across the towns surveyed were spontaneous and forthcoming in their responses to interview requests, and were enthusiastic in their participation, including extending warm hospitality to the evaluation team at every instance.

The timing of the field work was fortuitous in that the survey was implemented in a satisfactory manner, and with no significant weather-related, election-related, COVID-related or conflict-related disruption. Access to the survey sites was not impeded and the scheduled general election. Simultaneously, the survey team got to experience first-hand, some of the living styles, local cultures, food habits and cooking styles, and discussed the relevant energy access challenges faced by the residents of grid connected as well as unconnected settlements.

The evaluation team had originally planned for the field visits to kick-off from briquetting stations (as “anchor respondents”) for the ICS component and had requested for the information relating to the locations and operations of the briquetting stations. Relevant SI solar PV sites were then to be visited as part of the wider site visit schedules. However, the project implementing agency informed the evaluation team in April 2021 that none of the briquetting stations were operational and there was nothing for the evaluation team to visit and observe with respect to the planned briquetting activities.

Missing data, internal contradictions and inconsistencies necessitated ‘triangulation’ of the raw data provided by the project implementing agency with data from secondary sources and papers and reports published by other development partners and implementing agencies, academic publications and project reports, and through engaging in discussions with people on the ground in relevant towns and villages. In addition to the need for customized travel plans to avoid possible disruptions, the need to verify site-specific data made it necessary for the field survey to be planned and implemented one day at a time and one-round-trip-out-of-Addis Ababa at a time. The program suggested by the Implementing Agency was followed to the largest extent possible with suitable schedule modifications, and with regular consultations with the province-level heads. The program had to be adapted to fit within the limited evaluation field time available after the evaluators seven-days self-quarantine on arrival and the need for the evaluators to leave well before the scheduled general elections were held with the possibility of violence and disruption that were predicted as a real possibility just before the election voting day.

The cook-stove producer trainee list as provided by the project implementing agency was used as the starting point for planning the field trips. The “anchor respondent” population for the survey was therefore a total of 75 cook stove artisans across the three provinces. A circle, as shown in Figure 1 was drawn with Addis Ababa as the approximate centre to define the round-trip distances that could be covered each day, given road conditions and the prospect for civil disturbance surrounding the then forthcoming general elections. This circle covered approximately 12% of the combined area of the three provinces included in the study. Simultaneously, care was taken to try and cover as many artisans as possible on each day’s trip out of Addis Ababa. The sample of 9 cook-stove artisans – a 12% sample of “anchor respondents”– so derived was both random as well as selected from the three regions surveyed, and the sample was combined with the end-use customers in the vicinity of each anchor respondent, (“clustered sample”).

Having identified the anchor respondents, the survey was extended to households having procured an ICS from the stove producers (“the test group”) and to the households in the vicinity of the test group that had not procured an ICS (“the control group”). Information relating to the cost of the stoves, time and money costs of fuel use, and demographic data were collected from the households; respondents did not reveal income levels and expense levels from before and after the acquisition of the stove.

Solar PV vendors and the locations of social institutions reported to have been supplied with PV systems by the project implementing agency were then identified from a detailed study of map data, the dataset provided by the project implementing agency, and through consultation with the PV retailers themselves, and attempts were made to visit suitable EU funded SI solar PV systems. In addition, woreda officials at these locations were contacted and were requested to grant appointments for personal interactions.

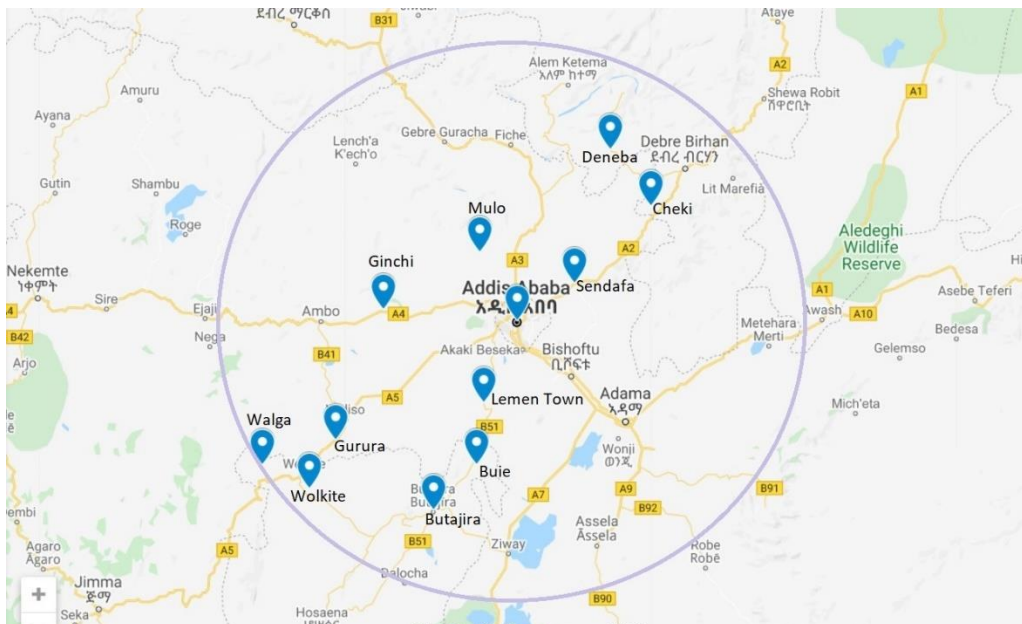


Figure 1: Coverage of field survey and specific towns visited across SNNPR Oromia and Amhara Regions

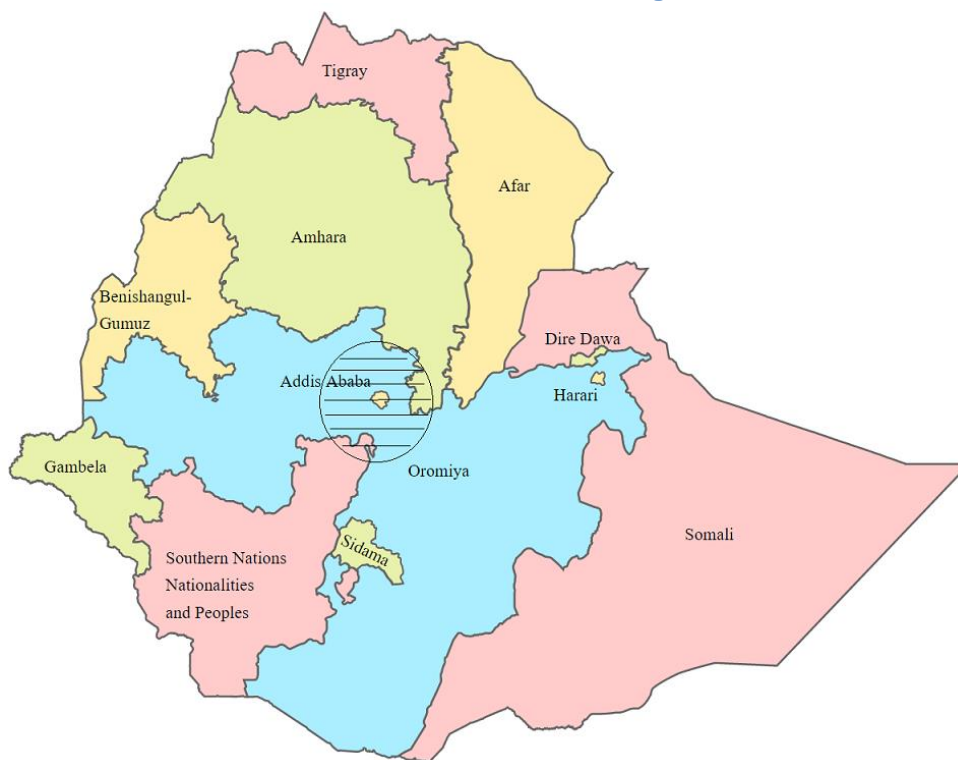


Figure 2: Coverage of field survey with respect to Ethiopia

The beneficiary survey was designed to adopt a participatory approach, with households to be interviewed, split in approximately equal numbers between beneficiaries (“test”) and non-beneficiaries (“control”). As suggested by the list of trainee-artisans provided by the Implementing Agency, as observed during the field survey and as mentioned in published literature (see for instance, Jagtenberg 2020 cited below), the project implementing agency appeared to have consciously selected just the one training program participant from each town. All the cook stove artisans (“anchor respondents”) visited across towns and provinces produced and distributed the Mirt-stove, but no other stove models²³. Given the time and other constraints, the homogeneity of the respondent population, language constraints, the single-use nature of the Mirt stove (*injera* production only), the evaluation team managed to survey a total of 21 Mirt stove customers and 7 households that did not acquire or use the Mirt stove (in addition to visiting the PV retailers and selected PV installations in the area). The survey observed homogeneity in the demographic characteristics of the respondents and consistency in responses. The use of randomly drawn samples from households located at various points within the rural settlements and similarly drawn random samples from control households eliminates any potential biases induced by household-specific resource endowments and location-specific privileges.

The evaluation team explained the context and details of the survey in the local language through the interpreter, and recorded responses offered by the participants, again through the interpreter. The quantitative data from the questionnaire survey was validated against subjective inputs received through a ‘look and listen’ approach and through photographic evidence gathered. Figure 3 summarizes the discrete stages of the survey. The two-way discussions (through the interpreter) sought to explore subliminal messages and the personal relevance of the stoves (or PV systems) that might not have been gathered through a questionnaire survey or might not have been derived from the results of statistical tests.

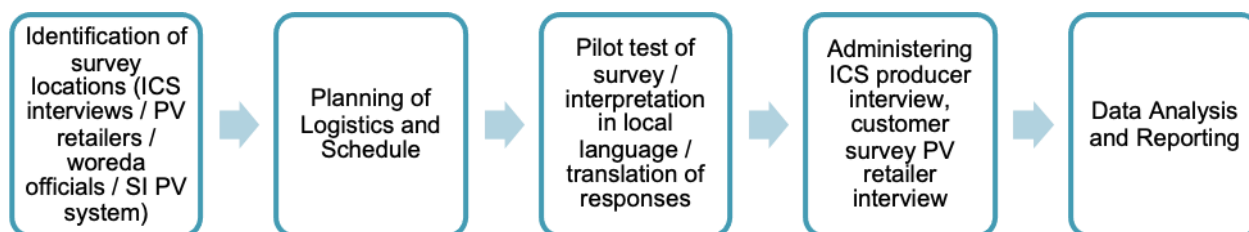


Figure 3: Discrete Stages of Sample Selection and Field Survey

²³“Most ICS producers that Endev has trained in Ethiopia produced the heavy concrete Mirt stove whose design is tailored towards specific Ethiopian dishes such as large *injera* pancakes. ... Endev purposely trains a certain number of producers per region in order to cover the whole country, instead of training producers that are spatially close.” Extracted from: Jagtenberg J H (2020) *The Local Production of Cleaner Cookstoves: Supporting the Growth of Cookstove Producers in a Local Market Context*, Eindhoven University of Technology (25 August), p. 63 of 117.

2. FINDINGS

2.1. Relevance

Relevance is whether the programme/project/component/activity is doing the right things, especially the extent to which the intervention objectives and design respond to beneficiaries' global, country, and partner/institution needs, policies, and priorities, and continue to do so if circumstances change.

2.1.1. Alignment with Ethiopia's Priorities

ICS

In 2011, the Government of Ethiopia (GoE) developed the Climate Resilient Green Economy (CRGE) strategy. At the macroeconomic level, the EU funded project activities are consistent with the ambitions and scope of the strategy²⁴. In particular, the project is directly linked to improving indoor air quality / living conditions of rural households by supplying improved lighting, improved cooking and baking technologies, and to increased rural household incomes (via avoided kerosene, wood/charcoal and health-care costs and lost incomes due to absence from work due to sickness), contributing to women's empowerment and children's education, all while also curtailing GHG emissions. The specific scope of the project overlaps very substantially with all of the four objectives of the country's CRGE of 2011:

1. Improve crop and livestock production practices for **higher** food security and **farmer income while reducing emissions**.
2. Protect and **re-establish forests** for their economic and ecosystem services, including as carbon stocks.
3. Expand electricity generation from **renewable sources of energy** for domestic and regional markets; and
4. **Leapfrog to modern and energy-efficient technologies** in transport, industrial sectors, and **buildings**.

However, the caveat is that although promoting ICS in principle is aligned with Ethiopia's needs, the project almost exclusive focus on the Mirt stove (with its heavy and fragile chimney, its high transportation cost, its limited application for just injera baking, and its dependence on imported cement), means that the intervention was not particularly well aligned with Ethiopia's wider long term ICS priorities.

Rating 4 out of 6 (Moderately Satisfactory)

SOLAR PV

Ethiopia has a low grid connection ratio and, as of 2019, 24% of Ethiopian households were using an off-grid solar product as their main source of electricity²⁵. The government projects that 35% or 9.2 million households can meet their electrification needs using standalone solar

²⁴ Ethiopia's Climate Resilient Green Economy (CRGE) of 2011, <https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=677&menu=865>, last accessed 16 March 2021.

²⁵ GOGLA (2019), Ethiopia Country Brief

PV solutions and intends to achieve this by 2025²⁶. Hence, in principle supporting an expanded role for pico solar PV and SI solar PV, as was done in the EU funded project, aligns closely with Ethiopia's priorities.

However, a key caveat is that only 20% of the EU funded SI solar PV systems can be expected to still be working beyond 2-6 years when their batteries fail. The supply of SI PV systems also did not utilise the private sector solar PV suppliers in Ethiopia that appear to be able to source the solar PV equipment— these factors call into question the alignment of the SI solar PV model promoted in the EU funded project with Ethiopia's long term off-grid solar PV electrification impact priorities. And for the pico solar PV activity, the sole focus on the 8-11% of the market that is served by “regulated” suppliers also greatly reduces the alignment of the EU funded support activities with Ethiopia's long term off-grid electrification priorities where 90% of pico solar PV systems continue to be supplied by the informal (unregulated) sector.

Rating 4 out of 6 (Moderately Satisfactory)

2.1.2. Linkage with SDGs et al

The Sustainable Development Goals relevant to the programme are SDG 3 (“Good Health and Well-being”), SDG 4 (“Quality Education”), SDG 6 (“Clean Water and Sanitation”), SDG 7 (“Affordable and Clean Energy”), SDG 9 (“Industry Innovation and Infrastructure”), SDG 11 (“Sustainable Cities and Communities”), SDG 13 (“Climate Action”), and SDG-15 (soil/land, forests, ecosystems).

ICS

The motivation for undertaking the project appears broadly aligned and linked with the SDGs, even though the SDG language is not explicitly used. The gender dimension is generally not explicitly mentioned throughout all the FA descriptions, and no gender analysis data is available from the Implementing Agency. However, the field visits indicated a strong involvement of women artisans in Mirt stove construction and sales and its dissemination.

Rating 5 out of 6 (Satisfactory)

SOLAR PV

The solar PV support of pico solar and SI solar are in principle strongly linked to SDGs 3, 4, 7, 11 and 13. The demonstration of larger pico solar systems is indirectly linked to SDG 6 through off-grid water pumping for personal use and irrigation, and to SDG 9 through support of productive uses.

Rating 5 out of 6 (Satisfactory)

2.2. Coherence

²⁶ MoWIE (2019), National Electrification Program 2.0

2.2.1. GoE; EU; and other Donors Alignment and Complementarity

ICS

At a high level, the project appears to have been suitably aligned, and complementary of other similar initiatives, with GoE development priorities and EU and other donors' objectives and initiatives.

However, at a practical / project component and individual intervention (activity) level there seems to be little practical complementarity with other EU or EUMS initiatives. For example, the EU funded National Biogas Program appears to be completely separately implemented by SNV and with Irish Aid funded ICS activities.

The survey team did not encounter biogas plants, on the way to, or at the sites visited for the survey. Informal discussions on stove and fuel related subjects, involving the Mirt stove artisans and the end-use consumers did not suggest the presence of biogas plants in the vicinity. The Implementing Agency for the biogas component of the project mentioned the weak overlap during the online conversation held as a part of the survey. Closer coordination among the two programs could have potentially employed the same artisans to mould the Mirt stoves and to construct the manage the biogas plants, thereby providing such artisans with the economies of scope that might contribute to enhancing the viability of both operations.

Rating 4 out of 6 (Moderately Satisfacto

SOLAR PV

There is considerable work being done by GoE, EU Member States, and other donors to expand the uptake of SI and Pico solar PV in Ethiopia, However, no evidence was sighted that the EU funded project pico solar PV support activity was strongly linked to the numerous and well-funded activities supported by other donors. This was supported by interviews with two relevant donors working in this area in Ethiopia. There was no mention of the EU funded project's pico solar PV support activity in the numerous recent reports by the FCDO Africa Clean Energy Technical Assistance Facility²⁷, Ethiopian academics²⁸, Lighting Africa²⁹, international academics³⁰, the Global Off Grid Lighting Association (GOGLA)³¹, or Power Africa³².

Rating 2 out of 6 (Unsatisfactory)

²⁷ Ethiopia 20210215 Stand-Alone Solar Investment Market-Map - TetraTech for FCDO

²⁸ Ethiopia 20201209 Socio-econ & env impacts of rural elect with Solar PV - Evidence from Southern Ethiopia - Energy for Sus Development

²⁹ Ethiopia 20201110 Lighting Africa ENREP Credit Line Supported Purchase of 1.2 million Solar Products / Lighting Global - WBG

³⁰ Ethiopia 20201020 Scaling Up Solar Pumps for Irrigation & Domestic Water Use / The Role of Blended Finance - Climate Policy Group

³¹ Ethiopia 20190715 GOGLA (Global Off Grid Lighting Assoc) Country Brief

³² Ethiopia 20191015 Off Grid Solar Project Market Assessment - Power Africa Offgrid Project (PAOP) - USAID

2.2.2. Private Sector Implementation Focus

ICS

Individual entrepreneurs – engaged in related or unrelated vocations – had been recruited for training in Mirt stove production. In theory, this has the potential to stimulate private sector development directly, and indirectly, through support activities including transportation and installation of the stoves, for instance.

However, in practise, each of the ICS artisans consulted viewed the production, marketing, sale and installation of Mirt stoves as a secondary occupation or a social objective – a hobby – which did not support his / her sustenance. Consequently, when cement prices rose, and as the artisans believed that the markets would be unable or unwilling to absorb the higher prices of the finished products, they ceased Mirt stove production, while continuing to pursue their livelihood activities. The program’s near-exclusive focus on the Mirt stove, and the low viability of Mirt stove production and distribution raise serious doubts on the sustained interest levels of the private sector.

Rating 2 out of 6 (Unsatisfactory)

SOLAR PV

The EU funded pico solar PV project support activities were aimed at only a very small subset of the private sector, those suppliers who were “approved” and were therefore supported as local quasi-monopoly suppliers and who were observed in the evaluation’s site visits as being able to charge higher prices. However, there are also hundreds of smaller, locally owned retailers of pico solar PV systems who supply around 90% of the pico solar products in Ethiopia³³. Some of the unverified solar lanterns and SHS imported through unregulated channels might no doubt be of poor quality, but the evaluation team readily found examples of solar products sold through unregulated channels that were in fact meeting Lighting Africa/Global standards (see Picture 1), and many of the “unregulated” pico solar products were observed to offer similar 2-year warranties to the more expensive products sold through regulated channels. But in all the project literature all “unregulated” products were labelled as being “counterfeit” and of “poor quality”, which is clearly not the case. This ground reality would have been easy to find, just as it was easy to find by the evaluation team by simply visiting solar PV vendors in the open market in Addis and in local towns while on site visits. The project supported intervention in the pico solar area therefore only supported 10% of the private sector pico solar suppliers and undermined the market for the 90% of pico solar system suppliers in the unregulated/informal sector. A more measured approach that took account of the dominance of unregulated suppliers would have been more effective in private sector focus terms.

For the SI solar PV systems supported with EU funding, four generic system capacities were provided. The separate discrete components for the 74 larger SI systems procured were sourced in Germany, shipped to Ethiopia, and regional energy bureau supervising the installations. It is not known where the 62 packaged plug-and-play Fosera and ovCamp SHS

³³Page vii and page 6: Ethiopia 20210215 Stand-Alone Solar Investment Market-Map - TetraTech for FCDO

for the 39 SI sites (using 1-3 each of such SHS) we're procured or for what cost. Meantime, the private sector solar PV suppliers in Ethiopia gained no business growth opportunities supplying suitably specifically tailored major system hardware components for the 74 larger and 62 smaller SI solar PV systems purchased with EU funding. The private sector suppliers have reportedly used donor FOREX funds to source major solar system components in other donor interventions in this area.

Rating 2 out of 6 (Unsatisfactory)



Picture 1: Products retailed in the open market meeting Lighting Global / Africa Standard

2.3. Efficiency

Efficiency measures whether the results obtained were proportionate to the economic cost and timeliness of the intervention. Efficiency is measured both at the program level and at the individual project level.

2.3.1. Turning Inputs into Outputs

ICS

In the absence of suitable component- and activity-based expenditure reports from the project implementing agency, the specific efficiency of inputs (EU funding) being turned into useful outputs cannot be definitively assessed, the numerator (€) is large, and the denominator (incremental ICS produced) output is unclear and likely to be small. This is not helped by a general paucity of specific data on the capacity building outputs.

For ICS, there is reasonable evidence that the promised cement, wheelbarrows, and other implements were not provided to all Mirt stove artisans attending training courses.

Handholding of trained rural ICS artisans following the training was a crucial component to ensure sustainability of their production, sales, and distribution operations. Efforts like marketing support, costing the product – perhaps with the help of the woreda officials concerned – sales support, transportation support were sorely missing.

Ensuring that the price of the stove was linked to raw material and labor costs while also returning sufficient profit margins was crucial in the overall plan. By leaving the artisans to their fate after the training, the program limited the profitability of ICS production and curtailed the sustainability of the initiative itself.

Rating 2 out of 6 (Unsatisfactory)

Solar PV

For the solar PV component, it is possible to find some of the hardware costs from the project literature provided, so for example the evaluation team could see that the solar lead acid batteries provided were reputable solar PV system related brands and were procured at competitive prices compared to a quick internet search of retail prices. However, full installed costs for the SI solar PV systems in total, let alone per system, were not available. The implementing agency was not able to provide actual expenditure by activity against budgets³⁴. Hence it is not possible to ascertain input costs by activity.

For the pico solar PV support activities, there is no apparent pre-intervention baseline sales data, nor any post intervention sales data that relates to project interventions. Yet even if suitable pico solar data were to be available, it presumably would only cover the 8-11% of the market provided by “regulated” suppliers, and multiple donors were working to support the market development alongside the EU funded efforts.

So, overall, the evaluation team has not been provided by the inputs at the level of detail required. The evaluation team only has the specific EUD funded SI solar PV system numerical outputs (system capacities and numbers). Actual battery life has not been gathered for the similar prior systems installed by the implementing agency with other donor funding since 2009 but would be expected to be 2-6 years. Based on around 130 battery cells being replaced for the implementing agencies 612 battery cells provided from 2009-2014 and 1048 battery

³⁴The evaluation team was advised that the EUD had also requested (on multiple (apparently six) occasions) actual expenditures against the FA budget codes for the clearing of payments, but that this has not yet been provided by the implementing agency to the EUD.

cells provided from 2009-2019, it appears that actual battery cell replacement rates are 10-20%.

Rating 2 out of 6 (Unsatisfactory)

2.4. Effectiveness

Effectiveness is whether the intervention is achieving its objectives and results. This includes analysing progress along the results chain causal pathway towards the desired impact.

2.4.1. Achievement of Planned Results

ICS

In the absence of detailed output data (planned or projected) from the implementing agency, it is not possible to evaluate the achievement of the project's planned capacity building activities. Across the three regions surveyed, for instance, a total of 75 artisans are reported to have been trained in [Mirt] stove production as a part of the initiative. It is not immediately apparent if this was the originally proposed figure (perhaps reflected within the request for funding submitted by EnDev *circa* year 2016). The basis for the determination of this number is also not known at the time of the survey. Further, the nomination / selection process for the artisans was not brought out clearly; some of the artisans surveyed had been trained a second time around. Some of the artisans visited were engaged in related vocations (masonry, for instance) while others were engaged in unrelated activity (electrical installation, for instance). The field survey revealed that some of the woreda officials were among the participating trainees, and such officials never worked on stove production subsequent to the training.

It also does not seem possible to evaluate the project's impacts from the project's indirect support activities, through the Woreda, for instance.

Rating 2 out of 6 (Unsatisfactory)

SOLAR PV

For the SI solar PV component, the FA had an allocated EUR 612,000 budget and it was stated that "100 ... Larger systems [would be provided] to provide basic electricity for light and the needed appliances of the respective facility". In practice, there were 43 600/1200/2400 Wp AC discrete component systems and 62 smaller (35Wp) packaged standard plug-and-play DC SHS provided to 32 SI (Social Institution) solar PV system sites. There also were a further 31 larger capacity discrete component systems still awaiting installation in May 2021.

The expected capacity of the 100 systems was not explicitly stated in the FA, but the 160 SI solar PV systems provided by the implementing partner with 2009 - 2014: MoH, Irish Aid, Doctors with Africa, USAID, and other funding were 2.0 – 2.2 kWp AC systems³⁵, not the 35W

³⁵ EnDev Ethiopia 20210521 SI Overview for 267 Other Funded Sites 2009-2019 & 113 EU Funded Sites 2018-2020

plug-and-play DC SHS deployed to 32 sites. Hence the SI solar PV component has not provided, let alone yet installed, the numerical 100 systems at the envisaged capacity per system that was envisaged. It was also implicit in the FA that the 100 new larger SI solar PV systems would continue in operation for the 25-year expected life of their solar PV panels, inverters etc. The challenge of ensuring that batteries would be replaced after 2-6 years was well known, but other than continuing to rely on MoUs with system recipients nothing tangible was done to ensure that batteries would actually be replaced.

In terms of Pico solar PV systems, there were a range of capacity building measures envisaged and a range of activities were in fact delivered. There was a €221,600 budget allocated to “Creating Financing Options”, where no tangible outcomes were achieved.

Rating 2 out of 6 (Unsatisfactory)

2.4.2. Adaptive Management for Results

ICS

The price of cement appears to have increased since 2018, and the field mission found that Mirt stove producers had ceased production in early 2021. These factors were not reported to the EUD in the (last available) annual report, nor have any adaptive changes been apparent by the project implementing agency.

It is also clear that the Mirt stove is at best only a partial answer to ICS needs - yet the Mirt stove still appears to be the primary ICS type supported under the project. Given the project's near-exclusive focus on production and dissemination of the Mirt stove, given the unviability of the production and marketing operations, the artisans were compelled to look for alternative means of livelihood to sustain their families. Mirt stove production was relegated to a secondary pursuit. The project could have explored the possibility of overlapping with the biogas program or pursuing other means of helping the artisans derive economies of scale and scope to enhance the viability of stove production operations. However, this was not done.

Rating 2 out of 6 (Unsatisfactory)

Solar PV

The challenge of most batteries not actually being replaced was apparently known by the implementing agency. For larger SI solar PV systems, the solution of switching from VRLA batteries to very long life LFP batteries was apparently identified but was apparently not pursued due to the extra cost of LFP batteries³⁶. It appears that the option of installing fewer larger AC systems with very long-life batteries and making up the target of 100 systems with more of the lower capacity and cheaper DC SHS already being used at 39 of the SI sites, or installing lower capacity, but longer life battery AC systems was not formally presented to the EU as a suitable adaptive management option. In addition, as of May 2021, the implementing agency still had five larger systems allocated to Tigray province, notwithstanding that since

³⁶As per personal communications from EnDev/GIZ to the evaluation team

November 2020 a major conflict had been underway in Tigray Province which shows no sign of abating. Given the ongoing delays to the last SI systems installations across Ethiopia, it is hard to have confidence that all the 31 remaining systems will be installed at relevant sites anytime soon.

In terms of the pico solar PV project activities, there is no evidence that the fact that only 8% -11% of systems were being provided by “authorised” channels was known or recognised, and there is no evidence of any significant adaptive management in this area. In terms of the budget of EUR221,600 allocated to “creating financing options” for pico solar PV systems, there is no evidence of any significant adaptive management being undertaken, alongside no evidence of tangible outcomes being achieved.

Rating 2 out of 6 (Unsatisfactory)

2.5. Impact

Impact is the extent to which the interventions have generated or are likely to generate significant positive intended effects. The intended effects were specified in the 2010 Programme FA as being additional RE generation, increased EE, and GHG mitigation.

2.5.1. Tangible Outputs/Results

ICS

Some useful capacity appears to have built with ICS artisans to build Mirt stoves, but this appears to be limited to one mould, one model and one product, or in other words, the capacity appears to be very purpose-specific with a low likelihood of extrapolation to the production and dissemination of other related or unrelated product

Rating 2 out of 6 (Unsatisfactory)

SOLAR PV

For the SI solar PV component, in May 2021, there were 43 larger 600/1200/2400 Wp AC systems and 39 smaller 35Wp DC SHS suitable quality SI (Social Institution) solar PV system installations, and a further 31 larger capacity systems were still awaiting installation compared with the 100 larger systems specified in the FA. Only 80% of the systems provided could be expected to have their batteries replaced when the batteries fail after 2-6 years. There was no apparent financing system in place for pico solar systems. For pico solar systems, some tangible support had been provided to local and national solar associations.

Rating 2 out of 6 (Unsatisfactory)

2.6. Sustainability

Sustainability is essentially whether the benefits achieved will last, that is the extent to which the net benefits of the intervention are likely to continue over the medium or long term.

2.6.1. Likely Post-Programme Results

ICS

The human capacity built by the project in the private sector [for mirt stove production] is likely to persist, but only if the price of cement decreases very soon, otherwise the artisans are more likely to move away to pursue other attractive livelihood options and are likely lose interest in returning to Mirt stove production.

Mirt stove production and dissemination was known to be unviable to begin with: all artisans surveyed had failed to recover all of their labor and indirect costs incurred (including transportation and installation costs). All of the surveyed artisans had pursued other livelihood activities distinct from Mirt Stove production to support their households. Under these circumstances, and even before the recent spike in cement prices, Mirt Stove production had become a secondary activity, and consequently, was lower in priority for the trainee-artisans. The spike in cement prices served to make an unfavorable situation worse and forced the artisans to cease production.

Rating 2 out of 6 (Unsatisfactory)

SOLAR PV

The EU funded pico solar PV support activities only covered the 11% of solar lanterns and 8% of home systems that were certified and imported through regulated channels³⁷. In addition, the EU contribution to support this market was not mentioned in recent reports covering this field by the other major donors active in this field in Ethiopia³⁸. Likely future post-programme results in the more expensive quasi-monopoly regulated pico solar PV market are therefore unlikely to be any more sustainable than they have been in the past.

For SI solar PV systems, only 10%-20% of past implementing agency installed SI solar PV systems appear to have had their batteries replaced (from 130 battery cells being replaced out of 612-1014 battery cells provided from 2009 to 2014 or 2019 for other donors by the implementing agency. Put another way, one can estimate that 80%-90% of past implementing agency installed solar PV systems are no longer operational³⁹. This would also be the likely fate of the EU funded SI solar PV systems supplied and installed under the project.

Rating 2 out of 6 (Unsatisfactory)

³⁷ Ethiopia 20210215 Stand-Alone Solar Investment Market-Map - TetraTech for FCDO

³⁸ FCDO Africa Clean Energy Technical Assistance Facility, Ethiopian academics, Lighting Africa³⁸, international academics, the Global Off Grid Lighting Association (GOGLA), or Power Africa

³⁹ This low actual SI system battery replacement reality was corroborated by a major other donor active in this field and by a major private sector solar systems supplier and installer.

2.6.2. Project Exit/Continuation Strategies

ICS

Given that the Mirt stove is only part of the required ICS solutions needed, there appears to be little need to continue an exclusive focus on Mirt stove production / artisan training. In addition, it is also not clear that the EU funded project implementing agency has been providing particularly effective ICS support activities in the country including awareness creation, market-responsive product design, product marketing, pricing, warehousing, and supply of intermediate products etc.

The briquette production element has not progressed during the project's tenure, and there appears to be little justification for the EU or other donors to continue support in this area in the future with the project implementing agency.

Rating 2 out of 6 (Unsatisfactory)

SOLAR PV

The implementing agency apparently expects that the solar PV component's broadly similar activities will continue with new donor funding. The issue of actual funding being obtained for any new SI solar system battery replacements is apparently under consideration by obtaining more credible funding commitments from relevant government bodies⁴⁰. There is no apparent consideration underway for the implementing agency to go back to old SI systems that they installed and replace the batteries with long life LFP batteries for those 80% of systems where the batteries will have failed after 2-6 years. Otherwise, like the 80% of systems funded by past donors, only 20% of EU funded SI solar PV systems can expect to continue working after 2-6 years when their batteries fail.

It is not clear what, if any, future pico solar support plans exist. The implicit continuation plan would be for the implementing agency to continue to support the 8 – 11% of pico solar systems provided by authorised retailers, while continuing to vilify the non-authorised retailers as selling "poor quality" and counterfeit" products.

Rating 2 out of 6 (Unsatisfactory)

2.7. EU Added Value

EU added value is the extent to which the EU interventions led to changes over and above those which could have been expected from national actions by EU Member States.

⁴⁰ To complement the evaluation findings, a key respondent with significant experience, and who was now working at another donor agency with a large active program in Ethiopia in the solar PV area, plus the managing director of one of the largest solar PV companies in Ethiopia, both reported that the necessary high level Ethiopian government-wide commitment was not in place for the necessary real major financial commitment that would lead to different future outcomes for funding expensive battery replacements over past inadequate funding being provided in practice to date.

ICS

Performance of the project component funded by Irish Aid appears to have been very similar to EU funded efforts in this project, hence the EU involvement does not appear to have added value compared to the Irish Aid interventions in Ethiopia.

Rating 3 out of 6 (Moderately Unsatisfactory)

SOLAR PV

Irish Aid has funded a EUR600,000 solar PV project in Tigray and SNNPR provinces from 2014-2019 operated by the same project implementing agency used by the EU funded project. The Irish Aid project apparently electrified 29 social institutions systems, provided 100,000 small solar PVs, and provided capacity building household awareness and access to solar PV that led to measurable significant increases in the use of solar PV and reductions in the use of kerosene for lighting, and reductions in lighting costs. This project appears to have had much more specific outputs than the EU funded project subject to the current evaluation.

FCDO (UK) has funded work alongside the Shell Foundation under the new Africa Clean Energy Technical Assistance Facility that works with other key agencies and donors including WRI, GOGLA, TERI, Lighting Global and the WBG. This work critically looked at real market realities and sales not just the sales by “authorised” solar system suppliers in Ethiopia.

There are also a range of off grid solar activities in Ethiopia being supported by EU Member State entities including KfW, NDF, SIDA, Irish Aid, UKAID, SNV, and GIZ.

However, the EU funded battery recycling activities were a useful project activity that had not been supported by any EUMS interventions.

Rating 3 out of 6 (Moderately Unsatisfactory)

3. OVERALL ASSESSMENT

ICS component

The ICS component of the project was stated to be promoting alternative cooking fuels from different biomass sources including agricultural wastes such as rice husks, sesame straw, coffee husks, and bamboo residues. This, in turn, was expected to reduce both forest degradation and greenhouse gas emissions. In doing so, the project was to address other cross-cutting issues, such as limiting the time that women and children spend collecting fuelwood and reducing safety hazards that women typically face when collecting firewood. Project documentation however suggests that on the ground, creating a sustainable market for the supply, sale and purchase of such fuel briquettes, has been constrained in areas with unhindered and free-of-cost access to raw biomass from shrub lots and other such sources⁴¹.

In a report submitted to Irish Aid in August 2020, the project implementing agency stated that several activities to support the development of briquette production had been conducted including the rehabilitation of briquetting plants and the technical and management training of technicians. The report to Irish Aid stated that due procurement processes had been followed and three (3) new small-scale briquetting machines had been installed and had commenced pilot operations. Further, three (3) additional existing briquetting machines were stated to have been refurbished. The report to Irish Aid further stated that the stove producers were linked with briquette producers and retailers to provide end-use customers with a complete package⁴². However, towards the commencement of the field survey phase, **the evaluation team was informed that the project had not managed to operationalize any of the proposed fuel briquetting stations.**

The following are mentioned as a brief illustration of the inconsistencies within and the limited reliability of the raw data⁴³ presented by the project, and the consequent need for triangulation of the basic data collected from multiple sources and compared with the data supplied by the project implementing agency.

1. The Gonzie (wood) stove made of clay was promoted [with or without project implementing agency involvement; with or without EU funding support] by manufacturers in the Gurage zone of SNNPR to support the cooking of *kocho*, a staple food in the area. The prices at which the 31,632 stoves are reported to have been sold between years 2015 and 2020 show no distinct demand patterns or discernible time-series sales patterns. Non-linear trend-line projections seemed to indicate a demand pattern more commonly observed with luxury goods – an increase in demand simultaneous with an increase in price.
2. The same dataset reveals that the metal-fabricated Institutional Rocket Stove (IRS) (wood) stove was sold to households at prices ranging from €17.5 to €166.67 (if one were to assume that this high price of €166.67 was an outlier or was the price of a large stove, the second highest price was reported at €136.11 and the third highest at €70.83: this is still a large multiple of the low-end price). The IRS (wood) stove appears

⁴¹ GIZ / EnDev Annual Progress Report dated 16 April 2018, p. 13 of 40.

⁴² GIZ / EnDev (2020) *Final Consolidated Report to Irish Aid*, August, p. 25 of 40.

⁴³ “Sales Data (2006 – 2020)”: MS Excel Workbook received from GIZ / EnDev on 29 March 2021.

to have been sold to social institutions at prices ranging from €99.29 to €418.06 (second highest at €372.62 and the third highest at €327.00). The IRS (wood) stove appears to have been sold to PU (productive uses of energy / commercial applications) at prices ranging from €8.00 to €186.67. The project implementing agency had informed the evaluation team that this wide price range from over the ten-year period 2010 – 2020 was related to variations in cooking-pot size supported by the stove, to variations in prices of sheet metal, and of the clay “combustion chamber”. Given the potential range of product sub-categories and the corresponding range of prices, a demand function could not be plotted for this product.

3. The Multi-fuel *Tikkil* (or *Tikikil*) stove appears to have been sold at prices ranging from Euro 5.73 to Euro 120 (**a 21:1 price ratio**) over the period 2007 – 2020. The project implementing agency has advised the evaluation team that this range in pricing was due to the volatility in pricing of galvanized sheet-metal and clay. The *Tikkil* (wood) stove appears to have been sold to households at a price range of €3.07 – €20.48 (**a 7:1 price ratio**) within the SNNP Region during the latter half of year 2020 alone. The second lowest price for this time window and this region was reported at €7.00 and the second highest price was recorded at €11.27, thereby representing a narrower range relative to the spread between the extreme values at either end.

The foregoing suggests that (i) **the market had not managed to process the price and supply information rapidly enough, and the market had not yet equilibrated the prices** of the raw-material, intermediate goods, or the finished product rapidly enough, or (ii) that the logistics costs were sizable enough for transactions to materialize at such a wide range in prices, (iii) or both.

4. The listing of 110 stove producers who were stated to have been trained⁴⁴ between 2017 and 2019 across the provinces of Amhara, Oromia, Tigray and SNNPR was provided to the evaluation team on 20 April 2021.
 - a. This raw data was employed as the first step in the survey design to identify “anchor respondents” from among the 75 “trainees” in the three provinces of Amhara, Oromia and SNNPR (including Sidama).
 - b. It was soon observed that an individual listed as a trainee was a member of the *woreda* (“district”) development council who had *not* attended the training program.
 - c. A second individual and a third individual who had attended the training were not on the list. These persons attributed the training to the district authorities (the *woreda* officials) and when questioned in the field phase had never heard of either GIZ or EnDev (project implementing agency).
 - d. The “Sales Data” workbook listed the Sendeffa Health Center in Oromia region as having been supplied with a 200Wp solar PV system by a vendor named [REDACTED]
 - e. The supervisor of the Sendeffa Health Center reported the centre had never hosted or used a solar PV system in the past 20 years.

⁴⁴ “Service Providers Trained by EU 2017 – 2019_04_202021”: MS Excel Workbook received from GIZ / EnDev on 20 April 2021.

- f. [REDACTED] identified herself, subsequently, as a cook-stove producer artisan in Awash town who had no business exposure relating to PV system supplies in Sendeffa town.
- g. The “Sales Data” workbook listed a 400 Wp solar PV system (€1,361.95) and a 600Wp solar PV system (€1,518.51) as having been installed at religious institutions during the first half of year 2018 by the Sodo *woreda* energy office. When consulted in person, *woreda* energy personnel confirmed that these systems were indeed planned for deployment but were never actually installed.
- h. These imperfections in input data came to light from the sample of sites visited and the sample of stove producers interviewed. Similar inconsistencies might well be embedded within the data relating to sites not sampled by the evaluation team.
- i. The annual reports submitted to the EU were more or less facsimile copies made over the tenure of the intervention, and gaps and inconsistencies in data highlighted during the inception phase of the evaluation were never clarified by the implementing agency. Table 1 from the Inception report is reproduced within this report as **Annex 4** to highlight the weaknesses in listing the annual targets for the program and consequently, in the presenting the end-of-year accomplishments.

Solar PV component

The predominant form of lighting in rural areas was reported to be kerosene lamps, with their high ongoing fuel cost, adverse impact on household air quality, and poor light quality. These kerosene lamps could technically and economically be replaced by affordable pico-solar lanterns and plug-and-play SHS, which would also offer user mobile phone charging at a minimal or no cost premium. The total elimination of kerosene-based lighting is an achievable target for Ethiopia – this has already been achieved in other developing countries. However, such an elimination of kerosene for lighting target would require a major reorientation of solar PV activities to reflect the real on the ground realities of solar PV in Ethiopia where informal suppliers are the major suppliers of systems, not the regulated suppliers who only supply around 11% of systems and who were the only suppliers supported by EU funded project activities.

The required technical quality standards for pico solar lanterns and SHS are already well established internationally through the World Bank Group (WBG) led Lighting Africa/Global “quality approval” program and its quality certification. Large numbers of manufacturers produce and distribute aesthetically designed and well packaged systems at reasonable prices. Around 2/3 of solar PV systems provided by “authorised” suppliers are reported to be quality approved systems, and some of the systems sold through open markets are also Lighting Africa/Global quality approved, see Picture 1 as above.

The more sustainable application of larger SHS with discrete system components appears to have been assumed to be addressable by training and business development support for local suppliers and their technicians. The recycling of limited-life lead acid batteries in legacy systems is highly relevant but will eventually be reduced in importance by the transition to longer life and no toxic materials LFP batteries. With LFP batteries that will likely last as long as the 5–10-year life of Pico solar systems and the 20-25 years of SI solar systems other components, battery replacements will no longer be relevant, the issue will then become whole

system recycling. And if the whole solar system is not recycled, at least the batteries will no longer be toxic.

3.2. Review of Literature and Use of Secondary Data

3.2.1. ICS component

An independent field survey previously conducted in three towns each from Amhara, Oromia and Tigray Regions covering “high sales”, “low sales” and “non-project” towns found similar adoption times for the *Lakech charcoal stove* and the *Mirt* stoves from the time they were introduced into the geographic area. The analysis of demographic and cook stove adoption data of 1557 respondents surveyed, however revealed that, **both income and education levels contributed to the adoption of the *Mirt* biomass stove**, while income increases alone increased the speed of the *Lakech* charcoal stove⁴⁵ (available at roadside shops at a lower price than *Mirt* stoves). Conversely, a lower household head education level and the higher levels of effort required in processing the fuel feedstock for some stove models were found to be barriers for adoption of prefabricated stoves in some areas⁴⁶. The evaluation team’s survey also covered an assessment of these demographic patterns of *Mirt* stove end-users.

Project documentation suggested that the *Mirt* stoves (with chimneys) had been promoted to households through focus group discussions and live demonstrations and to commercial bakers, because the stove was designed to reduce the quantity of smoke, first through more complete combustion of the input biomass feedstock, and then to evacuate smoke away from the cook, thereby protecting the person concerned from smoke inhalation. A field study⁴⁷ in Agarfa district of Oromia National Regional State found that almost all households living in the district used firewood, animal dung and crop residues as dry / solid fuel for baking and cooking food items. The study had found that a large proportion of respondent-consumers felt that the ***Mirt* stove was not flexible enough** as it (i) could only be used to bake *injera*, and (ii) could not be adjusted for various plate/pan sizes.

All the cook stove artisans visited by the evaluation team only produced *Mirt* stoves. The aspects of (i) rigidity in end-use purpose (ii) changes in fuel-use (iii) reduced quantity of smoke and improved indoor air quality were assessed during the survey.

The National Biogas Program (NBP), also co-funded by the EU, and implemented by SNV claims to have installed 31,506 biogas digesters by January 2021, across 400 districts spread largely over Amhara, Oromia, SNNPR (including Sidama) and Tigray and in smaller numbers across four other regions. The program claims to have “rolled out” the ‘GM Energy’ *injera* baking stove, and to have been working on improving the B(energy) stove and to have come

⁴⁵ Abebe Damte and Steven F Koch (2011) “Clean Fuel Saving Technology Adoption in Urban Ethiopia”, *University of Pretoria working paper* no. 9 of year 2011.

⁴⁶ Mesafint Molla Adane, Getu Degu Alene, Seid Tiku Mereta and Kristina Lutomya Wanyonyi (2020) “Facilitators and Barriers to Improved Cookstove Adoption: A Community-Based Cross-Sectional Study in Northwest Ethiopia”, *Environmental Health and Preventive Medicine*, 25:14, p 1 – 12.

⁴⁷ Biruk Fikadu Gebreyess, Negussie Zeray, Belesti Wodaje, Debela Bonsa and Haymanot Asfaw (2017) “Perceived Shortcomings of *Mirt* Stove in Ethiopia: The case of Agarfa District, Oromia Region, Ethiopia”, *J Agriculture Extension and Rural Development*, 9 (3) p. 39 – 46.

up with bio-slurry promotion and mainstreaming guidelines⁴⁸. The EU funded ICS project initiatives did not **overlap with the entrepreneur, product, and market development activities** of the NBP except through participation in the Ethiopian Clean Cooking Alliance⁴⁹.

A World Bank working paper⁵⁰ from June 2015 had observed that “giving the *Mirt* stove away for free and supporting community-level user networks are estimated to lead to more use.” Approximately overlapping with year 2014, *Cooperazione Internazionale* Foundation of Italy was involved in the distribution of 6,000 locally fabricated Tikikil Rocket stoves in the Somali Region and Oromia region, and *Carbon Sink* helped the project secure a Gold Standard (CDM) certification⁵¹.

In the fuel-use and emissions continuum stretching from traditional / existing open three-stone stoves at the one end, all the way through to “zero-on-site-emission” electric stoves at the other, a study⁵² of cook-stove utilization and fuel consumption patterns in parts of SNNPR concluded that the moulded-clay Gonzie stoves were as effective at firewood saving and reducing end-use emission as the cement – made *Mirt* stoves. The Gonzie stoves (that are understood to be currently produced and sold) were believed to be more sustainable because they provided flexibility in application and the clay could be extracted locally, while the cost of cement made the *Mirt* stove unaffordable to most end-use consumers. The study also recommended continuous training in ICS production for the local community, “with proper follow up”.

This evaluation has collected data to evaluate the extent to which such observations as above relating to consumer, demographic, product and market characteristics, consumer tastes and end-use patterns were built into the design and implementation of the EU funded project interventions before and in the project’s implementation since the project’s start in February 2017. Specific evaluation questions were employed for the interviews with the anchor respondents and the end-use customers to collect such data through direct queries or through drawing inferences from the responses received.

1. What contribution did the project make to increased ICS sales?
2. Absent donor support, is ICS production and distribution commercially viable yet in Ethiopia?
3. Will ICS production and distribution need financial support for the foreseeable future? Can carbon finance mechanisms be used effectively for that purpose?
4. Was the EU funded ICS support cost-effective?
5. What needs to change for the emergence of a stand-alone self-sustaining ICS sector?
6. Are the promised health benefits actually delivered by the chimney component of the *Mirt* stoves supported by the project?

⁴⁸ SNV (2016) <https://snv.org/update/ethiopia-biogas-programme-makes-injera-baking-easy>, (April) and https://rise.esmap.org/data/files/library/ethiopia/Documents/Clean%20Cooking/Ethiopia_Clean%20cooking%20sector%20in%20Ethiopia.pdf, (August, 2019), last accessed 18 March 2021

⁴⁹ Confirmed by SNV / National Biogas Program of Ethiopia during the online interaction in May 2021.

⁵⁰ Abebe D Beyene and others (2015) “The Improved Biomass Stove Saves Wood, But How Often Do People Use It?: Evidence from a Randomized Treatment Trial from Ethiopia”, *Policy Research Working Paper No. 7297*, The World Bank Group, p. 1 – 40.

⁵¹ Gold Standard (2014) “Improved Cook Stoves in Southern Ethiopia”, <https://webcache.googleusercontent.com/search?q=cache:dR8SVwfCOBMJ:https://www.goldstandard.org/projects/improved-cookstoves-southern-ethiopia+&cd=5&hl=en&ct=clnk&gl=in>, last accessed 14 June 2021.

⁵² Miftah Fekadu Kedir, Tsegaya Bekele and Sisay Feleke (2019) “Problems with *Mirt*, and Potentials of Improved Gonzie and Traditional Open Cook Stoves in Biomass Consumption and End Use Emission in Rural Wooden Houses of Southern Ethiopia”, *Scientific African* 3, p. 1 – 16.

7. Do beneficiaries understand the health need for a chimney and are they willing to pay for it?

In the ICS component, for *injera* producing and consuming regions of the country, the project visualized the *Mirt*-Stove – with an integrated chimney– as a “ground-breaking”, convenient and energy-efficient means for cooking and baking; an appliance that the EU funded project sought to deploy to help mitigate indoor air pollution and to conserve fuel wood and thereby to reduce deforestation. However, a review of literature on the subject suggests that the market response to the stove that could possibly deliver these benefits was already known to be lukewarm, possibly because of the price, the convenient availability of complementary goods (fuel briquettes / fuel wood in this case) or owing to inertia of use in the baseline alternative⁵³.

The project implementing agency has advised based on 15 years of implementation experience, that developing a **self-sustaining market** required an integrated approach with multiple stakeholders playing their respective parts. The project implementing agency states, for instance, that it is preferable for NGOs to *not* subsidize the capital costs of the stove on behalf of the poor, but to rather identify the means to lowering production and distribution costs through economies of scale, for instance⁵⁴. Such proposals combined with radio broadcasts and other marketing efforts, and the prospects of partnerships with micro-finance agencies added to the **supply-side push** of the program. The limitations highlighted, primarily relating to the inability of producers, wholesalers, transporters and traders in making sizable investments to organize value chains and to deliver the *Mirt* stoves in large numbers continued to be a key supply-side push constraint.

A review of project documentation and secondary data confirmed that **little emphasis was placed on understanding end-user requirements, or on enhancing the end-user-households’ ability to pay for what is essentially a non-income-generating consumer-durable**. The program was required to create market linkages, and cement, the key input to *Mirt* stove production was in short supply. Practically all the stove producers interviewed had suspended production owing to the scarcity and the consequent high price of cement. Stove producers who were interviewed by the evaluation team in the field had hoped that project implementing agency personnel would visit their premises to understand the prevailing circumstances first-hand but, besides the periodic phone call to check on sales numbers, no project implementing agency representative had [reportedly] ever visited a *Mirt* stove producer in person.

Additionally, the intervention logic does not appear to have **derived lessons from previous phases** of EnDev implementation in Ethiopia and did not seem to have built appropriate remedial measures into subsequent phases of implementation⁵⁵. For instance, the justification for continuing with the training of *Mirt* stove artisans was not apparent, among other parameters of the program. The geographic overlap or complementarity of the selection of ICS trainees with previous interventions was not revealed. Consequently, it was not apparent if new ground was covered or if existing markets were being further developed by new entrants.

⁵³ Health sector specialists from the Ministry concerned apparently insisted on 100% smoke evacuation; GIZ to share notes from a focus group discussion on the subject.

⁵⁴ EnDev Ethiopia, Annual Progress Report published April 2018, p. 13 of 40

⁵⁵ The project implementing agency has been requested, but has not yet shared any end-of-project report for previous intervention (end-2016) and any elaboration on inputs to the logic of the present intervention

Among the challenges listed⁵⁶ was the dispersed nature of settlements of rural households and inadequate access to roads; this feature of the target markets was said to have cost more time and labour than “initially planned”. The dispersed nature of settlements might not have changed significantly relative to earlier phases, and if it did change, the settlements might have become more densely populated over time with additional houses being built on vacant plots of land, given the increase in population since the interventions first began.

The intervention logic does not mention a time horizon within which a self-sustaining market was expected to emerge. In other words, the creation of such a market would mean and would imply the progressive phasing out of the project intervention itself. The evaluation sought to assess the feasibility of specifying **a timeframe** for the creation of a “self-sustaining market” for stoves and briquettes (and for PV solar systems). The evaluation has assessed prevailing market circumstances, supply-side maturity, and consumer-receptivity for the product to chart a course for such tapering of the initiative within a broad time horizon. This is discussed in detail further in this report.

The intervention logic did not appear to distinguish between “activity” and “achievement” and the availability of details of the operational briquetting plants illustrates this lack of focus on outcomes and hence on impacts.

For instance, the report submitted to *Irish Aid* in August 2020 speaks of three briquetting machines installed at sites that did not receive adequately reliable “three-phase” power supply. **The machines were not operational.** The report acknowledges that the availability of electricity supply to run the plant was not assessed in detail⁵⁷. Yet, significant emphasis appears to have been placed on the procurement *process* including the selection of contractors / local suppliers through open bids, indigenous production of equipment etc. by the time the evaluation team reached Ethiopia, it was confirmed that none of the briquetting machines were operational and that there was nothing for the evaluation team to see⁵⁸.

The intervention logic did not make specific reference to the compilation of data, verification of data, and the dissemination of *coherent* data in readily accessible formats for scrutiny as well as for academic research and eventually to guide policy design.

The terms of reference (ToR) for the present evaluation speak of one million ICS being sold by 490 small scale producers trained under the program, benefiting some 700,000 persons. This presentation seems to suggest that some persons were using more than one stove promoted by project implementing agency— which is a distinct theoretical possibility – but this needs to be explicitly mentioned all the same. On the other hand, the National Improved Cook Stove Program data cited within the report submitted to *Irish Aid* speaks of the dissemination of 15 million ICS between years 2005 and 2016 (prior to the launch of the current phase). If one were to assume the correctness of this estimate, at an average family size of 5 persons, the 15 million ICS should have covered most if not all of the rural areas in the country, leaving little room for the initiation of the presently evaluated project.

⁵⁶ EnDev Consolidated Report to *Irish Aid*, August 2020, p. 30 of 40

⁵⁷ The project implementing agency have yet to elaborate on the pre-installation survey, provide relevant information on site selection for briquetting machines, and catchment area analysis for the briquettes to be produced.

⁵⁸ “There is nothing so useless as doing efficiently that which should not be done at all.” -Peter Drucker

Furthermore, the financing agreement specifies that for each €100,000 spent on the project, project implementing agency trained stove producers should sell [at least] 300 ICS. This corresponds to approximately 28,530 stoves for a total project cost estimated at €9,509,518 at the time of the launch of the current phase. Reliable and accurate data is essential for the project to be in a position confirm the achievement of such milestones as set forth within the Financing Agreement⁵⁹. The Mirt stove producers interviewed reported having produced and sold between 5 and 10 stoves a month, on average. Extending this estimate to stove producers faced with similar market circumstances – and a customer base under similar socio-economic categorization – would imply a production and sale of 4,500 to 9,000 Mirt stoves each year by the 75 cook-stove artisans working in Oromia, Amhara and SNNPR (including Sidama).

The Growth and Transformation Plan (GTP – II) for Ethiopia specifies GoE objectives of an overall ICS target of 11.45 million additionally disseminated over the period 2015/2016 – 2019/2020, and the construction and operation of 250 briquetting plants. The GTP-II then provides the overall context of ICS promotion in Ethiopia. The project implementing agency report of August 2020 to *Irish Aid* speaks of Public RE Demonstrations (PRED) being conducted in Tigray and SNNPR to reach over 112,000 spectators but makes no mention of such demonstrations in other provinces. The sample of stove artisans and their customers interviewed across the regions during this evaluation had never heard of the Mirt stove being promoted on the radio and had never viewed a demonstration. The project implementing agency confirmed that the expected briquetting stations were not yet operational. The project implementing agency has not made any claims confirming or denying their contribution towards the achievement of the GTP-II's 11.45 million ICS as targeted by the present funding round. Based on available raw data it is not possible for the evaluation team, to confirm if these targets had been surpassed or even met over the three-year period up to February 2020, or with the extension through to December 2020.

3.2.2 Solar PV component

Key aspects of solar PV deployment for the “regulated market supported by the project are only apparent from careful study of secondary sources”, such as what is the baseline annual sales values. There is no apparent robust survey data on how long solar system batteries last, or what percentage of batteries are replaced versus the solar systems just stopping working and being abandoned or being thrown away. The unregulated market that the Tetra Tech for FCDO of February 2021 report states is around eight time larger than the regulated market was ignored and vilified in project literature. It is not apparent from the project and other sources literature reviewed to date what were the baseline⁶⁰ level, sales rate and compliance with Lighting Global quality standards of overall pico solar PV lanterns and plug and play SHS sold in Ethiopia, and what the current usage level is vis-à-vis kerosene and dry cell battery and payment for mobile phone charging. Hence the pertinent evaluation issue of what contribution the project made to pico solar PV lanterns and plug SHS changes during the project's implementation from February 2017 to date cannot be answered.

In terms of larger discrete component solar PV systems supplied to higher income households and institutions, it is very likely that in the great majority of cases that sufficient O&M funds

⁵⁹Financing Agreement between the European Commission and the Federal Democratic Republic of Ethiopia, Agreement number ET / FED / 038 – 370 signed on behalf of Ethiopia on 19 February 2016, p.9 of 11.

⁶⁰As of January 2017, when the EU funded Ethiopia project interventions started

cannot be found in the relevant regional Bureaus of energy, health, and education to keep the systems operating beyond their first technical issue, let alone to afford the inevitable battery replacement. Hence, donor or government provision of such larger discrete component solar PV systems generally does not lead to a sustainable system in practice.

Hence the relevant solar PV evaluation questions are:

1. what proportion of discrete component solar PV systems are continuing in operation (for the current and previous stages of EnDev Ethiopia) when technical issues arise, or when their batteries need to be replaced?
2. What contribution did the project make to pico solar PV lanterns, and packaged and plug and play SHS increased sales?
3. Are the claimed large proportion of pico solar PV lanterns, and packaged and plug and play SHS that are 'poor quality or counterfeit 'just of low output'⁶¹ or just not formally approved⁶²?
4. What proportion of discrete component solar PV systems are continuing in operation when technical issues arise, or when their batteries need to be replaced?
5. Are discrete component solar PV systems not continuing in operation when technical issues arise, or batteries need to be replaced due to a lack of: (a) suitable institutional management systems; (b) suitable local maintenance providers; or (c) intrinsic institutional affordability?

3.3. Stakeholder Analysis

The Government of Ethiopia, Ministry of Water, Irrigation and Energy (MoWIE) is responsible for the planning, development and supervision of the energy sector in the country, and for overseeing, among others, the Rural Electrification Fund, implementation of the National Electrification Plan 2.0 (NEP 2.0). Recently (2020), MoWIE also took over the mandate for planning and managing cooking related energy use. MoWIE is the designated official implementing partner for the project. The Regional Energy Bureaus of the provinces of Amhara, Oromia, Tigray and Southern Nations Nationalities and Peoples Region (SNNPR) / respective Regional Governments are co-implementers at the provincial/ regional level and are responsible for co-financing specific components of the interventions.

The Environment, Forestry and Climate Change Commission (EFCCC) is the nodal agency for coordinating UNFCCC / clean development mechanism (CDM) related activity in the country, as well as hosting the Designated National Authority (DNA). The commission provides support to the country's power sector, through amongst others, promoting the Lighting Africa / Lighting Global initiative. The commission used to hold the mandate of promoting ICS in Ethiopia, but this has recently (2020) been moved to MoWIE.

The Ethiopia Standards Agency (ESA) is another relevant organisation, through its role in adopting or developing suitable standards for ICS, pico solar PV, SHS packaged systems, and larger discrete component solar PV systems.

⁶¹ i.e., SE4All Tier 0 and maybe Tier 1, or Lighting Africa's/Lighting Global's "basic electricity needs (lighting and mobile phone charging)"

⁶² i.e., Lighting Africa/Global approved but not approved in Ethiopia?

The World Bank Group's (WBG) Lighting Africa and Lighting Global programme works to provide the 2/3 of the people of Africa (600 million people) without grid electricity with modern, high-quality off-grid lighting and energy products. This is to be achieved, in particular through meeting basic electricity needs (lighting and mobile phone charging) through quality-verified off-grid solar products. Lighting Africa is working in Ethiopia to support the importing of qualifying products, including quality verified solar lanterns.

The secretariat of the National Improved Cook Stove Programme (NICSP) was until late 2020 hosted within the EFCCC. MoWIE is currently in the process of taking over and reorganizing the national cooking activities under the Ethiopian Rural Energy Development and Promotion Center (EREDPC). The NICSP hosts and manages regional offices in the different regions of the country, helps build capacity, and coordinates the implementation of technology, market, measurement / reporting / verification. This is expected to be continued under the MoWIE REDPC regional setup. The government has included the dissemination of fuel-efficient and emissions-efficient ICS as a component within the public health programme, and hence health-sector extension workers also serve to promote the acquisition and use of ICS in various regions.

Another key stakeholder is the Energy Development Partners Working Group to get other development partners' views on the project design, implementation, achievements, and remaining challenges. Relevant development partners include UNDP, UNHCR, the UK's FCDO (formerly DFID), and EU Member State development agencies such as Irish Aid, Italian Cooperation, etc.

3.4. Methodology and Implementation

This evaluation was carried out according to the EU guidelines and methodologies –notably complying with Better Regulation Guidelines and Evaluation methods, scoping the whole results chain (intervention logic) and the OECD/DAC/EU quality standards and criteria for evaluation. The evaluation particularly focuses on the project's **outcomes and impacts** over time as well as developing key takeaways and lessons learned by understanding whether the intervention has worked or not and the reasons for its failure or success, thus making recommendations to improve the EU's future projects in terms of project development, planning, design, implementation, and evaluation. The evaluation serves as a **fact finding** and analysing exercise to help all stakeholders concerned learn from the experience.

The project is composed of three main interventions: the ICS; solar PV for pico solar, SHS and social institutions; and Micro Hydro Powered mini-grids which was later changed to solar PV powered mini-grids. The third component of solar mini grids is still ongoing and is envisaged to end in 2023, and as such will not be evaluated. As requested in the ToR, the Mid-term evaluation team (MTE Team) conducted a *de facto* final evaluation for the completed activities, specifically for **Component 1 (Improved Cook Stoves)** and **Component 2 (Solar PV)** of the project. The evaluation assessed each component against each Evaluation Question (EQ) to develop a complete disaggregated insight into the performance of the whole project being evaluated.

The evaluation was conducted with the full set of DAC criteria: **Relevance, Coherence, Efficiency, Effectiveness, Impact** and **Sustainability** as well as the EU specific evaluation criterion, **EU added value**. Towards this end, the evaluation attempted to develop a baseline of ICS and solar PV work in the country to attempt to project a counter-factual which would

serve as a benchmark for the current set of interventions. The **incremental** achievements (or otherwise) of the EnDev project phase were assessed based on such a counter-factual baseline.

Prior to the commencement of field work, the evaluation team undertook research to collate data and information from published sources and to design the detailed survey and the survey instruments based on the inferences to be drawn.

1. The “population” being surveyed included the people who benefitted from the **use of** the improved cook-stoves and solar PV systems in **three provinces** within the country targeted by the project (Oromia, Amhara and SNNPR including Sidama) – noting that the ongoing conflict in Tigray province precluded any surveys being undertaken there.
2. The “test group” (“sample”) was to be as **representative** as possible, and hence the evaluation team selected samples from across each of the regions.
3. The demographic details of the four provinces: dispersion by age, gender, education levels, income levels, vocation were analysed to the extent that such census data was available in the public domain.
4. The MTE team employed the solar PV distribution/market and stove producer locations as the “hub”, with the PV retailer / stove producer as the “anchor respondent” given that the pico solar PV systems are imported and that the Mirt stove is a concrete ‘ring’ that cannot be transported over long distances esp. on bad roads.
5. The field survey started by mapping the locations of the Mirt stove producers and then going on to identify end-users (for pico solar PV systems and stoves: “**clustered sample**”) around the importers/markets/producers at varying distances⁶³.
6. The “control group” of respondents consisted of the people characterized by the same set of demographic and income variables (“*ceteris paribus*: all other variables held constant”) but people who did not buy / use the ICS or the solar PV systems.
7. For the ICS portion of the survey, the team assessed the access to complementary goods: briquettes (price / pick-up location) and raw biomass / agriculture residues (free of cost / distance to be covered) and their influence in the buy / use decision.

The evaluation **also considered whether cross-cutting issues were mainstreamed** (how much and how well) in the implementation of the programme, its governance and monitoring. These cross-cutting issues were gender, environment, climate change, SDGs and their inter-linkages, the principle of “leave no-one behind” and the rights-based approach methodology. The evaluation team gave due consideration to **EU visibility**, as an intrinsic element of each action financed by the EU.

3.5. Project Implementation Schedule

The evaluation process was carried out in consecutive phases: **Inception, Field, Synthesis.**

Due to international travel and quarantine constraints and high health risks because of the Covid-19 pandemic, the MTE KE1 expert was unable to travel in person to Ethiopia for the field phase. The KE1 joined as many meetings as practical virtually where internet connections

⁶³ Charity Garland, Michael Johnson, Kirstie Jagoe and Tara Ramanathan (2016) *Cookstove Field Study Resources: Information, Tools and Sample Forms for Researchers, Communities and Organizations*, Clean Cooking Alliance, <https://www.cleancookingalliance.org/binary-data/DOCUMENT/file/000/000/485-1.pdf>, last accessed 11 June 2021.

and time zone time differences permitted such participation; KE1 and participated in frequent debriefs with the KE2 (and colleague) undertaking the field phase. The KE2 expert travelled to Ethiopia for the field phase on the 30th of April and undertook seven days of self-quarantine upon arrival as required by the regulations prevailing in Ethiopia at the time. The field mission was restricted to Addis Ababa, SNNPR, Oromia and Amhara – and KE2 did not undertake field visits to Tigray Province, given the ongoing conflict in the region. Within Ethiopia, the KE2 (and colleague) made their own arrangements for logistics within the country, security arrangements, setting up of respondent interviews and scheduling field visits, two-way translation, food and beverage supplies and all other arrangements that were required for smooth and safe completion of the field work. The field mission was completed by 20 May 2021 and the KE2 (and colleague) returned to India by 22 May 2021. The field mission program as implemented – including the list of online interviews – is presented within **Annex 1**.

3.6. Survey: Methodology, Design, Implementation, Data and Analysis

The overall objective of the EU-funded intervention was to increase the sustainable access to *modern energy* in Ethiopia through market development for *modern energy technologies and services*⁶⁴. As stated within the project’s documentation, the achievement of this overall objective was to be assessed through the commercial dissemination of improved cook stoves (ICS), measured by stove sales and market trends (stove sales, sustainable market development and reduced emissions). Further, project performance and sustainability were to be measured by the *increase* in annual ICS sales, the quantity of briquettes “commercialized” each year, and by ensuring that at least 90% of trained stove producers and briquette marketers remained in business. Similar parameters and measures were specified to assess the performance of the solar PV component of the initiative. In promoting the adoption of solar PV systems, retail solar shops with trained technicians capable of attending to complaints within 24 hours of receiving a call, technicians to be trained and adequate market awareness created, leading to installations in social institutions, sale and installation of solar PV home systems (SHS) and pico-solar systems.

The projected outputs from the project included (at the time of launch in early 2017) enhancing stove production, establishing charcoal/(briquette) production plants, and designing and implementing financing mechanisms for stove production [units / entrepreneurs]. “Market analysis should [therefore] be an integral part of the monitoring, evaluation and reporting systems⁶⁵ and the overall project cycle of EnDev...even if measurable, the question remains whether the action – causality relationship can be established ex-post.” This NL Agency / GIZ report on assessing the establishment of a self-sustaining market, whose part-title reads “Indicators for Energizing Development”, merely recommended that indicators had yet to be chosen to aid in outcome, impact / sustainability monitoring and then went on to recommend “operationalization” of such indicators. Despite the report’s title reading “Measuring Market Development”, the said report is of little use in actually measuring market development outcomes or in comparing such outcomes with *ex ante* targets.

⁶⁴ European Union Grant Agreement for Pillar Assessed Organizations, dated 18 Jan 2017, Annex 1: Comprehensive Work Programme / Logical Framework, p. 34-35 of 36.

⁶⁵ Ilka Neyla Buss (2013) “Measuring Market Development: A Framework and Indicators for Energizing Development”, Netherlands Ministry of Economic Affairs / GIZ, p. 7 and 8 of 95.

Estimating the benefits delivered by the EU project funding in Ethiopia, and attributing the outcomes to such funding, in isolation, would implicitly involve assuming that other variables affecting residents had remained constant over time. However, in reality, other social and economic parameters vary over time, while other development partners were also engaged with similar interventions being implemented in Ethiopia over the same time horizon. The methodology therefore began with attempts to construct a counter-factual scenario to map the evolution in ICS / PV usage over the period (2017 – 2020) and to assess the *incremental* benefits delivered by the EU funded project. Assuming that the two groups of residents – project beneficiaries and those excluded by the (PV or ICS) project – were faced with similar social and economic conditions prior to 2017 and that all other social, geophysical and economic parameters would impact the two groups of people in exactly the same manner. During the early stages of survey design and implementation, the “non-beneficiaries” were presumed to represent the counter-factual scenario.

Further, the *stove performance and emissions test* conducted in December 2019 had employed the 3-stone open fire stove as the baseline to benchmark the performance of the “Improved Cook Stoves” including the Institutional Mirt Stove (IMS) and the Institutional Rocket Stove (IRS). Such benchmarking meant and implied that the IMS / IRS / other were being promoted to displace the 3-stone open fire stove, and consequently to lower the fuel use and to lower corresponding emissions⁶⁶; (emission reductions computed under test conditions might themselves have been marginal but aggregating such estimates at the field / user level would not just be challenging but also unscientific for reasons discussed subsequently within this report). The evaluation’s field survey of ICS producers and customers was therefore originally structured to gather data to help undertake a **before-and-after comparison** of welfare outcomes between “project” and “control” households – respectively, households *acquiring and using the ICS and those that did not acquire and use the ICS*. Data relating to conditions prevailing prior to acquisition were to be drawn from respondent memory. This inter-temporal comparison of welfare outcomes between “project” (“test”) households and “control” households formed the basis of the difference-in-difference estimate. The incremental impact of the EU funded project’s initiative was to be evaluated in terms of the difference between relevant outcomes for the two sets of habitations across the two points in time.

However, despite best efforts, the evaluation team could not access recent demographic census data for dispersed and rural settlements (especially those with populations less than 20,000 persons) that would have been necessary to select a representative sample of end-use customers and non-customers.

Additionally, since during the early stages of the field survey it was observed that (i) **the Mirt stove did not really displace the 3-stone “open fire” stove**, or for that matter, any of the other incumbent cooking options, and (ii) since the Mirt stove was merely an add-on to a portfolio of cooking options within households / commercial establishments (“the test group respondents”), and (iii) since respondents rarely offered specific responses to questions relating to incomes and costs, the *before-and-after* assessment of the economic and social returns from the initiative could not be completed. Given the apparent minimal *net* benefits delivered from employing the Mirt stove, the non-adopter households (“the control group”) did not see any merit in adopting the Mirt stove. For the foregoing reasons, the difference-in-

⁶⁶Egzieryalew Ayele (2019) “A Report on Water Boiling Test on IRS and IMS”, GIZ / EnDev, p. 12 of 21.

difference approach as originally proposed to assess the change in well-being between the test group and control group respondents was not implemented.

The disconnect among the premise, the solution, the activity and the eventual outcomes, the ambiguity in data and measurements and the use of selective reporting appears to be endemic to the program's implementation, as exemplified by the disconnected and selective assertions made within the August 2012 brochure brought out by GIZ / EnDev. *"In Ethiopia, biomass is widely used for cooking⁶⁷ and people do this beyond sustainable yield. The extraction of firewood for cooking is an important source of deforestation. The rural population chops more than 150 thousand hectares of trees every year and uses it as firewood. Today, less than four percent of the once abundantly forested country is covered with trees. EnDev concentrates on the introduction of fuel-efficient cooking stoves."*

The widespread use of biomass for cooking certainly appears to be true, while claims relating to extraction "beyond sustainable yield" need to be quantified and verified. Likewise, "the extraction of firewood for cooking" might be an important source of deforestation but it is certainly subordinate to the extraction of timber for construction, clearing forest land for agriculture, using timber for transmission networks and for other applications which are not mentioned in the brochure. The rural population might be chopping 150,000 hectares of trees every year – but claims relating to the *exclusive* use of such wood to meet cooking needs appear to be a stretch especially given the extensive use of dung cakes as fuel to supplement fuel-wood use– and such claims need to be quantified and substantiated. Additionally, these assertions do not mention the plantation and regeneration of eucalyptus, casuarinas, pine and other species that provide timber for construction as well as for cooking fuel⁶⁸. While the brochure asserts that *"EnDev concentrates on introduction of fuel-efficient cooking stoves"*, it says nothing about the specific activity, the output, or the outcome in terms of displacing the incumbent cooking options, or reducing aggregate fuel-wood use, aggregate emissions or of lowering the rates of deforestation.

The evaluation team had originally planned for the field visit to kick-off from briquetting stations (as "anchor respondents") for the ICS component and had requested for the information relating to the locations and operations of the stations. The project implementing agency informed the evaluation team in April 2021 that none of the briquetting stations were operational and that there was nothing for the evaluation team to visit and observe⁶⁹. Therefore, fuel supply arrangements from before the intervention were assumed to continue during the period 2017 – 2020 (and into year 2021 at the time of the field survey). Further, if one were to assume that a Mirt-stove (with or without the chimney) constituted "modern energy technology" as specified in the logical framework forming part of the EU Funding Agreement⁷⁰, and if one were to attempt to assess the state of "market development" for such a technology

⁶⁷ EnDev (2012) *Energizing Communities in Ethiopia*, Project Brochure, p. 19 of 23.

⁶⁸ See for instance the UN Food and Agriculture Organization's notes on natural forests, plantation forests, trees outside forests, and demand and supply of wood: <http://www.fao.org/3/ab582e/AB582E04.htm#588>.

⁶⁹ The evaluation has not received information on whether EU funding supported any briquetting stations or whether such support (to stations that were not operational at the time of the evaluation) was received exclusively from Irish Aid.

⁷⁰ SNV Ethiopia, Ethio Resource Group and Megen Power (2018) "Review of Policies and Strategies Related to the Clean Cooking Sector in Ethiopia", Strengthening the Enabling Environment for Clean Cooking Project, opine that when compared against standards defined by the Global Alliance for Clean Cook stoves, the Mirt and the Gonzie would be classified as "not efficient" and "not clean", falling under "Tier 0" on efficiency of fuel use and indoor air pollution.

option, a good starting point would be to plot the demand function for the stove to establish a relationship between the numbers of stoves sold over the years and the corresponding price points. The sales data provided by the project implementing agency was analysed for the three provinces – Amhara, Oromia and SNNPR (including Sidama) – to try and define a demand function and to examine the possibility of the market’s ability to discover prices for the quantity of stoves consumed. The plot of the demand function is presented within **Figure 4**. The Mirt stove does not appear to demonstrate a “downward sloping” demand pattern consistent with a mature market for “normal” goods, with the superimposed trend-line exhibiting a mere 3% in explanatory power. **The quantity sold and the corresponding price did not appear to be driven by market circumstances.** This hypothesis, based on the sales data provided, fed into the design and implementation of the survey.

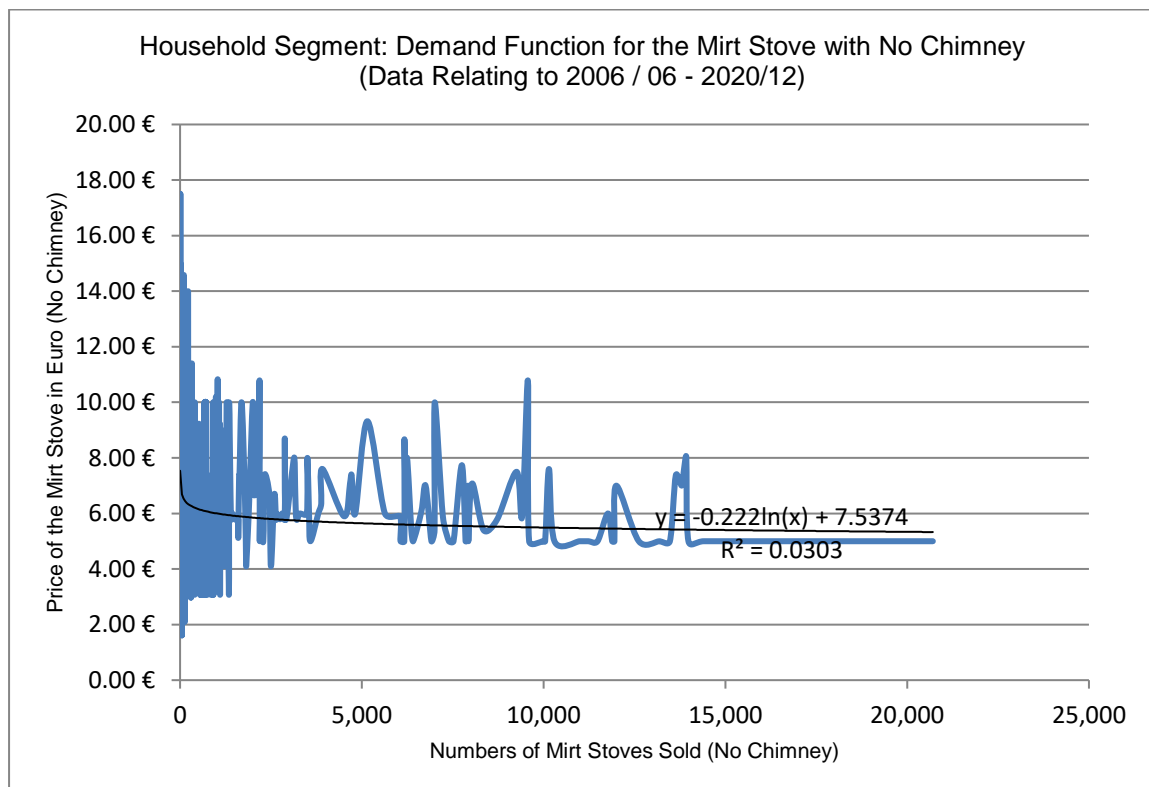


Figure 4: Demand Function for the Mirt Stove (without Chimney) based on quantity and price data over the years 2006 – 2020: Source: Report Authors

The following are the observations / data from interviews with cook stove artisans:

- All the cook-stove artisans randomly selected from across regions and towns as “anchor respondents” were Mirt stove producers.
- Some of the cook-stove artisans visited by the evaluation team were already producing the Mirt stove before being sent for project supported *woreda* training, while few of the others worked as masons. Some of the artisans were picked up at random and nominated for training.
- At the time of being invited for the training, the artisans were promised a wheelbarrow, screens and other implements, and 1,000 kg of cement as seed capital. None of the trainees reported having received these inputs.
- One anchor respondent visited had received a shed contracted for construction by the project implementing agency and was informed of at least six other artisans having received such a shed each. The design of the shed had not

- taken the end-use requirement into view and hence did not serve the purpose of securing his material and implements.
- e. Project implementing agency personnel spoke to the trainees over the phone to record half-yearly sales data and prices. Artisans reported that they struggled to work simultaneously on production operations and on sales and marketing and requested for support from the woreda / project implementing agency. Anchor respondents had hoped for visits by the project implementing agency representatives for personal interaction.
 - f. None of the Mirt stove producers interviewed had ever been visited by project implementing agency personnel.
 - g. **Across all the stove producers visited, the price at which the Mirt stove was retailed did not reflect the total direct and indirect costs of production, transport, and installation.**
 - h. The Mirt stove producers sold between 5 and 10 stoves each month⁷¹, on average, earning between ETB 50 and ETB 100 in gross margins (over cement + sand costs).
 - i. After the training, Mirt-stove production continued to serve as a subsidiary activity for all of the respondents. Each of them derived sustenance from other mainstream commercial activity including building construction, beer brewing, livestock rearing etc.
 - j. The management / book-keeping training provided did not help them arrive at a cost-plus pricing formula for their product. Further, some of the producers interviewed were convinced that the money they lost on each individual unit could be recovered from growing production volumes (!)
 - k. In the months leading up to May 2021, all the stove producers had suspended production because cement was in short supply and price of cement had almost doubled within a short time horizon. Artisans believed that their respective market segments could not absorb the higher prices of the Mirt if the artisans were to embed the higher prices of cement into their product prices.
 - l. **Mirt stoves did not in fact displace the incumbent 3-stone stove options.** The Mirt stove was often an add-on to the existing portfolio of cooking options, which included the 3-stone stove option that continued to be used alongside the Mirt stove.

The following are the observations / data from interviews with Mirt stove end-users (test group) and from the households that did not acquire the Mirt stove.

- a. Mirt stove users were largely women and all the women interviewed had attended middle or high school. Women with higher education levels chose the Mirt stove with the chimney.
- b. Respondents from both groups confirmed separate / standalone kitchens.

⁷¹ (i) The lack of demand for Mirt stoves, (ii) the producers' need for support with sales and marketing, and (iii) the recommendation to **not train additional Mirt stove producers until significant demand warranted such addition in production capacity**: was highlighted by Accenture / The Global Alliance for Clean Cook-stoves way back in July 2012. The report also recommended improving the selection criteria of Mirt stove trainees and strengthening the production management, distribution, sales, marketing and finance components of the training program. Ref Accenture (2012) "Enhancing Markets for Improved Cookstove Development and Promotion Support in Ethiopia", Global Alliance for Clean Cookstoves, 10 July, p.63 – 64 of 114, https://www.cleancookingalliance.org/resources_files/ethiopia-market-assessment-report.pdf

- c. The test group households tended to be larger homes – with 3 out of 4 respondents confirming that their homes had 3 rooms or more – while almost 3 out of 4 control group respondents confirmed having 2 rooms or fewer.
- d. All the respondents – test and control groups – had heard of the Mirt stove from their neighbours or from the cook-stove producer; none had heard of a radio advertisement or a demonstration; none had attended focus group discussions.
- e. In all cases, the stove producers convinced the end-users to acquire and use the Mirt stove through their own social interactions and personal contacts.
- f. All the respondents had paid for the Mirt stove from personal funds and savings.
- g. A large proportion of the test group households paid for fuelwood, while a large proportion of control group households used dung cakes or gathered fuelwood in the form of branches and other residues left at construction sites. None of the households surveyed used fuel briquettes.
- h. All the respondents in the test group employed multiple stoves (monthly fuel bill for averaged at ETB 618), while roughly half the households among the control group employed multiple cooking options (monthly fuel bill averaged at ETB 511).
- i. On average 5 of 6 test-group respondents confirmed satisfaction with the time saving, safety and efficiency of the Mirt and were happy with the price paid for the Mirt stove (the price itself fell between ETB 270 and 600).
- j. Not only did the Mirt stove *not displace* the traditional 3-point option, the acquisition and installation of the Mirt led to increased usage of the stove itself, referred to as “rebound consumption” in literature⁷², leading to an increase in aggregate consumption of biomass fuels⁷³.

Employing the “control group” as a surrogate for a counter-factual and computing the difference-in-difference was assumed to eliminate outcomes that might have materialized independent of the intervention. In the present context, however, the Mirt stove (as used by all the anchor respondents interviewed) did not displace the incumbent options but was an add-on⁷⁴. Hence, the aggregate fuel consumption and monthly fuel-related expenses were known to *increase* by the amount of the fuel consumed by the Mirt stove. For the same reason, the control group respondents didn’t feel a compelling need to acquire and use a Mirt stove in

⁷²Zulfikar Yurnaidi and Suduk Kim (2018) “Reducing Biomass Utilization in the Ethiopia Energy System: A National Modeling Analysis”, *Energies*, 11, 1745; doi:10.3390/en11071745.

⁷³ Multiple stove use (“stove stacking”) is a common practice in Ethiopia: Mesafint Molla Adane, Getu Degu Alene, Seid Tiku Mereta and Kristina Lutomya Wanyonyi (2020) “Facilitators and Barriers to Improved Cookstove Adoption: A Community-based Cross-Sectional Study in Northwest Ethiopia”, *Environmental Health and Preventive Medicine*, 25:14, p. 1 – 12.

⁷⁴ This line of thought relating to the efficiency of the Mirtstove relative to the 3-stone stove has been pursued by others as well, without necessarily validating the prospect of displacement of the incumbent by the Mirt stove. Yibeltal T Wassie and Muyiwa S. Adaramola (2021), for instance, in their paper “Analysis of Potential Fuel Savings, Economic and Environmental Effects of Improved Biomass Cookstoves in Rural Ethiopia”, *J Cleaner Production*, 280, p. 1 – 14, claim “the results showed that compared with the traditional open fire tripod; the use of ICSs could reduce household’s fuel-wood consumptions on average by 1.72 – 2.08 tons per household per year. These fuel-wood savings translate to potential emissions reductions of 2.82 – 3.43 tCO₂e per stove per year.” **They implicitly assume displacement of the incumbent by the Mirt stove and do not provide for the fact that the “traditional open fire tripod” continues to be used after the acquisition and installation of the Mirt stove – given that the two cooking options offer totally different services.**

addition to the existing stock of their cook-stoves (stove “stacking” as the use of multiple cook-stoves is reportedly a common practice in Ethiopia).

As for the end-users, analysis of the responses to the questionnaire survey and of the opinions expressed during interviews revealed that end-users did not necessarily value the Mirt stove as a standalone physical asset with intrinsic worth, but more as the means to an end. The perceived value was further conditioned by the rigidity in “*injera* only” purpose-specification of the Mirt stove, and the [low] frequency of its use by the median end-user. ‘Look and listen’ survey data and opinions aired during personal interviews revealed that, invariably, the Mirt stove was used twice a week by each household⁷⁵ on average, or less frequently. Other cooking options including the three-stone option, the sheet-metal covered clay stove (Lakech / Gonzie⁷⁶ / Tikikil Rocket Stoves / other) were used more frequently for all non-*injera* cooking, coffee warming and for other applications. In effect, the Mirt stove that was actively promoted by the producers was an add-on to the existing portfolio of cooking options, and in rare instances, the Mirt stove had helped replace an existing Mirt stove.

Householders and some of the producers alike observed that the chimney as supplied alongside the Mirt was not designed in view of the site conditions in customers’ homes, and was over-specified, heavy, clumsy, and with sections of the chimney falling to the ground and breaking into pieces during installation, or shortly after. Further, in kitchens where the walls were built with brick and mortar, the householders chose not to puncture the wall to install the chimney, while in other situations, the timber and manure walls were not designed to support the loads imposed by chimney sections.

Higher school attendance of boys and girls through improved air quality, enhanced educational attainment, improved health and nutrition are social returns that indirectly feed into economic outcomes. In principle, therefore, the overall economic returns to Mirt stove acquisition and utilization – and the displacement of the 3-stone or other rudimentary incumbent options – could be estimated by cumulating the gains from fuel saving, lower expenditure on healthcare, lower losses in income due to ill-health and other similar monetary measures.

In practice, however, the Mirt stove producers interviewed were unable to recover the indirect costs (water, electricity, labour, and transportation) and administrative overheads (space rental etc.) and consequently were losing money on each Mirt stove sold. This weakness in arriving at the appropriate levels of ‘cost+’ pricing for the Mirt stove might also apply to other Mirt stove producers not interviewed but who were faced with similar socio-economic circumstances. **Unfortunately, the losses incurred by the producers were not known to result in corresponding gains for the customer households either**, given the increased fuel-use from employing an additional stove in the kitchen, insufficient evacuation of the smoke from the new Mirt stove, and the continued use of the 3-stone or other incumbent option for non-*injera* cooking. In reality, the tangible monetary benefits derived by residents could be

⁷⁵ This is consistent with the finding of Abebe D Beyene *et al* (2015) of the World Bank cited previously.

⁷⁶ The *Gonzie* stove is supported by the World Bank / InfoDev / Climate Technology Program with funding from U.K.’s [erstwhile] Department for International Development (DfID), Australia’s Department of Foreign Affairs and Trade (Australian Aid), Denmark’s Ministry of Foreign Affairs (DANIDA), Norway’s Ministry of Foreign Affairs, and the Netherlands’ Ministry of Foreign Affairs: “Green Entrepreneurs Bring Clean Cooking to Ethiopia”, 21 July 2017, <https://www.infodev.org/articles/green-entrepreneurs-bring-clean-cooking-ethiopia>, last accessed 14 June 2021.

small (or negative) relative to the cost of the Mirt stove, even when the latter is apparently sold at a discount.

3.7. Summary Findings

The evaluation team has not sighted process maps developed to guide implementation of the present program: such maps would, ideally, lay out a coherent program specifying activities to be implemented and ends to be achieved, the agencies responsible to lead and manage such process steps / activities, the inputs to and outputs from each process-step, the documentation trail that would record such inputs, outputs, resources allocated and controls, and finally, the prospect of attribution of achievements⁷⁷. The evaluation team has not come across a mention of such a process map in other literature accessed or project documentation received from the project implementing agency. EU funding was intended to achieve “market development” for “energy technologies and services”. Towards this end, the *woreda* level and region-level bureaucrats, the nodal Ministry at the central level, project implementing agency, and private sector participants are reported to have been implementing activities within their respective domains. Literature reviews and the field mission have been unable to attribute specific activities, outputs or accomplishments to the individual agencies involved, and by extension to the EU funding provided for the stated purpose.

Worse, in some cases, the Mirt stove artisans were nominated for training as a substitute for the seed-capital – cement, wheelbarrow, shed etc. promised to them, and that the Mirt stove artisans had been expecting. In the case of the supply of PV hardware to social institutions, the project implementing agency have devolved unto themselves, and by extension, to the equipment suppliers, a two-year warranty, following which all responsibilities for upkeep were shifted to the government agencies concerned. There was no evidence sighted to suggest that the government agencies concerned were adequately equipped with the skills, or suitably endowed with the budgets, required to take on such responsibilities.

3.7.1 Mirt Stove component

Given this evident inadequacy in planning, the program implementation has been characterized by **significant role ambiguity**, with the project implementing agency team playing counterparty to the government in seeking specifications and inputs for supply of equipment and services, and then contracting with the private sector on behalf of the various levels of government for the supply of such services and hardware. Yet, the value added from such intermediation is unclear. For instance, despite the fact that the low demand for the Mirt stove in the market⁷⁸, and the unattractiveness of Mirt stove production had been flagged as early as year-2012 by the Global Alliance for Clean Cooking / Accenture, the EU funded project team has persisted with adding production capacity – without confirming the need for doing so – during the EU funded project starting February 2017. Further, despite the

⁷⁷ See for instance Integrated Definition Methods: Function Modeling Method: https://www.idef.com/idefo-function_modeling_method/.

⁷⁸ Accenture (2012) “Enhancing Markets for Improved Cookstove Development and Promotion Support in Ethiopia”, Global Alliance for Clean Cookstoves, 10 July, p.63 – 64 of 114, https://www.cleancookingalliance.org/resources_files/ethiopia-market-assessment-report.pdf

highlighted need for sales and marketing support and for more intensive training in management processes, in the case of the Mirt stove artisans, apart from collecting sales data from time to time, the project has had no evident role to play in hand-holding the artisans post their training. This is even though the Logical Framework calls for quarterly field visits to gather beneficiary and stakeholder feedback, and bi-annual supervision missions, and annual rapid assessment missions. The evaluation team has not seen evidence that such field missions and rapid assessments were indeed undertaken, or that the data compiled to draw inferences for the project's implementation, or to guide planning for subsequent initiatives.

In computing fuel savings and emission-reductions the Mirt stove is incorrectly benchmarked against the "traditional" three-stone open fire option, because the latter continues to be used even after the acquisition of the Mirt stove. Across regions, many rural households visited used cow dung cakes as primary or supplementary fuel: this further reduced the extent of deforestation attributed to fuel wood use for cooking. This aspect is not accounted for in the project documentation and reports developed prior to this evaluation. Consequently, the assumptions relating to (i) fuel saving from using the Mirt stove, and (ii) of the smoke being evacuated from the kitchens (which is not always the case because the chimney in some cases would terminate within the kitchen itself), (iii) of the improved air quality, and (iv) the program's contributions to avoiding deforestation and to mitigating global emissions and climate change are likely to have been **significantly exaggerated**.

Further, **defining the Mirt stove in isolation (and equally solar PV systems) within an individual household as the project boundary for such assessments could be considered unscientific**, as the emissions from the whole of the EU funded project's implementation – including project-related air and surface travel, emissions from import of equipment by sea, emissions attributed to energy use at the various project offices and the like, need to be quantified to assess the genuine impact of the project as a whole in mitigating emissions in the country. When specified in detail and appropriately quantified, it might well be revealed that the project-related travel and energy-use more than compensated for the marginal mitigation in emissions, if any, from the use of the Mirt stoves sold in small numbers each month by the 75 producers working in the 3 regions surveyed, and equally for the project attributable increase in solar PV systems for their 2-year lives.

Above all, the training programs aimed at developing cook-stove artisans – predominantly the Mirt stove – and the "authorization" accorded to *what appears to be randomly nominated* and "trained" solar PV retailers have resulted in the creation of **local monopolies**. The cook-stove prices were regulated by the artisans' own perceptions of the limits to their customers' willingness-to-pay for the stove. In the context of the PV retailers, having created the localized monopolies "authorized" to retail imported PV hardware, and guided by outdated and imperfect information, regional governments appear to have resorted to arbitrarily regulating the prices at which such PV equipment could be sold. In either case, the local monopolies are unable to distinguish their offerings in the market, and end-use customers have had little say in choosing a vendor or a product of their liking, or in arriving at the price paid for the product made available to them. While the stated objective might have been creating a competitive market to offer a wider choice-set for the end-customer, the project implementing agency's ongoing program has moved in the exact opposite direction, and **the program has resulted in restricted choices with an unresponsive homogenous product portfolio sold at cost-plus prices that accommodate significant value-chain inefficiencies** to be borne by the poor rural residents of Ethiopia.

The market structure that has progressively evolved is a direct consequence of the nearly random selection process, picking on average, one stove artisan trainee or one solar PV retailer trainee from a town. Given the wide geographic dispersion, and the small size of each vendor's operations, it is impossible for their territories to overlap, and consequently for the PV retailers / Mirt stove artisans to compete against each other to provide a product / service or price for the end-users. This geographic spread has also made it difficult for the *woreda* / project implementing agency personnel to interact more closely and more meaningfully with the entrepreneurs post their training. None of the cook stove artisans interviewed, for instance, confirmed being visited in person by a project implementing agency representative for post-training follow-up.

An end-to-end view of the value chain, beginning with an identification of end-user needs and an understanding of end-user circumstances – and moving backwards, culminating in designing a responsive product or service, supported by the supply of complementary goods and services⁷⁹ – would have created a more streamlined and contiguous picture of the value chain. This would have helped with identifying the right product portfolio and the right price points to deliver the desired outcomes for the end-users. The project would have then identified the missing links in such a value chain and intervened more meaningfully and more systematically to make a positive impact on the ground. Such an organized approach would have resulted in a streamlined process map providing for the allocation of responsibilities and resources and thereby enhancing accountability at each step of the process.

3.7.2 Solar PV component

The evaluation team visited the Jarso Health Center equipped with a project implementing agency sponsored 1,200 Wp PV system supporting several refrigerators and a set of lights. See Pictures 2 and 3 as below. The evaluation team also visited the Dumburii Health Post supplied with a 600Wp system supporting the lighting loads and mobile phone charging at the Post. The *woreda* personnel concerned were supposed to have filled in questionnaires to justify the supply of the PV systems to these institutions, and in-turn, the hardware was supposed to have been customized and supplied in response to the data received. The evaluation team requested copies of the questionnaires and for sample responses received from *woreda* personnel concerned. Even as the documents requested were awaited from the project implementing agency, discussions with project implementing agency personnel revealed that, notwithstanding any questionnaire derived information, the PV systems were supplied to relevant institutions in standard 35Wp, 600Wp, 1,200Wp and 2,400Wp capacities to cover their assumed present and future loads. The larger systems utilised 2V VRLA (valve regulated lead acid) gel batteries, modules connected in series to add up to 12 or 24 or 48V and had relevant attendant power electronics and controls. See Pictures 2, 3 and 4 as below.

⁷⁹ “Unfulfilled customer needs exist because of a lack of product innovation arising from limited capacity to evaluate and execute ideas as well as the absence of suitable feedback loop that allows people at the top to understand customer needs and preferences. It is critical to continuously improve product designs as this helps to ensure that customers' needs are being met.” In addition, the year-2012 report by Accenture / Global Clean Cooking Alliance, cited previously, had highlighted the need for specialization of labor and the coordinated distribution of stoves and fuels (page 21-22), sales support for producers, stove demonstrations, and cost-effective / targeted marketing (page 23).



Picture 2: Battery connected in series and the power electronics installed at one of the larger capacity system sites visited by the team

For the EU funded SI solar PV systems implemented under EU funding, the project implementing agency provided only four (4) types of generic systems⁸⁰. For the larger capacity three (3) types of system, the project implementing agency purchased the components in Germany, shipped them to Ethiopia, provided training to the regional energy bureau who supervised the installations but who provided essentially no follow up O&M services - in particular for the critical short (2-year warranty) life VRLA batteries in larger systems. It is not clear where the 62 sets for 39 SI sites of LFP battery DC SHS by Fosera (with 3-year OEM warranty) or ovCamp (with a 2-year battery warranty) plug-and-play 35Wp capacity systems were purchased from, or for how much.

The project implementing agency were aware of the option of using 10-year warranty LFP (LiFePO₄) batteries in the larger three sizes of systems but did not pursue this⁸¹. It would have still been possible to still install 100 systems (as per the specific SI solar PV installation numbers in the FA) with fewer larger systems using higher cost long life LFP batteries and with a higher proportion of the smaller capacity plug-and-play smaller systems that were already being supplied with LFP batteries. Meantime, there are several suppliers in Ethiopia who are capable of: sizing the larger systems more accurately for actual site needs and O&M funding capacity; sourcing and importing suitable quality solar PV products if the donor provides the foreign funds; installing the systems; providing ongoing O&M; providing suitable replacement lead acid batteries. These suppliers in Ethiopia are already actively promote the use of longer life LFP battery options⁸².

⁸⁰ 30 Wp plug-and-play systems with 12 V Li Ion batteries, and 600Wp, 1200Wp, and 2400Wp with 12, 24 and 48 V VRLA battery banks, and using 6,12 or 24 2V Hoppecke or BAE 2V solar cells in series.

⁸¹ The project implementing agency considered that the extra cost of using LFP batteries would have precluded the delivery of the stated 100 SI systems— as per personal communication from the project implementing agency.

⁸² This was reported in an interview with a major solar system supplier in Ethiopia, and this could also have been corroborated by searching supplier websites for other Ethiopian Solar system suppliers as was done by the MTE team.



Picture (set) 3: The MTE team interviewing the Health Center staff in Jarso (top-left), the 1,200Wp Solar PV array at the Jarso Health Center (top-right); the refrigerators in use at the Jarso Health Center (bottom-left and bottom-right)

The key life limiting component of any standalone solar PV system is widely known⁸³ to be the batteries, and specifically the type and specifications of the batteries supplied and how they are used. For larger solar system VRLA batteries, the limitations on battery life are battery quality, how much the batteries are discharged in their daily duty cycles as measured by their average depth of discharge (DoD), the ambient temperature, the battery charging regime and how fast the batteries are discharged. With most of Ethiopia having a temperate climate, good quality batteries being used, suitable professional installations (as appears to be the case with the larger EU funded installations) and suitable battery management systems (BMS) being used, the DoD is then the primary deciding factor in battery life. At the assumed 60% DoD value used⁸⁴, the specific large systems' VRLA batteries supplied⁸⁵ would have a life of 1700-2300 cycles (4.7-6.3 years a 365 daily cycles per year), while at 80% DoD the life would be 1200-1600 cycles (3.3-4.4 years) depending on the two brands of batteries used and all at an ambient air temperature of 20°C. It should be noted that DoD of over 80% is stated by the

⁸³ The project implementing agency had already installed 244 SI solar PV systems by the time the International Procurement Specifications for the EU funded project were finalised.

⁸⁴ It was confirmed by the project implementing agency that no measurements had been done of actual DoD levels in SI systems in Ethiopia. Equally it appears that actual battery lives in the field are also unknown as no follow up site visits or calls are done past the one-year handover check.

⁸⁵ BAE Secura PVV Solar VRLA-GEL battery 2v, 729Ah @C10 and HOPPECKE sun | power VR L 2 -750. The project implementing agency international procurement specifications published in December 2018 specified VRLA (gel), 2V cell, 682Ah@C10 batteries with Life cycles of a minimum of 2,300 cycles [6.3 years] at 60% depth of discharge and 1,500 cycles [4.1 years] at 80% depth of discharge at 20°C.

manufacturers as to be strongly avoided as it would lead to very much shortened life and the batteries would then be outside their warranty conditions. Actual in the field large capacity systems' battery lives are unknown⁸⁶ but is assumed to be 2 - 6 years⁸⁷, but could be even less if the “free” donor electricity supply was overused (for neighbouring village mobile phone charging etc) or wasted (with all lights being left on for the whole night or electric cooking stoves being used etc) due to a lack of user understanding or a lack of user ownership – both of which can be expected.

Very long lifetime LFP batteries suitable for larger capacity SI solar PV applications have been commercially available since early 2017. Two OEM LFP battery suppliers, Simpliphi and Discover AES, offer LFP batteries for solar systems at a warranted 10,000 cycles at 80% DoD, a 92-98% round trip efficiency (RTE) compared with around 80% RTE for VRLA batteries. And by eliminating cobalt, the risk of thermal runaway, fire propagation, operating temperature constraints, and toxic coolants are reduced. Hence there are no toxicity risks if such dead batteries are discarded in the field, as is most likely the case for most of the SI solar PV systems installed by donors to date in Ethiopia given the small number of solar system batteries recycled to date. The LFP batteries come with an integrated Battery Management System (BMS) and can deliver 100% DoD.

The best lifetime LFP batteries are projected to have a 20–25-year calendar life. If best lifetime LFP batteries had been used, then one would have had complete solar PV systems that should be able to operate for 20-25 years with only routine maintenance of cleaning solar panels and maintaining electrical connections. This would then avoid the intractable problems of who pays for the periodic 2-to-6-year VRLA battery replacements, and the current reality that that 80% of larger SI systems and nearly 100% of smaller plug-and-play SI systems and 100% of pico solar lanterns and SHS will be abandoned or discarded in the field after 2-6 years of use when their batteries fail. Longer life LFP batteries were commercially available in suitable capacities from 2016⁸⁸. A change to longer life LFP batteries could therefore have been accommodated before the larger SI solar system components were ordered in Germany from October 2018.

For pico solar PV systems, the project supported activities were aimed at a small subset of the private sector supply chain, which was those suppliers who were “approved” and were therefore supported as quasi-monopoly suppliers and who were observed in the evaluation's site visits as being able to charge higher prices than the informal sector's pico solar PV suppliers. The project implementing agency supplied the evaluation team with 2012-2020 Pico PV HH (Household), Pico PV SI Pico PV PU (Productive Uses), SHS HH, SHS SI, and SHS PU 6-monthly sales data covering the period from June 2012 to Dec 2020⁸⁹. However, it is unclear what contribution the project implementing agency efforts made to these sales, as the

⁸⁶ It is understood that the project implementing agency have not confirmed actual DoD values in the field for their systems supplied in Ethiopia – as per personal communications from the project implementing agency.

⁸⁷ A major successful private sector solar PV system provider of large PV solar systems in Ethiopia advised that after around 5 years batteries died, there is no funding from the donor or from government for battery replacement, so the systems stop working. The supplier had never heard of a donor funded solar PV system's battery bank being replaced.

⁸⁸ See for example:

<https://web.archive.org/web/20160921122814/https://www.victronenergy.nl/upload/documents/Datasheet-12.8-Volt-lithium-iron-phosphate-batteries-EN.pdf>

⁸⁹ EnDev Ethiopia 20201231 PV 2012-2020 & ICS 2006-2020 Sales Data

project implementing agency efforts were of a capacity building and industry supporting nature.



Picture (set) 4: The 12V battery pack (top-left) and the 600Wp solar PV array at the Dumburii Health Post (top-right) and some of the connections constituting the installation at the Health Post (bottom-left and bottom-right).

In practice, there are hundreds of smaller, locally owned retailers of pico solar PV systems, and these suppliers are more likely to obtain their necessary stock and operational funding from family, friends, and angel investors rather than from formal channels supported by donors. Hence these suppliers are essentially invisible to donors and the government. However, in practice 89% of solar lanterns and 92% of home systems are such uncertified, off-brand generics that are imported through unregulated channels, and these portable lanterns and SHS combined sales continue to grow year on year. A large quantity of the unverified pico solar PV products crosses the borders with neighbouring countries like Kenya and Somalia and are traded on a cash basis with local currency⁹⁰. Yet, as is the case in all donor funded pico solar market literature sighted, the project implementing agency pico solar support activities literature dismissed all such products as “counterfeit” and “poor quality” and essentially wished them out of existence.

Now some of the unverified solar lanterns and SHS imported through unregulated channels are no doubt of poor quality, but the evaluation team readily found examples of solar products for sale on a cash basis through unregulated channels that were in fact Lighting Global approved products, and all products were clearly marked with actual brand names -they were not pretending to be a regulated/Lighting Africa/Global brand -and many were offered with similar 2-year warranties to the more expensive products sold through regulated channels.

⁹⁰ Ethiopia 20210215 Stand-Alone Solar Investment Market-Map - TetraTech for FCDO

The retailers were very upfront on the quality differences and origins of different suppliers' products that were available at different pricing points.

But in all project implementing agency project literature all unregulated products were labelled as being “counterfeit” and of “poor quality”, which clearly is not always the case. See picture sets 1 above and 5 as below. These “unregulated” pico solar products were recently found in a comprehensive February 2021 report undertaken by TetraTech for FCDO to comprise 88% to 91% of pico solar and SHS products being sold in Ethiopia. This is the longstanding market reality in Ethiopia, and no amount of vilification of the dominant unregulated products sector as “counterfeit” and of “poor quality” will change this on-the-ground reality.



Picture (set) 5: Evaluation team personnel inspecting a plug-and-play solar PV system on sale at a retail outlet (top-left) and the PV systems on sale at a city market in Addis Ababa, some with Lighting Global Certification (top-right); evaluation team personnel unpacking a plug-and-play system for inspection (bottom-left) and a potential customer visiting one of the solar PV retailers at the market (bottom-right)

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

4.1.1 Multi-Purpose ICS Options Ignored

The limitations of a near exclusive focus on Mirt stoves with their concrete chimneys; only being able to cook injera, and the asset's only being used twice a week while other stoves are still used multiple times per day- was known at project inception. If suitable field visits and open interviews with Mirt Stove artisans and users had taken place this could also readily have been independently identified. There was a long history of development and support in Ethiopia of multiple types of ICS that was not utilised, including multiple other stove types that can be used for more than just cooking injera. The dependence on cement for stoves / chimneys, with the frequent cement supply shortages, and cement chimney fragility and high cost of transport could have been readily identified by the project during its implementation too. The clay-based *improved Gonzie* stove might be evaluated as a potential alternative cook-stove option⁹¹.

The issue goes beyond a weak original project design: the project's implementation was lacking in ICS on the ground implementation M&E and a lack of subsequent adaptive management. The project Mirt stove support activities' impacts cannot be quantified as they were primarily indirect capacity building and training oriented with negligible post-training handholding of the artisans, if at all.

4.1.2 Suitable Cost-Plus ICS Pricing Training Not Provided

None of the cook stove artisans visited by the evaluation team had received training on how they should price their Mirt stoves to cover all their costs and make a suitable net margin and hence earn a sustainable livelihood. Some of the Mirt stove artisans thought that producing and selling more stoves below full cost would somehow make the production and sales of Mirt stoves profitable.

Consequently, Mirt stove manufacturing and sales was an add-on to Mirt stove artisans' other income generating activities. Again, the project's implementation was critically lacking in the necessary curiosity and there was no validation of assumptions during project implementation, and hence this key issue was never addressed. Mirt stove training was viewed and conducted almost as a standalone activity with little post-training support or evidence of adaptive management. Hence, the post-intervention sustainability of the EU funded Mirt stove support activities undertaken in the project is very questionable.

4.1.3 Dominance of Unregulated Suppliers in Pico Solar PV Market Ignored

The project's pico solar PV support activities were explicitly predicated on the unregulated sector's pico solar products essentially being not important as they were seen as being (all) of

⁹¹ M F Kedir, T Bekele and S Feleke (2019) "Problems of Mirt, and Potentials of Improved Gonzie and Traditional Open Cook Stove in Biomass Consumption and End Use Emission in Rural Wooden Houses of Southern Ethiopia", *Scientific African*, 3, <https://doi.org/10.1016/j.sciaf.2019.e00064>.

“poor quality” and/or “counterfeit”. The support activities undertaken were implicitly predicated on the regulated pico solar PV sector being the only relevant sector to support to grow to provide the dominant supply of pico solar products in Ethiopia. Neither assumption is supported by the on-the-ground facts. If this had been recognised, then the project interventions could, for example, have focussed on promoting Lighting Global certified products and suppliers offering and honour 2-year or longer warranties regardless of source, and not on only supporting “certified suppliers” at the expense of the majority supply of pico solar products coming from “unregulated” informal sources.

The regulated market supply of Lighting Global certified products still accounts for only a small minority of the market- 89% of solar lanterns and 92% of home systems are still being imported through unregulated channels⁹². It is readily apparent from the literature and from on the ground observations (see Picture (sets) 1 and 5 as above) that not all pico solar PV systems sold through unregulated channels are “poor quality” and/or “counterfeit”. Again, the project’s implementation was critically lacking in curiosity and independent critical thinking, and hence this key issue was not addressed in any project pico solar PV support activity adaptive management. The project’s contribution to growing the pico solar PV market in Ethiopia and its impacts in increased overall sales (including the dominant unregulated sector) remain unquantifiable.

4.1.4 Social Institution’s Solar PV Systems 2-6 Years Life Ignored

The EU funded project activities provided 43 large capacity discrete component and 62 smaller packaged standard plug-and-play SHS at 39 sites. The systems appear to be suitable quality SI (Social Institution) solar PV system installations. A further 31 larger capacity discrete component systems were in Addis at the project implementing partner’s regional office still awaiting installation in May 2021. No doubt the new electricity supply brought to the rural health posts/centres, farmer training centres, and vaccination centre social institutions are highly appreciated by the government, the recipient organisations, and the local beneficiaries.

However, there were fundamental deficiencies with the intervention design and implementation, as follows: (1) no meaningful site-specific evaluations were undertaken to underpin the Wp of solar panels and the kWh of batteries chosen – there were simply one to three 35Wp plug-and-play SHS or a 600/1200/2400Wp system with 12/24/48V battery banks of standard 2V VRLA cells provided at each SI site; (2) the real ability of the new “owners” of the systems to actually be able to fund the necessary ongoing O&M and particularly the expensive 2-6 yearly battery replacements for the larger capacity systems is not borne out by previous installations dating back to 2009 by the implementing agency only appearing to have an actual 10-20% actual battery replacement rate; (3) the very capable Ethiopian solar PV supply private sector played only a minimal role in doing the physical installations of the larger systems and could have sourced the hardware if provided with the necessary FOREX as was successfully done by other donors; (4) the valve regulated lead acid (VRLA) batteries used in the larger systems can be expected to have a real world 2-6 year life while 10-25 year life LFP (Lithium Ferrous Phosphate) batteries were commercially available from early 2017 but were not used; (4) there was no follow up by the implementing agency for the EU or their other

⁹²Ethiopia 20210215 Stand-Alone Solar Investment Market-Map - TetraTech for FCDO

donor funded SI systems after their 6 - 12 months post installation inspection, so there is no data on the actual subsequent sustainability of operations.

The result is that, if past is prologue, in 80% of cases it is expected that the EU funded SI solar PV systems will be used for only 2-6 years and then cease working when the LFP batteries in the smaller SHS and the VRLA batteries in the larger systems are not actually replaced – with the rest of the expensive 25-year lifetime of PV panels, inverters, etc in the larger systems then being wasted. This means that the EU funding will achieve minimal positive demonstration effects or impact, all else being equal as the responsible line ministry/authority would also have been responsible for battery replacement in these past systems and it appears that in only 10-2-% of cases were the batteries actually replaced in practice.

4.1.5 Component/Activity Based Expenditure Not Provided

The Financing Agreement (FA) and associated annexes had budgets broken down by component and activity. However, the project implementation reporting was only by type of expenditure – despite reportedly six EU requests and also several evaluation team requests⁹³. This means that the EU and the evaluation team cannot determine the funds spent on specific components and activities within the 48.8% (as of 16 February 2020⁹⁴) spent of the scheduled EU's EUR 8.85 million project budget. Hence the efficiency and effectiveness of the project's use of EU funds cannot be determined for key specific activities such as the SI solar PV systems provided as the real total costs for this component and activity are not known.

4.2. Lessons Learned

4.2.1 Need to Focus on Real On-The-Ground Realities

The EU funded project activities supported: (1) ICS production of Mirt stoves (sold below real costs by artisan producers with heavy and fragile cement chimneys) that are only able to be used for cooking injera; (2) that only 8 - 11% of pico solar PV systems are sold (at higher prices) though regulated channels; and (3) the procurement in Germany, shipping to Addis and installation in rural Ethiopia of 74 SI (Social Institution) larger capacity solar PV systems where if past-is-prologue 80% will permanently stop working when their batteries fail after 2 to 6 years.

However, all project activities lacked a solid basis on actual on the ground realities at the programming, inception and implementation phases. The failure of adaptive design and implementation management for all interventions were in areas where the EU funded implementing agency had been operating since 2006 in Ethiopia. Hence the actual on-the-ground realities could have been readily ascertained and appropriate and timely corrections could have been made.

⁹³ The proposal submitted by GIZ requesting for EU funding may have specified the activities to be undertaken and the results to be achieved in more detail, but this proposal was not made available for review by the evaluation team.

⁹⁴ The latest project expenditure information provided to the evaluation team was dated 10th June 2020 and was in the project's 3rd Annual Progress Report

The lesson learned is that in project concept development, design, and implementation phases the implementing agency must continuously keep questioning the interventions' assumptions and must as required go to the EU as the funding agency to make any necessary adjustments in a timely fashion.

4.3. Recommendations

4.3.1 EUD to Ensure a Stronger Measurable Results Focus

It is recommended that the EUD significantly reinforces its independent M&E verification focus and capacity, so that for future programmes and projects such as in the project being evaluated here, either: (1) the implementing agency is made to undertake the necessary results focused M&E that was lacking in this project; (2) the EUD adds suitable in-house staff or engages suitable contractors.

This would ensure that: (a) the projects have real results focused M&E plans; (b) M&E plans are followed; (c), independently verifiable and meaningful outcome and impact level information is continuously gathered and regularly reported to the EUD. This would then prevent a recurrence of the current situation, where the evaluation team lacks the necessary baselines and post-intervention incremental data to quantify the impact of the EU funded project at its implementation end points for the ICS, pico solar, and SI solar PV components for which it is understood that nearly all relevant EU funds have now been expended.

4.3.2 EUD to Explicitly Support Wider Private Sector Implementation

It is recommended – to avoid a repetition of the deficiencies found in this project in future interventions – that future EUD interventions in Ethiopia be explicitly based on a meaningful wider private sector project origination, implementation, operation, and ongoing O&M focus.

This will enhance actual useful demonstration effects and to maximise real private sector development and local competition to drive down prices and improve the interventions' utility to end beneficiaries. This would minimise future recurrences of preventable negative situations - as found in the current project - where: (1) a niche product (the Mirt ICS) was not promoted alongside other products (other types of ICS) that were also needed by end users; (2) the real on-the-ground situation and challenges were not identified or addressed – for (a) the Mirt stove limitations; (b), the dominance of the pico solar PV market by products sold through unregulated channels was wished away by claiming that all unregulated products were “counterfeit” and/or “low quality”; and (3) the strong indication that 80% of donor provided SI large capacity solar PV systems did not actually have their batteries replaced after their 2-6 years useful battery life is up was easy to determine - while 10-25 year LFP battery options were available but were apparently not formally presented to the EU as a critical adaptive management change that was needed.

Annex 1 - Online Consultations and Field Visit Itinerary

List of online / remote interactions (after kick-off)

Date	Day	Agency	Participants	MTR Team	Location
22-Mar-21	Monday	Gaia Clean Energy		Sunderasan	Online
04-May-21	Tuesday	European Union Delegation to Ethiopia		Frank Pool, Sunderasan, Ramachandra Pai	Online
04-May-21	Tuesday	GIZ / EnDev Team		Frank Pool, Sunderasan, Ramachandra Pai	Online
04-May-21	Tuesday	SNV / National Biogas Program of Ethiopia (NBPE)		Sunderasan, Ramachandra Pai	Online
09-May-21	Sunday	Green Scene Energy Ethiopia / Solar PV importer and vendor in Ethiopia		Frank Pool, Sunderasan, Ramachandra Pai	E-mail exchange
10-May-21	Monday	Sun Transfer Solar / Solar PV importer and vendor in Ethiopia		Frank Pool, Sunderasan, Ramachandra Pai	Online
12-May-21	Wednesday	USAID - Power Africa Project		Frank Pool, Sunderasan, Ramachandra Pai	Online
12-May-21	Wednesday	Irish Aid - Civil Society Funding		Frank Pool, Sunderasan, Ramachandra Pai	Online
15-May-21	Saturday	Yefam Solar / Supplier to the Health Centers in the Jimma Zone of Oromia region		Sunderasan, Ramachandra Pai	Telephone / 091 160 7472

Annex II - Field Visit Program as Executed

Note that the survey was limited to day-long trips to minimize uncertainty while maximizing the potential for data acquisition at least time and money costs – ensuring coverage of respondents from all 3 regions. The destinations were largely as suggested by the Implementing Agency but the trips were re-ordered to alternate between longer and shorter drive-distances.

Date	Day	Region	Woreda (District)	Town	Name of Anchor Respondent	Technology	Contact Number	Distance from Addis Ababa (km)	Remarks
08-May-21	Saturday	Addis Ababa	Not Applicable	Not Applicable		Solar PV	Multiple	Not Applicable	the MTR team visited numerous solar PV dealers and collected data on system specifications, pricing, warranty conditions, installation costs and other aspects.
10-May-21	Monday	Oromia	Dendi	Ginchi		ICS	0913-591369 / 0993-404926	88	Met [redacted] at his workshop and visited end-use customers in nearby settlements
11-May-21	Tuesday	Amhara	Angolela Tera	Cheki		ICS	No phone contact	100	[redacted] listed as a trainee - she was actually a woreda development council member - and had not attended the training
11-May-21	Tuesday	Amhara	Angolela Tera	Cheki		ICS	No phone contact	100	[redacted] attended the training program in Kombolcha - she was not listed as a trainee - both [redacted] had never heard of GIZ / EnDev.
11-May-21	Tuesday	Amhara	Angolela Tera	Cheki		ICS	0933 - 017248	NA	[redacted] as employed at the woreda; he had attended the training program; he was not listed as a trainee; he had

									since been transferred to a different location.
12-May-21	Wednesday	Addis Ababa	Not Applicable	Not Applicable		Not Applicable	N.A.	NA	Briefing meeting with the EUD in Addis Ababa
14-May-21	Friday	SNNPR	Abeshege	Walga		ICS	0922 - 512676	177	██████████ was working as an electrician; he attended the ICS program in Hawassa.
14-May-21	Friday	SNNPR	Wolkite	Wolkite		Solar PV		160	██████████ was trained as a solar PV retailer and installer, and he operated a shop in Wolkite town in SNNPR; he worked in close collaboration with officials from 16 woredas around his home base
14-May-21	Friday	Oromia	Goro	Gurura		ICS	0947-770396	120	██████████ had attended the training program; had many stoves in inventory; sold through personal contacts and word-of-mouth
17-May-21	Monday	Oromia	Bereke	Sendefa		ICS	0912-181727	45	ICS producer in Sendeffa; sold by word of mouth and through personal contacts; worked as a mason and was trained by the woreda some 8 years back. She asked for support and the woreda simply sent her to attend the GIZ / EnDev program and she is still left with no seed capital or equipment.
17-May-21	Monday	Oromia	Bereke	Sendefa		Solar PV	Not available with us	45	The Sendeffa Health Center was listed as a site fitted with a 200 Wp solar PV system,

									costing €511.88, installed by [REDACTED].
17-May-21	Monday	Amhara	Siy Debrna Wayu	Deneba	[REDACTED]	ICS	0923-472612 / 0912-078231	131	[REDACTED]
18-May-21	Tuesday	Oromia	Mulo	Mulo	[REDACTED]	Solar PV	Not available with us	85	The Mulo Hospital supervised the Jarso Health Center and the Dumburii Health Post; The supervisor confirmed the working of the Solar PV systems at the two sites.
18-May-21	Tuesday	Oromia	Mulo	Jarso Health Center	[REDACTED]	Solar PV	0910-121697	110	The Jarso HC had received a 1200 Wp AC system that catered to the needs of the HC and was installed by late 2019 (estimated).
18-May-21	Tuesday	Oromia	Mulo	Dumburii Health Post	[REDACTED]	Solar PV	0912-165126	110	The Dumburii HP had received a 600 Wp AC system that catered to the needs of the HP and nearby Police quarters and was installed by late 2019 (estimated).
19-May-21	Wednesday	SNNPR	Sodo	Buie	[REDACTED]	Solar PV	0912 - 783051	100	The "sales data" provided by EnDev/GIZ had mentioned installation of 400Wp and 600Wp systems at religious institutions - these were not installed - [REDACTED] referred the MTR team to his colleague at the woreda office who in-turn introduced a solar PV dealer

19-May-21	Wednesday	SNNPR	Sodo	Buie		Solar PV	0909 - 343675	110	██████████ operated a dealership selling mobile phone accessories, stereo systems and mostly plug-and-play PV systems;
19-May-21	Wednesday	SNNPR	Meskan	Buie		Solar PV		120	Site visit to one of ██████████ PV installations: 120Wp SHS AC system in a nearby village
19-May-21	Wednesday	SNNPR	Meskan	Butajira		Solar PV	0911 - 158877/ 0916 - 582621	134	██████████ had secured a large working capital loan at 18% per annum interest to accumulate inventory. The plan included visiting the cattle breeding center (200Wp system) but the dealer reported that access was restricted.
19-May-21	Wednesday	SNNPR	Meskan	Butajira		ICS	0912 - 095205/ 911546628	134	██████████ was listed as a trainee but she was not trained by GIZ / EnDev during 2017 - 2020; she was selling the Mirt below cost to stay relevant
19-May-21	Wednesday	Oromia	Kersana Malima	Lemen		Solar PV	Not applicable	65	Large PV system (~11kWp), well designed and well built; operational
20-May-21	Thursday	Addis Ababa	Not Applicable	Not Applicable		Solar PV	Not applicable	Not Applicable	Physical verification of the components for 30 (or 31) solar PV systems held in inventory at the EnDev/GIZ project office

Annex 3 - Evaluation Matrix

Evaluation Aspect	Evaluation Questions	Findings ⁹⁵
Relevance	<u>Alignment with Ethiopia's Priorities</u> - Were the project objectives / activities aligned with the development goals/priorities/plans of the GoE?	The project's broad objectives and activities were closely linked to the development goals, priorities and plans of the GoE at the project FA signature. However, the detailed activities undertaken were not very relevant, comprising: solely supporting Mirt stoves that have heavy and fragile cement chimneys and can only be used for cooking injera pancakes; only supporting the 9-11% of pico solar PV systems sold through authorised channels; and providing SI solar PV systems that were not matched to specific site needs and with batteries that would only last 2-6 years and in 80-90% of cases would not be replaced.
	<u>Linkage with SDGs et al.</u> – Did the project align with, and contribute to, SDG 7 (Affordable and Clean Energy), other relevant SDGs, Leave No-One Behind and the Rights Based methodology, gender equality, and other relevant environmental and social development goals in line with the EU Green Deal approach?	The project objectives were broadly aligned and linked with the SDGs et al, even though the SDG <i>et al</i> language is not generally explicitly used. The gender dimension was not explicitly mentioned, but the field visits indicated a strong involvement of women as local artisans in Mirt stove construction, sales and distribution.
Coherence	<u>GoE / EU / and other Donors Alignment and Complementarity?</u> - Were the project activities aligned with the GoE needs/situation/plans/ aspirations and with EU policies and strategies related to Africa and other relevant EU policies; and were they complementary to Member State (esp. Irish Aid and DFID) and other donors (esp. WB)?	<p>The design of the project was suitably aligned and complementary of other relevant initiatives, at a high level, with GoE development priorities and EU and other donors' objectives and initiatives.</p> <p>However, at a practical component and individual intervention (activity) level there was little practical complementarity with other EU or EUMS initiatives, with the EU funded National Biogas Program being completely separately implemented by SNV, or with the Irish Aid funded ICS and SI solar PV work. There was no mention of EU funded solar PV work in the publications and reports of other donors and other initiatives active in the solar PV field in Ethiopia</p>
Coherence	<u>Private Sector Implementation Focus</u> – Did the project contribute to an increased private sector role in delivering ICS and solar PV in Ethiopia?	<p>The burgeoning private sector is being used to deliver the Mirt <i>injera</i> stove and the support of ESEDA is positive for the support for the private sector in solar PV growth. However, the project interventions were driven via by local woreda officials, and their real and sustainable private sector implementation focus was weak</p> <p>The equipment for the larger SI solar PV installations was sourced in Germany, while Ethiopian firms were side lined who had the capacity to supply, install, operate and maintain suitable high-quality solar PV hardware. Some of the indigenous companies have supplied and installed [relatively] large community / town level water pumping projects in different parts of the country.</p> <p>The project supported" certified/authorised" pico-solar and 'plug-and-play' SLS/SHS provided systems at a higher cost and with shorter warranties than the private sector working through the open market. And the"</p>

⁹⁵ The means of verification for the findings were provided documents, documents that could be found from open sources, respondent interviews, and interviews and feedback received from the implementing agency and the EUD

Evaluation Aspect	Evaluation Questions	Findings ⁹⁵
		<p>certified/authorised” suppliers only account for 9-12% of the pico solar PV market and gained no business support from the project, in fact they were dismissed and vilified for selling “poor quality” and “counterfeit” products.</p> <p>The region / <i>woreda</i> “authorized” vendors interviewed strongly believed that private sellers (shops) offered poor quality, “counterfeit” product, and offered no post-installation service. The MTE team found that identical ‘plug-and-play’ packaged product sold in the open market (same packaging, same brand, same quality, and same warranty) were sold at lower prices relative to the “authorized” vendors with enough evidence of longevity of the business to suggest the likelihood of the warranty commitments being met.</p>
Efficiency	<p><u>Turning Inputs into Outputs</u> – Did the inputs provided by this EU-funded project produce outputs/results/outcomes/ impacts in a timely and cost-effective manner?</p>	<p>In the absence of suitable component and activity-based process maps, documentation schedules, and expenditure reports from GIZ / EnDev, the specific efficiency of inputs (EU funding) being turned into outputs cannot be assessed. This is not helped by a paucity of specific data on the capacity building outputs / outcomes⁹⁶.</p> <p>In terms of tangible outputs, the field survey suggests that while 43 reasonable quality conventional SI large solar PV have been installed, another 31 of the large systems are yet to be installed. 62 sets of 35Wp SHS were supplied to 37 SI institutions. So only 43% of the target of 100 large solar PV systems had actually been installed as of May 2021, and even if the remaining 31 large systems are installed, there will still be a 26% shortfall in large systems compared to the FA target of 100 large systems.</p> <p>For ICS, there was strong evidence that the promised cement / wheelbarrow and other “seed-capital” was not actually provided to all Mirt stove artisans attending training courses.</p> <p>The limited information on <i>ex ante</i> expectations, projected output, anticipated results, allocation of responsibilities among the agencies involved, outcomes and desired impacts limits the possibility of ascribing a value to the EU-funded project. In addition, for the SI solar PV systems, the reason for sourcing the systems in Germany, and the actual installed costs of systems were not made available. For the 62 sets of 35Wp SHS provided to 37 SI sites, the source of purchasing and the cost was not provided.</p> <p>SI systems could have provided a great opportunity to GIZ/EnDev to handhold, gear up the local vendors and to train the local entrepreneurs/market and set the benchmark for PV system procurement and deployment in Ethiopia. Importing the complete system with a very large battery bank of conventional 2 V VRLA batteries and then offering a 2-year warranty did not actually add to the capacity of local entrepreneurs. The local governments are expected to replace the batteries when</p>

⁹⁶ Irish Aid and implementing partners speak of €35 being sufficient to provide “a fuel-efficient cook stove, skills and training”: <https://vita.ie/a-cook-stove-cooperative-changes-ejigaeyhus-life/>, last accessed 14 June 2021. By that benchmark measure, the cost of training 110 Mirt stove producers (as claimed by EnDev 2017 – 2020) should add up to €3,850 including providing 1 Mirt stove to each of them.

Evaluation Aspect	Evaluation Questions	Findings ⁹⁵
		<p>such replacement is due, irrespective of whether they are technically equipped or adequately funded to do so.</p> <p>In India, for instance, the solar PV modules are warranted for 25 years, batteries for 5 years and the benchmark price per Watt for off-grid systems is set at a maximum Euro 1.16⁹⁷ (including hardware, transport, installation and 5-year maintenance commitments) all inclusive, meaning that the system cost for a 600Wp system would amount to approximately €696 (rounded off to €700) and €1,392 (rounded off to €1,400) for a 1,200Wp system, and €2,784 (rounded off to €2,800) for a 2400Wp system. Shipping and logistics costs applicable might elevate these estimated costs by a few percentage points. Substantially larger increases in end-use prices would need to be adequately justified.</p> <p>The EU funded project paid €337,658 FCA Hamburg for the hardware for 72 solar systems comprising a mix of 600/1200/2400Wp systems with 24-month warranties. Shipping, transport to site and installation are not known would be additional costs. At India prices, 74 sets of 2400Wp systems would be EUR 207,200 fully installed with 5-year warranties. This suggests that the project SI systems costs provided by the project are around double Indian costs, with only 40% of the warranty provided in India.</p> <p>In the case of ICS hand holding trained rural artisans after training was a crucial component to ensure the sustainability of their business operations. For several years, trainees have been requesting for seed capital, sales/ marketing support, support with arriving at 'cost+' pricing for their product, information exchange through the woreda etc.</p> <p>Ensuring that the price of the Mirt stove was consistent with the recovery of total direct, indirect and overhead costs is crucial for the sustainability of the producers / their Mirt production operations, but this was not supported in the project.</p>
Effectiveness	<p><u>Achievement of Planned Results</u> – Were the planned project key outputs/outcomes/impacts achieved, or do they need to be assessed again at a later date?</p>	<p>In the absence of detailed output data (projected and actual) from the project implementing agency, suitably cross-checked and verified by an independent agency, it is not possible to evaluate the achievement of the <i>outcomes</i> and <i>impacts</i> from the project's planned capacity building or other activities⁹⁸. Based on the extrapolation of field survey estimates, Mirt stove dissemination triggered by EU funding could be closer to 20,000 - 40,000 units against targets of 240,000, for instance.</p>

⁹⁷Ministry of New and Renewable Energy, Government of India, "Benchmark costs of Off-grid solar PV systems for the year 2020 – 21" dated 25 June 2020, https://mnre.gov.in/img/documents/uploads/file_f-1593090586363.pdf, last accessed 14 June 2021.

⁹⁸With direct support from EU, 100 rural off-grid social institutions will receive solar power technology, 100,000 solar lanterns and 1,300 solar home systems will be *commercially disseminated*. In addition, 100 production sites with *enhanced manufacturing* of improved cookstoves will be established and supported by *promotional activities*, 240,000 improved cookstoves will be commercially disseminated, 1,100 will be provided to social institutions and 2,000 will be sold to businesses. Source: Energising Development Ethiopia: <https://www.giz.de/en/worldwide/18899.html>, last accessed 14 June 2021.

Evaluation Aspect	Evaluation Questions	Findings ⁹⁵
	<p><u>Adaptive Management for Results</u> - Were project activities adapted to better contribute towards to GoE’s evolving national priorities and/or EU priorities and were outputs /results/outcomes adapted to more directly lead to tangible impacts?</p>	<p>It also was not possible for the evaluation to assess the project’s success in meeting the numerical targets for the Mirt stoves or pico solar: impacts that might flow from the indirect support activities.</p> <p>In the SI solar PV area, instead of the planned 100 larger systems installed, only 43 have been installed to May 2021, with 31 systems at the GIZ regional office but yet to be installed.</p> <p>The price of cement appears to have increased since 2018, and the field mission found that Mirt stove producers had ceased production in early 2021, these factors have not been reported to the EUD nor have any adaptive changes been apparent from the project implementing agency. It is also clear that the Mirt stove is at best only a partial answer to ICS needs - yet the Mirt stove still appears to be the primary ICS type supported under the project.</p> <p>For pico solar PV, the claimed “poor quality/counterfeit/unclear origin and unavailability of FOREX” claim was not supported by a visit to a large open market and field observations. In fact, the “certified” systems being sold through regulated channels and “authorized dealers” with project support had shorter warranties and higher prices than similar systems available from the private sector.</p> <p>For SI solar PV systems provided by the project, it had not been reported to the EUD that only 43 systems had been installed, with 31 at GIZ yet to be installed versus a target of 100 larger systems. It has also not been reported to the EUD that in practice SI solar PV systems will only operate for 2-6 years until their batteries fail. LiFePO₄ non-toxic batteries are now being offered by the private sector in Ethiopia, and offer 20-25 year lives for larger systems, but this does not yet appear to have been suggested by the project to the EUD as a suitable adaptive management option.</p>
Impact	<p><u>Tangible Outputs/Results</u> - What are the tangible outputs/results /impact/outcomes produced by the project that are related to outcome/impact improvements /SDGs and related policy and administrative frameworks? What are potential negative and/or unintended impacts resulting from the project?</p>	<p>The primary tangible outputs produced by the project are the 43 SI solar PV systems that have been installed, and the 31 systems at the GIZ regional office waiting to be installed, out of the 100 large systems detailed in the FA. However, the impact of the systems will almost certainly be only 2-6 years of operation and then abandonment with the other 60% of the cost of the systems unable to operate for their 25-year design life. This then adds to the 267 systems installed by GIZ / EnDev, and more by other donors, that will also have been largely abandoned after 2-6 years when their lead acid batteries fail.</p> <p>Some useful capacity appears to have built at ESEDA and with ICS artisans to build Mirt stoves, but this appears to be limited given that Mirt stove production itself is not adequately remunerative for the persons concerned.</p>
Sustainability	<p><u>Likely Post-Programme Results</u> – Does the project deliver likely sustainable results, such as improved human and institutional capacity, stakeholder ownership, an environment more conducive to self-sustaining private sector-led</p>	<p>The human capacity built by the project in the private sector for mirt stoves is likely to persist, but only if the price of cement for Mirt stoves decreases or if the margins on the product prices were to be increased. And in any case, the Mirt stove is at best only part of the ICS solutions needed.</p>

Evaluation Aspect	Evaluation Questions	Findings ⁹⁵
	<p>provision of associated goods and services, or better policies and tangible outcomes/ impacts?</p>	<p>For pico solar PV, the capacity built by the project in the public sector is unlikely to persist, given the normal rotation of government staff and the higher prices and similar warranties offered by the “authorized” suppliers compared with private sector suppliers. The real private sector supply capacity has not been the focus of the project and appears likely to persist regardless of project activities. The ESEDA capacity built is useful, but its sustainability is questionable absent ongoing donor funding.</p> <p>For SI solar PV systems, the project has added 43 more large systems (along with 1-3 plug and play smaller systems installed at 39 sites, and 31 more large systems in Ethiopia but yet to be installed) to 267 separately funded systems installed by GIZ/EnDev and an unknown number of systems separately funded by other donors. 80-90% of these 267 systems installed by GIZ/EnDev, plus the grant funded systems installed by other providers, can be expected to run for 2-6 years and then stop when their batteries need replacement, leaving a wasted 60% of balance of system cost unable to be useful for the remaining 20 years of physical life.</p> <p>As listed within the “efficiency” section the project has not focused on strengthening the capacity of all Mirt stove producers or PV retailers but has sought to impose a separate layer of entrepreneurs with or without prior connection with the particular trade. PV products retailed by existing local entrepreneurs were often labelled “poor quality/counterfeit/unclear origin”, creating an “us versus them” atmosphere within the industry.</p> <p>The fact that the MIRT stove promoted by the project serves as one amongst several stoves will mean and imply that the project would not have a perceivable impact on reducing fuel wood use or on the larger issue of deforestation. Deforestation attributed to building construction, agriculture, grazing etc. will continue independent of the production and sale of mirt stoves across the regions, towns and villages.</p>
	<p><u>Project Exit / Continuation Strategies-</u> What, if any, exit strategies, further extensions or additional funding could lead to enhanced outcomes/impacts?</p>	<p>Given that the Mirt stove is only part of the required ICS solutions needed, there appears to be little need to continue an exclusive focus on Mirt stove construction / artisan training. In addition, it is also not clear that GIZ/EnDev are providing particularly effective ICS support activities in Ethiopia besides the woreda-organized training itself.</p> <p>The charcoal / briquette production component of the project has not progressed during the project, and there appears to be little justification for the EU or other donors to continue support in this area in the future with GIZ/EnDev.</p> <p>As regards pico solar, the private sector is already providing suitable equipment, and the “authorized” suppliers supported by the project are providing similar warranties and more expensive systems. So further support to providers of “authorized” systems does not appear to be justified. Some ongoing support to ESEDA and the ICS associations would be useful if funds were available and if accountability for expenditure and outcomes could be ensured.</p>

Evaluation Aspect	Evaluation Questions	Findings ⁹⁵
EU Added Value	<u>EU versus EU Member State</u> – Did EU involvement in the project add value compared to EU Member State (EUMS) interventions in Ethiopia?	The Irish Aid funding of GIZ/EnDev appears to have achieved similar results to the EUs funding ⁹⁹ . No examples were evident for the MTE team to determine that EU involvement had added [greater] value compared to EUMS interventions in Ethiopia.

- Notes: 1. FA - Financing Agreement (of the programme)
2. GoE – Government of Ethiopia

⁹⁹ See for instance: Vita (undated) “A Cook Stove Cooperative Changes Ejigayehu’s Life”, <https://vita.ie/a-cook-stove-cooperative-changes-ejigaeyhus-life/>, last accessed 14 June 2021.

Annex 4 - Documents Reviewed

1. Process Documents

Design Documents – Solar

Design and Specifications

- 20170328 Construction Document for the Installation of Solar PV systems
- 20180403 BoQ for Installation Costs

Handover Forms

- 20180809-16 PnP (Plug & Play) System Delivery Signed Forms – Oromia
- 20180908- PnP System Delivery Signed Forms – Amhara
- 20181008- PnP System Delivery Signed Forms – SNNPR
- 20181024 Amhara Official Handover Form Example – Signed
- 20200214 Annex-II-600W Solar PV System Take-Over of Solar PV Installations - EU Template Form
- 20210309 Oromia official acceptance form example – signed

Testing & Commissioning Manuals

- 600 & 1200W PV System Testing & Commissioning Form - for EU Phase-I
- 20200515 1200W PV System Oromia Health Centre Testing & Commissioning Form – Signed
- 20200530 1200W PV System Tigray FTC Testing & Commissioning Form – Signed

PV Rack Designs

- 20190523 600Wp System Rack Schematic
- 20190625 1200Wp System Rack Schematic
- Clamp Drawings

Selection criteria

- 20190302 Assessment Form EU Solar Template
- 20190312 Solar PV installation ToR for 16 Systems in Amhara
- 20190625 EnDev-ETH BTOR for Sample Site Access Verification Field Mission
- Selection Criteria for PV Installers - Qualification & Team Composition – Template

Site Selection general

20180124 Pre-Selection Criteria for Electrification – Template

- 20180201 key factors for distribution EU SI and pico PV – EU
- 20180430 EU Social Institutions Selection – Updated

FTC

- 20180209 Rationale for Farmer Training Centre PV
- 20180222 FTC Proposed-Visited-Selected for PV Systems Equipment-(BB1)

System size categories

- 20171120 Planning - Cost Scenario & Distribution Key for EU SI Systems for 2018-2019
- 20180124 Selection of SI System Numbers by System Size for the EU project v.1.2

ICS process Document

Briquetting Documents

- 1st Phase IA - FINAL - Feasibility Study of Briquette Production in SNNPR Report - Final 2
- Briquette plant Standard Operating Procedure
- BRIQUETTE PRODUCTION & STORE BUILDING BoQ

- Briquetting site selection criteria
- Contract agreement for briquetting production machine provision - Andnat Farmers Union

Gap Assessment – Associations

- 20190815 Gap Assessment for ICS & Solar Regional Associations- for GIZ EnDev

Semi- Industrial Reports

- 20190805 GIZ-EnDev ICS Pottery Semi Industrial Producer Support-Assessment Report-FANA-Draft-aa-Rev-
- Annex-1 Valuation Points of The Producers Pre-Selected For GIZ-EnDev ICS and Pottery Semi-Industrial Production Support
- Annex-2 - Summary of the Selected Producers' Justified Support Needs and Specification of Prioritized Machineries and Tools
- Annex-3 Description of the Selection Criteria and its Assigned Weight for the Evaluation-aa-
- Pictures of Selected ICS and Pottery Producers-R-

Procurement

International materials

EU SI PV Phase I and II International Materials

- 201812 15 International Procurement Specifications – FINAL

Quotation and Order

- 8013K02_Datenblatt_Batfuses_K1_klein
- 20181029 Asantys Order w Prices for EU Phase 1 - 213,234 EUR for 50 Systems FCA Hamburg
- 20181218 Asantys Packing lists - for EU Phase 1
- 20190129 Solar 23 Order w Prices for EU Phase II - final. - 124,424 EUR for 22 Systems FCA Hamburg
- ANF_18_2577_GIZ_Zusatzangebot für 7200066008_Victron displays
- B27-0801-301__digital
- Battery BAE PVV 2V Cells - EN - 2016.06
- Circuit Breaker Standard DCMCB__QY-range 80 125 250 600V
- Datasheet-Battery-Protect-65-A--100-A--220-A-EN
- Datasheet-Phoenix-Inverter-1200VA-5000VA-EN
- Datasheet-SmartSolar-charge-controller-MPPT-100-30-&-100-50-DE
- Datasheets Solar23 PV Module for EU Phase II-revised & final specifications
- DB_HIKRA_PLUS_EN50618_en_09_2016
- DBL_H07RN
- Inverter SB30-50-DEN1721-V24web
- Inverter SI4.4M_6H_8H-DEN1717-V10web
- MC4
- Offer Asantys EU Phase 1_Alternative
- PV Module Excellent xxxPERC60_EN_2018

Solar23_old offer - do not use

- Datenblaetter Solar23_old panels + batteries
- Technische Angebot Solar23-old panels and batteries

EU-Phase I Packing List

- Plug and play product

- 20171121 0 Procurement Specs for 150Wp Plug and Play Systems – SG

Local. Materials

- 20200219 Local procurement BOQ for 600, 1200 and 2400Wp SI Systems - 35,394 EUR Estimate

Tax commitment letters and MOU

- 20111110 Letter from SNNPR MEA re Tax Exemption for 3 briquetting machines
- 20180425 MoU extension with SNNPR
- 20180516 Tax commitment letter from Amhara Regional Bureau of Health for 16 SI PV Systems worth 89,000 EUR
- 20180612 Oromia Tax & Customs Clearance Commitment Letter for 2018-19
- 20190320 MoU between EnDev& Oromia
- 20190320 MOU between SNNPR MEA &EnDev
- 20191121 Tax commitment letter from Amhara to EnDev re 3 Sets of Briquetting Machinery
- 20210101 SNNPR MEA Letter to GIZ re Solar PV Tax

2. Technical and Business Training Manuals

Business

- 20191112 Solar marketing Training- Hawassa SNNPR
- Business Management Training for Mirt Producers – Amharic
- Training Manual Solar Business – Amharic

Business Training Manual

- 20190704-07 Proceedings of Solar Business Management and Organizational Management Training
- Training manual final – Amharic
- Training Manual for Solar Energy Business – Generic
- Training Manual Solar Business - Amharic

Technical ICS

Criteria and Other Documentation

- 20090102 Selection Criteria - Household Rocket Stove Producers – Template
- 20090102 Selection Criteria - Institutional Rocket Stove Producers – Template

Brand member selection criteria

- EnDev Oromia ICS producers Status analysis
- Final Brand Entry Criteria - Solar Retailers_Mar2017
- Final Draft Brand Entry Criteria - Solar PV Installers_Mar_2017
- Final Draft Brand Entry Criteria_ IRS Enterprises__Mar2017
- Final Draft Brand Entry Criteria Gonzie Enterprises_Mar2017
- Final Draft Brand Entry Criteria Mirt enterprises_Mar2017
- Final Draft Brand Entry Criteria Tikikil enterprises_Mar2017
- Final_ Guiding questionnaire for ICS _Users_Jan_2017
- Final_Data_Collection_Sheet_For_ICS_Jan_2017
- Final Data Collection Sheet for Solar Systems_Jan_2017

Manuals

- 081211_Training Manual Mirt – Amharic
- GIZ Tikikil stove user guide - EN
- GIZ Tikikil stove user guide-Amharic
- GMDR operation manual in Amharic
- HHRS-Training Manual-Amharic-
- IMS construction manual
- IRS manual Amharic
- Manual for Production of Tikikil
- Manual_ for production and installation of concrete chimney solution to Mirt

Solar**Installation and End User training**

- 20190121 BTOR for New Mirt Stove Producers Establishment
- Phaesun PV Analyzer Technical Training

Training materials on PV installation

- 01 Basics of Solar PV - Retailers Training Manual – Generic
- 20140102 Awassa Solar Home System Training Technical Part
- 20190523 PV Rack for 600Wp Systems
- 20190625 PV Rack for 1200Wp Systems
- 20200214-Solar installation training Manual for Companies - EU Phase-I – PowerPoint
- 20200925 EU- Phase-1 End Users Training Document
- Do's and Don'ts for Handling Your PV System – Generic
- Fencing Schematic for EU 1200Wp Solar Systems – Generic
- Victron Energy Inverter System Training - EU – Generic
- Victron Phoenix Inverter Operation - detailed – Generic

3. Capacity Building schedule and operational plan**Operational plan**

- EnDev ET EU Up scaling _HH energy component 2019-20 annual Plan_FINAL-20190207

EU initial plannings

- 20170403 EnDev EU Annual Operation Planning - Tigray-2017
- 20170420 EnDev EU Annual Operation Planning – SNNPR
- 20170424 EnDev EU Annual Operation Planning – Oromia
- 20170424 EnDev EU+NORAD Annual Operation Planning – Amhara

4. Capacity Building Schedules Implemented**21. Participant lists**

- 20171125 EnDev-ETH BTOR re Locally Produced Briquette Machine Assessment
- 20180501 EnDev-ETH BTOR on SI Site Selection Field Mission
- 20181222 BTOR by Anteneh Gulilat - Problem Investigation of Turmi & Erboke HC Solar PV Systems w Grid Connection & Broken PV Panels & FLA Replacement Batteries
- 20190121 BTOR on Mirt Stove Producers Establishment - Production – Installation
- 20190424 BTOR on Mirt Stove Business Management Training
- 20190507 Entrepreneur and Business Development Training Presentation – Generic
- 20190507 Mirt Stove Business Management Training Report
- 20190706 EnDev-ETH BTOR on Business Mgmt Training for Solar Retailers & Technicians – Generic
- 20190708 EnDev-ETH BTOR on Organizational Management Training for Executive Committee of Regional Solar Assoc

- 20190710 EnDev-ETH Back to Office Report on Troubleshooting of Dysfunctional Systems at N. Shoa Electrified Schools
- 20190710 EnDev-ETH BTOR for Solar Association Workshop
- 20190723 EnDev-ETH BTOR on Batu Oromia BD Training
- 20190805 EnDev-ETH BTOR of Training of Trainers (ToT) on Mirt-Tikikil-IRS ICS technologies
- 20190806 EnDev-ETH BTOR for Project Mgmt, Contract Admin & Tech Training for Solar Retailers
- 20200306 EnDev-ETH BTOR for field mission on EU 4 HC PV Installations in Guji and Borena
- 20200729 BTOR Anteneh for 6 HC EU-I PV System Installations
- BTOR for Supervision of Solar PV System Installations
- EnDev-ETH Proposed 5-Tonne Isuzu Truck Transportation System for 60 & 96 Mirt Injera Cookstoves
- ICS Sample Business Plan for Trainees – Amharic

3 Recent studies on solar market and products

- BERF Ethiopia Foreign Exchange for Businesses - Oct 2018 - DFID Funded
- PAOP-Ethiopia-MarketAssessment-Final_508 - Oct 2019
- Stand-alone solar-Ethiopia-Investment-Market-Map-_Feb-2021-1-compressed

Documents - EUD - EnDev MoM

- 20180904 EU Del EnDev ETH quarterly meeting minutes
- 20181209 EU project site visits Agenda for 09-11 Dec 2018 DRAFT
- 20200409 EU Del EnDev ETH 1-Quarterly Meeting ZERO DRAFT HANDOUT revised
- 20200409 EU Del EnDev ETH 1-Quarterly Meeting ZERO DRAFT HANDOUT
- 20200507 EU Del EnDev ETH 1-Biweekly meeting draft
- 20200521 EU Del EnDev ETH 2 Biweekly meeting draft rev
- 20200611 EU Del EnDev ETH 3-Biweekly meeting draft revised
- 20200625 EU Del EnDev ETH 4-Biweekly meeting notes
- 20200724 EU Del EnDev ETH 5-Biweekly meeting draft
- 20200724 EU EnDev Biweekly meeting
- 20200728 EU Del EnDev ETH 5-Biweekly meeting Draft final
- 20200812 EU Del EnDev ETH6-Biweekly
- 20200813 EU Del EnDev ETH 6 Biweekly meeting FINAL
- 20200827 EU Del EnDev ETH 7 Biweekly meeting FINAL
- 20200909 EU Del EnDev ETH 8 Biweekly meeting
- 20200910 EU Del EnDev ETH 8 Biweekly meeting notes FINAL
- 20200913 EU Del EnDev ETH 8 Biweekly meeting Final
- 20201008 EU Del EnDev ETH 9 Biweekly meeting notes DRAFT
- 20201008 EU Del EnDev ETH 9 Biweekly
- 20201017 EU Del EnDev ETH 10 Biweekly meeting
- 20201021 EU Del EnDev ETH 10 Biweekly meeting DRAFT
- 20201022 EU Del EnDev ETH 10 Biweekly meeting notes final
- 20201022 EU Del EnDev ETH 10 final
- 20201102 EU Del EnDev ETH 11 draft
- 20201105 EU Del EnDev ETH 11-Biweekly meeting notes final
- 20201108 EU Del EnDev ETH 11-Biweekly meeting final
- 20201126 EU Del EnDev ETH 12 draft
- 20201126 EU Del EnDev ETH 12 draft1

- 20201203 EU Del EnDev ETH 12 Biweekly meeting notes final
- 20210204 EU Del EnDev ETH 1 Monthly meeting notes DRAFT
- 20210304 EU Del EnDev ETH 2 Monthly meeting notes DRAFT
- 20210304 EU Del EnDev ETH 2 Monthly meeting notes DRAFT

Documents – ICS

- EnDev Ethiopia 20110318 ICS Sample Warranty Receipt – Oromia
- EnDev Ethiopia 20111115 Mirt Stove 2p Brochure
- EnDev Ethiopia 20111115 Mirt Stove Training Manual – Amharic
- EnDev Ethiopia 20111115 Tikikil Stove 2p Brochure
- EnDev Ethiopia 20140915 ICS in Ethiopia (EnDev) Results 2006-2014
- EnDev Ethiopia 20141109 Improved Cooking & Baking Stove Sustainability Study
- EnDev Ethiopia 20180618 ToR for Feasibility Study for Semi-Industrial Support for ICS Production – AZ
- EnDev Ethiopia 20190419 ToR for Consultancy services for IRS & IMS Last Mile Strategies- Clean Version
- EnDev Ethiopia 20190815 Gaps Assessment & Support Packages Design for Regional Solar & ICS Associations – Final
- EnDev Ethiopia 20190815 Gaps Assessment & Support Packages Design for Regional Solar & ICS Associations
- EnDev Ethiopia 20191215 Boiling Water Test of Tikikil Multifuel Stove
- EnDev Ethiopia 20191215 Cooking Test of Upesi Stoves
- EnDev Ethiopia 20191215 Test Report on Institutional Mirt & Rocket Stoves (IMS & IRS)
- EnDev Ethiopia 20200818 Consolidated Report on ICS in Tigray & SNNPR to Irish Aid
- EnDev Ethiopia 20200917 Update on Establishing a Functional ICS Warranty System in Oromia
- EnDev Ethiopia 20210421 ICS Producers Trained by EU from 2017 – 2019
- EnDev Ethiopia GIZ Tikikil stove user guide – Amharic
- EnDev Ethiopia GIZ Tikikil stove user guide – EN
- Ethiopia 20080315 Mirt Stove Impact Assessment - for MoARD/GTZ SUN Energy Programme
- Ethiopia 20110415 Clean Fuel Saving Technology Adoption in Urban Ethiopia - Damte and Koch
- Ethiopia 20170315 Perceived Shortcomings of Mirt Stove in ET- Agarfa District-Oromia - in Journal of Agricultural Extension & Rural Development
- Ethiopia 20190815 Clean cooking sector in Ethiopia - SNV report on NBP
- Ethiopia 20191015 National Improved Cookstove Program (NICSP) 2013-2019 Terminal Report - USD1.8 M Barr Foundation Funded
- Ethiopia 20200515 Facilitators and Barriers to Improved Cookstove Adoption - in Environmental Health & Preventative Medicine
- Ethiopia 20210224 AICSA (Amhara ICS Assoc) AGM & 3-Year Strategic Planning Workshop - Moderation Report
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- EnDev Ethiopia 20180327 Primary Schools 600Wp & Health Centres 1.200Wp PV Systems Assumed Load Profiles
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- LFP Batteries - SimpliPhi-Power-PHI-38-kwh-24v-48v-battery-datasheet
- LFP Batteries - SimpliPhi-Power-PHI-batteries - 10 years or 10,000 cycles (27 years) @ 80% DoD Limited Warranty
- LFP Batteries - Super B 2Wh @ 2,000€ wo VAT - 13,2V/160Ah w BMS - 27kg - 5000 cycles @ 80% DoD
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Annex 5 - Summary of ICS Targets and Implementation Achieved during each Reporting Period

(2017 – 2018, 2018 – 2019 and 2019 – 2020)

Parameter	Annual Progress Report						Remarks
	2018		2019		2020		
	Planned	Actual	Planned	Actual	Planned	Actual	
Stakeholder Workshops	6	4	91	101	16	17	
Supply of technical equipment to ICS producers	30	9			66 sheds	5 sheds	In 2020, 122 new ICS producers received start up material including moulds; 38 new ICS producers received start up material including moulds;
Chimney Training	?	174					
Technical training in stove performance testing (WBT and CCT)	?	1					
Technical and business training	?	4	10	9	10	5 businesses / 3 tech	In 2019, 4 workshops were held for management of associations / strategic leadership.
Semi-industrial ICS production	?	0	7	?	?	?	In 2019, 22 candidates were selected for further scrutiny
Supply of modern production equipment to ICS producers	2+	0	?	?	7	?	In 2020, 2 training programs were to be held for ICS producers and potters
Conduct of CDM Workshop ¹⁰⁰	1	1	?	?	1	?	In 2019, a CDM workshop for all of East Africa was held
Development of Component Programs of Activities (CPA) ¹⁰¹	2	?	4	?			
Creation of implementation monitoring databases	2	?	?	?			

¹⁰⁰GIZ / EnDev to share IA CDM evaluation study

¹⁰¹GIZ / EnDev to share HEMIS database / implementation report

MFI linkages ¹⁰²	2	?	?	?	?	0	□
Annual Progress Report							
	2018		2019		2020		
Parameter	Planned	Actual	Planned	Actual	Planned	Actual	Remarks
Production of chimney moulds for Mirt stove	150	20	380	213	400	296	Write up for 2020 (page 21 of 56) claims that 400 concrete chimney moulds were produced and distributed; and those 341 concrete chimney moulds were produced and distributed; but the distribution adds up to 296 units.
Supply of low-cost chimneys for Mirt stove	11,000	80/342 (mud)	12000	318	8000	?	
Focus group discussions on indoor air quality	100	4	?	0	120	0	In 2020, agreement was concluded with the Union of Ethiopian Women Charitable Associations
Stove performance tests	4	4	4	4	6	?	
Value addition to stoves	2	2 (Upesi and Tikikil)	2	2	4	?	
Procure and install briquetting machines	12	0	?	0	?		
Introduce efficient charcoal production system	1	0	?	0	?3		In 2020, "finalized the construction" of 3 kilns

¹⁰²GIZ / EnDev to share detailed information on MFI involvement for the cooking component / PV component.

Annex 6 - Evaluation Team Members

Frank Pool is a Category I international sustainable energy expert and team leader with 43 years of professional experience. He has worked on 48 renewable energy and energy efficiency projects and has physically worked in 51 countries. He has worked extensively on project monitoring and evaluation, technical review and management, project design, project management, project evaluation and team leadership in: Africa; West, South, East, Central and South-East Asia; Europe and the Balkans; Pacific Islands, Caribbean, Australia, and his native New Zealand. He has recently specialised in EE/RE/CC mitigation evaluations, feasibility studies, reviews, energy policy and action plan development; project design; project implementation; project and program evaluations; technical-market-financial-economic reviews; presentations and communications. He has developed clean energy policies, master plans, and regulatory frameworks. He has over 11 years of experience in evaluation of EU and other donor-funded projects in the energy sector including remote evaluations, as well as TL for evaluations in Sub-Saharan Africa: Mauritius, Nigeria, Rwanda, Zambia and the ECOWAS region.

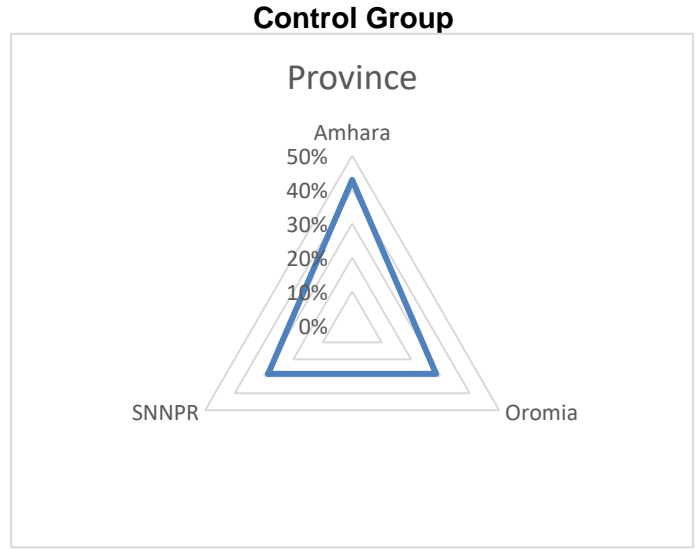
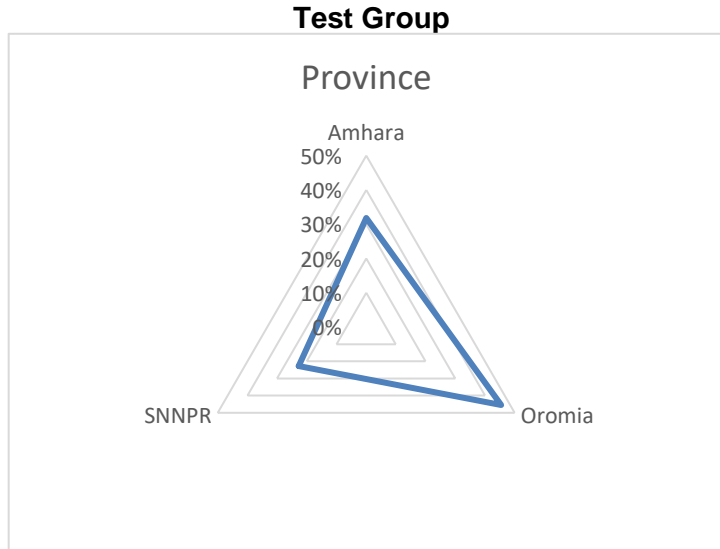
Dr. Srinivasan Sunderasan brings close to 30 years of diversified experience in Infrastructure Project Management, Investment Management and leadership in multi-cultural environments. He has been exposed to several industries including Financial Services, Hospitality, White Goods, Construction, Telecom, Energy (Fossil Fuels as well as Renewable options) and to Consulting work.

In the past, he has been the Dy. Country Manager-India for the US\$ 30m IFC/GEF Photovoltaic Market Transformation Initiative (PVMTI), Investment Officer – India for the US\$ 50m Solar Development Group (SDG) and Investment Officer – South Asia with the Triodos Renewable Energy for Development Fund (TRED Fund). In addition to his project implementation experience from across countries and continents, he has authored 8 books on various aspects of cleaner energy policy, programs and pricing. He has authored over 45 research papers and case studies, many of which have been accepted for publication without comment by international English language, peer-reviewed (non-open access) journals.

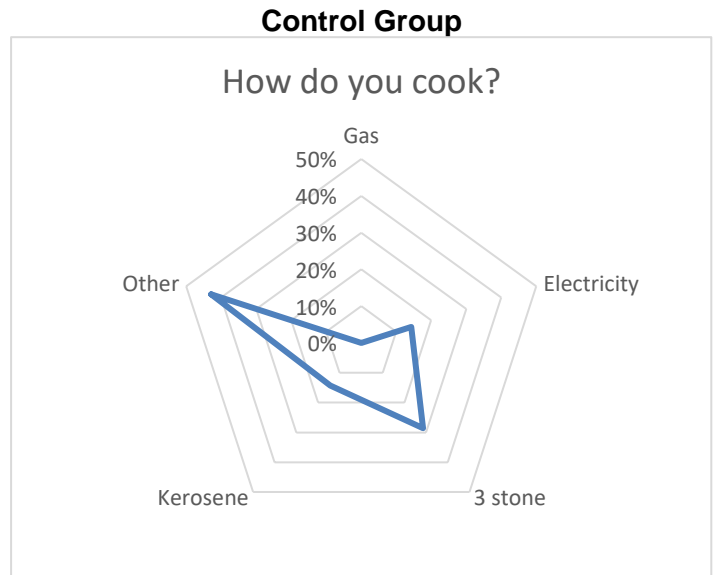
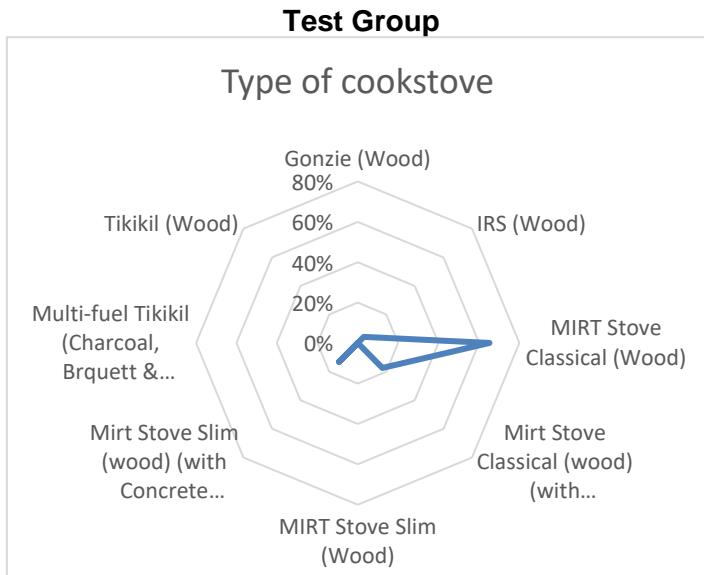
Sunderasan has been awarded a Doctoral Degree in Business Economics by the University of Vienna, Austria, for his work on the Renewable Energy industry and markets. He has also undertaken graduate course work specializing in International Economics and Industrial Organization at the University of Vienna. His first degree is in Civil Engineering, followed by a Masters' Degree in Business Administration (MBA) from King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia. He has acquired graduate qualification in Environmental Law at the National Law School of India University, Bangalore, and graduate qualification in Architecture leading to a listing with the Council of Architecture in India. More recently he has completed coursework on sustainable tourism (USAID / George Washington University) and on specified aspects of jurisprudence through Harvard University's online education initiative.

Annex 7 - Data / Analysis of Survey Responses

Coverage: Province

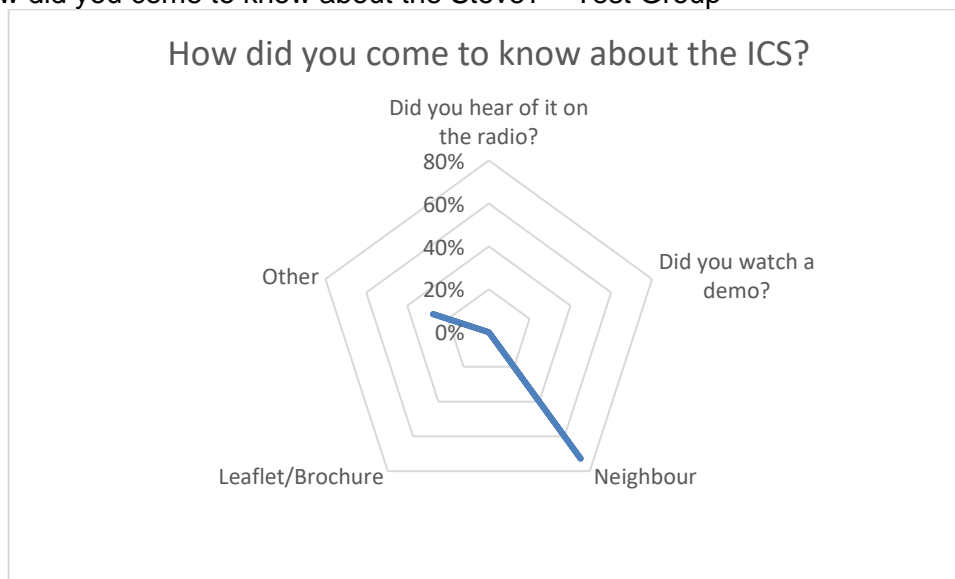


Model of the stove



1. Impact assessment of outreach initiatives

a. How did you come to know about the Stove? – Test Group



b. How did you make the decision to buy the stove? – Test Group

Option	Count
Did the radio broadcast motivate you to go and buy the stove?	1
Did the market demonstration impress you?	1
Did the cost impact your purchase decision?	3
Did the health benefits impact your decision?	3
Other	14
Total	22

c. How did you mobilize money for the ICS – Test Group

Option	Count
Personal funds and savings	22
Borrowed from friends & family	0
Micro-finance loans	0
Commercial loans	0
Combination	0
Remittance	0
Total	22

2. Household- and setting-related characteristics

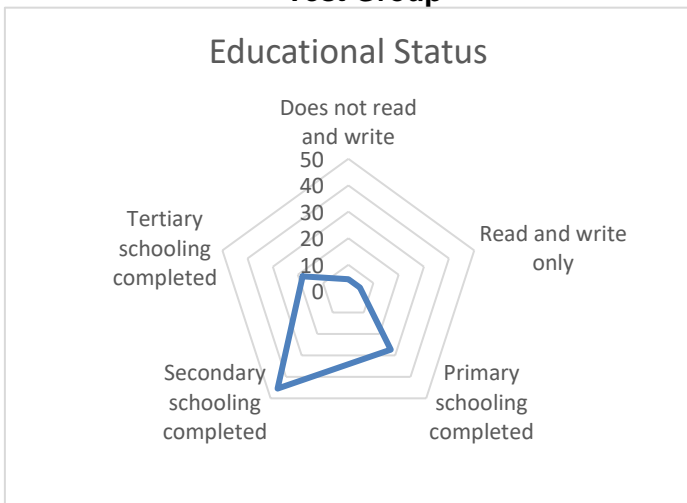
a. Gender of the household head:

Test Group	
Option	Count
Female	5
Male	17
Total	22

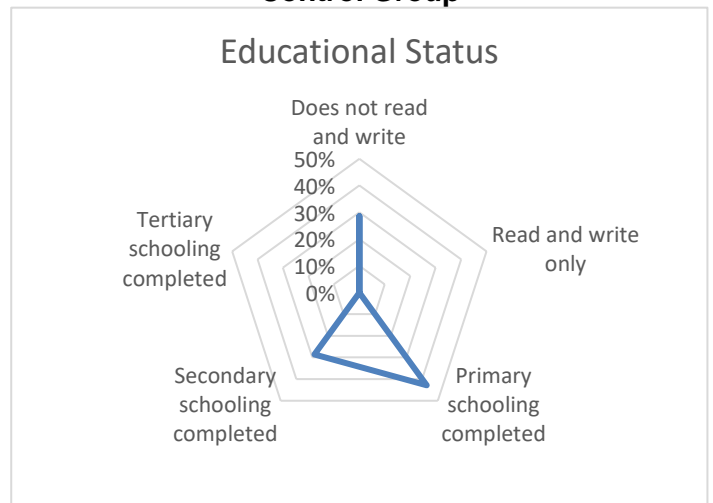
Control Group	
Option	Count
Female	4
Male	3
Total	7

b. Educational status of the household head: *Refers to the role of an educational level attained by the household head in stove adoption. It was assessed by classifying into five categories as*

Test Group

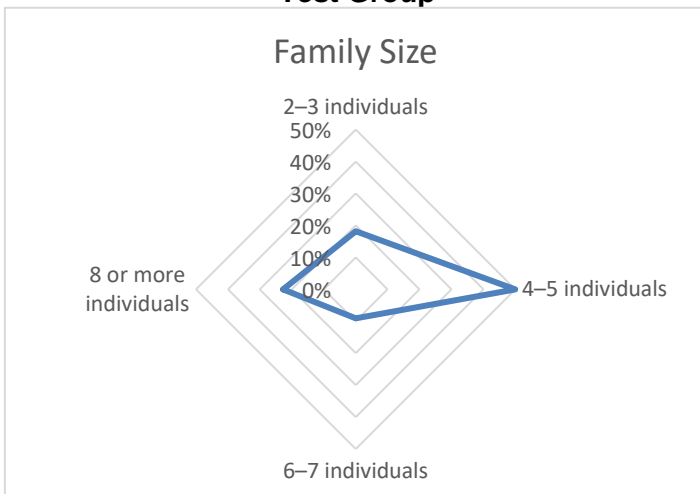


Control Group

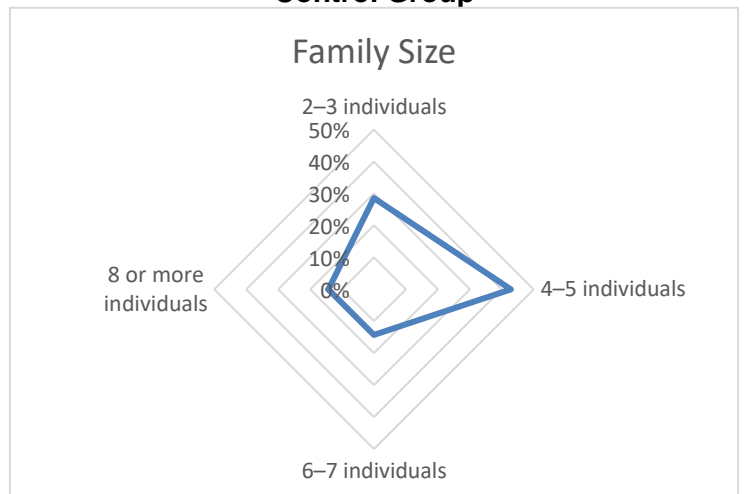


c. Family size of the household: *Refers to the role of the total number of individuals permanently living in the household in ICS technology adoption, and it was assessed by classifying into four categories as*

Test Group

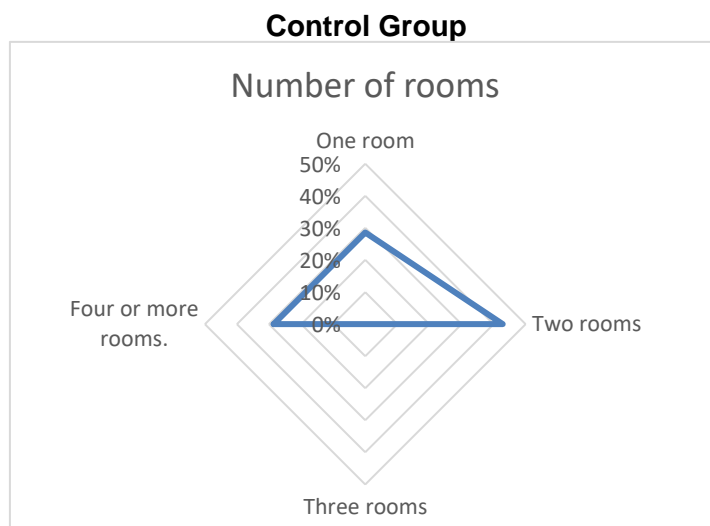
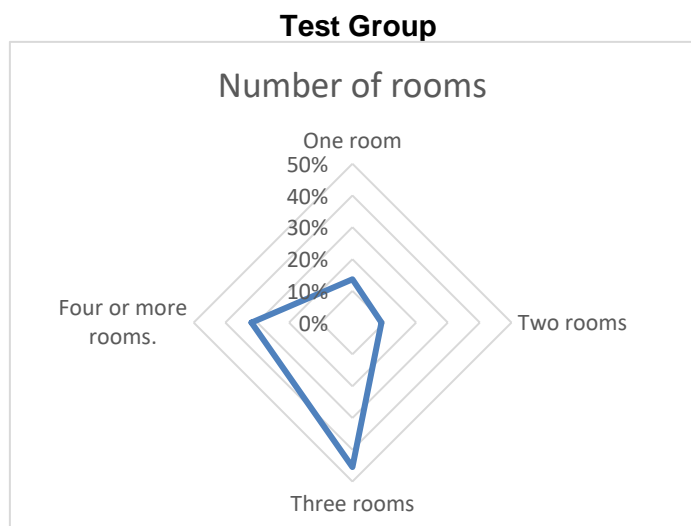


Control Group



d. Number of rooms:

Refers to the role of adequate space inside the main living house for placing a permanent stove in ICS technology adoption as measured by the total number of rooms in the main living house, and it was assessed by classifying into four categories as



e. House ownership: Refers to the role of house ownership status in stove adoption, measured as

Test Group

Option	Count
Private/own	7
Own	15
Total	22

Control Group

Option	Count
Private/own	4
Own	3
Total	7

f. Location of cooking quarter: Refers to the role of a cooking quarter location in stove adoption as assessed through observing and asking respondents about the location of the main cooking quarter of the household by classifying into

Test Group

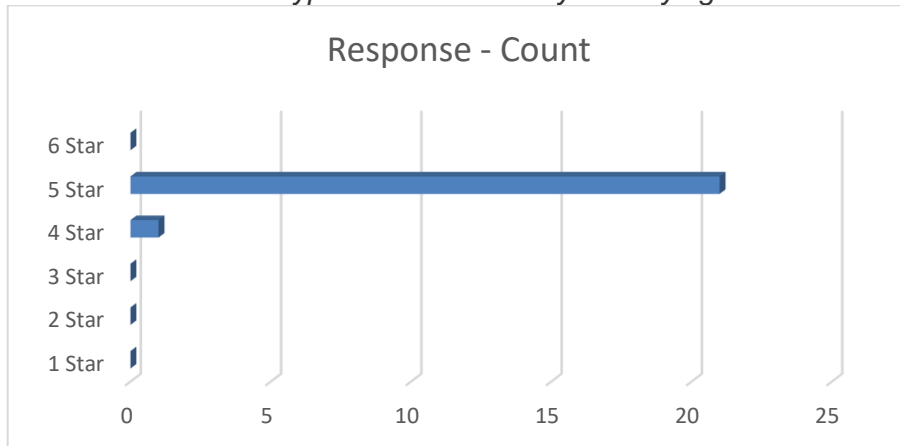
Option	Count
Separate kitchen	22
Inside the living house	0
Total	22

Control Group

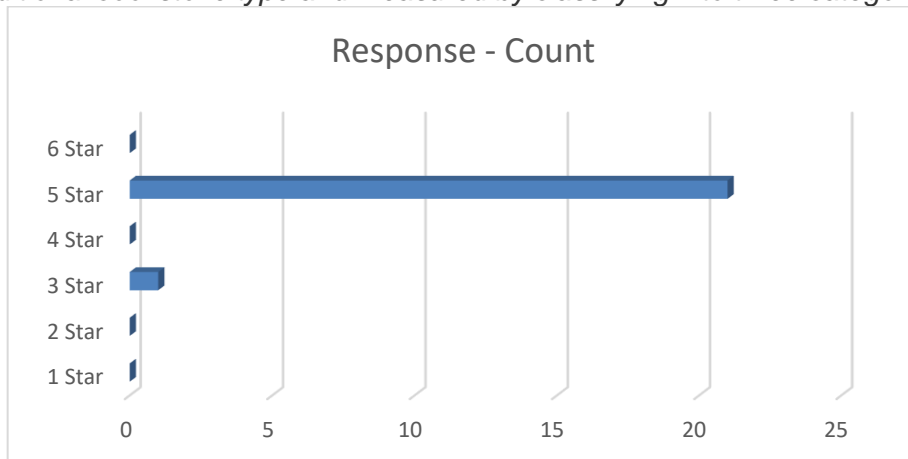
Option	Count
Separate kitchen	5
Inside the living house	2
Total	7

g. Fuel source: This refers to the role of a fuel source as assessed by asking respondents about their main source of fuel for household cooking purposes by classifying into three categories as

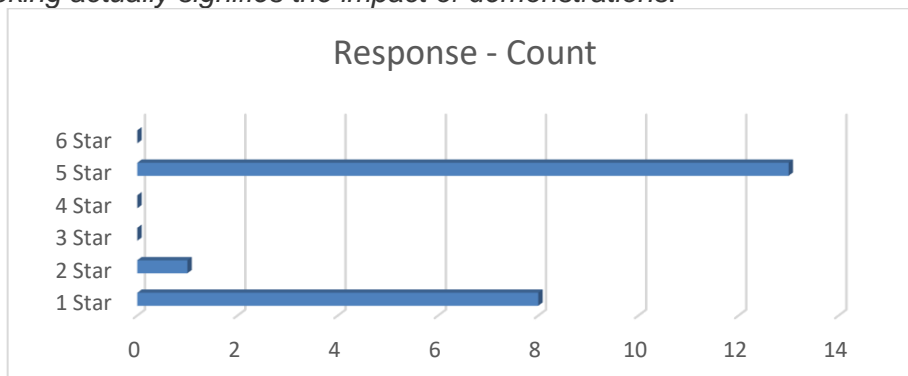
- b. ICS stove durability: *This refers to the role of perceived stove durability in adoption as assessed by asking respondents about the durability of ICS technologies compared to the traditional cookstove types as measured by classifying into three categories:*



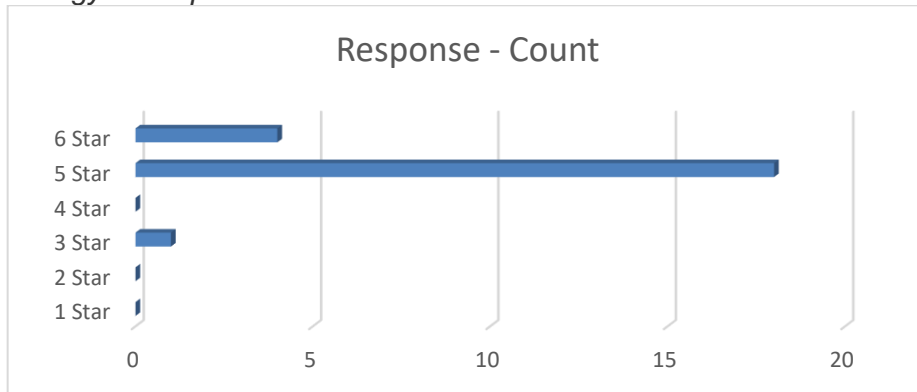
- c. Fuel-saving benefit: *This refers to the role of perceived importance of the fuel-saving benefit of ICS technology in stove adoption as assessed through asking respondents about the importance of fuel-saving characteristic of ICS technology compared to the traditional cookstove type and measured by classifying into three categories as*



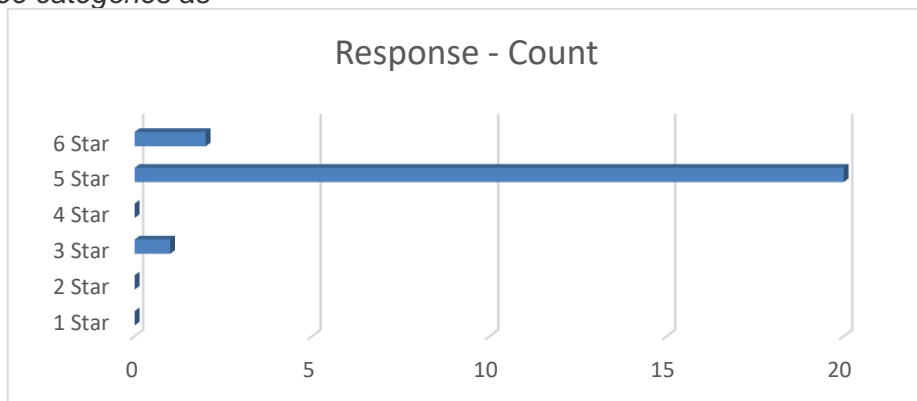
- d. Purchase decision: *This refers to demonstrations conducted wherein various ICS models were displayed and based on observations like less fuel consumption and faster cooking actually signifies the impact of demonstrations.*



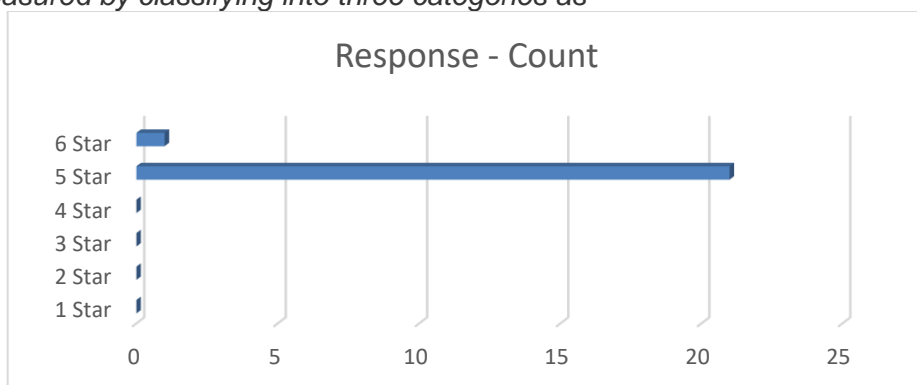
- e. Health benefit: *This refers to the importance of a perceived health benefit of ICS technology in adoption.*

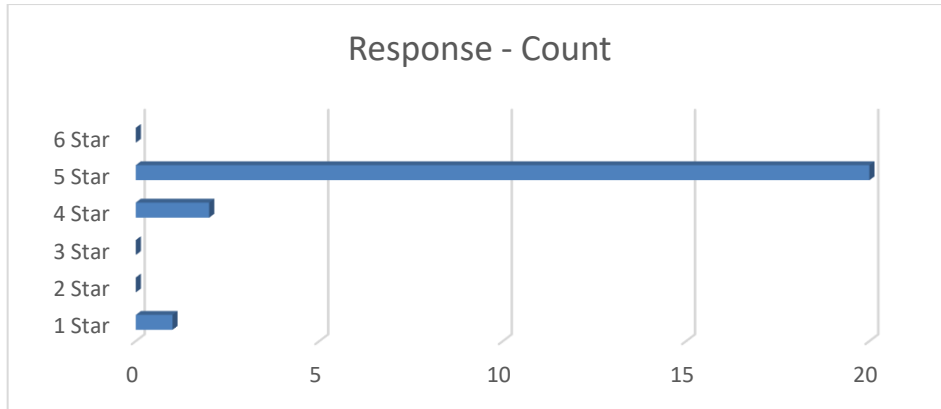


- f. Time-saving benefit: *This refers to the importance of perceived cooking time-saving benefit of a stove technology in adoption, and it was assessed through asking respondents about the value of the time-saving characteristic of ICS technology in adoption compared to the traditional cookstove type and measured by classifying into three categories as*

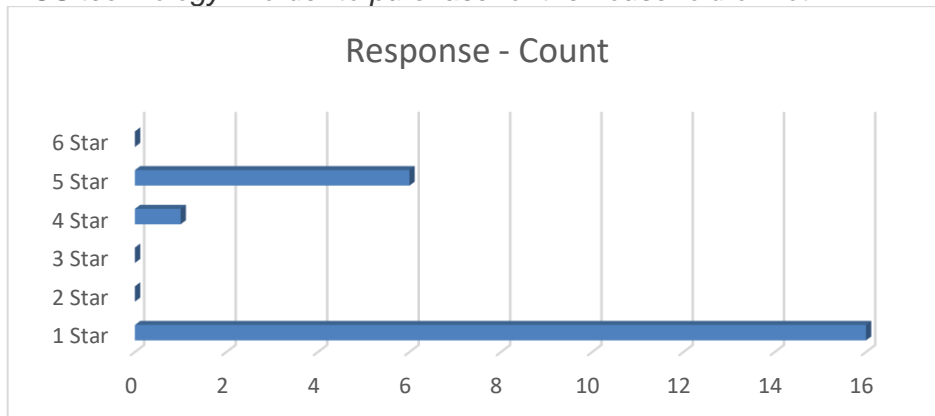


- g. Safety benefit: *This refers to the value of the perceived importance of safety benefits in ICS technology adoption. In this study, the key safety concern was child burn injury prevention capacity as assessed by asking respondents about the importance of safety benefits from using ICS technology compared to the traditional cookstove type and measured by classifying into three categories as*

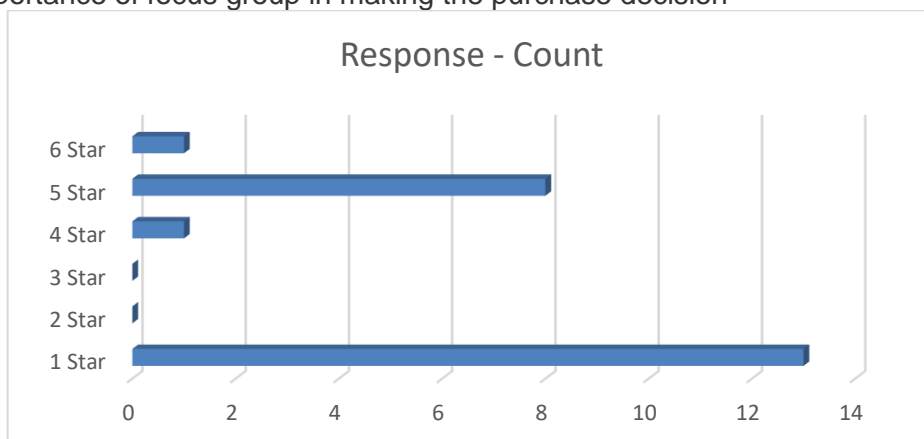




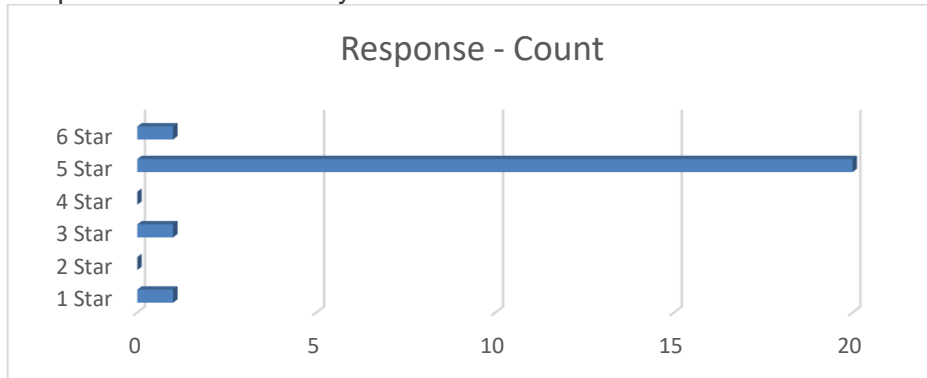
- c. Demonstration experience on stove use: *Refers to the role of stove promotion strategy in ICS technology adoption. It was assessed through asking respondents about the availability of ICS technology promotion strategy within the locality as measured by their previous experience of live ICS use demonstration by promoters about the use of any new ICS technology in order to purchase for the household or not*



- d. Importance of focus group in making the purchase decision



d. How important was availability of fuel?



e. Understanding of demand-side initiatives to help consumers buy the stoves – measures to increase incomes (like tree plantation / sale of bio-slurry). Compared to 2016 – ease of selling produce from 2017 to 2020 – scale.

