

BioCity Turku Research Program

# Advanced Bioresources and Smart Bioproducts - Towards Sustainable Bioeconomy

Director: Academy Professor Eva-Mari Aro, University of Turku

Vice-director: Professor Stefan Willför, Åbo Akademi University



Turun yliopisto  
University of Turku



ÅBO AKADEMI



# Why & How?

← VASTAA

←← VASTAA KAIKILLE



biocityturku-bounces@lists.utu.fi käyttäjän Ulla Karhunen <ulla.karhun

ma 27.4.2015 9:09

Saapuneet

## Get out of the box and think widely!

**Vastaanottaja:** biocityturku@lists.utu.fi;

Open forum about the future functions of the BioCity Turku organization and new research programmes for 2016-2020.

May 7 at 8.15-11.00

President Auditorium, BioCity, Tykistökatu 6, Turku

Preliminary programme:

8.00 Coffee

8.15 Kalervo Väänänen (UTU)

8.25 Niklas Sandler (ÅAU)

8.35 5 min comments by

Pentti Huovinen (UTU, Faculty of Medicine)

Reijo Lahti (UTU, Faculty of Mathematics and Natural Sciences)

Tapio Salmi (ÅAU, Faculty of Science and Engineering)

Riku-Matti Levomäki (Turku Science Park Ltd.)

Päivi Rautava (VSSH/Hospital District of Southwest Finland)

TBA (Turku University of Applied Sciences)

Eleanor Coffey (Turku Centre for Biotechnology)

Saara Hassinen (SalWe)

Matti Kokkala (VTT)

TBA (TEKES)

~9.30 Open discussion

## What can we offer and develop in Turku?

### Starting points

1. Collaboration between the two universities in Turku
2. Theme must be scientifically challenging and societally important



## What is the Bioeconomy?

- The bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea.
- **Photosynthesis** produces all renewable **bioresources** in land and sea
- **Modern science** (chemistry, engineering, synthetic biology etc) provides tools for creating **smart bioproducts**

## Bioeconomy:

Food  
Materials  
Energy  
Nutrition  
Climate  
Circularity  
Innovation



PUU JA  
METSÄ

KALAT JA  
VEDET

ENERGIA

KEMIA

RUOKA

LUONNON  
PALVELUT

SUOMI  
KEHITTÄÄ

## BIOTALOUSSTRATEGIA



Suomen kansallisen biotalousstrategian tavoitteena on luoda uutta talouskasvua ja uusia työpaikkoja biotalouden liiketoiminnan kasvulla sekä korkean arvonlisän tuotteilla ja palveluilla, turvaten samalla luonnon ekosysteemien toimintaedellytykset. Strategian johtoajatuksena on, että Suomessa luodaan kilpailukykyisiä ja kestäviä biotalouden ratkaisuja maailmanlaajuisiin ongelmiin ja synnytetään sekä kotimaahan että kansainvälisille markkinoille uutta liiketoimintaa, joka tuo hyvinvointia koko Suomelle.

### Kestävää kasvua biotaloudesta – Suomen biotalousstrategia



Serious science is scarcely involved!

[AINEISTOPANKKI »](#)

[BIOTALOUS LYHYESTI »](#)

[BIOTALOUSSTRATEGIA »](#)

[HYÖDYLLISIÄ LINKKEJÄ »](#)

[KANSALLINEN BIOTALOUSPANEELI »](#)

[OTA YHTEYTTÄ »](#)

[TAPAHTUMAKALENTERI »](#)

[TULEVAISUUSTARINAT »](#)



PUU JA METSÄ	KALAT JA VEDET	ENERGIA	KEMIA	RUOKA	LUONNON PALVELUT	SUOMI KEHITTÄÄ
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## YHTEYSTIEDOT



### ASK A FINN – SUOMEN BIOTALOUDEN TOIMIJOIDEN YHTEYSTIEDOT

Biotalous vahvistuu hyvällä yhteistyöllä! Alla olevasta tietokannasta löydät suomalaisia organisaatioita ja yhteyshenkilöitä biotalouden eri toimialoilta hallinnosta kaupallisiin toimijoihin. Jos haluat välittää yhteystietoja esim. ulkomaisille kumppaneillesi, löydät tietokannan myös [englanninkielisenä](#).



[Ilmoita oma organisaatiosi](#) mukaan!

### SUOMEN BIOTALOUSSTRATEGIA

Suomen biotalousstrategian toteutusta koordinoi työ- ja elinkeinoministeriö yhdessä maa- ja metsätalousministeriön ja ympäristöministeriön kanssa. Ota yhteyttä, kerromme mielellämme lisää Suomen tavoitteista ja toimenpiteistä biotaloudessa:

teollisuusneuvos, ryhmäpäällikkö **Mika Aalto**, TEM, puh. 029 504 7267, [mika.aalto@tem.fi](mailto:mika.aalto@tem.fi)  
apulaisosastopäällikkö **Liisa Saarenmaa**, MMM, puh. 029 516 2429, [liisa.saarenmaa@mmm.fi](mailto:liisa.saarenmaa@mmm.fi)  
neuvotteleva virkamies **Merja Saarnilehto**, YM, puh. 029 525 0259, [merja.saarnilehto@ymparisto.fi](mailto:merja.saarnilehto@ymparisto.fi)

### BIOTALOUS.FI-SIVUSTON TOIMITUS

Lisätietoja biotalous.fi-sivustosta: [toimitus@biotalous.fi](mailto:toimitus@biotalous.fi)

[Päätoimittajan ja toimituksen yhteystiedot](#)

## YHTEYSTIETOPANKKI





## What is the Bioeconomy?

- The **bioeconomy comprises** those parts of the economy that use **renewable biological resources** from land and sea.
- **Photosynthesis** produces all renewable bioresources in land and sea
- **Advanced science** (chemistry, engineering, synthetic biology etc) provides tools for innovations in bioeconomy

## Bioeconomy:

Food  
Materials  
Energy  
Nutrition  
Climate  
Circularity  
Innovation



Center of Excellence of Academy of Finland  
**Molecular Biology of Primary Producers**



Center of Excellence of Academy of Finland  
**Molecular Biology of Primary Producers**



Turun yliopisto  
University of Turku



Helsingin yliopisto  
University of Helsinki

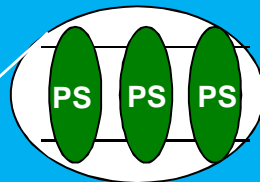
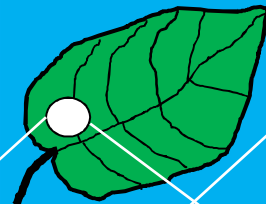
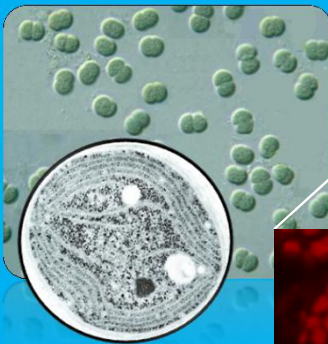
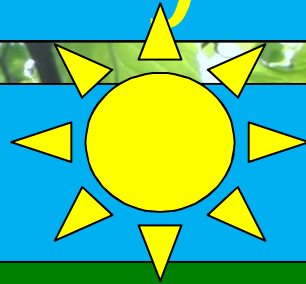


ACADEMY  
OF FINLAND



Center of Excellence of Academy of Finland  
**Molecular Biology of Primary Producers**

# Photosynthesis



Food  
Paper & Fibers  
Pharmaceuticals  
Biomass  
Fossil fuels  
Direct Solar Fuels  
Novel chemicals





# Johan Gadolin Process Chemistry Centre - PCC

## at Åbo Akademi University



Check out the latest PCC news [HERE!](#)

### Johan Gadolin Process Chemistry Centre - PCC

PCC merges chemistry and chemical engineering to provide the solutions for the future. The goal is to develop new, sustainable technologies for making selected platform chemicals, fine and specialty chemicals as well as healthpromoting materials and chemicals. The research is mainly focused on two important types of molecules appearing in forest biomass, namely hemicelluloses and lignin. The research work is done in close collaboration with industrial companies. PCC also has an extensive international collaboration network with partners all over the world.

The executive board of the Centre consists of Professor [Stefan Willför](#) (chairman), Professor [Johan Bobacka](#) (vice chairman), Professor [Leena Hupa](#), Professor [Reko Leino](#) and Professor [Tapio Salmi](#). The Centre also has two Senior Scientific Advisors; Prof. em. [Ari Ivaska](#) and Prof. em. [Bjarne Holmbom](#).



Center for Functional Materials (FUNMAT) is a research center in functional materials based at Åbo Akademi University. FUNMAT is combining the expertise in chemistry, physics, biology, paper coating and printing to develop functional materials, devices and large area manufacturing for interfacing with biological systems. The multidisciplinary research is done in close collaboration with industry and our extensive collaboration network throughout the world.



[FRONTPAGE](#) | [PRESENTATION](#) | [PUBLICATIONS](#) | [TRAINING & EDUCATION](#) | [CONTACTS](#)

### Upcoming events

13.10.2016

# BioCity Turku Research Programs

**BIOCITY TURKU**  
BIOCITY TURKU  
BIOCITY TURKU



Home About Us Events **Research Programmes** Doctoral Programmes BioCity Symposium

keywords...

Advanced Bioresources and Smart Bioproducts

Biomaterial and Medical Device Research Programme

Computational and Molecular Methodologies for Life Sciences

Diagnostic Technologies and Applications

Turku Centre for Lifespan Research

Receptor Programme

Translational Infectious Disease and Immunity Research Programme

## Research Programmes

### BioCity Turku Research Programmes

In the winter 2016 seven research programmes selected by a committee formed by rectors of University of Turku and Åbo Akademi University were selected to join BioCity Turku for the five year period (2016-2020):

- Advanced Bioresources and Smart Bioproducts – Towards Sustainable Bioeconomy ←
- Biomaterial and Medical Device Research Programme
- Computational and Molecular Methodologies for Life Sciences
- Diagnostic Technologies and Applications
- Lifespan of Cardiovascular, Inflammatorv. Endocrine & Metabolic Disorders - LIFESPAN
- Receptor Programme
- Translational Infectious Disease and



# Partner organizations:

- University of Turku, Department of Biochemistry / Molecular Plant Biology
- University of Turku, Department of Chemistry
- University of Turku, Department of Information Technology
- Åbo Akademi University, Johan Gadolin Process Chemistry Centre (PCC)
- Åbo Akademi University, Theology
- Åbo Akademi University, Biosciences

Associated research groups participating in the programme:

- Åbo Akademi University, Center for Functional Materials (FunMat)

Collaborator:

- Turku Science Park / Smart Chemistry Park



## University of Turku:

Department of Biochemistry / Molecular Plant Biology:

Research groups of:

Professor Eva-Mari Aro

Professor Eevi Rintamäki

Professor (tenure track) Paula Mulo

Senior researcher Yagut Allahverdiyeva-Rinne

Senior researcher Natalia Battchikova

Senior researcher Hiroaki Fujii

Senior lecturer Saijaliisa Kangasjärvi

University lecturer Esa Tyystjärvi

Senior lecturer Taina Tyystjärvi

Department of Chemistry:

Research groups of:

Professor Juha-Pekka Salminen

Professor Carita Kvarnström

Department of Information Technology:

Research group of:

Senior lecturer Risto Punkkinen



## Åbo Akademi:

Johan Gadolin Process Chemistry Centre (PCC)

Research groups of:

Professor Johan Bobacka

Professor Leena Hupa

Professors Reko Leino and Jorma Mattinen

Professors Tapio Salmi and Dmitry Murzin

Professor Stefan Willför

Theology: Theological ethics and life-view research

Research group of: Professor Mikael Lindfelt

Biosciences

Research group of: Docent Jussi Meriluoto

Associated research groups participating in the programme

Center for Functional Materials (FunMat):

Research groups of:

Professor Ronald Österbacka

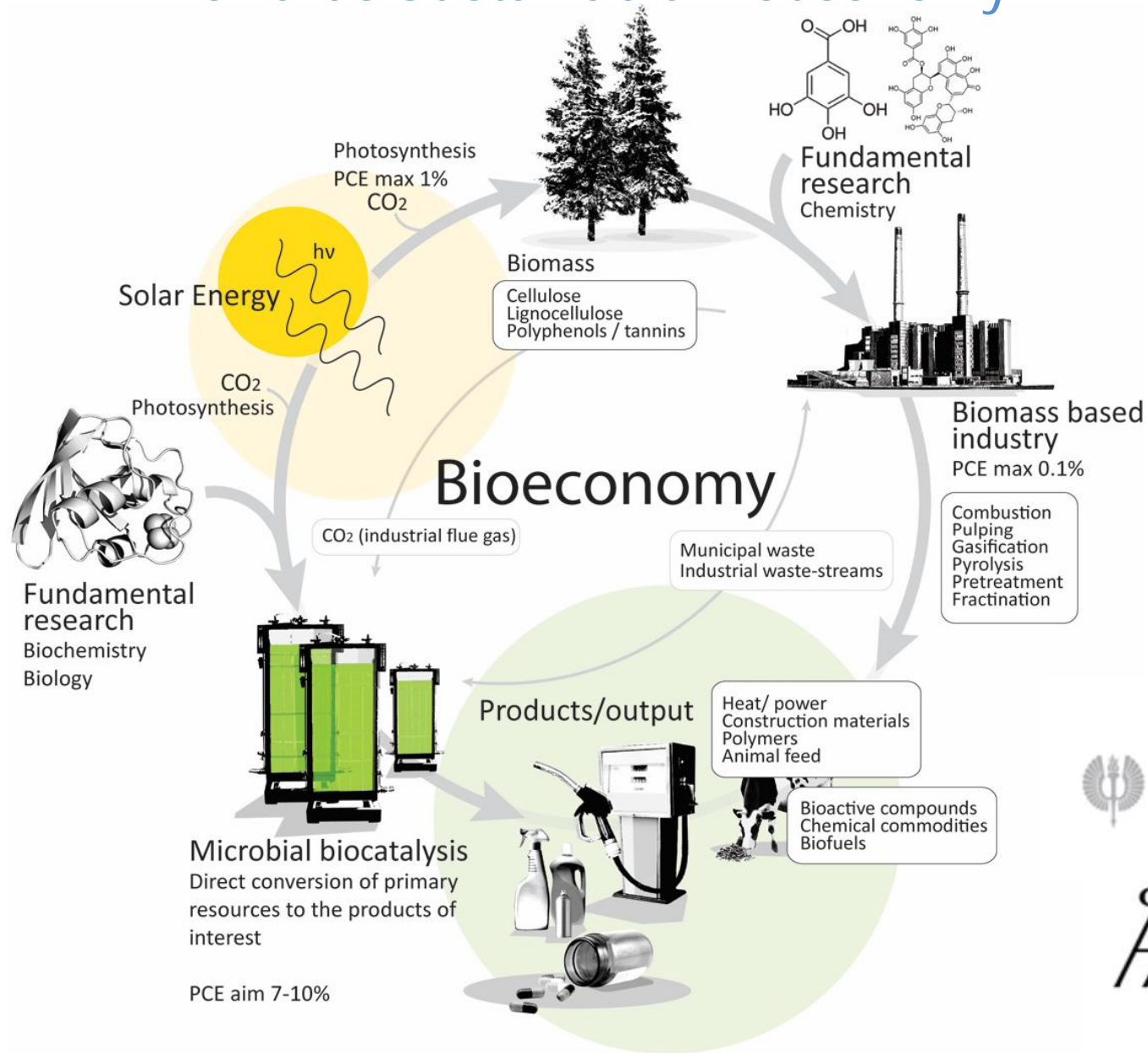
Professor Martti Toivakka

Professor Jouko Peltonen

Professor John E. Eriksson

Professor Carl-Eric Wilén

# Advanced Bioresources and Smart Bioproducts Towards Sustainable Bioeconomy





## Advanced Bioresources and Smart Bioproducts

Towards Sustainable Bioeconomy



### A BioCity Turku Research Programme 2016-2020

**Director:** Academy Professor Eva-Mari Aro, University of Turku, [evaaro@utu.fi](mailto:evaaro@utu.fi)

**Vice-director:** Professor Stefan Willför, Åbo Akademi University, [swillfor@abo.fi](mailto:swillfor@abo.fi)

Economically competitive and sustainable bioeconomy solutions are urgently needed to guarantee sustainability in the foreseeable scarcity of natural biomass production. The BioCity Turku Research Programme “**Advanced Bioresources and Smart Bioproducts**” program utilizes the synergy emerging from basic research from the **University of Turku** and **Åbo Akademi University**, combined with applied science and engineering, as well as extensive cooperation with industry. Our joint efforts will be used to boost the development of bioeconomy, sustainable use of clean technology, **high-tech renewable natural resources**, as well as **efficient recycling of materials**. The

## Contact:

Coordinators:

**Marjaana Suorsa**

[marjaana.suorsa@utu.fi](mailto:marjaana.suorsa@utu.fi)

**Otto Långvik**

[olangvik@abo.fi](mailto:olangvik@abo.fi)

# Planned activities

- **joint seminars**, in which the researchers from UTU and ÅA will **get to know each other** and become familiarized with the **scientific and methodological expertise** of each group
- **tailored doctoral courses** to support the present course offer of UTU (including the Turku School of Economics) and ÅA.
  - Summer School in Wood Biopolymer Science “New materials from trees”, Åland, August 2016
  - “Towards Bio-based Finland”, a course dealing with economical and societal transition towards low-carbon and resource-efficient Finland
    - Spring term 2017, UTU will organize
  - “Publishing seminar / course”, UTU organizes (collaboration with the Doctoral Programme of Molecular Life Sciences)
    - Seminar: ethics, open access, impacts
    - Course: preparing figures for publications
    - December 2016
- **additional workshops and seminars** dealing with bioeconomy



Turun yliopisto  
University of Turku



ÅBO AKADEMI





Fortum now announces to start  
focusing on renewable energy  
i.e. the forests  
GREAT!!!! BUT!!!!

# Sustainability and multi-functionality in Europe's forests

EASAC Workshop  
Brussels Feb 16, 2016

- Local Host in Feb workshop: Belgian Academies
- Hosting for the report: Finnish Academy of Science and Letters
- High level experts from **15** countries:
  - FI, SU, SE, NL, CZ, AU, BE, FR, GE, GR, IT, UK, PO, HU, RU
  - Multidisciplinary approach, including energy, economics, forestry, conservation, ecology and climate change experts



Report chair:  
Prof. Jaana Bäck  
from HY





## WELCOME TO LEARN ABOUT THE DIVERSE FINNISH BIOECONOMY

**By 2030 we need 50% more food, 45% more energy, and 30% more water. The solution is bioeconomy.**

Finland aims for a low-carbon, energy-efficient society, founded on the use of renewable natural resources and recycled materials. For Finland bioeconomy brings an annual output of 100 billion euros, growth of exports, 100 000 new jobs and increased well-being, with due respect for the environment. Welcome to learn about strategic development of bioeconomy and collaboration between different sectors in this work!

[READ MORE...](#)

## WELCOME

Blog from Suorsa and Aro:

### Basic Research: a Necessity for Unlocking the Finnish Bioresources ..... new

technologies and innovations are urgently needed for sustainable energy production - also in Finland. The European Academies of Science Advisory Council (EASAC), with the Finnish Academy of Science and Letters (Suomalainen Tiedeakatemia) as a lead academy, is currently preparing a science-based report on sustainable use of forests for policy makers in EU. The report will be published by the end of 2016-beginning of 2017 and will hopefully serve also the Finnish decision makers in implementing sustainable forestry policy.



[BIOECONOMYFI IN TWITTER](#) 

[BIOECONOMYFI IN LINKEDIN](#) 

[CONTACT US](#) 

# Nordic Bioeconomy

## Theme

Nordic Safe Cities

Nordic co-operation on gender equality

Education and research in the Nordic Region

New Nordic Food

Efforts to combat human trafficking

→ Nordic Bioeconomy

Bioeconomy in the Arctic Region

Nordic Bioeconomy Panel

NordBio

Bioeconomy in the Baltic

The aim of bioeconomy is a sustainable production and use of natural resources. A cross sectorial and systematic approach, with a basis in circular economy, are the hallmarks of the Nordic Council of Ministers' initiatives within bioeconomy. Here we highlight programmes, project activities and networking initiatives in the bioeconomy sector under the Nordic cooperation umbrella. Nordic Council of Ministers works in a macro-regional context initiating, catalyzing and facilitating activities to realize bioeconomy in the Arctic Region, the Baltic Sea Region and the Nordic Region.



NORDIC BIOECONOMY

[Bioeconomy in the Arctic Region](#)



## Nordregio Forum 2016: From Fossil to Bio-based and Sustainable Economy



**EARLY BIRD  
PRICE €175  
before October  
(€210 full price)**



### From Fossil to Bio-based and Sustainable Economy - Innovation and Policy for Green Transition in the Nordic Region

22-23 November 2016, Scandic Marina Congress Center, Helsinki, Finland

### Nordregio Forum 2016: From Fossil to Bio-based and Sustainable Economy

Date & Time:

2016-11-22 09:00 - 2016-11-23 16:00

Place:

Scandic Grand Marina, Helsinki ([Click to view map](#))

SAVE DATE IN MY CALENDAR

### Early bird price in September!

**EARLY BIRD PRICE 2 DAYS 175€  
(August-September)**

Normal price for 2 days 210€ (October-November)

Normal price for 1 day 140€

**Hotel bookings:** With Nordregio Forum code **BNOR221116** a discount price from Scandic Grand Marina (Katajanokanlaituri 7, 00160 HELSINKI) until 11 November.



Liisa Saarenmaa,  
Ministry of Agriculture  
and Forestry, Finland

Jukka Teräs,  
Nordregio



Kees W. Kwant,  
Netherlands  
Enterprise Agency

Annika Rosing,  
Nordic Council of  
Ministers



Mika Anttonen,  
Founder, Chair  
St1 Energy Company

Professor  
Hans Westlund  
KTH Royal Institute  
of Technology,  
Stockholm



Assistant Professor  
Charlotta Soderberg,  
ETS Luleå University  
of Technology

## From Fossil to Bio-based and Sustainable Economy - Innovation and Policy for Green Transition in the Nordic Region

22-23 November 2016, Scandic Marina Congress Center, Helsinki, Finland

**Nordregio Forum 2016 is all about green transition: How to make it happen? Meet and exchange ideas with innovators and policy-makers who are leading the way. Get inspired by a great line-up of speakers, and use the market place and group sessions to promote your green region or green solution, and to find new partners.**

Nordregio Forum 2016 will also serve as the final conference for the Nordic Prime Ministers' green growth initiative. It will sum up the results from the many projects under the initiative and formulate new Nordic collaboration measures towards a green economy.

Nordregio Forum is the meeting place for policymakers, researchers and businesses working with green growth and green transition towards sustainable regional development in the Nordics.

The full programme will be available in September.

*"The future energy decisions are made today – the Nordic countries should be the global leader."* Mika Anttonen, Founder, Chair of St1 Energy Company

**Registration is open now (follow the link on the right). We look forward to meeting you in Helsinki 22-23 November!**

Normal price for 2 days 210€ (October-November)

Normal price for 1 day 140€

**Hotel bookings:** With Nordregio Forum code **BNOR221116** a discount price from Scandic Grand Marina (Katajanokanlaituri 7, 00160 HELSINKI) until 11 November.

118€ single room/ night

128€ double room/ night

Book via: <https://www.scandichotels.fi/>

» **REGISTER NOW**

### Programme in brief

Programme in brief is available through the link. Full programme will be available in September.

» **Programme in brief (pdf)**

### Green Growth in Nordic Regions

#### 50 ways to make it happen

A Collection of cases in the Nordic region is now available online! Many of the cases will be at the Nordregio Forum 2016 market place: Come and exchange

You are here: [Home](#) > [Apply for funding](#) > [Announcements](#) > [Call for pre-proposals for Nordic Centres of Excellence: Advancing the bioeconomy transition in the Nordic region](#)

## Call for pre-proposals for Nordic Centres of Excellence: Advancing the bioeconomy transition in the Nordic region

NordForsk launches a new two-phase call for proposals for Nordic Centres of Excellence within the Nordic Bioeconomy Programme. The programme aims to fund three Nordic Centres of Excellence within a budget of NOK 90 million. Application deadline for the first phase is 16 March 2016.

The objective of the Nordic Bioeconomy Programme is to generate new knowledge on how to promote and advance the transition to a bioeconomy-based society in the Nordic countries. The programme now launches a two-phase call for proposals for Nordic Centres of Excellence.

The call is relevant for all sectors (e.g. agriculture, forestry, marine, food and other) in the bioeconomy, but with an emphasis on new and innovative areas of research and innovation in order to understand the bio-economy transition in a holistic perspective. In this call water is a common denominator and can be either the research subject or an integral part of the proposal, but does not have to be the main theme.

Calls for pre-proposals must be submitted electronically through the NordForsk Application Portal **by 16 March 2016**. International experts will assess the pre-proposals, and the programme committee will assess the relevance to the call and the Nordic added value. Selected pre-proposals will then be invited to the second application phase, with deadline in September 2016.



### Contact person

**Unni Rørslett**  
Senior Adviser  
+47 906 86 141  
E-mail



### Contact person

**Marianne Aastebøl Minge**  
Senior Adviser  
+47 936 02 527  
E-mail

### Facts about the call

#### Budget

90 MNOK

#### Application expired

16.03.2016 – 14:00 CET

#### Programmes

[Nordic Bioeconomy Programme](#)

#### Topics

[Tiedotteet](#)[Uutiset](#)[MMM sosiaalisessa mediassa](#)[Tapahtumat](#)[Verkkolähettykset](#)[Lausuntopyynnöt](#)[Tarjouspyynnöt](#)[Kärkihankkeet](#)[Hankerahoitus, määrärahat,  
avustukset](#)[Kunniamerkkien hakeminen](#)[Avoimet työpaikat](#)[Tilaa aineistoja](#)

# Sinisen biotalouden kehittämissuunnitelman sidosryhmätilaisuus

MAA- JA METSÄTALOUSMINISTERIÖ

Aika: ke 14.9. klo 12.00– 15.00

Maa- ja metsätalousministeriö järjestää keskiviikkona 14.9. sidosryhmätilaisuuden sinisen biotalouden kansallisesta kehittämissuunnitelmasta ja sen toimeenpanon käynnistämisestä. Tilaisuudessa eri sidosryhmillä on vielä mahdollisuus kommentoida ja vaikuttaa kehittämissuunnitelman sisältöön ja sen toteuttamiseen.

Kehittämissuunnitelman tavoitteena on luoda kasvua vesiosaamisesta ja vesiluonnonvarojen kestävästä hyödyntämisestä. Suunnitelmaa on laadittu yhdessä Luonnonvarakeskuksen, Suomen ympäristökeskuksen, Teknologian tutkimuskeskus VTT:n, ELY-keskusten, ympäristöministeriön, työ- ja elinkeinoministeriön sekä muiden sidosryhmien kanssa. Tällä hetkellä kehittämissuunnitelma on lausuntokierroksella ja sitä voi kommentoida 2.9. asti ([www.mmm.fi/lausunnolla](http://www.mmm.fi/lausunnolla)).



What do we do in:

Molecular Plant Biology  
Department of Biochemistry



Turun yliopisto  
University of Turku

....how do we currently contribute to  
sustainable bioeconomy

....what could we do in collaboration in  
this BioCity Turku Program?



Cyanobacteria  
Algae (green algae, diatoms)  
Mosses and Ferns  
Conifers (spruce)  
Angiosperms



# Photosynthesis

Efficiency/Regulation/Protection

Communication  
with  
environment

Communication  
*in planta*

Development &  
Stress & Acclimation

1. Enhancements of Biomass Production for Food and Bioenergy
2. Synthetic Biology for Direct Fuel and Chemical Production



Center of Excellence of Academy of Finland  
**Molecular Biology of Primary Producers**

Three examples

## 1. Living Factories

**Ongoing Tekes project**

## 2. Towards versatility of aquatic production platforms: unlocking the value of Nordic bioresources

**On second round of the two phase NordForsk NCoE program**

## 3. Photosynthesis 2.0

**In dreams but negotiations with EU have been promising**



Turun yliopisto  
University of Turku



**Tekes**

# Living Factories Programme

## LIVING FACTORIES: Synthetic Biology for a Sustainable Bioeconomy (LiF)

Consortium:

prof. Merja Penttilä, VTT Technical Centre of Finland  
prof. Markus Linder, Aalto University  
prof. Eva-Mari Aro, University of Turku



# Roadmap for Synthetic Biology in Finland



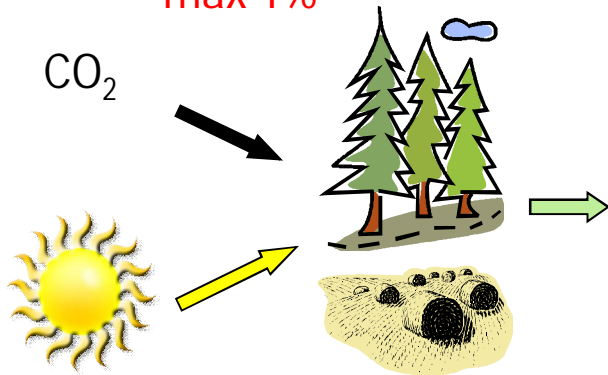
**Synteettinen biologia kestävän biotalouden  
mahdollistajana - Tiekartta Suomelle**



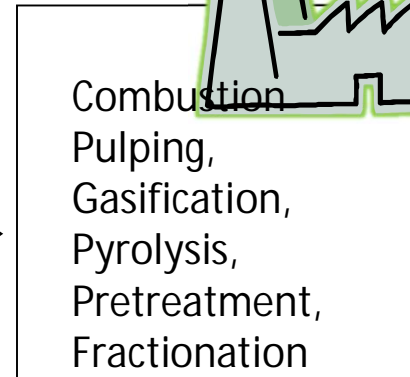
Photon Conversion

Efficiency  $PCE =$

max 1%



Biomass based factories



Combustion  
Pulping,  
Gasification,  
Pyrolysis,  
Pretreatment,  
Fractionation

- Construction materials
- Heat/power
- Fuels
- Chemicals
- Fibers
- Nanocellulose

$PCE = \text{max } 0.1\%$

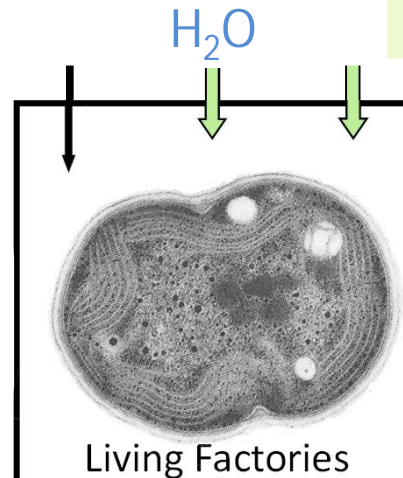
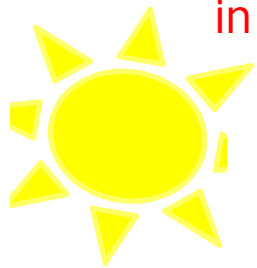
Current biorefinery developments

Industrial flue gas  
Atmospheric  $CO_2$

$CO_2$

Direct and efficient conversion of solar energy and  $CO_2$  into products without a biomass phase!  
Cell functions as a catalyst!

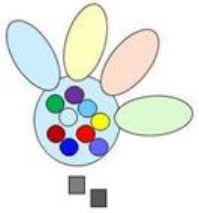
$PCE$ : aim 7-10%  
in cyanobacteria chassis



Living Factories  
Synechocystis 6803

- Chemicals
- Aromates
- Fuels
- Polymers
- Proteins
- Nanobio products

Bioproduction in the future:  
Direct conversion of primary resources to the product of interest

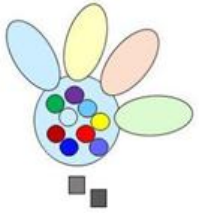


*Living Factories*

## Biological Solar Fuels / Solar Chemicals

- *Synechocystis* sp. PCC6803 is the production platform
- Sun light, H<sub>2</sub>O and CO<sub>2</sub> are inexhaustible raw materials
- Synechocystis functions as a catalyst
- Direct production – no biomass phase - higher photon conversion efficiency

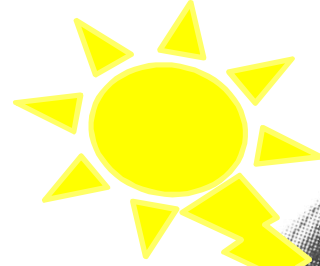




Living Factories

Substrates

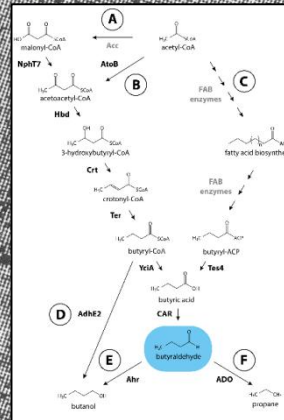
Products



1. **Thylakoid re-design and re-construction for maximal solar energy conversion to target products**

Solar biofuels  
Solar chemicals

2. **Enhancement of  $CO_2$  acquisition**



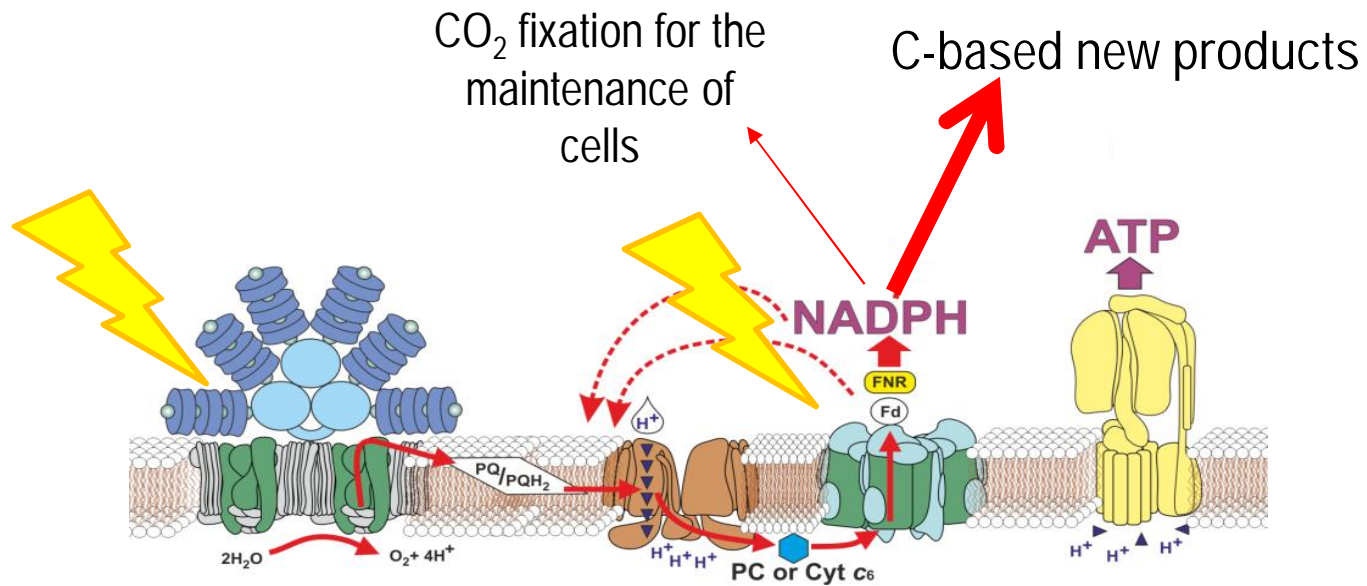
3. **Pathway design and construction for production of carbon-based solar fuels and chemicals**

If we can create strong sinks for electrons – no protective electron transfer pathways are needed!!

**Cyanobacterial cell functions as a catalyst!  
Biomass production will be limited!**



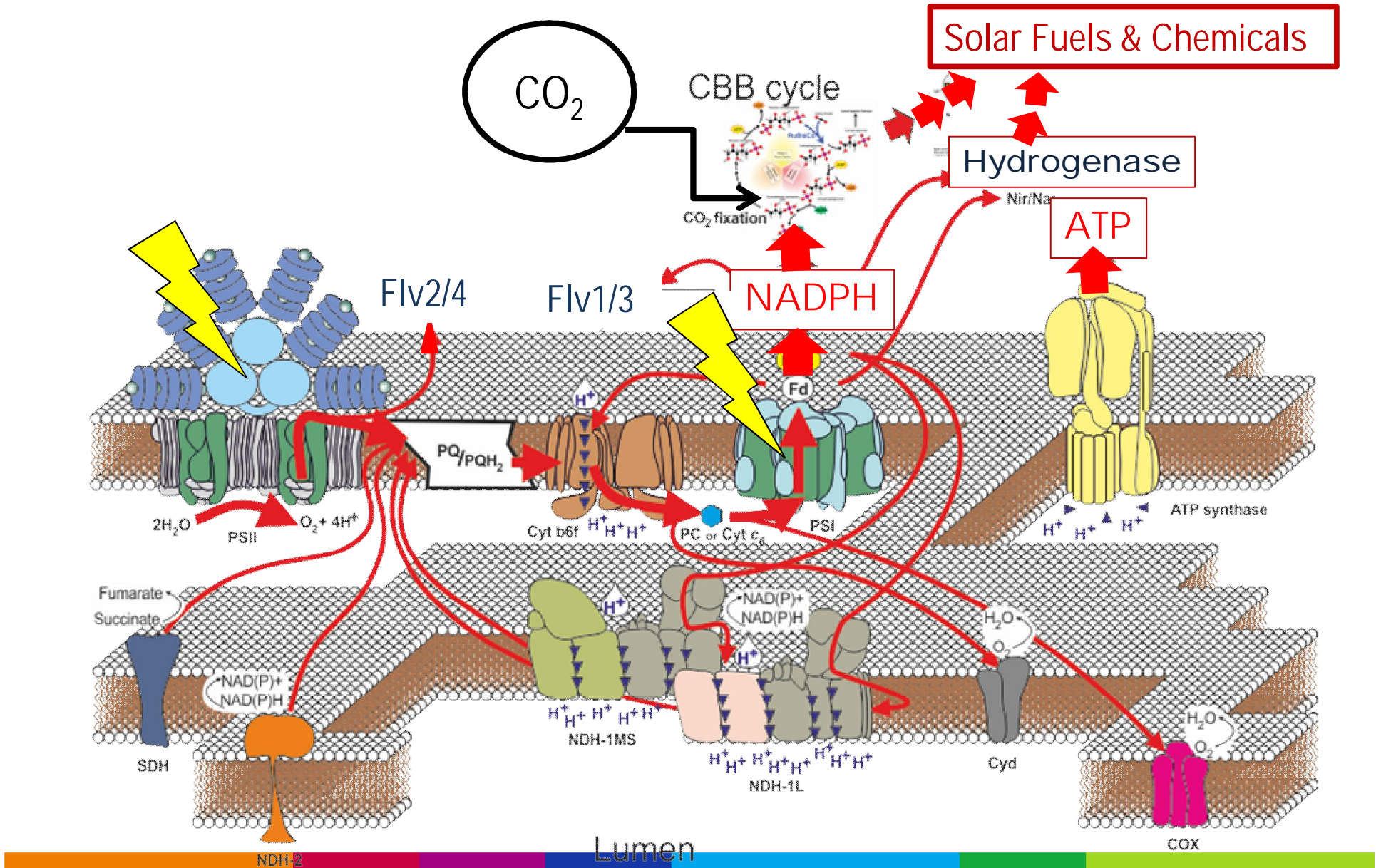


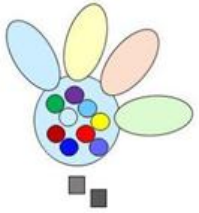


- Photosynthetic organism functions as a catalyst and produces **NADPH** and **ATP**
- CO<sub>2</sub> fixation is enhanced
- Major part of CO<sub>2</sub> fixation should be directed to new products
- Only minor part of CO<sub>2</sub> fixation is used for growth and maintenance of cells

Solar energy is first stored in **NADPH** and **ATP** .... then in target products

Needs strict planning, modelling and engineering to avoid the escape of "high-energy" electrons derived from water

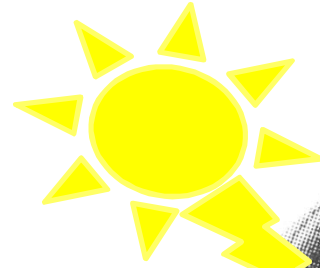




Living Factories

Substrates

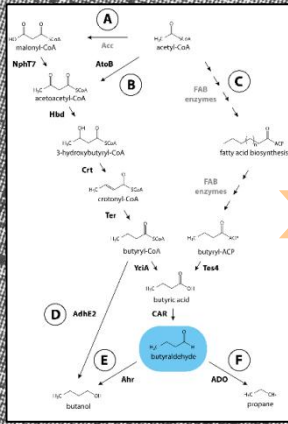
Products



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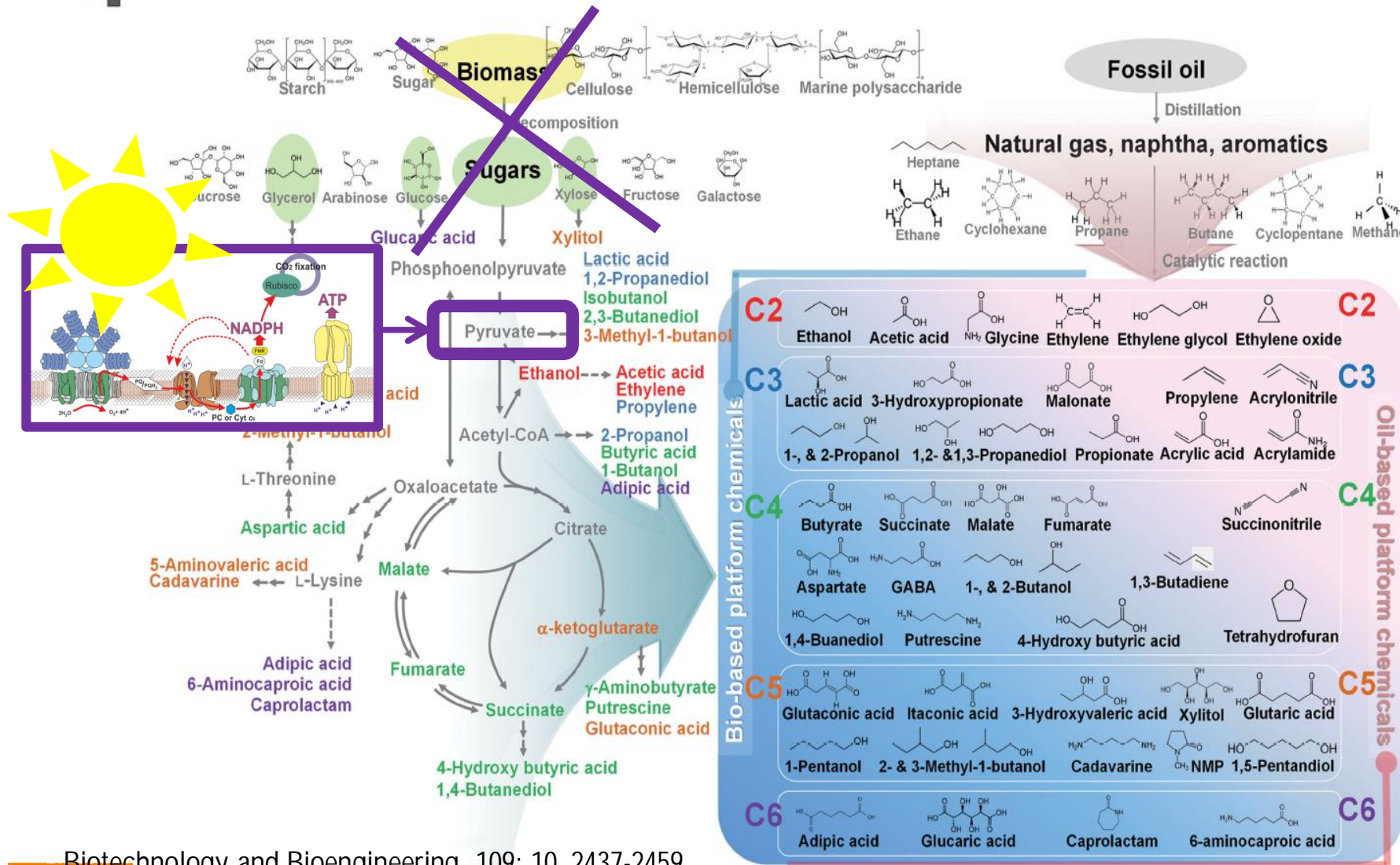
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Biomass production will be limited!**



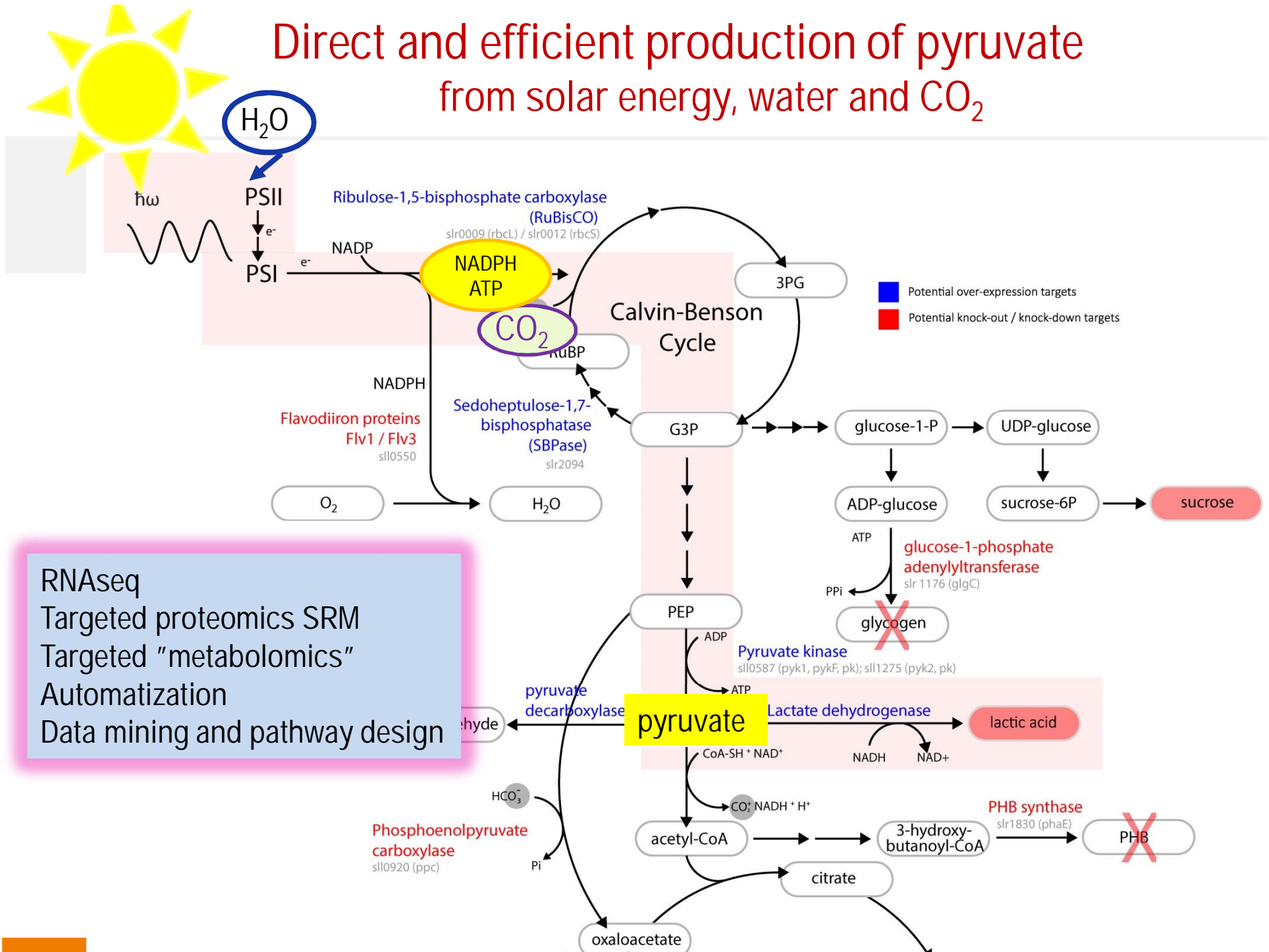
# Living Factories



Cell chemistry can provide fuels and platform chemicals to replace oil - but also chemicals for novel industrial applications

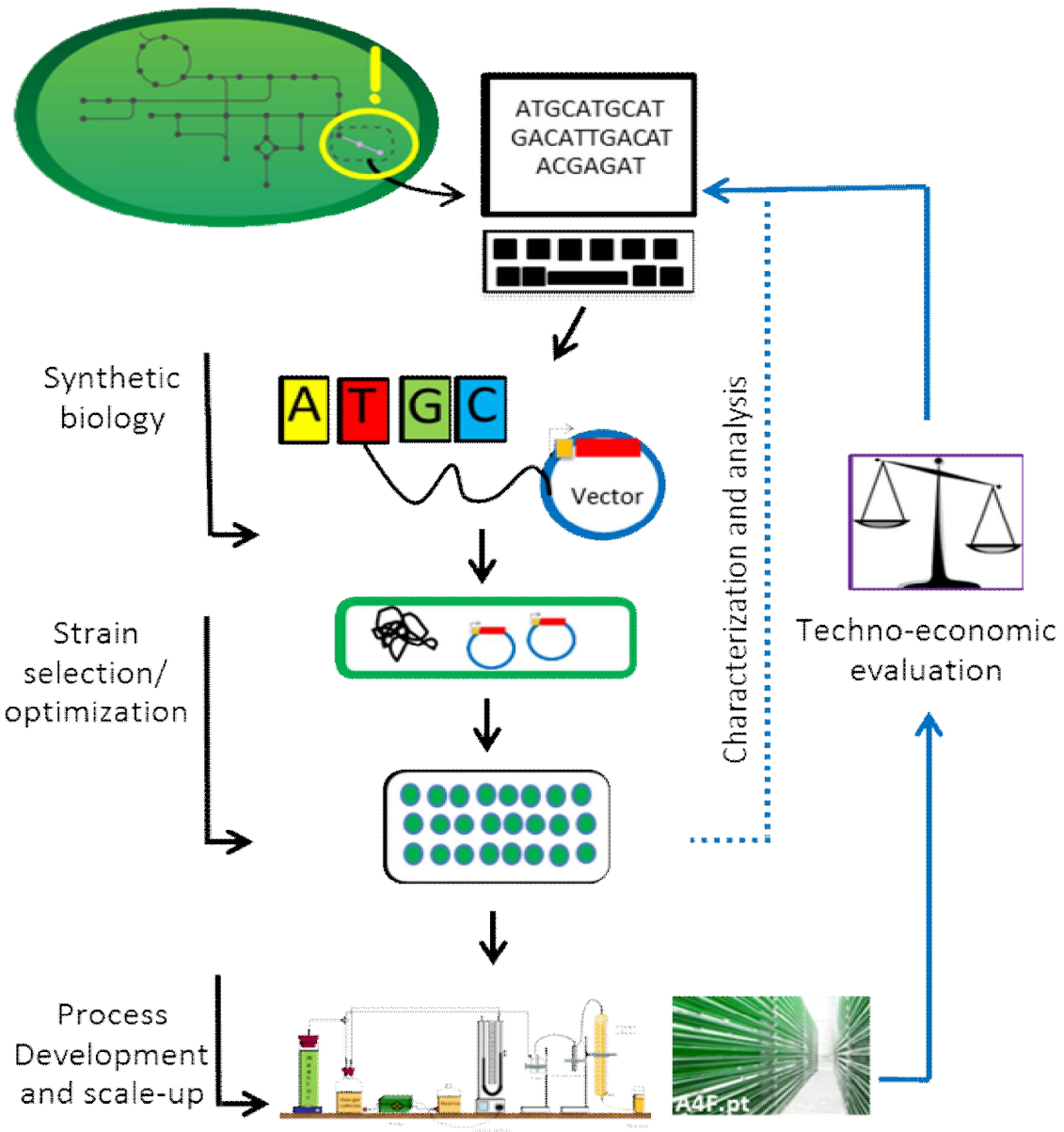


# Direct and efficient production of pyruvate from solar energy, water and CO<sub>2</sub>



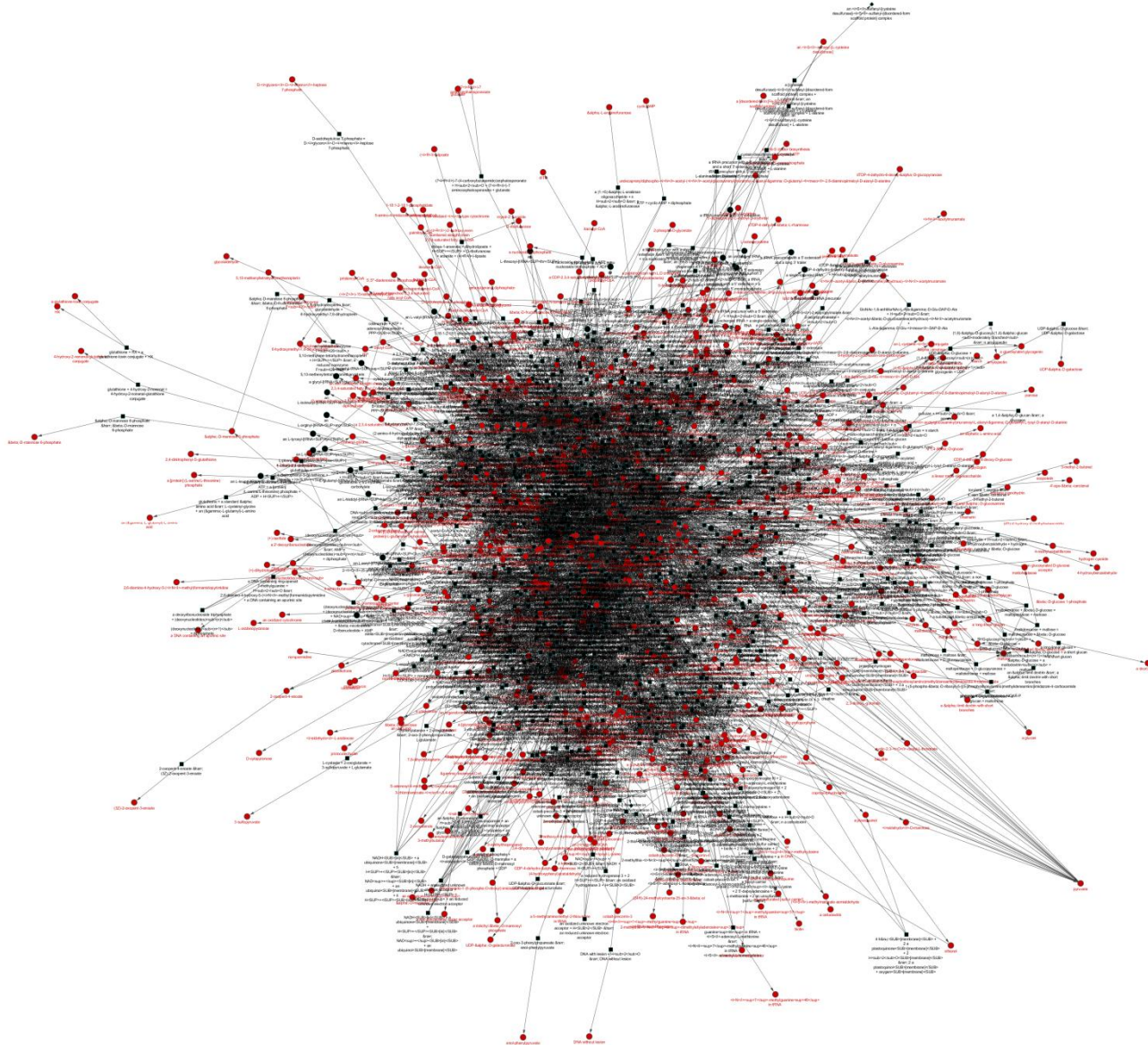
RNAseq  
 Targeted proteomics SRM  
 Targeted "metabolomics"  
 Automatization  
 Data mining and pathway design





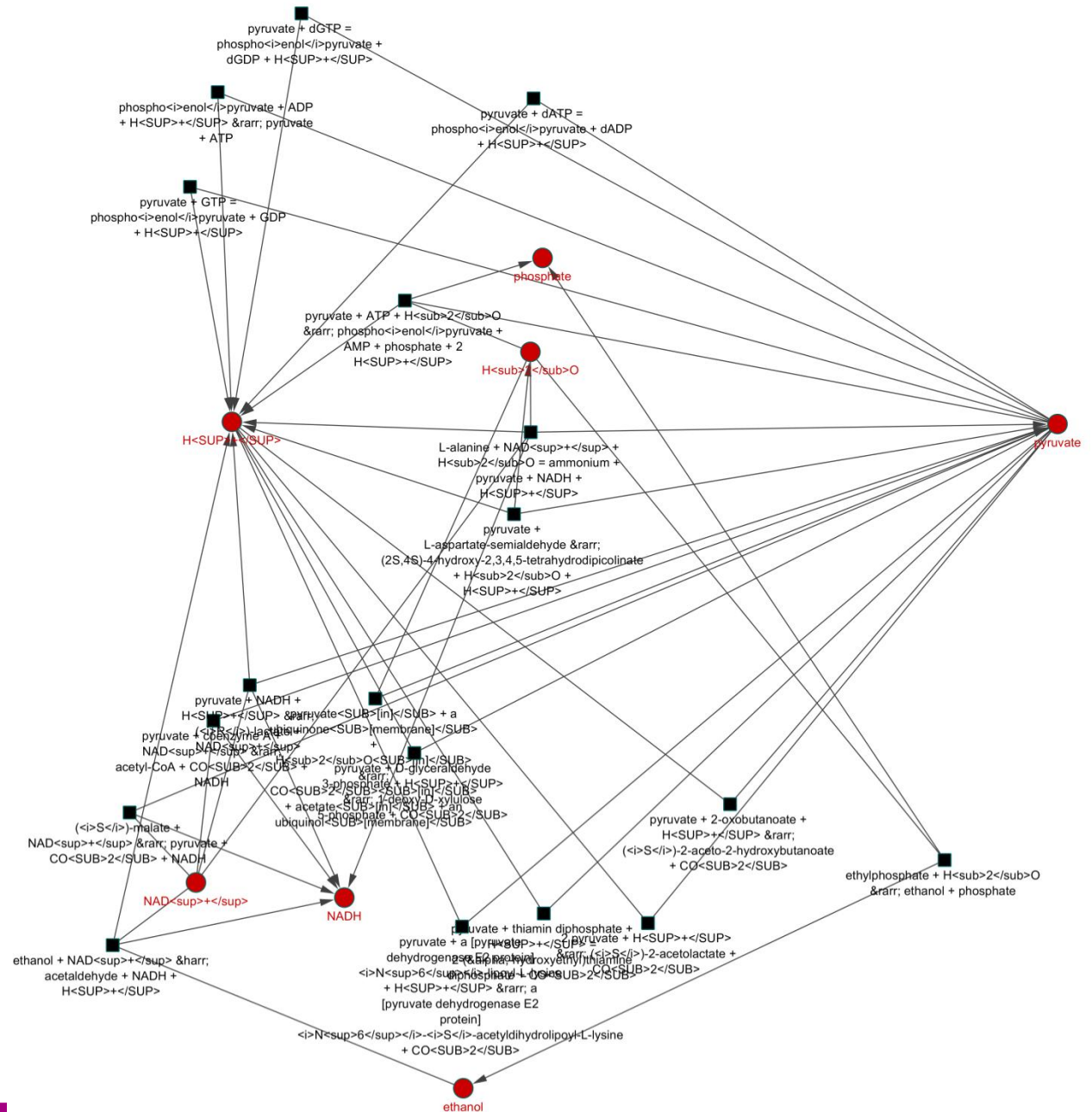


# Modeling; from pyruvate onwards





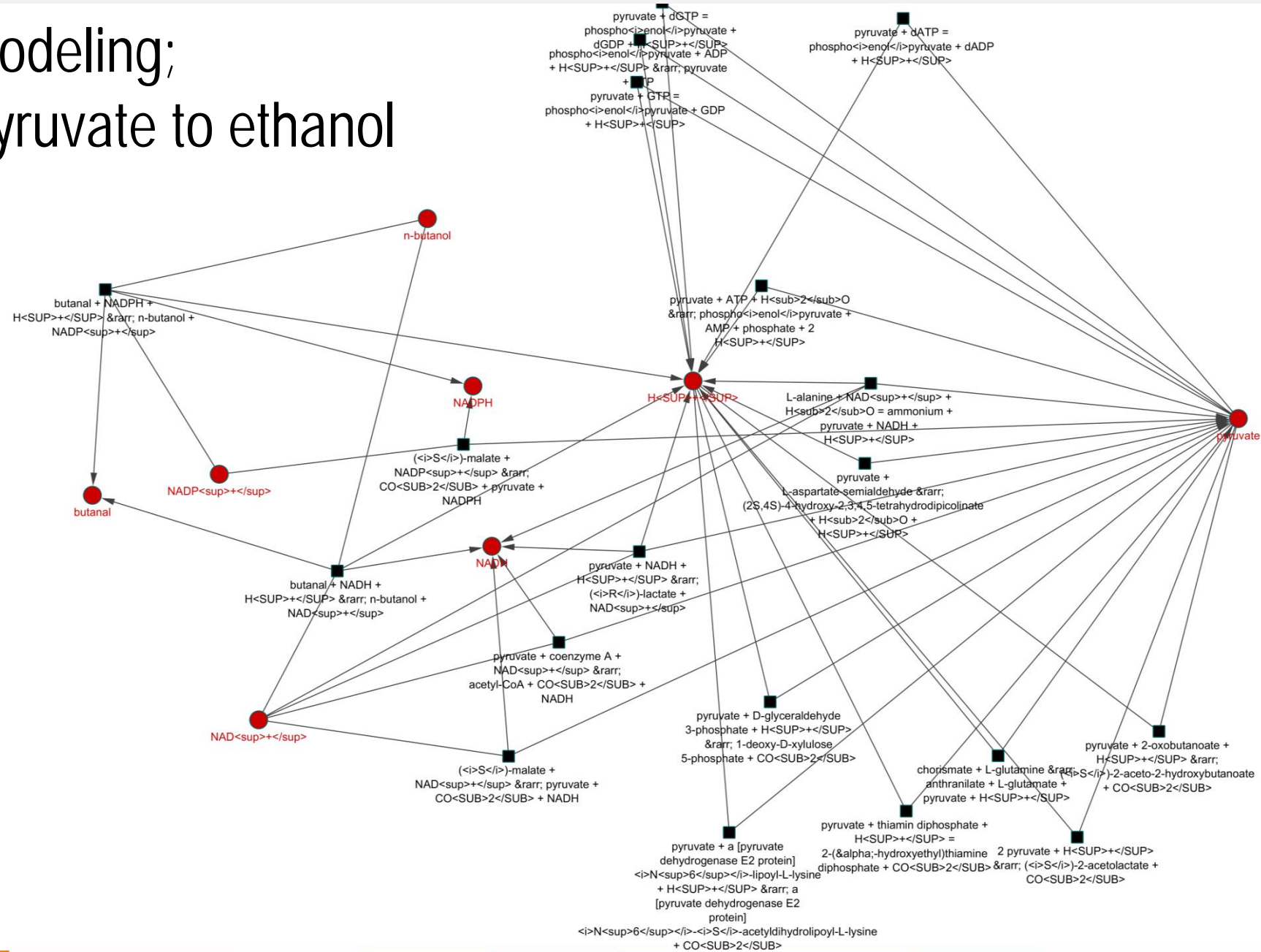
# Modeling; Pyruvate to ethanol



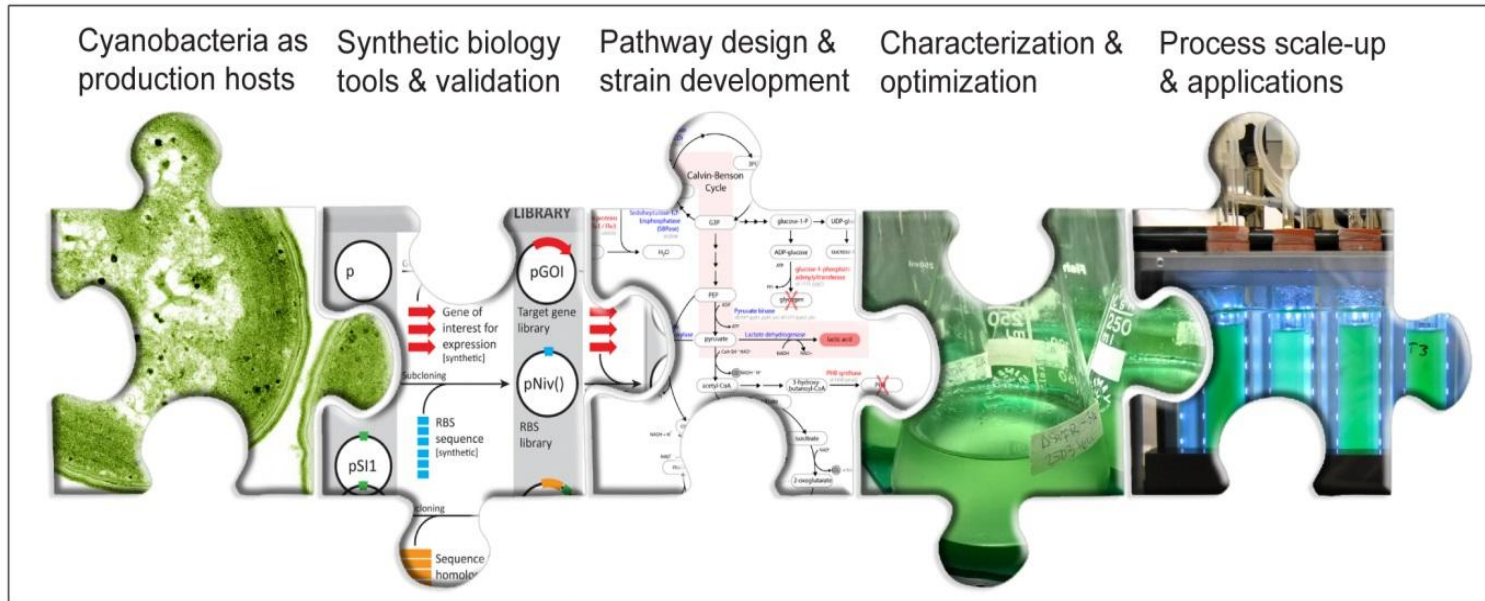




# Modeling; Pyruvate to ethanol



# Towards Sustainable Bioeconomy



CO<sub>2</sub> + water + sun light → biofuels and chemical commodities



Full proposal was submitted in September 2016 with our unit as a coordinator

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You are here: [Home](#) > [Apply for funding](#) > [Announcements](#) > [Call for pre-proposals for Nordic Centres of Excellence: Advancing the bioeconomy transition in the Nordic region](#)

## Call for pre-proposals for Nordic Centres of Excellence: Advancing the bioeconomy transition in the Nordic region

NordForsk launches a new two-phase call for proposals for Nordic Centres of Excellence within the Nordic Bioeconomy Programme. The programme aims to fund three Nordic Centres of Excellence within a budget of NOK 90 million. Application deadline for the first phase is 16 March 2016.

The objective of the Nordic Bioeconomy Programme is to generate new knowledge on how to promote and advance the transition to a bioeconomy-based society in the Nordic countries. The programme now launches a two-phase call for proposals for Nordic Centres of Excellence.

The call is relevant for all sectors (e.g. agriculture, forestry, marine, food and other) in the bioeconomy, but with an emphasis on new and innovative areas of research and innovation in order to understand the bio-economy transition in a holistic perspective. In this call water is a common denominator and can be either the research subject or an integral part of the proposal, but does not have to be the main theme.

Calls for pre-proposals must be submitted electronically through the NordForsk Application Portal **by 16 March 2016**. International experts will assess the pre-proposals, and the programme committee will assess the relevance to the call and the Nordic added value. Selected pre-proposals will then be invited to the second application phase, with deadline in September 2016.



### Contact person

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### Contact person

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### Facts about the call

#### Budget

90 MNOK

#### Application expired

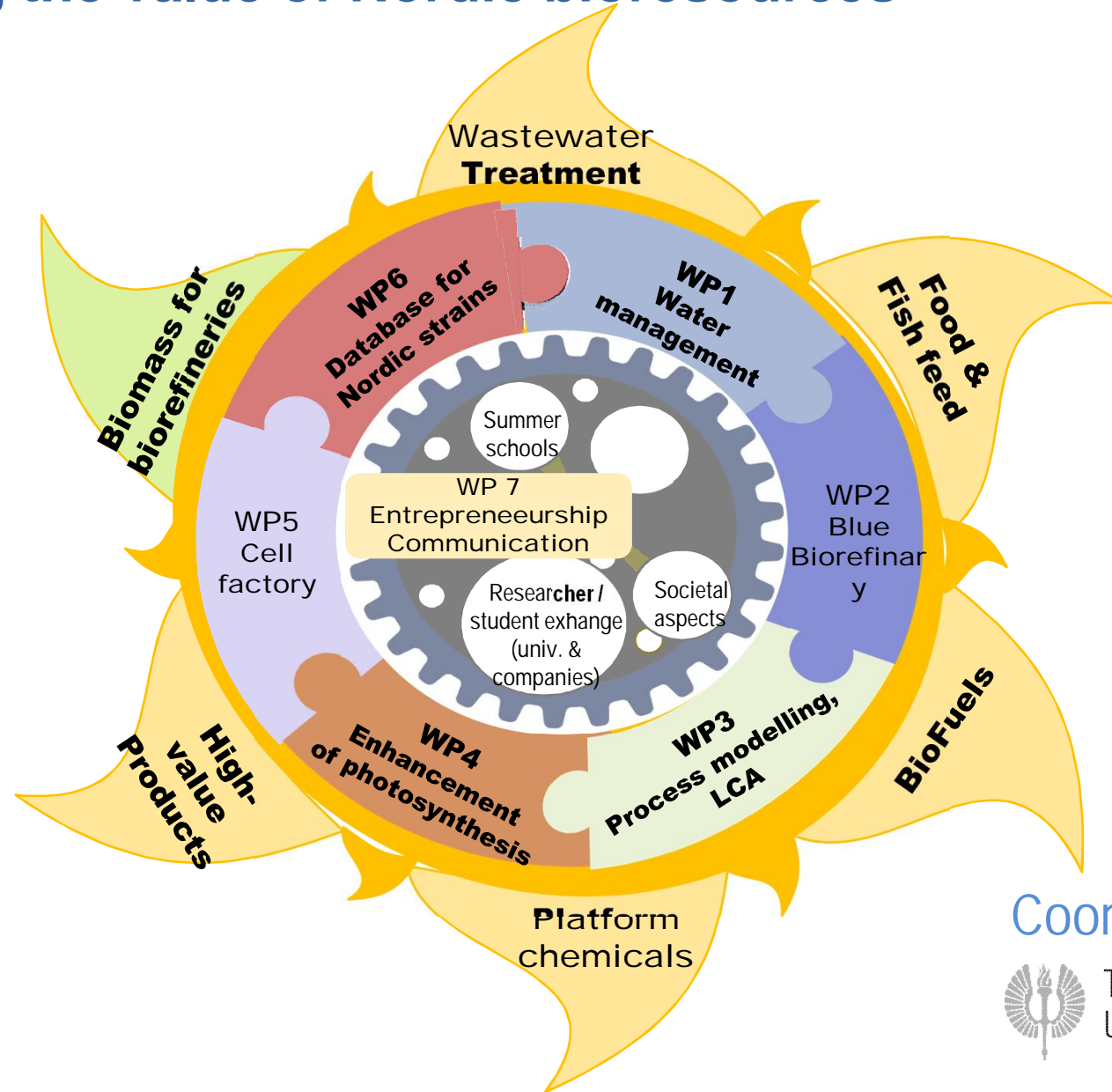
16.03.2016 – 14:00 CET

#### Programmes

[Nordic Bioeconomy Programme](#)

#### Topics

# #82845 Towards versatility of aquatic production platforms: unlocking the value of Nordic bioresources



Coordinator:



Turun yliopisto  
University of Turku



# PHOTOSYNTHESIS 2.0



Plant Power  
for the Future

A Proposal

One billion  
EU FET Flagship  
Project  
Presented in the  
Commission in J  
and negotiations  
continue

EU Flagship Project - a billion euro project

## PHOTOSYNTHESIS 2.0

Under negotiation in EU Commission  
Starts earliest in 2019



Turun yliopisto  
University of Turku







WOOD AND FOREST	FISH AND WATERS	ENERGY	CHEMISTRY	FOOD	ECOSYSTEM SERVICES	FACTS AND CONTACTS
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### WELCOME TO LEARN ABOUT THE DIVERSE FINNISH BIOECONOMY

**By 2030 we need 50% more food, 45% more energy, and 30% more water. The solution is bioeconomy.**

Finland aims for a low-carbon, energy-efficient society, founded on the use of renewable natural resources and recycled materials. For Finland bioeconomy brings an annual output of 100 billion euros, growth of exports, 100 000 new jobs and increased well-being, with due respect for the environment. Welcome to learn about strategic development of bioeconomy and collaboration between different sectors in this work!

[READ MORE...](#)

## WELCOME

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@UPM\_News

UPM is the first forest industry company invited to join the United Nations' Global Compact LEAD. [bit.ly/2ceLTqE](http://bit.ly/2ceLTqE) #forestindustry

**NEWS**

09.09.2016

**Finnish-Chilean cooperation on bioeconomy**

The Minister for Foreign Affairs of Finland Timo Soini signed on 9 August a Memorandum of Understanding on...

[Read more...](#)

23.08.2016

**CHEMISTRY** CASE

