Changes in the energy system; future energy system in a large company point-of-view

Dr Heli Antila, CTO
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IEA has constantly failed in wind and solar scenarios (2016 wind 487 GW and solar 299 GW)
Battery technology costs have declined faster than estimated before

Target price for Tesla model 3 and GM Bolt battery storages

Source: Bloomberg New Energy Finance, 2016
Future energy system features:
- Security of Supply a limited resource
- Energy a non limited resource

- Clear Seasonality
- Wind most competitive
- Intermittent power

- Low seasonality
- PV most competitive
- Intermittent power
Solar more competitive in sunbelt, wind in North – in retail, solar compelling everywhere, also in the Nordics

World Solar and Wind LCOE’s using newest publicly available data


LCOE assumptions:
- 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

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 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:
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Solar more competitive and fits to seasonal demand

Wind more competitive and fits to seasonal demand


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Average power prices in Nordics and Germany were very close in December 2014 ...

Source: Nord Pool Spot, Bloomberg Finance LP
... but hourly prices were very different!
Price pattern is getting more important than average price

Volatility = 17.7 €/MWh
Volatility = 3.9 €/MWh

Source: Nord Pool Spot, Bloomberg Finance LP
Reality in Germany – and it is not getting easier
March 2014

Hourly power market price in Germany in March 2014

Electricity generation in Germany in March 2014

Source: Electricity generation graph: Bruno Burger, Fraunhofer ISE, price curve: Bloomberg Finance LP, Wind capacity: EWEA
We are putting our growth strategy to work

**Vision**
For a cleaner world

**Megatrends**
- Climate change and resource efficiency
- Urbanisation
- Active customers
- Digitalisation, new technologies

**Mission**
We engage our customers and society to drive the change towards a cleaner world. Our role is to accelerate this change by reshaping the energy system, improving resource efficiency and providing smart solutions. This way we deliver excellent shareholder value.

**Strategy**
- Drive productivity and industry transformation
- Grow in solar and wind
- Create solutions for sustainable cities
- Build new energy ventures
We are building smart and helpful services that give our customers peace of mind.

Our services will change our customers’ lives

- Solar panels
- Electricity retail
- Smart heating
- EV charging
- Virtual power plants
- Smart living solutions
- Insurances
We are pioneers in electric vehicle charging

Fortum Charge & Drive is a pioneer in electric vehicle charging.

Our network consists of 1,500 smart chargers in 11 countries
In Fortum’s groundbreaking VPP-pilot household loads are sold to balance the system in the Frequency Containment Reserve (N).
Fortum is building a Virtual Power Plant business for distributed demand-side resources, either b2c or b2b

- **Energy markets competence**
  - Hydro optimization
  - Market forecasts
  - 24/7 physical trading desk
  - Good position in Nordics

- **VPP**
  - The VPP-platform is a software solution to connect, monitor, optimize and control distributed loads and storages

- **Customer Access**
  - 1.3 million Nordic retail customers
  - Existing and developing customer offerings
  - Good contacts to major commercial, industrial and governmental counterparties in home markets
How to get best of district heating

- Waste recycling, further processing and finally fuel
- Excess heat from data centers
- From steering to controlling heat with Fortum Heat pilot
- District heat demand response
- Higher value of biomasses before energy use
- Cooling solutions
**Fortum HorsePower – example of internal start-up**

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>New bedding and manure service for horse stables</td>
<td>The customer chooses a bedding material – regular deliveries</td>
</tr>
<tr>
<td>New solid biofuel to internal and external customers</td>
<td>Regular manure pick-up</td>
</tr>
<tr>
<td>Sawdust</td>
<td>Transport and feeding to plant process</td>
</tr>
<tr>
<td>Cutter shavings</td>
<td></td>
</tr>
<tr>
<td>Wood pellets</td>
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We will invest in start-ups focusing on energy-related technologies. Our goal is to be in the forefront of energy technology and application development.

We have therefore teamed up with the software agency Futurice to embark on a new kind of cooperation that combines our expertise in solar energy and Futurice’s expertise in software design.

(The image is from TRINE and our cooperation on a solar power project in Sidonge, Kenya).
Or is it all about culture to be able to grow instead of shrink?

**“Avoidance focus”**

- Stay safe
- Risk aversion: worry about everything that can go wrong
- Alert to avoid loss and failure
- Stick to what you have and try to preserve current conditions
- Work slowly & methodically and pay attention to details
- Usually not extremely creative but very analytical and good problem solvers
- Prepare for the worst

**“Achievement focus”**

- Play to win
- Usually see their targets forming a path towards success and opportunities
- Like to work and make progress quickly
- Consider a large amount if ideas
- Risk taking
- Think creatively
- Often extremely optimistic
- Focus on new opportunities

Join the change!