Workshop Report

Solar Panel Waste Workshop at the Century City Conference Centre – 5th March 2019

Sub-Saharan Africa is experiencing a large increase in the amount of installed solar PV systems with some already becoming waste through transit and installation damages, mishandling and extreme weather events. Others are already becoming obsolete due to the pace of technology development.

In response to the rise of this new waste stream and the projections for a significant rise in the near future; GreenCape and Inspired Evolution with the help of SAPVIA held a workshop to discuss the challenges and opportunities associated with waste solar panels, or End-of-life (EOL) solar panels.

The workshop was attended by 39 delegates from industry, government and academia. The morning session was opened by the City of Cape Town's Mayoral Committee Member for Economic Opportunities and Asset Management; Alderman James Vos. Alderman Vos spoke about steps being taken by the city to increase local business activities and to grow certain sectors, namely the green economy, through initiatives like GreenCape and the Atlantis Special Economic Zone.

The first presentation of the session was given by Mr Christopher Clarke, a managing partner at Inspired Evolution Investment Management on "Shedding light on the dark side of solar". Christopher demonstrated how Inspired Evolution is part of a growing movement to fund the instalment of utility scale solar energy infrastructure in Sub-Saharan Africa. For investors, this brings with it the consideration of knock on effects and downstream impacts. While Solar PV has a significantly lower carbon footprint than other sources of energy and is the cheapest new build energy source, there is still an end-of-life consideration for solar panels. He also pointed out that Inspired Evolution and other Fund Managers are committed to sustainability through every stage of the value chain and therefore involved in this initiative to find solutions for end-of-life PV panels.

The second presentation was given by Dr Mark Williams-Wynn from the Thermodynamics Research Unit at the University of Kwazulu Natal (UKZN). In his presentation, Mark explained the basics of how a PV panel converts light into electricity. He went on to explain the different types and compositions of PV panels; most (95%) panels are primarily Silicon based (crystalline & amorphous) with the remaining 5% containing hazardous chemicals and heavy metals like Cadmium telluride or Copper indium gallium selenide. Nonetheless, solar panels are classified as a hazardous waste and will be banned from landfill disposal in South Africa from August 2021 (*GN.R. 636, August 2013, National Norms and Standards for Disposal of Waste to Landfill*). The PV cells comprise only 4% of the weight of the panel, while the casing and glass make up the rest of the weight. This is an important consideration when assessing the processes and logistics of the component materials. Mark pointed out that the manufacture of PV cells is energy intensive and that using recycled cells to make new ones would only use 20-30% of the energy as using virgin raw materials. This is why countries close to recycling and manufacturing of panels will offer to pay for old panels, as they contain valuable components. Cells containing Cadmium telluride are highly valued by the manufacturers due to the scarcity of tellurium, therefore these cells are exported from around the world back to the manufacturers. He also pointed out that while solar panels have been popular in RSA for the last 15 to 20 years, they have a lifespan of between 20 to 50 years. Therefore, the main stream of waste solar panels that we have seen so far has mostly

come from damaged panels, however the amount of solar panel waste coming from aged and obsolete panels is likely to rise significantly in 5 years, necessitating a well-planned strategy.

The third presenter was Wido Schnabel, chairman of the SA Photovoltaic Industry Association (SAPVIA) who spoke about the role of SAPVIA in the industry for utility scale as well as small scale PV. Wido showed the audience that there are already 1474 kW installed capacity of utility scale solar energy, without accounting for private and small scale, with many new instalments coming online in the years ahead. Wido pointed out that an unnecessary amount of panels are damaged leading up to the installation due to a lack of skills, lack of standards and poor quality of installations. For this reason SAPVIA has introduced the PV Green Card which aims to train installers, regulate the industry and prevent wastage. Wido is confident that the scope and future of PV energy in Africa is immense, which means that end-of-life solutions are critical to ensure sustainability of this industry.

The fourth presentation came from Patricia Schroder from Urban Elements and Reclite, speaking about the existing processing capacity they have in South Africa. She explained the components typically found in a solar panel and what Reclite does with each part. They dismantle the frame using the metals to recover some of the cost of their process. They then mechanically delaminate the PV cells from the class covering which is crushed up for local processing. The PV cells which are a fraction of the net weight are then stored, exported or disposed. Patricia is confident that Reclite can handle the pre-processing of waste solar panels at their facility in Gauteng but a solution for the cells would still be required. Companies using their service would need to be willing to pay the logistics and processing costs.

After a well-deserved tea and snacks break, a short and inspiring presentation was given by Patricia Gomes, the ambassador for Singularity University in South Africa. She spoke on “Exponential Moonshot Thinking” where she gave an explanation of how modern technology is growing exponentially and that the fourth industrial revolution is a time of rethinking and creating a future that we are all better off in. She told the audience about their mission to educate, inspire and empower leaders to use these exponential technologies to overcome humanities greatest challenges. The challenge of solar panel waste is seen as a great opportunity for Africa to find future solutions through exponential thinking.

After this the MC explained the topics for breakaway discussion which were categorised into 3 headings; 1) Legal, 2) Logistics & Location and 3) Technical Solutions & Funding. The guiding questions for discussion along with the summary of outcomes has been recorded in the section below:

<u>Legislation</u>

- Which legislative enablers and barriers are there to local processing of waste PV panels?
- What new legislation is required or steps to be taken that can enable local solutions?

- Discuss the role of Government Strategies, Legislation, IndWMP's and EPR programmes to enable solutions

It was noted that electronic waste which includes solar panels will be banned from entering landfills from August 2021, which is one of the driving factors for finding alternatives. It was noted that regulation and enforcement of landfill bans would be difficult and that solar panels in various forms or stages of destruction would probably still find their way into landfills and that better enforcement measures needed to be set in place.

There was lots of discussion around the licensing requirement for processing facilities which would receive more than 30 tonnes per month, which are prohibitive (lengthy and expensive). Therefore some thought it might be better if there were small and/or mobile dismantling and pre-processing facilities that could operate locally and below licensing thresholds. However this would require further investigation for feasibility.

Awareness on best practice from installation to end-of-life was seen as a barrier to reducing and managing solar panel waste. Self-regulation like the PV Green Card could reduce waste and increase awareness of the value of a used solar panel, could help divert it from landfill. Consumer awareness could also push companies to take proactive steps towards closing the loop on solar panels.

Special economic zones, like the Atlantis Cleantech SEZ were seen as legislative enablers to creating local solutions, due to assistance from government and the various incentives for using these locations. This could be an option for a new processing plant. SEZ's could also form recycling hubs where all the various components inside solar panels have a use.

Extended Producer Responsibility (EPR) schemes legislated by government in place of mandatory Industry Waste Management Plans (IndWMP) could help the PV industry define their own end-of-life management methods. This should make provision for the funding of logistics, pre-processing and processing of waste solar panels. While some maintained that the onus remains with the owner of the panels at the time they become waste.

A comparison of utility scale vs SSEG will determine the type of contract and should include the costing for servicing, removal and end-of-life solution.

There is no nationwide registration system for solar panels, which makes them hard to trace and therefore reduces the responsibility of final owners. If an embedded chip or other smart tracing mechanism was used to trace panels, they could be diverted back to the manufacturers or other designated solutions which were prearranged.

<u>Technical Solutions & Funding</u>

- Which end-of-life solutions look the most promising to you as an industry stakeholder?
- How will it address the various types and models of solar panels?
- Who should fund these end-of-life solutions?

It seemed from this discussion that everyone agreed that for the short term (next 5 years) there would not be enough quantities to make a full local recycling facility feasible, therefore the PV cells at least would need to be exported to countries where those types are currently recycled. However local dismantling was strongly endorsed. There is also a need for ongoing R&D for new technologies that would keep the value of the materials in the country, once economies of scale can be reached.

It was suggested that a full market survey of all types of PV cell in use should be conducted to quantify and assess the scope for waste interventions. This was attributed as a role for industry associations, such as SAPVIA or perhaps a relevant government department to conduct.

There was a discussion about local capabilities to remanufacture or refurbish used cells for use in the second hand market. This would only apply to panels that have not been damaged but have reduced in output efficiency.

One aspect that could make recycling feasible would be logistics optimisation and local dismantling.

It was pointed out that the technology and materials used in new solar panels is ever changing and therefore the solutions for the next generations of waste solar panels may differ from current panels. There is therefore an opportunity to leapfrog over recycling technologies already operating in Europe.

There was also a discussion around who should bear the cost of end-of-life management; should it be the manufacturer (and costed into the sale price) or should it be the buyer, who is the owner of the panel? Where should the cost of recycling be factored in, the owner or installer? The full life cycle cost needs to be factored in. It was suggested that an independent third party could administer the funds for end-of-life management, for example a ring-fenced tax on new panels could be used to fund end-of-life solutions.

There is also a need for testing and sorting of the panels at the point of use to reduce unnecessary wastage and reduce logistics costs. This could lead to a stream of panels available for reuse in off-grid applications like social development projects, or for repair companies to add value to removed panels. The stages of a sorting process would include: 1) assessment 2) repair 3) resale / donation 4) dismantling. From here the sorted parts would be sent off for further use locally or abroad.

The group was strongly aligned with applying the waste management hierarchy of preventing, reusing and repairing panels before diverting them to a recycling process. At the point of recycling, the facility should be adaptable to inputting various types of solar panels, including new technologies.

In order to promote accountability and responsible practices for end-of-life solutions, there needs to be some form of traceability of solar panels. Serial numbers or embedded chips might be able to help link panels to sources, owners and facilities. It was suggested that sellers should hold the buyers of panels accountable by implementing a deposit and refund system for panels, however this raised the issue of theft of panels before the end-of-life.

<u>Location & Logistics</u>

- Where should the chosen treatment solution be located? Use the map provided
- Who should undertake to establish such a treatment solution?
- What logistical considerations will impact the selection of the best site?

This discussion concentrated largely on the opposing options of local solutions vs a centralized facility, although many also called for a partnership between these two options.

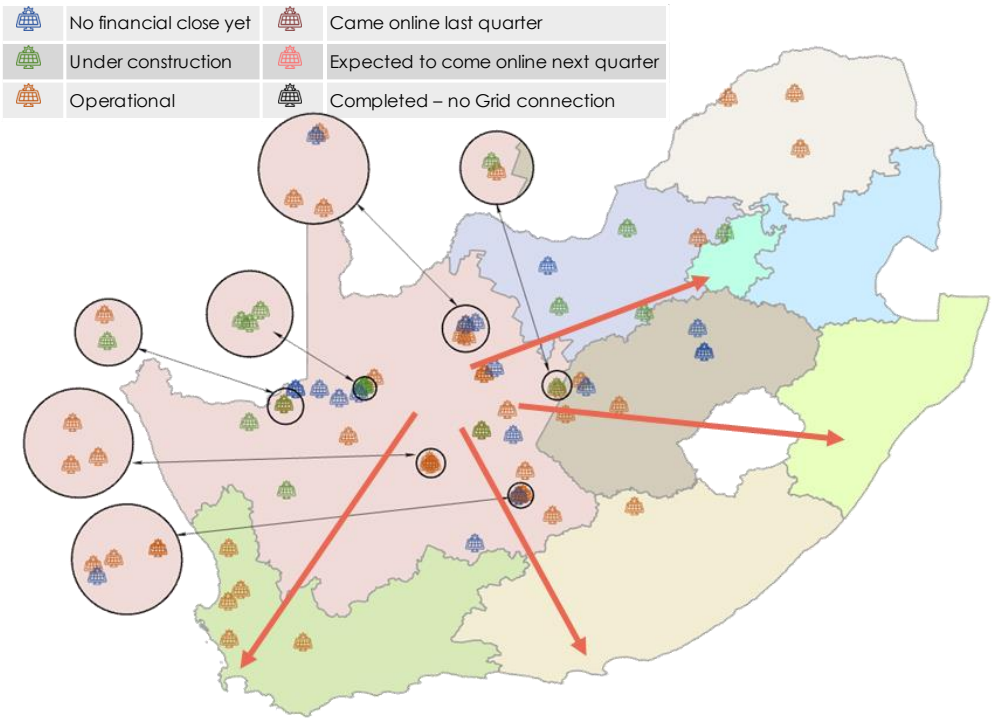
Proponents of local solutions noted how this would; a) reduce logistics costs as various components could be sent directly to the point of recycling, b) reduce the carbon footprint

associated with logistics as in previous point, c) increase local economic development (LED) as opportunities and materials would be located close to the PV installations where long term job creation is an ongoing concern, and d) skills development to local communities tied to LED opportunities. This approach needed a solution in place for every fraction of the panel and a market survey to be done for the scope and infrastructure requirements of this option. It could potentially use existing municipal infrastructure for storage and dismantling of panels.

Proponents for a centralized solution cited economies of scale which are likely to make a single recycling solution viable sooner. This might also reduce cherry picking and disposing of unwanted components, as the solution provider would have a contract for a complete solution to the panels. There would also be more accountability as a central solution provider could be regulated (licensed) and audited easier. One delegate mentioned that processing the lower value materials in solar panels requires cross subsidisation from the higher value components in order to make complete recycling viable.

The map below shows the location of utility scale solar PV installations (existing, pipeline and planned). (*Ref: Independent Power Producers Procurement Programme (IPPPP), June 2019*) Most (60%) existing facilities are located in the Northern Cape and more are planned for this region.

The red arrows show the logistics considerations discussed. New panels would be transported into the country via one of the main ports, mostly Cape Town and it was suggested that to make the most logistical sense a large scale solution should be based in one of these port cities, as reverse logistics from the utility scale instalments would reduce costs significantly. Proponents of dismantling at source said that this would help to send components into different directions where they can be processed, such as aluminium which would be sent to Hulamin in Pietermaritzburg, glass could be sent to PFG in Gauteng and PV cells could be sent back to ports of export.



After the breakaway discussions, the delegation ate lunch together before departing from the event, while the academic representatives returned to the venue for the bursary contest briefing given by Marike Fourie from Inspired Evolution Investment Management.

Marike took them through the Corporate Social Investment (CSI) mission of Inspired Evolution in the next financial year. They want to invest into proprietary knowledge, innovation and design, and targeted impact. Therefore they want to spend roughly R200,000 on a bursary and associated costs for a post-graduate student that has a research focus on renewable energies and related fields, without being too prescriptive of the exact content of study.

In order to contend for this amazing prize, entrants will need to create a proposal that addresses the following topic: “Find feasible solutions and implementable policies, based on international best-practice, which can avoid and/or mitigate the unintended consequences of the renewable energy sector e.g. solar PV waste management.” The proposal should cover issues like; technology or process to be used, materials to be beneficiated, applications for recovered materials, markets to be addressed, financial considerations and legal and logistical challenges and solutions.

Submissions of proposals should be in MS Word or PDF format, 2 to 3 pages in length including text and imagery and should be emailed to Marike at marike@inspiredevolution.co.za by the 30th of March 2020.

This is an opportunity for entrants to be innovative and creative in their thinking to impress the judges and secure this opportunity.

After submissions are assessed by the team of judges, shortlisted candidates will be notified of the contest date in early May 2020, where they will get a chance to make a presentation of their ideas to a small panel of judges and a small audience. This will be the final stage and the winner will be announced at this event.

Take home messages:

- The delegation agreed to form a “working group” of interested and affected parties who would like to continue collaboration to help address the challenge of end-of-life solar panels.
- Anyone who would like to be included into this working group that has not already emailed a request, must please email Oliver at oliver@greencape.co.za
- Students to email their submissions by the 30th of March 2020.