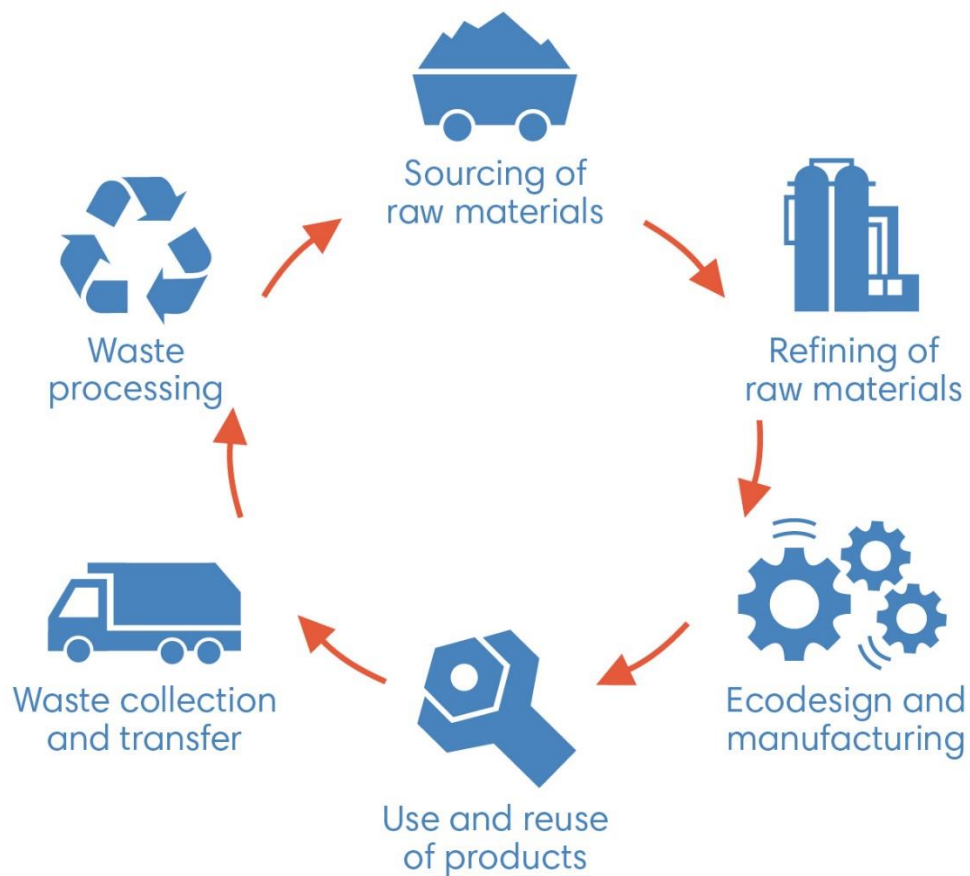


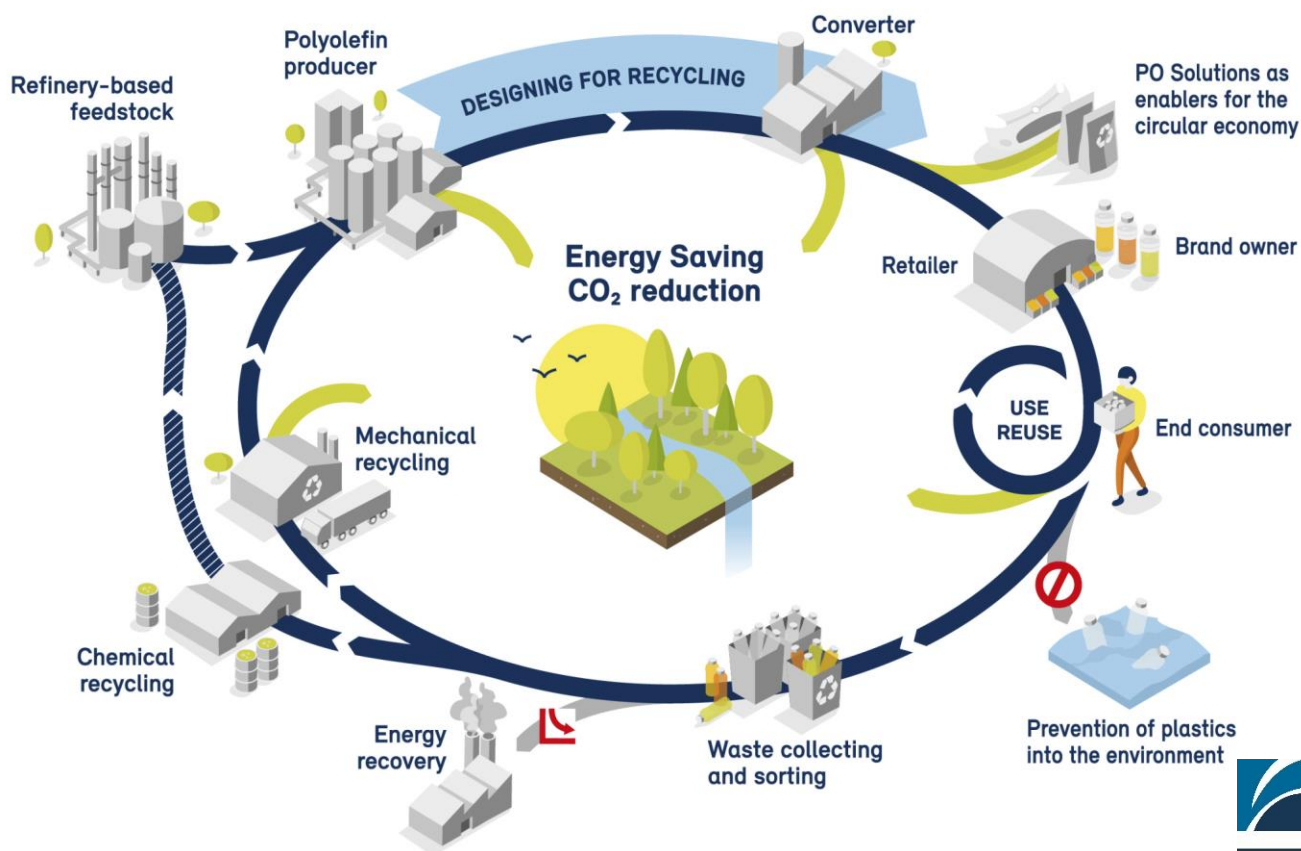
Circular Economy

Example cases from the
Chemical Industry in Finland

Chemistry enables Circular Economy



Borealis view on polyolefins circular economy



Keep Discovering

KEMIANTEOLLISUUS

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CPKelco: Produces CMC*, Cellulose gum, for various applications

Detergents

- CMC prevents dirt from sticking to textiles

Oil drilling

- In the drilling fluid CMC is used as an additive, which promotes the removal of stone aggregates and compresses the drilling well



Yoghurt

- CMC works as a thickening agent

Papermaking

- In coating CMC works as a binder and lubricant

Ice cream

- Due to its water retaining capacity CMC prevents the formation of frost and ice

CPKelco

A HUBER COMPANY

* Carboxymethyl derivative of cellulose

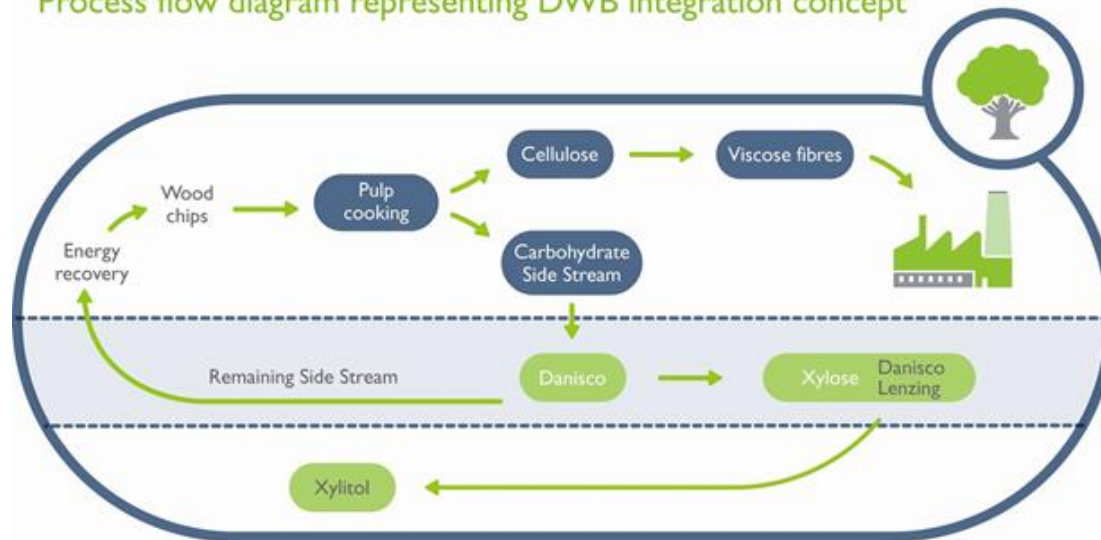
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DuPont Nutrition & Biosciences: Xylitol with health benefits from pulp and paper industry side streams

- Xylitol is manufactured with hydrogenation technology from xylose purified from pulp and paper industries' side streams. The carbon footprint of the product is ca. 90% lower than that of xylitol produced by Chinese competitors using corn cobs as raw material.
- DuPont N&B is world's leading xylitol producer: the largest xylose plant in the world is located in Austria and the world's largest xylitol plant in Kotka, Finland.
- Xylitol is used as a tooth-friendly sweetener: it has been clinically proven to decrease tooth decay (EFSA approval).

Process flow diagram representing DWB integration concept



Fortum recycles consumer plastic packages into new raw materials

- At Riihimäki plastic refinery, plastic waste is turned into recycled plastic granulates – a raw material for plastics industry to replace virgin materials in plastics production.
- Ca. 12 000 t of consumer plastic packages and industrial plastic waste was recycled at Riihimäki plastic refinery in 2018.
- Modern, high-tech production facility with carefully designed sorting, washing and compounding processes for LDPE, HDPE and PP plastics.
- Outcome of the recycling process is a high quality recyclate suitable for various purposes from household appliances, industrial and commercial films to blow molded articles.
- Plastics recycling has an important role in circular economy, as one kilogram of recycled plastic saves 1.5 kilograms of CO₂ when used instead of virgin plastic.

Kemira: Adding circularity to our economy

- **21%** of raw materials used in Kemira's global manufacturing came from recycled sources or industrial by-products.
- **70-80%** of inorganic coagulants from recycled sources to treat wastewater, drinking water, in industrial water treatment applications.
- Mining landfill contains **3.5 million tons** of ferric sulfate – 10 to 15 year supply – helping put 40 years of accumulate waste back into our circular economy.

KEMIRA HELPS TO TREAT
320 million
PEOPLE'S ANNUAL WATER



KEMIANTEOLLISUUS

kemira

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Kiilto: Wallpaper adhesives containing starch



1. Potato field



2. Potato



3. Refining



4. Extracted starch

Starch – from field to wall



5. Adhesive R&D



6. Adhesive production



7. Finished wallpaper adhesive



8. Home wall

KiiltoClean: Use of enzymes in laundry detergents improves wash performance

Understanding of Finnish conditions and customers



Serto detergent fluids function especially well in Finnish conditions.

Finnish product development



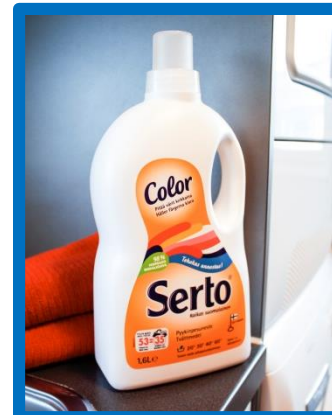
We focus on active and sustainable product development. Our products are zeolite & phosphate free and biodegradable.

Production processes in the city of Turku Finland



We develop and produce our products in Finland in a safe and responsible way respecting the environment.

Sustainably produced customer tailored laundry detergent



The tensides in our Serto products are biodegradable and enzymes biobased. A smaller dose of detergent is needed to ensure a good washing result.



Serto
Raikas suomalainen

KEMIAN TEOLLISUUS

KiiltoClean

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Lassila & Tikanoja: enabling the reuse of waste oils and emulsions

Where do waste oils and emulsions originate from?

- We collect waste oils, oil contaminated water and different emulsions from the industry, harbours, workshops and farms.

How are waste oils and emulsions processed?

- Oils are analyzed, processed and unified at L&T's recycling plant.
- Used lubricant oils are directed to business partners for regeneration or purification.
- Oils and emulsions which are unsuitable for regeneration are processed at L&T's recycling plants in Lahti, Jyväskylä and Oulu (Finland).

How are the processed waste oils and emulsions utilized?

- The regenerated lubricant oils are processed into base oil, which is sold further to be used as a raw material in the lubricant industry.
- The side streams of the regeneration are utilized as bitumen.
- Oils which are unsuitable for regeneration are converted into recycled fuel for industrial use at L&T's recycling plant.



Lumene: raw materials from the arctic nature

THE JOURNEY OF CLOUDBERRIES

LUMENE

1 PICKING THE BERRIES FROM FINNISH NATURE



2 BERRIES ARE PRIMARY USED IN FOOD INDUSTRY



3 EXTRACTION OF BERRY SIDE STREAMS



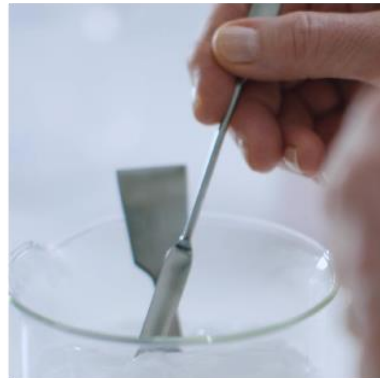
4 DEVELOPMENT OF MULTIPLE VALUABLE SKIN CARE INGREDIENTS



5 PRODUCT DEVELOPMENT AT LUMENE LABORATORIES



6 TESTING OF PRODUCT SAFETY AND EFFICACY



7 PRODUCTION TAKES PLACE IN ESPOO FACTORY



8 SUSTAINABLY PRODUCED SKIN CARE, CRAFTED WITH FINNISH WILDERNESS



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Molok: Block Collection increases recycling rate




Block Collection


On-ground & Semi-Underground



Compact station




6-10 fractions



Max 100 m Walking distance to the closest station	Max 200 m Distance between two stations
20-50 Households	40-100 Users
Target group Single-family house in densely populated areas	

Excellent divisibility



6.5m

1.6m

Sorting close to home

- Collection of 6-10 waste fractions within a walking distance – even for single family houses
- Enables doubling of the recycling rate, 25 % -> 50 %
- Less transportation, less emissions
- More materials to recycling instead of incineration

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MOLOK[®]

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Neste: Innovative NEXBTL technology for the production of renewable traffic fuels

- Almost any oil or fat can be refined into Neste's renewable products. Raw materials include e.g. animal fat from food industry waste, waste and residues from vegetable oil refining, as well as vegetable oils.
- The **share of waste and residues** of all renewable raw materials is **already ca. 80 %**, with an aim to further increase the share
- The use of the product is **expanding** from traffic fuels also **to production of other chemical products such as plastic raw materials**



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St1 Biorefinery Production in Circular Economy

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

Waste & process residues sources



Food Industry & Retail



Municipal & Commercial



Wood Industry



Recycling

Feedstock & Sourcing
Partners

St1 Biorefinery Solutions



Etanolix®



Bionolix®



Cellunolix®

Technology & Development
Partners

Biorefinery products

Ethanol

Biogas

Heat &
Power

Advanced Biofuels & Renewable Energy

Animal
Feed

Organic
fertilizers

Carbon
dioxide

Agriculture & Nutrient Recovery



Bioproducts for various industries
and applications

- Bioplastics
- Biochemicals

Off take & Development Partners



Recycling is an important part of Yara's production and R&D

Yara implements recycling in its production by utilising raw materials, side flows and waste heat. Yara also promotes circular economy by researching and developing recycled nutrient solutions.

Recycled raw materials:

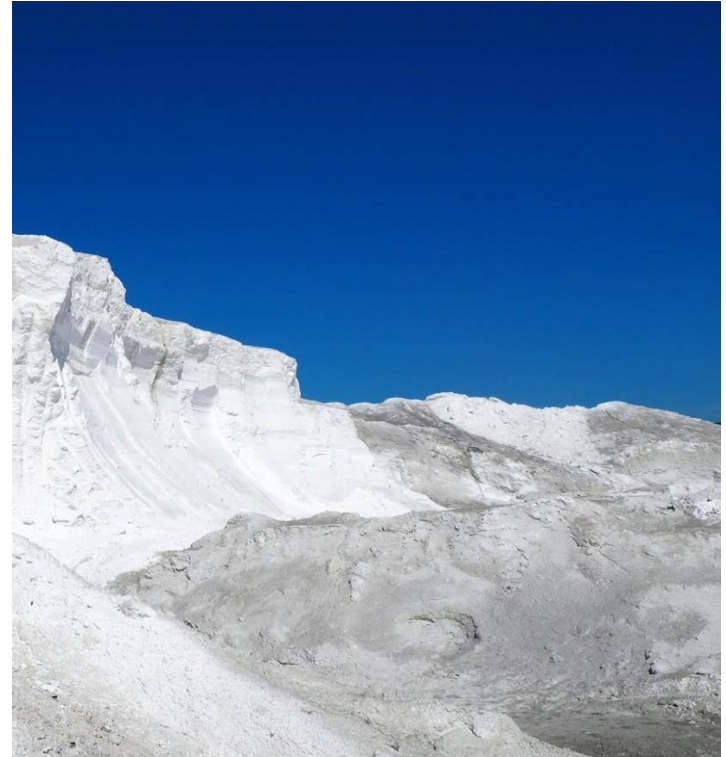
- Mineral pyrite from Pyhäsalmi mine to be used in sulphuric acid production
- Etching solutions from the electronics industry used in fertilizer production

Side flows for reuse:

- Iron oxide for the steel and cement industry
- Gypsum for effective water protection
- Carbon dioxide (CO₂) and hydrochloric acid for different industries
- Waste heat from own production used to heat homes

R&D of recycled nutrients:

- Supplemental solutions for recycled nutrients
- Research of recycled nutrients at Yara Kotkaniemi
- Recycled fertiliser R&D project with UPM



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Pramia Plastics: Granulate, Flake, Preform 100% recycled rPET



Pramia Plastic

**EVERYTHING
WE DO IS
100%
RECYCLED
rPET**

Granulate • Flake • Preform

WWW.PRAMIAPLASTIC.FI

Muovipoli: Boosting up bio economy and circular economy innovations

- New Plastics Center NPC



- R&D and testing services



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Facts & Figures about the Finnish Chemical Industry

<http://www.kemianteollisuus.fi/en/about-industry/facts-and-figures/>

We all **need** chemistry