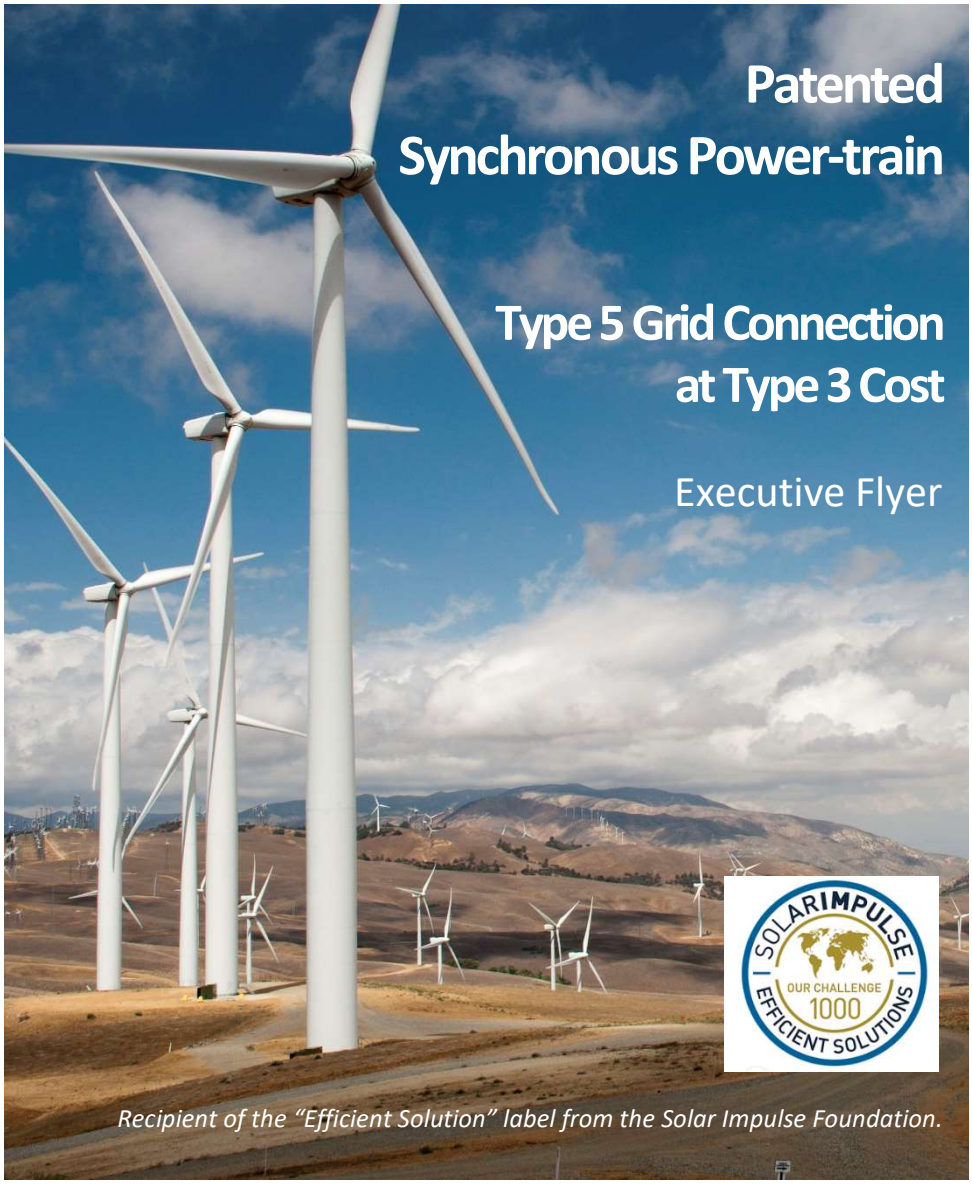
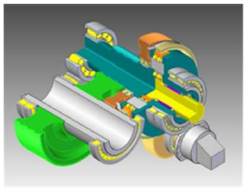


Recipient of the "Efficient Solution" label from the Solar Impulse Foundation.

- **Patented Technology**
  Multiple countries, recent patents, IEC-certified technology.
- **More than 1000 turbine-years track record**
  All synchronous and directly grid-connected, including 46 MW wind farm generating 10% of NZ's wind power, and boosting system strength. Proven in New Zealand and Scotland.
- **Low cost – less than a Type 3 turbine**
  Additional hydraulic system handles only 5% of rated power, loses less than 1%, keeps capital and O&M cost down, easily replaced up-tower.
- **No power electronics (PEC)**
- **Scalable to 2 MW, 5 MW, 10 MW, and above**



Wind turbine grid connection types are for example explained in: https://www.site.uottawa.ca/~rhabash/ELG4126WindGenerators.pdf

Synchronous generation improves system stability in voltage faults and provides inertia, essential in frequency faults.

Partner with SyncWind Power Ltd to take this global.

- ✓ Synchronous wind turbines are trusted and understood by electricity system operators.
- ✓ "Type 0" in power industry = Type 5 in wind industry (more grid-friendly than Type 4).
- ✓ Avoid the prospect of future constraints by electricity system operators.
- ✓ Avoid costs and well-known reliability issues of power electronic converters (PECs).

SYNCWIND

Advantages of SyncWind's Synchronous Power-train:

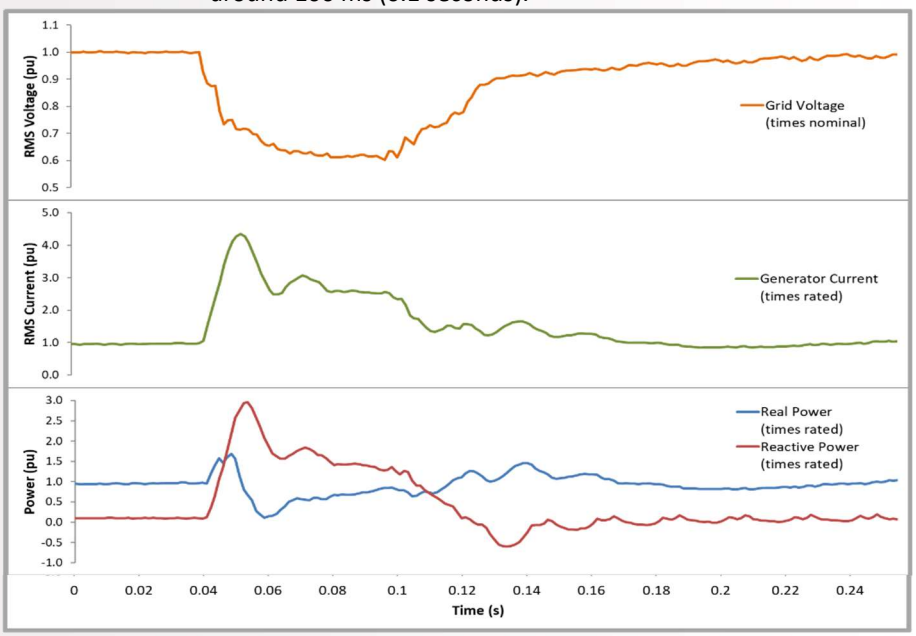
- **Solution to gearbox reliability problems:** Torque Limiting Gearbox (TLG)
- **Excellent low wind performance:** Low variable speed (LVS) System
  Typically 5% higher AEP and 4 m/s cut-in suits low wind sites (class 3&4). Patented LVS enables broad-band variable wind turbine speed. (Generator speed stays synchronous).
- **Full synchronous capabilities will lift barriers to renewable future:**
  - **System strength:** Voltage stability with short-circuit current available to 1000% rated

Figure 1 - Example of fault contribution & ride-through: A system voltage dip to 60% of normal voltage that lasted around 100 ms (0.1 seconds).

The voltage dip

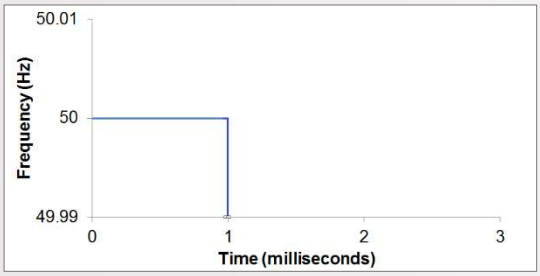
The short-circuit current response. Note that this instance is many times rated current (the 1.0 pu level). This cannot be provided by PEC systems, which are limited to 1.0 pu or a little above.

The real and reactive power response - the red trace shows reactive power immediately being exported to oppose the dip in voltage before settling as voltage recovers.

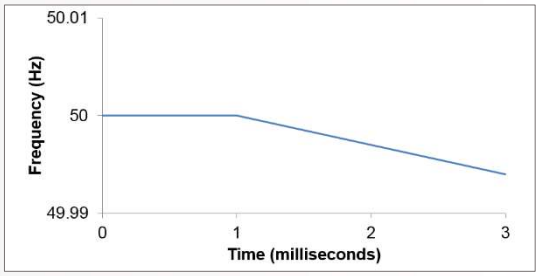


  - **Reactive power capabilities:** 100% kVAr continuous rating
  - **Generator is a synchronous condenser:** Can run with no wind (if small motor added)
  - **Physical inertia:** Frequency stability due to generator inertias being synchronously tied

Figure 2 - The basic principles of physical inertia: Fundamental PEC versus Synchronous generator frequency response



PEC generator has no inertia so frequency could change abruptly on a millisecond timescale, destabilising grid.



Synchronous generators contribute at distance to stability by electro-magnetic sharing of inertia.

  - **Very fast frequency response (FFR):** When in FFR/load-following mode, the total measurement-controller-actuator time is a few tenths of a second, uses turbine inertia.

We 'Synchronise the *Wind*' directly into the grid.

SYNCWIND

© SyncWind Power Ltd
Genoa, Italy
mobile: +39 338 448 8604
Geoff@windflow.co.nz
www.SyncWind.org