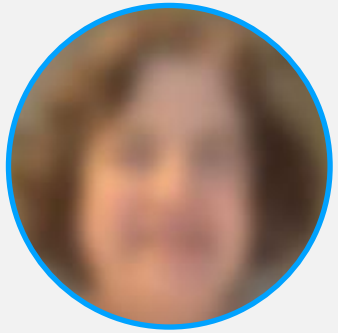
Session 5B: Sustainable Planning of Industrial Parks

Mohamed Mazen

GIZ Egypt, Session Moderator

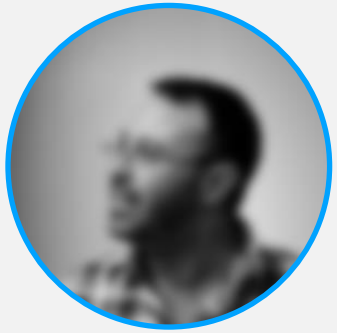
Hannes Utikal

Provadis University of Applied Sciences Frankfurt



Marian Chertow

Yale University Center of Industrial Ecology



Ahmed Huzayyin

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Tomorrow Labs GmbH

Implemented by:

SIA Conference Cairo 2023

CO_2-footprint of chemical parks

Prof. Dr. Hannes Utikal, 07.06.2023

Process4 Sustainability

Cluster for climate-neutral process industries in Hesse

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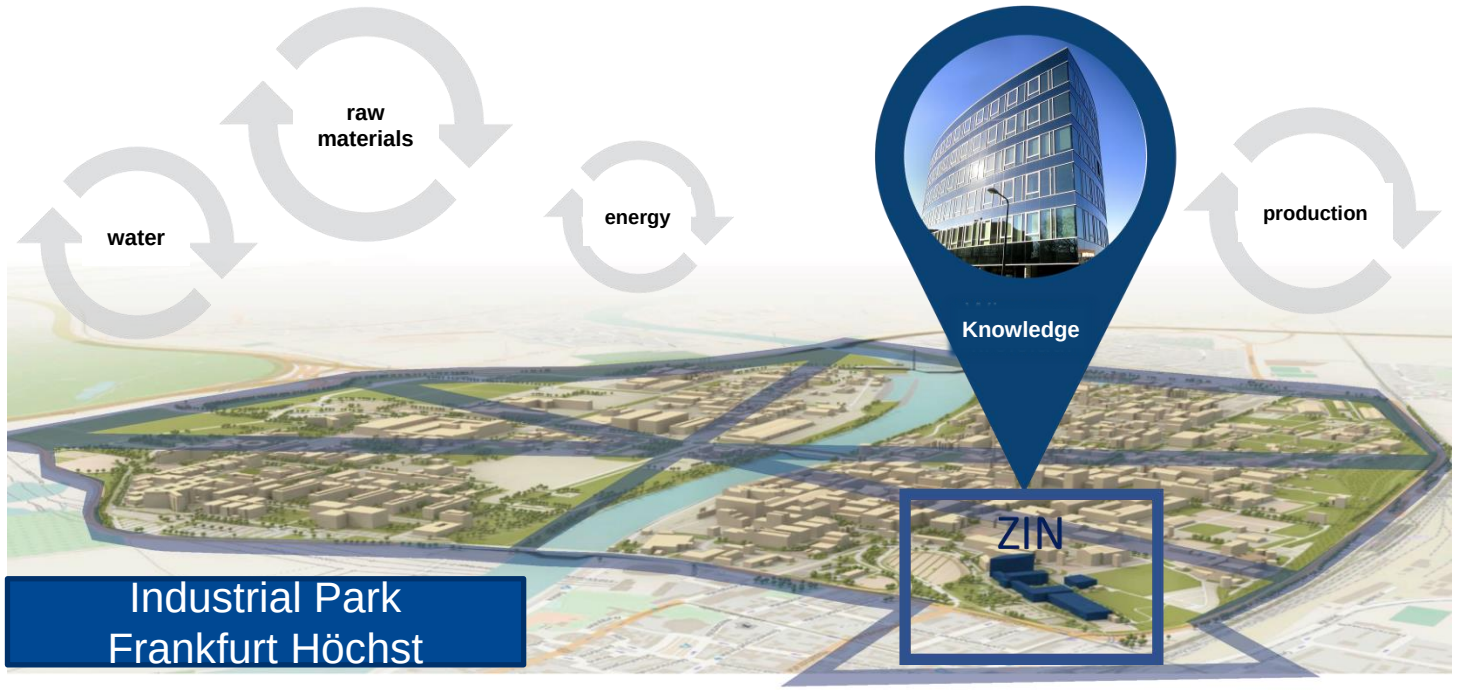
Hessisches Ministerium für Wirtschaft, Energie, Verkehr und Wohnen

Center for Industry and Sustainability as part of the Industrial Park Frankfurt Höchst



Joint Activity with GIZ
Virtual Academy for the Management of Sustainable Industrial Areas

provadis Hochschule

Sustainable Industrial Area Management

Program

- 6 months program with a workload of 80h
- Blended learning concept: live online lectures, group work, reading material, individual pitch training
- 4 modules:
  1) Exploring sustainability in industrial parks,
  2) Framing goals, KPIs and stakeholders to become an Eco Industrial Park,
  3) Designing actions across all dimensions (economic, environmental, social) towards scaling your Eco Industrial Park,
  4) Communication, implementation and monitoring
- Roadmap development

Participants

- 50+ participants in 2021 and 2022 from 10+ countries
- Receive a certificate upon successful participation
- Are introduced to relevant concepts regarding sustainable industrial area management and apply them to their specific environment in order to strengthen their practical skills

Develop
a transition pathway
for your industrial area!

STUDENTS BY PROVADIS
THINKING INDUSTRY NEW

CO_2-footprint of chemical parks

1. The challenge: Defossilisation of the chemical industry

a. The industrial park Frankfurt: The German chemical industry in a nutshell
b. The cluster Process4sustainability.eu

2. Techniques behind the development of a transformation pathway

a. Collecting (enough) data
b. Developing scenarios
c. Defining relevant topics
d. Roleplaying
e. Identifying the main levers for change and finding analogies with other networks

3. A look into the furure

a. Defining work packages
b. Additional supporting activities
c. Creating new business opportunities

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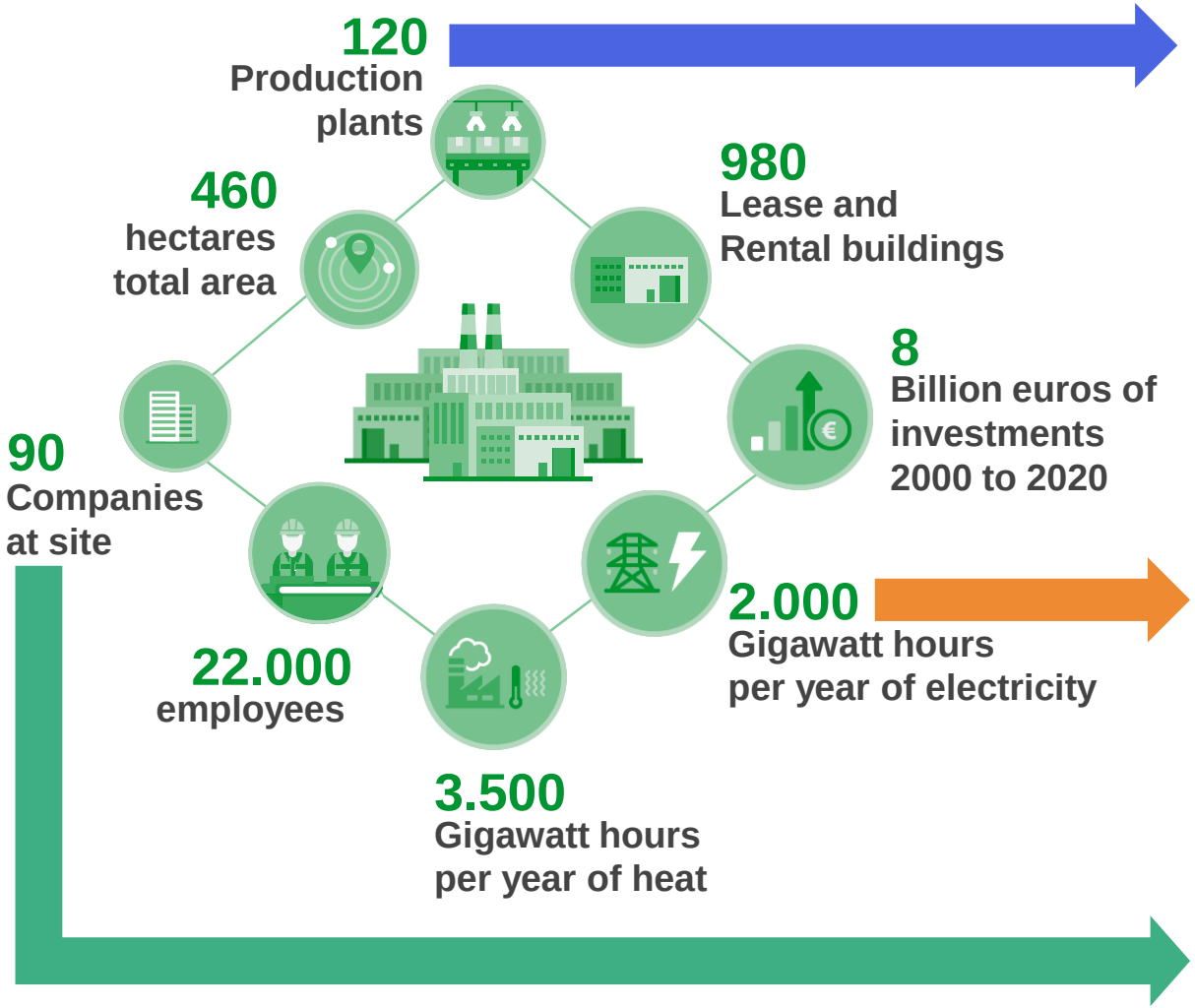
Our industrial park in Frankfurt Höchst



„The German chemical industry in a nutshell“:

Pigments, plastics, polymers, coatings, dyes, salt, gases, energy processes, biogas, acids, alcohols, aldehydes, amines, fungicides, herbicides, insecticides, silicates, biofuels, food additives, powders, sulfur chemicals, fluorides, functional chemicals, fine chemicals, agrochemicals, enzymes, antibodies, pharmaceutical products, …

Enough to power 600k – 1 Mil. households

Potentially 90 different goals and opinions, mostly international producing companies with limited EU commitments

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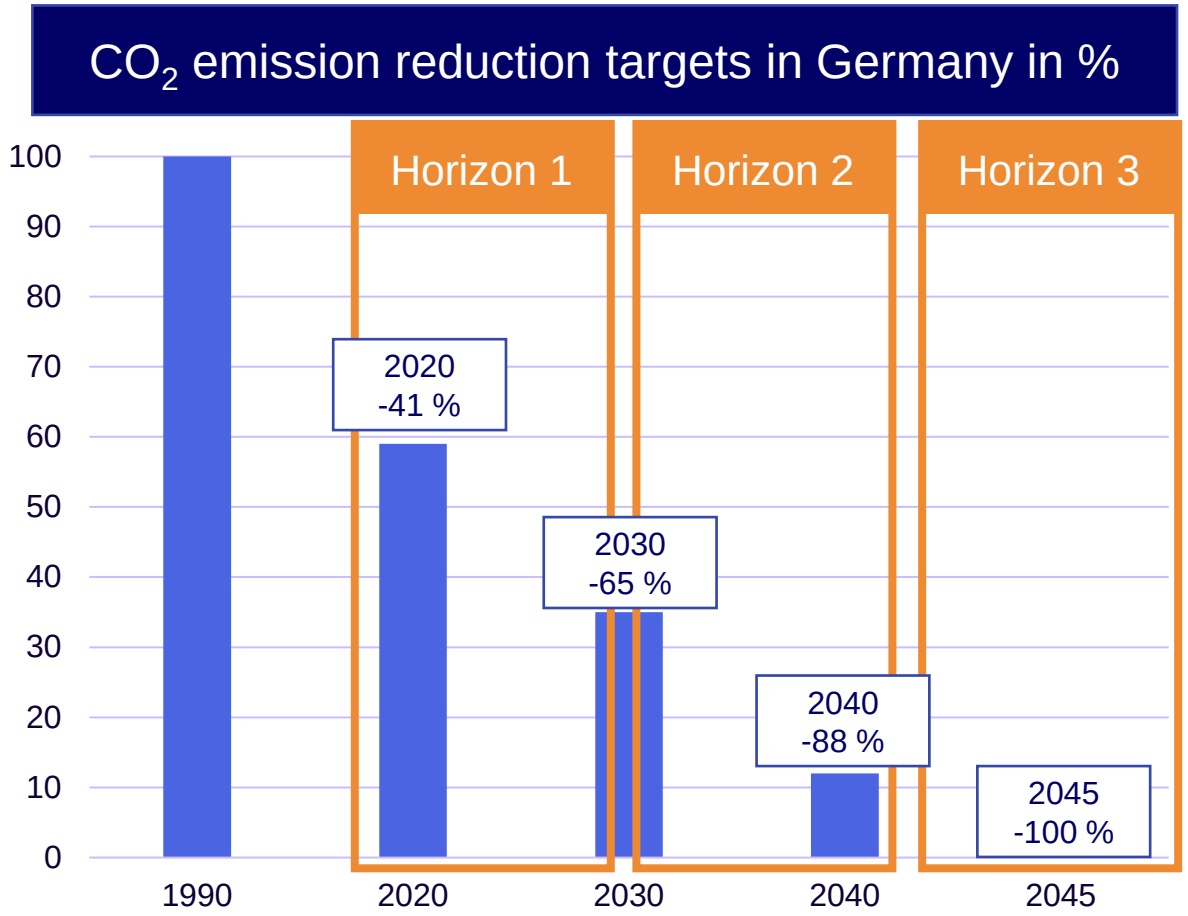
How do we bring it all together?



Source: Umweltbundesamt – Klimaschutzgesetz 2021

- Which reduction targets apply for the industrial park? Are we energy or chemical industry?
- How do we develop a transformation strategy while maintaining economic strength, especially during an energy crisis?
- What is the voice that speaks for all companies on site?
- What must happen in each horizon?

Our approach: Process4 Sustainability

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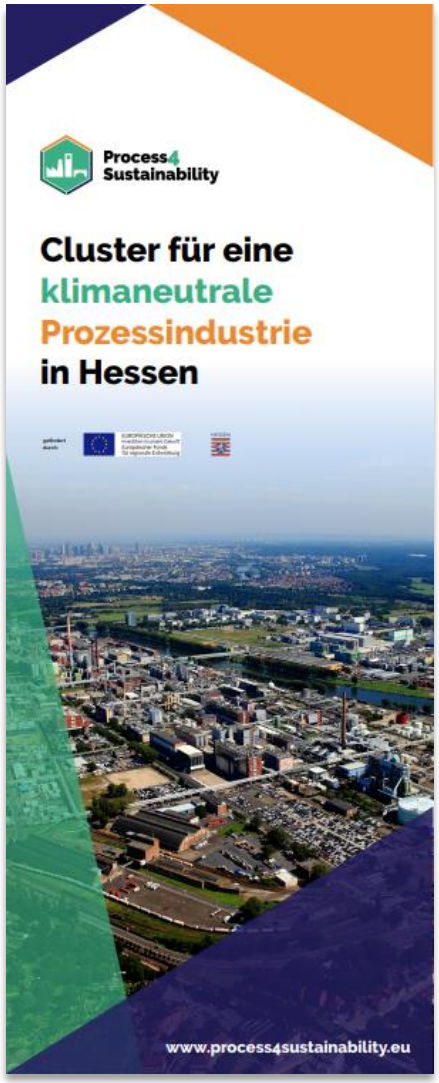
Cluster Process4Sustainability
managed by the Center for Industry and Sustainability (ZIN)



About: Europe wants to become CO2 neutral - as early as possible, but by 2050 at the latest. The process industry and its partners are central to the success of this transformation: **together**, we can develop **new markets** through **innovative solutions**, **save energy and raw materials**, **replace fossil CO2** sources, and increasingly **use CO2 as a resource**.

Process4Sustainability is a platform for the alliance of the willing.

Our role: Set-up and **management** of the **cluster and its activities**. We **translate** the goal of CO2 neutrality for individual companies and the **specific local conditions** and offer our partners practical knowledge about the **levers** of CO2 neutrality, new **markets** and innovative **business models**. We create **future markets** by connecting solution providers with the demand side.

Founding Partners

provadis Hochschule
infraserv höchst
BAYER
sanofi
kuraray
Celanese
The chemistry inside innovation™

Solution Partners

right°
INERATEC
CO2BIOCLEAN
ARCUS
CAPHENIA
And more…

Network Partners

DECHEMA
House of Energy
VCI
TECHNISCHE UNIVERSITÄT DARMSTADT
eit Manufacturing
Co-funded by the European Union

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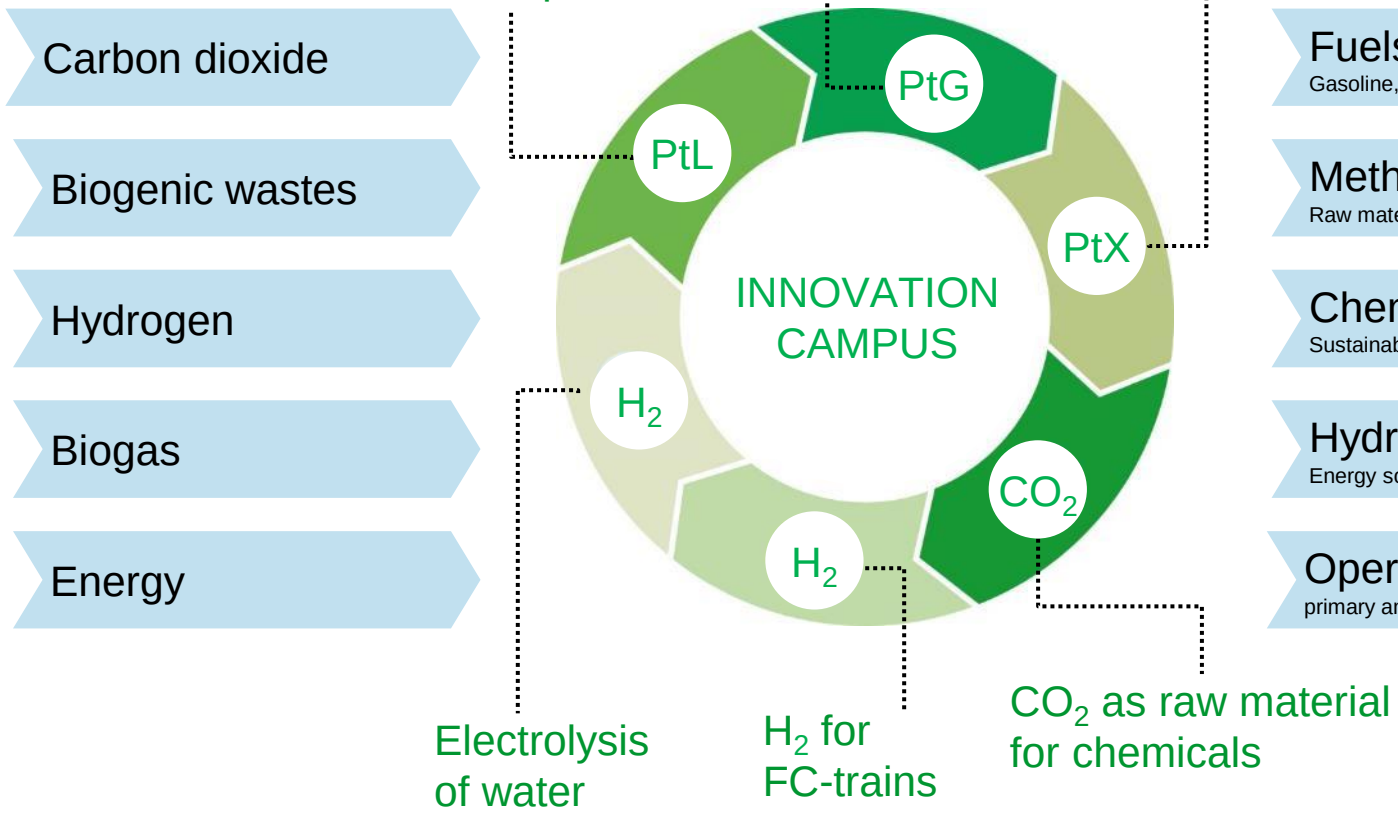
Industrial park Frankfurt Höchst as Innovation Campus



INERATEC

Europe‘s largest eFuel plant will be built in 2023

The world‘s largest fuel cell train fleet is fueled at our site.

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- Carbon Footprint Reports of the site manager (Scope 1+2), mandatory
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- Working groups per topic (CO_2 footprint, water recycling, green steam)

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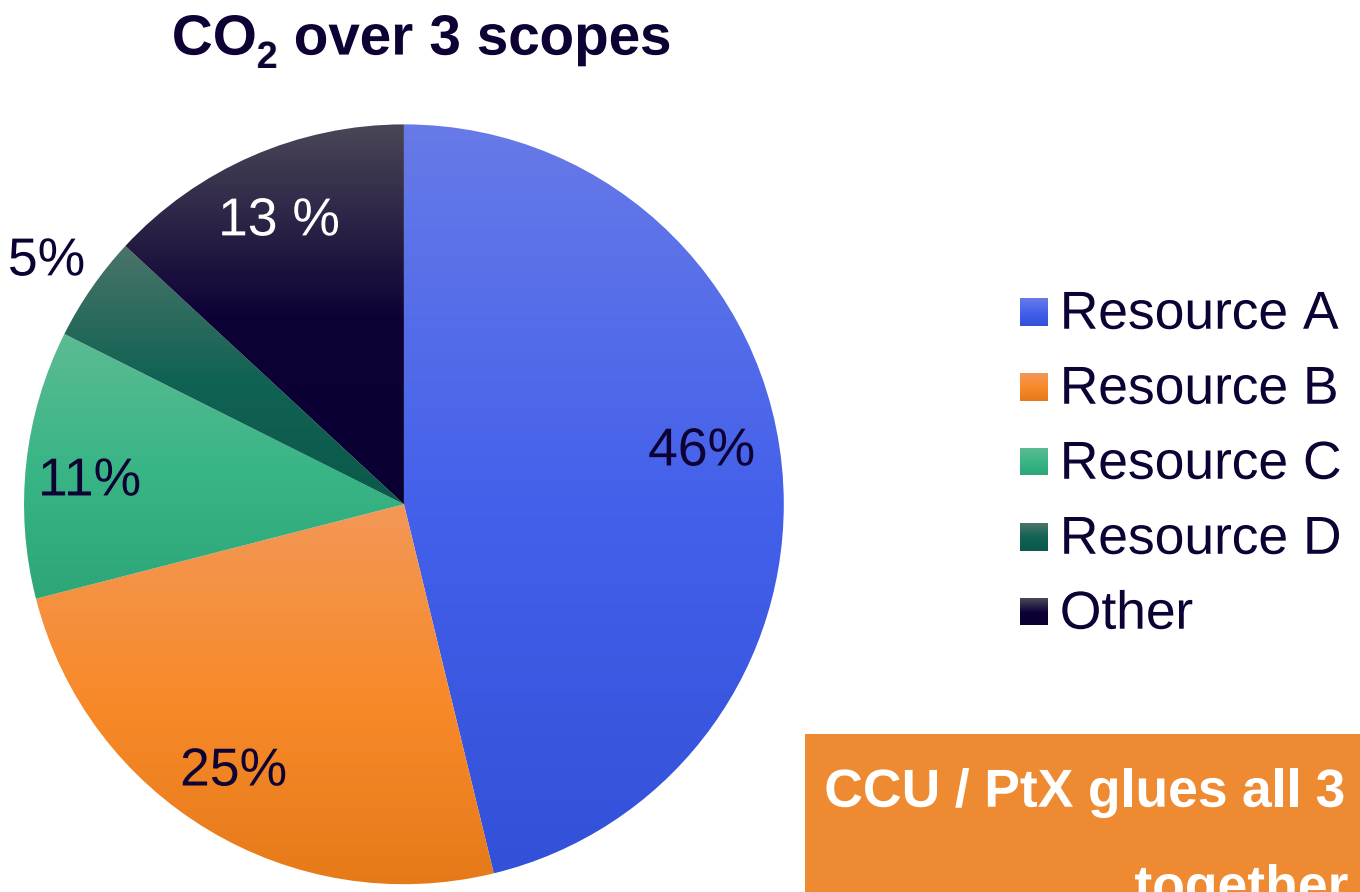
Estimation of Scope 1,2,3 (energy- and raw material-based emissions)
(Energy production, energy purchase; used raw materials: CO_2 emissions calculated for 2021)

87 % of emissions can be reduced by replacing 4 resources



CCU / PtX glues all 3 CO_2 scopes together

Sources: IPH Carbon Footprint Report Update 2020, Internal ISH data, figures from ISH Energy Management

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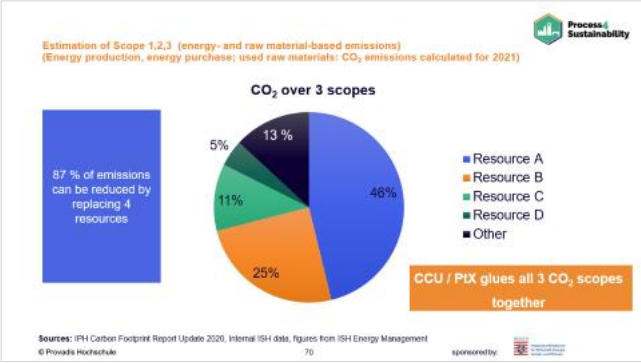

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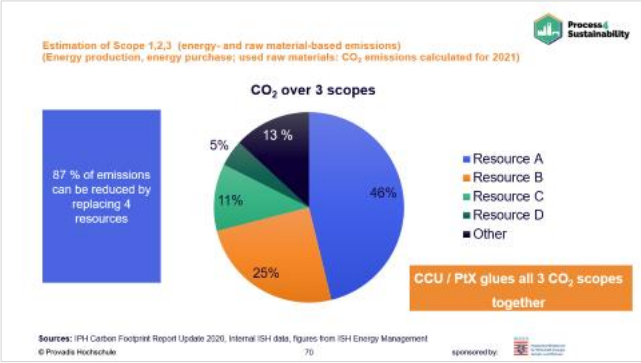
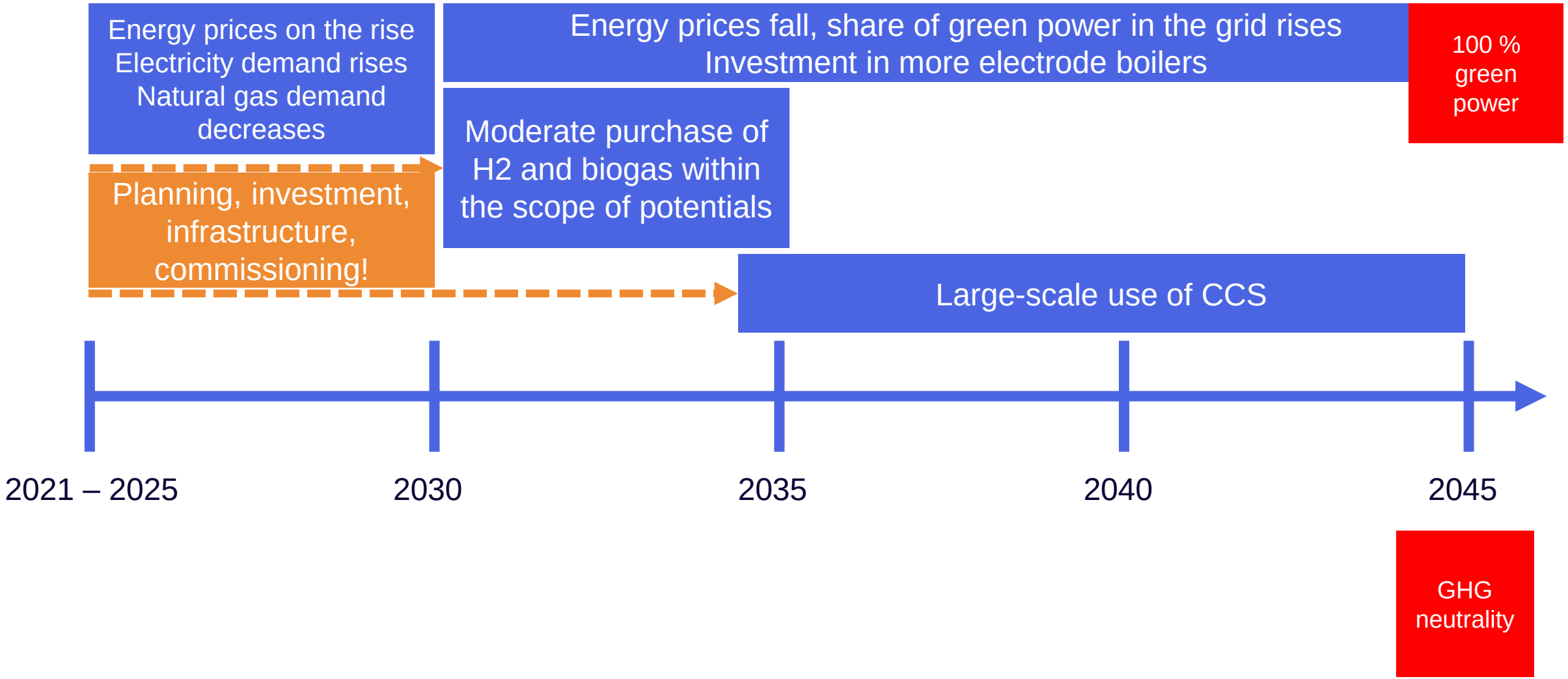


Transformation pathway "technology mix": Focus on Scope 1 and 2 emissions, which are legally binding, we achieve CO_2 neutrality in 2045.



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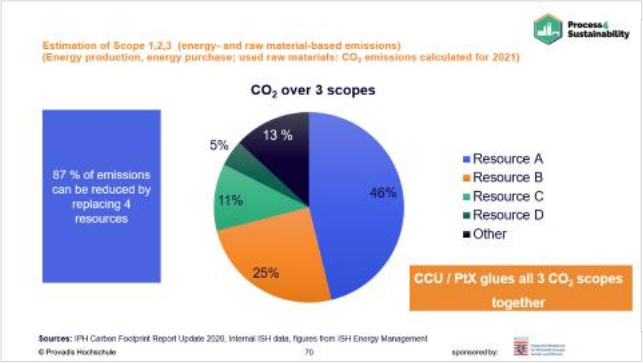

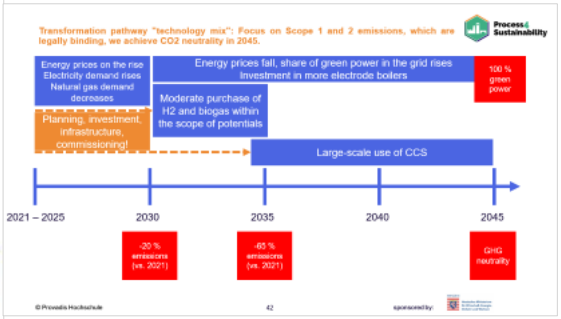

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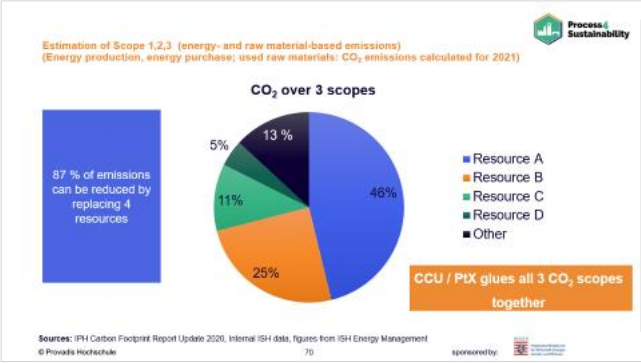
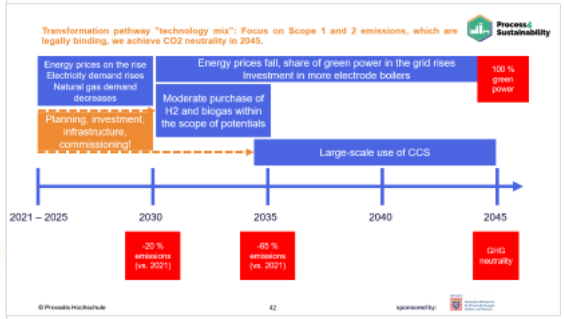
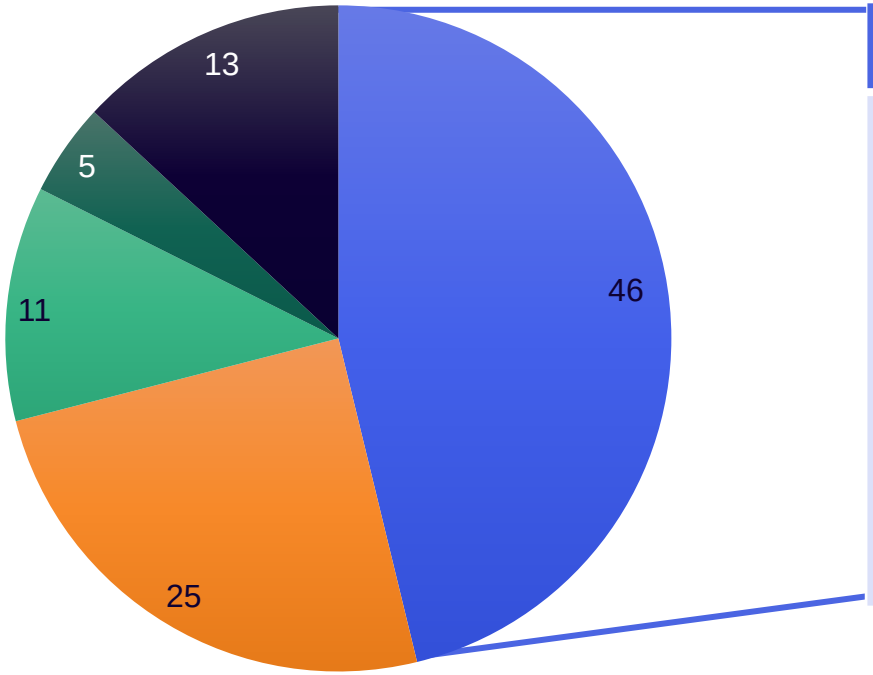




12 Levers to reduce the carbon footprint of the industrial park Frankfurt Höchst Scope 1+2+3

Reduction potential by substitution of… [%]



Carbon Source		Levers to be validated
A 46.2 % CO_2 emissions	1	Green power
	2	Process electrification
	3	Synthetic Methane (CCU)
	4	Carbon free burning gas (H2, methane pyrolysis)
	5	Biogas / biogenic methane

4 Main Carbon Sources are responsible for 87 % of total CO_2 emissions

Basis: ISH Carbon Footprint-Report 2020, internal reports

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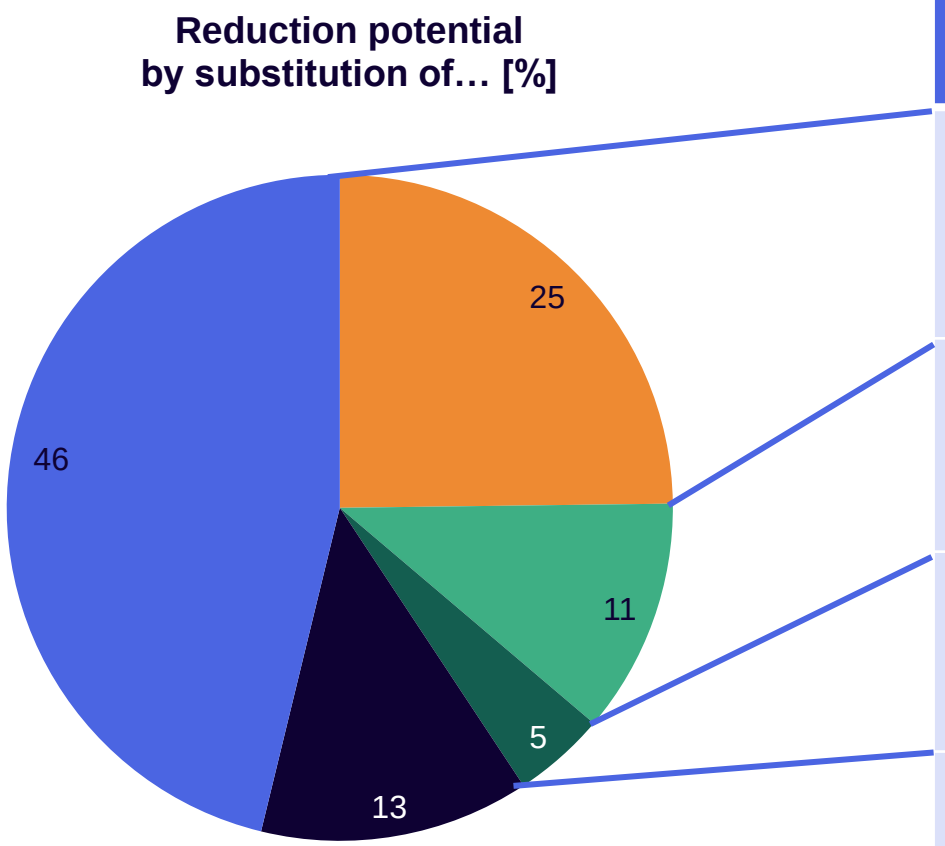

Carbon Source		Levers to be validated
B 24.8 % CO_2 emissions	6	Ethylene from CO2 (CCU)
	7	Plastics Recycling + Cracking
C 11.4 % CO_2 emissions	8	Synthetic Methanol (CCU)
	9	Methanol via biogenic compounds
D 4.5 % CO_2 emissions	10	Synthetic Acetic Acid from CO2 (via Methanol)
Supporting Technologies	11	CCS
	12	Recycling

4 Main Carbon Sources are responsible for 87 % of total CO_2 emissions

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There is really good literature, you don‘t have to re-invent the wheel!
e.g. A.SPIRE

Process4 Sustainability

Scope 1 + 2	1	Green electricity
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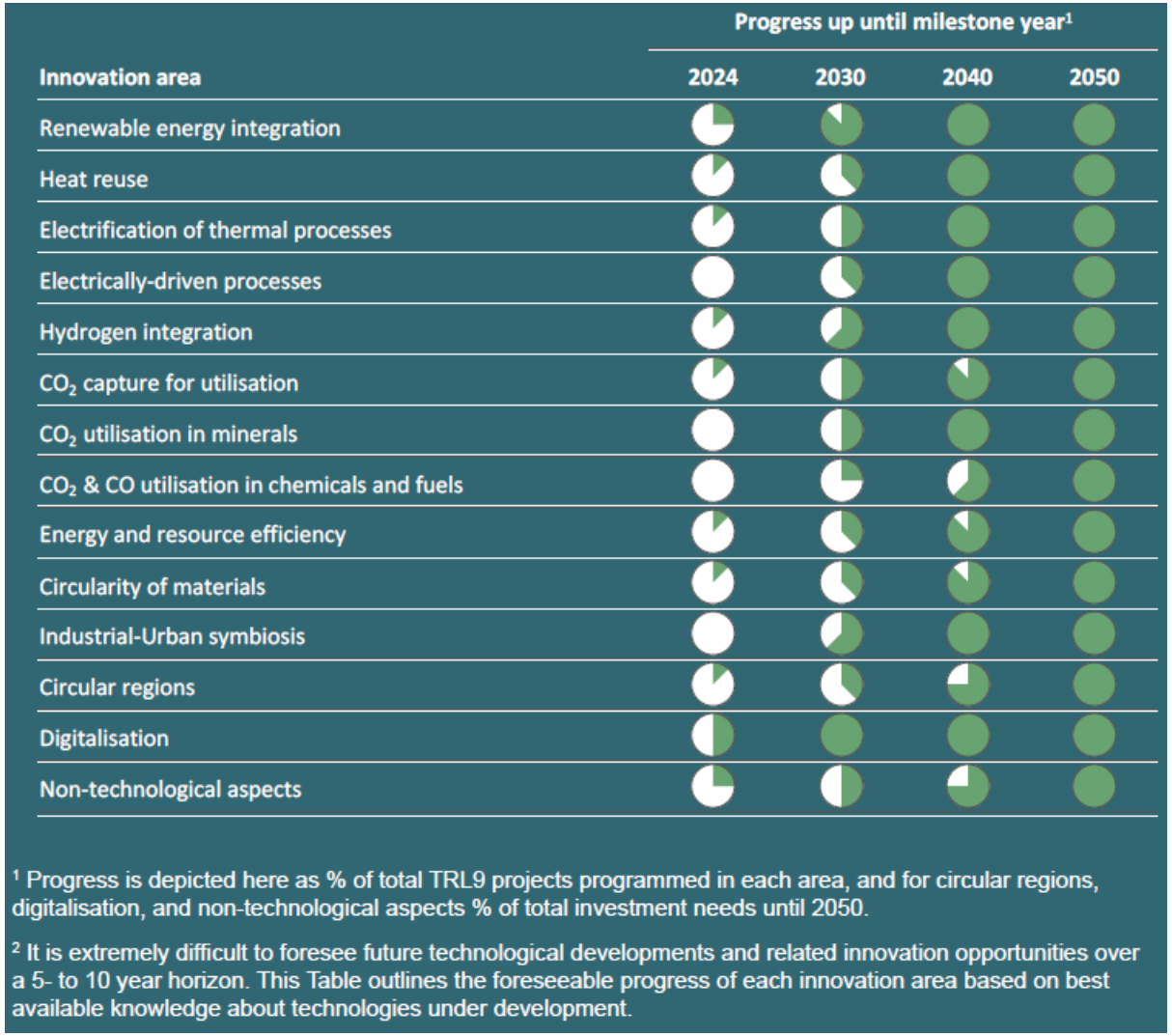
	3	Synthetic Methane from CO2 (CCU)
	4	Carbon-free burning gases (H2, Methane pyrolysis)
	5	Biogenic Methane
Scope 3	6	Green ethylene from CO2 (via Ethanol) (CCU)
	7	Recycling + Cracking
	8	Synthetic Methanol From CO2 or biomass (CCU)
	9	Methanol from green Ethanol
	10	Synthetic Acetic Acid from CO2 (via Methanol) (CCU)
	11	CCS
	12	Recycling



Innovation area	Progress up until milestone year[1] 2024	2030	2040	2050
Renewable energy integration				
Heat reuse				
Electrification of thermal processes				
Electrically-driven processes				
Hydrogen integration				
CO_2 capture for utilisation				
CO_2 utilisation in minerals				
CO_2 & CO utilisation in chemicals and fuels				
Energy and resource efficiency				
Circularity of materials				
Industrial-Urban symbiosis				
Circular regions				
Digitalisation				
Non-technological aspects				

[1] Progress is depicted here as % of total TRL9 projects programmed in each area, and for circular regions, digitalisation, and non-technological aspects % of total investment needs until 2050.

[2] It is extremely difficult to foresee future technological developments and related innovation opportunities over a 5- to 10 year horizon. This Table outlines the foreseeable progress of each innovation area based on best available knowledge about technologies under development.

Source: p4planet_07.06.2022._final.pdf (aspire2050.eu)

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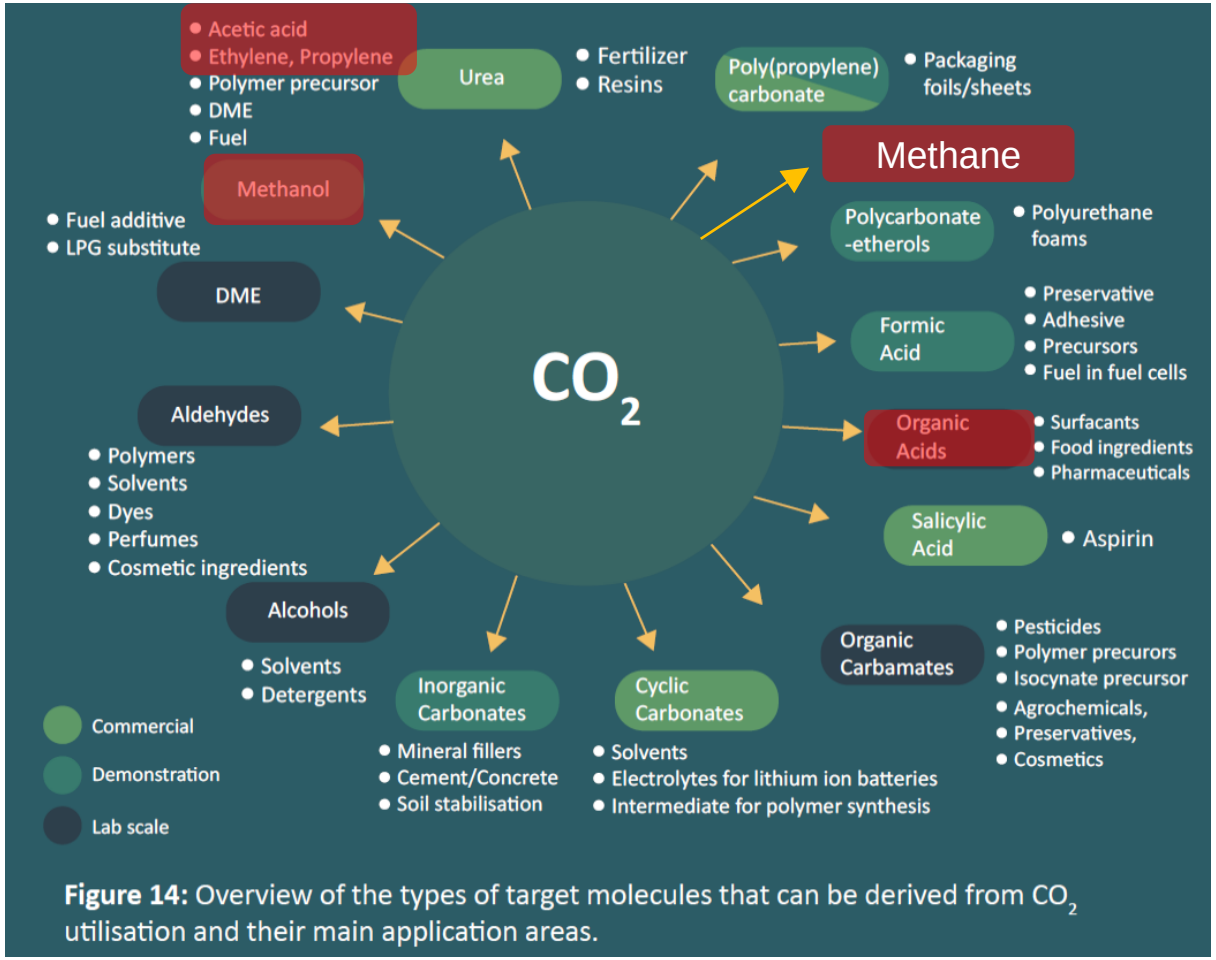

Figure 14: Overview of the types of target molecules that can be derived from CO_2 utilisation and their main application areas.

Source: p4planet_07.06.2022._final.pdf (aspire2050.eu)

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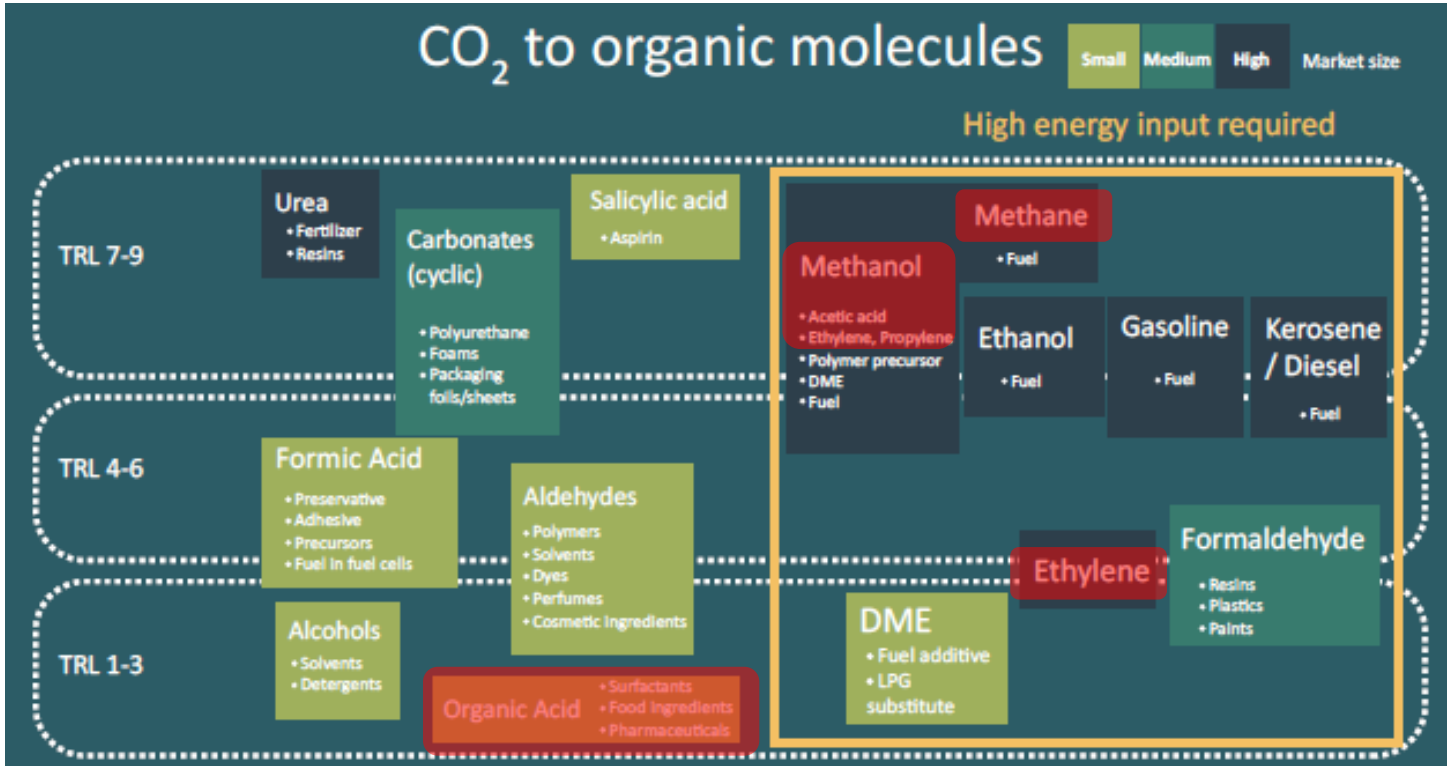

Adapted from: DECHEMA, Low carbon energy and feedstock for the European chemical industry (2017)

Figure 20: Target molecules of chemical CO_2 utilisation and status of development[147].

Source: p4planet_07.06.2022._final.pdf (aspire2050.eu)

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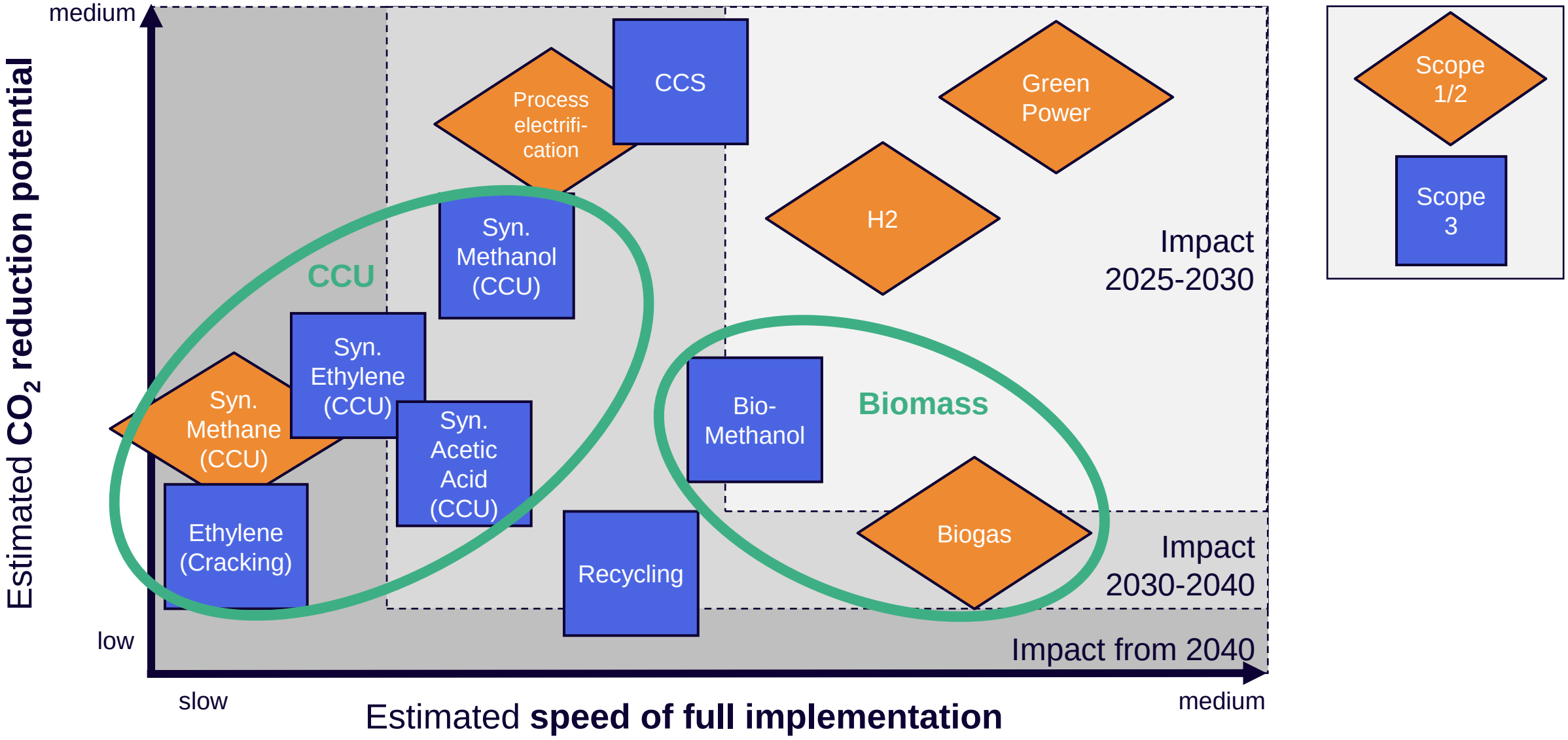
Fokus transformation pathway: 12 levers

CO_2 reduction potential over speed of full implementation



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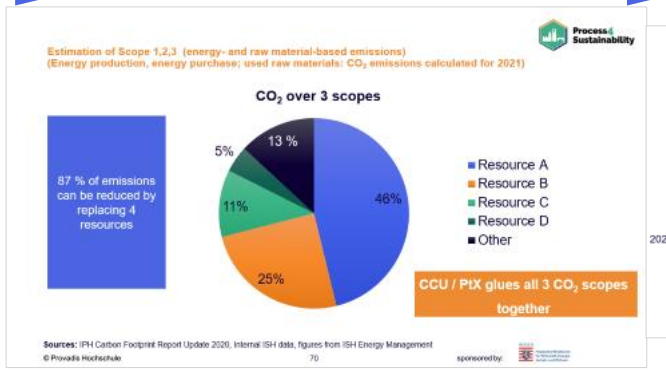

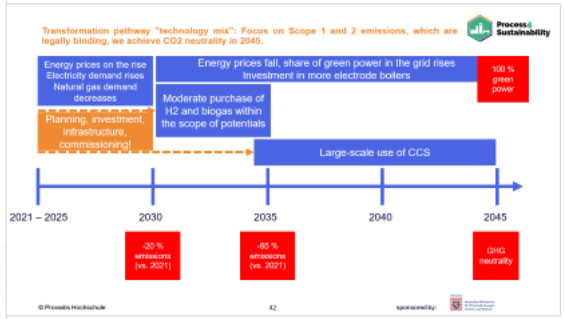

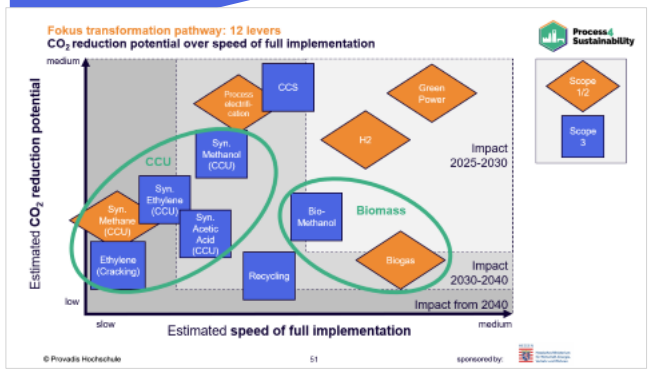

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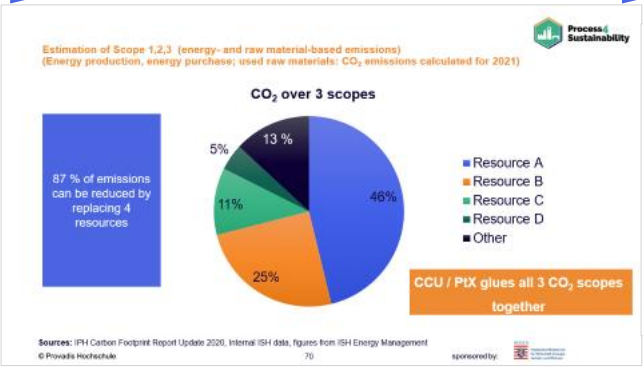
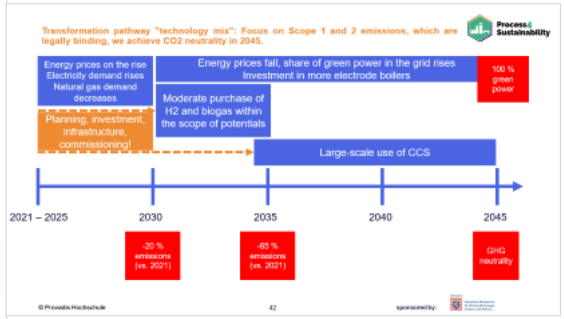
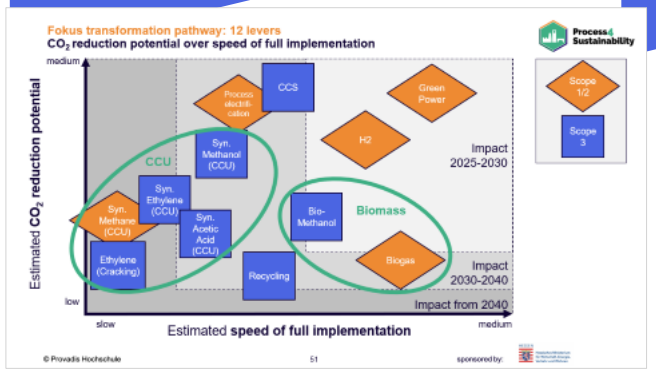
Define concrete work assignments

- After the installation of a mesh of filters
- Deep dive into different topics
- Who is responsible? Wo needs to work together (use past questionnaires!)
- Be bold and suggest project sketches
- Next steps: partnering, funding and project development







Work assignments Status Quo - Green Power → for self-identified lead challenge owner!

Work Package	Project need 2023+	Method	M1	M2	M3	M4
A - Status Quo on site	Demand	Desk Research				
	Potential	Expert interviews on site				
	Initial technological situation	Expert interviews on site				
	Energy Strategy on state level (Hesse)	Expert interviews (external)				
B - Technological & ecological potential	Use knowledge from networks (Process4Planet; Chemistry4Climate)					
	Desk Research - PPAs, certificates, RE parks (investment and participation)					
	Expert interviews					
C - Economic potential	Cost	Desk Research; expert interviews				
	(Public) funding	Desk Research, networking				
	Additional markets	add on: Case studies with cluster partners, when to expect migration tendencies for production (impact analyses on increasing electricity price)				
D - Social & regulatory aspects	Assessment by VCI (chemical industry association)	Expert interview (after Desk Research)				
	Assessment of regional stakeholders	Expert Discussion State Secretary on the Hesse Strategy				

Milestone: Briefing document on technology, economy, society

Milestone: Stakeholder communication on energy strategy

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Methodology to estimate individual transformation pathways

How much CO_2 is located on site for each scope?

- Carbon Footprint Reports of the site manager (Scope 1+2), mandatory
- Expert interviews (Scope 1+2)
- Emission reports of all local productions, mandatory → basis for Scope 3
- Other environmental reports
- Working groups per topic (CO_2 footprint, water recycling, green steam)

Scenario development

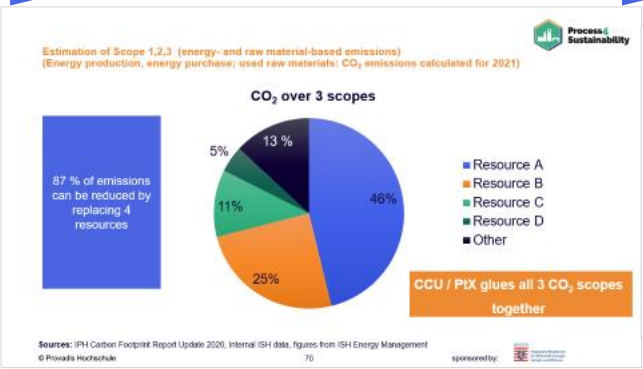
- With the help of experts (DECHEMA), we developed 3 scenarios with different impacts, speeds and technologies
- We developed a timeline on when those technologies should be invested in and ready to be implemented

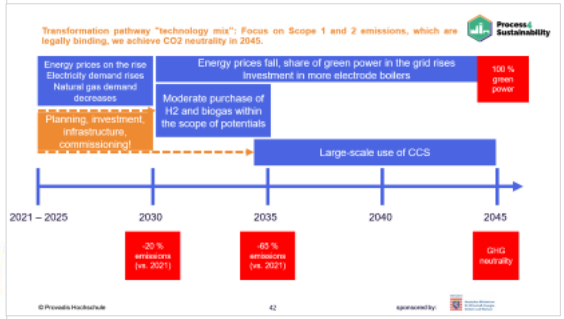
Questionnaires and desk research

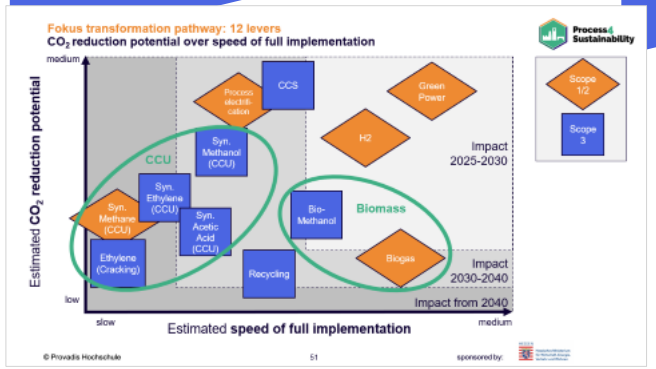
- What are relevant topics in our partner‘s view?
- Who has which role? Who is challenge owner, who is challenge lead? Who is supporter or bystander?
- There is very good literature out there
- Different filters help you to figure out the most promising ideas and when to implement them

Define concrete work assignments

- After the installation of a mesh of filters
- Deep dive into different topics
- Who is responsible? Wo needs to work together (use past questionnaires!)
- Be bold and suggest project sketches
- Next steps: partnering, funding and project development







Themenpaket	Projektplanung 2022 / 2023	Methode	M1	M2	M3	M4	
A - Status Quo im IPH	Bedarf	Desk Research					
	Potenzial	Expertengespräche mit ISH					
	Technologische Ausgangssituation (am IPH)	Expertengespräche mit ISH					
	Energiestrategie Hessen	Expertengespräche					
B - Technologisches & ökologisches Potenzial	Nutzung Wissen aus Netzwerken (Process4Planet, Chemistry4Climate)						
	Desk Research - PPAs, Zertifikatmodelle, EE-Parks (Investition und Teilhabe)						
	Experteninterviews						Milestone: Briefing-Dokument zu Technologie, Ökonomie, Gesellschaft
C - Ökonomisches Potenzial	Kosten	Desk Research; Expertengespräch (ISH: Strompreisentwickungen)					
	Öffentliche Förderung						
	Zusatzmärkte	add on: Case Studies bei P4S Unternehmen, ab wann Abwanderungstendenzen für Produktion zu erwarten ist (Auswirkungsanalysen zu steigendem Strompreis)					Milestone: Stakeholderkommunikation zu Energiestrategie
D - Gesellschaftliche & regulatorische Aspekte	Einschätzung VCI	Expertengespräch Hr Rothermel (vorher Desk Research)					
	Einschätzung regionaler Stakeholder	Expertengespräch Staatssekretär Hessen zur Hessenstrategie					

Next up: carbon-based business models

Process4 Sustainability

Seabound Partners with Crestchic Loadbank to Test Its Carbon Capture Technology for Ships

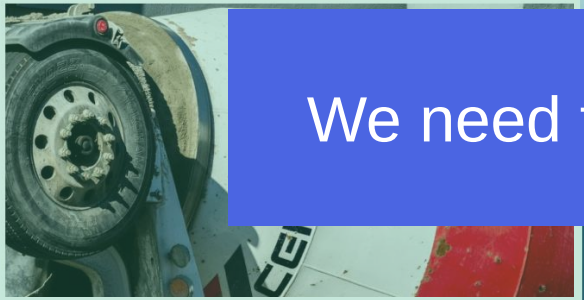
by Suzanna Hayek | Jan 16, 2023

A CarbonQuest CCS System Captures CO2 Emissions from New York City High Rise

by Suzanna Hayek | Dec 14, 2022

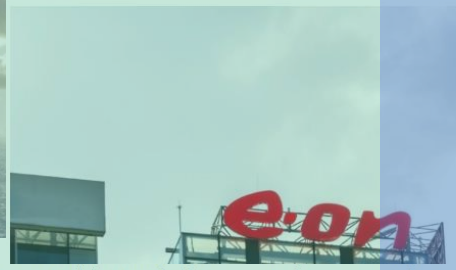
Cemex Announces Carbon Capture Projects Around the Globe to Decarbonize the Construction Value Chain

by Suzanna Hayek | Nov 22, 2022



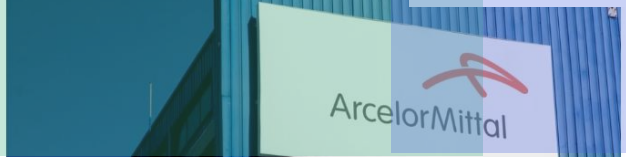
Horisont Energi and E.ON Strengthen Efforts on Industrial Storage of CO2 in the North Sea

by Suzanna Hayek | Dec 6, 2022



ExxonMobil, Mitsubishi Heavy Industries to Advance Next Generation Carbon Capture Technologies

by Suzanna Hayek | Dec 5, 2022



Air Liquide, Fluxys Belgium, Port of Antwerp-Bruges Awarded EU Funding to Build CO2 Export Terminal

by Suzanna Hayek | Dec 14, 2022

supports environmental targets

LanzaTech Partner On Presents The First Shoe Made From Captured CO2

by Petya Trendafilova · September 19, 2022 · 2 minute read

AIR Vodka

Impurity-free vodka made from CO_2

Restock Coming Soon

Drizly
Minibar
Reservebar
Caskers

Sustainability Innovation

CO_2 as a new raw material – becoming a jack of all trades

Carbon Capture

Utilization

Innovation

We need to give opportunity and innovation the spotlight they deserve.

Sources: carboncapture-expo.com, carbonrecycling.is, Celanese press release, carbonherald.com, covestro.com, aircompany.com

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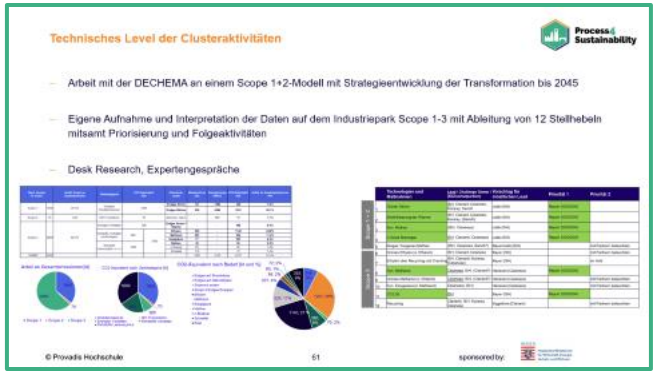
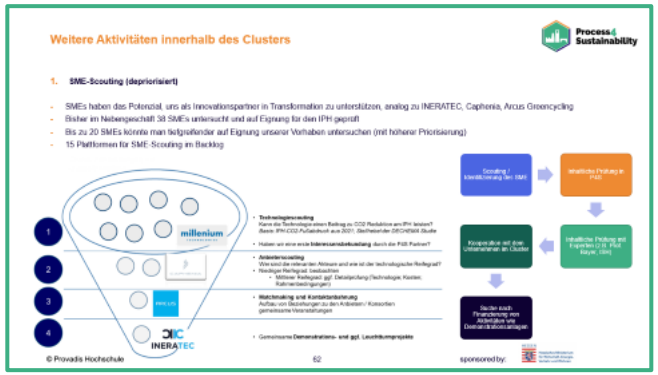
That‘s not all! There is much more you can do in terms of communication, networking and business development

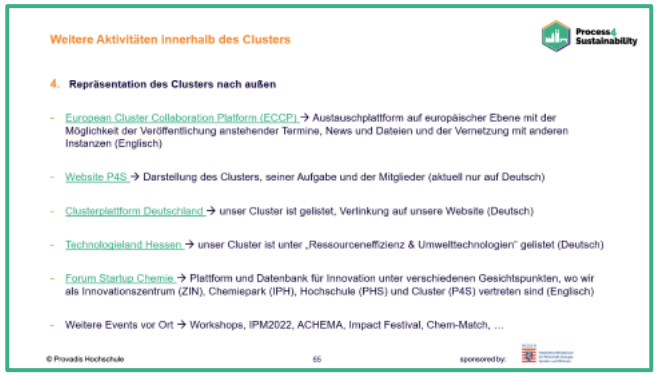


Strategy and support for transformation

Work with networks for knowledge, growth and increased influence, acceleration of your own and society’s goals

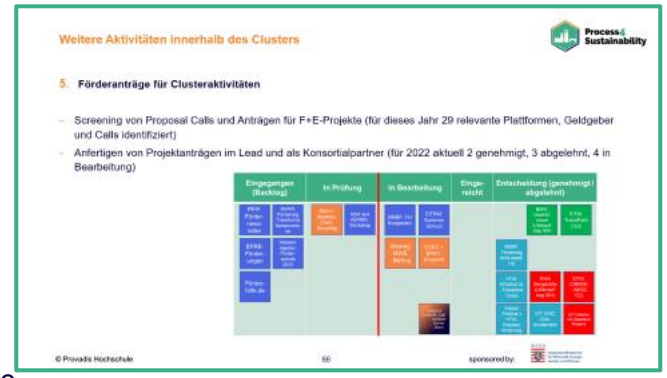


Identification and acquisition of partners and solution providers (cluster growth!)



Visibility of your activities online, outreaches, formation of alliances and communities of interest

Making technology tangible; communication and good reporting is key



Funding your activities, formation of consortia, generation of benefit from your activities

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Networking since 2021

Focus groups	Funding networks	Publication networks	Associations
CCS Forum (Bellona, NGO) (membership)	EIT Manufacturing (project funding)	Journal of Business Chemistry (publisher)	VDI
A.SPIRE / Processes4Planet (membership)	Hubs4Circularity (founding member)	CHEManager	VDMA
Nationaler Begleitkreis Chemisches Recycling (NBCR) (membership)	HTAI (funding partner)	Handelsblatt	VCI, Chemistry4Climate (activities in WG)
Nova institute (cooperation)		IHK	Cluster Dekarbonisierung der Industrie (CDI)
DECHEMA (cooperation)		European Cluster Collaboration Platform (ECCP)	Chemie³ (HessenChemie)
cefic (first contact)		Impact Festival (network partner 2023)	
giz (cooperation)			

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Wrap-up and take-home messages

1. **We are the „chemical industry in a nutshell“**, which gives room for innovation and transferability of technologies. We invite first-of-its-kind plants in order to proof concepts to feature start-ups and scale-ups. We are convinced: relevant topics in Frankfurt Höchst will be relevant at many other places, too.
2. We **digged deep into available data**, which can be hard to get in the first place. We needed to **calculate our Scope 3 emissions** to get a better understanding of our situation (there are different methods to get there).
3. The **cluster approach** helped us to find one voice in a multi-stakeholder environment.
4. **Know your experts** in each field, they can help you advance in a specific topic really fast. You don‘t need to re-invent the wheel! There are tons of studies and reports already.
5. **Find your partners, customers and networks**. Use questionnaires. Each of them can work as a filter for a myriad of options.
6. If you have a **good mesh of differnet filters**, you can proceed with a short list of options that remain for you, specifically.
7. **Be bold! Define work packages and ask questions**. Give them to your partners, customers and networks. You might be surprised what you find if you keep at it.
8. **Innovation is opportunity** in new and emerging markets.
9. There are **many additional activities** you can undertake to **support your transformation strategy**.

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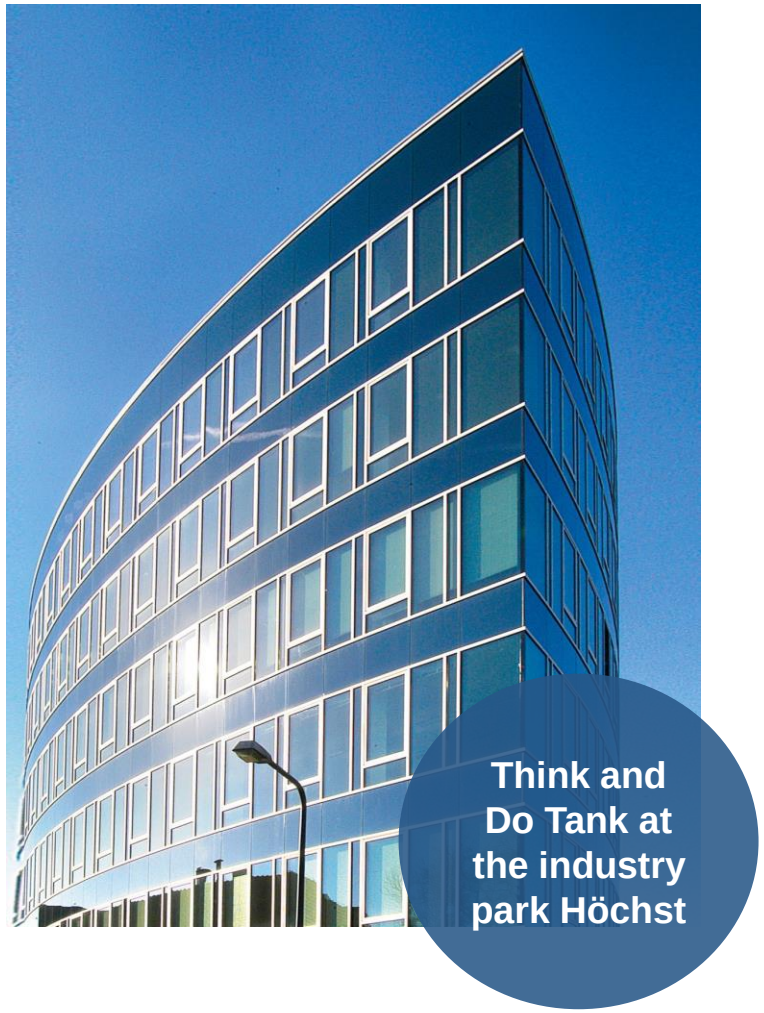
Why collaborate with Zentrum für Industrie und Nachhaltigkeit (ZIN) @ Provadis?

provadis Hochschule



Benefits

- Industry know-how: based at one of the largest industrial parks in Europa and collaborating closely with decision makers in the industry park: 15 + years of experience
- Context awareness: experience in adapting concepts to different contexts (e.g. managing a start-up support program in 10+ countries for more than 5 years); creating a virtual academy with GIZ on sustainable industrial area management, 50+ participants since 2021
- Didactical know-how: 15+ years of experience in developing challenge-specific further education and study programs
- Blended-learning and network management experts: 10+ years of experience in managing cross-country, multi-stakeholder networks
- Professionalism: Being part of one of the leading German education providers for the chemical industry with expertise in e-technology solutions, vocational training, further education and accredited study programs.

Contact: Hannes.Utikal@provadis-hochschule.de

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THINKING INDUSTRY NEW

Your cluster office

Process4 Sustainability

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