STRATEGIC DEVELOPMENT PLAN FOR THE CENTRE FOR RENEWABLE AND SUSTAINABLE ENERGY STUDIES

2018–2022

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CENTRE FOR RENEWABLE AND SUSTAINABLE ENERGY STUDIES

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

NRF National Research Foundation

Eskom

sasol reaching new frontiers

UNIVERSITEIT STELLENBOSCH UNIVERSITY

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Executive Summary

The Centre for Renewable and Sustainable Energy Studies (CRSES) was established to conduct and coordinate research activities in renewable and sustainable energy studies. The Centre was established to develop the much-needed human capacity in the country, to promote and advance innovation in the field of renewable and sustainable energy, as well as to generate and disseminate knowledge (awareness).

The Centre serves as a focal point for renewable and sustainable energy research. The Centre is also one of the Eskom Specialization Centres in Renewable Energy and hosts the Eskom Chair in Power Systems Studies.

This document is the strategic development plan for the Centre for the period 2018 to 2022. It defines the Centre in terms of what it is, how it is positioned within Stellenbosch University, and how it is managed, as well as the positioning of the Centre at a national level. The plan aligns the Centre with the national government priorities through the alignment of the Centre with the provisions of the various relevant legislative prescripts. The plan also elaborates on the Centre's objectives, activities and key performance indicators (KPIs).

In addition to the information above, the strategic plan presents the marketing plan for the Centre. The key aspect of the strategy is the use of national and international collaborations to coordinate research activities in renewable and sustainable energy studies, as well as in power systems studies. The Centre also serves as an independent consultant, offering impartial consultation services to the industry, governments and state-owned enterprises (SOEs) on issues related to renewable and sustainable energy, as well as power systems studies. The consultation work includes, but is not limited to, feasibility studies, grid integration of renewable energy, etc.

1. INTRODUCTION

1.1. About the Centre

The Centre for Renewable and Sustainable Energy Studies was established in 2007 to facilitate and stimulate activities in renewable energy studies and research at Stellenbosch University. The aims of the Renewable and Sustainable Energy (RSE) Hub are to develop human capital, deepen knowledge, and stimulate innovation and enterprise in the field of RSE. Currently, the DST is still supporting the work of the Centre through an annual grant administrated by the National Research Foundation (NRF).

Stellenbosch University was designated the Specialisation Centre in Power Renewable Energy as part of the Eskom Power Plant Engineering Institute (EPPEI). The research and teaching activities sponsored by Eskom focus on concentrating solar power (CSP) and wind energy, and also include the Eskom Chair in Power Systems Studies situated within the Centre.

The Sasol Technology Group sponsored the new facilities for the Centre for Renewable and Sustainable Energy Studies, and also sponsors the work and facilities of the Solar Thermal Energy Research Group (STERG) at Stellenbosch University in support of its New Energy Business Unit.

1.2. The Positioning of the Centre at the University

The Centre is well positioned at Stellenbosch University. The different divisions under the Vice-Rector: Research, Innovation and Postgraduate Studies (Research Development, Library and Information Service, and Information Technology) place emphasis on the promotion of research outputs and innovation at SU to ensure that, in the long run, the institution builds on its frontrunner status.

Furthermore, products and services are developed that can bring about economic and/or social improvement in the country. The Centre works in line with the national government as it seeks to promote cutting-edge research and support academic

excellence within and outside Stellenbosch University through collaborative efforts within the National System of Innovation.

The University's knowledge base is strengthened by the expansion of existing and the creation of new multidisciplinary research entities, while the establishment of strategic research partnerships helps the SU to be financially sustainable.

The Centre is one of the multidisciplinary research centres located within the Faculty of Engineering. CRSES reports via the Management Advisory Board to the Vice-Rector: Research and Innovation. The management and administrative staff of CRSES are appointed by the Faculty of Engineering. CRSES is managed on a daily basis by a Director and Associate Director, assisted by a Management Committee.

2. CENTRE STATEMENTS

2.1. Vision

The Centre for Renewable and Sustainable Energy Studies enables Stellenbosch University, in partnership with other universities and other research entities within the National System of Innovation in South Africa, to be recognised as the leading, most well-known and most productive research and development (R&D) network in the field of renewable and sustainable energy in Africa. The Centre also enables the University to have a positive impact on the livelihoods of all members of society in general.

2.2. Mission

The mission of the Centre is to facilitate cutting-edge research and development activities and human capacity development in renewable and sustainable energy, as well as in power systems studies, through the mobilization and fair distribution of the appropriate resources from Stellenbosch University, government, industry, other universities, other organisations and other entities within the National System of Innovation. The Centre also seeks to establish collaboration with other universities and research centres in South Africa and internationally. The Centre also aspires to reach as many people as possible through its various awareness programmes.

2.3. Values

The Centre strives to uphold the highest standards in terms of both the research and general ethical principles as applied in society in general, and by Stellenbosch University in particular. Our engineers and researchers are highly trained to always uphold these values in their everyday activities.

3. **THE CENTRE'S PRIORITIES AND GOALS**

The Centre for Renewable and Sustainable Energy Studies continues to advance the three priorities identified in the National Development Plan, 2013. These are:

- Raising employment through faster economic growth.
- Improving the quality of education, skills development and innovation.
- Building the capability of the state to play a developmental transformative role.

These priorities/goals are discussed further below centred around the latter three priorities set out in the National Development Plan and they are as follows:

3.1. Human capacity and skills development

The Centre strives to produce highly skilled scientists, engineers and academics who will be able to compete successfully in the global knowledge economy. This will be done primarily through the training of Master's and PhD candidates, and through Postdoctoral fellows associated with the various departments within the Faculty of Engineering of Stellenbosch University, as well as at other Universities in South Africa through collaborative efforts. Interns will also be trained at the Centre through mentorship by senior engineers and engineers within the Centre and in the various relevant departments.

Human capacity development is at the heart of the strategic focus areas of the South African government, particularly in scarce skills areas such as renewable and sustainable energy, as well as in power systems research, amongst other areas. The Centre is well positioned to assist the national government in human capacity development in these areas of specialization.

The capacity development programme will go beyond Stellenbosch University. It will also take many forms, covering the training of people from industry through accredited short courses, the training of students through the facilitation of their Master's and PhD programmes, the training of interns who will be paired with engineers at the Centre, as well as the training of students from other Universities

and their lecturers through collaborative efforts. These will include, but will not be limited to, the mobilization of resources together with other institutions (particularly HDIs) for the installation of state-of-the-art equipment. The facilitation and management of research at a national level will also form a key human capacity development activity.

3.2. Creation and transfer of new knowledge

It is commonly known that the most effective tool for knowledge creation is the training of Doctoral and Post-Doctoral Students. The Centre will continue to facilitate and support the training of PhD and Post-Doctoral Students in support of knowledge creation and transfer. The major part of the resources mobilized by the Centre will be directed towards the training of PhD and Post-Doctoral fellows, as well as Master's students who will feed the PhD and Post-Doctoral streams. Research that solves real industrial and societal problems will be supported, and the knowledge created through this research will then be transferred to the industry and society to solve real industrial and societal challenges. Some of the knowledge created will be transferred through short courses and the teaching of undergraduate courses by academics supported by the Centre.

3.3. Outreach, awareness and advocacy

Outreach and awareness are important aspects for any entity or institution involved in knowledge creation and dissemination. This will guide the Centre in marketing itself and its activities. The Centre will take advantage of existing awareness programmes as well as come up with its own awareness programmes to inform society in general about renewable and sustainable energy initiatives and power systems.

3.4. Objectives

The objectives of the Centre were drawn from the priorities set out in the National Development Plan and they are as follows:

The Centre's goals	Objectives
Human capacity and skills development	• To enhance the existing R&D opportunities in renewable and sustainable energy in South Africa in particular, and in Africa in general. • To create a critical mass of expertise in renewable energy (RE) and in energy in general to support both the industry and the public sector, including SOEs. • To produce highly skilled engineers and scientists capable of successfully competing in the global knowledge society and contributing meaningfully to SA's knowledge economy.
New knowledge creation and transfer	• To create and promote a culture of innovation in applied R&D and engineering, with specific reference to renewable and sustainable energy as well as power systems studies.
Outreach, awareness and advocacy	• To maintain and enhance the existing renewable and sustainable energy awareness and other programmes in the country. • To encourage sustainable livelihoods through various environmental and renewable energy awareness programmes.
Research coordination and support for governments	• To coordinate research in renewable and sustainable energy, as well as power systems, at a national level to support the objectives set out in the National Development Plan. • To assist the national government in addressing the grand challenges identified in the National Development Plan. • To serve as a national renewable and sustainable energy asset for South Africa, and as a point of entry for renewable energy by the African community in particular and the

	international community in general. • To facilitate and coordinate national initiatives on behalf of the national government and the private sector. This will include conferences and workshops, as well as the hosting of international visitors.
Technical support for government and industry	• To provide cutting-edge practical technical solutions to African governments and the private sector that can be applied to enhance the quality of life of African society in general. • To enable the generation and transfer of appropriate knowledge to public servants, communities and the private sector.
Transformation in the field of renewable energy research area	• To exploit national opportunities in RE by using government's established recognition and trust and by unpacking the opportunities with regard to the national and governmental objectives. • To use the Centre's location (at Stellenbosch University) and the Centre's established expertise and networks to ensure that transformation of students and staff takes place. • To increase the number of black students graduating with Master's degrees in renewable energy and power systems studies.
Collaboration and networking	• To strengthen existing collaboration and the establishment of strategic partnerships at a national and international level.
Fundraising	• To mobilise adequate funding from government and the private sector to support these activities.

4. GUIDING LEGISLATIVE PRESCRIPTS

The objectives, vision and mission of the Centre are guided by the following national legislative prescripts:

4.1. Science and Technology White Paper, 1996

The Science and Technology White Paper, 1996, lists and deals comprehensively with the fundamental requirements for a science and technology policy for South Africa. These requirements are examined under the following five broad, interrelated themes:

- Promoting competitiveness and employment creation
- Enhancing quality of life
- Developing human resources
- Working towards environmental sustainability
- Promoting an information society

The White Paper further states that a prime objective of the National System of Innovation (NSI) is to enhance the rate and quality of technology transfer and diffusion from the science, engineering and technology (SET) sector through the provision of quality human resources, effective hard technology-transfer mechanisms and the creation of more effective and efficient users of technology in the private and government sectors.

4.2. National Biotechnology Strategy, 2001

The National Biotechnology Strategy, 2001, recognizes that the successful commercialization of public sector-supported research and development (R&D) requires strong linkages between institutions within the National System of Innovation and a vibrant culture of innovation and entrepreneurship, assisted by incubators, supply-side measures and other supporting programmes and institutions.

It also recognizes that, in addition to our current transformation, we also have to face a transition from an industrial society to one that is knowledge-based. Technological development and industries emerged during the industrial revolution. The main elements of these developments included energy, chemicals, manufacturing and communications. The Centre is strategically positioned to deal with the aspects related to sustainable energy. Linkages will also be created between the Centre and other institutions within the NSI and with other training institutions.

4.3. National Research and Development Strategy, 2002

The National Research and Development Strategy, 2002, identified the following strategic objectives:

- Achieving mastery of technological change in our economy and society (Innovation)

Without the establishment of new technology missions aligned to the quality-of-life goals and economic and industrial strategies, we will not be able to make progress towards a knowledge economy.

- Increasing investment in South Africa's science base (human capital and transformation)

South Africa is suffering from "frozen demographics" in the science, engineering and technology workforce, both with respect to race and gender. A winning human resource strategy will require new approaches to and investments in both the supply and demand sides.

- Creating an effective government science and technology system (alignment and delivery)

The objective here is to streamline responsibilities between various government departments.

The National R&D strategy also recognizes that experience in other countries has shown that the greater involvement by people from previously excluded sectors of the community cannot be left to chance or market forces. Special programmes are required for the promotion of women in science.

4.4. National Energy Act, 2008

The National Energy Act (Act 34 of 2008) sets out the core aspects of the mandate of the Department of Education (DoE). These are to:

- ensure that diverse energy resources are available in sustainable quantities and at affordable prices in the South African economy to support economic growth and poverty alleviation, while also taking into account environmental considerations;
- plan for the increased generation and consumption of renewable energy, and for a contingency energy supply;
- hold the strategic energy feedstock and carriers, and to ensure adequate investment in appropriate upkeep, and access to energy infrastructure;
- collect data and information regarding energy demand, supply and generation;
- promote the efficient generation and consumption of energy, electricity regulation and energy research.

4.5. Nanotechnology Strategy, 2006

The Nanotechnology Strategy, 2006, recognizes that nanotechnology is about new ways of making products or enhancing existing processes. It is expected to have a major impact in the next decade, especially in sectors such as energy storage, conversion and distribution, aerospace, medicine, electronics, ICT and associated technologies. In energy storage and distribution, nanotechnology holds much hope for the creation of viable industries on the basis of portable and sustainable power.

Internationally there generally is consensus that nanotechnology's major benefits include, amongst others, the development of cheap, efficient solar cells for the provision of clean energy that can reduce time spent collecting wood for fuel, thereby

reducing exposure to health hazards such as lung cancer, which is commonly attributed to burning wood for fuel.

4.6. Ten-Year Innovation Plan, 2008

The Ten-Year Innovation Plan, 2008, is aimed at guiding SA's medium- to longer term transformation towards a knowledge-based economy through technology development and innovation.

The enablers include: Human resources, supported through the centres of excellence, research chairs and professional development programmes, and knowledge infrastructure such as science councils, SOEs and global projects.

The grand challenges identified in the plan include:

- Farmer to Pharma
- Space science
- **Energy**
- **Climate change**
- Human and social dynamics

Energy is the backbone of the economic development of any society. It is the main input in the production of goods and services. It therefore defines the economic activities of a country and areas within the country, and their extent. However, the extraction and use of fossil fuels to produce energy comes at a huge environmental cost at both a local and global level, mainly in the form of climate change. The effects of climate change are felt mainly by the poorest in any society, as it impacts negatively on a range of economic activities such as agriculture/food security. There is also the issue of the energy poverty in South Africa that affects most rural communities. Renewable energy technologies and systems can be used to address the latter challenges. Decentralized renewable energy systems play a key role in alleviating rural energy poverty. This is because electrification using the utility grid is not feasible in most cases where households are located far apart, and they are usually far from the grid. The Centre will strive to conduct cutting-edge research geared towards the development of renewable energy technologies and systems

that can be deployed in rural areas to solve the energy crisis in such areas. One such a system supported through the Centre was the development of the solar turtle. (http://www.solarturtle.co.za/)

4.7. National Development Plan, 2013

The National Development Plan, 2013, calls for South Africa to sharpen its innovative edge and continue contributing to global scientific and technological advancement. This requires greater investment in research and development, better use of existing resources, and more nimble institutions that facilitate innovation and enhanced cooperation between public science and technology institutions and the private sector.

The production of sufficient energy to support industry at competitive prices and ensuring access for poor households while reducing carbon emissions per unit of power by about one-third, is identified as an enabling milestone by 2030.

Another key enabling milestone identified in the plan is environmental sustainability and resilience. The Plan requires achievement of the peak, plateau and decline trajectory for greenhouse gas (GHG) emissions, with the peak being reached around 2025. Economy-wide carbon price and zero emission building standards should be entrenched by 2030. The Plan requires absolute reductions in the total volume of waste disposed to landfill each year and sets as a requirement the production of at least 20 000 MW of energy from renewable sources by 2030.

The National Development Plan of South Africa also advocates the strengthening of youth service programmes and the introduction of new, community skills-based programmes aligned with the national qualification and skills development framework so as to offer young people life skills, entrepreneurship training and opportunities to participate in the mainstream and programmes of local economic development. Universities have with a mandated obligation entrenched in the Higher Education Policy Framework to provide training programmes aligned with the National Development Plan.

4.8. Integrated Resource Plan, 2010

The national government set a target of a 40% renewable energy contribution by 2030; this target is in the Integrated Resource Plan, 2010 that was approved by cabinet in 2010. It is through the efforts of centres such as the Centre for Renewable and Sustainable Energy Studies that enough human capacity can be developed in the country to enable government to reach this target. The contribution of the Centre to this will be in a number of ways, including human capacity development and knowledge generation and transfer, as explained later in this plan.

5. SITUATIONAL ANALYSIS

5.1. Current activities

5.1.1 Academic

- Fund academic positions at Stellenbosch University
- Coordinate postgraduate programmes
- Present and sponsor postgraduate modules
- Supervise research and coursework postgraduate students
- Award bursaries to postgraduate students

5.1.2 Research

- Identify, formulate and propose research projects
- Conduct research, as contract research or academic research projects
- Publish results in theses, reports, papers and articles

5.1.3 Consulting

- Specialist consulting, e.g. feasibility studies and assessments
- Technology evaluation
- Policy advice for the public sector

5.1.4 Training

- Short courses (as part of the academic modules)
- Workshops, specialised and in-house short courses
- Awareness
- Forums, open days, lectures
- Schools programme

5.2. Strengths

The strength of the Centre lies in the fact that it is well established in the renewable and sustainable energy space. It also has human capacity, both internally and in the pool of human resources around Stellenbosch University. It also has well-established links in the country and abroad.

5.3. Weakness

Although the Centre is well established and has comparatively excellent human capacity, there are areas that could be improved upon as far as human capacity is concerned to cover all areas of renewable and sustainable energy research. The human capacity could then assist the Centre with the exploitation of its full potential, and the Faculty of Engineering in general in terms of renewable energy and power systems research.

5.4. Opportunities

There are plenty of opportunities in renewable energy research and development activities. This is because the field is relatively new and growing fast. The Centre is well positioned to explore these opportunities.

5.5. Threats

It is clear that the substantial funding received by the Centre on an annual basis is not entirely sustainable. Uncertainties also exist around some of the funding streams. This is the major threat facing the sustainability of the Centre. A model needs to be developed for sustainable income generation.

6. AREAS OF BUSINESS

6.1. Solar energy

Solar energy is the radiant energy produced in the sun as a result of nuclear fusion reactions (a reaction in which nuclei combine to form more massive nuclei, with the simultaneous release of energy). It is transmitted to the earth through space in quanta of energy called photons, which interact with the earth's atmosphere and surface. The strength of solar radiation at the outer edge of the earth's atmosphere when the earth is taken to be at its average distance from the sun is called the solar constant, the mean value of which is 1.37×10^6 ergs per sec per cm^2, or about 2 calories per min per cm^2.

The strength of the solar energy available at any point on the earth depends on the day of the year, the time of day, and the latitude of the collection point. Furthermore, the amount of solar energy that can be collected depends on the orientation of the collecting object.

Research in the solar energy field has concentrated on both the active and passive solar systems. The main topic of study around solar energy has been the efficiency of the active solar systems and their lifespan. The design of passive solar buildings has also been of keen interests amongst researchers. The Centre will continue to conduct and facilitate both pure and applied research on active and passive solar systems within and outside Stellenbosch University.

The research will be focused more on the following aspects:

- Network integration
- Energy modelling and grid interaction
- Grid support and storage technologies
- Plant performance
- Solar resource assessment
- Measured vs. forecasted performance
- Effects of soiling

- Module and string mismatching
- Layout optimization
- Dynamic plant modelling
- Performance monitoring
- Technology assessment
- High efficiency thin film vs. S-ci modules

Feasibility studies will also be conducted in support of industry and government departments that want to establish the feasibility of undertaking specific projects.

6.2. Biomass, bioenergy and waste to energy

Biomass is the organic matter produced by photosynthesis. During photosynthesis, plants convert solar energy into stored chemical energy. Biomass energy comprises fuelwood, twigs, straw, animal dung, vegetable matter and agricultural waste. Processed biomass includes charcoal, methane, sawdust and alcohol produced from fermentation processes. Biomass is renewable as long as the rate of extraction balances the rate of regeneration.

Biomass is used either directly or is converted into forms that are convenient for transport and use. For energy purposes, biomass is converted into other forms such as charcoal, gas, ethanol and electricity. Biomass energy conversion technologies range from simple, traditional processes such as charcoal production in earth mounds to modern, highly efficient processes such as power co-generation.

The Centre will continue to conduct and facilitate research in the following areas:

- Detailed description of mass and energy flows in biomass conversion
- Sizing of equipment and utilities (capital and operating costs)
- Environmental assessment, e.g. Life Cycle Analysis (LCA, based on mass and energy flows, combined with feedstock supply
- Integrated sustainability assessment (identify viable solutions)

The following are examples of biorefinery processes to be supported through research:

- Ethanol and electricity (bioprocess)
- Lactic acid, ethanol and electricity (bioprocess)
- Furfural, ethanol and electricity (chemical and bioprocess)
- Butanol and electricity (bioprocess)
- Methanol and electricity (gasification-synthesis)
- FT syncrude fuel, prior to refining (gasification-synthesis)
- Jet fuels
- Higher value chemicals/fuels co-produced with electricity

6.3. Wind energy

Wind is a form of solar energy. The uneven heating of the atmosphere by the sun, the irregularities of the earth's surface and the rotation of the earth cause winds. Wind flow patterns are modified by the earth's terrain, water bodies and vegetative cover. This wind flow or motion energy can be harvested by modern wind turbines and used to generate electricity.

The Centre will continue to conduct and facilitate research on the following aspects:

- Off-shore and on-shore wind energy research (esp. support, anchoring, vibrations and power systems)
- Large wind turbines (esp. optimisation, aerodynamics and mechanics)
- Control systems (monitoring, turbine response and safety)
- Network studies from wind energy impact
- Power mechanics
- Modelling and control systems
- Small-scale application

6.4. Ocean energy

Ocean energy is a renewable energy source that can be used to generate electricity from tidal streams, waves or differences in salinity. Over 70% of the earth is covered by water. The ocean is subject to the impact of wind, tides and ocean currents and thus carries with it large quantities of energy. This means that the 'fuel' is inexhaustible and free. The different forms of ocean energy also have relatively little impact on the environment.

6.5. Hydro energy

Hydroelectricity is based on simple principles of using falling water to spin a shaft connected to an electric generator; the greater the fall of water, the greater the power to spin the shafts that are used to drive electric generators.

Hydroelectric power is the oldest form of renewable energy. Hydroelectric power, or “hydropower” as it is called, involves electricity generated by the force of moving water as it flows through a turbine. The water flows from a higher elevation to a lower elevation. The turbines are connected to electrical generators, which produce the power. Hydropower involves no emissions during the generation process. The energy generated is essentially derived from the sun and therefore is inherently renewable. Energy from the sun causes evaporation from the lakes and oceans and the water returns to the earth by precipitation.

Hydroelectric power plants thus capture the energy released by water falling through a vertical distance and transform this energy into useful electricity. The rotation of the water turbines is transferred to a generator that produces electricity. The volume of the water and the distance of the vertical drop are critical factors in determining the quantity of electricity generated.

6.6. Power/energy systems studies

Electrical power system studies involve power system modelling and network simulation in order to analyze electrical power systems using design/offline or real-time data. Power system simulation software is a class of computer simulation programs that focus on the operation of electrical power systems.

The research in power systems studies will involve the following aspects:

- Impact of distributed energy resources on the network
- Flexibility on the future grid
- Support services on the future grid
- Operations and maintenance of Eskom-owned RE plants
- Emerging renewable energy applications, e.g. micro-grids or solar thermal desalination
- Spatial planning of renewable energy power plants.
- Integration of various power systems

6.7. Energy policy, finance and economics

Energy policies form an important and integral part of renewable and sustainable energy research and development activities. The energy sector is always viewed from demand and supply perspectives. The South African energy sector has historically tended to promote policies that predominantly address supply-side issues, without necessarily looking at the various demand sectors. In South Africa, the demand side is generally analysed in terms of the energy requirements of households, industry, commerce, mining, transport and agriculture. Supply sub-sectors include the coal, nuclear, liquid fuels, gas and renewable energy systems.

From a policy perspective, social problems can arise in both the demand and supply sub-sectors. Identifying the causes of these problems can be difficult. Causal linkages may extend beyond the energy sector. Energy policies therefore must be carefully coordinated with other social sectors and also be coordinated between energy sub-sectors. To cope with multiple causal linkages, energy policy analysis usually commences with the demand side by means of a process known as ‘integrated energy planning’. This process recognizes that energy is not an end, but is rather consumed as a means to an end. Policy must facilitate optimal energy consumption and production to meet social needs. This requires consumer choice and the operation of market forces. Above all, the energy policy formulation sector requires appropriate technical data to inform policy makers. The Centre is well positioned to assist with the policy formulation process, either directly through active

participation in government committees that deal with policy formulation, or indirectly through human capacity development in the policy formulation space.

Finance is defined as the system that includes the circulation of money, the granting of credit, the making of investments, and the provision of banking facilities, as well as the science or study of the management of funds. Economics studies how individuals, businesses, governments and nations make choices on allocating resources to satisfy their wants and needs and tries to determine how these groups should organise and coordinate efforts to achieve maximum output.

Macroeconomics: concentrates on the behaviour of the aggregate economy

Microeconomics: focuses on individual consumers

The Centre will continue to conduct feasibility studies that include the financial and economic feasibility of renewable energy projects in general. The Centre will continue to provide policy briefs to the South African government, as well as assist with the development and/or revision of various renewable energy policies.

7. SCOPE OF WORK AND KEY PERFORMANCE INDICATORS

Objective No.	Objectives	Activities	Key performance indicators (KPI)
1	To enhance the existing R&D opportunities in renewable and sustainable energy in South Africa in particular and Africa in general.	Establish a solid and functional collaborative network within South Africa and in other African countries, taking advantage of available human and financial resources for the advancement of renewable and sustainable energy research and development activities in the latter countries.	Establishment of functional collaborative networks that are well funded in SA and other African countries.
2	To create a critical mass of expertise in renewable energy and energy in general to support both the industry and the public sector, including SOEs.	Mobilization and distribution of financial resources to enable the training of Master's and PhD students in Engineering and Physical Sciences. Mobilize and retain highly qualified human resources who will assist with the training of Master's and PhD students, as well as the	The amount of funds mobilized and allocated for bursaries and support of Master's and PhD students. The number of Master's and PhD graduates from Stellenbosch University and other institutions that collaborate with Stellenbosch University. The number of interns taken in by the Centre

		training of interns and junior engineers.	and departments within Stellenbosch University that are in collaboration with the Centre. The number of junior engineers trained in the Centre and other departments/institutions that are in collaboration with the Centre.
3	To create and promote a culture of innovation in applied R&D and engineering, with specific reference to renewable and sustainable energy.	Promote and support innovative research at Stellenbosch University and in other institutions that collaborate with the Centre. Mobilize financial resources to support innovative research and development initiatives at Stellenbosch University and other institutions that collaborate with the Centre.	The amount of financial resources mobilized and allocated to cutting-edge research that results in or has potential for patent filing. The number of supported personnel who are involved in cutting-edge research that results in or has potential for patent filing, both at Stellenbosch and other institutions that are in collaboration with the Centre.
4	To produce highly - skilled engineers and scientists capable of successfully competing in the global knowledge society and contributing	Support the collaborative training of junior engineers in the workplace environment after University. Seek training	The number of Master's and PhD graduates who receive training at the Centre and in industry, as well as in other departments within

	meaningfully to SA's knowledge economy.	opportunities in the industry for Master's and PhD graduates associated with the Centre. Train engineers and scientists through short courses and structured Master's degrees.	Stellenbosch University and in other institutions that are in collaboration with the Centre. The number of engineers and scientists completing the short courses supported by or through the Centre from industry and academics.
5	To maintain and enhance the existing renewable and sustainable energy awareness and other programmes in the country.	Participate in activities in which renewable and sustainable energy can be/is promoted. Mobilize resources to support initiatives that take renewable and sustainable energy awareness to schools and communities. Initiate renewable and sustainable energy resources awareness programmes on Stellenbosch University campuses and in the Western Cape in general.	The number of activities in which renewable and sustainable energy is promoted by the Centre. The amount of funds raised for support of activities that take renewable and sustainable energy awareness to schools and communities. The number of renewable and sustainable energy awareness programmes initiated at Stellenbosch University and in the Western Cape in general.
6	To coordinate research in renewable and sustainable energy, as	Create a network of research institutions and centres conducting	The creation of a network of institutions conducting research in

	well as power systems studies, at a national level to support the objectives set out in the National Development Plan.	research in renewable and sustainable energy, as well as power systems studies. Coordinate the research in the latter fields from the Centre.	renewable and sustainable energy, as well as power systems studies, and the number of research centres involved in the network.
7	To assist the national government in addressing the challenges related to climate change as identified in the National Development Plan.	Mobilize resources and support research in the field of renewable energy that is aimed at mitigating the impact of climate change associated with the use of fossil fuels. Undertake renewable energy and power systems feasibility and other studies on behalf of government and the private sector.	The amount of resources mobilized to conduct research in the field of renewable energy in general, and in power systems studies. The number of feasibility and other studies undertaken on behalf of government and the private sector, including SOEs.
8	To serve as a national renewable and sustainable energy asset for South Africa, and as a point of entry to renewable energy by the African community in particular, and the international community in general.	Participate in the country's national and international engagements in renewable and sustainable energy and power systems. Serve South Africa in most strategic committees that deal with issues within the Centre's area of business. Create useful	The number of national and international engagements that the Centre will be involved in. The number of international and African engagements with the Centre. The visibility of the Centre at a national, African and international

		African and international linkages/ collaborations and market the Centre robustly in Africa and at an international level.	level.
9	To strengthen existing collaborations and establish strategic partnerships at a national and international level.	Work closely with existing partners on joint projects, including submission of joint research proposals, co-supervision of students, and student and scientist exchange programmes. Establish new collaborations with particular emphasis on historically disadvantaged institutions so that they can benefit from the human and financial capacity of the Centre, and of Stellenbosch University in general.	The number of joint projects undertaken with existing partners between 2018 and 2022. The number of new collaborations and partnerships established between 2018 and 2022. The number of new collaborations established with other institutions, and the respective benefits associated with the partnerships.
10	To provide cutting-edge practical technical solutions to African governments and the private sector that can be applied to enhance the quality of life of African society in	Respond to calls for proposals by governments and the private sector on feasibility and other studies in the Centre's area of business. Identify and approach	The number of technical studies undertaken on behalf of industry and government departments in South Africa in particular and Africa in general.

	general.	various potential partners (government departments and industry) for implementation of joint projects.	
11	To enable the generation and transfer of appropriate knowledge to public servants, communities and the private sector.	Create knowledge transfer platforms in the form of community projects funded by government and other donors. Administer and facilitate short courses conducted by experts in the field. Organize and participate in knowledge-sharing events.	The number of community projects undertaken. The number of people from industry and government attending short courses.
12	To facilitate and coordinate national initiatives on behalf of the national government and the private sector. These include conferences and workshops, as well as the hosting of international visitors.	Partner with national government departments, government agencies and industry to coordinate national government and industry initiatives in renewable and sustainable energy as well as power systems (e.g. development and registration of courses).	The number of initiatives coordinated on behalf of national government or in support of government policies, and or with government agencies such as SANEDI, EWSETA, etc.

13	To mobilise adequate funding from government and the private sector to support the Centre's activities.	Respond to calls for funding proposals, and approach relevant government departments and industry to mobilize financial resources.	The amount of funds raised to support the Centre's activities.
14	To exploit national opportunities in RE through using government's established recognition and trust and through unpacking the opportunities with regard to the national and governmental objectives.	Hold tri-lateral meetings between CRSES, the DST and the NRF aimed at identifying and exploiting opportunities in RE.	The successful hosting of the trilateral meetings and the number of opportunities emanating from such meetings.
15	To use the Centre's location (at Stellenbosch University) and the Centre's established expertise and networks to ensure that transformation of students and staff takes place.	Encourage industry-based black staff to pursue postgraduate degrees on full- and part-time basis. These staff will be largely drawn from Sasol, the CSIR and Eskom. Encourage public servants to pursue postgraduate degrees and diplomas on a full- and part-time basis. These people will largely be drawn from the National Department of	The number of industry people and public servants pursuing postgraduate degrees and diplomas in RE at Stellenbosch University and taking courses coordinated or supported by the Centre.

		Energy, the Department of Science and Technology and municipalities.	
16	To establish access by black students to Master's degrees.	Encourage black interns with junior degrees to enrol for Master's degrees at Stellenbosch University. Support black interns through bursaries and mentorship when they enrol for Master's degrees.	The number of black students enrolling and successfully completing Master's degrees at Stellenbosch University with assistance from the Centre.

8. PERFORMANCE TARGETS

8.1. Human capacity development

The target is to produce seventy (70) Master's and PhD graduates by 2022. These include Master's students enrolled for taught Master's facilitated through the Centre. They also include Master's and PhD students receiving assistance (bursary, supervision, etc) from the Centre who will be registered in other institutions in South Africa and abroad. The target is also to mentor ten (10) interns at the Centre, and the interns will be encouraged to register for higher degrees and will be provided with bursaries to further their studies. At least five (5) Postdoctoral fellows will also be trained through the Centre over the five-year period. The accompanying table presents the summary of human capacity to be developed over the five-year period.

Table 8.1: Human capacity to be developed between 2018 and 2022

Human capacity category	**2013-2017**		**2018-2022 target**
	Target	Output	
Master's and PhD students	60	75	70
Postdoctoral fellows	0	5	5
Interns	0	9	10
Total	**60**	**89**	**85**

8.2. Research outputs

The target is to publish hundred (100) articles in accredited journals and peer-reviewed conference proceedings, including articles written by the Centre staff, students supervised by the Centre staff, as well as students who receive bursaries from the Centre while conducting their research. This will also include articles published by students who are part of any collaborative research with a bursary provided by the Centre or through the Centre. The students can be registered at any recognized University or University of technology in South Africa, Africa or internationally.

Present ten (10) research articles in national and international conferences organized locally or at an international level. Publish two (2) book chapters; the book chapters can be by any of the students or academics associated with the Centre. Produce at least two (2) patents. The accompanying table shows the summary of the research outputs target.

Table 8.2: Summary of research outputs target from 2018 to 2022

Outputs	**2013-2017**		**2018-2022 target**
	Target	Output	
Journal articles and conference proceedings	45	132	100
Conference presentations (not published)	0	0	10
Book chapter	0	0	2
Patent application	0	0	2
Total outputs targeted	45	132	**114**

8.3. Energy policy briefs

The Centre has been producing one (1) policy brief per year in a selected field. This target will not be changed. A total of 5 (five) policy briefs will be produced and shared with government and the National Research Foundation. These policy briefs will also be made available publicly through the Centre's website.

8.4. Collaborations

The Centre currently collaborates with a number of institutions inside and outside South Africa. The following diagram shows the current network of collaborators:

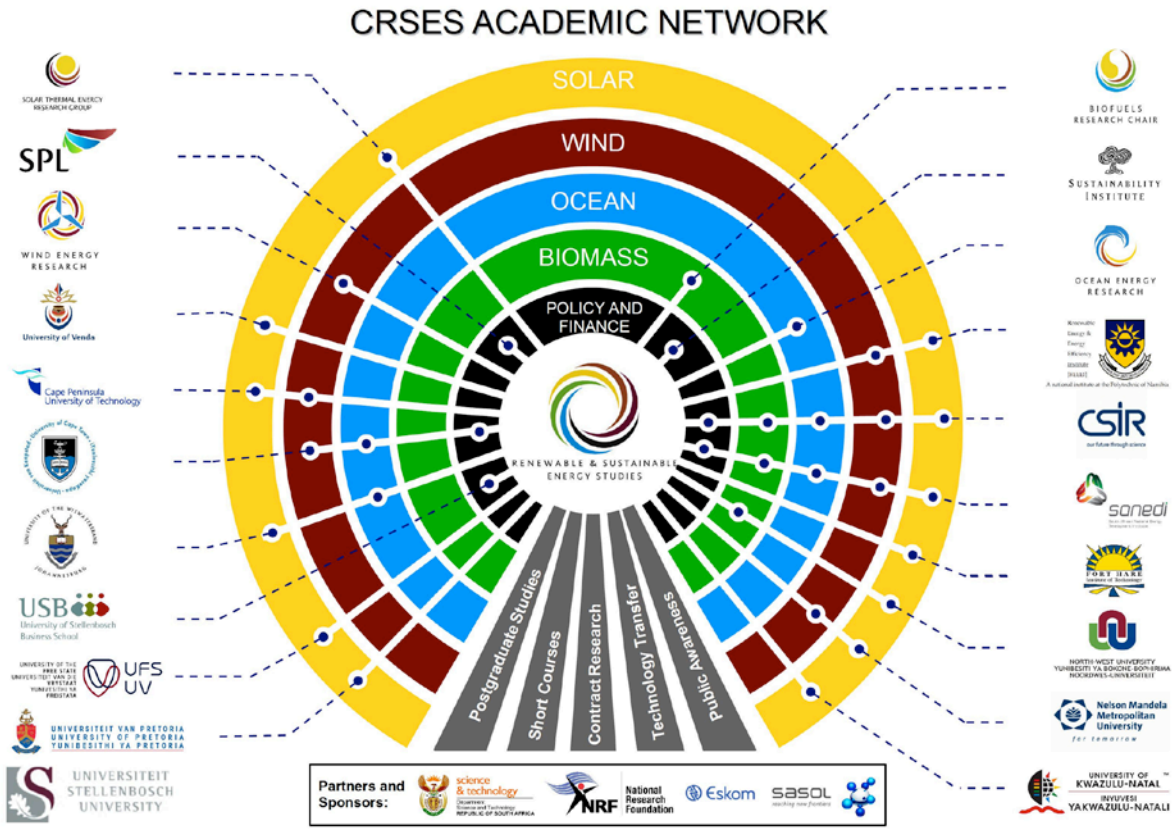


Figure 8.1: The CRSES network of collaborators in various renewable energy systems

Through our specialization Centre in Power Systems Simulation we have developed the following network of collaborators:

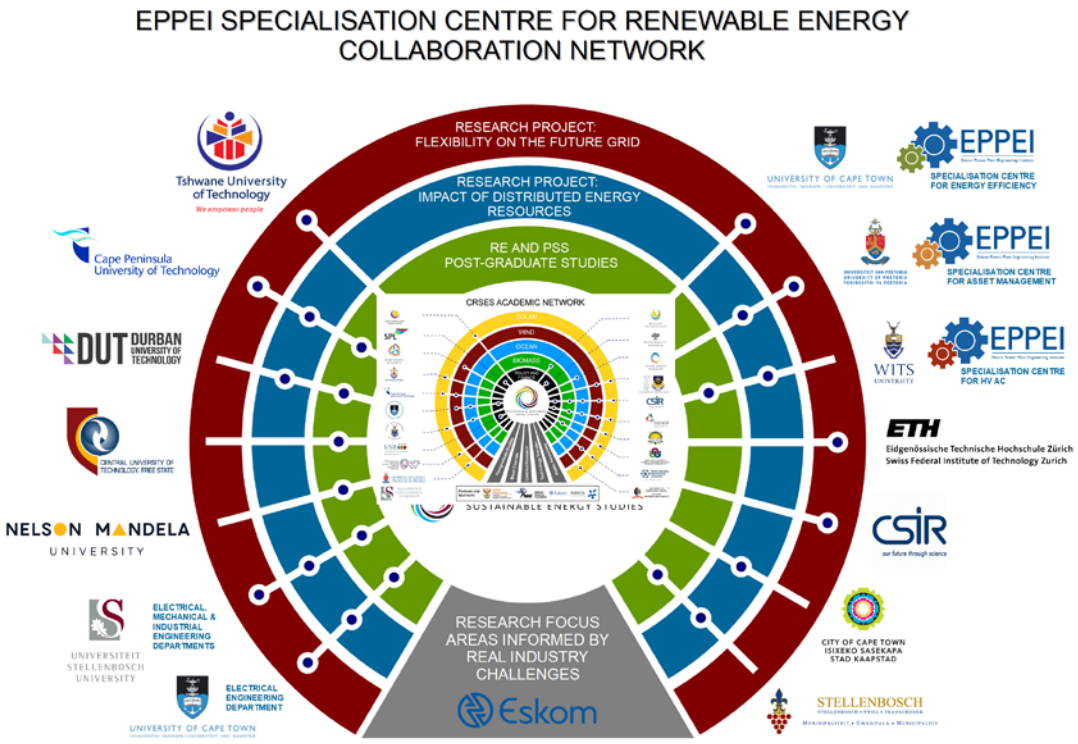


Figure 8.2: The network of collaborators in the CRES EPPEI Specialization Centre in Power Systems Simulation

The current local and international collaborations will be maintained, while an additional ten (10) new national and international collaborations will be established. These networks will assist the Centre in training highly skilled engineers and scientists locally and abroad. They will also enable us to embark on a highly effective exchange programme.

8.5. Outreach and awareness

Table 8.3 shows the targets for outreach and awareness for the years 2018 to 2022 using the schools programme.

Table 8.3: Summary of outreach and awareness targets from 2018 to 2022

Output	**2013-2017**		**2018-2022 target**
	Target	Output	
Schools reached	0	779	700
Teachers trained	0	1 089	1 000
Other Universities (training of trainers)	0	0	4
Total outputs targeted	0	1 868	**1 704**

The Renewable Energy Schools Programme will target the training of 200 teachers per year and 1 000 teachers between 2018 and 2022. This program will reach 700 schools between 2018 and 2022. Lecturers from four (4) Universities across South Africa will be trained to conduct teacher training using the material developed for the school's programme. More information will be shared through the attendance of at least two national conferences where presentations will be made.

The Centre will continue to support the National Renewable Energy Symposium, with a target to have at least 25 students presenting their research work per year and 125 student presentations between 2018 and 2022. The Centre will also continue to support the South African Solar Energy Conference (SASEC) with a target of having at least 30 presentations per year and 150 presentations between 2018 and 2022.

8.6. Technical studies for industry and governments

The technical studies/contract research conducted by the Centre includes the following:

- Solar PV advisory services
- Solar thermal (low temperature) advisory services
- Solar thermal module testing
- Ocean energy advisory services
- (Solar) Resource studies (via GeoSun)
- Bio-energy advisory and feedstock testing (via Process Engineering)
- Renewable energy policy
- Network modelling
- Market reviews
- Technology evaluation/review
- Macro-economic analyses for renewable energy
- Sustainability consulting
- Sustainability projects
- Modelling of renewable energy
- GIS modelling relating to renewable energy
- Renewable energy education

Figure 8.3 shows the total value of funding received through contract work done by the Centre in the past five years.

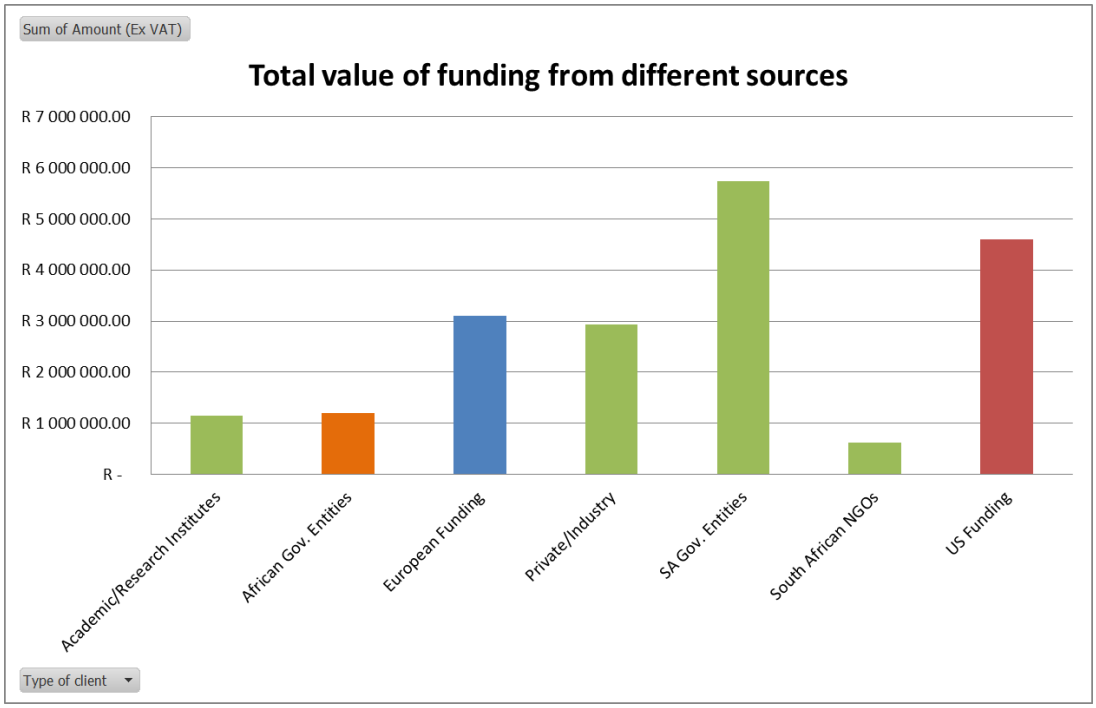


Figure 8.3: The total value of funding received by the Centre for various sources in the past five years

The Centre has received about R19 200 000 from various sources for contract work in the past five years, as indicated in Figure 8.3. No target was set for this. The target is to raise R20 000 000 from 2018 to 2022. This will include funds from studies conducted by the staff of the Centre, as well as studies conducted by the Centre in collaboration with other partners. Some of this funding will be used to support students and to pay salaries, and a good fraction of this funding will be set aside in a "sustainability" cost centre to ensure sustainable funding of the Centre going forward.

8.7. Knowledge transfer

The Centre supports National Diploma and Master of Engineering courses in renewable energy and power systems engineering. These courses are largely registered in the departments of Mechanical Engineering and Electrical Engineering at Stellenbosch University. Some of the courses are registered in the School of Public Leadership. The Centre opens up the various courses to industry, students from other Universities and public servants during the week for contact lecturing and runs a block of short courses, at a nominal fee. Each course runs for a week and the participants receive attendance certificates at the end of the course. The idea is not

to make profit through running these courses, but rather to transfer knowledge to the scientific community and public servants. These are well-established courses delivered by highly skilled academics who are respected authorities in the various fields of specialization. The courses are as follows:

- Sustainable Development
- Renewable Energy Systems
- Introduction to Solar Energy
- Wind Energy
- Renewable Energy Policy
- Thermal Energy Systems
- Renewable Energy Finance
- Bio-energy
- Hydro and Ocean Energy
- Advanced Photovoltaic Systems
- Energy Storage
- Integrated Supply-side Technologies

Table 8.4 shows the attendance of short courses between 2013 and 2016 and the target for 2018 to 2022. There was no specific attendance target in the past five years. The details of the courses are available in Appendix B of this document.

Table 8.4: The attendance of short courses between 2013 and 2017 and the target for 2018 to 2022

Short course attendance 2013-2016						**Target 2018-2022**
	2013	**2014**	**2015**	**2016**	**2017**	
RE Systems	7	3	6	6	0	20
Intro to Solar Energy	7	3	10	6	4	30
RE Policy	2	2	4	4	1	13
Thermal Energy Systems	2	1	5	0	0	10
RE Finance	1	2	6	8	5	25
Bio-energy	0	4	2	2	1	10
Wind Energy (from 2015)			1	4	0	5
Ocean and Hydro Energy (from 2015)			1	2	0	2
Advanced PV (from 2016)				12	3	18
Energy Storage (2017 only)					12	15

The targets are informed by the fact that a number of external factors, such as the changes in the implementation of renewable energy policies in the country, affect attendance numbers. It is envisaged that the signing of the additional 27 renewable energy projects will result in more uptake of the renewable energy-related courses.

8.8. Funding

Table 8.5 shows a summary of the funding target from 2018 to 2022. This is informed by the percentage growth/decline in funding received by the Centre over the past five years.

Table 8.5: Summary of funding targets from 2018 to 2022

2013	R 26 056 450
2014	R 19 042 931
% Growth / Decline (-)	- 37 %
2015	R 14 817 956
2016	R 14 604 722
% Growth / Decline (-)	- 15 %
2017	R 18 004 489
% Growth / Decline (-)	19 %
Target (2018-2022)	7%

The Centre is financially stable, as presented in the financial requirements for the Centre. The target is to increase the funding by at least 7% per year from 2018 to 2022.

9. **MARKETING PLAN**

The marketing plan is designed to increase visibility, strengthen the Centre's reputation and improve its communications efforts. The plan is to target donors/funders, media, students, and other Universities and research centres. The plan will take advantage of the competitive edge of the Centre and Stellenbosch University in general, as well as the existing and new collaborations that will be established.

The key pillars of the marketing strategy are:

9.1. Website management

This involves regular website updates with the latest information emanating from the Centre's activities and events. These will include, but are not limited to:

- Latest news
- The job opportunities page
- The information on the renewable energy short courses
- Postgraduate programmes
- The schools programme pages
- Calendar events

9.2. Social media

Social media is a strategic marketing tool because most people spend a lot of time on social media. There will be regular, timely and, at times, live updates on social media, particularly during the Centre's events such as conferences and workshops. The social media to be targeted for this purpose include Facebook, Twitter, LinkedIn and Instagram.

9.3. Advertising

The Centre will have a marketing budget that will be used to advertise the Centre's activities and events in strategic publications in the online or print media. The

publications will be strategically identified and they should have the most relevant audience to maximize the Centre's visibility amongst the relevant people. The publications should also have the capability to reach out to an audience that the Centre cannot reach without using the publications.

The Centre will also continue to have a presence on the websites of collaborators for advertising purposes.

9.4. Events marketing and promotion

A robust approach to events marketing and promotion will be adopted. The events-marketing strategy will involve the following:

- Setting of event goals
- Determining and allocating event budgets
- Identifying the event target market
- Devising communication tactics
- Identifying strategic collaborators and developing collaboration tactics/strategy
- Developing a marketing timeline/project plan and deliverables

9.5. Public relations

The Centre will have a marketing manager who also deals with public relations. This person will be responsible for updating the scientific community and relevant stakeholders about the various developments at the Centre. This person will devise a strategy to reach out to as many people as possible on a regular basis.

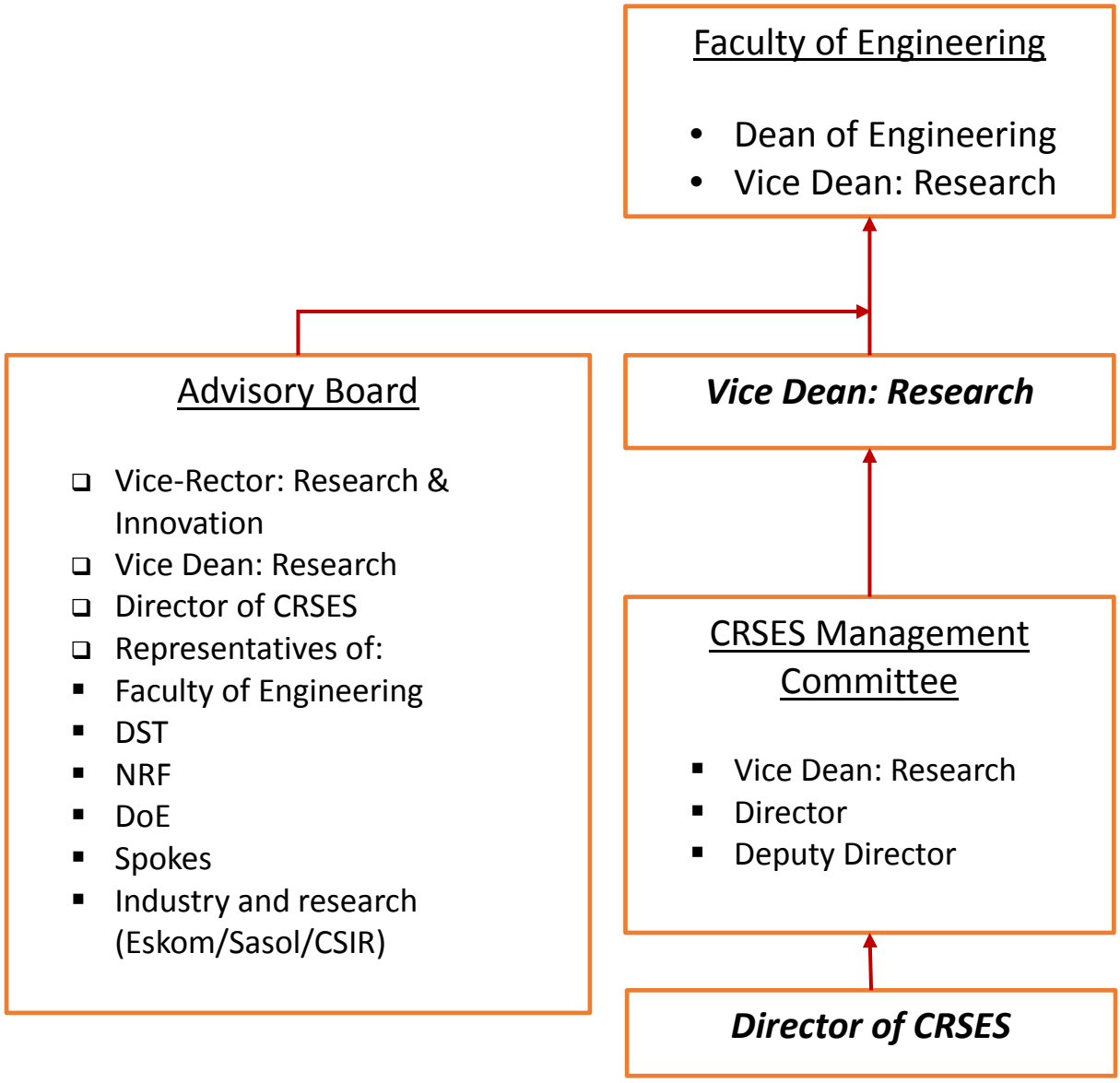
9.6. Publications

The Centre will continuously publish information in the form of brochures, published annual reports and all other relevant information that can assist in marketing the Centre. The strategic plan of the Centre will also be published in summary form on the Centre's website.

10. **GOVERNANCE SYSTEMS**

10.1. Management structure

The Centre is managed through an Advisory Board. The Advisory Board is in place to advise on strategy for the Centre and approve the strategic plans presented by the Director. The management structure is illustrated in the figure below.



The Advisory Board consists of not less than seven (7) or more than nine (9) members, comprising of at least the following people:

- The Vice-Rector: Research and Innovation, or his nominee (ex officio)
- The Director of the Centre (ex officio)
- The Dean of Engineering or his nominee (ex officio)
- A representative of the Department of Science and Technology, nominated by the Director General of the department
- A representative of the Department of Energy, nominated by the Director General of the department
- A representative of the National Research Foundation, nominated by the Executive Director responsible for the DST Centre programme
- A representative of the spokes nominated by all Universities involved with the spokes; this is a roving responsibility that changes every year
- A representative from industry nominated by the Centre's board
- Any other member(s) who are deemed able to make a technical contribution to the Centre, to be nominated by the Centre's Board, or any other member(s) who can make a contribution to the key performance areas of the Centre, to be nominated by the Centre's Board
- The chairperson is nominated jointly by the Vice-Rector (Research and Innovation), or his nominee, in consultation with the NRF Executive Director responsible for the Centre programme

The terms of reference of the Advisory Board are as follows:

- Advise on and approve objectives for the Centre.
- Advise on and approve the strategic plan for the Centre.
- Discuss and resolve matters of policy that relate to the Centre.
- Approve annual business plans, including budgets.
- Approve annual progress reports.
- Make recommendations concerning the progress through developmental gates
- Monitor, evaluate and comment on the performance of the Centre.

- Assist in the promotion of, and lobbying for support for, the Centre to facilitate the achievement of the objectives of the Centre.
- Advise the Centre on its resource requirements, including the budget.

In fulfilling their fiduciary role, the members of the Centre's Board will be expected to observe policies and principles of good corporate governance and to cooperate in efforts to apply these. This may include the provision of personal details, declaration of conflicts of interest and reporting of fraudulent activities.

A member of the Board, excluding the *ex officio* members, shall be appointed for a period of three (3) years, but shall be eligible for reappointment. The *ex officio* members will serve while in office.

A Board member may nominate an alternate to represent him/her at meetings if he/she is not able to attend. To this end, duly signed proxies must be submitted prior to the commencement of any Board meeting.

A Board member effectively vacates his/her position if he/she resigns, is absent for three (3) consecutive Board meetings without apology, of if the Chairperson terminates his/her membership.

Meetings of the Board shall be held locally at least twice (2) per annum, at such time and place as the Board may determine. The meeting documents shall be prepared and communicated by the Centre to the Board two weeks before the meeting. The minutes shall be the Centre's responsibility and shall be distributed a month after the meeting.

The Chairperson may, by giving reasonable notice, at any time convene a special meeting of the Board, which shall be held at such time as he/she may direct.

The quorum for a meeting of the Board shall be five (5) members, and at least Stellenbosch University must be presented by its respective board member/s.

A decision of the Board shall be taken by resolution of the majority of the members present at any meeting of the Board and, in the event of a split vote on any matter,

the Chairperson shall have a casting vote in addition to his/her deliberative vote as a member of the Board.

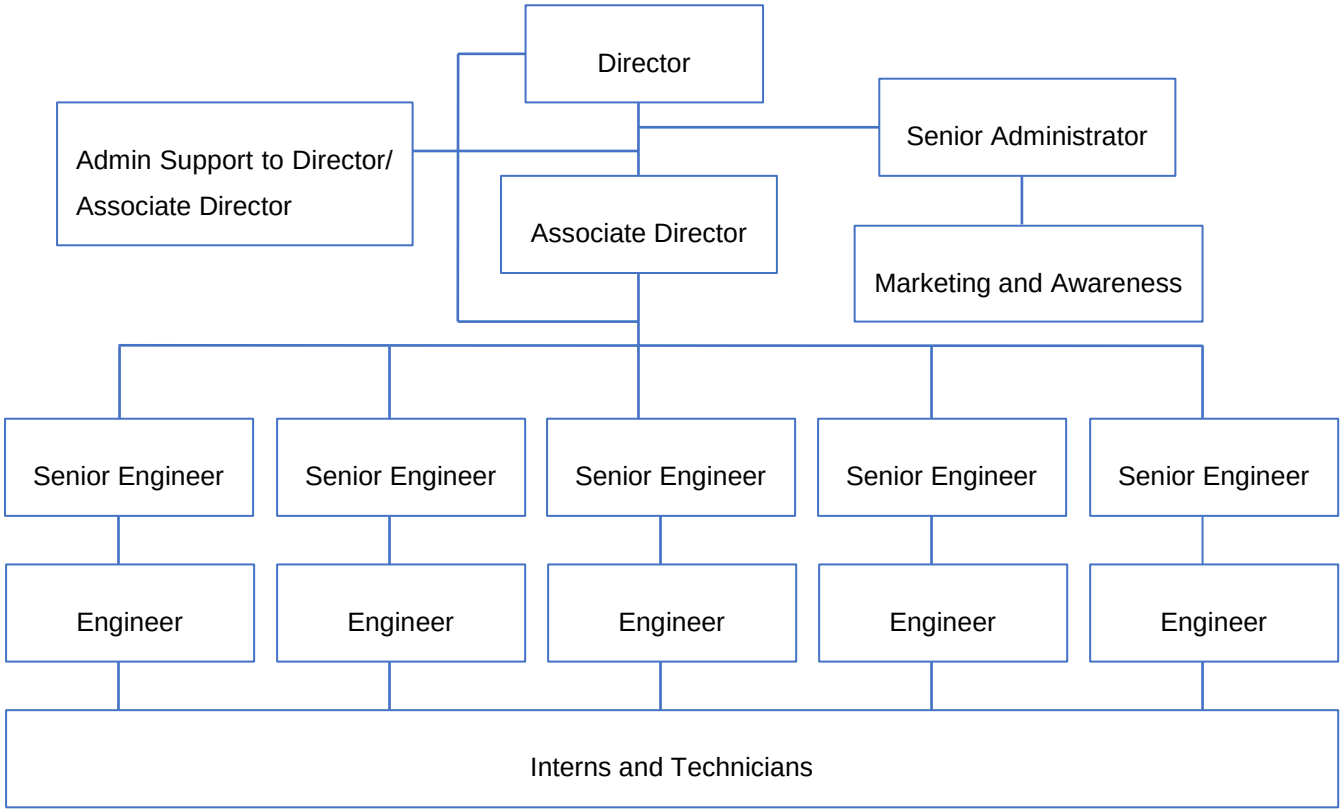
Where the Chairperson is not available, the Board members may elect a Chairperson for the particular meeting. The Chairperson for the day shall be voted for only by members who are present and by a show of hands.

Subject to the approval of the Chairperson, any other person may attend and participate in a meeting of the Board but may not vote.

The Centre for Renewable and Sustainable Energy Studies is responsible for providing secretarial support to enable the Board to perform its function and providing for expenses necessary for the functioning of the Board.

10.2. Organogram of the Centre

The organogram of the Centre is provided in the figure below.



10.2.1 Job descriptions

10.2.1.1. Director

The Director's role is to provide strategic leadership to the Centre, as well as to take the lead in the mobilization of resources to advance the activities of the Centre. He/she is also the accounting officer of the Centre in all aspects. The Director is responsible for the following activities:

- Providing leadership to the Centre by making strategic decisions and drafting strategic documents and recommending these for approval by the Management Committee.
- The day-to-day running of the Centre at the level of chief executive officer.
- Internal and external reporting on the Centre's activities, including reporting to the Management Committee on a monthly basis and reporting to project funders.
- Human resource management, including recommendations for the hiring of staff members to the Management Committee, ensuring that staff members conduct their work in an efficient and effective manner, as well as ensuring human capacity development at the Centre.
- General office management, including enforcing office rules, and ensuring the safety and security of staff, students and all other people associated with or visiting the Centre.
- Organizing and chairing or nominating a chairperson for all staff and associated meetings.
- Allocating resources to staff and students associated with the Centre. The resources could include work stations, computers, etc.
- Budgeting, financial management and controls, including expenditure controls.
- Fundraising for the Centre.
- Establishing and managing internal and external collaborations.
- Reviewing and approving all proposals before they are sent out to funders or in response to calls for proposals.

- Approving all project quotations before they are sent to prospective customers.
- Approving all project reports generated by various project managers/leaders before they are sent to project funders and/or other interested or affected parties.
- Providing oversight of the overall management of the Centre's activities and projects.
- Representing the Centre in the Faculty Board and other faculty committees as determined by the Dean of the Faculty.
- Representing the Centre in the University Senate and all other associated Senate committees as determined by the Deputy Vice-Chancellor/Vice-Chancellor or any relevant authority.

10.2.1.2. Associate Director

The Associate Director's role is to assume the duties of the Director in case the director is unable to perform his/her duties due to illness, leave or any other reason that may arise. The director may also assign duties to the Associate Director as and when he/she deems fit.

10.2.1.3. Senior Administrator

The Senior administrator's role is to offer administrative support to the Director with all the administrative activities of the Centre. He/she is responsible for the following:

- Assisting the Director in budgeting, financial controls and management.
- Initiating the drafting of financial reports and other key reports as assigned by the Director.
- Managing the administrative and other support staff of the Centre, including the Administrative Support staff of the Director and the marketing and awareness staff.
- General administration of the Centre's activities, as and when assigned to do so by the director.

10.2.1.4. Marketing and awareness support staff

The role of the marketing and awareness staff is as follows:

- Implementing all awareness programmes.
- Marketing of the Centre internally and outside Stellenbosch University, at a local and international level.
- Developing marketing material.
- Packaging of marketing material for distribution or use on various marketing platforms.
- Updating the Centre's website and managing the Centre's activities such as conferences.

10.2.1.5. Administrative support to Director and Associate Director

The role of the Administrative Support staff to the Director and Associate Director is to assist the Director and Associate Director with the general administration of their daily activities, including the following:

- Receiving guest at the Centre.
- Answering telephone enquiries and responding to the phones of personnel who are out of town.
- Making tea/coffee for guests and clients.
- Keeping reception area and office neat and tidy.
- Maintaining Excel database of industry contacts.
- Obtaining quotes for printing.
- Obtaining quotes for personnel flights.
- Filing of documents as and when necessary.
- Sending mass emails to the public and students.
- Supporting the engineers with regard to data collection, obtaining quotes, making photocopies and doing other tasks as needed.
- Maintaining attendance figures for forums and other events offered by the Centre and providing support with serving refreshments during functions and forums.

- Bookings of boardrooms for client/guest meetings.
- Maintaining distribution lists in Outlook.
- Maintaining a list of renewable energy contacts.
- Maintaining a list of overseas courses related to renewable energy.
- Performing other duties as requested by supervisor.
- Making name tags and drawing up attendance registers for conferences.
- Maintaining records and contacting EPPEI students as needed.
- Keeping the kitchen clean and neat; ordering supplies on time.
- Issuing purchase orders for kitchen supplies.
- Dispatching of packages via courier, issuing purchase orders.
- Mail: collecting, submitting mail for dispatch, emergency by-hand pieces.
- Waste paper: organising regular pick up.
- Photocopy machine: Ensuring there is always paper, replacing ink cartridge when needed, keeping the area need and tidy.
- Undertaking all other administrative duties as assigned by the Senior Administrator, Director or Associate Director.

10.2.1.6. Senior Engineers

The role of the Senior Engineer is to conduct research and development activities in the respective area of specialization, including the following:

- Assisting the Director in the mobilization of financial resources through research proposals as well as other funding proposals.
- Coordinating collaborative research activities with other institutions that are in partnership with the Centre.
- Managing research and consultation projects/contract research on behalf of the Centre as assigned by the Director.
- Mentoring engineers and interns associated with the Centre in the respective fields of renewable energy and power systems.
- Attending meetings on behalf of the Director, as well as representing the Centre in strategic activities related to the Centre's core business as assigned to do so by the Director.

- Supervising Master's and PhD candidates associated with the Centre and who are registered at Stellenbosch University and/or other Universities that are in research collaboration with the Centre.
- Publishing research articles in high-impact journals accredited by the national Department of Higher Education and Training.
- Presenting research findings at national and international conferences.
- Assisting the Director in drafting reports for submission to project funders and other interested parties.
- Assisting the Director in the day-to-day running of the Centre in general.
- Presenting reports to interested and/or affected parties as assigned to do so by the Director.

10.2.1.7. Engineer

The role of the Engineer is to conduct research and development in support of the Senior Engineer in the respective area of renewable energy or power systems, and it includes the following:

- Conducting academic research and consultation projects as assigned by the Senior Engineer.
- Publishing research findings in high-impact journals accredited by the national Department of Higher Education and Training.
- Presenting reports to funders and other interested or affected parties as assigned by the Senior Engineer or Director.
- Writing project reports as assigned by the Senior Engineer or Director.
- Mentoring interns as well as assisting technicians with complex technical work.

10.2.1.8. Interns and technicians

The interns will be taken in by the Centre for training to improve their skills and knowledge in the field of renewable energy and power systems. They will be mentored primarily by engineers, and to a lesser extent by senior engineers. The

technicians will do all the technical work for the Centre, both on and off campus. They will also receive mentorship from engineers.

11. **PERFORMANCE MONITORING AND EVALUATION**

The performance of the Centre is monitored on a monthly basis through the Management Committee chaired by the Vice Dean (Academic Affairs). There is also a Management Advisory Board, which advises on strategic issues as indicated under the section on governance. The Advisory Board meets twice a year and also assesses the performance of the Centre. A detailed performance report is presented to the Advisory Board by the Director of the Centre. In addition to this, progress reports are produced on the various projects at a frequency required by the various funders. These reports also feed into the main annual performance report. The annual performance report is submitted to the office of the Deputy Vice-Chancellor (Academic Affairs).

12. **POSSIBLE FUNDING STREAMS**

There are various funding streams available to the Centre, among which the following:

- Contract research work conducted in areas of business
- The National Research Foundation (NRF)
- The National Department of Science and Technology
- The National Department of Energy
- The South African National Energy Development Institute
- State-owned enterprises such as Eskom
- Industry partners such as SASOL
- Other donors

13. **FINANCIAL REQUIREMENTS**

The financial requirements of the Centre are based on staff requirements, student support in the form of bursaries, running expenses for the Centre, and academic as well as capital expenses. A budget projection for the year 2018 is presented herein. The budget projections for 2019 to 2022 will be completed on a yearly basis a year before the respective year. These budgets will change depending on the availability of funding.

13.1. Operating budget for 2018

The accompanying table shows the operating budget for 2018:

Table 13.1: Operating budget for 2018

Budget item	**Budget amount (ZAR)**
Personnel Cost: Core staff	R 5 203 353
Personnel Cost: Academic/Research staff	R 5 144 647
Running Expenses	R 2 006 709
Academic Expenses	R 384 000
Capital Expenses	R 283 900
Bursaries	R 5 736 667
Contingency	R 667 571
5% of Total NRF grant	R 667 571
TOTALS	**R 19 426 847**
INCOME	**Total Budgeted Funds**
Projected Income for 2018	**R20 902 465**
Reserves December 2017	R7 752 651
Projected Reserves December 2018	R9 228 269

The operating budget for the years 2019 to 2022 will be done on a yearly basis.

APPENDIX A: CURRENT HUMAN CAPACITY

PROF SAMPSON MAMPHWELI

Director

Professor Sampson Mamphweli holds a Master's degree from the University of Venda and a PhD from the University of Fort Hare. He worked as a Senior Researcher and Associate Professor at the University of Fort Hare, where he started working as a Researcher while conducting his PhD in 2005. Prof Mamphweli also possesses a number of certificates in Renewable Energy and a mini-MBA certificate in Green Energy from the Green Power Academy in Britain. He has published more than 45 research articles in peer-reviewed journals, as well as three book chapters, and has presented more than 36 research articles at national and international conferences, including eight invited presentations and keynote addresses. He has supervised 18 Master's and PhD students to completion. Prof Mamphweli previously raised funding and implemented a considerable number of renewable energy projects in the Eastern Cape while at the University of Fort Hare. His primary area of specialization is biomass gasification and biogas digesters. He also managed a number of renewable energy projects on behalf of the Faculty of Science and Agriculture at the University of Fort Hare. Prof Mamphweli is a member of the South African Institute of Physics. He is also a member of a number of committees that deal with renewable energy issues at a national government level. Prof Mamphweli started off his career at the South African National Parks before moving to the University of Cape Town, where he worked as a Research Technician before joining the University of Fort Hare as an Eskom Research Fellow in 2005. He is a recipient of the prestigious University of Fort Hare Vice-Chancellor's Emerging Researcher Medal for the year 2012. Prof Mamphweli joined Stellenbosch University in July 2017 as Director of the Centre for Renewable and Sustainable Energy Studies.

DR BERNARD BEKKER

Eskom Chair in Power System Simulation and Associate Director

Dr Bernard Bekker obtained his PhD in Electrical Engineering from the University of Cape Town, studying off-grid electrification projects. He originally trained as an electronic engineer, working in banking as a systems and network analyst, before redirecting his career towards his two passions: green building and renewable energy. After co-founding a solar PV company, which continues (via an acquisition in 2015) as one of the top commercial installers in South Africa today, he joined a hybrid inverter design and manufacturing company as CEO in 2014. In June 2017 he joined Stellenbosch University, focusing his research on power system planning and operation, specifically related to the increasing prevalence of grid-connected distributed storage and generation.

DR NAWAZ MAHOMED

Associate Professor

Nawaz Mahomed received his BScEng and MScEng degrees from the University of Cape Town and his PhD in the field of Mechanics from the Institute for Fundamental Technological Research of the Polish Academy of Sciences in 1998. Prior to joining the Department of Mechanical and Mechatronic Engineering as Associate Professor in 2015, he held positions at the Cape Peninsula University of Technology (including position of Dean), the Institute for Maritime Technology (Armscor), the Department of Science and Technology and the CSIR. His research interests include computational modelling and the simulation of high viscous flows and metal solidification, dye-sensitised photovoltaic cells and other thin film technology applications.

MR ULRICH TERBLANCHE

Senior Research Engineer

Mr Ulrich Terblanche holds a BEng in Mechanical Engineering from Stellenbosch University. He completed his MSc degree in Sustainable Energy Engineering from the Royal Institute of Technology (KTH) in Stockholm, Sweden. Former work experience includes project engineering and piping design in the oil- and gas-refining sector, analyses of using excess heat for district heating and electricity generation in the cement manufacturing industry, as well as PV-hybrid systems and energy-efficient design in the renewable energy sector. His focus includes sustainable energy solutions, industrial energy efficiency analyses, and PV and hybrid system design. Mr Terblanche is currently the in-house Project Manager for all the projects at the CRSES.

MS KARIN KRITZINGER

Senior Research Engineer

Ms Karin Kritzinger holds a Bachelor's degree in Commerce and a Master's degree in Philosophy (renewable energy) from Stellenbosch University. Having originally trained as an accountant, and then farmed for 16 years, she has a solid understanding of energy and resource flows. She has worked as an independent sustainable energy consultant and was the sector development manager of energy efficiency at the GreenCape Initiative until January 2013. In February 2013 she was appointed as a researcher at the Stellenbosch University Centre for Renewable and Sustainable Energy Studies (CRSES). She currently holds the position of Senior Research Engineer at CRSES and manages the inter-university programme in power system simulation (IUP – PSS) within the Eskom Power Plant

Engineering Institute (EPPEI). Her research areas include energy policy and finance, energy modelling and local government.

MS THERESE LAMBRECHTS

Schools Programme Manager

Therese Lambrechts holds a BMus Ed degree from Stellenbosch University. She successfully completed her Master's degree in Environmental Education at Rhodes University. She manages the Schools Programme at the Centre, which aims to develop knowledge of the socio-ecological challenges and associated risks of climate change, as well as of South Africa's need for a sustained supply of clean energy, specifically among South African youth. She has developed and implements appropriate learning support material on renewable energy for teachers nationally. The aim of her studies was to investigate how teachers utilise the learning material in order to improve both the material and the effectiveness of the programme.

MR ANGELO BUCKLEY

Research Engineer

Mr Angelo Buckley holds a BEng degree in Mechanical Engineering from Stellenbosch University. He successfully completed his Postgraduate Diploma in Renewable Energy (cum laude) at Stellenbosch University and is employed as a Research Engineer at the Centre for Renewable and Sustainable Energy Studies.

MR NDAMULELO MARARAKANYE

Research Engineer

Mr Ndamulelo Mararakanye holds a BSc (Eng) and MSc (Eng) (with distinction), obtained from the University of Cape Town in 2013 and 2017 respectively. His MSc thesis focused on developing, modelling and simulating control systems for hybrid power systems for rural electrification. He is employed as a Research Engineer in the Centre for Renewable and Sustainable Energy Studies.

MR JASON FAIRHURST

Research Engineer

Mr Jason Fairhurst completed his BEng in Mechatronic Engineering at Stellenbosch University in 2013. In 2015 he obtained his MEng degree (Cum Laude) in Mechanical Engineering – Renewable Energy, in which he focused on ocean wave energy. Jason's expertise lies in fluid dynamic modelling, optimization and mechanical design. His position and skillset contribute greatly to the Ocean Energy pillar of CRSES, through which we hope to bring ocean energy conversion to South Africa. He is also a co-founder and director of two non-profit organizations that focus on educating the youth about living sustainable lifestyles and on community upliftment through social interaction.

MS NTOMBI NQANDELA

Intern

Ms Ntombi Nqandela, an intern at the Centre for Renewable and Sustainable Energy Studies at Stellenbosch University, holds a BTech in Mechanical Engineering from Cape Peninsula University of Technology and is currently registered for a PGDip in Renewable Energy at Stellenbosch University.

MR DONALD FITZGERALD

Intern

Mr Donald Fitzgerald is currently an intern at the Centre for Renewable and Sustainable Energy Studies at Stellenbosch University. He holds a MSc in Mechanical Engineering from the University of KwaZulu-Natal that focused on the design of a supersonic turbine running in the first stage of a liquid-propellant rocket engine turbopump.

MR LAVHELESANI MALULEKE

Intern

Mr Lavhelesani Maluleke is an intern at the Centre for Renewable and Sustainable Energy Studies at Stellenbosch University. He is currently completing his qualification in Mechanical Engineering at the Cape Peninsula University of Technology.

MS JOS LIEBENBERG

Senior Administrator & Financial Officer

Ms Jos Liebenberg holds a BA degree (Unisa) and Higher Education Diploma (University of Pretoria). She is the Financial and Administrative Officer for the Centre for Renewable and Sustainable Energy Studies at Stellenbosch University.

MS SANDELIZE HEYDENRYCHT

Receptionist & Administrative Assistant

Ms Sandelize Heydenrycht holds a National Diploma in Management from Boland College at Stellenbosch, and is aiming to study further in the near future. She is the Receptionist and Assistant to the Director and Associate Director of the Centre for Renewable and Sustainable Energy Studies at Stellenbosch University.

MS CARLA NEL

Administrative Officer

Ms Carla Nel holds a diploma in Retail Business Management from the Cape Peninsula University of Technology and a diploma in Web Development and Design from Prestige College. She is the Administrator who deals with the Short Courses, and also deals with Marketing and issues related to Post-graduate studies in Renewable Energy.

APPENDIX B: SHORT COURSES

Renewable Energy Systems

(Certificate of Attendance)

Synopsis:

This course forms the foundation of the various modules in Renewable and Sustainable Energy Studies. It addresses the **scientific, engineering** and **resource aspects** of various types of renewable energy systems, and the integration of systems to provide effective and sustainable production and delivery of energy.

Course participants are exposed to an introductory level of technical insight into the various renewable energy production, storage and transmission systems, and will apply the knowledge in a project-based learning experience. The main themes include:

- Basic concepts of Mechanics, Energy, Heat Transfer, Thermodynamics and Electricity related to renewable energy technologies;
- Introduction to Renewable Energy Technologies:
    - Solar Thermal Energy
    - Solar PV Technology
    - Geothermal Energy
    - Bioenergy
    - Wind Energy
    - Hydropower
- Renewable Energy Storage and Transmission
- Case studies of renewable energy systems.

No academic credits can be obtained through this course.

Who should attend:

Engineers, technologists and technicians active in the energy sector. Architects, planners and developers. Government and local authority officials. Investors.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level will be awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

Registration

The course is designed for a restricted number of attendees so as to personalise and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

Registration must be done online.

Check our website:
www.cres.sun.ac.za

No registration is final until you have received confirmation by e-mail from Stellenbosch University.

Course Fees

- Contact us for the course fees for the particular year.
- **Cancellation of enrolment will be subject to a 15% handling fee**, however, substitutions will be accepted.
- Attendance without payment will not be permitted.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course or change the lecturer, in which case all fees will be reimbursed in full on request.
- The course fee includes all study material and tea/coffee and lunches.

Presenter

Prof Nawaz Mahomed joined the Department of Mechanical and Mechatronic Engineering and the Centre for Renewable and Sustainable Energy Studies (CRSES) in 2015, having previously held positions at the CSIR, the Department of Science and Technology, the Armscor Institute for Maritime Technology and CPUT. He holds degrees in Mechanical Engineering from the University of Cape Town and a PhD in Mechanics from the Polish Academy of Sciences. His research interests cut across a broad range of applications in the field of mechanics of high viscous flows and heat transfer. He has worked on the development of die-sensitised solar cells employing flexible substrates, and the modelling and simulation of the behaviour of metallic thin films used in PV technology. From 2011 to 2014, as Dean of the Faculty of Engineering at CPUT, he jointly led the development of the SA Renewable Energy Technology Centre (SARETEC) in cooperation with CRSES. During this period, he also facilitated a number of cooperation partnerships in renewable energy, which included technology projects for sustainable livelihoods and the localisation of renewable energy technologies. He is currently involved in two Europe-funded projects on the “Development of a Harmonised Modular Curriculum for the Smart Grid” and “Academic Initiative for Renewables”.

Bio-Energy

Synopsis

The course considers the practical and commercial application of the various technologies for biomass conversion into bio-energy. The production of first- and second-generation bio-fuels, electricity and heating as the main forms of renewable energy are covered, with an emphasis on the critical issues of sustainability, energy efficiency and commercial feasibility. The following aspects of bio-energy production are included:

- Sustainable supply of biomass for bio-energy production
- Electricity production from biomass
- Bio-ethanol production, including substrate preparation, microbial conversion and separations
- Thermo-chemical conversions, including combustion, gasification and pyrolysis, and the use of these for green electricity production
- Biogas production, for example from landfill sites, animal dung and waste-water treatment
- Biodiesel production, including process basics, product purification and waste treatment

The selection of the most appropriate technology to combine sustainable biomass supply with energy demands is a central thread throughout the course. The sustainability of the value chain for the various biomass sources and conversion technologies is an important component of the course. The entire value chain is considered comprehensively, partly through group work, which is a key learning activity in the course.

Who should attend

Engineers, technologists and technicians active in the energy sector. Government and local authority officials. Architects, planners and developers. Investors.

Certification

A Certificate of Attendance with an indication of the CPD points and level will be awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

No academic credits can be obtained by attending this course.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

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Course Fees

- Contact us for the course fees for the particular year.
- **Cancellation of enrolment** will be subject to a 15% handling fee. substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full.
- The course fee includes all study material, tea/coffee and lunches.

Presenter

Prof Johann Görgens is a professor in the Department of Process Engineering at Stellenbosch University. He holds a PhD in Biochemical Engineering and has more than 15 years of research experience in biomass processing and bio-energy production, dealing with both technical process development/ optimisation and the commercial viability of various bio-energy options. His interests are the sustainable life cycle management of renewable energy technologies, with an emphasis, over the past five years, on bioenergy value chains.

Introduction to Solar Energy

(Certificate of attendance)

Synopsis

The course consists of an introductory study of solar energy systems and covers a wide range of solar-related topics.

It will give an insight into solar resource assessment, including standard solar measurement instruments, satellite-derived solar data, solar modelling software and solar maps and layers.

The manufacture, system design and installation of photovoltaics are covered. PV systems that are covered include: off-grid-, residential-, commercial- and utility-scale systems. Concentrating photovoltaics (CPV) and solar trackers are included.

The course also covers solar thermal systems. It includes basic principles of thermodynamics, heat transfer and optics. It then covers technologies such as concentrated solar power (CSP), solar water heaters (SWH) and solar cooking.

A full day is dedicated to site visits, which typically include a solar manufacturing facility (either PV, inverter or SWH) and a commercial solar installation (typically a large rooftop PV installation on a wine farm of factory).

No academic credits can be obtained by attending this course.

Who should attend

Engineers, technologists and technicians active in the energy sector. Architects, planners and developers. Government and local authority officials. Investors.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level is awarded to all participants who attend the full course. from Monday morning to Saturday lunchtime.

Registration must be done online.

Check our website:
www.cres.sun.ac.za

No registration is final until you have received confirmation by e-mail from Stellenbosch University.

Course Fees

- Contact us for the course fees for the specific year.
- **Cancellation of enrolment** will be subject to a 15% handling fee.; however, substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full.
- The course fee includes all study material, tea/coffee and lunches.

Presenters

Mr Riaan Meyer holds a BEng in Electrical Engineering and an MScEng in Mechanical Engineering. He joined CRSES in 2006 and has worked on a number of solar-related projects. In 2012 Riaan became the Managing Director of GeoSUN Africa, a spin-off company from CRSES that focuses on solar resource-related services and products. GeoSUN Africa is active in a number of Sub-Saharan African countries.

Dr Johann Strauss is a senior lecturer in the Department of Electrical and Electronic Engineering. He holds a PhD in Electrical Engineering. His main research fields are electrical energy systems and efficient energy conversion. For the past few years he has concentrated in particular on free-piston Stirling engines/linear generators and photovoltaic systems.

Hydro and Ocean Energy

Synopsis

Ocean and hydropower can make a significant contribution to the generation of renewable electricity. In this introductory course, both ocean and hydro energy associated with the elevation or movement of water are studied, giving students a basic overview of the relevant resources, conversion technologies, project development and implementation, and the associated environmental and economic impacts.

Hydro Energy

The course deals with the aspects listed here: Environmental, social and economic impacts and the Hydrological Impact Assessment Protocol. World and South African hydrological resource magnitude. Existing hydro installations in the world and in Africa. Types of hydro power plants and turbines. Turbine-selection criteria: specific speed and specific power parameters. Turbine efficiency. Hydraulic design, hydraulic losses, pipe friction and other losses. Multiple turbine units. Basic operational constraints. Costing. Cost of hydropower. Micro-hydropower systems. Technology developments. Future scenarios.

Ocean Energy

It is possible to extract energy from ocean waves, currents, tides, and salinity and temperature gradients, and to use it to generate electricity. In this course, the different ocean energy resources are studied, as well as the conversion technologies applicable to each. In addition, aspects such as resource measurement and assessment, technology readiness, environmental concerns and the economics of ocean energy projects will be addressed, with particular emphasis on the available resource along the South African coast.

No academic credits can be obtained by attending this course as short course for industry.

Who should attend

Engineers, technologists and technicians active in the energy sector. Architects, planners and developers. Government and local authority officials. Environmental investors.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level is awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

Registration must be done online.

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No registration is final until you have received confirmation by e-mail from Stellenbosch University.

Course Fees

- Contact us for course fees for the specific year.
- **Cancellation of enrolment** will be subject to a 15% handling fee, however, substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full.
- The course fee includes all study material, tea/coffee and lunches.

Presenters:

Prof Wikus van Niekerk holds a PhD in Mechanical Engineering from the University of California at Berkeley and is the Director of the Centre for Renewable and Sustainable Energy Studies. His main research areas are the conversion of the energy in ocean waves and currents to useful mechanical and electrical power. He has published a number of papers and articles in the area.

Prof Theodor von Backström holds PhD and DEng degrees from Stellenbosch. He taught Turbo-machinery and Fluid Dynamics at Stellenbosch University. He supervises graduate students in fluid machinery and renewable energy systems and is rated by the National Research Foundation as a researcher with considerable international recognition.

Advanced Photovoltaic Systems

(Certificate of Attendance)

Synopsis

The aim of the course is to provide attendees with the understanding and tools to design grid-tied (including hybrid configurations with backup power) PV systems within the South African solar resource, technical and legislative contexts. The underlying design criteria will be to optimize the energy yield versus lifecycle costs of the PV system within the given resource, technical and legislative constraints, i.e. optimizing the financial viability of the system.

Specifically, the following topics are covered:

- Solar resource and irradiation data sources
- Different solar PV technologies
- Photovoltaic panel: electrical characteristics, maximum power point, influence of shading and diffuse irradiation, etc.
- Photovoltaic array: impact of positioning and tracking, string design and DC cable sizing, etc.
- Connection to the distribution grid: power electronics basics, earthing and circuit-breaker design, system sizing, AC cable sizing, South African regulations and standards, etc.
- Financial viability: understanding tariffs, payback, etc.

No academic credits can be obtained by attending this course.

Who should attend

Engineers, technologists and technicians involved in the marketing, design & implementation of grid-tied PV systems.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for four (4) Continuous Professional Development points. A **Certificate of Attendance** with an indication of the CPD points and level will be awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

Registration must be done online.

Check our website:
www.cres.sun.ac.za

No registration is final until you have received confirmation by e-mail from Stellenbosch University.

Course Fees

- Contact us for course fees for the specific year.
- **Cancellation of enrolment** will be subject to a 15% handling fee, however, substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full.
- The course fee includes all study material, tea/coffee and lunches.

Presenters

Dr Arnold Rix is a senior lecturer in the Department of Electrical and Electronic Engineering at Stellenbosch University. He holds a BEng and a PhD degree in Electrical Engineering. His main research field is photovoltaic systems. For the past few years he has been working in the renewable energy sector on the construction of large-scale wind turbines and the development, construction and grid connection of utility-scale photovoltaic generation plants.

Dr Bernard Bekker is a consultant in the renewable energy field to a variety of clients, including GreenCape, enerGworx and MLT Drives, specialising in PV system modelling and design. He holds a PhD in Electrical Engineering. Other areas of interest include energy provision to deep rural schools, smart grids and systems engineering.

Renewable Energy Financing

Synopsis

The global drivers of decoupling economic growth and addressing climate change have seen much emphasis placed on the development of renewable energy projects. This module enables participants to understand the parameters that influence the financial aspects and project design of renewable energy initiatives in Africa. The participant will become familiar with a range of instruments, the financial structuring tools needed to attract investors, and how to use alternative financial sources, like carbon finance, outside of the commercial financial institutions to ensure the financial viability of renewable energy projects. The module therefore aims to empower professionals to incorporate appropriate financing into their decision-making pertaining to renewable energy projects. This includes:

- The basic financial metrics, such as IRR, NPV, DSCR and LCOE,
- Understanding the economic justification for and impact of renewable energy projects,
- Understanding which sustainability drivers have an effect on the renewable energy business,
- Understanding what barriers exist to renewable energy project implementation from a financial perspective, and
- Understanding what opportunities exist to facilitate renewable energy implementation.

The module is aimed mainly at sensitising participants to qualitative issues in renewable energy projects, but also enables participants to deal with quantitative measures.

No academic credits can be obtained by attending this course.

Who should attend

Engineers, technologists and technicians active in the energy sector. Architects, planners and developers. Government and local authority officials. Investors and bankers.

Certification

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level is awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

Registration must be done online.

Check our website:
www.cres.sun.ac.za

No registration is final until you have received confirmation by e-mail from Stellenbosch University.

Course Fees

- Contact us for course fees for the specific year.
- Cancellation of enrolment will be subject to a 15% handling fee. No refunds will be made after this date; however, substitutions will be accepted. Attendance without payment will not be permitted.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full. The course fee includes all study material, tea/coffee and lunches.

Presenter

Dr Jako Volschenk, senior lecturer in Environmental Finance at the University of Stellenbosch Business School. A number of guest lecturers from industry participate in the course as experts in specific fields, such as project finance, ecological economics and alternative financing.

Renewable Energy Policy

(Certificate of attendance)

Synopsis

One of the greatest developmental challenges is how to increase access to affordable energy services to enable productive economic activities and improvement in quality of life, while decreasing the harmful implications of such services that may negatively affect access to future energy services. Africa in particular faces major challenges in the supply, distribution and consumption of energy. The security of energy supply, in general, is receiving top priority due to the escalating prices of hydrocarbon fuels. In energy-distribution terms, many communities still lack access to modern energy resources. The intensity of the energy used in countries such as South Africa is a further concern, as are the emissions from burning fossil fuels. These challenges beckon sustainable energy value chains and the need to assess and identify the most sustainable options, and future, for Africa. Therefore, evaluating and forecasting the impacts of potential national and regional responses to future energy systems from non-conventional energy resources is essential to ensure long-term national and regional sustainability.

This module focuses on policy interventions to promote renewable energy value chains, which are viewed as sustainable alternatives to conventional energy, and provides participants with an overview of the policy context, which must be understood as the regulatory, institutional and market setting for renewable energy technologies (RETs). To understand the policy context, the sustainability of RETs must be understood from the perspectives of policymakers and other stakeholders. The module is subsequently designed to address the following questions:

- What do sustainable RETs mean?
- How can sustainable RETs be assessed, identified and prioritised?
- How can appropriate RETs be managed as sustainable energy value chains in Africa?
- What tools can be used to promote appropriate and sustainable RETs?

No academic credits can be obtained by attending this course.

Who should attend

Engineers, technologists and technicians active in the energy sector. Architects, planners and developers. Government and local authority officials. Investors and bankers.

Certification

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level will be awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first- come, first-served basis.

Registration must be done online.

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Course Fees

- Contact us for the course fees for the specific year.
- **Cancellation of enrolment** will be subject to a 15% handling fee; however, substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full. The course fee includes all study material, tea/coffee and lunches.

Presenter

Prof Josephine Musango, senior lecturer in the School of Public Leadership and Deputy Coordinator of the Sustainable Development Programme.

A number of guest lecturers from industry, government and other academic institutions participate in the course as experts in specific fields, such as energy modelling, ecological economics, climate change and alternative financing.

Thermal Energy Systems

(Certificate of attendance)

Synopsis

The course consists of a study of the conventional energy systems that contribute to the total energy mix throughout the world today. The course will give insight into the current world energy supply and the demand for conventional energy, including consumption figures for various end users. The supply of and demand for conventional energy in South Africa is also covered. The contribution made by each of the systems across the various continents and for the major industrialized countries will be discussed. For each of the major systems, the methods of energy generation and production, as well as the supply networks, will be covered. The main themes for the course include:

- Introduction to Conventional Energy Systems;
- Thermodynamic Cycles;
- Coal;
- Electricity;
- Nuclear;
- Gas Turbines;
- Oil and Natural Gas;
- Transport; and
- Energy Efficiency and the Future.

No academic credits can be obtained by attending this course.

Who should attend

Engineers, technologists and technicians active in the energy sector. Architects, planners and developers. Government and local authority officials. Investors.

Please note that in order to fully benefit from this course, some mathematical ability will be advantageous in order to significantly appreciate several of the relevant concepts.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level will be awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

Registration must be done online.

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Course Fees

- Contact us for the course fees for the specific year.
- **Cancellation of enrolment** will be subject to a 15% handling fee; however, substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full. The course fee includes all study material, tea/coffee and lunches.

Presenters

Mr Richard Haines is a senior lecturer in the Department of Mechanical and Mechatronic Engineering at Stellenbosch University. He has a BScEng (Mech) degree and a MScEng degree from the University of Kwazulu-Natal. He has spent over twenty years in industry, specialising in product development and testing. His research and teaching interests include investigating and testing alternative fuels suitable for internal combustion engines.

Dr Jaap Hoffmann is a senior lecturer in Mechanical and Mechatronic Engineering at Stellenbosch University. He obtained his BEng, MEng and PhD in Mechanical Engineering from Stellenbosch University. He has spent twenty years in the power-generation industry, doing computational fluid dynamics (CFD) for the last fourteen years. His interests are dispersed two-phase flows and solar thermal energy.

Wind Energy

(Certificate of Attendance)

Synopsis

This module deals with the harvesting of energy from wind. It addresses the availability of the resources, the types of systems and machines, their capabilities and limitations, the processes of setting up such systems, and their associated costs and environmental impacts.

Wind Power

Brief history, current state of industry and industry drivers. Predominant technologies and trends, theory of operation, electro-mechanical and aerodynamic principles. Fundamentals of power quality and grid integration. Wind energy project development: process and methodologies, including wind resource assessment. Feasibility factors such as energy capture calculation, environmental impact assessment, grid aspects and essential economics.

No academic credits can be obtained by attending this course.

Who should attend

Engineers, technologists and technicians active in the energy sector. Architects, planners and developers. Government and local authority officials. Investors.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level will be awarded to all participants who attend the full course, from Monday morning to Saturday lunchtime.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

Registration must be done online.

Check our website:
www.cres.sun.ac.za

No registration is final until you have received confirmation by e-mail from Stellenbosch University.

Course Fees

- Contact us for the course fees for the specific year.
- **Cancellation of enrolment** will be subject to a 15% handling fee; however, substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full. The course fee includes all study material, tea/coffee and lunches.

Presenter

Mr Gareth Erfort is a lecturer in the Mechanical and Mechatronic Engineering Department at Stellenbosch University. He previously worked for the CSIR and spent two years abroad working on international civil engineering projects. He is completing his PhD thesis on Vertical Axis Wind Turbines, utilising CFD and genetic algorithms.

Integrated Supply-side Technologies

(Certificate of attendance)

Synopsis

The course provides insight into the supply side of the power system. The focus is on the power delivery characteristics of conventional power stations, intermittent renewable power stations and utility-scale energy storage.

Economic dispatch, energy storage scheduling, load-frequency control and inter-area power flow, dynamic system stability and inertia are also covered.

An overview of applicable network codes and regulations, and an introduction to power system modelling and simulation software, are provided.

No academic credits can be obtained by attending this course.

Who should attend?

Any person or organization that needs to learn more about the supply side of the power system, integration of renewable energy supply, power system simulation and electricity planning will benefit from this course. Attendees are required to hold an engineering diploma or degree or show extensive work experience in the power engineering field.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level is awarded to all participants who attend all three days of the course.

Registration

The course is designed for a restricted number of attendees so as to personalize and maximize the learning experience. Bookings will be taken on a first-come, first-served basis.

Registration must be done online.

Check our website: www.cres.sun.ac.za

No registration is final until you have received confirmation by e-mail from Stellenbosch University.

Course Fees

- Contact us for the course fees for the specific year.
- **Cancellation of enrolment** will be subject to a 15% handling fee; however, substitutions will be accepted. **Attendance without payment will not be permitted**.
- In the case of unforeseen circumstances, Stellenbosch University reserves the right to cancel the course, in which case all fees will be reimbursed in full. The course fee includes all study material, tea/coffee and lunches.

Presenter

Dr Bernard Bekker holds the positions of Eskom Chair in Power System Simulation and Associate Director of CRSES (Centre for Renewable and Sustainable Energy Studies) within the Engineering Faculty at Stellenbosch University.

His research focuses on power system planning and operation, specifically related to the increasing prevalence of grid-connected distributed storage and generation.

Energy Storage

(Certificate of Attendance)

Synopsis

The objective of the module is to enable participants to understand the concepts and technologies used for electric energy storage (ES). The course highlights lithium ion (Li-ion) batteries as the dominant technology in new projects, and addresses the complex safety, performance and life issues of this technology. The technical and financial parameters that drive the project designs of grid-connected and off-grid ES will be discussed. The participants will become familiar with the major factors that determine energy storage selection and sizing, and will be provided with various case studies to use as benchmarks. The module therefore aims to provide professionals with sufficient understanding to establish the key requirements and financial benefits of energy storage technology and applications in various grid-connected and off-grid systems.

No academic credits can be obtained by attending this course.

Who should attend?

Any person or organization that needs to learn more about electrical systems, the integration of renewable energy supply, and electricity planning will benefit from this course.

Certification and Accreditation

The module has been registered with the Engineering Council of South Africa for Continuous Professional Development points. A Certificate of Attendance with an indication of the CPD points and level will be awarded to all participants who attend all three days of the course.

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Presenter

Mr Gerhard Swart is a multidisciplinary systems engineer and technology strategist, consulting through Alphadot (Pty) Ltd, particularly in the fields of renewable energy and electric vehicle technologies. He is also co-founder and chief technical officer of BattCo Energy Storage Systems (Pty) Ltd, a start-up that provides large-scale batteries for stationary and mobile applications.

Through his work in the development of the Joule electric vehicle and the establishment of the UWC Energy Storage Innovation Lab, he has become a recognised authority in the field of energy storage.