

Rotaheat enables wind turbines to efficiently decarbonise heating

Heat, the neglected sibling to Electricity and Transport.

Of the three key energy use areas: electricity, transport and heat, environmentally friendly low carbon alternatives have largely been established for electrical and transport demands. Meeting low-carbon electricity and transport demands only requires continued deployment of existing solutions.

Low carbon heating solutions are a particular challenge for nations towards the poles where demand is highly seasonal (see Figure 1). In the UK, where the primary source of heat is the combustion of gas, the demand for heat annually exceeds £15 billion¹ and is a significant contributor to carbon emissions.

Larger consumers of heat, such as for heating public swimming pools and spaces, operating process industries or growing crops

under cover, all urgently need to mitigate cost increases whilst seeking alternatives to combusting fossil fuels. Existing alternatives are constrained; solar thermal, is inappropriate during winter months, electrical heating stretches grid capacity and alternatives like heat pumps are proving to be expensive, run counter to seasonal requirements and worsen grid capacity issues.

Realising government net zero policies requires new low carbon heating solutions which can be rapidly deployed and contribute to solving these issues.

Wind, a renewable energy supply that meets the seasonal demand of heat

The seasonal strength of wind uniquely provides greater power generation capabilities to meet the seasonal peak demands for heat.

Rotaheat recognised both the urgency and scale of this opportunity to deploy low carbon heating solutions. Rotaheat worked, with the support of the UK's DESNZ, to show how seasonal demand for heat could efficiently be met through the exploitation of those seasonal winds.

Wind to Heat, a scalable and innovative solution

Building on the lessons of a first Wind-Thermal solution using a vertical axis wind turbine, Rotaheat developed a scalable approach for horizontal axis wind turbines that would:

- deliver low carbon heat, considering both embedded carbon and carbon emissions,
- perform under modest wind typical of built-up environments, and
- deliver an economic return comparable to natural gas consumption.

Our demonstrator reference design delivers over 40kW of heat and avoids the inefficiencies of generating electricity. Our approach addresses the need for a drive train within the horizontal axis wind turbine's (HAWT) nacelle to yaw and avoid the twisting of pipes carrying heated fluid.

The heart of the drive train consists of:

- a bevel gear unit providing a nominal step-up ratio of 10:1 whilst transferring the motive power from a horizontal to vertical shaft arrangement, and
- Rotaheater Micro efficiently converting the mechanical power to thermal energy.

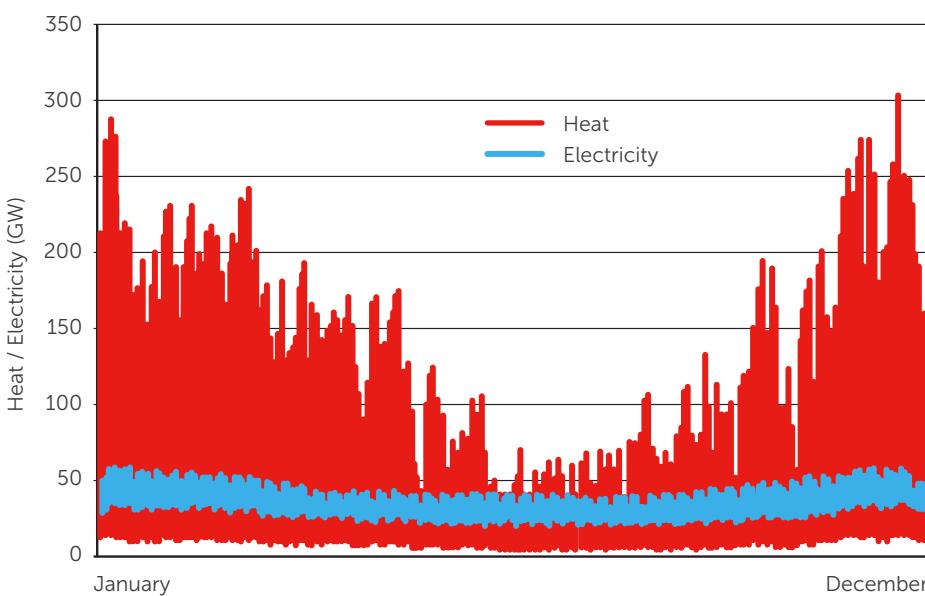


Fig 1. UK Year **heat** and **electricity** profile

Source: DESNZ; Grant Wilson, Lecturer at the University of Birmingham

¹Source: Digest of UK Energy Statistics

To test and evaluate the drive train, we used a 455kW variable drive and

electric motor to simulate wind turbine blades rotating from 1 to 60RPM under a range of conditions (see Figure 2).

Our solution ensures:

- the bevel gear unit is fixed relative to the yawing nacelle,
- the Rotaheater heat generator is fixed relative to the mast, and
- all fluid pipework remains static as the nacelle yaws.

Results from different configurations consistently showed a smooth and steady increase in power as the driving torque and low speed shaft increased (see Figure 3).

The Benefits

This simple approach enables wind turbine manufacturers to readily enhance their marketable proposition by:

- fulfilling market demand with an efficient wind-thermal offer, and
- reducing a turbine's cost through replacing an electricity generating sub-system with a heat generating sub-system.



Fig 2. Rotaheat's HAWT Wind-to-Heat test rig

Rotaheat's wind-to-heat solution offers wind turbine manufacturers a significant potential opportunity to the decarbonization of heat agenda.

With its proven effectiveness, efficiency, and environmental benefits, this innovative solution

offers a scalable and sustainable alternative to fossil fuel-based heating systems. As the world accelerates towards a greener future, Rotaheat stands ready to work with you, address renewable heat challenges and pave the way for a cleaner, more sustainable energy landscape.

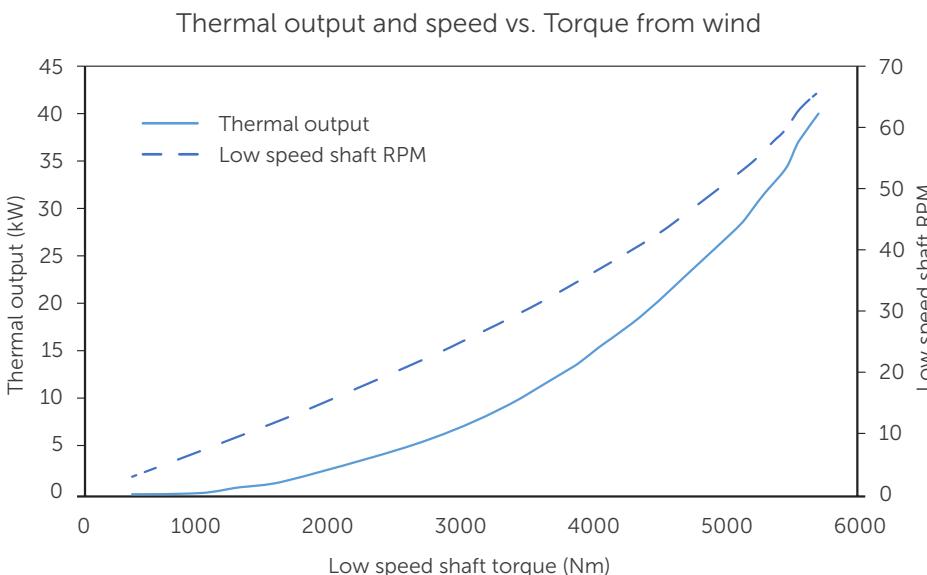


Fig 3. Thermal output and drive shaft speed vs. Torque from wind.

Are you ready for your wind turbines to embrace sustainable heating solutions?

Contact Rotaheat today to learn more about how our wind-to-heat solution can transform your energy strategy and contribute to a more sustainable future.

Email us at: info@rotaheat.co.uk to start the conversation.

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