

# Handling the Risk of Renewable Investments NORDIC LESSONS FOR THE EUROPEAN MARKET

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## Agenda

#### Wind in the Norway and Sweden – Full Market exposure

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How do Market Participants Manage the Risk in the Nordics

Lessons Learned for the European Market



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## Investments in Norway and Sweden are fully exposed to market risks



## Main characteristic of the Nordic market: High share of flexible hydro power



#### COMMENTARY

- The Nordic market has a high share of hydro power (in particular Norway), most of which is flexible hydro power with reservoirs
- In addition, the is some substantial amount of nuclear generation located in Sweden and Finland
- Remaining sources are wind, and some thermal generation, most of which is CHP (and rather inflexible)
- For the future, one expects large volumes of wind to enter the market, due to favorable conditions and the need to replace old nuclear (mostly Sweden)

## The Nordic power market is characterized similar risk factors as European markets

#### Hydro balance is an important price driver...

- The Nordic market is energy balance driven
- Hydrology (wet/dry years) has a large impact on annual average prices
- Future: wind production volumes will be equally important

#### ... but fuel prices are of high importance for price level

- **Fuel prices matter** despite high degree of hydro
- Interconnections with continent (and in future UK) set the water value by defining the opportunity cost



#### Observed prices



#### Source: EEX, Nordpool, Nasdaq

## Additional risk factor for the Nordic market: Area price risk

## SE 46,30 SE2 46.30 46.30 SE3 44.64 SE4 46,30

#### Current bidding zone setup

#### How it works

- Bidding zones are an important instrument for handling internal bottlenecks
- Current setup: Norway 5 zones, Sweden 4 zones, Denmark 2 zones, Finland 1 zone
- Norwegian TSO Statnett can change number of price zones and price zone definition
- In some weeks there can be large price spreads in the market
- Note: Sweden was "forced" to introduce price zones

Source: Statnett

## Different risk exposure in Norway and Germany

Norway	Germany
Double market risk	(Nearly) no market risk
<ul> <li>Full exposure to power price</li> </ul>	<ul> <li>FIT (nowadays auctioned, uncertainty before investment)</li> </ul>
<ul> <li>Uncertain revenue from certificate price</li> </ul>	<ul> <li>FIT effectively a PPA with the government / consumer</li> </ul>
<ul> <li>Full exposure to cannibalisation, but flexible system</li> </ul>	<ul> <li>Market premium considers only <i>relative</i> cannibalisation</li> </ul>
Volume risk	Volume risk
(Realised) risk of collapse of certificate market	Future: Risk of increasing cannibalisation
Area price risk	(Low) risk of price areas being introduced
But: High level of investment activity	But: Auctions undersubscribed

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## Investments are usually secured by long-term PPAs A number of new players entered the market

#### **Producers & Investors**

 Investments in wind are now often realized with investment funds on the owner side:



 European utilities with clear RES investment mandates also look to the Nordics for good projects



 Traditional Nordic utilities that invest often team up with international investor or European utility



### **Off-takers**

 New players on the demand side have a RES focus and a wish to realize new projects through PPAs, often for *data centers*



- Traditional power intensive industry, mainly aluminium smelters, has also started to think differently
  - Connecting PPA's to specific wind projects
  - Cost based rather than price based pricing of PPA's





## PPAs play a very important role to secure the investment

Case study 1: Lehtirova realised with developer, financial investor and a PPA - 148 MW, 490 GWh, operational in 2018



## PPAs play a very important role to secure the investment

Case study 2: The Fosen project involves a physical contract with sleeving - 1000 MW, operational from 2019 onwards



- Statkraft owned by Norwegian state
  - 52.1% of project 521 MW
  - No direct PPA
- TrønderEnergi Owned by municipalities
  - 7.9% of project 79 MW
  - No direct PPA
- Nordic wind power owned by
  - 40% of project 400 MW
  - PPA with Norsk Hydro effectively taking all their volumes from start of operation
  - "Sleeving arrangement " with Agder Energi: Handling the variable power from the wind farm in order for Nordic Wind Power to sell stable base load power to Norsk Hydro

## Roughly, one can distinguish three levels of "sleeving"

#### BALANCING

- In the Nordics, wind parks are balance responsible
- Thus, deviations from announced generation schedule have to be managed or paid for
- This implies extra balancing costs for wind power in the Nordic market
- Due to high share of flexible generation, balancing costs are (so far) moderate, but may increase in the future

#### MARKET VALUE - CANNIBALIZATION

- The costs of converting volatile generation into a base-load product
- Boils down to value of wind/cannibalization in one or other form



#### ANNUAL VOLUME

- Additional volume risk due to annual variation
- In years with little wind, prices are in tendency higher than in other years – water value effect



Source: Simulated power prices and generation mix obtained from TheMA power market model

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What do we need to support wind investments in a post EEG-world? *Investors are traditionally risk averse, so..* 

Hedging market price risk

- $\checkmark$
- Hedging with PPAs is interesting for both investor and offtaker
- Value of green energy for some consumers



- Risk management
- Increased need for analysis and long term modelling
- Tools are tried and tested in the Nordics

Cannibalisation



- Can (must) be taken into account in due diligence process
- Yearly cannibalisation is only a rough indicator

Sleeving



- Easy in Nordics with sufficient hydro
- Might be more challenging in Germany

Project evaluation



- Yearly volumes no longer sufficient
- Production profiles, location, operational risk (EinsMan, balancing energy)



 $\checkmark$ 



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## It will be increasingly important to understand and mitigate market risks Example: Some "new" risks are on the horizon – The ghost of new bidding zones



#### Zone split has strong impact on value of wind



## Future generation mix and flexibility in market (incl. interconnectors) are essential



## Summary and concluding commentary

Years of experience with market exposure of wind in the Nordics, and investments are NORDIC continuously growing. New investors and players are entering the market EXPERIENCE The importance of power markets for wind investors is increasing. Either directly (full market INCRFASING exposure) or indirectly (cannibalization for assets in portfolio). Market risks and cannibalization MARKET RISK factors for portfolio or individual plants can be modeled, valued and priced. The way investment decisions are made will change, and PPAs will become more common to RISK mitigate risk also in European markets. Eventually, all boils down to the market value of wind. MANAGEMENT Cannibalization factors are just an indicator.



## THEMA helps you understanding markets and market risks, and in making right decisions THEMA Consulting Group, Oslo, Berlin

- THEMA offers in-depth market intelligence and analysis, supported by comprehensive databases and sophisticated modelling tools. THEMA is a sought-after forecasting and modelling provider for the European power sector, a fact reflected by its strong and growing list of European clients
- We offer a broad spectrum of services, including price forecasts for the European and Nordic power sector, bespoke analysis and advice, DD, and advanced model solutions, including licenses for our renowned power market model TheMA
- For further info, please contact:



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#### We are not only modelling experts, but understand the market dynamics



## What is needed to value a PPA or wind assets

- In our power market model, we model representative wind parks for each area
  - First assessment often used based on THEMA's standard long-term forecasts
  - Can be used as a first indication for value of wind in different areas across Europe
- For concrete projects (e.g. PPA valuation, DD), we typically use asset specific wind series provided by clients
- We often perform a historical benchmark analysis, as well as analysis for future years. Future years may be based on THEMA's standard forecast, bespoke scenarios, or forward markets (in which case we apply our simulated price structure)
- Often used indicators for base-load PPA-type contracts include (non-exclusive)
  - Average sell prices and volumes
  - Average buy price and volumes
  - Risk assessment for certain generation percentiles (P90) or price scenarios

## In the context of PPAs, cannibalization is an important variable

## Definition of annual cannibalization

 For an asset with generation *Gen(t)* in each hour t the cannibalization factor is defined as:

 $\frac{\sum Gen(t) * Price(t)}{\emptyset Price * \sum Gen(t)}$ 

 It is nothing else but the ratio between the generation weighted price and the annual average price

#### What it does and does not measure

- It expresses how your asset performs compared to a pure baseload unit
- It allows you to make a proxy for your income stream if you have the average price
- It is not
  - an indicator of how wind affects prices
  - an indicator of how flexible your asset is
  - an indicator of how your hourly generation correlates with hourly prices
  - …and many other things

## Note: The annual cannibalization can be strongly "biased" by seasonality



Source: Simulated generation patterns and cannibalization factors obtained from TheMA power market model

## This is why cannibalization is also measured on monthly level

#### Simulated monthly cannibalization NO3 (2025)



#### **Implications for PPAs**

- PPAs are often done with a monthly generation obligation (x% of P50 for that month), instead of an annual baseload obligation (x% of P50)
- This accounts better for the seasonality of generation for wind assets
- In this case, the monthly cannibalization is the relevant variable for assessing the value of wind or a PPA
- In the end, the realized price is the determines the value of generation, <u>not</u> the cannibalization factor(s)



## High investment activity in the Nordic market – despite low certificate prices



## High investment activity in the Nordic market – despite high market exposure



#### Flexible hydro reduces "cannibalization"



Source: https://globalwindatlas.info/; simulated power prices obtained from TheMA power market model