# The Department of Science & Technology (DST) Renewable & Sustainable Energy Scholarships Programme (RSES)

## Call for applications for 2013

# Information Manual

**Read this manual carefully before completing the online application form.**

*This manual has been compiled based on the relevant DST programmes as contained herein and all applications that are within the strategic focus areas within South African universities will be considered.*

Your application will however only be considered if you comply with the requirements as set out this manual

**Complete the application form which can be found at**

https://nrfsubmission.nrf.ac.za/

## 1. Background and introduction

The Department of Science and Technology (DST) previously provided funding to support human capital development for the renewable energy sector through the South African National Energy Research Institute (SANERI). In 2011 the DST decided to migrate this programme to the National Research Foundation (NRF).

This programme is now called the Renewable and Sustainable Energy Scholarships programme (RSES). The primary focus is to provide scholarship grants at Masters and PhD levels focusing on research studies that will support and facilitate the shift towards a sustainable energy sector.

In line with the draft DST energy research focal areas, the grants are offered to candidates that are focusing on the following focus areas:

- Cleaner fossil fuel development, including clean coal technologies;
- Renewable energy (bioenergy including bio-fuels, solar energy, wind energy, etc.);
- Energy impact on the environment;
- Energy for socio-economic development;
- Energy system planning and modelling; and
- Energy policy research.

The RSES Programme is meant to both support students that are in the DST-driven initiatives like the Renewable Energy Research Chairs, Renewable Energy Hub and Spokes, as well as those who may be studying towards the relevant qualifications in other universities within South Africa, particularly in the renewable and sustainable energy field.

The current DST energy research programmes are herewith mentioned below:

- Energy Research Chairs:
  - Research Chair in Biofuels and other clean alternative fuels (ligno-cellulose) at Stellenbosch University ;
  - Research Chair in Clean Coal technologies at the University of Witwatersrand; and

- Associate Research Chair in Biofuels and other clean alternative fuels at North West University
- The Renewable Energy Hub at the Stellenbosch University; and
- Energy Spokes Programme comprising:
  - Wind energy spoke ( Stellenbosch University and the University of Cape Town),
  - Solar photovoltaic (PV) spoke (Nelson Mandela Metropolitan University and University of Fort Hare), and
  - Solar thermal spoke (Stellenbosch University and the University of Pretoria).

The information in the manual has been limited to the above programmes because of the existing relationship, but future manuals containing human capital development grant funding will be more inclusive.

Funding is therefore made available for Masters and PhD postgraduate studies in 2013 at universities across South Africa which offer studies that will further the objectives of the renewable energy sector as listed herein.

## 2. Eligibility for Doctoral and Masters scholarships from the RSES Postgraduate Scholarship Programme

2.1. South African citizens and permanent residents of South Africa who wish to complete a Doctoral and Masters degree at a South African university. Please note that preference will be given to candidates from the designated groups, including female students.

2.2. These scholarships are available to university graduates with degrees in Engineering, Natural Science, AgriScience, Management Science, Law, Economics, and other related and relevant disciplines.

2.3. The relevant qualifications for eligibility are- Hons BSc, BSc Eng, BEng or MTech for Master's and MSc or MSc Eng for Doctoral degrees.

2.4. Scholarships are available for successful candidates studying on a full-time basis in the field of Renewable and Sustainable Energy.

2.5. Funding is available for study at any South African university. However, specific funding is available for the DST Energy Research Programmes at the Energy Chairs, Hub and Spokes, where both coursework and research Master's, as well as Doctoral degrees are

offered, are located at specific participating universities. These latter universities are Nelson Mandela Metropolitan, North West University, University of Cape Town, University of Fort Hare, University of KwaZulu-Natal, University of Pretoria, and the Stellenbosch University.

## 3. Research proposals and supervision

3.1. All Doctoral and Masters scholarship applicants who are registering for a research focussed degree **MUST** submit a research proposal. The exception would be for a taught degree.

3.2. Each research proposal must be endorsed by the supervisor responsible for the research and who is attached to the relevant university.

3.3. Applications submitted without a research proposal will **NOT** be considered for a scholarship.

3.4. **The research proposals must be written by the student, and NOT by the supervisor of the research**.

3.5. Refer to the research topics in Annexure A**.** Students must contact the supervisor of the project, to discuss with the supervisor their (the student's) eligibility for the research project. The student must submit their application with the endorsement of the supervisor (the supervisor must endorse the application by submitting a report online). The student will need to register with the university where the supervisor is based.

3.6. If a student wishes to undertake research that is not listed in Annexure A, he/she may submit a proposal, written by the student and with endorsement from the proposed supervisor, for consideration. However, please note that projects deemed to directly address critical aspects of research aligned to the renewable energy sector as listed in Annexure A will be given priority over those with a more generic scope.

## 4. Structure of the RSES Postgraduate Scholarships for 2013

4.1. Value of scholarship:

### i. Doctoral

| Item | Value |
|---|---|
| Scholarship Duration: | 3 years (subject to satisfactory progress) |
| Scholarship value | R 100 000.00 |
| Tuition Fees | Determined by institution |
| Registration fees | Determined by institution |
| Accommodation | R1700pm/10months (Feb-Nov) |
| Meals | R900pm/ 10 months (Feb-Nov) |
| Pocket money | R750pm/ 10 months (Feb-Nov) |
| Book Allowance | R5000 p.a. |
| Once-off computer allowance for students recruited at postgraduate level. | R7000 |

**NOTE:**

- **All funds are paid to the university for disbursement to the student between January and March of each year.**
- **The universities are expected to distribute funding under the same guidelines as stipulated with free standing NRF scholarships.**

### ii. Masters

| Item | Value |
|---|---|
| Scholarship Duration: | 2 years (subject to satisfactory progress) |
| Scholarship value | R 85 000.00 |
| Tuition Fees | Determined by institution |
| Registration fees | Determined by institution |
| Accommodation | R1700pm/10months (Feb-Nov) |
| Meals | R900pm/ 10 months (Feb-Nov) |
| Pocket money | R750pm/ 10 months (Feb-Nov) |
| Book Allowance | R5000 p.a. |
| Once-off computer allowance for students recruited at postgraduate level. | R7000 |

**NOTE:**

- **All funds are paid to the university for disbursement to the student between January and March of each year.**
- **The universities are expected to distribute funding under the same guidelines as stipulated with free standing NRF scholarships.**

**Additional discretionary items (Masters and PhD):**

- The programme has a limited budget for travel grants for both Masters and PhD students which may be paid for approved travel related to studies. This grant is focussed on international conferences where the student is invited to participate as opposed to just attending. The grant includes subsistence, accommodation, conference registration and travel expense. A motivation for travel must be provided at least two months before any trip is to be undertaken and a written report must be provided to the RSES Programme via the National Research Foundation (NRF) two weeks after returning from the trip.
- Please note that students must apply for these items separately and with supporting documentation and endorsements as required. The NRF may support these depending on the feasibility and strength of the application and available funding.

## 5. Conditions of RSES Scholarship Awards

*The following conditions are extracted from the RSES Scholarship Agreement to be signed by all successful applicant students and of which the full document shall represent the legal conditions of the award.*

5.1. The award of a RSES scholarship to a student will be based on past, current and potential academic performance. Selection criteria will include equity targets of the programme, academic merit, promise of research ability, leadership qualities and previous award of various prizes and honours.

5.2. In addition to the above criteria, the award of the RSES scholarship will be based on the feasibility and merit of the applicant's research project proposal.

5.3. Once a RSES scholarship is awarded, a change in course of study, or institution where the studies are to be undertaken, or a change of supervision, requires prior approval from the RSES Programme.

5.4. Continued funding is dependent on satisfactory performance determined through the submission of progress reports twice a year, as well as compliance with the overall conditions of the award.

5.5. Based on the assessment of your progress, the RSES Programme in its sole discretion may extend your scholarship for a period not exceeding one further year for MSc studies, and two further years for PhD studies (beyond the standard duration stipulated herein). **The standard period is two years for a Masters and three years for a Doctoral degree.**

5.6. Students who do not obtain the degree for which the scholarship was awarded, or relinquish their studies, or leave the tertiary institution during the period for which the scholarship was awarded, will have to refund all payments already received from the RSES Programme. The RSES Programme may waiver this condition at its sole discretion.

5.7. Students may be required to present their work at national or international conferences and/or symposia at the request of the RSES Programme.

5.8. Students will be required to present their work at the Bi-Annual Energy Postgraduate Scholarship Conference as organised by the RSES Programme.

5.9. Students are compelled to attend all Developmental Activities as arranged by the RSES Programme. These include (but are not limited to):

5.9.1. Bi-Annual Energy Postgraduate Scholarship Conference,

5.9.2. Annual Lifeskills Workshop

5.9.3. Other activities will be communicated to students, of which most are held over weekends or during vacations.

5.10. On completion of the studies supported by means of an RSES scholarship, students are required to submit proof of obtaining the degree concerned.

5.11. Students may, on the completion of their degrees, be requested to take up posts offered by the DST through the RSES Programme for a limited period, normally aligned to the duration of funding support.

5.12. Successful students who are offered the RSES Scholarship by the NRF are required to complete and sign the RSES Scholarship Agreement which will be communicated at the time of the Award.

5.13. A list of successful candidates will be published on the NRF website as soon as the internal NRF approval processes for the Award are finalised.

5.14. Students that are unsuccessful may enquire from the NRF through their postgraduate/research or financial aid office on how to improve their application in the next round.

5.15. Appeals, in the case of unsuccessful applicants, will only be considered in extremely exceptional cases that are motivated strongly and in detail and are considered warranted for appeal.

## 6. How to apply for funding

6.1. Applications must be submitted through an online application process to the National Research Foundation (NRF): https://nrfsubmission.nrf.ac.za/NrfMkII/

6.2. Register/ Login using your email address and password.

6.3. Select create new application from the list of existing calls.

6.4. Select the call for which you are applying to: RSES – Masters and Doctoral Scholarship

6.5. Select Apply now.

6.6. Complete all screens and sub- screens online for application summary, application and biographic information, research project information, supervisor and referees (please ensure you select the invite button after entering their details) and outputs.

6.7. Once complete click on the check completeness and submit form tab to check if all sections are complete.

6.8. Click on the submit application tab.

6.9. Your application will be directed to the NRF for further assessment and selection through a panel review process.

6.10. Successful applicants' will be notified through the university research office no later than 15 December 2012

6.11. **Online applications will be submitted via the Financial Aid / Research Office at the university where you intend registering for the degree, to reach the NRF by 15 October 2012. Please consult the university with regard to their internal closing dates, which will be prior to 31 October 2012.**

## Deadline for applications 31 October 2012

## 7. Contacts

Questions may be directed to Nozine Nqeketo at nozine.nqeketo@nrf.ac.za.

# ANNEXURE A - RSES FOCUS AREAS AND RESEARCH PROJECTS 2013

## 1. Focus Areas

i. Cleaner fossil fuel development, including clean coal technologies;
ii. Renewable energy (bioenergy including bio-fuels, solar energy, wind energy, etc.);
iii. Energy impact on the environment;
iv. Energy for socio-economic development;
v. Energy system planning and modelling; and
vi. Energy policy research.

## 2. Research Topics

***NOTE: It is advisable to make contact with the supervisor of the research topic BEFORE submitting your application.***

### i. Senior Chair of Energy Research (CoER): Biofuels & Other Clean Alternative Fuels ( Stellenbosch University)

| No. | Project Title | Project Description | Qualifications and Skills Required | Link to CoER Research Focus Area/s | Supervisor (and contact details) | University (at which research will be undertaken) |
|---|---|---|---|---|---|---|
| 1 | Butanol production | Process modelling, energy efficiency and economics of butanol production from molasses and | BEng or MEng or MScEng Chemical Engineering | Modelling of Biorefineries (Technology Assessment) | Prof JF Görgens | Stellenbosch University |

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| | | lignocellulose | | | | |
| 2 | Integrated ethanol production | Integrate 1st and 2nd generation ethanol production from energy crops | BEng Chemical Engineering | Modelling of Biorefineries (Technology Assessment) | Prof JF Görgens | Stellenbosch University |
| 3 | Lignocellulose fractionation | Supercritical water and ionic liquids for lignocellulose fractionation into major chemical constituents | BEng Chemical Engineering or BScHons in chemistry or wood science | Development of Biorefinery Technologies | Prof JF Görgens | Stellenbosch University |
| 4 | Xylan extraction and modification | Process modelling, energy efficiency and economics of xylan extraction from lignocellulose and modification | BEng Chemical Engineering | Modelling of Biorefineries (Technology Assessment) | Prof JF Görgens | Stellenbosch University |
| 5 | Jet fuel production | Process modelling, energy efficiency and economics for comparison of biological and thermochemical processes for jet fuel production from lignocellulose | BEng Chemical Engineering | Modelling of Biorefineries (Technology Assessment) | Prof JF Görgens | Stellenbosch University |
| 6 | Biomass co-gasification | Co-gasification of biomass with coal: Investigate kinetics and synergies | BEng or MEng or MScEng Chemical Engineering | Thermochemical biomass conversion | Prof JF Görgens | Stellenbosch University |
| 7 | Bio-oil characterisation | Characterisation and upgrading of bio-oils from pyrolysis of lignocellulose | BEng Chemical Engineering | Thermochemical biomass conversion | Prof JF Görgens | Stellenbosch University |
| 8 | Consolidated bioprocessing yeast development | Integrate cellulase encoding genes into haploid yeast strains and screening of progeny after mating for superior cellulase secretion | MSc Microbiology | Biochemical conversion | Prof WH van Zyl | Stellenbosch University |
| 9 | Consolidated bioprocessing yeast development | Comparing β-glucosidase and cellobiose phosphorylase for efficient cellobiose utilization in *S. cerevisiae* | MSc Microbiology | Biochemical conversion | Prof WH van Zyl | Stellenbosch University |
| 10 | Enzymatic hydrolysis of local feedstock | Optimise mix of enzyme(s) required for hydrolysis of different substrates to desirable end-product(s) | MSc Microbiology | Biochemical conversion | Prof M Bloom / Prof WH van Zyl | Stellenbosch University |

## ii. Associate Research Chair: Biofuels & Other Clean Alternative Fuels (North West University )

| No. | Project Title | Project Description | Qualifications and Skills Required | Link to Associate Chair Research Focus Area/s | Supervisor (and contact details) | University (at which research will be undertaken) |
|---|---|---|---|---|---|---|
| 1 | Simulation and techno-economic evaluation of a bio-refinery using the base components of the plant | Simulation of bio-refinery using base compositional analysis of plant material as well as research results generated within the research group. | **Qualifications:**<br><br>Bachelor of Engineering (Masters level) or Master of Engineering (PhD level)<br><br>**Skills**:<br><br>Competency in use of engineering simulation packages<br><br>Strong chemical engineering background | Reduction in energy requirement for bio-product processes | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |
| 2 | Bio-chemicals from biomass | This study will investigate the production of various biodegradable plastics from waste organic materials. | **Qualifications:**<br><br>For Master's level:<br><br>Bachelor of Engineering or BSc(Hons) degree or | By-product beneficiation | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |

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| | | | For PhD level:<br><br>Master of Engineering or MSc<br><br>**Skills**:<br><br>Competency in biochemistry, microbiology or biotechnology<br><br>Strong chemistry competence | | | |
| 3 | In-situ biodiesel production | This study will focus on optimizing the in-situ production of biodiesel and other bio-chemicals using liquefaction and alternative energy resources. | **Qualifications:**<br><br>For Master's level:<br><br>Bachelor of Engineering or BSc(Hons) degree or<br><br>For PhD level:<br><br>Master of Engineering or MSc<br><br>**Skills**:<br><br>Competency in biochemistry, microbiology or biotechnology or chemical engineering | | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |

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| 4 | Evaluation of new feedstock for bio-energy production | This study will focus on evaluating a new non-edible feedstock (such as algae) for the production of a wide range of bio-energy products | **Qualifications:**<br><br>For Master's level:<br><br>Bachelor of Engineering or BSc(Hons) degree or<br><br>For PhD level:<br><br>Master of Engineering or MSc<br><br>**Skills**:<br><br>Competency in biochemistry, microbiology or biotechnology or chemical engineering | Reduction in processing costs for bio-energy production | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |
| 5 | Ultrasonic assisted pretreatment of lignocellulose material | This study will be a continuation of an existing project and will focus on optimizing the production of biofuels and/or biochemicals from lignocelluloses materials using ultrasonic irradiation techniques. | **Qualifications:**<br><br>For Master's level:<br><br>Bachelor of Engineering or BSc(Hons) degree or<br><br>For PhD level:<br><br>Master of Engineering or MSc | Reduction in energy requirement for bio-product processes | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |

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| | | | **Skills**:<br><br>Competency in biochemistry, microbiology or biotechnology or chemical engineering | | | |
| 6 | A study of the kinetics of microwave assisted biodiesel production | This study will focus on determining the kinetic parameters for producing biodiesel in a continuous microwave reactor for purposes of scale up. | **Qualifications:**<br><br>For Master's level:<br><br>Bachelor of Engineering or BSc(Hons) degree or<br><br>For PhD level:<br><br>Master of Engineering or MSc<br><br>**Skills**:<br><br>Competency in biochemistry, microbiology or biotechnology or chemical engineering | Reduction in energy requirement for bio-product processes | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |
| 7 | Bio-butanol from bioethanol | This study will focus on establishing a production route to produce bio-butanol directly from bioethanol | **Qualifications:**<br><br>For Master's level:<br><br>Bachelor of Engineering or BSc(Hons) degree or | By-product beneficiation | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |

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| | | | For PhD level:<br><br>Master of Engineering or MSc<br><br>**Skills**:<br><br>Competency in biochemistry, microbiology or biotechnology or chemical engineering | | | |
| 8 | Co-gasification | This project will be done in conjunction with the Clean Coal Research group and will focus on the investigating the effect of biomass on coal kinetics | **Qualifications:**<br><br>For Master's level:<br><br>Bachelor of Engineering<br><br>For PhD level:<br><br>Master of Engineering<br><br>**Skills**:<br><br>Competency in chemical engineering | By-product beneficiation | Prof S Marx<br><br>Sanette.marx@nwu.ac.za<br><br>(018) 299 1995 | North-West University (Potchefstroom Campus) |

## iii. Research Chair in Clean Coal technologies at the University of Witwatersrand

| No. | Project Title | Project Description | Qualifications and Skills Required | Link to Research Chair (Clean Coal) Research Focus Area/s | Supervisor (and contact details) | University (at which research will be undertaken) |
|---|---|---|---|---|---|---|
| 1 | **ADVANCED DRY COAL BENEFICIATION: i.e. for different sized coals using different processes** | 1. Studies to understand and improve efficiency in various dry beneficiation process applications - including but not limited to jigging, X-ray sorting and electrostatic separation<br>2. Allied studies in fundamental and advanced coal characterisation in order to enhance optimum performance and efficiency in dry coal processing | BSc (Eng) Metallurgy<br>BSc (Geology, Chemistry) | | Prof Rosemary Falcon<br>Co-supervisors/associates<br>• Mr Johan de Korte<br>• Mr Lionel Falcon<br>• Mr Carl Bergman | Witwatersrand<br>in association with Mintek and CSIR |
| 2 | **IMPROVING THE EFFICIENCY OF INDUSTRIAL COAL-FIRED BOILERS: i.e. combustion and thermal efficiencies, with environmental impact abatement** | 1. Studying the impact of SA coals in conventional travelling grate or shell boilers and in bubbling or circulating fluidised bed boilers in order to optimise combustion and minimise $CO_2$ emissions with particular reference to the use of SA's | BSc (Eng) Chemical or Mechanical Engineering | | Prof Rosemary Falcon<br>Co-supervisors/associates<br>• Prof Mark van der Riet | Witwatersrand<br>In association with Eskom<br>CSIR |

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| | | high ash coals and discards<br><br>2. Studying the origin and formation of $PM_{2,5}$ forms of fly ash and their capture from coal-fired power stations in order to minimise the health hazards of those particulate emissions and to meet the impending DEA Air Quality limitations | BSc Geology, Chemistry or Environmental Sciences; or<br>BSc (Eng) Metallurgy | | • Dr Chris van Alphen<br>• Dr Adam Luckos<br>• Prof Ray Everson | North West University |
| 3 | **$CO_2$ MITIGATION AND UTILISATION: i.e. use of algae for (1) $CO_2$ capture and (2) co-firing with coal and (3) development of allied algal (and alternative biomass)-sourced industries.** | **1.** Studying the potential of algae as sinks for $CO_2$ capture from coal-fired and/or co-fired combustion or gasification plants in order to **minimise $CO_2$ emissions;**<br><br>2. Studying the potential of the resultant algal products for use as a **source for co-firing** with coal in combustion<br><br>3. Studying the potential of the resultant algal products as a **source of materials** / **uses** in industrial processes. | BSc Chemistry, Life sciences<br><br>BSc (Eng) Chemical or Mechanical Engineering<br><br>bSc (Eng) Chemical or Mechanical Engineering | | Prof Rosemary Falcon<br><br>Co-supervisors/associates<br>• Dr Pasi Vainikka<br>• Mr Brian North CSIR<br>• Mr Norman Magaziner | Witwatersrand<br><br>In association with<br>Eskom<br>CSIR<br>VTT (Finland) |
| 4 | **ADVANCED HIGH-** | Study of coal as a source of carbon | BSc (Eng) Chemical, | | Prof Rosemary Falcon | Witwatersrand |

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| | **VALUE USES FOR COAL** | in the manufacture of high value carbon products. e.g. substitutes for coke, graphite or a substrate for carbon nanotubes | metallurgical or Mechanical Engineering | | Co-supervisors/associates<br>• Prof Sunny Iyuke<br>• Dr John Clark<br>• DR Lourens Erasmus | In association with Sasol |

### iv. Renewable Energy Hub (Stellenbosch University)

| No. | Project Title | Project Description | Qualifications and Skills Required | Link to Hub Research Focus Area/s | Supervisor (and contact details) | University (at which research will be undertaken) |
|---|---|---|---|---|---|---|
| 1 | Wave Energy | South Africa has an extended coastline with a variety of sea conditions. In the 1970's the Ocean Energy Research Group (OERG) at Stellenbosch University did substantial research on utilising wave energy. It was found that the SA coast line has at certain locations up 45 kW/m crest length and the Stellenbosch Wave Energy Converter was designed and verified through model testing. This project, initially funded by De Beers/Anglo American, Boart, LTA, | Appropriate masters-degree | Renewable Energy | Prof Wikus van Niekerk | Stellenbosch University |

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| | | and Murray & Roberts was shelved.<br><br>In this study the work of the OERG, as well as other available information will be revisited. A survey of existing devices compiled and matched with the available sites along the SA coast. Part of the analysis will include estimating the cost and efficiencies of the available sites. A new patent on a device that will be installed in a harbour wall was registered last year and a number of projects associated with this project are available. | | | | |
| 2 | Ocean current energy | South Africa has an extended coastline with a variety of sea conditions. In the 1970s the Ocean Energy Research Group (OERG) at Stellenbosch University identified the Agulhas ocean current as a constant, large renewable energy resource. Over the last 5 years Eskom measured the current and estimates that the current is flowing between 1, 5 m/s and 2 m/s. There are few machines available to harvest this energy.<br><br>Stellenbosch University is working with Sea Renewable Energy (Pty) Ltd on the development a two rotor device for this application. A number of projects are available in this programme | Appropriate masters-degree | Renewable Energy | Prof Wikus van Niekerk | Stellenbosch University |

## v. Wind Energy Spoke (Stellenbosch University and the University of Cape Town)

| No. | Project Title | Project Description | Qualifications and Skills Required | Link to Wind Spoke Research Focus Area/s | Supervisor (and contact details) | University (at which research will be undertaken) |
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| 1 | Renewable Energy, Network Integration, Power Quality, System Operation: Development of Renewable Energy Test Platforms | South Africa's recent Integrated Resource Plan (IRP2) has set clear goals for the inclusion of Renewable Energy sources in its future energy mix. This includes a target of 16% from Renewables by 2030, of which wind power is to be the main component. Renewable sources are significantly different from classical fossil fuel-based generation technologies. They are distributed geographically, operate intermittently, integrated at distribution or sub-transmission levels and have limited reactive power control capability. Another significant difference is that renewable energy generators are often connected to the grid by means of power electronic | Relevant undergraduate and/or postgraduate degree in engineering.<br><br>Interest in Wind energy. | Postgraduate Research Topics:<br><br>The postgraduate research topics proposed includes the following:<br><br>• Development of aggregation models and methodologies for distributed generation technologies. This will facilitate the representation of mechanical and electrical dynamics of these systems that are distributed within a wind farm, or entire farms that are distributed | Prof P. Pillay, Prof M.A. Khan, Dr P.S. Barendse and Prof K.A. Folly<br><br>E-mail: azeem.khan@uct.ac.za<br><br>Tel # : +27-650-5956 | Department of Electrical Engineering, University of Cape Town (UCT) |

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| | | converters, whilst traditional synchronous generators are directly connected. The presence of active converters introduces new dynamics and harmonic issues, but also presents interesting possibilities for mitigating the effects of classical power quality (PQ) problems through the control of the converters. The afore-mentioned differences present new challenges for the viable integration of Renewables into existing electricity grids. In particular, the impact of large-scale integration of wind power on the South African (SA) grid is of significant interest and must be investigated thoroughly. Currently in South Africa, good expertise is available to perform simulation-based investigations. However, the accuracy of these results is seriously affected by the complexity of the models used and the approximations made. The results obtained may therefore be significantly different from the actual performance of the system. In addition the engineers working in this field do not get a physical feel for the system from simulation- | | geographically. This will facilitate power system studies.<br><br>Students required: 1x MSc<br><br>• Design of scaled laboratory prototypes of wind or other generators as per methodologies developed above. These machines will have scaled electrical and mechanical parameters that will represent utility-size machines. This will include the development of test-rigs for mounting the machines in the laboratory. The per unit results of the laboratory scale systems will represent the full scale units. Models of the network will be included as well.<br><br>Students required: 2x MSc, 1x PhD<br><br>• Development of power | | |

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| | | based studies. The exact performance can only be obtained on the actual system which of course is not feasible. Laboratory testing is the best way to accurately model the actual system dynamics and assess the discrepancies between computer simulations and actual system. This proposal relates to the development of scaled prototypes for laboratory testing of power generation with particular reference to renewable energy and independent power production. The idea is to develop machines such that the results in per unit, represents the full scale machines and system. Previous work in the early 1960's related to the development of laboratory-based systems to investigate the interaction of large synchronous turbo-generators with electricity networks. However, this type of research, education and training has never been conducted on renewable based generation. Thus, this system does not exist elsewhere in the world, and will result in significant benefits for the power industry and the country. | | electronic converters with output filters and associated control strategies to interface the lab-based generators to the grid emulator. The control strategies will be formulated for the aggregated models developed during this research.<br><br>Students required: 2x MSc<br><br>• Development of emulators, which will represent the aerodynamic and mechanical dynamics of large turbines. The aggregation methodologies developed will be applied to the emulator design.<br><br>Students required: 2x MSc<br><br>• Design of a grid emulator for interfacing and testing the generators from renewable energy and independent | | |

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| | | | | generation systems. Power electronic converters will be used in conjunction with the available large machine sets to emulate prevalent grid PQ conditions, such as dips, swells, unbalance, overvoltage, under-voltage, fault-ride through, low voltage ride through, etc. This system will serve as the Point of Common Coupling (PCC) for the independent and renewable energy generators. Precise control and filtering of the converter is essential in order to prevent its dynamics from interfering with the behavior of the generators during emulated PQ conditions.<br><br>Students required: 1x MSc, 1x PhD<br><br>• Literature scan on modeling, Power Quality (PQ) issues and problems related to grid-integration of large generators fed from renewable energy and independent power | | |

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| | | | | producers. The grid integration problems will include: stability, fault ride through, low voltage ride through, etc. Different generator technologies are being used and will be studied. Implementation of PQ problems at the PCC of the renewable/IPP generators by means of the grid emulator. Detailed experimental investigations will be conducted on the behavior of the generators under these conditions. Also, control methodologies will be investigated to mitigate the effect of these PQ problems on the operation of the generators. The experimental results will be compared with simulation results from several power system simulation software packages. Investigation of stability (both transient and voltage) problems associated with grid integration of generators fed from renewable energy or | | |

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| | | | | independent power producers in relation with strong and weak grids.<br><br>Students required: 1x MSc, 1x PhD | | |
| 2 | Design of large-scale reluctance synchronous drive-train wind generator | The reluctance-synchronous drive-train wind generator is an alternative for permanent magnet drive-train wind generators, with the advantage of a very low cost and robust rotor. In this study the focus is on the optimum design of a medium speed 1 MW reluctance synchronous wind generator. Specific attention will be given to the rotor design. To confirm the design tests will be done on a small-scale prototype. | B.Eng (Electrical) for Master and M.Eng (Electrical) for PhD. Electrical machine design background. | Wind energy: generator technology. | Prof MJ Kamper<br>kamper@sun.ac.za<br>021 808 4323<br>072 064 6367 | Electrical Engineering<br>Stellenbosch<br><br>University |
| 3 | Network integration of wind farm with slip-synchronous permanent magnet wind generators | The slip-synchronous permanent magnet generator is a new type wind generator that is connected directly to the power system grid. In this study the integration of a wind farm of slip-synchronous wind generators with the power system network is investigated. This includes the modeling, simulation, low-voltage ride-through capability | B.Eng (Electrical). Power system background. | Wind energy: network integration. | Dr Nkosinathi Gule<br>nathi@sun.ac.za<br>072 634 9633 | Electrical Engineering<br>Stellenbosch<br>University |

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| | | and reactive power control of such a grid-connected wind farm. | | | | |
| 4 | Position sensorless control of reluctance synchronous drive-train wind generator system | The reluctance-synchronous drive-train wind generator is an alternative for permanent magnet drive-train wind generators, with certain advantages. Accurate estimation of the rotor position without the use of a position sensor, however, is required for this drive. In this study techniques are investigated to obtain position sensorless control of this type of of wind generator. | B.Eng (Electrical) for Master and M.Eng (Electrical) for PhD. Control system and signal theory background. | Wind energy: wind generator control. | Prof MJ Kamper<br>kamper@sun.ac.za<br>021 808 4323<br>072 064 6367 | Electrical Engineering<br>Stellenbosch University |
| 5 | Integrated permanent magnet wind generator gearbox | Conventional wind generator systems suffer from the use of mechanical gearboxes due to cost, mass and maintenance. To improve this, this study is on the design and testing of a permanent magnet gearbox that is integrated with a medium speed permanent magnet wind generator. | B.Eng (Mechatronic / Electrical). Mechanical and Electrical machine design background | Wind energy: generator technology. | Dr R Wang<br>rwang@sun.ac.za<br>021 808 4335<br>072 252 5643 | Electrical Engineering<br>Stellenbosch University |
| 6 | System identification and parameter estimation for wind generator condition monitoring | The condition of every large-scale wind generator is of the utmost importance. For condition monitoring the estimation of the parameters of the whole generator system is necessary. In this study techniques are used to do system identification and parameter estimation of a double-fed induction wind generator. | B.Eng (Electrical). Power systems, system modeling, Matlab. | Wind energy: condition monitoring. | Prof JHJ Vermeulen<br>vermeuln@sun.ac.za<br>021 808 4326<br>082 854 4194 | Electrical Engineering<br>Stellenbosch University |

## vi. Solar photovoltaic (PV) Spoke (Nelson Mandela Metropolitan University and University of Fort Hare)

| No. | Project Title | Project Description | Qualifications and Skills Required | Link to solar PV spoke Research Focus Area/s | Supervisor (and contact details) | University (at which research will be undertaken) |
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| 1 | Characterization of grid-tied micro-inverters | With the increased development of Photovoltaic (PV) systems in South Africa, there is an interest in using multiple smaller micro-inverters for domestic installations. Multiple micro-inverters have an advantage over a single larger inverter as the array can be configured to take shading into account. This proposed project will investigate the performance of grid-tied micro-inverters in the range of 300-500 W. The investigation will include the development of a comprehensive test-bed to characterize micro-inverters with respect to various electrical parameters under different irradiance and temperature conditions. These include efficiency, output signal quality, accuracy of output signal frequency and energy losses. | Relevant undergraduate degree as stipulated in the criteria | Solar | Prof Ernest van Dyk<br>Fax: +27 41 504 1959<br>Tel: +27 41 504 2259<br>E-mail: Ernest.vanDyk@nmmu.ac.za<br>Website: http://www.nmmu.ac.za/energy | Nelson Mandela Metropolitan University |

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| 2 | **Development of a large area light beam induced current measurement system** | The detailed characterization of defects in photovoltaic (PV) modules may be facilitated by using a large area light beam induced current measurement (LA-LBIC) system. The LA-LBIC system uses a focussed white light source as beam probe that is scanned across a PV module while measuring photo-response and current-voltage (I-V) characteristics. The proposed project involves the analysis of point-by-point photo-response and I-V maps of various PV modules in order to identify cell mismatch and performance degrading defects. | Relevant undergraduate degree as stipulated in the criteria | Solar | Prof Ernest van Dyk<br>Fax: +27 41 504 1959<br>Tel: +27 41 504 2259<br>E-mail: Ernest.vanDyk@nmmu.ac.za<br>Website: http://www.nmmu.ac.za/energy | Nelson Mandela Metropolitan University |
| 3 | **Development of a comprehensive adaptive PV MPPT algorithm** | In order to extract the maximum electrical power from photovoltaic (PV) modules, maximum power point tracking (MPPT) algorithms are used in many commercial PV control circuits such as charge controllers and DC-AC inverters. The maximum power point typically changes as the PV module's current voltage (I-V) characteristic changes under the influence of environmental conditions. Many maximum power point tracking (MPPT) algorithms lack the ability to rapidly and efficiently | Relevant undergraduate degree as stipulated in the criteria | Solar | Dr FJ Vorster<br>Fax: +27 41 504 1755<br>Tel: +27 41 504 3051<br>E-mail: Frederik.Vorster@nmmu.ac.za<br>Website: http://www.nmmu.ac.za/en | NELSON MANDELA METROPOLITAN UNIVERSITY |

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| | | track the maximum power point under changing environmental conditions such as ambient temperature, total irradiance intensity and intensity distribution on the PV module. A more comprehensive "intelligent" algorithm that adapts its operational mode according to changing environmental conditions will be designed and characterized. | | | ergy | |
| 4 | **Comprehensive PV topographic parameter extraction combining LBIC, EL and thermal imaging** | The Photovoltaic (PV) Research Group in the Physics Department at NMMU continues to develop new and innovative characterisation techniques on PV module and cell level. These include several Light Beam Induced Current (LBIC) techniques, electroluminescence (EL) techniques and thermal imaging. A number of novel current voltage curve (I-V) parameter extraction routines have also been developed for PV devices. In order to fully identify and characterise performance degrading defects, results from I-V parameter extraction techniques need to be combined with LBIC, EL and thermal imaging data to create a more comprehensive representation of the various defect types in PV modules and cells. The proposed project will address these topics | Relevant undergraduate degree as stipulated in the criteria | Solar | Dr FJ Vorster<br>Fax: +27 41 504 1755<br>Tel: +27 41 504 3051<br>E-mail: Frederik.Vorster@nmmu.ac.za<br>Website: http://www.nmmu.ac.za/energy | NELSON MANDELA METROPOLITAN UNIVERSITY |
| 5 | **Optimisation of DSWH thermal storage system.** | The efficient operation of Domestic Solar Water Heating (DSWH) systems rely heavily on the ability of | Relevant undergraduate degree as stipulated in the | Solar | Dr FJ Vorster<br>Fax: +27 41 504 1755 | NELSON MANDELA |

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| | | the thermal storage system to store the absorbed heat as well as to deliver the maximum percentage of the absorbed heat, in the form of warm water at an acceptable temperature to consumers. To ensure the efficient operation of the thermal storage system, the absorber and storage system need to be well matched so that sufficient warm water can be delivered for a particular consumer profile. The influence of tank stratification effects, forced mixing as well as the characteristics of the solar absorber will be investigated to optimise the system. | criteria | | Tel: +27 41 504 3051<br>E-mail: Frederik.Vorster@nmmu.ac.za<br>Website: http://www.nmmu.ac.za/energy | METROPOLITAN UNIVERSITY |
| 6 | **Optimisation of Concentrator Photovoltaic (CPV) optical systems.** | The potential of concentrator photovoltaic (CPV) systems to generate electricity at a lower cost than standard PV modules has been demonstrated, with several companies already deploying large-scale CPV systems. The optical sub-system is a crucial component of any CPV system and needs to be optimised to ensure maximum performance of the overall system. This proposed project will investigate concentrated irradiance level and uniformity across a PV receiver surface for both low and high concentrator systems. | Relevant undergraduate degree as stipulated in the criteria | Solar | Prof Ernest van Dyk<br>Fax: +27 41 504 1959<br>Tel: +27 41 504 2259<br>E-mail: Ernest.vanDyk@nmmu.ac.za<br>Website: http://www.nmmu.ac.za/energy | NELSON MANDELA METROPOLITAN UNIVERSITY |
| 7 | **Fluid and thermal experimental and theoretical analysis of air** | | Relevant undergraduate degree as stipulated in the | Solar | Prof Alan Nurick<br>Tel: +27 011 559 3476 / | University of |

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| | **flow windows using a LDV.** | | criteria | | 082 574 5229<br>E-mail: alann@uj.ac.za | Johannesburg |
| 8 | **Analysis of the use of evacuated solar tubes for heating of air.** | | Relevant undergraduate degree as stipulated in the criteria | Solar | Prof Alan Nurick<br>Tel: +27 011 559 3476 /<br>082 574 5229<br>E-mail: alann@uj.ac.za | University of Johannesburg |
| 9 | **An investigation of the thermodynamic performance of enhanced water stills.** | | Relevant undergraduate degree as stipulated in the criteria | Solar | Prof Alan Nurick<br>Tel: +27 011 559 3476 /<br>082 574 5229<br>E-mail: alann@uj.ac.za | University of Johannesburg |
| 10 | **The effects of glazing's on the performance of a PV/Thermal hybrid solar cells.** | | Relevant undergraduate degree as stipulated in the criteria | | Prof Alan Nurick<br>Tel: +27 011 559 3476 /<br>082 574 5229<br>E-mail: alann@uj.ac.za | University of Johannesburg |
| 11 | **The effect of glazing on the transfer of solar irradiance and illuminance through double paned windows.** | | | Solar | Prof Alan Nurick<br>Tel: +27 011 559 3476 /<br>082 574 5229<br>E-mail: alann@uj.ac.za | University of Johannesburg |

## vii. Solar thermal spoke (University of Stellenbosch and the University of Pretoria).

| No. | Project Title | Project Description | Qualifications and Skills Required | Link to solar thermal spoke Research Focus Area/s | Supervisor (and contact details) | University (at which research will be undertaken) |
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| 1 | Stand-alone (off-grid) solar Stirling dish electrical power supply unit | This objective of this project is to develop a stand-alone electrical power supply system for off-grid rural communities. The ultimate outcome of the project is to produce a locally manufactured knock-down do-it-yourself kit suitable for mass distribution throughout Africa. This is a relatively complex project requiring the use of a number of different disciplines.<br><br>The following projects have so far been identified:<br><br>1 Test and characterise the performance of a 25 kWelectrical and 100 kWthermal Stirling engine 22 V 50 Hz power unit.<br><br>2 Theoretically simulate, design manufacture and test a 3 kW free piston Stirling engine electrical power generating unit. (Ivan | Bachelor's degree in engineering or equivalent for MEng | Related to focus technology of the Solar thermal spoke strategic plan 2013-2017.<br>It is a new priority research item for the new Eskom renewable energy centre of excellence. | Mr. RT Robert Dobson<br>rtd@sun.ac.za | Stellenbosch University |

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| | | Deetlefs)<br><br>3 Construction and control of a 12 m2 parabolic reflector dish for the free 3 kW free piston Stirling engine electrical power generating unit. (Gerro Prinsloo)<br><br>4 Dynamic FEM structural analysis including fluctuating wind loading and structural optimisation<br><br>5 Make a 3 kW Eskom-grid compatible electrical supply unit.<br><br>6 The evaluation of a locally manufactured 3 kW solar Stirling dish system for African enlightenment.<br><br>7 Industrialization/ commercialisation for local manufacture of a self-standing 3 kW electrical power system<br><br>8 CFD simulation and analysis of a Stirling Dish fluctuating under fluctuating wind conditions. | | | | |
| 2 | Concentrating solar power (CSP): Linear Fresnel reflector pilot plant research | The linear Fresnel reflector plant concept is another focus technology of the solar thermal energy research group. Research focuses on a proposed 2 MW pilot plant for the Western Cape but the technology has been identified for process heat use as well as for hybridization of | Bachelor's degree in engineering or equivalent for MEng<br><br>Master's degree in engineering or equivalent for PhD | Focus technology of the Solar thermal spoke strategic plan 2013-2017. | Prof Theo von Backström twvb@sun.ac.za<br><br>Prof Thomas Harms tmh@sun.ac.za | Stellenbosch University |

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| | | existing coal power stations.<br><br>Project 1: Research and development of a direct steam receiver. Theoretical and experimental work is required to understand and control the two phase flow problem for saturated or superheated steam turbine application.<br><br>Project 2: Development of a linear Fresnel concentrator for process heat. This project is a continuation of an existing project that shows much promise.<br><br>Project 3: Power plant modeling to assess the suitability and requirements of a linear Fresnel collector field to augment energy to a conventional coal power station. | | | Eskom Chair (to be appointed) | |
| 3 | Concentrating solar power (CSP): Central receiver pilot plant component research | The SUNSPOT plant concept devised by Prof DG Kröger is a focus technology for the solar thermal energy research group. Research focuses on a proposed 5 MW pilot plant. Multiple projects will be available as listed here<br><br>Project 1: Heliostat module optimization for cost based on any number of factors including structural, drivetrain, control, optical, wind loading, dual use and minimal impact of land. This project requires | Bachelor's degree in engineering or equivalent for MEng<br><br>Master's degree in engineering or equivalent for PhD | Focus technology of the Solar thermal spoke strategic plan 2013-2017. | Prof Theo von Backström (Thermoflow)<br>twvb@sun.ac.za<br><br>Prof Thomas Harms (Thermoflow)<br>tmh@sun.ac.za<br><br>Prof Hanno Reuter (Thermoflow)<br>hreuter@sun.ac.za<br><br>Prof Albert Groenwold (Optimization) | Stellenbosch University |

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| | | theoretical development/optimization as well as experimental validation using the solar roof laboratory. This project can be combined with a Sasol funded R500 000 heliostat field to be deployed in 2013.<br><br>Project 2: System thermal and thermodynamic modeling for a 5 MW SUNSPOT pilot plant. This project would be complimentary to an existing PhD project and look at more detail on the optimization of the receiver and/or storage system and/or hybridization with backup fuel. Experimental validation on some aspects may be required depending on the final objective.<br><br>Project 3: Heliostat ray tracing software development and validation continuing on a ray tracing tool developed in STERG. Parallelization, optimization and tuning for central receiver plants all potentially in scope.<br><br>Project 4: Development of mechatronic systems for central receiver plants. For cost reduction and lower operating and maintenance effort, the use of UAVs has been identified for monitoring, calibrating and cleaning of mirrors efficiently for the vast heliostat | | | albertg@sun.ac.za<br><br>Prof Gerhard Venter (Optimization)<br>gventer@sun.ac.za<br><br>Prof Anton Basson (Automation)<br>ahb@sun.ac.za<br><br>Dr Willie Smit (UAVs)<br>wjsmit@sun.ac.za<br><br>Eskom Chair (to be appointed) | |

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| | | fields. This project is a first effort in the research group coupling UAVs and CSP plants and continues from mechatronic projects on heliostats. | | | | |
| 4 | Concentrating solar power (CSP): Scenario modeling for short to long term rollout of CSP in SA | CSP is one of the three major renewables in the South African integrated resource plan. In order for transmission and resource planning, scenario modeling is becoming increasingly important. These scenarios require a variety of disciplines and methods to be considered. These projects are by nature theoretical (typically limited or no experimental work).<br><br>Project 1: Scenario modeling with a focus on thermodynamics of plants but including consideration of other key resources and constraints. Use of geographic information systems (GIS) will be part of the modeling. Strategic assumptions for the future will be required.<br><br>Project 2: Mathematical robustness and optimization modeling considering the resources and constraints mentioned for Project 1 above. | Bachelor's degree in engineering or equivalent for MEng<br><br>Master's degree in engineering or equivalent for PhD | Focus R&D of the Solar thermal spoke strategic plan 2013-2017. | Prof Theo von Backström twvb@sun.ac.za<br><br>Prof Thomas Harms tmh@sun.ac.za<br><br>Prof Albert Groenwold albertg@sun.ac.za<br><br>Eskom Chair (to be appointed) | Stellenbosch University |
| 5 | Concentrating solar power (CSP): Supercritical CO2 or other fluids for proposed CSP technology | The use of CO2 as working fluid in solar power plant has been proposed as a method to achieve higher efficiency at a lower receiver temperature. This project requires a thermodynamic or thermo-economic | Bachelor's degree in engineering or equivalent for MEng<br><br>Master's degree in engineering or | Focus R&D of the Solar thermal spoke strategic plan 2013-2017. | Prof Theo von Backström twvb@sun.ac.za<br><br>Prof Thomas Harms tmh@sun.ac.za | Stellenbosch University |

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| | | investigation into the application of CO2 as closed cycle working fluid. The project requires a detailed investigation into applicable turbomachinery (turbine and pumping/compression) and/or thermodynamic modeling of the cycle accounting for the cyclic nature of the sun. Additional or alternative working fluids and heat transfer fluids can be considered based on current research or the students own discoveries. | equivalent for PhD | | Mr Robert Dobson<br>rtd@sun.ac.za<br><br>Eskom Chair (to be appointed) | |
| 6 | Solar Radiation, Heat Transfer and Pressure drop in Porous Media | Concentrated solar power (CSP) with thermal storage has the potential to supply all South Africa's future energy needs. Existing plant typically use molten salts as heat transfer fluid, and a conventional Rankine (steam turbine) cycle to generate electricity. Worldwide, supply of salts is limited. The SUNSPOT cycle proposes the use of a Brayton (gas turbine) cycle during the day, storing the waste heat in a rock bed to drive a Rankine cycle at night. The efficiency of the Brayton cycle is driven by the maximum temperature that can be obtained at the receiver. The cycle is quite sensitive to the pressure drop across the receiver. Provided that the desired receiver temperature of 800 ℃ + can be achieved, the SUNSPOT cycle is an attractive addition to current CSP | Bachelor's degree in engineering or equivalent for MEng | Focus R&D of the Solar thermal spoke strategic plan 2013-2017. | Dr JE Hoffmann<br>hoffmaj@sun.ac.za | Stellenbosch University |

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| | | technologies.<br><br>Gases have poor heat transfer characteristics, and it is a challenge to achieve the desired temperatures. Enhancing heat transfer usually comes at the expense of increased pressure drop. Porous media have excellent blackbody characteristics, and it may be used in combination with optically transparent materials is a receiver.<br><br>The aim is to develop, test and optimize porous media for heat transfer and pressure drop. | | | | |
| 7 | Concentrated Solar Power Tower Receiver | Concentrated solar power (CSP) with thermal storage has the potential to supply all South Africa's future energy needs. The SUNSPOT cycle proposes the use of a Brayton (gas turbine) cycle during the day, storing the waste heat in a rock bed to drive a Rankine cycle at night. The efficiency of the Brayton cycle is driven by the maximum temperature that can be obtained at the receiver. The cycle is quite sensitive to the pressure drop across the receiver. Provided that the desired receiver temperature of 800 °C + can be achieved, the SUNSPOT cycle is an attractive addition to current CSP technologies. | Bachelor's degree in engineering or equivalent for MEng<br><br>Master's degree in engineering or equivalent for PhD | Focus R&D of the Solar thermal spoke strategic plan 2013-2017. | Dr JE Hoffmann<br>hoffmaj@sun.ac.za | Stellenbosch University |

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| | | Gases have poor heat transfer characteristics, and it is a challenge to achieve the desired temperatures. Enhancing heat transfer usually comes at the expense of increased pressure drop. Furthermore, high temperatures and thermal cycling can lead to radiation losses, thermal stress, fracture and sealing problems in pressurized receivers. This project aims to address issues identified with pressurized receivers, and to resolve some of them. Several receiver concepts have been proposed and tested with varying success worldwide. These range from cavity receivers, open volumetric receivers, particle receivers and pressurized volumetric receivers. Different routes have been identified to improve on current receivers.<br><br>The project aim to move the receiver design pass the "proof-of-concept" phase to the point where it is ready for prototype development. This should also be a milestone en route to full commercialization of the SUNSPOT cycle. | | | | |
| 8 | Heat Transfer Fluids for Concentrated Solar Power Tower | Concentrated solar power (CSP) with thermal storage has the potential to supply all South Africa's future energy needs. The | Bachelor's degree in engineering or equivalent for MEng | Focus R&D of the Solar thermal spoke strategic plan 2013-2017. | Dr JE Hoffmann<br>hoffmaj@sun.ac.za | Stellenbosch University |

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| | | SUNSPOT cycle proposes the use of a Brayton (gas turbine) cycle during the day, storing the waste heat in a rock bed to drive a Rankine cycle at night. The efficiency of the Brayton cycle is driven by the maximum temperature that can be obtained at the receiver. The cycle is quite sensitive to the pressure drop across the receiver. Provided that the desired receiver temperature of 800 ℃ + can be achieved, the SUNSPOT cycle is an attractive addition to current CSP technologies.<br><br>Using air as process fluid negates the need of a secondary heat exchanger between the receiver and turbine. Gases have poor heat transfer characteristics, and it is a challenge to achieve the desired temperatures. Enhancing heat transfer usually comes at the expense of increased pressure drop. Furthermore, high temperatures and thermal cycling can lead to radiation losses, thermal stress, fracture and sealing problems in pressurized receivers.<br><br>Existing plant typically use thermal oils or molten salts as heat transfer fluid, and a conventional Rankine (steam turbine) cycle to generate electricity. Oils are flammable, and | | | | |

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| | | break down above temperatures of about 400 ℃. Salts require trace heating at ambient temperatures. Worldwide, supply of salts is limited.<br><br>Liquid metals (Na, K and eutectic mixtures thereof) provide excellent heat transfer characteristics, but are highly reactive when exposed to water. Public perception is strongly biased against it.<br><br>Explore the use of an alternative heat transfer fluid that is affordable, safe, and environmentally friendly to overcome the problems posed by air in the receiver. | | | | |
| 9 | Evaluating the optimum conversion technology for concentrator solar power (CSP) for a South African context. | CSP is a fast emerging renewable energy technology and is particularly attractive for South Africa which receives some of the highest DNI (direct normal insolation) solar radiation levels in the world. Basically various geometry configurations of mirrors are used to concentrate solar power to heat a central receiver or a group of receivers. Typically this power is used to create steam that runs a turbine which subsequently operates an electric power generator. This model is identical to the traditional coal power plant with its attendant transmission losses from a central location en route to a remotely located consumer load. | Bachelor's degree in engineering or equivalent for MEng | Related to focus R&D of the Solar thermal spoke strategic plan 2013-2017. | Prof AB Sebitosi<br>sebitosi@sun.ac.za | Stellenbosch University |

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| | | However this concentrated heat could also be used directly by the final application. Moreover the power usage would be onsite and bypass the need to construct expensive transmission infrastructure and recurrent power loss in transmission.This latter option is particularly attractive given that South Africa's mining sector is one of the major consumers of electricity and one may question the wisdom behind converting heat energy to electricity if the final requirement is smelting for example. Attractive as this option may appear the current south African norm remains electric usage and no critical evaluation for such a potent alternative has been undertaken and published.<br><br>This project will look at the energy conversion and consumer technologies for CSP and develop a decision making tool to advise an investor as to which technology to use in a given South African context. | | | | |
| 10 | Rock bed thermal energy storage system configuration | Energy storage is the key to the successful roll-out of renewable energy. A major advantage of concentrating solar power (CSP) systems is the possibility of storing thermal energy. This technology is | Bachelor's degree in engineering or equivalent for MEng | Focus R&D of the Solar thermal spoke strategic plan 2013-2017. | Prof TW von Backström (Thermal, flow)<br>twvb@sun.ac.za<br><br>Dr Corne Coetzee | Stellenbosch University |

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| | | very effective in returning the stored energy. Previous students have investigated the effect of rock shape and size on pressure drop and heat transfer in rock beds. They have also investigated the durability of various types of rock. The objective of the proposed thesis is to configure a model rock bed, based on the information available. The emphasis will be on the structure and construction of the complete system, including the inlet and exit ducting. A physical model should be built and the system should be simulated using the flow network code Flownex, DEM or similar. | | | (DEM)<br>ccoetzee@sun.ac.za | |