REVOLUTIONARY WIND TECHNOLOGY PIONEERED BY McCAMLEY

Suppliers of Revolutionary Urban Renewable Power

By 2050, we could get all the energy we need from renewable sources.

Director General, James P. Leape
WWF International

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Revolutionary Wind Turbines by McCamley

Introduction

The McCamley wind turbine is designed to be mounted on buildings in built-up areas to help facilitate a growth in Urban Renewable Power (URP). It can also be mounted on a pole and be positioned in open or remote areas to provide power to locations with no grid connection. With its unique characteristics, it challenges many of the issues that have prevented an expansion of wind power into both the urban and remote environments. We are now accepting orders for the **M**cCamley **T**urbine **12**kW (MT12) which will be available for delivery and installation by August 2013.

McCamley Turbine's Features

- Self-starting - no input from the grid is required to start the turbine
- Self-starts at wind speeds as low as 1.8 m/s
- No shut down speed - can continue to operate in storm force winds
- Is able to operate in wind from any direction
- Airspeed within stator greater than wind speed outside
- Minimal noise and vibration
- Bird and Bat friendly
- Light weight design can help reduce building structural requirements
- Multi-leg design gives better load distribution into the building and structurally redundancy for additional safety
- Blades are encased in a stator which affords extra protection
- Designed to be aesthetically pleasing
- Can be branded with corporate colours and logo without any effect on turbine
- Energy produced can be used immediately or stored

Prototype Testing and Development

McCamley Turbine 1kW (MT01) Prototype Testing

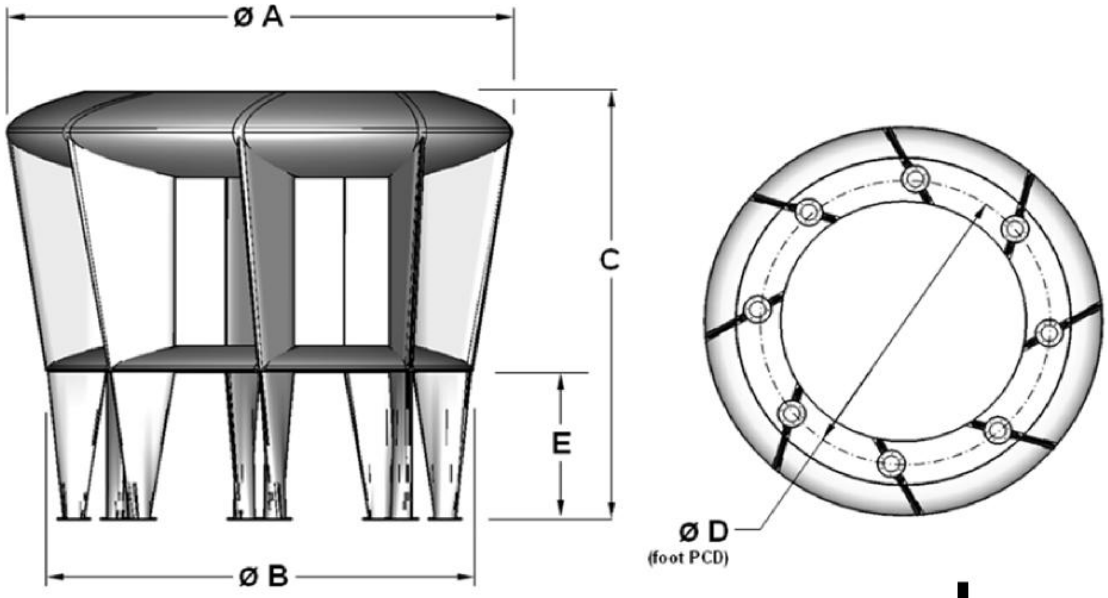
Prototype testing continues with the MT01 flying on top of a tower block in Lyaskovets, Bulgaria and at Keele University in the UK. Data collected from both turbines is being used by our Engineering team as part of our ongoing test programme. Recently 1kW turbine in Bulgaria recorded an output exceeding 1.5kW in wind speeds between 12 – 13 m/s.

Currently in production is our 1kW machine destined for a rooftop in London and is our last scheduled MT01 prototype. From Q4 of 2012, we are manufacturing a small batch of the MT01 for use as technology demonstrators and to support upcoming urban energy studies, which are part of sustainable green cities projects in the Middle East and North Africa i.e. Abu Dhabi, in the United Arab Emirates.

McCamley Turbine 12kW (MT12) Turbine

Development of the MT12 is now at the point where we are receiving orders for the turbine with deliveries scheduled to commence in August 2013.

The table below gives typical size versus rated power for our machine.



POWER	max rated power	kW	1	3	6	12	24
DIMENSIONS	ØA	(m)	3.70	6.07	8.32	11.35	15.53
	ØB	(m)	3.12	5.10	6.05	9.57	13.15
	C	(m)	3.08	4.88	6.69	8.47	10.85
	ØD	(m)	2.70	4.45	6.10	8.31	11.38
	E	(m)	1.00	1.42	1.95	2.00	2.00
	rotor diameter	(m)	2.00	3.27	4.49	6.13	8.43

Benefits to owners of McCamley turbines

- Reduce Electricity Costs
- Reduce Carbon Emissions
- Generate an income from Feed-in Tariffs (FiT's)
- Provide power to off grid locations
- Power can be stored for Uninterruptible Power Supplies (UPS) or peak demand times
- Improve Energy Efficiency Certificates (EPC) rating
- Reduce demand on Grid & contribute to a Nations energy security

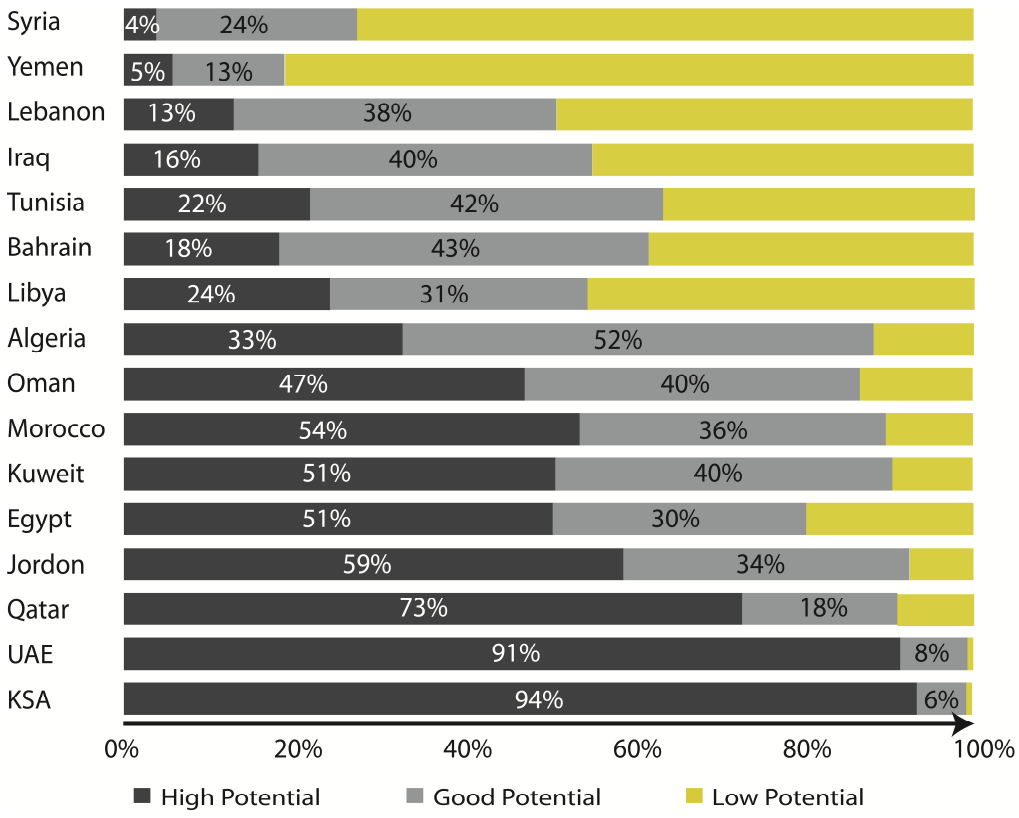
MENA Renewable Energy Market Size

Over the last decade, attention has begun to swing toward the MENA region's rich — and broadly unexploited — wind renewable resource. MENA the world's most energy-rich (oil and gas) region has remarkable wind speeds. This positions the regions as the next shining star in the world of renewables.

In order to provide insight on current and future trends in the development of MENA's renewable sector, on Nov 2012 Ernst & Young conducted a survey of 190 experts in the region across various disciplines including investors, bankers, technology experts and government representatives.

"The survey identified Saudi Arabia, the UAE, Qatar, Jordan and Egypt as the most attractive MENA markets based on a five-year horizon, though for different reasons. Whereas Saudi Arabia, the UAE and Qatar were selected due to the availability of financial resources through major initiatives such as KACARE, Masdar and the "green" FIFA World Cup 2022, Jordan and Egypt were identified as attractive markets on account of their increasing populations driving strong energy demand growth and also the need to secure more jobs through the local economic activity generated by clean technology expansion."

See country attractiveness in MENA region below based on Ernst & Young conducted a survey.



Twenty Years Yield of MT12

The MT12 McCamley Turbine, in Average Wind Speeds (AWS) of 6m/s, will produce 25,000 kW of energy a year. Over a 20 year period each turbine would yield around **$393,689** in revenue and electricity savings.

With an AWS of 7m/s the 20 year yield in revenue and electricity savings from the MT12 would be **$544,275**. Below are examples of the increased yields in relation to various AWS.

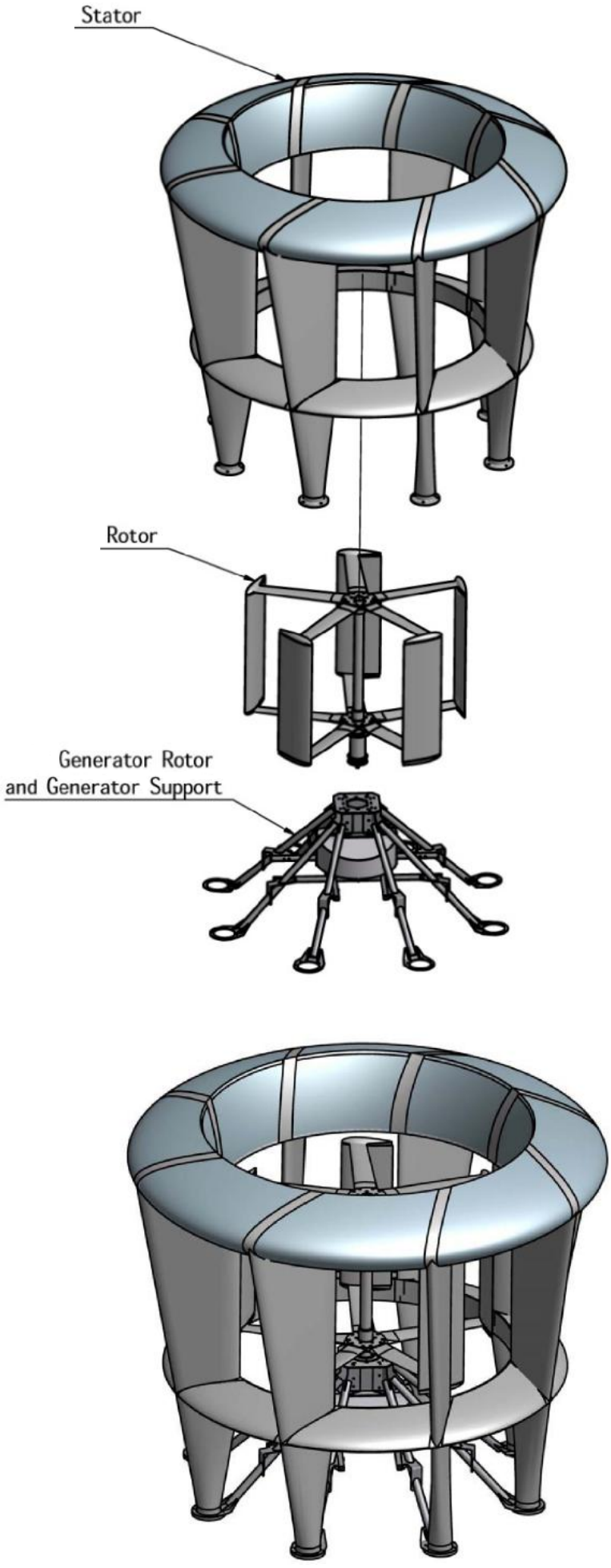
We can provide you with a personalised illustration depending on your location allowing you to accurately calculate your Return on Investment.

AWS (M/S)	20 year yield
5.5	$320,000
6	$393,689
6.5	$468,957
7	$544,275
7.5	$615,925
8	$687,568
8.5	$762,460
9	$837,362

Potential Sites for the MT12

- Government Buildings
- Local Authority Buildings
- Office Blocks
- Apartment Blocks
- Airports
- Hospitals & Medical Centres
- Sports Stadiums
- Community Centres
- Bus Stations
- Railway Stations
- Fire Stations
- Police Stations
- Schools
- Prisons
- Sea Ports
- Retail Parks
- Manufacturing Sites
- Cinemas
- Motorway Service Stations
- Roundabouts
- Petrol Stations
- Hotels
- Supermarkets
- Leisure Centres
- Farms and agricultural land
- Offshore
- Remote, off grid locations

Turbine Design



McCamley Turbine Family

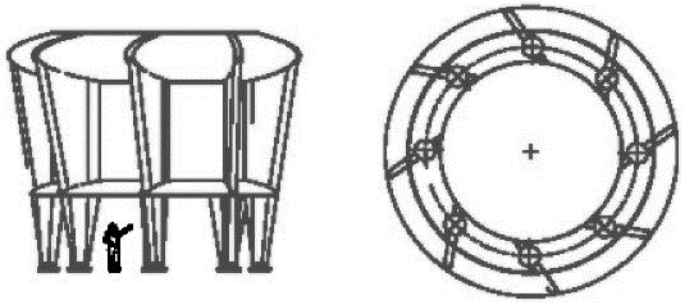
MT01

The McCamley Turbine is fully scalable and we are currently working on plans for 5MW & 10MW turbines that are for use in large offshore projects.

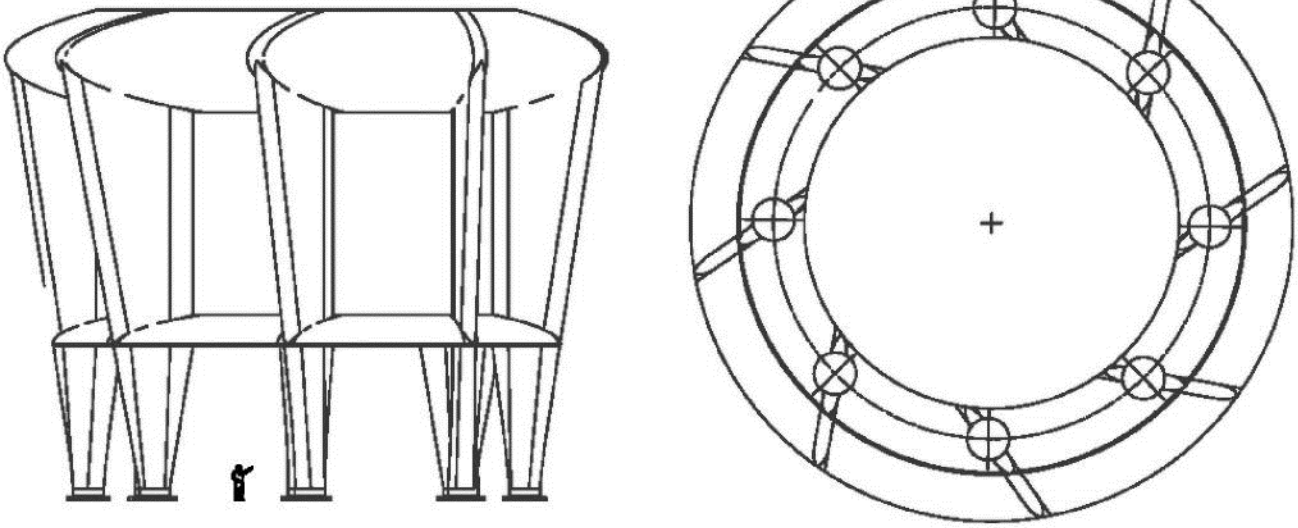
With a base diameter of just 9.57m and a height of 8.47m, the **MT12** is the perfect solution for urban renewable energy generation and overcomes the typical problems and inefficiencies attributed to VAWTs (Vertical Axis Wind Turbines).

In cities with average wind speeds averaging 7m/s the turbine will pay for itself in year 5 and will yield in electricity savings and income $544,275 over 20 years.

MT12



MT105



Ordering and Payment Terms

Option 1

Most customers choose the standard aircraft industry contract and payment terms.

- 10% option purchased upon order. This secures a slot on production line, which can be cancelled at any time with a 2% retention fee.
- 25% due once a delivery date is provided and your turbine(s) is/are going into production.
- 35% due upon delivery
- 25% due when commissioned
- 2.5% due after 6 months of operation
- 2.5% due after 12 months of operation.

Option 2

100% due upon order; in this instance the cost per turbine is reduced by 5%.

Volume Related Discounts

Volume related discounts are available as follows:

Orders Over 50 Units of MT12 Turbines

If payment **Option 1** is selected then each turbine is discounted by 5% per turbine, reducing the cost per turbine, which includes delivery, build and installation anywhere in MENA region, subject to site survey.

If payment **Option 2** is selected then each turbine is discounted by 10% per turbine, reducing the cost per turbine, which includes delivery, build and installation anywhere in MENA region, subject to site survey.

Orders Over 100 Units of MT12 Turbines

If payment **Option 1** is selected then each turbine is discounted by 15% per turbine, reducing the cost per turbine, which includes delivery, build and installation anywhere in MENA region, subject to site survey.

If payment **Option 2** is selected then each turbine is discounted by 20% per turbine, reducing the cost per turbine, which includes delivery, build and installation anywhere in MENA region, subject to site survey.

FAQs

How does it work?

The McCamley turbine is low speed, high torque machine that is designed to be very low in both noise and vibration, to self-start in low wind speeds without taking energy from the grid and to continue generating electricity in Omni directional gusting storm winds and turbulent winds around the rooftops of tall buildings. The turbine comprises:

- a rotor and stator of revolutionary design
- an axial flux generator - advanced electronic inverters with high efficiency across the entire range of power outputs
- control algorithms which maximise the power extracted from the available wind

The stator's primary function is an aerodynamic augmentation device as well as providing protection from the rotating blades. Braking of an operating Turbine to cause it to stop is done electrically and regulation of the speed in high wind conditions is done by the passive governing of the blade pitch.

What is it made of?

The main structural items of the McCamley Turbine series of roof mounted turbines make significant use of composite materials. This has been done to ensure that they can be engineered as lightweight structures with sufficient strength and stiffness and also be aerodynamically smooth. The lightweight approach is aimed at minimising turbine structural mass to facilitate a reduction in:

- structural reinforcement of existing building stock
- installation equipment lifting capability required
- man handling loads
- shipping costs

The primary composite used is Glass Reinforced Plastic (GRP). Structural beams (all blades) use a sandwich construction where the core material is foam. Due to the nature of this foam, the GRP resin system used for the beam itself is a two part epoxy. For large panel surfaces that do not need to be a structural beam, the resin system is changed to cheaper polyester.

The stable multi-leg design helps distribute wind loading and ensures a high degree of structural redundancy. By using GRP for the majority of the components the turbine is relatively light in weight, again aiding its suitability for use on rooftops.

What is the business opportunity?

The market for the manufacture and installation of renewable energy products is rapidly expanding, especially throughout the Middle East and North Africa region. Driven by governmental support and legislation that 20% of the total energy should come from Renewable Energy sources by the year 2020, technologies such as wind power have become common place within society.

There is a gap in this market for the supply of wind turbines that can successfully operate in Urban Environments. Traditional wind turbines are inefficient, take energy from the grid when starting, are prone to failure, noisy, visually unattractive and cannot cope with the fluctuation and turbulence of wind regimes in such environments.

The key intellectual properties of McCamley's technology support the concept of a low tip speed Vertical Axis Wind Turbine (VAWT) which enables it to successfully overcome these perceptions in both urban and peri-urban environments. In addition, the McCamley Turbine is more aesthetically pleasing to look at than its more traditional Wind Turbine competitors.

Is it scalable?

The McCamley turbine design is fully scalable and plans already exist for 12kW, 24kW, 100kW, 1MW and 5MW turbines.

What are the results so far?

Since 2012, the McCamley Vertical Axis Wind Turbine (VAWT) at Keele University is in operation. Data has been collected and used to indicate the associated Power Curves, which show the relationship between wind speed and Power output of the turbine. It has been clearly demonstrated that the McCamley turbine can self-start, is quiet to the human ear and can generate power at low wind speeds.

Recent high winds in Bulgaria of 12 – 13 m/s; we recorded data demonstrating that the 1kW turbine has peak outputs exceeding the 1kW.

Sales enquiries so far?

The PR event associated with the launch of the first 1kW prototype turbine at Keele University has resulted in over 80 sales enquiries worldwide. These range from enquiries from Middle East and North Africa countries such as KSA, Iraq, Jordan, Bangladesh and Djibouti to European Countries such as Germany, Greece and Portugal. Also we have sale enquiries from East Africa, Micronesia and the South Pacific

Where is the turbine to be manufactured?

It is our intended business model that McCamley MiddleEast Ltd will be a selling, manufacturing, marketing, installing, commissioning and maintaining organisation in joint venture with selected partners.

It is also our intention to ensure that the manufacture of the bulk of the turbine will be undertaken within the Middle East and North Africa regions. We have already researched the presence of businesses that can undertake the composite work and the precision engineering work and are in discussions. We have been working closely with Investment Boards in various countries to pursue this vision and make it a reality. We would welcome discussion from local/regional businesses interested in our innovative technologies.

Development of the 12kW turbine

The wind turbine technology to be used is being demonstrated by a 1kW prototype that has been erected and operated at Keele University. This machine is an augmented vertical axis wind turbine characterised by having both a static and rotating part, where an eight blade stator shrouds a five bladed rotor.

McCamley's design philosophy is to conservatively oversize the bearing and its housing using market leading quality products that are self-lubricating and sealed for life. The extra cost this incurs is considered good value for money given the 'single load path nature' of this component. Consequently, existing technology and solutions are utilised. Structural integration of the generator involves both the support and stability of the Generator and its connection to the rotor. The detail design and work required will be dependent upon the Generator design adopted.

The multi pole axial flux air gap generator used in the 1KW Turbine operating at Keele University will be replaced by the development of a similar but iron core based axial design. This is necessary to reduce cost through the requirement of less Neodymium magnetic material and increase efficiency through an increase in magnetic flux density. There may be an economic case for the inclusion of a gearbox with a step up ratio of between 3 and 5:1. This would result in a smaller, more compact lower cost generator but may have reliability /service implications. This alternative will be studied and a decision made during the development process.

For the initial prototypes of the 12 kW system, active rectification with two back to back inverters will be used. This will enable us to achieve short timescales to working hardware which can be used to de bug and prove the Inverter Control and System Control software. For cost and efficiency reasons a dedicated Inverter system will be designed and developed. This production Inverter will include passive rectification, a boost / buck circuit to control the DC link voltage and a multi leaved Inverter. This design approach will maximise efficiency across the entire power range of the Turbine.

Innovation

This revolutionary wind Turbine will be more effective than existing designs in that its efficiency is high, it has a larger operational weather window and it does not need power from the grid to spin up. The target for efficiency is to surpass the Betz limit, which will be a factor of 2 better than existing VAWT's. It is also quiet and bird and bat friendly.

Given that many cases exist where wind turbines have to be shut down when the wind is too strong this Turbine will form the basis of a family of larger machines that could operate comfortably and safely through storm force winds.

Sitting on eight legs, the stator is extremely stable offering a very different external view of a wind turbine to any observer.

The rotor has a low blade tip speed and high solidity that enables it to self-start in very low wind speeds. Blade pitch is governed passively and automatically. The top rotational speed of the rotor is a design parameter that can be set. This means that the rotor speed is independent of wind speed above its design setting, meaning gusting storm force winds do not pose a threat and the Turbine will continue to generate electricity.

The electrical design of both the generator and the inverter will preserve the Turbine's generated energy in that both designs are optimised for efficient energy conversion across the complete range of wind speeds.

The iron core axial flux rare earth magnet based generator will be novel in that it will generate at high efficiency across a wide range of speeds.

The Inverter control software will be optimised to reduce switching and conduction losses. The production Inverter (not included in this application) will be a multi leaved construction which progressively uses more silicon as the power output increases. There will also be the facility included to directly charge a bank of high voltage batteries so that the system could still provide power during low wind conditions.

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