PPA eller ”Merchant Trading”
– riskhantering och resultatoptimering i en osäker framtid.
A good hockey player plays where the puck is.
A great hockey player plays where the puck is going to be.
— Wayne Gretzky
Utvikling i kraftbalanse i Norden
Fordelt på land (2018 - 2030)

- Norge
- Sverige
- Danmark
- Finland

<table>
<thead>
<tr>
<th>År</th>
<th>TWh</th>
<th>Norden:</th>
</tr>
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<tbody>
<tr>
<td>2018</td>
<td>-17</td>
<td>7 TWh</td>
</tr>
<tr>
<td>2020</td>
<td>-8</td>
<td>23 TWh</td>
</tr>
<tr>
<td>2030</td>
<td>0</td>
<td>36 TWh</td>
</tr>
</tbody>
</table>

Figur 14: Kraftbalansen i Norden øker i NVEs analyse med 29 TWh fra 2018 til 2030.
Wind electricity generation in the EU more than triples to 1 100 TWh by 2040; The rapid increase of variable forms of generation calls for new approaches to system integration.

© OECD/IEA 2017
Power Purchase Agreement

...fancy name for an agreement to purchase power
Långsiktiga investeringar kräver långa elavtal
Långsiktiga investeringar kräver *nuförtiden* långa elavtal
Facebook
Google
Apple
IKEA
AkzoNobel
AstraZeneca
BMW
Carlsberg
Coca Cola
GM
H&M
Novo Nordisk
Ricoh
Walmart

PPA
Facebook
Google
Apple
IKEA
Apoteket
Varför köpa från marknaden till 40 EUR/MWh när du kan ”bygga själv” för 35?
Eon eyes growth into Nordic corporate PPAs

(Montel) German utility Eon is considering signing long-term power purchase agreements (PPAs) with corporates in the Nordic region due to favourable market conditions, the company told Montel in a recent interview.

Vattenfalls vd: PPA:er behövs för att nå svenska klimatmål

(Montel) PPA-kontrakt kommer att vara en viktig ingrediens när Sverige ska nå klimatmålet om noll nettoutsläpp till 2045, sa Vattenfalls vd Magnus Hall under sitt anförande vid Vind 2018-konferensen i Stockholm. Han varnade också för att de svenska vindkraftsprojekten i dagsläget är för små.
Wind power is likely to trump other forms of generation when Finland holds a competitive tender for 1.4 TWh of renewables production later this autumn, according to consultancy Pöyry.

“Costs for wind power are so cost effective that it will be challenging for other production forms to make competitive offers in the tenders”, said Pöyry's Jenni Patronen during the Energia 2018 conference in the Finnish city of Tampere on Wednesday.

Finland is set to hold a renewables auction to subsidise projects with a combined annual output of 1.4 TWh in November-December. The system is open for all renewable electricity production forms except hydropower.

Increasingly attractive
Wind power is becoming increasingly attractive in Finland and this year developers have already announced four decisions to build wind farms without subsidies in the 2020s, backed by long-term power purchase agreements (PPAs).

“These PPAs work in the same way as subsidies do for the wind power developers. They guarantee an income and allow the investment to be made”, Patronen said.
Statkraft agrees first wind power PPAs in Germany

Statkraft has signed power purchase agreements (PPAs) with several wind farms (46 MW) in Germany, the first such deals in the country, it said on Monday.

Wind increasingly attractive for Nordic PPAs – Hydro CEO

(Montel) A reduction in the cost of installing large-scale wind power makes the technology increasingly attractive for long-term power purchase agreements in the Nordic region, the CEO of Norwegian aluminium producer Norsk Hydro said on Tuesday.

Danske nyhetsklipp

Ørsted har inngått en 15-årig PPA-avtale med tyske Innogy, som innebærer at selskapet vil håndtere produksjonen fra den kommende vindkraftparken Triton Knoll (860 MW) i Storbritannia i markedet. (Pressemelding)
All corporate PPAs per year and per country

- Denmark
- Poland
- Spain
- UK
- Sweden
- Norway
- Netherlands
- Finland*
- Ireland
- Belgium*
All corporate PPAs per country and per year

- Norway
- Sweden
- Netherlands
- UK
- Spain
- Finland
- Ireland
- Denmark
- Poland
- Belgium

Legend:
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018 YTD
Long-term corporate PPAs; no risk and no opportunity...

...and a considerable loss in value longer out on the curve. Typically, a long-term (corporate) PPA is priced 30-40% below the expected value 5-15 years out in time.

"You give away an enormous amount of value in terms of the price you can get with active hedging compared to what the long-term forward price curve is showing."
# Longer term - Price forecasts Nordic power

<table>
<thead>
<tr>
<th>Approximate estimates*</th>
<th>2020</th>
<th>2025</th>
<th>From</th>
</tr>
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<tbody>
<tr>
<td>Shepherd Energy</td>
<td>32</td>
<td>36</td>
<td>Dec-17</td>
</tr>
<tr>
<td>Scandem</td>
<td>32</td>
<td>39</td>
<td>Fall-17</td>
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<tr>
<td>Sweco</td>
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<td>Fall-17</td>
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<tr>
<td>Bixia</td>
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<td>Wattsight/MK Online</td>
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<td>49</td>
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<tr>
<td>Thema Consulting</td>
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<td>36</td>
<td>June-18</td>
</tr>
<tr>
<td>Storm Geo Nena</td>
<td>28</td>
<td>32</td>
<td>Fall-17</td>
</tr>
</tbody>
</table>

| Market price 1st May 2018 | 29 | 30 |
| Market price 1st Sep 2018 | 35 | 32 |

| Average forecast | 31 | 35 |

*Communicated at events and articles*
Avoiding Nordic power price risk with long-term PPAs to please lenders and investors come at a very high cost and loss of flexibility. The timing risk is substantial.
Timing risk
Timing risk elcert
PPA:

- Dyrt!
- Värdeförlust jmf med prognoser
- Timing-risk
Vad kostar det att bygga vind i Norden?

”- vi kan bygga hur mycket ni vill för 25 EUR/MWh”

NORWEAs* seniorrådgivare, Andreas Thon Aasheim, sa i januari 2018 på Montels elcertifikatkonferens: ”glöm 40 EUR/MWh – vi kan bygga hur mycket ni vill för 25 EUR/MWh!”.

Finnish wind farms could now be built with a long-term marginal cost below **EUR 29/MWh**, said a director at Sweden’s energy authority this week, adding major projects required a price of just below EUR 35/MWh....

This is still high compared to the long-term marginal cost of **EUR 23.60/MWh** that energy group St1 hoped to achieve at its planned Davvi wind power plant (800 MW) in northern Norway – with a 6% return on investments.
Lägre och lägre produktionskostnad för vind betyder mindre och mindre risk att utnyttja marknaden!
När är risken tillräckligt låg för banker och andra riskaverta långivare?
”Marknadsrisker kan hanteras men politiska risker vill man inte ha”

Thina Saltvedt, Nordea, Vind2018
Han menar dock att en ”merchant market också ger en trygghet. Då vet man vad som gäller och riskerna kan hanteras”, säger han. ”Stödsystem är svårare att lita på”.

Fredrik Norell, Blackrock, Vind2018
Annual PV additions: historic data vs IEA WEO predictions
In GW of added capacity per year - source International Energy Agency - World Energy Outlook

please send comments to:
a.e.hoekstra@tue.nl
@aukehoekstra
Global annual PV installed capacity increased by over 29% YoY in 2017
Solar Forecasts
IEA installed solar power forecasts have been frequently revised up

Source: Bloomberg New Energy Finance
Note: WEO 2002-2009 is Reference Scenario and WEO 2010-2015 is New Policies Scenario

>300 GW in dec 2016 (IEA-PVPS)
Cars that drive themselves while you sleep only two years away, says Elon Musk

The Observer, April 27th 2017
Electric Vehicle Lithium Ion Battery Costs

The cost of running an electric vehicle on lithium ion batteries must be less than $150 per kilowatt hour to compete with vehicles that run on oil. Below are cost and market estimates for these batteries.

Source: Rapidly falling costs of battery packs for electric vehicles by Bjorn Nykvist and Mans Nilson, 2015

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Batteries Are Improving Dramatically

Falling Prices ($/kWh)

Improving Energy Density (Wh/kg)

55$/kWh
the Hornsdale Power Reserve

100 MW/129 MWh – 50 million USD

“The Tesla big battery in South Australia has already taken a 55 per cent share in the state’s frequency and ancillary services market, and lowered prices in that market by 90 per cent, new data has shown.”

“Various estimates have put the cost savings to consumers from the FCAS market alone at around $35 million, just in the first four months of its operation.”
Global cumulative storage deployments

Source: BloombergNEF
BNEF’s latest Long-Term Energy Storage Outlook sees the capital cost of a utility-scale lithium-ion battery storage system sliding another 52% between 2018 and 2030, on top of the steep declines seen earlier this decade. - This will transform the economic case for batteries in both the vehicle and the electricity sector.
LITHIUM-ION EV BATTERY EXPERIENCE CURVE COMPARED WITH SOLAR PV EXPERIENCE CURVE

Historical price (USD/W, USD/MWh)

Cumulative production (MW, MWh)

- Crystalline Si PV module
- Li-ion EV battery pack

- 1976
- 1988
- 1998
- 2004
- 2008
- 2010
- H1 2014
- 2014

$m = 24.3\%$

$m = 21.6\%$
ONSHORE WIND LEVELISED COST ($/MWh)

- Wind costs have fallen 50% since 2009
- Learning rate 19%

SOLAR PV MODULE COST ($/W)

- Module costs have fallen 99% since 1976, 80% since 2008
- Learning rate 24.3%

Note: Pricing data has been inflation corrected to 2014. We assume the debt ratio of 70%, cost of debt (bps to LIBOR) of 175, cost of equity of 8%. Source: Bloomberg New Energy Finance

Note: Prices are in real (2015) USD. 'Current price' is $0.51/W. Source: Bloomberg New Energy Finance, Maycock
När är risken tillräckligt låg för banker och andra riskaverta långivare?
It is possible for the wind power producer to take control of its hedging and risk at a lower cost, with maintained flexibility, lower timing risk and most importantly without giving away 20-40% of the value further out in time.
By setting up an **in-house merchant trading function**, focusing on cash flow and not production, it is possible to construct a hedging strategy with almost similar risk profile as a long-term (corporate)PPA but with maintained long-term value, flexibility and lower timing risk.
With the necessary knowledge and experience, it is possible to set up a lean hedging or merchant trading function without the complexity and number of employees in a typical energy trading or portfolio management organisation.
Merchant Trader Organisation "Lean"

RISK Management

- Analysis
- Traders
- Market access
- ETRM-system
- HR/Legal, etc.
- Simple Inhouse ETRM-system
- IT-support & dev.
- Back-office
Wind producers becoming merchant traders

Longer term PPAs “traded”