



Overview of Europe - Activities on cellulose nanomaterials

PRESENTED BY:

Heli Kangas

Research Team Leader, Project Manager

VTT Technical Research Centre of Finland Ltd



Drivers for advanced biomaterials & nanomaterials



Legislation
e.g. EU bans single
use plastics
potential alternatives
from bio-based materials



Consumers
prefer green
solutions



**Sustainable
production,**
Abundant raw
material,
Utilisation of side
streams



**Biodegradability
Compostability
Recyclability**

Single-use plastics: New measures to reduce marine litter

Europe is tackling the 10 most found plastic waste items on Europe's beaches promoting sustainable alternatives.



Cotton buds

Ban on single use **cotton buds** made with plastic, to be replaced on the market with sustainable alternatives.



Cutlery, plates, straws & stirrers

Ban on single use **cutlery, plates, straws and stirrers** made with plastics, to be replaced with more sustainable alternatives.



Sticks for balloons and balloons

Plastic **sticks** for balloons to be banned and replaced with sustainable alternatives. On **balloons**, producers to contribute to awareness-raising, clean-up, collection, waste treatment and introduce new labelling on the environmental impact of the product and recycling options for consumers.



Food containers

Significant national consumption reduction of plastic **food containers**. Producers to contribute to awareness-raising, clean-up, collection and waste treatment.



Cups for beverages

Significant national consumption reduction of plastic **cups for beverages**. Producers to contribute to awareness-raising, clean-up, collection and waste treatment.



Beverage containers

Producers to contribute to awareness-raising, clean-up, collection and waste treatment of **beverage containers**; product design requirements to attach **caps and lids** to beverage containers; **90% separate collection target for plastic bottles**.



Cigarette butts

Producers to contribute to awareness-raising, clean-up, collection and waste treatment of **cigarette butts** and other plastic tobacco product filters.



Bags

Producers to contribute to awareness-raising, clean-up, collection and waste treatment of lightweight **plastic carrier bags**, in addition to existing measures in the existing Plastic Bags Directive.



Crisp packets/sweet wrappers

Producers to contribute to awareness-raising, clean-up, collection and waste treatment of **plastic packets and wrappers**.



Wet wipes and sanitary items

New labelling requirements for **sanitary towels and wet wipes** to inform consumers on environmental impact of the product and how to dispose of it properly. Producers to contribute to awareness-raising, clean-up, collection and waste treatment of **wet wipes**.

Fishing gear

Producers of fishing gear containing plastics will be required to cover the costs of waste collection from port reception facilities and its transport and treatment. They will also cover the costs of awareness-raising measures.

Source: EC



Cotton is the most widespread profitable non-food crop in the world. Its production provides income for more than 250 million people worldwide and employs almost 7% of all labor in developing countries. Approximately half of all textiles are made of cotton.

The global reach of cotton is wide, but current cotton production methods are environmentally unsustainable—ultimately undermining the industry's ability to maintain future production.

Bringing cotton production in line with even minimally acceptable environmental standards is a challenging task. WWF is working with a coalition of global partners to promote the sustainable production and use of cotton in a variety of ways.

20,000 LITERS

The amount of water needed to produce one kilogram of cotton; equivalent to a single t-shirt and pair of jeans.

CELLULOSE NANOMATERIALS – PRODUCTION STATUS

• FiberLean
• CelluComp

• Wicor
Weidmann (CH)
• InoFib (FR)
• Cosun Biobased
Products (NL)
• Sappi (NL)
• CTP/FCBA (FR)
• Melodea (IL)
• EMPA (CH)

• Betulium (FI)
• UPM (FI)
• Borregaard (NO)
• Stora Enso (FI)
• VTT (FI)
• RISE (SWE)
• PFI RISE (NO)
• BillerudKorsnäs
(SWE)
• SP Processum ,
Holmen, Melodea
(SWE)
• Norske Skog (NO)

• Commercial
• Pre-commercial
• Pilot
• Under
planning/construction

UPM Biochemicals



- Biofibrils are products based on micro- and nano-fibrillated cellulose which give liquid product formulations new rheological characteristics or strengthen material properties.
- [GrowDex®](#) is a novel wood-based cellulose nanofibril hydrogel for 3D cell culturing and other biomedical applications. It is highly biocompatible with human cells and tissues – but without any animal- or human-derived material.



UPM's FibDex®, A Wood-Based Innovation For Wound Care, Receives Regulatory Approval And CE Mark

UPM launches a new advanced wound care product for the European market. FibDex® is the first wound dressing created from wood-based nanofibrillar cellulose to receive regulatory approval and be awarded a CE mark. Nanofibrillar cellulose, which has been shown to be biocompatible with human cells and tissue, forms the core of the dressing. UPM's proprietary nanotechnology, combined with over a decade of research into nanofibrillar cellulose and a highly professional R&D, has resulted in the development of this unique product.

2017

2019

More with less with MFC

Building on a long partnership, Stora Enso is supporting Elopak with renewable innovations that can help them remain competitive. One such innovation is the New Natura Concept (NNC), based on Micro Fibrillated Cellulose (MFC).

PUBLISHED: 2/17/2016 9:30 AM

Aiming to make packaging as light as possible, Elopak initiated trials once MFC was available from Stora Enso's Imatra Mills.

"By using MFC, we get the maximum yield out of the raw material and thus more packaging material per ton of board. Important properties, such as stiffness and internal strength, are maintained, with less weight. Within Europe, there are various incentives and regulations to reduce the weight of packaging material. The

partnership with Stora Enso makes it easier for us to reach these targets," says Tom Egenes, Director Strategic Sourcing at Elopak.

As an international supplier of paper-based packaging solutions for liquid food, Elopak is continually developing its expertise to match changing demands for packaged food. The company depends on secure supply. "We have converting plants in Europe, Russia and North America, so it is crucial to have a partner that can supply 24/7. Sourcing from two Stora Enso mills with the exact same quality gives us peace of mind and ensures that the value chain is never broken."

Elopak has piloted the NNC in the Eastern European market, offering it to all dairies in the region. More than 100 million packages have been produced successfully. During 2016, Elopak intends to test NNC board in Western Europe.

A future for MFC

In January this year, Stora Enso announced investments in its consumer board mills in Imatra and Ingerö, Finland, and Fors, Sweden. The intention of these investments is to continue the commercialisation of microfibrillated cellulose (MFC) as well as accelerate product development.

PUBLISHED: 2/17/2017 9:00 AM

packaging while maintaining stiffness and internal strength.

In packaging, MFC brings advantages in source reduction, strength enhancement, lightweighting and renewable barrier materials. Due to its exceptionally high strength properties and 100% renewable raw materials, MFC is designed to outperform current fossil-based materials, such as plastics, in a variety of applications.

"There is a big pull in the market for fossil-free materials for the packaging industry. Plastics in the sea, global warming and mounting waste – these are all challenges and pressing consumer and industrial demand for better solutions. Additionally, major companies and brand owners have targets to reduce their environmental footprint. We are all on the same train here," says Jukka Kankkunen, who works with the MFC Commercialisation, Consumer Board.

Moving ahead, Stora Enso will continue to focus on source reduction and fibre-based packaging that consumes less raw materials. In parallel, we are exploring barrier layers for grease, mineral oil and oxygen, as well as biodegradable film as a replacement for aluminum in paperboard packaging. These have potential in markets such as fast food and long shelf-life products like jams, juice, sports drinks, candy and snacks.

"According to one of our customers, aluminum film carries as much as 50% of the CO2 footprint of their primary packaging material. Imagine millions and millions of food and beverage products. Reducing the aluminium component could make a big difference," concludes Jukka.

Initially focused on the liquid packaging board segment, Stora Enso is the first company to have successfully launched a commercial paperboard packaging including MFC. Commercial activity started in 2015 at the Stora Enso Imatra plant, which is the world's largest MFC facility. Today, raw material is provided for selected commercial consumer board solutions, enabling lighter weight

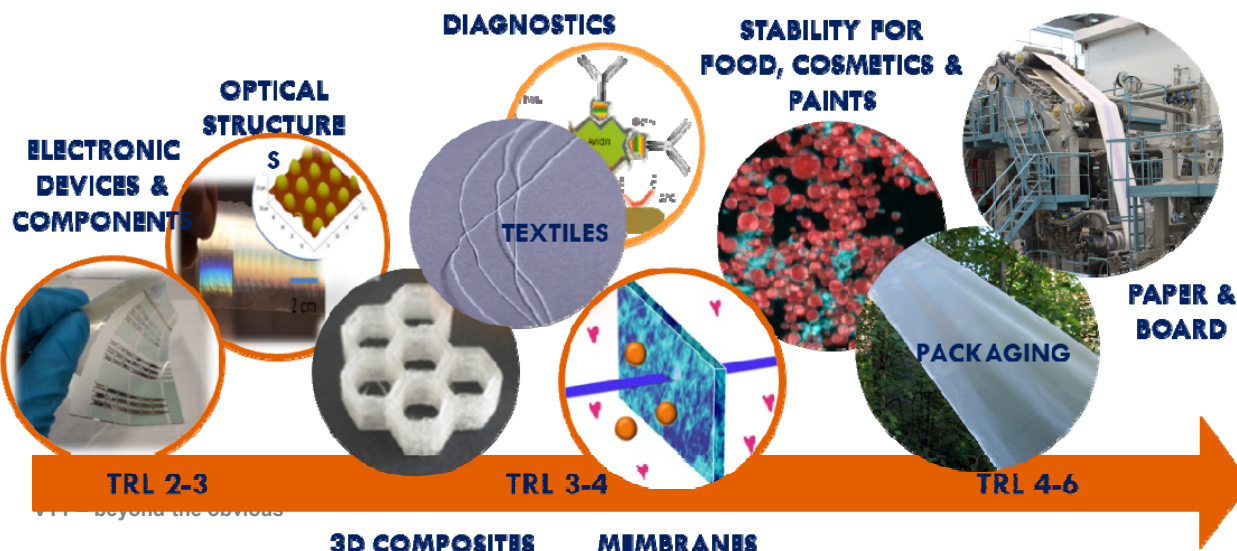
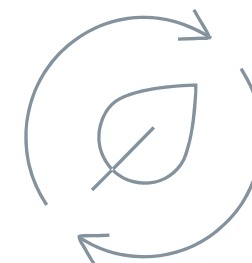
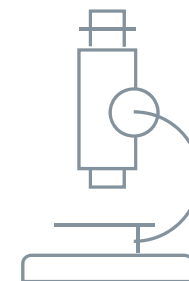
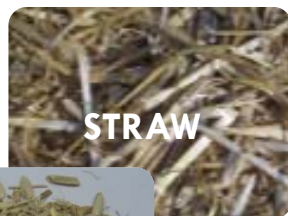
OUR TOTAL OFFERING

[Biomaterials](#)

[Packaging](#)

[Paper](#)

[Wood Products](#)



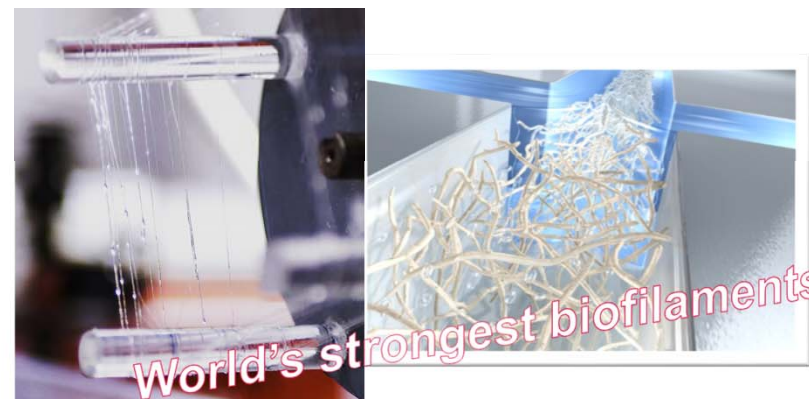
Nanocellulose activities at RISE Research Institutes of Sweden



Transportable mobile production plant for nanocellulose CNF pilot in Stockholm



Up-scaling of nanocellulose filaments through flow-focusing



CNC pilot in Örnsköldsvik



Nanocellulose films for printed electronics



Advanced characterization of CNF



BillerudKorsnäs

Mobile factory that produces nanocellulose, 2014

Exploring new technologies - launches full scale tests adding MFC to its paperboard, 2016

CNC pilot

The pilot plant for production of CNC based on Melodea's technology, which has been built on the site in Örnsköldsvik, is currently undergoing final adjustments and start up trials (status May 23, 2019).

The plant will be the first of its kind in Europe and is an important step for enabling large scale production of crystalline nanocellulose for research and industrial development applications.

The pilot is owned by RISE Processum, Holmen, MoRe Research and Melodea.

EXILVA FROM BORREGAARD

Active customer prospects

- >20 applications
- Net increase ~50 prospects per month

Industrial scale production

- Current capacity 10 000 tons 10% paste
- Prepared for rapid expansion

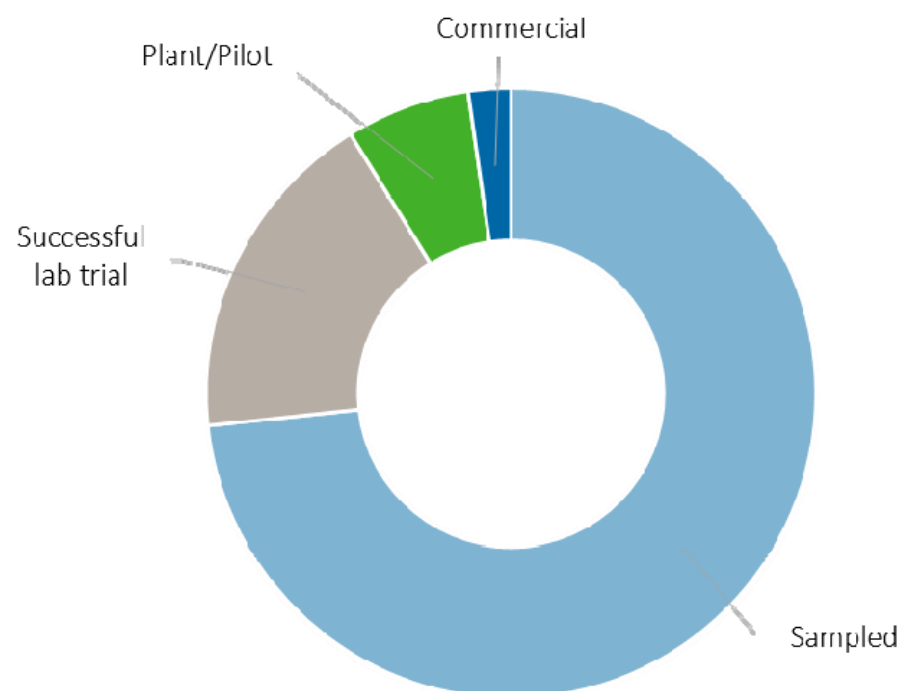
Time to market (from sampled)

- 3-5 years

Challenges

- Secrecy limits feedback and support
- Handling, dosing, scheduling
- Crowded IP landscape

Active customer prospects >1500



RISE PFI, Nanocellulose research

Engineering of nanocelluloses for various applications, examples:

- **Paper and packaging**
 - Printing paper
 - Barrier properties
 - Plastic substitutes
- **Rheology and emulsions**
 - Enhanced oil recovery
 - Drilling fluids
 - Paint
 - Foodstuffs
 - Personal care products and detergents
 - Cement
- **Medical applications**
 - Wound healing
 - Tissue engineering
 - Drug delivery



Paper



Packaging



Oil field
applications



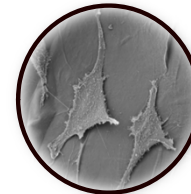
Food



Cement



Wound healing



Tissue engineering

- The product is a MFC-mineral composite, produced by co-grinding the mineral with fibre to transform the fiber into MFC.
- A full-scale commercial supply of MFC is in operation.
- Solutions for papermaking and packaging – for strength increase.

Curran® is a product by



- Microfibrillated cellulose based on waste streams of root vegetables.
- Production of Curran® fibres and granules (solids content around 20%)
- Application areas include e.g. biocomposites and rheology modifiers in paints & coatings, concrete, drilling fluids, cosmetics, personal care and home care products.



- Sappi has built a pilot-scale plant for CNF production, at the Brightlands Chemelot Campus in The Netherlands.
- Low cost cellulose nanofibrils (CNF) production with a unique patented process.
- The plant has been designed to produce CNF, but will also be capable of producing CMF.
- The CNF produced by Sappi has unique morphology, and can be specifically modified for either hydrophobic or hydrophilic applications.
- Potential applications for CNF include lighter and stronger fibre-reinforced composites and plastics in the production of next-generation lighter, fuel-efficient vehicles, thickening water-based products such as paints, foods and concrete, future replacement for plastic films in composite packaging, films in lithium batteries and touch-screens and biomedical applications such as wound dressings and regenerative medicine.



- Cosun's Betafib is a micro cellulosic fibre derived from vegetable raw materials (residual flows).
- Produced by patented processing without chemical modification.
- Betafib delivers high suspension efficacy and at the typical low dosage levels it becomes a cost efficient enabling technology.
- The excellent shear thinning and 3D structuring behavior of Betafib is caused by its specific morphology at micro scale level.
- Potential applications include e.g. liquid detergents, paints and coatings and oil and gas.



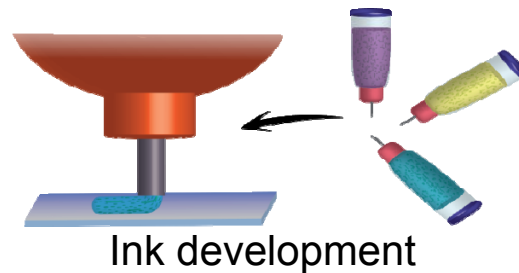
- Weidmann MicroFibrillated Cellulose (WMFC) is a product based on high quality pulp and carefully separated cellulose fibrils with high aspect ratio and narrow particle size distribution, free of chemical side groups.
- WMFC can be made of several raw materials like wood pulp or fiber from perennial plants.
- Weidmann Fiber Technology has commissioned its pilot facility in August 2015 and able to provide its materials to the market.
- Several MFC grades, including WMFC Q_advanced, eco and custom.
- Potential applications include oleophylic sponges, board&paper, building industry, filtration / environmental remediation and cosmetics.

Nanocellulose activities at Empa



NCF production

Printed cellulose materials & devices

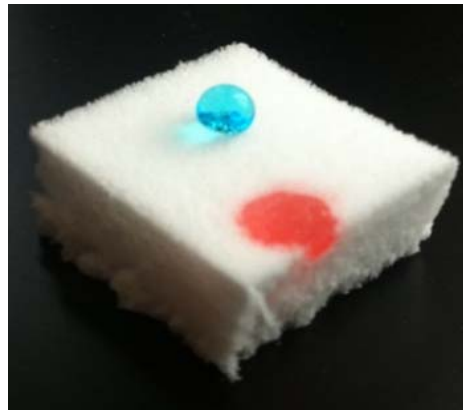


Printed functionality



Autonomous operation

Cellulose for cultural heritage



Foams/Sponges



Material and process development

CTP / FCBA - InTechFibres



- Manufacture of micro- and nano-objects from lignocellulosic material.
- NaMiCell platform for manufacturing of microfibrillated cellulose.
- Chemical, enzymatic and mechanical pre-treatments.
- Laboratory and pilot scale (30-70 kg/day) production.



- Production based on commercially viable and sustainable process that allows the production of Cellulose Nano Crystals from the sludge of the pulp and paper industry and other sources.
- Potential applications include paper and paperboard, bio-based packaging, acrylic glues, paints, adhesives and cement.
- Melodea also develops unique technologies that utilize the self-assembly properties of Melodea CNC into high barrier coatings

Microproducers



Natural Fibres for Volume Industries

Betulium Oy is a Finnish clean-tech company established in 2013. Betulium provides renewable, biodegradable, and high-performance water-based cellulose materials to replace or supplement synthetic organic polymers in a vast number of industrial applications. The company manages versatile production premises and application laboratories in Espoo, Finland and currently employs cutting-edge professionals in the field of material science with valuable experience in entrepreneurship, business development, and international business.



Academia

FINLAND

- Aalto University – Professors Rojas, Kontturi, Maloney
- Åbo Akademi – Prof. Toivakka
- University of Tampere
- University of Oulu – Prof. Liimatainen
- University of Eastern Finland

SWEDEN

- KTH Royal Institute of Technology
- Stockholm University
- Mid Sweden University

UK

- Imperial College
- Edinburg Napier

FRANCE

- Grenoble INP Pagora

BELGIUM

- KU Leuven

Slovenia

- University of Maribor

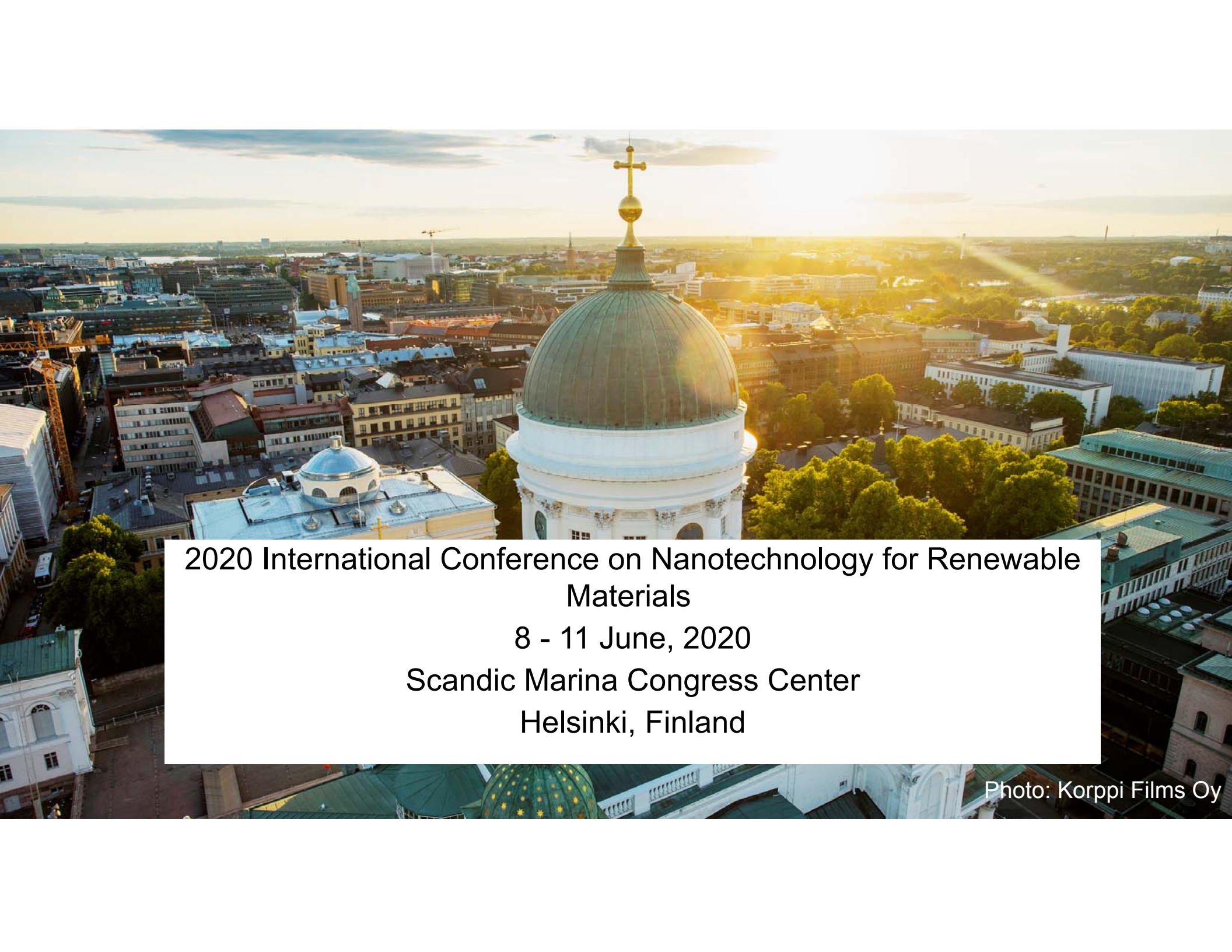
Acknowledgements

Kristin Syverud, PFI RISE

Gilberto Siqueira, EMPA

Mats Hjørnevik & Hans Henrik Øvrebø, Borregaard

Anna Calmark, RISE

An aerial photograph of Helsinki, Finland, taken at sunset. The sun is low on the horizon, casting a warm golden glow over the city. In the foreground, the large green copper dome of St. Nicholas Cathedral is prominent, topped with a golden cross. The city's dense urban landscape, with various buildings and green spaces, stretches out behind the cathedral.

2020 International Conference on Nanotechnology for Renewable Materials

8 - 11 June, 2020

Scandic Marina Congress Center
Helsinki, Finland

Photo: Korppi Films Oy



Thank you

PRESENTED BY

Heli Kangas

Research Team Leader, Project Manager
VTT Technical Research Centre of Finland Ltd
Heli.kangas@vtt.fi

