

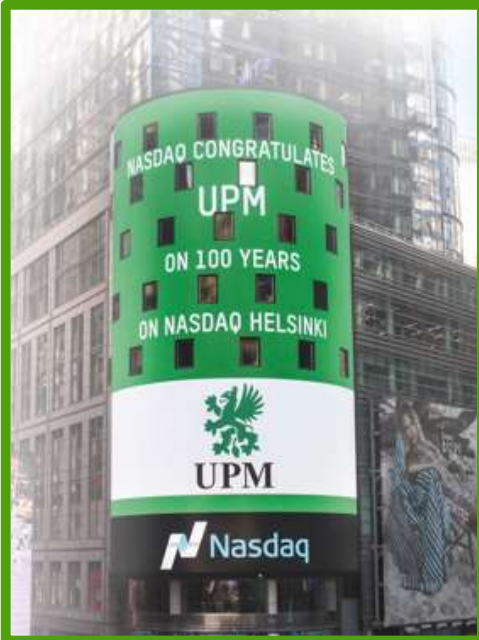
GROWDEX® - AN INNOVATIVE WOOD CELLULOSE-BASED MATRIX FOR 3D CELL CULTURING

EuroNanoForum

June 21, 2017
Juuso Konttinen
VP, UPM Biochemicals



COMPANY



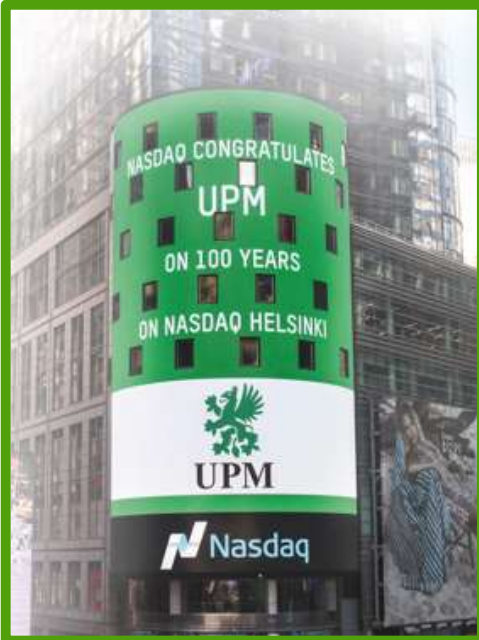
NANOCELLULOSE



COMMERCIALIZATION



COMPANY



NANOCELLULOSE



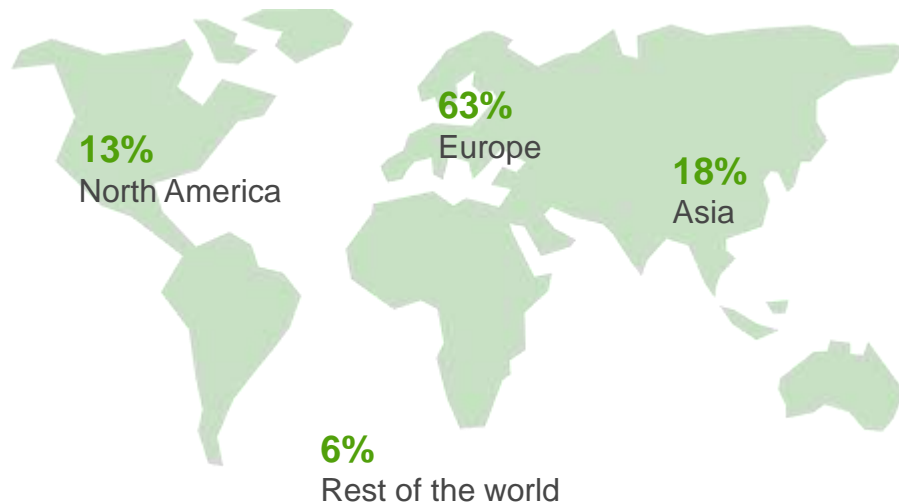
COMMERCIALIZATION



Global businesses – local presence

UPM's sales by market 2016

EUR 9,812 million



54
production plants
in **12** countries



19,300
employees
in **45** countries

12,000
customers
in **120** countries

85,000
shareholders
in **40** countries

55,000
suppliers
in **70** countries

UPM today



UPM BIOREFINING

Pulp
Plantations
Biofuels
Sawmills
Wood Sourcing
and Forestry



UPM ENERGY

Hydro-, nuclear-
and condensing power
(incl. shares in energy
companies)
Electricity production
and trading



UPM RAFLATAC

Label materials
for product and
information labelling



UPM SPECIALTY PAPERS

Fine and specialty
papers in China and
APAC
Labelling material
globally



UPM PAPER ENA

Magazine papers,
newsprint and fine
papers for various
end-uses



UPM PLYWOOD

Wisa® Plywood
and veneer products
UPM Grada®
wood material



UPM BIOCOMPOSITES

UPM ProFi
UPM Formi

UPM BIOCHEMICALS

Chemical building blocks
Lignin products
Biofibrils
Biomedical products

External proof of our responsibility

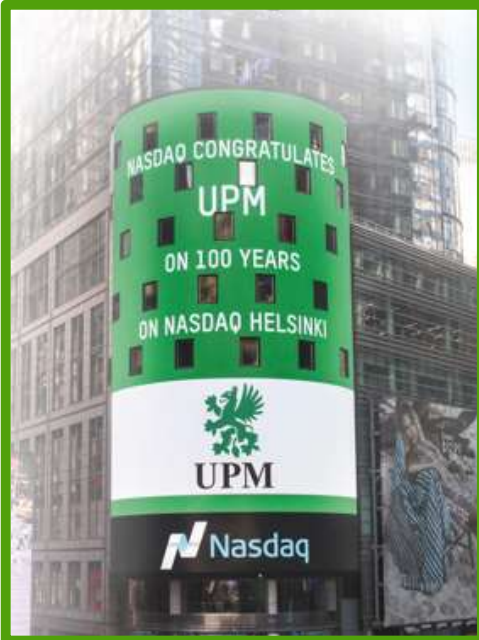
The wood we use and our products are verified by third party certificates and ecolabels.



Our consistent efforts in responsibility have received recognition from several third parties and made us one of the industry leaders in several indices.



COMPANY



NANOCELLULOSE



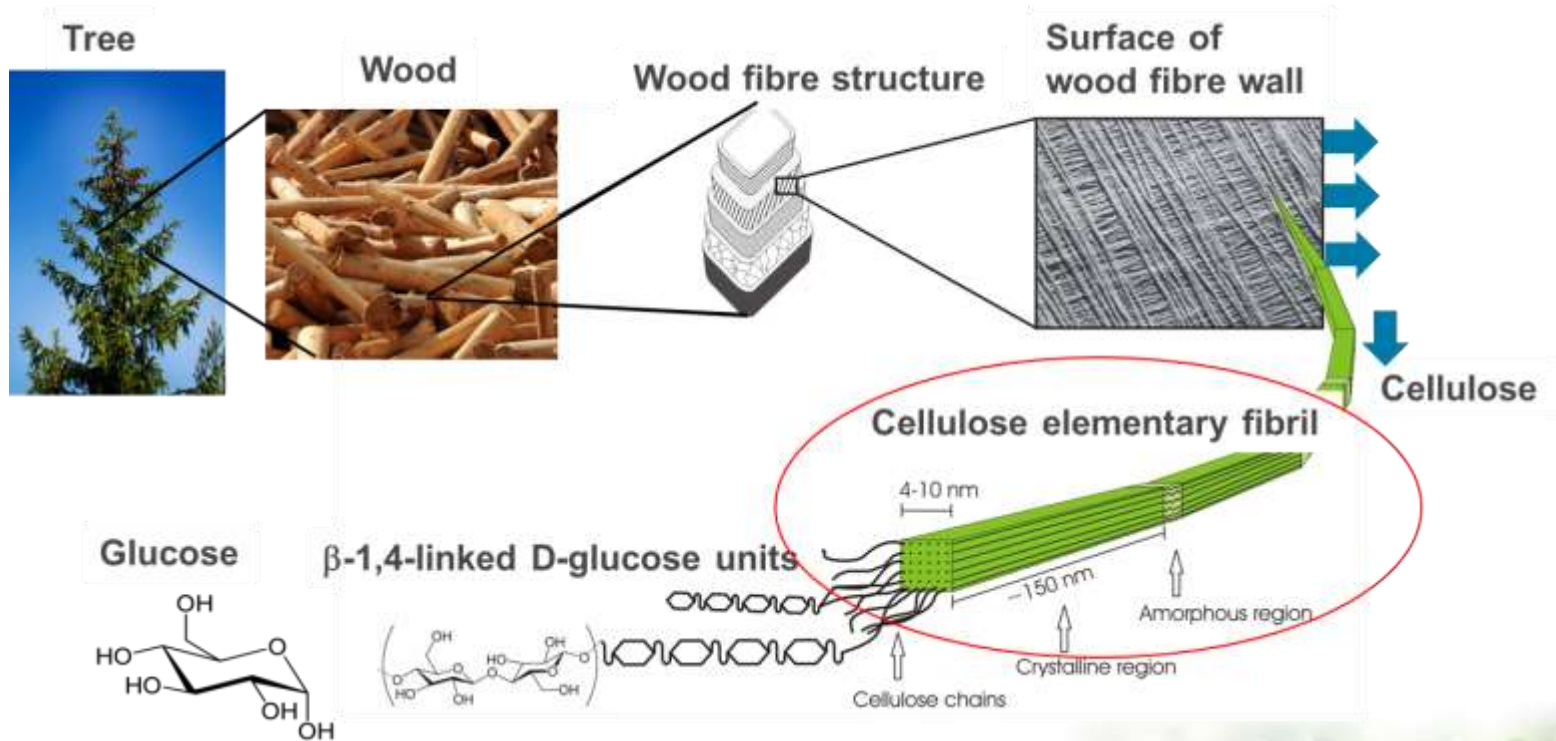
COMMERCIALIZATION



Biofuels and biochemicals are natural evolutionary steps in wood based value creation

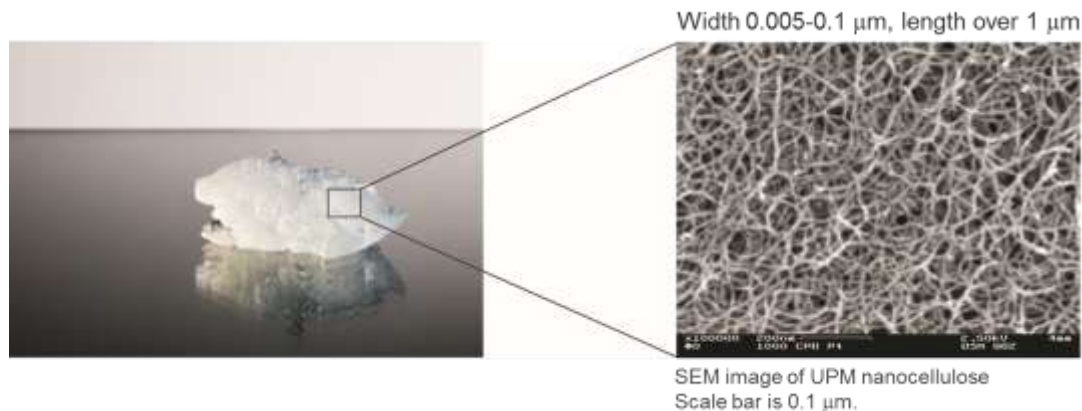


Nanocellulose originates from trees



Nanocellulose is a material innovation

- Due to the high specific surface area (small size) and hydrophilicity, the cellulose elementary fibrils, *i.e.* Biofibrils, form a strong hydrogel with water



- Biofibrils have typically very high aspect ratio: the length might be several micrometers while the diameter is in nanometer scale

GrowDex[®]

— NATURAL GROWTH —



Key material properties of GrowDex®

- Plant based *i.e.* non-animal based
- Highly viscous *i.e.* high gel force and tunable
- High water retention
- Pseudoplastic - pipettable and injectable in gel format
- Tolerates salts, temperatures and pH (hydrogel pH 6-7)
- Storage and handling in room temperature
- Not autofluorescent
- Semitransparent


- Very low batch to batch variation
- Scalable production at UPM
- Possibility to use in clinical applications



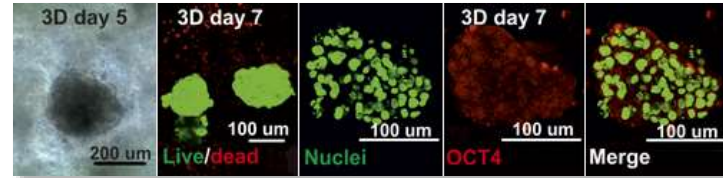


Enabling development of new medical treatments

GrowDex®
cellulose based hydrogel
for life science applications



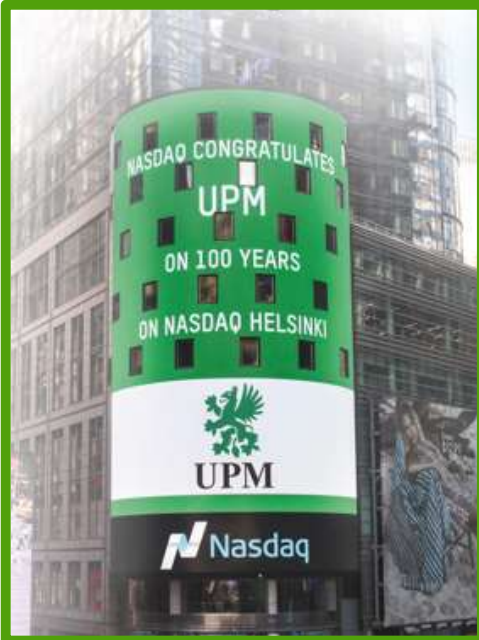
3D Cell Culturing Matrix for e.g. Cancer Research



Membranes for e.g. Wound Care Applications



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NANOCELLULOSE



COMMERCIALIZATION



UPM nanocellulose journey

UPM makes the first nanocellulose tests

< 2006



First cell culture tests with Helsinki University. UPM starts to build its IPR portfolio

2008



2008

UPM establishes Finnish Nanocellulose Centre together with scientific partners



Marketing of GrowDex® starts, first fairs and customer tests

2014



2012

First scientific articles related to GrowDex™, research continues



2015

Several organizations are using and testing GrowDex®. Business is expanding to new applications



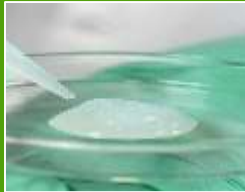
UPM Biomedicals - a new life science platform opportunity for future



UPM BIOMEDICALS



CELL CULTURING PLATFORM



WOUND HEALING PLATFORM



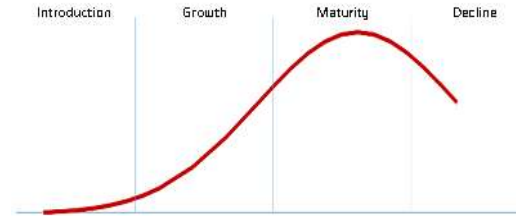
OTHER NEW PLATFORMS



RIGHT PEOPLE



RIGHT TIME



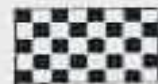
RIGHT PLACE



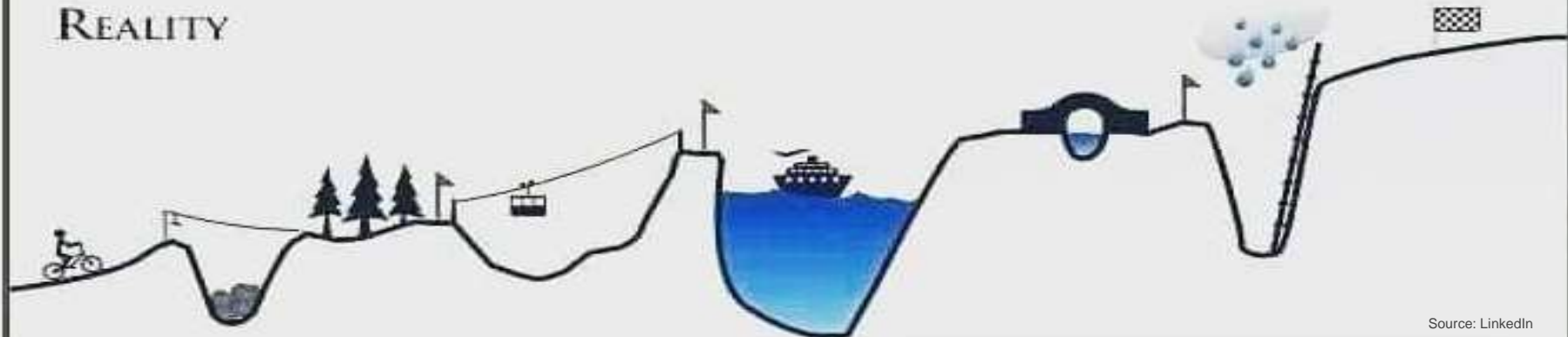
RIGHT LEADERSHIP



YOUR PLAN



REALITY



Source: LinkedIn



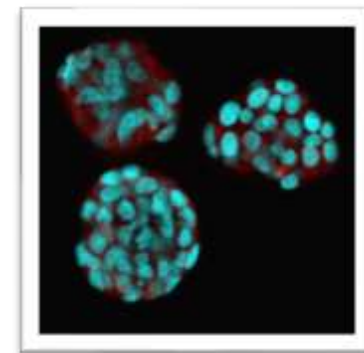
UPM

The Biofore
Company



3D cell culture

- **GrowDex®** supports 3D cell culturing, e.g. liver cell, liver cancer cell, ESC, iPSC, etc.
- Published results (by Helsinki University)
 - WA07, human embryonic stem cell line
 - iPS(IMR90)-4, iPS-DF19-9-7T, human induced pluripotent stem cell lines
 - HepG2, human liver carcinoma cell line
 - HepaRG, hepatic progenitor cell line
 - ARPE-19, human retinal pigmented epithelial cell line
- Several other cell types have been tested/are being tested (unpublished)



HepG2 spheroids cultured in 3D NFC hydrogel (© Liisa Kanninen, Helsinki University)



1. **GrowDex®** can simply be mixed with culture media and cells due to its fluid characteristics
2. **GrowDex®**'s concentration and stiffness can easily be modified to provide optimal environments for different cell types
3. **GrowDex®** is a continuous gel matrix allowing diffusion of small molecules such as nutrients and oxygen
4. **GrowDex®** nanofibril network physically resembles human ECM
5. **GrowDex®** is biocompatible and supports growth of various cell types and e.g. formation of 3D spheroids
6. **GrowDex®**'s cellulose nanofibril matrix can easily be degraded with cellulase enzyme while retaining the grown cell structure
7. **GrowDex®** enables hPSC culturing without feeder cells, no genotoxicity found
8. **GrowDex®** can be used in multidispensers and automatic pipetting systems