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2023 Stellenbosch Engineering Industry Showcase

New Technologies
for Wind Energy

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- 1 Introduction
 - Renewable Energy Mix in South Africa
 - Wind Energy
 - Issues
- 2 Technologies
 - Brushless DFIGs
 - Speed Estimation
 - Magnetic Gears
 - Other Non-PM Machines
 - PM Machines
- 3 Opportunities



Introduction



Prof Maarten
Kamper



Prof Rong-Jie
Wang

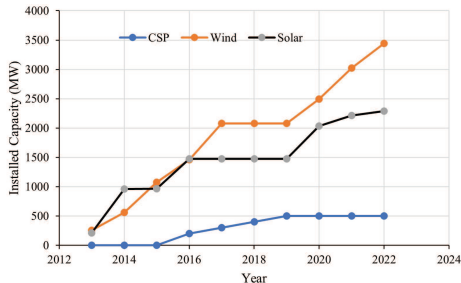


Dr Nkosinathi
Gule

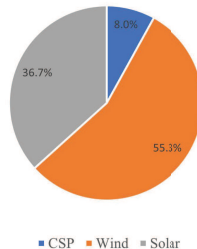


Dr Karen
Garner

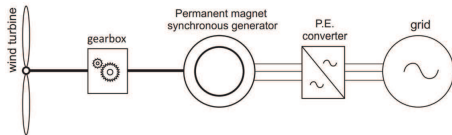
Renewable Energy Mix in South Africa



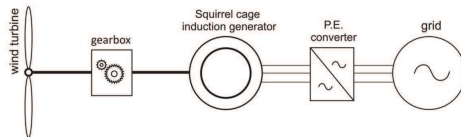
Installed Capacity from 2013 to 2022



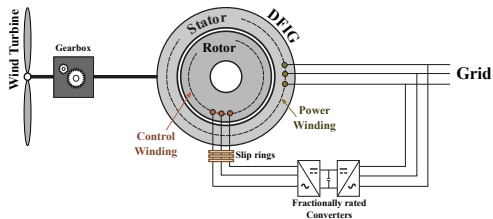
Installed Capacity in 2022



Geared synchronous generator

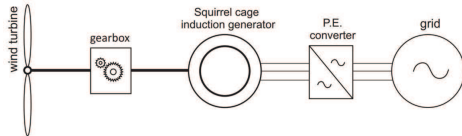


Squirrel cage induction generator

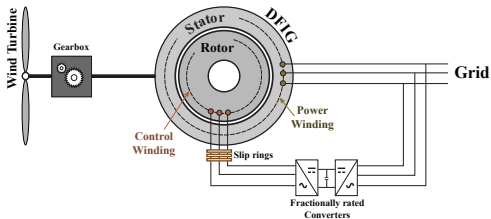


Doubly fed induction generator (DFIG)

- Slip ring and brush assemblies
- Gearbox
- Power electronics
- Encoder/resolver

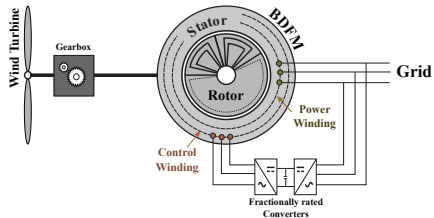


Squirrel cage induction generator

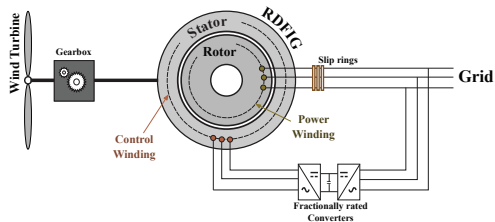


Doubly fed induction generator (DFIG)

Brushless DFIGs

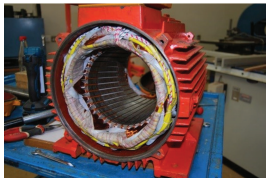
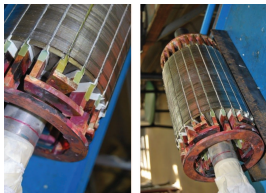


Double stator brushless-DFIG



Rotor-tied DFIG

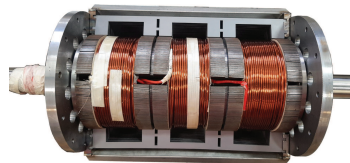
Brushless DFIGs (continues...)



Cage+nested
loop rotor and stator

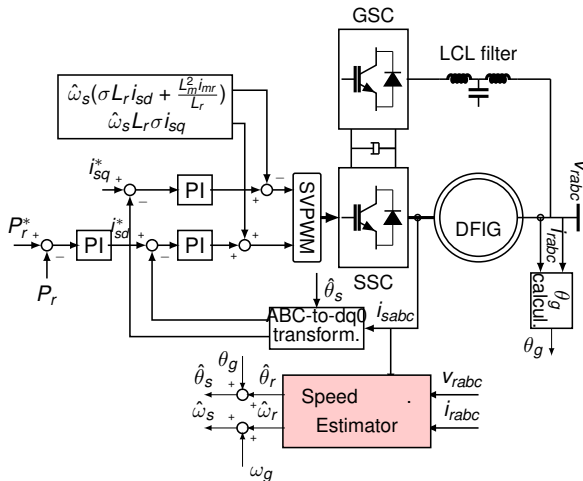


Wound rotor



Rotary transformer

Speed Estimation

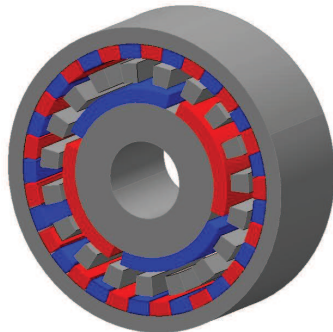


- **Advantages:**

- No mechanical contact
- No lubrication
- No overload damage
- Increase in energy efficiency
- Increase in reliability
- High gear ratios

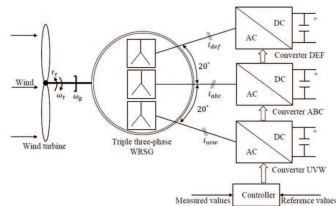
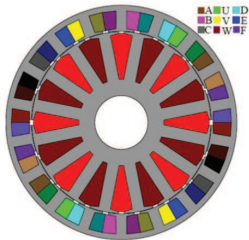
- **Disadvantages:**

- High amount of PM material
- Cost is challenging



- **Wound rotor synchronous machines**

- Non-overlap stator winding
- Triple 3-phase winding and converter-fed
 - Converter fault-tolerant
 - Cancelling MMF harmonics



- Gear-ratio PM machine

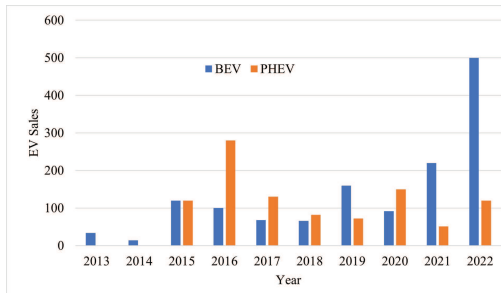
- Single air gap

- High torque density



Opportunities

- Electric vehicles
- Electric aircraft
- Condensers
- Wind energy conversion + green hydrogen



Thank you
Enkosi
Dankie