

SynBioTec  
ERA Chair in Synthetic Biology  
University of Tartu, Estonia

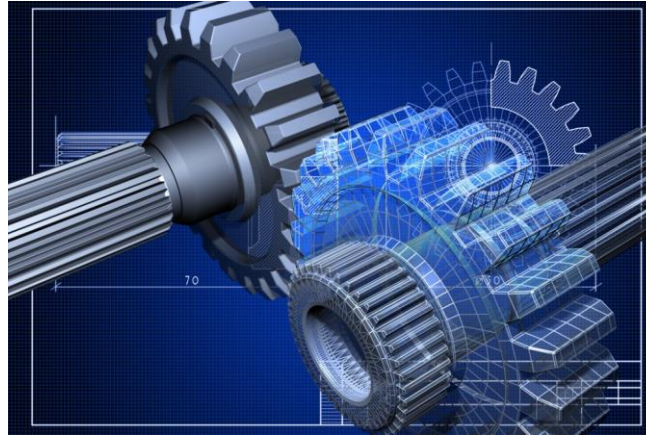
Petri-Jaan Lahtvee  
ERA Chair holder  
10.10.2017



# Institute of Technology



- Molecular biology
- Plant signaling
- Virology
- Biochemistry
- Synthetic Biology



Biology + Engineering = Synthetic Biology

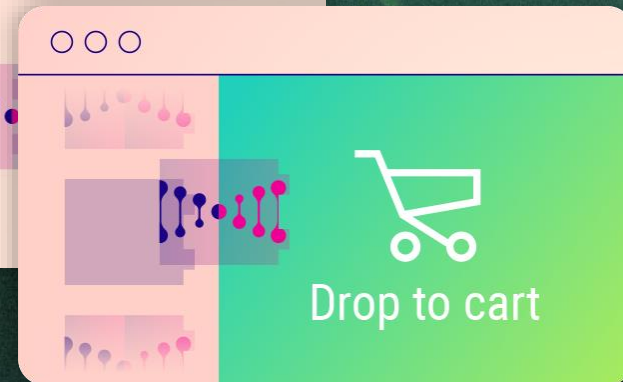
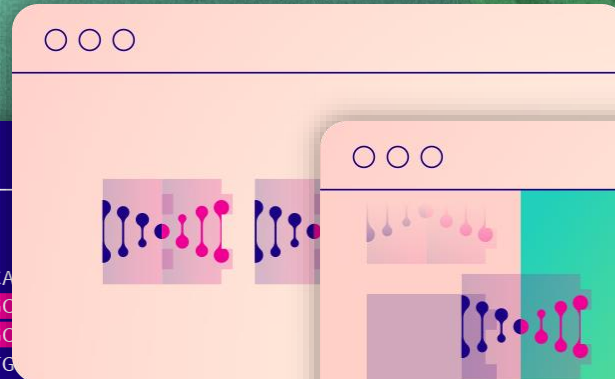


# Reprogramming life

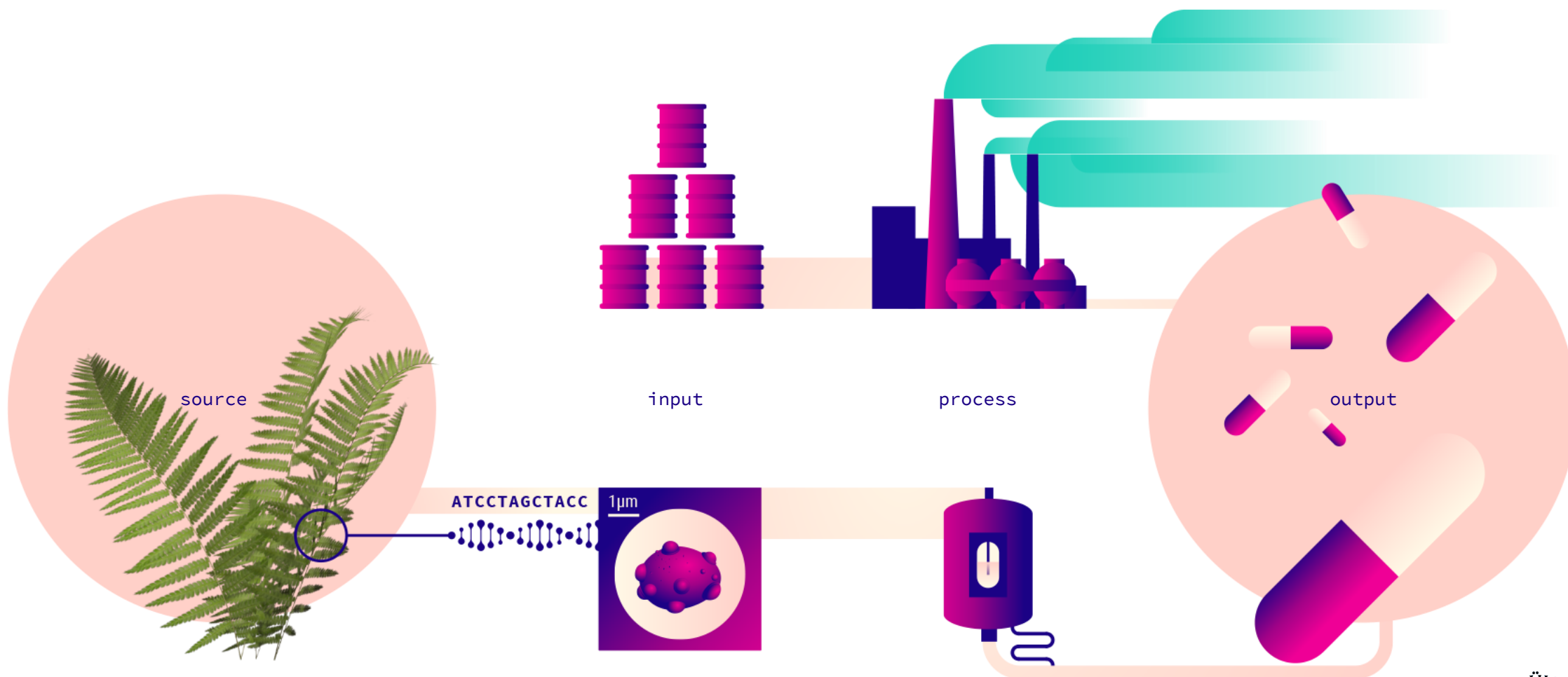


```
○○○
last login 10.05.2017 on console
User:~
User:~ATTGCACGC
GCATTGCACGCATTG
TGCACGCATTGCACG
```

```
○○○
last login 10.05.2017 on console
User:~
User:~ATTGCACGCATTGCACGCATTGCACGCA
GCATTGCACGCATTGCACGCATTGCACGCATTGC
TGCACGCATTGCACGCATTGCACGCATTGCACGC
CGCATTGCACGCATTGCACGCATTGCACGCATTG
TTGCACGCATTTGCTTGCCCCGCATTAAATTGCACGCA
```



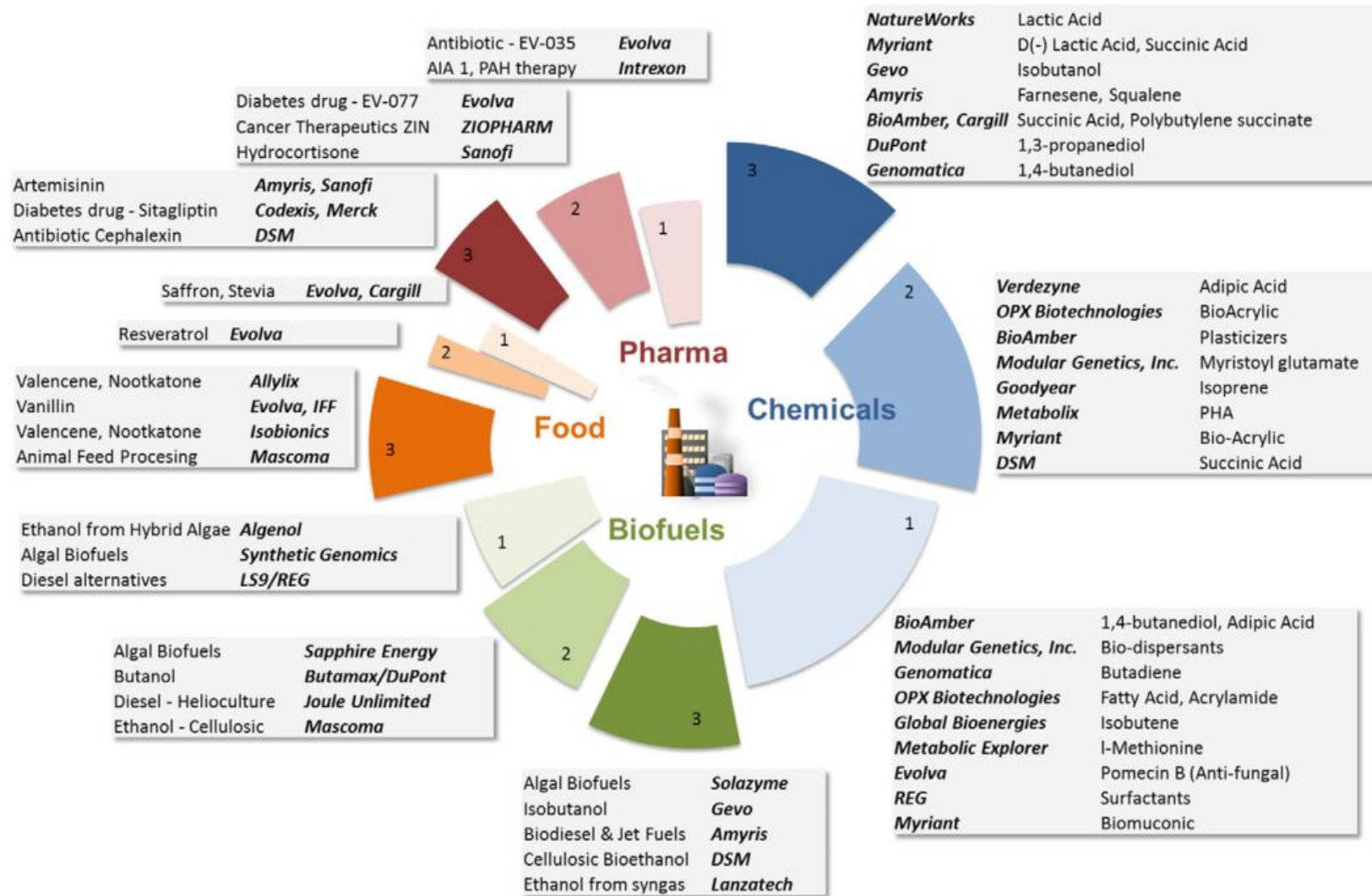
# Traditional chemical industry



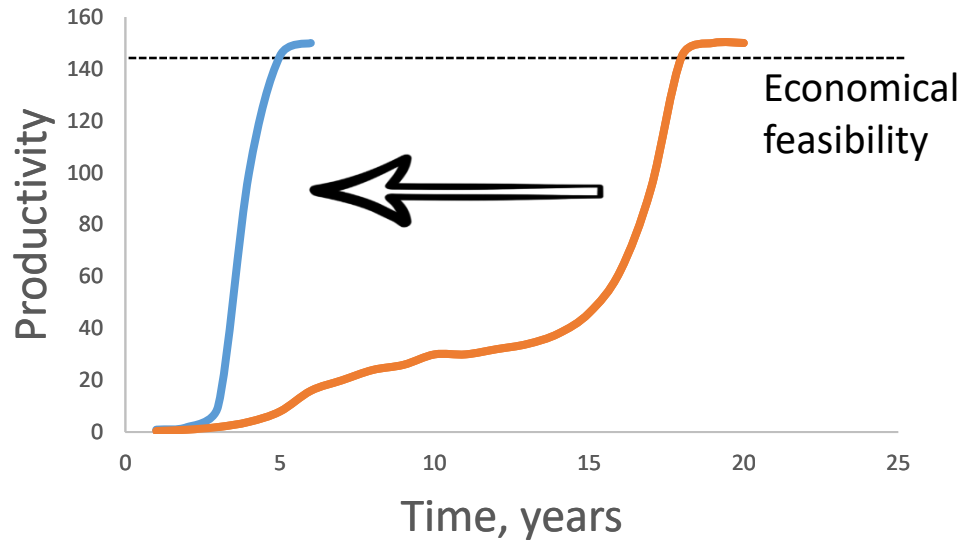
Cell factories



# Variaty of products on or reaching the market



# Strategy



Development of **platform strains** to speed up the process of bringing new strains to the market.

## Challenges:

- Improved productivity of precursor metabolites
- Consumption of non-favored substrates
- Improved robustness towards stresses

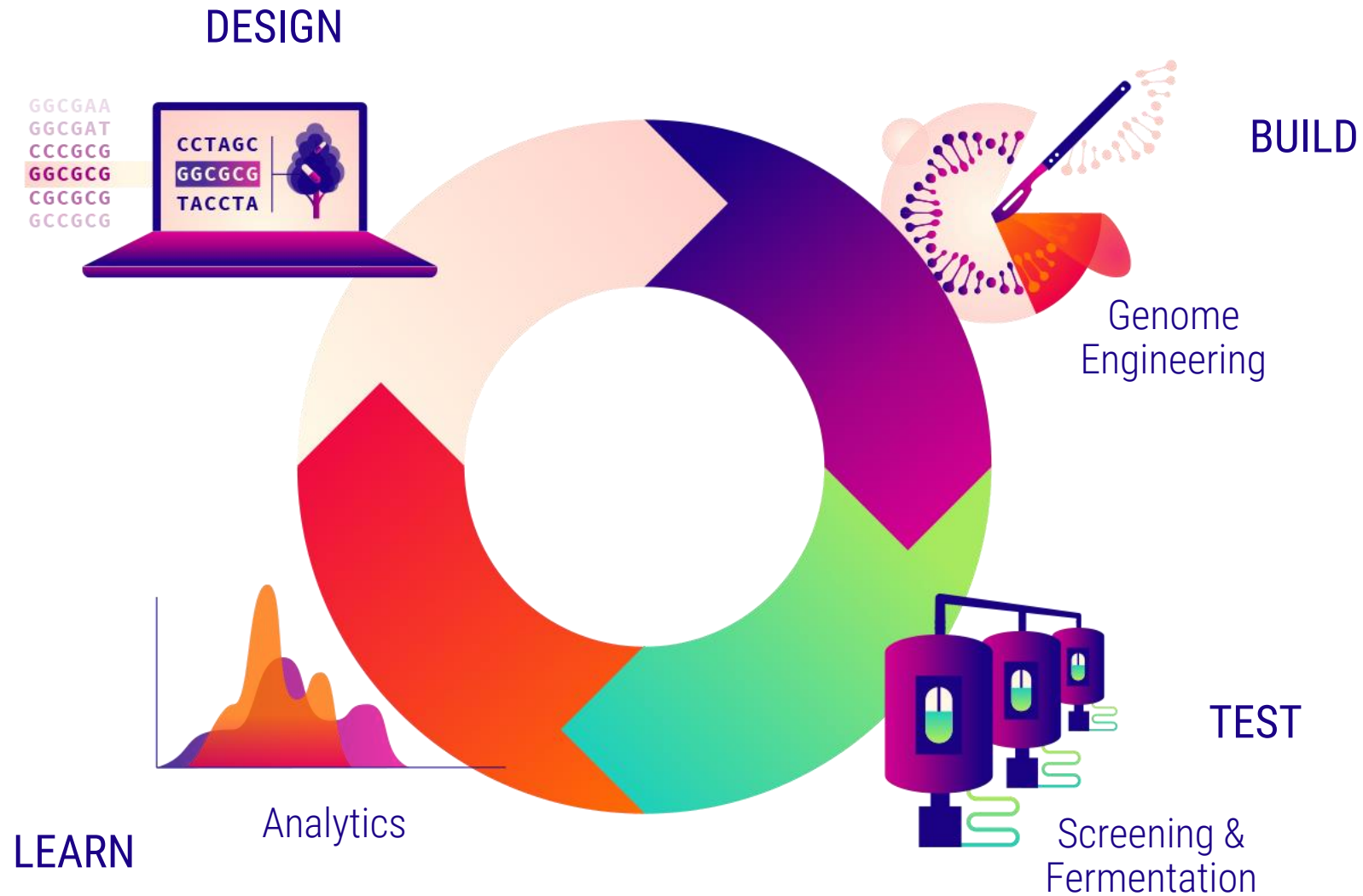


# Synthetic Biology group

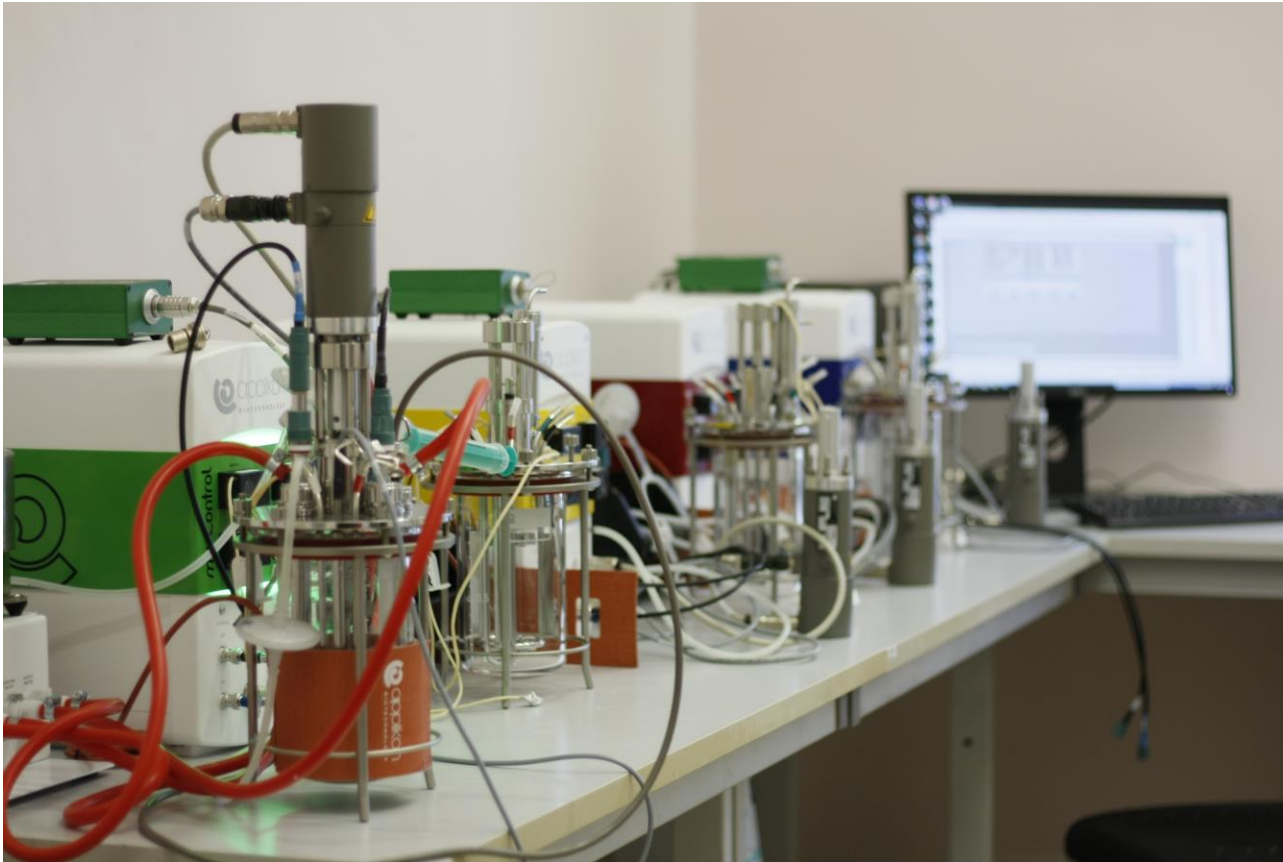
- 9 people
  - PI/Group leader
  - 5 postdoctoral fellows
  - 1 Research engineer
  - 2 Undergraduate students
- 3 complementary fields
  - Metabolic engineering (synthetic biology)
  - Fermentation Technologies/physiology
  - Bioinformatics/metabolic modeling



# Design-Build-Test-Learn Cycle



# Fermentation platform



# Main achievements

- Team of nine researchers
- Cultivation platform with four bioreactors
- Global collaborators
- Personal Research Funding (four years, 200 kEUR)
- Archimedes Funding (four years, 200 kEUR)
- H2020-widespread Teaming project in collaboration with NNF Center for Biosustainability, Denmark (2<sup>nd</sup> round, 400 kEUR for 1 year)



# Celestial – cell factories for future bioeconomy

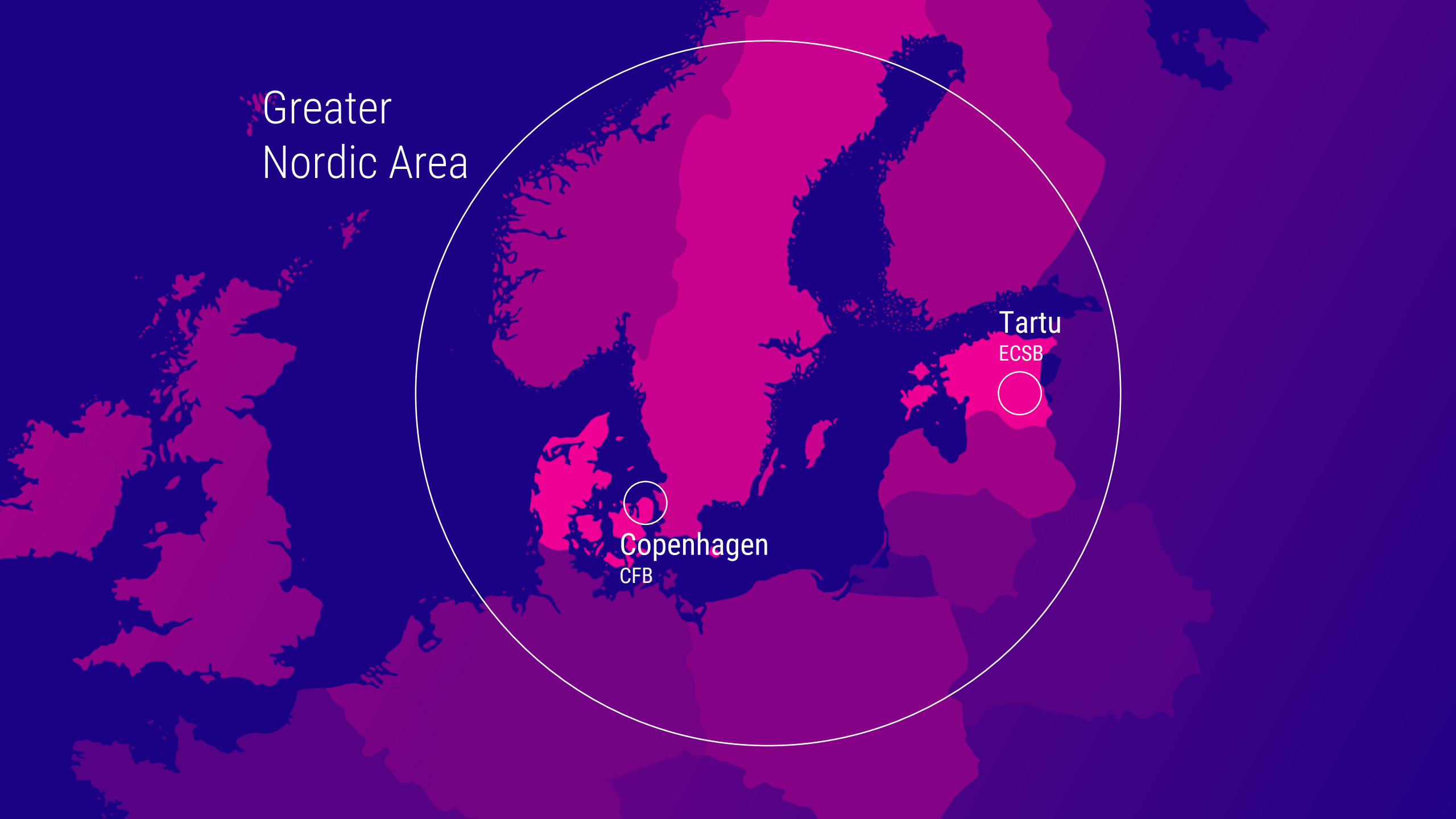
H2020 – Widespread – Teaming 2<sup>nd</sup> stage



Greater  
Nordic Area

Copenhagen  
CFB

Tartu  
ECSB

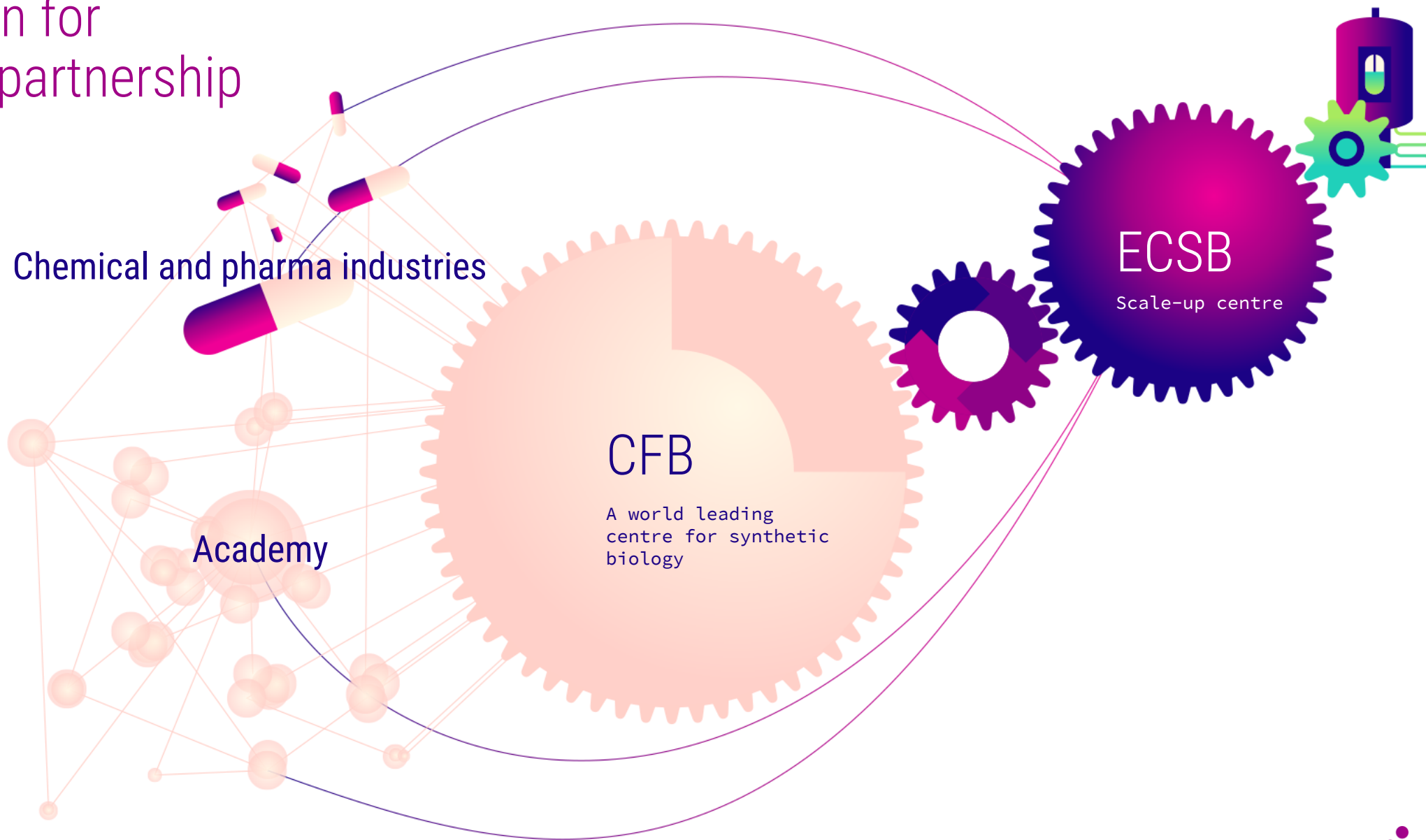




In collaboration with a leading  
centre for synthetic biology

Novo Nordisk Foundation Center for Biosustainability (CFB)

# The vision for teaming partnership





ECSB 2020

ECSB 2016

Investment  
vessel



New start-ups



Consortium of  
research labs

Curricula

Access to core  
facilities

Broad Foundry  
core facility for SB

Pilot plant  
microbial cells

GMP  
production  
facility of  
Icosagen  
Cell Factory

Mammalian  
cells





Synthetic biology in Estonia:  
a historical opportunity

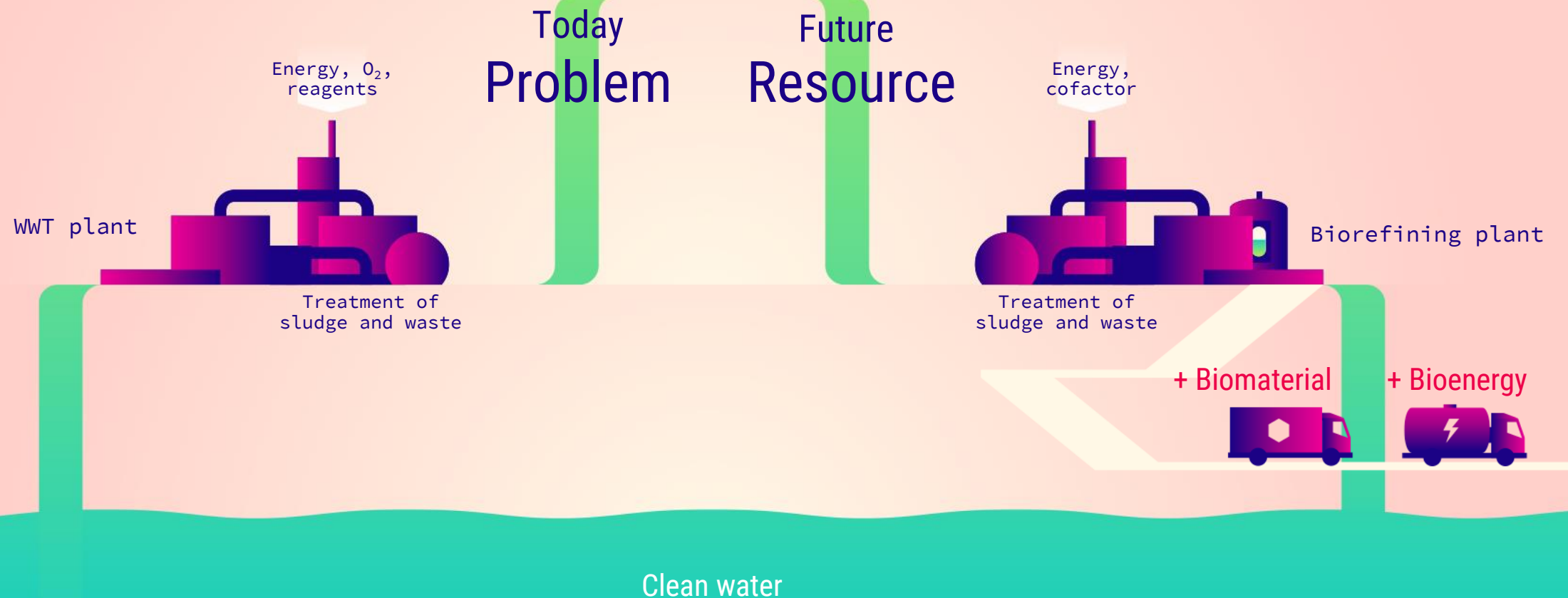
Local substrate



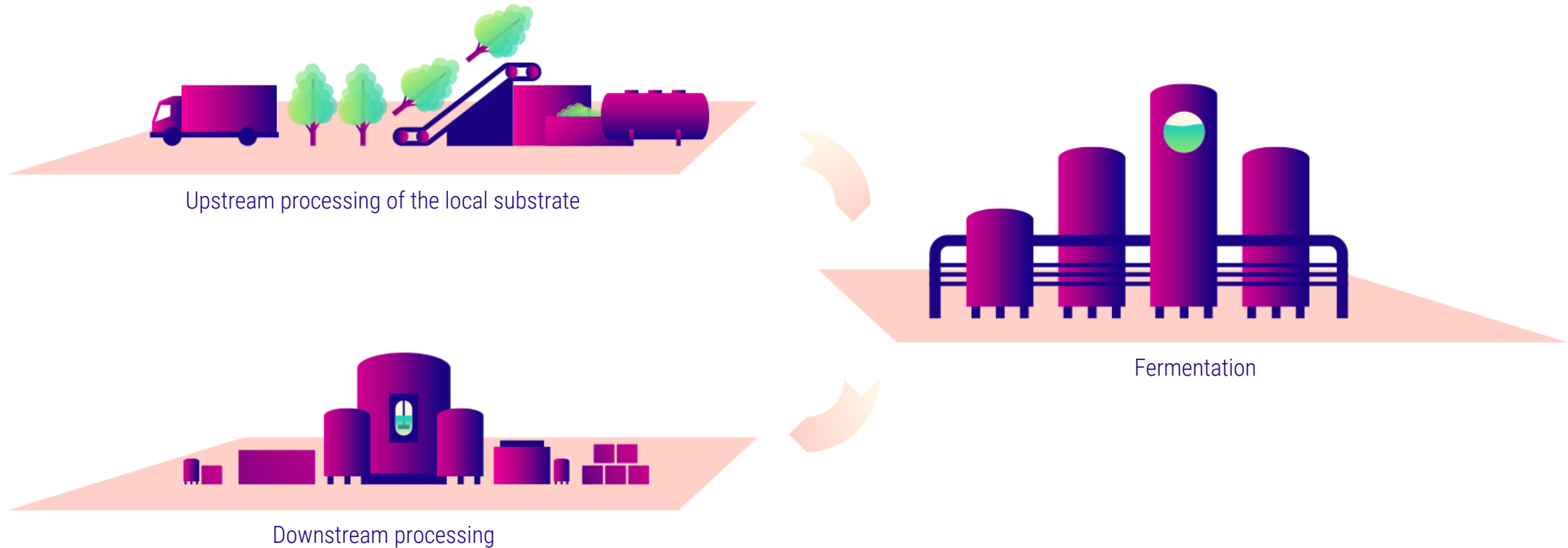
Value added chemicals



# Polluted wastewater



# Pilot-scale platform for bioprocess optimization and scale-up





A photograph of a laboratory setting with metal shelving units filled with numerous clear plastic jars, each with a white lid. Two students, a man and a woman, are in the foreground. The man is holding one of the jars, and both are looking at it with interest. The background shows more shelves filled with similar jars, suggesting a large-scale experiment or storage of samples.

International, innovative curricula  
combining molecular biology and engineering

Following the  
examples of the  
leading universities

150 undergraduate  
students + masters  
and Ph.D programs

International education  
centre for bioprocess  
optimization and pilot  
plant operations

iGEM



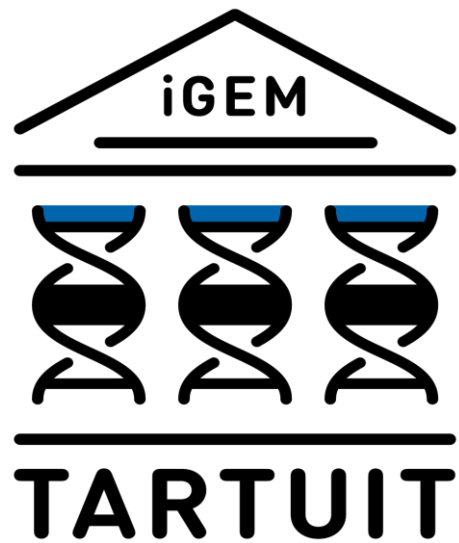


# Synthetic Biology

based on standard parts







Connection into an international technology development network



iLoop & ECSB Pilot plant





# Our joint projects & groups: Eukaryotic Cell Factories





# Our joint projects & groups: Bacterial Cell Factories



Microbial Evolution  
and Synthetic Biology

CFB



Bacterial Synthetic  
Biology and Antibiotic  
Resistance

CFB



Bacterial Molecular  
Biology and  
Biosensors for  
Antibiotics

UT



Bacterial stress  
responses

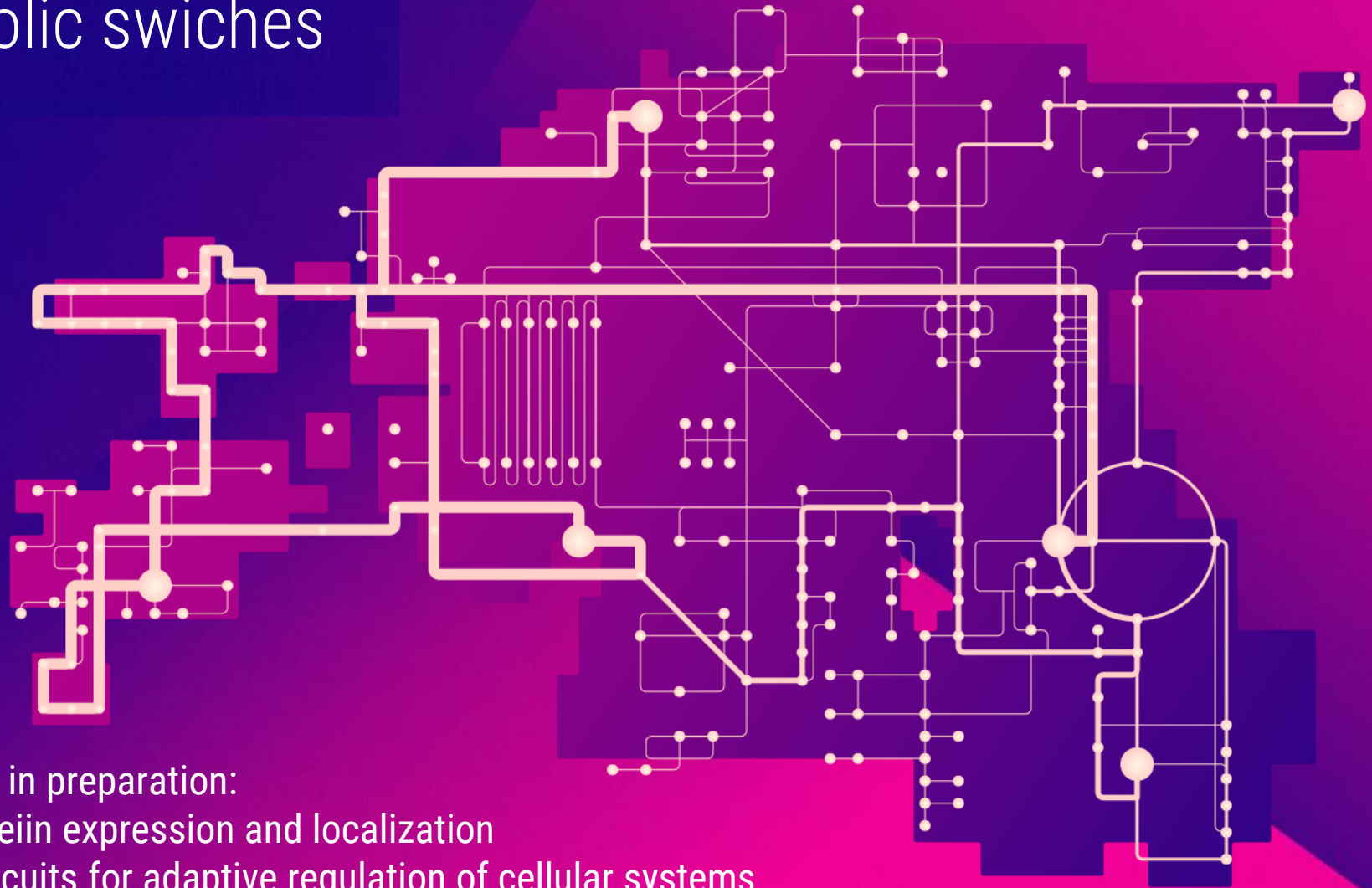
UT



Bacterial Cell  
Factory  
Optimisation

CFB

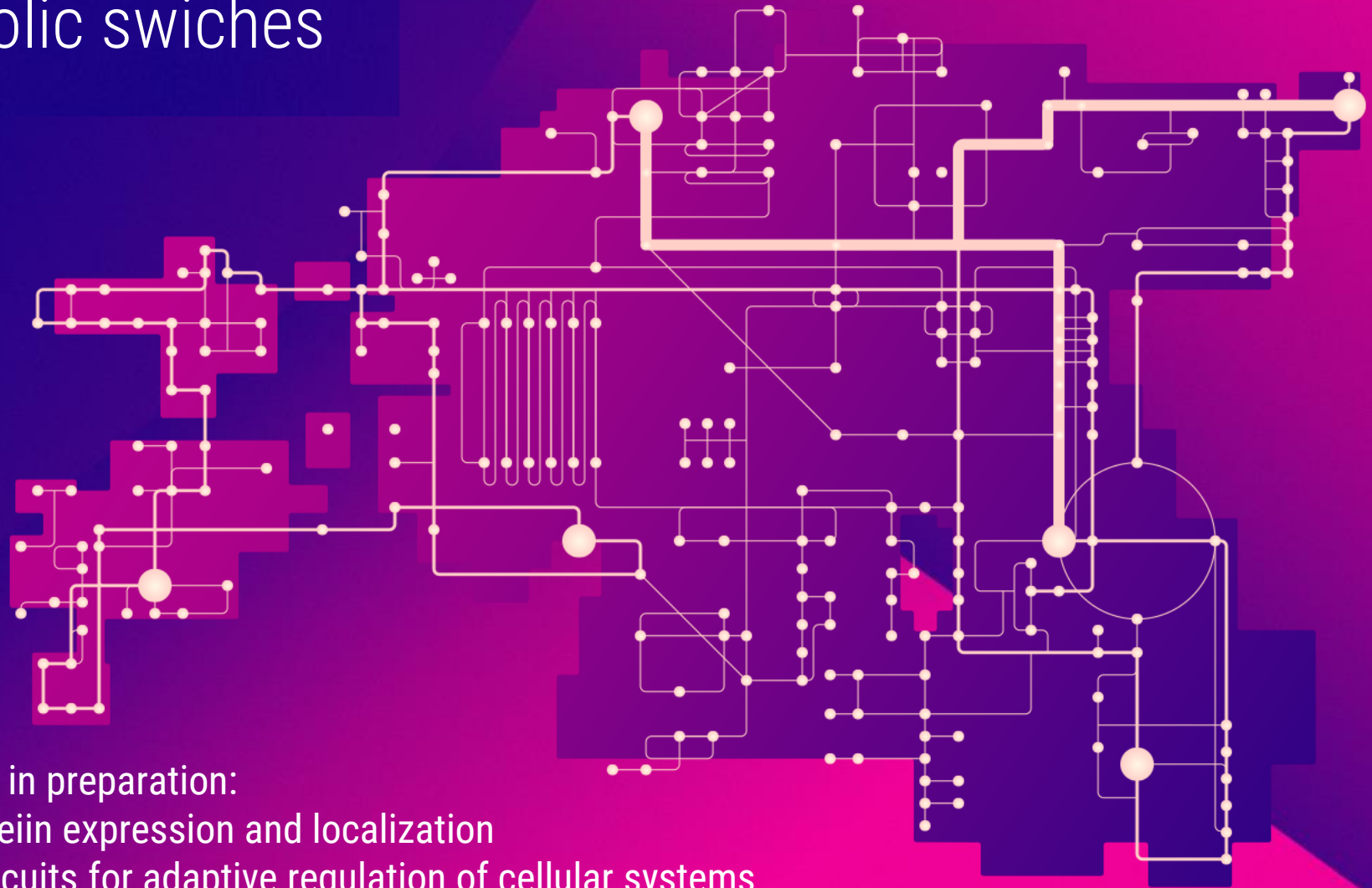
# Adaptive metabolic switches



Patents applications in preparation:

1. Regulation of protein expression and localization
2. Sensory kinase circuits for adaptive regulation of cellular systems

# Adaptive metabolic switches



Patents applications in preparation:

1. Regulation of protein expression and localization
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# Thank you for your attention!

