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Local employment through the low-pressure solar water heater roll-out in South Africa

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Introduction

In February 2013, the United Nations Secretary-General's High-Level Panel of Eminent Persons on the post-2015 development agenda failed to identify climate change as a priority issue (United Nations 2013). The defined framing questions for the panel's work and the most recent announcement highlight sustainable growth with equity, wealth through management of natural resources and partnerships - but not the detrimental impact of climate change on development (Field 2013). This shortcoming is a reflection of the current discourse. Even though changing, climate change and development are still located in two different camps. Although much work has gone into bridging this gap by potentially aligning policy agendas, the challenge to achieve integration of climate and development objectives is still obvious on the ground (Rennkamp 2012). Solar water heating in South Africa is one such on-ground example which, when investigated thoroughly, presents a learning opportunity.

South Africa's state utility Eskom is aiming to implement one million solar water heaters (SWHs) by the year 2014/15 (DOE 2009). The million solar geysers are intended to contribute to about 23% of the country's renewable energy target of 10 000Gwh (DME 2003). The SWH programme has identified six different markets, including upper- and middle-income, but also low-income households, new-build homes, the geyser replacement market, and an industrial and commercial market. The potential for LP SWH rollout is said to include 6.32 million households with up to R6 500 monthly income. These are households without electric geysers, reliant on stove-based water-heating. By including households with geysers, with a monthly income not exceeding R8 000, the potential market grows by another 1.38 million. (DOE 2009). Aware of existing barriers to mass-implementation of SWHs, the programme set out to increase the number of trained plumbers qualified to install SWH (DOE 2009). With the intention to mobilise a wide range of government departments and development priorities round the solar water heating programme, the ministerial expectations were that no fewer than 100 000 jobs would be created through this programme in the manufacturing, installation and maintenance of the systems (DOE 2009).

The SWH market offers low- and high-pressure heater. Low-pressure solar water heaters (LP SWHs) are installed on governmental social housing projects to provide warm water for household purposes like bathing, dish washing and cleaning; in higher-income households LP SWHs provide heated water for swimming pools. High-pressure systems are installed for mid- to high-income households, offering a higher water-pressure suitable for showers (not standard in government housing projects). The roll-out is supported by a rebate scheme and implemented by private companies. Country-wide, between 2008 and Jan 2013 a total of 314 703 SWHs were installed. Of these are 58 170 high-pressure systems and 25 533 low-pressure systems (Eskom 2013). In the case of LP SWHs, companies often collaborate with local municipalities to identify project sites. Such project sites are generally government-funded social housing projects. Here houses built under the Reconstruction and Development Programme (RDP) are retro-fitted with SWH. Households generally receive these systems for free. At the end of 2013, the LP SWH rebate system was phased out and replaced with a contractual approach. This change is meant to speed-up the roll-out, installing the remaining 685 297 solar geysers within the next one to two years (Eskom 2012).

Although the energy savings associated with the roll-out are well documented, potential socio-economic impacts and developmental co-benefits are currently not sufficiently analysed and documented. This study advances this understanding by contributing to the evidence-base on developmental impacts of SWHs, with a particular focus on the contribution of LP SWHs to the alleviation of poverty and inequality through creating employment in local, benefitting communities. The research investigates the ways direct employment is created in the benefitting communities in the installation and maintenance of the systems. Exploring the question of how the different approaches to maintenance contribute to employment creation, this report incorporates findings from the literature as well as interviews with industry stakeholders, in particular SWH installers.

Poverty and inequality

Solar water heaters contribute to sustainable improvement of livelihoods and have the potential to create jobs in South Africa while directly alleviating poverty. The potential changes caused by a SWH on a household are many, but relatively greater at the household level than when looking at poverty and inequality statistics. According to Prasad and Visagie (2006) the SWH industry has the potential to contribute R1 383 million to GDP and R176 million to the income of low-income households.

Groves et al (2011) highlight the benefits of the Kuyasa project to low-income households by providing a saving of 50-60% on electricity costs through the use of a SWH compared to an electric geyser. The economic benefits for communities like Kuyasa include a reduction in energy costs through purchasing less paraffin and electricity. A cost–benefit analysis considering energy-efficiency measures, including SWH s in low-cost housing, reveals that in addition to energy cost savings the quality of life of households can be improved by increasing comfort and decreasing indoor air pollution (Winkler et al 2002).

Wlokas (2011) evaluates the contributions of SWHs to poverty alleviation in South Africa. The paper uses the sustainable livelihoods approach to the evaluation of two SWH projects (Kuyasa CDM Project and Zanemvula SWH Project), and finds a positive association between access to SWH and the increase of household capital and a reduction of vulnerability. SWH technology reduces the need for unsafe, less clean and more expensive fuels such as paraffin for water heating. Improved indoor air quality, decreased fire safety risks and reduced spending are the consequences. For households using an electric kettle to heat water for purposes like bathing, washing dishes, making hot drinks, and doing laundry, it allows for a reduction in electricity costs which can represent a large component of household expenditure. A significant benefit of SWHs, particularly in urban but also rural low-income communities, includes the reduced risks of devastating fires, often associated with the use of traditional biomass for fuel and with poor quality appliances. The findings of the study also indicate a significant reduction in vulnerability of the benefiting households, and improvements in their financial capital, consequential on the installation of solar water heaters.

Improvements in financial capital are supported by the findings of the Kuyasa CDM project. The report approximates annual energy expenditure savings of R625 per household, attributed to installation of renewable energy technology, including LP SWHs (Du Toit 2010). This represents an increase in disposable income and household savings, which can be used for other economic purposes (such as education).

Wlokas (2011) argues that human capital increases through training and employing community members and increased income security through (temporary) employment. Increased incomes, income security and reduced expenditures on electricity and the associated fuel savings contribute positively to reducing inequality.

Furthermore, there is potential for improved health through being able to bath and wash with warm water and improved indoor air quality through reduced indoor use of fuels like paraffin. The research indicated that households find it easier to send children to school on time, as getting ready in the morning is less time-consuming through the instant availability of warm water for bathing. School attendance is therefore listed as a benefit of SWHs. Maintaining healthy living conditions and reducting indoor air pollution while providing sustainable alternative energy for water heating therefore highlights the important developmental impacts of SWH technology.

Less obvious changes with regard to psychological health can also be documented. It was found that the most

commonly reported change was that the SWH households observed greater relief, easier life and a proud feeling about the improved and modernised home (Wlokas 2010). Using the systems theory approach to sustainable development, Du Toit (2010) finds that access to hot water is associated with greater perception of equal distribution of rights, and lower levels of depression. In addition to meeting the subsistence needs of low-income communities, Du Toit highlights the benefits in terms of increased community participation, understanding and self-esteem associated with SWH rollouts. These benefits include increased autonomy as a result of the employment opportunities created, and an improvement in wellbeing from feelings of being an integral part of developmental and environmental initiatives. Furthermore, Du Toit finds improved perceptions of better protection of rights as access to energy services becomes more equitable.

Reflecting on South Africa's rising costs of electricity, the cost savings from SWH s are expected to have a higher impact on low-income households. Unfortunately, the initial costs of installation limit access to poorer households; relatively high up-front costs deter many low-income households from using SWH technology.

Goldman (2010) highlights the fact that significant backlogs in terms of adequate housing and access to energy still exist. This suggests that in order to realise the impact of SWH technologies on effectively reducing inequality, it is imperative to prioritise the SWH projects targeted at low-income households. Ensuring more equitable access to the technology will have a more sustainable impact on improving inequality, but will require continuous government assistance to overcome the capital expenditure barrier, in order to ensure that low-income households gain access to the benefits of SWH technology.

Overall, the impact on inequality occurs as a secondary benefit of both poverty alleviation and job creation. The direct impacts of SWH industry on inequality are not adequately addressed within the literature. Furthermore, any mention of the impact on inequality is assumed to be a result of the impact of SWH technology on poverty alleviation. Increases in household income from improved employment opportunity and improved access to basic services, in this case hot water, are expected to contribute to reducing inequality. As such, the direct impacts on inequality are not easily quantified, and in most cases are assumed within the literature based on supporting literature around energy and poverty. Ultimately, the impact of SWH on inequality will be dependent on the extent to which they are targeted at poorer households, and hence on the overall impact on alleviating poverty. Additionally, taking into account the temporary nature of jobs in the SWH industry, the potential impact on inequality cannot fully be realised unless a holistic approach to SWH implementation is adopted.

Employment creation

According to the South African government, SWH technology is a potential significant job creator through local manufacturing of systems and the emergence of an installation and maintenance industry. The Energy Minister Dipuo Peters in her speech at the launch of the one million SWH programme expected 100 000 additional jobs to be created (DOE 2009). The potential for job creation in manufacturing, retail sales, as well as system design and installation needs to result from increased adoption of SWH technology in addition to local job creation from business development in SWH-related technologies. However, Goncalves(2011) highlights a shortage in available skills within the industry which, he adds, has the potential to be four times as labour-intensive as the conventional geysers industry. The sustainability of these jobs is therefore questionable and substantially limited in cases where the necessary accreditation training is not provided. Goncalves also points to the fact that the majority of the employment benefits of the SWH industry occur in the installation phase. However, the cost competitiveness of SWHs manufactured in China implies that a considerable amount of value addition and employment potential in manufacturing of SWHs is lost.

Austin et al (2003) report that the employment potential of renewable energy in South Africa, based on the most optimistic projection of employment in the SWH industry is 118 421 direct jobs by 2020. This is equivalent to 8 733 jobs/TWh, placing SWH second in terms of direct employment creation after biodiesel technology. However this estimate is based on a scenario where 100 percent of houses have SWHs in 2020. The study further finds that if the national government implemented more ambitious targets for SWH penetration, over 355 000 new jobs could be directly and indirectly created by 2020.

Prasad and Visagie (2006) estimate the job creation potential of the SWH industry at 5 909 jobs (according to 2005 estimates). However, given that South Africa's conditions are highly conducive to the implementation of solar technologies, and expansion of the industry, the benefits of SWH technology in terms of employment creation are expected to be substantially higher. A study conducted by Rutovitz in 2010 suggests that some of the reduction in electricity generation in the Revolution scenario, which sees a 60% reduction South African emissions by 2050 (compared to the 2005 level), will be because of SWHs displacing electricity. The study assumes that 10% of the energy efficiency savings in the Revolution electricity supply are because of SWH and employment is only calculated for that proportion, and as a result can be expected to be much higher.

Eskom's industry survey established that over 700 people were busy in the industry in 2009. The rise in jobs is mainly due to increased installation numbers and less to manufacturing or sales growth. 'The survey indicated that each SWH installation typically takes one day using a team of three to four people. Therefore, with approximately 18 500 units installed during 2008, installation capacity exists to install about 120 units per day, employing 480 (Eskom 2009). By the end of 2011 this number had grown to 968 (SESSA 2011).

A Greenpeace analysis of energy sector employment used numbers from 2003 through work done by the company Agama in South Africa. Including retailing and distribution under installation, Greenpeace expected a construction and installation employment of 15.7 per MW, and manufacturing employment of 14.3 per MW in 2002, declining to 11.7 per MW and 10.7 per MW by 2010 (Greenpeace 2010).

While employment is fairly well documented it does not differentiate between the LP and HP SWH scene. The reported and discussed information excludes casual and temporary workers and assistants potentially involved in the community liaison, installation and maintenance of LP SWH in low-income communities. Installing companies are, however, often either contractually bound to involve people from the local, benefitting communities or are recommended to do so by Eskom or the partnering municipalities.

Of all LP SWH projects in the country, the Kuyasa CDM project is the best known and best documented. It represents a good example of employment creation potential through SWH initiatives in low-income communities. A total of 87 people from the community of Kuyasa were trained and hired in the administration, installation and education included in the project (Goldman 2010). Training represents another positive impact made by the project, as mostly unemployed community members of Kuyasa received certified training in plumbing and electrical skills. This was made possible by spending at least 30% of the budget on training and skills development (Goldman 2010). However, as mentioned by Groves (2010), the experience of the Kuyasa project revealed that almost all employees were laid off on completion of the two-year project. Only very few previous employees have found employment in other places. Some people are still involved in the maintenance of the systems in Kuyasa and one person set himself up with an enterprise providing ceiling insulation for houses (Kuyasa resident, 2013). Further research is needed to explore the impact training and job experience has had for the involved people.

It is clear that despite the Kuyasa CDM Project approaching the creation of long-term income generating benefits with much deliberation, it is a challenge to get it right – even more so when working on short projects (small number of installations). The challenge in enhancing the employment impact of the LP SWH industry therefore lies in ensuring the creation of long-term employment and support of enterprise development. This will require progressive government policies, and providing funding and guidance for the installing companies to allow them to engage with local job creation in a meaningful way.

Models of employment creation and maintenance in local communities

This research contributes information collected in telephone interviews with companies that install LP SWHs. About 60 were contacted, and 13 companies involved with the low-pressure roll-out were available for interviews. Companies involved with HP SWH only were not interviewed. Seven additional stakeholder interviews were held, as listed below. A total of 20 interviews were held.

Table 1: Interviewed stakeholders

Type of stakeholder	No of interviews
Solar water heating company involved with low-pressure roll-out	13
European donor organisation	1
South African green jobs initiative	1
Industry association	1
Local municipality	3
Provincial sustainable energy forum management	1

The Eskom rebate programme supported the implementation of about 250 000 LP SWHs between 2008 and December 2012. Within this programme, companies were able to claim back a certain amount of the installation costs (depending on the type of system and other factors), but were also advised to involve people from the local communities where the projects were located. It was, however, not possible to access the exact guidelines given by Eskom to the companies for this involvement. Interviewees reported that they were given very vague recommendations for how to go about things. The interviews were held with the intention to find out more about the companies' practices with regard to this involvement. Three themes were identified: involvement of local residents in projects in general, training of locally employed people, and the involvement of local residents in the maintenance of projects.

Involvement of local residents in projects in general

Interviewed companies report different motivations leading to the involvement of local residents in the implementation and maintenance of LP SWH projects. Only one company, out of all 13 interviewed, is not involving local residents at all in their projects. Only two companies were found contractually obliged to involve local people, while ten companies stated to do so in any case. The motivation for companies to involve, employ or even formally train local people in the absence of contractual obligations varies as well. One company considers it the most cost-effective way to involve unemployed local residents in support of the project implementation for relatively small costs (labour costs; other costs like transport to site are negligible); another company appreciates it as their responsibility to contribute towards youth empowerment and employment. Five companies were recommended by local municipalities or Eskom to involve local residents. Figure 1 categorises the different motivations: voluntary involvement, contractually required and no involvement.

Figure 1: Motivation for companies to involve local residents in projects

Involvement of members of the benefitting community in the installation of lp swh				
Voluntary involvement			Contractually required	No involvement
Social responsibility	Considered most cost-effective	Recommended by municipalities and/ or Eskom		

Interviewees were asked what tasks and responsibilities were given to the people employed from local community. Six companies assign simple plumbing and similar tasks to them during installation of the systems, three companies have plans or even practices in place involving local residents not only in the installation phase but also for maintenance work later on. The remaining companies interviewed stated that they do involve people, but could not specify for what – these companies were usually still busy designing their roll-outs. The employment numbers vary from maybe one or two people per project to around 12 or even 30 local residents per project. One company was able to give a ratio, reporting that it employs 4 people per 1000 LP SWH installations. Another company said it had trained 400 people for a project consisting of 5000 solar water heater installations.

The number of people possible to train and employ per project was stated to be linked to a number of factors including: size of project (number of installations), time available to implement the project, and budget for training and availability of additional funding for training of local residents. The interviews revealed that know-how in terms of community involvement and willingness also influences numbers. It becomes clear that a great variety of possible project designs exist and subsequently the contribution of LP SWH projects employment in the local communities differs from company to company and also between projects.

Training for employment of local residents

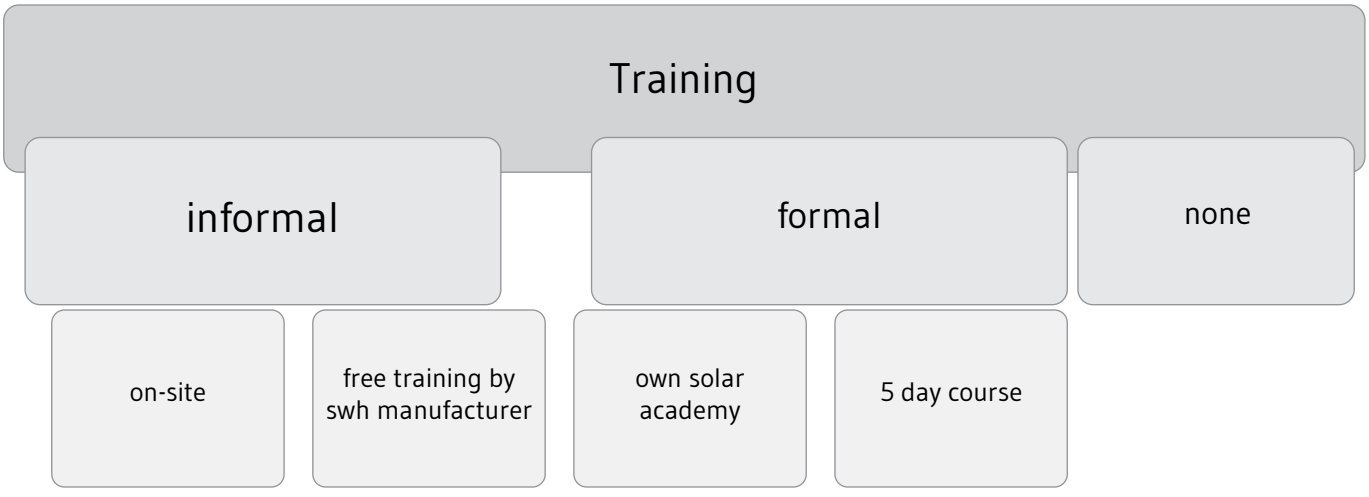
In 2009, the Eskom survey on 'The South African Solar Water Heater Industry' found two main forms of training being provided: informal training on the job, through experienced SWH plumbers who transfer their skills and knowledge to inexperienced SWH plumbers, and formal training through external service providers. This survey was concerned with the formal side of the industry, and did not include employment or training questions related to the employment and training of residents from local communities in the research.

Our research focusses on this less documented side of the industry. Despite the different focus in our research, the interview results support Eskom's findings. In our interviews companies reported that they either conduct informal trainings on-site or organise formal training. Of the twelve interviewed companies which usually involve people from the local communities in their projects, seven train new employees and workers on-site and five enrol staff to either training offered by manufacturers or in certified training courses with solar academies.

The conversations with companies indicated that the type of training provided depends on the availability of funding. More than once, the pressure on budget and implementation time experienced in tender processes was explained to be the reason for limited involvement of local residents. One interviewee suggested collaboration with industry associations as a possibility to free additional funding to support training.

Training of local residents to assist with the installation of the SWH directly translates into capacity for maintenance of the systems. Depending on the maintenance plan a project has developed or, even more important in the absence of such plan, knowledge and skills in the operation and maintenance of the new technology are a great advantage if available locally. The next part of the study sheds some light on the thinking and practices of companies about the longer-term operation and maintenance of the installed technologies.

Figure 2: Type of training provided for employees from local communities



Community participation in maintaining projects

Solar water heaters need maintenance. If operated with care and knowledg, repairs can be kept to a minimum, but attention will have to be paid at some point to parts of the system up on the roof. A general five year warranty requires companies to service SWH if found faulty during that time. Problems which fall outside of the warranty responsibility of the installing company can, however, also occur, either if caused through external influences or if they occur in year six, seven or eight of the system's lifetime. Affluent households might have agreed to a maintenance contract with the supplying company. According to Eskom's survey such contracts are priced between

R200 and R500 per year. Maintenance contracts are more often offered by importing companies, instead of the supplying companies which leaves even the majority of wealthy SWH customers without a maintenance plan covering problems beyond the warranty (Eskom 2009).

In the case of LP SWHs, which are generally provided for low-income households and financed by government, the maintenance costs and practicalities seem to be even less thought through. In the interviews six companies said that they were not involved in maintenance at all as they are contracted to installation only. Two companies state that they are generally interested in assisting local residents in developing a maintenance scheme that works for the local community and makes successful use of locally available skills. Three other companies made it clear that even though their maintenance responsibility is limited to the warranty time and scope, they are putting deliberate effort into capacitating members of the local community, in general people who they previously employed during the installation phase, to take on the maintenance task beyond the warranty. Four different approaches were identified and are summarised in Table 2.

The interviews revealed that maintenance is often overlooked and simply not budgeted for. Companies freely talked about the fact that they had not thought about the need for maintenance or lack the experience or funds to concern themselves with the issue. Two companies pointed out that maintenance is particular crucial as, in their opinion, the majority of LP SWHs installed are of poor quality and prone to becoming faulty. One interviewee said the solution for longer-term maintenance considerations, which are in particular a concern for low-income households which lack the financial means to pay for repairs occurring during the lifetime of the systems, is service-level agreements with municipalities. The ownership and service responsibility of the solar geyser should lie with local government to ensure maintenance.

Table 2: Maintenance approaches

Maintenance			
Company maintenance - During the 5 year warranty phase - Regional company representatives service swh in case of complaints	**Mixed company + community maintenance** - During 5 year warranty phase and potentially afterwards continued (depending on community) - Company supports trained members of the benefitting community to maintain swh	**Community maintenance** - During 5 year warranty phase and potentially afterwards continued (depending on community) - Trained members of the benefitting community are contracted to maintain the swh	**No maintenance plan** - Budget constraints don't allow for maintenance - Maintenance responsibility lies with a different company than the installing - Company is inexperienced and has not thought further than the installation of the swh

Discussion

The question guiding this research was how the different approaches to maintenance contribute to employment creation within the benefitting communities. It became obvious that maintenance, despite carrying maybe the greatest potential to create long-term jobs in local communities, has received littlest attention to date. Even though the companies interviewed have different contractual arrangements in terms of the inclusion of people from local communities, none has reported to be asked by the funder or contractor to establish a long-term community-run maintenance scheme. This is a major shortcoming, considering the potential for job creation and the growing need, with time, to maintain and fix the installed heaters.

The involvement of local residents in the design and implementation of technology delivery projects does not come naturally to the companies active in the market. On the contrary, it appears that they find it rather difficult to involve communities in their practices. Companies that stated that a lack of knowledge and capacity prevents them from engaging with local residents more actively reflect an important conflict. While such companies are trained and staffed to deliver technically sound installation and potentially maintenance of solar geysers, dealing with people - often their customers - can be seen as a somewhat unfamiliar task or even a distracting and annoying element of their work. Negotiating the need for adaption of technology delivery schemes to local economic and social contexts can be challenging, especially from a narrow viewpoint in which engineering and social considerations are separated.

The compromise would be expected to be the business case, but here the opinions about profitability of more participatory approaches to rolling-out LP SWH differ amongst companies. Very few companies see a business case in involving community members, though understanding the detailed design of their projects could reveal interesting lessons for the industry.

From this research and discussion, it can be said that if recommendations or even contractual obligations are made in this regard, guidance should be given or at least made accessible to the companies needing to deliver on these less familiar tasks. More research is needed to explore the impact training and job experience has for people involved in projects like Kuyasa. This information needs to inform guidance formulated for installing companies.

Finally, employment potential also lies within the education aspect in these projects. The new technology installed needs to be explained to households to ensure optimal usage and prevent damages and injuries. The respondents in this research have not been able to provide information about this aspect of their work. The authors are aware of municipal practices to include information about SWH in training households undergo when receiving a new-build house. Such training is, however, not provided in the case of retro-fitting and a major concern in particular is projects which lack long-term maintenance plans.

Conclusion

This research looked at involvement of local communities in LP SWH projects. Company practices with regard to the involvement of people from local communities, training and employment were explored in order to answer the questions of how different approaches to maintenance contribute to employment creation within the benefitting communities. Four different approaches to maintenance were found. Of these, two involve local residents, and supporting or contracting them for maintenance work is believed to provide the greatest potential to generate additional income opportunities there.

More generally, training and employment during installation and maintenance of projects varies amongst companies. Few, however, have made the effort to develop a deliberate approach. For a number of reasons, including stresses on budget and time and lack of know-how, locally available skills are often ignored.

It is clear that participatory design of projects is a challenge for companies. That said, recommendations by Eskom and municipalities to involve local residents need to be scrutinised and possibly accompanied by guidance supporting sensible implementation of this recommendation. Projects deliberately attempting to create long-term income-generating benefits through training and employment need to be evaluated and lessons disseminated.

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