STEPS

Sustainable Plastics and Transition Pathways

Josefin Ahlqvist (Ph D, Project leader, Collaboration office, Lund University)

5 September 2024, WIRA – SuPRA 4–5 september 2024, Södertälje

STEPS

– Sustainable Plastics and Transition Pathways

A research programme at Lund University funded by Mistra (*a foundation based on one of the old wage earner funds*):

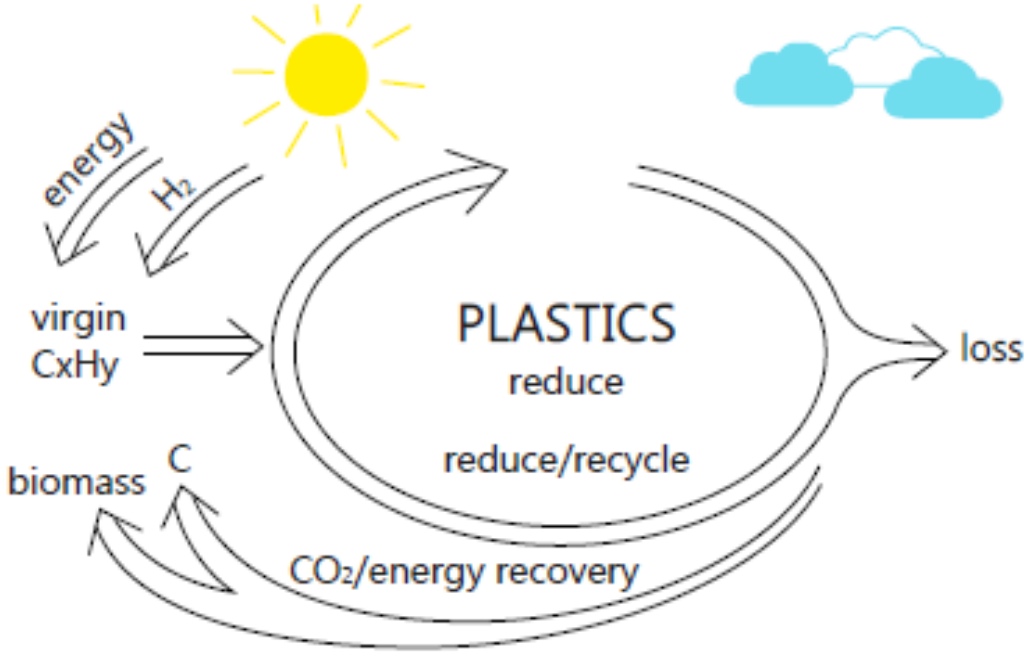
- Programme period 1: 2016-2020
- Programme period 2: 2021-2024
- 2 universities, 2 institutes, Region Skåne and 22 industrial partners
- 12 research groups, 10 PhDs
- 95 MSEK from Mistra SEK
- 32 MSEK from participating partners

MISTRA

Stiftelsen för miljöstrategisk forskning

STEPS – Vision and approach

Vision of a future society where plastics are produced, used and recycled in a circular economy



Hollistic approach – with initial focus on polyesters

STEPS – Multidisciplinary research programme

TECHNICAL DISCIPLINES ↔ **SOCIAL SCIENCES**

Biotechnology

Chemical engineering

Polymer technology, CAS

Product design

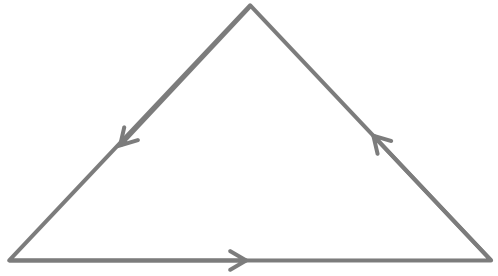
Textiles, Mölndal

Environment and Energy Systems / CIRCLE

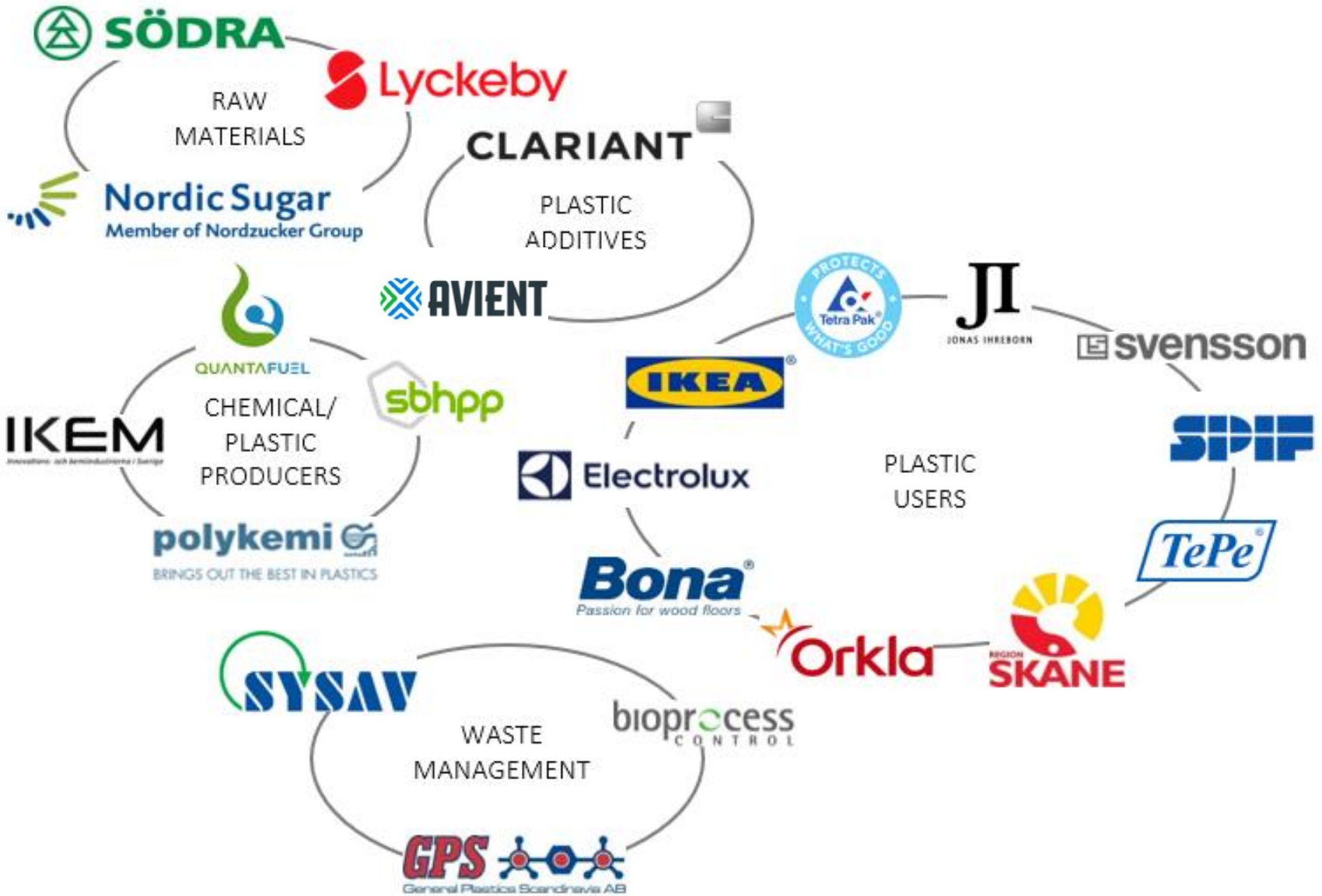
Political Science

Human and Economic Geography

Div. Production, Marketing and Policy



In collaboration with public organisations and industry along the whole value chain.



STEPS

An independent, initiated and committed Board of Directors with extensive and broad relevant knowledge

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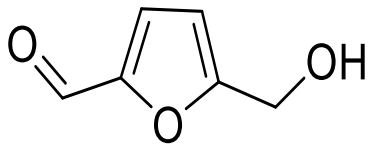
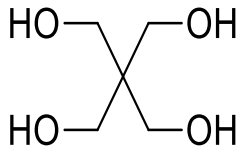
StepOn: Polyurethane floor coating



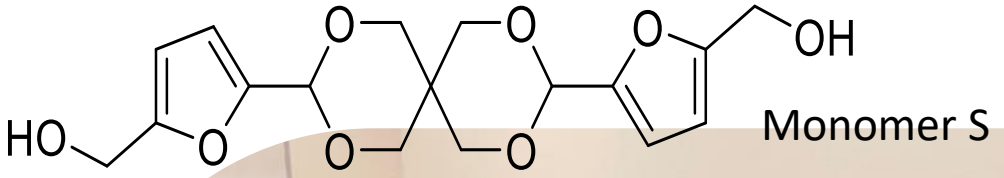
HMF

Dehydration of fructose

+



Biobased polyol (Voxtar) from Perstorp

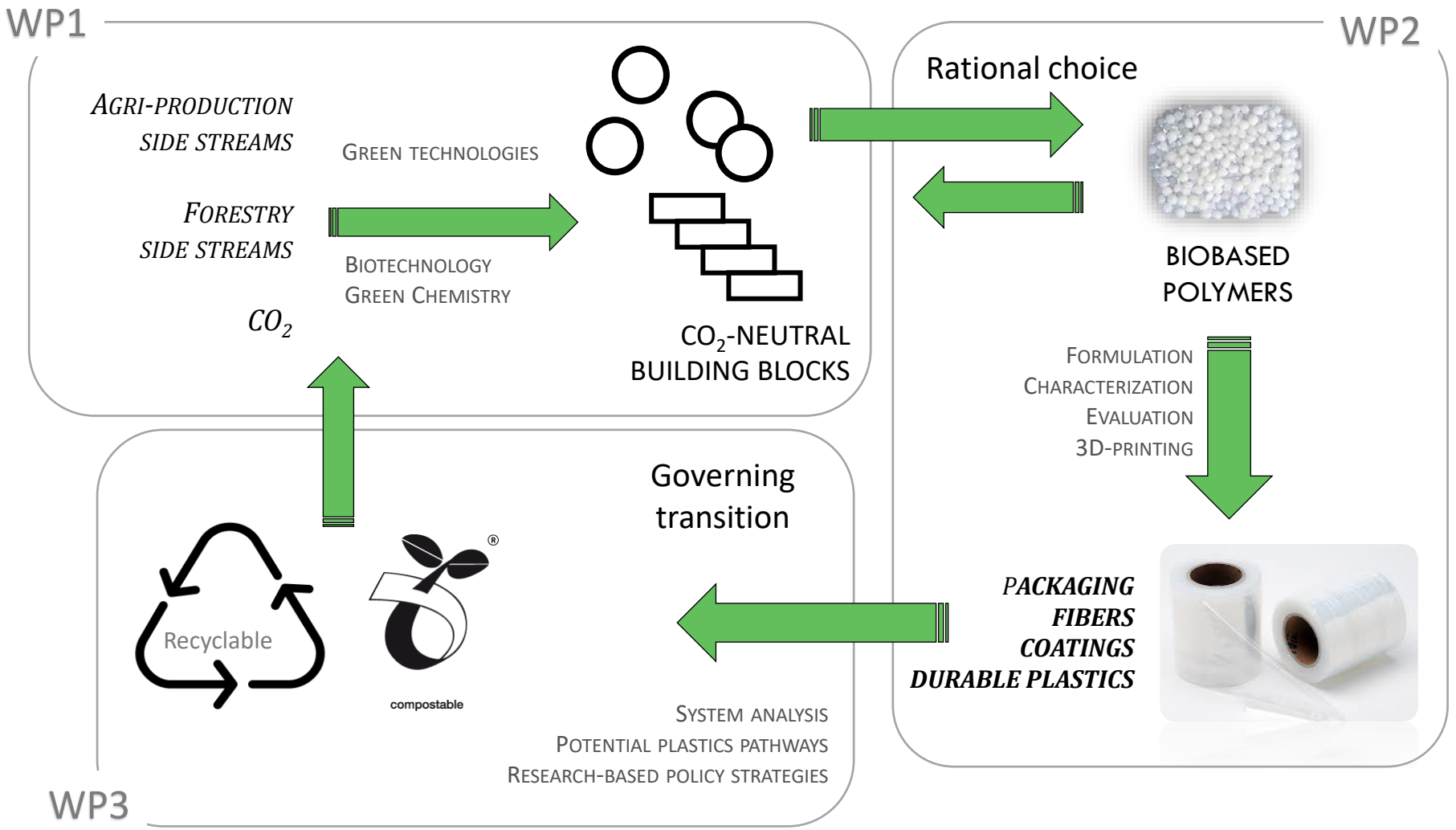


Monomer S

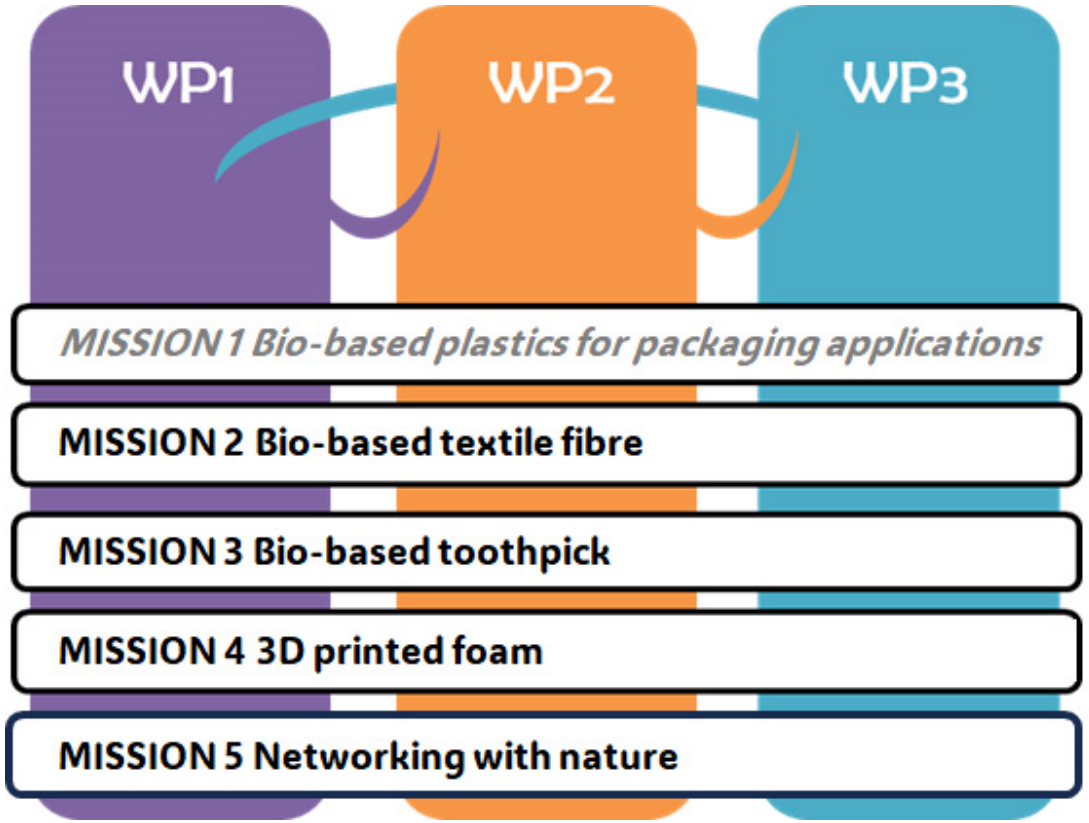
Wooden floor coating made in 2017 – still good

Polyester textiles – Step-in

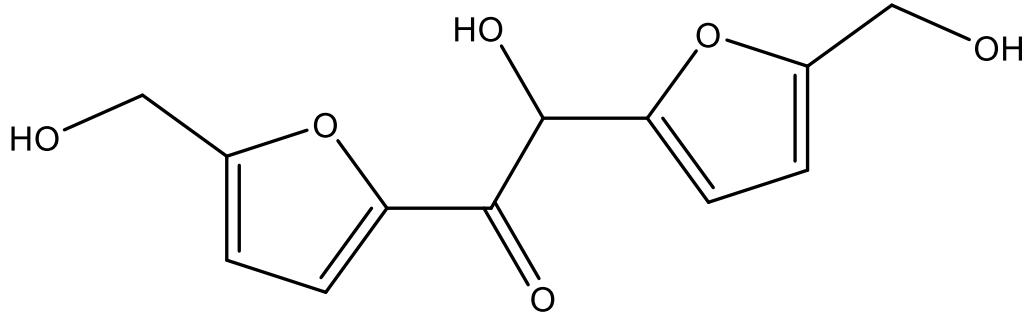
Three intertwined work packages



5 missions



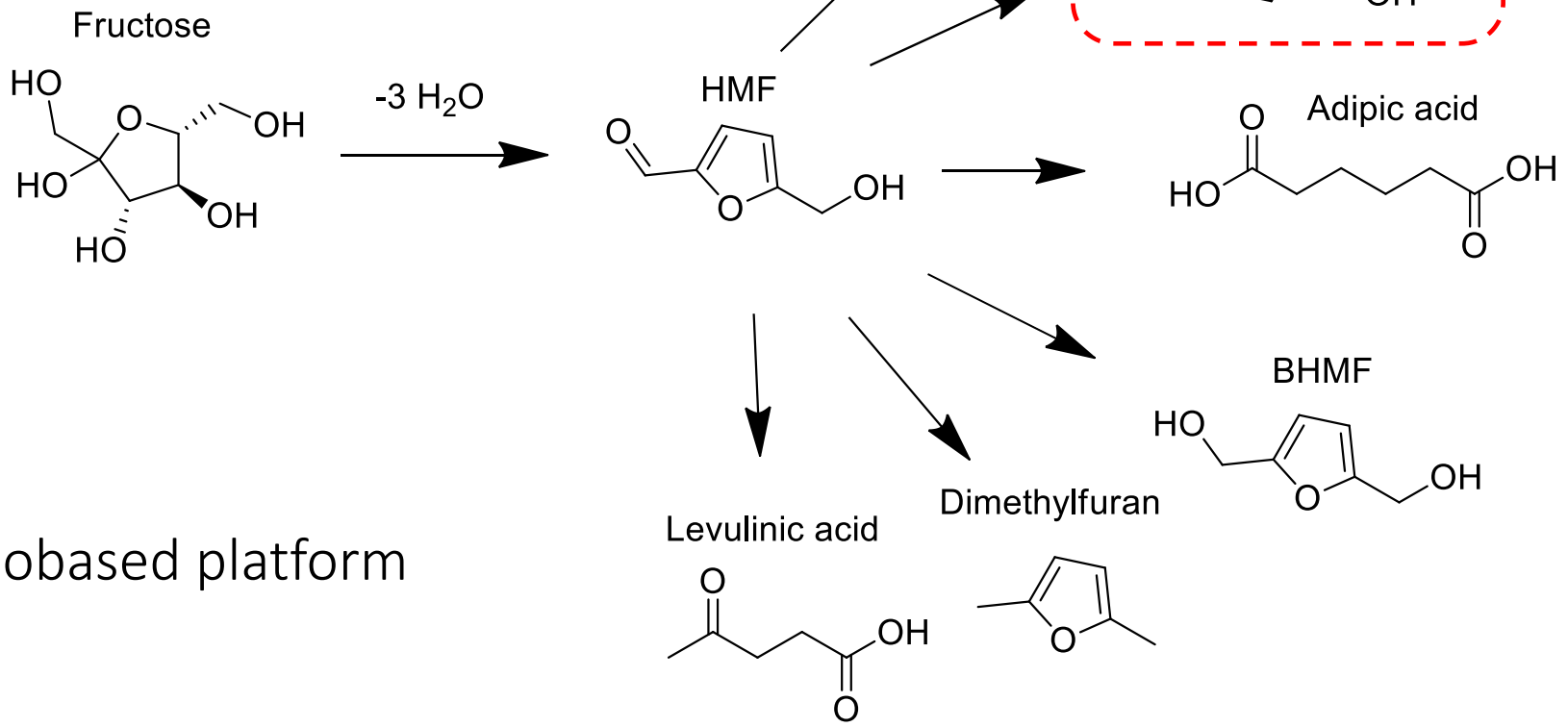
COMPLETED



A furoin and furil

Touch down: WP1 - utilize both bioprocess technology and traditional chemistry processes

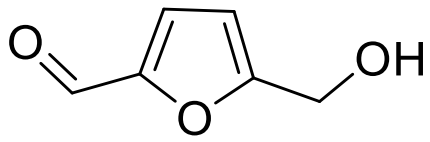
- Sugar – useful feedstock in short to mid term
- Cellulose – potential feedstock
- Platform for a wide range of building blocks for chemicals, materials and energy carriers



5-HMF is one important biobased platform

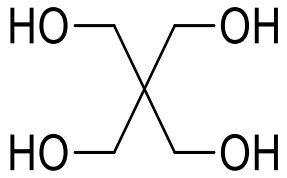
5-Hydroxymethylfurfural (5-HMF)

Touch down: WP2 - improving chemical recycling by bio-based spirocyclic acetal monomers



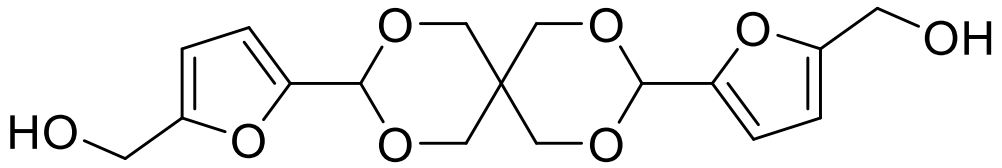
HMF

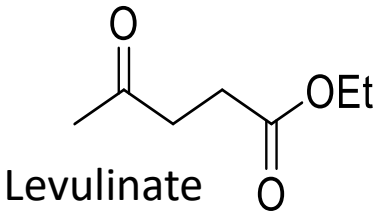
5-Hydroxymethylfurfural (5-HMF)



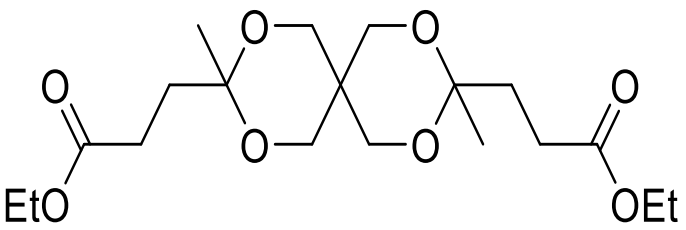
Penta

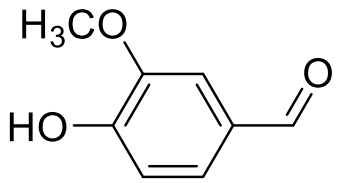
(Voxtar™)



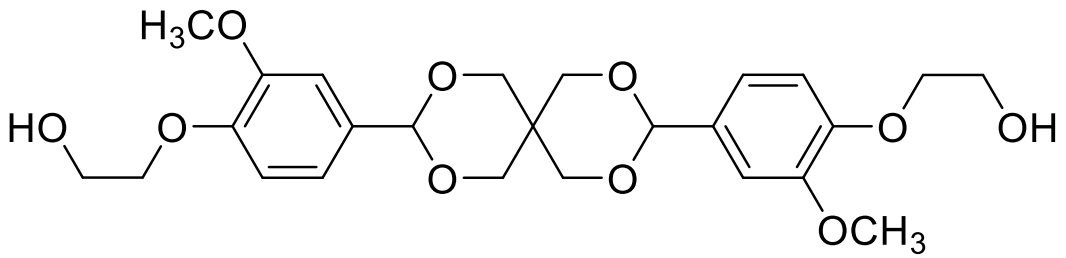


Levulinate



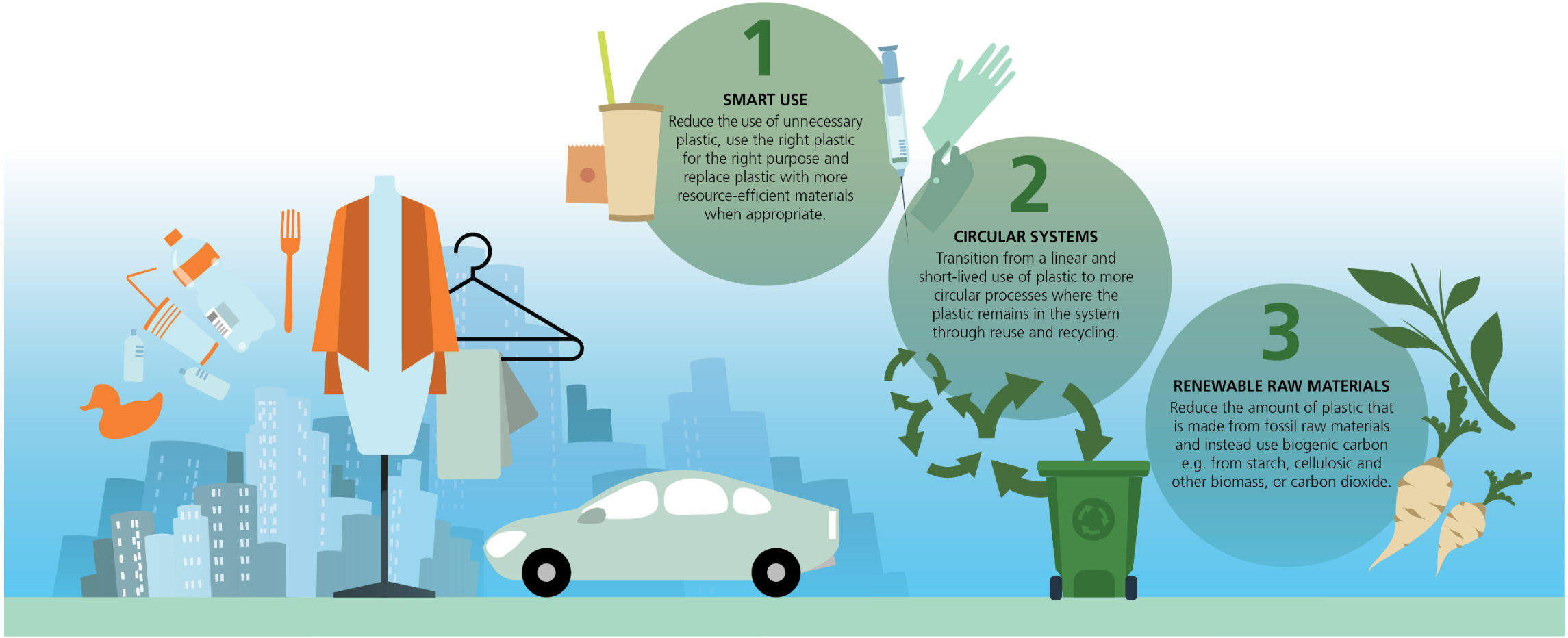


Vanillin



Warlin et al. (2019) Green Chemistry 21, 6667
Mankar et al. (2019) ACS Sust Chem Eng 7, 23, 19090
Valsange et al. (2021) Green Chemistry 23, 5706

Touch down: WP 3 - monitor and report on the ongoing Global Plastic Treaty and influence EU



3 PATHWAYS TOWARDS SUSTAINABLE PLASTICS

STEPS missions are to driven by the industrial partners

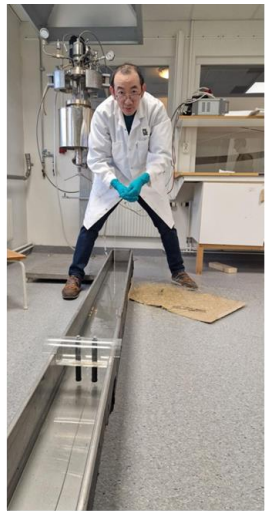
Mission 1: Bio-based plastics for packaging applications: Level of food protection versus ease to recycle (study finalized)

Mission leader: Tetra Pak
Other STEPS stakeholders involved: GPS, Lund University, Nordic Sugar, Orkla Foods

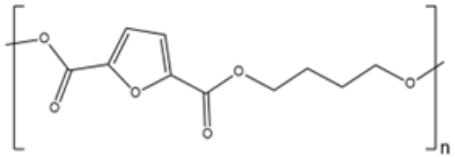
Mission 2: Bio-based textiles (currently focusing on the up-scaling of PBF fibers in 5 L reactor)

Mission leader: RISE IVF, IKEA.

Other STEPS stakeholders involved: Clariant, GPS, Ludvig Svensson, Lund University


Zengwei collecting PBF


Reactor and PBF



Mission 3: Bio-based toothpick (several lignin based monomers were tested, now focusing on up-scaled polymerisation of one promising monomer at Sumitomo)

Mission leader: TePe

Other STEPS stakeholders involved: Clariant, Lund University, Nordic Sugar, PolyKemi, SBHPP (Sumitomo), GPS

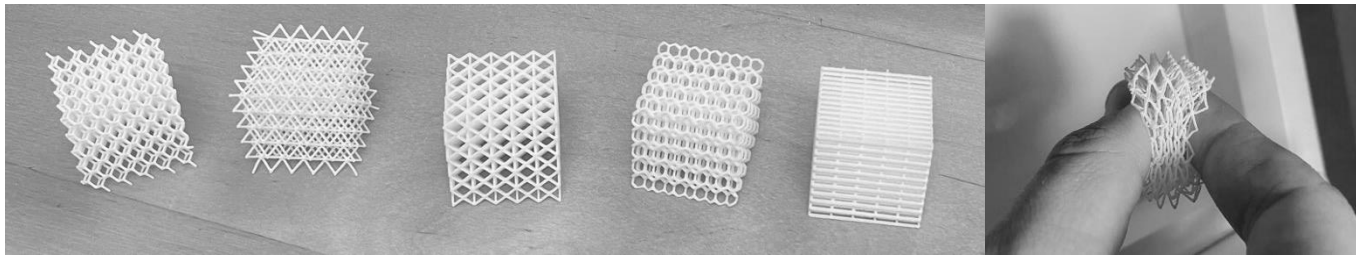
Mission 4: 3D Printed Foam (replace polyurethane foam using structures from biobased materials)

Mission leader: Jonas Ihreborn AB

Other STEPS stakeholders involved: Lund University, Nordic Sugar

Test prints

PLA PHA PHB+PLA



Mission 5: Networking with Nature (cross-linking polyeruthane coatings in a one-component solution)

Mission leader: Bona

Other STEPS stakeholders involved: Lund University, Nordic Sugar, Perstorp

Mw build-up challenges in a home environment

- Non-hazardous
- Quick
- No volatiles
- No heating
- No chemical competence

1 K, the sole option.
Only for polyacrylates

Seeking for new funding to:

- Evaluate the enzymatic route
- Evaluate the organic route

Bona®

Other activities informs consumers, producers and public organisations through media, training and other channels

SUMMER SCHOOL ON SUSTAINABLE PLASTICS

Mon, 7 Aug 2023, 9:30 am – Fri, 18 Aug 2023, 4:00 pm

And educates doctoral and master's students

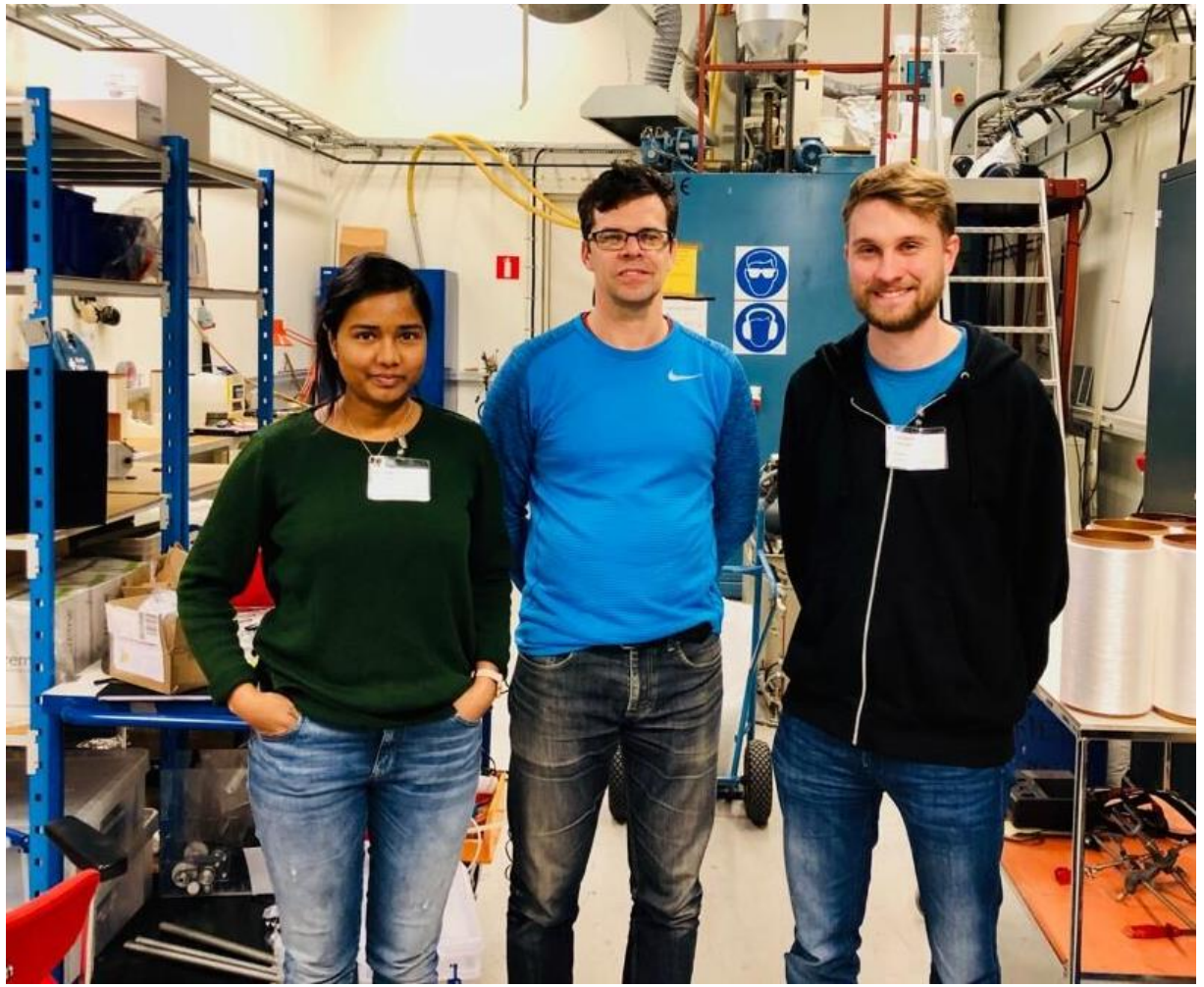


Image:
To the left -
Post doc. Smita Mankar, MIT
To the right -
Post Doc. Niklas Warlin, Stanford

And please come to our final conference!

Conference

STEPS Towards Sustainable Plastics, 7-9 October 2024

Welcome to STEPS three-day conference focusing on sustainable plastics pathways in Lund, Sweden!

This event will feature plenary sessions with national and international speakers from academia, high-level organisations and industry, individual presentations, panel debates and a poster session!

Join us for the full conference, or attend one or two days. There's also opportunity to submit an abstract in our two parallel sessions!

Biobased building blocks and polymer design
Plastics Governance; panel with Nordic ministers.

Read more and register!
www.steps-mistra.se/stepsconference

The conference is organised by the STEPS programme.

WHEN: 7 – 9 OCTOBER, 2024, LUNCH to LUNCH
WHERE: STADSHALLEN, LUND, SWEDEN

STEPS
LUND UNIVERSITY
MISTRA

Academy

CONTRIBUTES

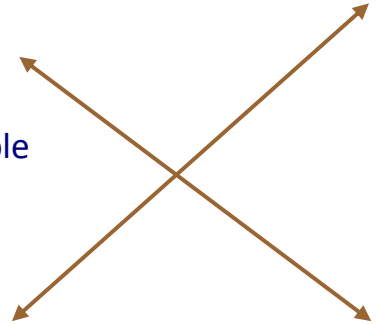
- Biotechnology tools
  - Biocatalysts and Bioprocesses
- LCA-analysis
- Innovation system analysis
- Know How
  - Biotechnology, renewable resources, LCA analysis

NEEDS

- More knowledge about:
  - The market
  - Requirements on products and processes
- Raw materials and equipment
- Real Industrial sites and applications

GOAL

- Get more scientific knowledge and results for publication
- Educate students
- See practical use of research efforts



Industry

CONTRIBUTES

- Know How
  - The market, Requirements on products and processes
- Raw materials and equipment
- Tests of products and process
- Facilities and personnel for pilot scale production test

NEEDS

- New molecules
- Environmental friendly process and chemicals
- Low production costs

GOAL

- To work more environmental friendly
- To get ahead of the competitors
- Earn more
- Learn more

When you have many stakeholders with different knowledge, needs and expectations:

Acknowledge the learning process which needs to take place between academia and industry.

Dialogue

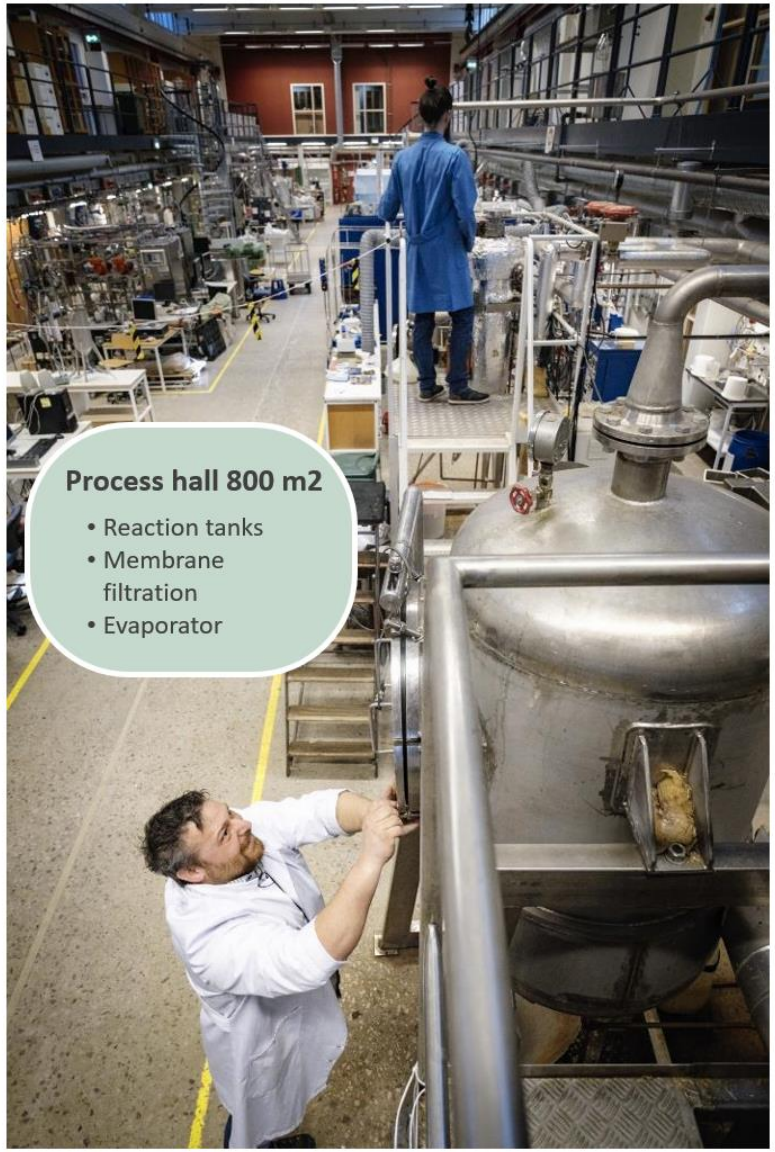
- Creates mutual trust
- Let us know what we may be able to do.
- Gives awareness among the partners for each others' conditions and ability to contribute
- Align the expectations and goals.

- Every aspect of a project may be discussed in detail, literally from molecular level to commercial requirements, company and societal policy strategies.
- Companies from different parts of the value chain may help each other with technical matters
- And can push each other forward by minimizing uncertainties regarding market value and supply costs.

Biotech Heights

Lund University Prepilot Plant

- Expertise and infrastructure for research, education and innovation within upscaling
- Possibility for more external users and more collaborations



Process hall 800 m2
- Reaction tanks
- Membrane filtration
- Evaporator

Biotech hall 200 m2
- *Modified microorganism cultivation*
  - Reaction tanks
  - Membrane filtration
  - Centrifuges

Food hall 400 m2
- Extrusion
- Wet milling
- Decanting, UHT, freeze dryer
- Test kitchen, bakery

STEPS

Contact

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STEPS

Thank you for listening!