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Engineering
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**The Renewable and Sustainable Energy Ecosystem within the SU
Engineering Faculty – Prof. Cristina Trois/CRSES**

Faculty of Engineering

Industry Showcase 2025

CRSES - Centre for Renewable and Sustainable Energy Studies



The CRSES Team



Prof Cristina Trois
Director



Prof Bernard Bekker
Associate Director / SARCHI chair in Power Systems
Simulation



Prof Craig McGregor
Associate Director



Francois Rozon
Senior Engineer/ Manager



Dr Munyaradzi Justice Chihota
Senior Engineer



Monique le Roux
Chief Engineer



Warrick Pierce
Principal Engineer



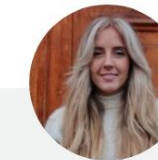
Christina Auret
Senior Engineer



Josh Dippenaar
Senior Engineer



Donald Fitzgerald
Research Engineer



Storm Morison
Research Engineer



Andrea Dell'Orto
Research Engineer



Simnikiwe Gulwa
Junior Research Engineer



Lavheleslani Maluleke
Junior Engineer



Johannes de Bruyn
Junior Engineer



Theunis Oosthuizen
Junior Engineer



Dr. John Edison Sempira
Post-doc Fellow in Engineering: ARUA-Centre of
Excellence for Energy/Chemical Engineering Depart



Sedzani Ratsibi
Project Commercialisation Manager



Elmien Lovell
Administrative & Financial Officer



Sandelize Heydenrycht
Administrative Officer



Keziah Maher
Short Course Administrative Officer



Fhatuwani Mulaudzi
Marketing and Communications Officer



Sydwell Tenza
Intern

TRAINING

Facilitate, coordinate and fund the training of academic students, interns and industry

FLAGSHIP PROJECTS

Initiate and drive national flagship projects



RESEARCH

Influence research focus areas and unlock research funding opportunities

CONSULTING

Conduct contract research and specialist consulting projects

AWARENESS

Increase public and institutional awareness and understanding

CRSES – Consulting and Advisory Services

Build a sustainable business on renewable energy technology, implementation and deployment

Collaborate with a network of leading experts in the fields of renewable energy, energy efficiency and energy storage. CRSES has dedicated renewable energy engineers and researchers - as well as access to University wide expertise and topical experts - to provide specialised, customised and impartial advisory services.

Our main services include:



KNOWLEDGE SHARING

Access the innovative ideas and skills of our research and development staff for market reviews, renewable energy software training and general discussions.



ADVISORY SERVICES

Draw from different areas of expertise for tender evaluations, energy audits, feasibility studies, grid integration and resource assessments.



PRODUCT COMMERCIALISATION

We help you nurture early-stage projects with concept evaluations and research backing to launch new products, technologies and services.



TECHNOLOGY REVIEW & TESTING

Get access to innovative ideas and technology. We perform contract services for technology reviews, equipment testing and laboratory services.

CRSES – Postgraduate Program and Short Courses

Lead: Dr Armand Du Plessis

20× Established short course modules at Stellenbosch University

Overview Courses	Renewable Energy	Power System Planning	Power System Operations	Hydrogen & Storage	Smart Grid & Analytics
<ul style="list-style-type: none">• Overview of the Power Plant Industry• Renewable Energy Systems• Hydrogen in the Energy System	<ul style="list-style-type: none">• Advanced Photovoltaic Systems• Solar Thermal Energy• Wind Energy• Water Power• Bioenergy	<ul style="list-style-type: none">• Long-term Power System Planning• Distribution Network Planning & Operations• Distribution Customer Concepts	<ul style="list-style-type: none">• Power System Operations• Power System Flexible Operations• Power System Data Analytics	<ul style="list-style-type: none">• Green Hydrogen Technology• Hydrogen Project Engineering• Energy Storage Systems	<ul style="list-style-type: none">• Smart Grid Technology Overview• Smart Grid Communications

Continuing Professional Education

CPD

Certificate of Attendance
or Competence

Postgrad Diploma

NQF 8

8 week-long modules

Structured Masters

NQF 9

8 week-long modules

Research Project (60 credits)

ARUA CoE in Energy / ARUA-GUILD CoRE-RE

Lead: Prof. Cristina Trois

Manager: Dr Andrea Dell'Orto



FLAGSHIP PROJECTS

CRSES_NEXT

SA Platform for Power Systems
Advanced Modelling, Forecasting,
Scenario Analysis, Decision
Support Tools



SARETEC

The South African Renewable
Energy Technology Centre

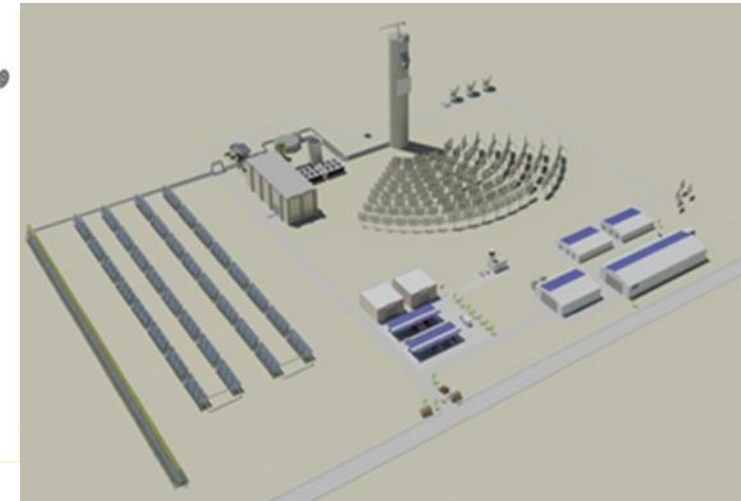
SAURAN

Southern African Universities
Radiometric Network

National Solar Research Centre
(ongoing)

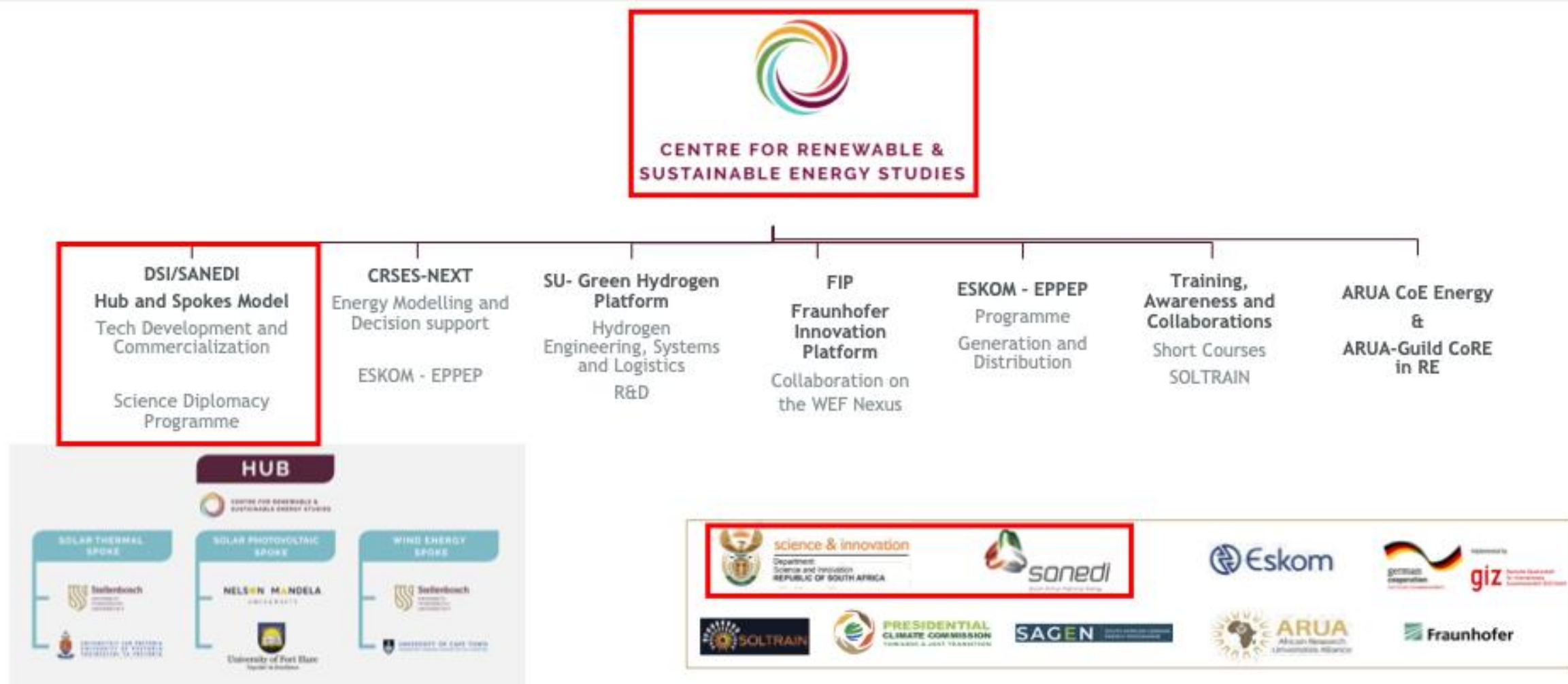


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go to the Data tab.



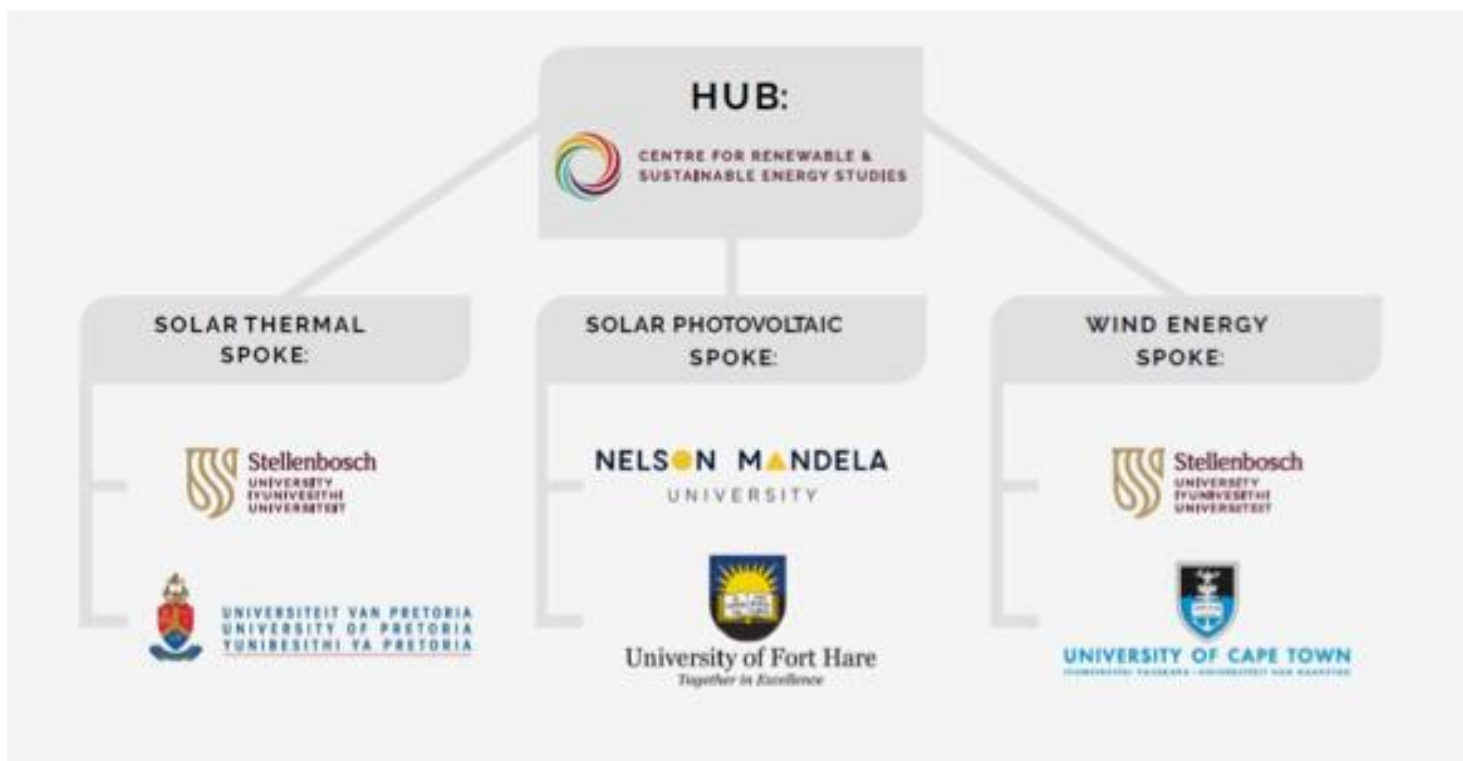
DSTI/SANEDI Renewable Energy Hub and Spokes Programme

Manager: Dr Francois Rozon



DSTI/SANEDI Renewable Energy Hub and Spokes Programme

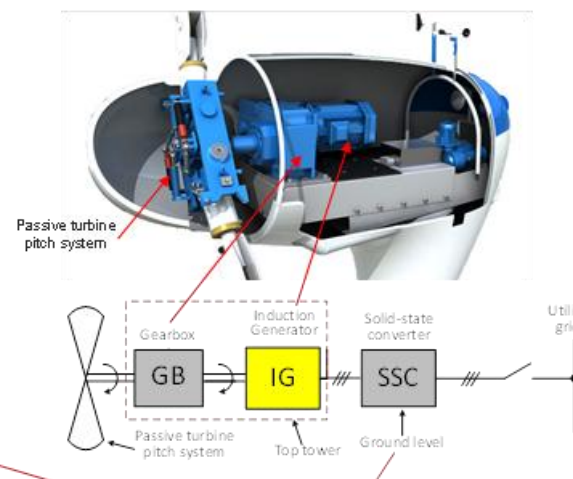
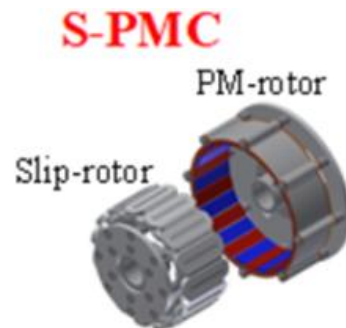
Manager: Dr Francois Rozon



- Five Universities and three thematic areas
- Each thematic area shared by two Universities in a “**collaborative**” fashion
- CRSES plays lead = project management and coordination



DSTI/SANEDI Hub and Spokes Programme – Prototypes



THE MASIA VILLAGE (Limpopo): LIVING LAB

- **Key infrastructure installed:** Solar PV Energy System, Water supply, fruit tree and vegetable growing shades, germination chamber
- **Training of interns** on agricultural production is ongoing
- First sweet potato crop grown, harvested and sold to the public in 2023
- Planting of first fruit nursery seeds and vegetable varieties began in Dec 23 and is ongoing
- **5 kW H2 Fuel Cell deployed**, Electrolyser from NWU still pending

ENERGY

- 20 kWp rooftop solar PV
- 20 kWh Li-ion storage
- 5 kW H2 Fuel Cell
- 2.5 – 4 kW Solar dish Brayton cycle system
- Additional 20 kWh Li-ion storage



WATER

- Borehole
- 5 x 5 000L Water storage tanks
- Water pumping equipment



FOOD

- Open sweet potato nursery field
- Vegetable and fruit tree nursery shades
- Essential Oils



OUTREACH: MEDIA and SCIENCE LABs

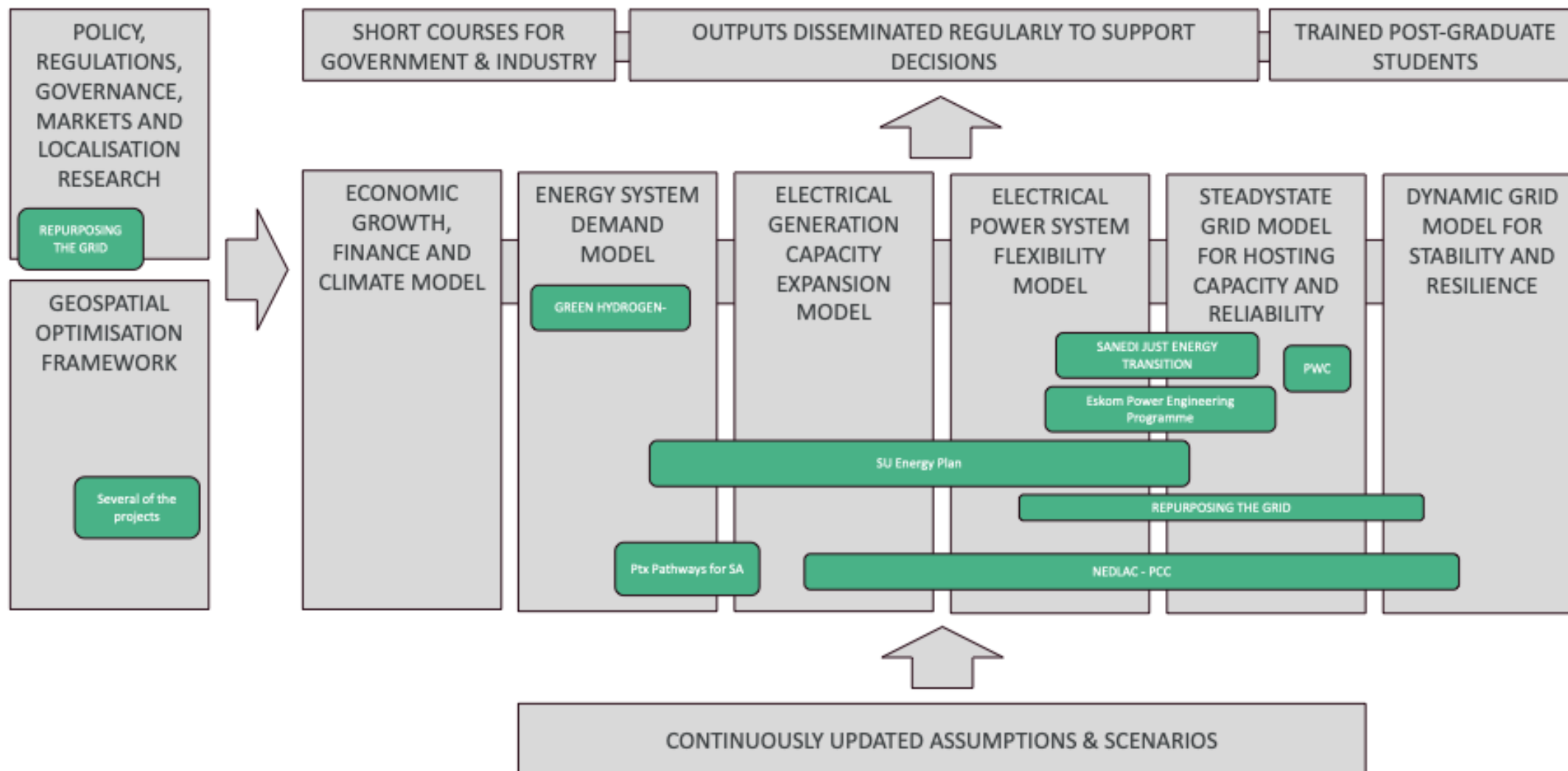


CRSES NEXT: National Energy and PtoX Trajectories



CRSES NEXT: National Energy and PtoX Trajectories

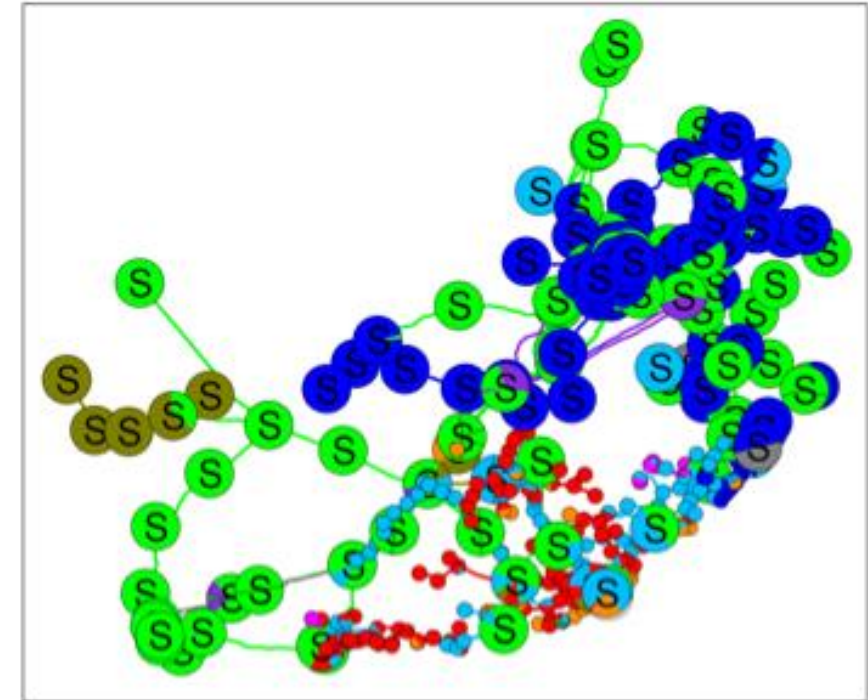
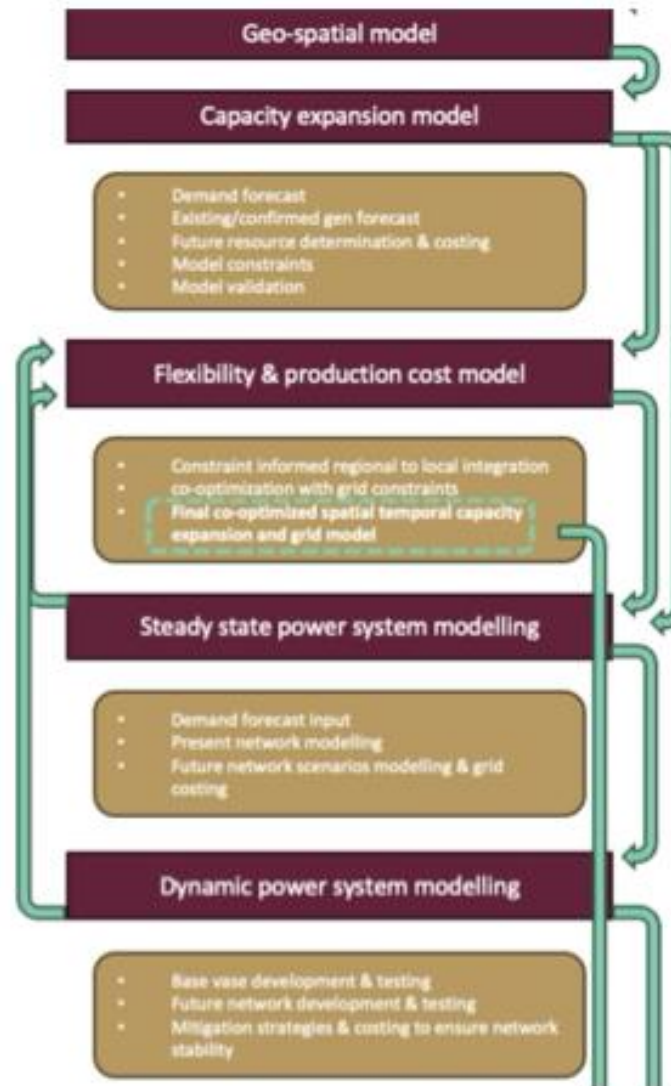
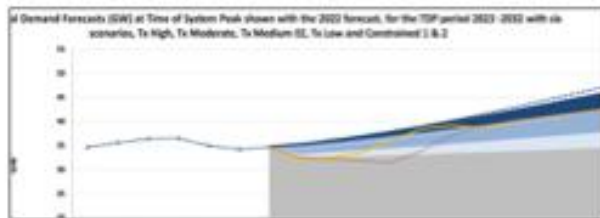
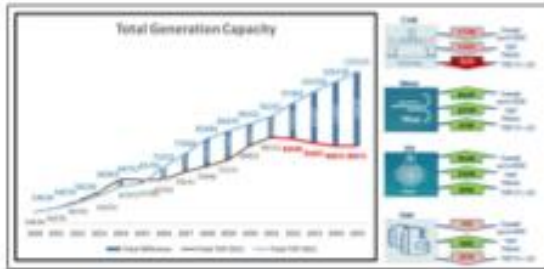
Lead: Prof. Bernard Bekker
Chief Engineer: Monique Le Roux



Source: Centre for Renewable and Sustainable Energy Studies, Stellenbosch University 2024

NEDLAC/PCC Power Systems and RE Integration Modelling

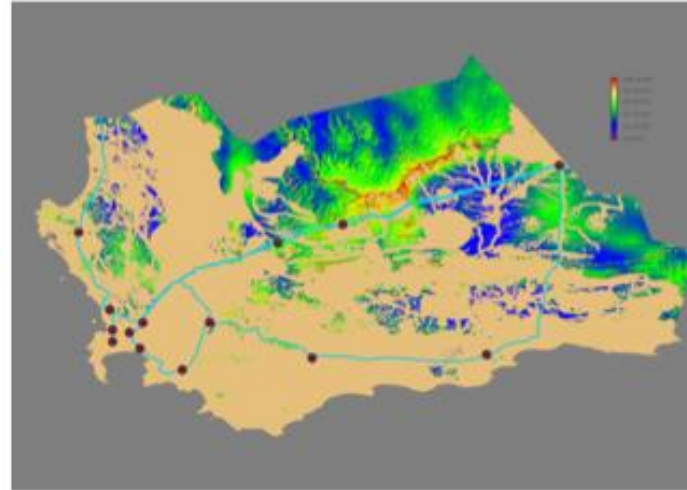
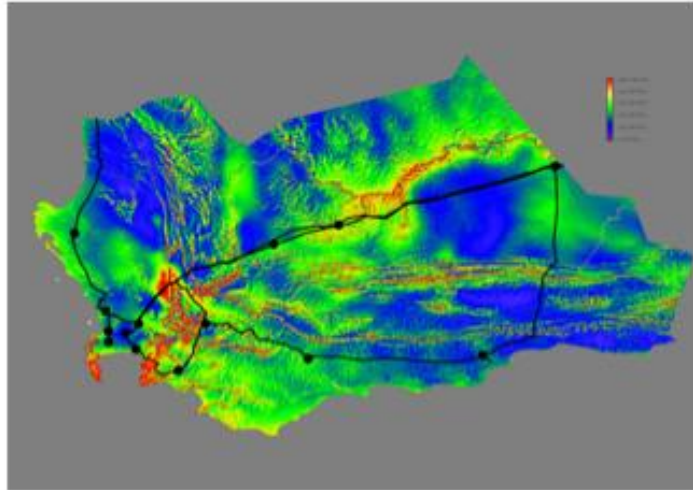
Lead: Monique Le Roux and Prof. Bekker



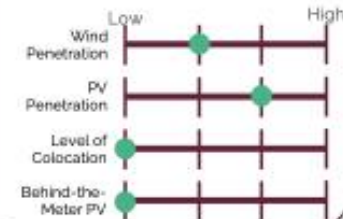
EPEP ESKOM – WC Transmission Network Map

Lead: Dr Chantelle Van Staden (Elec Eng)

EPEP project for 2024: Western Cape Transmission Network Maintainability Map 2024



Scenario Selectors

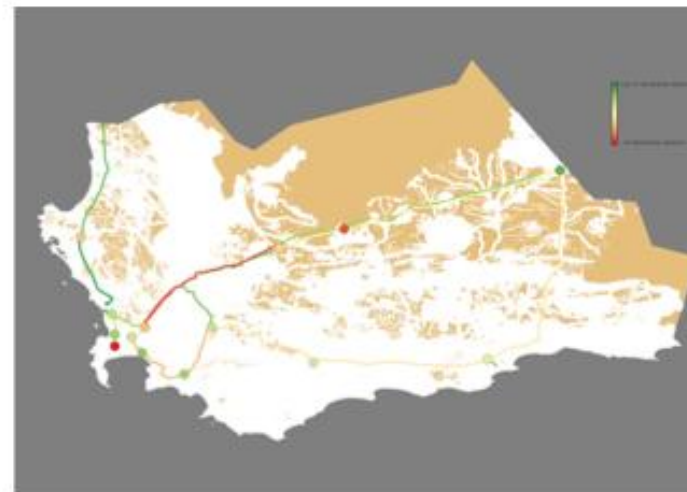
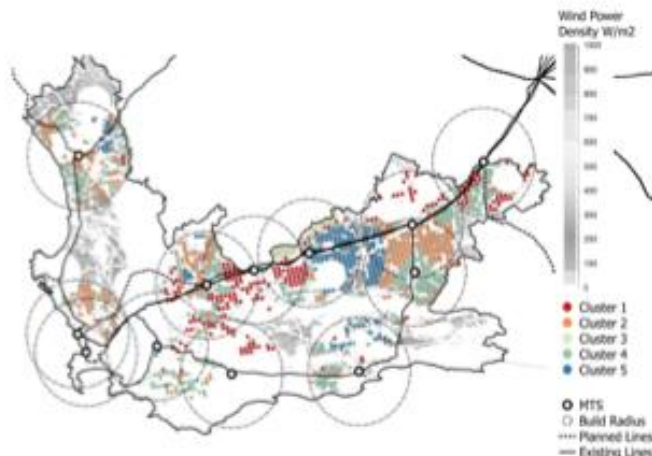


Explanation

This map displays the maintainability metrics for the Western Cape transmission network. This includes maintenance headroom, thermal loading, voltage ranges and curtailment of renewable generation. The scenario selectors display the results for various installation scenarios. The colour of a network component indicates maintenance headroom periods. Hovering over a component shows more detailed information.

Legend

C = Curtailment (Energy/year) (%)
M = Maintenance Headroom (Occurrences/year)
V = Voltage Out of Range (Hours/year) (%)
L = Maximum Thermal Loading (Per year) (%)

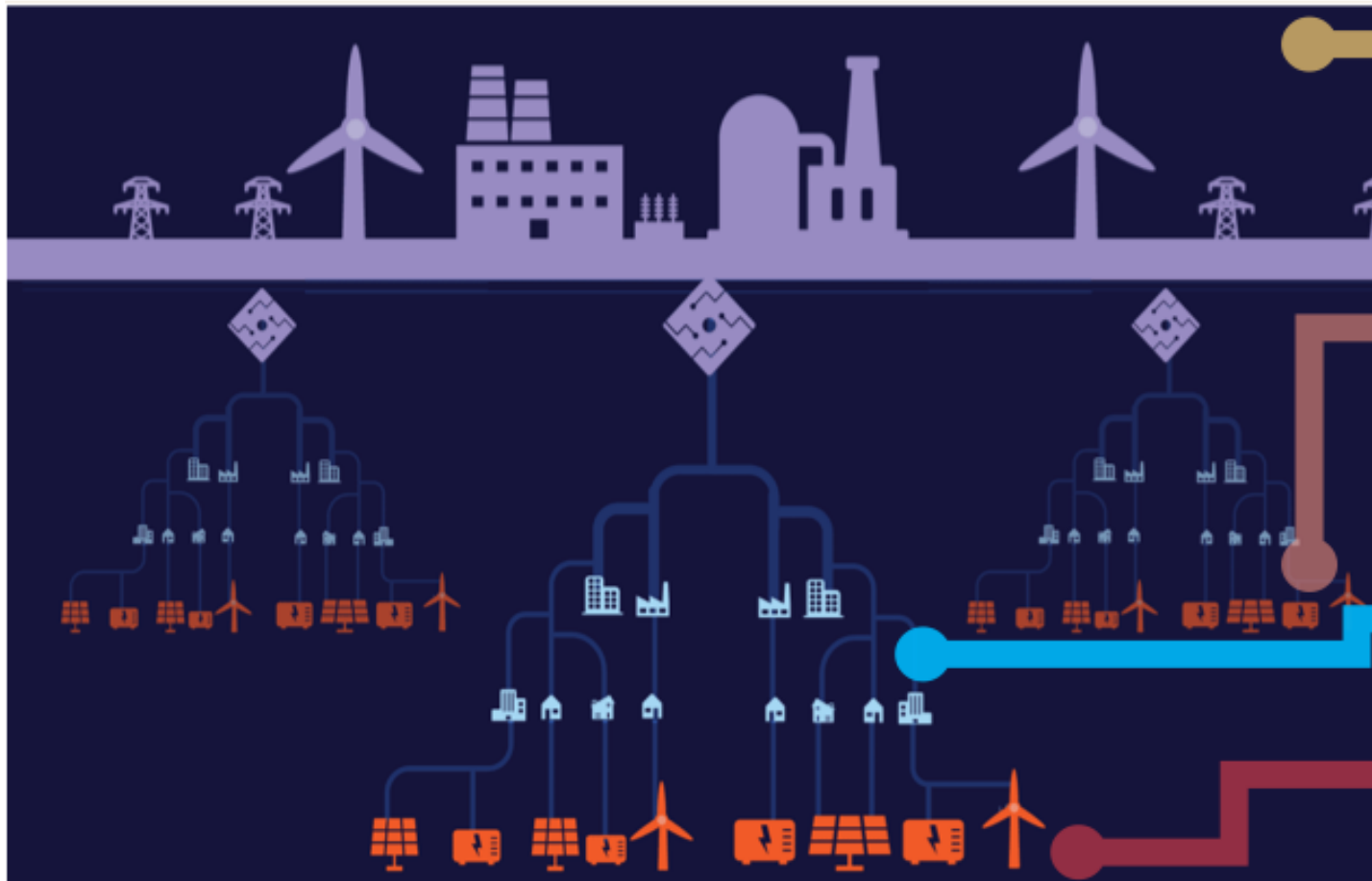


SANEDI JET – Optimal grid planning for municipalities

Lead: Dr Justice Chihota

Problems addressed in the JET Research Programme in support of optimal grid planning and sustainability

Lead: Dr Justice Chihota



What **grid planning and operation principles** apply to such a decentralized system?

What **load modelling techniques** are relevant to capture new trends in loads and generation? – variability, uncertainty, coincidence, dynamic load patterns.

What are the **hosting capacity limits** of the existing system for DER integration? How is this assessed and regulated?

What considerations are critical for **municipal distribution operations** in the wake of high penetration of distributed technologies?



Visualising South African Electricity Data

Explore compelling visual illustrations of South African electricity data that are regularly updated to provide informed insights into the current state of the electricity sector.

[READ MORE](#)

Our Mission

The Centre for Renewable and Sustainable Energy Studies (CRSES) at Stellenbosch University **advances a sustainable future** through world-class renewable and sustainable energy research, advisory services, awareness campaigns and training programmes.

Our Core Activities



Technology
development and
commercialization



Research



Training



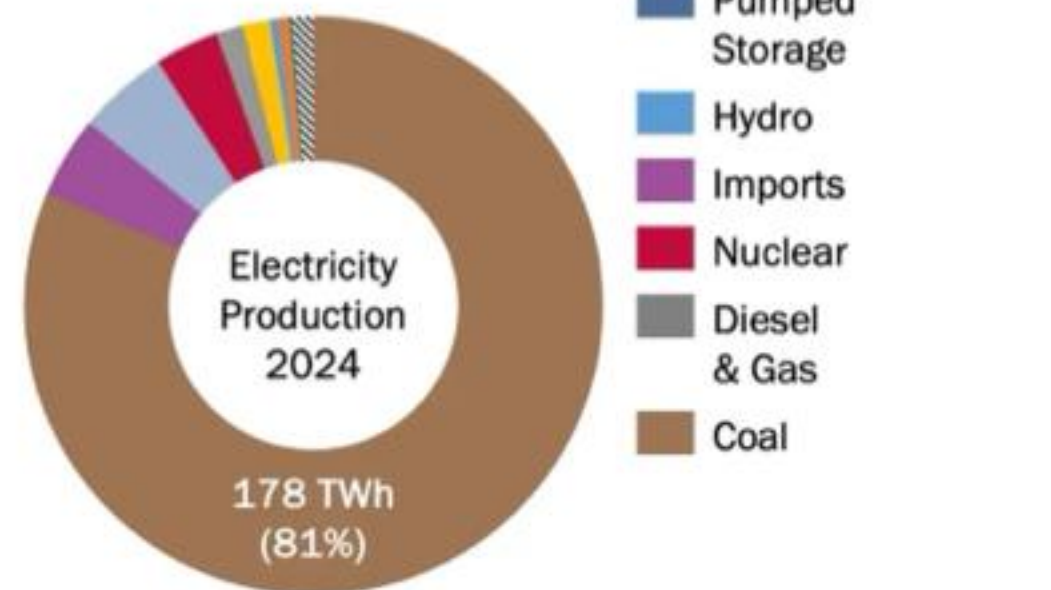
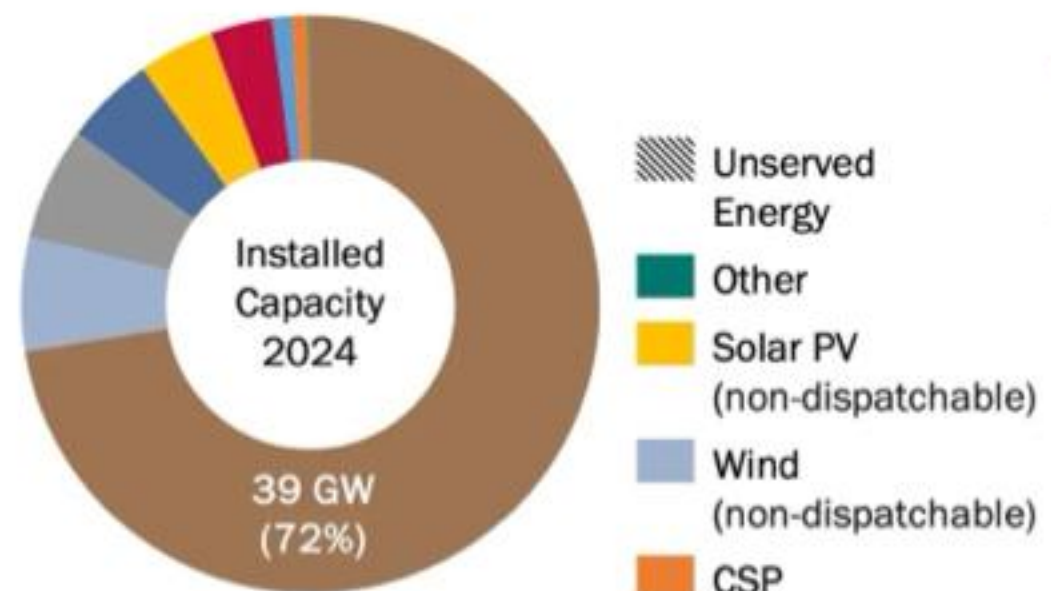
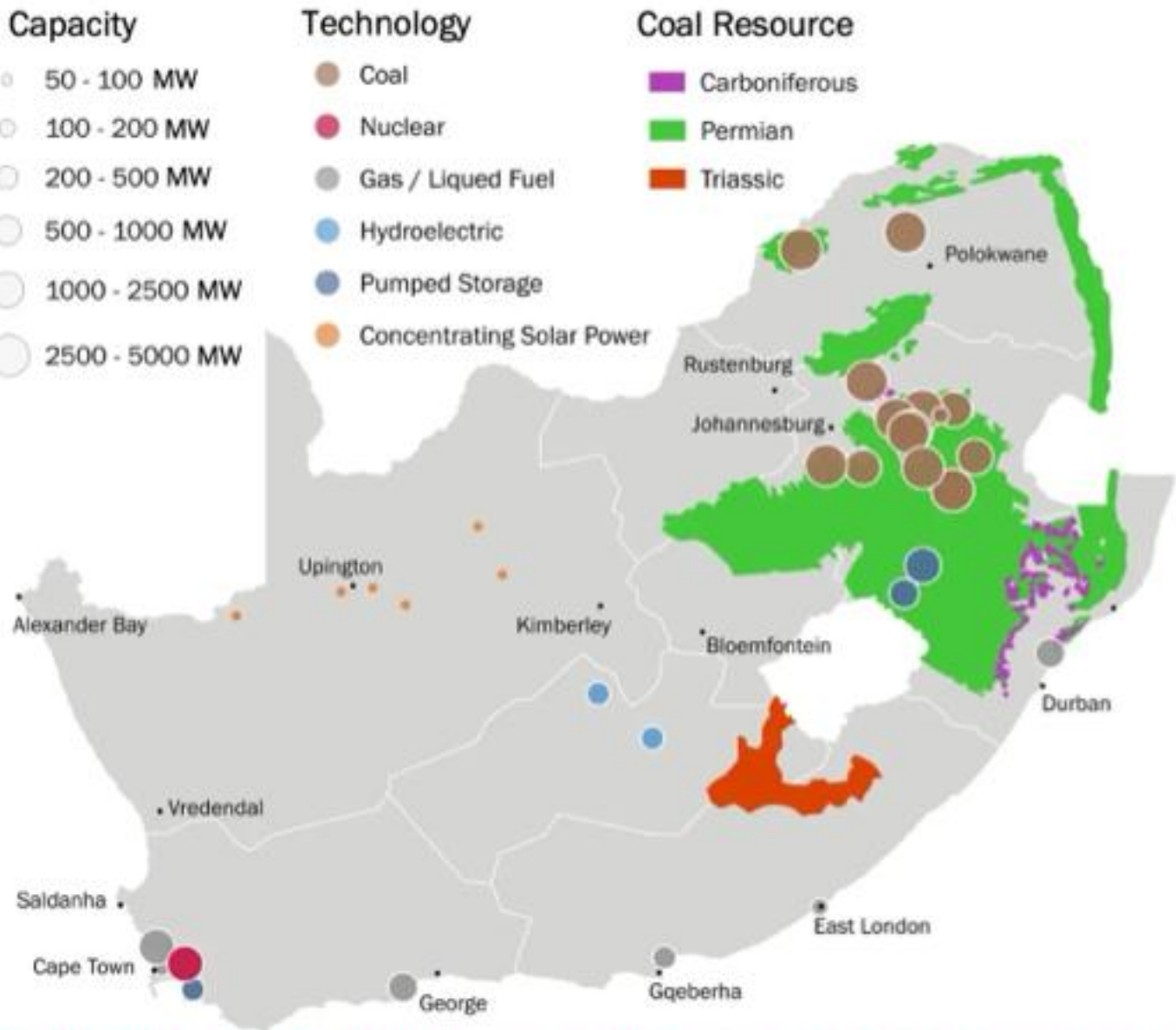
Awareness



Advisory Services



South African Dispatchable Power Plants



GREEN HYDROGEN ENGINEERING RESEARCH PLATFORM

Lead: Prof. Craig Mc Gregor
Manager: Dr Paul Thiele



GREEN HYDROGEN ENGINEERING RESEARCH PLATFORM

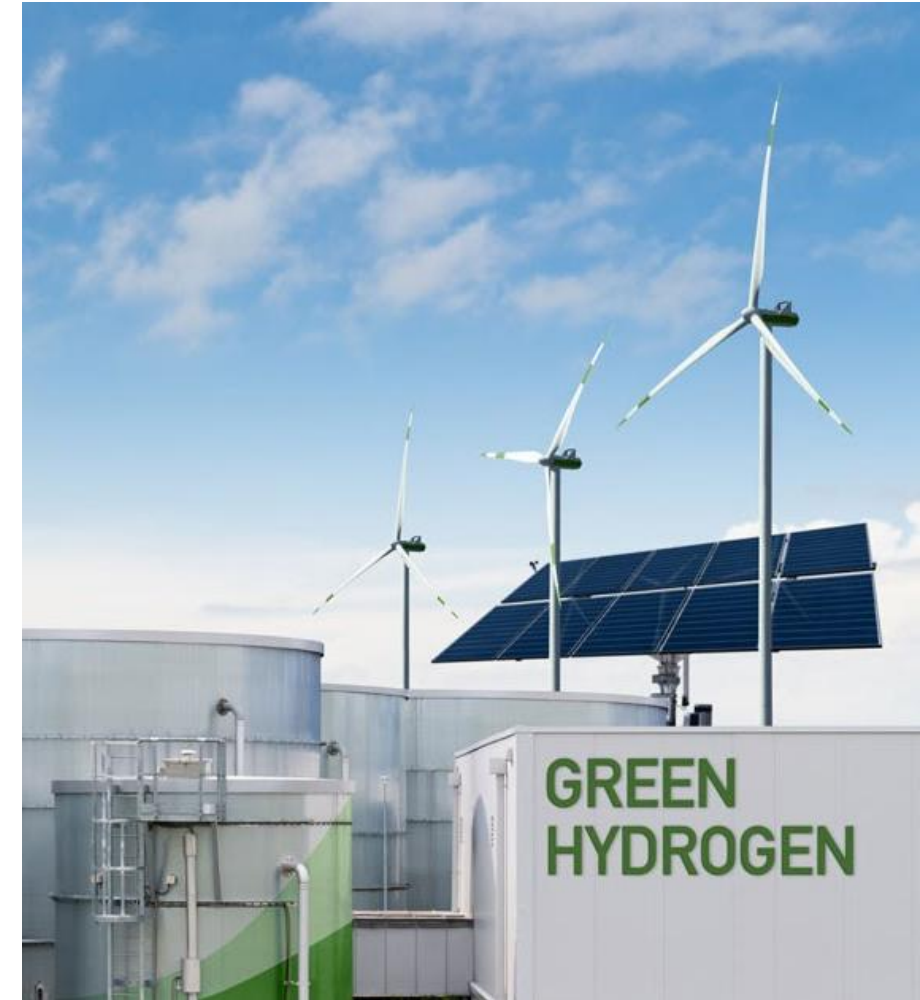
Lead: Prof. Craig Mc Gregor
Manager: Dr Paul Thiele

Vision:

- Positioning Stellenbosch University as a leading centre for clean hydrogen research and innovation in Africa

Strategic Objectives:

- Establish a world-class research platform in green hydrogen engineering
- Develop internationally connected research programmes
- Create strategic pathways for global research collaboration and funding



GREEN HYDROGEN ENGINEERING RESEARCH PLATFORM

Lead: Prof. Craig Mc Gregor
Manager: Dr Paul Thiele

Systems and Integration

- Techno-economics
- Optimisation studies
- Policy Implications
- Hydrogen strategy and roadmaps

Electrolytic Cells and Stacks

- Electrolytic and fuel cells
- Advanced manufacturing
- Power bed fusion

Alternative Production

- Biogas pyrolysis
- Microbial photo-bioreactors
- Photoelectro-catalytic (PEC)

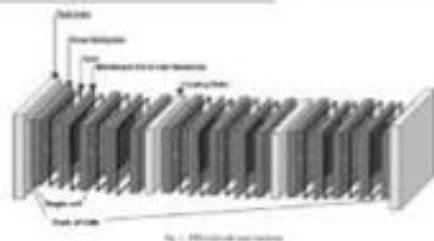
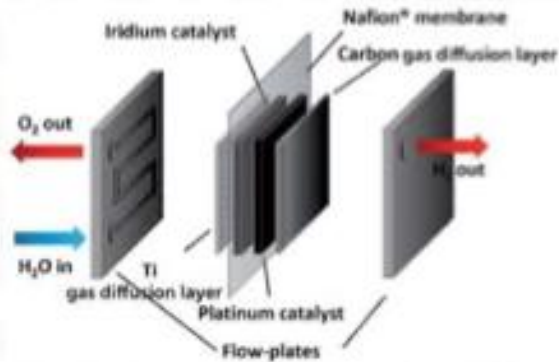
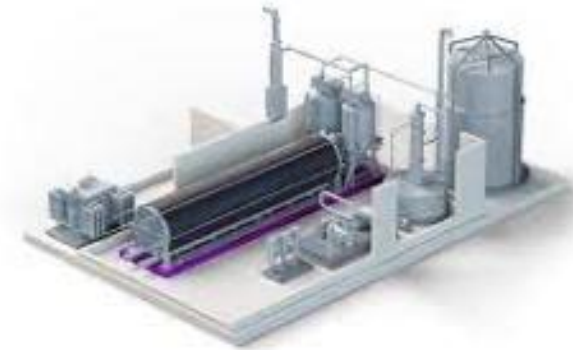
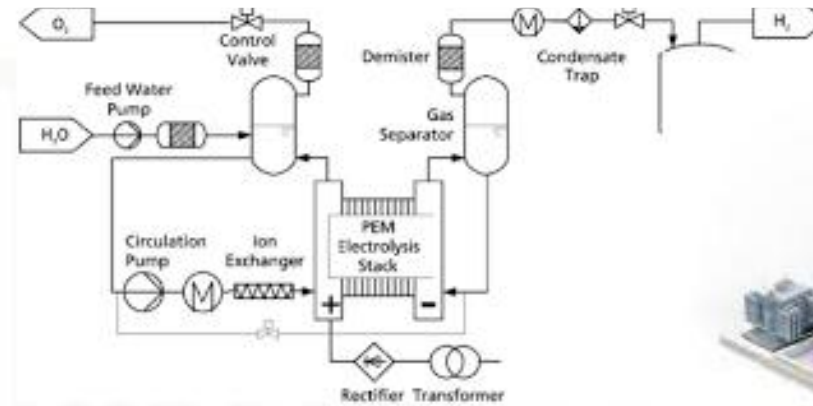
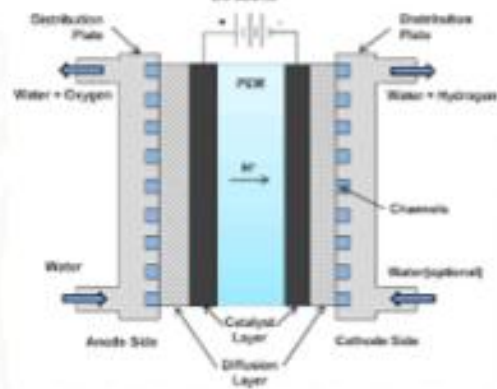
Storage and Usage

- Biorefinery upgrading
- Combustion and turbines
- Hybrid FC locomotive

Modelling

Laboratory studies and field tests

Technology Programme – Electrolyser/Fuel Cells Stacks and BOP



TreadStone
Technologies, Inc.



Components – M&M, IND

Process – ChE

H₂O/H₂/O₂ – ChE, CIV

Power – E&E

Control – E&E, ChE

BOP – M&M

Safety – ChE, CIV, E&E

Green Hydrogen – Integration and Transition

Sasol/DSI-NRF SARChI Chair in Green Hydrogen - Integration and Transition

Prof Paramespri (Prathieka) Naidoo

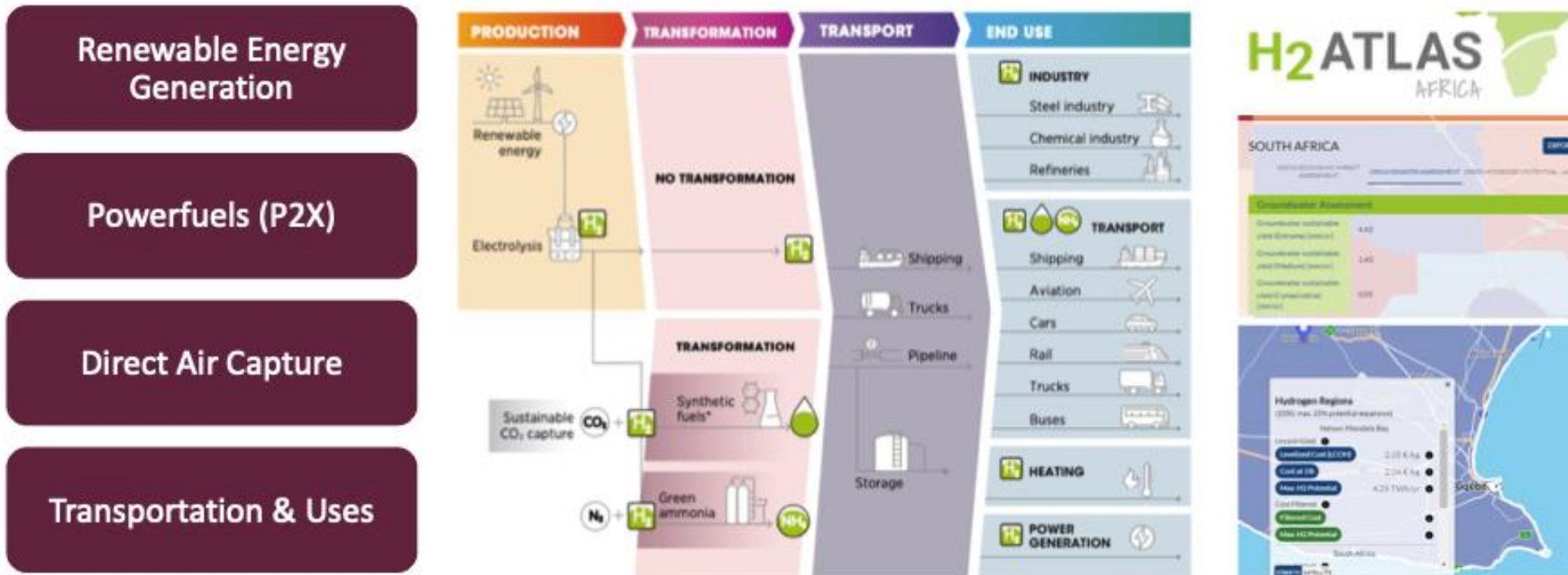


Image: International Renewable Energy Agency, 2020

Photocatalytic production of Hydrogen

Optic prototypes for photocatalytic production of H₂

Prof Craig McGregor
Prof Neil Goosen

Intent:

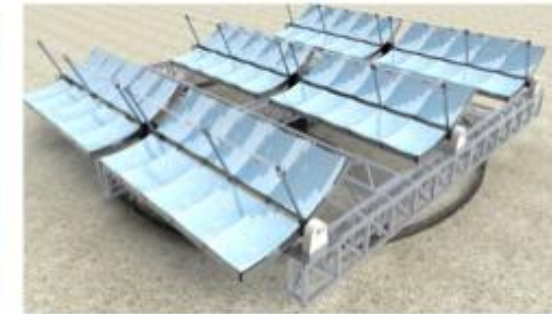
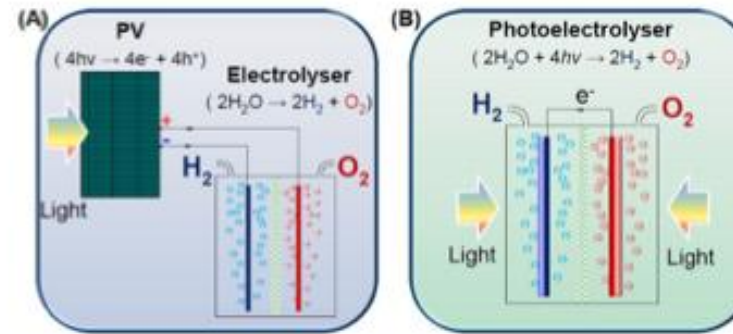
- Prototype development

Funding:

- EPSRC H2 Grant, UK

Collaborators:

- Dr Anna Hankin, Imperial College London
- SU Physics department



Photocatalytic hydrogen production via solar water splitting is a one step process to hydrogen, as apposed to convetional PV-electrolysis.

The novelty of the ICL project is in the:

- photoelectrochemical (PEC) reactor design (including optimisation of electrode geometry)
- optics used to guide light into the PEC
- the modularity of the PEC device, making it readily scalable beyond prototype dimensions and
- the use of up-scaled oxide-based photoelectrodes to achieve spontaneous water splitting

Advanced Manufacturing – Photo/electrolytic cells

Advanced manufacturing and surface modifications of water photo/electrolytic cells

Dr Melody Neaves

Dr Gerrit Ter Haar

Intent:

- Additive manufacturing of key water electrolyser components
- Surface modifications such as surface nanotechnology
- Mechanical performance such as electrolyser durability

Laser powder bed fusion

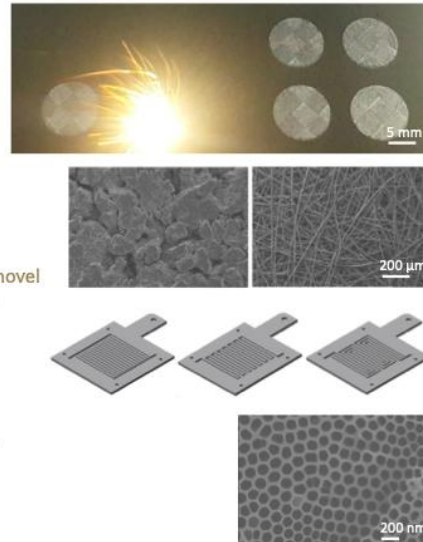
Leveraging key advantageous of additive manufacturing for electrolyser components

Porous gas diffusion layers & bi-polar plates

Leveraging additive manufacturing for novel design and manufacturing possibilities

Surface modifications

Novel surface modification such as nanotechnology (titanium dioxide) for photocatalytic properties.



The study of Hydrogen combustion for Micro Gas Turbine applications

Chaz Fenner
Supervisor:

- Prof SJ van der Spuy
- Prof R Laubscher

Intent:

- Combustor prototype development

Collaborators:

- Mrs Bronwyn Meyers (CSIR, Co-investigator)



A twin-shaft MGT facility

- Fully instrumented with proven reliability
- Reconfigurable (hardware and software)
- Designed and built by Dr Brian Ssebabi (funded by the DSI)

Project focus

- Combustor designed to co-fire LNG, H₂ and LNG-H₂ mixtures
- Reduction of thermal NO_x and Carbon emissions

Value for the M&M department

- A MGT facility capable of firing LNG, H₂ and LNG-H₂ mixtures
- H₂ storage and delivery infrastructure

Hydrogen-powered vehicles

Hydrogen powered minibus taxi concept for South Africa

Chris Abraham

Supervisors:

- Prof MJ Booysen
- Dr A Rix
- Prof Thorsten Zenner (Germany)

Intent:

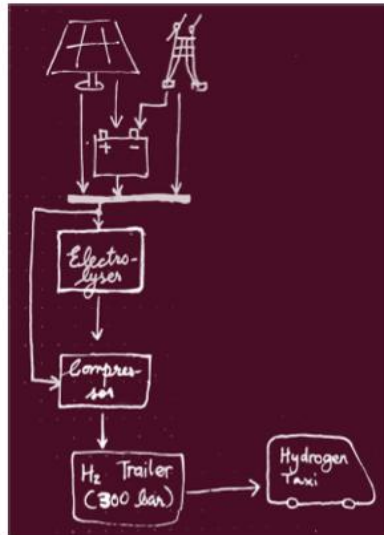
- Energy systems modelling

Funding:

- GIZ hydrogen capacity building
- MTN South Africa

Collaborators:

- Reutlingen University
Engineering | EyobuNjineli | Ingenieurswese



Background:

- 70% of SA relies on inefficient minibus taxis.
- System needs to be reformed for sustainability.
- Battery EVs have range problems with long distance taxis
- Hydrogen could be a possible alternative.
- (SA has potential for hydrogen production.)

Objectives:

- To design a feasible concept of Hydrogen powered long-distance minibus taxis.
- To test this concept using simulation.
- Optimise system economically and ecologically.

Hydrogen as sustainable fuel for Freight Transport in South Africa

Dr Joubert van Eeden

Intent:

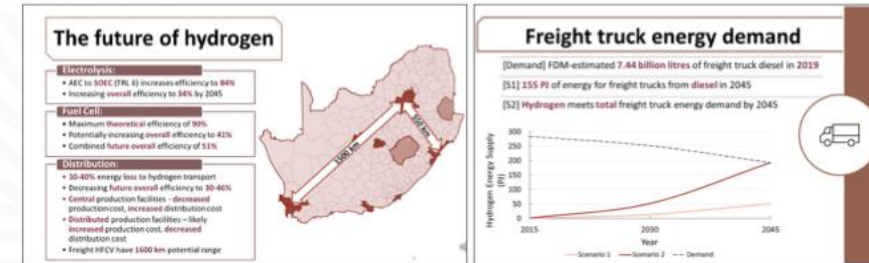
- Extent required to transfer SA Transport system to H2

Funding:

- None to date

Collaborators:

- Ruan van Schalkwyk
- SRF-SA partners



Scenarios:

- Hydrogen-fuelled 7.5-32 t light, medium and heavy commercial vehicles
- Scenario 1: Hydrogen replaces 5% of freight truck diesel by 2030 and 25% by 2045
- Scenario 2: Hydrogen replaces 20% of freight truck diesel by 2030 and 100% by 2045

Renewable Energy requirements by 2045:

- [S1] 3x and [S2] 12x current wind energy capacity increase
- [S1] 5x and [S2] 19x current solar PV energy capacity increase
- [S1] 1720 km² and [S2] 6440 km² of onshore wind farm area
- [S1] 290 km² and [S2] 1090 km² of solar PV farm area

Bio-hydrogen from waste and SAF

Green hydrogen as reagent in green chemicals and sustainable aviation fuel

Prof Johann Gorgens

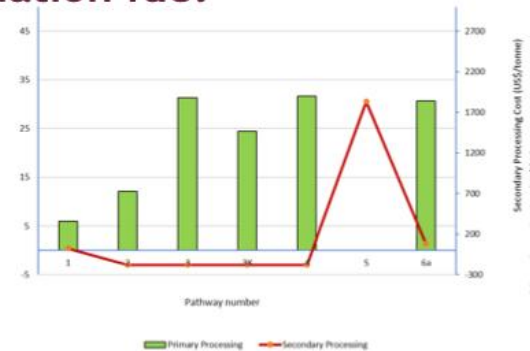
Intent:

- Compare self-produced vs external hydrogen sources for chemicals and SAF production
- Self-produced implies bio-based hydrogen; external sources of green hydrogen
- Substantial economic and environmental impacts

Collaborators:

- Sugarcane masterplan

Engineering | EyobuNjineli | Ingenieurswese



Motivation

- Green hydrogen is an essential reagent in the production of green chemicals and sustainable aviation fuel
- Biomass-processing to green chemicals and SAF occur in areas rich in biomass sources => limited landspace available for solar- and wind-based hydrogen
- Wide range of projected selling prices for solar- and wind-based hydrogen, from 1.5 to 4.4 US\$/kg

Potential for bio-hydrogen production from organic waste

Prof Cristina Trois
Prof Johan Gorgens
Prof. Eugene van Rensburg
Prof. Robbie Pott

Intent:

- Insertion of 2-Stage AD technology at full scale

Funding:

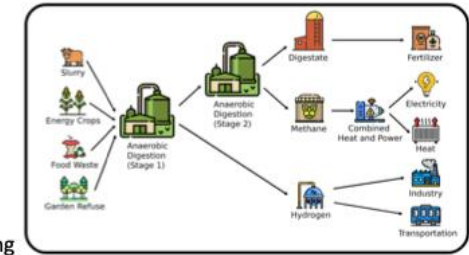
- LEAP RE and UNEP/CCAC

Collaborators:

- Prof. Frederic Coulon, Cranfield University (UK)

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- **Feasibility of 2-stage AD** in South African municipalities
- **Suitability of available feedstocks**
 - fruit & veg market waste
 - garden refuse
 - energy crops from phytocapping
- **Full-scale** implementation
- Pathways for **insertion** into the portfolio of available methods



Potential for Green Hydrogen in the Energy Mix

Optimization study to diversify energy-mix to supply green hydrogen production in South Africa

Esmeralda Mukoni

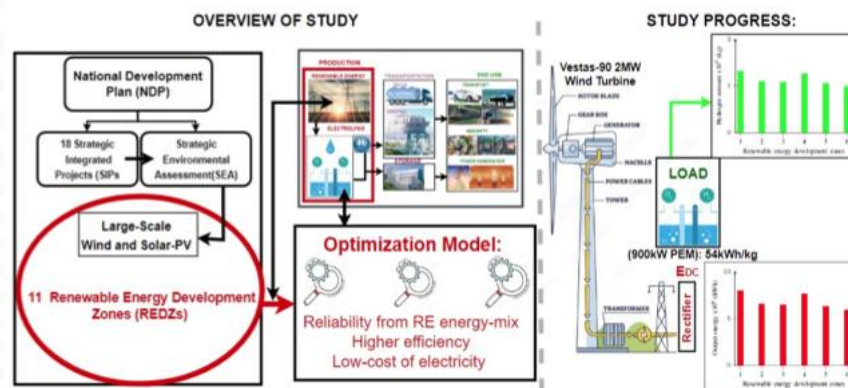
Supervisor: Dr K.S Garner

Intent:

- Energy-Mix/Ratio of Wind and Solar-PV to supply green hydrogen production.

Funding:

- GIZ hydrogen capacity building



Green hydrogen production's potential to alleviate South Africa's future grid congestion

Dr Bernard Bekker
Ndamulelo Mararakanye

Intent:

- Inform future grid planning and operations

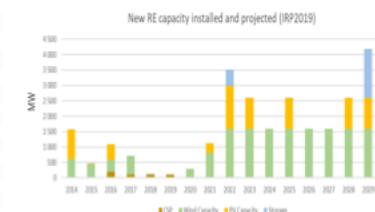
Funding:

- GIZ

Collaborators:

- Eskom CoE Planning

- Problem: Highest renewable resource regions will have no / little grid capacity by 2023 (Eskom GCCA 2021)



versus



- Study 1: Technical feeder analysis study to inform green hydrogen production's role in unlocking generation connection capacity constraints in the Northern Cape
- Study 2: Network congestion management principles necessary to unlock the potential of green hydrogen production in the Northern Cape

Figures: Department of Energy, Integrated Resource Plan, October 2019 / Eskom Generation Connection Capacity Assessment (GCCA) 2021



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**Thank you
Enkosi
Dankie**