

Towards Solar Economy

Introduction to Fortum's activities and ideas in Solar Economy

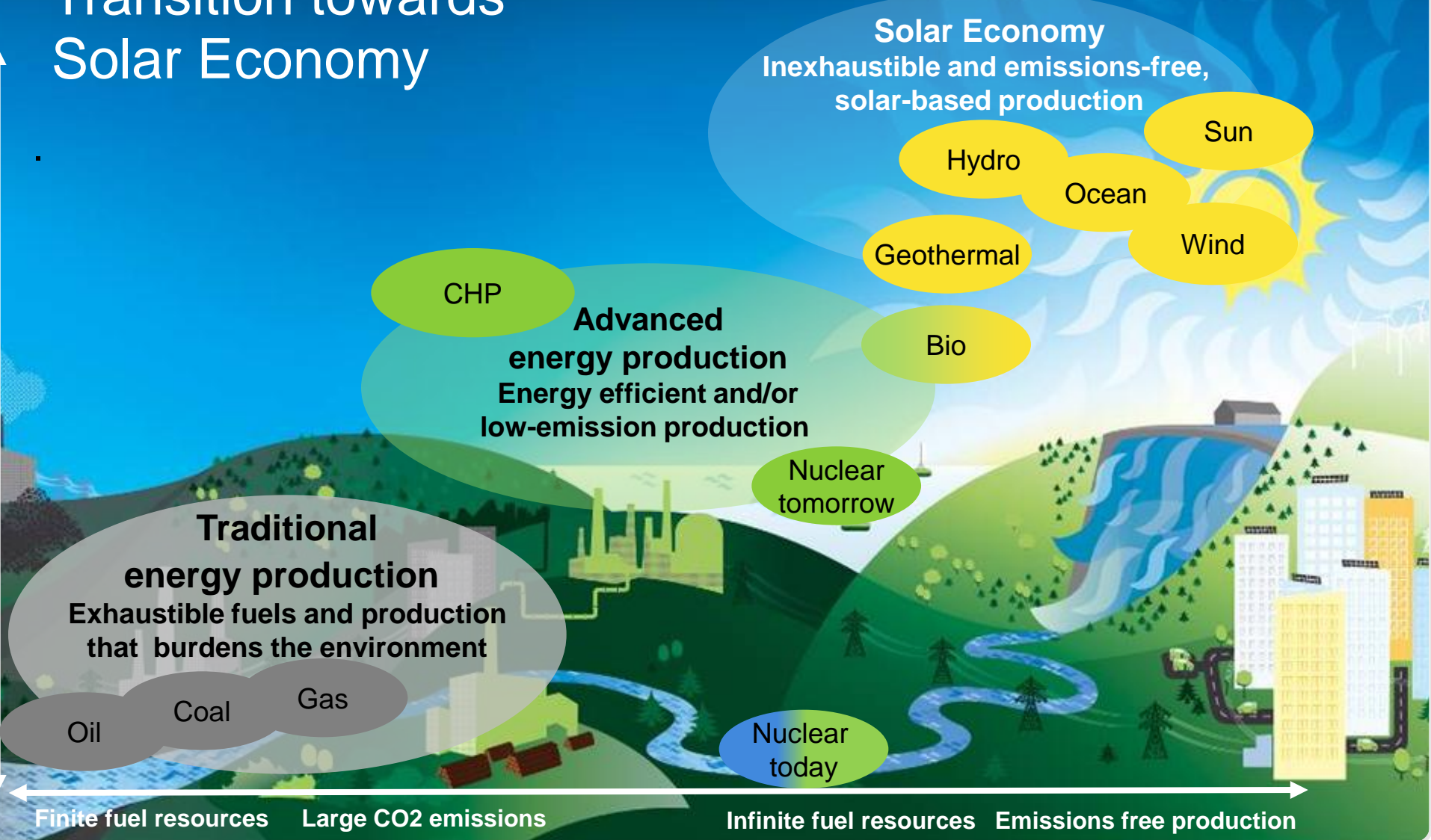
Presentation at Atomexpo, Moscow, 4 June 2012

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Transition towards Solar Economy

High
Resource & system efficiency
Low



Finite fuel resources

Large CO2 emissions

Infinite fuel resources

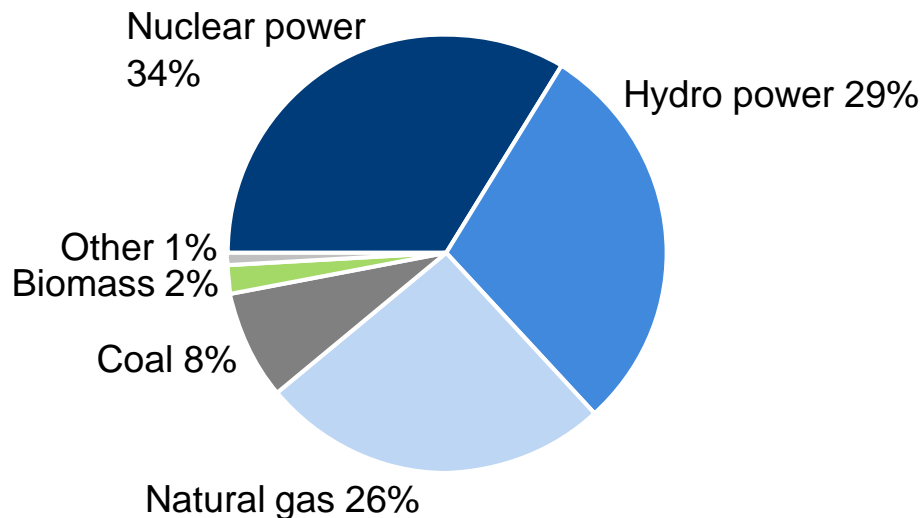
Emissions free production

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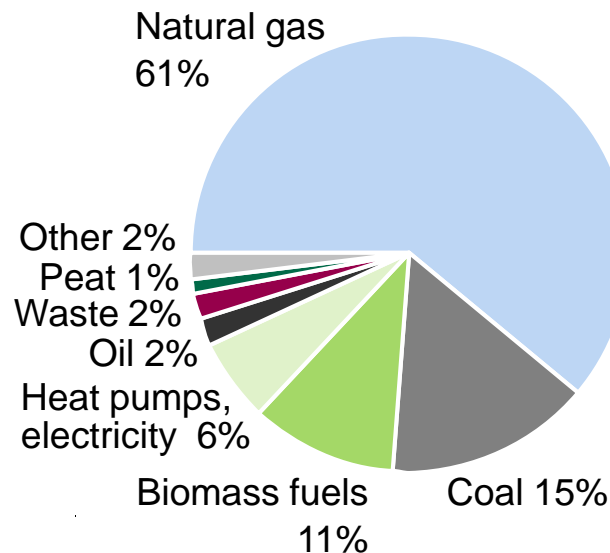
Fortum's power and heat production by source

Fortum's power generation in 2011



Total generation 72.7 TWh
(Generation capacity 14,826 MW)

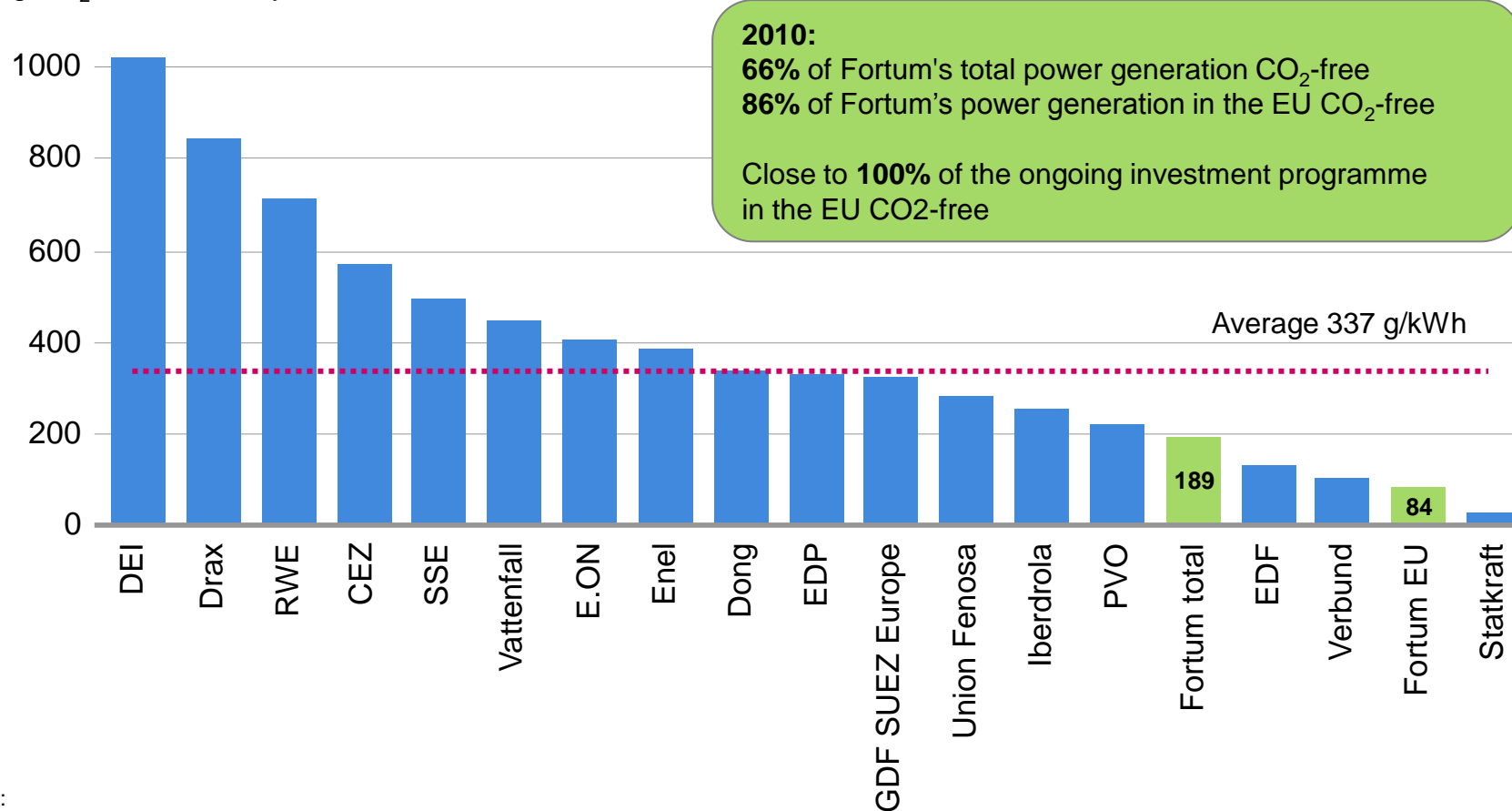
Fortum's heat production in 2011



Total production 47.4 TWh
(Production capacity 24,732 MW)

Fortum's carbon exposure among the lowest in Europe

g CO₂/kWh electricity, 2010



Source:
 PWC & Enerpresse, Novembre 2011
 Changement climatique et Électricité, Fortum

Note:
 Figures for all other companies include only European generation.

Today: Nuclear power needed

- Nuclear power important as a large-scale CO₂ free production form
- New technologies e.g. CHP can improve efficiency
- Complementarity with the on-going development of renewable energies towards tomorrow's solar economy

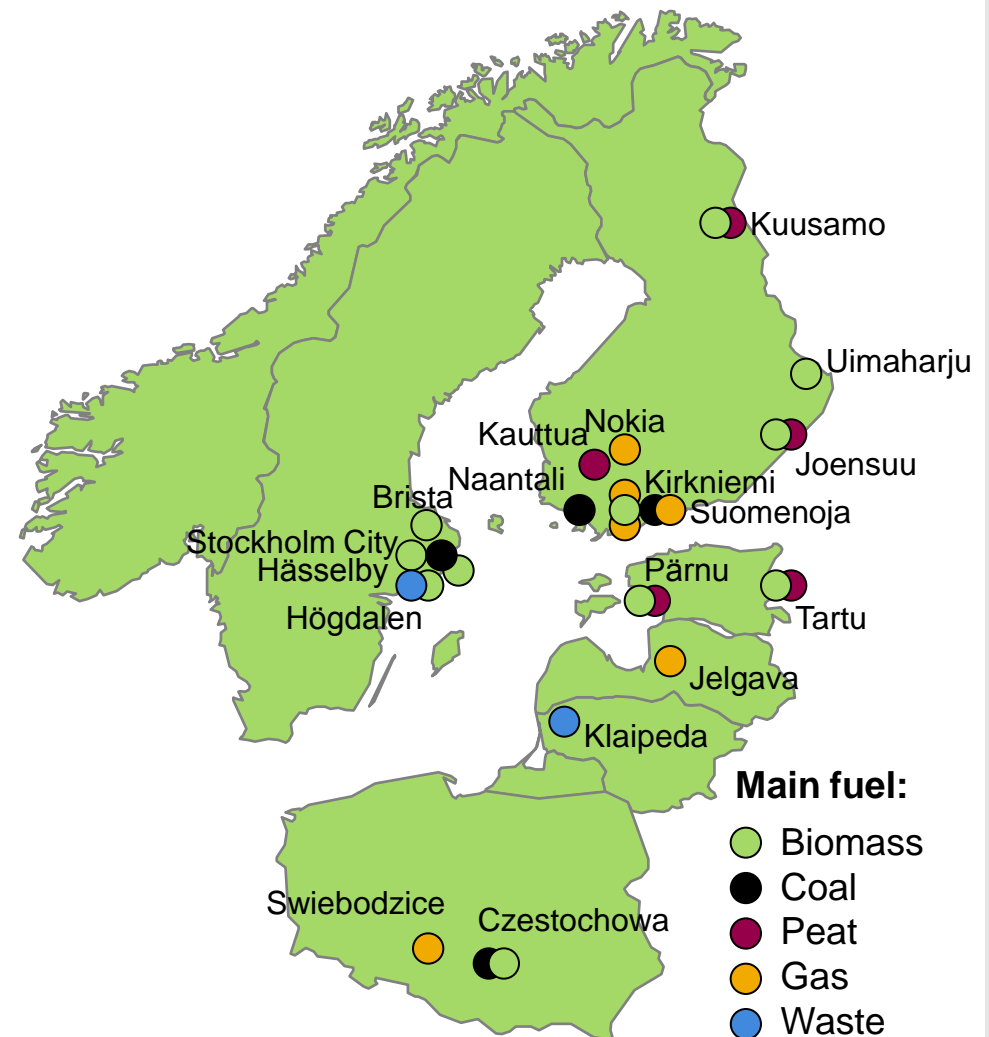
Today: New solutions linked to energy-efficient CHP production are part of the solution

- Biomass, waste, bioenergy and biofuels
- Pyrolysis technology
- New bio-fired combined heat and power plants
- A competitive opportunity for by-products of forestry and agriculture

Large fleet of CHP plants in Nordic countries and Baltic Rim

Biofuels and waste to energy concepts in major role in new CHP projects

- CHP capacity in Nordic Countries and Baltic Rim approximately 1600 MW_e and 2800 MW_{heat}
- Strong growth especially in Baltic countries and Poland during last years with waste to energy and bio fuel concepts in major role
- Projects finalized in 2010
 - Estonia, Pärnu: Co-firing of biofuels and peat in a CHP plant. 24 MWe/45 MWt
 - Poland, Czestochowa: Co-firing of coal and biofuels in a CHP plant. 64 MWe/120 MWt
- Projects under construction
 - Lithuania, Klaipeda: Waste to Energy CHP 20 MWe/50 MWt, (ready 2013)
 - Sweden, Brista: Waste to Energy CHP 20 MWe/60 MWt, (ready 2013)



Hydropower : Today and tomorrow a key component in solar economy

- ~ 30% of Fortum's energy production is based on hydropower
- Hydropower is today the only tried and true renewable energy production form with a long history of use
- Increased efficiency potential remains high with new technologies

Over a century of experience in hydropower

- Majority of Fortum's hydro power production located in Sweden and Finland
- Own hydro production ~22 TWh annually
- Total hydro power capacity in Nordic countries ~4700 MW
- 260 plants with power plants up to 275 MW
- Oldest plants in the fleet have been originally commissioned in 1890's
- Additionally nearly 800 MW capacity in Russia and ~200 MW in Norway through share ownerships



Tomorrow: new sources broaden the scope and role of renewable, emissions-free energies

Fortum's current initiatives:

- Seabased technology (10 MW)
- Waveroller by Finnish AW-Energy
- Cooperation with DCNS in France
- Investigating and testing solar opportunities

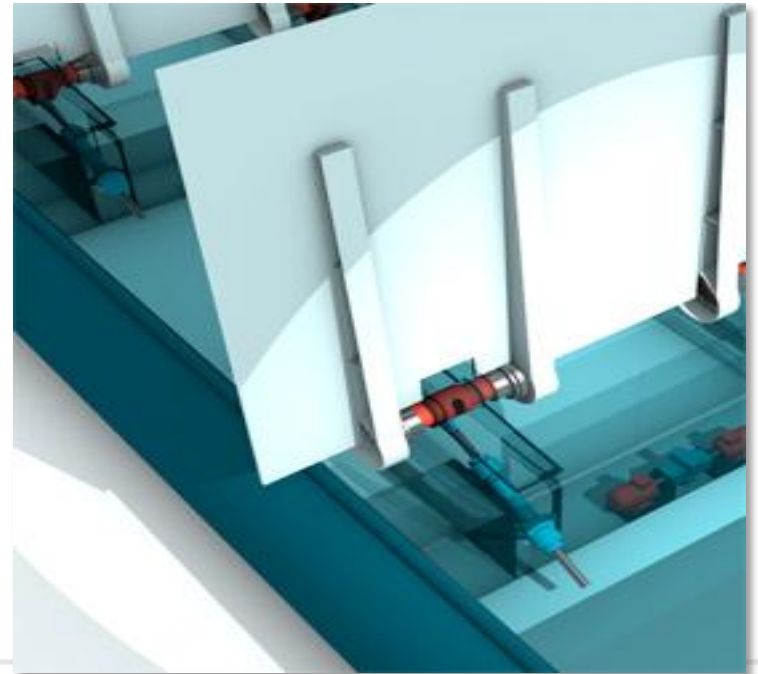
Wave power

- Fortum is confident that wave energy will play a key role in future energy system
- Large potential globally – up to 10% of global electricity consumption
- Fortum is a shareowner in AW Energy which is developing a new technology called WaveRoller based on surge waves:
 - Pilot plant in operation in Portugal and another one under construction (3*100 kW)
 - Fortum and DCNS are preparing to cooperate in this area of wave power technology (demonstration project at MW scale)
- Fortum also made the decision to invest in a 10 MW demonstration project in Sweden; first part of investments expected in 2012 (total investment 25 M€)

Buoys of Seabased Energy in Sweden



WaveRoller Concept



Stockholm Royal Seaport (SRS) – a sustainable urban district with world class aspirations

Vision and objective

- Royal Seaport – A sustainable urban city performing **world class**
- Year 2030 the Royal Seaport is fossil free and climate positive

Fortum role:

- Fortum is developing the smart-grid system to the area with ABB and KTH (Royal Institute of Technology)

Focus areas:

- Effective energy end-usage
- Sustainable transportation
- Local re-cycling
- Life style issues
- Adaptation to climate change

Fortum focus areas in solar economy - summary

As a medium-sized European player Fortum wants to concentrate its development activities in transition to solar economy to the areas with most expertise and highest future potential

Key focus areas:

- **Hydropower**: Fortum is among the leading hydropower companies in Europe and is seeking to expand
- **Bio-CHP**: 4th largest heat producer globally and among largest producers of bio based power and heat in Europe
- **Wave power**: Forerunner status in technology development with large projects ongoing, e.g. world's largest (10MW) wave power park
- **Solar power**: Previously smaller scale developments in Nordic countries, now looking for expansion
- **Smart grids**: Fortum highly active in the sector that is vitally needed in transition to solar economy: CO₂-neutral cities with distributed energy production and smart grids, advancing adoption of electric vehicles



Back-up

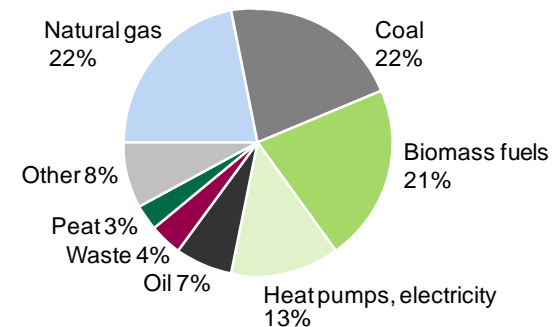
Excellence in Combined heat and power with multiple fuels

Fortum among the largest producers of bio-based heat globally

- Fortum is the leading district heat provider in the Nordic countries and the Baltic Rim and 4th largest globally
- Resource-efficient CHP as one of corner stones in Fortum's strategy
- Use of bio fuels 8,2 TWh and waste derived fuels 1,6 TWh in 2010
- CHP solutions in various settings including district heating, industrial process steam and heat, etc.
- Fortum is also actively involved in R&D projects with new sources and technologies to utilize biofuels (e.g. pyrolysis oil)



**Fortum's European
heat production in 2010**



European production 26.1 TWh
(Production capacity 10,698 MW)

Solar power

- Several R&D projects and small scale demonstrations in Nordic countries
- Solar power installations realized in both ground installations and rooftops
- In Nordic conditions, ground-based installations do not have favorable conditions
- Consequently, Fortum has concentrated on developing smaller scale installations integrated in buildings together with energy-efficient construction technologies
- Fortum is considering development of large-scale solar business in areas with higher irradiation levels

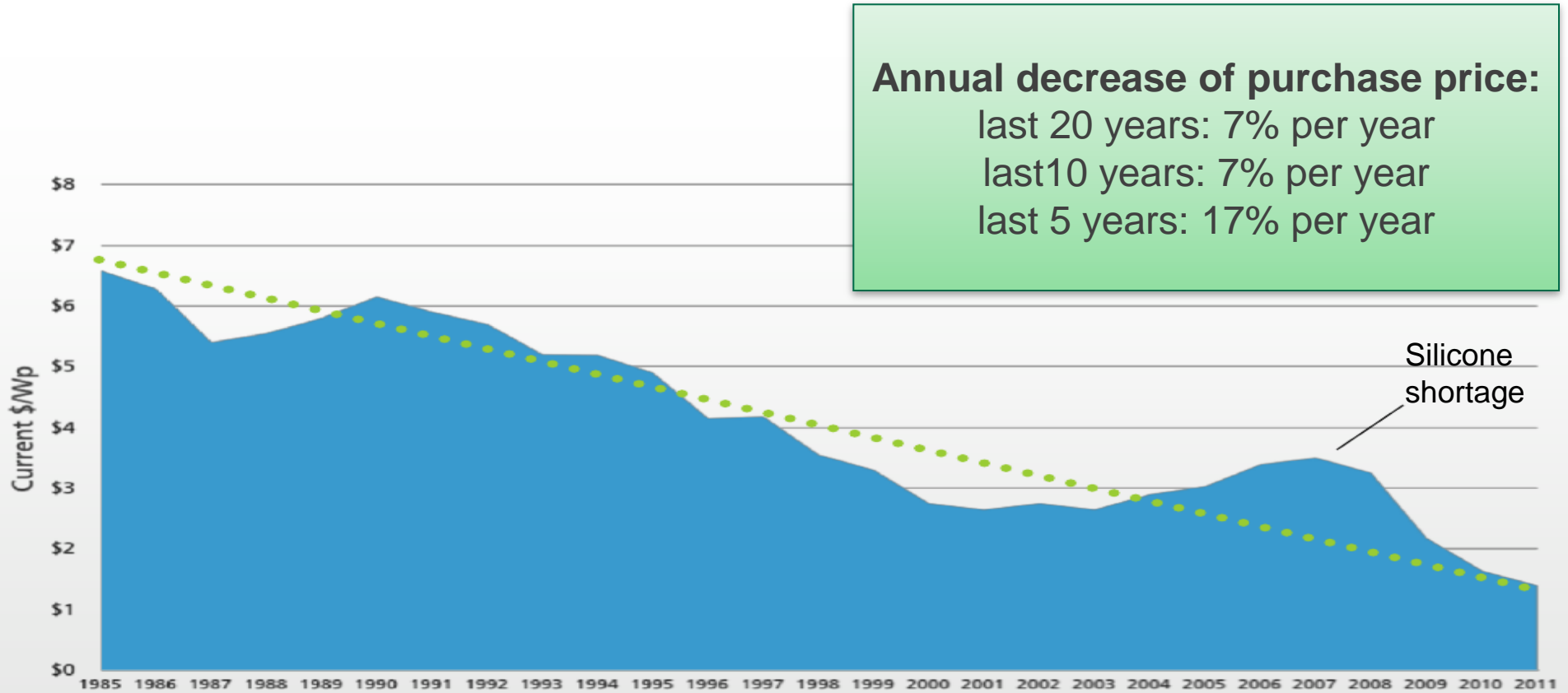
Espoo City car depot, a 55 kW PV system to charge electric vehicles – Helsinki Capital Area Climate Award 2011



Glava Energy Center in Sweden, a 108 kW PV system connected to Fortum's grid – largest ground-mounted PV system in the Nordics



Investment costs in solar – solar panels



*Installation cost not included

Royal Seaport – Key Facts

Area: 236 hectares. Land owned by the City of Stockholm.

Building start: 2010

Completion: 2025

Current construction: soil remediation, infrastructure

First occupancy: 2012

New apartments: 10,000

New work spaces: 30,000

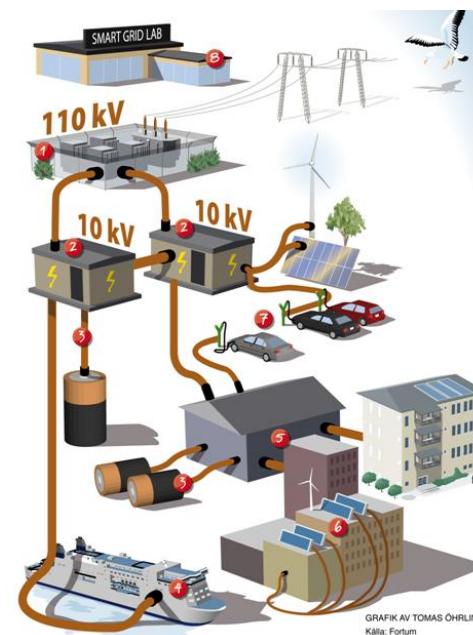
Commercial areas: 600,000 sqm

Energy target: 55 kWh sqm/year

Distance to city centre: 2,1 miles

Infrastructure: Biogas buses, city tram, metro, district heating, new lanes for pedestrians and cyclists etc.

The smart grid essential for reaching the sustainability targets



- 1 Active homes with demand response
- 2 Integration of local energy production
- 3 Use of electric vehicles and smart charging
- 4 Energy storage for customers and grid
- 5 Smart and electrified port
- 6 Smart grid infrastructure
- 7 Smart grid lab – Innovation Center