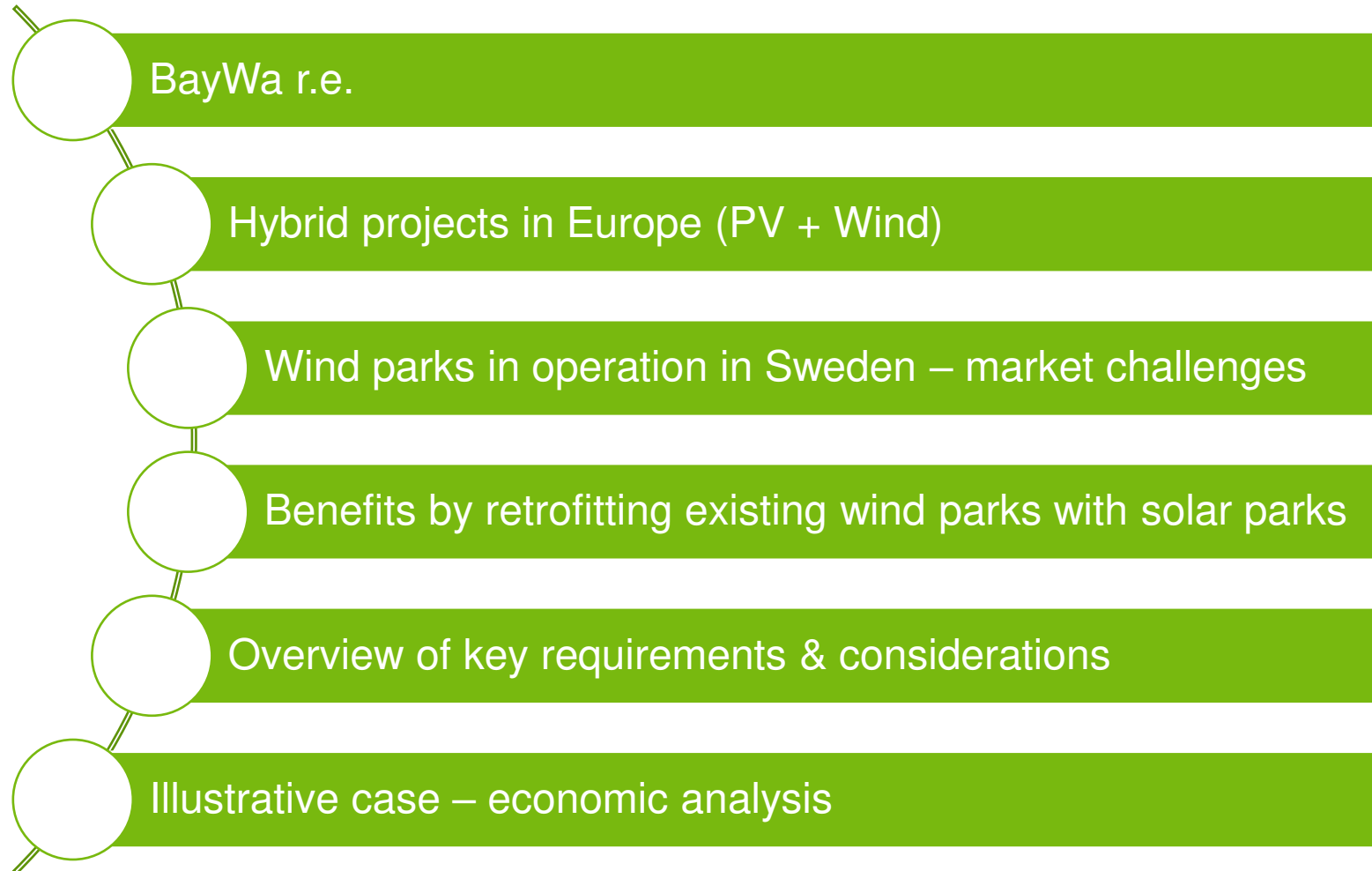


# How existing Wind Parks benefit when retrofitted with new Solar Parks?





# CONTENT





**With our shareholders we contribute to the global energy transition that is essential to the future of the planet**

**BayWa BayWa AG**

- Founded in 1923
- Globally active group
- Core segments: Energy, Agriculture, Building Materials, Innovation & Digitalisation
- Over 3,000 locations in more than 50 countries

**Energy Infrastructure Partners AG (EIP)**



- Founded in 2014, specialist energy investors
- Collective assets focused on high quality, large-scale renewables and system-critical energy infrastructures
- Extensive network, transaction and investment management experience

**51% 49%**



**BayWa r.e. AG**



# BayWa r.e. – renewable energy solutions



## Wind Projects

We draw on our long-standing experience to find the right solution for every partner and every site, on- and offshore.

- Project development
- Turnkey construction
- Project financing
- Optimisation and repowering
- Community investment options
- Long-term operations



## IPP/Energy Trading

We are also an Independent Power Producer with a growing portfolio and an expanding energy trading business.

- Direct marketing
- Energy trading and off-take options as PPAs for merchant plants
- Long term PPAs for new built projects without feed-in tariff
- Flexibility management



## Solar Projects

Our customers benefit from expert technical knowledge and global best-practice management.

- Project development
- Turnkey construction
- Project financing
- Power Purchase Agreements (PPAs)
- Community investment options



## Solar Distribution

We combine a comprehensive product range with outstanding customer service.

- Outstanding product quality
- Logistics expertise
- Seminars and training
- Comprehensive digital services
- Partner services for decentralised energy solutions



## Operations

Thanks to our technical and commercial project management, we maximise every projects potential.

- Technical and commercial management for wind, solar and bioenergy
- Installation and maintenance of charging stations with own regional service teams
- Long-term operations
- Rotor blade servicing



## Bioenergy

We offer sector-leading expertise thanks to our many decades of working within the agricultural sector.

- Planning and technical consultancy
- Project development
- Turnkey construction
- Feedstock management
- Digital solutions for biogas operations



## Energy Solutions

We create tailor-made Energy Solutions for commercial and industrial clients from self-consumption to green electricity supply.

- Integrated solutions (PV roof-top & ground-mounted installations, carports, storage and e-mobility concepts)
- Financial models (investment, leasing or Power Purchase Agreements)
- Focus on internal sustainability goals, national regulations and on-site parameters



# BayWa r.e. AG global footprint

AMERICAS



**>3,300** employees globally

EMEA



Locations in **31** countries

APAC



**3.6**bn Euro turnover 2021

 BayWa r.e. location     Active in the market



## Our portfolio covers a broad range of renewable energies



### Projects

**4 GW** installed capacity in wind and solar globally.

**16 GW** global **project pipeline** solar and onshore and offshore wind.



### Operations

**9 GW** under **operational management**; **digital asset operations** expertise and **technical management** for solar, wind farms and biogas plants; services in energy trading.

**7 GW** **direct marketing portfolio** and broad energy trading services incl. PPA.

New **IPP portfolio**; plans to ramp up to 2.5 GW in the medium term.



### Solutions

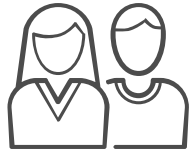
**25 years** of **solar distribution experience**, a wide range of quality products and services for about **11,000** **installation** and **sales partners** globally.

**Tailor-made Energy Solutions** for **commercial and industrial clients** from self-consumption to green energy supply.



# BayWa r.e. in the Nordics - A growing organisation

## BayWa r.e. Nordic figures (Q1 2022) :



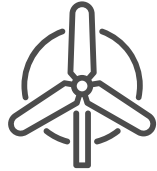
**28**

employees



**234 MW**

wind power  
under  
management



**62 MW**

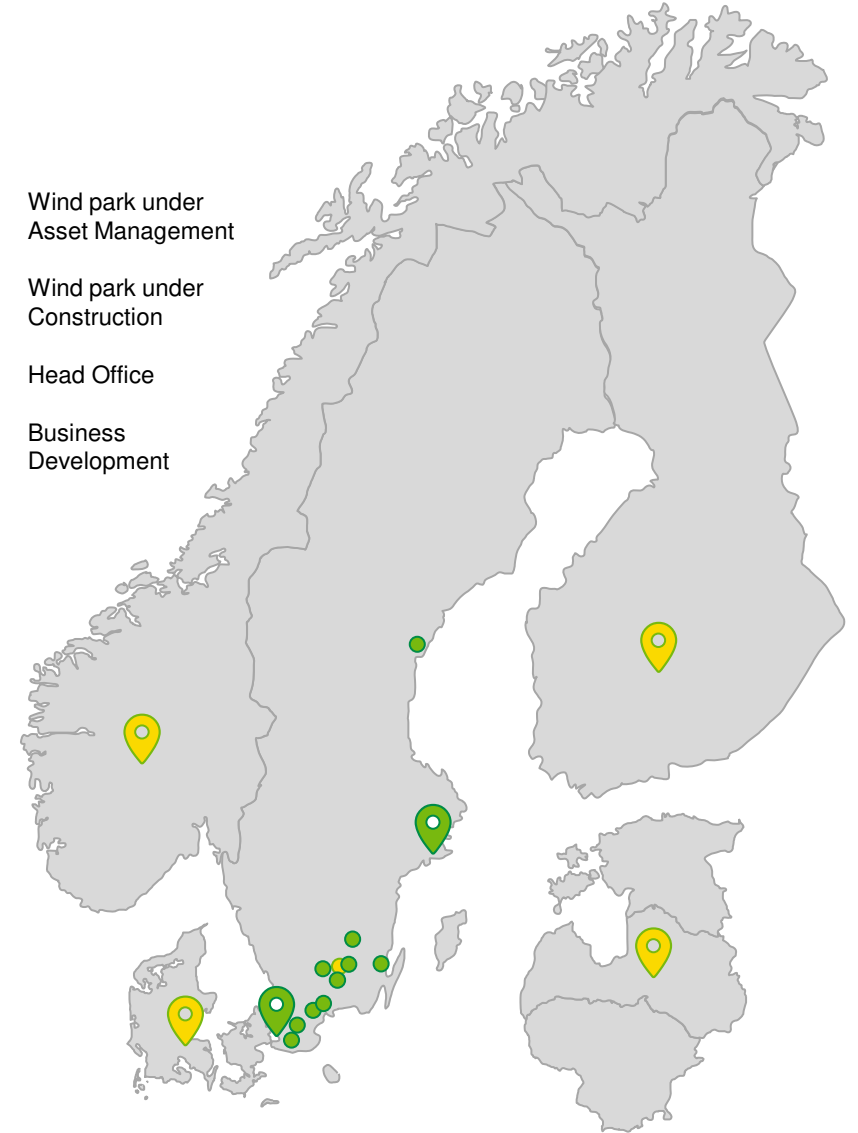
wind power  
under  
construction



**>360 MW**

wind & solar  
under  
development

- Wind park under Asset Management
- Wind park under Construction
- 📍 Head Office
- 📍 Business Development



### Q4 2021 project update:

- Recently commissioned :
 

Målajord	14,5 MW
Lyngsåsa	94,6 MW
- In construction :
 

Furuby	62,0 MW
--------	---------



1

# Hybrid projects in Europe (PV + Wind)





## In Europe

By 2020 Europe had:

- 7 hybrid wind/solar power plants built
- 22 wind farms co-located with storage

Source: Wind Europe (2020)

Examples:

- Parc Cynog (Pendine, Wales, UK) - 2016  
~5 MW of Solar and 3,6 MW Wind  
Vattenfall
- Haringvliet (Netherlands) - 2022  
22MW Wind + 38MW of Solar+ 12 battery containers.  
Vattenfall

Source: PV Magazine (2022)



**Reasons why deployment are not accelerating:**

- Governments need to establish hybrid power plants in their legal framework;
  - To simplify the permitting
  - To provide guidelines for monitoring, power traceability and power labelling
  - To facilitate installation and connection of more total renewable energy capacity than the contracted one with the grid owner:
    - Taking into consideration that the power output would not exceed the contracted capacity.



2

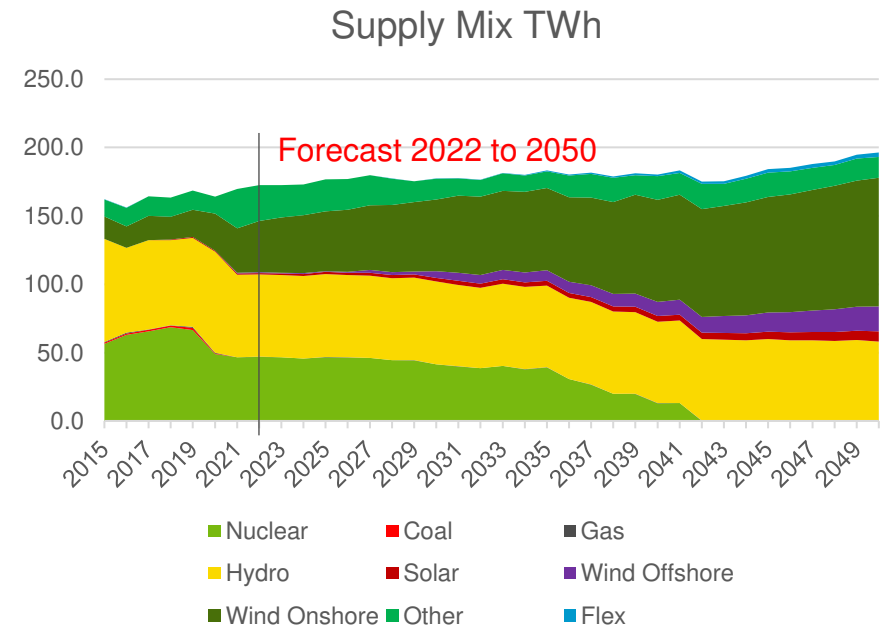
## Wind parks in operation in Sweden – market challenges



## Current Market challenges for Wind Power Producers in Sweden

- Increase penetration of wind power (thus more variability in production) results in:
  - Wind energy producers effectively receiving lower prices than the wholesale price or time weighted prices.
- Movements in the fuels markets arising from the Russia-Ukrainian conflict result in:
  - An increase in the volume risk for baseload PPAs
  - An increase in the wind capture rate losses in certain price areas
- Some market actors like Vattenfall are buying back volumes hedged earlier due to increasing volatility creating more uncertainty on the EPAD market.

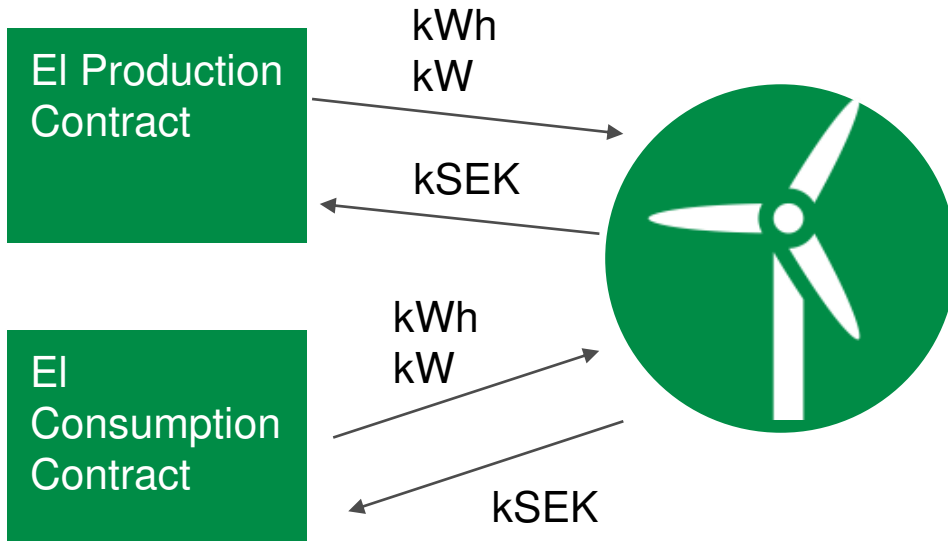
→ Wind energy producers effectively receive lower revenues in certain price areas



Source: WoodMackenzie, 2021



## Highlight of Grid Production and Consumption Fees



- For grid access, the production and consumption contracts charge the Wind Power producers based on:
  - Installed capacity and power consumed (MW)
  - Energy produced and consumed (MWh)
- Grid fees can be significant, as much as 30% of total OPEX or more than 8% of revenues.
- Grid fees can be an income depending on the wind farm's location on the electricity network and if retrofitted with a solar park.



3

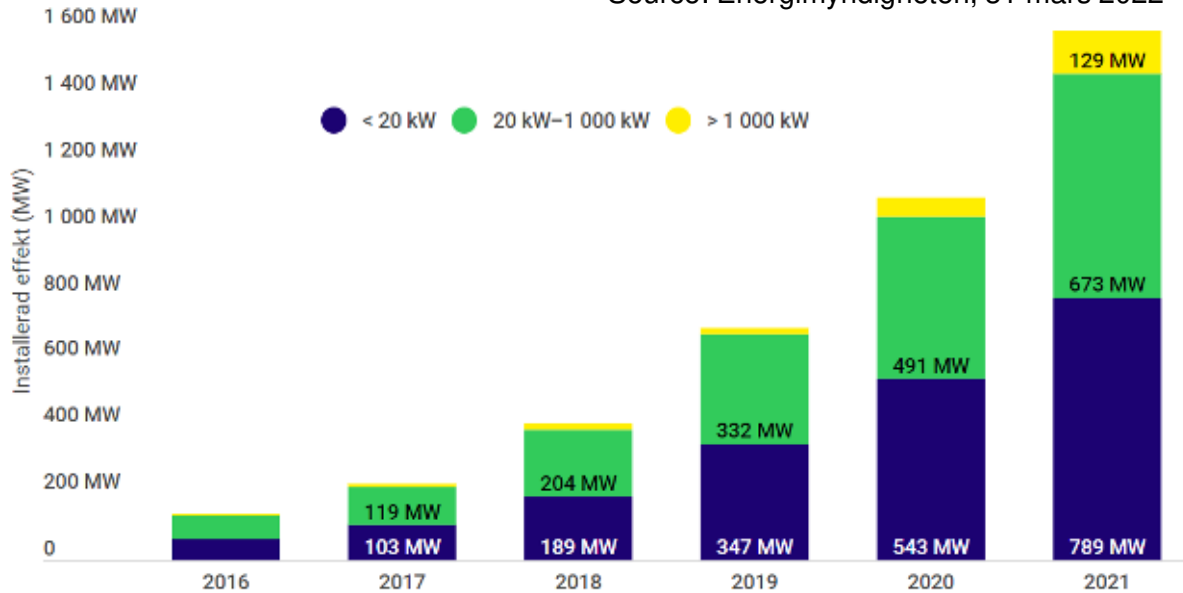
Benefits by retrofitting  
existing wind parks with  
solar parks



# Increase of grid-connected Solar Parks in Sweden

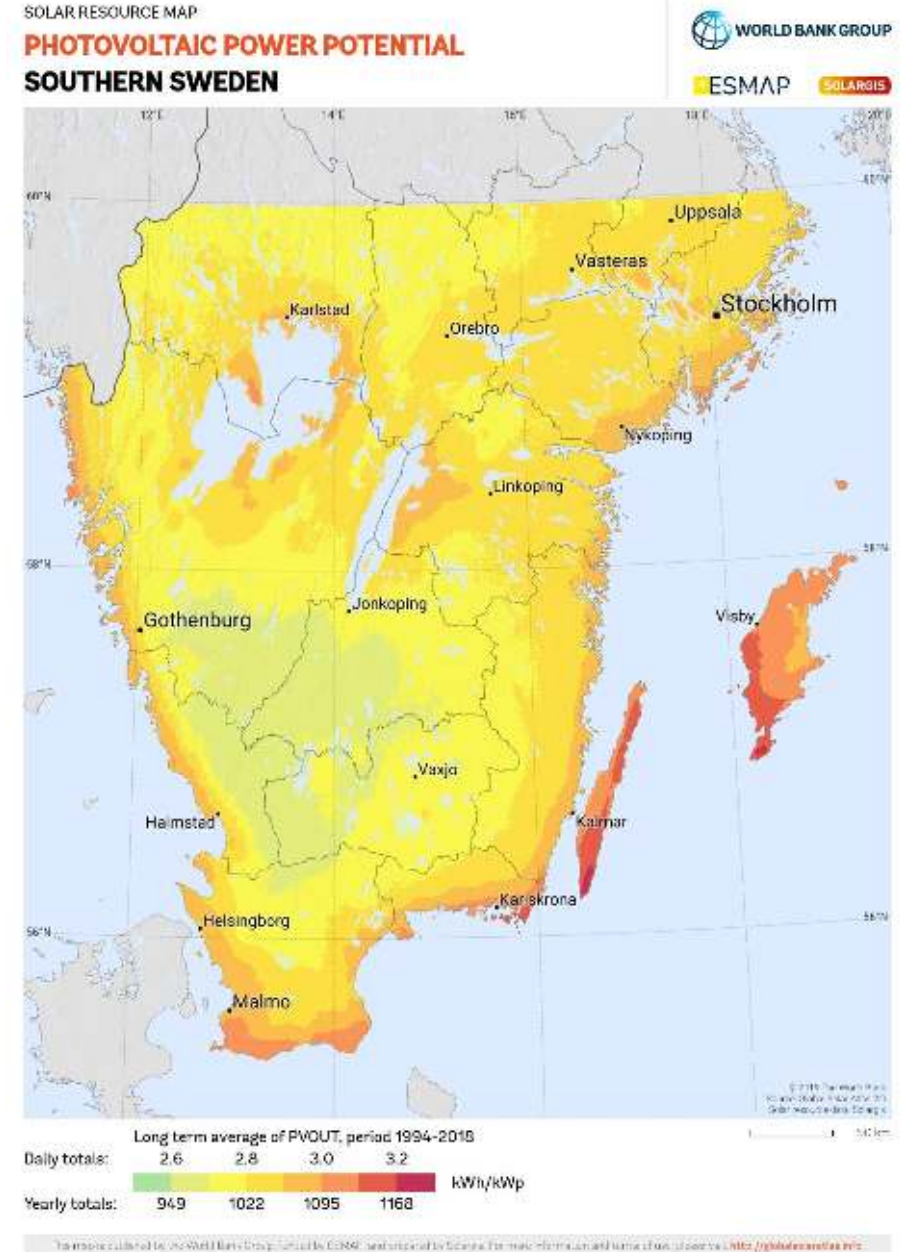
## Accumulated power of PV system installed

Source: Energimyndigheten, 31 mars 2022



### SKÅNE: total of 28,3 MW with PV Parks >1MW

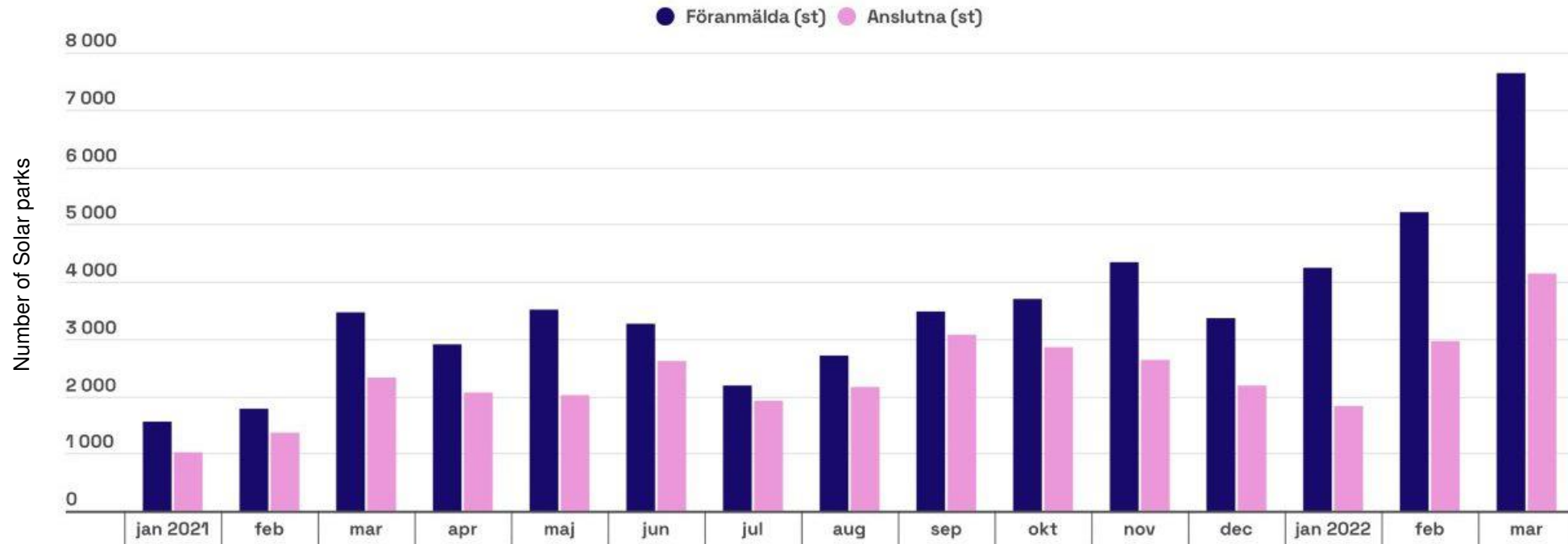
- Kristianstad: 3,4 MW
- Malmö: 1,3MW
- Sjöbo: 8,6 MW
- Skurup: 15 MW





# Grid Capacity Limitation for upcoming PV Parks

Connected and Pre-registered PV Parks to the Grid



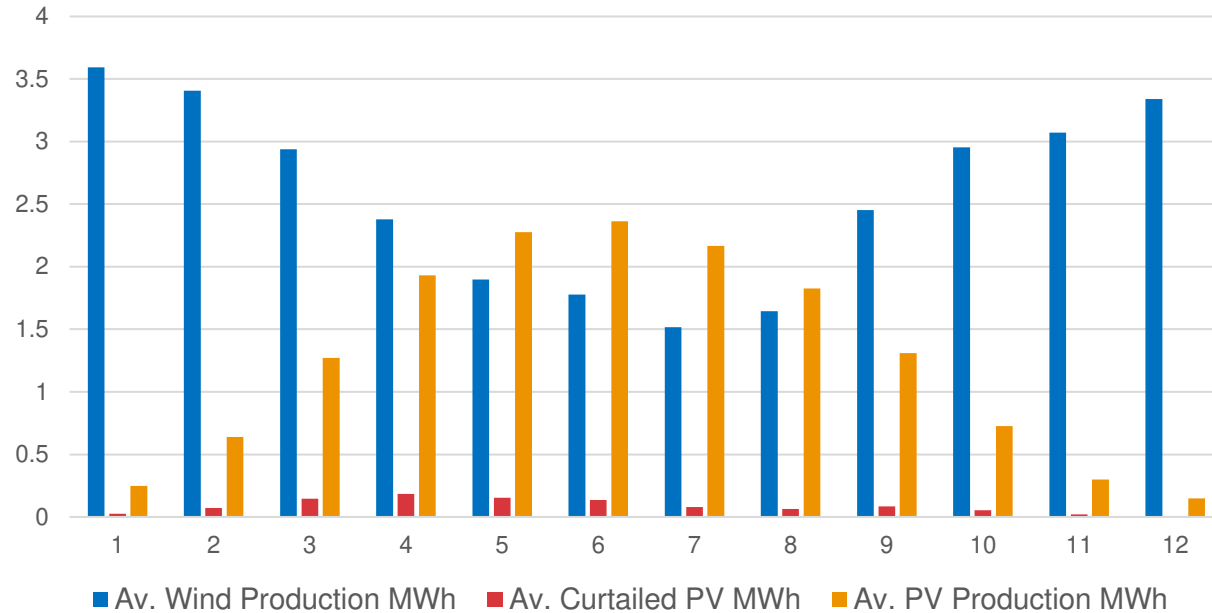
Source: Svensk Solenergi

- Pre-registrations have increased. LLAs need to be signed before requesting for grid connections.
- Grid companies will need to be prepared to expand their capacity.
- There is capacity at the existing wind farms substations.
- There could be better opportunities when connecting PV Parks to existing Wind Parks.

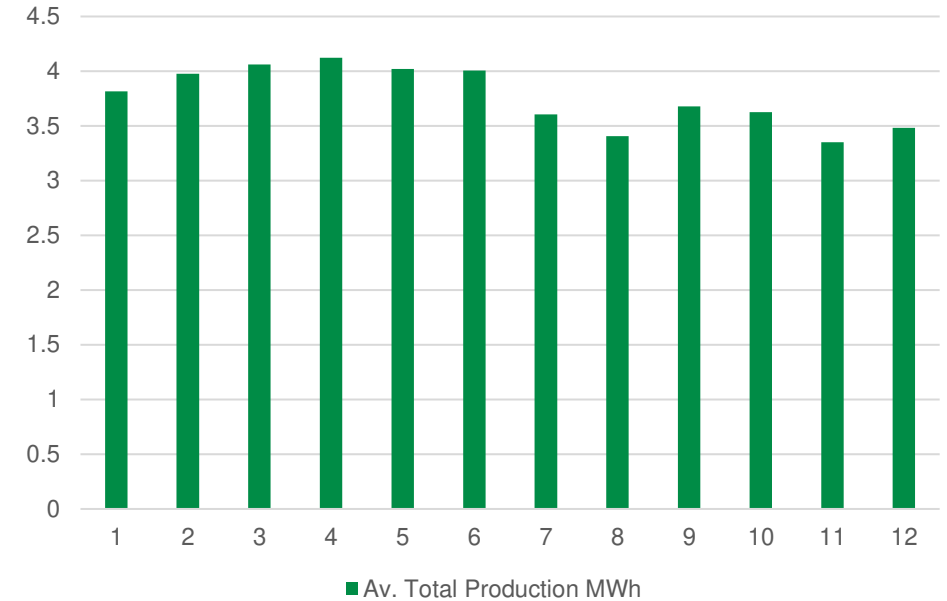


# Complementary Production Profile of PV and Wind Park

Monthly Av. Production per Technology



Monthly Av. Total Production MWh



Synergies:

- More stable energy output
- Higher grid utilization

**More cost-efficient project!**





# Retrofitting Existing Wind Park with PV Park

- Complementarity of load curves:
  - Improves the total capacity factor and utilization factor of the power systems equipment (transformer station, cables, etc.)
  - Could reduce the unpredictability of renewable energy, improving the stability of the electricity supplied.
- When using the same grid connection point of the wind park:
  - Use of power systems infrastructure is optimized. Synergies on O&M and CAPEX. New costs for Power controller, cables, measurements, fiber optic, etc.
  - Grid OPEX (production and consumption fees) are reduced and can become an income.
  - Faster connection times than a stand-alone solar park due to the high rise of pre-registered PV plants.
- Efficient land-use: The different technologies are all built at the same location and not scattered. Land starts to be a scarce resource in some counties, and regional zone planning is becoming more restrictive.
- Solar parks cover a lot of land, but when operating they do not disturb animals, nature or humans, when existing species and habitats are well complemented with the infrastructure, and they have been taken care of in construction.
- Short permitting timeline



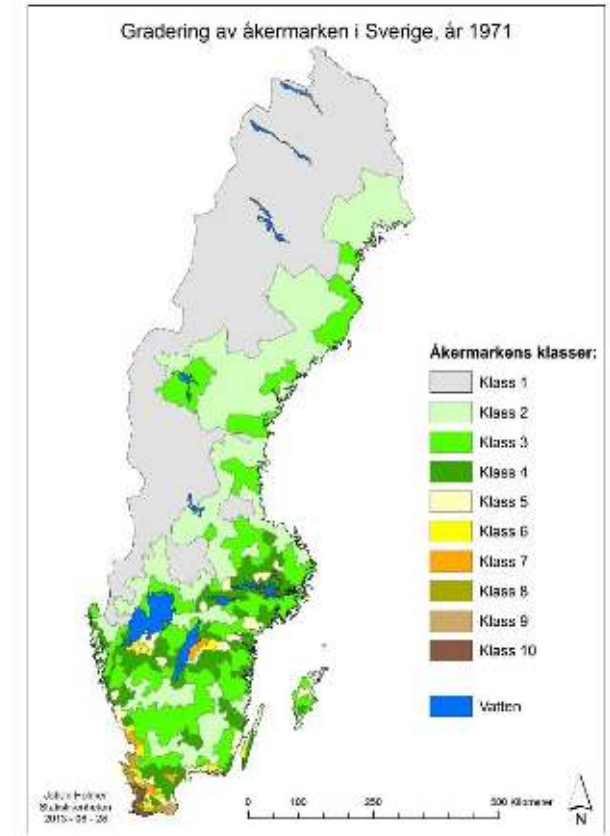
4

# Overview of key requirements and considerations



## Conflicts & Interests Evaluation for PV Parks

- Conflicting land use with High classification Agricultural land.
  - Case of Land and Environment Court in Växjö. Positive arguments:
    - Public interest: production of fossil-free electricity in Skåne and reduced carbon dioxide emissions
    - Prove temporary claim for the land → not a question of permanently putting the land out of agricultural production
    - Prove alleviation of capacity shortage that exists in terms of electricity supplies in southern Sweden
- Natural monuments
- Small swamp forests
- The outdoor interest
- Cultural monuments
- Red listed species in the location
- Specific habitats, biotopes
- Airports: glare studies could be needed to alleviate risks in airplane approaches
- Others



### BayWa r.e. Elde PV Park 22MW, Netherlands





## Permitting PV Parks– County Administrative Board

The measure requires notification for consultation pursuant to Chapter 12, Section 6 of the Environmental Code, and the notification is sent to the County Administrative Board.

The basis for the notification is

- Technical description including measures for cables, possible fencing, access roads and other peripherals that need to power PV.
- Nature inventory according to Swedish standard
- If > 5 ha is used, an EIA is needed including consultation with those concerned

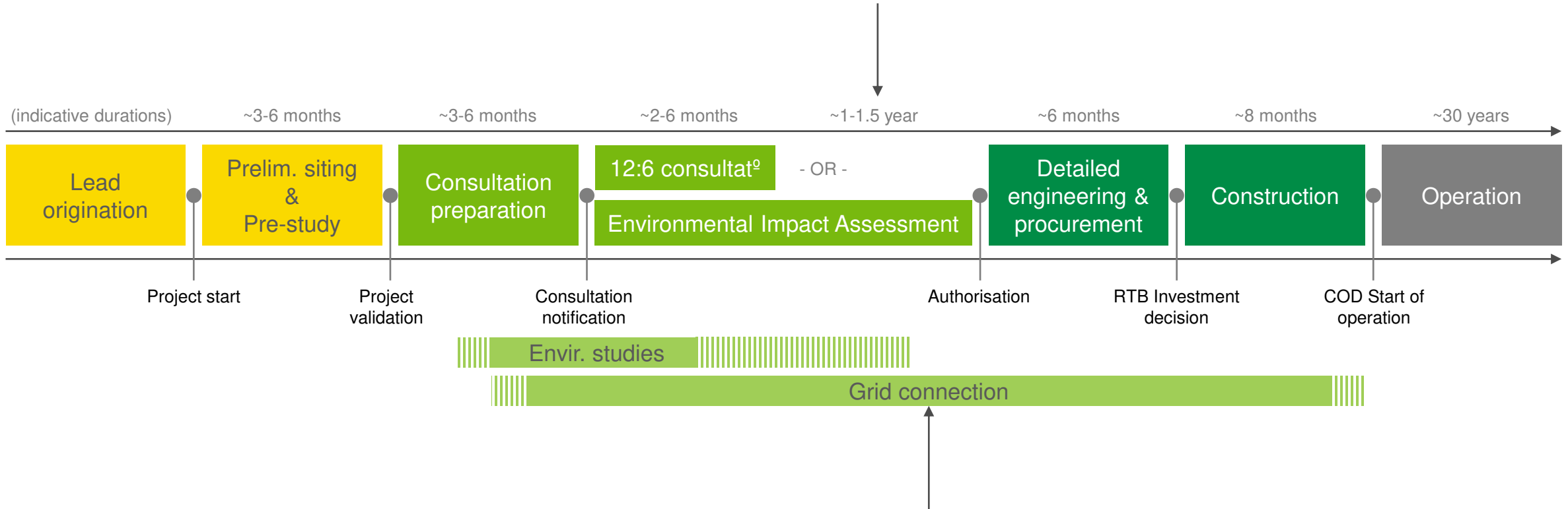
Time: Prepare a basis for a registration of 6-8 weeks. The county administrative board's response time for complete submitted documents is 6 weeks.

For the ancient monuments as foundations of houses: require consultation with the county museum



# Considerations in Project development timeline

- Shorter times for Permit approval than Wind Parks



- Could take longer than expected due to the High rise of pre-registered PV Plants. More grid capacity needed.
- Ideally, earlier registrations would be the solution, but Grid owners are talking about requiring land lease agreements and other documentation in place.



## Other considerations

### Environmental permitting:

- If the permit of the existing Wind Parks is reaching its expiration date, a new solar park can use the existing grid connection and for a hybrid combination the permit of the wind park should be extended.
- A new permit for PV Park required (depends if it is less than 5MW – just a notification).

### Land Lease Agreements

- If solar project will use same property of wind park, Land lease agreements need to be extended and amended for solar park construction. Separate LLA for the Solar Park can be signed.
- No Swedish regulations or competing land use interests affect the retrofitting.
- Today: LLA are being signed for 49 years.

### Layout:

- If PV park is too close to turbines: Ice throw, Shading by the blades and the tower can impose a disadvantage.
- If PV Park is located further apart from the turbines, this would increase cabling cost, trenches/blasting, and induce line losses, active and reactive power-wise.
- **Grid Connection**
- Same consumption and production contracts may be used for hybrid solar wind system if grid code allows.

### Economics

- Key economic metrics of the hybrid combination (CAPEX of PV park, curtailment of PV Park, updated grid fees income, project IRR, etc.)



# Grid connection requirements and strategy

## Grid Connection requirements:

- Existing wind farms normally fall under the technical requirements of SvKFS 2005:2.
- If connection point shall not change → check if requirements are valid for PV Park or if Compliance with the EU Regulation Requirements is needed: Frequency and voltage support alignment with RFG and EIFS
- System integration between wind and solar
  - Curtailment of capacity in accordance with contract fulfillment with DSO
  - Evaluation of strategies for curtailing the energy production and measuring and controlling the total output

## General topics to clarify:

- Check if certification is needed for superordinate park controllers (controls both PV & Wind)
- Adapt best solution for PV system measurement, control and curtailment.
  - Is it necessary to measure the PV system separated for revenue reasons or can it be measured together with the wind farm?
- Fiber optic connection to SCADA or wind turbines
- Protection issues – liability disclaimer with wind turbine supplier.



5

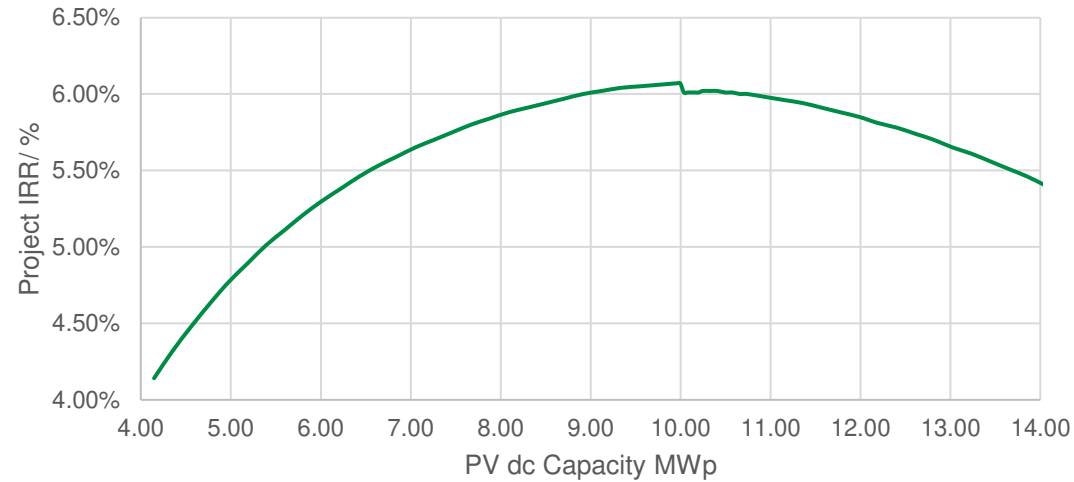
# Illustrative case – economic analysis





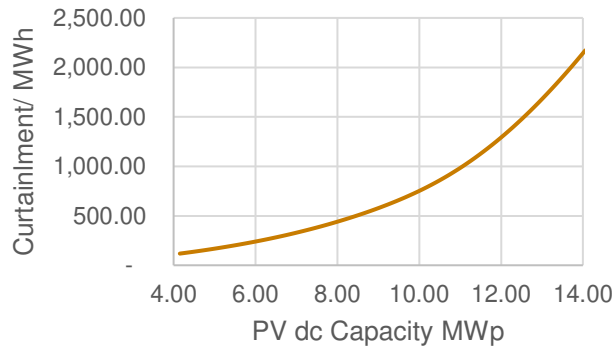
# PV Capacity and Curtailment Evaluation for illustrative case

### PV dc Capacity vs project IRR

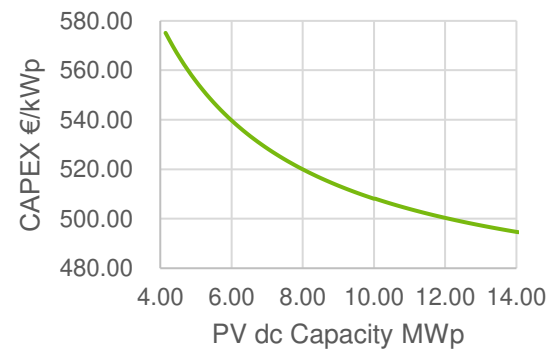


■ Best preliminary PV dc Capacity: 10 MWp

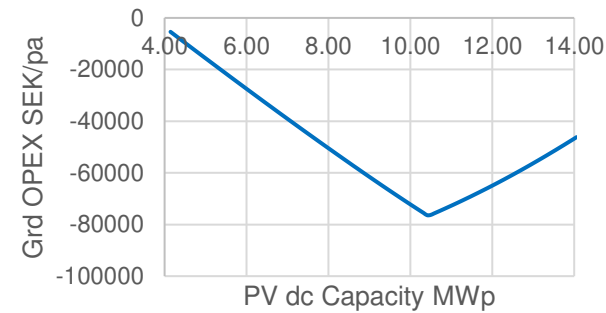
### PV Capacity vs Curtailment



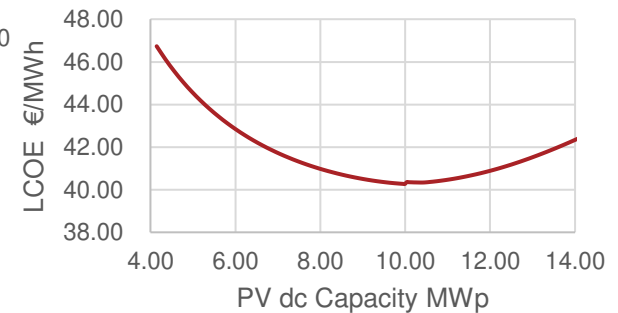
### PV dc Capacity vs CAPEX



### PV dc Capacity vs Grid OPEX SEK/pa



### PV dc Capacity MWp vs LCOE



■ Grid Opex includes also production from Wind Park



# Thank you!

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