In the future it is more important WHEN you use electricity than how much



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Future energy system features:

• Security of Supply a limited resource • Energy a non limited resource



Solar more competitive in sunbelt, wind in North – in retail, solar compelling everywhere, also in the Nordics



NOTE: Solar and wind resources and CAPEX may largely vary by individual projects, even on same region, thus impacting LCOE. Hence, figures are indicative and LCOE assumptions: do not aim to present our geographical preferences for given technologies but rather illustrate progress of wind and solar globally, long-term

PV LCOE assumptions based on EU PV Technology Platform report and EU PVSEC 2015 paper. Wind CAPEX and OPEX Sweco: Incitamenten för investeringar i kraftproduktion, Capacity factors from BNEF LCOE low case. Indicative wind capacity factor for Russia from IFC Advisory: Services Russia's New Capacity-based Renewable Energy Support Scheme

- 7% real WACC
- CAPEX, OPEX globally uniform; lifetime solar 30y, wind 25y
- Assumption that capacity factor will increase for solar 7.5% and wind by 15% from 2016 to 2030
- 20% higher CAPEX for the rest of the world compared to low cost Nordic
- Uniform 20% corporate tax assumed



Managing seasonality creates challenges in Nordics Example of a single-family house

- Challenge:
 - Need to transfer 15,000 kWh energy from summer to winter
- This would mean:
 - 2,343 Tesla Powerwalls(6.4 kWh capacity, 3,000\$)
 - Investment of 7 million USD
 - Space needed 468 m³







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Energy and capacity balance in Germany 2015



Source: ENTSO-E Statistical Factsheet 2015, ENTSO-E Summer Outlook 2016, Fortum

25.05. 2015 at 03:00 (time) 36 146 MW





... but hourly prices were very different ! Price pattern is getting more important than average price



Source: Nord Pool Spot, Bloomberg Finance LP, Fortum

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MW	Installed capacity 31 Dec '14	Average Generation in March '14
Solar	38 500	4 450
Wind	39 200	6 170

Source: Electricity generation graph: Bruno Burger, Fraunhofer ISE, price curve: Bloomberg Finance LP, Wind capacity: EWEA, slide: Fortum



How can the Nordic countries continue to be successful?

- To be successful in the future, we need more:
- Hydro power
- Combined Heat and Power
- Wind / solar power
- Demand flexibility
- Batteries
- Nordic cooperation

- Can solve seasonality and intermittence Can solve seasonality Provides energy Can solve intermittence on a daily level
- Can solve intermittence on a daily level
- Can solve intermittence on a daily level and seasonality
- How well we handle the seasonality problem in the Nordic will in large scale define how competitive energy market we will have

