CENTRE FOR RENEWABLE &
SUSTAINABLE ENERGY STUDIES

| CRSES ANNUAL REPORT 2015 |

UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

science
& technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National
Research
Foundation

Eskom

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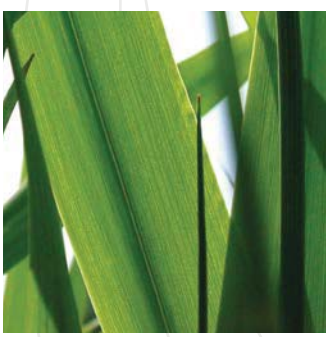
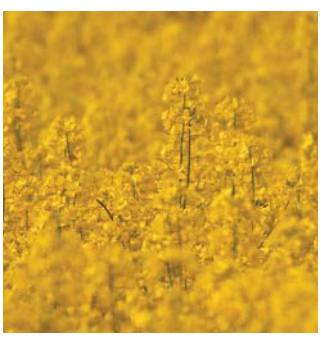



FOREWORD

The Centre for Renewable and Sustainable Energy Studies at Stellenbosch University (SU) was established in 2007 as the national hub of the Postgraduate Programme in Renewable and Sustainable Energy Studies. The Centre acts as a central point of entry into SU for the general field of renewable energy. The research focus includes solar thermal and photovoltaic systems, wind, geothermal, bioenergy and using the ocean as source of energy. The projects undertaken by the Centre range from initial feasibility studies for the deployment of renewable energy to highly technical studies on specific technologies. In this respect, innovation and building human capital in the field are seen as two of the main contributions made by the Centre.

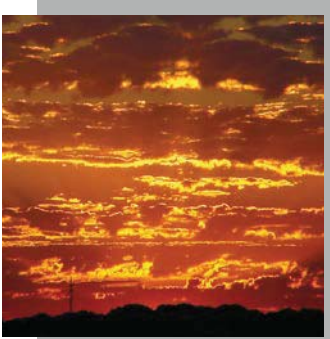
The primary objective of the Centre remains the training of scientists and engineers with the required technical expertise to unlock the country's renewable energy resources on the one hand, and to implement appropriate technology for using renewable energy in a sustainable manner on the other. The academic programmes started in February 2007 with 30 students enrolled on the two coursework master's degrees and various research degrees at the master's and doctoral level. In the 2015 academic year nine postgraduate modules were presented, starting with general modules on renewable energy technology, policy and finance, as well as specialised modules on advanced solar photovoltaic systems and bioenergy. A total of 24 students received bursaries from the Centre in 2015. Nineteen graduated; 17 graduated with a master's degree and two with doctoral degrees. A total of 22 peer-reviewed journal papers and 77 conference papers were published in 2015.

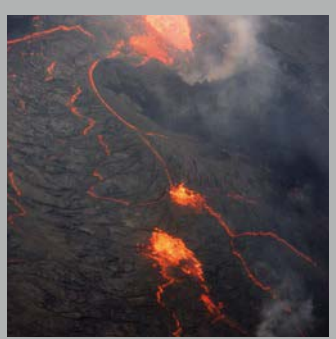
This is the tenth annual report of the Centre and spans the period 1 January to 31 December 2015. It represents the ninth full academic year that the Programme has been in place. This report presents an overview of our activities as we look back on 2015 as a year of consolidation. We were able to meet and exceed the targets set by our various stakeholders because of strong, motivated students and hard-working, well-qualified staff. To them I express my appreciation and gratitude because without motivated people we will never achieve our objectives.

The main assets of the Centre remain the excellent staff, both those employed by the Centre as well as the other academics and researchers associated with the Centre, the excellent facilities at Stellenbosch University, and the dedicated students at the different universities cooperating with the Centre.

I look forward to an even more exciting 2016 and trust that you will find this report interesting and inspiring.

Prof Wikus van Niekerk, *Director: Centre for Renewable and Sustainable Energy Studies*
16 March 2016





BUILDING HUMAN CAPITAL

The Centre's schools' programme 2015

We had another exciting year equipping teachers and learners with knowledge about renewable energy. 2015 was the first year for which we secured external funding for this activity, and it was the year during which we reached the milestone of training the thousandth teacher!

From a survey completed in 2014, it was evident that teachers of various subjects such as geography, life sciences, technology and physical sciences, are using the renewable energy learning and teaching support material (RE LTSM) provided by the Centre. Because of this, the aim of the Centre's schools' programme for 2015 was to develop materials and activities that can be used in more than one subject and to define a roll-out strategy for this support material. This resulted in the introduction of the RE LTSM in two workshops for geography teachers, in collaboration with the Department of Education's geography curriculum advisors. In further collaboration with the Schools Development Unit of the University of Cape Town, geography and natural science teachers received additional training in the Climate Change and Fundisa for Change areas.

Successful projects

While securing funding for the schools' programme remains an ongoing challenge, two proposals submitted last year led to successful project implementation, namely:

- The **Cape Higher Education Consortium** (CHEC) requested the implementation of the learning support material to students (pre-service teachers) of the Faculty of Education at Stellenbosch University who are studying a postgraduate Certificate in Education, with curriculum studies in geography.
- **Economic Development Solutions** (EDS) requested that the Centre provided professional development training on renewable energy to teachers in the Kathu area. EDS is a company appointed by Windfall to act as its socio-economic and enterprise development implementation agent. Windfall is an independent power producer, and the owner of a 75 MW solar PV plant close to Sishen. The project included developing activities in mathematics, physical science and geography that were suitable for incorporation in the CAPS curriculum. A three day-course was presented to teachers in Kathu.

Subject-specific learning materials were added to the RE LTSM offering, including:

- Mathematics for grade 8-9: focusing on global graphs and data handling
- Physical science for grade 10-12: exploring solar panels, the efficiency of solar panels and generators, and to demonstrate mechanical power by using a wind turbine to do the work
- Geography for grade 10-12: the content, aligned with the CAPS curriculum, focuses on data handling, map work and paper GIS

Community development

The schools' programme represented the Centre at the Department of Science and Technology's (DST) Imbizo on Friday 12 June 2015 in Cofimvaba. Community members and learners in Cofimvaba had an opportunity to view and interact with science and technology exhibits at the Imbizo where the Minister of Science and Technology, Naledi Pandor, addressed the community.

Spine Road High School visited the Centre on the 29 May 2015 and the scholars enjoyed an introduction to renewable energy, after which they toured the Centre's wave flume and the solar roof.

Community members and learners in Cofimvaba had an opportunity to view and interact with science and technology exhibits at the Imbizo.

Growth plans

In order to improve the footprint of the RE LTSM in 2016, one focus will be to implement the teacher professional development programme at other locations across the country. This will be in collaboration with independent power producers, as we did at the Sishen solar power plant. Another focus is to build on the relationships established through the Fundisa for Change programme, and to host more workshops in other provinces in collaboration with Fundisa partners. An ongoing project will be updating the RE LTSM offering with current developments in renewable energy in South Africa.

Learners together with Therese Lambrechts at the Cofimvaba Imbizo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PUBLIC PARTICIPATION PROGRAMME
GUEST

BUILDING HUMAN CAPITAL continued

2015 Graduates

The following 19 students have graduated in 2015 and copies of their completed theses, where available, can be found at http://crses.sun.ac.za/research-completed-research.php

All theses from Stellenbosch graduates are also available at https://scholar.sun.ac.za/

Some of the students who were supported by bursaries from the Centre are at other universities in South Africa, or are supervised by staff supported by the NRF grant.

March/April 2015:

Ms C Auret MEng (Research)	SU	SU Supervision
Mr JP Terblanche MEng (Research)	SU	SU Bursary & Supervision
Mr A Michaels MEng (Research)	SU	SU Supervision
Mr KC Smith MEng (Research)	SU	SU Supervision
Mr K Hobbs MEng (Research)	SU	SU Supervision
Mr J Fraser MEng (Research)	SU	SU Supervision
Mr A Hariram MEng (Research)	SU	SU Supervision
Ms A Grobler MEng (Research)	SU	SU Supervision
Mr NR Anderson MEng (Research)	SU	SU Supervision

Some of the students who were supported by bursaries from the Centre are at other universities in South Africa, or are supervised by staff supported by the NRF grant.

December 2015:

Mr J Fairhurst MEng (Research)	SU	SU Bursary & Supervision
Ms I Meyer MEng (Structured)	SU	SU Supervision
Ms C Haak MEng (Structured)	SU	SU Supervision
Dr M Brooks PhD	SU	SU Supervision
Mr OO Craig MEng (Research)*	SU	SU Bursary & Supervision
Mr JL Larmuth MEng (Research)	SU	SU Supervision
Mr HJ Lombard MEng (Research)	SU	SU Supervision
Mr JJ van der Westhuizen MEng (Research)	SU	SU Supervision
Mr C Homan MEng (Research)	SU	SU Bursary & Supervision

*non-South African

The following students obtained the postgraduate Diploma in Engineering (Renewable Energy Studies):

Ms C van der Merwe
Ms M Mtshali
Mr V Matshoba
Mr MA Verity
Mr IR Kuiler
Mr DJJ Boesak
Mr MR Nunes

One of the Centre's interns, Elias Maela, building a solar tracking device.

Graduated Bursary Students

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	**Total**
M Phil/M Eng/MFor	2	2	4	5	6	3	6	0	5	2	**35**
MSc/MScEng/MCom/MEng (Research)	2	2	5	9	8	8	10	4	16	15	**79**
PhD	1			2	1		3	2	4	2	**15**
Total	**5**	**4**	**9**	**16**	**15**	**11**	**19**	**6**	**25**	**19**	**129**

TRAINING

Advanced Photovoltaic Systems Short Course

Solar photovoltaics (PV) is an emerging technology in South Africa and is therefore incorporated in the training programme for graduate students at Stellenbosch University. Collaboration with industry highlighted a need for the training of professionals from various disciplines to enable the understanding of solar PV systems and provide a foundation for future work in this field. As a result, this course was developed to enhance and expand the 2015 offering of short courses and meet the existing demand for further training in this field.

The Advanced Photovoltaic Systems short course provides attendees with the understanding and tools to design grid-tied PV systems (including hybrid system configurations with backup power) within the South African solar resource, technical and legislative contexts. The required outcome of the designed system is to optimise the energy yield versus lifecycle costs of the PV system within the given resource, technical and legislative constraints, and thus optimise the financial viability of the system.

Specific topics that are covered in the course include measuring the solar resource, determining other climate data and understanding how these influence the performance of different solar PV technologies. The electrical characteristics of the most common photovoltaic modules are discussed and the effect of shading is explained in combination with optimum positioning and tracking.

Students are shown how to interpret datasheets and electrical design regulations which enables them to design a basic PV plant with a battery backup system that conforms to best engineering practices. These systems are then priced and the financial viability is calculated, taking various factors into account such as current and future tariffs, capital costs, and inflation, operation and maintenance costs. Apart from the shared theoretical knowledge and classroom exercises, students are taken on a field trip to visit operational, grid-tied PV plants that consist of rooftop and ground-mounted installations.

This course is aimed predominantly at engineers, technologists and technicians involved in the marketing, design and implementation of grid-tied PV systems, while also providing a better understanding of photo-voltaic systems to people from other industry sectors.

Municipality Workshop: Potential PV penetration study

A scoping workshop on potential PV penetration in the Western Cape was held on 3 November 2015 at the V&A Waterfront in Cape Town. Facilitated by Prof Wikus van Niekerk, attendees included representatives from the City of Cape Town, Eskom, Stellenbosch University, Drakenstein Municipality, Saldanha Bay Municipality and GreenCape.

The purpose of the workshop was to define parameters for a collaborative study to determine the potential impact on distribution and transmission networks from disaggregated solar photovoltaic on the City of Cape Town, smaller municipalities and Eskom. The collaboration aims to stimulate investment in private and public PV installations by enabling informed decision-making from both the private and the public sectors.

After an introduction to the study, delegates shared their study outcome requirements based on the perspective of their organisation. Existing research results were identified, collated and shared, and the proposed project objectives and methodology were discussed. In addition, the data availability and ownership, partner expertise and time availability, and collaboration responsibilities were discussed and determined.

Consensus was reached that the study will explore the following:

- Penetration levels, location and ownership of PV systems
- Consumption patterns, including potential changes in these patterns and the associated load on the grid
- Power flows, including changes due to future small-scale embedded installations
- Measures of risk and safety concerns on the grid
- Potential need for strengthening and supporting of the grid
- Monitoring needs and equipment
- Requirements for investment in the network by Eskom and municipalities
- Changes in network maintenance and operational procedures, including cost analysis, for Eskom and municipalities
- New dynamic response devices to support the power quality on the grid
- Integration of batteries and power storage

While the study will focus predominantly on the technical aspects of PV penetration, the financial aspects in terms of additional operational cost investments will also be considered. The study aims to demonstrate whether the grid is valuable, or not, for small-scale embedded installations. Acknowledging that electricity income, costs and tariff structures are important to municipalities, care will be taken to include all relevant information so that further studies focusing on the financial and tariff structures can build on the results of this study.

Showing students the switchgear and protection equipment that safely connects a PV system to the electrical grid.

The Advanced Photovoltaic Systems short course provides attendees with the understanding and tools to design grid-tied PV systems within the South African solar resource, technical and legislative contexts.

COLLABORATION AND IMPACT

Venda/Zululand SAURAN

In 2015, the Southern African Universities Radiometric Network (SAURAN) continued to grow by adding two more solar measurement stations, at the University of Venda and University of Zululand, collecting data in these two regions for the first time, and making it publically available. SAURAN plans to add more stations to the network in the near future and maintain the existing facilities through a strong collaborative effort with universities and funding support from Eskom, South African National Energy Development Institute (SANEDI), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and USAID.

SAURAN: University of Venda Station

SAURAN added a solar measurement station at the University of Venda near Thohoyandou, South Africa. The station was funded by USAID and has equipment for measuring high accuracy global horizontal irradiance (GHI), diffuse horizontal irradiance (DHI) and direct normal irradiance (DNI) as well as air temperature and wind data, in up to one minute resolutions. The data can be downloaded from the SAURAN website at http://www.sauran.net/.

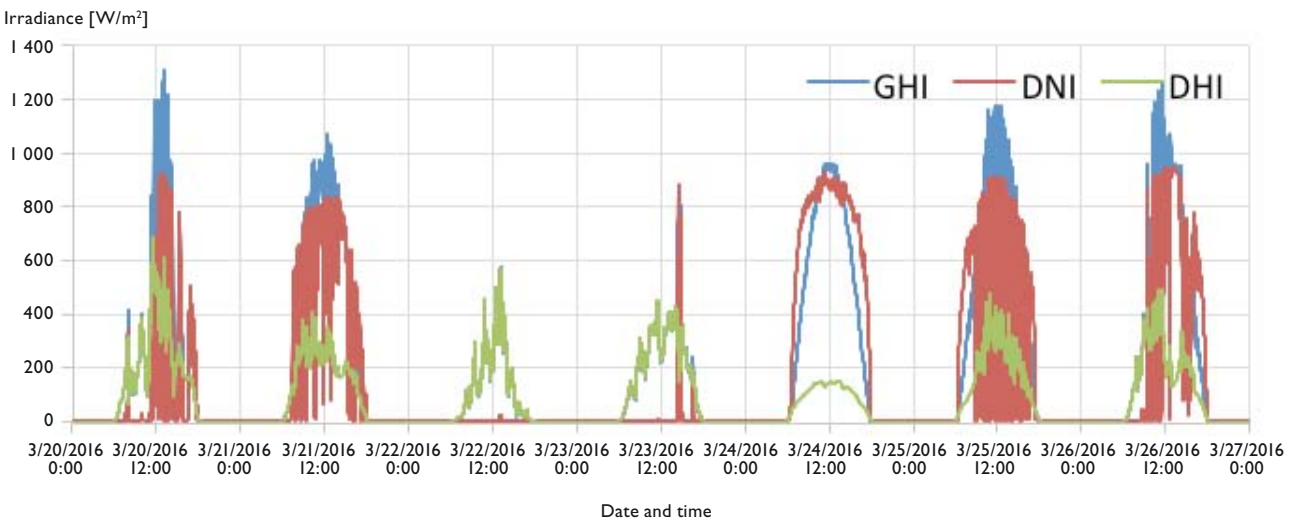
In the figure below, a sample data set shows the minute-averaged irradiance for the station at the University of Venda, for the period of 20 to 26 March 2016. The data shows that the only clear sunny day was on 25 March. The 22nd and 23rd of March show almost entirely overcast days, where the DHI (diffuse horizontal irradiance) dominates.

SAURAN: University of Zululand Station

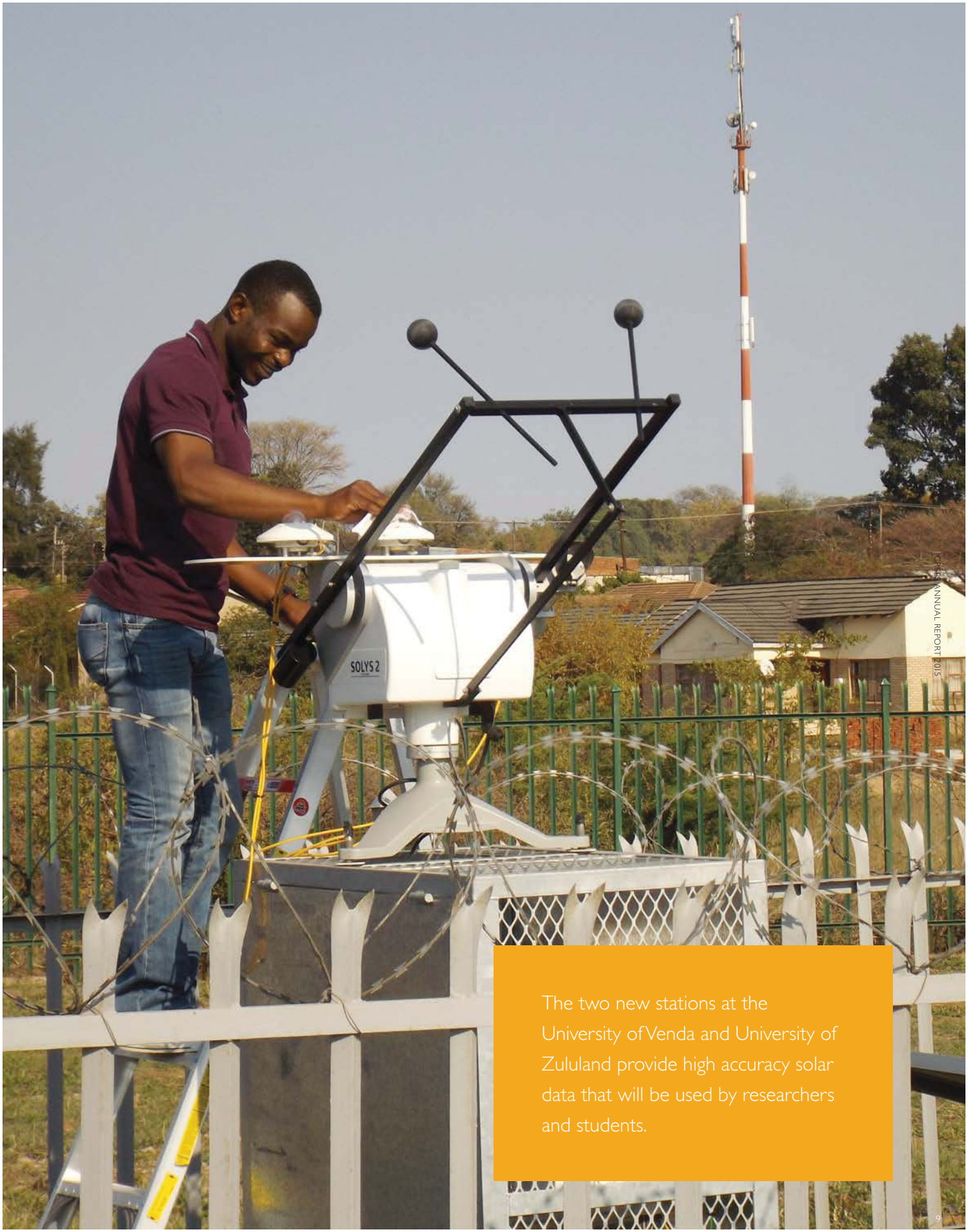
Towards the end of 2015, the implementation of the latest addition to the SAURAN network at the University of Zululand was underway. The station equipment was originally located on a farm near Vryheid as part of SAURAN, where it has recorded data since 2013. With sufficient data captured in the Vryheid region, it was decided to move the station to the University of Zululand where it has been actively recording data since the beginning of 2016. The original funding for the station was from the GIZ.

The two new stations provide high accuracy solar data on up to one minute intervals and this data, made accessible to the public, will be used by researchers and students at these universities and elsewhere.

Above: University of Zululand SAURAN station showing the solar tracker and measurement equipment
Opposite: University of Venda's SAURAN station pyranometers being cleaned



Below: Minute-averaged solar irradiance data for the week of 20 to 26 March 2016, from the SAURAN station at the University of Venda in Thohoyandou, South Africa



The two new stations at the University of Venda and University of Zululand provide high accuracy solar data that will be used by researchers and students.


7
THE INNOVATION
ATLANTIS

AWARENESS AND OUTREACH

SAIREC exhibit

The South African International Renewable Energy Conference (SAIREC) was held at the Cape Town International Convention Centre, from 4-7 October 2015.

The conference was the sixth in a series of global conferences, hosted in Africa for the first time, under the theme "RE-Energising Africa". Convened by the Renewable Energy Policy Network for the 21st Century (REN21), the event was hosted by the South African Department of Energy and the South African National Energy Development Institute.

SAIREC provides a global platform for government ministers, high-level decision makers, specialists, industry thought leaders and private sector parties to discuss their visions, experiences and solutions to accelerate the global scale-up of developing and using renewable energy.

Complementary to the conference programme, a number of side events were offered, and the Centre was involved in four of these:

- BAPEPSA: Development of a Biomass Action Plan for Electricity Production in South Africa
- SolarPACES: Concentrated solar power workshop on policy and strategy for growth
- ADA (Austrian Development Agency): Results of the Southern African Solar Thermal Training and Demonstration Initiative
- ISES (International Solar Energy Society): Role of solar heating and cooling technologies in meeting a growing energy demand

The Centre also represented Stellenbosch University by manning a stall during the event.

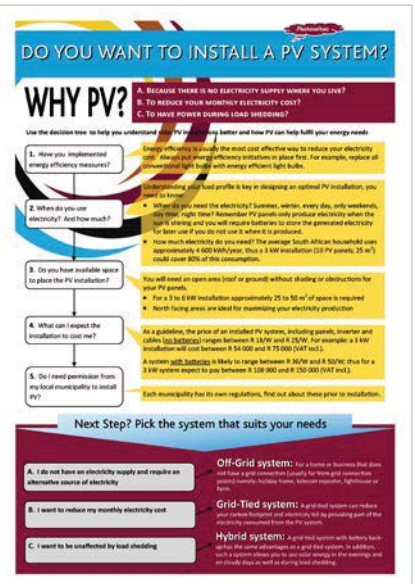
Weekly Briefing Note

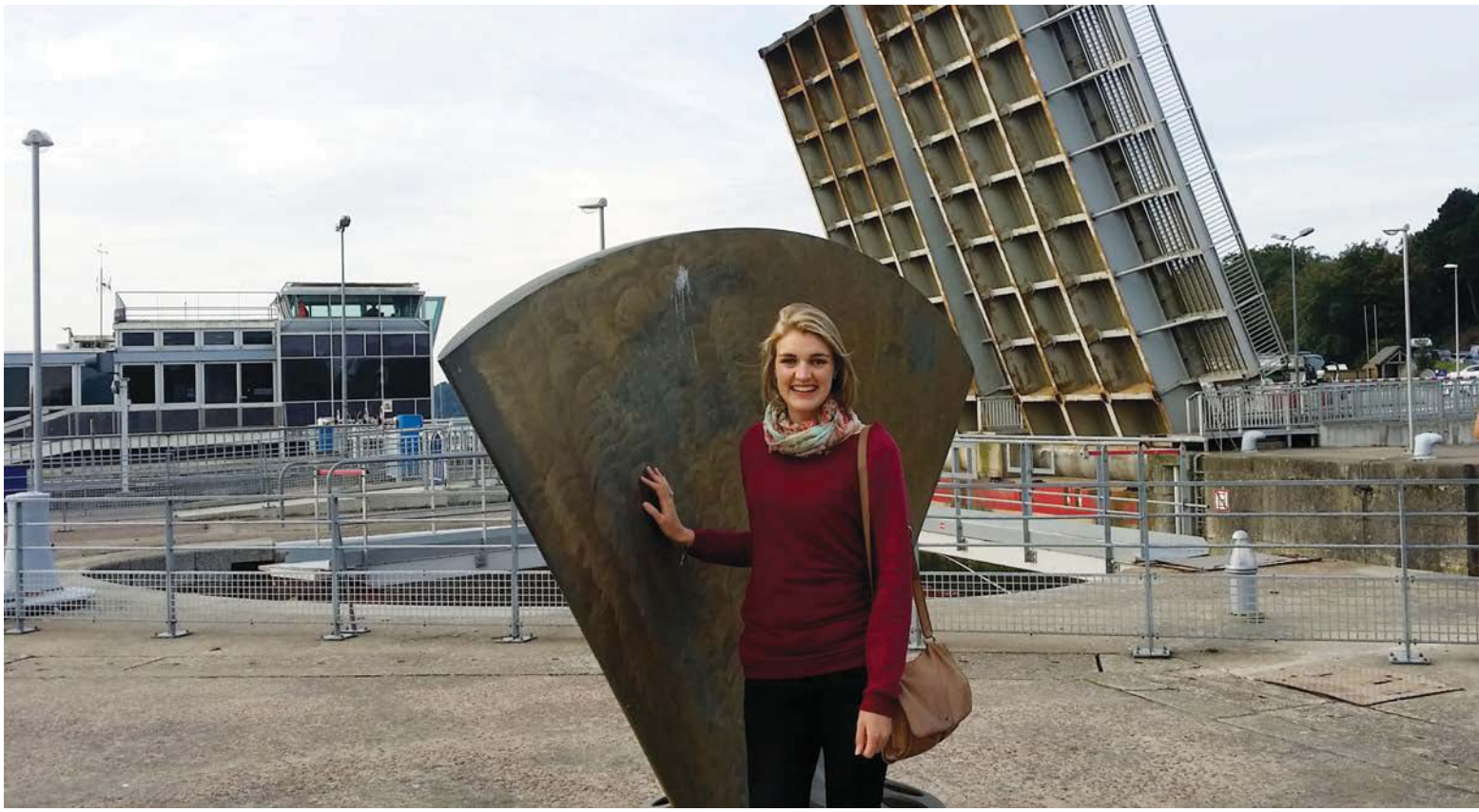
A marketing and awareness campaign to showcase the activities and accomplishments of the Centre was initiated in 2015. Through a regular newsletter, the *Weekly Briefing Note*, interested parties are kept informed about new projects and new technologies developed at the Centre.

The aim of the campaign is to interact more with clients and interested parties, and increase brand recognition both locally and abroad. The newsletter is distributed to other research institutions, Eskom, local industry, international partners, government policy makers, state, provincial and municipal departments and private consultants.

Each newsletter focuses on a specific topic, such as photovoltaic systems in the first *Weekly Briefing Note*, and readers are invited to to provide feedback via the newsletter, or on social media platforms.

Interested parties wishing to join the mailing list and stay informed of the activities of the Centre can follow this link http://ow.ly/ytnY302IrTV.





RESEARCH CONTRIBUTION

11th European Wave and Tidal Energy Conference: Nantes, France 6 to 11 September 2015

The 11th European Wave and Tidal Energy Conference (EWTEC) took place in Nantes, France from 6 to 11 September 2015. Imke Meyer attended, presenting her research on resource characterisation of the Agulhas current, titled *Characterisation of the Agulhas Current as a Resource for Marine Energy Extraction* authored by I Meyer and J L van Niekerk. A full paper on this work was published with the conference proceedings. The conference covered all aspects of ocean energy examining the resource, technology and economic and environmental aspects. Meyer's research tied in well with the overall theme of the conference, whilst showcasing the work done in South Africa in this field.

Meyer had the privilege of visiting the La Rance tidal barrage located on the north coast of France. This tidal barrage has 24 turbines installed at the plant and a production capacity of 240 MW. It was commissioned in 1966, and thus many of the lessons learnt by the engineers working on the project should be heeded by today's researchers and industry leaders.

Solar Thermal Energy Research Group and the Helio100 project

The Helio100 project entails Stellenbosch University developing a new small heliostat, of which 50 heliostats of 2 m^2 were deployed on the Mariendahl experimental farm.

The Centre hosted, supervised and assumed overall financial risk for the project, while the Technology Innovation Agency provided the funding. As such, the finances for this project, approximately R15 million over 18 months, are not reflected in the financial reports of the Centre.

This project was successfully implemented in 2015 and showcased at the international SolarPACES conference in October. The project also made international news through an article published in *The Guardian* newspaper in the UK.

STERG showcasing Helio100 at SolarPACES 2015

The annual SolarPACES conference was held in the Cape Town International Convention Centre from 13 to 16 October and the Solar Thermal Energy Research Group (STERG) was well represented with this conference being so close to home. It was also attended by local and international delegates from research institutes, governmental bodies, financial institutions and commercial entities in the CSP (concentrated solar power) industry.

The Centre, the Helio100 project and STERG shared a booth and presented as a joint Stellenbosch University exhibition at the conference. The booth was an inviting space for conversations about all CSP-related work and research at Stellenbosch University.

Opposite: Imke Meyer at the La Rance tidal plant with a model of one of the turbine blades
Above: Helio 100: Official technical tour of SolarPACES 2015

Of the 551 delegates attending from 38 countries, 43 delegates were from Stellenbosch University with the majority being members of STERG or affiliates of the group. Twelve papers were presented, as well as several co-authored papers and 13 posters. These presentations and sessions were opportunities for STERG members to showcase their research to a global community and to discuss their ideas about work, design and improvements to be carried out within the CSP industry.

The technical tour was offered on Saturday 17 October, directly after the conference, and was attended by approximately 200 delegates. This tour included a visit to Kirstenbosch Botanical Gardens in Newlands and a drive through the Cape Winelands to the Helio100 pilot facility near Stellenbosch. This visit was very well received, and although this is a relatively small CSP system, delegates congratulated the Helio100 team on excellent progress and an enjoyable visit.

SolarPACES 2015 was successful in bringing together the global community of CSP experts, as well as interested new parties. STERG was pleased to have been closely involved in conference, and this year's conference will be well remembered as a significant contribution towards demonstrating the local potential of CSP to our partners in the technology.

SOLTRAIN 2 is a project funded by the Austrian Development Agency to increase the uptake of solar thermal energy technology in southern Africa.

SOLTRAIN 2

The SOLTRAIN 2 project was initiated by the Austrian Development Agency (ADA) and is implemented by AEE Institute for Sustainable Technologies (AEE INTEC) from Austria in cooperation with project partners from South Africa, Lesotho, Namibia, Mozambique and Zimbabwe. The overall goal of this project is to encourage the switch from a fossil fuel-based energy for water heating to a sustainable solar energy supply.

A number of courses for professionals were presented in the partner countries by specialists from AEE INTEC. The content of the technical training courses included the theoretical and practical background to be able to design, build and install solar thermal systems.

RESEARCH CONTRIBUTION continued

In order to apply the knowledge gained during the training courses, and to increase public awareness, one goal of this project was to install 40-50 solar thermal demonstration systems of different sizes and applications at social institutions and small and medium enterprises in the so-called flagship districts. The flagship district of the Western Cape was defined as the area within a 100 km radius around Stellenbosch. Funded by the ADA, these demonstration systems enable education through technical tours and visits to the systems for decision-makers, prospective clients and the general public to see how this technology can be installed and functions in practice.

On Friday 27 November 2015, the Centre hosted a highly successful technical tour to three solar thermal demonstration systems in the Western Cape's flagship district, at:

- Stellenbosch University's Solar Roof Laboratory (6 m² collector area)
- Huis Horison – Stellenbosch (18 m² collector area)
- CBC Brewery – Paarl (120 m² collector area)

Much interest was shown by tour delegates, and technical experts and systems installers presenting the guided tour answered questions and initiated discussions about the technology and demonstration systems.

Launch of the South African Solar Thermal Technology Road Map

The Centre hosted a very successful launch of the South African Solar Thermal Technology Roadmap (SA-STTRM) on 19 March 2015 in Midrand. Hosted in partnership with the AEE Institute for Sustainable Technologies (AEE INTEC) and the Sustainable Energy Society of Southern Africa (SESSA), the workshop was attended by delegates from industry, research institutions, government and government agencies.

The SA-STTRM is a sector-specific roadmap underpinning and informing the wider Solar Thermal Technology Road Map, an initiative of the Department of Energy and the Department of Science and Technology, supported by the International Energy Agency.

The SA-STTRM documents the progress of solar thermal technology in South Africa and analyses the technological, legislative, regulatory and other barriers that need to be overcome to accelerate the deployment of this technology.

The SA-STTRM is part of SOLTRAIN 2, a project funded by the Austrian Development Agency to increase the uptake of solar thermal energy technology in southern Africa. For the SOLTRAIN 2 project, three southern African regional technology platforms were set up, and the thermal technology roadmap developed is one of the outcomes of the South African technology platform. The Centre coordinated the development of the initial roadmap document with input from other working groups.

On 27 November 2014, the SA-STTRM draft document was discussed at an open stakeholder meeting in Cape Town. The outcome of this workshop and further comments were then incorporated into the SA-STTRM document released in March 2015.

The vision of the SA-STTRM is that by 2030 there should a ½ m² metre of solar thermal collectors installed for every population member of South Africa. This equates to an estimated 30 million m², where there is currently only approximately 1,5 million m² installed. Thus to meet this ambitious target, an annual compounded growth in installations of 25% over the next 15 years is required.

Below: Soltrain Western Cape Flagship District Technical Tour – Solar Roof Laboratory, Stellenbosch University

FINANCIAL POSITION OF THE CENTRE

The Centre has three main sources of income. It receives an annual core grant from the Department of Science and Technology (DST) through a contract with the National Research Foundation (NRF). As the Specialisation Centre in Renewable Energy Technology in the Eskom Power Plant Engineering Institute (EPPEI), the Centre receives an annual contribution that is shared between the Centre and the Solar Thermal Energy Research Group (STERG) at Stellenbosch University. The remainder of the income comes from a number of private and public entities for contract research projects, and from short and in-house training courses.

The annual grant from the DST/NRF is mainly used to support the appointment of three senior academics at Stellenbosch University, provide bursaries for postgraduate students and contribute to the running expenses of the Centre. In 2015, this grant came to R4,91 million, of which R3,33 million was used for the appointment of staff. The contribution of the DST/NRF is supplemented with other funds from the Centre so that in total R9,59 million was spent on the various academic and research activities of the Centre in 2015. An amount of R2,02 million was spent on bursaries for postgraduate students.

The contribution from Eskom on the EPPEI programme for 2015 was R1,8 million, of which R875 000 was available to the Centre. The remainder was transferred to the Department of Mechanical and Mechatronic Engineering to support the Eskom Chair in Concentrating Solar Power as well as STERG. An amount of R480 782 was spent on bursaries for postgraduate students.

With more than R6 million in reserves, the Centre is in a favourable position for 2016.

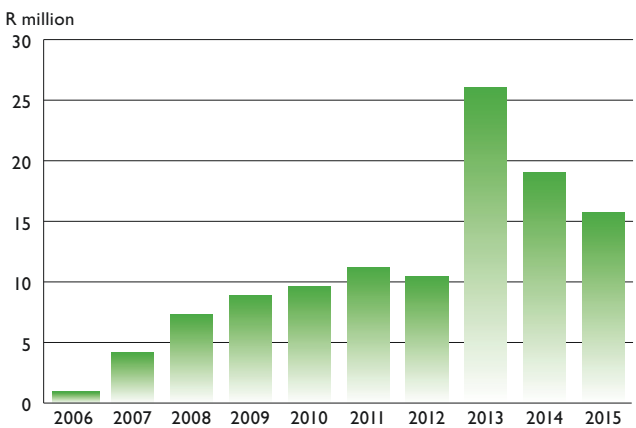
The comprehensive income statement of the Centre for all the cost points, including the Eskom EPPEI and project funds is included on page 16 and 17. The overall income of the Centre until 31 December 2015 was R15 768 110, 16% down from 2014, while the total expenditure decreased to R16 313 985. The total reserves at the end of December 2015 were R6 117 367, as can be seen in the table below. The main reason for the overall income reduction was that in 2015 Eskom informed the Centre that the contribution to the EPPEI Specialisation Centre in Renewable Energy Technology at Stellenbosch University will be R1,85 million due to the current financial challenges that the utility faces. In order to maintain the contracts of staff paid from this programme, the reserves of the EPPEI programme held by Stellenbosch University were used.

The Centre showed sustained growth in income from 2007 to 2011. In 2012, the income decreased slightly, mainly due to the decision of the DST to transfer the Renewable Energy Bursary Programme from the Centre to the NRF. In 2013, the income of the Centre more than doubled, predominantly due to the large projects completed for Eskom and GIZ. This growth was not sustainable, as reflected in the reduced income in 2014 and 2015. With more than R6 million in reserves, the Centre is in a favourable financial position for 2016. It is however anticipated that the current financial constraints in the economy will negatively affect the future income of the Centre and it is therefore important that the Centre further diversifies current income streams.

Funds available at the Centre

	31 Dec 2015 (12 months)	31 Dec 2014 (12 months)
Total income for the year	**R 15 768 110,16**	R 18 810 060,48
Total expenditure for the year	**R -16 313 985**	R -17 179 913
Expenses	**R -15 708 917**	R -15 346 779
Equipment	**R -605 068**	R -1 833 134
Total net transfers from Centre cost points	**R -3 112 236**	R -2 284 384
Net surplus/shortfall for the period	**R -545 874**	R 1 630 147
Funds available 1 January	**R 12 030 320**	R 12 684 557
Net surplus/shortfall for the period	**R -3 658 110**	R -654 236
Subtotal	**R 8 372 210**	R 12 030 321
Balance sheet items	**R -2 254 843**	R -1 102 189
Funds available 31 December	**R 6 117 367**	R 10 928 131

Annual income of the Centre



STATEMENT INCOME AND EXPENDITURE – ALL COST POINTS IN THE CENTRE

FOR THE PERIOD ENDING:	31/12/2015	31/12/2014
TOTAL INCOME	**-14 817 956,31**	**-19 037 403,54**
Conference/congress (no vat)	-450 110,65	-185 681,45
Contract research (taxable)	-3 143 161,61	-3 085 663,52
Donation: special purposes	-25 000,00	-70 000,00
Income foreign exempt	-173 177,50	-16 297,00
Income: bursary	-80 000,00	-204 500,00
Income: foreign_zero rate	-659 356,79	-2 984 958,10
Income: NRF apportioned	-4 919 683,00	-4 640 720,00
Income: NRF thrip(zero rate)	-1 385 749,00	-1 122 851,00
Income: sundry taxable	-1 105 659,72	-1 437 618,24
Interest receive: internal all	-547 702,01	-684 591,73
Profit/loss: exchange rate deb	-4 399,48	0,00
Profit: exchange rate foreign	-17 056,55	-2 943,50
Sales: to internal org units	-59 400,00	-37 209,00
Short courses	-447 500,00	-646 600,00
Sundry income: non-taxable	-1 800 000,00	-3 917 770,00
TOTAL EXPENDITURE	**16 111 621,81**	**17 169 802,14**
CURRENT EXPENDITURE		
Advertisements: general	46 031,99	110 697,03
Affiliation & registration expenses	495 944,19	234 543,74
Bicycle maintenance	136,09	0,00
Bursary postgraduate	3 707 310,11	2 232 339,77
Bursary undergraduate	94 000,00	66 480,00
Cell phone airtime	1 254,12	2 189,53
Cell phone rent	4 212,03	2 666,39
Chemicals	270,75	0,00
Cleaning costs – external firm	17 295,06	18 270,36
Cleaning materials	166,20	0,00
Clearence fee non-capital	0,00	821,58
Clothing: other	0,00	11 730,31
Clothing: protective	1 195,26	0,00
Computer materials	38 487,70	413 781,13
Consultation fees	1 658 460,63	3 823 602,80
Consumable materials	183 395,34	271 306,41
Copy and printing	95 305,91	217 412,50
Courses	800,00	800,00
Crockery	186,78	0,00
Electronic components	265 206,76	11 084,13
Entertainment: general	54 647,56	126 674,55
Fencing materials	0,00	36 400,20
Flowers and gifts	5 401,52	3 762,63
Foreign exchange loss	18 224,02	18 049,02
Fuel, oil, lubricants	11 661,94	9 455,59
General research costs	0,00	50 000,00
General vehicle expenditure	76 795,88	66 247,18
Glass ware	0,00	1 307,77
Handbooks and manuals	860,00	3 262,50
Insurance, licenses & 3rd party	850,00	2 409,00
Interest paid: internal apportioning	1 169,13	20 875,90
Internet network email levy	62 643,97	64 732,06
IP transfer fee	163 563,94	60 280,22
Irrecoverable debt written off	3 550,00	0,00
Levy: ICRR (indirect cost)	560 983,75	801 910,33
Levy: space and facility	11 685,00	18 113,79
Maintenance of apparatus	829,25	657,01
Maintenance of computer	0,00	1 126,00
Non-capitalised books	3 950,00	9 325,20
Postage and courier services	29 814,26	3 412,60

FOR THE PERIOD ENDING:	31/12/2015	31/12/2014
Prizes and medals	4 950,00	2 500,00
Refreshments: non-academic	51 163,97	12 254,22
Rent of equipment general	3 242,05	4 533,52
Rent of rooms	9 593,69	25 865,00
Research materials	21 301,45	0,00
SCW non-capitalised	7 945,39	750,87
Services	211 952,27	37 895,78
Smaller furniture and equipment	22 625,53	24 911,57
Software	46 578,67	127 747,12
Sponsorship/donation out institutions	1 000,00	200,00
Stationery	17 736,96	23 982,53
Subscription & membership fees	67 462,93	48 142,62
Subscription books & magazines	0,00	6 944,39
Sundry expenses	568 227,25	0,00
Telephone: calls	13 478,98	13 917,77
Telephone: rent	27 834,01	32 977,13
Total remuneration	5 650 141,46	4 949 561,48
Translation and editing	6 561,50	3 905,00
Transport cost	45 260,43	4 444,61
Travel: accommodation visum parking	298 167,88	232 357,50
Travel: foreign travel subsistence	336 496,25	379 762,06
Travel:daily allowance air car	336 412,26	489 016,68
Workshops	142 131,38	199 270,58
ASSET TRANSACTIONS		
Asset scrapping/transfers	-135 771,42	-248 671,19
Depreciation	1 000 350,33	852 841,44
Income: internal assets	-940 037,07	-604 170,25
Profit/loss: assets	75 458,16	0,00
Asset adjustments	0,00	0,00
Asset purchases	605 068,36	1 833 134,48
OPERATING (SURPLUS) / SHORTFALL FOR PERIOD	**1 293 665,50**	**-1 867 601,40**
FUNDS TRANSFERS	**3 112 235,81**	**2 514 088,91**
Transfers from	9 392 358,94	10 249 804,72
Transfers to	-6 280 123,13	-7 735 715,81
NET (SURPLUS) / SHORTFALL FOR THE PERIOD	**4 405 901,31**	**646 487,51**
Plus: ACCUM (FUNDS) / SHORTFALL ON 01/01/2015	**-12 162 729,90**	**-12 809 217,41**
ACCUM (FUNDS) / SHORTFALL ON 31/12/2015	**-7 756 828,59**	**-12 162 729,90**
MIN: BALANCE SHEET ITEMS	**1 589 498,88**	**1 302 189,28**
Creditor provision balancing	-12 350,00	-93 000,00
Debtors control account	1 476 613,49	1 367 057,83
ICRR control	-155 309,52	-141 064,08
Loan account bridging funds	300 000,00	200 000,00
Space and facility control account	-16 316,22	-19 736,22
Sundry creditors	-3 138,87	-11 068,25
FUNDS AVAILABLE ON 31/12/2015	**-6 167 329,71**	**-10 860 540,62**

Director: Financial Services

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STAFF




A: Mr Alejandro Lupion-Romero – Lecturer
B: Ms Jos Liebenberg – Administrative & Financial Officer
C: Ms Therese Lambrechts – Schools Programme Manager
D: Ms Corli Leonard – Research Engineer
E: Mr Eugéne Joubert – Research Engineer
F: Mr Cebo Silinga – Research Engineer
G: Ms Carla Nel – Marketing and Course Coordinator
H: Mr Athi Ntisana – Researcher
I: Prof Alan Brent – Associate Director
J: Mr Ulrich Terblanche – Research Engineer
K: Ms Karin Kritzinger – Researcher
L: Prof Wikus van Niekerk – Director
M: Ms Sandelize Heydenrycht – Receptionist
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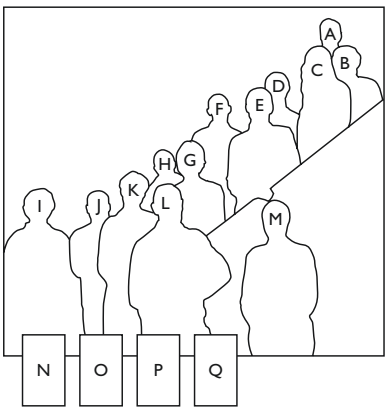
O: Mr Elias Maela – Intern
P: Mr Angelo Buckley – Junior Engineer
Q: Ms Imke Meyer – Research Engineer



CONTACT DETAILS

Sandy Heydenrycht
Email: crses@sun.ac.za
Tel: 021 808 4069
Fax: 021 883 8513

Postal address
Centre for Renewable and Sustainable Energy Studies
Stellenbosch University, Private Bag X1, Matieland 7602

Physical address
Centre for Renewable and Sustainable Energy Studies
4th Floor Knowledge Centre
Corner of Banghoek and Joubert Street
Stellenbosch 7600

GPS co-ordinates 33°55′44.60′S 18°51′51.47′E

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ACKNOWLEDGEMENTS

Copy and editing: Alison Budge
Photographs: Anton Jordaan
Design and layout: Jenny Frost Design
Printing: Hansa Print
Publishing coordinator: Aletta Jordaan