Grüner Wasserstoff: Emissionsbilanzierung und -grenzwerte

Vergleich der Methodik des Delegierten Rechtsakt zur Lebenszylusanalyse

Trans4ReaL

Agenda

1. Regulatorische und private Standards zu grünem Wasserstoff
2. Vergleich der Methodik zur Emissionsbilanzierung
3. Ergebnisse: CO_2-Fußabdruck

Regulatorische und private Standards zu grünem Wasserstoff

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Was ist grüner Wasserstoff?

H_2

?

Produktion aus Elektrolyse mit
Strom aus erneuerbaren Energien

CO_2-Fußabdruck

Regulatorische und private Standards zur Emissionsbilanzierung von Wasserstoff

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Inflation Reduction Act (IRA)

Clean Hydrogen Investment Tax Credit

RED II Delegated Act zu Art. 28(5)

EU Taxonomie

CertifHy

Green Hydrogen Organisation

TÜV Süd

TÜV Rheinland

Motivation für Vergleich von DA und LCA

Bilanzierungsmethodik | **Grenzwert**

Renewable Energy
Directive 2018/2001 (RED II)

EU Taxonomie

Vergleich der Methodik zur Emissionsbilanzierung

Delegierter Rechtsakt mit Lebenszyklusanalyse

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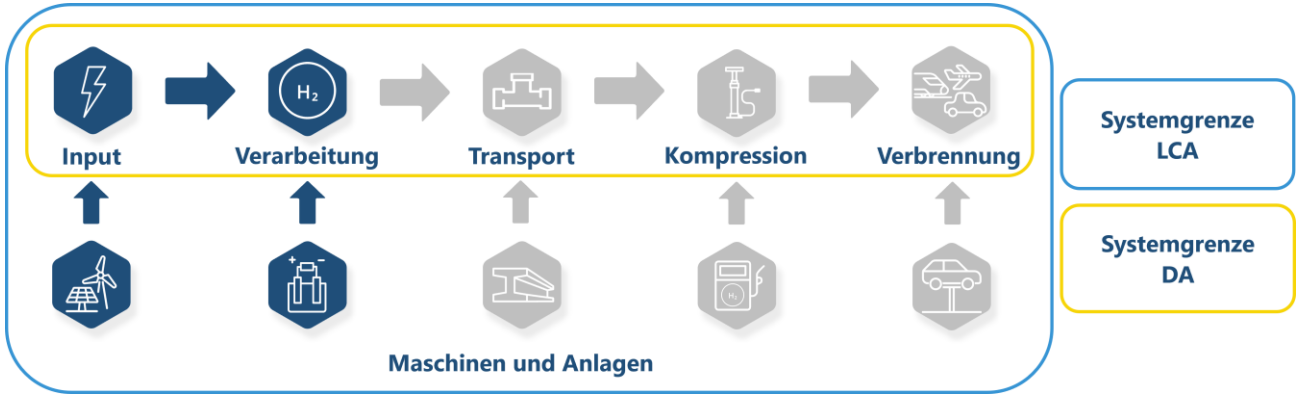
Vergleich der Methodik zur Emissionsbilanzierung

- Systemgrenze: DA schließt Emissionen von Maschinen und Anlagen aus

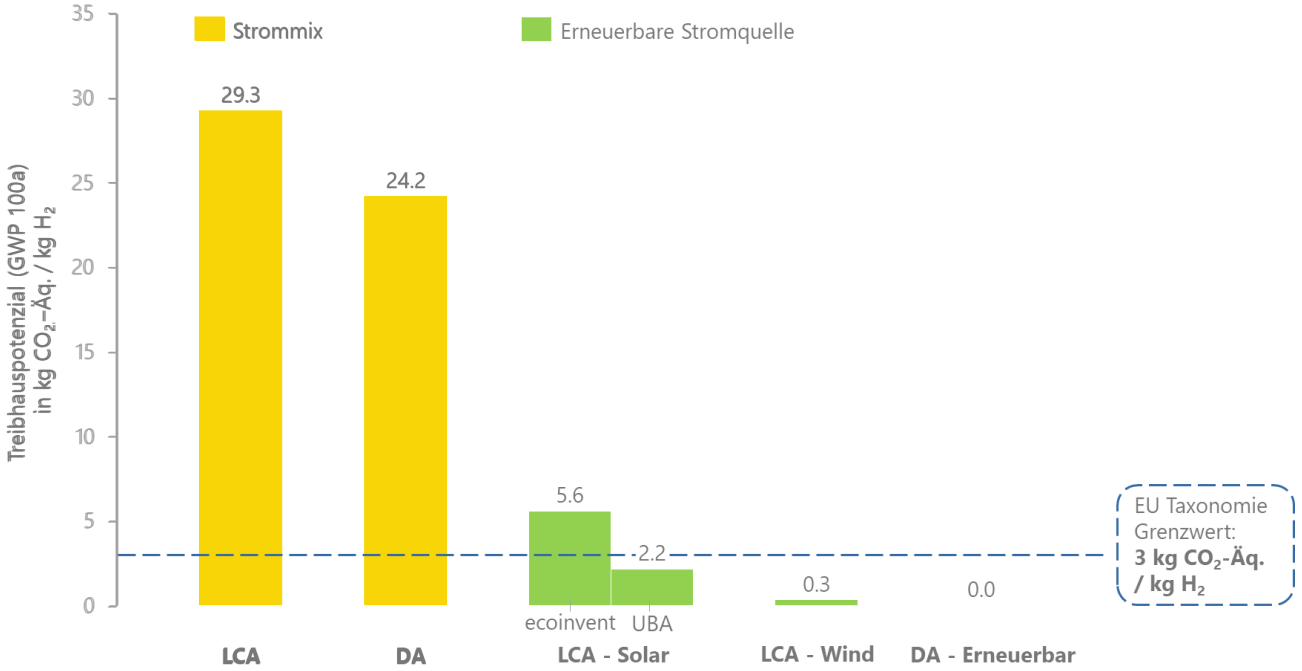


- PEM Elektrolyse
- Betrachtete Stromquellen
  - Strommix für Deutschland 2018
  - Erneuerbare Energien

Ergebnisse

CO_2-Fußabdruck von Wasserstoff aus Elektrolyse

CO_2-Fußabdruck im Vergleich



Ergebnisse

Der CO_2-Fußabdruck nach der **LCA-Methode ist höher** als nach der **DA-Methode**.

Der für die **Elektrolyse verwendete Strom** ist entscheidend für den Fußabdruck entscheidend:
Die Wasserstoffproduktion aus dem deutschen Strommix verursacht deutlich mehr Emissionen als aus erneuerbarem Strom.

Nach **DA-Methodik** führt die Verwendung von Strom aus **erneuerbaren Energien** zu einem CO_2-Fußabdruck von nahe **null**.
Unter Anwendung der **LCA-Methodik** ist der CO_2-Fußabdruck von Wasserstoff aus **Sonnenenergie größer als der von Windkraft**.

Bei LCA hängt die **Überschreitung des Grenzwerts** in der EU Taxonomie von der **Datenquelle** für den Emissionsfaktor von **Solarstrom** ab.

Fazit

- Schaffen eines zuverlässigen und kohärenten Rechtsrahmens für die Emissionsbilanzierung von grünem Wasserstoff
- Angleichen des Grenzwerts für den CO_2-Fußabdruck an die festgelegte Methodik
- Standardisieren der Emissionsbilanzierungsmethode und der Datenbasis, um die Vergleichbarkeit des CO_2-Fußabdrucks von Wasserstoff zu gewährleisten


Thank you.

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Quellen

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- European Commission (2021) Delegierte Verordnung (EU) 2021/2139 der Kommission vom 04. Juni 2021 zur Ergänzung der Verordnung (EU) 2020/852 des Europäischen Parlaments und des Rates durch Festlegung der technischen Bewertungskriterien, anhand deren bestimmt wird, unter welchen Bedingungen davon auszugehen ist, dass eine Wirtschaftstätigkeit einen wesentlichen Beitrag zum Klimaschutz oder zur Anpassung an den Klimawandel leistet, und anhand deren bestimmt wird, ob diese Wirtschaftstätigkeit erhebliche Beeinträchtigungen eines der übrigen Umweltziele vermeidet. Ausgefertigt am 2021-06-04, Version vom 2021-06-04; Brüssel
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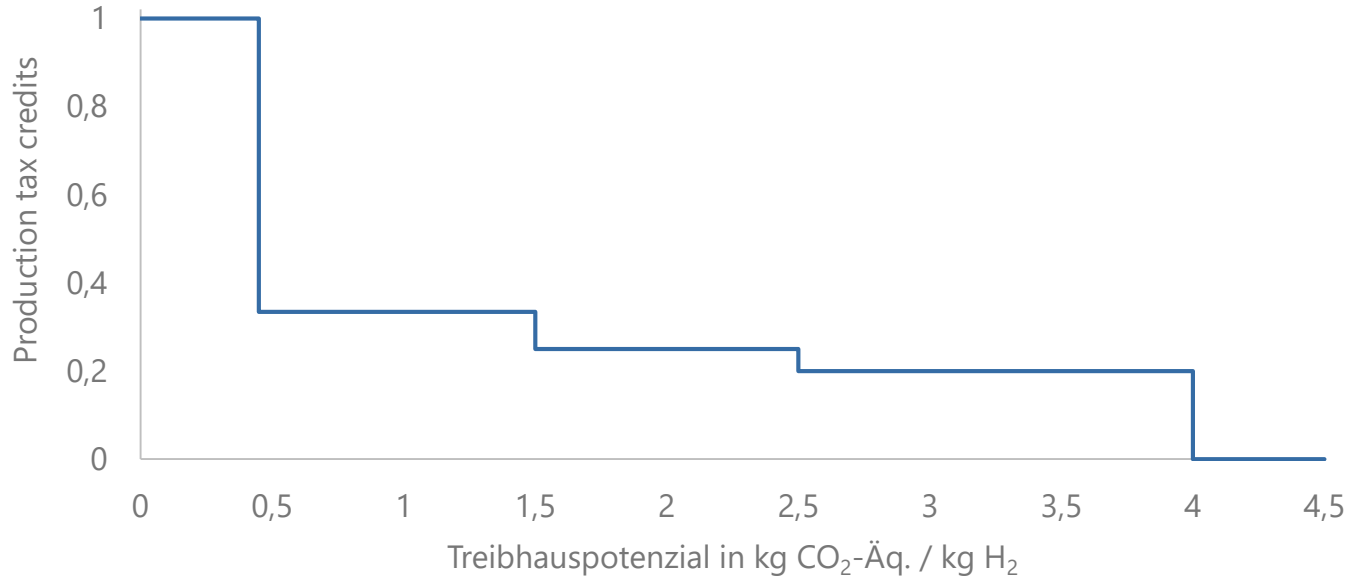
Back-Up

IRA: Tax Credits abhängig vom CO_2-Fußabdruck



Standards und Regularien für Wasserstoff

	Regulatorik / Label		Grenzwert in kg CO_2-Äq./kg H_2	Produktion
EU	DA Art. 28(5) RED II	LCA ohne Anlagenbau	3,4	H_2
	EU Taxonomie	LCA oder nach DA Art. 28(5) RED II	3,0	-
UK	Low Carbon Hydrogen Standard	LCA ohne Anlagenbau	2,4	H_2 H_2 + Bio-masse/Müll
USA	Inflation Reduction Act (IRA)	tba; auf Basis des Modells GREET	> 4,0	-
Canada	Clean Hydrogen Investment Tax Credit	LCA ohne Anlagenbau	> 4,0	H_2 H_2
CertifHy (EU)	Green H_2	LCA ohne Anlagenbau	4,4	H_2
	Low-carbon H_2	LCA ohne Anlagenbau	4,4	
TÜV Süd (DE)	Green H_2	LCA ohne Anlagenbau	3,4	

H_2 Electrolyse mit EE-Strom H_2 SMR + CCUS  aus Erneuerbaren (EE-Strom, Biomethan, …)  nicht erneuerbar

IEA report: hydrogen definitions based on emission intensity

Table 3.1 Overview of existing and planned certification systems and regulatory frameworks for hydrogen, ammonia and other hydrogen-based fuels

Purpose	Name	Market / jurisdiction	System boundary	Product	Demand sector	Status	Chain of custody	Production pathways	Emissions intensity level (kg CO_2-eq/kg H_2)
Regulatory	UK Low Carbon Hydrogen Standard; UK Low Carbon Hydrogen Certification Scheme	United Kingdom	Well-to-gate	Hydrogen		Operational (certification scheme under development)		Electrolysis, natural gas with CCUS, biomass and waste	2.4
Regulatory	Renewable Transport Fuel Obligation	United Kingdom	Well-to-point of delivery	Hydrogen	Transport	Operational	Mass balancing	Renewable energy excluding bioenergy	4.0
Regulatory	EU Taxonomy	European Union	Well-to-gate	Hydrogen		Operational		All	3.0
				Hydrogen-based synthetic fuels					3.4
Regulatory	Renewable Energy Directive II	European Union	Well-to-wheel	Hydrogen, hydrogen-based synthetic fuels		Under development	Mass balancing	Renewable electricity; low-carbon electricity (< 65 g CO_2-eq/kWh)	3.4

IEA report: hydrogen definitions based on emission intensity

Purpose	Name	Market / jurisdiction	System boundary	Product	Demand sector	Status	Chain of custody	Production pathways	Emissions intensity level (kg CO_2-eq/kg H_2)
Regulatory	Low-carbon fuel standard (LCFS)	California (United States)	Well-to-wheel	Hydrogen	Transport	Operational	Book-and-claim	Compressed H_2 from SMR w/o CCUS using natural gas	14.1
								Liquefied H_2 from SMR w/o CCUS using natural gas	18.1
								Compressed H_2 from SMR w/o CCUS using biomethane	11.9
								Liquefied H_2 from SMR w/o CCUS using biomethane	15.5
								Compressed H_2 from electrolysis using grid electricity	19.8
								Compressed H_2 from electrolysis using solar or wind electricity	1.3
Regulatory	Clean Hydrogen Production Tax Credit	United States	Well-to-gate	Hydrogen		Under development		All	2.5-4 2.5-1.5 1.5-0.45 <0.45
Regulatory	Clean Hydrogen Investment Tax Credit	Canada	Well-to-gate	Hydrogen		Under development		Electrolysis, natural gas with CCUS	2-4 0.75-2 < 0.75
				Ammonia					<4

IEA report: hydrogen definitions based on emission intensity

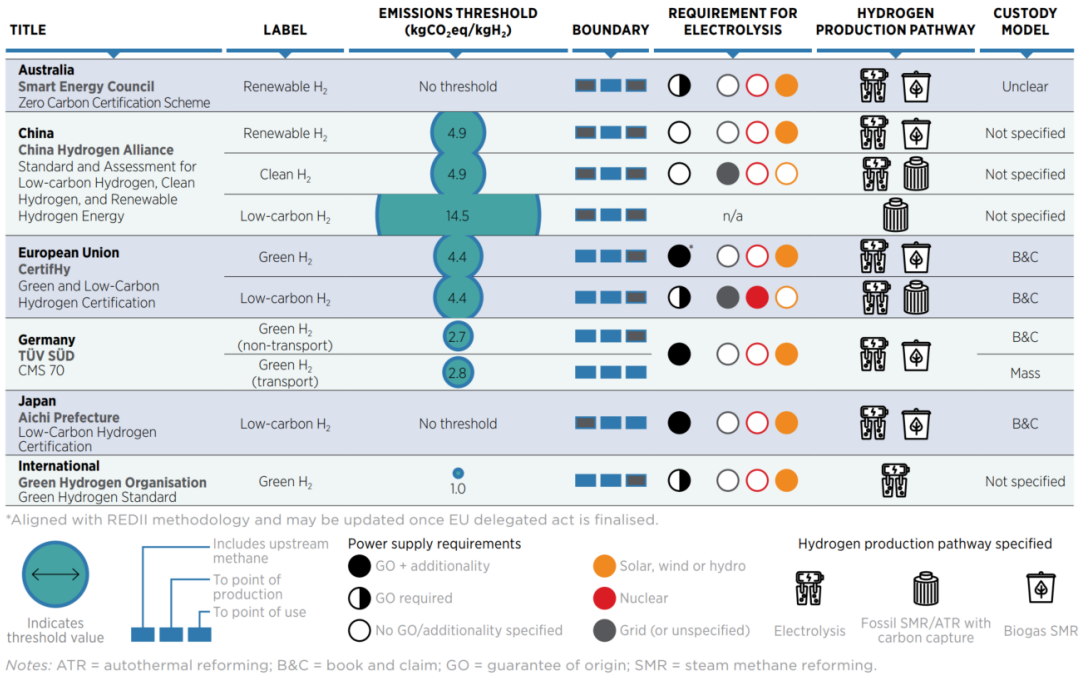
Purpose	Name	Market / jurisdiction	System boundary	Product	Demand sector	Status	Chain of custody	Production pathways	Emissions intensity level (kg CO_2-eq/kg H_2)
Voluntary	Standard and Evaluation of Low-Carbon Hydrogen, Clean Hydrogen and Renewable Hydrogen (China Hydrogen Alliance)	China	Well-to-gate	Hydrogen		Operational	Not specified	All	Low-carbon hydrogen: 14.5 Renewable hydrogen, clean hydrogen: 4.9
Voluntary	CertifHy	European Union	Well-to-gate	Hydrogen		Operational	Book-and-claim	Renewable electricity	Green hydrogen: 4.4
								Nuclear electricity, fossil fuels with CCUS	Low-carbon hydrogen: 4.4
Voluntary	Low-carbon hydrogen certification system (Aichi Prefecture)	Japan	Well-to-gate	Hydrogen		Operational	Book-and-claim	Renewable electricity, biogas	-
Voluntary	Green Hydrogen Standard (Green Hydrogen Organisation)	International	Well-to-gate	Hydrogen		Operational	Not specified	Renewable electricity	1
				Ammonia		Under development			0.3 kg CO_2-eq/kg NH_3
Voluntary	Climate Bonds Standard & Certification Scheme	International	Well-to-gate	Hydrogen		Operational		Electrolysis, natural gas and waste biomass	2022: 3.0 2030: 1.5 2040: 0.6 2050: 0.0

IEA report: hydrogen definitions based on emission intensity

Purpose	Name	Market / jurisdiction	System boundary	Product	Demand sector	Status	Chain of custody	Production pathways	Emissions intensity level (kg CO_2-eq/kg H_2)
Voluntary	TÜV SÜD CMS 70	European Union	Well-to-gate	Hydrogen	Transport	Operational	Book-and-claim	Renewable electricity	1.1
								Biomethane, glycerine	2.3-3.4
					Outside transport			Renewable electricity	1.1
								Biomethane, glycerine	2.1-3.2
			Well-to-point of delivery		Transport		Mass balancing	Renewable electricity	2.8
								Biomethane, glycerine	4.5-5.6
					Outside transpor			Renewable electricity	2.7
								Biomethane, glycerine	4.3-5.4
Voluntary	World Business Council of Sustainable Development	International	Well-to-gate	Hydrogen		Proposal	Not specified	All	Reduced-carbon hydrogen: 6 Low-carbon hydrogen: 3 Ultra-low-carbon hydrogen: 1
Voluntary	Ammonia Energy Association	International	Well-to-gate	Ammonia	All sectors	Under development	Not specified	All	

Notes: CCUS = carbon capture, utilisation and storage; SMR = steam methane reforming; H_2 = hydrogen. The "Demand sector" column indicates whether the certification system or regulation is limited to using the hydrogen in a specific sector.

IRENA: voluntary market mechanisms



TITLE	LABEL	EMISSIONS THRESHOLD ($kgCO_2eq/kgH_2$)	BOUNDARY	REQUIREMENT FOR ELECTROLYSIS	HYDROGEN PRODUCTION PATHWAY	CUSTODY MODEL
Australia **Smart Energy Council** Zero Carbon Certification Scheme	Renewable H_2	No threshold				Unclear
China **China Hydrogen Alliance** Standard and Assessment for Low-carbon Hydrogen, Clean Hydrogen, and Renewable Hydrogen Energy	Renewable H_2	4.9				Not specified
	Clean H_2	4.9				Not specified
	Low-carbon H_2	14.5		n/a		Not specified
European Union **CertifHy** Green and Low-Carbon Hydrogen Certification	Green H_2	4.4				B&C
	Low-carbon H_2	4.4				B&C
Germany **TÜV SÜD** CMS 70	Green H_2 (non-transport)	2.7				B&C
	Green H_2 (transport)	2.8				Mass
Japan **Aichi Prefecture** Low-Carbon Hydrogen Certification	Low-carbon H_2	No threshold				B&C
International **Green Hydrogen Organisation** Green Hydrogen Standard	Green H_2	1.0				Not specified

*Aligned with REDII methodology and may be updated once EU delegated act is finalised.

Notes: ATR = autothermal reforming; B&C = book and claim; GO = guarantee of origin; SMR = steam methane reforming.

IRENA: voluntary market mechanisms

COUNTRY/ REGION	NATIONAL HYDROGEN STRATEGY	BOUNDARY AND SCOPE (SECTORS)	EMISSIONS THRESHOLD ($kgCO_2eq/kgH_2$)	POWER SUPPLY REQUIREMENT FOR ELECTROLYSIS	HYDROGEN PRODUCTION PATHWAY	REGULATORY MECHANISM	STATUS OF REGULATORY MECHANISM
United Kingdom	**Government of the United Kingdom** UK Hydrogen Strategy	(Energy)	24	◑ ● ● ●		**BEIS** Low Carbon Hydrogen Standard	To be implemented in 2022 Certification scheme **to be developed by 2025**
		(Transport)	3.9	● ○ ○ ●		**UK Dept. for Transport** Renewable Transport Fuel Obligation	**Active**
European Union (Proposed)	**European Commission** A hydrogen strategy for a climate-neutral Europe	(Transport, energy)	3.4	●* ○ ○ ●		**European Commission** RED II	**Active** New Delegated Act of RED II **proposed in May 2022**
		Boundary not specified	3.0	◑ ● ● ●		**European Commission** EU Taxonomy	**Active**
United States (Proposed)	**US Department of Energy** National Clean Hydrogen Strategy and Roadmap	(Transport, energy)	4.0	○** ● ● ●		**US Department of Energy** H2Hubs draft *(may be adopted by standard for clean H_2 production)*	CHPS not yet finalised H2Hubs criteria requires 2 $kgCO_2/kgH_2$ at point of production to qualify
		(Transport)	No threshold (Certificate issued based on reduction from annual target)	◑ ● ○ ●		**California Air Resources Board** Low Carbon Fuel Standard - California only	**Active**

*refers to delegated act criteria, grid connected conditions in delegated act undergoing revision and are subject to change.
**denotes no detail of additionality in draft, but is yet to be finalized.

Indicates threshold value

Includes upstream methane
To point of production
To point of use

Power supply requirements
- GO + additionality
- GO required
- No GO/additionality specified
- Solar, wind or hydro
- Nuclear
- Grid (or unspecified)

Hydrogen production pathway specified
- Electrolysis
- Fossil SMR/ATR with carbon capture
- Biogas SMR

Notes: ATR = autothermal reforming; B&C = book and claim; GO = guarantee of origin; SMR = steam methane reforming.