Since 1857

Gresham House

Specialist asset management

UK ONSHORE WIND

INVESTMENT FUNDAMENTALS

Background to Gresham House

Gresham House plc (Gresham House) is an AIM quoted specialist alternative asset manager, with over £2.3 billion in assets under management. The Group provides funds, direct investments and tailored investment solutions including co-investment, across a range of highly differentiated alternative investment strategies. Gresham House's expertise includes, renewable energy, forestry, housing and infrastructure, strategic public equity and private assets.

Gresham House aims to deliver sustainable financial returns and is committed to building long-term partnerships with clients (institutions, family offices, high-net-worth individuals, charities and endowments), to help them achieve their financial goals.

In May 2018, Gresham House acquired 100% of FIM Services Limited, a specialist forestry and renewable energy asset manager in a deal which combined two leading UK specialist asset managers with complementary experience across forestry and renewable energy.

Gresham House has a proven capability in originating, acquiring, constructing and managing the operation of UK renewable energy infrastructure assets.

To discuss anything referenced in this paper, please contact us by email at admin@greshamhouse.com. For retail investor queries please contact Wayne Cranstone, Investment Director on 01451 843 900, for institutional investor queries please contact Heather Fleming, Head of Institutional Business on 0203 873 5908.

Introduction

In the last decade installed capacity of UK onshore wind has grown at over 20% annually and amounts to over 21 gigawatts (GW) across 8,900 sites. Between July and September 2018 almost a third of the UK's electricity came from renewable sources. In December 2018 another milestone was reached when actual wind generation reached 15GW, 25% of the peak electricity demand of the UK which is around 60GW. This exceptional growth has been driven by government energy policy, financial support, predictable output, consistent reductions in capital and maintenance costs and increased efficiency of generation technologies.

This gives direct investors the opportunity to hold a sustainable real asset with an attractive return and low financial risk in today's uncertain economic environment.

The main government support regime for onshore wind, the Renewables Obligation (the RO) closed on 31 March 2017. This has significantly decreased new onshore wind development, although subsidy-free is becoming more viable. Existing operational assets with a proven track record continue to be in high demand and consolidation in the secondary market towards long-term asset holders is leading to further yield compression. This trend is likely to further increase as the pool of high-quality and available assets decreases over the next two to three years.

Onshore wind is a mature technology with low operating risk that benefits from up to 20 years of fixed, index-linked government backed revenue.

There is an opportunity to acquire operational assets over the next few years to benefit from long-term stable cash flows, with potential future upside from increases in power prices, further yield compression and life extensions.

Contents

Section 1: Why UK onshore wind?

The rationale for long-term investment in UK onshore wind continues to be compelling, due to the benefits of:

- **Highly cash-generative assets with a 30+ year economic life**
- **Well established, proven technology, backed by long-term maintenance contracts with excellent performance guarantees**
- **Low volatility in annual output with robust post construction energy forecasts, ensuring healthy cash distributions**
- **c.50% of the revenue coming from fixed, index-linked government support secured for up to 20 years from accreditation, via Renewable Obligation Certificates (ROCs)**
- **Exposure to the potential upside in UK power prices forecast over the life of the asset**
- **Further yield compression due to an ongoing shift towards long-term asset holders and slowdown in new onshore wind development**

Section 1: Why UK onshore wind?

The UK is one of the best locations for wind power in the world with a well established industry, a long-term secure government support regime for operational assets and the best wind resource in Europe.

The UK's wind resource is derived from its long, exposed coastlines and low mountain ranges. Excellent wind speeds means that the UK accounts for approximately 40% of Europe's wind resource and typically provides capacity factors at onshore wind farms of c.30% and offshore wind farms of c.40%.

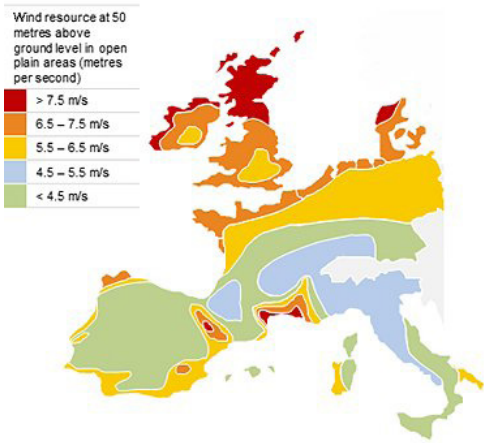
The UK has experienced substantial growth in onshore wind deployment since 2003 as shown in the chart opposite, benefitting from the falling cost of turbines and the attractive index-linked 20-year ROC regime.

Given this excellent renewable resource, installed capacity in the UK has now exceeded 21GW, comprising 6.5GW of offshore wind, 11.6GW of onshore wind built under the RO and small-scale assets supported by the Feed in Tariff (FiT) scheme totalling 0.7GW. A further 2.3GW is operating under the Contract for Difference scheme (CfD).

The RO scheme closed to new capacity on 31 March 2017. A grace period existed after this date to facilitate delayed projects. As of January 2019 all RO grace periods have expired. As a result it is expected that deployment in the short to medium term will be low with new subsidy-free developments requiring tip height increases to be economic.

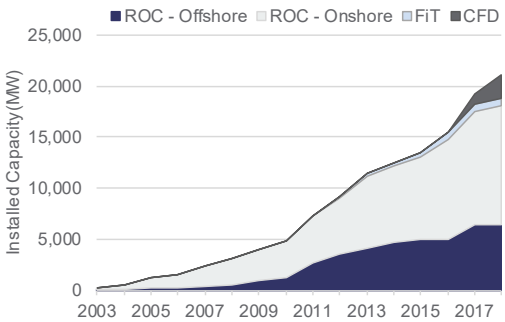
The industry is well established in the UK, Europe and globally, such that reducing capital and operating costs along with technological improvements will help to deliver more subsidy-free developments in the future.

European wind resource map



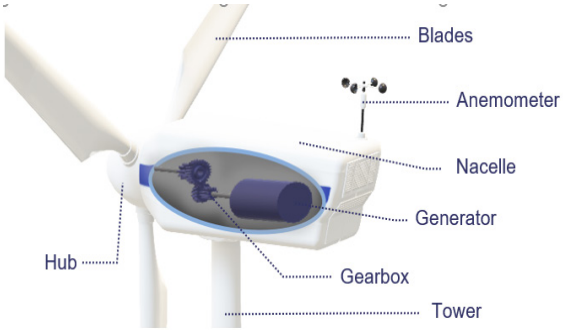
Source: Risø National Laboratory

UK wind deployment

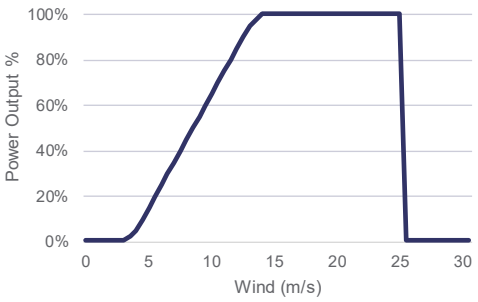


Source: ROC, FiT & CfD Registers

Turbine diagram

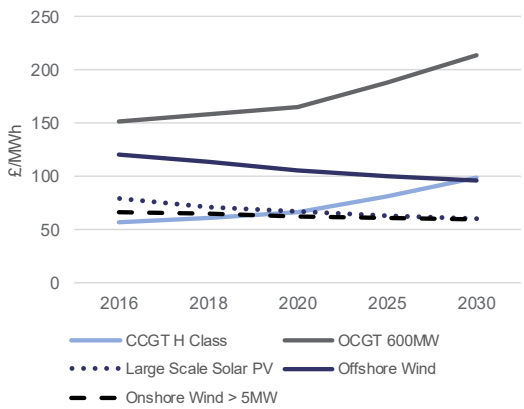


Typical turbine power curve



Source: Siemens Turbine Data

BEIS LCOE Forecast £/MWh 2016 - 2030



Source: BEIS Electricity Generation Cost (November 2016)

Proven technology

Wind turbine technology is the most mature renewable energy technology. While there have been significant technological advancements over the last ten years, both in terms of size and efficiency, the basic principle of wind technology remains the same. There are two main types of turbine, those which use a gearbox and those that are direct drive. In the first instance the wind turns the turbine blades around the hub and a shaft connects the rotor to a gearbox. The input of 15 to 20 rotations per minute (RPM) is output at around 1,800 RPM through the gearbox along an output shaft into the generator, converting kinetic energy into electrical energy. A direct drive turbine operates in a similar way, except it negates the need for a gearbox which improves reliability and simplifies maintenance, although generally they are heavier and more expensive. From the generator, the electricity is fed into a transformer which steps up the voltage to reduce electrical losses in transit. The electricity then feeds into a substation where the electricity is exported onto the local distribution network or exported onto the transmission network depending on the size of the wind farm.

Turbines start to generate electricity at low wind speeds, typically of 3m/s to 4m/s (7mph to 9mph) which in the UK is generally experienced for 75% to 85% of the time. The amount of electricity generated from a site increases with wind speed up to c.15m/s (34mph) where the maximum output of the turbine is reached. Output is then maintained at this level until a turbine automatically shuts down by ‘feathering’ the blades (turning out of the wind) when the wind reaches speeds of c.25m/s (57mph), to protect itself from storm damage.

Wind turbines are often criticised for being inefficient because on average they are operating at 30% to 40% of their total potential capacity. Wind turbines are designed to be able to operate up to their maximum capacity when the wind is in optimum conditions, which for generation is not going to be all the time. What is important is the cost of each unit (MWh) of electricity generated from wind compared to alternative technologies. The latest report published by the Department for Business, Energy and Industrial Strategy (BEIS) shows that for projects expected to be commissioned by 2025, onshore wind and solar will be the cheapest sources of generation technologies on a Levelised Cost of Energy basis (LCOE). The LCOE takes into account the total cost of generating electricity from development costs through to construction and operating costs and is therefore considered the fairest method of comparing the cost of energy across all technologies.

It is this reduction in LCOE that will continue to drive subsidy-free wind developments.

Section 2: Drivers of return

Robust revenues

Typically, c.50% of revenue from UK onshore wind assets are derived from the government's RO support scheme, a 'locked-in' 20-year index-linked price per MWh of power generated. This support is 'grandfathered', meaning any potential future changes to the support scheme will not affect existing accredited sites.

The wholesale electricity price provides the remaining c.50% of revenue. It is widely forecast that power prices will increase at a rate beyond inflation in the long term due to a number of factors including growing demand for electricity and constrained supply.

Historically, wholesale electricity price increases have exceeded inflation over the medium and long term and it is Gresham House's view that this, along with inflation-linked ROCs, will continue to provide investors with an inflation hedge.

As c.50% of the revenue is from the legislated index-linked ROCs, the potential for upside for onshore wind investors will come directly from the rate of increase in the wholesale electricity price, the rate of inflation and the length of life extensions.

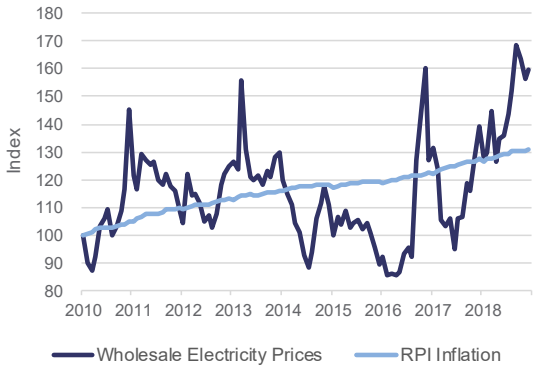
Yield compression

Both capital and operational costs for onshore wind continue to fall and, as a result, projects are being developed 'subsidy-free'. In the short to medium term there will be increasing demand for a shrinking pool of available operational subsidised assets as long-term investors continue to acquire such assets.

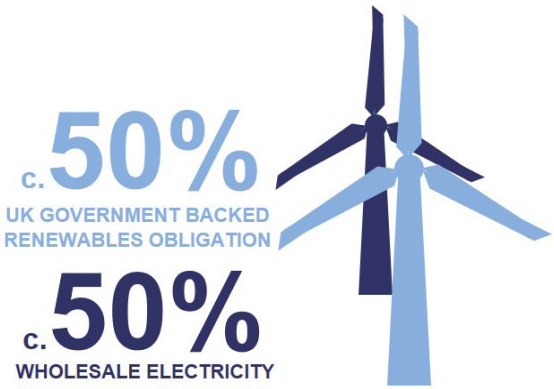
The security provided by onshore wind's index-linked cash flow has proved highly attractive to institutional investors. Given onshore wind's rapidly reducing capital and operating costs it is highly unlikely that government support will be re-introduced. Without widespread fixed-price Power Purchase Agreements (PPAs), subsidy-free renewable assets will be fully exposed to the wholesale electricity price. Onshore wind assets accredited under the RO, and therefore receiving subsidies, are likely to be considered a lower-risk alternative and of preference to institutional grade investors, resulting in further yield compression.

Increasing demand for onshore wind assets and a slowdown in supply will increase values in the short and medium term.

Wholesale Electricity Prices against RPI Inflation (Indexed Base Jan 2010=100)



Source: ONS, Mitie



UK electricity demand growth is linked to population growth, GDP growth and increasingly to decarbonisation of the economy.

The National Grid is the designated System Operator for the UK, responsible for the real-time balancing of electricity supply and demand. It devotes significant resources to forecast how it can maintain a reliable and fully functioning electricity system, both now and into the future. In July 2018 the National Grid released its annual report titled 'Future Energy Scenarios' (FES).

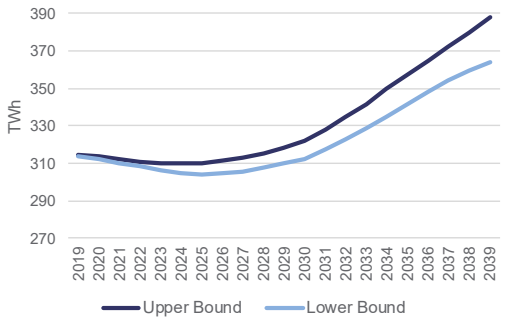
It is evident from the chart on the right, which summarises National Grid's upper and lower demand forecasts, that they consider the future demand is likely to be significantly higher than current levels, driven by population growth and electrification of the heating and transport sectors. The extent to which demand rises will depend on the extent of the electrification of these sectors and economic cycles. Electrification of the transport sector is now firmly underway, whilst the heating sector remains a largely untapped but potentially huge source of future demand growth.

Under the most conservative scenario for the uptake of electric vehicles, it is estimated that by 2040, 47% of vehicles on the road will be electric vehicles rising to 86% by 2050.

Global electric vehicle sales are forecast to show similar growth rates to that witnessed in the renewable energy sector at the start of the decade. Only a modest amount of growth from the transport and heating sectors is currently factored into long-term power price forecasts, suggesting significant upside from future demand and thus power prices.

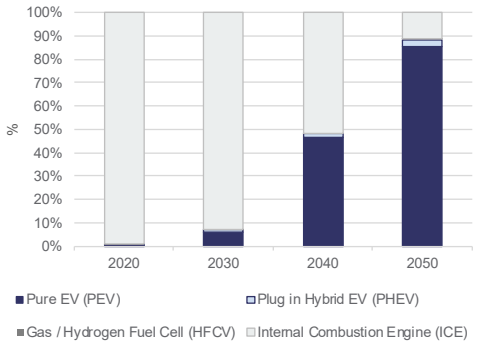
Electrification of the transport sector will cause ongoing growth in electricity demand.

National Grid forecast UK electricity demand



Source: FES National Grid

Vehicles by fuel type



Source: FES National Grid

The future power supply mix

The UK is experiencing a huge change in its power generation mix which will continue over the next decade. In the last five years coal fired electricity generation has fallen by 84%. 2017 saw the first coal-free day of electricity generation since the beginning of the industrial revolution. In May 2019 the UK maintained a full week without the need for coal fired generation. All coal capacity (13GW) is due to be decommissioned by 2025, in addition over 9GW of nuclear capacity is forecast to shut down between 2023 and 2035. Overall, c.17% of the UK's current generating capacity is due to be decommissioned by 2025. The extent and potential timeline of these closures has long been known and the government had expected new gas builds to maintain the UK's security of supply in the short to medium term.

However, the significant capital costs required to build new large scale gas plants requires energy prices of £65 to £80 per MWh to justify investment. Therefore the current wholesale price of c.£40 per MWh is insufficient to incentivise the additional private investment the government desires.

With this backdrop of plant closures the mechanism introduced to secure system supply was the Capacity Market which paid generators for being available. In November 2018, the European Court of Justice ruled that the mechanism could be in breach of EU State Aid rules. As a result the UK Government has witheld payments and cancelled upcoming auctions. This is likely to impact both new conventional generating capacity which has lost a potential revenue stream and end of life assets such as coal and gas plants that may close earlier than expected.

The lack of market driven new builds should lead to a tightening of system supply and an increase in energy prices around periods of system stress.

In the longer term, these problems are likely to persist, unless there is a significant rise in the wholesale electricity price to facilitate market driven new builds.

84%

REDUCTION IN COAL FIRED GENERATION SINCE 2012

9GW

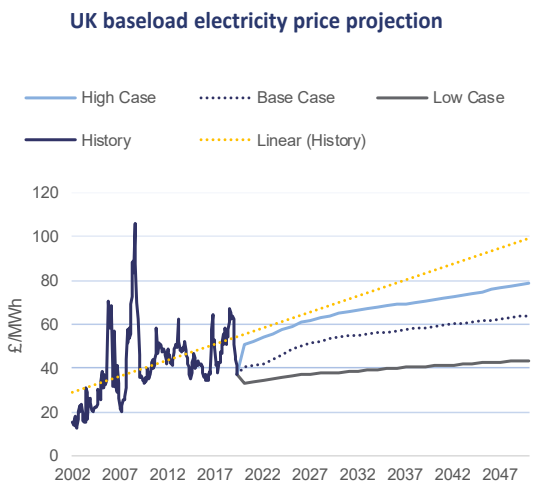
OF NUCLEAR FORECAST TO SHUT DOWN BETWEEN 2023 & 2035

Electricity price outlook

The combination of increased demand for electricity over the long term and a constrained supply, provides the fundamentals for higher wholesale electricity prices in the future.

The chart on the right highlights the upside potential for wholesale electricity prices. These could rise towards £65 per MWh in the long term, which is some 70% higher than the current wholesale price. This higher price scenario is notably consistent with the historic linear trend for electricity prices over the last two decades, indicating the clear potential to enhance investment returns.

The UK's pending exit from the EU still causes significant uncertainty regarding the relationship between the UK and the EU's energy markets. Uncertainty is likely to have a short-term impact on volatility and a medium-term impact as developers of new build generation adopt a wait and see approach, which will put further pressure on already tight electricity supply margins.



Source: National Grid FES report (July 2017) and GH analysis pre-2019

Section 3: Asset life and generation

Competition and technological developments within the wind turbine manufacturing industry has led to significant improvements in turbine performance, reliability and cost. Major components have a design life of at least 25 years and perhaps as long as 40. Operations and Maintenance contracts are usually provided by the turbine manufacturer, and include long-term availability guarantees of at least 96%.

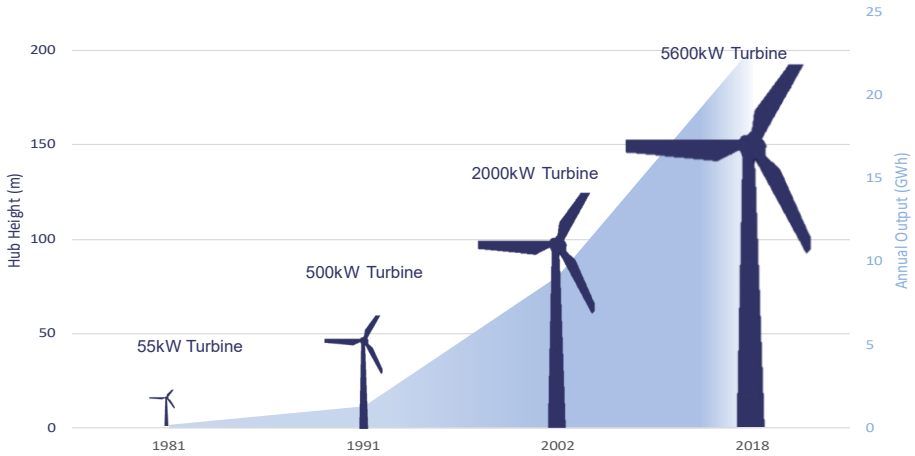
Output from onshore wind generating assets can vary from day to day but volatility in output is relatively low on an annual basis.

Gresham House believes that life extensions to wind farms will be granted as assets are shown to be economically effective beyond 30 years and they have become an integral part of the electricity network. This can provide significant upside for investors as current acquisition prices do not reflect this potential.

Turbine manufacturers are also offering extended warranties on their products as the longevity of the equipment increases.

The first mass produced wind turbines, the Vestas 30kW machines, have been operational since 1980 without the need for major component replacement.

Onshore turbine height and annual output



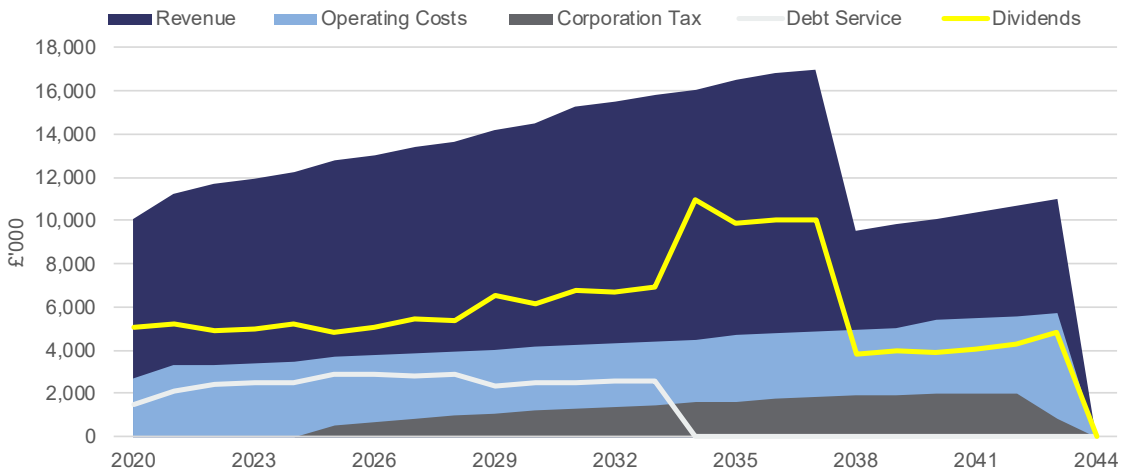
Source: Based on Vestas products

Section 4: Attractive Distribution Profile

A typical wind farm's cash distribution profile is expected to rise with inflation and rising wholesale electricity prices. The majority of wind farm assets are held in limited company structures with long-term bank debt in place. For a leveraged wind farm, with relatively low and fixed operating costs, c.40% of revenues would be expected to be available for dividends with an average dividend yield of c.10% over the 25 year life of the project. Tax relief on the capital cost of plant and machinery means that little or no corporation tax would be expected to be paid in the first five to six years of the project's life.

Cash flows from wind farms are relatively stable; c.50% of the revenue stream is index-linked (the ROC revenue), operating costs are low (c.30% of revenue), and inter-annual variability of output is low, providing annuity type cash flows from these assets.

30MW wind farm indicative cash flow

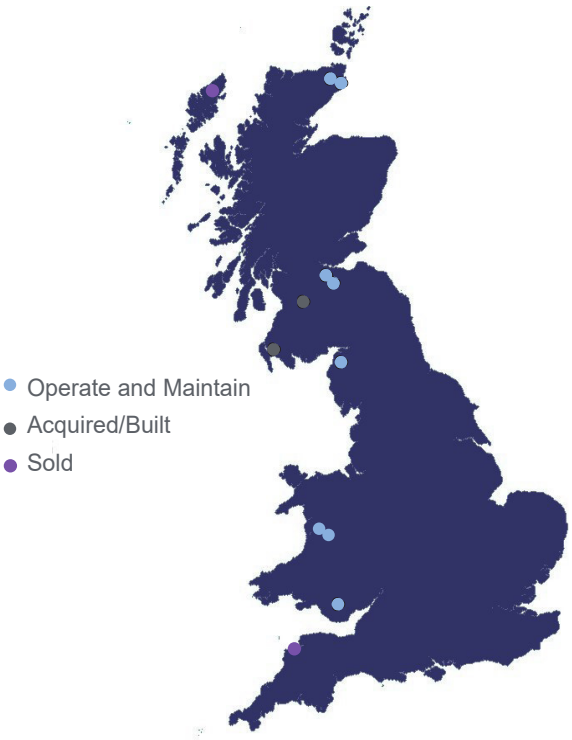


Source: Gresham House

Section 5: Gresham House origination and asset management

Gresham House promotes investments into operational onshore wind assets which use top tier reliable equipment.

GH operational sites



Asset acquisition/enhancement

Gresham House has a proven track record of maximising returns and minimising risk from renewable energy projects through:

- Acquisitions: selective purchases (proven developers, respected construction firms, quality asset owners)

  Gresham House has proven its acquisition process adds value to investors by

  - Originating a regular supply of attractive investment opportunities
  - Tracking the market for recent acquisitions, current sales and monitoring vendors and buyers in the market
  - The ability to source and deliver opportunistic and off market transactions. Implementing a rigorous financial, technical and legal due diligence process for every purchase

- Active management: enhancing returns

  - Well-structured operations and maintenance contracts maximise output from the wind farm and also minimise life-cycle costs
  - Gresham House has a dedicated asset management team for renewable energy assets, ensuring close monitoring of costs and performance optimisation
  - Gresham House's daily tracking of the wholesale electricity price market also informs decisions of how to sell electricity and when to fix prices to secure the best returns
  - Independent advice enhancing returns through life extensions

Section 5: Gresham House origination and asset management

Gresham House acts solely to maximise investors' returns. Gresham House's independence allows detailed return driven advice to be provided to investors.

Risk management

A well-selected and well-managed portfolio with diversified geographic locations and equipment suppliers will minimise the residual investment risks.

Gresham House also ensures the procurement of a suitable range of manufacturers' warranties and performance guarantees to protect income. In addition, placing insurance cover to protect from material damage and business interruption helps de-risk investment returns further.

The main risks to the investment are:

- A portion of the income from electricity production is from a wholesale power price which fluctuates: the wholesale price may increase or decrease which will affect the return from the asset;
- Government policy may change which will affect the subsidised portion of the income;
- Weather, especially wind speeds, will affect the volume of electricity generated by the asset and also the overall demand for electricity and the wholesale power price;
- The asset, or part of it, may fail or not perform according to forecast and impact on the volume of electricity generated;
- The level of capital allowances, dividend tax or other tax treatments may change affecting individual investors post tax return.

Direct acquisition opportunities

- Gresham House is continually appraising acquisitions for direct investments. Please contact us if you would like further information on current acquisition opportunities (contact details are provided on Page 1).

Glossary

Capacity Market	Government introduced scheme to ensure sufficient capacity is maintained in the UK electricity network. This is achieved by providing payments to reliable sources of capacity.
Contract for Difference (CfD)	Contract between a low carbon generator and the government. The generator receives a price known as the 'Strike Price' for each unit of generation.
Feed-in-Tariff (FiT)	Government programme designed to promote the uptake of renewable and low-carbon generation.
Gigawatt (GW)	Measure of power, equal to 1,000MW.
Kilowatt (KW)	Measure of power, equal to 1,000W.
Kilowatt hour (KWh)	Measure of energy, 1KWh is equal to a sustained power delivery of 1KW for one hour.
Kinetic Energy	The energy that is possessed due to motion.
Levelised Cost of Energy (LCOE)	A measure of the cost of electricity generation measured on a consistent basis across technologies.
Megawatt (MW)	Measure of power, equal to 1,000KW.
Megawatt hour (MWh)	Measure of energy, 1MWh is equal to a sustained power delivery of 1MW for one hour.
Power Purchase Agreements (PPA)	Legal contract between a generator and an entity that agrees to purchase electricity directly from the generator.
Renewables Obligation (RO)	Main Government support mechanism for large scale renewable electricity projects in the UK.
Renewables Obligation Certificate (ROC)	Certificates that are issued to operators of renewable generating stations accredited under the Renewable Obligation (RO).
Watt (W)	The rate a source of energy uses or produces one joule during one second.

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Gresham House Asset Management Limited is certified to the ISO 9001 standard

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