



CENTRE FOR RENEWABLE &
SUSTAINABLE ENERGY STUDIES

• 2017

CRSES ANNUAL REPORT



CONTENTS

FOREWORD.....	1
BUILDING HUMAN CAPITAL	2
TRAINING	6
RENEWABLE ENERGY MARKET TRANSFORMATION PROJECTS.....	8
AWARENESS AND OUTREACH	10
RESEARCH CONTRIBUTION.....	12
INTERNATIONAL COOPERATION	14
PUBLICATIONS	15
FINANCIAL POSITION OF THE CENTRE	17
STATEMENT OF INCOME AND EXPENDITURE Until December 2017	18
STAFF.....	20
CONTACT DETAILS	21
ACKNOWLEDGEMENTS	21

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.

Research focus areas include solar thermal and photovoltaic systems, wind, geothermal, bioenergy and using the ocean as a source of energy. The projects undertaken by the Centre range from initial feasibility studies to highly technical investigations into specific technologies. As such, innovation and building human capital in the field are seen as two of the main contributions made by the Centre.

2017 was a successful year at the Centre. Changes in the staff complement include the welcoming of Dr Bernard Bekker as the Eskom Chair in Power Systems Studies in May, and I joined as the Centre Director in July. A number of interns were trained and mentored, after which some left for job opportunities elsewhere, one was employed as an engineer at the Centre and another is continuing his studies at Stellenbosch University, funded by the Centre. A considerable number of bursaries were awarded and we were pleased with the number of students that graduated. As testimony to the fact that the Centre coordinates cutting-edge research and development initiatives, some staff and students received awards and recognition. The Centre also successfully presented ten short courses on renewable energy topics.

Projects undertaken included a number of specialist feasibility studies, and market transformation projects saw the Centre installing renewable energy technologies at Mariendahl, Stellenbosch University's experimental farm, in order to better serve the community living there. The school awareness and outreach programme reached many learners, while the renewable energy postgraduate symposium excelled with a record of 38 presentations on solar thermal technologies and 16 presentations on various renewable energy topics.

With regards to international collaborations, the Centre continued to get involved in a number of projects, such as Innovate UK, NUFFIC and many others. The Centre published extensively in internationally recognised journals, and a number of staff and students presented at conferences.

Financially, the Centre performed extremely well in 2017. A key development that I introduced as the Centre Director is the Strategic Plan 2018-2022. This Plan seeks to strengthen the existing activities at the Centre and bring in new ways of conducting business. In line with the relevant legislative prescripts of South Africa, the Plan has clearly defined the Centre's priorities and goals, business focus areas and scope of work, with associated key performance indicators. I am looking forward to a fruitful 2018 and beyond.

Prof Sampson Mamphweli

Director: Centre for Renewable and Sustainable Energy Studies
November 2018



BUILDING HUMAN CAPITAL

Interns

As part of its structured mentoring programme, the CRSES aims to host at least two Department of Science and Technology (DST)/ National Research Foundation (NRF) – funded interns per annum.



Ms Ntobi Nqandela, is an intern who graduated from CPUT; she is enrolled for her Postgraduate Diploma in Renewable Energy and her studies are sponsored by the Centre.

"I started my internship at the CRSES at Stellenbosch University (SU) in February 2016 and completed it in December 2017. During this time the Centre funded my studies and in December 2017 I obtained a Postgraduate Diploma in Renewable Energy. The internship provided me with experience in the workplace and helped me to apply the knowledge gained from my studies in solving real-life problems. I gained knowledge and skills in the renewable energy industry through working on the projects and the courses that I attended while at the Centre. Having the opportunity to work with experienced engineers and researchers has contributed a great deal to starting my career. Through the projects, I gained the courage to take on tasks that I would previously have thought to be impossible. These included pre-feasibility studies for renewable energy technologies and required using computer modelling software and writing reports based on the results of the studies. My communication, computer and writing skills improved noticeably.

The Centre offers a congenial environment and facilitates the transition from being a student to being a skilled professional. Having a wonderful mentor who was always willing to take the time to teach and introduce us to new skills and knowledge also contributed to learning. The skills that I acquired play a major role in my career and I am grateful to the Centre for the internship opportunity and the continuous support of my studies in renewable energy."



Mr Tshepo Gaonnwe from CUT completed his term as intern on 30 March 2017.

"I completed my internship at the CRSES at SU between April 2016 and March 2017. A work plan for my internship had been prepared and included working on the CRSES solar roof laboratory, testing the Kessel solar water heater system, being involved in Southern African Universities Radiometric Network (SAURAN) projects, and attending short courses in renewable energy. The internship included attending other short courses offered by the NRF and performing extra tasks related to my studies that were not mentioned in the CRSES work plan.

For the SAURAN projects, I was part of a team that installed a solar measurement station at Fort Hare University and the Namibian University of Science and Technology with GeoSUN Africa (see photo on page 3). I did maintenance of solar measurement stations at Sutherland, Vanrhynsdorp and the Richtersveld. I worked at GeoSUN Africa for a month, monitoring the solar measurement station, and visited photovoltaic (PV) solar plants at Kathu with GeoSUN to calibrate equipment used to measure solar irradiance at the plant.

I learnt a great deal through this outstanding experience and it will definitely be useful in the future. The mentor was wonderful, helpful, encouraging and motivating. The environment at the Centre was agreeable, and the necessary resources were available. I would like to thank the NRF and the CRSES team for the opportunity."

In 2017, the Centre accommodated four interns, one from the Cape Peninsula University of Technology (CPUT), one from the Central University of Technology (CUT), one NRF intern from the University of KwaZulu-Natal (UKZN), and an intern from France.

Mr Donald Fitzgerald from UKZN replaced Mr Gaonnwe as an NRF-appointed intern. He started his term on 1 April 2017.



"I completed my internship at the CRSES at SU between April 2017 and March 2018. During this time I was involved in many different projects, some of which included pre-feasibility studies for rooftop solar PV installations. These techno-economic projects involved the computational modelling of PV cells on the rooftop areas in question, as well as coupling these results with a detailed financial model of the system.

One particular project involved the coupling of a PV system with a biogas system, which would use the organic waste produced by a factory to generate sustainable heat and electrical energy. Another project included managing and maintaining a network of weather stations around Southern Africa known as SAURAN, which involved management of onsite personnel and site visits for station repairs or relocation.

Other projects included renewable energy desalination research, some solar thermal work and various smaller research assignments. I also attended various short courses during the internship and feel that I have gained great insight into renewable energy during my internship and have acquired sufficient experience to advance to a junior engineer position at the Centre. I would like to thank the NRF, the DST and especially the CRSES for providing me with this opportunity."

Mr Marc Calteau, foreign intern from the National Institute of Applied Science in Lyon, France.

In 2017, the CRSES agreed to take on an additional intern from the National Institute of Applied Science in Lyon, France. Under the guidance of one of the Centre's engineers, the intern, Marc Calteau, designed an experiment that involved monitoring and evaluating the difference in impact of a solar thermal geyser vs a solar PV geyser system. This included modelling the water demands of the families, designing the systems that would adequately provide for their needs and managing the procurement process required to get the equipment on site.

In collaboration with the sponsors of the project, SU and AEE INTEC, the systems were installed in October 2017; just six months after Marc arrived in the country. Marc is still involved from abroad, as he receives regular updates on how the project is running.

This project is only one example of the many projects that the CRSES has facilitated with the threefold aim of positive social impact, providing hands-on experience for young engineers, and broadening the body of knowledge on renewable energy.



BUILDING HUMAN CAPITAL *continued*

2017 Graduates

The following 17 students graduated in 2017, and copies of their theses and dissertations, where available, can be found at www.crses.sun.ac.za/research-completed-research.php

All theses by SU graduates are also available at www.scholar.sun.ac.za/

March/April 2017

Dr L Heller* PhD	SU supervision & bursary
Dr M Lubkoll* PhD	SU supervision
Mr E Grobbelaar MEng (Research)	SU supervision & bursary
Ms G Morar MPhil	SU supervision & bursary
Mr C Lombard MEng (Research)	SU supervision & bursary
Mr A Treurnicht MEng (Research)	SU supervision & bursary
Ms J Rudman MSc	SU supervision & bursary
Mr C Joubert MEng (Research)	SU supervision & bursary
Mr M Sklar Chik MEng (Research)	SU supervision
Ms J O'Brien MEng (Research)	SU supervision

September 2017

Mr I Kuiler MEng	CPUT supervision & SU bursary
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December 2017

Mr O de Meyer PhD	SU supervision
Mr HF Laubscher MEng (Research)	SU supervision
Mr JC Nel MEng (Research)	SU supervision & bursary
Mr RN Laurie MEng (Research)	SU supervision & bursary
Mr JJ Swart MEng (Research)	SU supervision & bursary
Ms L Swart MEng (Research)	SU supervision & bursary

*non-South African

The following nine students completed the Postgraduate Diploma in Engineering:

Mr JHJ Coetzee
Mr MR Msibi
Mr N Nkosi
Ms N Nqandela
Ms N Ravat
Ms NSL Simelane Dlamini
Mr RG Stevens
Mr LW Sixinti
Ms T van den Aardweg

SANEA/SANEDI Energy Awards

The recipients of the 2017 SANEA/SANEDI Energy Awards were announced at a prestigious banquet and awards ceremony on Friday, 15 September 2017.

These awards are designed to generate public, government and business awareness of achievements in the energy sector. The aim is to inspire innovation and actions to address future energy needs in a sustained and responsible manner.

The CRSES was well represented at the awards ceremony:

Ndamulelo Mararakanye, a research engineer at the CRSES, received the 2017 SANEDI/RECORD Young Researcher Award for Renewable Energy Research Excellence.

Therese Lambrechts, the CRSES Schools Programme manager, received the SANEA Energy Education Award.

Willem Landman, a former CRSES bursary holder and SU PhD graduate, received a SANEA/RECORD highly recommended certificate for a young researcher in renewable energy.

2017 Nigeria Community Excellence Award

Toyosi Craig, a PhD bursary holder, received the 2017 Nigerian Community Excellence Award: Most Outstanding Nigerian Student in South Africa. The awards ceremony brought together officials from the Nigerian High Commission and Consulate, top government officials from Nigeria, members of the Nigerian community in South Africa, representatives of Nigerian associations, corporate South Africans, top South African government officials, citizens and members of the African Diaspora. The Most Outstanding Nigerian Student category of the award was introduced this year and was sponsored by Old Mutual South Africa to honour the best performing Nigerian student on South African soil.

The awards had over 400 nominations, and only three nominees made it to the finals in the Most Outstanding Nigerian Student category. Toyosi Craig was announced as the winner at the event, held at the Encore Theatre Complex, Hatfield, Pretoria, on 14 October 2017.

Toyosi Craig also won the prize for the best presentation for his paper presented at the South Africa Institute of Industrial Engineering (SAIIE) 27th Annual Conference in October 2017, hosted by North-West University at Stonehenge in Africa.

Graduated bursary students

	2006-2010	2011	2012	2013	2014	2015	2016	2017	Total
MPhil/MEng/MFor	19	3	6	0	5	2	2	2	39
MSc/MScEng/MCom/MEng (Research)	26	8	10	4	16	15	6	12	97
PhD	4		3	2	4	2	1	3	19
Total	49	11	19	6	25	19	9	17	155



2017 SANEI/SANEDIA ENERGY AWARDS: Ndamulelo Mararakanye and Karen Surridge.

TRAINING

The Centre provides short courses and in-house training for companies to train their staff on the different technical, financial and policy aspects of renewable energy. Various elective modules are available. Companies select a combination of appropriate modules for each training course, with the duration and focus of each course determined by the company's areas of interest and the time available.

The following modules were presented during 2017:

- Renewable Energy Systems
- Renewable Energy Policy
- Renewable Energy Finance
- Introduction to Solar Energy
- Advanced Photovoltaic Systems
- Bioenergy
- Wind Energy
- Hydro and Ocean Energy
- Thermal Energy Systems

New short course – Energy Storage Systems

An additional course, Energy Storage Systems, was developed in 2017. This course will also be available in 2018 – as a short course for the energy industry and an academic course for postgraduate students. As Gerhard Swart, the course presenter, put it:

"Energy storage has become one of the most interesting areas of research and development as well as implementation in a world where the cost of electricity from intermittent renewable resources is reduced to a level below that of conventional energy. At the same time, many parts of the world have encountered a constrained supply of electricity, putting energy security at risk, another driver for the development of energy storage technology. With the dawn of electrical vehicles and mini- and micro-grids upon us, the potential market for energy storage devices will explode, further stimulating research and development and driving down costs."

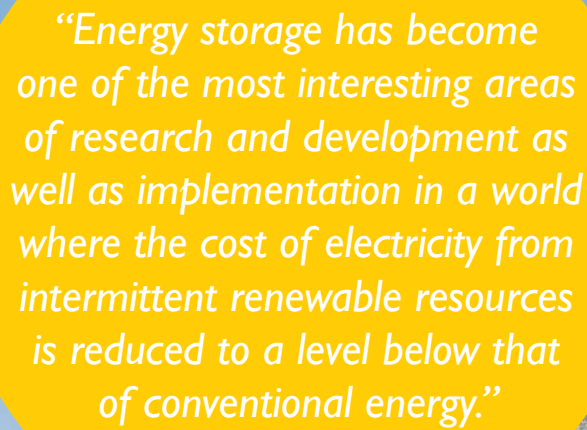
Energy storage is a vibrant and fast-developing area, and this course will provide delegates with the necessary background to understand the present and future energy storage landscape and also to make appropriate technology choices when implementing renewable energy and security of supply solutions."

Below are two examples of workshops presented to industry and other institutions in 2017:

- **SU** and the Council for Scientific and Industrial Research hosted a workshop in Pretoria on Monday 16 January 2017 on "The Role and Value of CSP as a Renewable Supply of Energy to the SA Power System". This workshop was held partly in reaction to the fact that in the recently released Draft Integrated Resource Plan 2016, no allocation was made for CSP in the South African electricity generation mix to 2050. The draft plan seems to have been based on modelling assumptions that were outdated, did not reflect the current market reality and did not acknowledge the dispatch ability and operational flexibility of CSP power stations. Consequently, the aim of the workshop was to discuss and demonstrate the value of concentrated solar power (CSP) for South Africa's power system, based on local and international research.

The DLR (German Aerospace Centre) and the National Renewable Energy Laboratory in the United States of America (USA) completed a study specifically on the value of CSP in South Africa. Two of their senior managers, Prof Dr Robert Pitz-Paal and Dr Mark Mehos, presented the results of the study at the workshop. In addition, research completed in Germany at the Fraunhofer Institute of Solar Energy as well as work done at SU for the World Wildlife Fund and NamPower was discussed. A number of other local researchers and representatives from the local CSP industry and Eskom participated in the workshop. (The presentations can be viewed at www.ow.ly/PaJn308bEwr)

- **Jason Fairhurst** presented a lecture on ocean energy at the International Ocean Institute (IOI), Southern Africa on 14 September 2017. The IOI maintains its focus on training and capacity-building programmes through its global network of centres and affiliated training courses. The IOI-SA, based in Cape Town, coordinates technical support, projects and training delivery for the African region. As the designated training centre for the African region of the IOI, the IOI-SA developed and established the annual Training Course in Ocean Governance for Africa in 2013. The course is modelled on the structure and content of other IOI ocean governance courses presented in Halifax and Malta and is designed to meet the needs of the African continent as a whole, with respect to particular ocean governance challenges. The course is run in partnership with the South African National Biodiversity Institute and the South African International Maritime Institute.



“Energy storage has become one of the most interesting areas of research and development as well as implementation in a world where the cost of electricity from intermittent renewable resources is reduced to a level below that of conventional energy.”



Bringing theory and practice together for the students of the Advanced PV System course.

RENEWABLE ENERGY MARKET TRANSFORMATION PROJECTS

The Centre plays a facilitating role in bringing new technologies to market or in assisting public and private entities to deploy existing technology but with new business models. In 2017, the projects focused on solar thermal and PV systems as well as a biomass plant.

Renewable energy in rural applications

The Centre undertook a project to install two solar-powered water-heating systems at the Mariendahl Farm. Mariendahl serves as SU's experimental farm and is located approximately 14 km north of Stellenbosch. Although both systems are solar powered, they are powered using two different technologies. One system is powered by solar thermal energy and is referred to as a solar water heating (SWH) system. The other system is powered using PV. The project was funded by SU through the SOLTRAIN initiative – managed by AEE-Intec in Austria and funded by the Austrian Development Agency (ADA) and the Organization of the Petroleum Exporting Countries (OPEC) Fund for Industrial Development (OFID).

The initial stage of the project included the modelling and simulation of each of the systems to identify suitable sizing. This simulation modelling was followed by a detailed financial analysis to investigate the feasibility of each system and detailed designs with the assistance of AEE-Intec. The systems should substantially reduce the electricity consumption of the residents as less grid electricity will be required for water heating. The aim of this project is to compare the systems, their performance and their cost-effectiveness.

A 2,4-m² flat-plate collector with a 200-L hot water storage capacity was designed and installed on one of the houses and another house was outfitted with a 1,5-kWp PV system. The PV system powers a direct current (DC)/alternating current (AC) element for heating the water in a 200-L hot water storage tank identical to the tank used in the SWH system. The DC/AC resistive element, a relatively new technology on the market, allows DC electricity from the PV system to directly power the resistive element without the need for an inverter. The element is able to operate with AC electricity from the national grid, which serves as a backup for when solar energy is insufficient. The SWH system is also equipped with a backup AC resistive element.

The PV and SWH systems are expected to provide 60% of each residence's hot water needs. Both systems are equipped with monitoring equipment, allowing the CRSES and AEE-Intec to monitor and evaluate the performance of the two systems. This will allow for a detailed technical and financial comparison of the types of technology based on system operation, project costs and energy costs.


Financing is currently being sought to provide solar water heaters to the remaining houses on the farm.



Victoria & Alfred Waterfront

The Victoria & Alfred (V&A) Waterfront in Cape Town is running a programme to implement sustainability initiatives, including the installation of renewable energy technologies. The Centre has assisted with this initiative since 2014 by suggesting the most suitable solar PV installations. This is done by identifying the optimal sizes and locations of PV systems on buildings owned by the V&A Waterfront, with the intention of generating electricity for own use. The electricity production potential is then determined through detailed system simulations and an evaluation of the historic electricity consumption profiles for these locations. This is followed by a financial evaluation to determine the expected system cost and financial savings through the reduction in electricity bills.

The Centre further assists by drafting technical specifications to be used in the tender process and participating in the tender adjudication as an independent technical advisor. The PV systems commissioned in the first phase of this project were installed by Sustainable Power Solutions (www.powersolutions.co.za) and to date PV systems amounting to more than 1.4 MW have been installed across V&A Waterfront properties. From January 2016 to May 2017, these PV systems have reduced electricity consumption from the grid by 2 418 MWh and reduced the carbon footprint of the V&A Waterfront by 2 491 tonnes. The Centre continues to assist the V&A Waterfront with the expansion of its PV capacity.



“The PV and solar-powered water-heating are expected to provide 60% of each farm workers’ residential hot water needs.”



AWARENESS AND OUTREACH

Renewable Energy Postgraduate Symposium 2017

The CRSES hosted its eighth annual national symposium to provide Masters and Doctoral students across South African institutions with the opportunity to present their research. The symposium took place from 12 to 13 July 2017 in the Knowledge Centre Building of the Faculty of Engineering, SU.

This symposium incorporated the Solar Thermal Energy Research Group (STERG) symposium, on 13 and 14 July, which focused on solar thermal energy topics.

Professor Wikus van Niekerk, the Dean of Engineering, welcomed the participants on the first day. Prof Sampson Mampwheli, Director of the Centre, then gave a keynote address: an insight into the future of the CRSES at SU.

The first day saw 16 presentations successfully delivered by students from four South African universities. The presentations included a diverse range of renewable energy topics such as solar thermal energy, solar PV, wind energy, bioenergy and policy. All presentations were very well received by the audience, who were eager to ask questions and engage in discussion with the speakers after every talk.

A record-breaking 38 presentations on various solar thermal energy topics were presented on the second day. STERG's research presentations were accompanied by presentations by colleagues from UKZN, the University of Pretoria (UP) and the University of Cape Town (UCT).

Abstracts of the papers as well as the full programme are published in the symposium proceedings, which are available on the Centre's website.

The Centre's Schools Programme

Climate change and renewable energy have only recently become part of the school curriculum in South Africa. Many teachers at secondary school level have to teach topics with which they are not necessarily familiar. The CRSES has established the Schools Programme to provide professional development and learning materials to aid educators in the teaching of renewable energy topics. This material has been introduced to over 1 000 educators in more than 800 schools over the last nine years. The material has been updated to keep pace with the development of new technologies and applications, and based on the feedback that the CRSES received from educators who used the material. The renewable energy material is used in the following curriculum areas: Geography grade 11, Life Sciences grades 11 and 12, Physical Science grade 11, Natural Science grade 9 and Mathematics grade 8. The material can be accessed at www.crses.sun.ac.za/service-schools

SunStep

In collaboration with SunStep, more than 600 learners visited Stellenbosch University during 2017. They received a presentation on renewable energy, had a tour of the solar laboratory and in the SunStep laboratory they built an electronic kit that they could take home.

Research

Research is a strong focus of the programme. Over the years, appraisals, questionnaires, workshop evaluations and surveys focused mostly on whether teachers used the learning material. A recent study investigated how teachers used the materials and whether value was added to their teaching and learning practices to further Education for Sustainable Development (ESD).

The result showed that teachers introduced learners to key concepts and broadened their knowledge on renewable energy but that the activities were not strongly enough orientated towards ESD as learner-led processes for enquiry and action. This outcome led to the challenge of developing activities through which learners could take action and engage with their own energy lifestyle.

During 2017, two energy audits were developed with the specific aim of determining whether the activities could lead to learners' engaging with their own energy use. These audits received funding support from the Cape Higher Education Consortium and the Energy Security Game Changer of the Western Cape Department of Economic Development and Tourism. The changes created by these activities led to learner-led enquiry and action.

Khobab Wind Farm

The CRSES also implemented the learning material with the teachers from Loeriesfontein Primary and Secondary School and visited the Khobab Wind Farm.

Challenges and way forward

In order to expand the footprint of the Schools Programme in 2018, the CRSES will explore the use of electronic platforms to distribute learning material.



Teachers and learners at the Khobab wind farm close to Loeriesfontein



RESEARCH CONTRIBUTION

The Centre is proud of staff members that have continued with studies and, as such, contribute more effectively to the research knowledge base and expertise of the Centre.

Degrees

Mr Ndamulelo Mararakanye holds a BSc (Eng) in Electrical Engineering from UCT. He successfully completed his MSc in Electrical Engineering (with distinction) at UCT and is employed as a research engineer at the CRSES.

Prof Wikus van Niekerk (previous Director of the Centre) holds a PhD in Mechanical Engineering from the University of California at Berkeley. He successfully completed his Executive MBA (with distinction) at the Graduate School of Business, UCT. He was awarded the Gold Award for his outstanding academic achievements in the EMBA. Prof van Niekerk was appointed as the Dean of Engineering on 1 July 2017.

Ms Therese Lambrechts holds a BMus Ed degree from SU. She successfully completed her Master's Degree in Environmental Education at Rhodes University. She manages the Schools Programme at the Centre, which aims to develop knowledge – specifically among South African youth – of the socio-ecological challenges and associated risks of climate change and South Africa's need for a sustained supply of clean energy. She has developed and implemented appropriate learning support material on renewable energy for teachers nationally.

Mr Angelo Buckley holds a BEng in Mechanical Engineering from SU. He successfully completed his Postgraduate Diploma in Renewable Energy (cum laude) at SU and is employed as a research engineer at the CRSES.

Conferences

The European Wave and Tidal Energy Conference (EWTEC) series are international, technical and scientific conferences focussed on ocean renewable energy and widely respected for their commitment to maintaining high standards in the quality of academic and industrial contributions to their proceedings.

EWTEC provides a forum where those at the forefront of technology development in the sector meet, interact, present their latest research and debate new ideas and issues pertinent to wave and tidal energy conversion. It thus provides attendees with a perfect forum for knowledge transfer and debate at the cutting edge of marine renewable energy technology.

This year, EWTEC took place in Cork, Ireland, where **Mr Jason Fairhurst** from the CRSES presented a paper entitled "Development and Application of a Wave Energy Conversion Simulation Model".

Other presentations ranged from the experimental testing of various wave and tidal energy converters to financial assessments to linear and non-linear representations of killer-whale blubber. EWTEC stands out as the most prestigious ocean energy conference in the world, and the 2017 event really supports this distinction. Ocean energy still has a long way to go to become competitive in the renewable energy industry, but EWTEC 2017 showed that progressive strides are definitely being made.

National and international conferences attended by staff and students

Conference	Attendees	Dates	Focus
Soltrain Conference Windhoek, Namibia	Wikus van Niekerk Karin Kritzinger Angelo Buckley	22 – 24 February 2017	SOLTRAIN is a project spanning six SADC countries to promote the use of solar thermal energy. More information: www.soltrain.org.za
Berlin Energy Transition Dialogue Berlin, Germany	Wikus van Niekerk	20 – 21 March 2017	To discuss the transition from a largely fossil fuel-based energy system to one that significantly reduces CO2 emissions, by making use of renewable energy resources such as wind, solar and biomass.
AMC Water Desalination Symposium Africa Durban, South Africa	Jason Fairhurst	24 – 26 May 2017	To broaden the Centre's knowledge base on the technical aspects of desalination as well as the South African market status. Reverse osmosis (RO) was established as the most appropriate method for desalinating sea water into drinking water.
European Wave and Tidal Energy Conference (EWTEC) Cork, Ireland	Jason Fairhurst	27 August – 2 September 2017	Jason presented a paper titled: "Modelling and testing of a submerged oscillating water column." EWTEC stands out as the most prestigious Ocean Energy conference in the world and this year's event held in Cork really supported this claim.
South African Sugar Technologists' Association (SASTA) congress Durban, South Africa	Willem Krog	15 – 17 August 2017	Willem is an MEng student and presented a paper on Solar Live Steam Generation and Solar Bagasse Drying for South African Sugar Mills.
IEEE Light Up a Billion Smiles International Workshop Johannesburg, South Africa	Wikus van Niekerk	9 June 2017	Prof van Niekerk chaired a session in this event which is partnered with Delft University of Technology, Georgia Institute of Technology, University of Johannesburg, Resolution Circle and the University of the Witwatersrand.
SolarPaces and Fraunhofer CSET Scientific Board meeting in Santiago, Chile	Wikus van Niekerk	29 September 2017	The Centre also co-sponsored the following students who presented oral papers at the conference: OO Craig, JC Nel, Willem Krog and Henk Laubscher.



Significant research contributions in 2017 were made by the Centre's Mr Ndamulelo Mararakanye, Prof Wikus van Niekerk, Ms Therese Lambrechts, and Mr Angelo Buckley

INTERNATIONAL COOPERATION

STARFLOAT and OPEC

In 2017, the Centre served as the sub-Saharan partner on two projects funded by Innovate UK. Innovate UK is a United Kingdom organisation that drives productivity and growth by supporting businesses to realise the potential of new technologies, develop ideas and make them a commercial success.

The STARFLOAT project tasked the CRSES with the responsibility of investigating the offshore floating wind market in Namibia, with the objective of uncovering certain industries that might share synergies regarding offshore floating wind. The key industry identified was desalination. Namibia, with a growing population and a diminishing water supply, will most likely incorporate desalination as a key part of the country's water security in years to come. This introduces an opportunity for innovation. The study carried out by the CRSES showed that the energy generated by offshore floating wind was competitive with current energy prices in Namibia but not likely to be competitive with onshore wind energy. The study showed that offshore floating wind could be used to support desalination most economically in areas that had been hit by disaster and were in need of immediate mobile energy and water, as well as areas in need of energy and water but lacking land mass.

The second project, OPEC (Offshore Platforms for Energy Competitiveness), also involved offshore floating platforms. This project saw the CRSES investigating the South African energy, water and food sectors in an effort to identify the most likely sector for incorporating OPEC technology. The project is still underway but has identified the food (aquaculture) and energy (wave and wind) sectors as having the most potential for incorporating the OPEC technology.

Southern African Solar Thermal Training and Demonstration Initiative

The Southern African Solar Thermal Training and Demonstration Initiative is funded by the ADA via the European Recovery Programme Fund and co-funded by OFID. The main activities of SOLTRAIN are focused awareness campaigns on solar thermal systems to inform all relevant stakeholders about the different applications of solar thermal energy and the related impact on security of energy supply, poverty, employment and the environment. In order to apply the knowledge gained during the training courses and to increase public awareness, 40 to 50 solar thermal demonstration systems of different sizes and applications were installed at social institutions and small and medium enterprises.

As part of the SOLTRAIN project and in collaboration with AEE-Intec, the ADA and SANEDI, the Centre organised a specialised course for professionals on solar heat for industrial applications and a technical tour of two installations in the Western Cape, which took place from 22 to 24 November 2017. This second specialised SOLTRAIN course on solar heat for industrial application focused on the analysis of industrial processes suitable for solar integration. Based on test cases, the participants learnt how to optimise industrial processes for the integration of solar heat. The training session was well attended, with 50 international and national delegates from various governmental, educational and industry sectors. The agenda is available on request. The technical tour

of two large solar thermal demonstration systems in Cape Town included Melomed Hospital and Warwick Mansions. These systems are both co-sponsored by the SOLTRAIN project.

National University of Lesotho Energy Research Centre

The National University of Lesotho (NUL) announced the establishment of an Energy Research Centre in early 2017. It has a close working relationship with SU and the CRSES, and during 2016, six of its academic staff attended seven of the renewable energy courses hosted by the Centre through Centre sponsorship. This was in preparation for the establishment of the Energy Research Centre. The NUL hosted the Renewable Energy Research and Innovation Symposium (from 23 to 26 January 2018 [www.nulistice.org.ls]) and two of the CRSES's staff submitted papers for the symposium. Prof Mamphweli attended as an invited speaker, together with Prof van Niekerk. Prof Nawaz Mahomed will serve on a panel to review the Master of Science in Sustainable Energy programme that is offered by the NUL.

Namibian Electricity Control Board

The Namibian Electricity Control Board (ECB) contracted the Centre to conduct a study to assess the impact on grid integration of intermittent renewable energy and to develop and implement a plausible methodology to reliably quantify the optimal renewable energy capacity that can be integrated into the grid in the Namibian Electricity Supply Industry (ESI).

The scope of the research included the following:

- Assess the status quo with regard to the grid integration of intermittent renewable energy in Namibia and future projections.
- Investigate and present international best practices on the impact of grid integration of renewable energy and targets.
- Assess the current challenges of grid integration of renewable energy in the Namibian ESI.
- Assess the impact of grid integration of renewable energy in the Namibian ESI with reference to the following:
 - Determine technical impact, for example network stability, power quality and reliability.
 - Determine costs.
 - Determine capacity limitations.
 - Determine and define renewable energy targets for Namibia.
 - Quantify the impact on regulation, load balancing and operating reserve requirements, taking Southern African Power Pool requirements into consideration.
 - Make recommendations on technical solutions for integrating large-scale renewable energy.
 - Conduct at least two stakeholder workshops as part of the necessary stakeholder engagement through a consultative process.

As part of the project, Mr Kavepurwa Kavetuna of the Namibian ECB spent two weeks at the Centre being trained in a number of skills on various technical programmes. A bi-weekly Skype training session also took place and was facilitated by Ulrich Terblanche and Ndamulelo Mararakanye.

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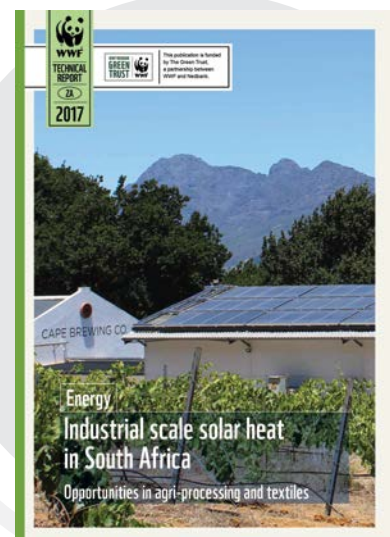
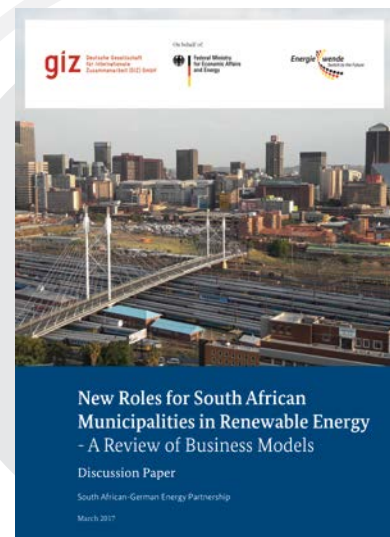
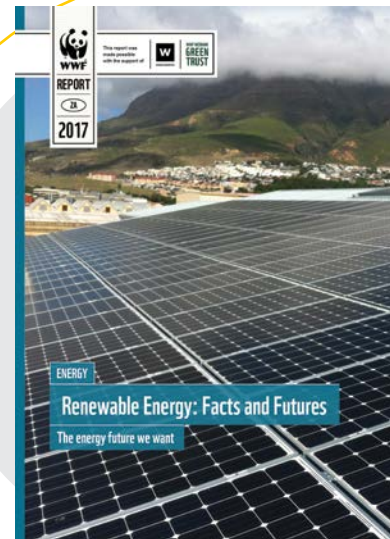
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FINANCIAL POSITION OF THE CENTRE

The Centre has three main sources of income: a core grant from the Department of Science and Technology, annual funding from Eskom, and income from research projects and short courses offered.

The CRSES receives an annual core grant from the Department of Science and Technology (DST) through a contract with the National Research Foundation (NRF). 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 2017, this grant came to R5,35 million, of which R3,05 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 R8,07 million was spent on the various academic and research activities of the Centre in 2017. An amount of R3,234 million was spent on bursaries for postgraduate students.

As the Specialisation Centre in Renewable Energy Technology for the Eskom Power Plant Engineering Institute (EPPEI) - Phase 2, the Centre hosts the Eskom Chair in Power System Simulation and receives annual funding from Eskom. The contribution from Eskom for 2017 was R4,18 million. An amount of R545 853 was spent on bursaries for postgraduate students and R597 012 was spent on salaries for the Chair and an administrative assistant.

“With more than R7 million in reserves, the Centre is in a favourable financial position for 2018.”

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.

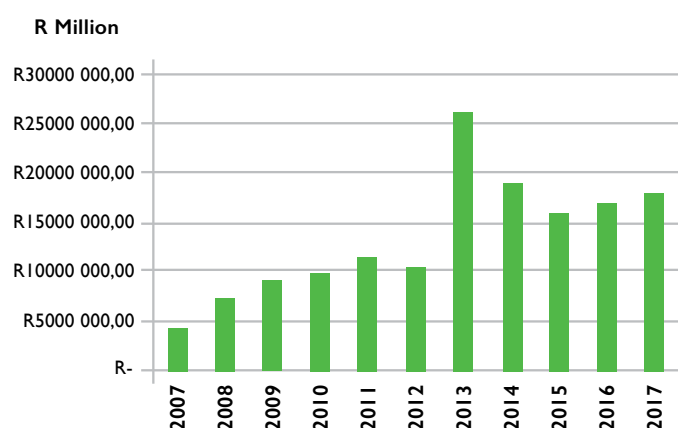
The comprehensive income statement of the Centre for all the cost points, including the Eskom EPPEI and project funds, is included on pages 18 and 19. The overall income of the Centre until 31 December 2017 was R18,004 million, 5.9% up from 2016, while the total expenditure increased to R14,981 million, up from R12,826 million in 2016. The total actual funding available at the end of December 2017 was R7 752 651, as can be seen in the table below.

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. This trend has reversed and income to the Centre increased in 2016 and 2017. With more than R7 million in reserves, the Centre is in a favourable financial position for 2018. It is however anticipated that the current financial constraints within Eskom 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 2016 (12 months) (R)	31 Dec 2017 (12 months) (R)
Total income to date	R16 994 412.75	R18 004 489.13
Total expenditure to date	R12 826 766.65	R14 981 741.0
Total transfers	R2 866 578.42	R2 820 159.49
Total equipment acquisitions	R 737 786.23	R607 133.29
Total post-graduate bursaries	R2 866 578.42	R3 234 950.4
Net surplus for period	R1 282 468.05	R 202 588.63
Accumulated funds from previous year	R7 448 138.35	R8 730 606.40
Debtors control account	R1 109 222.00	R1 216 078.87
Funds available 31 December	R7 736 727.03	R7 752 651.30

Annual income of the Centre



STATEMENT OF INCOME AND EXPENDITURE

Until December 2017

For the period ending :	31/12/2017	31/12/2016
TOTAL INCOME	-18 004 489.13	-16 994 412.75
CONFERENCE/CONGRESS (NO VAT)	-74 064.20	-86 038.36
CONTRACT RESEARCH (TAXABLE)	-1 729 422.00	-1 055 686.21
DONATION: SPECIAL PURPOSES	-60 000.00	0.00
INCOME FOREIGN EXEMPT	-148 035.00	0.00
INCOME: BURSARY	0.00	-106 250.00
INCOME: FOREIGN_ZERO RATE	-3 035 376.98	-840 897.65
INCOME: NRF APPORTIONED	-5 350 000.00	-5 165 667.00
INCOME: SUBSIDY GENERAL	0.00	0.03
INCOME: SUNDRY TAXABLE	-2 485 710.27	-2 001 562.00
INTEREST RECEIVE: INTERNAL ALL	-510 868.49	-725 916.94
PROFIT/LOSS: EXCHANGE RATE DEB	-232.71	-2 220.26
PROFIT: EXCHANGE RATE FOREIGN	-279.48	8 565.03
SALES: TO INTERNAL ORG UNITS	-430 500.00	-158 510.00
SUNDRY INCOME: NON TAXABLE	-4 180 000.00	-6 860 229.39
TOTAL EXPENDITURE	14 981 741.01	12 826 766.65
CURRENT EXPENDITURE	26 704.50	32 611.39
ADVERTISEMENTS: GENERAL		
ADVERTISEMENTS: POSTS	144 058.57	0.00
AFFILIATION & REGISTRATION EXP	54 239.14	117 708.39
ANALYSIS SERVICES	4 708.00	0.00
BURSARY POSTGRADUATE	3 234 950.46	2 866 578.42
BURSARY UNDERGRADUATE	3 675.00	40 855.00
CELL PHONE AIRTIME	12 028.18	6 088.76
CELL PHONE RENT	1 864.96	2 812.00
CHEMICALS	0.00	-16.62
CLEANING COSTS - EXTERNAL FIRM	21 663.84	20 242.76
CLEANING MATERIALS	911.68	974.38
CLEARANCE FEE NON-CAPITAL	24 876.70	52 700.32
CLOTHING: OTHER	1 134.00	8 441.73
COMPUTER MATERIALS	51 277.24	3 636.21
CONSULTATION FEES	127 648.12	1 271 666.75
CONSUMABLE MATERIALS	3 264.39	32 971.67
COPY AND PRINTING	89 860.64	213 762.73
COURSES	15 290.00	50.00
CROCKERY	0.00	600.55
ELECTRONIC COMPONENTS	0.00	11 070.43
ENTERTAINMENT: GENERAL	66 780.15	115 716.92
FLOWERS (NOT GIFTS)	0.00	633.05
FOREIGN EXCHANGE LOSS	45 632.44	1 057.25
FUEL, OIL, LUBRICANTS	0.00	803.38
GENERAL VEHICLE EXPENDITURE	96 673.12	51 948.86
GIFTS	3 871.58	1 894.21
GLASS WARE	158.63	0.00
HANDBOOKS AND MANUALS	2 433.04	8 000.00
INS, LICENSES & 3RD PARTY	1 168.00	32 503.62
INTEREST PAID: INTERNAL APPOR	1 370.41	2 472.82
INTERNET NETWORK EMAIL LEVY	55 478.58	72 754.17
IP TRANSFER FEE	121 439.95	99 986.22
LEVY: ICRR (INDIRECT COST)	1 090 481.17	312 000.59
LEVY: SPACE AND FACILITY	589.55	0.00
MAINTENANCE BUIDINGS-STELLENBO	1 578.71	0.00
MAINTENANCE OF APPARATUS	1 242.27	116 390.40
MEDICAL EXPENSES	0.00	26.27
NON-CAPITALISED BOOKS	0.00	900.00

For the period ending :	31/12/2017	31/12/2016
PHOTOGRAPHIC EXPENDITURE	0.00	125.00
POSTAGE AND COURIER SERVICES	4 257.78	5 647.46
PRIZES AND MEDALS	5 500.00	5 500.00
REFRESHER COURSES AND SEMI	0.00	100.00
REFRESHMENTS: NON ACADEMIC	82 668.62	65 611.75
RESEARCH MATERIALS	35 952.00	0.00
SCW NON-CAPITALISED	16 050.00	11 712.66
SEED PLANTS TREES	0.00	1 022.65
SERVICES	1 343 425.85	320 269.57
SMALLER FURNITURE AND EQUIPMENT	4 203.78	9 629.41
SOFTWARE	35 317.92	14 850.00
SPONSORSHIP/DONATION OUT INSTI	0.00	7 000.00
STATIONERY	30 233.75	34 642.06
SUBSCRIPTION & MEMBERSHIP FEES	23 721.95	86 372.32
SUNDRY EXPENSES	0.00	15 200.00
TABLE & KITCHEN WARE	0.00	131.27
TELEPHONE: CALLS	8 601.31	9 860.75
TELEPHONE: RENT	15 877.21	18 384.05
TOTAL REMUNERATION	6 595 160.49	5 010 657.28
TRANSLATION AND EDITING	16 256.88	27 420.83
TRANSPORT COST	0.00	5 082.50
TRAVEL: ACCOMMODATION VISUM PA	236 553.89	269 261.20
TRAVEL: FOREIGN TRAVEL SUBSIST	250 981.40	207 901.10
TRAVEL: DAILY ALLOWANCE AIR CAR	396 042.81	363 475.74
TYRES	0.00	390.00
WORKSHOPS	97 957.06	98 890.19
ASSET TRANSACTIONS	-669 151.70	-292 801.88
ASSET SCRAPPING/TRANSFERS		
DEPRECIATION	1 199 460.60	1 138 119.59
INCOME: INTERNAL ASSETS	-746 289.60	-958 139.13
PROFIT/LOSS: ASSETS	84 772.70	112 821.42
ASSET PURCHASES	607 133.29	737 786.23
OPERATING (SURPLUS) / SHORTFALL FOR PERIOD	-3 022 748.12	-4 167 646.10
FUNDS TRANSFERS	2 820 159.49	2 885 178.05
TRANSFERS FROM	8 060 739.03	8 155 276.08
TRANSFERS TO	-5 240 579.54	-5 270 098.03
NET (SURPLUS) / SHORTFALL FOR THE PERIOD	-202 588.63	-1 282 468.05
Plus: ACCUM (FUNDS) / SHORTFALL ON 01/01/2017	-8 730 606.40	-7 448 138.35
ACCUM (FUNDS) / SHORTFALL ON 31/12/2017	-8 933 195.03	-8 730 606.40
Min: BALANCE SHEET ITEMS	1 180 543.73	993 879.37
DEBTORS CONTROL ACCOUNT	1 216 078.87	1 109 222.00
ICRR CONTROL	-35 535.14	-99 859.33
LOAN ACCOUNT BRIDGING FUNDS	0.00	0.00
SUNDRY CREDITORS	0.00	-15 483.30
FUNDS AVAILABLE ON 31/12/2017	-7 752 651.30	-7 736 727.03



F Majiet
Director: Financial Services

STAFF



Prof Wikus van Niekerk
Director (until 30 June 2017)



Prof Sampson Mamphweli
Director (from 1 July 2017)



Prof Alan Brent
Associate Director (until 30 June)



Dr Bernard Bekker
Associate Director (from 1 July)



Prof Nawaz Mahomed
Associate Professor



Mr Ulrich Terblanche
Research Engineer



Ms Karin Kritzinger
Researcher



Ms Therese Lambrechts
Schools' Programme Manager



Mr Angelo Buckley
Research Engineer



Mr Ndamulelo Mararakanye
Research Engineer



Mr Jason Fairhurst
Research Engineer



Mr Donald Fitzgerald
Intern



Ms Ntombi Nqandela
Intern



Mr Tshepo Gaonnwe
Intern



Ms Jos Liebenberg
Administrative & Financial Officer



Ms Carla Nel
Marketing and Course Coordinator



Ms Sandy Heydenrycht
Receptionist

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 XI, 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

www.crses.sun.ac.za

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