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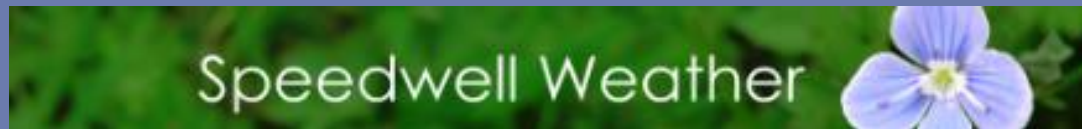
Managing Wind Exposure:
Synthetic Wind Farm Benchmarks
An Introduction

weatherXchange® the independent platform which facilitates index-based weather risk transfer

weatherXchange

Powered by weather data from:

Speedwell Weather

Environmental Finance Winner

2013 → 2014 → 2015 → 2016 → 2017
Annual Market Rankings

Best advisory/data service in the Weather
Risk Management – Global Category

weatherXchange / Speedwell Introduction

- weatherXchange Limited provides the weatherXchange® Platform which helps companies with weather risk structure a hedge and then send pricing requests to multiple protection sellers.

- Speedwell Weather Limited is the parent company, founded in 1999. It provides software and weather data and services to the index-based weather risk market and is the provider of quality-controlled weather data to the weatherXchange Platform

Who Hedges Wind?

Two use cases:

* Owner/operators looking to protect against too little wind.
  Synthetic Wind Farm Benchmarks

* Non-renewable producers who want to protect against the impact of unusually large amount of wind generated power impacting their profitability in a given year.
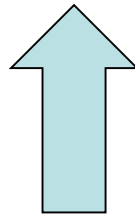 **National Wind Benchmarks**

The requirements of an index appropriate for wind hedging

- Composition needs to be sophisticated enough to be a good proxy for actual energy output, but not so complicated that no one understands it. No hedge can be perfect

- The index needs to have a long history to allow protection sellers to price the structure

- The composition of the benchmark needs to be frozen during the life of the risk period. A risk taker cannot have a moving target.

- The index needs to have a back-up in case of failure of data source

- The index needs to be provided for as long as the life time of the weather hedge

- The index needs to have a real-time feed to allow real time P&L monitoring and risk management

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What type of wind indexes are available?
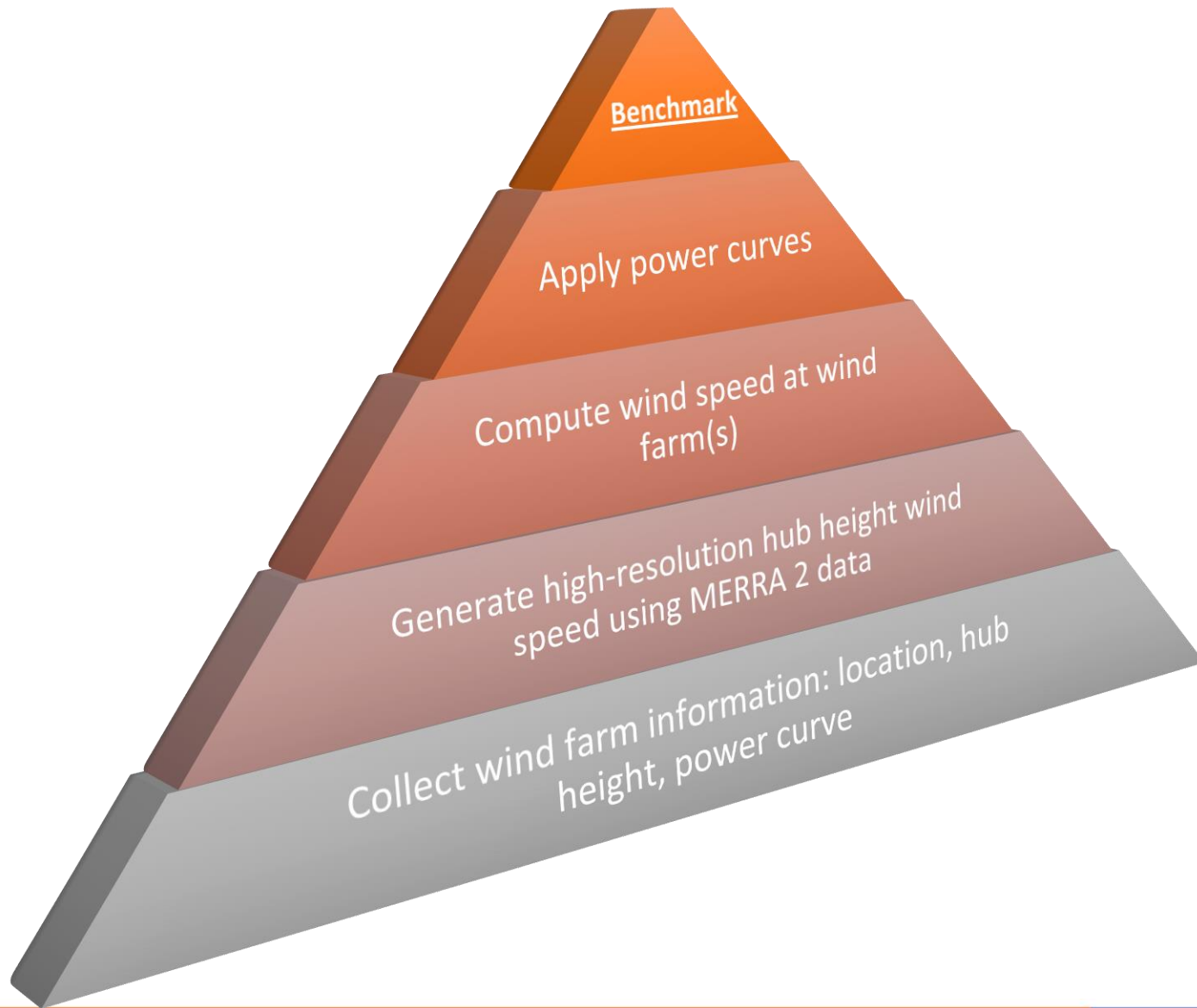
All parametric hedges require an underlying index

- Use actual energy output of your wind farm.
  Very low basis risk

- Create a weather index based on wind speed data

  - Use 10m mast measurements. High basis risk

  - Use "gridded data" to derive hub-height wind speeds, adjust for power curve. Can be Low Basis Risk

"Synthetic Wind Farm Benchmark"
Built using high-resolution gridded wind data

How we create Wind Benchmarks

Benchmark

Apply power curves

Compute wind speed at wind farm(s)

Generate high-resolution hub height wind speed using MERRA 2 data

Collect wind farm information: location, hub height, power curve

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Wind farms – variety of masts

Height of wind masts varies widely (typically 45 – 105 metres)

Many different turbine manufactures, each with unique operating range and efficiency (Power Curve)

These are all taken in to account

# Inputs to Benchmark calculation - History

Collect Metadata

- City: Ujue
- 23 turbines: Enercon E40/500 (power 500 kW, diameter 40 m)
- Total nominal power: 11,500 kW
- Operational
- Onshore wind farm
- Developer: Acciona Energia
- Operator: Acciona Energia
- Owner: Acciona Energia
- Source: http://www.aeeolica.org/en/about-wind-energy/wind-energy-in-spain/wind-map/
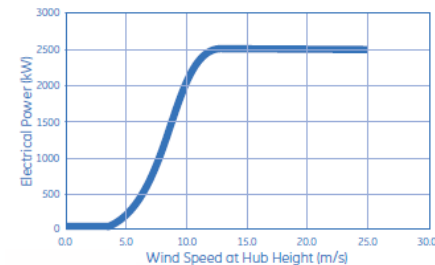
Derive high resolution gridded wind speeds
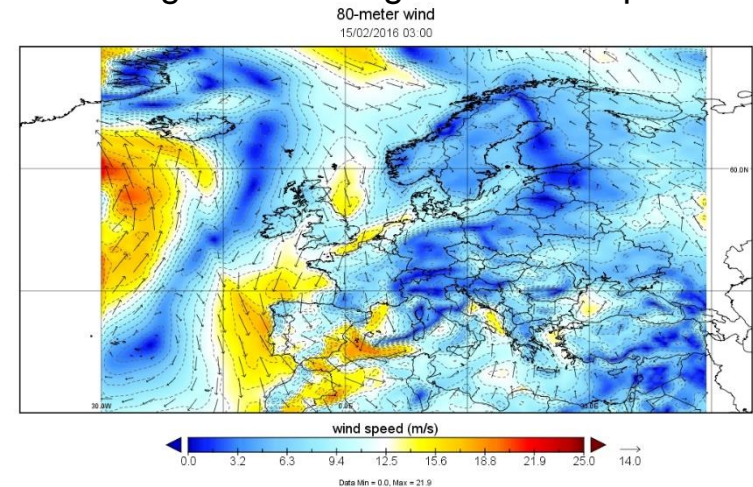
Use 3d modelling to derive hub height wind speed
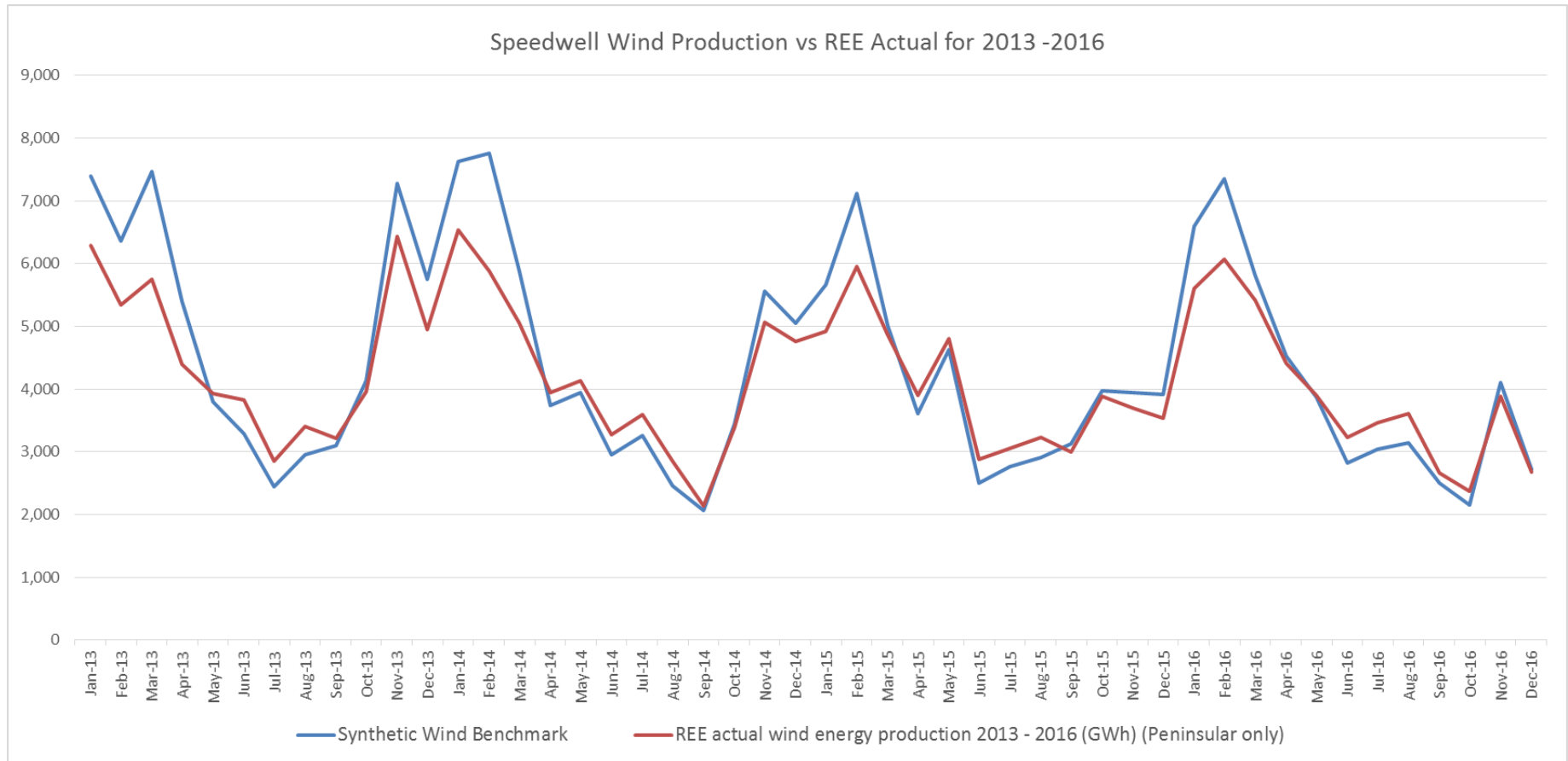
Hub height daily mean wind speed (ms-1)
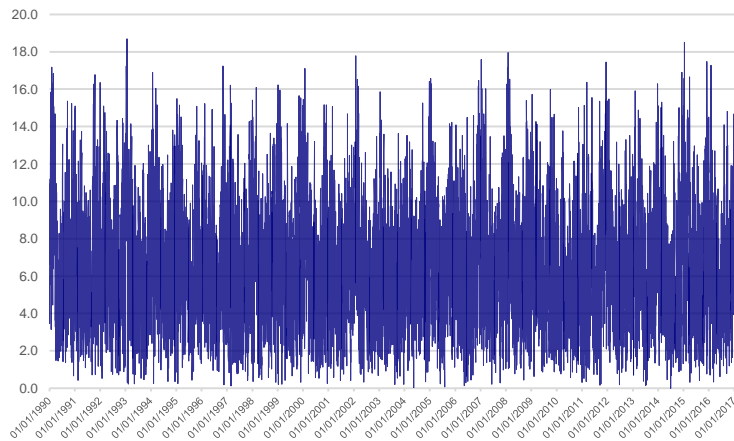
Compute theoretical energy generated using appropriate wind turbine power curve

Spain Peninsular Benchmark

- National ("peninsular" = mainland only) Benchmark replicating actual energy output (GWh)

- Configured using national installed capacity as of end 2016

- Index 'locked' with current configuration

- Homogenous historical series available

- Real-time updates and forecasts available

- New Benchmark will be created each year to account for changes in installed capacity

- Benchmark will be maintained, even if superseded while there is open interest

- **And we can do this anywhere in the world.**

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Spain – Peninsular 2016 Benchmark Results

Speedwell Wind Production vs REE Actual for 2013 -2016

Legend: Synthetic Wind Benchmark — REE actual wind energy production 2013 - 2016 (GWh) (Peninsular only)

UK Balancing Mechanism Results

Speedwell UK Index (BM wind farms) versus Gridwatch observed

— Speedwell UK Index - BM (GWh) — Gridwatch published (GWh)
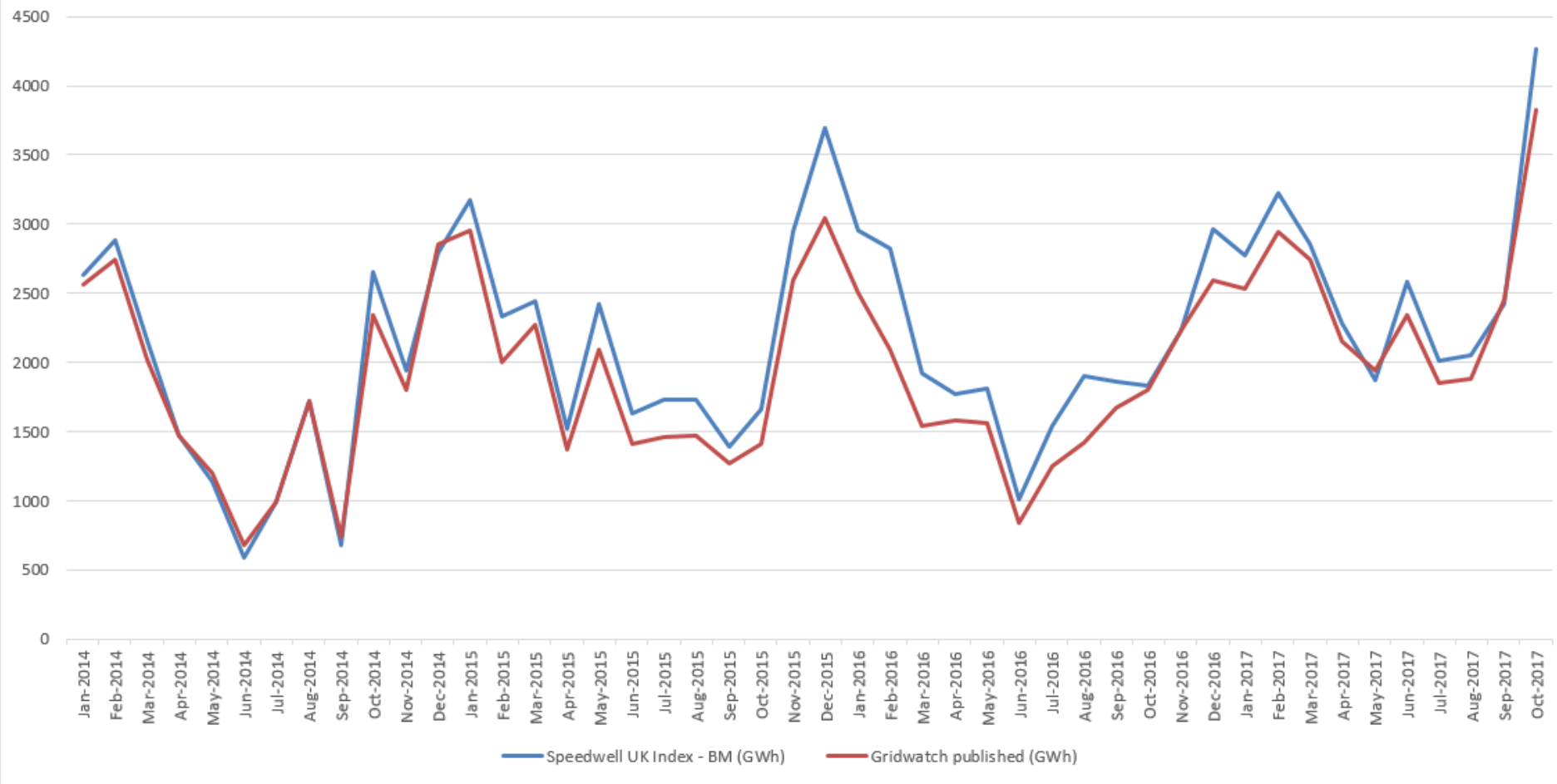
German Offshore Wind Results

Speedwell Germany Offshore Index versus TenneT observed

Simple Hedge based on 10m Mast? :

- CAUTION using a 10 m wind mast may be ok if you are buying a put option, but it may be dangerous with a swap.

- Because energy output is non linear with respect to wind speed, a swap based on average 10m wind speed can lead to situations where you have to payout even though your production is below average

- This will arise when wind speeds are a little above average

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Using a weatherXchange Wind Farm Benchmark

To be clear…..

- **We do not intermediate in transactions: ie we are not brokers**. We would be happy to introduce you to broker/advisors We do not deploy our own capital to offer weather protection ourselves

- **We provide the weatherXchange Platform to help facilitate the market**, ie to make it more accessible in all areas: wind, temperature, hydro, agri-based etc

- **We believe there is a developing economic need for weather risk protection in the wind sector**. We look at the specific example of our Spanish Wind Farm Benchmark, the first national index we have released

- We want to help this process by making available the indexes that hedgers need to make this work for them and to make the process of then using those indexes easy…that is what weatherXchange is for
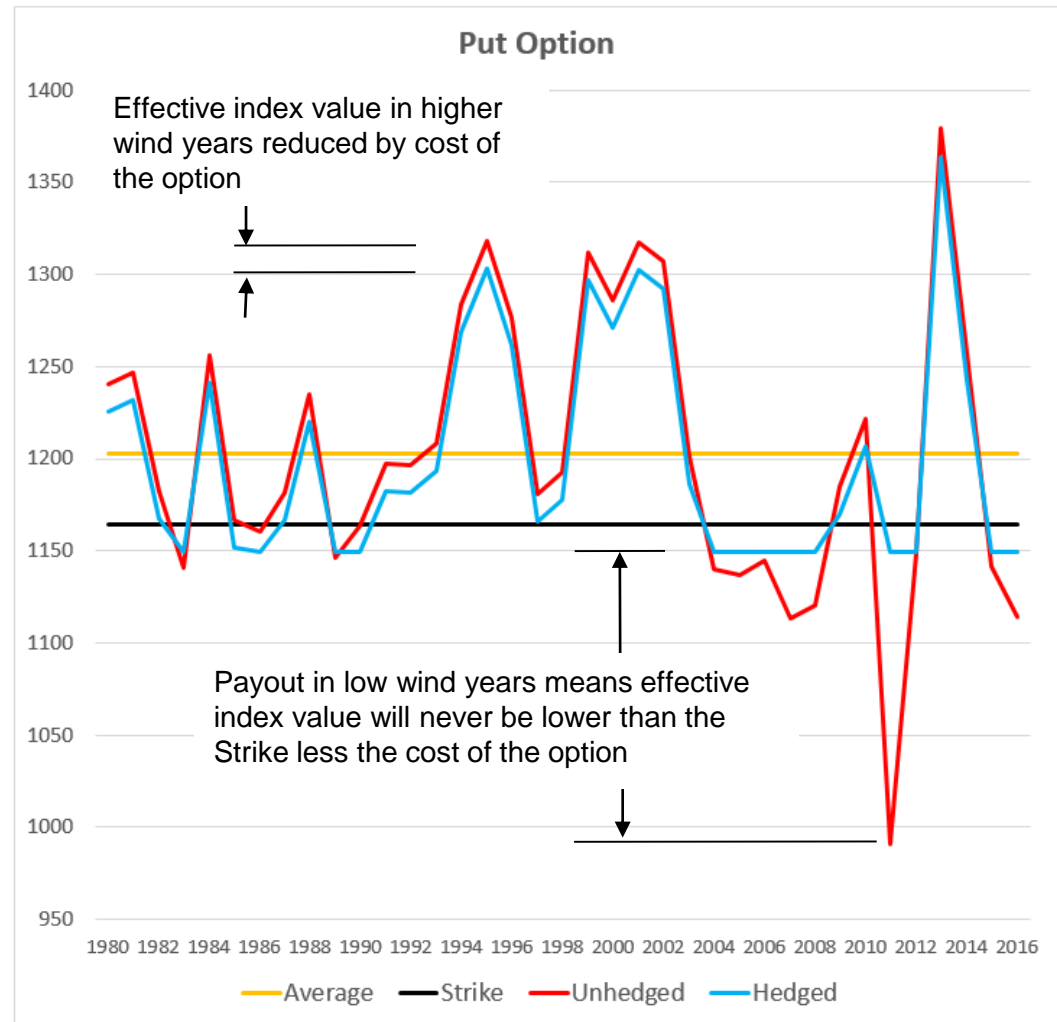
What type of payoffs are available?

1 Put option
Receive payment below a certain level ("Strike"). Payout is proportionate to how far below a certain value "Strike" the index is

Consequence
Payment in low wind years no lower than Strike less cost of option. Payment in other years reduced to the extent of the cost of the put option.

Put Option

Effective index value in higher wind years reduced by cost of the option

Payout in low wind years means effective index value will never be lower than the Strike less the cost of the option

— Average — Strike — Unhedged — Hedged

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What type of payoffs are available?

2 Collar

Receive payment below a certain level ("Strike1").
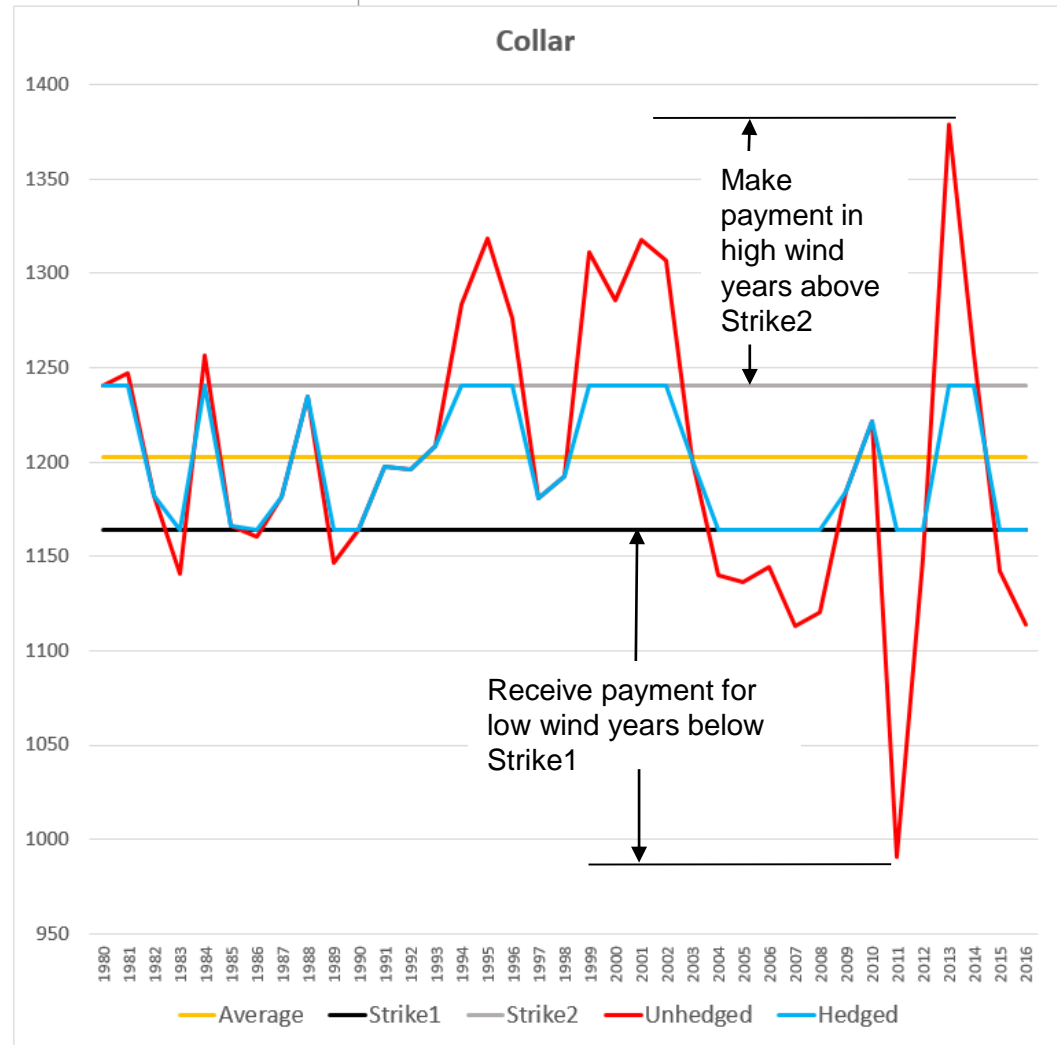
Make payment above a certain level ("Strike2").

Payout is proportionate to how far below/above the Strike

Consequence:

Give away upside to protect downside but retaining some variability in the middle

Generally zero-premium. In effect the purchase of a put option in return for the sale of a call option

Note: in general the payoffs are also capped in both directions

Collar

Make payment in high wind years above Strike2

Receive payment for low wind years below Strike1

Legend: Average — Strike1 — Strike2 — Unhedged — Hedged

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What type of payoffs are available?

3 Swap

Receive payment below a certain level ("Strike").
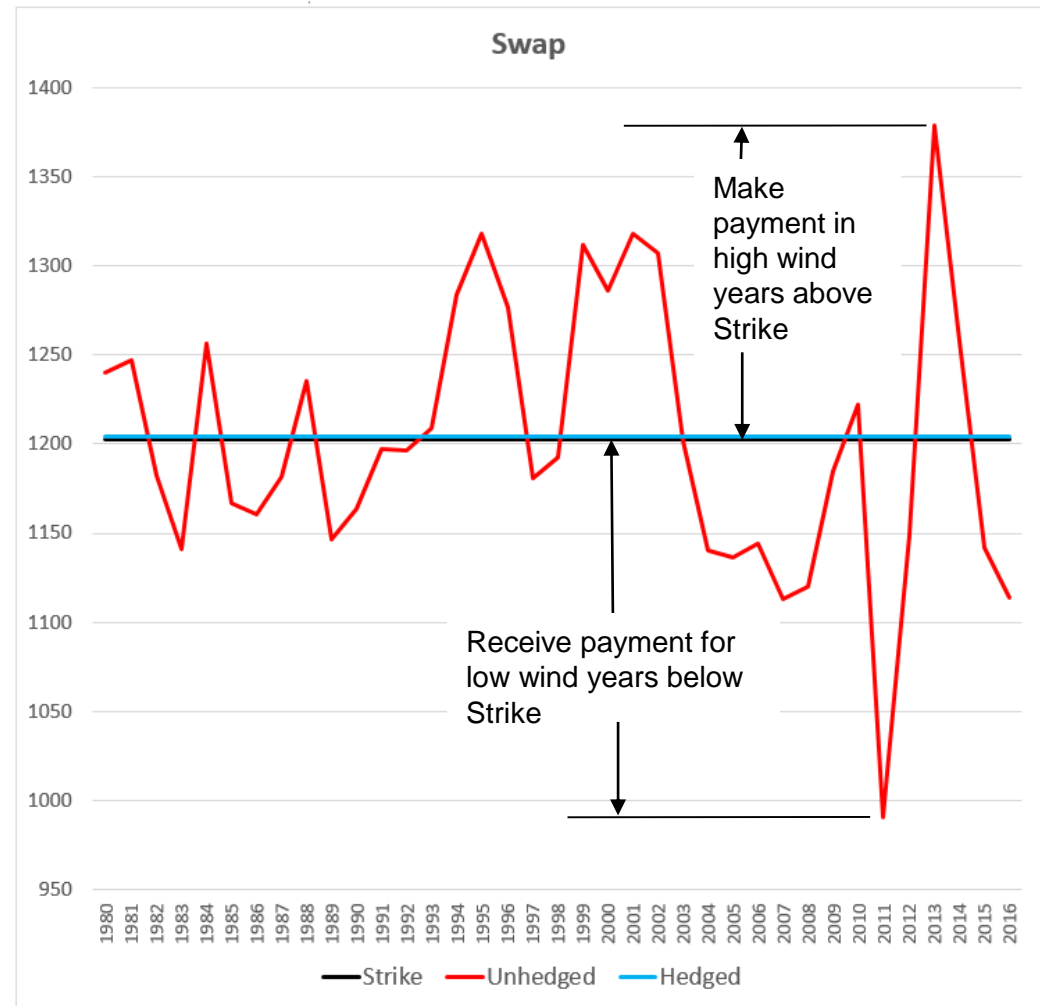Make payment above the Strike.
Payments are proportionate to how far below/above the Strike

Consequence:

Give away all upside to protect all downside

Can be zero-premium or can be premium-paid.

Note: in general the payoffs are also capped in both directions

Swap

Make payment in high wind years above Strike

Receive payment for low wind years below Strike

Strike — Unhedged — Hedged

Using weatherXchange to structure a hedge: example screenshot 1: Structuring a one month hedge using the Spain National Wind Index

Using weatherXchange to structure a hedge: example screenshot 2: Requesting Instant Indicative Pricing

Get Automated Indicative Prices from Protection Sellers

	Company Name	Contact	Profile	Website	Other Information
☐	Coriolis Capital Limited	Guillaume Legal Tel +44 20 3159 5232		⬀	Investment Fund. Weather Risk Management Specialist
☐	MSI GuaranteedWeather	Brad Davis Tel +1 (913) 253-1220		⬀	Global Weather Risk Manager
☐	Munich Re Trading LLC	Bill Windle Tel +1 (832) 592-0057		⬀	Global Insurance and Reinsurance Company
☐	Nephila Capital Ltd Bermuda	Richard Oduntan Tel +1 (441) 298 7734		⬀	Investment Fund. Weather Risk Management Specialist
☐	Sompo Global Weather	Marty Malinow Tel +1 (917) 281 0701		⬀	Global Specialty Insurance company. Formerly known as Endurance

Get Indicative Prices   **Cancel**

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How to Proceed

- Access existing Benchmarks on weatherXchange or ask us to produce a Synthetic Wind Farm Benchmark. This can be one or more assets which can be far apart

- There is no charge on the basis that you will put the RFP through weatherXchange..

- We will send the index to you.

- If it is a good fit, then you can get a feel for how the weather market prices your risk: use weatherXchange to structure a hedge: eg a short swap or a put option protecting against low wind speed

- Save the structure, adjust as necessary, then send an Request for Pricing

- If happy with the price, trade. weatherXchange are not involved. This is all off-platform.

- Request Settlement Data feeds

- We can also deliver daily P&L, VaR for internal reporting

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Questions?