From concept to demonstration

Developing an advanced biofuel project

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Next generation energy company

Fortum

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Our geographical presence today

Nr 1  Heat

Nr 1  Distribution

Nr 2  Power generation

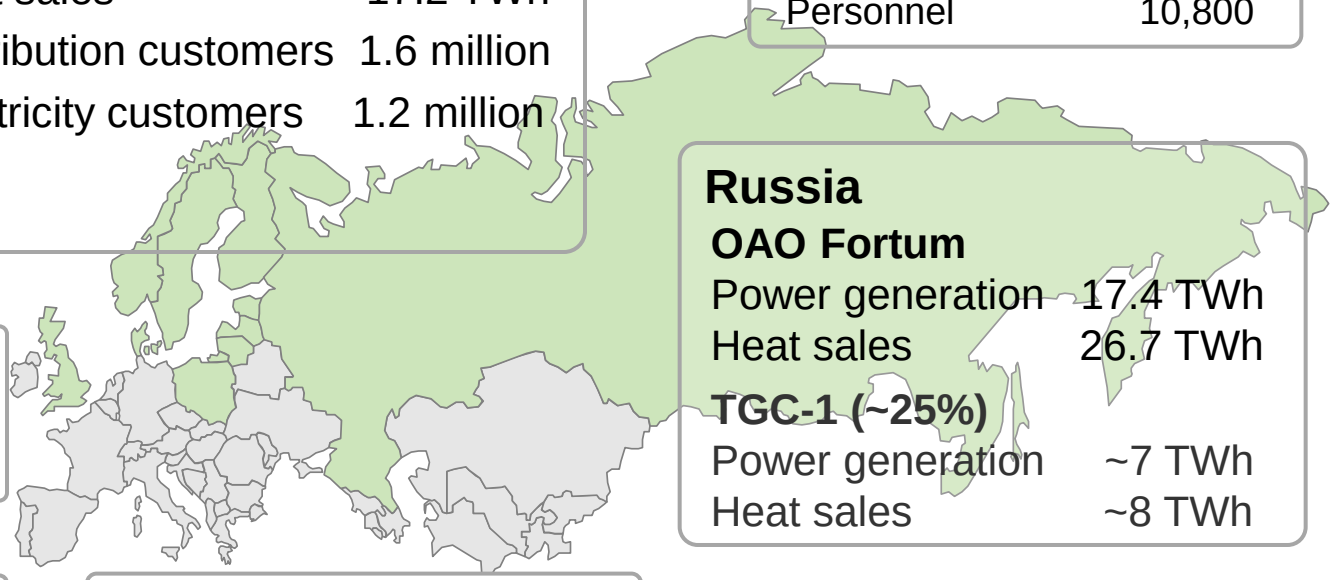
Nr 2  Electricity sales

Nordic countries

Power generation	53.1 TWh
Heat sales	17.2 TWh
Distribution customers	1.6 million
Electricity customers	1.2 million

Key figures 2011

Sales	EUR 6.2 bn
Operating profit	EUR 2.4 bn
Balance sheet	EUR 23 bn
Personnel	10,800



Russia

OAO Fortum

Power generation	17.4 TWh
Heat sales	26.7 TWh

TGC-1 (~25%)

Power generation	~7 TWh
Heat sales	~8 TWh

Great Britain

Power generation	1.2 TWh
Heat sales	2.1 TWh

Poland

Power generation	0.6 TWh
Heat sales	4.3 TWh

Baltic countries

Power generation	0.4 TWh
Heat sales	1.1 TWh
Distribution cust.	~24,000*

* Distribution business sold Jan 1, 2012

Transition towards Solar Economy

Solar Economy

Solar based production with
high overall system efficiency

Sun
Hydro
Ocean
Wind
Geothermal
Bio

CHP

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

Nuclear
tomorrow

Traditional
energy production
Exhaustible fuels that burden
the environment

CCS

Nuclear
today

Oil
Coal
Gas

High
Resource & system efficiency
Low

Finite fuel resources
Large CO2 emissions
Infinite fuel resources
Emissions free production

Next generation
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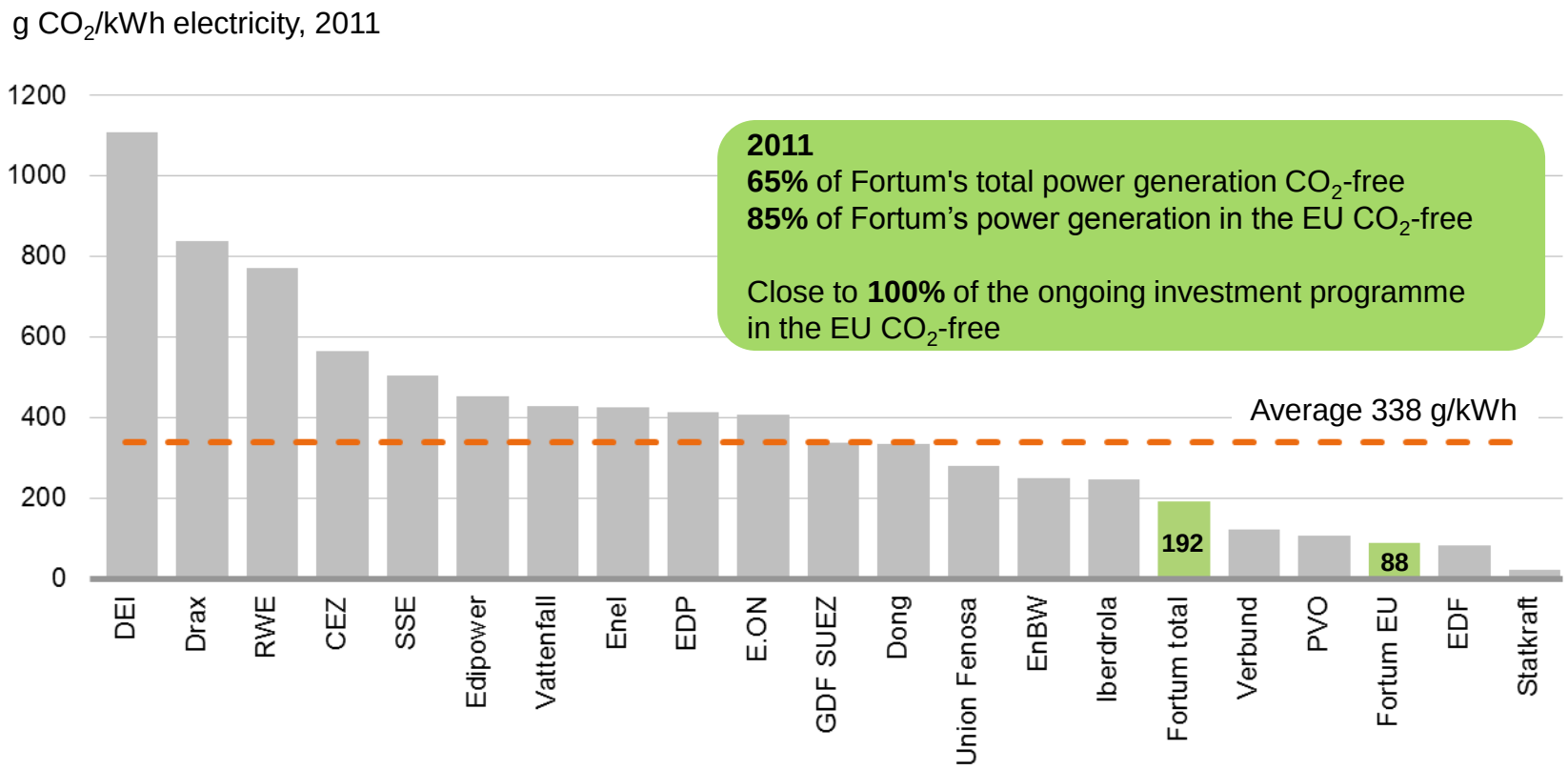
Fortum's carbon exposure among the lowest in Europe



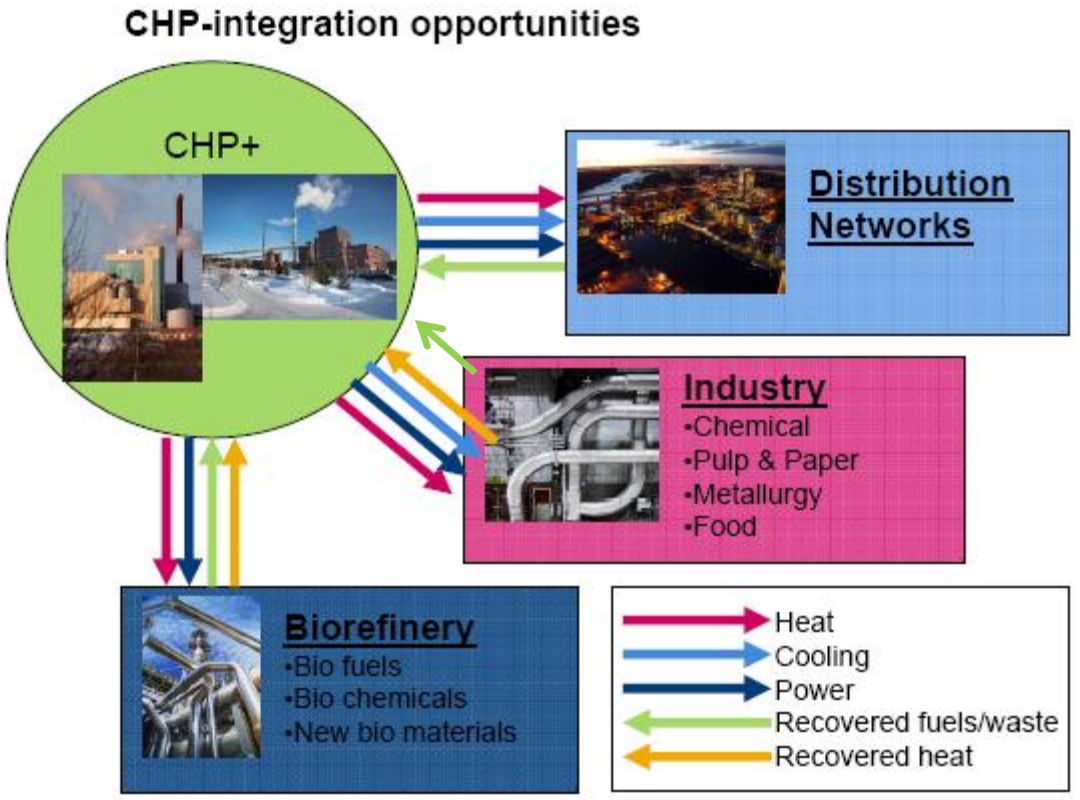
Note: Only European generation except "Fortum total" which includes Russia.

Source:
PWC & Enerpresse, Novembre 2012
Changement climatique et Électricité, Fortum

New CHP+ concepts (Combined Heat and Power)
Integrated production adding value

Key rationale and potential

- CHP is the most efficient way for converting fuels to power and heat
- CHP enables utilization of variety of different fuels, waste and industrial side products
- Stable heat loads enabling better utilization of assets
- New business through wider product range; new products in addition to electricity, heat and cooling
- New sustainable solutions for decreasing emissions by replacing fossil fuels and further improving energy efficiency



Drivers and triggers for new biofuel technology investment

1. Market outlook
   - New business potential – customer demand
   - Savings potential (technology, fuels, O&M…)
   - Political aspects – trends and clear priorities
2. Novelty value - potential for competitive advantage
3. Synergies with existing business
   - Modularity – opportunities to duplicate/integrate to new plants/markets
4. Sustainability
   - Carbon footprint, emissions
   - Public acceptance
5. Partnering opportunities – resources
   - Research
   - Technology provider
6. New technology risks - opportunities for public funding
   - R&D support
   - Innovation funding for demonstration phase

From R&D initiative to investment
Case pyrolysis oil production

- **First pilot 2001 (“stand alone type”)**
  - Market was not ready (low oil price, no price for CO_2)
- **Feasibility studies 2007- 2008**
  - Market outlook getting more favourable for CO_2 –lean solutions (e.g. EU 20-20-20 targets)
- **Fortum joins R&D consortium with Metso, VTT and UPM in 2009**
  - Strong partners with natural roles, CHP –integrated technology
- **Pilot testing in Metso laboratory supported by VTT, combustion testing in Fortum heating plant 2009 – 2011**
- **Investment decision for a demonstration plant in February 2012**
- **Pyrolysis oil production will start in Joensuu at Q4 / 2013**

The production and usage of bio oil is one route to low-carbon energy production



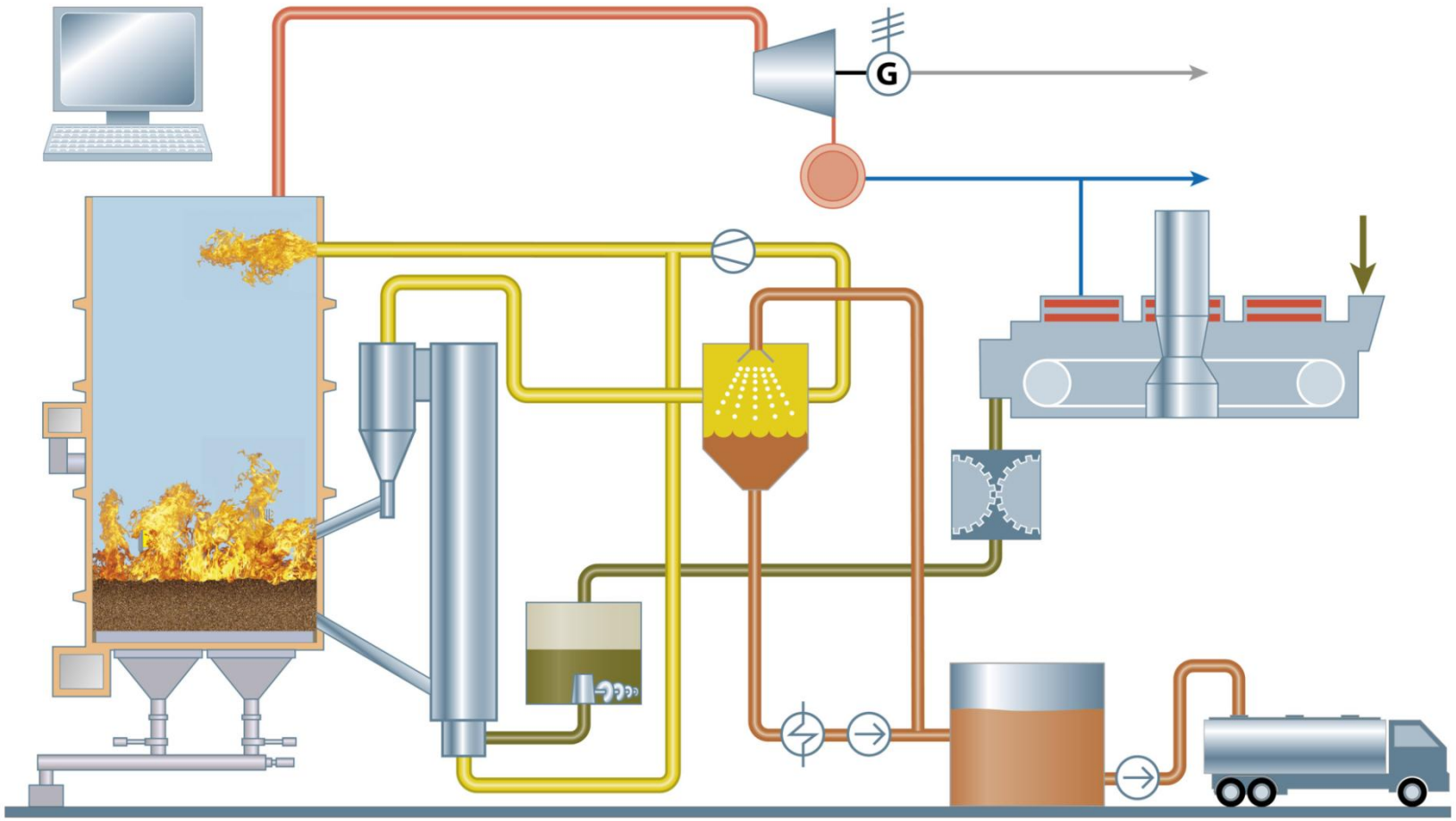

Fuels of the power plant =
the raw materials of bio-oil

CHP plant
- electricity production
- heat production
- bio-oil production

Final consumption of bio-oil
Low-carbon production of heat and steam

Bio-oil production integrated with electricity and heat production is not only highly energy efficient but also progressive alternative because of its investment and operating costs.

CHP Integrated pyrolysis process



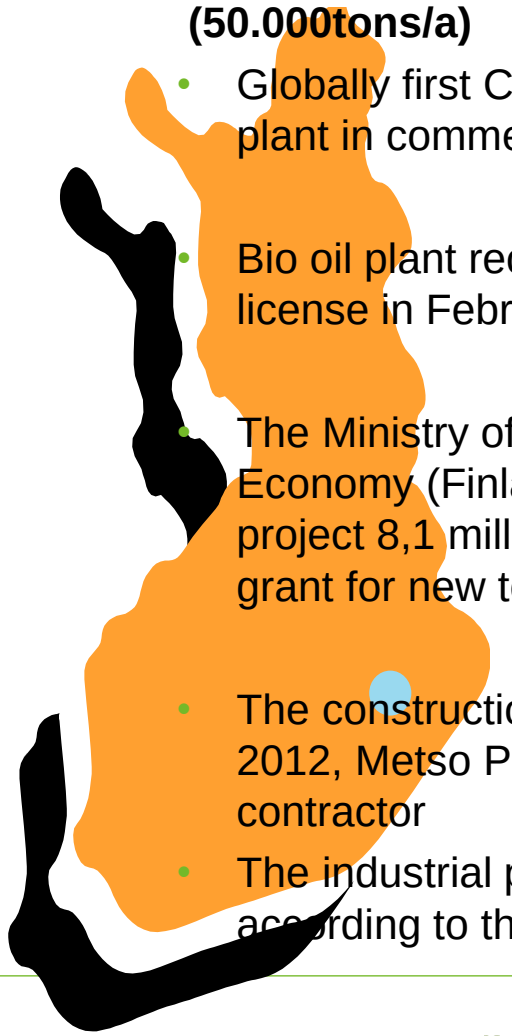
Source: Metso

From reasearch to production

Bio-oil production plant to Joensuu

Eastern Finland is a great location for the first bio-oil plant because:

- Raw material is available in near-by areas:
  - Logging residues
  - First thinning wood
  - By-products of pulp and paper industry
- The plant uses already lots of wood-based fuels
- The current boiler fits for the purpose and Fortum´s district heating operation gives good platform for continuous production
- There is strong knowhow of forestry and bio energy in Eastern Finland



Joensuu demonstration plant (50.000tons/a)

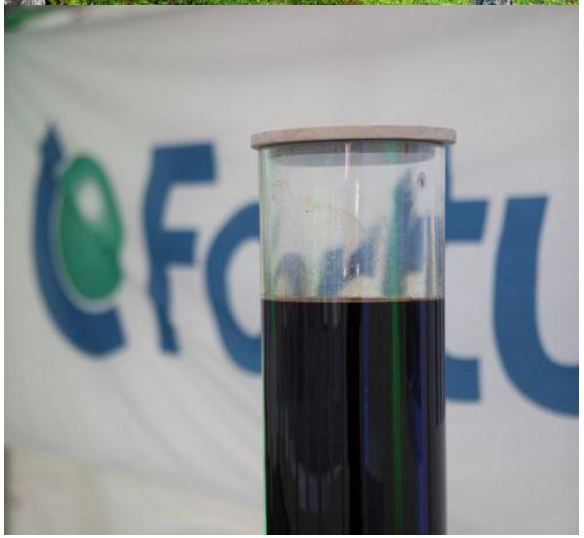
- Globally first CHP-integrated pyrolysis plant in commercial size
- Bio oil plant received an environmental license in February 2012
- The Ministry of Employment and the Economy (Finland) has allocated the project 8,1 million euros of investment grant for new technology
- The construction work started in June 2012, Metso Power as a turn key contractor
- The industrial production of bio oil starts according to the plan in Q4 / 2013

Pyrolysis oil – sustainable alternative for fossil oil

- Raw material is local wood-based bio-mass
- By replacing fossil fuels with bio-oil, the carbon dioxide emissions of heat production can be reduced over 90%
- Wood-based bio-oil is practically sulphur–free ->
  Positive impact on the local air quality
- Planned output of bio-oil is approximately 50,000 tonnes annually:
  - District heating for 10,000 detached houses or for 24,000 medium size apartments
  - Approximately 60,000 tonnes reduction of CO_2 emissions
  - Approximately 320 tons reduction of sulphur dioxide emissions

Future outlook

- First step to replace fuel oils in heat production
- Future applications can be further refining to products with higher market value (e.g. traffic fuels)



THANK YOU!

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