



ECOWindS

A New Low Cost Permanent
Magnet Generator (PMG)
for Offshore Wind

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Why Did We Start Out?

We were aware of:

- 1) The need for cost reduction, and
- 2) A move to rare earth (neodymium) PMGs to facilitate cost reduction via upscaling.

However, we were also aware of

- 1) The costs and potential long term supply constraints associated with using rare magnets, and
- 2) That PMG manufacturers had been unable to develop a viable ferrite based offering.



Our Key Research Question

- Q. How would it be possible to reduce PMG cost?
- A. Remove neodymium iron boron, an expensive and scarce magnetic material and replace it with ferrite a much cheaper and readily available alternative.

We were aware that there would be challenges, particularly generator weight, but we used the question to help define our project objectives.

Project Objectives

To design from first principles a new PMG that would:

- 1) Only use ferrite magnets, i.e. remove a reliance on rare earth magnets,
- 2) Would be viable at a multi MW level, i.e. in the 6MW to 10MW range, and
- 3) Would deliver significant LCOE reductions via CAPEX and OPEX savings.



Recognised Challenges

- Ferrite is not as strong as Neodymium Iron Boron (Neo). Its magnetic field is generally 1/3rd strength of Neo.
- The natural assumption is that 3x more magnetic material will be required making generator weight a problem issue.
- Achieving viable efficiency.



Potential Advantages

- Could eliminate a reliance on expensive rare earth magnets.
- Ferrite is a very low cost by comparison with Neodymium.
- Ferrite is an abundant material – it is highly unlikely that it will cause any sort of downstream supply or pricing issues.
- Higher Curie Point, i.e. it does not demagnetise at low temperatures.
- Easier to work with
- Inert



How Did We Get Started?

- Obtained equity investment plus grant funding from OrbisEnergy.
- Additional support received from GROW:OffshoreWind.
- Secured project partners:
 - Cambridge University – FEA
 - BVG Associates – Product Design & Specification
 - DNV GL – Electro Magnetic Study
- Developed a structured R&D programme with key research objectives.



What Did We Do?

- Set up detailed internal R&D project to map fields and developed an in-house software programme to calculate performance.
- Commissioned Cambridge University to develop FEA software programme.
- Worked with UK suppliers to establish available materials.
- Designed and manufactured demonstration prototype.



Achievements and Results

- Built a working prototype
- Design has been validated
- Weight gain be managed effectively
- 5 patent filings with more to follow
- A comprehensive development road map

PROJECT CONCLUSION

CAPEX reductions and OPEX savings are achievable that can deliver significant reductions in LCOE.

Availability of Magnetic Materials



It is estimated that the worldwide reserves of ferric oxide (iron ore) amount 800 billion tonnes

2015 Global production of Neodymium 35,900 tonnes



2015 Global production. of Dysprosium 1,902 tonnes



Where Next?

- Our expertise is in technical innovation, fabrication and IP development.
- We are looking for an industry partner to work with us to commercialise our PMG from its current prototype stage to operational multi MW units.



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