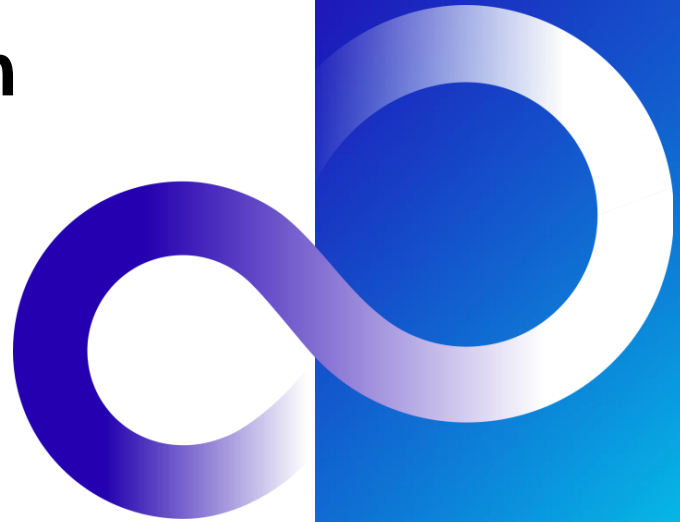


24. April 2024

FUJITSU

# Potenzial und Grenzen von Wasserstoff - Strategien in Japan -



Dr. Martin Schulz  
Chief Economist  
Fujitsu Ltd.

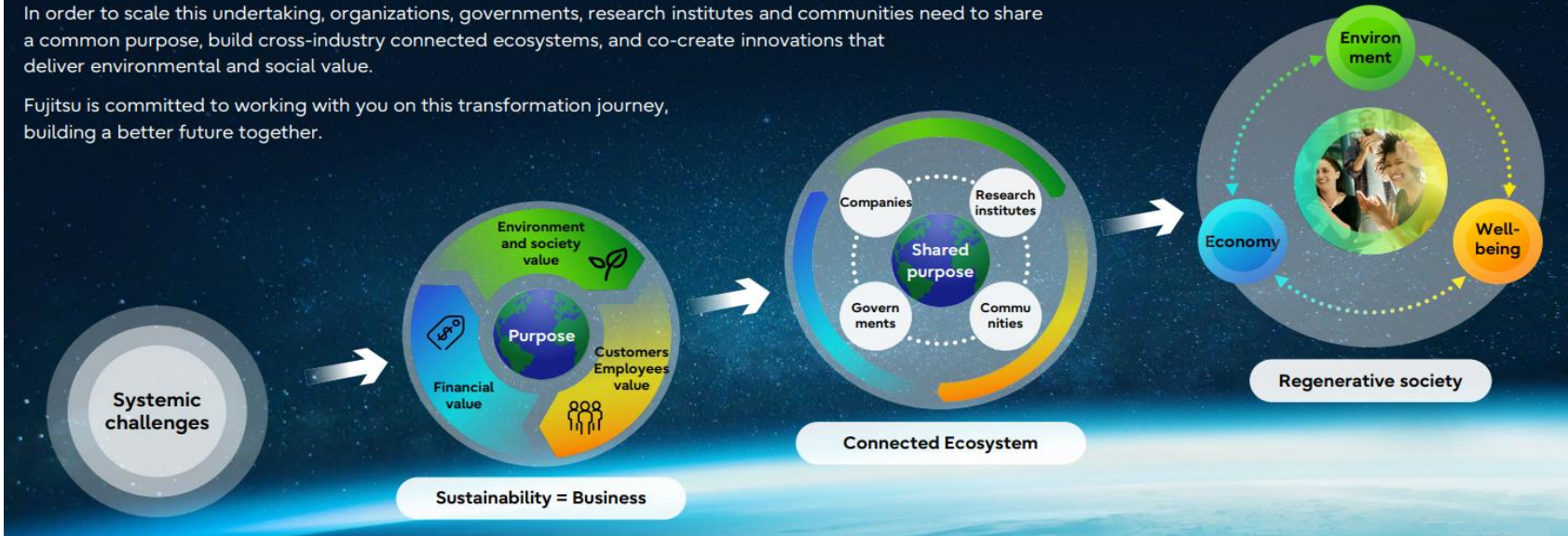
- Warum beschäftigt sich ein Volkswirt in einer IT-Firma mit Wasserstoff?

## Our journey to a regenerative society

Nobody can predict the future, but we can shape the future by imagining the kind of society we want to create. Because the challenges we face are complex and intertwined, it is not easy to realize a regenerative society. However, if all stakeholders proactively cooperate for common goals, and technology is used correctly, it can become a reality.

The first step is to identify issues that organizations need to address, and to integrate sustainability into business. In order to scale this undertaking, organizations, governments, research institutes and communities need to share a common purpose, build cross-industry connected ecosystems, and co-create innovations that deliver environmental and social value.

Fujitsu is committed to working with you on this transformation journey, building a better future together.



## Regulation

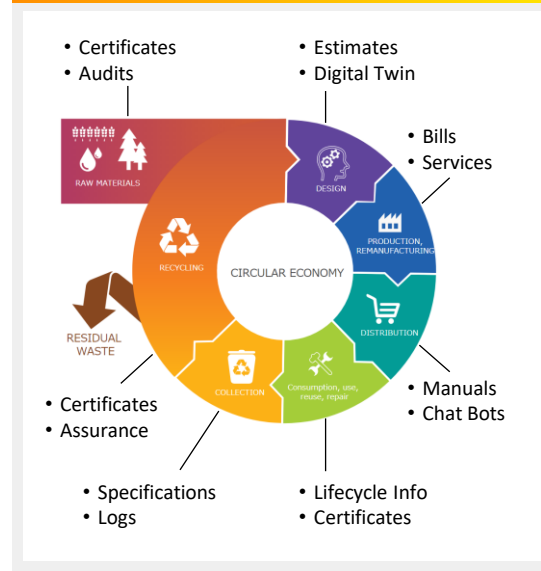
(Carbon Neutral)



**Carbon Accounting**  
(2024-)

## Data

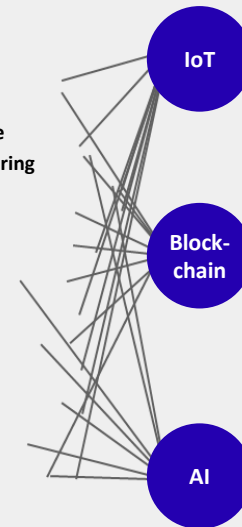
(Carbon Economy)



## Technologies

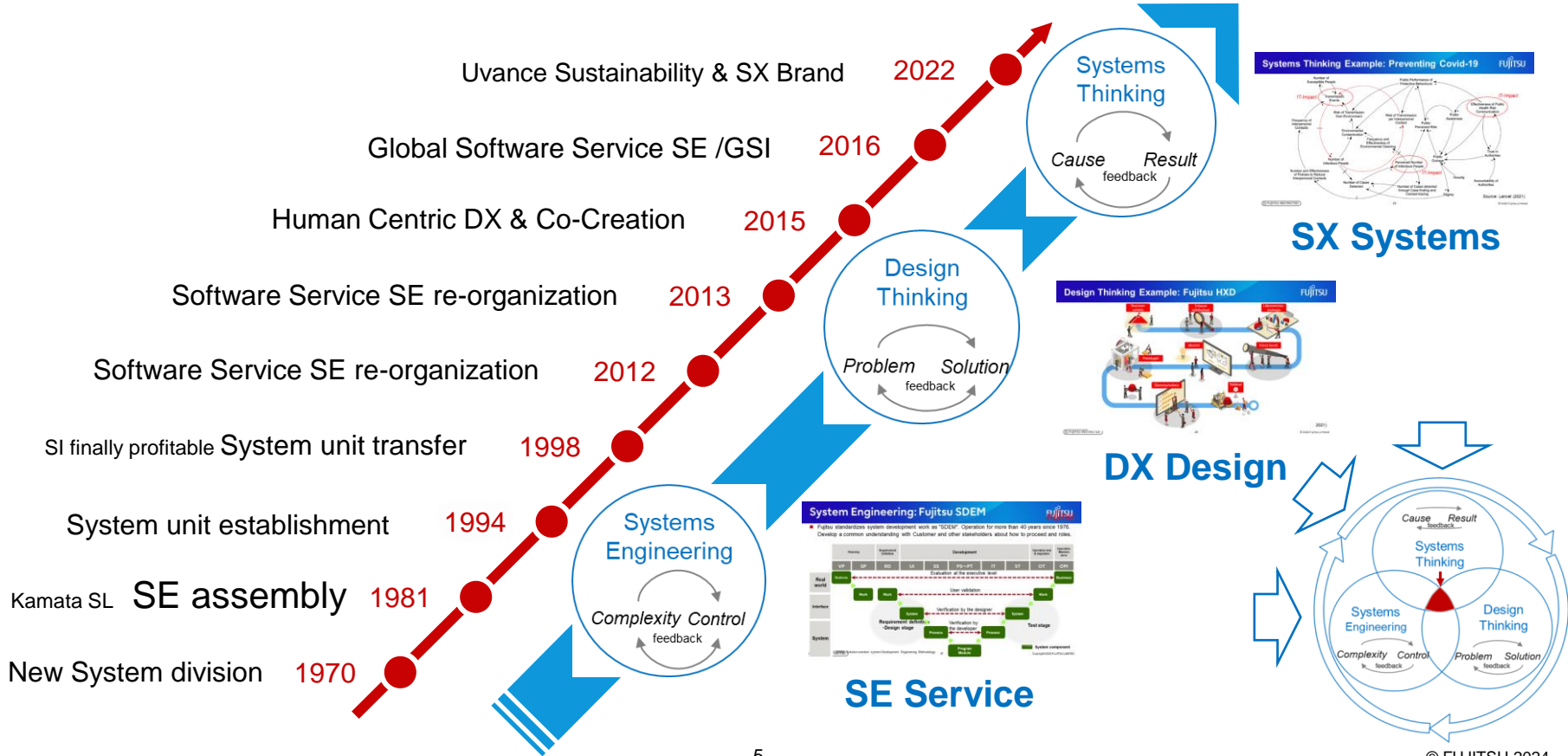
(Circular Economy)

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



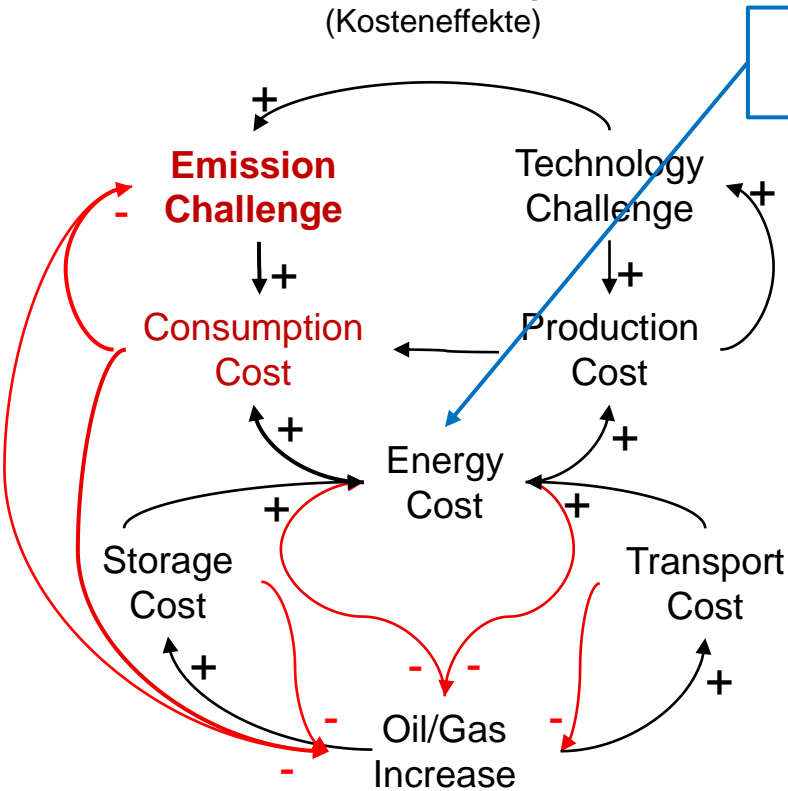
**“Circular Economy 2.0” builds on new ecosystems and technology integration**

# Fujitsu – “Systems Engineering” zu “Systems Thinking”

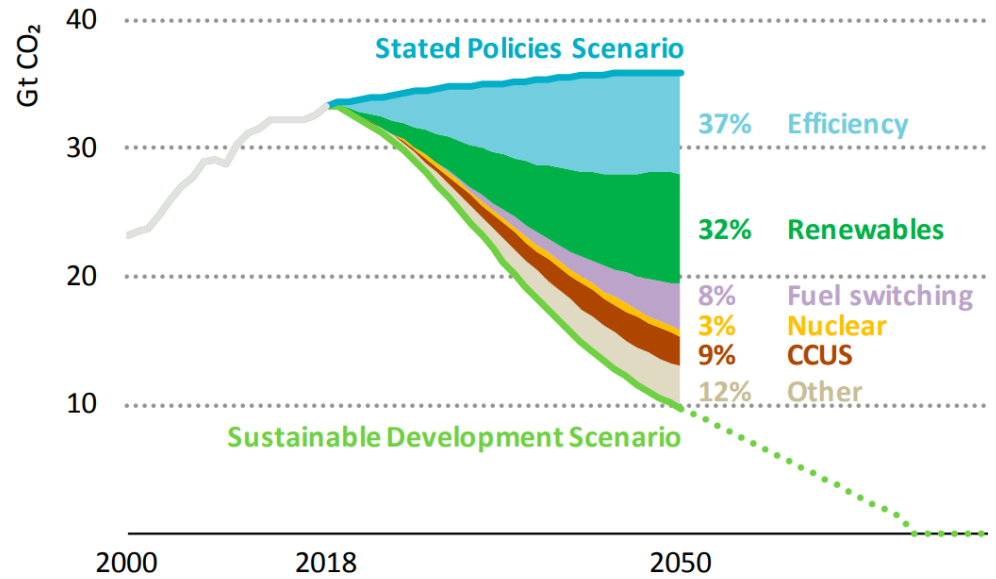


- Von fossilen zu erneuerbaren Energien

## Fossile Energie (Kosteneffekte)



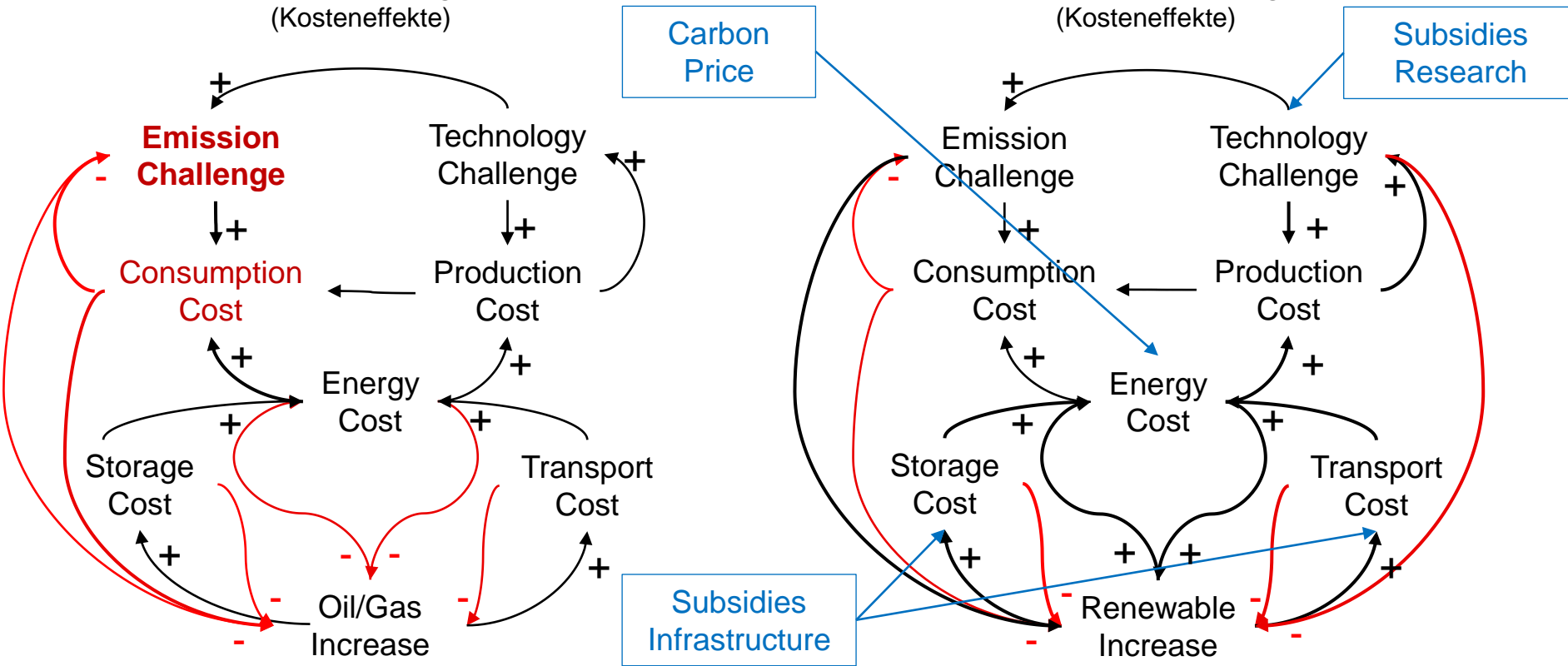
## Notwendige CO2 Reduktionsmaßnahmen



Source: IEA (2019) – World Energy Outlook.

## Fossile Energie (Kosteneffekte)

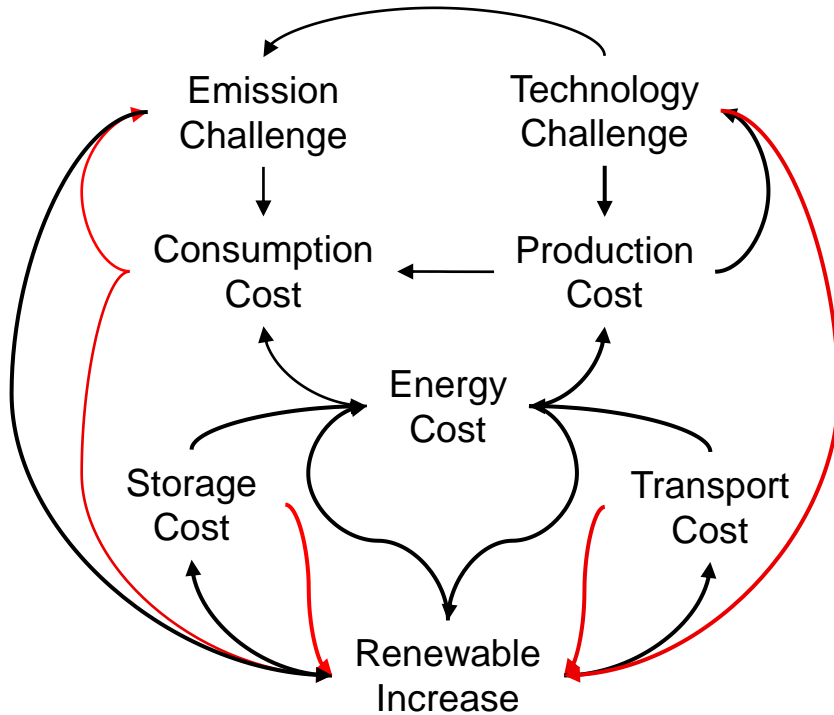
## Erneuerbare Energie (Kosteneffekte)



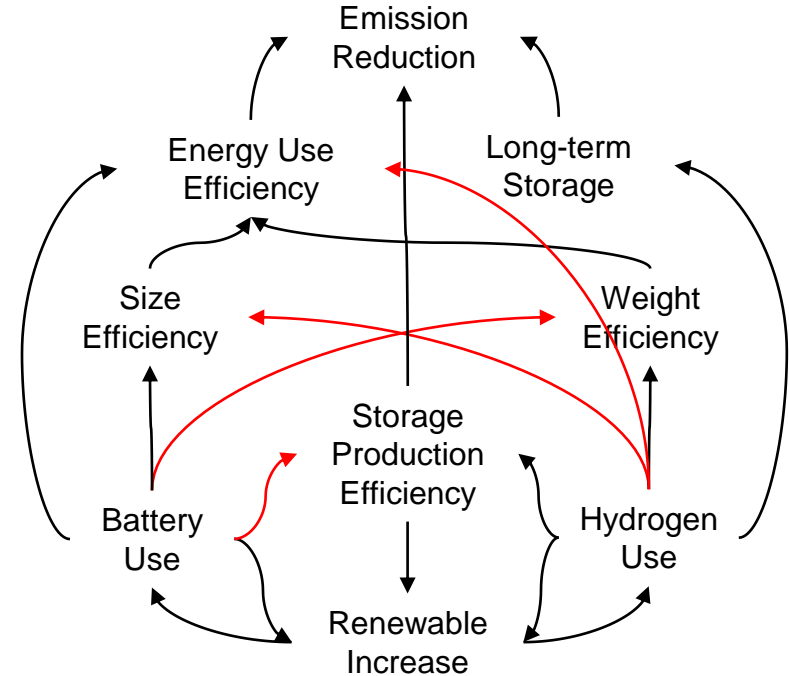


- Strom & Batterien oder Strom & Wasserstoff als Energieträger?

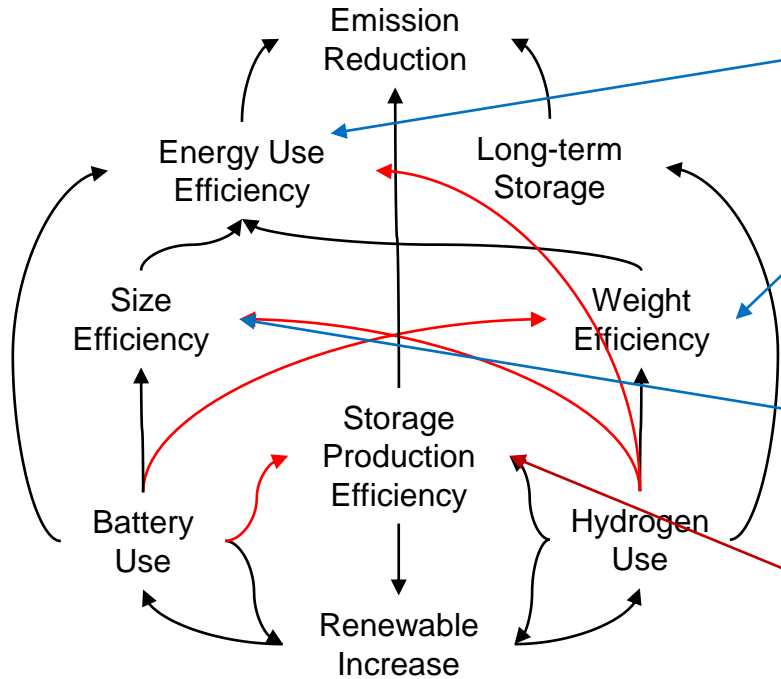
## Erneuerbare Energie (Kosteneffekte)



## Batterie vs Wasserstoff (Effizienz)



## Batterie vs Wasserstoff (Effizienz)



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

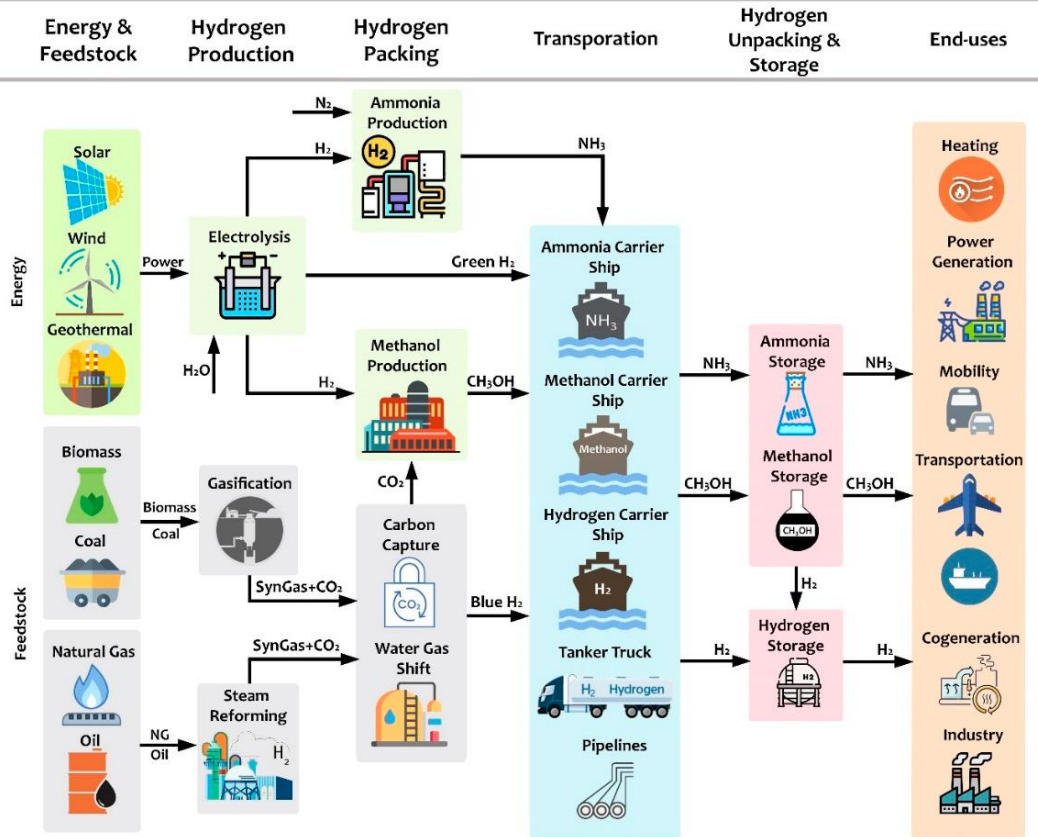
	130kW/500km Drive Train	400km Tesla/Mirai
EV:	326kg	2.3 tones
Bt:	152kg	1.9 tones

	Tesla 240 liter battery / Mirai 120 liter (240 liter size)
EV:	0.4 kWh/dm <sup>3</sup>
Bt:	96 kWh
H2:	0.7 kWh/dm <sup>3</sup>
	84 kWh

**Batterie Umweltlasten (Kobal, Nickel, Lithium...)**  
**Batterie Recycling noch ineffizient...**

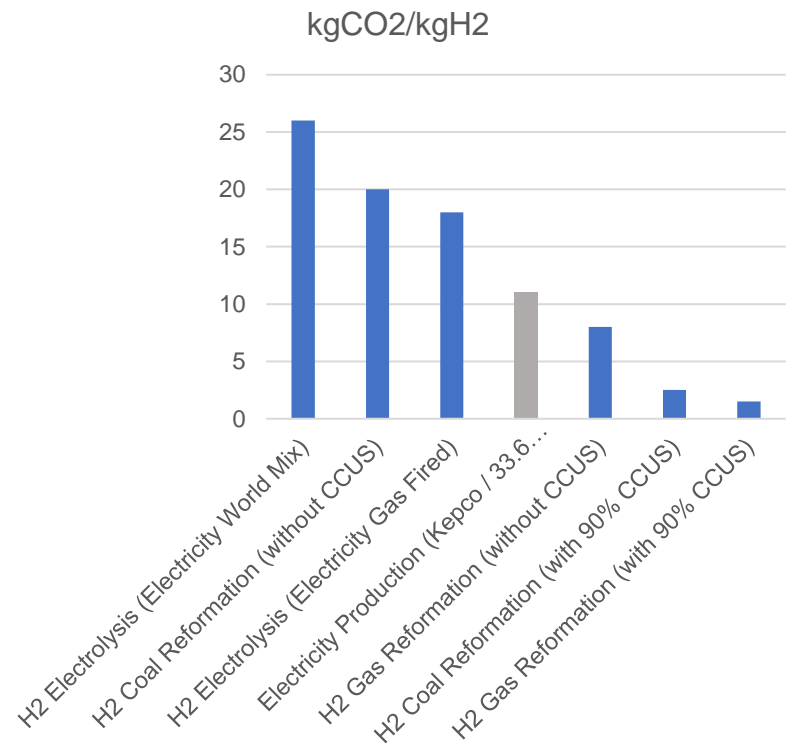
Source: Tsakiris (2019), Handwerker (2021)

# Wasserstoffwirtschaft – Effizienz bestimmt Nachhaltigkeit FUJITSU



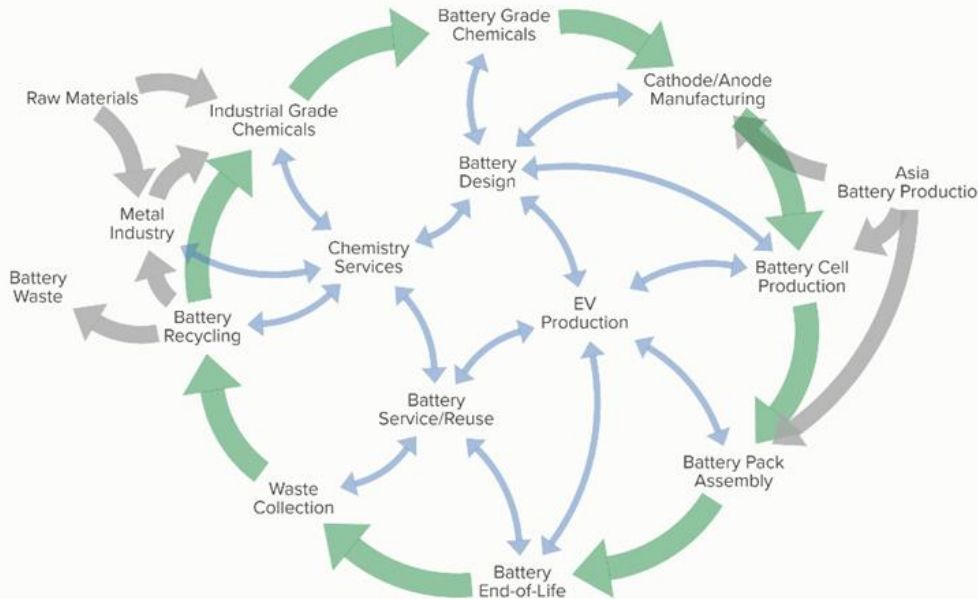
Quelle: (2024).

## CO<sub>2</sub>-Emissionen Wasserstoffproduktion



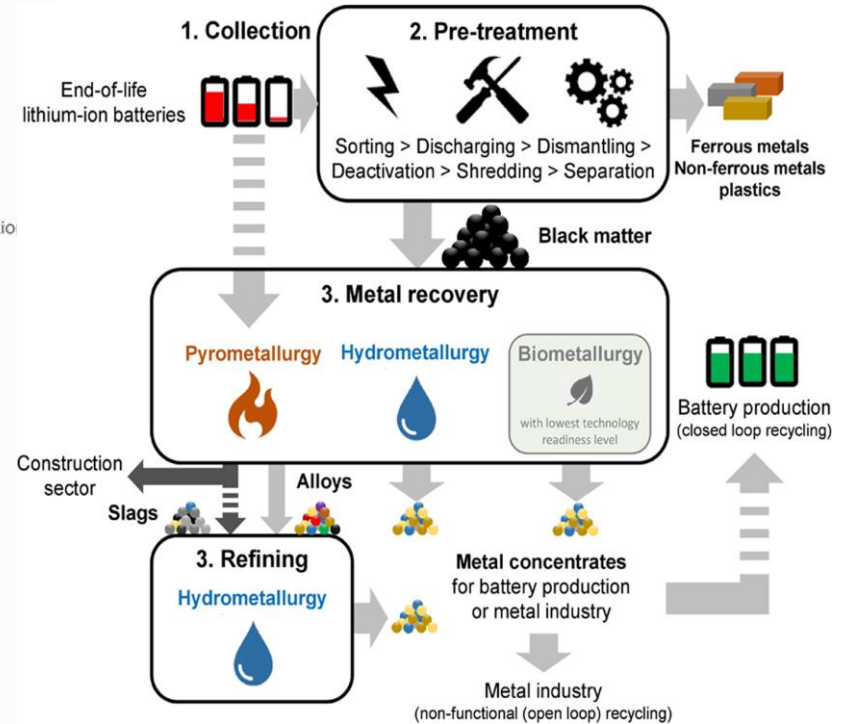
Source: IEA 2019; KEPCO 2020, S. 53.

## Batteriewirtschaft (Effizienz)



Source: Atsumi (2024).

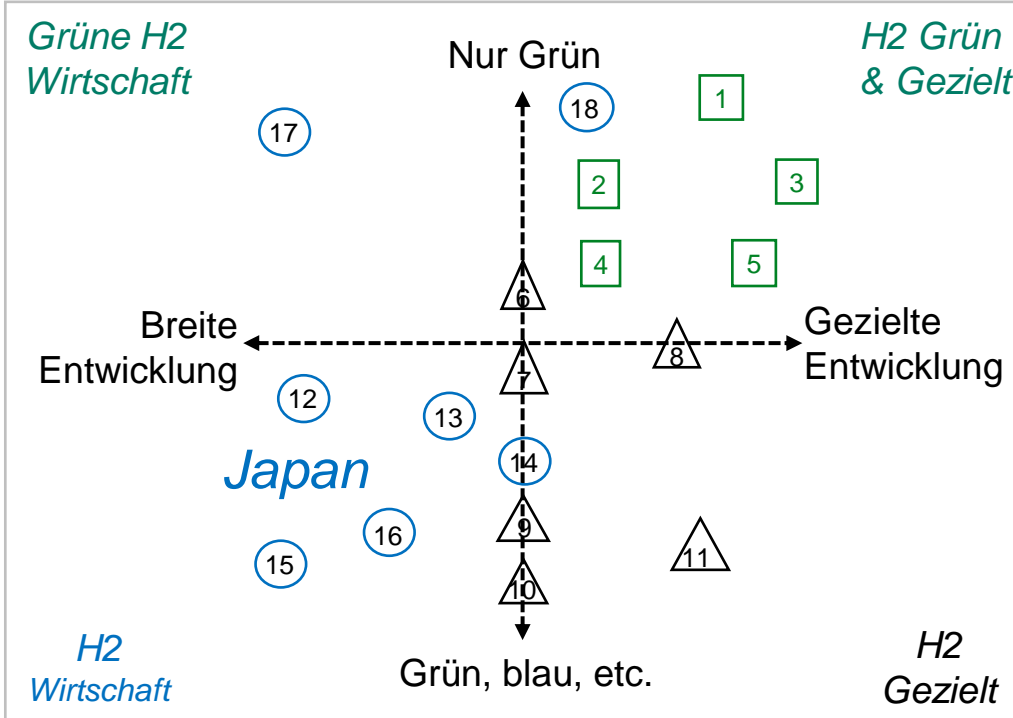
## Li-Ion Batterie-Recycling



Source: Windisch-Kern (2021).

## Wasserstoffziele in Deutschland & Japan

(Effizienz)



- Umweltorganisationen**
  - 1: DNR
  - 2: BUND
  - 3: WWF
  - 4: Deutsche Umwelthilfe
  - 5: Klima-Allianz
- Forschungsinstitute**
  - 6: Jülich
  - 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

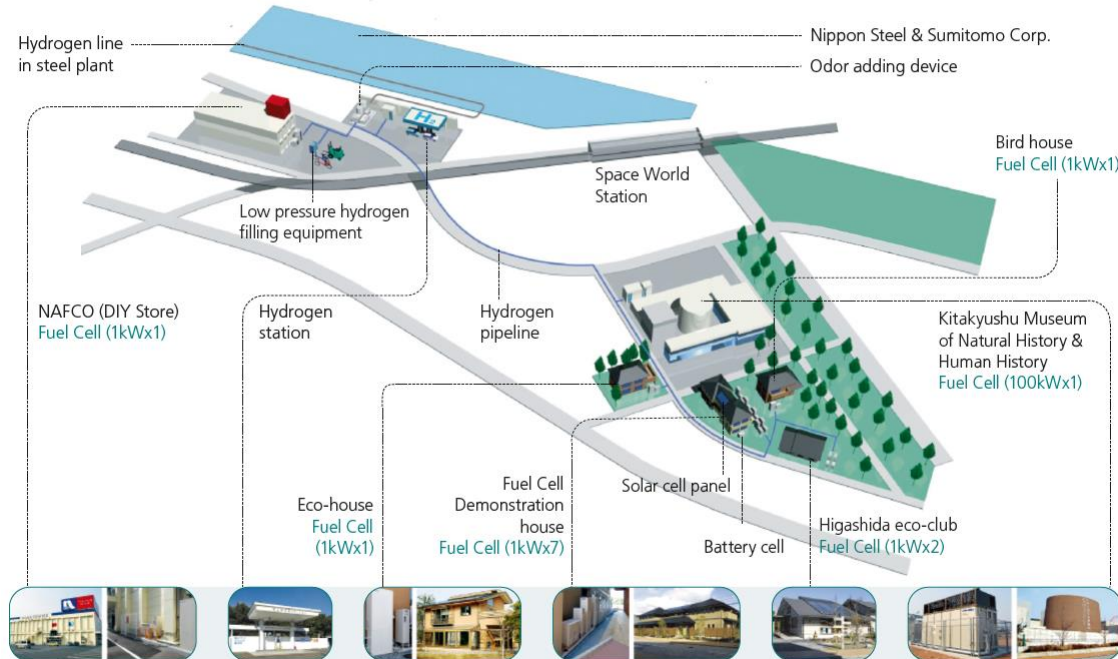
- Sony hat die Li-Ionen Batterie und Toyota hybride Antriebe entwickelt. Warum fokussiert Japan trotzdem so stark auf Wasserstoff?
  - **Konkurrenz mit Korea/China/Asien:** Batterieentwicklung ist relativ einfach zu kopieren, erfordert einen hohen Materialeinsatz und enge Zusammenarbeit mit der Elektronikindustrie.
  - **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](#)

- Von Projekten zur Strategie



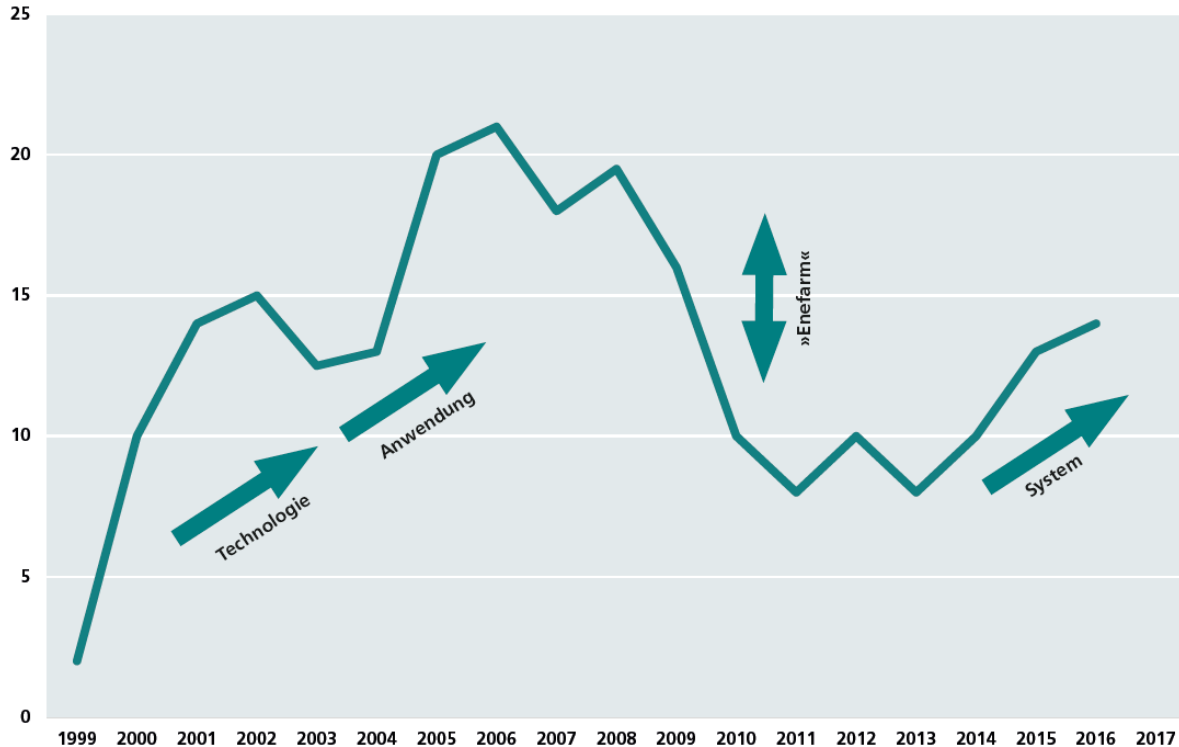
## HySut Kitakyushu Hydrogen Town (2011–2014)

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

## NEDO Hydrogen Budget (Milliarden Yen)



Quelle: Hikima et al. (2020)

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

# Wasserstoffwirtschaft – Drei Ebenen der Strategie

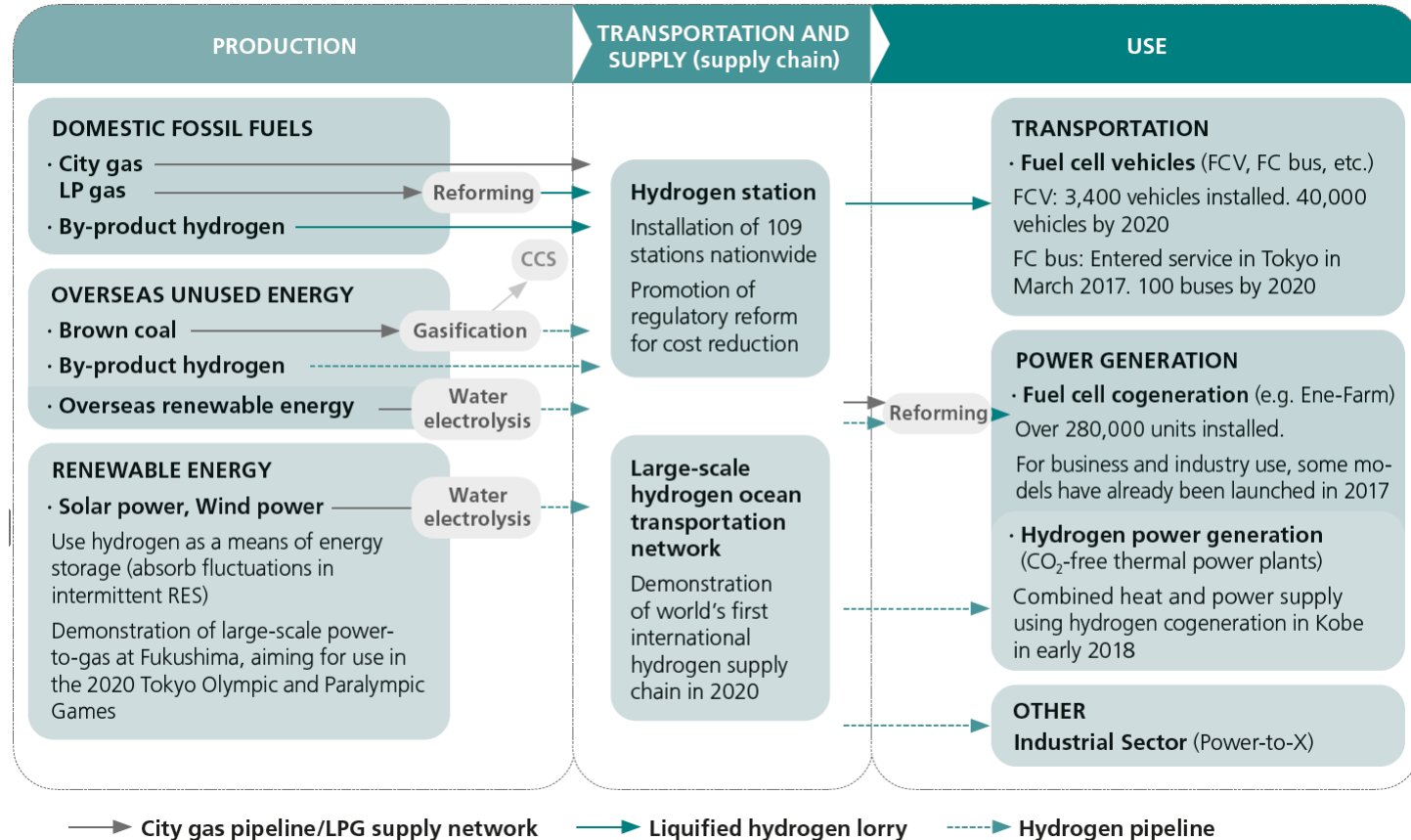
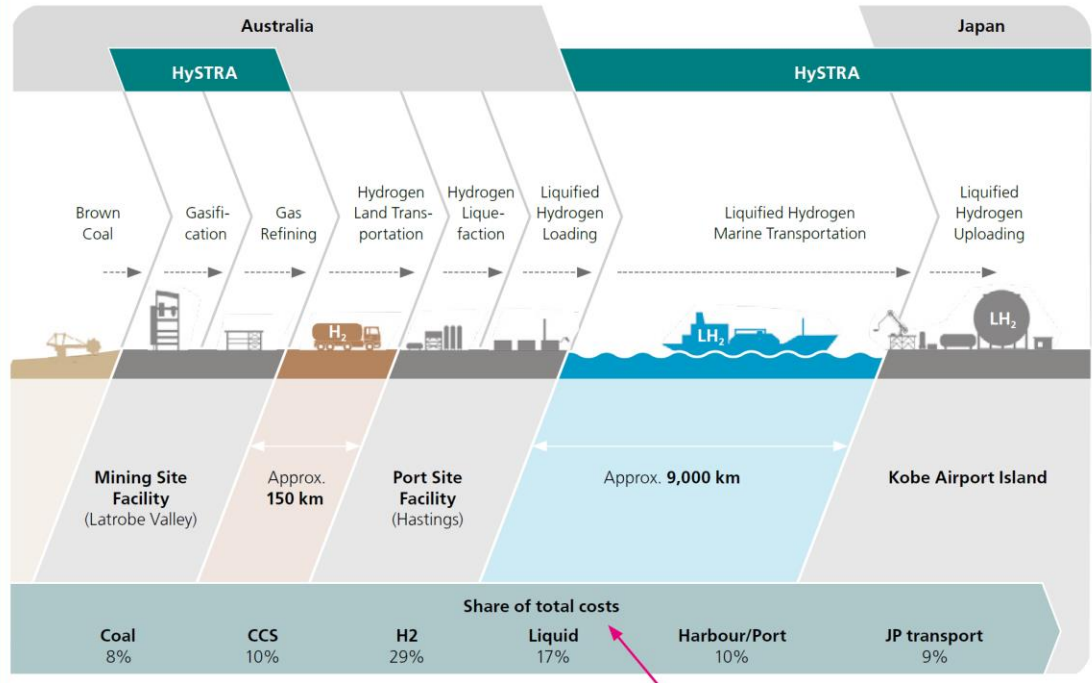
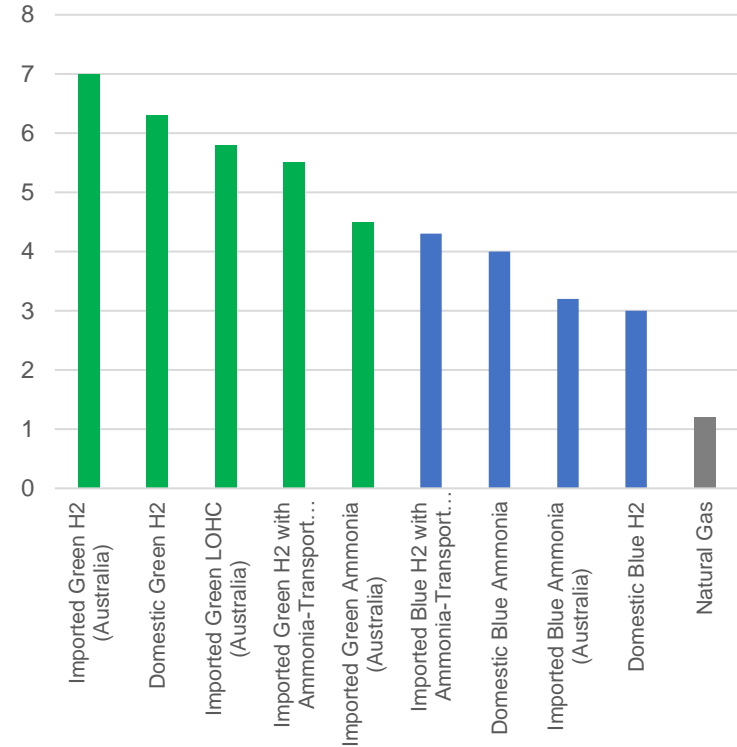


Abbildung 15  
HySTRA-Lieferkette und Kosten

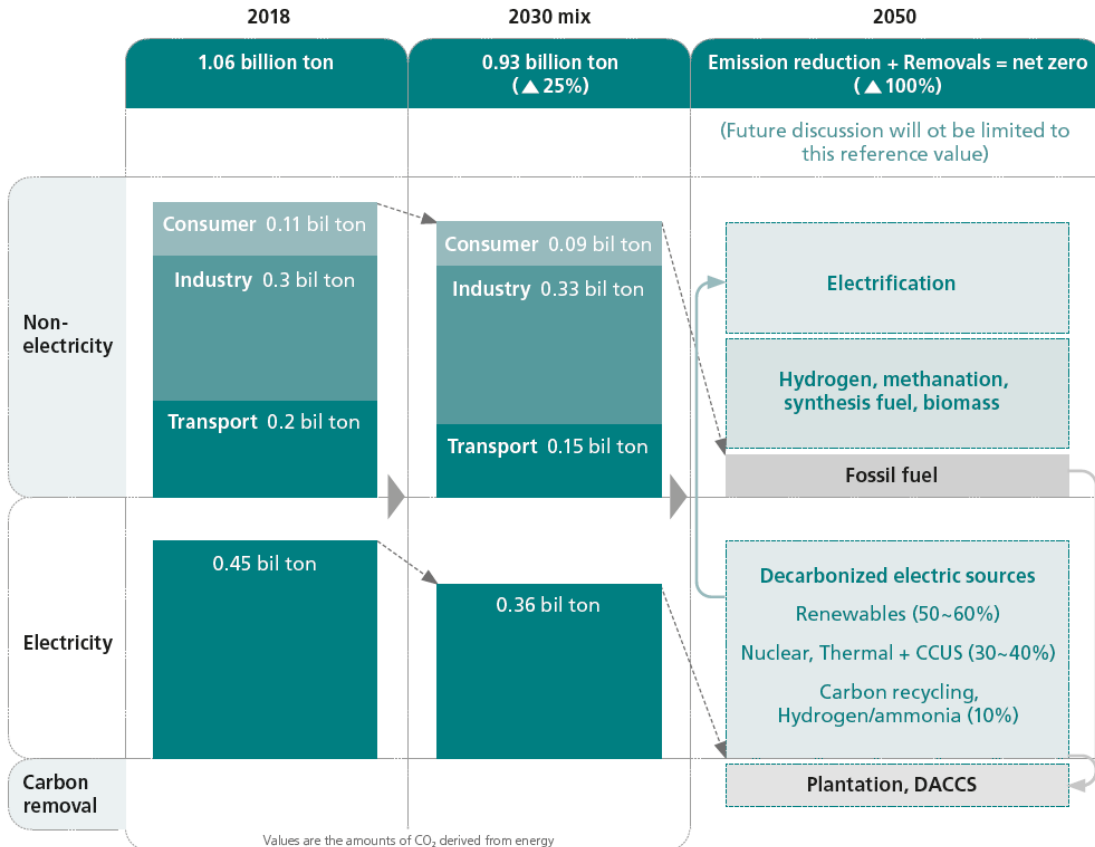


Quelle: Hystra (2021).

USD-kgH2



Quelle: IEA 2019, S. 82-83.



## Japans „Green Growth“ Strategie

- Erneuerbare, Atom, Wasserstoff und CCUS

30-50%  
Increase of  
electricity  
demand

### Wasserstoff

Nachfrage: 3/12/20MT (2030/40/50)

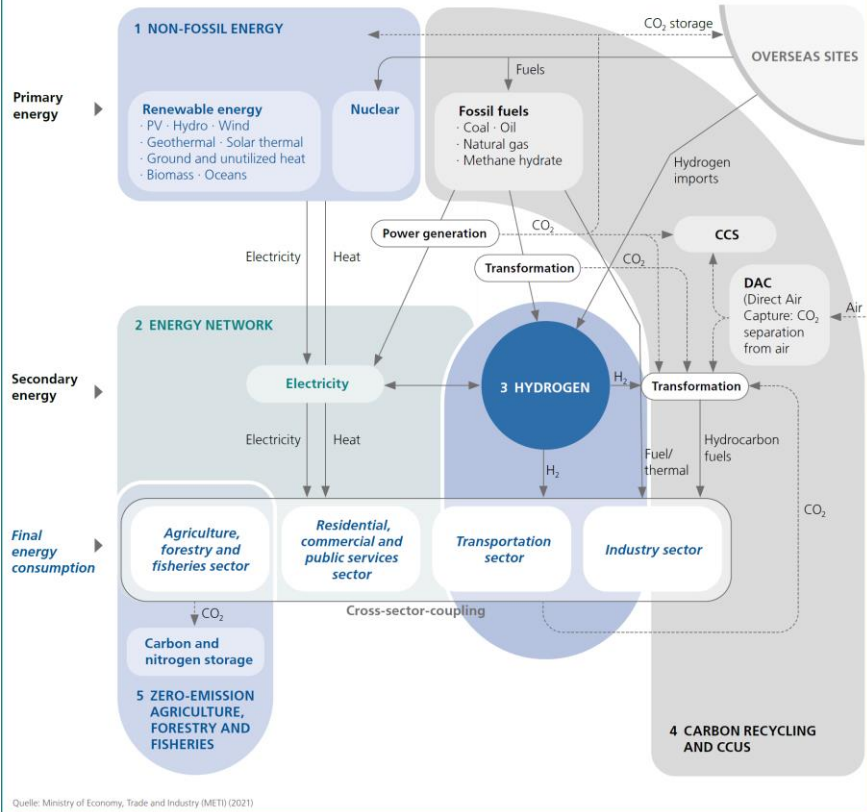
Produktion: 2MT

Maximum  
usage of CCUS

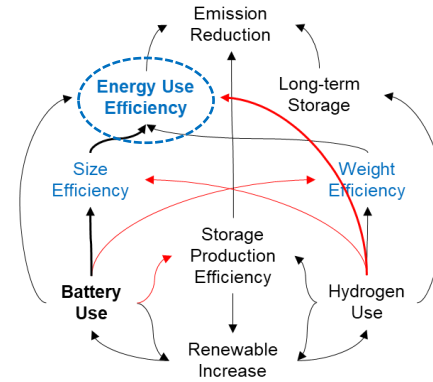
- Electrolyser: 15GW (weltweit)
- Co-firing: Ammonia 20%

# Wasserstoffwirtschaft – Der Verbraucher wird entscheiden FUJITSU

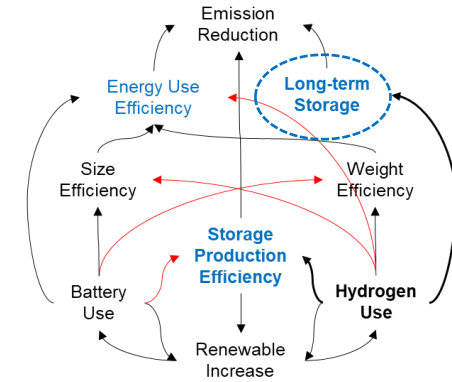
Abbildung 4  
Energieversorgung mit Strom und Wasserstoff



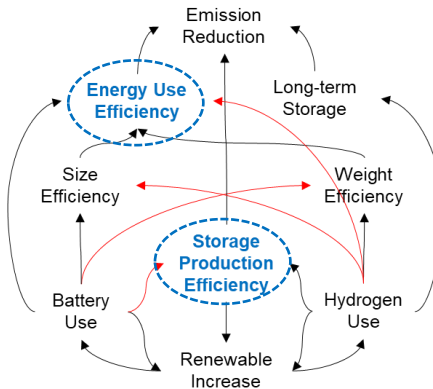
## Verkehr / Mobilität



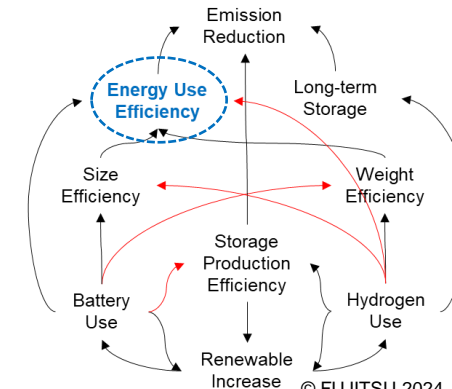
## Energie / Netz / Schwerindustrie



## Verarbeitende Industrie



## Haushalte



# Thank you

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

Dr. Martin Schulz

[schulz@fujitsu.com](mailto:schulz@fujitsu.com)

