Electricity market developments in Nordic/Baltic and Russia

Tallinn, 30.9.2015
Simon-Erik Ollus, Chief Economist, Fortum
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Summary

• Nordic and Baltic power market a pioneer in power market development: Affordable power prices, low emissions, good security of supply

• Multiple demands on power market going further: Technological development, decarbonisation, renewables, consumer behavior and digitalization changes the scene

• Strong growth of subsidized RES and poor power demand has decreased power prices to unsustainable low levels.

• Consumer plays an increasingly important role. And the Electricity market need to incentivize them to be active.

• The Russian Power Market reform was the World’s largest single power market reform and completed by end of 2010. Russian power market consist of two markets, one for energy and one for capacity

• Russian heat sector reform started enabling Russia to decrease energy intensity of its economy
Content

• Summary

• **Fortum briefly**
  - Nordic & Baltic energy markets and challenges
  - Russian energy markets and challenges
Our current geographical presence

**Nordic countries**
- Power generation: 48.0 TWh
- Heat sales: 3.3 TWh
- Electricity customers: 1.3 million

**Russia**
- OAO Fortum
  - Power generation: 23.3 TWh
  - Heat sales: 26.0 TWh

**Poland**
- Power generation: 0.7 TWh
- Heat sales: 3.4 TWh

**Baltic countries**
- Power generation: 0.7 TWh
- Heat sales: 1.2 TWh

**India**
- Power generation: 9 GWh

**Key figures 2014**
- Sales: EUR 4.1 bn
- Comparable operating profit: EUR 1.1 bn
- Balance sheet: EUR 21 bn
- Personnel: 8,200
Fortum's carbon exposure among the lowest in Europe

Note: Fortum's specific emissions of the power generation in 2014 in the EU were 39 g/kWh and in total 177 g/kWh.
Only European generation except “Fortum total” which includes Russia.

Source: PWC & Enerpresse, December 2014
Climate Change and Electricity, Fortum

EU 2050 target is about 20 g CO₂/kWh for electricity generation
Towards solar economy

Traditional energy production
Exhaustible fuels that burden the environment

Advanced energy production
Energy efficient and/or low-emission production

Solar Economy
Solar based production with high overall system efficiency

High Efficiency

Low Efficiency

High Emissions

Emission free

Solar
Wind
Hydro
Ocean
Geothermal
Bio

Nuclear today
Nuclear tomorrow

CHP
CCS

Interconnectors
Active Consumer
Smart applications
Demand Response
Storage

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Content

• Summary

• Fortum briefly

• Nordic & Baltic energy markets and challenges

• Russian energy markets and challenges
Nordic market the pioneer in power market liberalisation and regional electricity markets. Nord Pool market was created in 1993, today 7 countries involved

- Nordic electricity market is the outcome of far-sighted and determined cooperation
- Today the market covers seven countries

Source: Fortum
Excellent generation mix in the Nordic and Baltic countries
Over a half of power generation is flexible hydropower

TWh

<table>
<thead>
<tr>
<th>Country</th>
<th>Fossil fuels</th>
<th>Nuclear</th>
<th>Biomass</th>
<th>Wind</th>
<th>Hydro *</th>
<th>Total generation in 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWh</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TWh %</td>
</tr>
<tr>
<td>Denmark</td>
<td>16</td>
<td>23</td>
<td>13</td>
<td>23</td>
<td>53</td>
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<tr>
<td>Norway</td>
<td>16</td>
<td>23</td>
<td>13</td>
<td>23</td>
<td>53</td>
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<tr>
<td>Sweden</td>
<td>16</td>
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<td>Finland</td>
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<tr>
<td>Baltic</td>
<td>16</td>
<td>23</td>
<td>13</td>
<td>23</td>
<td>53</td>
<td>383</td>
</tr>
</tbody>
</table>

Nordic net export in 2013: 0.4 TWh
Baltic net import in 2013: 4.8 TWh

* Normal annual Nordic hydro generation 200 TWh, variation +/- 40 TWh

Source: ENTSO-E Statistical Factsheet 2013
The Nordic countries have one of the world’s lowest CO₂ emissions levels. Average emissions are only 80 g CO₂/kWh.

Electricity generation’s specific CO₂ emissions, gCO₂/kWh in 2011.

EU 2050 target is about 20 g CO₂/kWh for electricity generation.
Nordic power market structure; classical structure regulated transmission and distribution systems, while competitive wholesale and retail markets

- **Competitive businesses**
  - Generation
  - Export, import, market coupling
  - Power exchanges and bilateral
  - Retail companies
  - Private customers, small businesses

- **Regulated businesses**
  - Transmission and system services
  - Distribution
  - Large customers
  - Independent transmission system operator
  - Independent distribution company

NordpoolSpot = Day ahead and Intraday market
Nasdaq = Financial market
Nordic wholesale markets consists in fact of several market places

- Financial Forwards
  - Managed by Nasdaq Commodities

- Day Ahead
  - Elspot
  - Managed by Nord Pool Spot

- Intra Day
  - ELBAS
  - Managed by Nord Pool Spot
  - Balancing market
    - Managed by TSOs

- Balance settlement, Imbalance Power
  - Managed by TSOs

- Markets for energy
  - 10 years...1d
  - 36...12 h
  - 33...1 h
  - Energy 12h ...0.5h
  - Capacity 10a...1d

- Markets for flexibility
  - 10 years...1d
Price formation in Nordic power market – hydropower utilized based on flexibility and marginal price view

![Diagram showing energy sources and variable production cost](image)

- **Hydro & wind power**
- **Industrial CHP**
- **Nuclear**
- **Coal condense**
- **CHP**
- **Gas turbines**
- **Gas & oil condense**

Supply
- Normal hydro balance

Demand
- Annual Demand (about 390 TWh)

Price
- Normal hydro balance

Variable production cost

Hydro power variation ± 30 TWh

- **Warm winter**
- **Cold winter**

Price formation in Nordic power market – hydropower utilized based on flexibility and marginal price view.
Nordic power price forecasting is dependent on several factors
Success in production optimization requires mastering the complexity of the Nordic power market

* Global economy affects both power demand (industrial activity in Nordics) and price of fuels
Precipitation in the Nordic system can fluctuate by ca. 80 TWh/a. This is equivalent to total Finnish demand and ca. 20% of the Nordic consumption.
Nordic, Baltic, Continental and UK markets are integrating – interconnection capacity will double by 2021

The Northern Seas Offshore Grid and the Baltic Energy Market Integration Plan are included as priority electricity corridors in EU’s Infrastructure Guidelines, approved in April 2013

New interconnections will double the export capacity to over 10,000 MW by 2021

New internal Nordic grid investments provide for increased available capacity for export to the Continent and Baltics

EU’s Connecting Europe Facility co-financing 3rd EE-LV transmission line, due to be ready by 2020

EU’s European Energy Programme for Recovery co-financing 700 MW NordBalt (ready 12/2015)

LitPol Link (500+500 MW) to connect the Baltic market to Poland by end-2015/20. It will open a new transmission route from the Nordic market to the Continent

Svenska Kraftnät agreed 3/2014 with 50Hertz to study a new Hansa PowerBridge DC link between Sweden and Germany

Two 1400 MW NO-UK links as EU Projects of Common Interest: NSN link to England agreed to be ready in 2021, NorthConnect to Scotland still requiring Norwegian permission

First direct 1400 MW NO-DE link contracted to be built by end-2019

New 1000-1400 MW DK-UK Viking Link not yet decided, but planned to be built by end-2020/2022

EU financial support for a 700 MW DK-NL link, due to be built by 2019

Jutland – DE capacity planned to grow by 860 MW by 2020, with further 500 MW increase by 2022

New 400 MW Zealand – DE Kriegers Flak connection by 2019

New interconnectors
New Nordic lines
Existing interconnectors
Market coupling milestones
- cross-border power flows optimised by power exchanges

- Market coupling between NL, BE and FR since 2006
- Market coupling for Central Western Europe (DE, FR, NL, BE) since 11/2010 with a continued coupling with Nord Pool Spot
- Poland coupled with Nord Pool Spot since December 2010
- NorNed (NO-NL) and BritNed (UK-NL) included in 2011
- Estonian price area in Nord Pool Spot since 2010 and Lithuanian area since 6/2012. Latvia joined in June 2013
- Czech, Slovakia and Hungary coupled together since September 2012. Romania joined in November 2014
- A common day-ahead market coupling for the whole north-western Europe was started in February 2014. Iberia (Spain & Portugal) joined in May 2014. Italy and Slovenia joined in February 2015
- Flow-based cross-border capacity allocation for further trade optimisation taken into use in May 2015 for the CWE region
- Lithuania-Poland (LitPol Link) coupling to start by end-2015
- CEE (Central Eastern Europe) market coupling region to join in 2017. Switzerland waiting for agreement with the EU
- In addition to day-ahead coupling, intraday market coupling and balancing market integration under development as well
Multiple demands on power market going further:
Technological development, decarbonisation, renewables, consumer behaviour and digitalization changes the scene

Demands on power markets

Yesterday

- Competitive electricity price
- Generation adequacy on national level

Today and in the future

- Competitive electricity price and generation adequacy on regional level
- CO₂-free power generation
- Increased RES generation
- Integrate intermittent generation
- Active consumer and increased DES
- Digitalisation, improved customer offerings and DSM opportunities
In Europe renewable power has been rapidly growing due to a variety of support mechanisms.

**EU 28 Generation mix forecast by technology**

**EU renewables targets**

- **Renewables % share**
  - 2010: 21%
  - 2020: 27%
  - 2030: 45%
  - 2040: 52%
  - 2050: 60%

- **RES-e in total electricity generation (estimations for 2020 and 2030)**
  - 2020 Target: 36%
  - 2030 Proposed target: 45%

- **RES in final energy consumption**
  - 2010 Actual: 12.5%
  - 2020 Target: 21%
  - 2030 Proposed target: 27%

Sources: DG Energy, Transport and GHG Emissions Trends to 2050, European Commission, 2013; European Environment Agency

http://www.eea.europa.eu/
German weather-dependent capacity above peak consumption

Balancing the system is challenging, but plants struggle to make profits due to oversupply

Sources: Bundesministerium für Wirtschaft und Energie, Eurelectric, Tenet, Fortum estimates
Average power prices in Nordics and Germany were very close in December 2014 …

Price = 32.4 €/MWh
Price = 31.5 €/MWh

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

Nordic (hourly Nord Pool spot system price)
German (hourly EPEX spot price)

December 2014
But power demand has been declining in recent years...

**TWh**

**Annual electricity consumption in Germany**

![Graph showing annual electricity consumption in Germany with a trendline indicating a decrease of approximately 10%.]

**TWh**

**Annual electricity consumption in the Nordics**

![Graph showing annual electricity consumption in the Nordics with a trendline indicating a decrease of approximately 3%.]

Source: Fortum Industrial Intelligence, ENTSO-E. Note, the consumption figures are the actual figures, not adjusted to normal temperature.
...while supply has been growing, driven by subsidised renewables

**Total supply and share of subsidized renewable energy in Germany**

- **2010**: 13% Subsidized RES (Wind, solar and biomass), 87% Other supply
- **2014**: 23% Subsidized RES (Wind, solar and biomass), 77% Other supply
- **Est. 2020**: 29% Subsidized RES (Wind, solar and biomass), 71% Other supply

**Total supply and share of subsidized renewable energy in the Nordics**

- **2010**: 10% Subsidized RES (Wind and biomass), 90% Other supply
- **2014**: 13% Subsidized RES (Wind and biomass), 87% Other supply
- **Est. 2020**: 21% Subsidized RES (Wind and biomass), 79% Other supply


Disclaimer: The presented future development is based on Markedskraft analysis, and does not represent a Fortum view on the development.
…and today the market is notably oversupplied and consequently power prices have declined

Power prices have declined by ~40% since 2011 and even ~60% since 2008

Source: Bloomberg
Current market conditions favour coal-fired generation over gas.
Poor power demand and generous subsidies undermine the commercial generation’s profitability.

Source: Bloomberg, August 2014
Levelized cost of electricity in Europe
Current market prices hardly justify any investments into new generation

The levelised cost shows the achieved electricity price required for an investment to break even over the lifetime of the project.

Disclaimer: The presented figures do not represent Fortum’s own view on the levelised costs of electricity. The figures are based on recent external publications. Key assumptions: real discount rate 5%, corporate tax 20%. Overnight costs, €/kW 5400 for nuclear, 747 for gas, 2304 for coal, 1269 for onshore wind, 3400 for offshore wind, 2700 for hydro, 975 for ground mounted solar. Peak load factor for ground mounted solar 19%; for onshore wind 27%; for offshore wind 34%, for large hydro 40%, for nuclear, gas and coal 91%. Economical lifetime: 30 years for solar, 40 years for nuclear and hydro, 25 years for others. Fuel prices are the market forward prices as of August 2015 extended by applying inflation of 2%. Note, there are large variations in cost of hydro, wind and solar depending on location and conditions.

Sources:
1. World energy council 2013, Cost of energy technologies
2. European PV Technology Platform Steering Committee, PV LCOE working Group: PV LCOE in Europe 2014-30, Final report
3. IRENA: Renewable power generation costs in 2014
Abundance of subsidies a challenge for the efficiency of the electricity market in Europe

Existing and planned capacity mechanisms in Europe:

Several countries are considering capacity markets
- to support the competitiveness of flexible generation and
- to drive new investments

Source: Fortum
The poor market conditions have triggered capacity withdrawal

~4 GW of early capacity withdrawal announcements in Nordic area during last half a year

<table>
<thead>
<tr>
<th>Date</th>
<th>Announcement Details</th>
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</thead>
<tbody>
<tr>
<td>June 2015</td>
<td>No license application for TVO’s Olkiluoto 4</td>
</tr>
<tr>
<td>June 2015</td>
<td>E.ON proposes not to resume production at O2 (661MW) and to close O1 (492MW) in 2017–2019</td>
</tr>
<tr>
<td>June 2015</td>
<td>PVO’s Kristiina (242MW) and Tahkoluoto (235MW) coal-condense mothballed</td>
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<tr>
<td>June 2015</td>
<td>Helen’s new bio CHP project (200 MW) put on hold and renovation of Hanasaari coal CHP plant cancelled; instead separate heat-only solutions</td>
</tr>
<tr>
<td>April 2015</td>
<td>Vattenfall to close Ringhals 1 (878MW) and 2 (865MW) between 2018-20</td>
</tr>
<tr>
<td>April 2015</td>
<td>Kanteleen Voima’s Haapavesi peat (160MW) and Tampereen Energiantuotanto’s Naistenlahti 1 gas-CHP (129MW) to capacity reserve</td>
</tr>
<tr>
<td>Nov 2014</td>
<td>Vattenfall not to upgrade Forsmark 3 (1170 MW) to 1340 MW</td>
</tr>
<tr>
<td>June 2014</td>
<td>Lietuvos Energija closed 2x150 MW gas units in Q1 2015 and closing 2x300 MW by 2016</td>
</tr>
<tr>
<td>April 2014</td>
<td>Naturkraft’s (Statoil &amp; Statkraft) Kårstø (420 MW) gas CCGT plant mothballed</td>
</tr>
</tbody>
</table>

In Germany, ~7 GW confirmed for closure by end 2018

- 4.9 GW closed since Jan-2014 (’14 =2.4 GW, ’15 ytd = 2.5 GW including 1.3 GW nuclear)
- 6.5 GW confirmed for closure by Dec-2018 (including 1.3 GW nuclear in end 2017)
- 11.9 GW waiting for permission to close (4.8 GW of which temporary/seasonal only)

Source: Fortum Industrial Intelligence, Bundesnetzagentur
Electricity wholesale price has dropped in recent years while retail price has climbed

Nordic wholesale and end-consumer prices in 2000-2014, €c/kWh:

Increased taxes, grid charges and subsidies have raised the price consumers pay for electricity

Source: Nord Pool Spot, Eurostat
Electricity retail market in transition – better utilisation of digitalisation needed

Consumer plays an increasingly important role

**Sizeable investments in smart meters and smart grids in all Nordic countries**

- Major opportunities in new, smart services
- Increasing demand-flexibility improves security of supply
- Reduces consumer costs

**All Nordic countries to transition to a retailer-centric market model**

- One interface and bill for the consumer
- More efficient data hubs
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• Fortum briefly

• Nordic & Baltic energy markets and challenges

• Russian energy markets and challenges
Russia is the World’s 4th largest power market

Power generation in 2014 based on gross output.
Source: BP Statistical Review of World Energy June 2015
Fortum has long experience of co-operation with the Soviet Union and Russia

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Construction of hydro power plants in Kola area</td>
<td>Electricity import to Finland</td>
<td></td>
<td></td>
<td>Construction of North-West CHP in St. Petersburg</td>
<td>Agreement on Joint Implementation of Kyoto Protocol with TGC-1</td>
<td>Executing of 2400 MW CSA investments in OAO Fortum (6 plants ready out of 8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nuclear fuel import to Finland*</td>
<td>Automation &amp; information system deliveries to thermal power plants</td>
<td>Safety improvements for nuclear power plants</td>
<td>Hydro refurbishments</td>
</tr>
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<td>Permanent presence in Moscow &amp; St. Petersburg</td>
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</table>

*) Including single largest purchase agreement of uranium with TVEL
The Russian Power Market reform was the World’s largest single power market reform and completed by end of 2010

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>Transition al model of electricity markets.</td>
</tr>
<tr>
<td></td>
<td>Launch of the current electricity markets model.</td>
</tr>
<tr>
<td></td>
<td>Only volumes deviating from the expected power balance were traded at market prices.</td>
</tr>
<tr>
<td>2006</td>
<td>Start of deregulation of the traded electricity volumes.</td>
</tr>
<tr>
<td>2007</td>
<td>Launch of the capacity market transitional model.</td>
</tr>
<tr>
<td></td>
<td>Start of deregulation of the traded capacity volumes.</td>
</tr>
<tr>
<td>2008</td>
<td>Adoption of the target capacity market rules.</td>
</tr>
<tr>
<td></td>
<td>Launch of the system services market.</td>
</tr>
<tr>
<td></td>
<td>Start of the electricity futures trading.</td>
</tr>
<tr>
<td>2010</td>
<td>All purchased/sold volumes are supplied at unregulated prices, except for supply to households and consumers of some regions.</td>
</tr>
<tr>
<td></td>
<td>Launch of the target capacity market model.</td>
</tr>
<tr>
<td>2011</td>
<td>Launch of RES support model.</td>
</tr>
<tr>
<td></td>
<td>• Heat market reform</td>
</tr>
<tr>
<td></td>
<td>• Gas prices liberalisation</td>
</tr>
<tr>
<td></td>
<td>• Development of the capacity market rules</td>
</tr>
</tbody>
</table>

### Day-ahead (spot) market

<table>
<thead>
<tr>
<th>Year</th>
<th>Deregulation of electricity volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>5-10%</td>
</tr>
<tr>
<td>2008</td>
<td>15-25%</td>
</tr>
<tr>
<td>2009</td>
<td>30-50%</td>
</tr>
<tr>
<td>2010</td>
<td>60-80%</td>
</tr>
<tr>
<td>2011</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Capacity market

<table>
<thead>
<tr>
<th>Year</th>
<th>Deregulation of capacity volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Fortum Industrial Intelligence
Ownership structure in Russian power industry

- The Russian electricity monopoly RAO UES ceased to exist 1 July 2008
- Transmission and distribution stayed natural monopolies
- Generation and sales activities were unbundled into competitive businesses
- Nuclear and large hydro power remained state-owned
- WGCs operate country wide (incl. E.ON.Russia and Enel Russia)
- TGCs are regional companies (incl. OAO Fortum)
- WGCs and TGCs have been privatized
- National interests have been carefully considered

Ownership structure in 2014

<table>
<thead>
<tr>
<th>State (direct ownership*)</th>
<th>Rugrids: transmission companies (FGC, IDGCs)</th>
<th>85%</th>
<th>System Operator</th>
<th>100%</th>
<th>Nuclear</th>
<th>100%</th>
<th>Hydro</th>
<th>67%</th>
<th>Inter RAO UES</th>
<th>30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other shareholders</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td>33%</td>
<td></td>
<td>70%</td>
<td></td>
<td>100%</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<td>100%</td>
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<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

FGC = Federal Grid Company
IDGC = Interregional Distribution Grid Company
WGC = Wholesale Generation Company
TGC = Territorial Generation Company

* Ownership through Federal Agency for State Property Management

Source: websites of related companies, Fortum Industrial Intelligence
Fortum - a major player in Russia

**OAO Fortum (former TGC-10)**
- Operates in the heart of Russia’s oil and gas producing region, fleet mainly gas-fired CHP capacity
- 23 TWh power generation, 26 TWh heat production in 2014
- Investment programme to add 85%, almost 2,400 MW to power generation capacity

**TGC-1**
- 29.5% of territorial generating company TGC-1 operating in north-west Russia
- ~7,200 MW electricity production capacity (more than 40% hydro), ~24 TWh electricity, ~28 TWh heat in 2014
Extensive investment programme in OAO Fortum nearly finished – 2 units still to be commissioned

- Total amount of investments EUR 2.5 billion
  - Of which approximately EUR 0.2 billion still to be invested as of April 2015
- Increasing capacity by ~ 85% by the end of 2015
- Six units commissioned
  - Nyagan 3 was commissioned in October 2014 and started commercial operations in January 2015
- Two new units in Chelyabinsk during H2/2015

![Graph showing MW comparison between 2010 and 2015](image)
Fortum invests in CHP, with clear advantages compared to condensing power production

Combined heat and power production (CHP) is more efficient than separate production

**CHP production**
- CHP Plants (co-generation)
  - Fuel: 100
  - Electricity: 25
  - Heat: 50
  - Loss: 25

**Separate production**
- Condensing plants
  - Fuel: 100
  - Electricity: 17
  - Heat: 46
  - Loss: 37

Boiler house
Fortum invests in the most efficient CCGT (combined-cycle gas turbine) generation in Russia, using fuels more efficiently and providing additional margin for new capacity.

Major part of power plants in Russia are very obsolete and inefficient;
Investor which builds the new efficient equipment has a better margin than the owner of the old plants;
Fortum is long term committed to Russia and delivers resource efficient solutions – Russia diversifies our portfolio

• **The power market reform:**
  – World’s largest single power market reform
  – Successful inflow of private capital into energy sector
  – Implementation of large-scale investment program and refresh of equipment stock

• **Russian power and heat markets:**
  – Wholesale spot market functions pretty well today
  – Financial market has started, but must be developed further in order to allow both buyers and sellers to hedge long term
  – Retail market still regulated
  – Heat sector reform started enabling Russia to decrease energy intensity of its economy
Summary

- Nordic and Baltic power market a pioneer in power market development: Affordable power prices, low emissions, good security of supply
- Multiple demands on power market going further: Technological development, decarbonisation, renewables, consumer behavior and digitalization changes the scene
- Strong growth of subsidized RES and poor power demand has decreased power prices to unsustainable low levels.
- Consumer plays an increasingly important role. And the Electricity market need to incentivize them to be active.
- The Russian Power Market reform was the World’s largest single power market reform and completed by end of 2010. Russian power market consist of two markets, one for energy and one for capacity
- Russian heat sector reform started enabling Russia to decrease energy intensity of its economy
Thank you