

**NGenTec designs and supplies permanent magnet generators using patented technology and proprietary engineering tools for low, medium speed and direct drive MW scale wind turbines.**

**Our innovative technology is developed from world-leading research undertaken at the University of Edinburgh to:**

- \* Decrease the cost of wind energy**
- \* Increase reliability**
- \* Maximise energy yield.**

**Our modular and air-cored design is smaller and lighter than any alternative, lowering the cost of manufacture and assembly. Based in Scotland, which is at the forefront of the international renewables energy market, we understand the requirements of both onshore and offshore applications and will work collaboratively with our customers to provide innovative and competitive drivetrain solutions.**

# Our Products and Technology

NGenTec products are a range of axial-flux air-cored permanent magnet generators for direct drive, slow and medium speed generation which have applications for onshore and offshore multi-MW wind turbines.

All our design theories have been verified and the design tools validated through extensive computer modelling. With proven manufacture methods we are also able to demonstrate the ease of assembly and maintenance of the stator and rotor.

NGenTec technology is truly innovative, bringing key performance advantages to wind turbine manufacture, assembly and energy yield.

NGenTec technology brings innovation, is a clear leader in the sector and brings key performance advantages to wind turbine manufacturers.

- \* High Reliability
- \* Minimum part count and use of standard components parts
- \* Modular construction, with built in redundancy and flexibility
- \* High efficiency across full operating range and energy yield
- \* Zero cogging torque
- \* Reduced weight and size
- \* Cost competitive
- \* Reduced through life maintenance

## Standardised Modular Components

The components in NGenTec generator technology are manufactured using standard and well proven industrial techniques within the electrical machines industry. Available materials are used throughout. The NGenTec machine is made up of standardised modular components simple to manufacture, assemble and transport.

Each component will be produced using a repeatable process with low level of specialist skills required in building conventional generator technology. Such processes favours automated production enabling a high level of quality and reliability of NGenTec machines. Each component can be supplied by multiple manufacturers thereby providing total secure and competitive supply.

The NGenTec generator line replaceable unit is light enough and can be lifted with a small internal wind turbine crane, should need be. Stacked multistage axial-flux NGenTec modules could be replicated along a shaft, to provide for different torque/power levels - allowing the same basic modules to be used in a number of different machine ratings lowering spare parts holdings, service and maintenance costs.

In its simplest form NGenTec generator consists of two fundamental parts of an electrical machine, the rotor and the stator.

## Product Suite

Medium Speed Generator	Slow speed Generator	Direct Drive
Most compact Lowest weight	Single – Stage gearbox	Minimum maintenance - No gearbox
Integrated with gearbox or stand-alone		

### Permanent Magnet Modular Rotor

Each stage of the NGenTec generator consists of a double-sided mild steel rotor plates, joined at one end to form a c-shape, with surface mounted permanent magnets within the c-shape.

All magnetic forces are neutralised within the rotor module structure so no magnetic forces are translated to the support structure. This allows for flexible integration into any wind turbine mechanical topology, simpler bearing arrangement and a lightweight structure.

### Air Cored Modular Stator

Individual stator coils are manufactured using customised moulds and adequate insulation to suit the machine technical requirements. In the air-cored winding, the coils are supported in a non-magnetic material, with no magnetic attraction forces between the rotor and the stator. Thus making manufacturing, assembly and maintenance significantly easier. With such construction, the generator has:

- \* No structural distortions
- \* No Unbalanced Magnetic Pull
- \* Zero cogging torque
- \* A very low cut-in speed
- \* Minimal noise
- \* No eddy current or iron losses.
- \* Improved efficiency yield through higher efficiency.

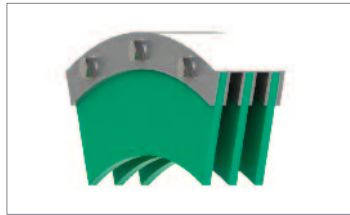
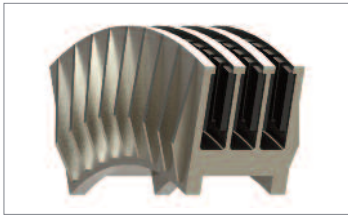
### Multi-staged Modular Machine

Each NGenTec generator comprises a number of independent stages that can be individually isolated for flexible control, redundancy and power production.

Each multistage generator stack can have a dedicated converter or multiple stacks can be linked to a single converter.

Whilst the NGenTec generator is designed for maximum reliability and minimum maintenance, in the event of a power generating circuit failure, the affected line can be isolated enabling the machine to continue to generate electricity until a suitable maintenance window is identified, reducing significantly opex costs.

A suitable number of operating stacks can be selected to suit the wind conditions and maximise generator efficiency across the full operating range.



## Capability

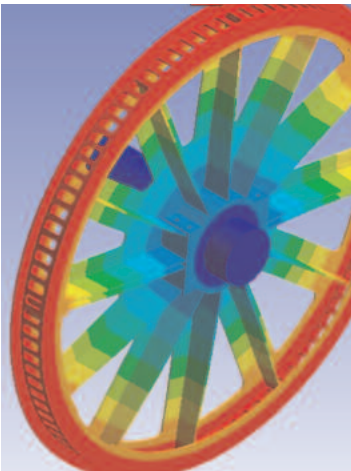
The NGenTec team boasts both extensive experience in the wind energy sector and exceptional engineering expertise. Primarily assembling in the UK, we are open to exploring mutually beneficial arrangements with wind turbine manufacturers.

We have proven design tools which accurately model and optimise generator designs, validated by extensive testing. The design tools integrate seamlessly to a number of other well-recognised engineering software packages used in electrical machines' electromagnetics, thermal and mechanical analysis and design verifications.

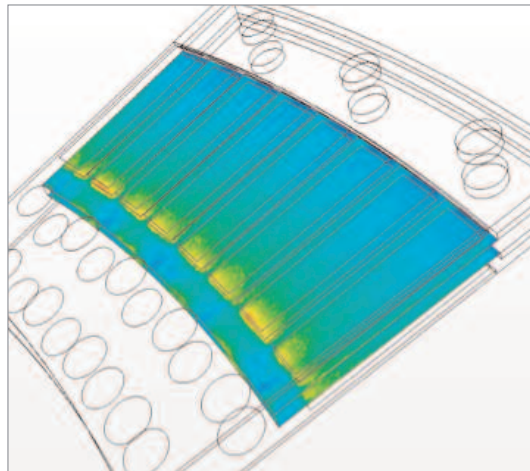
NGenTec can also:

- \* Manage the interface with the remaining systems (gearbox, nacelle, converters, protection and switchgear, brake and torque-limiting device)
- \* Assist with the integration within the wind turbine
- \* Provide a set of model machine parameters for turbine loads and concept development

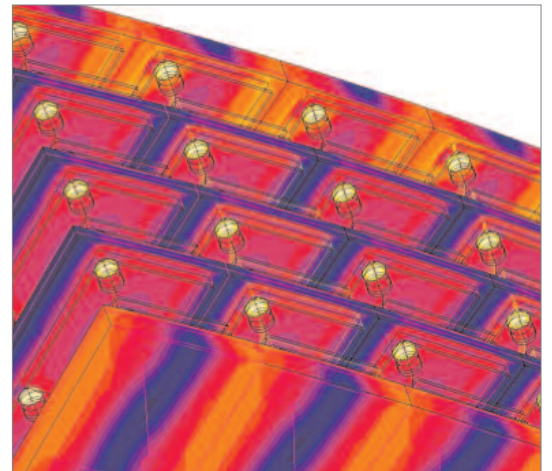
NGenTec also has strong links to world-leading Scottish universities and our location provides practical benefits to manufacturers looking to capitalise on Scotland's drive to become a world leader in wind energy generation.



Structural Finite Element Analysis of rotor



Thermal Computational Fluid Dynamics of stator



Electromagnetic modelling of rotor

## Executive Team

Experienced management team with over 100 man-years of combined experience in electrical engineering and renewable technologies. NGenTec has also assembled a first class engineering team.

### **Dr Makhlouf Benatmane** CEO and Director

Makhlouf (Ben) has 20 years of experience of management and electrical engineering. He joined the Company in early 2011 from Converteam where he led their worldwide wind and renewables operation. He was responsible at Converteam for strategic business planning, product definition and delivering the significant positive financial performance of the renewables sector of Converteam business.

### **Jim Boyd** Chief Financial Officer

Jim, a qualified Scottish Chartered Accountant, is an experienced commercial finance manager with considerable finance, corporate finance and general management experience gained in a number of sectors. He has worked with 3i, one of the leading UK based venture capital organisations, managed a market leading offshore oil and gas logistics business and been closely involved in managing a leading edge technology oil and gas engineering design business.

### **Dr Nazar Al-Khayat** Chief Technology Officer

Nazar is an accomplished engineering manager with more than 20 years of product development experience in automotive, industrial and power generation sectors. He has over 40 scientific publications and 10 patents covering powertrain architectures and controls, novel electrical machines topologies, power electronics and renewable applications.

### **James Murray** Business Development Manager

James has a MEng degree in Product Design Engineering from the University of Strathclyde. He has 7 years' experience in engineering design and management which includes 6 years within the aerospace sector as a project manager and technical lead on various development projects. He has been closely involved in the development of the Company to date. James is a Saltire Fellow.

### **Dr Charles R Gamble** Chief Marketing Officer

Charles has 20 years of experience in the wind turbine sector, held Director positions within engineering, marketing and business development with turbine manufacturers, and Garrad Hassan and Partners the global wind consultants. He joined the Company from Nordic Windpower, where he was CTO, designing and building 1MW onshore wind turbines. He is a Chartered Engineer with a background in power and electrical machines.



Dr Makhlouf Benatmane



Dr Nazar Al-Khayat



Dr Charles R Gamble



Jim Boyd



James Murray



## Our Partners

Throughout NGenTec's drive to be the supplier of choice of direct drive, slow and medium speed permanent magnet generators, the company enjoys the support of both public- sector organisations and private companies.

### **DBGS Industrial Partnership**

In 2010, David Brown and NGenTec announced an industrial partnership which will see David Brown provide engineering expertise and testing services for the first 1MW prototype of NGenTec's innovative wind turbine generator.

David Brown has been recognised as a leading specialist in power transmission engineering and manufacture for more than 150 years and has a strong reputation for gearing excellence and innovation. The company has a rich and successful history of engineering for some of the world's most challenging industries including land and marine defence and power generation applications and is ideally placed to be NGenTec's partner of choice for engineering services.

Using its experience in supplying mission critical industries, David Brown designs and manufactures onshore and offshore wind turbine gearboxes from 1.5 – 7MW and provides a full range of aftermarket services including upgrade programmes and asset management through its network of global service and repair centres.

David Brown has 6 manufacturing facilities and 11 service centres present across five continents serving local markets with locally employed teams of specialists.

### **Our principal funding partners**

- \* David Brown Gear Systems
- \* Scottish Enterprise
- \* Department of Energy and Climate Change (Environmental Transformation Fund)
- \* SET Venture Partners
- \* University of Edinburgh (Edinburgh Technology Fund)

The NGenTec team is committed to working collaboratively with wind turbine manufacturers to provide the ultimate drivetrain solution to provide the lowest lifetime cost of energy.

If you would like to know more, please contact:

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