26. April 2024

Potenzial und Grenzen von Wasserstoff
- Strategien in Japan -

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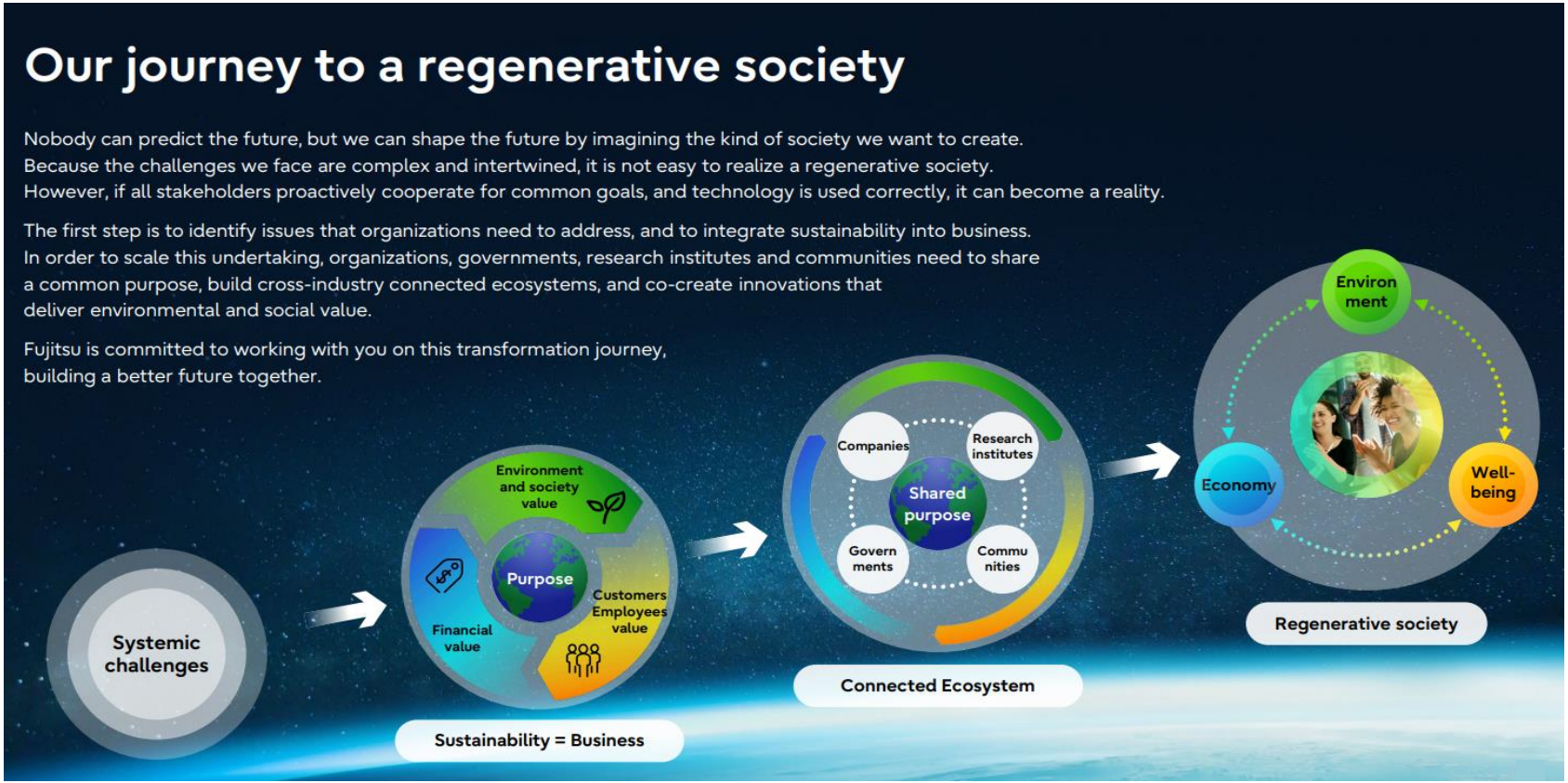
Fujitsu Ltd.

Potenzial und Grenzen von Wasserstoff

- Warum beschäftigt sich ein Volkswirt in einer IT-Firma mit Wasserstoff?

Fujitsu - Von “digitaler” zu “nachhaltiger” Transformation



Innovation – Daten in einer Kreislaufwirtschaft

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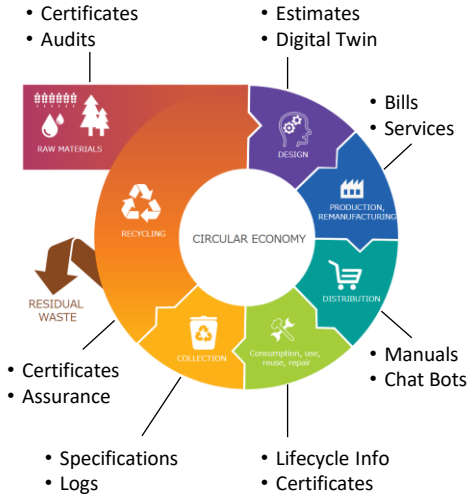
Regulation
(Carbon Neutral)

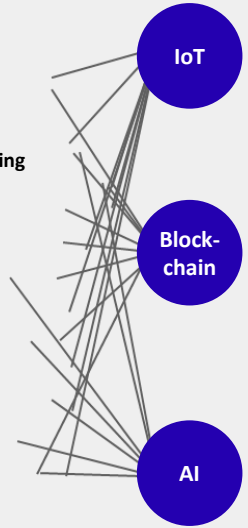
Carbon Accounting
(2024-)

Data
(Carbon Economy)



Technologies
(Circular Economy)

1. **Traceability information**
2. **Material reuse**
3. **Tracking for maintenance**
4. **Decentralized manufacturing**
5. **Digital passports**
6. **Waste tracking**
7. **Asset sharing**
8. **Product as a service**
9. **Material exchange**
10. **Mfg as a services**
11. **Consumer information**
12. **Product design**
13. **Material recovery**



"Circular Economy 2.0" builds on new ecosystems and technology integration

Fujitsu – “Sytems Engineering” zu “Systems Thinking”

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Uvance Sustainability & SX Brand 2022

Global Software Service SE /GSI 2016

Human Centric DX & Co-Creation 2015

Software Service SE re-organization 2013

Software Service SE re-organization 2012

SI finally profitable System unit transfer 1998

System unit establishment 1994

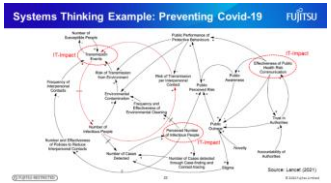
Kamata SL SE assembly 1981

New System division 1970

Systems Thinking

Cause Result

feedback



SX Systems

Design Thinking

Problem Solution

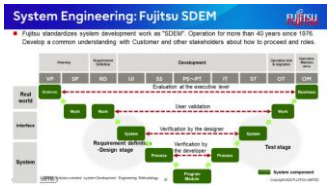
feedback

DX Design

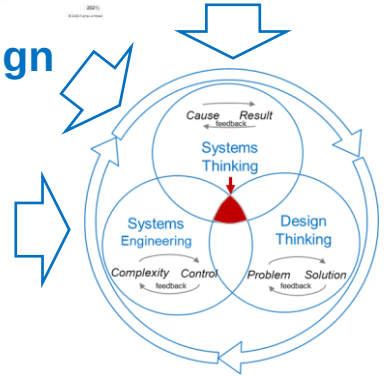
Systems Engineering

Complexity Control

feedback



SE Service



Potenzial und Grenzen von Wasserstoff

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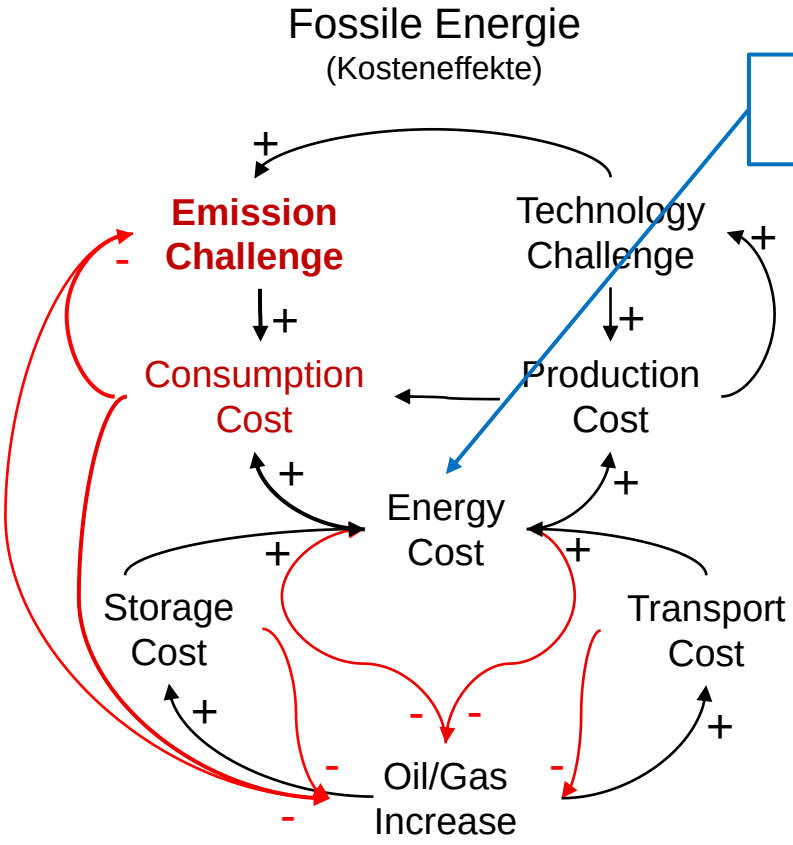
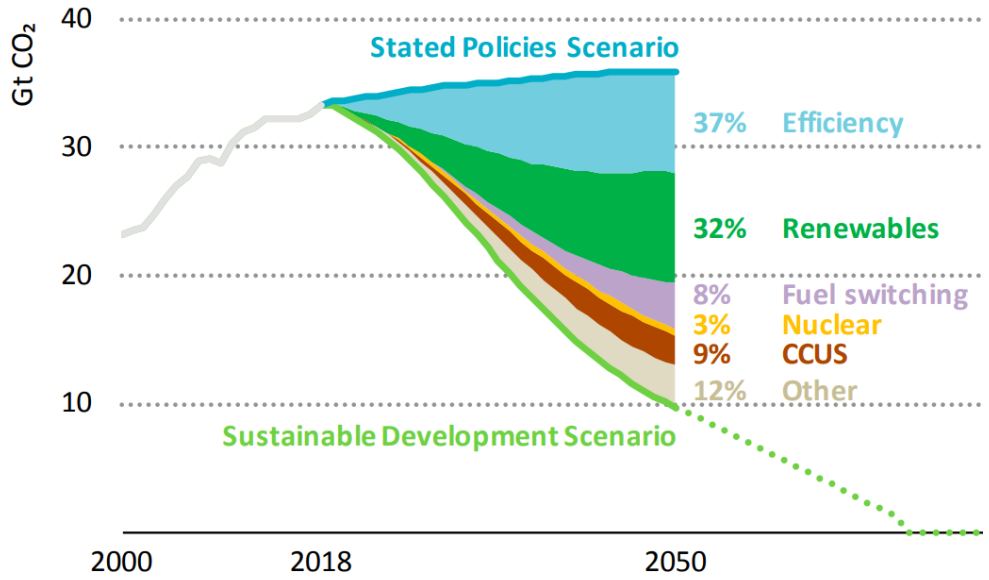
- Von fossilen zu erneuerbaren Energien

Fossile Energiewirtschaft – Schwer zu ändern

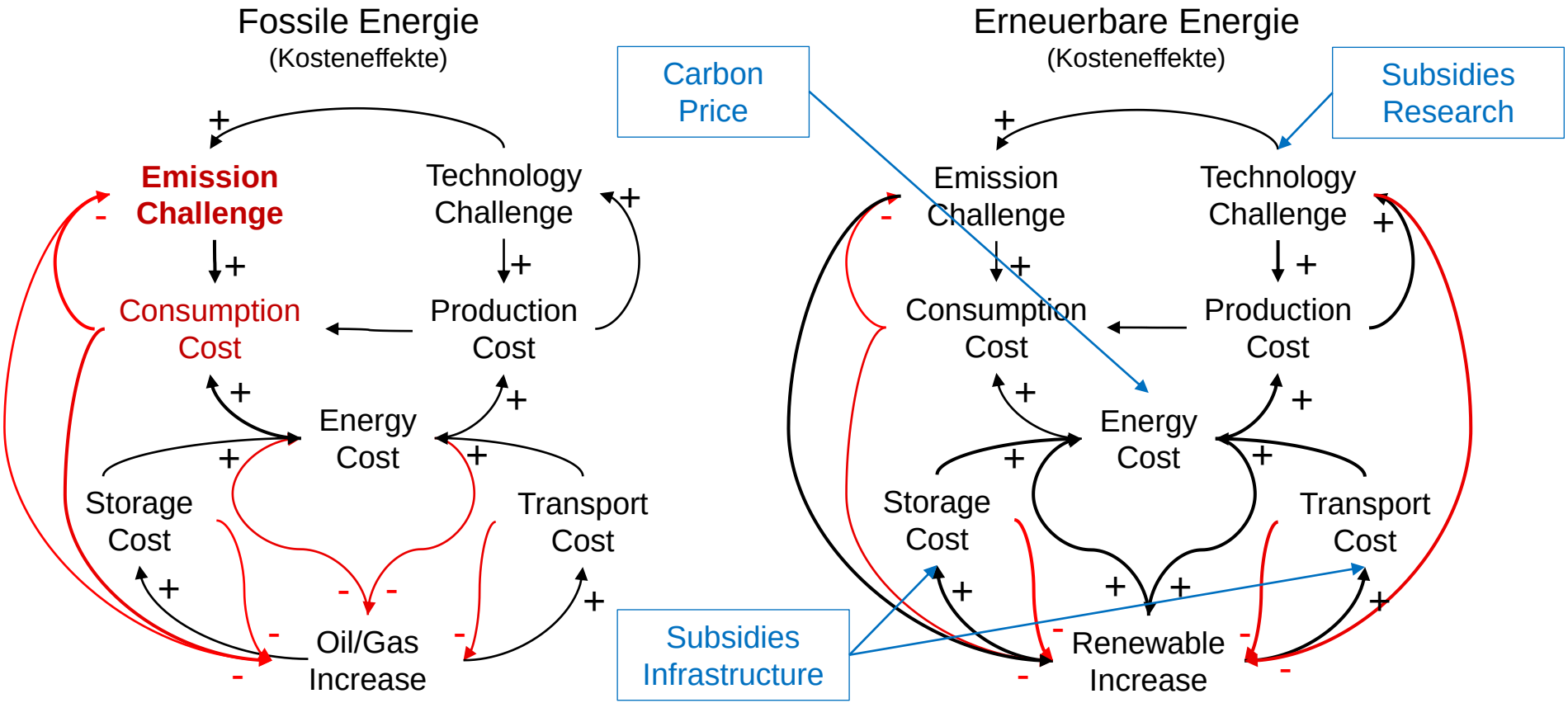


Notwendige CO2 Reduktionsmaßnahmen



Source: IEA (2019) – World Energy Outlook.

Erneuerbare Energiewirtschaft – Was ist anders?



Potenzial und Grenzen von Wasserstoff

- Strom & Batterien oder Strom & Wasserstoff als Energieträger?

Erneuerbare Energiewirtschaft – Batterie vs Wasserstoff

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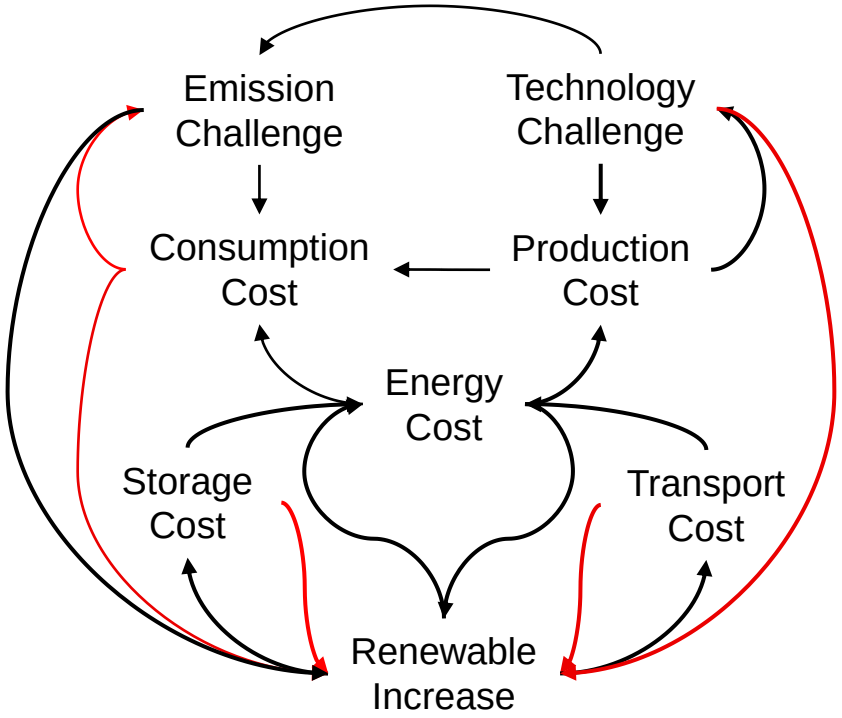
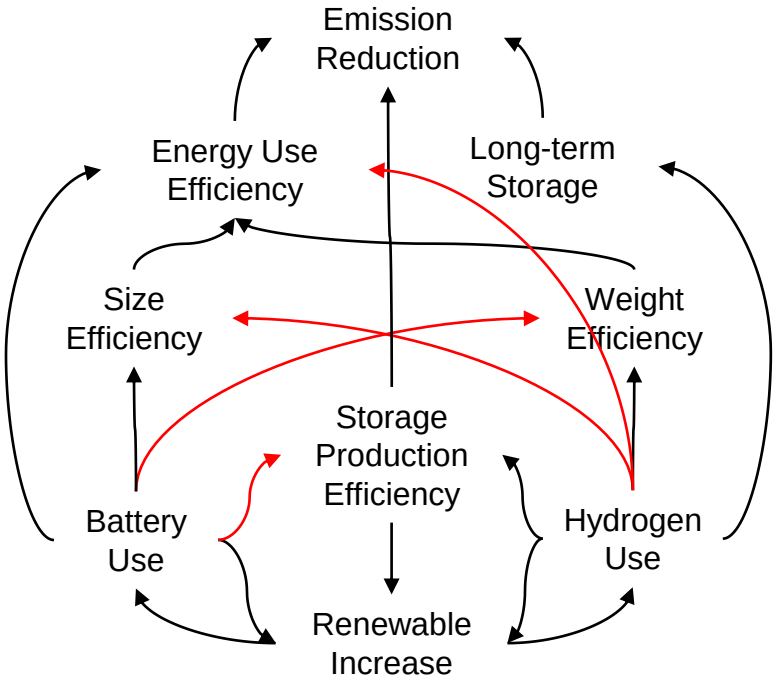
Erneuerbare Energie
(Kosteneffekte)



Batterie vs Wasserstoff
(Effizienz)



Erneuerbare Energiewirtschaft – Batterie vs Wasserstoff

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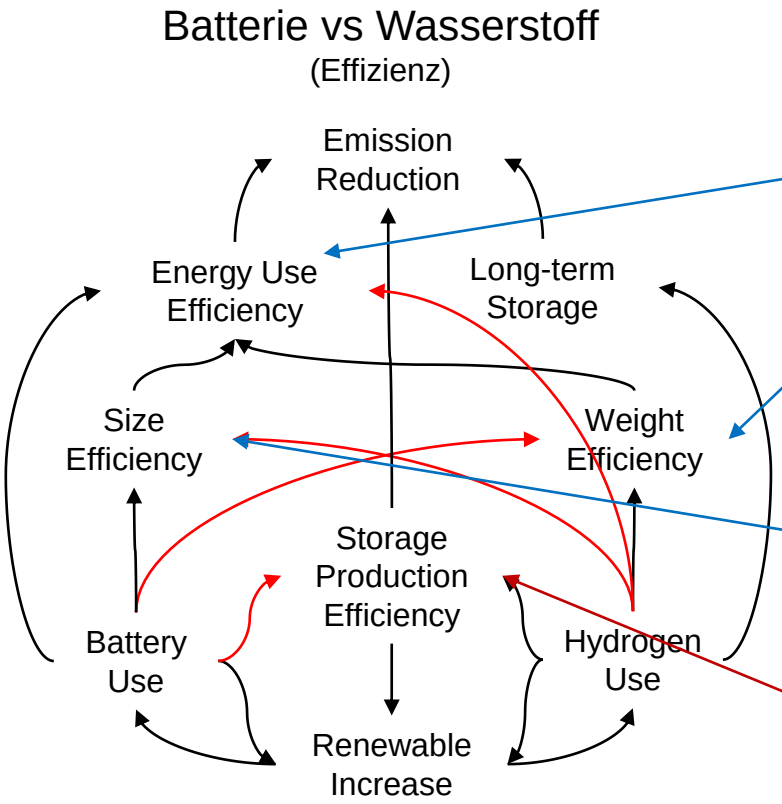

EV	Tank2Wheel	Well2Wheel
HEV:	30%	25%-10%
Bat:	85%	80%-65%
H2:	55%	40%-25%

EV	130kW/500km Drive Train	400km Tesla/Mirai
Bt:	326kg	2.3 tones
H2:	152kg	1.9 tones

EV	Tesla 240 liter battery / Mirai 120 liter (240 liter size)
Bt:	0.4 kWh/dm3 96 kWh
H2:	0.7 kWh/dm3 84 kWh

Batterie Umweltlasten (Kobal, Nickel, Lithium…)
Batterie Recycling noch ineffizient…

Data Sources:
Tsakiris et. al. (2019) - Analysis_of_hydrogen_fuel_cell_and_battery_efficiency.pdf (dtu.dk)
Handwerker et. al. (2021) - Comparison of Hydrogen Powertrains (mdpi.com)

Wasserstoffwirtschaft – Effizienz bestimmt Nachhaltigkeit

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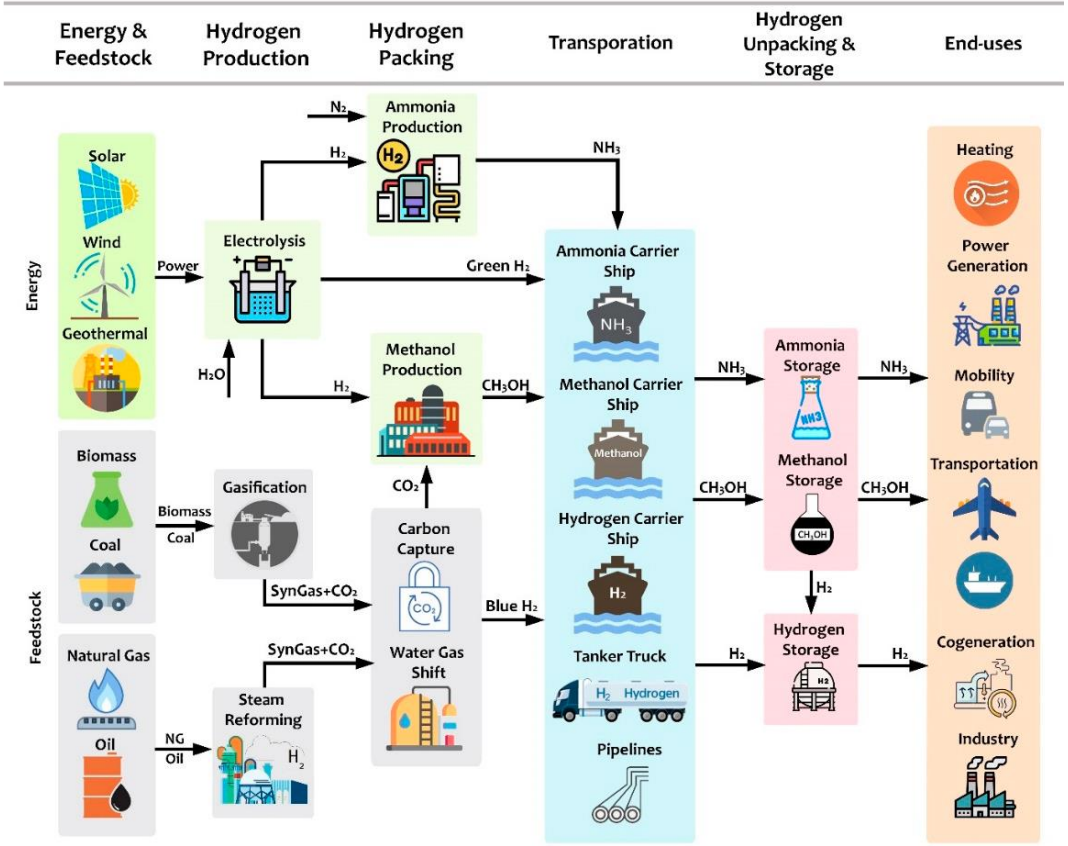
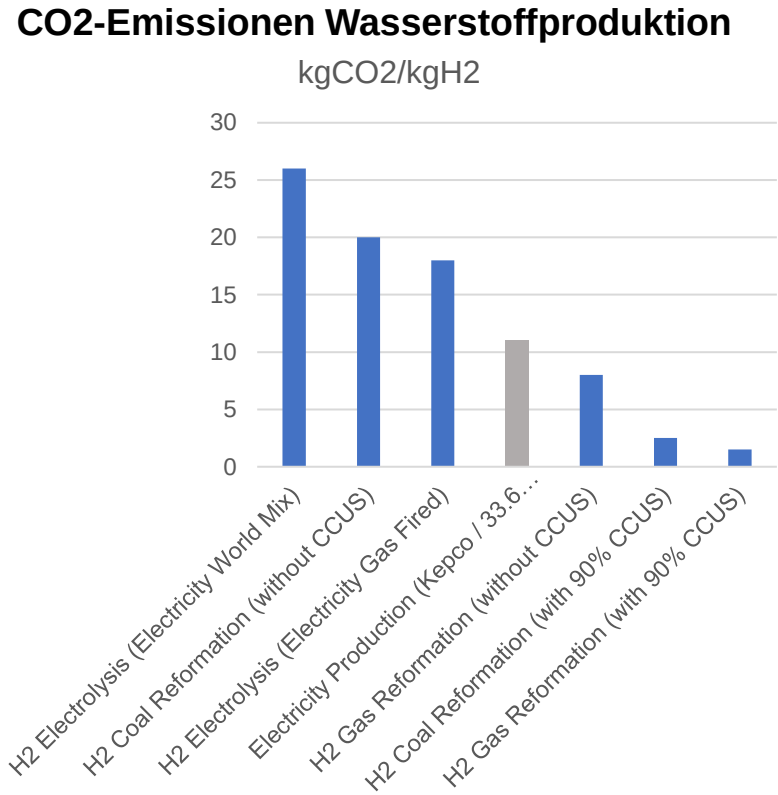


Quelle: Salimi et. al. (2022) – The Role of Clean Hydrogen Value Chain (mdpi.com)



Source: Schulz (2022) - Zukunft Wasserstoff?

Batteriewirtschaft – Recycling bestimmt Nachhaltigkeit

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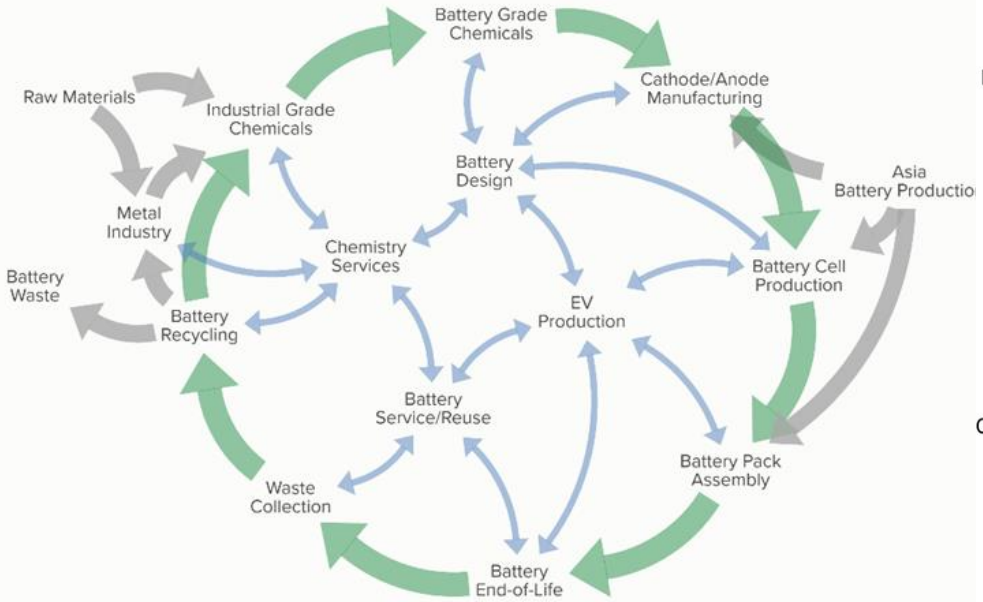
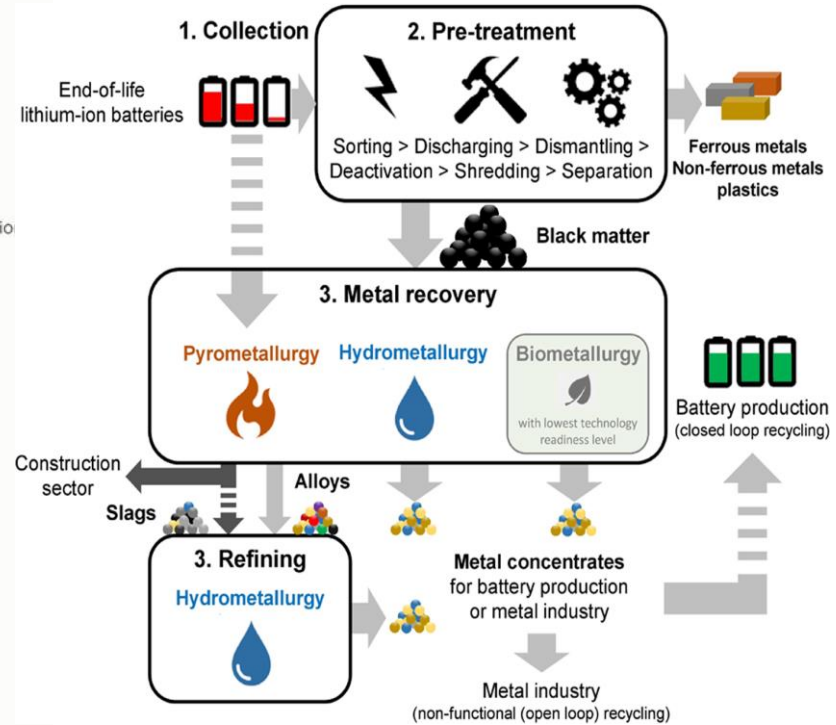
Batteriewirtschaft
(Effizienz)



Source: Atsumi, Yui (2024) – Green vs Circular Chemistry.

Li-Ion Batterie-Recycling



Source: Windisch-Kern (2022) – Recycling chains for lithium-ion batteries: - ScienceDirect

Wasserstoffwirtschaft – Gezielt Grün oder viel Blau?

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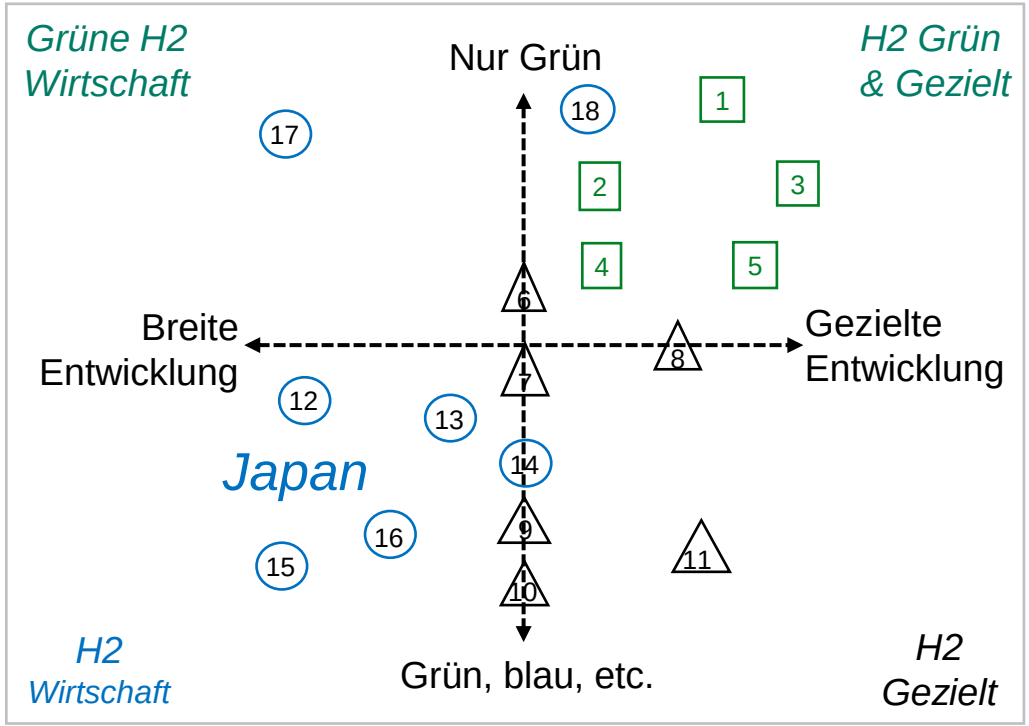
Wasserstoffziele in Deutschland & Japan

(Effizienz)



Umweltorganisationen

1: DNR
2: BUND
3: WWF
4: Deutsche Umwelthilfe
5: Klima-Allianz

Forschungsinstitute

6: Jüllich
7: Wuppertal Institut
8: Agora Energiewende
9: Fraunhofer ISE
10: Fraunhofer ISI
11: Öko-Institut

Industrieverbände

12: DVGW
13: BDI
14: VCI
15: BDEW
16: VKU
17: DWV
18: BEE

Source: Kern / Schmelzle (2023).

Potenzial und Grenzen von Wasserstoff

- Sony hat die Li-Ionen Batterie und Toyota hybride Antriebe entwickelt. Warum fokussiert Japan trotzdem so stark auf Wasserstoff?

  - **Konkurrenz mit Korea/China/Asien:** Batterieentwicklung ist relativ einfach zu kopieren, erfordert einen hohen Materialeinsatz und enge Zusammenarbeit mit der Elektronikindustrie.
  - **Komplexe Technologien:** Hybride und Brennstoffzellen-Fahrzeuge haben das Potenzial langfristig Beschäftigung und Wettbewerbsfähigkeit sichern.
  - **Infrastruktur:** Öl/Gas-basierte Import und Infrastrukturnetzwerke können weiterverwendet werden.

- **Literatur:** Zukunft Wasserstoff? Potenziale, Herausforderungen und Lösungen der japanischen Strategie

Potenzial und Grenzen von Wasserstoff

- Von Projekten zur Strategie

Wasserstoffwirtschaft – Erfolgreiche Industrieparks

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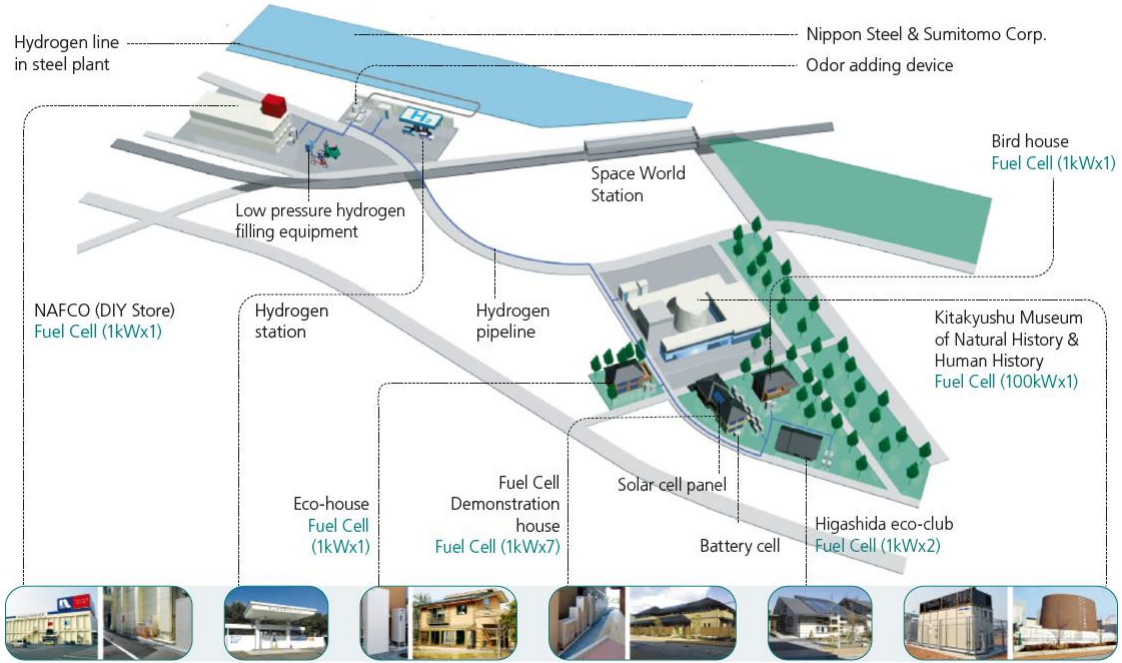
HySut Kitakyushu Hydrogen Town (2011–2014)

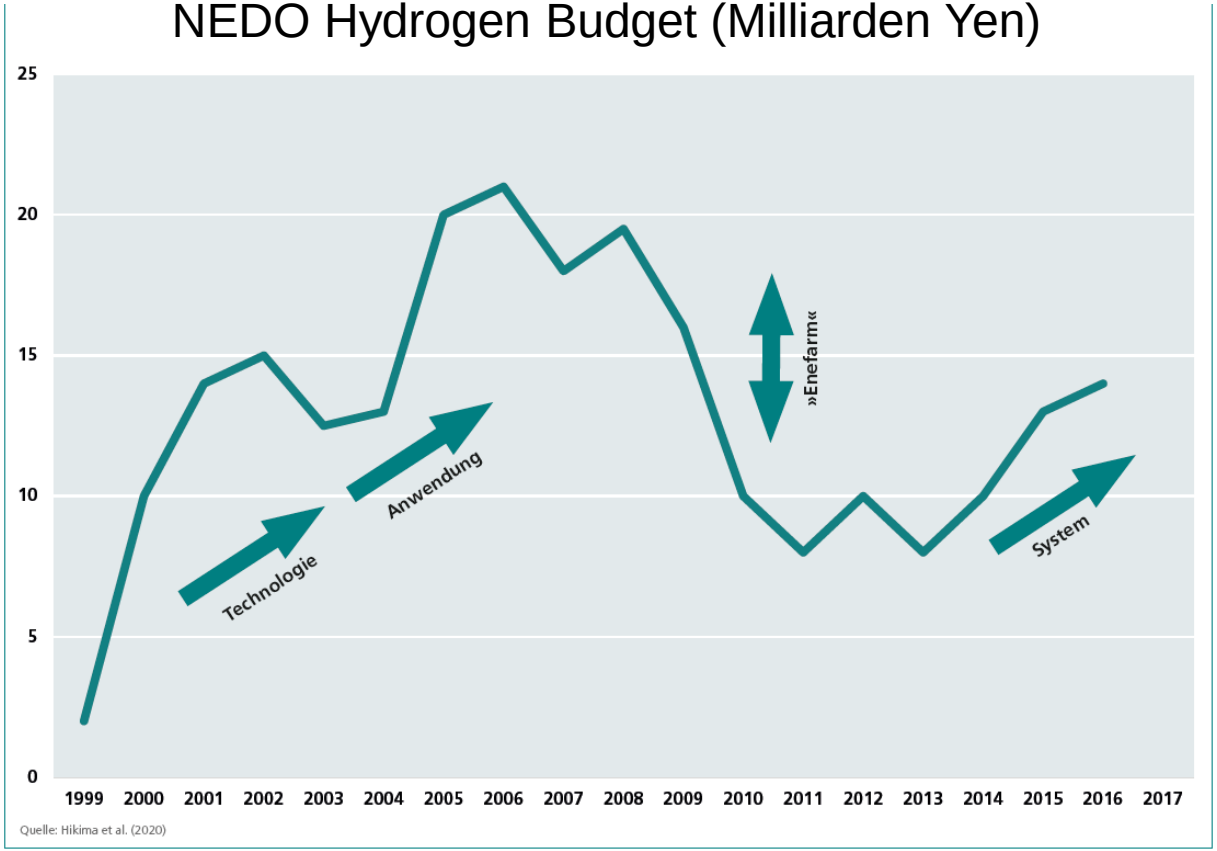
1. Technical demonstration of hydrogen supply through pipeline for "stable supply", "safety assurance" and "appropriate charging procedures".
2. Demonstration of pure-hydrogen type fuel cells for actual home and business uses over years.
3. Demonstration of hydrogen supply on specialty small vehicles: FC bicycles and FC lifts.



- Optimierung mit Pipelines, Zwischenspeicherung, Kraft-Wärmekoppelung

Source: Hysut (2015).

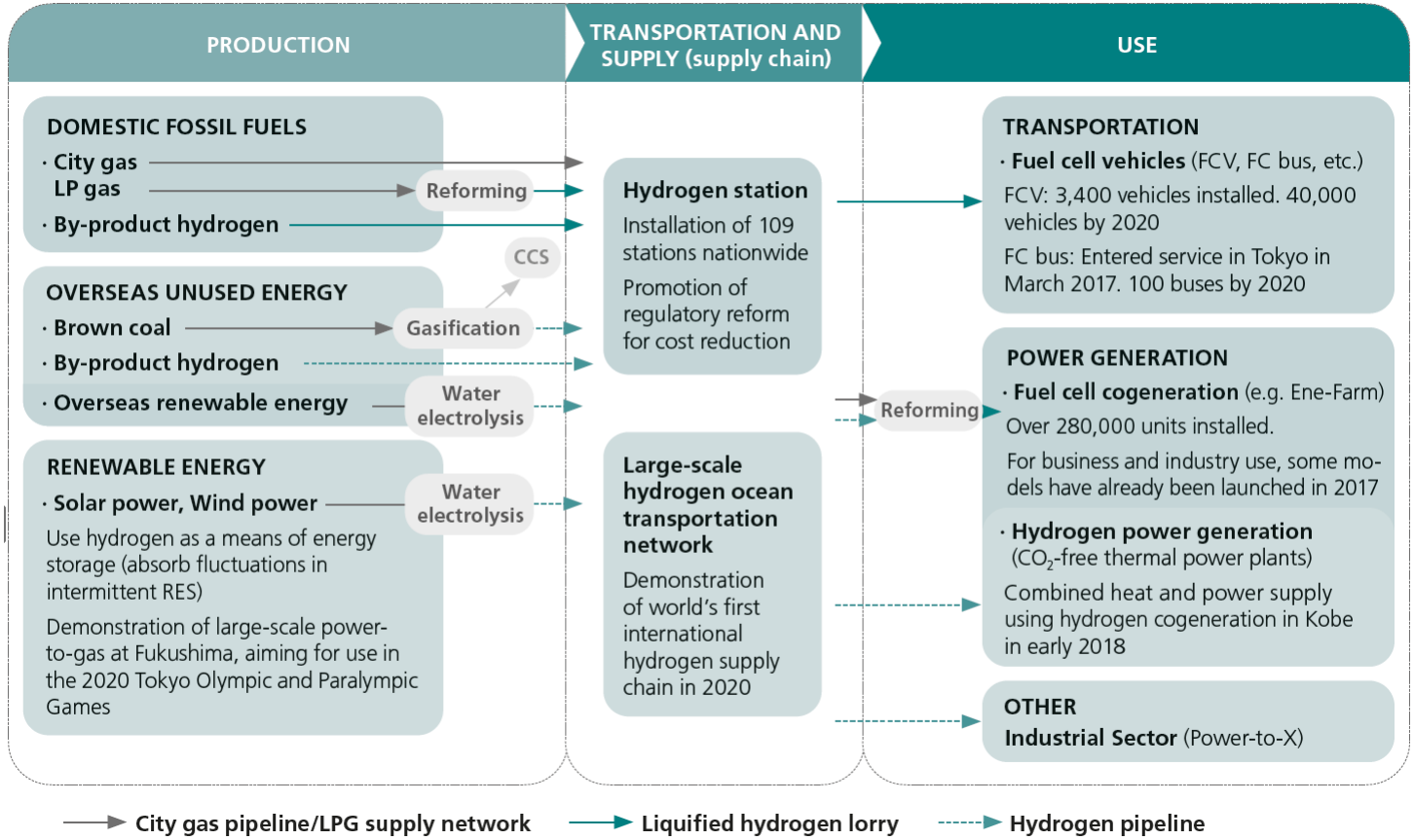
Wasserstoffwirtschaft – Erfolglose Brennstoffzellen



- Entwicklung von kleinen „Enefarm“ (2009) Brennstoffzellen für den Haushaltsgebrauch
- Erdgas – Wasserstoff – Strom – Wärmekopplung mit 87% energetischer Gesamteffizienz
- Keine Chance gegen „EcoCute“ Wärmepumpen und Klimaanlagen mit einer Effizienz von 400%
- **Konkurrenz zu Entwicklung und Einführung von erneuerbarer Energie**

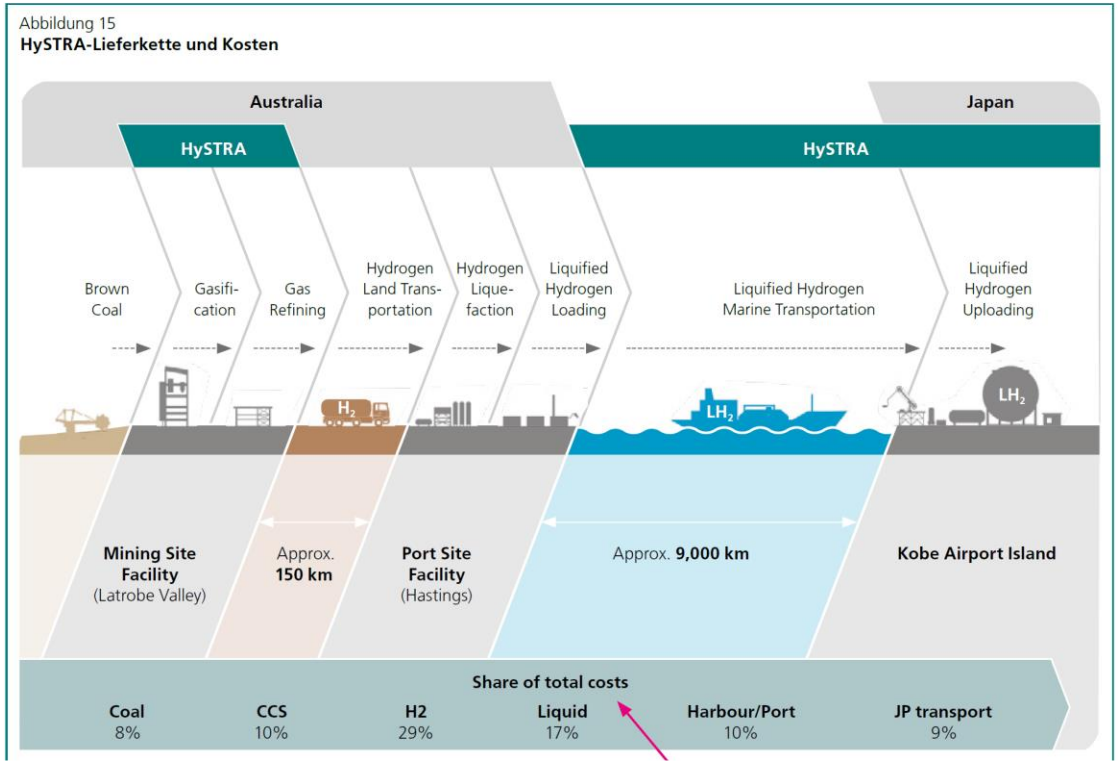
Source: Source: Schulz (2022) - Zukunft Wasserstoff?; based on Hikima (2020). (2019).

Wasserstoffwirtschaft – Drei Ebenen der Strategie

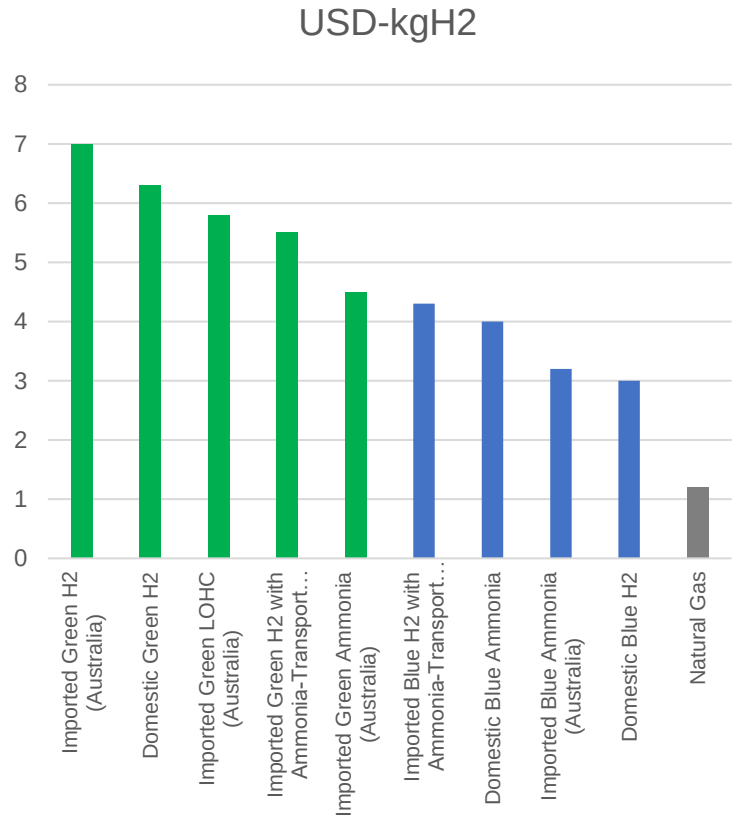


Source: Source: Schulz (2022) - Zukunft Wasserstoff? ; based on METI (2019).

Wasserstoffwirtschaft – Fokus auf Infrastruktur

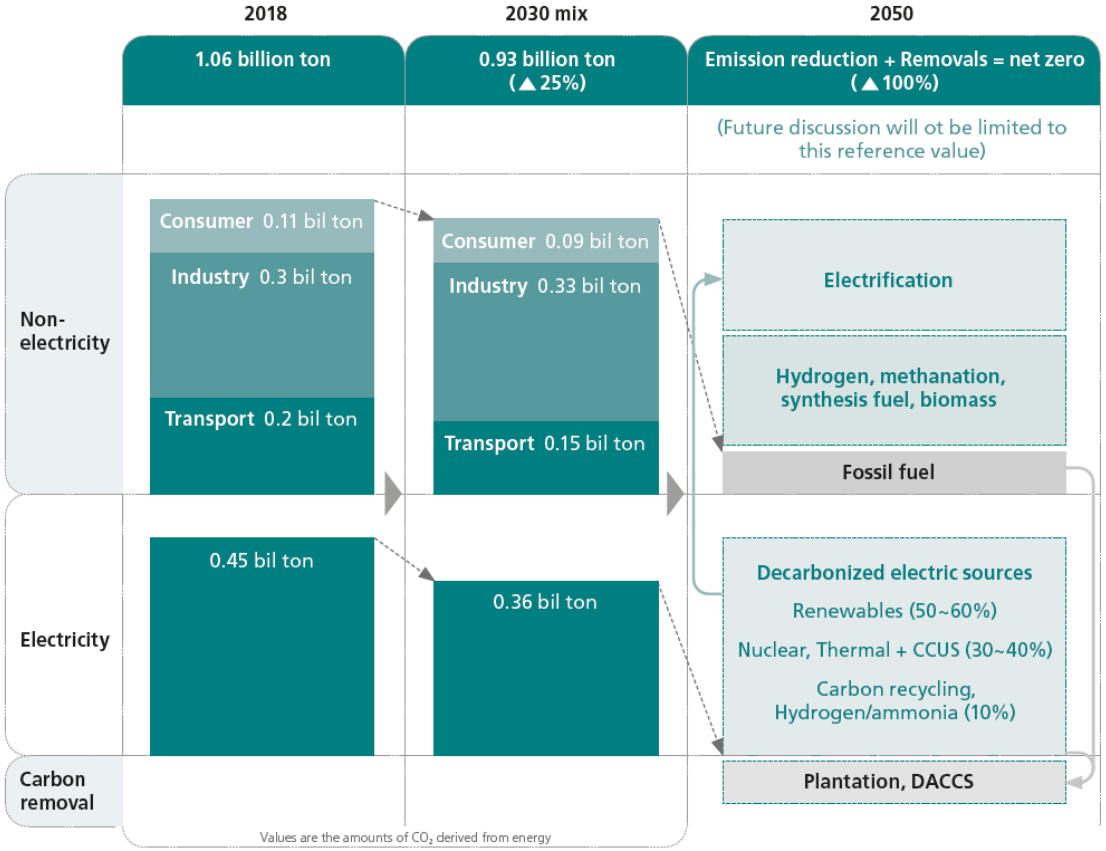


Source: Schulz (2022) - Zukunft Wasserstoff? ; based on Hystra (2021).



Source: Schulz (2022) - Zukunft Wasserstoff? ; based on IEA 2019, S. 82-83.

Wasserstoffwirtschaft – Zentraler Teil der 2050-Ziele

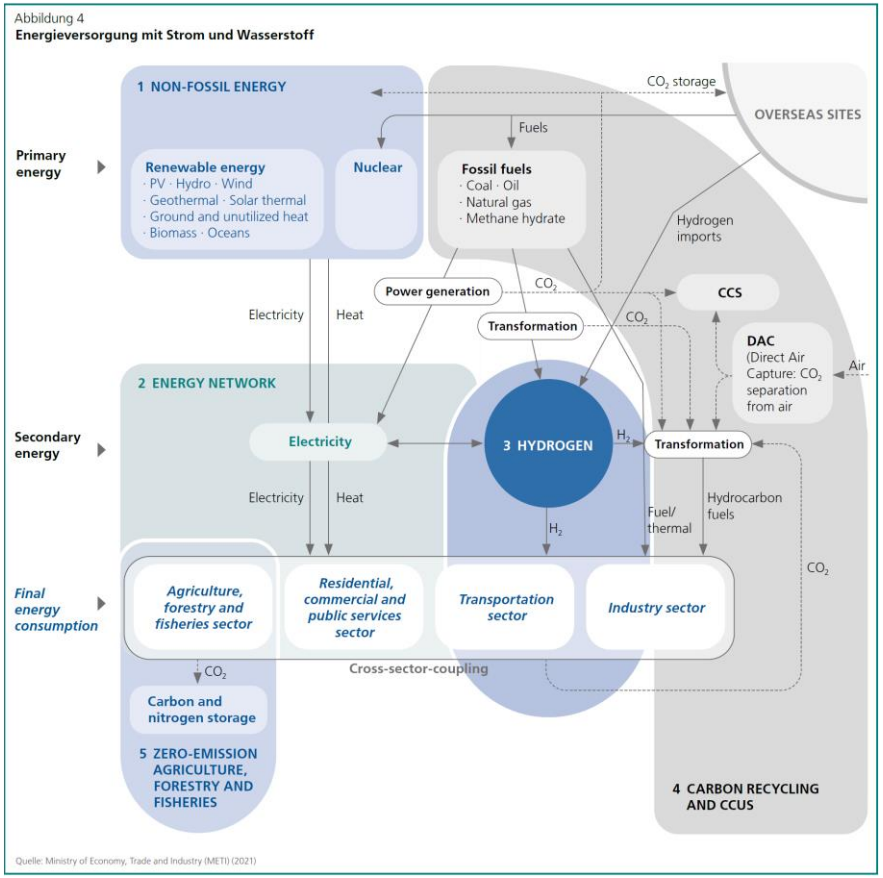


Japans „Green Growth“ Strategie

- Erneuerbare, Atom, Wasserstoff und CCUS
- **Wasserstoff**
  Nachfrage: 3/12/20MT (2030/40/50)
  Produktion: 2MT
- Electrolyser: 15GW (weltweit)
- Co-firing: Ammonia 20%

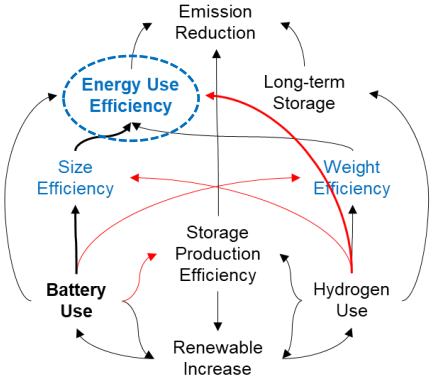
Source: Schulz (2022) - Zukunft Wasserstoff? ; based on METI (2019, 2023).

Wasserstoffwirtschaft – Der Verbraucher wird entscheiden

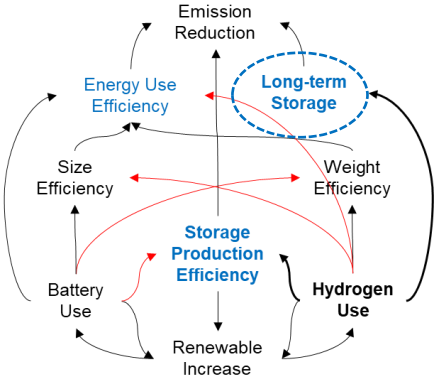


Source: Schulz (2022) - Zukunft Wasserstoff? ; based on METI (2019.

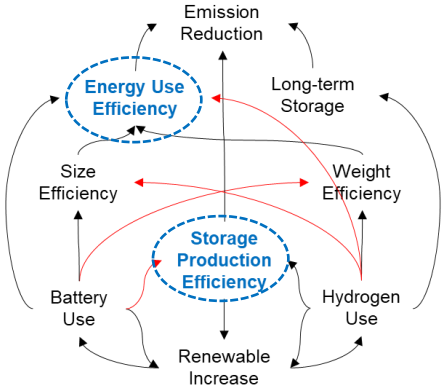
Verkehr / Mobilität



Energie / Netz / Schwerindustrie



Verarbeitende Industrie



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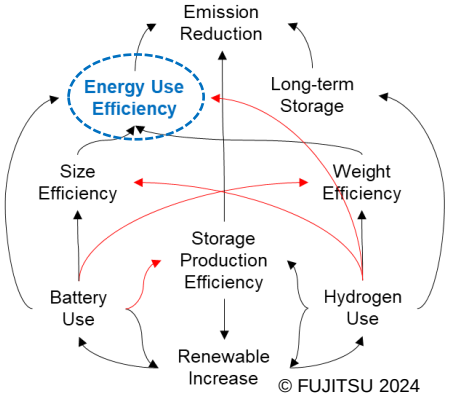
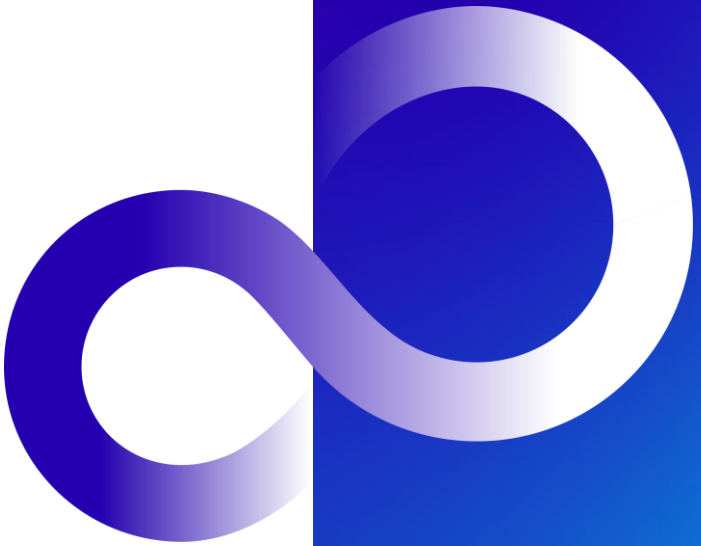


Thank you



If you have any questions relating to the content of this document, please get in touch:

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