IEA IETS TASK 21
NET-ZERO INDUSTRIAL SYSTEMS IN A CIRCULAR ECONOMY FRAMEWORK

Carbon Dioxide Capture und Industrial Symbiosis

2025-01-27

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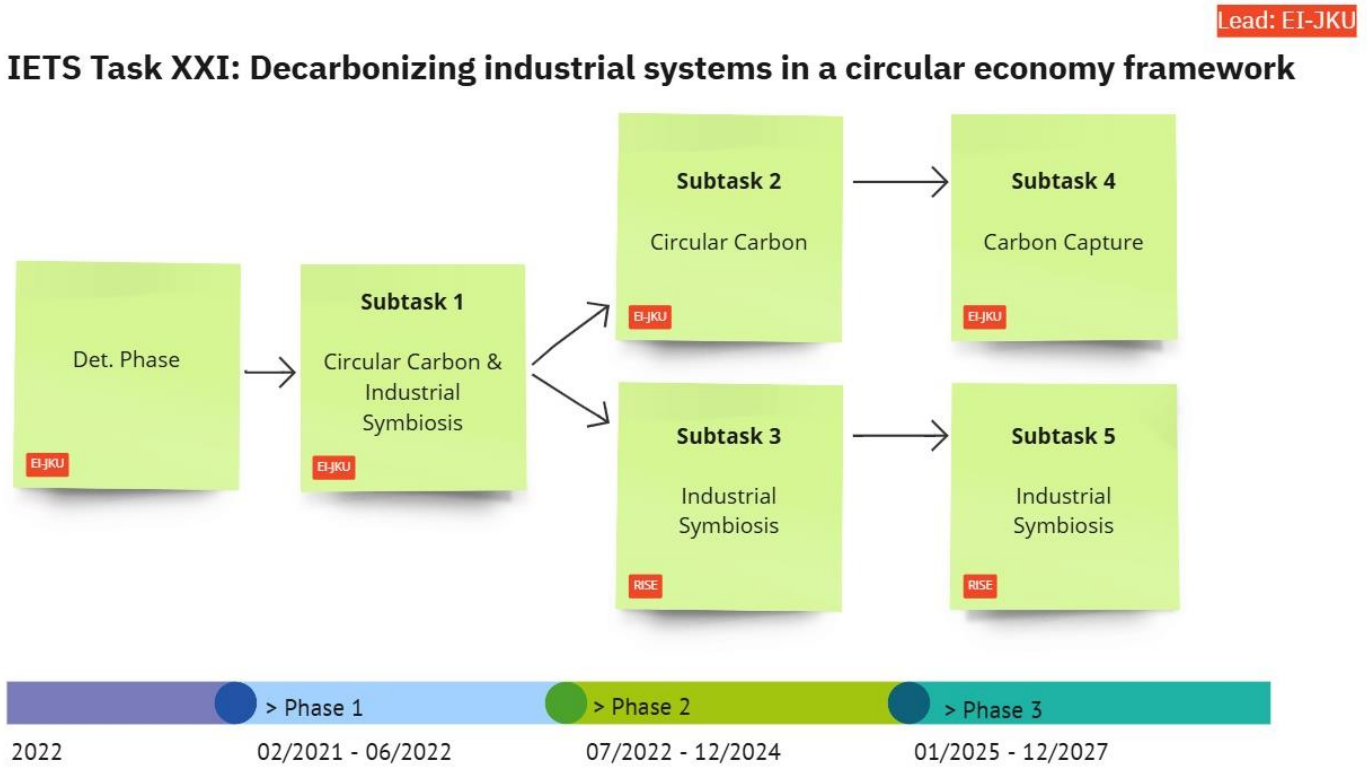
IEA IETS Task 21

Entstehung & Tätigkeiten Phase 2

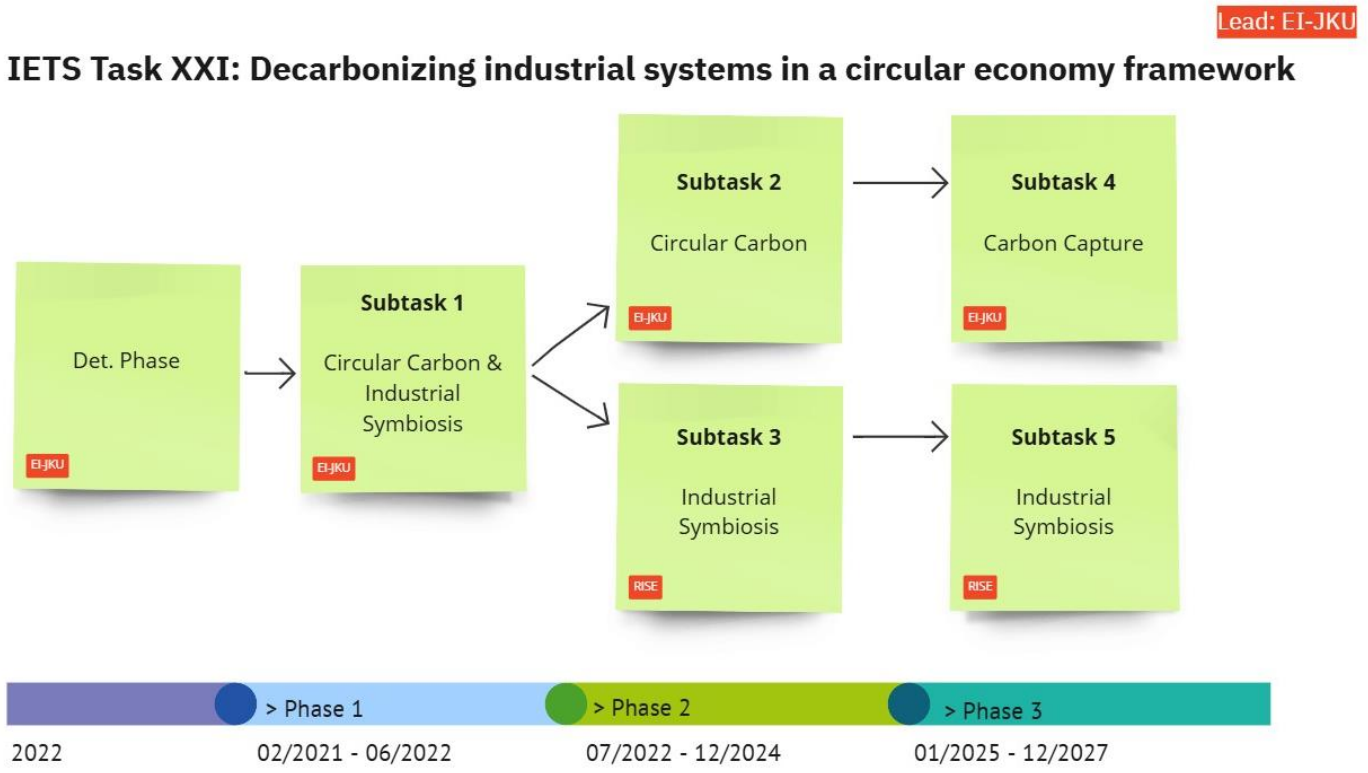
- Subtask: Circular Carbon
  - Activity: LCA modelling
  - Activity: Carbon capture in industry
  - Activity: Networking
- Subtask: Industrial Symbiosis
  - Activity: Definition and delimitation
  - Activity: Good practice examples
  - Activity: Business Models
  - Activity: Networking



IEA IETS Task 21

Internationale Partnerstruktur

- Österreich (Task Management)
- Schweden – RISE, Wa3rm
- Dänemark – SDU, DTU, Greenlab
- Deutschland – KIT
- Italien – PoliTo, ENEA
- Kanada – UQTR
- Niederlande – TU Delft
- Norwegen – SINTEF
- Portugal – Universität Lissabon
- USA – UMich / Global CO2 Initiative



Circular, avoided, or captured carbon?

#taxonomy

- Thema Begrifflichkeiten
  - Unterschiedliche Ergebnisse
  - Vorsicht in Verwendung angebracht
- „Dekarbonisierung“
  - Net-Zero
- „Circular Carbon“
  - Carbon Dioxide Capture

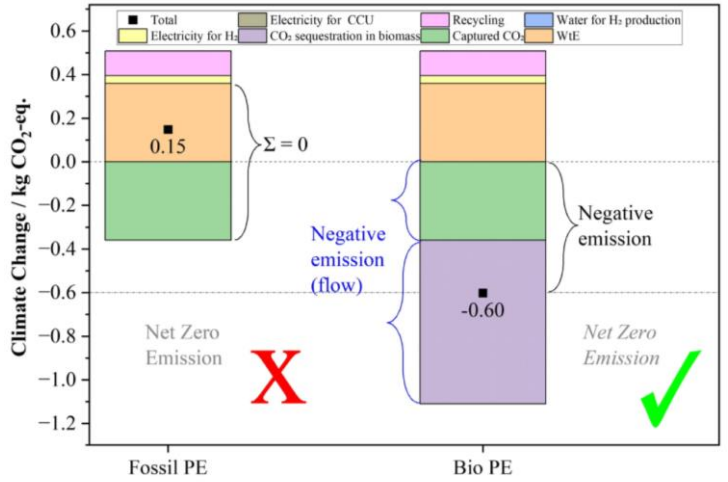


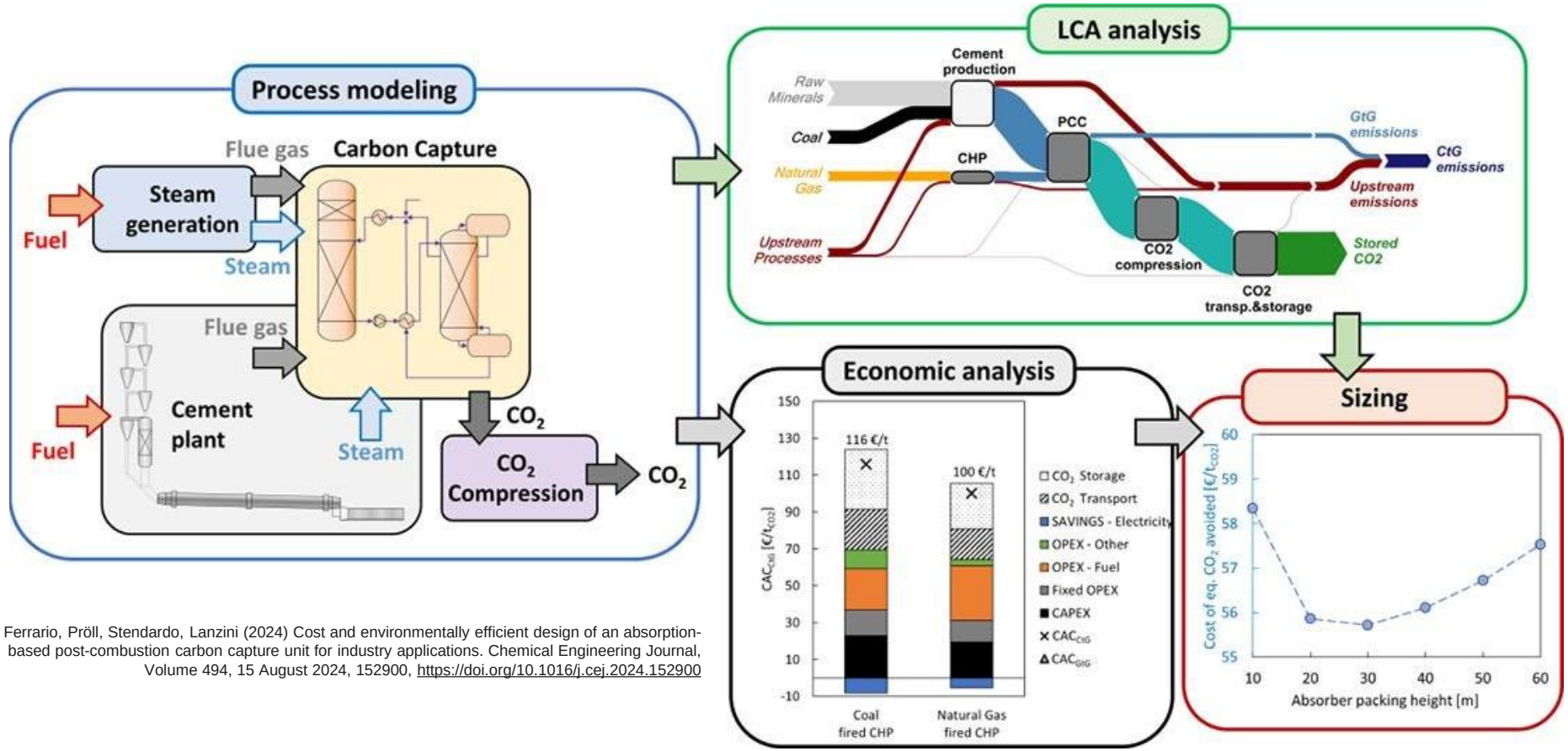
Figure: The results for the climate change impact for the fifth case study discussing CCU and NZE.
Source: Zeilerbauer et al. (2024). Circular, avoided, or captured carbon (dioxide)? - A taxonomy approach for life cycle assessment and CO2 accounting. Carbon Management, 15(1). https://doi.org/10.1080/17583004.2024.2408285

	Number of Articles						
	Google Scholar	Scopus	WebOfScience	Documents Downloaded	After DuplicateRemoval	Excluded	Analysed
Avoided Burden	1 080	65	31	90	54	8	46
Avoided Carbon	590	8	8	46	29	12	17
Avoided CO2	956	13	22	65	48	12	36
Carbon Capture	16 000	529	688	90	61	21	40
Carbon Credit	3 240	76	43	90	57	10	47
Circular Carbon	340	7	11	48	34	13	21
Circular CO2	8	0	1	9	8	4	4
Negative Emission	1 200	88	43	89	61	21	40
Net Zero Emission	3 100	34	55	90	58	14	44
Total				617	410	115	295

Figure: Number of articles (documentation of the online searches)
Source: Zeilerbauer et al. (2024). Circular, avoided, or captured carbon (dioxide)? - A taxonomy approach for life cycle assessment and CO2 accounting. Carbon Management, 15(1). https://doi.org/10.1080/17583004.2024.2408285

Carbon sankey diagrams

CO_2-Pfade für die Zement- und Stahlindustrie



Ferrario, Pröll, Stendardo, Lanzini (2024) Cost and environmentally efficient design of an absorption-based post-combustion carbon capture unit for industry applications. Chemical Engineering Journal, Volume 494, 15 August 2024, 152900, https://doi.org/10.1016/j.cej.2024.152900

CCU/CCS value chains

Project-based analysis of new value chains

- Projekte mit Fokus CCU
  - Themenstellungen?
  - Kooperationen?

- Erkenntnisse:
  - Märkte aufbauen: Projekt-Annahme einer großtechnischen CO_2-Versorgung
  - Fokus CCU-Produkte: Produktion von Basischemikalien und Kraftstoffen.
  - Infrastruktur aufbauen: CO_2 wird aktuell in Flaschen transportiert.
  - CCUS in hard-to-abate industries & BECCUS.

New value chains with **Carbon Capture Utilization** and/or **Carbon Capture Storage**

(Project) short title	(Project) full title *incl short description of the approach to utilize/capture the CO2*	(Project) Status	Finalization/Project end Year	Country	Website (if available)	Funding source

Carbon Caputure - VALUE CHAIN

SOURCE	CAPTURE	TRANSPORT	UTILIZATION/STORAGE

• *Information on whether biogenic or fossil energy sources*
• *Information on e.g.*
  ◦ *Burning of hydrocarbons for power and/or heat generation*
  ◦ *Industrial processes/production of building materials*
  ◦ *Production of (renewable) fuels*
  ◦ *Direct air capture*
  ◦ *Liquid fuels used for transportation*
	Information on e.g.
	• *Capture: via pre-combustion, post-combustion, oxy-fuel, other*
	• *Technology: sorbent, solvent-based and membrane separation*
	• *Economic and cost drivers*
	• *Environmental, safety and risk factors*
	• *Technology Readiness Level (TRL)*
		Information on e.g.
		• *Pipeline, road, ship and rail options*
		• *Economic and cost drivers*
		• *Environmental, safety and risk factors*
			Information on e.g.
			• *Utilization category (Enhanced oil recovery or enhanced gas recovery, Chemical conversion to feedstock materials, direct synthesis of CO_2 based polymers, production of building materials)*
			• *Storage type*
			• *CO_2 requirements*
			• *Potential abatement effect*
			• *Technology Readiness Level (TRL)*
			• *Economic and cost drivers*
			• *Environmental, safety and risk factors*

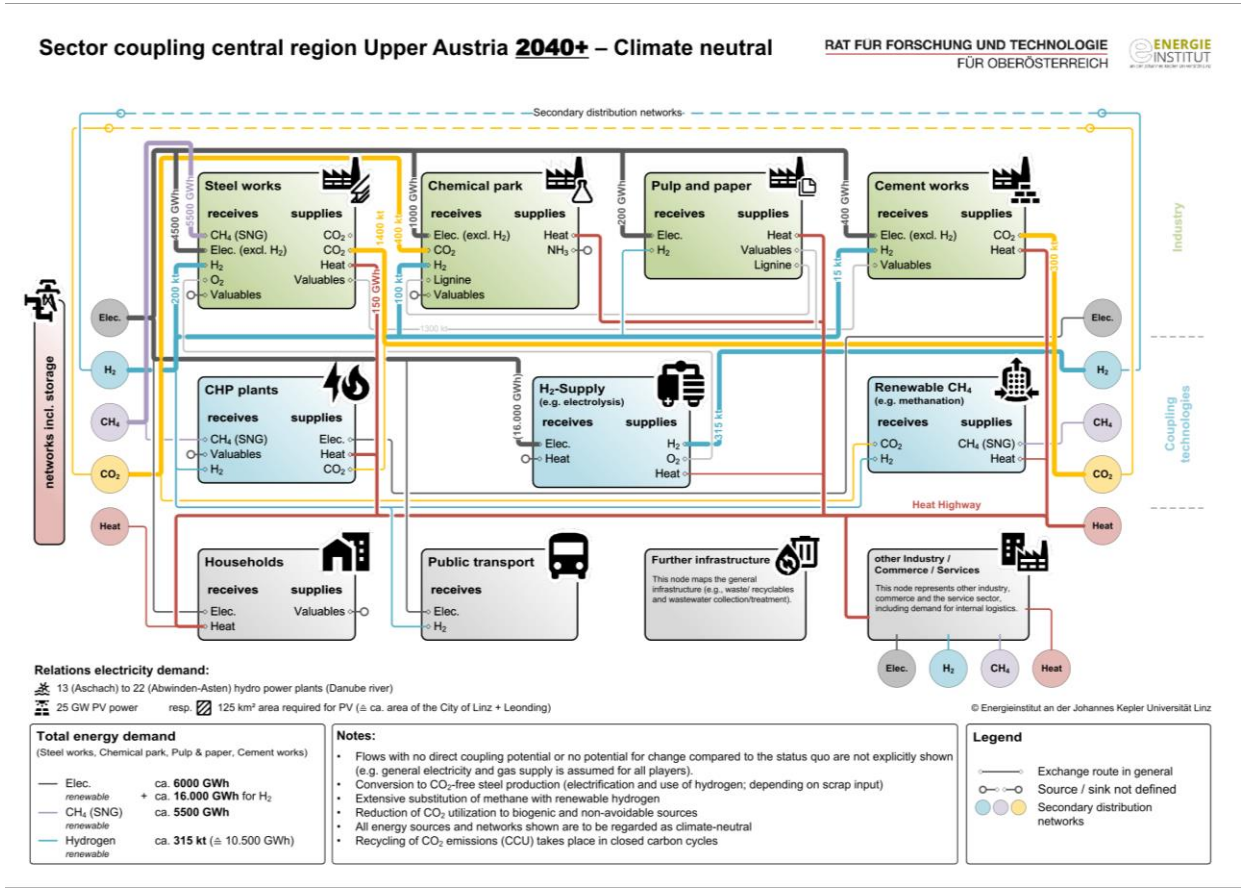
GENERAL CONDITIONS of the Business Model

VALUE PROPOSITIONS	KEY ACTIVITIES	KEY RESOURCES	STAKEHOLDERS
• *Which problem are we helping to solve?* • *Value delivered to customer?* • *Value delivered to the common good?* • *What bundles of products/services are we offering to each customer segment?* • *Which customer needs are we satisfying?* • *Characteristics (like newness, performance, customization, "getting the job done", design, brand/status, price, cost reduction, risk reduction, accessibility, convenience/usability)*	• *What key activities are required by the value propositions?* • *How could research and development (of new processes) help?* • *What steps are critical in the implementation of CCU facilities?* • *What monitoring mechanisms are used?* • *Are there any particular challenges or technical hurdles that could arise?*	• *What key resources are required by the value propositions?* • *What key resources are required regarding finance and investment (e.g. research, development and implementation)?* • *Types of resources (technological, infrastructure, financial, physical, human)*	• *Who are the key partners/key suppliers and what is the motivation for the partnership? Are there any key activities?* • *What strategies are used to ensure effective partnerships and collaborations?* • *Are you currently looking for new collaborations and how?* • *What about the public perception?*
CUSTOMER SEGMENTS	**REVENUE STREAMS**	**COST STRUCTURE** **for research/development/implementation/monitoring/ maintenance/operating costs)**	**ADDITIONAL INFORMATION**
• *For whom are we creating value?* • *Who are/would be the most important customers?* • *What is the type of market in the business environment and their characteristics (mass, niche, segmented, diversified, mulit-sided platform)?* • *What is the market potential/expected demand?*	• *For what value are the customers willing to pay?* • *For what do they currently pay?* • *Are there license fees for the use of CCU technologies?* • *Is the process creditable for CO_2 certification?* • *Is funding and government support available?*	• *What are the most important cost factors?* • *Which key resources are the most expensive ones?* • *Which key activities are the most expensive ones?* • *How dependend are the production costs on volatile ressources and markets?*	
MAIN SUCESSFACTORS		**MAIN BARRIERS TO OVERCOME**	
•		•	
•		•	
•		•	

Industrial-Urban-Symbiosis

Industrial Symbiosis Facilitation Tools

- Unterschiedliche Tools:
  - Bewusstsein schärfen
  - Potenzial aufzuzeigen
- Dimensionen der Tools:
  - Kurzfristig (Potenzial) … langfristig (Vision)
  - Detailliert … illustrativ
  - Populär … datengetrieben
- „Facilitation“ als Ziel
- Beispiele:
  - Zukunftsbild Zentralraum OÖ
  - Greenlab Designer (DK)



Industrial-Urban-Symbiosis (I.U.S.)

Österreichische Umfrage zu Best Practice

- Ansatz
  - Befragung von Institutionen
    - Wirtschaftskammer(n)
    - Standortagentur(en)
    - Industriellenvertretung(en)
  - Ca 30 Institutionen, n=10
  - Was sind die Diskussionsthemen bei Gesprächen mit Mitgliedsunternehmen

- Ergebnis
  - I.U.S. ist quasi kein Thema bei Gesprächen bei Neuansiedelungen
  - I.U.S. ist selten ein Thema bei Gesprächen mit bestehenden Betrieben
  - Best Practices Projekte existieren: Beispiel Erneuerbare-Energien-Gemeinschaft der INKOBA Sterngartl Bad Leonfelden

IEA IETS Task 21

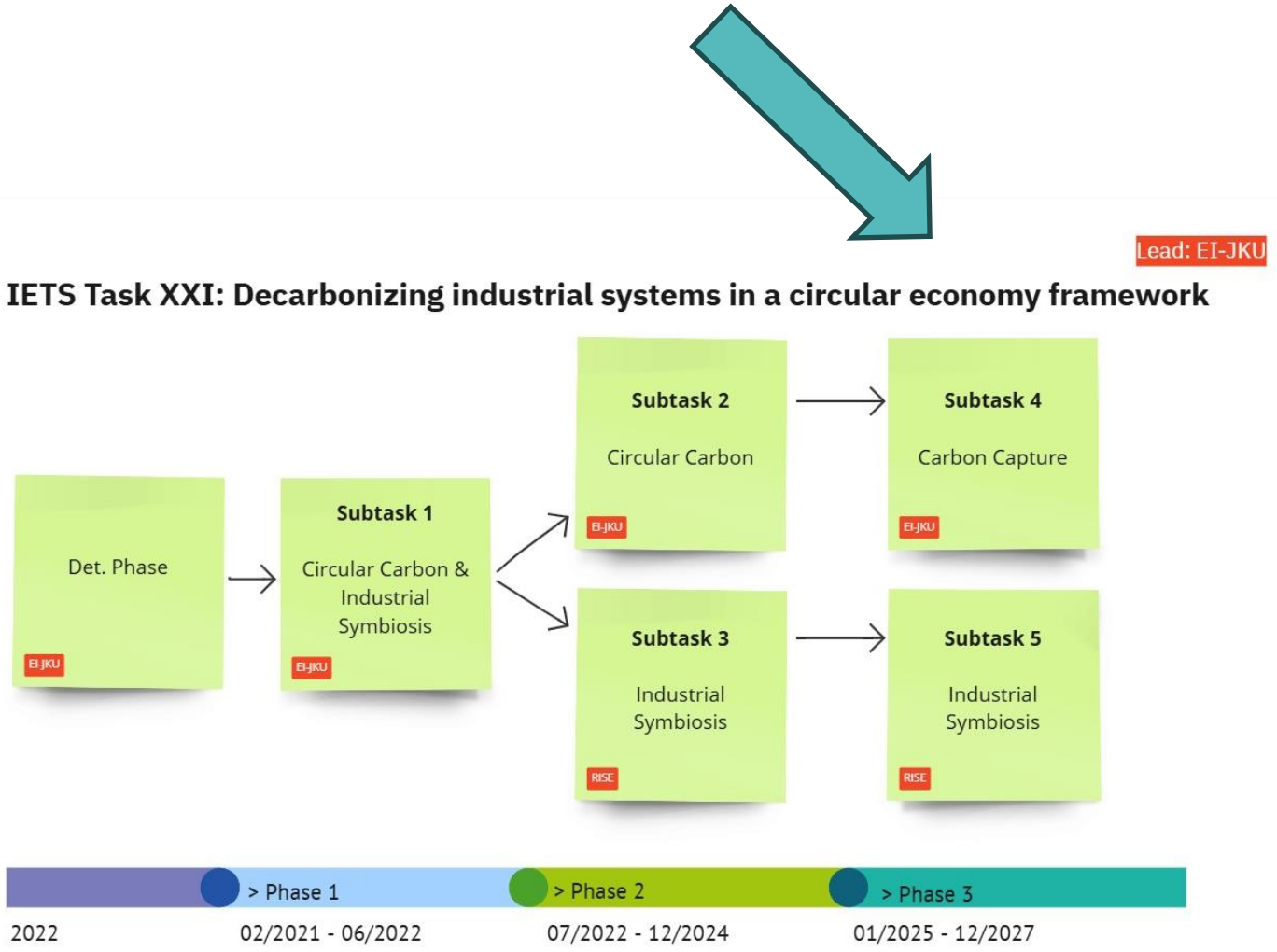
Ausblick Phase 3

Subtask 4: Carbon Dioxide Capture in Industry

- Comparison of national perspectives on CCUS
  - CO2 management strategies
  - National legal provisions
- CCU Value Chains and Stakeholder Database
- Integration of carbon dioxide capture in industry
  - CC trade-offs (purity, quality, energy)
  - Real-life challenges of CC in industry
- Networking

Subtask 5: Facilitation of Industrial Symbiosis

- Portfolio of Industrial Symbiosis Facilitation tools
- Broadening the perspectives on Implementing technologies for Industrial Symbiosis
- Networking



DANKE!

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