ZCI Project Masterclass 4

Energy Storage Solutions of Renewable Energy

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ILMATAR

Katja Koponen
Director of Business Development

Ilmatar – a Nordic energy company and independent power producer

We are a Nordic energy company and an independent power producer, that focuses exclusively on renewable energy. The development, construction, ownership and maintenance of renewable energy, especially wind and solar power projects form the basis of our business. Taking responsibility over the whole value chain is a unique operating model for an energy company in Finland and Nordic countries.

We enable a more sustainable future!

Ilmatar is owned by funds managed by Omnes Capital and IWP Partners Oy.

1 GW renewable energy at production and construction stage

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In Operation

Humppila-Urjala

26 MW

NESTE BOREALIS

Kurikka

48 MW

NESTE BOREALIS

Joroinen

5 MW

Merchant

Alajärvi

221 MW

NESTE

Elias – 4 WPPs

134 MW

Merchant

Under Construction

Pahkakoski

186 MW

Confidential

Korpilevonmäki

43 MW

Mondelēz International

Advanced Stage

Project Goldeneye

450 MWp

Investment Portfolio

6 Projects

Late-stage to RTB

Growth examples beyond ~1.0 GW

Knihult

55 MWp

PPA to be negotiated

Late Stage

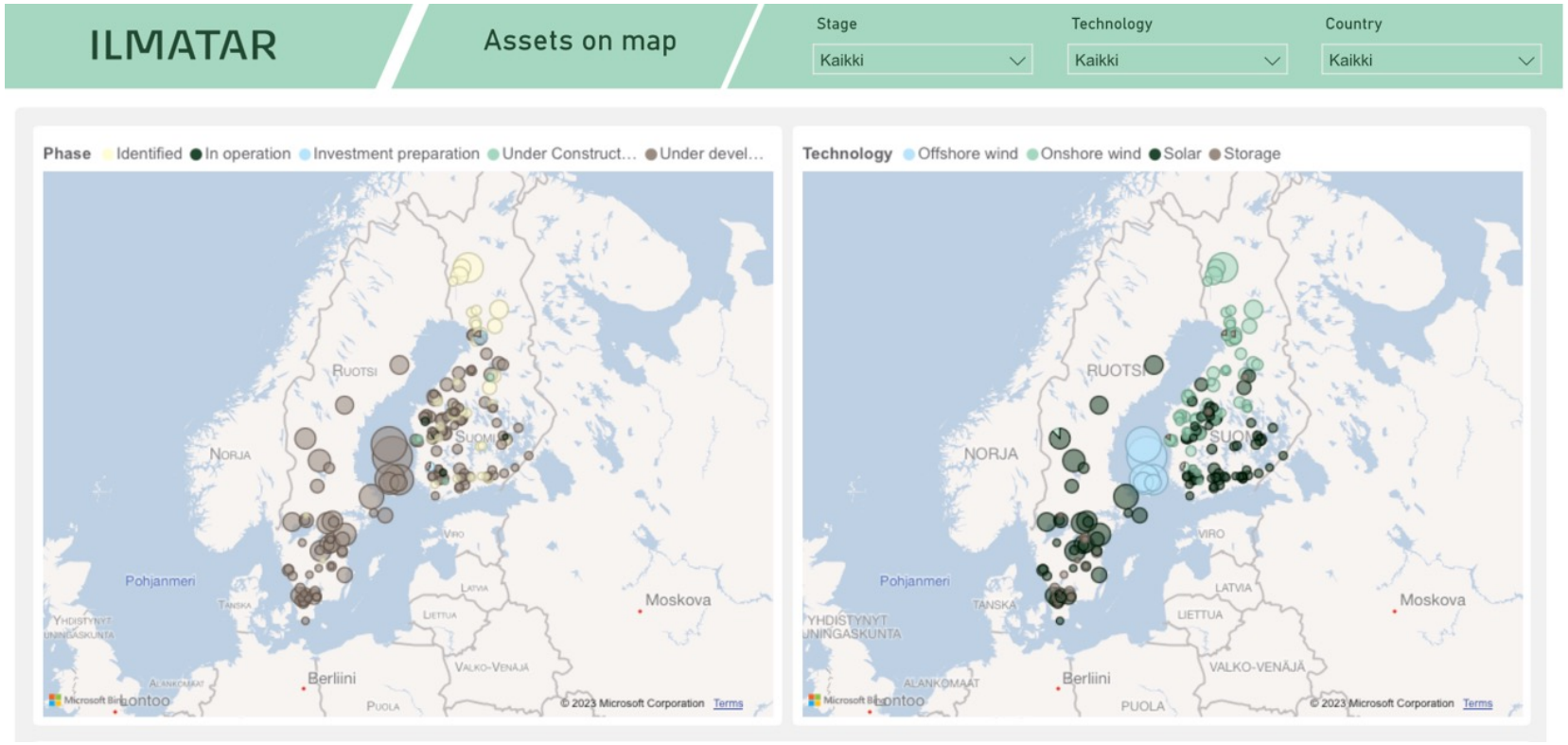
Ollinkorpi

75 MW

PPA to be negotiated

Late Stage

Project development portfolio



Pipelines in Finland & Sweden, MW

- On-shore wind 5 100
- Off-shore wind 11 700
- Solar PV 18 000
- Energy storage 900

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BESS Development

Why RES Based IPP Should Have BESSs?

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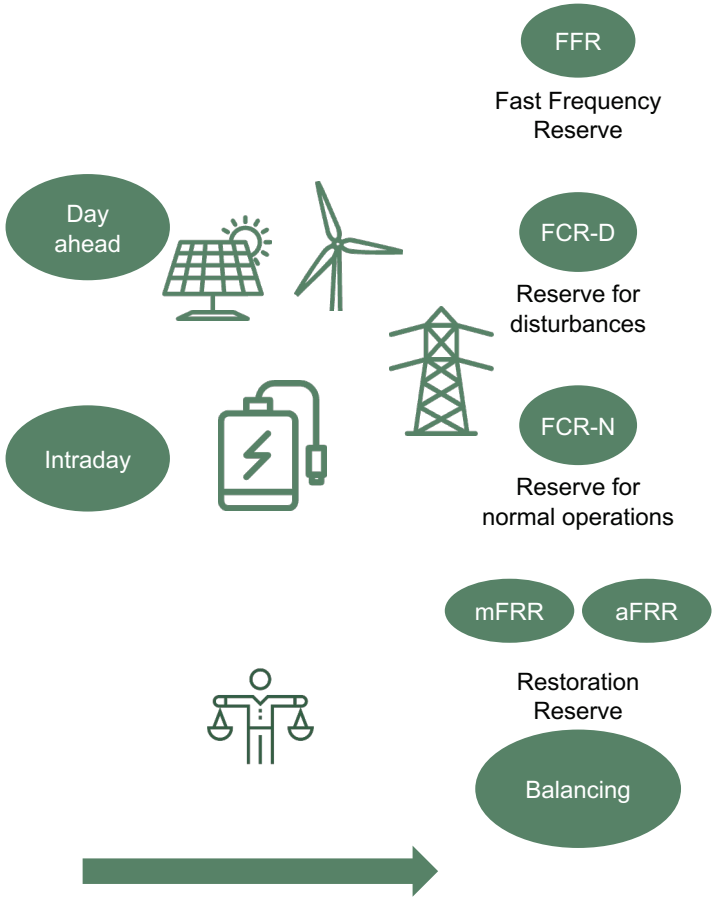
Multimarket and Co-Located Allocation Enables to Spread the Market Risks & Balance the Cash Flows

BESS can be Coupled with RES to Balance Production Profiles and Maximize Grid Usage

- Maximize value of produced energy
  - Peak shaving
  - Time shifting, spot arbitrage
- Lower grid costs
  - Opportunity to oversize RES production in connection point
  - Opportunity to assemble BESS to the grid without own grid connection agreement or own transmission infrastructure
  - Opportunity to utilize the solar PV connection point at the moments when solar production is low or in zero
  - System balancing done in local level decrease the grid tariffs and improves energy efficiency



Reserve and Balancing Markets are Currently the Preferred Revenue Stream for BESS

- A BESS can provide **ancillary services in the TSO grid,** participating in the reserve markets
- Out of the different marketplaces, especially suitable for BESS is the FFR due to lower competition from other technologies
  - other suitable marketplaces are the FCR-N, FCR-D up, FCR-D down, aFRR and mFRR markets
- Reserve markets are currently the preferred revenue stream for BESS actors and provide freedom in the geographical placement of the BESS
- A BESS is also able to **participate in arbitrage**, though it is seen as a secondary revenue stream currently

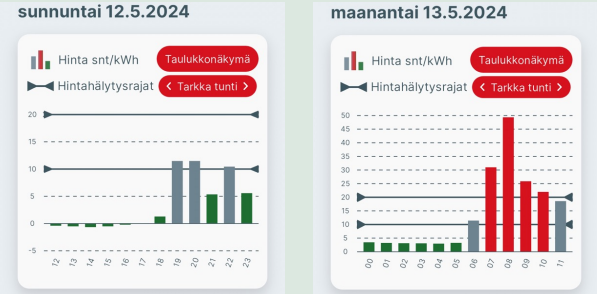
RES based power system value of markets is moving more and more towards balancing services

How Energy Storage Benefits EV Charging?

Case examples

Industrial level - Energy Storage at Production Site

- Industrial level storage solutions decrease the market price volatility
- When storages next to the highways, makes it possibility easily to build EV charging stations for heavy EVs (e.g. with 2 MW charging power)
- Makes it easier for EV chargers to forecast monthly / annual costs
- Charging prices in the future based on SPOT-prices (day-ahead prices)
- System prices decreased



Block house level – Energy Storage at Parking Area

- Microgrid systems: solar production, storage and consumption ”behind the same meter”
- Payback time easy to calculate
- Storage makes it possible to charge the storage at low price level and discharge from the storage to EVs when prices are high
- Time shifting: production at the daytime, consumption at the nighttime
- System prices decreasing, still quite high

Private house level – Energy Storage for Private Use

- Microgrid systems: solar production, storage and consumption ”behind the same meter”
- Storage makes it possible to charge the storage at low price level and discharge from the storage to EVs when prices are high
- Time shifting: production at the daytime, consumption at the nighttime
- System prices slowly decreasing, still high, payback time at the moment long
- Also EV V2G possibility to use at the private level easily

Development of Ilmatar BESS Portfolio

Brownfield / Retrofitted projects	Greenfield projects
Retrofitting BESSs to the already excisiting RES sites. Grid connection and substation excisting: • plug and play • fast access to markets • short development period	Add BESS to the solar PV, wind or hybrid projects already at project development stage. Project permitting and financing in one package. Project level optimization. Ensure also LDES project possibilities.

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Ilmatar BESS Pipeline

Ilmatar Co-location BESS Portfolio

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Finland

186 MW

74 MWp

87 MW

43 MW

90 MWp

Pahkakoski

50 MW / 100 MWh

Ypyrinneva

12 MW / 24 MWh

Västervik

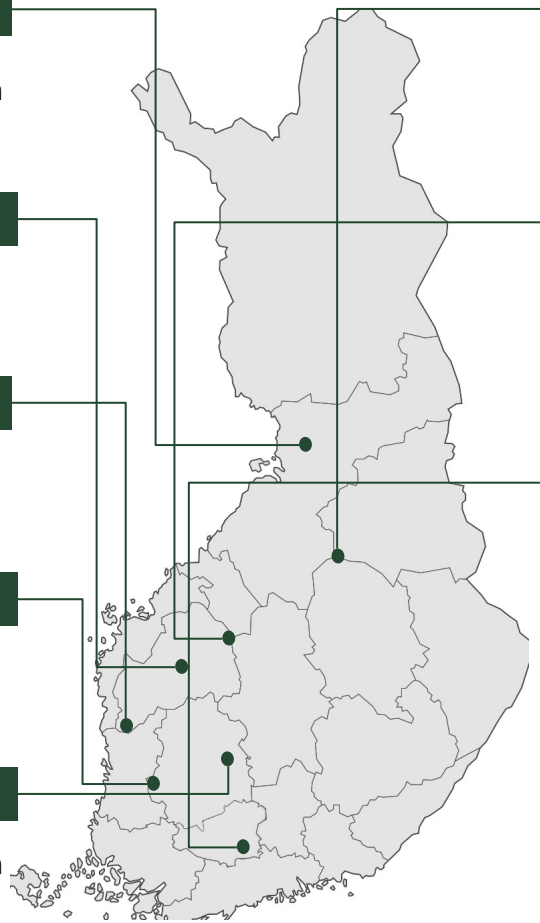
25 MW / 50 MWh

Korpilevonmäki

10 MW / 20 MWh

Juupajoki

50 MW / 100 MWh



Piiparinmäki

30 MW / 41 MWh

Co-owned with Nuveen Infrastructure

211 MW

Alajärvi

25 MW / 50 MWh

~100 MWp

221 MW

Riihiviita LDES opportunity

20 MW / 200 MWh

~40 MWp

BESS information 222 MW / 585 MWh 04/2024

Location	Decentralized spread around Finland
BESS type	Li-ion 2h and LDES
Grid connections	Secured & Shared grid connections with RES
Operational lifetime	At minimum 15 years

Ilmatar Sweden BESS Projects

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Motala Olivehult
100 MW / 200 MWh, 550 MW PV

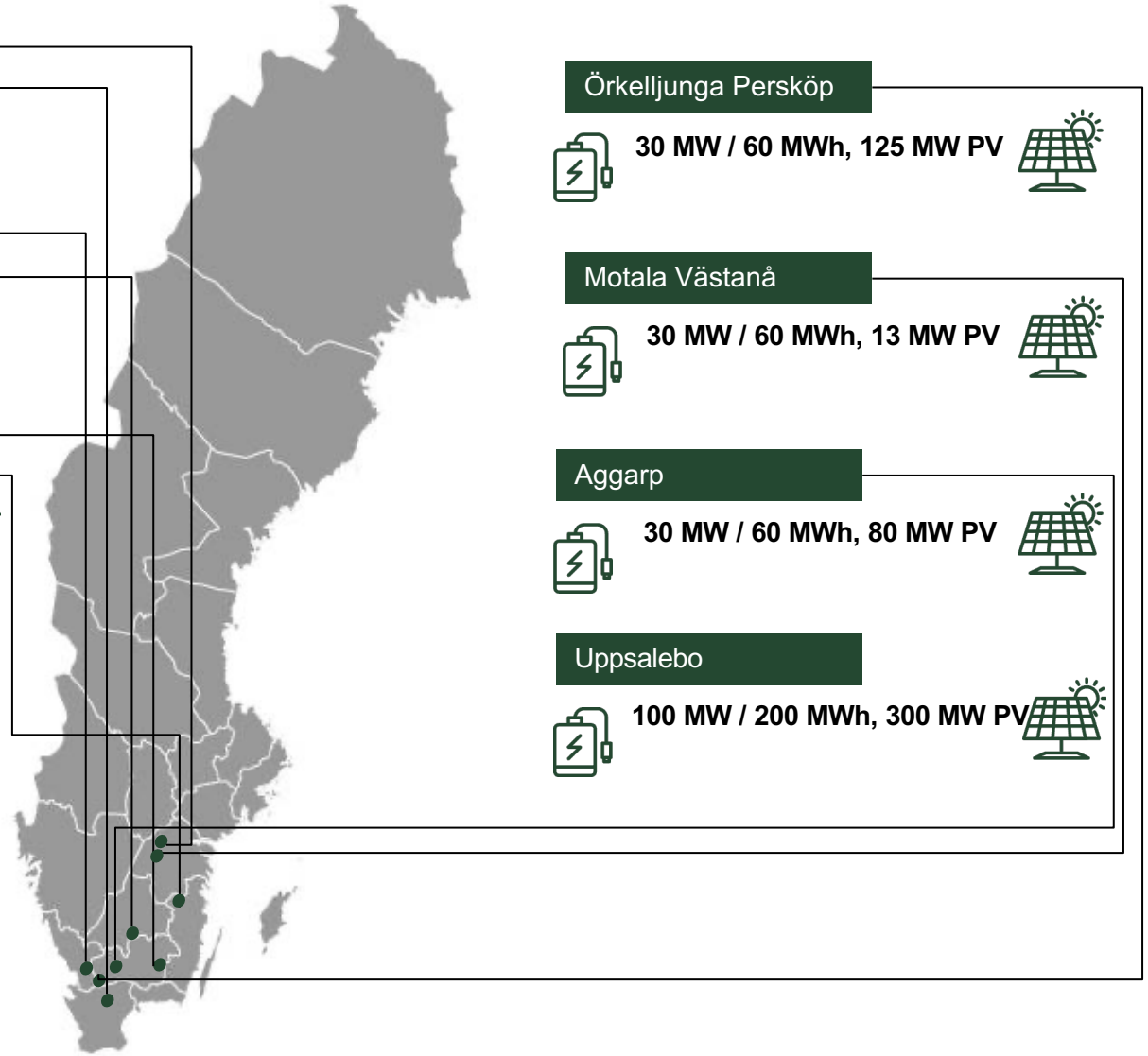
Hässleholm Angsholm
30 MW / 60 MWh, 140 MW PV

Halmstad Tönnersjö
90 MW / 180 MWh, 450 MW PV

Värnamo Horshult
30 MW / 60 MWh, 63 MW PV

Älmhult Äskya
100 MW / 200 MWh, 380 MW PV

Kinda Krutebo
30 MW / 60 MWh, 86 MW PV



Örkelljunga Persköp
30 MW / 60 MWh, 125 MW PV

Motala Västanå
30 MW / 60 MWh, 13 MW PV

Aggarp
30 MW / 60 MWh, 80 MW PV

Uppsalebo
100 MW / 200 MWh, 300 MW PV

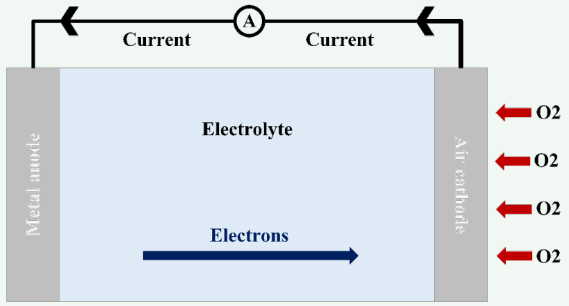
BESS information

Location	Focus area – SE3 and SE4
BESS type	2-hours battery with ancillary & spot arbitrage capabilities
Grid connections	In process and co-located with RES
Operational lifetime	At minimum 15 years

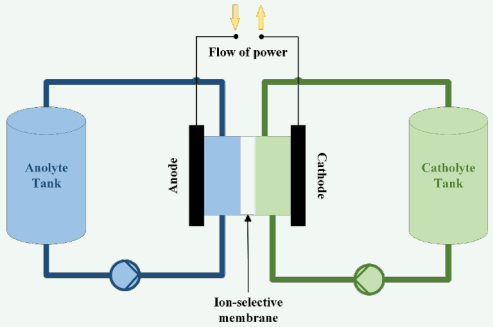
Next Generation of Energy Storage

Long Duration Energy Storage & System Integration

Chemical

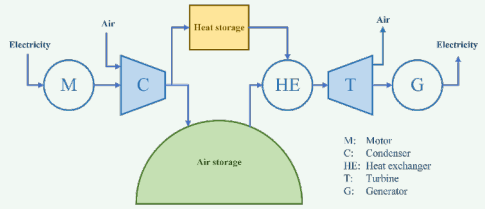


Metal-air Energy Storage

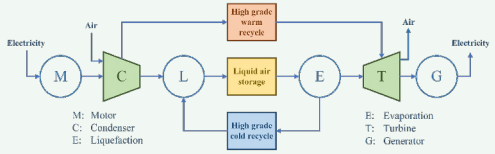


Redox flow Energy Storage

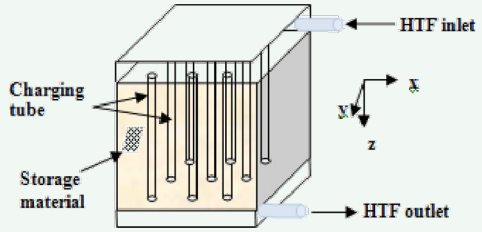
Non-chemical



Compressed-air Energy Stortage



Liquid-air Energy Storage



Thermal Energy Storage

Based on the reseach and analysing process Ilmatar has in-house capability to

enlarge energy storage project development, construction and market trading from current Li-ion BESS portfolio also to LDES technologies.

The 1st legally binding building permit for LDES has received 04/2024.

Location in Southern Finland, hybrid with solar PV and possibility to attach to the district heating pipeline.

Enlarging from Li-ion BESS also to other storage technologies enables ”deeper” energy storage and sector integration.

Compared e.g. to hydro / pumped hydro storages, these technologies are faster to develop, cheaper to build and flexible to locate

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Case Examples

Project Ainola Case Study: 30 MW BESS Project

30 MW BESS That will be Integrated to the Piiparinmäki Wind Farm

In Ainola, Ilmatar developed a 30 MW / 41 MWh battery energy storage solution that will be connected to an existing substation and wind farm. At signing (took place in 3/2023), a 90% shareholding in the SPV was transferred to Glennmont Ilmatar's role in Ainola going forward:

- Construction manager
- Technical and commercial manager once facility has been energized
- Asset operation (trading the asset to different markets) once COD has been reached
- Co-owner (10%) who will benefit from an earn-out linked to future performance of the asset

Key Information	
PPA	n/a
Debt	n/a
Technology	Containerised system (30 MW / 41 MWh) delivered by Alfen
Capacity	30 MW / 41 MWh
FID	2023
COD	Q2/2024
Owner	Glennmont Partners (90%), Ilmatar Energy (10%)

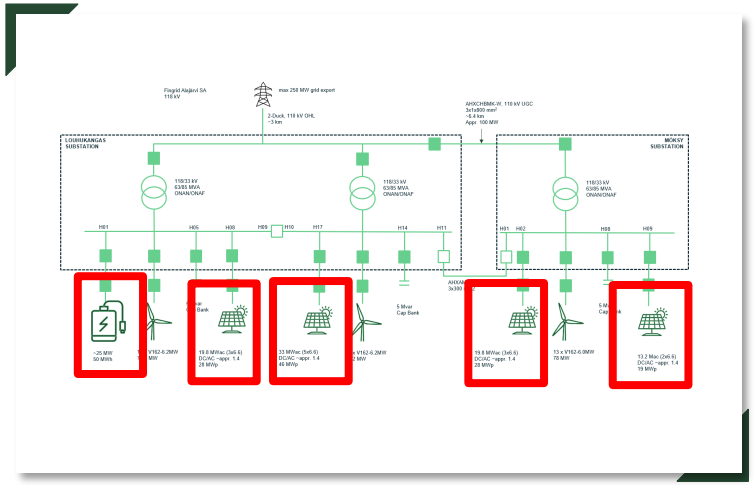
Timeline

2021	2022	2023	2024
IE and Glennmont begin discussion on developing a BESS to the Piiparinmäki wind farm area	IE handles permitting, develops business case and builds technical connection plan	All contracts and tendering finalised and construction works commence	

Sources: Company information

Alvar Case Study – A Pioneering Multi-technology Generation and Storage Hub

Developing our Flagship Site, Project Aalto, Into A Landmark Hybrid Project



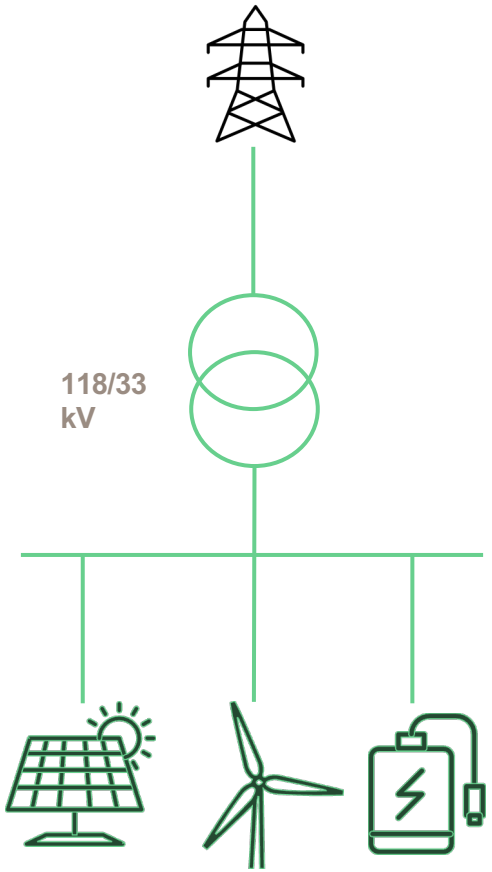
Key Information	
Technology	Full hybrid park (Wind, Solar, BESS)
Wind	*221 MW*
BESS	25 MW/50MWh
Solar	Möksy PV 1: 50 MWp Louhu PV 1 and Louhu PV 2: 100 MWp
Grid Connection	HV & MV grid infrastructure constructed as part of Project Aalto (2021-2023). Spare MV feeders and Möksy and Louhu substation can be utilized “as is” for BESS & PV interconnection. Including hybrid component to an existing wind farm sercures full utilization of already invested grid infrastructure. The production profiles of wind and solar well aligned for hybrid usage, component dimensioning can be followed with minimal solar power curtailment.
Control	Secure hybrid control optimizing production value
FID	Dec-2024 (Möksy PV 1, Louhu BESS) May-2024 (Louhu PV 1 and Louhu PV 2)
COD	Dec-2025 (Möksy PV 1, Louhu BESS) Jun-2025 (Louhu PV 1 and Louhu PV 2)

Timeline

2021-2023	*Project Aalto (Möksy 13 x 6.0 MW, Louhu 23 x 6.2 MW Vestas V162s), 110/33 kV substations and 110 kV grid constructed and brought to COD*
2022-2023	*Project Alvar* *Securing land leases* *Permitting* *Technical design* *Procurement* *Grid interconnection studies*
2024	*All Project Alvar permits legally valid and binding, construction contracts negotiated, technical interconnection study completed, financing, FID & construction start*

Notes:
1) Ilmatar illustration on SLD
2) Source: Möksy PV 1 permit visualisation material

Benefits of Hybrid Production Plant Project



Commercial

- Hybrid projects benefits from diversification via merchant exposure from different markets while enjoying stable PPA cash flows

Land Use Agreements

- Shared road use and cable route agreements
- Time saving in LLA processes compared to separate processes

Infrastructure and Grid Connection

- Shared use of in-park transmission cables
- Shared use of in-park sub-stations
- Maximum utilization of grid connections
- Shared use of roads

Loads and Load Management

- Different production profiles and intermitted production allows calculative over-loading
- Securing and management with hybrid controlling system

Permitting

- Time saving compared to separate projects
- Cost sharing in EIA- and master planning processes

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Thank you!