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SOLTRAIN
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[Botswana] Clean Energy Research Centre hosts successful SOLTRAIN conference

Dr. Edwin Matlotse

University of Botswana's Clean Energy Research Centre (CERC) hosted a successful SOLTRAIN Conference at the University of Botswana (UB) Conference Centre in Gaborone in early February. The event included tours of solar thermal installations in the Gaborone.

The conference kicked off with an address by the UB VC, Prof. David Norris, welcoming participants from institutions and companies from Lesotho, Mozambique, Namibia, Zimbabwe and South Africa. He expressed thanks to the SOLTRAIN community and assured the project sponsors that his institution would continue to support their efforts going forward.

SOLTRAIN Conference attendees - 2018

In his address, Minister of Environment, Natural Resources Conservation and Tourism, Honourable Tshekedi Khama, emphasized the reality of climate change and lauded the practical activities that the SOLTRAIN project espouses which go beyond policy. He acknowledged the positive impact that SOLTRAIN activities had in the SADC sub-region, and expressed his thanks.

Mr. Matthias Radosztics, from the Austrian Embassy, emphasised that climate change is on our doorstep and needs effort from everyone in order to mitigate its negative impacts. He commended the SOLTRAIN country partners for coming together at the event and for taking the opportunity to reflect on project outcomes as well as to share experiences and ideas on taking SOLTRAIN forward.

Mr. Werner Weiss of AEE-INTEC highlighted the cumulative contribution of SOLTRAIN to the COP21 agreement in terms of GHG emissions (please see below for a more detailed article on this). Further, Mr. Kudakwashe Ndhlukula of SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) also thanked the project sponsors and outlined ways in which the country partners might sustain efforts when the project draws to a close.

Other notable contributions included Mr. Nico Snyders, from Namibia's Ministry of Mines and Energy, sharing Namibia's solar water heating experiences with their national housing programme which is assisted by up to 50% grants from the SOLTRAIN project. Ms. Karin Kritzinger of Stellenbosch University spoke the SOLTRAIN student bursary scheme and Mr. Ivan Yaholnitsky (BBCDC) and Mrs. Helvi Ileka (NEI), provided their perspectives relating to their institutions' co-operation on their solar baking project.

Another highlight of the conference was delivered by the Director of Energy and Environment Partnership for Southern and East Africa (EEP), Mr. Wim Jonker Klunne, who provided an outline of EEP's funding relating to the participating countries' roadmaps and their respective implementation.

[South Africa] SOLTRAIN promoted at Stellenbosch University Open Day

SOLTRAIN material was on display at the Stellenbosch University Open Day on 24 February 2018. Staff from the Centre for Renewable and Sustainable Energy Studies, one of the South African SOLTRAIN partners, were on hand to answer all the questions. The Open Day is an annual event and is very popular with prospective and existing students.

[Namibia] Research underway comparing solar thermal vs. solar PV for water heating

Helvi Ileka and Rudi Moschik

The Namibia Energy Institute (NEI), at the Namibia University of Science and Technology together with AEE-INTEC, have installed the first photovoltaic water heater (PWH) in Namibia using a special DC/AC element for heating the water. The installation is for research purposes under the SOLTRAIN project.

Through SOLTRAIN, NEI has already installed 62 solar water heaters (SWH) at low cost houses in Windhoek's Otjomuise township between December 2015 and March 2016.

In addition, measurement and verification systems were installed at six houses, four of which had SWH installed while the other two used electrical geysers, and data has been collected and analyzed at these houses since 2016. The installation of PWH now takes the research a step further.

The PWH installation consists of six solar PV modules with a cumulative 1.59kWp capacity which are connected directly to a resistive element for heating a 300l tank using direct current (DC) without an inverter. The element is also able to operate from the house mains AC supply as a backup for when there is not sufficient sun to power the element with solar.

The PWH system was installed at one of the houses which was previously monitored using a standard electrical geyser. Another house, which also used an electrical geyser and which was also previously monitored, was equipped with a thermosyphon unit consisting of a 300l tank and 4m^2 collector. Both systems were designed based on the hot water demand per person in the respective houses as analyzed for one year.

This provides a comprehensive research platform for the comparison of SWH and PWH in Namibia, the results of which will be highly informative for both the housing and energy sectors in the country. In addition, the pilot project also be aims at exploring the possibility of adopting the photovoltaic water heating system in off-grid areas where it could be used to provide basic electricity needs including the provision of hot water.

6 Solar modules power the element

Senior Shimhanda, a Master of Environmental Engineering student at NUS, with a specialization in renewable energy systems, is working with NEI as an intern to work on the pilot project as part of his final research to complete his Masters thesis. He was directly involved in the installation of the two systems and monitoring equipment, and will also collect and analyse the data.

According to Shimhanda, "it is essential to conduct a techno-economic analysis of the existing water heating systems in the Namibian context in order to determine the best domestic water heating technology between SWH and

photovoltaic water heating. The outcome of the research will help prospective Namibian consumers choose the most efficient and cost effective solution between SWH and PWH".

Shimhanda added that the research into the SWH and the PWH aims to answer the following questions.

- Whether existing water heating systems are viable technically and economically
- Their possible impacts on the environment
- The initial capital costs and operation costs of each water heating system
- Which technology is more cost-effective in terms of performance and economic benefits and;
- Which technology is more efficient and less prone to intermittent weather fluctuations.

Mr Nicolas Marembo, the owner of the PWH system who also contributed to its cost, was trained on the functionality of the system and reports that he is happy with the system so far.

The beneficiary of the first photovoltaic water heater (PWH) Nicolas Marembo (right) with Senior Shimhanda, the Master of Environmental Engineering student (left) and Helvi Ileka, (centre), Head at the Centre for Renewable Energy and Energy Efficiency at NEI

[Lesotho] BBCDC's 'Green Lantern' - Marketing for hearts and minds

Ivan Yaholnitsky

In December, BBCDC put up a large advertising sign in Mohales Hoek at the site of BBCDC's solar energy sales operation. The sign is just next to the main southern highway and enhances the exposure of SOLTRAIN and our solar energy products and services. We call it a 'Green Lantern'.

In one of their recent newsletters, The Climate Reality Project gave these four suggestions for action on Climate Change, drawing on the work of professional psychologists studying change processes in a systematic way:

- Connect the climate crisis to what's happening in real communities to reduce psychological distance.
- Make climate action a group experience to promote social norms.
- Talk about what we're gaining, not what we're losing, to avoid loss aversion.
- Give your friends real ways to take action to prevent "environmental melancholia."

I think they are useful, especially in regard to the broader mission of the SDGs and future work of SOLTRAIN in Lesotho and regionally.

We hope the Green Lantern fits this pattern. We need to get SOLTRAIN into each and every far flung community in Lesotho, and demonstrate that cost effective lifestyle and hygiene solutions are available and feasible. Positive social activities and processes will drive adoption and innovation. It is true that we need to lead with benefits and qualitative enhancements rather than costs.

Finally, we need to provide opportunities for more participation. When a solar water heater is put up on a roof, it should not be done by one or two people. Rather assemble a crowd and let everyone pitch in. Throw a party with hot dogs grilled in a solar cooker. Music and food create lasting memories. I call on my colleagues and friends in SOLTRAIN to embrace the above. Let us go out and win it. The Green Lantern is meant to herald of much better times. Hope for humanity.

[Lesotho] SOLTRAIN-funded project takes the prize in Kazakhstan

The National University of Lesotho (NUL) solar thermal project funded by SOLTRAIN made headlines in Astana, Kazakhstan, where it was awarded first prize in the category "Future Energy."

The project demonstrated an innovative and unconventional solar energy system that garnered the world's attention according to NUL's Mr Anadola T'siu, the designer of the system.

This was not the first time the project had received accolades. In 2016, it won second prize at the International Conference on Solar Technologies & Hybrid Mini Grids to Improve Energy Access held in Bad Hersfeld, Germany, at which it was recognised for its potential for alleviating energy poverty in rural Lesotho.

Dimitri Kerkentzes, Deputy Secretary General of the Bureau of International Exhibitions, lauded the project as a concrete example of the core values of both Expo 2017 Astana and Expo '90, to promote sustainability and environmental protection. Mr. Shinya Kubota of the Expo '90 added that the project fully embodies the harmonious coexistence of nature and mankind, the fundamental principle of the Expo '90 Foundation.

The solar energy system offers traditional water heating for general use, space heating (including under floor heating and wall radiation heating) and can also generate electricity using the Organic Rankine cycle, thus eliminating the need for unsustainable and expensive storage batteries.

A published paper on the system can be found at this link. https://www.researchgate.net/publication/318344342_Construction_and_Performance_Evaluation_of_A_Low-Cost_Flat-Plate_Solar_Energy_Collector

The students who developed the solar collectors

[Botswana] SOLTRAIN's first demonstration system in Botswana has been completed

Andrew Obok Opok

Botswana's first solar thermal system subsidized by SOLTRAIN was commissioned in February this year. SOLTRAIN's partner in Botswana, the Centre for Clean Energy Research, University of Botswana, actively guided and supported the project through the phases from inception to installation and commissioning. The beneficiary of the project is Mara-u-Pula Secondary School, which is a premium Senior Secondary School located in the proximity of Gaborone Central Business District.

With a price tag of close to 18,000 Euros, the project timeline took roughly three months from the time of submission of application for the SOLTRAIN subsidy to installation and commissioning, and the design and installation was done by Botswana-based company, So Solar (Pty) Ltd.

Technical Description of the systems

The installation consists of two pumped solar thermal water heating systems. The first is for the boy's boarding house which was a refurbishment. This system was sized to provide hot water for 65 students and consists of a 2000 litre tank with a heat exchanger and an electric heater as backup. It was designed to operate with a 90% solar fraction and is powered by 16 flat plate collectors in combination of series and parallel. Due to roof orientation, the collectors face north west and consequently, a modest addition to the collector area was needed to compensate for the orientation away from north. The pumped system supplies 1800 litres per day on average.

The second system is installed at the girl's boarding house and is designed to meet water demand for 65 girls. It consists of a hot water tank of 2000 litres and is powered by 12 flat plate collectors, also connected in a parallel

and series arrangement. The collectors face north for optimal solar gain.

Systems Monitoring

To comply with SOLTRAIN requirements, the systems are equipped with remote monitoring capabilities to enable their performance to be tracked on a continuous basis. A number of parameters are captured and recorded, including collector inlet and outlet temperatures, storage tank heat exchanger temperatures across the primary and secondary loops, mass flow rates for the heat transfer media, water glycol mixture for the input and output of the collector circuit and the mass flow rates for the heat exchanger system. More importantly, the solar radiation resource available at the site is monitored continuously to enable the yield, efficiency and economic performance to be evaluated over a desired time-horizon.

Site Visit and Quality Assurance Training

The completion and commissioning of the Mara-u-pula system coincided with two important SOLTRAIN events in Botswana, namely, SOLTRAIN's annual two-day conference held in early February, and SOLTRAIN's Quality Inspectors: Solar Water Heating training course which took place after the conference. Conference delegates were taken on a site visit to the installation where they experienced the contribution that SOLTRAIN is making in practice towards promoting and developing capacity in the field of solar thermal systems in Botswana.

South Africa: SOLTRAIN promoted at Stellenbosch University Open Day
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[Lesotho] SOLTRAIN ended 2017 on a high note

Puleng Mosothoane

SOLTRAIN ran a technical tour late last year and invited representatives from solar companies, academic institutions, the public sector and those who had previously attended SOLTRAIN training sessions to participate.

The 37 participants were treated to a number of interesting site visits which included a range of solar technologies, including BBCDC's now famous solar cooking technologies.

The technical tour was followed by a dissemination course for 38 participants run by Mr Sehloho Holomo from BBCDC and Mr Anadola Tsiu from the National University of Lesotho, both of whom had attended previous SOLTRAIN train the trainer courses.

Another technical tour will be run in late June this year with another dissemination course happening shortly thereafter.

[South Africa] How do we implement Solar Thermal Technologies in a Techo-Economically feasible way in South Africa?

Dr Karen Surridge

The SOLTRAIN project aims to tackle water heating energy needs and create opportunities through addressing the solar water heating sector across six partner countries in the Southern African Development Community (SADC), namely, Botswana, Lesotho, Mozambique, Namibia, South Africa, and Zimbabwe, through training, awareness raising, performance monitoring and demonstration systems.

The SA government has realised that a low carbon economy can bring benefits and in particular it will support climate change mitigation measures. The Government has already committed to reducing carbon emissions in South Africa by 34% by 2020 and 42% by 2025 depending on certain conditions. In order to meet these emissions reduction targets, several strategies will need to be used towards meeting this goal.

On the 6th February 2018, SANEDI hosted the launch and discussion of the "Solar Thermal Technology Implementation Plan for South Africa" as part of Phase III of the SOLTRAIN programme. This plan outlines what needs to be achieved in order to meet the SOLTRAIN visionary target to have ½ m² of net solar thermal collector area for every member of the population by 2030 in South Africa.

It is split into 5 "Roadmaps" that essentially outline projected installations needing to be met in order to achieve the goal:

Roadmap 1: High Pressure Residential Solar Water Heating

To grow the installed area to ~12 000 000 m² by 2030, requires a growth rate of 21% per annum on annual installations

Roadmap 2: Low Pressure Residential Solar Water Heating

The South African government has committed to install 600 000 units over two years. For the purposes of this roadmap, it is presumed that this commitment of 300 000 units per year will be sustained up to 2030, to produce a total installation number of 5 200 000 units

Roadmap 3: Industrial/Commercial/ Multi-Family Residential installations for Solar Heating and Cooling

If this market is grown with 40% per year on total installations, there will be 48 848 m² of solar collectors installed by 2030

Roadmap 4: Unglazed Swimming Pool Solar Water Heaters

If this market is grown with 35% per year on total installations, there will be 527 630 installations, or 10 522 598 m² of solar collectors installed by 2030, which represents 65% of the current number of swimming pools in South Africa

Roadmap 5: Passive Solar Thermal (PST) heating/cooling of buildings
It should be noted that solar thermal buildings include at least one day's integral thermal storage as a result of the prescribed interior thermal mass (SANS10400XA).

Over 50 people from across sectors (industry associations, science councils, private sector, government departments, academic institutions, municipalities, NGOs and State-owned entities) attended this launch and shared

in a presentation of the document as well as a lively panel discussion to explore roles in support of the implementation plan for Industry, Government and R&D sectors. Key to achieving this is a focus on awareness and marketing, institutional issues, workforce development (in terms if training and education) and research and development. Valuable points to this end were raised during the panel discussion:

- Knowledge sharing is key and important information must reach decision makers as well as the general public, just as important is coordination between sectoral role players, what is a possible mechanism to achieve this?
- How is government support obtained for this sector and which government department/s should endorse this?
- How is SWH linked to industrialisation and development of the industry in South Africa and what is needed in terms of support by the government? And how can this link to the Special Economic Zones or Industrial Parks initiatives
- What is the local potential for evacuated tube technology in terms of job creation, possibilities of a municipal/government tariff levee, the local and export value chain?
- Should there be research and development with an RRR (reduce, reuse, recycle) focus for the sector?
- How do potential users know what is a good system? Should market competition define this?
- How to approach solutions to testing and certification (energy efficiency rating B) challenges? How to make component testing easier?
- Technology reputation is key to a successful implementation
- Defining a strategy, coordination, knowledge management, awareness, systemic approach and an implementation plan, broader vision
- How to identify and exploit any competitive advantages for South Africa in this sector?
- How to avoid peaks?
- Consider incentives vs. rebates
- How to address and achieve system simplicity?
- The Sustainable Energy Society of Southern Africa (SESSA) has a company list of certified installers and is an instrument for public awareness
- Consider the implications of using PV to reach the defined targets
- Consider the concept of heat ESCos (Energy Service Companies)

It was suggested that SOLTRAIN might explore the possibility of compiling a study on "lessons learned" that focuses on what strategies should not be repeated, showcasing together with learning of successes and failures and how to maintain stability in a solar water heating roll out programme. A further study, might explore the heat technology, area vs. yield, competitive advantages and systems for commercial and industrial application, and to a large extent this is being addressed the Solar PayBack Project being implemented by SANEDI (https://www.solar-payback.com).

In addition to the above, it should be noted that the National Solar Water Heating Programme is in the process of being moved to Central Energy Fund (CEF). One of the sub-programmes under this, the Repair/Replace programme, which is at an advanced stage, has been delegated to the DoE-IPP Office. Additional information, in regard to the NSWHP current status and objectives, can be accessed at https://solarwaterheating-programme.co.za

Following the launch of the implementation plan document several key stakeholders representing industry, government, research and development were hosted on a site visit to explore some of the SOLTRAIN systems

installed in the Gauteng area during SOLTRAIN phases 2 and 3. The aim of this tour was to showcase different types of systems at different scales and their deliverable performance.

Achieving this vision will require an effective, long-term and balanced policy effort to allow for optimal technology progress, cost reduction and ramp-up of industrial manufacturing for mass deployment. The South African Government will need to provide long-term targets and stable supporting policies to build confidence for investment in manufacturing capacity and deployment of solar thermal systems.

SOLTRAIN's cumulative carbon & cost-savings impact quantified

Werner Weiss and Monika Spörk-Dür

The installation of solar thermal demonstration projects is an important part of the SOLTRAIN programme's activities. On the one hand, the installations allow the SOLTRAIN community to apply knowledge gained during the training courses, and on the other hand, to show and demonstrate different solar thermal applications from small-scale systems for single family houses to large-scale systems in industrial applications.

638 tons of avoided CO_2 emissions

The annual solar yield of all solar thermal systems is 1,834 MWh. This corresponds to electricity savings of 2,017 MWh/a and 638 tons of avoided CO_2[1*)], and the figures for the individual countries can be seen in the table

below.
The avoided electricity cost corresponds to ZAR 4.3 million based on city of Cape Town tariff in 2015 of 213.90 c/kWh including VAT.

At COP21 (United Nations Climate Change Conference), which took place in December 2015 in Paris it was agreed to respond to the global climate change threat by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels

Country	Total collector area [m2]	Total capacity [kWth]	Number of Systems	Solar yield [MWh/a]	Electricity savings [MWh/a]	Avoided electricity cost [ZAR]	CO2 reduction [tco2/a]
Mozambique	41	29	2	36	40	85,223	12
Nambia	269	188	79	245	269	576,189	85
South Africa	1,608	1,126	89	1,148	1,263	2,701,257	398
Zimbabwe	393	275	30	333	366	783,355	117
Lesotho	82	57	21	72	79	169,417	25
TOTAL	**2,393**	**1,675**	**221**	**1,834**	**2,017**	**4,315,442**	**638**

Annual solar yield and corresponding electricity savings as well as avoided CO_2 emissions of all solar thermal systems by end of December 2017, which were funded by ADA and OFID and installed in phase I - III of the SOLTRAIN project.

The systems also serve as best-practice examples in order to facilitate broader market uptake.A cumulative 221 solar thermal systems with a combined collector area of 2,393 m² had been installed by end of December 2017 in the six SOLTRAIN partner countries.

and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. This can be reached by switching from a mainly fossil fuel-based economy to an energy supply system based on renewables, and the figures outlined above demonstrate the contribution

1*) based on oil equivalent

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The Southern African Solar Thermal Training & Demonstration Initiative is a regional initiative on capacity building & demonstration of solar thermal systems in the SADC region. It is funded by the Austrian Development Agency & co-funded by the Opec Fund for International Development.

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