BIOFUELS ENGINEER

More than 75% of South Africa's primary energy needs are provided through coal generated power, with significant contributions to carbon emissions and greenhouse gasses. As the threat and pressures of climate change increases, innovation is needed to explore renewable sources of energy. Biofuels engineering investigates the uses and implementation of fuels derived from plant sources such as sugar and starch crops to provide cleaner, renewable energy.

Biofuels engineers research, design and develop products, tools, procedures and processes that generate biofuels for electricity and powering vehicles and machinery. They consider all the complex factors that go into the production of alternatives to fossil fuels and work to redirect established scientific principles for producing energy into innovative technological solutions.

Biofuels engineers primarily work in offices and sometimes research laboratories and may spend time in environments such as manufacturing plants and crop farms.

Skills

Biofuels engineers must have strong mathematical competence, a comprehensive knowledge of scientific principles and its application and competent in the use of engineering and design software. They will additionally benefit from:

- Extensive analytical and logical reasoning ability
- Creative problem-solving
- Strong attention to detail
- Sound project management skills

Tasks

- Evaluate the benefits and challenges of alternative energies and experiment with new products and technologies
- Analyse existing biofuels systems providing solutions to optimise production or develop new systems
- Research the economic and environmental factors in the production of biofuels
- Oversee prototype processes and supervise subsequent projects

Studies

B.Sc.Eng. in Bio-resources Engineering at UKZN

B.Sc.Eng. in Chemical Engineering at UCT and Wits

B.Eng. in Chemical Engineering at NWU, SU, UKZN and UP

Diploma, Advanced Diploma, M.Tech in Chemical Engineering at CPUT, DUT, MUT, TUT, UJ, UNISA and VUT

Employers

National, provincial and local government.

Biofuels, renewable and private energy companies.

Research institutions.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

BIOMASS PLANT TECHNICIAN

South Africa's energy provision is dominated by large-scale coal operations. Moving toward cleaner and sufficient energy provision to meet the country's domestic and economic needs, requires the exploration of innovative, alternative energy sources such as biomass, for example. Operating within a biomass plant involves working with varied plant matter that can be used directly or converted into biofuel for power generation.

Biomass plant technicians provide technical support and services in the installation and operation of biomass power plant processes, systems, facilities and equipment. They control and adjust the production of biofuels and perform routine maintenance to the mechanical and electrical equipment used. They also calculate and load biomass feedstock, maintain records and report on the quality and quantity of daily production.

Biomass plant technicians typically work in small teams with other plant personnel, working between the plant site and an office to complete reports. They work under relatively dangerous conditions and are required to wear protective clothing and equipment.

Skills

Biomass plant technicians require good technical knowledge of biomass properties, mechanical and production processes as well as a thorough understanding of plant safety and regulations, coupled with:

- Machine and mechanical operating capability
- Good problem-solving and analytical thinking ability
- Strong organisational competence
- Written and verbal communication skills

Tasks

- Operate, inspect, maintain and repair biomass processing equipment
- Calculate, measure, load, mix and process varied biomass materials
- Record operational and production data
- Troubleshoot equipment faults and contact specialist contractors for support

Studies

Diploma, Advanced Diploma, M.Tech in Electrical Engineering specialising in Process Control at CPUT, MUT, VUT and WSU

Biomass plant technicians can also benefit from a National Certificate in Fossil Power Plant Operations at National Qualifications Framework Level 1 to 4 offered at TECHNISA, accredited by the Energy and Water Sector Education and Training Authority. Training could also take place on the job with mentoring by an experienced technician.

Employers

Biomass power production plants.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

ELECTRICAL ENGINEER

Electricity powers the daily lives of people and is the foundation of all social and economic activity. All aspects of production and consumption across all value chains rely on electrical power, for production, manufacture, transport, storage, amongst other support services. Electrical engineering involves the design, building and maintenance of electrical systems for the generation and use of electrical energy.

Electrical engineers design, develop and supervise the manufacture, installation, operation and maintenance of equipment, machines and systems for the generation, distribution, utilisation and control of electrical power. They test equipment, solve operating problems and estimate the time and cost of electrical engineering projects. Electricity generation in South Africa is heavily dependent on coal, with significant environmental impacts. There is a concerted drive to steer South Africa towards increasing renewable electricity generation.

Often working as part of a team of specialised engineers, electrical engineers can work in between offices, power plants and substations. They could also work in production and manufacturing plants.

Skills

Electrical engineers must have extensive mathematical ability and a comprehensive knowledge of the processes of electricity generation. They will also benefit from:

- Very strong analytical and logical reasoning competence
- An extensive knowledge of electricity use contexts
- Creative problem-solving skills
- Competence in the use of popular engineering and design software

Tasks

- Advise on and design electrical equipment, power stations and systems
- Supervise, control and monitor the operation of electrical systems
- Establish control standards and procedures to monitor performance and safety of varied electrical systems
- Determine manufacturing methods, maintenance and repair of electrical systems

Studies

B.Eng. in Electrical Engineering at SU, UJ and UP

B.Sc.Eng. in Electrical Engineering at UCT, UKZN and Wits

Diploma, Advanced Diploma, M.Tech in Electrical Engineering at CPUT, CUT, DUT, MUT, TUT, UNISA, VUT and WSU

Employers

National, provincial and local government.

Construction, production and manufacturing companies.

Renewable and private energy organisations.

Research institutions.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

ELECTRICIAN

More than 84% of South African households are connected to the national grid with the aim of further increasing access to electricity. To support its commitment to reducing carbon emissions by 2050, South Africa is also committed to clean energy and moving away from coal fired power provision. Safe and equitable access to clean energy requires efficient and well-trained electrical service providers and tradesmen.

Electricians install, test, connect, commission, maintain and modify a multitude of electrical equipment, wiring and control systems. They detect and repair faulty light and other electrical power systems. Some also work with and advise on renewable technologies and energy efficient electrical systems such as wind turbines and solar panels, for example.

Electricians work both indoors and outdoors and are often exposed to hazardous conditions, equipment and situations. They can work jointly with building contractors and building maintenance managers to ensure correct electrical installations and repairs.

Skills

Electricians need a comprehensive knowledge of electrical circuits and systems as well as understand the laws and regulations that govern electricity provision, along with:

- Strong logical reasoning and problem-solving competence
- Ability to read and interpret technical electrical drawings
- Good physical stamina
- Good verbal and written communication ability

Tasks

- Install, maintain and repair electrical wiring systems and equipment
- Plan the layout and installation of electrical wiring, equipment and fixtures
- Inspect electrical systems to identify hazards and defects
- Troubleshoot and diagnose electrical system faults and failures

Studies

Diploma, Advanced Diploma, M.Tech in Electrical Engineering at CPUT, CUT, DUT, MUT, TUT, UNISA, VUT and WSU

National Vocational Certificate in Electrical Engineering Studies at National Qualifications Framework Level 2, 3 and 4 offered at majority of Technical and Vocational Education and Training Colleges.

National Vocational Certificate in Electrical Infrastructure Construction at National Qualifications Framework Level 2, 3 and 4 offered at most Technical and Vocational Education and Training Colleges.

Vocational registration of electricians is a requirement for practice.

Employers

Local government.

Manufacturing and mining companies.

Private electrical service companies.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

ENERGY EFFICIENCY TECHNICIAN

South Africa remains highly dependent on coal fired electrical power, despite its commitment to the Paris Agreement and reducing greenhouse gases to net zero by 2050. The exploration of cleaner renewable energy options will support a transition to a carbon neutral economy with decreasing reliance on coal fired electricity and its environmental and health impacts. Energy efficiency involves the adaptative measures and technologies used to reduce energy consumption.

Energy efficiency technicians evaluate electrical installations, equipment and processes to determine the amount of energy used and lost to improve energy usage and recommend and install energy conserving measures. They audit the ventilation, heating and cooling, lighting and power systems during building construction and at manufacturing plants. Some can be consulted to provide energy usage goals for businesses and analyse costs and benefits of energy saving devices.

Energy efficiency technicians work alongside electrical engineers and technicians as well as building owners and managers. They often work in an office environment and travel to conduct site inspections of homes, businesses and industrial environments to determine causes of energy wastage and make recommendations for efficient use.

Skills

Energy efficiency technicians require a technical knowledge of energy saving technologies and electrical equipment and an understanding of energy efficiency compliance regulations. They will further benefit from:

- Methodological problem-solving skills
- Ability to read and interpret building plans and schematics
- Ability to use design and energy modelling software
- Good verbal and written communication skills

Tasks

- Monitor the manufacture, installation, utilisation, maintenance and repair of electrical systems
- Provide technical support in electrical equipment research and development
- Assemble and install energy saving systems
- Plan installation methods, checking completed installations for safety compliance

Studies

B.Eng. in Electrical Engineering at SU, UJ and UP

B.Sc.Eng in Electrical Engineering at UCT, UKZN and Wits

Diploma, Advanced Diploma, M.Tech in Electrical Engineering at CPUT, CUT, DUT, MUT, TUT, UNISA, VUT and WSU

Employers

Provincial and local government.

Energy provision and service companies.

NPOs and private consultancies.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

GEOTHERMAL TECHNICIAN

South Africa's coal reserves are estimated at 53 billion tonnes, providing 77% to power generation. There is however increasing pressure, both domestic and globally to explore alternative energy sources for the country's domestic and economic needs while meeting its sustainable growth requirements with minimal environmental impact. Geothermal power is produced using heat in the form of steam or hot water to produce electrical energy.

Geothermal technicians perform technical activities for the generation of power from geothermal energy sources. They install, test and maintain commercial geothermal heat pumps and monitor and take readings of the equipment, making necessary adjustments to increase performance and energy outputs. They are also responsible for inspecting machinery, making basic repairs and calling in more specialised technicians to address serious challenges. They can also provide reports and suggestions based on current performance of geothermal machinery.

Geothermal technicians work in small teams with other plant personnel. They mainly work outdoors in relatively harsh conditions and are required to use protective clothing and equipment on site.

Skills

Geothermal technicians require solid technical knowledge of geothermal power production processes and a thorough understanding of health and safety regulations. They will additionally benefit from:

- Good problem-solving and analytical skills
- Strong organisational competence
- Machine and mechanical operating capability
- Written and verbal communication skills

Tasks

- Operate, inspect and maintain geothermal plant equipment
- Test water sources for factors such as flow volume or contamination
- Record operational and production data making needed adjustments
- Troubleshoot equipment faults, contacting specialist contractors for support

Studies

B.Eng. in Electrical Engineering specialising in Energy Systems at SU, UJ and UP

B.Sc.Eng in Electrical Engineering specialising in Power Systems at UCT, UKZN and Wits

Diploma, Advanced Diploma, M.Tech in Electrical Engineering specialising in Process Control at CPUT, MUT, VUT and WSU

Geothermal technicians can also benefit from a National Certificate in Fossil Power Plant Operations at National Qualifications Framework Level 1 to 4 offered at TECHNISA, accredited by the Energy and Water Sector Education and Training Authority. Training could also take place on the job with mentoring by an experienced technician.

Employers

Geothermal power production manufacturers.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

HYDRO POWER PLANT CONTROLLER

South Africa's energy system is dominated by large-scale coal operations. Global and local pressure is however prompting a move towards cleaner power production to sustain the country's economic and domestic needs. Hydropower, energy generated from moving water, is being explored as a viable alternative to burning fossil fuels. South Africa currently has a mix of small hydroelectricity stations that contributes 2.2% electrical power to the national grid with the potential to produce more.

Hydro power plant controllers provide technical support and services in the installation, operation and maintenance of hydropower plant processes, systems, facilities and equipment. They start up and power down electrical generation systems, monitor and adjust equipment to ensure optimal performance. They also keep records of ongoing power plant operations to identify processes that can be improved.

Hydro power plant controllers work in small teams with other plant personnel and supervisors and work between electrical control rooms and the power plant floor. They can be required to work long hours and wear protective clothing.

Skills

A technical understanding of electricity generation equipment and processes is required by hydro power plant controllers, coupled with:

- Ability to read and interpret electrical readings and meters
- Problem-solving and troubleshooting skills
- Safety conscious with a keen attention to detail
- Good written and verbal communication

Tasks

- Operate and control hydropower systems and equipment
- Monitor equipment and troubleshoot when challenges arise
- Clean and maintain equipment to prevent failure and deterioration
- Complete station records, logs and reports

Studies

Diploma, Advanced Diploma, M.Tech in Electrical Engineering specialising in Process Control at CPUT, MUT, VUT and WSU

Hydro power plant controllers could benefit from a National Certificate in Hydro Power Plant Process Control Operations at National Qualifications Framework Level 2 to 4, accredited by the Energy and Water Sector Education and Training Authority. Training could also take place on the job with mentoring by an experienced mentor.

Employers

Hydropower generation plants.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

NUCLEAR POWER PLANT CONTROLLER

Coal fired power stations currently dominate electrical power generation in South Africa. There is however increasing domestic and global pressure, to explore alternative energy sources to meet needs for sustainable growth. Nuclear energy currently contributes 3% to the national power grid. Expanding the scope of nuclear power generation requires the safe control of nuclear energy and its radioactive deposits to ensure minimal impact to the environment and human health and wellbeing.

Nuclear power plant controllers provide technical support and service in the installation, operation and maintenance of nuclear power plant processes, systems, facilities and equipment. They monitor performance indicators and record and review components, adjusting fission rates, pressure, water, temperature and flow rates, for example. They also run scheduled tests on all equipment to ensure safe and efficient nuclear operation.

Nuclear power plant controllers work as part of a team in control rooms, occasionally inspecting the plant for equipment testing. They can work long hours as nuclear reactors require constant attention and are required to wear strict protective clothing.

Skills

Nuclear power plant controllers require a comprehensive knowledge of nuclear energy reactors and power generation processes. They will also benefit from:

- Excellent problem-solving ability
- Ability to keep accurate and consistent records
- Keen attention to detail and an awareness for safety
- Physical and mental endurance

Tasks

- Control start-up and shutdown of nuclear power plant equipment
- Operate and control nuclear power generating systems
- Inspect, clean and maintain plant equipment and machinery
- Monitor and troubleshoot challenges found in nuclear operating systems

Studies

Diploma, Advanced Diploma, M.Tech in Electrical Engineering specialising in Process Control at CPUT, MUT, VUT and WSU

Nuclear power plant controllers will also benefit from a National Certificate in Nuclear Power Plant Process Control Operations at National Qualifications Framework Level 3 to 5, accredited by the Energy and Water Sector Education and Training Authority and Eskom. Training could also take place on the job with mentoring by an experienced mentor.

Employers

Nuclear power generation plants.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

POWER GENERATION OPERATIONS MANAGER

South Africa produces over 47 000 megawatts, mostly through coal generation, with significant impact on the environment especially through high levels of greenhouse gas emissions. Through the Paris Agreement, South Africa is committed to reducing its emissions, through renewable energy sources. The safe and effective operation of diverse energy generating plants will ensure sustainable, sufficient and varied power generation to meet the country's short and long-term energy needs.

Power generation operations managers plan, direct and coordinate the work activities and resources of power generation and ensure that targets are met. They carry out regular plant inspections to ensure plans are on schedule as well as inspect production equipment and machinery, making sure repairs and maintenance are carried out. They also set work schedules, evaluate employee performance and enforce safety protocols. Some are involved in the strategic planning and development for new power generating plants.

Power generation operations managers work with engineering technicians and professionals to optimise energy production. They spend a large amount of time on the plant floor inspecting and managing operational challenges. They work long hours and are required to wear protective clothing.

Skills

Power generation operations managers require extensive experience and knowledge in power generation, including plant operations and equipment, along with:

- Strong managerial and business experience
- Creative problem-solving and analytical thinking ability
- Understanding of labour legislation and safety regulations
- Good written and verbal communication skills

Tasks

- Control the operation of the production plant and establish operation procedures
- Determine, implement and monitor production strategies, polices and plans
- Establish and manage budgets, identifying opportunities to increase business success
- Oversee the acquisitions and installation of new plant and equipment

Studies

B.Sc.Eng. in Electrical Engineering at UCT, UKZN and Wits

B.Eng. in Electrical Engineering at SU, UJ and UP

Diploma, Advanced Diploma, M.Tech in Electrical Engineering at CPUT, CUT, DUT, MUT, TUT, UNISA, VUT and WSU

Employers

National, provincial and local government.

Biofuel, renewable and private energy companies.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

RENEWABLE ENERGY ENGINEER

South Africa is highly dependent on fossil fuel for its power generation, which results in high levels of carbon emissions. As a signatory to the Paris Agreement, it is committed to reducing greenhouse gas emissions by 2050. Geographically, the country is well placed for generating renewable energy with its abundance of natural resources, sun and wind. These alternative energies will provide a diverse mix of cleaner energy to meet the country's needs while meeting its global emission reduction targets.

Renewable energy engineers research and design renewable energy technologies, equipment and power generation plants. They plan and oversee the installation of renewable energy power plants, decide on the most ideal location and ensure that the sites operation meets engineering and environmental standards. They can also develop and improve existing procedures and assess and review energy production systems and technologies, advising on methods and techniques to reduce energy costs and improve energy efficiency.

Renewable energy engineers work in multidisciplinary teams with engineering technologists and technicians and can consult with geophysicists, geologists and climate change scientists. They work mainly in an office environment and occasionally travel to plant sites to oversee installations or address operational challenges.

Skills

Renewable energy engineers need extensive experience and a comprehensive knowledge of electrical engineering and will also benefit from:

- Strong mathematical competence
- Creative problem-solving and analytical thinking ability
- Ability to coordinate and manage complex projects
- Understanding of current energy policies and legislation

Tasks

- Advise on and design power plants and systems
- Supervise, control and monitor the operation of electrical generation, transmission and distribution systems
- Determine manufacturing methods for electrical systems
- Establish control standards and procedures to monitor performance and safety of electrical generating and distribution systems

Studies

B.Sc.Eng. in Electrical Engineering at UCT, UKZN and Wits

B.Eng. in Electrical Engineering at SU, UJ and UP

Diploma, Advanced Diploma, M.Tech in Electrical Engineering at CPUT, CUT, DUT, MUT, TUT, UNISA, VUT and WSU

Employers

National, provincial and local government.

Construction, production and manufacturing companies.

Renewable and private energy organisations.

Private consultancies.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

SOLAR POWER PLANT TECHNICIAN

While coal still dominates the South African energy mix, renewable energy is increasingly being explored, such as solar energy, which currently contributes 558 megawatts to the national grid. As a signatory to the Paris Agreement, South Africa needs to shift from high carbon coal emitting towards renewable energy, to reduce carbon emissions and support measures to address climate change. The efficient and effective operation of solar power plants will contribute to this shift and enable increasing use of renewable, solar powered energy.

Solar power plant technicians provide technical support and services in the installation, operation and maintenance of solar power plant processes, systems, facilities and equipment. They start up and operate power generating systems such as turbines and generators, making adjustments when needed, and monitor electrical, mechanical and electronic equipment to ensure optimal performance. They also keep operational logs and reports and perform preventative maintenance and repairs where deterioration or failure has occurred.

Solar power plant technicians work alongside supervisors and other plant personnel to assess equipment operating systems. They carry out numerous inspections of the power plant throughout the day and may be exposed to hazardous equipment and situations.

Skills

Solar power plant technicians need a technical knowledge of the generation and production of solar energy and understand plant health and safety regulations, coupled with:

- Machine and mechanical operating capability
- Logical troubleshooting and problem-solving skills
- Strong organisational and analytical thinking competence
- Written and verbal communication skills

Tasks

- Operate and control power generating systems and equipment
- Monitor equipment performance, taking corrective action if needed
- Maintain station records, logs and reports
- Clean, maintain and perform repairs on power plant equipment

Studies

Diploma, Advanced Diploma, M.Tech in Electrical Engineering specialising in Process Control at CPUT, MUT, VUT and WSU

Solar power plant technicians can also benefit from a National Certificate in Electrical Engineering at National Qualifications Framework Level 2 to 4 offered at most Technical and Vocational Education and Training Colleges. Training could also take place on the job with mentoring by an experienced technician.

Employers

Public power utilities.

Private solar power companies.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha

WIND ENERGY ENGINEER

South Africa's energy sector is largely fuelled by coal generated electricity. As a signatory to the Paris Agreement, it has to significantly reduce greenhouse gas emissions by 2050. To enable this shift, renewable energies are increasingly being explored. Wind energy in particular has high potential for electricity generation, particularly in the well positioned coastal areas of the Western and Eastern Cape. Wind energy engineering involves the process of designing and implementing wind farms for the production of clean electrical energy.

Wind energy engineers design, build and monitor wind turbines and wind farms. They analyse annual wind speed and direction data to determine the best location for a wind farm and design and develop the electrical systems, specifications and materials for wind technology components. They plan and oversee the installation of wind turbines and coordinate operations to meet engineering and environmental standards. They also analyse performance data and strategise to maximise operation costs and energy generation.

Wind energy engineers consult with climatologists, geophysicists and other engineering professionals on the development and running of a wind farm. They work in offices and research and development laboratories and travel to sites to oversee the construction and inspection of wind turbines and related processes.

Skills

Wind energy engineers require a solid understanding and experience in the practical application of electrical or mechanical engineering and aerodynamic principles, along with:

- Excellent analytical and logical reasoning competence
- Creative problem-solving skills
- Competence in popular engineering and design software
- Knowledge of current energy legislation and policies

Tasks

- Advise on and design wind power stations and systems
- Supervise, control and monitor the operation of electrical generation, transmission and distribution
- Establish control standards and procedures to monitor performance and safety
- Determine maintenance and repair of existing power generation systems

Studies

B.Eng. in Electrical or Mechanical Engineering at NWU, SU, UJ and UP

B.Sc.Eng. in Electrical or Mechanical Engineering at UCT, UKZN and Wits

B.Sc.Eng. in Aeronautical Engineering at Wits

Diploma, Advanced Diploma, M.Tech in Electrical or Mechanical Engineering at CPUT, CUT, DUT, MUT, UNISA, VUT and WSU

Employers

Wind energy providers.

Manufacturing companies.

Energy agencies, partnerships and consultancies.

WWF

Forestry, Fisheries and the Environment
Higher Education and Training

khetha