

Advanced Biofuels and more from biorefinery – cooperation is the key to success

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St1 Oy
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St1 vision: "To be the leading producer and seller of CO₂-aware energy"

Our goal is to

- Develop and commercialize functional and environmentally sustainable solutions
- Deliver these solutions profitably

Each solution must be

- Technically ready for use today
- Ecologically and ethically sustainable
- Logistically feasible

$$E = St^1$$

St1 home market

ST1

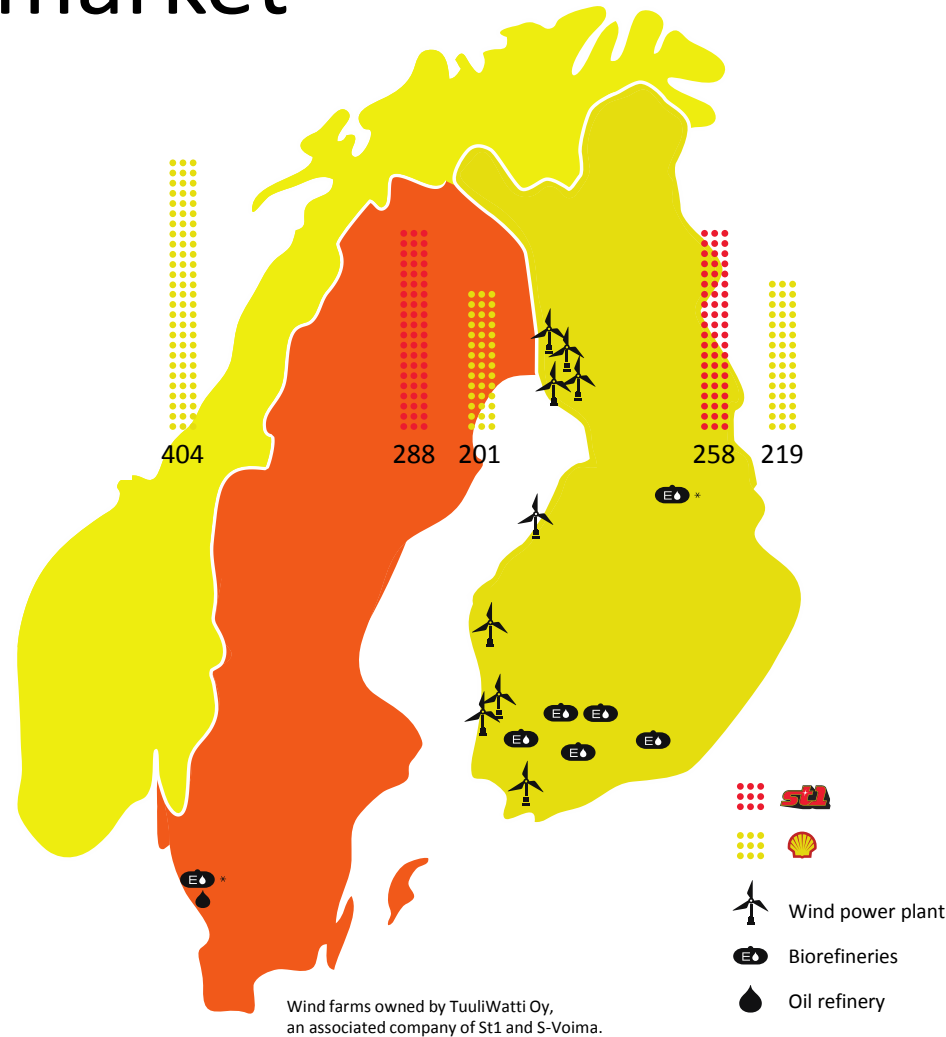
Home market consists of Finland, Sweden and Norway.
Headquarters in Helsinki.
Employs more than 770 people.
Operations are strengthened by strategic long-term partnerships in various areas.

STATION NETWORK

Total of ca. 1300 St1- and Shell-sites in Finland, Sweden and in Norway.

ENERGY PRODUCTION

Biorefineries producing waste-based advanced ethanol. Industrial wind power plants. Geothermal pilot heat plant under construction. Oil refinery in Sweden.



MARKET SHARES 2018

FINLAND

Petrol	23%
Diesel	19%
Light fuel oil	21%

SWEDEN

Petrol	19%
Diesel	15%
Light fuel oil	22%

NORWAY

Petrol	23%
Diesel	20%
Marine gas oil	22%

KEY FIGURES 2018

Net Sales, MEUR

6,885

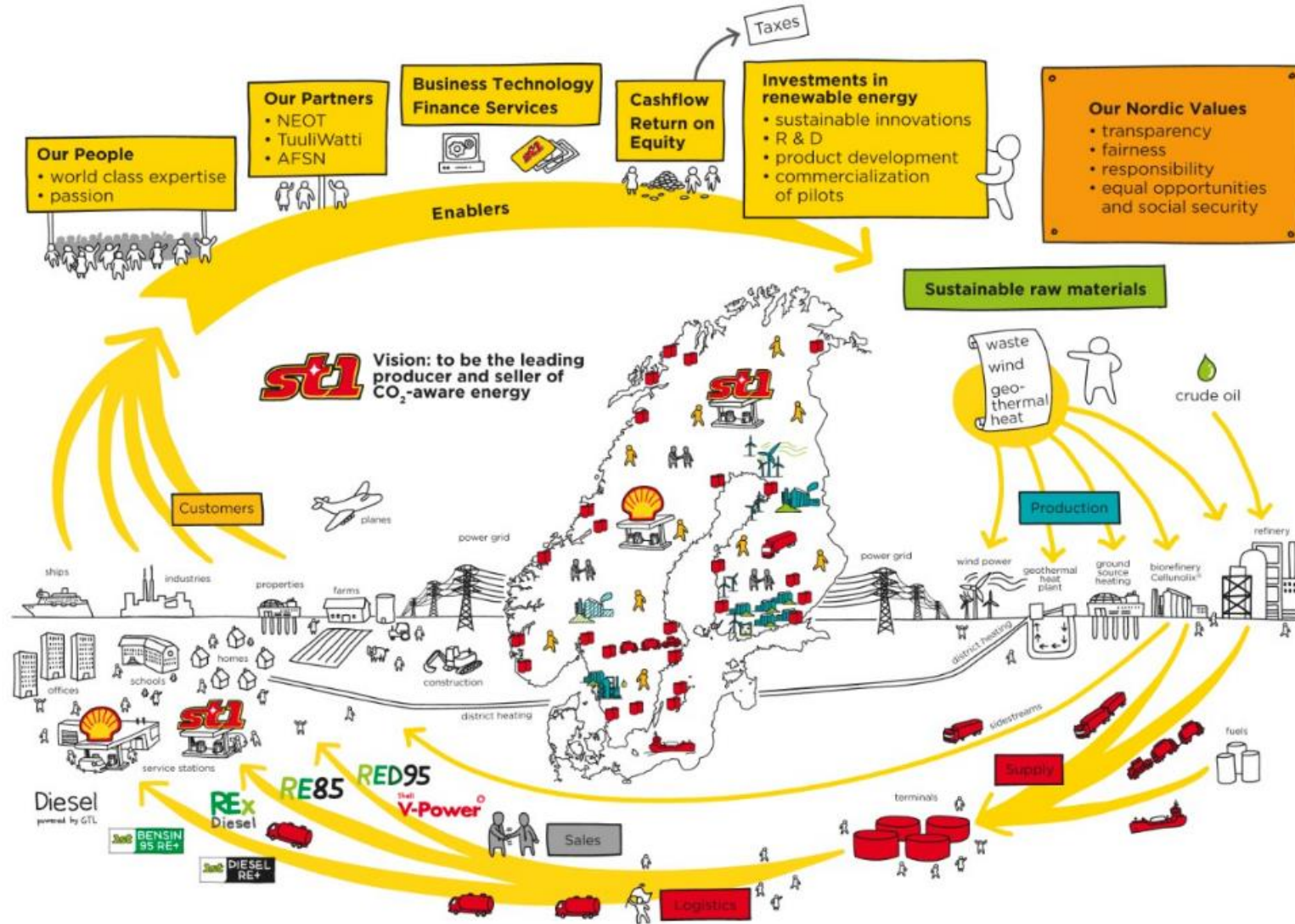
Profit for the period, MEUR

55.3

Return on Equity, %

7.0

ST1 VALUE CHAIN



[St1 value chain video](#)

St1 Biorefinery Business Development & Production



St1 Advanced Ethanol Production in Circular Economy

- Over a decade St1 has developed waste based advanced ethanol production concepts for various waste feedstocks.
- Biorefinery concept and technology development is done hands-on from lab to pilot and furthermore to demonstration scale ending up to a commercial replication.
- Current development focus is in
 - new feedstock
 - Process enhancement
 - own enzyme onsite production
 - biorefinery side products to valuable renewable products.
- Development is made in partnership with world class commercial and academic partners.

Waste & process residues sources



Food Industry & Retail



Municipal & Commercial



Wood Industry



Recycling

Feedstock & Sourcing Partners

St1 Biorefinery Solutions



Etanolix®



Bionolix®



Cellunolix®

Technology & Development Partners

Products and co-products

Ethanol

Biogas

Heat & Power

Advanced Biofuels & Renewable Energy

Animal Feed

Soil Improvers

Fertilizers

Agriculture & Nutrient Recovery



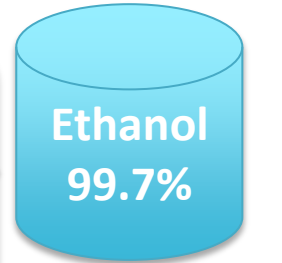
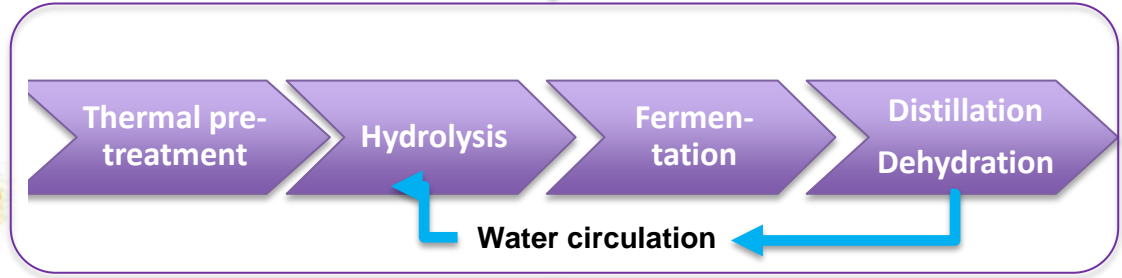
Future Products

Off take & Development Partners

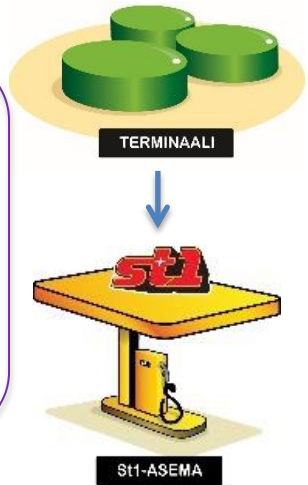
St1 Cellunolix[®] process is optimised for softwood saw dust



- Energy**
 - steam
 - electricity
- Additives**
 - enzymes
 - yeast
 - chemicals
- Utilities**
 - water
 - cooling water

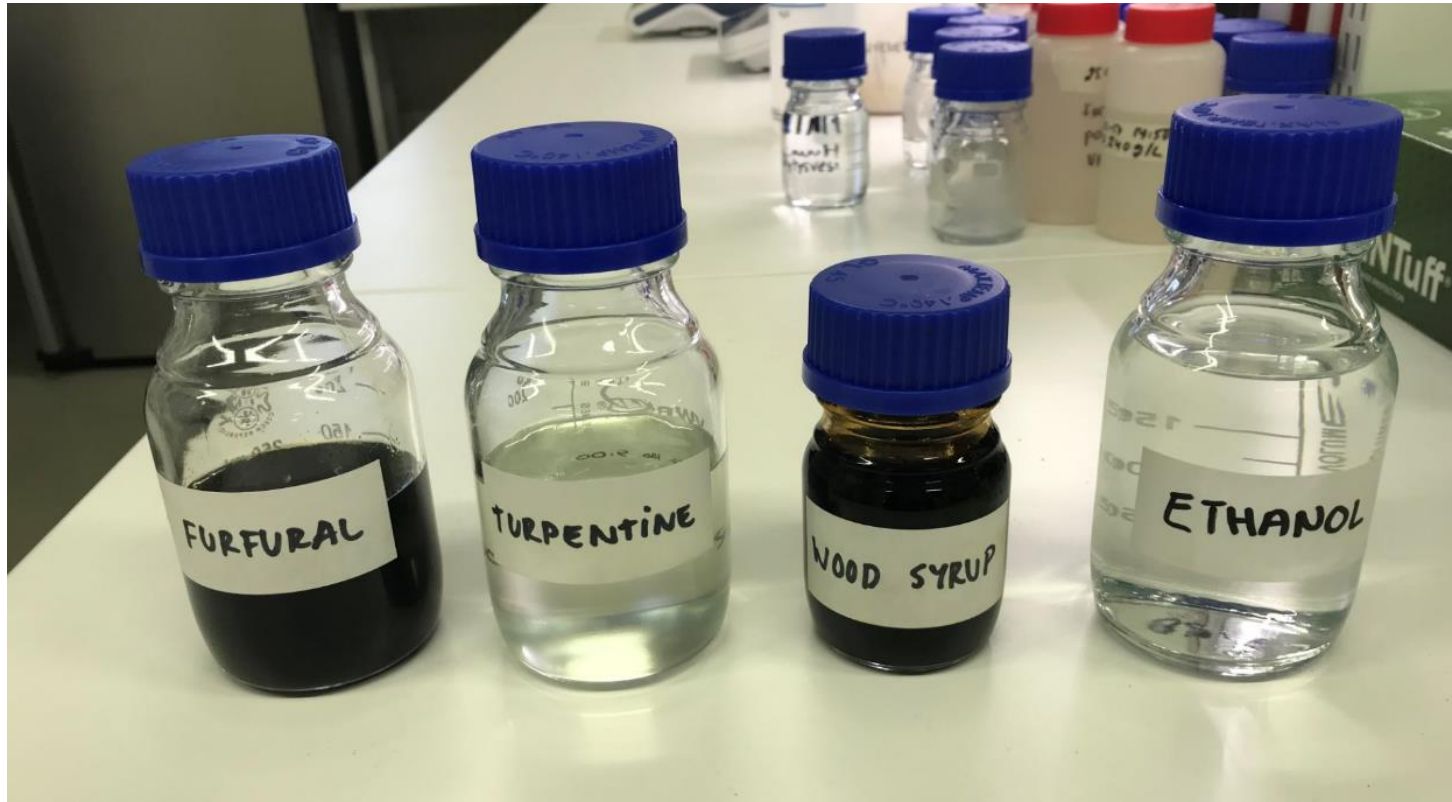


- Biorefinery products:**
-
- Waste water**
- anaerobic digestion
 - existing waste water treatment plant
 - water systems



Cellunolix[®] Products

Sustainable & biobased solutions for different uses and applications



St1 Cellunolix[®] lignin – Research co-operation

- St1 lignin research started in May 2017
- Wide co-operation with companies, research institutions and universities on lignin utilization
- Information on lignin applications and lignin quality
- Several approaches on lignin utilization
 - Lignin to pellets to replace coal
 - Lignin to bio-oil
 - Lignin biochemicals and biomaterials
 - Lignin to biogas and butanol



Cooperation also in process development is key to success!

Pre-treatments – the source of many troubles !

Source: API Europe

Symptoms

- 5 commercial biorefineries >>€1.5 billion
- Yield <250 L/t – weak pre-treatment fractionation
- Availability 25% - 75% (years after start-up) – plugging

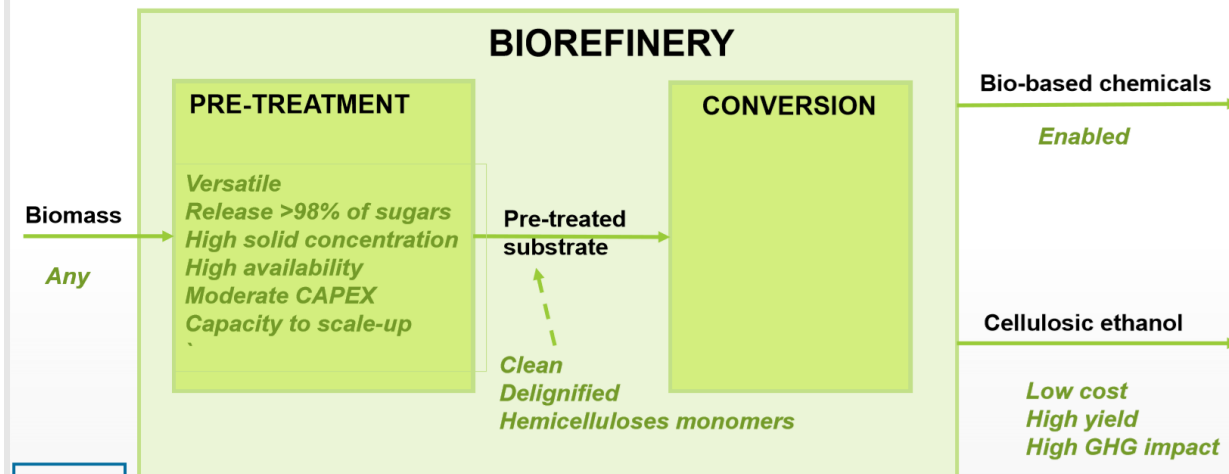
Amongst causes

- Tests of pre-treatment technologies at batch scale – not continuous
- Tests for few hours <100
- Did not reveal long term operating problems
- Did not test for lignin “stickiness” (scanning calorimetry, viscosity)



Pre-treatment is the foundation of the biorefinery

Source: API Europe



API USA and API Europe are implementing these learnings in pre-treatment development

A large black and white ship is shown from a low angle, sailing on the ocean. The ship's hull is black, and its superstructure is white with a blue stripe. The sky is a mix of blue and orange, with a bright sun setting on the horizon. The water is dark blue with some whitecaps. The overall scene is dramatic and scenic.

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