

*Supplementary Material*

**Perception of Carbon Capture and Utilization - a framing analysis of German speaking media**

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## 1 Supplementary Tables

**Supplementary Table 1: Developed codebook with coding rule.**

Code: Main_category/subcategories	Description / Coding Rule/Guiding Question
<b>Problem_definition</b>	Framing Category by Entman; understood here as: <i>What is the main topic of the text?</i>
Problem_definition/context/_main_theme	What is the main topic of the coded text passage, in which CCU technologies are (also) discussed? In contrast to the second sub-category, this code indicates the theme of the coded text passage that exists outside of the CCU topic but where CCU plays a big enough role so that the article was taken into the data material.
Problem_definition/context/_main_theme/Investment_in_CCU/S/_Support_program	Funding decisions by the German Government or German / EU funding programs are described, explained or announced.
Problem_definition/context/_main_theme/Energy_security	The main topic of the coded text passage is about secured energy supply (in Germany).
<b>Problem_definition/CO2Utilization</b>	<b>Framing Category by Entman; The main part of the coded text passage is just about CCU.</b>
Problem_definition/CO2Utilization/Capture_technology	The main part of the coded text passage is a (technical) description of a (new) CO2 capture technology.
Problem_definition/CO2Utilization/Transformation_of_CO2	The main part of the coded text passage is a (technical) description of a (new) process

	of CO2 transformation, e.g., into a carbonated base chemical.
Problem_definition/CO2Utilization/Combination_of_H2_and_renewable_energy	In these text passages, CCU is put in context with other decarbonization technologies, mainly green H2 and RE. E.g., comparing the costs/effectiveness of the technologies or listing them as compatible approaches.
Problem_definition/CO2Utilization/Transport_of_CO2	The main part of the coded text passage is the topic of CO2 transportation from an industrial point source to the production site where the CO2 is used as feedstock. E.g., CO2 pipelines, truck, shipping, etc.
<b>Diagnose_Causes</b>	Framing Category by Entman; Causal interpretation: What is the overall context in which this topic is being presented? What is the motivation for talking about CCU?
Diagnose_causes/energy_security	The overall context of the coded text passage is concerns about the Energy security in Germany, e.g., in the context of the full invasion of Russia into Ukraine in 2022 or variable renewable energy sources. In this context, CCU is introduced as one building block in a “new” energy system.
Diagnose_causes/environmental_awareness	The overall context of the coded text passage is climate change / the need for an energy transition. E.g., mentions of the Paris Agreement.

Diagnose_causes/Efficiency_/_innovation	The overall context of the coded text passage is the introduction of an innovation. E.g., Effectiveness or efficiency gains that come with the new technological process are described,
Diagnose_causes/Distinction_from_CCS	The overall context of the coded text passage is a proactive distinction from CCS. E.g., risks or low social acceptance rates of CCS – that don't relate to CCU.
<b>Moral_Judgement</b>	Framing Category by Entman; Moral evaluation: Is the choice of adjectives and examples more positive or negative?
Moral_Judgement/Positive_Connotation	Overall more positive adjectives or examples are being used in the coded text passage. E.g., effective, efficient, safe, beneficial.
Moral_Judgement/Negative_Connotation	Overall more negative adjectives or examples are being used in the coded text passage. E.g., un-effective, risky, expansive.
<b>Treatment_Recommendation</b>	Framing Category by Entman; When policy recommendations are being written out.
Treatment_Recommendation/Limited_Resource_:_use_CCU_where_truly_needed	Recommendations on the field of application (e.g., in which CO2-intensive industries should the technology be applied, in which not) due to limited energy, or financial resources.
Treatment_Recommendation/Funding_needed	Funding as a tool to support the scale-up of CCU technologies in GER (funding for R&D, pilot projects, etc.)

Treatment_Recommendation/Sector_coupling	Synergies between various decarbonization tools (RE, H2, CCU, Recycling, etc.) or bringing together the various stakeholder perspectives (policy, science, society, business): Facilitating synergies to successfully scale up CCU technologies in GER.
Treatment_Recommendation/Development_of_standards_/political_support	Policy recommendations that focus on the need for clear standards and regulations, to increase investment security and comparability.
Treatment_Recommendation/Technological_progress_/scale-up	In the coded text passage, technological progress is seen as the main driver for the CCU rollout in GER. More technological-focused view on the trajectory.

**Supplementary Table 2: Co-occurrence matrix between main frame-categories. Highest values marked in red followed by purple indicate higher co-occurrence values.**

Codesystem	Research	Policy Realm	Business actors	Capture Technology	Pointso	DA	Transformation of CO2	Final product / use	base chemicals	e-fuels (oft auch PTX)	Environment Awareness	Efficiency/Innovation	Negative Assessment	Fear of environmental degradation	Skepticism (technical)	Positive connotation	effective	Need for Defossilization	Treatment Recommendation	"sector coupling"	Technological progress/scale-up
Actors\Researchers	0	34	44	74	50	34	86	117	67	41	112	62	51	7	43	117	70	61	8	27	26
Actors\Policy Realm	34	0	25	33	17	17	16	41	13	27	45	30	13	4	9	50	25	27	4	16	13
Actors\Business actors	44	25	0	69	59	23	51	101	40	43	65	76	27	5	19	81	41	40	5	27	23
CO2 Utilization\Capture Technology	74	33	69	0	91	52	50	101	46	44	75	52	28	5	21	79	46	39	6	25	20
Capture Technology\Pointso	50	17	59	91	0	19	39	74	41	29	54	37	20	3	13	58	30	30	3	16	18
Capture Technology\DAC	34	17	23	52	19	0	16	43	11	22	33	17	10	2	9	31	20	12	2	12	9

CO2 Utilization\Transformation of CO2	86	16	51	50	39	16	0	92	47	25	61	51	24	2	21	69	43	35	5	12	19
Transformation of CO2 \Final product / use	117	41	101	101	74	43	92	0	100	96	112	89	52	8	41	136	84	58	6	24	31
Final product / use\base chemicals	67	13	40	46	41	11	47	100	0	23	49	32	26	4	20	62	38	33	5	10	13
Final product / use\e-fuels (oft auch PTX)	41	27	43	44	29	22	25	96	23	0	46	44	32	5	24	53	37	19	5	13	12
Diagnose Causes\Environment Awareness	112	45	65	75	54	33	61	112	49	46	0	58	48	9	42	136	77	73	8	38	25
Diagnose Causes\Efficiency/Innovation	62	30	76	52	37	17	51	89	32	44	58	0	17	3	14	73	40	26	2	20	15
Make Moral Judgement\Negative Assessment	51	13	27	28	20	10	24	52	26	32	48	17	0	15	70	30	17	15	4	8	11
Negative Assessment\Fear of environmental degradation	7	4	5	5	3	2	2	8	4	5	9	3	15	0	8	5	2	4	1	3	2
Negative Assessment\Skepticism (technical)	43	9	19	21	13	9	21	41	20	24	42	14	70	8	0	23	13	12	4	7	9
Make Moral Judgement\Positive connotation	117	50	81	79	58	31	69	136	62	53	136	73	30	5	23	0	116	107	8	35	35
Positive connotation\effective	70	25	41	46	30	20	43	84	38	37	77	40	17	2	13	116	0	26	6	19	22
Positive connotation\Need for Defossilization	61	27	40	39	30	12	35	58	33	19	73	26	15	4	12	107	26	0	5	20	16
Treatment Recommendation\'s sector coupling"	27	16	27	25	16	12	12	24	10	13	38	20	8	3	7	35	19	20	7	0	13
Treatment Recommendation\Technological progress/scale-up	26	13	23	20	18	9	19	31	13	12	25	15	11	2	9	35	22	16	1	13	0

**Supplementary Table 3: Co-occurrence matrix for “CCU consumer product-frame”. Highest values marked in red followed by purple indicate higher numbers of co-occurrences.**

Codesystem	Capture Technology	Pointsource	Final product / use	base chemicals	e-fuels (oft auch PTX)	Environment Awareness	Efficiency/Innovation	Positive connotation
CO2 Utilization\Capture Technology	0	91	101	46	44	75	52	79
Capture Technology\Pointsource	91	0	74	41	29	54	37	58
Final product / use\base chemicals	46	41	100	0	23	49	32	62
Final product / use\e-fuels (oft auch PTX)	44	29	96	23	0	46	44	53
Diagnose Causes\Environment Awareness	75	54	112	49	46	0	58	136
Diagnose Causes\Efficiency/Innovation	52	37	89	32	44	58	0	73
Make Moral Judgement\Positive connotation	79	58	136	62	53	136	73	0

**Supplementary Table 4: Co-occurrence matrix for “Climate protection-frame”. Highest values marked in red followed by purple indicate higher numbers of co-occurrences.**

Codesystem	Capture Technology	Pointsource	Transformation of CO2	Final product / use	Environment Awareness	Positive connotation	effective	Need for Defossilization
CO2 Utilization\Capture Technology	0	91	50	101	75	79	46	39
Capture Technology\Pointsource	91	0	39	74	54	58	30	30
CO2 Utilization\Transformation of CO2	50	39	0	92	61	69	43	35
Transformation of CO2 \Final product / use	101	74	92	0	112	136	84	58
Diagnose Causes\Environment Awareness	75	54	61	112	0	136	77	73
Make Moral Judgement\Positive connotation	79	58	69	136	136	0	116	107
Positive connotation\effective	46	30	43	84	77	116	0	26
Positive connotation\Need for Defossilization	39	30	35	58	73	107	26	0

**Supplementary Table 5: Co-occurrence matrix for “economy benefit-frame”. Highest values marked in red followed by purple indicate higher numbers of co-occurrences.**

Codesystem	Transformation of CO2	Final product / use	Efficiency/Innovation	Positive connotation
CO2 Utilization\Transformation of CO2	0	92	51	69
Transformation of CO2 \Final product / use	92	0	89	136
Diagnose Causes\Efficiency/Innovation	51	89	0	73
Make Moral Judgement\Positive connotation	69	136	73	0

**Supplementary Table 6: Number of segments assigned to each code.**

Code Main_category/subcategories	Number of segments assigned
<b>Problem_definition</b>	
Problem_definition/context/_main_theme/Investment_in_CCU/S/_Support_program	41
Problem_definition/context/_main_theme/Energy_security	5
<b>Problem_definition/CO2Utilization</b>	
Problem_definition/CO2Utilization/Capture_technology	438
Problem_definition/CO2Utilization/Transformation_of_CO2	796
Problem_definition/CO2Utilization/Combination_of_H2_and_renewable_energy	57
Problem_definition/CO2Utilization/Transport_of_CO2	24
<b>Diagnose_Causes</b>	
Diagnose_causes/energy_security	6
Diagnose_causes/environmental_awareness	198
Diagnose_causes/Efficiency/_innovation	137

Diagnose_causes/Distinction_from_CCS	11
<b>Moral_Judgement</b>	
Moral_Judgement/Positive_Connotation	218
Moral_Judgement/Negative_Connotation	465
<b>Treatment_Recommendation</b>	
Treatment_Recommendation/Limited_Resource: use_CCU_where_truly_needed	6
Treatment_Recommendation/Funding_needed	11
Treatment_Recommendation/Sector_coupling	137
Treatment_Recommendation/Development_of_standards/_political_support	37
Treatment_Recommendation/Technological_progress/_scale-up	77
Sum	2664
Other (not used for framing analysis, but for general investigation)	
CCU as main theme	199
Geographical realm	533
Actors	623
Sum	4019

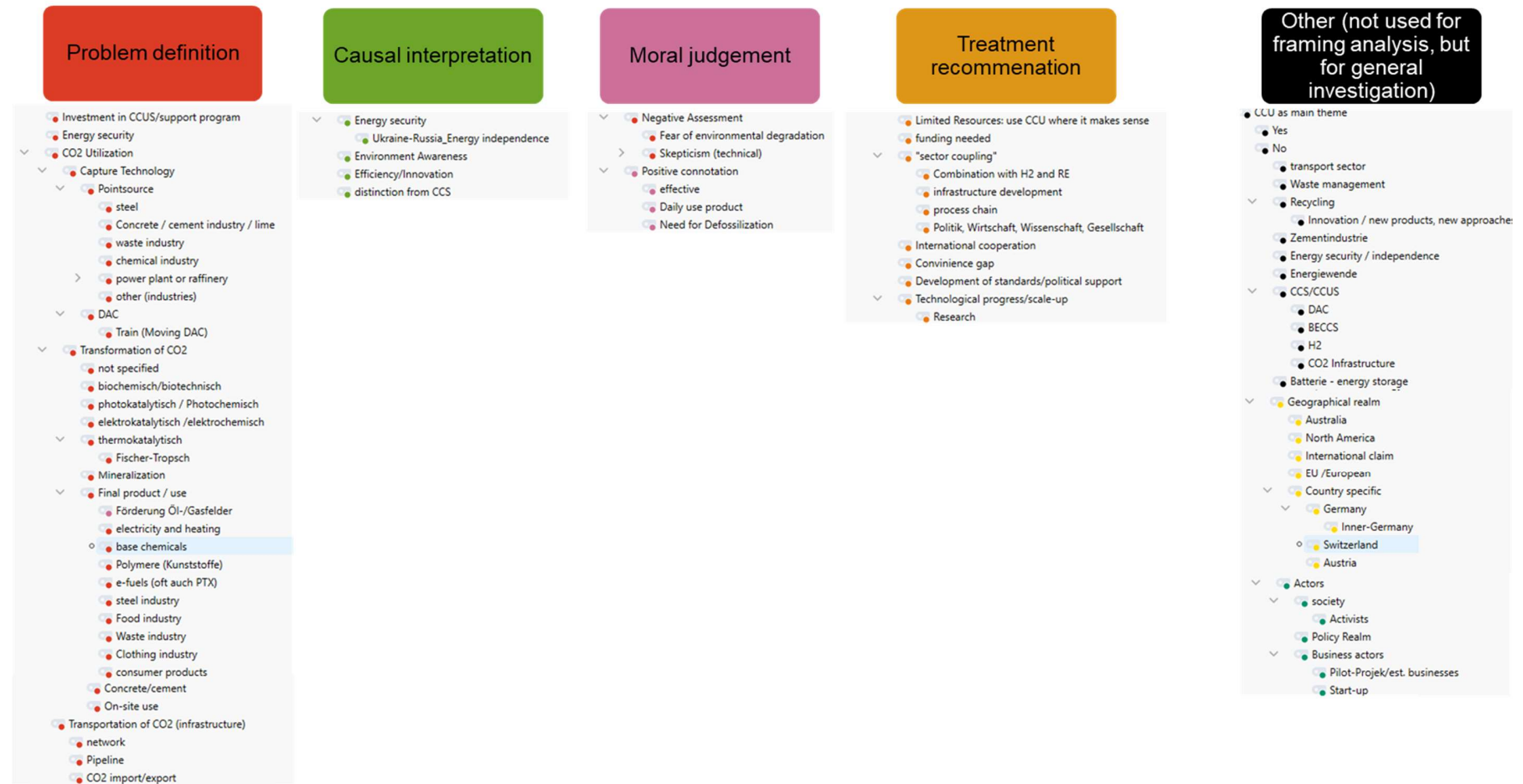
**Supplementary Table 7: List of media outlets used in dataset and their share of used articles.**

<b>Media outlet</b>	<b>Number of articles</b>	<b>Share of articles in dataset</b>
Solarify	11	9%
CHEManager	6	5%
Process	6	5%
Utopia	5	4%
Austria Presse Agentur	3	2%
Handelsblatt	3	2%
aktiv	2	2%
Bioökonomie.de	2	2%
Deutschlandfunk	2	2%
Elektroniknet	2	2%
Energiewirtschaftliche Tagesfragen	2	2%
Focus Online	2	2%
Klimareporter	2	2%
prozesstechnik	2	2%
pv magazine	2	2%
Reisetopia	2	2%
Renewable carbon news	2	2%
Zeit Online	2	2%
Wetter.de	2	2%
Achgut	1	1%
AllgäuHIT	1	1%
Baublatt	1	1%
Berliner Zeitung	1	1%
Biospektrum	1	1%
Böblinger Kreiszeitung	1	1%
Chemie Report	1	1%
Chemie Technik	1	1%
cleanthinking.de	1	1%
DAS INVESTMENT	1	1%
DEAVITA	1	1%
Der Landbote	1	1%

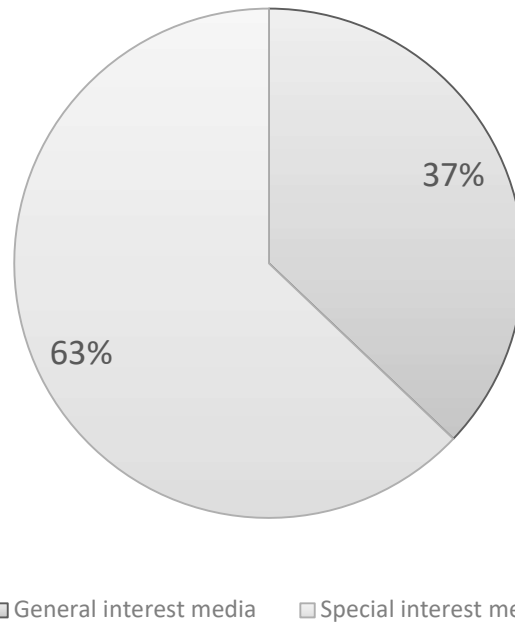
<b>Deutsche Verkehrs-Zeitung</b>	1	1%
<b>Die Linde.</b>	1	1%
<b>energy of tomorrow</b>	1	1%
<b>Erfahrer</b>	1	1%
<b>euractiv</b>	1	1%
<b>Euwid</b>	1	1%
<b>ey.com</b>	1	1%
<b>Finanzen</b>	1	1%
<b>Finanztreff.de</b>	1	1%
<b>Formfaktor</b>	1	1%
<b>Forschung und Wissen</b>	1	1%
<b>forum nachhaltig wirtschaft</b>	1	1%
<b>Future_Zone</b>	1	1%
<b>GEO</b>	1	1%
<b>German-architects.com</b>	1	1%
<b>Greenpeace-magazin</b>	1	1%
<b>GTAI</b>	1	1%
<b>Hamburger Morgenpost</b>	1	1%
<b>Heise Online</b>	1	1%
<b>Jura Forum</b>	1	1%
<b>K-Zeitung</b>	1	1%
<b>Main Post</b>	1	1%
<b>MarketScreener</b>	1	1%
<b>MDR</b>	1	1%
<b>Nachhaltig leben</b>	1	1%
<b>Nau.ch</b>	1	1%
<b>ND-aktuell</b>	1	1%
<b>Neue Verpackung</b>	1	1%
<b>Neue Züricher Zeitung</b>	1	1%
<b>payoff</b>	1	1%
<b>Plas.tv</b>	1	1%
<b>Plasticker</b>	1	1%
<b>PT-Magazin für Wirtschaft und Gesellschaft</b>	1	1%
<b>Recycling</b>	1	1%

<b>Rheinische Post</b>	1	1%
<b>Rhein-Neckar-Zeitung</b>	1	1%
<b>Saarbrücker Zeitung</b>	1	1%
<b>Salzburger Nachrichten</b>	1	1%
<b>Scinexx</b>	1	1%
<b>Spektrum</b>	1	1%
<b>Spiegel Online</b>	1	1%
<b>Sprit +</b>	1	1%
<b>Stahl - Wirtschaftsvereinigung Stahl</b>	1	1%
<b>Tagesschau</b>	1	1%
<b>Tagesspiegel</b>	1	1%
<b>TOP Agrar</b>	1	1%
<b>VBIO</b>	1	1%
<b>Verkehrsrundschau</b>	1	1%
<b>Wind Journal</b>	1	1%
<b>Wochenblitz</b>	1	1%
<b>Edison</b>	1	1%
<b>Energy News Magazine</b>	1	1%
<b>Market steel.de</b>	1	1%
<b>Stadt + Werk Online</b>	1	1%
<b>Report</b>	1	1%
<b>energie.de</b>	1	1%
<b>Automobil Industrie</b>	1	1%
<b>vbzonline</b>	1	1%
<b>tips</b>	1	1%
<b>EU Recycling</b>	1	1%
<b>ORF</b>	1	1%
<b>Main-Echo</b>	1	1%
<b>Augsburger Allgemeine</b>	1	1%
<b>RESET</b>	1	1%
<b>PACKAGING 360°</b>	1	1%
<b>B4B Schwaben</b>	1	1%

## 2 Supplementary Figures



Supplementary Figure 1: Summary of all used subcategories and their subcodes (i.e., some subcategories were split into multiple codes)



**Supplementary Figure 2: Distribution of Media types in dataset.**