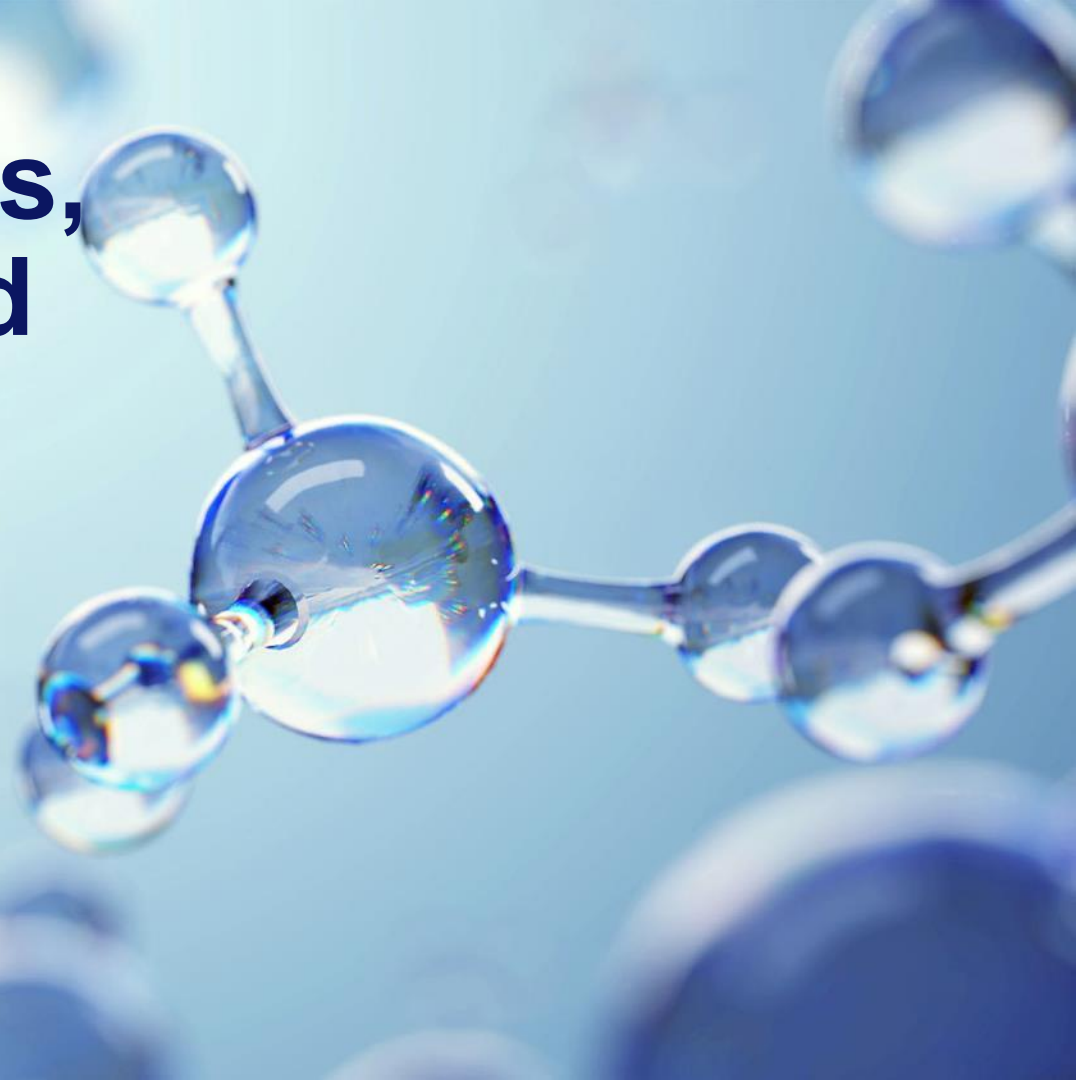


VTT - Microbes, enzymes, food research and more

July 18, 2018

BIO World Congress on Industrial
Biotechnology

Mervi Toivari



VTT – impact from excellence

VTT Technical Research Centre of Finland Ltd is one of the leading research, development and innovation organizations in Europe. We help our customers and society to grow and renew through applied research. The business sector and the entire society get the best benefit from VTT when we solve challenges that require world-class know-how together and translate them into business opportunities.

Our vision

A brighter future is created through science-based innovations.

Our mission

Customers and society grow and renew through applied research.

Strategy

Impact through scientific and technological excellence.

Established in

1942

Owned by

Ministry of
Economic
Affairs and
Employment

258 M€

Net turnover and
other operating
income (VTT
Group 2017)

2,368

Total of personnel
(VTT Group
31.12.2017)

27%

Doctorates and
Licentiates
(VTT Group
2017)

36%

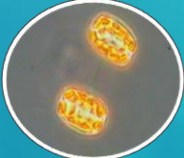
from abroad
(VTT Group
2017)



VTT INDUSTRIAL BIOTECHNOLOGY AND FOOD RESEARCH



Yeasts and bacteria



Algae and cyanobacteria



Enzymes *in vitro* & *in vivo*



Plant cells



Filamentous fungi

GMO and non-GMO biotechnical tools, process development, piloting

Food and beverage

Chemicals

Pharma

Biofuels

Industrial enzymes

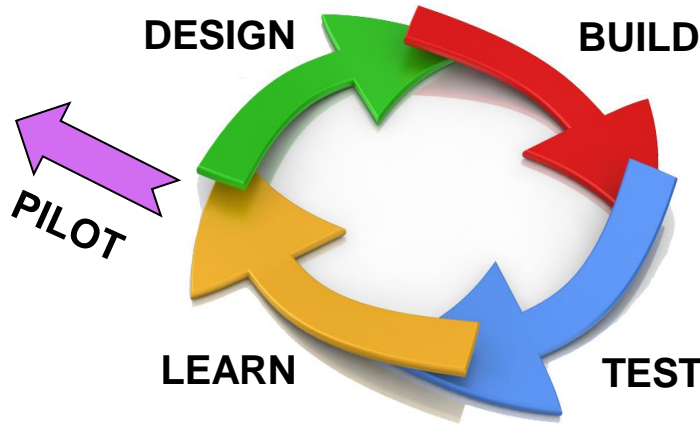
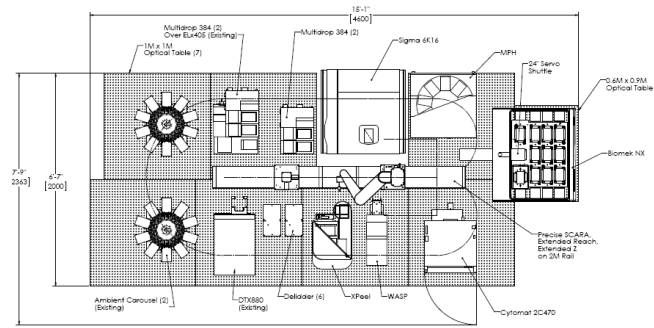
Cosmetics

Bioplastics



National Bioeconomy infrastructure From synthetic biology to piloting

A versatile computing platform for design, prediction and analysis



A robotic platform for efficient DNA assembly, transformation and strain screening

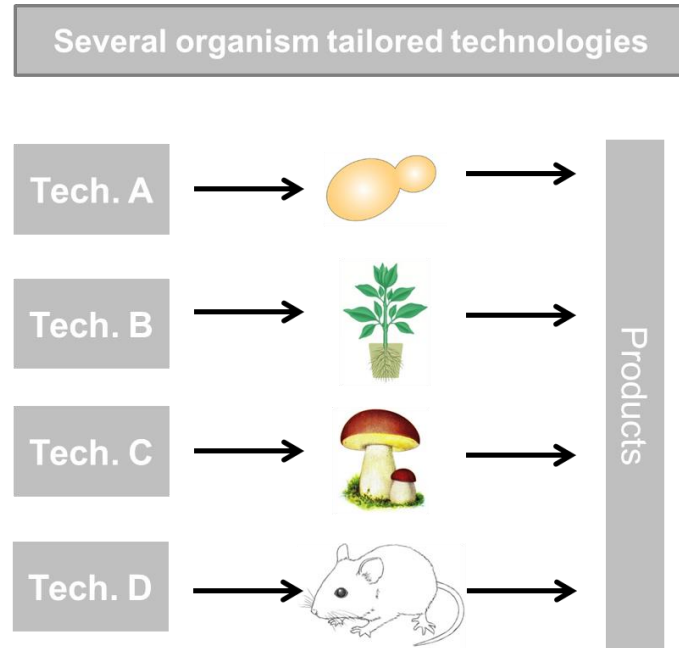


Controlled parallel bioreactor systems with automated sampling and analytics

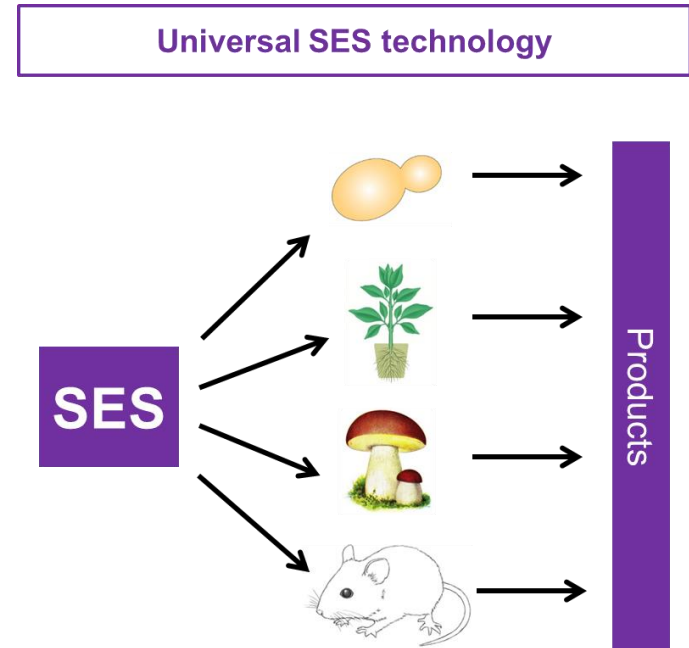


Need for synthetic biology tools: A novel, simplified solution for gene expression

Current situation

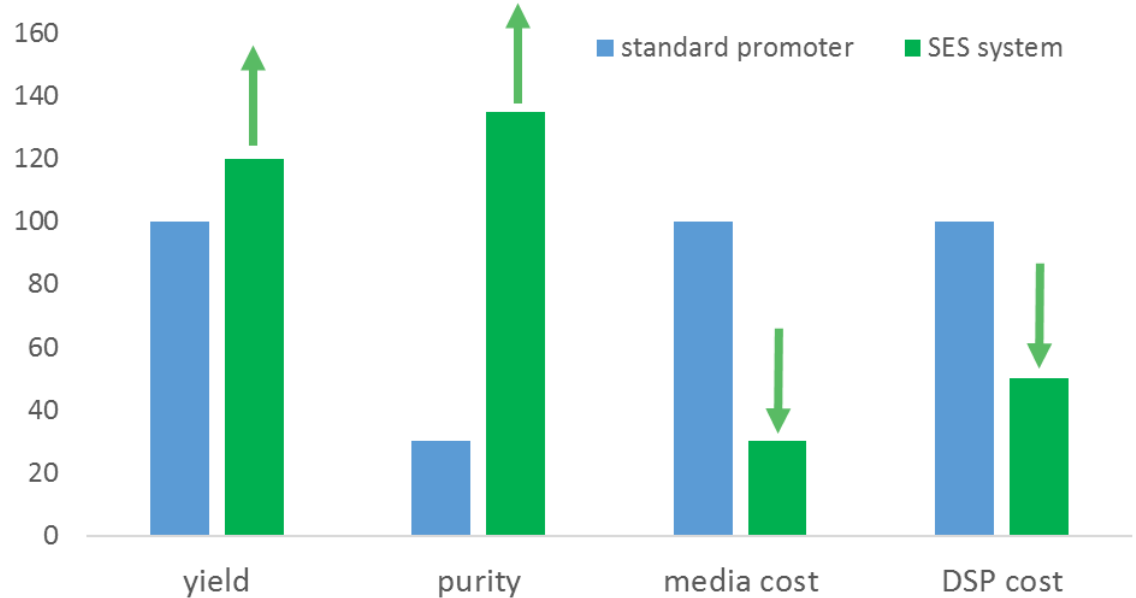


SES solution



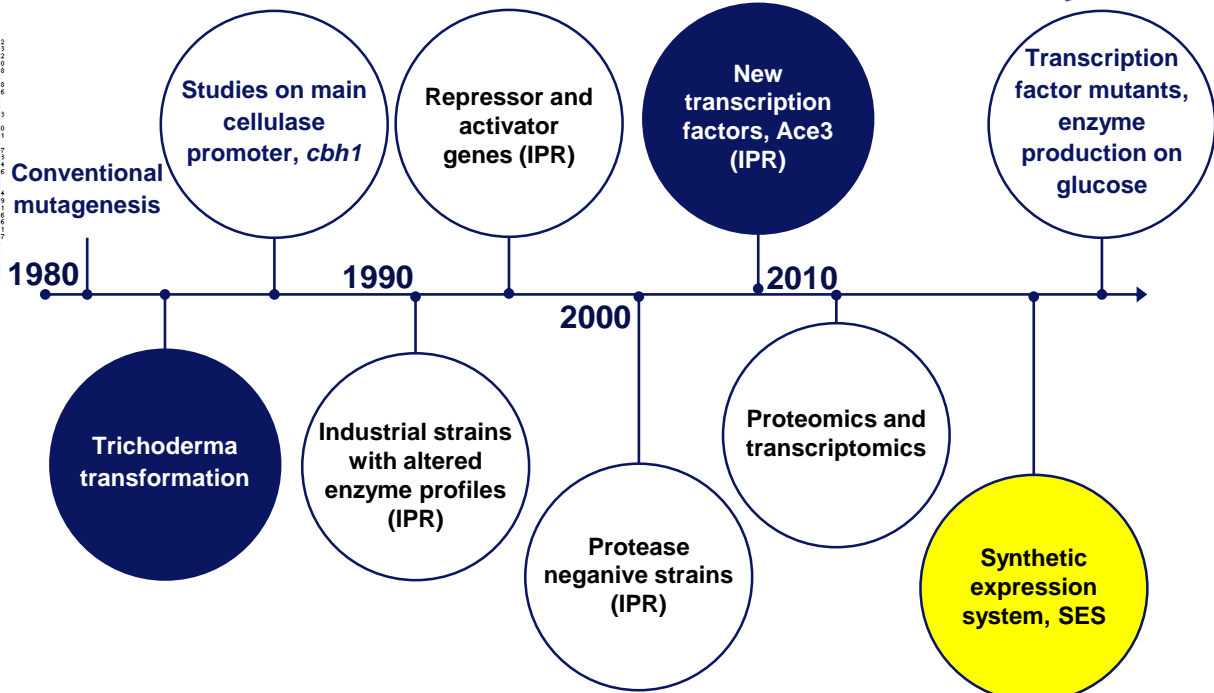
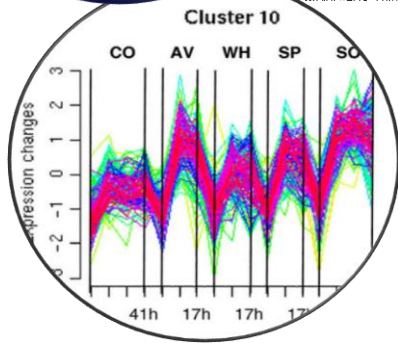
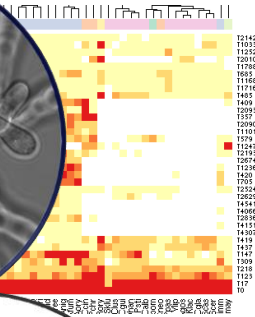
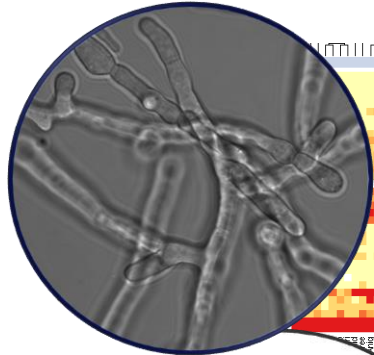
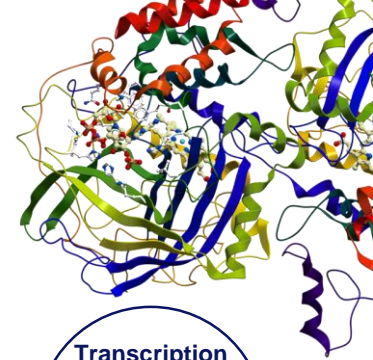
The SES system for protein production in *Trichoderma reesei*

- Robust and shorter bioprocess
- Simpler media
- Higher productivity
- Unprecedented purity
- Less downstream processing
- Universal for all fungal hosts



Cost efficient on-site cellulase production

VTT's path to improved cellulase strains



Milk without Cow

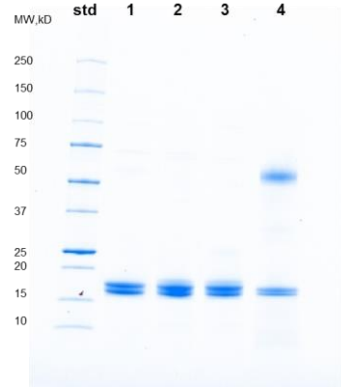
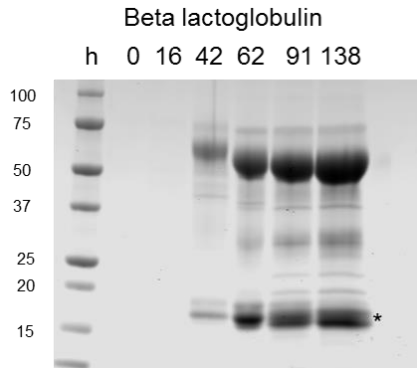
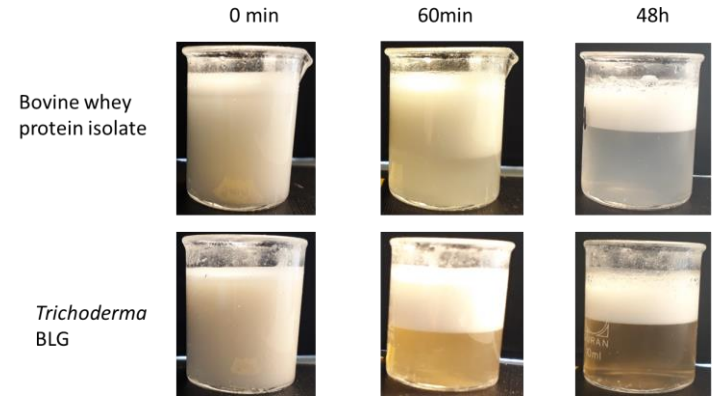
Beta lactoglobulin (BLG)

Produced by *Trichoderma reesei* in bioreactors reaching levels up to 4 g/L

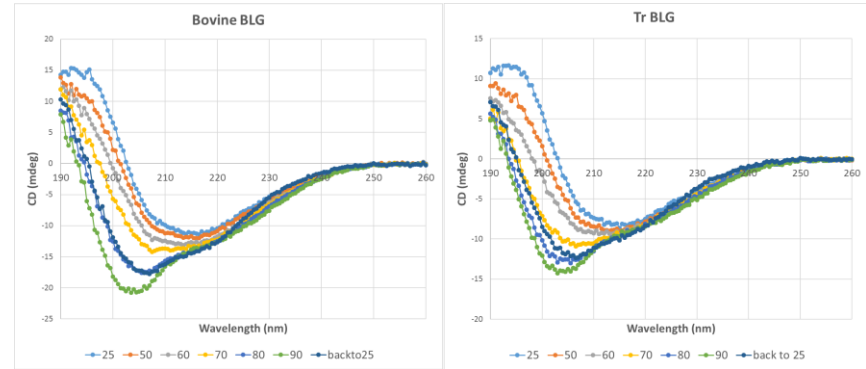
Purified protein has similar folded structure compared to the bovine material

Emulsions also look similar to the bovine reference

Emulsions made with 0.05% gellan gum



Secondary structure (far UV)



Egg without Chicken

Ovalbumin

We have produced it using *Trichoderma reesei* in bioreactors at levels reaching 4 g/L

Functional testing has been done to confirm that it forms gel structures and it foams

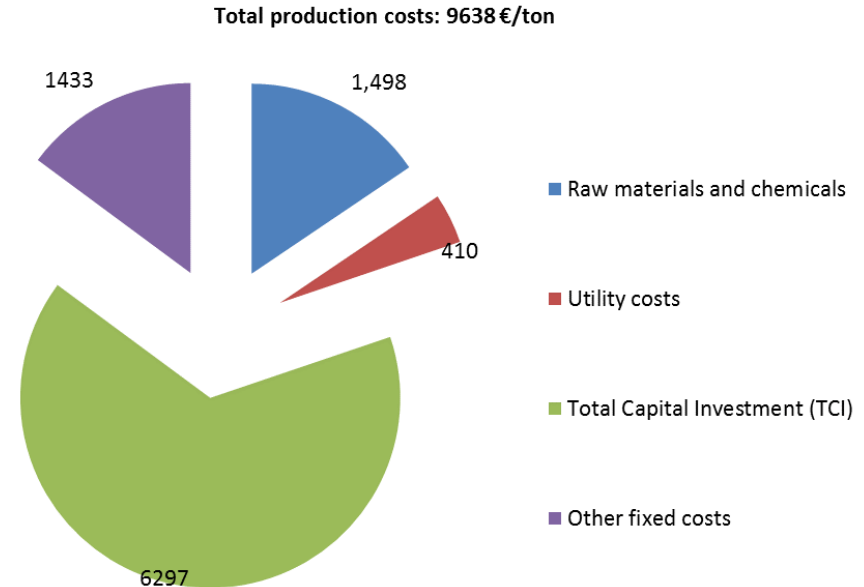
Ready for scale up and further functional testing

4 g

Productivity
per litre

Costs on a par with Chicken

- Egg albumin 6000-12 000 euros/ton
(a very cheap protein)
- Calculated cost of ovalbumin produced by *Trichoderma* in a 100 m³ bioreactor
(assuming only 1 g/L production level)
 - **Total cost ~ 9500 euros/ton**
 - **Cost reduces further > 100 m³ scale**



Food Economy 4.0 - Smart food brings wellbeing for the planet & people

1.0 Hunting & collecting



2.0 Agriculture



3.0 Mass production of food



4.0 Smart food production



Healthy & sustainable food ingredients

Agile food manufacturing

Solutions at consumer interface

Food economy 4.0



VTT's vision of an era of smart consumer-centric food production

Plant Cells as Food

Plant Cells

produce many of the same valuable molecules as whole plants and have therefore been used in pharmaceutical and cosmetic industries. Now they are entering food.

21-37%

Dietary fibre

14-19%

Protein



Valuable phenolics

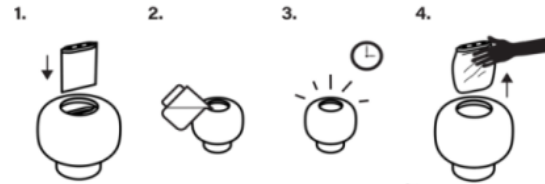
Suvanto et al 2017, <https://www.ncbi.nlm.nih.gov/pubmed/28382519>

Nordlund et al 2018, <https://www.sciencedirect.com/science/article/pii/S0963996918301388>

A home bioreactor

Growing plant cells for food may take place even at home. Ultra local and ultra clean.

Way to build familiarity



Food From Air

Solar Foods produces an entirely new kind of sustainable
nutrient-rich protein using air and electricity.



SOLAR FOODS

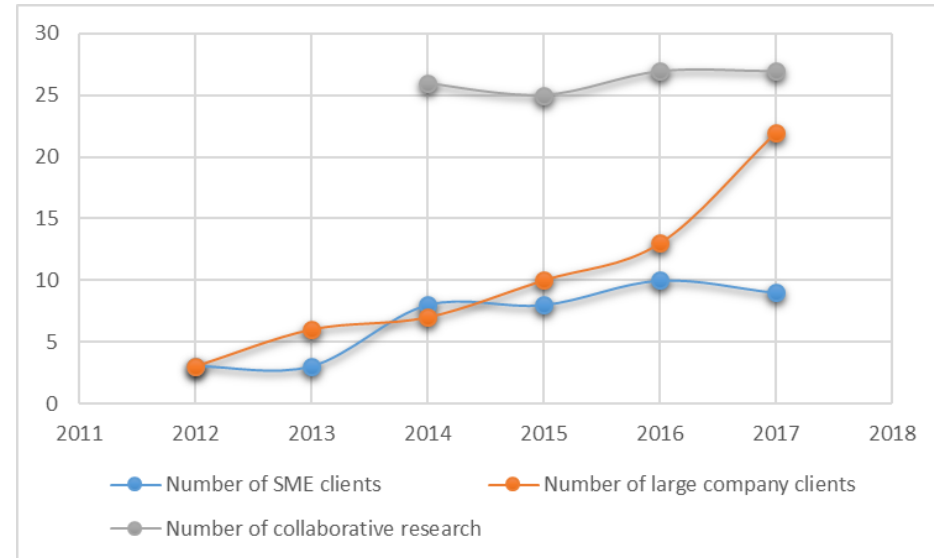
VTT industrial biotechnology and food research offers

- **One-stop-shop:** Strain and process development, bioinformatics, enzymology, analytics, techno-economics, patent surveys – All services and expertise from one organization
- **VTT Background IP available for licensing**
- **Flexible business models**
- **Customer owns project results**
- **Faster market entry**



VTT industrial biotechnology project portfolio

- Strong growth in VTT industrial biotechnology customer assignments, especially with large companies during the past 5 years.
- About 70% of the VTT Ind Biotech commercial operations are with international customers
- Roughly 30 jointly funded research per year
- SynBio start-up companies are our customers, and the SES-synthetic promoter system is currently under testing in several companies.



Open positions!

<https://jobs.vtt.fi/vacancies>

- Research Scientist for metabolic engineering and synthetic biology
- Research professor, Food Production
- Research professor, Bioengineering



FREE VTT WEBINARS 2018

MAY 17

Food without Fields

Cellular agriculture for sustainable food production

JUNE 7

3D printing of cellulosic materials

Enabling On-demand production of novel applications

AUGUST 30

Zero waste packaging: Bio-degradable cushioning

Light-weight, bioinspired packaging solutions

SEPTEMBER 27

Cellulose-based plastics

Thermoplastics out of cellulose renewing the industry

NOVEMBER 15

Mastering shredder residues with organics

Improved energy and material recovery by gasification



Register at: makingoftomorrow.vtt.fi/webinars



Thank you for your attention!



**A brighter future is created
through science-based innovations.**



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