



# C-GEN Direct Drive

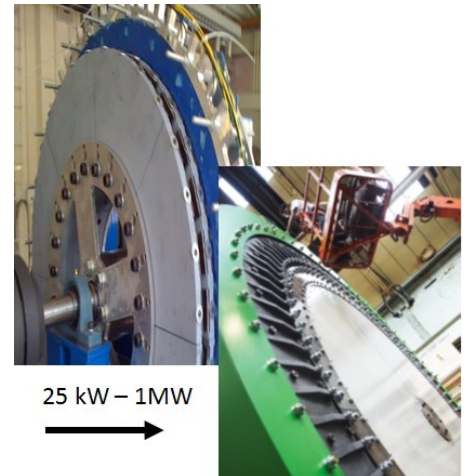


THE UNIVERSITY  
of EDINBURGH

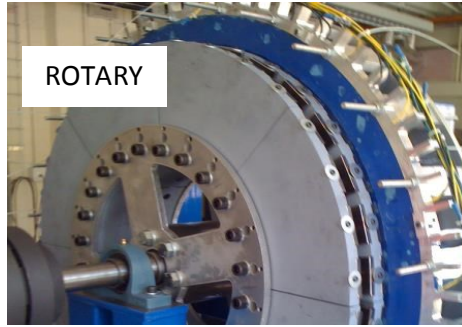
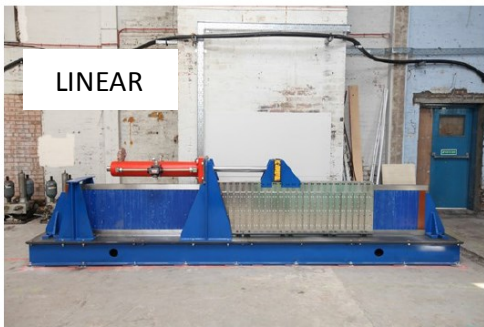
*The PTO solution with high reliability, survivability, availability & affordability.*

## WES STAGE 3 OBJECTIVES

- Demonstrate C-GEN in a real environment, at a relevant scale and under realistic load profiles.
- Industrialise the design and manufacture of C-GEN for marine renewable applications.
- Obtain certification/qualification from an independent body.
- Align the commercial strategy with device developers for a full scale Stage 4 demonstrator.



## TOPOLOGY



## SCALABILITY:

**25kW to 1MW in one step**

## AFFORDABILITY:

CAPEX Target - £400k/MW

LCoE Target - £150/MWh

## APPLICABLE TO ALL OFFSHORE RENEWABLES



## AVAILABILITY, RELIABILITY AND SURVIVABILITY

- MTBF – target 5 years
- 5 x electrical & mechanical overload capability
- Modularity provides redundancy
- Maintenance on vessel – low MTTR
- Flooded operation provides inherent overload capability



Modularity - offshore O&M

Contacts : [Markus.Mueller@ed.ac.uk](mailto:Markus.Mueller@ed.ac.uk), [Paul.Noble@haywardtyler.com](mailto:Paul.Noble@haywardtyler.com)





# C-GEN Technology



THE UNIVERSITY  
of EDINBURGH

*C-GEN is an advanced proven multi-stage air-cored direct drive PM generator technology providing high reliability and availability in renewable energy converters.*

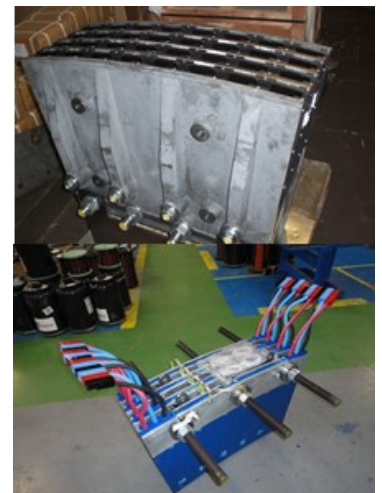
The differentiating design features of the patented C-GEN design include:

- an axial flux topology with C-shaped rotor core
- an air-cored stator arrangement
- generator divided into several axial generator stages that are electrically independent
- generator rotor and stator divided into low weight standardised modules around the circumference



**C-GEN PMG technology has the following USPs over existing generator technologies used for direct drive:**

- 1. No Magnetic Attraction Forces closing the airgap** - simplifies the support structure required, and simplifies final assembly.
- 2. No cogging torque** - more of the input mechanical energy will be converted to electrical energy, and noise and vibration will be reduced.
- 3. High Degree of Modularity** - the use of air-cored coils allows a high degree of modularity in both the stator and rotor construction.
- 4. Higher availability** – C-GEN is a multi-stage machine, eg a 4 stage 1MW generator consists of 4 separate 250kW machines, all of which can be isolated. A fault in one stage can be isolated and the remaining 3 stages can generate increasing availability, annual energy yield and hence reducing LCOE.
- 5. Ease of O&M** - the high degree of modularity enables replacement of single faulty modules rather than the complete machine. This reduces O&M costs and increases the turnaround of any O&M procedures. Depending upon the size of the device, the O&M procedure could be done on board a ship using an on-board crane or using a crane in a nacelle of a wind turbine.



Modular Construction

Contacts : [Markus.Mueller@ed.ac.uk](mailto:Markus.Mueller@ed.ac.uk), [Paul.Noble@haywardtyler.com](mailto:Paul.Noble@haywardtyler.com)

