



Struer Denmark

April 2015

# **Advanced Ethanol Production From Waste and Process Residues**

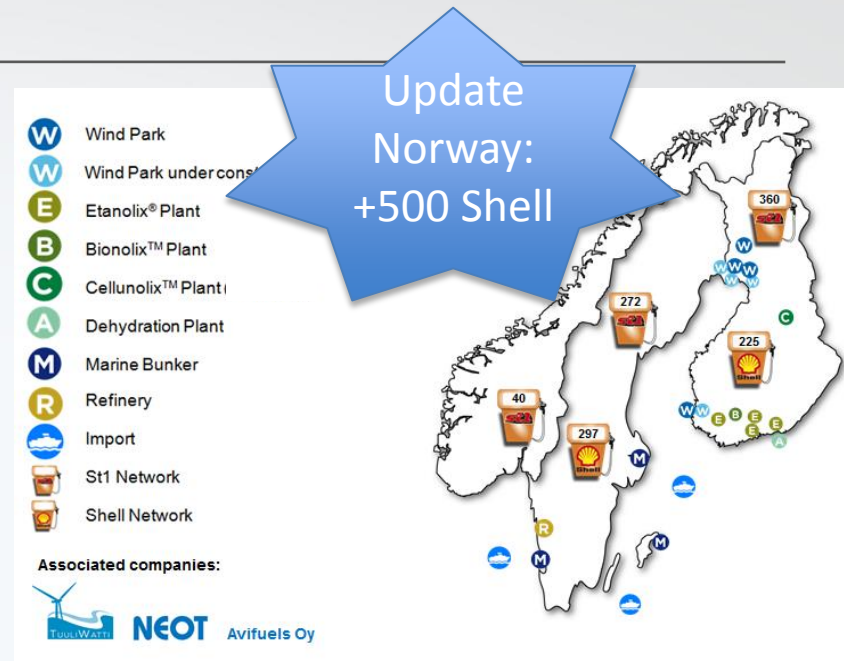
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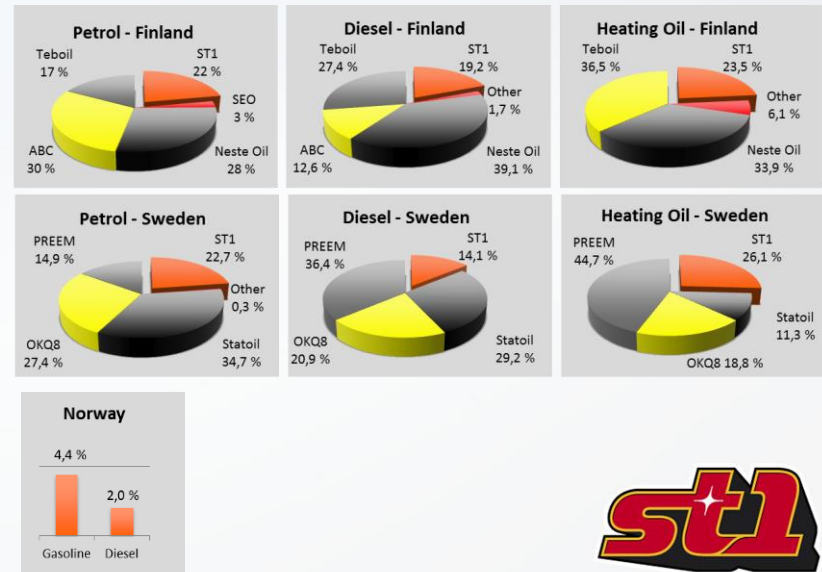
# St1 - Background

- Founded in 1995
- Privately owned
- Turnover €6,8 Billion (proforma '13)
- Areas of business
  - Fuel Retail through 1.100 St1 & Shell branded networks in the Nordics
  - Oil refining in Gothenburg, Sweden
  - B-to-B and B-to-C Direct Energy Sales



Associated companies (partly owned by St1 Nordic Oy)

North European Oil Trade Oy	North European Bio Tech Oy	TuuliWatti Oy	Avifuels Oy
Fuel supply for Finnish operations Co-owned with SOK	Waste-based ethanol production facilities Co-owned with SOK	Industrial windpower Co-owned with S-Power	Aviation refuelling at Finnish airports Co-owned with SFR



# St1 Biofuels - turns waste into sustainable biofuels

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- St1 Biofuels Oy was established in 2006.
- The company has pioneered in waste-based bioethanol production with several plants built.
- The expertise of St1 Biofuels lies within biochemical processes, technology development, engineering, turn key project deliveries and operational excellence.
- This world class knowledge in waste-based ethanol production technologies is now available globally.



# Why ethanol from waste and residues?

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## Why ethanol?

- Liquid fuel that replaces gasoline directly in existing fleet, ensuring speed to market.
- Globally most widely used and well known biofuel
- Possibility for vast reduction of fossil GHG emissions.
- Market exists still for decades
- Superior weight efficiency vs. batteries



## Why from waste and residues?

- Unused or underused source of energy
- No direct or indirect land use issues
- No negative impact on the availability of food
- No negative impact on food price
- Avoidance of methane leak to atmosphere from landfills
- Domestic production to replace imported fuels



# St1's RE85 High blend ethanol

- Contains 80–85% of bioethanol produced from Finnish biowaste
- Cuts transport-related fossil CO<sub>2</sub> emissions by up to 80%
- For Flex-fuel vehicles (FFV)
- Optimized to challenging Nordic climate conditions in development project with The Finnish technical research Centre of Finland (VTT)
- Distribution network expanding in St1 and Shell network
- RE85 has received the Key Flag symbol from The Association for Finnish Work as the first motorfuel in Finland



**RE**  
**85**





## St1's RED95 Ethanol Diesel

- Contains 95% of bioethanol produced from Finnish biowaste
- Cuts transport-related fossil CO2 emissions by up to 90%
- Cuts near-emissions up to 70%
- For Scania Ethanol Diesel vehicles
- Trans ECO project with The Finnish technical research Centre of Finland (VTT)



# Food Industry Process Waste and Residue - Etanolix® Plant

## Feedstock characteristics

- High ethanol yield from starch and sugars
- Variable in quality and quantity
- Often contains salt, inhibitors and impurities
- Packed in paper, plastic, bags etc.
- Cost connected to quality and local utilization

## Sources

- Food industry: bakeries, breweries, potato processing, alcohol production etc.
- Retail: shops, logistics and shop bakeries

## Collection systems

- Integrated site: industrial sources
- Direct transportation from bakery/source
- Dedicated collection from shops
- Return logistics to industry or logistic hub

## Etanolix® Plant

Feedstock: Food industry process waste and residues - Package removal included

Product: Renewable Ethanol:  
- EU Double counted  
- US Advanced Ethanol

Capacity: 5 – 10 million liters/year/unit

CO<sub>2</sub> savings: Up to 90 %

Co-product: - Protein rich liquid animal feed or  
- High yielding biogas plant feed

Units: 4 units in Finland, 1 unit under construction in Sweden



Jokioinen Etanolix®



Lahti Etanolix®



Vantaa Etanolix®



Hamina Etanolix®

# Etanolix® Göteborg – Ethanol plant integration to an Oil Refinery

## Production capacity

- Ethanol (as per 100% EtOH) 5.000 m<sup>3</sup>/a

## Feedstock

- Industrial bakery waste & industrial process residue
- Out dated waste bread from shops and markets
- Approx. 20.000 t/a feedstock is required

## Products

- Anhydrous fuel grade ethanol
- Liquid animal feed for pig farms / feed for biogas plant (AD)

## Time Line

- Production starts early 2015

## Etanolix 2.0 LIFE+ project

Etanolix® concept further development & demonstration:

- New raw material handling
- Unique way of integrating the ethanol plant in a conventional refinery:
  - direct ethanol blending to vehicle fuels and in an effective way distribution to the consumers
  - utilize excess energy, cooling systems and wastewater treatment plant
- Refinery personnel's expertise and experience for safe and optimal operation





# Recycling of source segregated biowaste - Bionolix®

## Feedstock characteristics

- Low ethanol yield
- Highly variable in quality
- Contains salt, inhibitors and impurities
- Packed in paper, plastic, bags etc.
- Positive cost - gate fee based

## Sources

- Municipalities
- Industry & Retail: factories, shops and logistics

## Collection systems

- Collection from source
- Return logistics to industry or logistic hub

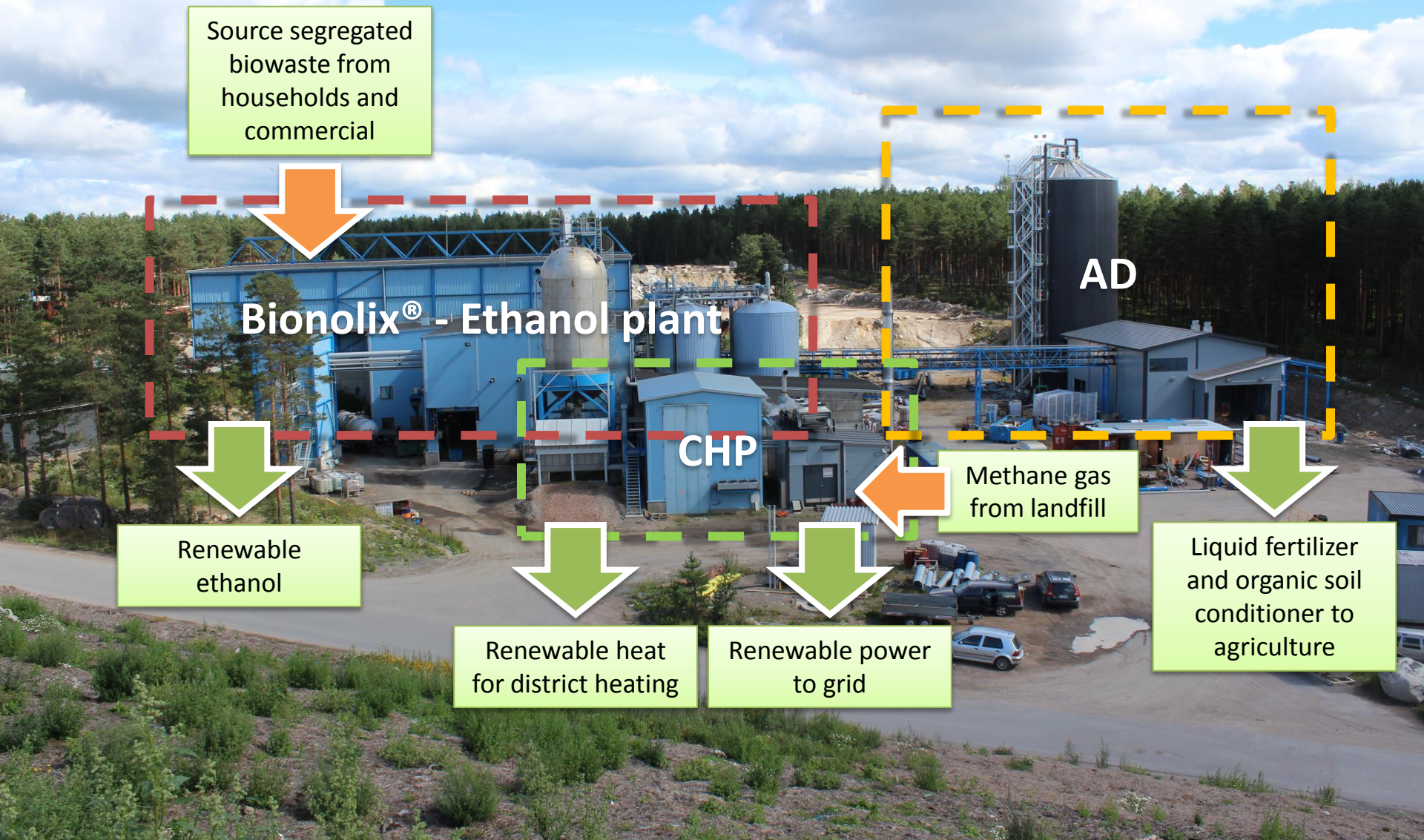


## Bionolix® Plant

Feedstock:	Source segregated biowaste
Product:	Renewable Ethanol
	- EU Double counted biofuel
	- US Advanced Ethanol
Capacity:	2 – 5 million liters/year/unit
CO <sub>2</sub> savings:	Up to 93 %
Co-product:	- Waste management service
	- Renewable heat and power
	- Organic soil conditioner
	- Liquid nitrogen fertilizer
Units:	1 unit in Finland



# Bionolix® Hämeenlinna, Finland – integration to landfill



# Sawmill side products: saw dust and chip - Cellunolix®

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## Feedstock characteristics

- Non-food ligno-cellulosic material
- High ethanol yield
- Stable quality
- Cost depending on local usage

## Sources

- Wood industry

## Collection systems

- Integrated to saw mill
- Direct transportation from saw mills

## Cellunolix® Plant

Feedstock:	Saw dust and chips
Product:	Renewable Ethanol <ul style="list-style-type: none"><li>- EU Double counted biofuel</li><li>- US Cellulosic Ethanol</li></ul>
Capacity:	10-100 million liters/year/unit
CO <sub>2</sub> savings:	Up to 90 %
Co-product:	<ul style="list-style-type: none"><li>- Lignin based solid fuels</li><li>- CO<sub>2</sub></li></ul>
Units:	1 <sup>st</sup> unit in Finland under construction – operation 2H2016



# Waste and process residues enables sustainable Advanced Ethanol production

- ✓ Feedstock: waste and process residues
- ✓ Plant: Etanolix®, Bionolix® and Cellunolix®



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