Case study:

Lessons from creating access to low-cost solar water heaters as the basis for the first gender-sensitive Nationally Appropriate Mitigation Action (NAMA) in Georgia

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List of Abbrevations

CDM – Clean Development Mechanism
CSO – Civil Society Organisaion
EEC – Eastern Europe and Caucasus
EECCA – Eastern Europe, Caucasus and Central Asia
EES – Energy Efficient Stove
EU – European Union
GEL – Georgian Lari
GS – Gold Standard
hh - Household
INDC – Intended Nationally Determined Contribution
KwH – Kilowatt Hour
LEDS – Low Emission Development Strategy
MDG – Millenium Development Goals
MRV – Measuring Reporting Verification
NAMA – Nationally Appropriate Mitigation Action
NGO – Non Governmental Organisation
RCDA – Rural Communities Development Agency
SDG – Sustainable Development Goals
SWH – Solar Water Heater
UNFCCC – United Nations Framework Convention for Climate Change
WECF – Women in Europe for a Common Future

Summary

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Poverty and lack of access to safe and sustainable energy
The population of Georgia, especially in rural areas, suffers from a lack of access to safe and sustainable energy. In particular in countries with cold winters, where heating is a necessity, "energy poverty" is an important dimension of overall poverty. Factors contributing to energy poverty are: a poorly maintained infrastructure, rising fuel costs, extreme weather conditions, and the increasing unpredictability of the climate.

Women have less access and control over income and assets
Gender roles are traditionally divided in Georgia. Women are responsible for the unpaid work in and around the house. Women have fewer opportunities to participate in economic activities. Women thus have less access and control over assets and income. Women and children make up the majority of the economically poor, and are most severely affected by energy poverty.

Health impacts from lack of safe energy disproportionately impacts women and children
Women and children suffer adverse health effects created by energy poverty. The burning of unsafe fuels such as plastic in the home leads to respiratory problems created by exposure to dangerous substances and indoor air pollution. As women and children are typically at home for a larger proportion of time they are more acutely impacted.

WECF's pilot programme: domestic solar heating
WECF aims to support safe, appropriate and sustainable energy options. Whilst improving energy security in rural areas of Georgia, WECF also aims to work on gender equality, incorporating both men and women into the process and ensuring women's needs are supported and participation is prioritised. In 2008, WECF and its partners launched a programme to adapt solar heating technologies to local needs and capacities, and responding to the needs and circumstances of women and men living in rural areas of Georgia. That same year WECF started piloting the implementation of low-cost solar water heaters based on local production with the involvement of women and men.

Benefits for women and men from the sustainable energy programme
Since 2009, 400 solar warm water heaters have been installed and are monitored by locally trained men and women, using local materials. The programme has been successful in several areas: it has reduced energy poverty (easy access to sustainable energy and less costs for fuel), environmental degradation (less resources need, e.g. wood) and climate change (less CO2 emissions). The solar technology also protects people's health. The programme has strengthened local capacity in regard to knowledge, gender equality and business opportunities for women and men.

Assessment and analysis of all aspects of the solar heating program
In 2014, the pilot program was extensively evaluated. The development of the technology, its adaptation to local conditions and the implementation of demonstration units was assessed in detail, with a specific focus on gender concerns. The design, implementation and monitoring of the programme including the training concept for local experts and its ability to be gender sensitive were analysed. The monitoring concept with regards to the reduction of CO2 emissions, the reduction of fuel consumption and the economic benefits for local users was assessed using verified methodologies. Finally, the measurements and conditions needed to create a model for replication for large-scale implementation of solar warm water heaters for domestic use were also assessed.

Purpose of the Case Study: formulating recommendations for a NAMA
The purpose of this case study is to present the findings of the practical implementation of solar warm water heaters as a new and specifically adapted technology to rural Georgian communities, and its gender implications. The Case Study will conclude with recommendations of how the successful spreading of solar heating can be scaled up through the rural areas of Georgia, creating increased wellbeing, gender equality and climate efficiency, whilst reducing poverty and environmental damage. The recommendations stand at the basis of the proposed "gender-equitable National Appropriate Mitigation Action" which has been developed by WECF and its Georgian NGO partners, in cooperation with the Georgian Ministry of Environment. The gender-sensitive NAMA plans the installation of solar water heaters and energy efficient stoves for at least 10-20,000 rural households in Georgia.

Two Georgian women, participants of the project's solar water-heater training, in front of a successfully built solar water heater.

I. Introduction

A. Introduction to this publication

This publication is based on the assessments and evaluation of the lessons learned by WECF and its project partners, as well as the users and technicians involved in the solar water heater activities in Georgia. The publication gives a detailed analysis of the lessons learned from the development of the appropriate low-cost solar heating technology, its implementation, the monitoring of the effectiveness and the added social and gender equity impacts. These findings and lessons learned have been used to formulate recommendations for how to scale up the results from 400 to 10,000 installed units, ensuring the same social and gender equality benefits. These recommendations are used for the design and implementation of a "gender-sensitive NAMA" to be implemented in the coming years in Georgia.

In Georgia's rural areas, women and children make up the majority of the economically poor and are most severely affected by "energy poverty". Factors contributing to energy poverty are a poorly maintained infrastructure, rising fuel costs, extreme weather conditions, and the increasing unpredictability of the climate. The lack of access to safe and affordable energy has meant that poor families have increasingly started to use unsafe fuel, such as plastic waste, biomass and wood. This has lead to respiratory diseases created by exposure to dangerous substances and indoor air pollution. As women and children spend more of their time indoors, they are most affected by indoor air pollution. Alternative safe energy systems were developed by civil society organisations including WECF International including energy efficient stoves and solar water heaters.

A locally appropriate solar water heater technology was developed, which can be used to heat water for use in the bathroom and kitchen, and in an extended version also for additional heating of the house. 400 solar warm water heaters (also called solar collectors) have been installed since 2009 using local materials and creating local income for women from energy services. The 400 solar heaters are being monitored and where necessary repairedby locally trained men and women. The shift to solar heaters has reduced deforestation and avoided CO2 emissions. To scale up these results, WECF and its partner CSOs have developed in cooperation with the authorities, a proposal for a National Appropriate Mitigation Action (NAMA). Four NAMAs have been prepared for Georgia, and this is the only "gender-equitable" one, unique worldwide. The proposed gender-equitable NAMA will install 20,000 units of solar heaters or energy-efficient stoves for rural households, ensuring that all conditions are created for women to equally participate in the implementation and monitoring of the energy systems. The social benefits of the NAMA will be monitored, including how far it will reduce the burden of unpaid work on women in target villages of Georgia. This will contribute to target 5.4. of the "Sustainable Development Goals" which aims to redistribute unpaid care work.

B.

International processes (UNFCCC and Post-2015 SDG) and gender equitable climate finance and national gender-sensitive implementation plans

1.1. SDGs

The lessons learnt from this case study are important not only for the development of the gender-sensitive NAMA in Georgia, but also in the light of national implementation of the Sustainable Development Goals Post-2015 agenda.

Governments globally will agree in September 2015 on the implementation of the new Sustainable Development agenda from 2015 to 2030, building on the Millennium Development Goals (MDGs) and the Sustainable Development Agenda (Rio+20). Unlike the MDGs, the new 17 Sustainable Development Goals and their 169 targets constitute an integrated comprehensive agenda, which all countries will implement universally. The new agenda will not be seen as a success unless all goals are achieved. Therefore goal 1 on ending poverty needs to be implemented alongside goal 5 on gender equality and goal 13 on climate change mitigation.

This case study provides some important lessons for achieving the goals in an integrated manner.

Sustainable Development Goal 1 aims to end extreme poverty. Target 1.2 specifically addresses reducing all dimensions of poverty for women. Addressing income poverty is not the only concern, but also addressing a lack of assets as a "buffer" against accidents, invalidity and "climate-related extreme events and (…) environmental disasters" (target 1.5).

Target 1.4 specifically states that by 2030, all men **and women**, should have equal rights to economic resources, as well as access to basic services, ownership, and control over land and other forms of property, inheritance, natural resources, appropriate new technology, and financial services such as microfinance. Target 1.b stipulates that this should be done through "pro-poor and gender-sensitive development strategies", for which this gender-sensitive NAMA can be used as an example. It will also contribute to achieving target 13.b for "mechanisms and capacities for effective climate change related planning and management (...) including focusing on women."

The implementation of the gender-sensitive NAMA will help to achieve the implementation of SDG1 in rural areas of Georgia, as it will bring cost-savings to the households where the solar water heaters and efficient stoves are installed. It will also specifically build the capacity of women – as well as men – to develop business opportunities, and thus increase income.

The gender-sensitive NAMA, when implemented, would also help to achieve SDG7 which aims to "Ensure access to affordable, reliable, sustainable, and modern energy **for all**", to "increase the share of renewable energy" (target 7.2), and to "double energy efficiency" (target 7.3).

For the first time a United Nations document sets a target (5.4) to "recognize and value unpaid care and domestic work". The NAMA case study has shown that in Georgia, the burden of care work weighs almost entirely on the shoulders of women. It is a traditionally gender-stereotyped role that assigns women to caring for children, ill family members, and subsistence home food-production. Changing this stereotype is important for allowing women to equally participate in climate mitigation and sustainable development programmes. SDG target 5.4 makes this a specific aim for all countries, and Georgia is called on to develop awareness and education as well as policies in this area. An important step towards achieving target 5.4 is to reduce the burden of domestic care placed on women by reducing the time required to secure energy and heating for the household. The installation of solar water heaters and energy efficient stoves will reduce the burden on women and children. Additional benefits include improved indoor air quality and respiratory health (SDG 3), reduced deforestation (SDG 14), climate change action (SDG 13), increased work opportunities for women and men (SDG 8), innovative technology development (SDG17) and sustainable consumption and production (SDG12).

➔ **NOTE**: The implementation of the gender-sensitive NAMA, installing 10.000 solar water heaters and 10,000 energy efficient stove in rural and remote communities of Georgia, would contribute to the implementation of Sustainable Development Goals 1, 2, 3, 5, 7, 8, 12, 13, 14 and 17.

1.2. Climate UNFCCC

The United Nations Framework Convention on Climate Change (UNFCCC)[1] aims "*to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. (…)".* This can only be achieved by reducing emissions and ensuring sustainability in all sectors of society and the economy. One concept of the UNFCCC is the so-called NAMA (national appropriate mitigation action). It is a concept for developing countries to design and implement mitigation activities appropriate to their countries. It is important to be aware that these mitigation activities can also be activities which tackle future emissions, e.g. which prevent increase of emissions in the future by installing low-carbon technologies today.

Particularly in transitioning and developing countries with cold winters, where heating is a matter of survival, energy poverty is recurrent, and poor communities struggle to get access to energy to fulfil their daily needs. The aim of the solar heating and energy efficient stove pilot projects was to demonstrate how domestic energy needs can be assured in a sustainable way, benefitting and involving women and men equally. What is required are 'Means of Implementation', provided by developed countries, to ensure capacity building, technology transfer, assessment and adaptation, and (micro)-finance. These means have to be allocated carefully since resources are limited. Choosing one type of technology will bind resources and capital, which might not be available for other types of technologies. Appropriate solutions are needed that can provide women and men with safe and

[1] aims "*to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. (...)".*

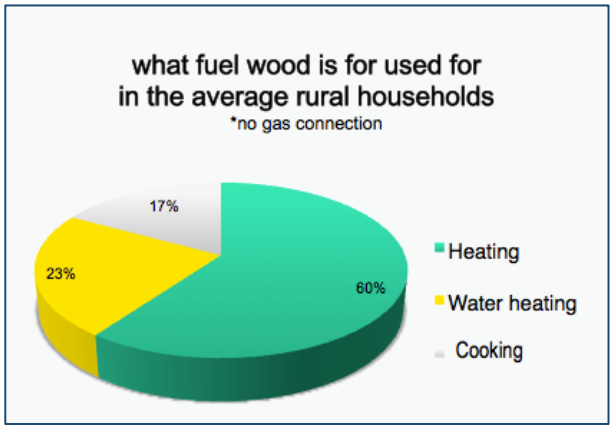
affordable energy and protect the environment, especially forests, thereby protecting the climate.
Looking at the gender dimensions of climate mitigation activities and technologies means to look at the realities of women and men in their daily lives and their needs, perspectives and responsibilities in their social, cultural, environmental and economic context. Women often do not have equal opportunities, access and control over resources and policy decisions.

➔ **NOTE**: Gender-equitable climate finance and national gender-sensitive implementation plans have to reflect these realities.

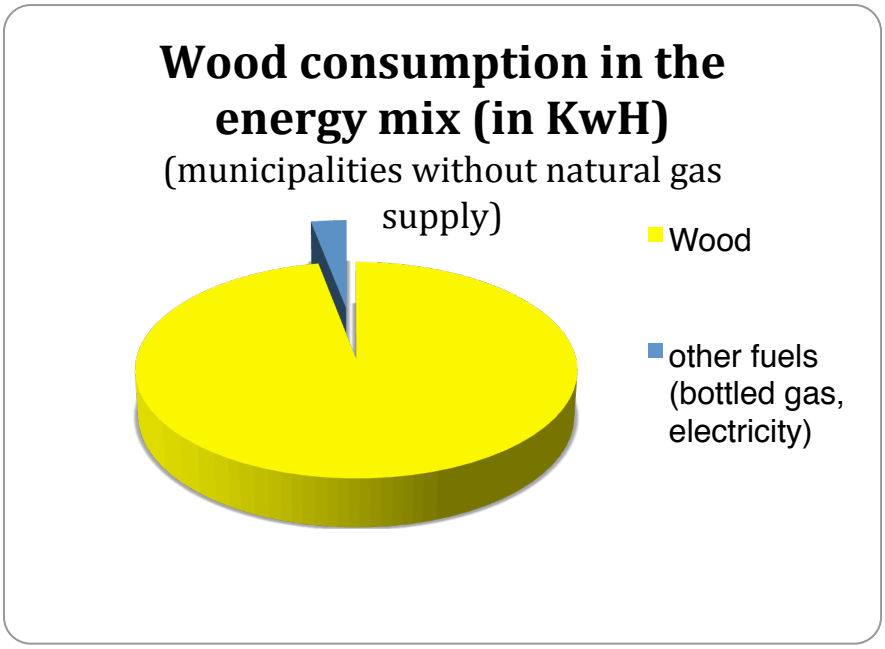
2. Energy situation in Georgia and the relation to gender and poverty

The issues of energy and climate change are crucial for Georgia. The national Green House Gas (GHG) inventory for the years 2000-2006[2] has shown that the energy sector, including transportation, is the leading sector regarding CO2 emissions in Georgia. Development of alternative sources of energy is crucial for emission reduction. Despite Georgia's abundance in potential renewable energy sources – such as wind, solar, geothermal and biomass– the country is still in the planning phase for utilizing these energy sources. Renewable energy sources play a role in providing energy services and mitigating climate change. GHG emissions associated with the provision of energy services are a major cause of climate change.

Water heating is the second largest energy expense in the average household in Georgia - it typically accounts for 23% of the utility bill[3]. The average rural household spends one third of their total household budget on energy. In rural areas approximately 70-80% of energy needs are met with wood and other conventional energy sources. In villages without natural gas it is as high as 97%. On average, households in rural communities burn up to 10m3 of firewood per year[4]. This has a severe impact on the environment, and produces large amounts of CO2 (1.5 tons of emissions per 1 ton biomass), contributing considerably to deforestation and thus to land degradation, which in turn has adverse effects on the quality of life and food security of the village population. Indoor air pollution created by burning plastic and other types of unsafe materials and fuels leads to respiratory illnesses. Insufficient availability of warm water for hygiene purposes likewise adversely affects human health.



[2] The third national communication of Georgia to the United Nations Convention on Climate Change has not been published yet, May 2015
[3] N. Lazashvili, 2012; Energy study on large-scale introduction of energy efficient household stoves in Georgia
[4] Research of Greens Movement of Georgia/Friends of the Earth Georgia



Deforestation, the uncontrolled use of wood resources, decreased soil quality and crop production have negative impacts on the environment leading to increased risks of natural disasters such as landslides, mudflows and avalanches. Ultimately, these issues pose serious threats to local communities and household's ability to sustain livelihoods, access a safe water supply, health and agricultural production, and therefore access to food and energy security.

In a typical Georgian household **gender roles** are traditionally assigned. It is the woman's responsibility to do the tasks involving warm water (dishes, washing clothes, cooking, children care, water for personal hygiene). Women spend a lot of time preparing warm water on traditional wooden stoves, however their warm water needs are often not met, many choose to use cold water in order to save on fuel, time and resources. Women benefit most from easy access to warm water as their labour burden is reduced which creates free time for other activities such as education or income generation. In addition to keeping the house clean, cooking and caring for children and other family members, women also often carry out agricultural work and are engaged in gathering wood or other fuel.

Exposure to hazardous emissions from burning fuels can be reduced by using alternative and sustainable energy sources. This benefits the health of women and children who spend a large proportion of time indoors exposed to indoor air pollution, and the environment through the reduction of burning solid fuels. Additionally, an improved warm water supply leads to better hygiene and has positive impacts on health, both of which are women's assigned responsibilities.

Average income levels are extremely low in rural areas, and few households can afford to buy a commercial Solar Water Heater or other energy efficient devices to reduce their energycosts. Access to (energy) credit is virtually non-existent in rural areas. The WECF pilot project on sustainable energy looked into the possibilities for developing financial instruments that are accessible to rural women and men, with special mechanisms to ensure access to credit for women who don't own land as collateral.

3.National strategies

The Ministry of Environment and Natural Protection of Georgia is drafting a Low Emission Development Strategy (LEDS) and an Intended Nationally Determined Contribution (INDC) plan, both concepts of the UNFCCC. In the preparation of the plan, the government is making predictions of future emissions and their reduction potential in different sectors, relevant to climate change, together with the help of external experts. These national plans imbed another concept of the UNFCCC; sector focussed nationally appropriate mitigation actions (NAMA). At the moment there are four different NAMA's planned to be implemented in Georgia: 1. Forest protection, 2. Energy efficiency (EE) in buildings, 3. Implementation of 10.000 EE stoves and Solar Water Heaters (SWHs), and 4. Energy efficiency in the transport sector.

A priority identified by the Ministry of Environment is the introduction of solar water heaters and energy efficient stoves in rural areas, based on their potential for emission reduction, poverty alleviation and forest conservation[5]. They have asked WECF and its NGO partner 'Greens Movement' to develop a Nationally Appropriate Mitigation Action (NAMA) on the implementation of these technologies.

The ministry of Energy and Natural Resources has been focused on the planning of large hydropower dams, which has provoked mass protests amongst civil society. As a consequence, the most important projects have been halted to allow for the carrying out of environmental impact assessments before construction. However, solar energy is now considered a feasible alternative to the hydropower dams and its development is another priority of the government.

A new law on energy efficiency and renewable energy is being prepared, based on the Association Agreement with the European Union. A draft has not yet been published, but it is already known that solar energy and energy efficiency will be addressed. WECF's partner Green Movement of Georgia/FoE is monitoring the process and is in close contact with the department of renewable energy of the Ministry of Energy and Natural Resources.

II. Assessment

A. Technology

1. Background

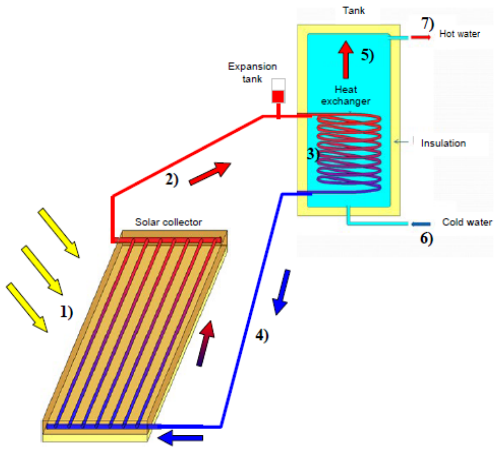
WECF and its local partners started introducing solar collectors to Georgia and other countries in Caucasus, Eastern Europe and Central Asia in 2008, through the framework of the "Empowerment and local action" project funded by the Ministry of Foreign Affairs in the Netherlands. At the beginning, local trainings with German experts were organized and

[5] TECHNOLOGY NEEDS ASSESSMENT AND TECHNOLOGY ACTION PLANS FOR CLIMATE CHANGE MITIGATION, UNEP, Min of Environment, 2012)

several solar collector models were built and tested in the countries, using different materials and technologies. The range varied from simple and cheap materials such as plastic, old bottles, or old radiators, up to more advanced technology using iron or copper. These materials are more expensive, and require instruments such as welding or solding machines to engineer, and the technical skills to work with these instruments.

The main criteria set by WECF was that all materials were available at local markets and could be constructed by local workmen – and women. During the following years, a solar collector model using iron flat plates and tubes in a wooden frame with a glass cover was developed together with local partners and the German solar collector company "Solar Partner Süd". This solar collector works on a gravity system and therefore does not need a pumps, i.e. electricity is not needed. Water tanks are equipped with a heat exchangerso the system is frost resistant and can be used all year round. From the different models tests, this one proved to be the best option, regarding costs, efficiency and construction requirements (For more information see http://www.wecf.eu/download/2014/April/updated-manualsolarcollectorsENG.pdf).

This solar collector type became the technology in the project "building local capacity for domestic solar heating, hot water and insulation for rural and remote areas in the EEC region", a project, funded by the European Commission from 2011-2015. This project was implemented by WECFand the Georgian partners, Greens Movement of Georgia, Rural Communities Development Agency, Social Development Center of Akhaltsikhe, and SEMA. Partners from Europe were GERES – Groupeénergiesrenouvelables, environnement et solidarités(France), Centre for Develoment and Environment of Bern University (Switzerland) and Solar Partner Süd (Germany) and Atmosfair (Germany).



2. Gender Sensitive Approach

Gender equality is of high priority to WECF and this extends to all projects. The equal outreach and involvement of women and men, and responding to their respective needs with regards to energy issues have been taken into careful consideration. The project was however not designed with the main aim of changing gender stereotypes of gender equality

legislation. The projects main aim was to develop safe and climate-friendly energy solutions for low-income rural households, in doing so in the most gender-equitable manner possible.

A gender sensitive approach encompasses the ability to acknowledge and highlight existing gender differences that cause inequality and incorporate these into strategies and action[6]. The training programme for the construction of the solar collector was a crucial component of the project and therefore gender roles have been considered when designing the trainings to ensure that they are accessible to women without perpetuating essentialist and traditional ideas of women. Such roles create barriers to women's development and the pursuit of gender equality. There has been a great amount of reflection on these roles on the level of the project, villages and nationally in order to challenge and overcome these lived inequalities that prevent women from achieving their potential. But also men are often challenged by their gender role. In rural areas in Georgia, men often do not have work and lack meaningful activities. By conducting the first trainings on solar warm water heaters men were very interested in the issue and in the construction trainings provided by WECF and partners. It gave them something meaningful to do, which had a beneficial impact on them and their family members by reducing domestic tensions.

WECF had set a target for womens participation, women did attend the trainings, but the interest and engagement was very low at first. Therefore WECF developed another training format, responding to the traditional division of gender roles in Georgia and the EECCA region. The training course was set up with different components, including a division of the participants and dedicated task in one construction and one maintenance/monitoring group, but also joint sessions. The trainings aimed for gender balance, but the participants could chose at which group they want to participate. Usually the construction group consisted mainly of men, the maintenance/monitoring group mainly of women.

An important part of the maintenance/monitoring group was also the analysis of the benefits of a solar warm water heater. The participants were usually amazed how much time and money they could save – especially the women. The analysis helped participants to perceive the traditional gender roles, and that women are much more using hot water then men in their daily tasks. The trainings highlighted existing cultural differences between the gender roles of men and women. Awareness amongst the participants was created around the issue that gender inequalities have an impact on every part of daily live and that changes of traditional gender stereotypes can benefit all.

As traditionally women are using most warm water, they are the first to notice in case the collector is not functioning optimally. It proved crucial for the correct use and maintenance of the solar collector that both men and women have a good understanding of its functioning, maintenance, possible problems and ways to solve them, and therefore participate equally in the trainings.

Mainstreaming gender within a training project means to disassemble gender-related conceptions and traditions by creating new ways and forms that lead to equality between men and women and help to raise awareness about this issue. Decisions that are taken by all members of a group (be it society of a family) are accepted more easily and implemented in a better way. Therefore, it is of importance for the success of the construction of a solar

[6]WECF, Gender in Sustainable Development – Collection of Exercises for Training of Trainers (TOT), 2014, p.51.

collector and its function that all members of a groups agree on how to build it and what for to use it. Furthermore, the participation of all in the decision-making process provides for all concerns, needs and wishes to be taken into consideration in advance.

3. Goals

The solar collector implementation programme has been developed to introduce the technology of solar water heaters to Georgia by WECF and partners since 2008. Besides the overall goals discussed above, the main measurable objectives of the programme are the reduction of CO2 emissions, e.g. reduction of fuel consumption, reduction of energy costs and poverty, and increase of living standards.

Domestic hot water systems have a great potential to alleviate poverty of rural populations, especially in remote areas. The systems promoted by WECF are designed in such a way that local workmen and women, using local materials, can apply them. In this way, the solar water heaters remain affordable for low-income households.

The training concept developed by WECF and partners, aims tolink the social context and the technology, i.e. the training courses consist of participatory community learning, construction, operation, maintenance and monitoring of the technology.
A core part of the programme is building local capacity by training workmen - and women -, selected from the rural population. These technicians will remain in the remote areas and assure sustainable maintenance and replication of the implemented technology.

The solar collector implementation program is aimed at rural domestic usage, combined with accessible local credit, to allow replication of these systems.

On the policy level, the programme strives for a better convergence of legislative and regulatory frameworks by elaborating concrete policy recommendations. Local partners are working closely together with local authorities and representatives of the Ministry of Environment and Natural Resources Protection of Georgia.

4. Results

Since 2011, in the framework of the project “Building local capacity for domestic solar heating, hot water and insulation for rural and remote areas in the EEC region” funded by the European Commission, more than 400 solar collectors have been constructed in Georgia by locally trained technicians, using local materials. The efficiency and the benefits of solar applications have been monitored and tested by WECF and partners. The interest and willingness of the local target population has shown to bevery high, and interest at national level is growing rapidly.

Solar collectors were implemented in 5 different regions of Georgia with different climate conditions: Khamiskuri, Kheta (Samegrelo-ZemoSvaneti region), Ivandidi (Imeretiregion),

Sagarejo (Kakheti region), Akhaltsikhe surrounding villages (Samtskhe-Javakheti region), Ereda, Chardakhi and Misaktseli (MtskhetaMtianeti region), and in other countries as well (Ukraine, Moldova, Armenia, Azerbaijan, Russia, Kyrgyzstan). Adaptation of technology to local conditions was one of the main targets of implementation. Together with the local population and local partners, challenges were analysed and technical solutions were developed for the different socio-economic, gender related issues and climatic conditions in the regions, on which we will elaborate later in this case study.

5. Technical monitoring, quality control, adaptation results

5.1.Technical monitoring

During the 4 years of the project, regular monitoring visits together with experts from Germany were organized. The purpose of the monitoring visits was to check if the technology had been correctly installed by the trained men andwomen, and to give support if any technical difficulties were encountered. The results of monitoring visits showed that most of the solar collectors were properly installed and produced hot water. The owners of the solar collectors, women and men, were usually satisfied. However, especially in the initialyears, in some cases there were construction mistakes linked to a lack of understanding of certain technical aspects. In these cases, the experts gave support and explained these aspects to the technicians. For new problems occurring, which were not yet covered by the training modules, solutions were developed jointly.

5.2.Technology evaluation training

A mid-term training session with all project partners, interested constructors and monitoring specialists was held by WECF and external experts in order to evaluate the technology implementation process, assess existing problems and find solutions. This theoretical training was combined with monitoring visits to all project villages in Georgia. The main focus of the training was the evaluation of newly introduced technologies (solar heating and natural insulation techniques) and the experience made with the solar collectors.

6. Lessons learnt and recommendations

An evaluation of the project "Building local capacity for domestic solar heating, hot water and insulation for rural and remote areas in the EEC region" shows that the solar collectors implemented as demonstration objects during the last four years in Georgia are working efficiently. Local partners played an important role in the adaptation and implementation of the technology, with the support of technical experts from Germany. If implemented correctly, under standard conditions, the solar collectors work without any problems and the solar collector owners are content with their efficiency.

6.1.Construction flaws

There have been only few cases where the solar collector did not work because of construction flaws. In these rare cases where solar collectors were not working, the issues have been identified; incorrect connectionsbetween pipes, wrongly shapedpipes, poor placement of expansion tank or installation in a wrong location direction (e.g. facing East or West instead of South or sometimes they were even placed in the shadow, e.g. below a tree, instead of in a sunny spot). This occurred only in the beginning of the project. In many cases the glass cover broke, either because it was fixed incorrectly or because of weatherdamage. This is mainly a visual problem that does not affect efficiency.

In many cases, when these original mistakes were corrected, efficiency was improved significantly, which is especially important for use in wintertime use.
The most commonly made mistakes are small details that considerably decrease efficiency of the whole system.

- Problems with the outside insulation: lack of protection from water or missing insulation of water tanks (this was an initialerror at the beginning of the project, but since then all tanks have been protected with a metal cover).
- Missing rain protection of the frame (another common issue at the beginning of the project).
- Open air placement of water tanks (this is related to the fear that tanks will break and damage the houseand sometimes because bathrooms are placed outside the house themselves. Over time an increased numbers of beneficiaries have agreed to place the tanks inside their home, as experience has shown the benefits of inside placement and the reliability of the tanks).
- Dirty glass due toevaporation when the wrong paint is used (again, experience has taught beneficiaries which paints to avoid and this is now being applied to ensure this problem no longer occurs).
- Missing or insufficient insulation of pipes (this is the most common problem that is still encountered. Insulation of pipes is considered the responsibility of the beneficiaries, however they often don't consider it as a priority and postpone it).

To achieve optimum efficiency, all details to ensure best level of insulation are a priority, but this requires a change of mentality thatmay take time and need further awareness raising.

In Georgia, it is not a common habit to insulate warm water pipes and even professional plumbers are not aware of the detrimental effectsof heat loss via missing or incomplete insulation to the overall efficiency of the water heating system. The same applies for the placement of warm water tanks, which traditionally are installed outside the house. This leads tovast heat losses in cold periods of the year. For successful implementation of all

details regarding insulation and efficiency the project requires well trained and experienced technicians who are aware of the importance of these factors.

In general, the most efficient way of avoiding or repairing construction flaws is to have a team of experienced, professional constructors located in the target community. It is crucial to build capacityof the technical staff of national and local partner NGOs, so that they are aware what is required to solve problems. From other WECF pilot projects in other countries (e.g. Armenia, Russia), WECFhas learnt that without technical staff, it is difficult for NGO partners to provide the needed support to beneficiaries and constructors and for monitoring (see chapter on monitoring and the gender roles).

6.1.1. Special challenge: warm water tanks

The various challenges with the warm water tanks were underestimated during project planning and at the beginning of implementation. Over the past few years, most of the technical problems occurred in relation to the warm water tanks. The tanks are the most expensive part of the solar collector system, high quality tanks are required and technological local adaptation to the potentially high water pressure is needed to avoid leakages. In the case of high water pressure, there are several technical solutions such as installation of pressure reduction valves to counter this issue.

The external experts from the company Solar Partner Süd, which donated expert time to the project, recommended the development of a pressure free water tank using the same principle as is used in German high-tech hot water boilers. Pressure free water tanks are much more durable than water tanks under pressure, they are also cheap and easy to construct. However, the partners and construction teams were content with the installation of pressure reducing valves, which had solved the encountered problems, and there was no space in terms of budget and trainings to extend the pilot using pressure free tanks.

Another aspect that should be considered is the oxidation of the warm water tanks, which were initially made from iron. Local experts foresaw the problems with corrosion after a couple of years of useand they started installing ‘anodes’ (a piece of aluminium that takes the corrosion away from the iron). However, in the future the tanks will need to be painted internally with a specific paint to ensure the water remains safe for drinking.
This problem could be avoided with the German pressure free tank, but this suggested tank has less capacity for holding warm water, and therefore they fear that beneficiaries willnot be able to use it as they would like.

On reflection, to implement an adapted warm water tanka complete practical training on warm water tanks would have been recommended, followed by a test phase to show if the proposed technology is working well and users are satisfied. This process would have taken several years and was not possible within the timeframe of the existing projects due to lack of time andfunds for additional trainings and pilots.

Tank construction became a central topic during the implementation of the project, i.e. most tanks were constructed in the headquarters of the partner NGO, Rural Community Development Agency (RCDA), who provided them to different target regions, where they were installed by an experienced construction team led by Greens Movement. Trials with the central production of tanks by an external factory were conducted but the quality was

unsatisfactory. The recommendation for the NAMA project is to organise the construction of tanks in a semi-centralized manner in 5 – 6 construction centers, based on1-2 standardized models. Another recommendation based on the experience presented in this case study, is that the technicians who are trained as solar heater installation specialists, should not be the same as those who will be responsible for tank construction.

6.2.Problems caused by externalcircumstances

In some cases, delays in construction were caused by problems with water supply. In some project villages the water supply during the winter was non-functional, therefor solar collectors could not operate. These circumstances either caused delays in installation of the solar collectorsor previouslyinstalled solar collectors could not be operational due to the lack of water. Another serious problem was the high pressure from central water supply systems, which caused leaks, and in a few extreme cases, even explosion of thewater tanks. The self-made water tanks are not resistant enough to high pressure. In areas with high water pressure, the recommendation from this case study is that a different type of tank is used. These issues were assessed in several meetings and trainings, and finally solved by installing pressure-reducers and clappers.

Some solar water heaters have been damaged by unexpected frost. The system is only frost resistant if anti-freeze has been put into the system. When the system is not emptied and frost occurs unexpectedly, or if users forget to turn off the taps fully, and some water remains, then damage can occur to the pipes. However, damaged pipes and tanks can be repaired easily by local workmen or the owners themselves.

6.3.Financial constraints

While interest in solar collectors has risen rapidly in the recent years, a typical problem amongst rural population remains; a lack of financial resources.
Monitoring results show that the use of solar water heaterreduced fuel costs by 43%, saving on average each household more than 150 EUR per year. A solar collector costs up to 375 EUR, therefore the payback time is 2-3 years. However, without access to subsidies or credit, low-income families simply do not have the requiredfundsto invest in a solar collector. Within the project, one model has been createdwhich was a subsidy of 100 Euro for low-income families. The remaining costs had to be covered by the beneficiaries. WECF and its partners have long waiting lists with people frommanyvillages that want to have a solar collector on these financial conditions. Such a subsidy, and/or low-interest loan are a pre-condition for the further dissemination for more solar collectors. Low-income families cannot providethe full amount in one single payment.

The project aims to reduce rural energy poverty. However, even with a subsidy of 100 Euro the collector is still not affordable to the poorest segment of the population, the extreme poor. This group often includes female single headed households. The most economically secure families have the greatest accessibility to buying the solar collectors, however these families usually already have an alternative water heating system in place and do not struggle to pay their energy bills, therefore they have less of a need to purchase the solar collectors.

In the course of the project, the collectors became cheaper and more efficient due to optimisation of its construction. In the future, it is expected that production will be even more efficient and economically accessible when bettertools are available. However to reduce costs substantially, we would have to sacrifice the efficiency of the solar collectors.

As a recommendation for the NAMA, the case study recommends top quality should be insured, and the use of cheap non-durable materials must be avoided. Instead, financial support for the lowest income group should be made available. This issue of weighting the cost versus the quality, and the long-term sustainability should be addressed at trainings and recommendations on quality materials should be given to constructors.

6.4. Acceptance

The acceptance of the new solar water heater technology during the adaption phase was not unanimous, due to some of the start-up problems. These start-up problems were, however, tackled and solved. After the problem-free implementation of many demonstration units, the interest amongst the population of target communities began to steadily rise.
The most important fact to bearin mind when planning similar projects is that this process took several years– starting with development and introduction of a new technology, and adaptation to local conditions, until the technology finally became ready for widespread implementation.

Our experience with short time projects in neighbouring countries shows that in one year interest in new technologies can be created and demonstrations can be built, but still it requiresmore years for thoroughintroduction and adaptation of a new technology to a new region or country, and for the formation of experienced construction and maintenance/monitoring teams to assure the quality of the technology. Equal attention to the social, environmental and economic context is of the same importance as the focus is not solely on the technology.

6.5. Gender

The gender approach to this project was to aim for equal involvement of women and men. To make this aim possible, a gender-responsive training concept was developed and conducted. The project did not aim to change gender stereotypes of gender behaviours per se, and indeed, this aspect did not see much evolvement. Women and men who took part in the gender-responsive training, acknowledged that there were gender differences, but were little inclined to change their social gender roles. The women usually did not (want to) get involved in the construction part of the training, and the men did not (want to) get involved in the maintenance/monitoring group. The construction work is seen as dangerous and physically heavy work – suitable for men, but not for women. The maintenance/monitoring work is seen as related to daily household work – therefore suitable for women. Women and men were both satisfied the solar warm water heater as they both benefit. The men get the possibility to save and to generate some income, and increase their social standing by engaging in a meaningful activity. This last point was the most important aspect for both young and old men. The men became very motivated to support the project expansion.
The women benefitted from the solar heaters as they saved a lot of time and reduced their unpaid work load, and once this became clear, developed into a driving force behind the project.

The project thus benefits women and men differently, but both groups were equally motivated by the results. The project main focus was not to change gender roles, but to tackle energy poverty, climate change and environmental degradation via sustainable energy. The project did not lead to a major change in gender roles, but it did result in a better understanding of the different needs and priorities of men and women, and the different benefits it procured for women and men.

➔ **As a recommendation** for future projects, it would be good to put the focus equally on gender equality in the sense of challenging existing gender roles more than has been done in the project so far and to put more attention on collection of sex and gender disaggregated data.

It would be interesting to see, if as a result, more women would be interested in the construction work and more men would be interested in the maintenance/monitoring work.

B. Capacity Building and Training

1. Preparation phase

From experience gained through trainings on solar collectors in 2011-2013, in the framework of the "Building local capacity for domestic solar heating, hot water and insulation for rural and remote areas in the EEC region" project, WECF and partners developed a participatory, gender-sensitive training concept. This training concept consists of several training modules on construction, use, maintenance, monitoring and business opportunities. Additionally, training modules specifically to train trainers were developed.

In order to achieve positive training results, a selection criteria for training participants was carefully developed and applied to guide the selection of participants. This is important because the training was offered for free, therefore to maximise the funding effectiveness, it was imperative that appropriate candidates were selected. The main attributes sought were reliability, being respected in the village, as well as high interest and motivation to be involved with the work onsolar energy. Women were strongly encouraged to apply for the training as WECF was aiming to achieve a balance in genders across the participants. For the construction trainings, previous technical skills, such as welding, were also important an important criteria. Project participants were required to be able to give their time to participate in project activities and be willing and motivated to have a demonstration solar collector at their house. Conditions for installing a collector on their house should not be too complicated, preferably with a water connection already in place. It was extremely important that the participants were willing to financially afford to contribute to the related costs of the solar collector.

For the selection of trainers, a special criteria was developed and applied, such as the ability and interest to teach others, awareness and knowledge of gender issues, technical skills and experiences, and having time to travel to other places in Georgia or abroad for trainings. Gender equality was aimed for, however an equal balance of men and women could not be

fully achieved. Furthermore, the aim was to have a gender balance of trainers, which was also not completely reached (4 women trainers and 6 men trainers).

The optimum number of participants per solar heater training group was 10 (maintenance/use/monitoring and construction); with two groups the total number of participants per training was 20 persons.

2. Training concept

In the first project phase, a first training on construction, use, maintenance and monitoring was conducted by WECF together with its local partners and external experts. 20 men were trained on construction and 14 women were trained on the maintenance, use and monitoring of the solar collectors. These participants were asked to, respectively, construct ormonitor solar collectors each in order to receive their master certificate.

The goal of the training was to build capacity of interested local people on the issue of solar collectors (heaters) within a timeframe of approximately 5 days in a participatory, gender-sensitive and inclusive manner. The training also aimed at showing the benefits of the use of solar collectors and to raise general awareness of this new technology.
The training on solar collectors was divided into two main parts reaching out to different participants:

- Construction
- Maintenance, use and monitoring

These parts wererun simultaneously. The construction of solar collectors, which is more technical, attracted more interest amongst men, whereas the maintenance use and monitoring was sought and attended more by women. Gender is a topic of the overall training session, the aim is to reach out to both men and women to achieve equal knowledge and understanding and thus to create awareness of gender stereotypes, barriers and women's rights amongst all participants. The training sessions aim to provide an equal foundation of knowledge of all participants regardless of their gender to enable and encourage participation in decision-making processes regarding the construction, needs and use of the technology. It is crucial that all voices are heard in the decision-making process in order to find the best solutions for the entire community and to contribute to gender equality. The training also includes a module on opportunities for local business development related to construction and maintenance of solar collectors, here the aim is to encourage both men and women to seek alternative and additional income from solar heater services.

Six interested and skilled trained constructors had the possibility to participate in a 3-week internship in Germany at the company Solar Partner Süd to acquire more detailed and practical knowledge of solar systems. These trainings proved to be extremely useful for deepening knowledge, but also a very important factor for motivation to implement the newly acquired skills in the target communities in Georgia.

2.1.Training of trainers

As a second step, the most interested and skilled participants (5 women and 7 men) from the first training round were invited to become trainers themselves. The training of trainers provided the tools and skills for conducting trainings in the local communities, using the modules on construction, maintenance, use and monitoring independently. Trained trainers

can be hired by the project or other organisations, thus possibilities for some income generation are given to the trainers.

2.2. Community trainings

After being trained, the trainers conducted trainings in the communities and in neighbouring countries according to the WECF modules. In Georgia, in total 69 women and 88 men have been trained in 8 community trainings, each lasting 4 days. In Armenia and Azerbaijan 6 additional trainings took place and 5 monitoring follow up visits occurred, lead by the trained trainers. Trained trainersare now also hired by other organisations increasingly frequently to conduct solar collector trainings for their beneficiaries. At least 30 trainings were conducted for other organisations as by end 2014. Unfortunately, male trainers were more frequently hired because these organisations underestimate the importance of women's involvement in general, and women's capabilities regarding the maintenance and monitoring of the solar collectors in particular.

2.3. Follow-up after training - Certification

After successful participation in the community trainings, participants had to either build or monitor two solar collectors in order to get their master certificate. In turn, they received financial help towards the cost of the construction materials. Certificates were only given when the solar collectors were installed correctly and working or when monitoring was conducted successfully. Details on the solar collector implementation were handled by local partners directly with trained participants.
Trained trainers had to conduct two test trainings in their communities in order to receive their certificate.

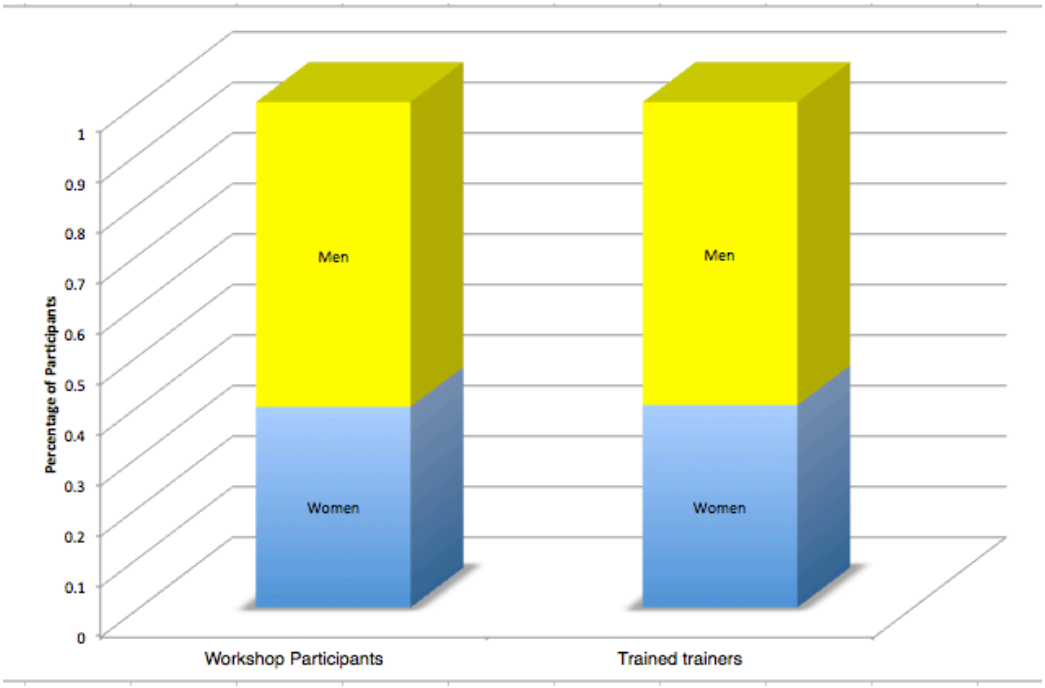
3. Lessons learnt and recommendations

3.1. Construction teams

Another important point is how construction is organized. Good examples from Georgia and some other countries (Armenia, Moldova) show that highest quality is achieved wherever trained individual's work together in construction teams (groups of 4-5 people) instead of constructors working individually. There are several advantages to working collectively. Firstly, tools can be shared which leads to a reduction in costs. Secondly, fewer errors are made as there are multiple people ensuring everything is being done correctly. Initially, the project design featured men and women working together in constructing, maintaining and monitoring the solar water heaters in order to pursue gender equality and challenge traditional roles for men and women. However, this did not happen due to several reasons. There was a lack of women interested and equipped with the necessary skills to participate in the construction work; therefore the construction teams mostly consisted of men. Furthermore, the women enjoyed it more to work in female teams, which maintain and monitor the systems, then to join a group of men constructors. In future projects this might slowly change, when more and more the typical male job sectors become accessible for women. This requires also gender equality efforts by vocational training institutions and educational institutions at large.

3.2. Number of people trained

50 women and 76 men were trained at the trainings for construction and maintenance/monitoring andfrom these, 4 women and 6 men were trained as trainers. Nearly 100% of the training participants followed up on the training as required by the training rules and were involved in the construction and monitoring of the solar collector after the training. From those who finalized the full training cycle, a few men and women started to really use the acquired skills for professional activities. There could have been more women and men generating employment after the training, if the NAMA project to scale up the construction and use of solar heaters would have already started. The regions are ready. When more collectors need to be constructed, there exist enough trained people who will be available to join and work on construction and maintenance. Selection criteria like welding/plumbing/administration skills, respected in the village, availability of participants were applied by the partner organizations, who chose the training participants. Despite the fact that the installation of the solar collectors waspartly subsidized by the project, some women and men could still not afford to provide their share of the costs. Therefore 'affordability and access to finances with a special focus on accessibility for women in vulnerable situations' was added as an element of the training sessions.
Below are some recommendations for a larger scale project such as the gender-sensitive NAMA that can contribute to even higher success rates.



3.3. Preparation and selection of training participants and solar collector owners

In each target village a participatory needs assessment was conducted. The assessment facilitated the beneficiaries in analysing their hot water and energy usage. The assessment showed that vast amounts of money, time and resources are used for heating water, thus demonstrating the need to alleviate these problems through solar collectors (water heaters). There are set indicators to monitor the success of the project, which grossly coincided with the indicators of the project framework. During these assessment exercises, it became clear

which were the most interested and active participants, which would benefit from taking part in the trainings.

Experience showed that it is important to have good pre-selection of training participants. Participants need technical skills and, most important, should have a real desire to generate warm water through the solar collectors. Participants also should be able and willing to invest the needed contribution for materials to construct a solar collector.

Often the community committee was consulted as part of the selection process to. Finally, a contract for participants who could not pay the training costs was created whereby if the participant does not meet the obligations and complete the training he or she must pay back the costs of the seminar.

3.4. Training fees

Initially, the original concept was that participants got the training for free but in return were obliged to build two solar collectors, afterwards the participant would then gain their certification (master certificate). However, during the midterm evaluation of the project, it was suggested to create a 'training registration fee' to encourage participants to attend and fully participate in the trainings. This has positive psychological associations - if you are willing to pay (even a little) you are most likely more committed to the project and have a reason for acquiring and using the new knowledge.

3.5. Involvement of women

The dual training concept with a focus on construction for one group, and on monitoring for the other, worked well. Participants could select which training, either on construction or on maintenance, they wanted to attend. This resulted in almost only men choosing construction, and women choosing the maintenance focus. Women as well as men both participated in a motivated manned in the training activities. Some women had an interest in obtaining construction skills, but they rarely participated in the actual construction activities, as this is traditional perceived as a men's job and the women lacked the welding skills. Some women also expressed their opinion that since women are already burdened by more unpaid care and domestic work then men, it is only fair that themen contribute at least with 'their' task of constructing something useful for the household.

As a result of the type of training chosen by the male and female participants, several households ended up with both a constructors and a maintenance expert, so that they could both construct and maintain their own solar water heater. But in other cases, this was not so, and a constructor would build a solar heater, but nobody in his family would be able to maintain it. The initial idea was that another trained maintenance technician – a woman – would help other households with the maintenance of their collectors. But existing insecurity for women travelling alone, and traditional gender stereotypes that women should stay at home made that in reality this has not happened.

- ➔ **As a lessons learnt and recommendation** for the planned NAMA, a basic maintenance training should be an obligatory part for constructors, and all women and men from households which apply to install a solar water heater should be encouraged to take a basic course in maintenance as well.

Not only traditional gender stereotypes, but very much also the **lack of time** for women in rural areas, due to their heavy burden of household responsibilities (caring, cooking, cleaning and looking after livestock) were one of the main reasons that in the end fewer women then men found the time to participate in the trainings. Also the fact that women's movements are restricted due to the idea that women should stay at home was a problem, as a few training sessions took place in the capital city. According to the latest reports of the CEDAW committee violence against women and domestic violence remain predominant problems in Georgia[7] and should be kept in mind when addressing women's participation in outside training events. The lesson learnt from this case study is that women's participation was better attained when training sessionswere organised within their own community, in comparison to when they had to travel to a national training.

➔ As a recommendation for the planned NAMA, in order to reach more female participants, the trainings should be adapted to a shorter training time per day and be organised as close as possible to their homes.

➔ Another proposal to increase women's participation is to offer childcare opportunities during the trainings, and to provide lower training fees for female participants.

➔ A further recommendation is that for each of the households where solar heaters are installed, and experienced monitoring team that includes at least one trained female trainer, helps the women of the beneficiary households to fill in the monitoring forms and explain the basic monitoring tasks. This worked especially well when the women trainers were paid a fee for this work.

3.6. Support by local experts

The trained local constructors are able to construct solar collectors but errors can still occur. One training session proved not to be sufficient for most participants to ensure the required quality. The local partner NGO's technical staff participated in the trainings the first times around, and thisproved to becrucial for the project, as they could assess which participants had achieved the required level of knowledge and experience. After some training, reliable work men/women emerged from the community that formedthe construction and monitoring teams. They becamemore experienced than the NGO staff in construction of solar heaters, and do most of the construction and installation work for their fellow villagers that obtained collectors at their homesafter taking part in the basic trainings. In this way, with the qualified masters working in construction teams, errors happened less frequently and high quality was guaranteed. In most cases the constructors are paid by beneficiaries, or the NGO partners, in which case they have become staff of the NGO partner organisations. These core teams ofmen and women are absolutely crucial for the success and sustainability of the project, and form the basis for widespread installation of solar water heaters In Georgia, as is planned in the NAMA.

[7]List of issues and questions in relation to the combined 4th/5th periodic reports of Georgia (2014) http://docstore.ohchr.org/SelfServices/FilesHandler.ashx?enc=6QkG1d%2fPPRiCAqhKb7yhsldCrOlUTvLRFDjh%2fx1pWBtffXXNKTPnVjD6I6%2bgb%2b%2fEwVijaY%2bYxoyfgTODkpvy3IaBUh0osDRCnQ919MDfdORbqF6RAsdnw9hGUKL00%2b9

3.7. Conceptual component

Evaluation of the training strategy as a whole shows very positive results. The trainings as planned were highly successful and amongst training participants a high level of knowledge was achieved. The most interested and motivated participants were trained as trainers and successfully conducted trainings in communities or neighbouring countries.
In the course of the project implementation the need for additional practical trainings regarding emerging issues such as technology adaptation and monitoring were needed. It was not possible to implement these additional trainings because the project plan was fixed and the budget would not allow it, flexibility of planning was not given. As a recommendation for similar projects and for the NAMA, allowing more flexibility to address emerging issues would be beneficial.

➔ Recommendation: for further training programmes include some additional trainings on emerging topics, and plan for more flexibilityto manage challenges that arise during the implementation process in a direct and adapted way.

This project created a special training track on monitoring, as a way to increase participation of women. The strategy worked, and even though not a full gender balance could be achieved, the participation rate of 35-40% of women is considered a success. Had the project concept only foreseen construction focussed training session, the participation of women would have been much lower. As a next step, and as part of a much broader strategy to achieve gender equality in all part of society and sectors of the economy, more should be done to encourage young women to develop technical skills such as welding, which are much needed in construction work.

The active outreach to involve women needs to be pursued to ensure equal opportunities for women and men in the energy and technology sector. For sustainable development of the society and economy, it is important that women as well as men participate in formulating needs for new technologies, deciding about new technologies and are involved in designing and evaluating new technologies. For this to happen an active strategy to overcome traditional stereotypes and perceptions is required. This type of projects can be a starting point for understanding gender roles and steps towards increasing equal opportunities. This type of project can act as an opportunity for women to acquire non-stereotypical knowledge and experiences that transcend their traditional gender role tasks, therefore contributing to women's empowerment.

C. Monitoring concept

Monitoring is an important theme and continues as an on-going process for the project described in this case study. This section focuses on the achievement of the main goals, which are the most important "hard indicators"which are needed as basis for registration of "Gold Standard" and development of NAMA, as the main options to scale up the project results (see chapter D.3). The main indicators there focus on the potential and achieved CO2 reduction (calculated from reduced fuel consumption) and the household's reduction of costs for energy needs. Another main indicator - as an additional benefit of installing a solar collector - is the increase of comfort and living standards of the project beneficiaries. Monitoring was done in a participatory way by the trained beneficiaries themselves.

1. Preparation phase / Methodology: Monitoring concept

The monitoring concept was developed in a participatory way, together with local partners, based on 'needs-assessment workshops' with the participation of beneficiaries in the target communities. At these needs-assessment workshops, the beneficiaries set their own indicators.
The main indicators presented in the paper were set according to the goals of the programme. For the different indicators different means of verification were defined. Most data is suitable to be gathered by the beneficiaries or monitoring teams in the communities themselves. Monitoring was integrated in partner meetings and in all trainings for communities.

2. How monitoring was implemented

To gather information on the main indicators, data was collected from households before and after the installation of a solar collector. Information was gathered on the consumption of fuel, costs, amount of water used and the temperature of warm water through a questionnaire. With this information the effect of the solar collector on fuel use, CO2 emissions and costs could be calculated. Unfortunately, only 30% of the solar collector questionnaires were returned making the data set small and incomplete. The data set was also not sex – and gender disaggregated.

➔ A recommendation for similar projects is to provide incentives for better coverage of the household base-line data, and to ensure sex and gender disaggregated data.

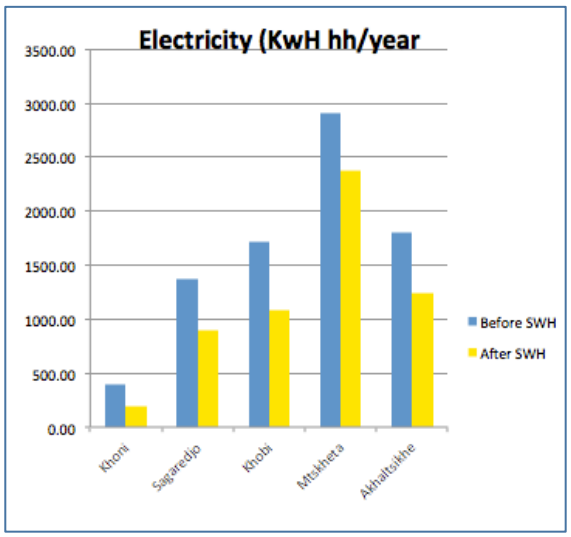
In a sample set of 25 households, the project partners installed water meters to measure the water flow through the collectors. As a rule, almost no rural households in Georgia have water meters, thus the need to install them and budget for these costs. Furthermore, thermometers were installed. Next, the households were asked to complete a logsheet with daily water consumption and water temperature at different times of the day. With this, CO2 emissions saved through the usage of the collector can be calculated based on the suppressed demand principle. The methodology proposes to take thereal hot water use as a base, and calculate the CO2 that would have been emitted, if they hadbeen heated with their previous source of fuel (mostly this was wood). This way the CO2 emission reduction can be established. It was observed that households used an increased amount of warm water after the instillation of the solar collector, indicating an increase in comfort and living standard.

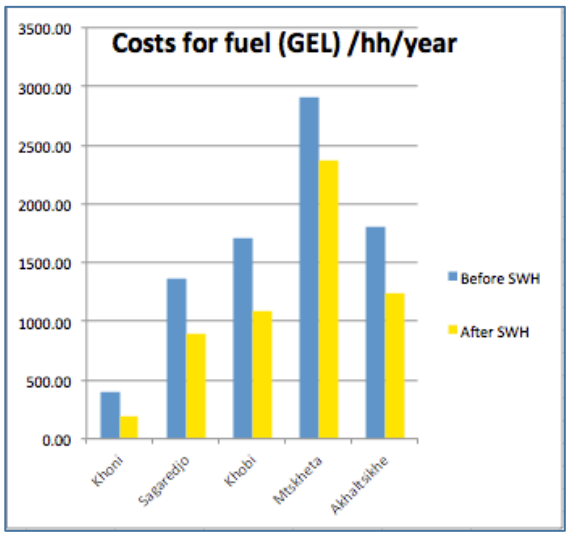
3. Lessons learnt and recommendations

The project's approach to measuring reduced fuel needs and costs gave positive results. From 2011 to 2014, 90 out of 330 solar collectors provided useful monitoring data and showed considerable reduction of fuel consumption and costs.

Calculations based on these results showed reduction of CO2 consumption of 700kg CO2 per solar collector. These results are useful on different levels: as a feedback for beneficiaries,

other interested households and partners as well as a base for national climate research, as it isthe only data of its kind available in Georgia. Gender disaggregated data in terms of the use of the spent money was not included in this project, buta survey by WECF (in another part of the country) showed that women and men seem to decide quite equally and jointly about the expenses in their household. It can be safely assumed that in a great majority of the households, women and men take decisions around energy and water together.[8]





3.1.Methodology

One issue encountered was the methodology of the data sampling itself. In the first two years, the collection of detailed baseline data was done via an Internet database (ZOHO), which unfortunately crashed at the time of midterm evaluation (data was mixed by exporting them from the database, and the original data set was lost). Furthermore, during the first phase of data collection, the ZOHO database had proven to be non-user-friendly for local partners, and the amount of required information turned out to be too much for the beneficiaries and partners to treat.

As a consequence, another Internet database was tested (Survey Monkey) which the partners found easier to use. Information sampled was reduced to 10 questions to assess the baseline situation before installation of a solar collector and a further related 10 questions after installation and use of the solar collector. Answers were then manually added into the database. The idea behind this was to make it as user-friendly and easy to handle as possible.
Finally, the feedback from local partners showed that a simple excel table is the preferred method and individuals are happy to enter the data directly.

3.2.Quality of data

In quite a number of cases, the quality of the data collected by the participating households was not of a good standard. The collection of highquality data required a lot of time and lot

[8]WECF (2014): Empower Women– Benefit for All, Gender Livelihood and Socio-Economic Study, Baseline Study Georgia, p. 12 and p. 26

of communication between WECF and local partners, more than had been planned for. One reason for this is that there are too many steps from data source (beneficiaries) via data collection (local monitoring persons) to the local partners and from them to WECF. Additionally, data collection in the villages was usually done manually and then transferred to the Internet database. There are already several steps where mistakes can happen in this process. At the end of the process, WECF staff were not fully satisfied with the data received meaning the data had to then go back to the data sources, via the partners, to correct mistakes and expand where necessary. This was a time consuming process.
Although questions were formulated clearly with exact figures required, such as “fuel consumption per month”, misunderstandings still occurred, such as for example cases where the consumption was indicated ‘per season’ instead of ‘per month’.
Furthermore, as consumption of fuel and costs are usually estimated rather than exactly measured and can vary from year to year depending on the actual weather conditions, the accuracy of the collected data cannot be entirely assured. The methodology does not allow for varying climatic conditions between different years, i.e. there is no control group. It could have happened that the year before the installation of the solar heater, the weather was cooler and used more fuel because of that, and that less fuel was needed the following year, irrespective of the new solar water heater. However, based on information from the local project NGO partners, we know that there were no big differences in temperature between the years before and during the monitoringexercise.

3.3. Conceptual components

Obtaining the results was a long process as monitoring was challenging and hard to implement. Partners as well as beneficiaries were introduced to monitoring methods in the trainings, and were involved in the process by setting indicators and developing questionnaires and other monitoring instruments. The effort and time needed to handle the monitoring data in a correct and useful way was underestimated by all project participants. The immediate challenge of the construction and maintenance of the solar collectorswere the main priority of the beneficiaries, collecting the data was of secondary importance to them.

Thelocal NGO partners’ tasks were to collect the data, whereas the task of WECF staff was the processing of the data to allow analysis and the use for ‘Gold Standard’ registration.
The main conclusion from the experience with the data monitoring procedure is that it could be improved and made easier if the whole data monitoring process were tobe handled locally by local partners with assigned staff dedicated to this issue. Since monitoring is an abstract and complex topic, real involvement and ownership can only be created when the whole process from defining indicators, data collection to data processing and presentation of monitoring results is seen as a priority for local project partners. At the beginning of the project, partners lacked capacity, but by now the partners should be able to carry out effectivemonitoring with the help of calculation tables for processing of monitoring data that were developed by WECF during analysis, which can be used directly by local partners to process their data.

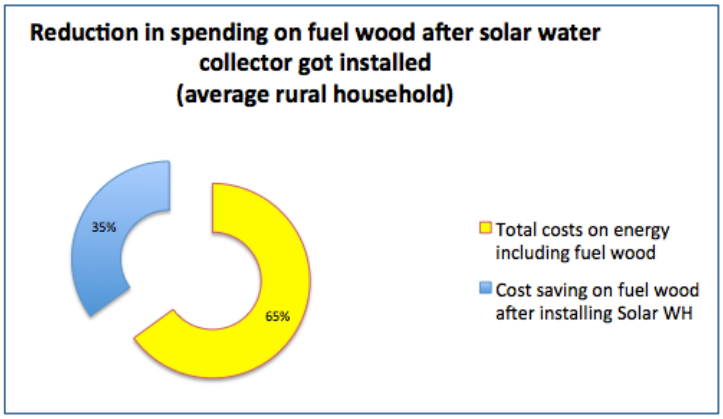
3.4.Social components and gender aspects

Women beneficiaries were trained in both maintenance and monitoring of the solar collectors. As women use the majority of the hot water throughout the day in their households, they are the first tonotice if the collector has decreased in efficiency or altogether stopped working. They are provided with the basic knowledge to check what could be wrong with the collector and how to solve possible maintenance tasks (e.g. to re-fill the fluid in the collector system).

They have also been asked to conduct monitoring on the effect of solar collectors on fuel use, fuel expenditures and hot water use. Women proved to be reliable monitors, but in general it was difficult for women to be granted time away from the home and their responsibilities, to do the monitoring at other households, especially if it was on a voluntary base. Even for well-trained and motivated women monitors, it was very hard to do monitoring in far-away places. From a point of view of quality of monitoring, its better to have one regional completely covered with solar heaters, then have a few in different places.

➔ A recommendation based on the lessons learnt is that locations for the implementation of the solar water heaters should preferably be concentrated close to each other rather than distributed scarcely at several distant locations.

It turned out to be effective, as demonstrated in a few successful villages, to form monitoring teams per village who received a small fee from the project to perform the monitoring tasks. Ideally, one team should do the monitoring process, so monitoring teams should not only collect data but also process data if possible. Or, at least, work in close cooperation with local partners who are responsible for presentation of monitoring results to the communities, the donors and on the national level.



3.5. Further development of monitoring plan / GS / MRV for NAMA

In order to prepare the concept for the “gender sensitive NAMA”, a monitoring plan - Monitoring, Reporting and Verification (MRV) was developed based on the project’s data monitoring experience. Monitoring will be implemented using data loggers and controlled by trained specialists. Thus, hot water flow and temperature differences between cold and heated water will be measured precisely in order to calculate saved CO2 emissions. Data will be taken from a representative sample of 100 solar collectors in 5 regions.

This approach is different, as the actual reduction of fuel consumption is not measured. Instead the amount of fuel that would have been used to heat the water to the desired temperature using the conventional fuel will be measured.
This methodology workswith the assumptionof “suppressed demand”, and is the standard methodology used for UNFCCC CDMandGS[9]. This has been already applied with the water temperature and water consumption methodology as mentioned above. Since the data will be measured with thermometers and water meters that record the data electronically in set time intervals, reliability of the data is also ensured.

D. Steps towards Upscaling – success stories and challenges

The long-term objective of the project was that, after the successful introduction of solar systems, the project would help achievethe replication and upscaling. The success of this is determined by supply side - fundamentals for local production such as local knowledge and infrastructure. There are two more crucial factors for up scaling on the demand side – interest amongst the local population, and therefore readiness to invest, and political support.

1. Awareness raising

Local awareness about solar systems has been raised on different levels with positive results. Local project partners are working continuously on information campaigns with press releases, radio spots, TV broadcasts and newspaper articles. This has proven to be an effective way to reach rural populations as well as decision-making authorities and different stakeholders. In the target villages, where solar collectors already are installed, the programme is well known and the interest amongst local population is increasing steadily. Women are often behind the awareness raising activities, as they see the benefit of saving a lot of time and unpaid care work. But also men have become active in awareness raising and promotion of solar water heaters, as they also save time and money, generate income and have a meaningful task to do. The participatory needs assessment helped communities realize that they indeed had an energy problem that couldbe solved, which motivated them to become active. People in the project villages are convinced that the collectors work efficiently, save energy costs and increase comfort, so they are ready to invest, and there are long waiting lists of people who have applied for the installation of a solar collector.

Positive feedback from solar collector owners is an important trigger to raise interest among neighbours, relatives and other community members. Families of beneficiaries report they have much increased their wellbeing and comfort with warm water readily available now. Some of these families have regular visits from neighbours, friends or relatives to use the warm water too. Often, together with the installation of a solar collector, a new bathroom is constructed so people have running warm water and even a shower, which is not at all the standard case in Georgian rural households. At the current stage the majority of the target communities are aware ofsolar collectors and are interested and ready to invest their own money to obtain one.

[9] Standard technologies for measuring real CO2 reductions, and reductions of future emissions had no mitigation technology measures been taken, as defined for different mechansims of the UN Climate convention, e.g. „Clean Development Mechanism-CDM“ and “Gold Standard - GS”.

Visibility of demonstration objects

Up to now, there have been more than 200 demonstration solar collectors in 5 regions in Georgia. The households and project partners have agreed to show their solar collector and be part of awareness raising efforts. As mentioned above, these demonstration objects are a very important factor to raise interest and spread the technology. To reach this goal, visibility is an important fact, so ideally, demonstration objects should be installed in a way that they are visible from the street and close by each other, to increase interest and acceptance in the neighbourhood.

Demonstrations at remote or distant places

Another important factor is the density of demonstration objects in the region. In some of the project areas, many project villages were located far from each other. A lesson learnt is that in terms of visibility and spreading technology, this should be avoided. Due to the distance, the knowledge exchange between the owners and constructors as well as monitoring teamsis usuallyalso more limited.

If problems occur with solar collectors in remote places they are more likely to remain unrepaired for a longer period of time, even if only caused by a small and easy to repair problem. A broken or defect demonstration unit is the worst-case scenario as it will instil negative ideas of the technology. For this reason, demonstration objects in remote places must be implemented carefully. The technology must be specifically adapted to the conditions of the place and well-trained workmen/women must be present in the same villageor nearby.

Social components of selection of beneficiaries

Financial resources are a problematic issue. In Georgia it is commonly argued that people cannot afford the solar collectors and need more subsidies. In one example, a family tool all the necessary steps to get support to build a solar collector for free, however, they did not have home water supply, and needed to buy a pump to fill the water tank. The family could not/did not want to invest the money needed for the pump, to the new solar collector could not be used and stayed idle for 12 months. The family pushed the local project partner hard so that they would pay for the pump, but this was not planned in the budget. In the end, the decision was taken by WECF and the project partner to move the solar collector to another household, which is now using it. This example helped to communicate to new beneficiaries that agreements need to be kept. It is a lesson learnt, that beneficiaries for demonstration units should be selected carefully. In order to support extremely poor families successfully a criteria must be developed to choose and motivate these families to learn about the maintenance of the collector.

2. Local production

One of the main goals was to create opportunities for local workmen and women to start a small business with sales and maintenance of solar collectors. Since technology adaptation took some time, implementation of businesses did not happen as quickly as initially hoped for. It provedcrucial to have strong local teams in the target regions of men constructing and installing, women working on monitoring and both spreading the word and promoting the

solar water heaters. The initial selection of the local women and men who will receive the certification training is of vital importance. Some 2-4 people per region who are motivated, skilled and ready to learn new skills create the best conditions and can at a later stage earn some additional income.

These construction and monitoring groups can be extended if the demand increases through new trainings and involving new people in the practical works. In some regions, they already cannot supply cover the existing demand and need extra resources in terms of tools, production space andtechnicians. The lesson learnt is that indeed it is well possible to generate local entrepreneurship based on solar collector construction in particular, less so for the monitoring and maintenance.

➔ **Lessons learnt**: the most successful examples were when construction groups were formed, rather than constructors working individually.

A basic requirement for solar heater business developed is access to the requiredinfrastructure for the solar collector production, sales and maintenance services. As previouslymentioned, experience shows that individuals were not as effective as groups. Currently, in all 5 target regions in Georgia, service centers are being created where well-trained staff are producing solar collectors as well as offering maintenance services. Monitoring is being offered by specialized staff at the service centers. Expansion of these service centres is planned when the NAMA starts.

➔ **Recommendation**: start cooperation with existing local manufactures to producesome parts of the solar collectors in larger scale in order to reduce the construction cost.

Cooperation with local policy makers is also crucial. A recommendation from the project is that municipalities should provide support and stimulate the development of small producers of solar equipment (in cooperation with NGOs) in their communities. For example, the municipality can provide them with space, tools and transport where possible.

Good tools are often rare and expensive in Georgia, but are crucial to increase efficiency of the solar collectors. For example, a more expensive camp welder enables the constructors to work with thinner metal for the absorber, which reduces costs and weight of the collector while increasing energy efficiency and hot water production. In most construction bases, old Soviet tools are used for forming metal. Replacing these with modern tools would make work less time consuming and improve the quality of the product.

➔ **A recommendation** for the NAMA is thus to plan in the budget for better quality tools e.g. for welding.

3. Financial aspects

To make solar collectors available for the lowest-income families, access to financial resources for capital investments has to be created. These include loans via community-based mechanisms such as revolving funds or savings-groups as well as micro-finance. Another option are provision of subsidies via national mechanisms or the international carbon market, like the Microscale Gold Standard and the concept of a Nationally

Appropriate Mitigation Activity (NAMA), a concept of the United Nations Framework Convention on Climate Change.

Financial mechanisms on community level

WECF Georgian project partner 'RCDA' developed a specialized financial instrument for the inhabitants of two target villages. The lease-purchase system, which RCDA has developed, is affordable and accessible for the great majority of the rural population. **Women make up 80%** of the clients for the lease-purchase financing instrument.T hey have often become the driving force behind the purchase of a solar collector, as in particular women benefit from a reduction of their domestic (unpaid) workload. Through the lease-purchase instrument, and because of the considerable savings on fuel costs, even women with a small income can afford it. The design of the lease purchase process proved successful on a small scale at the testing phase: the first clients are paying back their lease. The local population has stated interested in a large-scale financial instrument to finance solar water heaters in Georgia.

The main challenge with the RCDA lease-purchase module is that it does not yet have a legal base. The money flow goes through RCDA, which in principle does not have the right neither to lease or sell solar collectors, nor to give loans. Secondly, larger up scaling of this scheme is challenging because it is based on personal and trustful relationship with the clients to make sure the money will be paid back. For bigger scale implementation this system will possibly be much more difficult to make a success.

- ➔ **The recommendation** based on these finding is that, for the future implementation of solar collectors via e.g. the NAMA, a legal financial mechanism will be needed to give loans to the local population.

Most people don't have the cash to pay for a Solar Water Heater (SWH) at once, but they are ready to take a loan and pay back over time. Because they save costs on energy, it is realistic to pay back within a reasonable time (9 – 18 months).

Currently, energy credits are available, but not many people make use of them because of very high interest rates of up to 30% per year. Few affluent people in Europe would take a credit with a 20-30% interest rate for a non-productive investment such as a solar collector. This is similar from low-income families in Georgia. It is also difficult for rural people to get a loan from a bank because property in rural areas is not accepted as collateral. This is especially a barrier for women, as assets are usually registered on the name of their husbands.

It is recommended that a financial mechanism for SWH should be accessible to rural people who don't have property to use as a collateral. Payback conditions should be flexible and adapted to the situation of the household, as was successfully shown by RCDA pilot revolving fund (lease-purchase). Besides, loans should have interest rates not higher than 8% per year. This could be achieved by implementation of scale, such as in NAMA, in combination with a trust fund. Most likely, the financial mechanism could be implemented in partnership with a bank.

➔ **Recommendation**: a special "window" for women in vulnerable situations should be a condition for cooperation with a banking sector partner.

Three banks already have shown interest to cooperate on SWH within a future NAMA project.

Furthermore, the rural population are sceptical about taking loans because they fear they could lose their homes if they cannot pay the loan back in time.

Based on the experience of local partners, it is recommended that the costs of solar collectors should be subsidized by 50% by the project (NAMA). The remaining would be generated by credit at favourable 8% interest rates (ca. 1/3rd of required funds) and a direct contribution from the owner (ca. 1/5th of the required funds).

National level- NAMA

The development of a large-scale solar heating energy programme can ensure empowerment of civil society and promote fundamental changes inthe energy situation in Georgia. As a result of the project presented in this case study, a proposal has been developed by WECF and its NGO partners, and in discussion with the Ministry of Environment for a Nationally Appropriate Mitigation Action – NAMA. The proposed NAMA focuses on scaling up the construction of solar water heaters for domestic use in rural areas, and combine it with energy efficient stoves, to achieve a substantial reduction of emissions and linked deforestation. The government of Georgia is striving towardsthe implementation ofsustainable development principles and has set the introduction and development of alternative energy practices as a priority. The proposed NAMA can be an instrument and chance for Georgia to begin implementing these processes. Greens Movement and WECF were explicitly asked by the Georgian Government, Ministry of Environment and Natural Protection, to develop NAMA in the country for 10,000 solar hot water collectors and 10,000 energy efficient stoves. The proposal as now designed, would make it the first "gender-sensitive NAMA" worldwide. The large-scale NAMA projectswill buildthe capacity of the government, local authorities and local implementers and create the required technical and institutional capacity. The NAMA would not only focus on installing the 20,000 units, but also work on creating the broaderenablingenvironment, for a more efficient energy sector, and the needed mechanisms to channel public finances and private investments towards, sustainable energy business models with equal opportunities for women and men.

Voluntary carbon market - GS registration

The solar collectors developed in this project were submitted to certification as a "Gold Standard Micro Scale project". The Gold Standard is an award winning certification standard for carbon mitigation projects that is recognised internationally as the benchmark for quality in both the compliance and voluntary carbon markets. Project partner 'Atmosfair' coordinated the submission. Through Atmosfair, the project collectors could receive carbon credits for compensating CO2 emissions.

Certification means not only additional funding, but also recognition of the quality and scale of the project and promoted technology. The monitoring data as required by the Gold

Standard, to prove the CO2 reduction which the project has achieved, has been gathered, analysed and submitted successfullyafter a long learning process (see chapter C on monitoring). A public stakeholder consultation meeting has been organized with participation of beneficiaries, NGOs, experts and the Ministry of Environment and Natural Protection (with ca. 50% women participation). As required by Gold Standard (GS), implications of the technologies on all levels have been discussed. Stakeholders were extremelypositive about the project and welcomed the implementation of more solar collectors and their GS certification. The Gold Standard certification can also be regarded as a preparation for the proposed NAMA, as the same methodologies are used to prove CO2 reduction and both require the identification of 'co-benefits' (additional benefits such as environmental protection and increased gender equality).

➔ **NOTE:** The Gold Standard certification obtained for the project is a preparation for the NAMA, as the same methodologies to prove CO2 reductions and co-benefits are applied

III. Recommendations for future projects / Conclusion

Implementation of solar collectors - initially as demonstration objects–was well achieved and the acceptance and interest among local population was high. The training concept that was developed, based on WECF's long-year experience with capacity building in the region, proved to be efficient and successful. Local workmen, as well as women experts for monitoring of solar collectors have acquired skills and knowledge that will be a base for further development of local businesses for the production of solar collectors.
After some years, solar collector technology has been successfully adapted to the conditions of the different target regions and is now ready for large-scale implementation under standard conditions.

Solar collector owners report being content with the installations; they now have running warm water from the sun, available for free, increased comfort, often a new bathroom or running (warm) water has been installed in kitchen and bathroom. Women have benefitted especially from the improved situation for household activities, childcare and hygiene, resulting in better health. In the long term this provides children with better educational opportunities. The time saved by easier access to energy provides women in particular with better opportunities to participate in economic activities.

According to monitoring results (2011-2014), after the installation of a solar collector consumption of wood as traditional fuel for heating water for households has been reduced by 10% during the cold season and 70% during the warm season. Combined with reduced gas and electricity use, this resulted in a 42% reduction of energy costs, which meant an overall 35% improvement of the household budget. The reduction of potential CO2 emissions amounted to 1077 kg for warm regions and 859 kg for cold regions per household per year, being thus beneficial in terms of mitigating climate change.
At the same time, local forests were saved, and especially illegal wood logging was reduced, as survey results attest.

The assessment showed that further improvements could be made to the concept, implementation and monitoring procedure revealed possibilities for improvements. Many points of improvement have already been included into further project planning. Based on the experiences of the past years an adapted monitoring procedure has been developed.

Technology transfer to a new region is always a challenge and needs time. Adaptation to different local conditions and constraints, as well as building the capacity of well-skilled local experts, can take several years.

After some years of adaptation, approximately 400 solar collectors in Georgia now work well without technical problems. However, the local situation in different places may differ and further adaptations might be needed when the technology is further replicated across the country.

Generally, most problems and challenges occurred due to restricted time planning, which seems to be a common problem of donor-funded projects with a short timeframe. Especially for training programmes, it would be useful to improve flexibility of planning and being able to handle challenges that come up during the implementation process in fast manner, adapted to the country situation. This can be achieved by designing the project concept in a more flexible manner within the possible frames of the donor requirements of precise planning and budgeting.

With regards to replication and upscaling of the technology, the programme in Georgia succeeded to create interest amongst the local population. A lot of people in the target communities are interested in solar energy now and would like to buy and install a solar collector at their house. However, lower-income families, which constitute a big part of rural population, cannot afford a solar collector without access to locally available subsidies, credits or loans. Additional programmes such as the planned NAMA and the creation of a financing instrument are needed. This is necessary to create a critical mass of solar collectors and strengthen the local solar collector service centers in a way that they can function independently interms of technical and human capacity as well as their increased visibility. Currently WECF and its local project partners are assessing potential mechanisms for national and global financing mechanisms - for both climate change adaptation and mitigation measures – the results of which will be presented later in the year.

With regards to the inclusion of women and their empowerment as an additional benefit of the project, the recommendation is to develop a broader national policy that also works with the educational and financial sectors, to create an enabeling environment for women's equal participation, as well as implementing the "gender-equitable NAMA". This can be done as part of implementing the Sustainable Development Goals at national level.

The lessons presented in thie case study show that the installation of solar water heaters in rural households has benefitted women most, as it strongly reduced their unpaid care and domestic workload. Women actively engaged in monitoring earned a small income. The men benefitted as well, as they were the majority of the trained and certified constructors, who were the first to earn an additional income as result of the project training. Overall the women and men in the households benefitted from a strong reduction of their fuel costs, freeing funds for other expenses, whilst the availability of hot water had increased.

As part of the NAMA, the training modules can be extended to train young women on practical and technical skills before the training sessions for solar heater construction start to ensure a more equal departure. However, for some necessary skills such as welding, this is almost impossible, as many years of experience are required to be able to build a good quality solar water tank. Jobs such as painting, accounting and MVR are one's where women's leadership can and should be promoted. In this way the gender-sensitive NAMA can aim to achieve 50% employment for women as a result. The gender trainings can be extended to work more on reducing gender stereotypes. The base line studies can be improved by gathering sex and gender disaggregated data, and apply disaggregation throughout the data collection as part of the progress monitoring. The financial mechanismsshould have specific facilities for women as, due to their lack of assets and land ownership they are disadvantages with regards to obtaining credits from commercial banks. A good practice to further develop is the lease-purchase facility that the project partner RCDA implemented successfully, and of which 80% of the beneficiaries were women. **Recommendations: making national plans** for energy supply and climate mitigation **gender equitable,** and thus ensure they are fully in accordance with the Post-2015 **Sustainable Development Goals (SDGs)** and their aim of reducing poverty and inequalities**:**

- **Ex-ante situation analysis: ensure strong gender analysis** in the pre-programme situation assessment. Ensure **participatory assessment methods** with local women and men equally involved in the pre-programme assessment
    - Needs-assessment to understand different priorities of men and women and different social and ethnical groups
    - Time use surveys to understand typical gender roles and distribution of upaid care work (*SDG 5.4*)
    - Power relations; women in local decision making bodies and gender division in decision making at all levels including including family planning and other SRHR issues (*SDG 5.5. and 5.6.)*
    - Gender dissagregated date on existing skills and capacities and education *(SDG 4)*
    - Violence against women and girls at home and in public spaces, occurrence of harmful practices such as honor killing, early and forced marriage (*SDG 5.2 and 5.3*)
    - Overview of gender equality and women's rights norms and regulation and their enforcement (*SDG 5.1*)
    - Gender disaggregated socio-economic data, social protection coverage, single headed female households, and housing and land tenure (*SDG 5.a.*)

- **Planning phase**: equal participation of **women and men** in particular from the target regions in the assessment of all options, the planning and concept development
    - Cost, risk and benefit assessements of various options and pathways, including existing traditional and endogenous technologies
    - Design of the programme concept
    - Selection and assessment of technologies,
    - Design/adaptation of technologies
    - Design and planning of the capacity building phase – aiming at gender parity

    - Design and planning of the financing mechanism - with a special focus on women's access to finance and applying Gender Responsive Budgeting
    - Design and planning of the building and operation and maintenance phase – ensure that, that if paid jobs are created they are also created for women!
- **Capacity development, testing and demonstration**: create all conditions for equal participation of women and men
    - Organisation of training and capacity building courses to be accessible for women and men from the target regions regarding time, location and cost, e.g. in the local communities, adapted to available times for both men and women. If necessary, specific measures such as child care to be organised as part of the training.
    - Courses to be designed so that both skills which women and men traditionally have can both be used (e.g. not only training which require heavy physical activities)
    - Test the technologies and adapt them to make use as much as possible of local materials and skills of women and men, and making them as affordable as possible without capitulating to bad quality
    - The most appropriate technologies, which have shown best satisfaction with both women and men should be demonstrated to allow many people to visit and test the technology for themselves
    - Create a pool of qualified women and men who are experts and can work in teams to provide the technologies on a greater scale

- **Bringing to scale**: create all conditions for equal participation of women and men in wide-scale application of the technology
    - Create a pool of qualified women and men who are experts and can work in teams to provide the technologies on a greater scale
    - Create the enabeling environment at national and local level for women full and equal participation in all spheres of society and economy
    - Implement a social protection floor including cash transfer and access to basic services (housing, school, health, food, water), - as women are the majority of the poor and doing most unpaid car work, they will benefit foremost
    - Adapt school, vocational and university curricula to include sustainable technologies for domestic application in rural and lowincome areas and involve girls as much as boys in technical and technological skill development
    - Raise awareness about equal opportunities for girls and boys, men and women and the need to overcome gender stereotypes
    - Strengthen awareness, legislation and persecution to end violence against women and girls at home, at the work place and in public transporation and public spaces
    - Create access to micro finance with specific windows for women, partly as grants and partly as a low income loan, with interest rates no above 8% annually, to support investments into sustainable energy technologies

- **Monitoring, evaluation and adaptation** need to be based on participative methods and gender disaggregated data
    - Both quantitative and qualitative monitoring gender-disaggregated data should be monitored

- Programme design should allow for adaptation based on results of monitoring