



CENTRE FOR RENEWABLE AND SUSTAINABLE ENERGY STUDIES

Annual Report 2009

**National Hub for the Postgraduate Programme in
Renewable and Sustainable Energy Studies**

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**March 2010
Prepared for: SANERI**



Centre for Renewable and
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Executive Summary

This report provides an overview of the activities, for the 2009 academic year, of the Centre for Renewable and Sustainable Energy Studies (CRSES), which is responsible for the Postgraduate Programme in Renewable and Sustainable Energy Studies, and is coordinated from Stellenbosch University. The academic programmes commenced in February 2007 with two coursework master degrees and other existing research masters' and doctoral programmes; in 2008 this was extended by another coursework masters degree. Forty-five students received bursaries from the Centre for the 2009 academic year while studying at seven different universities. Twenty two bursary students completed their masters degrees in 2009 and early 2010, as well as the first PhD. Eight postgraduate modules were presented and a number of projects were successfully completed. Five forums covering various topics on renewable and sustainable energy were held, growing in popularity and attendance. Three spokes were identified and recommended for support to SANERI in 2007. Unfortunately the funding of these spokes remained small in 2009. The total expenditure of the SANERI funds in 2009 was R 6 047 559.30 with a surplus in the account at the end of the year of R 1 699 342. SANERI paid a total amount of R 6 146 500 to the Centre. A surplus of only R 71 940.70 or just more than 1% was realised on the approved budget from SANERI. The total income of the Centre grew by 21% to R 8 963 988.79 while expenditure rose to R 6 595 362.13. The total reserves in the Centre at the end of 2009 was R 4 131 511.24. Of the forty-five students that received bursaries in 2009 30% were black and 24% female. These fall short of the original targets of 85% black and 45% female students. A number of steps were put in place to address this shortfall from 2010 onwards.

The Centre is well positioned to continue with the programmes and projects in 2010 with dedicated staff, motivated students and a supportive University Management.

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1. Introduction

The South African National Energy Research Institute (SANERI), a division of the Central Energy Fund (CEF), awarded Stellenbosch University in 2006 the responsibility to act as the national hub of a Postgraduate Programme in Renewable and Sustainable Energy (RSE) Studies. The Programme model described in the original call for proposals was that of a hub that will be supplemented by a number of spokes in different fields of renewable and sustainable energy. The official launch of the Programme took place on Thursday 3rd August 2006 with the signing of the contract between Stellenbosch University and SANERI. The overall objective of this initiative is to develop and enhance national capacity in renewable and sustainable energy in support of accelerated and shared economic growth. This objective is to be achieved by building human resource capacity, creating and disseminating knowledge, and finally by stimulating innovation and enterprise in the field of renewable and sustainable energy.

The primary objective of the Postgraduate Programme in Renewable and Sustainable Energy Studies at the University 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 implement appropriate technology for using renewable energy in a sustainable manner on the other. The academic programme started in February 2007 with thirty students enrolled on the coursework masters degrees and various research degrees. In the 2009 academic year eight postgraduate modules were presented, starting with general modules on renewable energy technology and policies and specialised modules on solar and bio-energy as well as a module on biomass production. A total of forty-five students received bursaries from SANERI via the Programme while studying at seven different universities in South Africa in 2009.

The Centre for Renewable and Sustainable Energy Studies (CRSES) at Stellenbosch University was established in 2007 to implement the intent of the contract between Stellenbosch University and SANERI and to manage this Programme. The Director of the Centre is Prof Wikus van Niekerk and the Associate Director, from the 1st of September 2009, is Prof Alan Brent. The Centre is currently involved in a variety of renewable energy projects, from the feasibility study of using renewable energy to power new housing developments in the Eastern Cape to projects investigating the feasibility of large-scale concentrating solar power plants as well as the measurement of the available solar resource. A number of these projects were feasibility studies as well as technology reviews on the use of renewable energy for a variety of clients.

This is the fourth annual report of the Centre and spans the period 1 January to 31 December 2009. It represents the third full academic year that the Programme has been in place. In this report the various activities of the Centre are presented, some of the challenges are highlighted, and the financial statements of the period 1 January to 31 December 2009 presented.

2. Academic Programmes

The academic programmes coordinated by the Centre currently consist of three coursework masters' degree programmes and a variety of research masters' and doctoral degrees. The coursework masters' degrees are presented at Stellenbosch University, one in the Department of Mechanical and Mechatronic Engineering as an M.Eng. in Mechanical Engineering with an emphasis on RSE, one in the School of Public Management and Planning as a B.Phil./M.Phil. programme in Sustainable Development, with an option to specialise in RSE, and the third an M.For. degree in the Department of Forest and Wood Science in the AgriScience Faculty. More information on the structure of the M.Eng. and B.Phil./M.Phil. programmes can be found in Appendix B and at the following website:

http://academic.sun.ac.za/crses/html/postgraduate_program.htm .

The research masters' and doctoral degrees are available at various academic departments at Stellenbosch University and also other universities, in particular the University of Cape Town, University of Pretoria, North West University, University of KwaZulu Natal, Fort Hare University and



Nelson Mandela Metropolitan University. Students enrol for the research degree in the relevant academic department and work in that research group while completing their studies. A list of research projects available at the various institutions cooperating with the Centre can be found at: http://academic.sun.ac.za/crses/html/research_topics.htm

The students that are enrolled for the three coursework master degrees, as well as some of the research students, meet in a number of renewable and sustainable energy (RSE) postgraduate modules that are presented in a transdisciplinary manner at the Sustainability Institute, which is situated at Lynedoch outside Stellenbosch. These modules are presented in a modular format where the students are required to do some preparatory reading, attend a week of contact, consisting of a five and half days at Lynedoch, and then they have to complete a number of individual assignments and projects. During the week of contact students participate in lectures, tutorials, group discussions, projects and some site visits. In 2009 eight modules were presented and the numbers of students who attended are listed in Table 1.

Most of the modules are also registered with the Engineering Council of South Africa (ECSA) so that executive students who attend these courses will receive recognition towards their required continuous professional development (CPD points). The modules were also attended by some of the research students as well as staff members involved with the programme to improve their background learning and understanding of RSE.

Table 1: Attendance of RSE Modules for 2009

<u>Module</u>	<u>Presenters</u>	<u>Total</u>	<u>Coursework</u>	<u>Research</u>	<u>Executive</u>
Renewable Energy Systems	Dr Ben Sebitosi & Riaan Meyer	29	28	0	1
Energy Efficient Cities	Dr Daniel Irurah	21	21	0	0
Renewable Energy Policy	Prof Alan Brent	28	24	0	4
Conventional Energy Systems	Dr Matt Heun & Richard Haines	14	13	1	0
Solar energy	Dr Ben Sebitosi & Riaan Meyer	17	11	1	5
Sustainable Biomass Production	Dr Bruce Talbot	2	2	0	0
Sustainable Land Use	Cori Ham	12	10	1	1
Bio-Energy	Prof Johann Görgens & Team	17	9	5	3
Wind & Hydro	Dr Matt Heun & Francis Jackson	15	9	4	2

From Table 1 it can be seen than some of the courses had a very small number of students enrolled. This was discussed in a Feedback Session in December 2009. One possibility that is currently being explored is to refocus the Sustainable Biomass Production module as a Bio-Energy I module, with an emphasis on *sustainable biomass production*, while Bio-Energy will become Bio-Energy II focussing on the *conversion technologies from biomass to energy*. Due to the general downturn in the national economy fewer executive students also attended the modules. In 2010 the enrolment cost has been reduced from R 12 500/module to R 7 500/module to increase the number of executive students.

3. Students and Bursaries

In 2009 SANERI made an amount of R 2.6 million available for postgraduate bursaries. In addition the Centre made R 300 000 of the SANERI Core Grant and R 340 000 from the reserves available so that the total available support for students came to R 3 240 000.

- In total 45 students at seven different universities in South Africa of whom 14 (30%) are black and 11 (24%) female received bursaries from the Centre in 2009.
- Most students progressed well and a 11 Masters' students graduated in December 2009 with another 11 Masters and one doctoral student expected to graduate in March/April 2010.
- In 2009 an amount of R 2 250 000 was paid to continuing students and R 990 000 to new students.
- An amount of R 140 000 was paid to new bursary students to acquire laptop computers.
- A post-doctoral researcher was partially supported by the Centre to supplement a grant of R 150 000 from SANERI.

4. Projects

A number of projects were completed in 2009. The tables below indicate the scope of the completed, continuing and new projects.

<u>Project Description</u>	<u>Client</u>	<u>Amount</u>
Feasibility study to use biomass to power 1 200 houses	Spier	R 80 000
Feasibility study of RE in Free State agriculture	Free State Provincial Government	R 400 000
Feasibility study for new housing project using RE	BCRDA (Somerset East)	R 274 000
Facilitating wind farm development	Windlab Systems	R 25 000
Variety of smaller projects	Various	R 50 000

- The following major projects started in 2008 or 2009 and continued into 2010:

<u>Project Description</u>	<u>Client</u>	<u>Amount</u>
Solar and wind resource mapping and training	UNEP	R 1 550 000
SWH testing and training	Austrian Development Agency	R 850 000
MeerKAT and SKA Solar Energy Study (with Hatch Africa)	DST and SKA Project Office	R 1 300 000
Solar energy study, roadmap and business plan	CSIR (DST)	R 200 000
Assessment of wave energy converted	WAG	R 171 000
Solar resource measurements	Exxaro	R 575 000

- The following projects were initiated in 2009 are still being negotiated:

<u>Project Description</u>	<u>Client</u>	<u>Amount</u>
Solar Energy in the Northern Cape and a MeerKAT CSP plant	German Development Bank (kFw)	R 55 000 000
Klipheuwel Research, Development and Training Facility	Eskom/DoE/Vestas/Suzlon/UCT/CPUT	R 50 000 000
Solar resource measurements	Group5, TWP, Lereko Energy	3x R 600 000

On these projects both staff of the Centre as well as other expert consultants in the University and private industry combined to form strong, multi-disciplinary project teams to execute the technical work. A number of international partners also contacted the Centre to discuss cooperation; examples are the GTZ and the German Development Bank who are interested to partner with the Centre on wind and CSP projects.

The projects undertaken by the Centre range from initial feasibility studies for the deployment of renewable energy to highly technical studies on specific technologies. The Centre is also regularly requested to assess the ideas of individual entrepreneurs that are referred to the Centre by

SANERI and others; however, to date no idea has been identified that can be pursued to commercialisation. Nevertheless, a register of these ideas and the responses of the Centre are now kept as requested by SANERI and DST.

Research work on the Stellenbosch Wave Energy Converter is continuing with funds allocated by the University. In 2008 a new patent application was submitted. This patent extends the application of the original Stellenbosch Wave Energy Converter, or SWEC, to a shore-based unit.

5. Forums and Awareness Programmes

In order to fulfil the public awareness mandate of the Programme a number of RSE forums were held during the course of 2009. These events were very successful and well attended, as usual. Most of the forums also received additional coverage in the print and radio media. The topics and attendance of the forums are listed in Table 2.

Table 2: Attendance of RSE Forums in 2009

<u>Topic</u>	Solar and Wind Energy Resource Mapping	Green Campuses	Green Energy for SA Cities	Sustainable Cities	Financing of Renewable Energy Projects in SA
<u>Attendees</u>	80	65	59	40	104

The format of these forums is that two independent experts are invited to introduce the topic, typically twenty minutes each, and then the floor is opened for a general debate between the members of the audience with additional inputs from the experts. Afterwards a small reception is held for additional informal discussions between the participants. This format proved to be popular and successful and will continue in 2010; topics considered include bio-diesel from algae, carbon trading, sustainable architecture and grid capacity to accommodate electricity from renewable sources.

In addition to the forums a school outreach project was initiated in 2008. Therese Lambrecht, an experienced project manager with a passion for climate change and renewable energy, developed material on climate change and renewable energy suitable for grades 6-9. The material now consists of a video, PowerPoint presentation and a workbook. During 2009 thirty sets of the material were distributed to twenty-one schools in the Winelands area. A workshop to introduce the material was held in June 2009 and twenty-eight educators attended. Roll-out and feedback of the material will be monitored in 2010.

Four general lectures on Renewable Energy were presented at a SAIMEchE branch meeting in the Western Cape, the AMU Conference in Port Elizabeth, the Franschoek Club and the Stellenbosch Rotary Club. Staff from the Centre participated in the National Renewable Energy Summit, SWH summit, WWF/CRSES CSP Workshop and other national events.

The flagship renewable energy event in South Africa was the ISES Solar World Congress in Sandton in October 2009. Stellenbosch University participated *en masse* in this event and nine papers from Stellenbosch University were presented at this international event and in addition four faculty members, a post doc, two engineers and four students attended the event. Four sessions were chaired by staff from Stellenbosch University.

The Director attended the European Wave and Tidal Energy Conference in Uppsala, Sweden, which was combined with a visit to wave energy companies in Scotland. As part of the UNEP project a visit to Paris was combined with other visits in Germany, notably the DLR, the Fraunhofer Institute for Solar Energy and the Jülich Solar Institute.

6. Spokes and Partnerships

The proposed model for the Programme was that of a hub complemented with spokes. Spokes focus on a particular technology, e.g. solar energy, wind energy, etc. A process was undertaken in 2007 where calls were solicited from a number of universities and these were then evaluated by the Management Board of the Programme. The following three spoke applications were recommended to SANERI:

- *Photovoltaic Research and Teaching* from NMMU and University of Fort Hare
- *Solar Thermal Power Generation* from Stellenbosch University and University of Pretoria
- *Technologies for Wind Energy* from University of Cape Town and Stellenbosch University

SANERI was only able to provide very limited funding in 2009 and also only at a very late stage in the academic year for these activities. This resulted in a significant scaling-down of the proposed activities. There is no clarity on the future funding of the spokes and at present no new spokes are being developed. However, relationships with spokes are well established and remain healthy. If sufficient funding for the spokes will become available they will be able to contribute to RSE research.

The Centre was instrumental to negotiate a five-year, R 3 million grant from Sasol to support a senior researcher in solar thermal energy in the Department of Mechanical & Mechatronic Engineering. This was in part possible due to an allocation of R 4 million by Stellenbosch University from their strategic funds to promote solar thermal energy research.

7. Staff

There were a number of staff changes in the Centre in 2009. Dr Ben Sebitosi, previously at UCT, was appointed from 1 January 2009 as a senior lecturer in the Department of Mechanical & Mechatronic engineering as one of the two academic positions sponsored by the SANERI grant. Prof Alan Brent has been appointed as professor in the School of Public Management and Planning and Associate Director of the Centre from 1 September 2009. Graham Gariseb completed his BTech degree, with distinction, at the end of 2009 and has left his part-time appointment at the Centre to continue with his full-time MTech studies at the CPUT.

The complete, full-time staff complement at the end of 2009 is shown in Table 3.

Table 3: Full-time staff complement

<u>Position</u>	<u>Incumbent</u>
Director (80% appointment)	Prof Wikus van Niekerk
Associate Director and Professor in the SOPMP	Prof Alan Brent (Appointed from 1 September 2009)
Senior Lecturer (M&M)	Dr Ben Sebitosi (Appointed from 1 January 2009)
Research Engineer	Mr Riaan Meyer
Research Engineer	Mr Duncan Palmer
Admin/Finance Officer	Ms Jos Liebenberg

8. Financial Reporting

In 2009 SANERI transferred R 6 146 500 to Stellenbosch University to support the Programme. These funds are all held in a separate account, cost point **11550**, to ensure easy auditing of how these funds were applied by the Centre according to the approved budget. In addition to the

SANERI payments interest to the value of R 76 789.73 accrued in this cost point as well as repayments of bursaries of R 99 396.68, to bring the total income for 2009 to R 6 331 322.13.

Table 4 lists the income into cost point 11550.

Table 4: Income received in SANERI cost point 11550 for 2009

		<u>Budgeted</u>	<u>Actual</u>
SANERI:		<u>R 6 146 500</u>	<u>R 6 146 500.00</u>
	Core Grant	R 3 536 500	R 3 546 500.00
	Bursaries	R 2 600 000	R 2 600 000.00
Other:		<u>R 0</u>	<u>R 183 822.13</u>
	Interest		R 76 789.73
	Diverse Income		R 8 635.72
	Income: Bursary repayments		R 99 396.68
	Total for 2009	<u>R 6 146 500.00</u>	<u>R 6 331 322.13</u>

The budgeted and actual expenses of the funding received from SANERI in 2009 are reflected in Table 5.

The major variances in the actual expenditure from the budgeted amounts were running and capital expenses. Under running expenses the major over-expenditure was for internet usage that increased from R 5 818.18 in 2008 to R 23 134.27 and conferences and workshops where the attendance of Centre staff and students of the Solar world Congress in Sandton made out a major portion of the R 63 868.39 variance. Under capital expenses there were only budgeted for ten students' laptops, namely R 100 000, but eventually fourteen new students received bursaries, hence an overrun of R 40 000.

Although the amount budgeted for academic expenses was reduced from 2008 to 2009 only R 2 504.45 of this was utilised, mainly because most of the library material required by the students was still purchased from the University Library's own budget and the required material for the courses are paid by the academic departments who in turn recovers it from the students.

In total R 6 047 559.30 of the R 6 146 500 received from SANERI was spent in 2009; of this R 71 940.70 or just more than 1% was not applied towards the expenses of the Programme and accrued in the reserves of the Centre. The reserve at the end of the year in this cost point came to R 1 699 343.33. These funds are kept in reserves to make provision for late payments from SANERI, as happened in 2009, as well as to support the continuing bursary students should the SANERI/DST funding be terminated at any stage.

In addition to the SANERI funding other sources of funding were also developed in 2009. The one week of contact of the RSE modules at Lynedoch are made available as short courses to industry. In 2009 fourteen executive students attended the various modules generating a net income of R 124 152.93. These funds are kept in a separate cost point, R1111, and the available funds in this cost point at the end of 2009 was R 413 378. The turnover of projects in 2009 grew to approximately R 2.2 million in 2009. The total reserves in the Centre, excluding the reserves in the SANERI cost point (11550) at the end of 2009, was R 2 432 168.

Audited financial statements are included in Appendix C. The first set is the consolidated income and expenditure for all the accounts (cost points) of the Centre. The second set represents only that of cost point 11550, the cost point in which all the SANERI funding are received and disbursed.

The premises at Lynedoch, consisting of a general office, a student office and a classroom, used by the staff and students of the Centre based at Lynedoch, as well as the students during the presentation of the modules, are sponsored by an annual grant of R 100 000 from the Spier Group. This three year grant came to an end in December 2009 and the floor space available to the

Centre at Lynedoch has been significantly reduced. The Centre has no financial commitment towards rent at Lynedoch.

The approved budget for 2010 requires a contribution from SANERI of R 6 329 800, R 3 829 800 for the core grant and R 2.5 million for bursaries. The complete budget for 2010 is shown in Appendix D.



Table 5: Expenditure for 2009 from SANERI Grant

		Budgeted	Actual	Variance
1. Staff		R 2 490 000.00	R 2 250 204.82	R 239 795.18
	Centre Staff Cost	R 2 490 000.00	R 2 250 204.82	
2. Running Expenses		R 433 000.00	R 516 102.84	-R 83 102.84
	Telephone, fax and internet	R 33 000.00	R 64 464.89	R -31 464.89
	Stationary and printing	R 20 000.00	R 21 072.32	R -1 072.32
	Travel (Staff Members)	R 60 000.00	R 88 696.47	R -28 696.47
	Travel (Students, Visiting Academics)	R 40 000.00	R 9 032.88	R 30 967.12
	Advertisements (including Web)	R 150 000.00	R 115 020.55	R 34 979.45
	Website development & maintenance		R 6 833.00	R -6 833.00
	Conferences and workshops	R 70 000.00	R 133 868.39	R -63 868.39
	Community Projects	R 60 000.00	R 62 305.00	R -2 305.00
3. Academic Expenses		R 70 000.00	R 2 504.45	R 67 495.55
	Textbooks,	R 0.00	R 0.00	R 0.00
	Teaching material & notes	R 70 000.00	R 2 504.45	R 67 495.55
4. Capital Expenses		R 140 000.00	R 168 272.70	-R 28 272.70
	Office furniture and equipment	R 10 000.00	R 6 233.02	R 3 766.98
	Classroom furniture	R 10 000.00	R 0.00	R 10 000.00
	Computers (Staff)	R 20 000.00	R 22 039.68	-R 2 039.68
	Computers (Students)	R 100 000.00	R 140 000.00	-R 40 000.00
	Facilities Renovation & Maintenance			
5. Contingency		R 413 500.00	R 300 00 0.0	R 113 500.00
	5% Contingency of total amount	R 113 500.00	R 0.00	R 113 500
	Add Bursaries for 2009	R 300 000.00	R 300 000.00	R 0.00
Total for 2009 (Core SANERI Grant)		R 3 546 500.00	R 3 237 084.81	R 309 415.19
7. Bursaries		R 2 600 000.00	R 2 837 474.49	R 237 474.49
	Bursaries (from Saner)	R 2 600 000.00	R 2 600 000.00	
	From CRSES Reserves		R 237 474.49	
	Total SANERI Grant for 2009	R 6 146 500.00	R 6 047 559.30	R 71 940.70

9. Equity Targets

In the Agreement signed between SANERI and Stellenbosch University the following equity targets were set for the students funded with bursaries over the entire five year initial term:

- Black (including Indian and Coloured persons): 85%
- Female: 45%

In Section 3 it was reported that these targets have not been met. The following actions were taken to meet these very ambitious targets:

- Advertisements were placed in publications that are widely read in the targeted communities such as the Sunday Times.
- All suitable black candidates were carefully listed and followed-up to ensure that they apply for the available bursaries.

In selecting the successful candidates for the bursaries the following criteria was used to allocate priority to certain candidates:

Equity		Excellence	
Black Female	3 points	Distinction (75% +)	3 points
Black Male	2 points	Very good (65% to 75%)	2 points
White Female	2 points	Good (55% to 65%)	1 point
White Male	1 point	Poor (less than 55%)	0 points

The two points were added and all candidates with a total of 4 or more points were awarded a bursary in 2009. In addition some candidates with 3 points were awarded with bursaries. The successful candidates are listed in Appendix A. The demographics of all the students who received bursaries in 2009 are as follows:

White: 64%	Male: 74%
Black: 36%	Female: 26%

It is clear that the targets of 85% Black and 45% Female will be a challenge to meet. The current strategy, which included personal contact and advertisements in national newspapers, which are widely read in the black community, led to an improvement in the number of new black students to 36% for 2009; however, the participation of females declined to below 30%. It is clear that the largest constraint on meeting these targets is the demographic profile of the target market; black and female students with a suitable bachelors or honours degree. It is well known that the numbers of black students who participate in tertiary education programmes are still very small, and well below these demographic targets. What is even more problematic is that this programme is a postgraduate programme and that there are very attractive employment opportunities for black graduates in South Africa, mainly driven by the skills shortage and employers trying to meet their own equity targets, which makes it even more difficult to attract black students into the programme.

10. Conclusions

A number of objectives were met in the third academic year of the programme:

- The basic academic, administrative and financial structures were strengthened to execute the contract between Stellenbosch University and SANERI.
- During 2009 forty-five students were supported with bursaries at seven different universities in South Africa.



- Eleven students received their masters' degrees in 2009 with another eleven expected to graduate in March/April 2010. The first doctoral student will also graduate in March when she receives her PhD.
- Five Discussion Forums on Renewable and Sustainable Energy topics were organised and well attended.
- A number of new projects in the field of renewable energy were undertaken.
- The Centre established itself as a national resource for information on renewable energy.

All this was achieved while still realising a small surplus on the funding received from SANERI and establishing a significant reserve for the Centre.

There were also some challenges to deal with:

- Finding good students, especially Black students will remain a challenge for many years to come.
- The late payment of the SANERI funds in the second half of the year required Stellenbosch University to allow over-expenditure on the cost point.
- The future funding of the Centre by SANERI/DST will remain a concern until the next five year contract has been negotiated and signed.

We look forward to a challenging and exciting 2010!

APPENDIX A: List of 2009 Bursary Students

Nr	Title	Surname	Names	Dept	Supervisor
1	Mr	Diedericks	PhD	Process Eng	J Gorgens
2	Ms	Leibbrandt	PhD	Process Eng	J Gorgens
3	Mr	Mokheseng	MPhil	SOPMP	M Swilling
4	Mr	Gosa	MPhil	SOPMP	M Swilling
5	Mr	Du Toit	MPhil	SOPMP	M Swilling
6	Mr	Sibisi	MPhil	SOPMP	M Swilling
7	Ms	Lagrange	MPhil	SOPMP	Dr A Stamm
8	Mr	Rautenbach	MEng	Mechanical Engineering	JL v Niekerk
9	Mr	Joubert	MEng	Mechanical Engineering	JL v Niekerk
10	Mr	Malatji	MFor	Forrestry & Wood Science	M Meincken
11	Ms	Botman	MSc	Forrestry & Wood Science	B du Toit
12	Mr	Allen	MScEng	Mechanical Engineering	DG Kroger
13	Mr	Kotzé	MScEng	Mechanical Engineering	J vd Spuy / L Lorenzen
14	Mr	Prah	MScEng	Process Engineering	L Lorenzen/L Calanan
15	Mr	Hugo	MScEng	Process Engineering	H Knoetze / J Gorgens
16	Mr	Van der Merwe	MScEng	Process Engineering	H Knoetze / J Gorgens
17	Mr	Potgieter	MScEng	E & E Engineering	M Kamper
18	Mr	Stegmann	MScEng	E & E Engineering	M Kamper
19	Mr	Sager	MScEng - UCT	UCT - Electrical Engineering	A Khan
20	Mr	Morse	MScEng - UCT	UCT - Electrical Engineering	H Winkler
21	Ms	Caga	MSc - UFH	UFH - Chemistry Dept	E Meyer
22	Mr	Nongauza	Masters - NWU	North West University	S Marx
23	Mr	Nquma	Masters - NWU	North West University	S Marx
24	Mr	Olivier	PhD - UP	University of Pretoria	J Meyer
25	Mr	Garach	BEng(Hons)/MEng	University of Pretoria	J Meyer
26	Ms	Hallquist	BEng(Hons)/MEng	University of Pretoria	J Meyer
27	Mr	Ntuli	BEng(Hons)/MEng	University of Pretoria	J Meyer
28	Mr	Roux	BEng(Hons)/MEng	University of Pretoria	J Meyer
29	Ms	Smith	BEng(Hons)/MEng	University of Pretoria	J Meyer
30	Mr	Coetsee	BEng(Hons)/MEng	University of Pretoria	J Meyer
31	Mr	Suliman	BEng(Hons)/MEng	University of Pretoria	J Meyer
32	Mrs	Krintzinger	BPhil	SOPMP	M Swilling
33	Ms	Wassung	BPhil	SOPMP	M Swilling
34	Mr	Donkin	MEng	Mechanical Engineering	JL v Niekerk
35	Mr	Gerber	MScEng	Electrical & Electr	J Strauss



36	Mr	Bekker	MScEng	Electrical & Electr	J Vermeulen
37	Mr	Joubert	PhD	Mechanical Engineering	JL v Niekerk
38	Mr	Pierce	PhD	M&M	TW v Backström
39	Mr	Gijar	PhD	SOPMP	M Swilling
40	Mr	Wakeford	PhD	SOPMP	M Swilling
41	Ms	Waller	MSc- ERC, UCT	ERC	A Marquard
42	Mr	Mabizela	MSc - UFH	UFH - Chemistry Dept	E Meyer
43	Mr	Thantsha	PhD - NMMU	Physics	E van Dyk
44	Mr	Menzies	MCom	Economics	E v Dyk & S Hoskins
45	Mr	Mouzouris	MScEng	Mech Eng - KZN	M Brooks

The following bursary students graduated in 2008:

Ms L Beviss-Challinor with a MEng (*cum laude*) in Mechanical Engineering, graduation in March 2008
 Mr W Kruger with an MPhil, graduation in March 2008

Mr JH du Toit with a BPhil (*cum laude*), graduation in December 2008, continuing with his MPhil in 2009
 Ms G Smit with a BPhil (*cum laude*), graduation in March 2008, continuing with her MPhil in 2008,
 Ms K Moloto with a BPhil, graduation in March 2008, continuing with her MPhil in 2008

Mr James Joubert with an MScEng (*cum laude*) in Civil Engineering, graduation in March 2008, continuing with his PhD in 2009
 Mr R Solomon with an MScEng in Electrical Engineering, graduation April 2008
 Mr D Palmer with an MScEng in Process Engineering, graduation December 2008

The following bursary students graduated in 2009

Mr T Gosa with a BPhil, graduation in March 2009, continuing with his MPhil in 2009
 Ms C Lagrange with a BPhil (*cum laude*), graduation in March 2009, continuing with her MPhil in 2009
 Mr MB Mokheseng with a BPhil, graduation in March 2009, continuing with his MPhil in 2009
 Mr N Sibisi with a BPhil, graduation in March 2009, continuing with his MPhil in 2009

Mr M Maliage with a MEng in Mechanical Engineering, graduation in March 2009
 Mr K Rautenbach with a MEng in Mechanical Engineering in March 2009
 Ms G Smith with an MPhil (*cum laude*) in March 2009
 Mr R du Toit with an MPhil in March 2009

Mr J Heyns with an MScEng in Mechanical Engineering in March 2009
 Mr W Pierce with an MScEng in Mechanical Engineering in March 2009
 Ms E Viljoen with an MScEng in Process Engineering in March 2009

Mr DV Garach with a BEng(Hons) in April 2009, continuing with his MEng in 2009
 Ms M Hallquist with a BEng (Hons) in April 2009, continuing with her MEng in 2009
 Mr MPM Ntuli with a BEng(Hons) in April 2009, continuing with his MEng in 2009
 Mr SM Roux with a BEng(Hons) in April 2009, continuing with his MEng in 2009
 Ms L Smith with a BEng(Hons) in April 2009, continuing with her MEng in 2009
 Mr JAL Coetzee with a BEng(Hons) in April 2009, continuing with his MEng in 2009
 Mr R Suliman with a BEng(Hons) in April 2009, continuing with his MEng in 2009

Ms Refiloe Ntoi with a BPhil, graduation in December 2009
 Ms Natalie J Wassung with a BPhil (*cum laude*), graduation December 2009, continuing with her MPhil in 2010

Mr Pholoso Malatji with an MFor in Forestry, graduation in December 2009
 Ms Stella Maphiri with an MSc in Forestry in December 2009

Mr Warren Morse with an MScEng, graduation in December 2009

The following bursary students will graduate in March/APril 2010

Ms Karin Kritzinger with a BPhil (*cum laude*), graduation in March 2010, continuing with her MPhil in 2010

Mr Motala B Mokheseng with an MPhil (*cum laude*), graduation in March 2010

Ms Katlego Moloto with an MPhil, graduation in March 2010

Mr Richard Donkin with a MEng (*cum laude*) Mechanical Engineering, graduation in March 2010

Ms Ilse Botman with an MSc in Forestry, graduation in March 2010

Mr Paul H Ackerman with an MScEng in Mechanical Engineering, graduation March 2010

Mr Kenneth G Allan with an MScEng (*cum laude*) in Mechanical Engineering, graduation in March 2010, he will continue with his PhD in 2010

Mr Johannes P Kotze with an MScEng in Mechanical Engineering, graduation in March 2010, he will continue with his PhD in 2010

Mr Adriaan Lombard with an MScEng (*cum laude*) in Electrical and Electronic Engineering, graduation in March 2010

Mr John NF O'Kenny with an MScEng in Industrial Engineering, graduation March 2010

Mr Ebenezer Prah with an MScEng in Process Engineering, graduation in March 2010

Mr Abraham van der Merwe with an MScEng in Process Engineering, graduation in March 2010

Ms Nadia Leibbrandt with a PhD, graduation in March 2010



Appendix B: Coursework Masters Programmes

Postgraduate Programme in Renewable and Sustainable Energy Studies		
<p>M.Eng. (180 SAQA credits, 180 US credits) Coursework 90 Credits: (1 Math & 2 Mech Eng Modules (45 credits) 5 RSE Modules (75 credits) including Sustainable Development) Project 60 Credits</p>	<p><u>Coursework Masters Programmes</u></p>	<p>B.Phil. (120 US credits) M.Phil. (120 US credits) Coursework 120 Credits (8 Modules) (B.Phil.) Project 120 Credits (or 60 Credits and 4 additional Modules) (M.Phil.)</p>
<p>Engineering 15 Credits:</p> <ul style="list-style-type: none"> <u>Mathematics: One of Linear Algebra or Partial Differential Equations</u> <p>Take at least two more for M.Eng. from:</p> <ul style="list-style-type: none"> Conventional Energy Systems* Advanced Heat Transfer Advanced Fluid-Dynamics Computational Fluid Dynamics Industrial Heat Exchangers Advanced Dynamics Advanced Strength of Materials Air-conditioning and Refrigeration Finite Element Structural Analysis <p>Required module from Sustainable Development Programme:</p> <ul style="list-style-type: none"> <u>Sustainable Development (15 US credits)</u> <p><u>Underlined</u> courses are required.</p>	<p>Renewable & Sustainable Energy Modules (15 Credits): (Take at least 4 for M.Eng. and B.Phil.)</p> <ul style="list-style-type: none"> <u>Renewable Energy Systems</u> <u>Renewable Energy Policy</u> <u>Solar Energy (PV and Thermal)</u> <u>Bio-Energy</u> <u>Renewable Energy Finance</u> <u>Wind and Hydro Energy</u> <u>Sustainable Production of Biomass</u> <u>Sustainable Land Use</u> <p><u>Underlined</u> courses are required.</p>	<p>Sustainable Development and Planning Modules (15 Credits each):</p> <ul style="list-style-type: none"> <u>Sustainable Development</u> <u>Sustainable Cities</u> <p>(Take at least two more for B.Phil.)</p> <ul style="list-style-type: none"> Leadership and Ethics Globalisation, Governance and Civil Society Applied Economics Corporate Citizenship Complexity Theory and Systems Thinking Biodiversity and Sustainable Agriculture Ecological Design for Community Buildings <p><u>Underlined</u> courses are required.</p>
<p>Host Department: Department of Mechanical & Mechatronic Engineering</p>	<p>Host departments: Mechanical & Mechatronic Eng., School of Public Management and Planning, Process Engineering, Forest and Wood Science.</p>	<p>Host Department: School of Public Management and Planning</p>



Appendix C: Financial Statement, all cost points



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Statement of Income and Expenditure - 11550,11551,R1111 For the period ending :	31/12/2009	31/12/2008
TOTAL INCOME	-8 963 988.79	-7 381 552.15
CONFERENCE/CONGRESS (NO VAT)	-220 776.00	-185 500.00
INCOME: BURSARY	-174 396.68	-19 478.24
INCOME: FOREIGN_ZERO RATE	-1 066 901.08	-259 140.01
INTEREST RECVD - INTERNAL ALLO	-191 561.34	-327 996.63
PROFIT/LOSS: EXCHANGE RATE DEB	-1 156.59	-6 122.22
PROFIT: EXCHANGE RATE FOREIGN	-270.54	0.00
SALES TO INTERNAL ORG UNITS	0.00	-1 500.00
SUNDRY INTEREST RECEIVED	144.38	-6 547.32
SUNDRY INCOME: NON TAXABLE	-6 146 500.00	-5 644 351.80
SUNDRY INCOME: TAXABLE	-1 162 570.94	-930 915.93
TOTAL EXPENDITURE	6 595 362.13	5 993 192.12
CURRENT EXPENDITURE		
ADVERTISEMENTS: GENERAL	97 687.85	152 903.87
ADVERTISEMENTS: POSTS	38 258.65	30 000.00
AFFILIATION & REGISTRATION EXP	72 864.61	5 148.00
AUDIOVISUAL EXPENDITURE	0.00	320.00
BURSARY POST GRADUATE	3 633 974.49	2 806 100.00
BURSARY UNDERGRADUATE	0.00	2 000.00
CELL PHONE AIRTIME	4 202.29	726.05
CELL PHONE RENT	5 801.70	6 323.84
CLEANING MATERIALS	119.14	149.81
CLOTHING: OTHER	12 633.11	0.00
COMPUTER MATERIALS	5 495.26	13 379.25
CONSULTATION FEES	545 490.83	573 560.35
CONSUMABLE MATERIALS	3 001.68	6 872.97
COPY AND PRINTING	27 991.46	18 262.13
COURSES	4 162.45	2 660.00
ENTERTAINMENT: GENERAL	53 849.08	84 032.70
FLOWERS, WREATHS, GIFTS	6 294.61	7 360.80
FOREIGN EXCHANGE LOSS	9 568.53	1 917.31
FOREIGN TRAVEL & SUBSISTENCE	86 889.32	13 122.00
INTEREST PAID: INTERNAL APPOR	9 095.39	0.00
INTERNET NETWORK EMAIL LEVY	23 933.13	5 818.18
LCW NON-CAPITALISED	0.00	33 191.31
LEVY: SURCHARGE	16 230.00	18 810.00
MAINTENANCE OF APPARATUS EN/O	342.00	8 063.07
NON-CAPITALISED BOOKS	2 405.00	12 624.71
PHOTOGRAPHIC EXPENDITURE	0.00	52.63
POSTAGE STAMPS AND TELEGRAMS	2 080.75	2 390.20
PRIZES AND MEDALS	1 000.00	0.00
PROMOTION MATERIAL	10 326.70	0.00
RENT OF EQUIPMENT-GENERAL	0.00	5 000.00
RENT OF ROOMS	500.00	200.00
SERVICES	15 483.00	6 015.00
SMALLER FURNITURE AND EQUIPMEN	10 762.48	14 594.56
SOFTWARE	28 422.04	2 850.00
STATIONERY	18 812.35	12 425.11
SUBSCRIPTION: BOOKS & MAGAZINE	600.00	0.00
SUNDRY EXPENSES	11 668.75	15 661.85





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Statement of Income and Expenditure - 11550,11551,R1111

For the period ending :	31/12/2009	31/12/2008
TELEPHONE INSTALLATION COSTS	0.00	280.89
TELEPHONE: CALLS	10 916.75	11 755.28
TELEPHONE: RENT	20 409.88	18 842.10
TOTAL REMUNERATION	1 511 779.18	1 866 978.75
TRAVEL & SUBSISTENCE: DEPARTM	144 659.80	58 694.28
TRAVEL & SUBSISTENCE: NON TEAT	98 792.04	121 631.16
WORKSHOPS	19 710.00	9 930.00
ASSET TRANSACTIONS		
ASSET PURCHASES	29 147.83	42 543.96
OPERATING (SURPLUS) / SHORTFALL FOR PERIOD	-2 368 626.66	-1 388 360.03
FUNDS TRANSFERS	694 806.00	165 000.00
TRANSFERS FROM	698 511.00	165 000.00
TRANSFERS TO	-3 705.00	0.00
NET (SURPLUS) / SHORTFALL FOR THE PERIOD	-1 673 820.66	-1 223 360.03
Plus: ACCUM (FUNDS) / SHORTFALL ON 01/01/2009	-2 550 404.71	-1 327 044.68
ACCUM (FUNDS) / SHORTFALL ON 31/12/2009	-4 224 225.37	-2 550 404.71
Min: BALANCE SHEET ITEMS	92 714.13	215 174.02
CREDITOR PROVISION BALANCING	0.00	-2 736.00
DEB CONTR-DT SYSTEM	92 714.13	217 910.02
FUNDS AVAILABLE ON 31/12/2009	-4 131 511.24	-2 335 230.69

JW Roux
Senior Director: Finance & Asset Management



Statements for SANERI Funds (CP 11550)



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Statement of Income and Expenditure - Centre for Renewable & Sustainable Stud

For the period ending :

	31/12/2009	31/12/2008
TOTAL INCOME	-6 331 322.13	-5 944 078.95
INCOME: BURSARY	-99 396.68	-19 478.24
INTEREST RECVD - INTERNAL ALLO	-76 789.73	-278 946.28
PROFIT: EXCHANGE RATE FOREIGN	-76.66	0.00
SUNDRY INCOME: NON TAXABLE	-6 146 500.00	-5 644 351.80
SUNDRY INCOME: TAXABLE	-8 559.06	-1 302.63
TOTAL EXPENDITURE	5 474 565.85	5 201 895.42
CURRENT EXPENDITURE		
ADVERTISEMENTS: GENERAL	94 117.85	147 903.87
ADVERTISEMENTS: POSTS	38 258.65	30 000.00
AFFILIATION & REGISTRATION EXP	45 905.41	5 148.00
AUDIOVISUAL EXPENDITURE	0.00	320.00
BURSARY POST GRADUATE	3 358 474.49	2 762 500.00
CELL PHONE AIRTIME	4 202.29	726.05
CELL PHONE RENT	5 801.70	6 323.84
CLEANING MATERIALS	119.14	149.81
COMPUTER MATERIALS	5 390.87	13 089.81
CONSULTATION FEES	335 263.38	312 056.40
CONSUMABLE MATERIALS	391.55	2 007.28
COPY AND PRINTING	20 184.00	14 987.23
COURSES	4 162.45	2 660.00
ENTERTAINMENT: GENERAL	29 943.54	26 098.28
FLOWERS, WREATHS, GIFTS	3 387.95	5 940.80
FOREIGN EXCHANGE LOSS	214.86	0.00
FOREIGN TRAVEL & SUBSISTENCE	27 365.00	13 122.00
INTEREST PAID: INTERNAL APPOR	9 095.39	0.00
INTERNET NETWORK EMAIL LEVY	23 134.27	5 818.18
LCW NON-CAPITALISED	0.00	21 700.11
MAINTENANCE OF APPARATUS EN/O	342.00	8 063.07
NON-CAPITALISED BOOKS	1 569.00	12 523.16
POSTAGE STAMPS AND TELEGRAMS	325.16	1 988.16
PROMOTION MATERIAL	10 326.70	0.00
RENT OF ROOMS	500.00	200.00
SERVICES	15 483.00	6 015.00
SMALLER FURNITURE AND EQUIPMEN	6 967.04	12 994.56
SOFTWARE	0.00	1 350.00
STATIONERY	17 254.44	12 425.11
SUBSCRIPTION: BOOKS & MAGAZINE	600.00	0.00
SUNDRY EXPENSES	0.00	147.95
TELEPHONE INSTALLATION COSTS	0.00	280.89
TELEPHONE: CALLS	10 916.75	11 755.28
TELEPHONE: RENT	20 409.88	18 842.10
TOTAL REMUNERATION	1 247 092.61	1 606 935.15
TRAVEL & SUBSISTENCE: DEPARTM	94 616.91	40 595.18
TRAVEL & SUBSISTENCE: NON TEAT	11 321.04	49 086.19
WORKSHOPS	10 350.00	9 930.00
ASSET TRANSACTIONS		
ASSET PURCHASES	21 078.53	38 211.96





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Statement of Income and Expenditure - Centre for Renewable & Sustainable Stud	31/12/2009	31/12/2008
For the period ending :		
OPERATING (SURPLUS) / SHORTFALL FOR PERIOD	-856 756.28	-742 183.53
FUNDS TRANSFERS	698 511.00	165 000.00
TRANSFERS FROM	698 511.00	165 000.00
NET (SURPLUS) / SHORTFALL FOR THE PERIOD	-158 245.28	-577 183.53
Plus: ACCUM (FUNDS) / SHORTFALL ON 01/01/2009	-1 541 097.94	-963 914.41
ACCUM (FUNDS) / SHORTFALL ON 31/12/2009	-1 699 343.22	-1 541 097.94
Min: BALANCE SHEET ITEMS	0.00	-2 736.00
CREDITOR PROVISION BALANCING	0.00	-2 736.00
FUNDS AVAILABLE ON 31/12/2009	-1 699 343.22	-1 543 833.94

JW Roux
Senior Director: Finance & Asset Management



Appendix D: Approved Budget for 2010

		<u>2009</u>	<u>2010</u>
<u>Staffing</u>		R 2 490 000	R 3 092 800
	Core staff	R 1 418 000	R 1 652 800
	Academic staff	R 1 072 000	R 1 440 000
<u>Running Expenses</u>		R 433 000	R 482 000
	Tel, Fax and Internet	R 33 000	R 60 000
	Stationary & Printing	R 20 000	R 22 000
	Advertisement & Website	R 150 000	R 150 000
	Conferences & Workshops	R 70 000	R 70 000
	Travel (Staff)	R 60 000	R 70 000
	Travel (Students and Visiting Academics)	R 40 000	R 40 000
	Community Projects	R 60 000	R 70 000
<u>Academic Expenses</u>		R 70 000	R 45 000
	Teaching Material & Books	R 70 000	R 45 000
<u>Capital Expenses</u>		R 140 000	R 145 000
	Office Furniture	R 10 000	R 10 000
	Classroom Furniture	R 10 000	R 10 000
	Computer Equipment (Students)	R 100 000	R 100 000
	Computer Equipment (Staff)	R 20 000	R 25 000
<u>Bursaries</u>		R 300 000	R 0
	Additional Bursaries	R 300 000	R 0
<u>Contingency</u>		R 113 500	R 65 000
	5% of Total	R 113 500	R 65 000
	<u>Total SANERI Grant (Operating Budget)</u>	R 3 546 500	R 3 829 800
<u>Bursaries</u>			
	SANERI Bursary Grant	R 2 600 000	R 2 500 000
	From Core SANERI Grant	R 300 000	
	From CRSES Reserves	R 500 000	
	<u>Total Available for Bursaries</u>	R 3 400 000	R 2 500 000
	<u>GRAND TOTAL OF SANERI GRANT</u>	R 6 146 500	R 6 329 800



Appendix E: New bursary students for 2009

CRSES New Bursaries for 2010					
	Name	Initials	Degree	Male/Female	Equity group
Mr	Moody	MP	MPhil	M	Black
Mr	Robinson	PB	MPhil	M	White
Mr	Jackson	C	MPhil	M	White
Mr	Du Plessis	J	MScEng	M	White
Mr	Hoffman	U	MScEng	M	White
Mr	Schenke	C	PhD	M	White
Mr	Kotze	JP	PhD	M	White
Mr	Allan	KG	PhD	M	White
Mr	Malatji	P	PhD	M	Black
Ms	Bergh	C	MScEng - University of Cape Town	F	White
Ms	Tait	LM	MSc - University of Cape Town	F	White
Ms	Coppez	G	MScEng - University of Cape Town	F	White
Mr	Du Plessis	PC	MScEng - University of Cape Town	M	White
Ms	Trautmann	CK	MScEng - University of Cape Town	F	White
Ms	Alexander	TL	MSocScie - University of Cape Town	F	White
Ms	Crozier	JL	MSc - NMMU	F	White
Ms	Mutepe	RD	MScEng -North West University	F	Black
Mr	Baloyi	H	MSc - North West University	M	Black
Ms	Meintjies	MM	MEng - North West University	F	White
Ms	Nquma	TY	PhD- North West University	F	Black

} Stellenbosch University

Appendix F: Publication of students and staff associated with the Centre

2007

Proceedings

Griffen, Gaermo, The development of a biofuels evaluation laboratory (production and engine testing) with special emphasis on biodiesel. Research & Development Conference, Hotel School, Granger Bay, Cape Town, South Africa, Department of Chemical Engineering CAPUT 2007: 1.

Palmer, Duncan, The development of a biofuels evaluation laboratory (production and engine testing) with special emphasis on biodiesel. Research & Development Conference, Hotel School, Granger Bay, Cape Town, South Africa, Department of Chemical Engineering CAPUT 2007: 1.

2008

Proceedings

Joubert J.R., 2008, "An investigation of the wave energy resource off the South African southwest coast", 2nd IASTED African Conference on Power and Energy Systems (AfricaPES 2008)

Journal Articles

Rossouw, Francois, Analysis and performance of axial flux permanent-magnet machine with air-cored non overlapping concentrated stator windings. IEEE Transactions on Industry Applications 2008; **44**(5): 1495-1504.

2009

Proceedings

Joubert J.R. and Van Niekerk, J.L., 2009, "Recent developments in wave energy along the coast of southern Africa", European Wave & Tidal Energy Conference (EWTEC).

Kenneth Allen, Kröger, Detlev., Fluri, Tom., Thermal energy storage in a rock bed. ISES Solar World Congress 2009, Johannesburg, South Africa, ISES 2009: 864 -875

Maliage, Maurice, Stall Considerations in Solar Chimney, Turbines. ISES Solar World Congress 2009, Johannesburg, South Africa, ISES 2009: 1156-1165

Meyer, Riaan., Fluri, Tom., Palmer, Duncan., Solar, hydro and wind electricity generation potential of the Free State province, South Africa ISES Solar World Congress 2009, Johannesburg, South Africa, ISES 2009: 124-133

Palmer, Duncan., Meyer, Riaan., Preliminary study of a 1200 house off-grid development powered from biomass ISES Solar World Congress 2009, Johannesburg, South Africa, ISES 2009: 1049-1056

Pierce, Warrick., van Backström, Theo., Evaluation and performance prediction of a wind turbine blade, 2009, Laminar Separation Bubble Prediction with CFD. ISES Solar World Congress 2009, Johannesburg, South Africa, ISES 2009: 1057-1064

Journal Articles

Brent, Allen., Kruger, Wikus., Systems analyses and the sustainable transfer of renewable energy technologies: A focus on remote areas of Africa, Renewable Energy 34 (2009) 1774–1781.

Brent, Allen., Hietkamp, Sibbele., Wise, Russel., O’Kennedy, Kenny., Estimating the carbon emissions balance for South Africa, SAJEMS NS 12 (2009) No 3 pages 263 – 279

Barry, M.L., Steyn, H., Brent, Allen., Determining the most important factors for sustainable energy technology selection in Africa

Other:

Joubert J.R., 2009, Chapter entitled "Ocean wave energy", Energy Efficiency made Simple 2009.

