Title:	**Productive use of renewably energy supporting applied entrepreneurship** **Lessons learned from a development project in rural Ethiopia**
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Abstract

Access to affordable energy - for basic needs as well as for national economic development - is a crucial concern for developing countries. Access to modern and sustainable energy services in rural areas, where the majority of the population is living in poverty, is a particularly urgent challenge, and one which has been recognized as crucial within the global development agenda.

The current dominant development model, focused on achieving macro-economic growth, gives priority to large-scale or centralized energy infrastructures for national growth or for meeting the urban demand. Rural areas of poorer countries are often at a disadvantage in terms of access to all types of services – roads, health facilities, markets, information and clean water. The high cost of providing these services in remote areas has led to new approaches being tried, based on self-help and the private sector rather than traditional government-led solutions. The missing access to electricity is primarily the reason for the poor operational environment of entrepreneurship especially in rural areas of developing countries, which poses many barriers to their development and limits their competitiveness. Energy services for household, agriculture and production serve as best examples as sectors exposed to enable entrepreneurship by productive use of renewable energy.

This paper describes the line-up, the challenges and the outcome of a development project in rural Ethiopia to support entrepreneurship based on the usage of renewable energy, in this case mainly photo-voltaic technology. In particular, this study tries to show up key features which are required to enable sustainable energy access and foster implementation challenges of developed business models in practice. Based on this experience, the paper discusses implications and lessons learned for a further development.

1 Introduction – The global context: Enabling Sustainable Energy Access

Research by the Global Network on Energy for Sustainable Development (GNESD 2004) has shown that even a modest level of modern energy services brings multiple and substantial benefits to poor households in remote rural areas. Thus, for sub-Saharan Africa, prioritizing energy access for the rural poor may be the first step to fostering human development and achieving the Millennium Development Goals (Kirai and Hankins 2009; East African Community 2007; Arvidson 2007). The issue of energy access has recently ascended the global policy agenda and is now a central topic in international development policy-making. The United Secretary-General Ban Ki Moon is leading a global Sustainable Energy for All Initiative (SE4All), a key objective of which is to attain universal access to modern energy services by 2030. The initiative prioritizes access to electricity and to clean fuels for household cooking and heating, as well as energy for productive use, especially in agriculture and local industry (Birol et al. 2012). It envisions three pathways: country actions by host governments, private-sector (commercial) initiatives, and bottom-up actions led by civil society.

In terms of productive use of energy, decentralized production and supply of electricity has an enormous potential to improve the economic situation of the rural population and deliver considerable welfare benefits. Traditional grid extension is no longer seen as the only solution. Decentralized supplies, whether at an individual household level or at community level, are now an established, cost-effective alternative for the people living in remote areas of poorer countries who are currently without access to electricity: “In developing economies, battery/solar systems have the potential to bring reliable power to places it has never reached.” (McKinsey 2013). With easier access to electric power, a positive regional economic development should be initiated, especially if the new resources are used for productive use. More locals will have and use electrical power, enabling employment causing other entrepreneurs to follow suit. Thus a self accelerating effect is initiated. In addition better access to communication technology will stimulate local economies by allowing more efficient agricultural trade, higher quality education, and exposure to small business ideas and trends.

2 Energy access in Ethiopia

The vast majority of the Ethiopian population (83.2% as of 2010) lives in rural areas, where modern energy services are rarely available. Only 4.8% of the rural population have access to electrical energy (Central Statistical Agency 2012). While many nations in sub-Saharan Africa face similar challenges, Ethiopia ranks particularly low in terms of energy progress, last out of 80 per the IEA's 2012 Energy Development Index (EDI), with an EDI of 0.04. Even Liberia and the Democratic Republic of Congo are rated better, with EDIs of 0.05 and 0.09, respectively (see Figure 1).

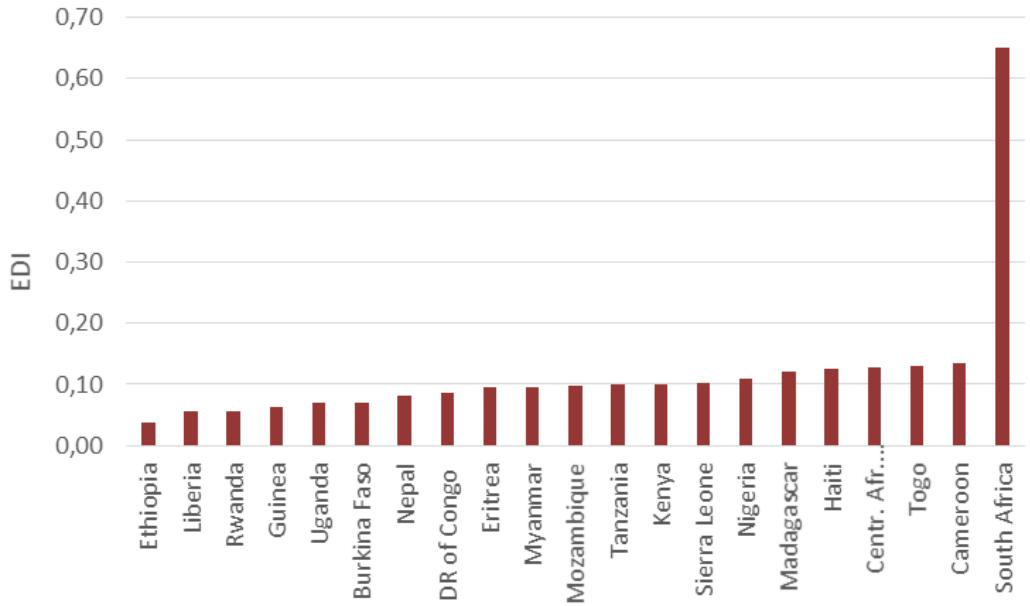

Figure 1: Ethiopia compared to other developing countries and South Africa

Source: http://webcache.googleusercontent.com/search?q=cache:EV-lmJLmJrUJ:www.iea.org/media/weowebsite/energydevelopment/2012updates/WEO2012EDIdatabase_WEB.xlsx+&cd=2&hl=de&ct=clnk&gl=de

Ethiopia has made large efforts to develop electrical power supply in recent years, with 48.3% of towns and villages connected to the grid as of July 2012, according to the Ethiopia Electric Power Corporation (EEPCO 2012). Increasing energy production is also a priority under Ethiopia's current five-year Growth and Transformation Plan (MoFED 2011), which aims to achieve a GDP growth of 11–15% per year from 2010 to 2015. The plan has an estimated total cost of $75–79 billion USD and includes specific targets on economic growth, poverty reduction, agriculture and rural development, industry and infrastructure development, and power and energy. Several large scale electrification projects are under development, most notably the 6,000 MW Grand Ethiopian Renaissance Dam on the Blue Nile, the subject of an intense dispute with Egypt and strong criticism from environmental

groups. Along with meeting Ethiopia's own energy needs, the new hydropower capacity is meant to help the country become a major exporter of electricity.

Rural electrification has also remained a priority, and the extent of high-voltage transmission lines across Ethiopia increased by a third in just three years, to 11,796 km in 2011/12 (EEPCO 2012). The total number of electricity customers had risen to 1.9 million by July 2012. In remote areas, Ethiopia is installing solar power at schools, health centres and other facilities. However, per capita electricity consumption remains at only about 200 kWh per year, far lower than the sub-Saharan average of 517 kWh in 2009, and a fraction of the 2009 world average, 2800 kWh per person. This suggests a great deal of work remains to be done to bring power to individual households and ensure they can afford to plug in.

3 The context between decentralized electrification and entrepreneurship

Integrating energy access for the rural poor into national development strategies would explicitly recognize the crucial role of energy in poverty reduction by productive use and support public and private actors' efforts accordingly by fostering entrepreneurship. Most non-state actors working on energy currently operate in a fragmented way, following their own objectives and policies. Yet research suggests that rural energy access projects will be most effective when they are demand-driven, not donor-driven (Mulugetta 2008; Wolde-Ghiorgis 2002).

The Government of Ethiopia generally supports the development of small and medium enterprises (SME). A competitive SME sector stimulates private-sector led growth and contributes to poverty alleviation through providing employment and income generation opportunities to the working poor. SME's are also a primary distribution system for basic goods and services for the majority of the population. In rural areas, however, very few small enterprises tend to graduate into medium enterprises. One of the most important constraints for SME development is the lack of access to sufficient and reliable electricity in rural areas. Given this the Government of Ethiopia promotes decentralized systems based on renewable energy resources – solar, wind, biomass and small-scale hydroelectric power – for rural electrification. While most projects provide reliable and cost-effective electricity, usually about 20%-25% fail (MoFED 2011) due to substandard equipment, inadequate after-sales services and poor monitoring and maintenance. Generally, the lack of skills generally constitutes a major problem for people in rural areas, because of lacking employment opportunities due to their limited employability or because they lack basic competencies

necessary for self-employment or founding new SME's. Having said that there is potential in defining the appropriate decentralized electrification technology as well in training users and communities by improving the understanding of operating and maintaining the energy systems. In the field of education, a special focus is placed on sector and regional value chains, through supporting private sector initiatives and actors identifying regional potentials of production, the development of new value chains and the realisation of investments of private businesses.

From a broader perspective Ethiopia can be regarded as sweet spot to develop business models to foster entrepreneurship: First, the effectiveness of governmental and institutions can be regarded as highly developed. In addition the country showed up double-digit GDP growth rates in the previous years. The GDP/head of roughly 500 USD (MoFED 2011), however, is remarkably poor in a global context. Going along with that 85% of Ethiopians live in rural areas in impoverished conditions. Further, only 15% of Ethiopians have access to a reliable power source, usually from the electric grid in urban areas (Central Statistical Agency 2012). However, this has not stopped technology from moving into rural areas. Cellular phone purchases, in addition to portable lamps, radios and televisions, and even hair care tools, continue to slowly rise despite limited access to power sources. Thus, the unique combination of a politically stable environment and a large potential for decentralized electrification produces a rare opportunity for creating business models.

4 Project design and expected outcome

The project under discussion was conducted by the Neu-Ulm University of Applied Sciences, Germany, (HNU) together with the Arba Minch University (AMU) in Ethiopia to develop, test and implement the project in Arba Minch. The Neu-Ulm University of Applied Sciences (HNU) is an international connected business school. It prepares bachelor and master students orientated towards future management tasks and runs different kinds of interdisciplinary projects in several African countries. The solar company Phaesun GmbH, the consulting company XCOM Africa GmbH, the association Sahay Solar Initiative e.V. and the Chamber of Crafts Ulm supported the project as industrial partners. The project was funded by the German Academic Exchange Service (DAAD) and focuses on entrepreneurial education with the objective to create job opportunities. That means, HNU and lecturers of the Arba Minch University developed jointly an applied entrepreneurship education programme at the Arba Minch University in Ethiopia. The term "applied" means that these business models for

entrepreneurs were developed by student groups and then had to be applied in practice. Hence, the component of education works on a technical and entrepreneurial level. Micro-entrepreneurs were trained to build and maintain prototypes for diverse kinds of businesses such as for productive use of energy businesses.

4.1 Entrepreneurship as the global project objective

The education on entrepreneurial skills is the key to integrate poorer population groups into regular employment. Poor population groups are rarely able to become entrepreneurs and are usually living from subsistence farming. For the people – especially in rural areas – the lack of qualification is a major obstacle in order to escape the poverty trap. Neither are they capable to find off-farm employment nor do they possess the necessary competence for autonomy. At present, value added production in rural areas in Ethiopia is low, further processed products are mainly imported. Thus there is room for activities as well as strategies for business environment improvement, value chain extension and investment promotion. The education in entrepreneurship supports the building of small manufacturing or servicing companies, changes the production structure by enabling value added production in the value-chain and creates economic diversity with high-quality characteristics. That means the dependency on pure commodity production is reduced. The increased regional wealth creates employment for rural people and leads to a substantial reduction in poverty. Thus, the educational part of the project follows an integrative approach in the sense that the two elements of the missing access to electricity – namely the entrepreneurship and technological side - are addressed simultaneously and developed in an integrated way (Figure 2).

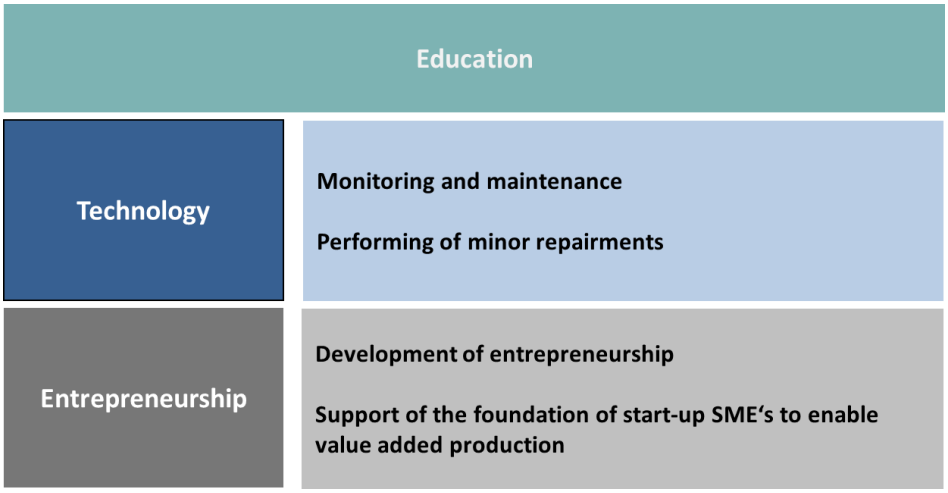

Figure 2: Components of the education module

Ethiopia is well endowed with renewable energy resources, which could be used to generate electricity to serve rural communities in an effective, powerful and ecological way. Promising results should be achieved in the field of solar technology due to the widespread natural availability. Thus the project focus lies on this technology to apply for enabling entrepreneurship.

4.2 The expected socio-economic impacts of the project

The global objective of the project was: The economic potential of small and medium enterprises (SME) and employment opportunities are improved by a sustainable and reliable access to decentralized electrification systems. In addition a particular objective is to show up innovation opportunities for entrepreneurship given an improved access to electricity for SME in a rural area of Ethiopia. Moreover, important socio-economic benefits can be expected:

- Generally the region's employment potential is improved through better performance in the respective economic sectors. The strengthening of SME performance capacity increases the real chances of accessing entrepreneurship, employment and income. Thus the project contributes to poverty alleviation by providing new employment opportunities in the SME sector.
- The fact that more people leave subsistence agriculture to work in the handicrafts and service sector, coupled with SME capacity development, results in an expansion of the market economy, which especially benefits the poor and female population.

In addition the introduction of training courses improves the employability of following target groups:

- Existing start-up companies and existing SME businesses as well as larger businesses in different value chains
- Employees and entrepreneurs in formal and informal SMEs as well as cooperatives in the non-agricultural sector (handicrafts, trade, services, small industry)
- School leavers and potential young business starters due to improved business prospects and the creation of new local employment opportunities

Given that the expectation for the outcome was that the developed business models should incorporate following characteristic features:

- Based on solar technology the application should be in rural areas.
- The businesses should be developed by local groups and finally locally owned and run.
- The developed enterprises should support local employment, meaning should contribute to productive use of renewable energies.
- The project outcome provides an answer how academic skilled persons in developing countries approach the challenge of entrepreneurship.

Following questions going along with the challenge to develop entrepreneurship were expected to be answered additionally:

- How can decentralized sustainable energy access for the rural poor be mainstreamed into Ethiopia's national development planning processes?
- What would be effective business ventures that could be profitable to local entrepreneurs and providing benefit to people living in rural Ethiopia?
- Which challenges are seen and experienced as most severe to develop enterprises from the ground on?
- What are viable business models developed by academic skilled persons familiar with the circumstances in Ethiopia?

5 Project implementation

5.1 Basic principles

The unique feature of the educational part of the project was the embedded practical part to enable experience for the students by implementing business models in practice. That is quite uncommon, but necessary to foster innovative entrepreneurship. "The really important entrepreneur – Schumpeter's who disrupts equilibrium with his innovations and thus creates economic growth – could not easily be formalized, and was left outside the system." (Reinert 2007). Corresponding to a special train-the-trainer concept from HNU, selected lecturers of AMU were trained at HNU and at Arba Minch with focus on the theoretical know-how in entrepreneurship. Following this, the lecturers of AMU took up the responsibility to initiate, develop and monitor the practical parts. HNU lecturers acted thereby as coaches and provided consulting on-demand.

The practical part was divided into two phases (Figure 3). In the first phase of the project, AMU lecturers together with the students developed a number of business models on a concept base. It has to be noted that these business models were developed by the discretion of the AMU lecturers and students solely. The second phase was dedicated to the implementation and evaluation of the business models originated in phase 1.

Besides producing the prototypes and ensuring the commitments of local authorities, the implemen¬¬tation phase confronted the students to organize the necessary funding by investors, mainly either by Micro Finance Institutions (MFI) or by Ethiopian private business people. Looking back, this proved to be the most important and difficult part of the project. To achieve the awareness and the commitments of these potential investor groups an investor road show was held in Addis Abeba.

The evaluation period of the implemented business models in practice covered nine months. These business models which were profitable at the end of the evaluation period were regarded as successful.

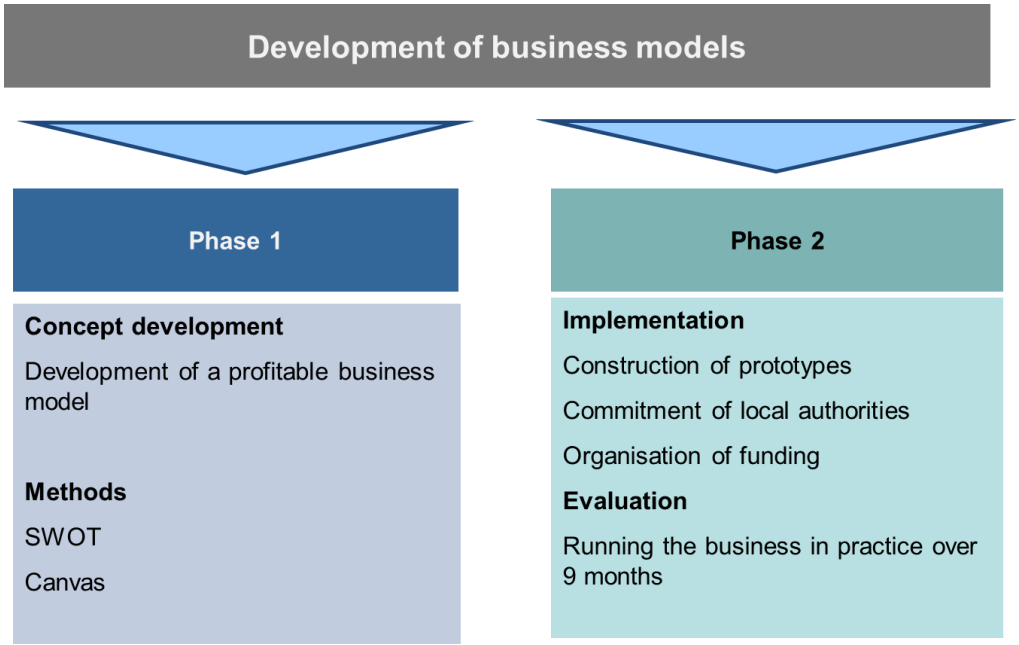

Figure 3: Structure of business model development and implementation

5.2 The chosen business models

In total 15 business models were developed in phase 1. Seven of these models can be classified as service provider, four can be regarded to provide entertainment, two can be assigned to agricultural productive use and two to general productive use. In detail:

Service provider:

- Mobile Solar Charger Wagon
- Mobile Solar Ice Cream Wagon
- Mobile Solar Hairdresser Wagon
- Mobile Solar Sandwich Wagon
- Mobile Solar Photography Service
- Solar Cafeteria
- Solar ICT Center

Entertainment:

- Mobile Solar Cinema
- Mobile Solar Rural Photographer
- Mobile Solar City Photographer
- Mobile Solar x-Box

Agricultural productive use

- Mobile Solar Cool Box
- Solar cooled warehouse chain

General productive use

- CNC Machine
- Solar Wagon Producer

5.3 The example of the Solar Wagon

Most of the developed business models based on the application of the solar wagon as a mobile energy generator. That is a moveable wooden box covered with solar panels providing a power of 50 W until 100 W. Different services for rural people can be provided by the solar wagon, mainly by using the electricity generated for cooling and entertainment purposes. The intentions of one of the business models, the Solar Wagon Producer, was to produce the solar wagon itself.

The originators of the solar wagon described the idea behind of it as follows: “Currently there is no solar wagon production in Ethiopia, but when we come to Africa there is one manufacturer from Rwanda. He produced the wagons from expensive materials so it is expensive. Also the service and mobility doesn’t target rural peoples. Because in rural areas there is no such a road which is suitable for that prototype. The service is also for urban peoples than rural peoples. This is new technology in Ethiopia and it is renewable energy supply and also supports government’s goal of rural development. This product increases their life quality because they can get services which was only found in cities. Our wagon is

mobile which makes it suitable for rural areas. Because in rural areas there is less people in one place so the service should be mobile." (Addis Abeba Roadshow 2015a).

This business model seemed to be attractive from the ground on. This generally positive appraisement was shared by all lecturers and participants of the project especially as the solar wagon was considered as an investment good dedicated to serve the other entrepreneurs and their later adapters as necessary prerequisite.

The Solar Wagon production could - because of missing support by an investor - not be established as a distinct business. Nevertheless, prototypes of the solar wagon had to be manufactured as they were needed for the other entrepreneurs of the project as mobile energy generator. The prototype production showed that the needed functionality is given and that the wagon even in piece production can be delivered at a reasonable price. It is important to note: The respective business model can be used to start a business at a later point of time. Being an investment good, the wagon could be an encouraging example of an extended value chain. Even during a first marketing phase characterized typically by low demand and incoming orders, these wagons could be manufactured as a secondary product within a product range of an already existing company. Of course, that practice may fit best for a business being active in a similar market and possessing experience in handling related operative assembling processes.

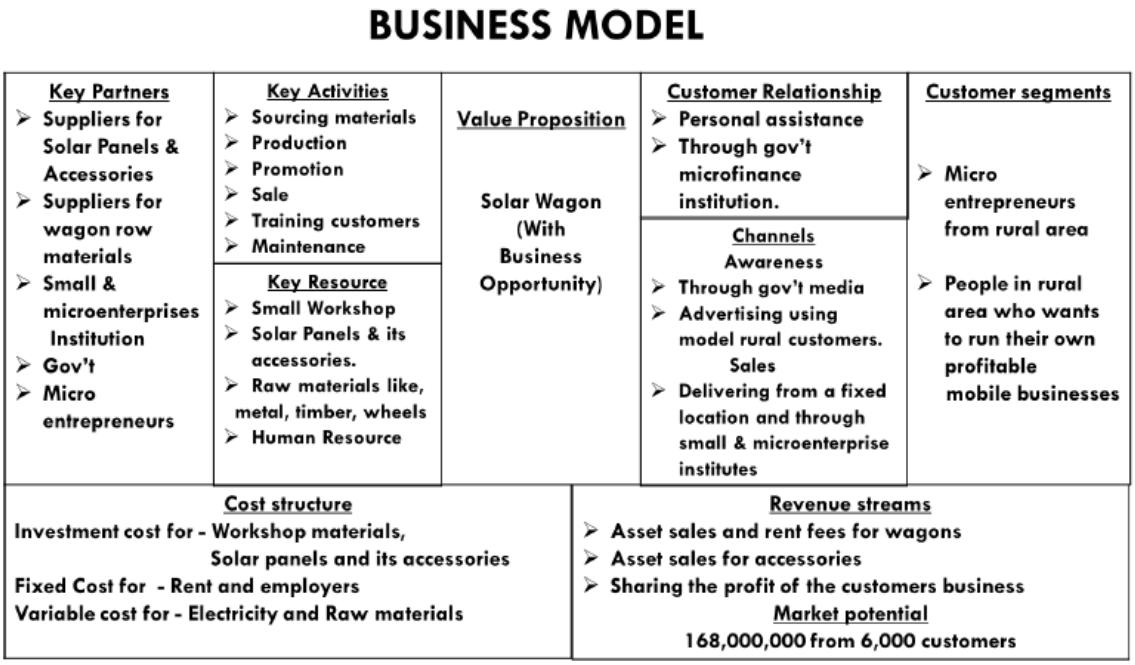

Figure 4: Canvas model for the Solar Wagon producer

This example made clear that the organization of the necessary funding was the most difficult

hurdle to move the business model from the concept status of phase 1 to a real business application implemented and evaluated in practice in phase 2.

5.4 The example of the CNC Machine production

To develop the business models in phase 1 classical methods like SWOT and the Business Canvas were applied. Figure 4 and 5 show as an example the Canvas models developed by the Ethiopian lecturer and students for the business models "Solar Wagon producer" and "CNC machine".

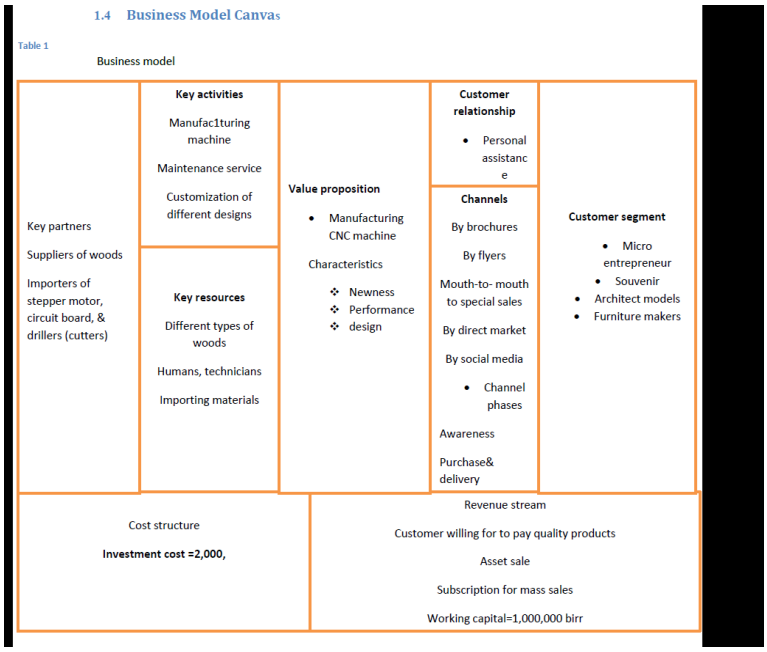

Figure 5: Canvas model for the business model CNC machine

The business canvas was extended by a strategic rationale of the business model itself. An example may be the business model "CNC machine" which was at the Addis Ababa Roadshow presented by one of the entrepreneurs as follows: "Our business is manufacturing CNC machine of wood working in Ethiopia. CNC is computer numerical controlled machine, conventionally, an operator decides and adjusts various machines parameters like feed, depth of cut etc depending on type of job, and controls the slide movements by hand. In a CNC Machine functions and slide movements are controlled by motors using computer programs. It works a 3D shapes like toys, souvenir & 3D architect models. Every work is controlled by computer. Our main goal is to achieve the most moderate designs, suitable & accurate sizes based on our customers' need. When we conduct a survey at different sites, we only can get one competitor. CNC machine will take advantage of the strong market demand for wood workers to drive its growth. Wood workers can be used for a variety of different applications,

Such as Kitchen cabinet, Furniture, Frames, Statues & etc. Our business provides the technology in all over Ethiopia .these machines sold under the company's own brand as well as many private levels. It is located in southern Ethiopia former business town of shashemane. Usually this type of machine is imported for laboratory purpose only & imported by high cost in Ethiopia but we make it in Ethiopia with cheap price for micro entrepreneurs, souvenir, & 3D architect models. Our goal is to satisfy the customers & inspiring technology. The business expects to gain a profitable markets share with in a very short period of time. Determinations have been made for the size of the market, amounts of budgeted advertising and promotion, and the number and kinds of distribution channels." (Addis Abeba Roadshow 2015b).

5.5 The search for starting capital and the practical tests

Finally the 15 business models were prepared as a presentation for possible financial investors as Micro Finance Investors and possible local investors to achieve a funding for the implementation phase 2. The business model "CNC machine" serves as an example for the presentation slides shown at the event (Figure 6 and 7).

Figure 6: Overview CNC machine applications

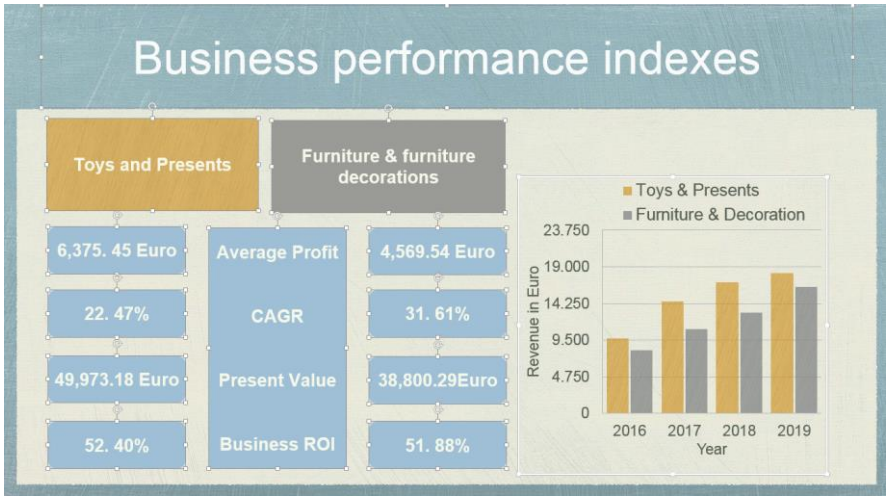

Figure 7: Profitability calculation CNC business model

During the second project phase, nine of the 15 business models could actually be made a reality and start as an income generating business. These business models achieved a funding commitment and could be realized and evaluated in practice over nine months. The necessary solar wagon as energy provider and the further equipment business-related equipment was constructed on a prototype base and implemented in Arba Minch and rural surroundings (see Figures 8 and 9).

Figure 8: Mobile Solar Rural Photographer

Figure 9: Mobile Solar Sandwich Wagon

It is important to note that all nine business models were financially profitable after the evaluation period. So it can be stated that the business concept of the following nine business models was a successful one:

Service provider:

- Mobile Solar Charger Wagon
- Mobile Solar Hairdresser Wagon
- Mobile Solar Sandwich Wagon
- Mobile Solar Photography Service
- Solar ICT Center

Entertainment:

- Mobile Solar Rural Photographer
- Mobile Solar City Photographer
- Mobile Solar x-Box

General productive use

- CNC Machine

6 Challenges in the project implementations

Productive use of energy is needed to increase the quality of life and reduce the need for rural people to walk into the city to obtain electricity services.

6.1 Important outcomes

In cities, productive use of energy offers the possibility to offer mobile moveable services for local customers and thereby, enables entrepreneurs to achieve a substantially higher turnover and income than with a stationary solution. For rural areas moveable solutions are needed to increase the target area and thus the income possibilities for such businesses. However, infrastructure conditions are often a major bottleneck. Hence, when considering moveable solutions, the area conditions have to be selected carefully. Moveable vehicles such as the mobile solar solutions are generally preferable for cities and flat ground areas. Stationary solutions should be targeted for hilly areas.

When it comes to the project organization it is inevitable that, involvement of different stakeholders tends to support an easier way for project implementation. Provided that they are identified properly at planning phase and awareness about their responsibility in the project properly communicated, they can input various resources for the success of the project implementation. In contrast to this, it has been observed that the multi-stakeholder nature of the project creates difficulty for the micro entrepreneurs facing the various rules and regulations. In addition, failure of key stakeholders at various levels induced negative impact to achieve on the planned outcome. This has been happened in an attempt to access loans from local micro finance institution. Concerning the entrepreneurship training, it has been conducted in long chain approach that is train the lecturers then the students again, students train the micro entrepreneurs. In the first project implementation phase coordinating such a chain stimulate extra activities, which were not in a plan before and resulted in additional time wasted on organizational tasks. In the second project, implementation phase the training directly delivered to the students together with micro entrepreneurs. The modification not

only breaks the long chain but also creates opportunity to work together and share constructive skill and knowledge in the classroom. Furthermore it is also clear that loss of commitment of some of the lecturers, students and other local stakeholders has brought negative impacts on the implementation. Interesting to note is that two proposed business models in the field of agricultural productive use were not implemented due to prohibitive high capital costs and low profitability. It was not possible to encourage Micro Finance institutions or local private investors to step in the funding of these business models - despite the fact that exactly these two business models would have delivered the highest benefit to local employment and to rural living conditions.

The major positive impact of the program was the creation of jobs with sustainable income for people who were previously jobless. They founded a business and learned to run that successfully as single entrepreneurs. Rural businesses have also improved the quality of life of the villagers. Potentially successful businesses in the field of productive use could be scaled up in the form of a production facility. This happened in the case of the CNC business model. It turned out that this business model was highly successful. The responsible AMU lecturer as the originator of the CNC business model earned in the implementation phase so much that he decided to leave the university and to found a company with several employees in the Ethiopian capital Addis Abeba.

Concerning the benefits for Arba Minch University, the long-term training program has enabled the university to deliver additional community services. Furthermore, the project concept has a convincing potential to be replicated throughout the country and can be transferred even to other countries with rural areas in need of decentralized electricity, as e. g. Tanzania.

6.2 Important lessons learned

Altogether, by comparing the expectations and the outcome some relevant lessons learned could be drawn. Assessing the compilation of the chosen business models, one has to state that the project objectives and expected socio-economic outcomes as described above were only met partly:

- Five of the developed 15 business models had the application in urban areas. The preference for urban business models was not only given by a higher expected profitability. Much more important was the fact that the originators of these business models wanted to found a start-up in the city due to their own personal preferences. Living in urban areas is considered as much more attractive than living in rural ones.

- Only two business models showed up characteristics of productive use. Further, four had clear entertainment purposes, meaning that the contribution to local development can be seen as quite limited. Particularly one business model, the mobile x-box, could be regarded as a business with the potential of specific negative consequences to the rural society. First there is no benefit by generating additional productive employment, simply due to the fact that the x-box has to be imported completely without any local manufacturing content. Secondly, the success of this business was extremely positive from a financial perspective, but incorporates the dangerous potential to make customers, especially young rural people, addicted by using the x-box in an over-exaggerated way.
- Most of the developed business ventures can be assigned to the field of food and services. These business models can be regarded as micro-enterprises with the characteristics to provide a positive effect usually to only one entrepreneur. Again, the potential for productive use in this case has to be classified as low.

7 Key insights and conclusions

It has to be noted that the business models were developed by the local student groups on their own discretion. The driving force behind was the expected profitability of a business model – other targets, as employment creation or productive use in the agricultural sector were regarded of minor importance. However, some ideas were diverted to those within the limits of resources we had. The limited resources were a specific challenge for business models in the field of rural productive use.

Following recommendations could be made for similar development projects in future:

1) **Entrepreneurship and application of innovative technology:** The combination of the usage of renewable energies and educating entrepreneurship is a systematic and fruitful way to support and promote successfully business activities and job creation in a rural area of a developing country. When it comes to the benefit for the Arba Minch University, the long-term training program has enabled to deliver additional community services and gained capacity building of its lecturers who were involved in the project.
2) **Implication to students' attitude:** Students are provided with practical Entrepreneurship training. It has to be underlined that entrepreneurship is included as a course in almost every university in Ethiopia, which is theoretically driven. However, students involved in the project were enabled to develop their own entrepreneurial

mind set to create own businesses rather than waiting for the government to provide them a job. In addition, it was an eye opening moment for them to see what sort of business solutions can be made out from what they learnt in their normal engineering classes. For instance, engineering students got the know-how to come up with different renewable energy solutions for various business opportunities in both rural and urban Ethiopia.

3) **Socio-economic teaching framework:** By introducing entrepreneurship programmes for productive use, a regulatory framework seems to be important to avoid negative socio-economic impacts for the society by focusing solely on profitability targets. Concentrating on profitability alone bears the risk to develop entertainment business models with the potential to influence the local society in a debatable way. Entrepreneurs in the area of entertainment could be economically highly profitable, but on the other hand provide poorly to regional development. Then the application of renewable energies could rather lead to destructive use rather than productive use. Thus, future projects have to consider the socio-economic, environmental and cultural situations of the selected area.
4) **Inclusion of local cultivators and farmers:** Future activities in the field of supporting rural entrepreneurship by renewable energy should include local farmers as participants. Local farmers are entrepreneurs from the ground on and therefore have the natural interest in improving their business by applying renewable energy for productive use. Finally there is a natural hedge against the negative effect that the entrepreneurship know-how is used for creating start-ups in urban areas. As a result selection criteria have to ensure the level of commitments of direct participants and external local stakeholders.
5) **Start-up financing as most challenging hurdle:** Finding interested investors and gaining their commitment to provide the necessary capital proved to be the most challenging part of the whole project. For this reason, the training of participants needs to work earlier and more profound on how to gain access to the necessary financial means. Already in phase 1 participants should be trained on working regularly on a comprehensive and credible market analysis. As well, the ability to develop credible plans on monthly and yearly sales and as well as on the corresponding cost structures deserves significantly more room within the training. The difficulties with these issues should not be underestimated: According to the experience gathered in the course of the project, most of the students could deal better with the technical challenges than

with the commercial topics. Receiving also support on how to find access to finance institutions and how to carry out a good presentation, the young entrepreneurs might have a much easier start and by this also might encourage others.

6) **Safeguarding the sustainability of project results:** Against the backdrop of the promising project results, the Arba Minch University proposed to establish a "Business Innovation Center (BIC)" with the objective to train young entrepreneurs on an ongoing basis. The job of the BIC will be to continue the training process started in the AEEP project and thus ensure sustainable ongoing results.
7) **Evaluation of impacts at later points of time**: A final lesson learned concerns the importance, to understand the project process as a ongoing learning process with relevance for all involved in the project. In case of the AEEP project, this included e.g. the staff from Ethiopia as well as from Germany both trainers and students and it even may include the organization of the donor. For the benefit of all stakeholders involved, the described learning process should not be aborted with the formal end of the project. Many important lessons learned may be missed in this case. Instead, to complete the learning outcome, a further evaluation of the project results should be carried out, e.g. about three years after the formal end of the project. The key questions may be: Which further positive unfolding impact can be identified. Or in case of a negative development: Which results remain at all? How did the established "Business Innovation Center" develop and how advanced the enterprises established during the AEEP project. Finally, it will be of ultimate importance to evaluate the feedback of this late evaluation and to understand the lessons which can be learned from this.

Recapitulating history and result of the project, it can be expressed that the design of the AEEP concept is well qualified for further replication. Using the gathered know-how and routine, as well as incorporating the above recommendations, the approach can be effectively used for repetition even on a broader scale and thus achieving an increased impact.

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