

Winzerverein Deidesheim

25. Oktober 2024

Wasser – Stoff für das Klima

Die japanische Energiepolitik – Energiewende anders?

Japan als Vorbild?

Aufbruch in die „Wasserstoffgesellschaft“

Dipl.-Ing. Kurt K. Heinz
„TÜV emeritus“, Tokyo



FCCJ

The
Foreign Correspondents' Club
of Japan



*H*_{ein}²-*O*

Stiftung
Foundation
財団法人

hin zur Wasserstoffgesellschaft
towards the Hydrogen Society
水素社会へ



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Promis als Erntehelfer



Mit großem Spaß im »Paradiesgarten« dabei: (von links) Lina Ulrich aus Miami, die ehemalige deutsche Weinprinzessin Susanne Winterling-Eichberger, Spitzenturnerin Elisabeth Seitz und Wissenschaftler Kurt K. Heinz.

Foto: Mohn

Dekarbonisierung

oder:

Retten wir den Riesling durch Wasserstoff?



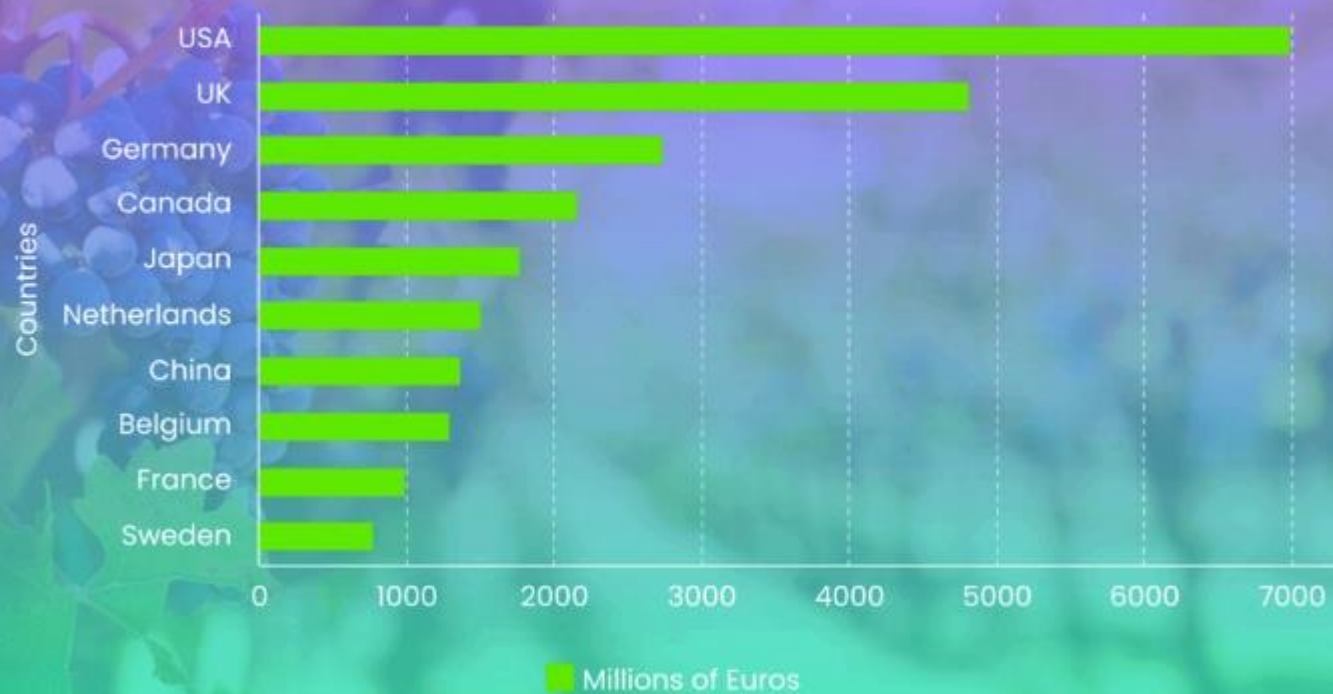
Weinregion Katsunuma
in Yamanashi-ken



Die Trauben hängen hoch

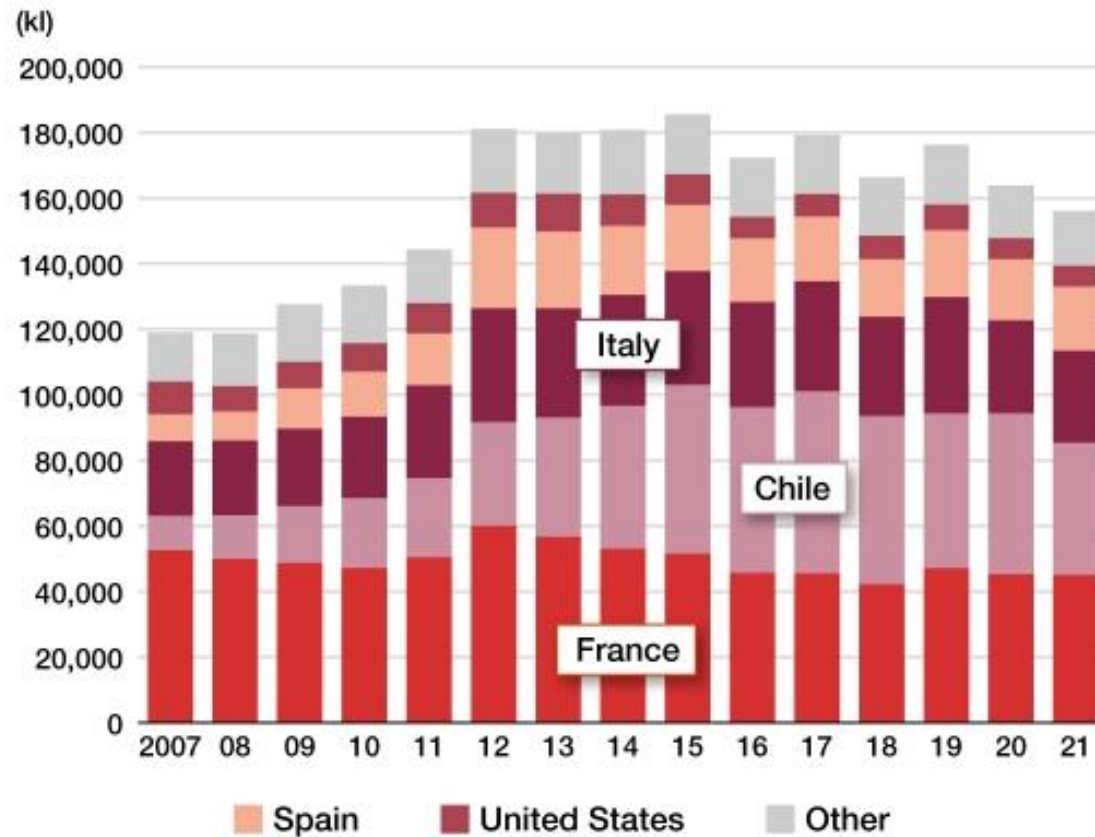
Largest Wine-importing Countries (2022)

vinaty



SOURCE: OIV

Japan's Imports of Still Wine



Created by *Nippon.com* based on data from the Ministry of Finance's Customs and Tariff Bureau.



März 2008: Morioka in Iwate-ken mit Präfekt Tasso



News

In Japan, everyone wants to become a sommelier

Mar 18 2024, 12:19

Anfang der 2000er Jahre gab es in Japan rund 7.000 zertifizierte Sommeliers.

Im Jahr 2023 verzeichnet die Japan Sommelier Association (JSA) knapp 40.000 akkreditierte Sommelier-Spezialisten.

Zitat: Wenn wir an Wein und Japan denken, denken wir oft an „Drops of God“.

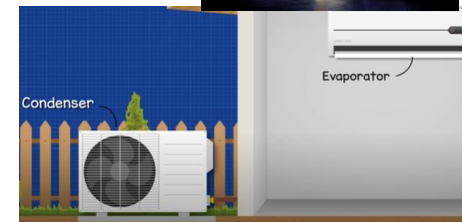


Warum und wieso hat Deutschland Japan nicht im Blick?

oder

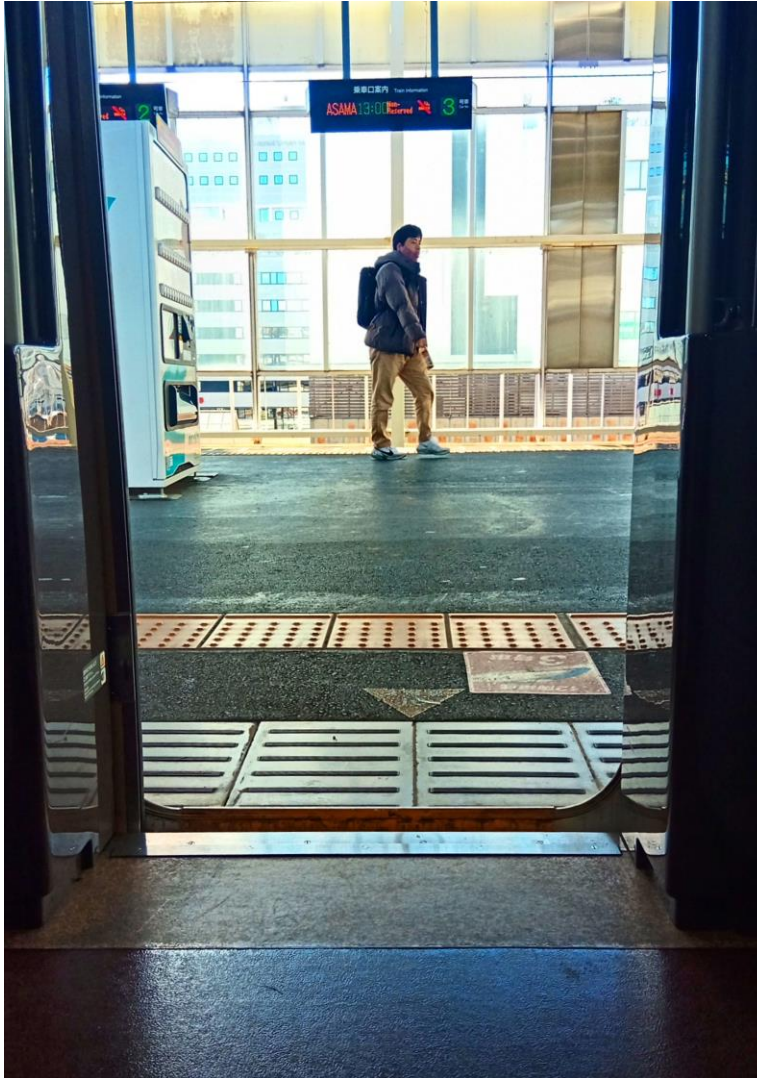
Warum nicht vom Meister lernen?

- **Dritt- bzw. viertgrößte Industrienation - Benchmarking?**
- **Großes und vorbildlich funktionierendes Eisenbahnwesen**
- **Maglev Zugsystem (603km/h) in Realisierung Transrapid???**
- **Klimaanlagen, sprich „Wärmepumpen“, überall**
- **2017: Proklamation „Wasserstoffgesellschaft“**





Shinkansen: Barrierefreies Einsteigen in alle Züge



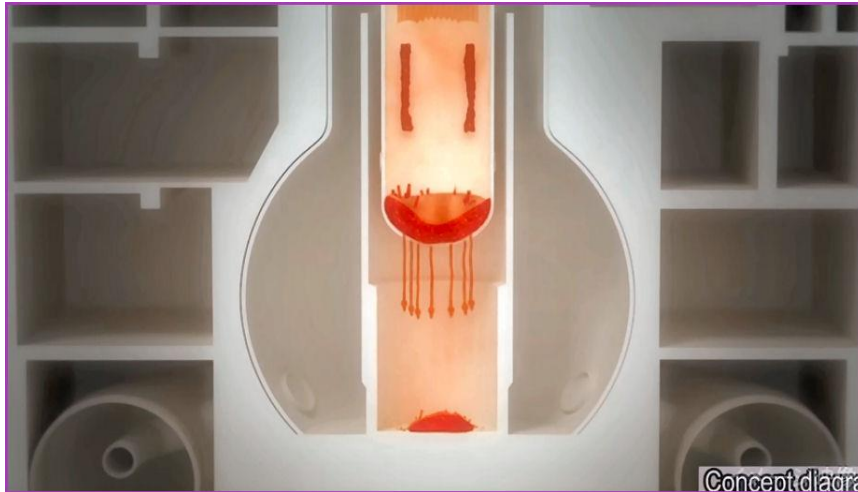
想定外

sō tei gai

das Denken – permanent - außerhalb

unvorstellbar

Die japanische Energiepolitik - Ist Wasserstoff die Lösung?



Geschmolzene Träume *oder* **Albtraum für 200 Jahre?**

- Aufräumarbeiten im havarierten Atomkraftwerk
- Export von AKWs gescheitert



Wasserstoff-Gesellschaft **Hydrogen Society**

- METI Programm
- Aktueller Stand der Energiewende in Japan

1000 riesige Wassertanks



Fukushima Daiichi, Juni 2018



Riesige Mengen von Mutterboden wurden entfernt. Dem Boden wurde Kalium zugesetzt, um das radioaktive Cäsium zu verdrängen und zu verhindern, dass es über die Wurzeln in die Pflanzen gelangt.

Quelle: [The Washington Post](#), Simon Denyer, 20. February 2019

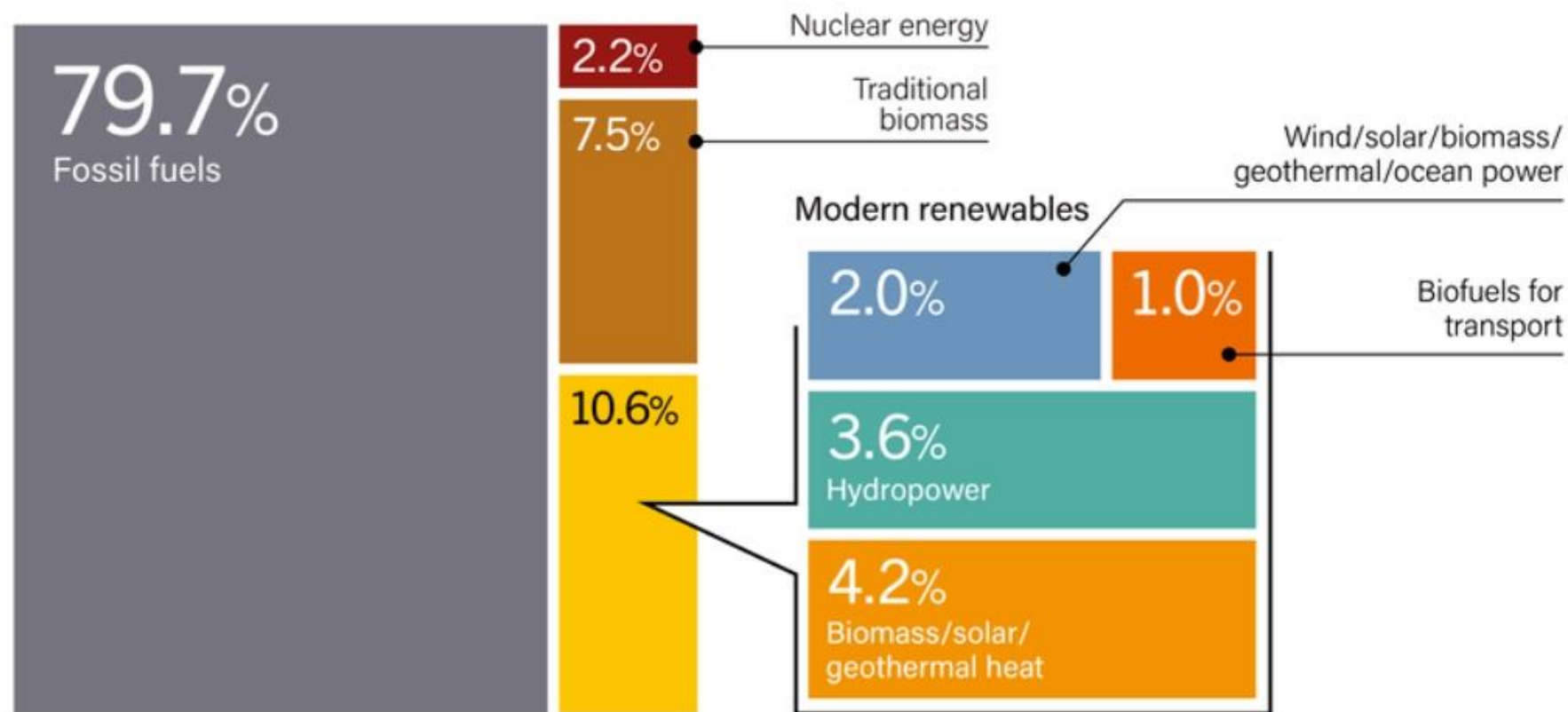
Japan's aging nuclear power infrastructure

(reactors used for at least 30 years)

	REACTOR (PREFECTURE)	POWER OUTPUT (IN MILLIONS OF KILOWATTS)	YEARS OF USE
Kansai Electric Power	Oi No. 1 (Fukui) → To be scrapped	1.18	38
	Oi No. 2 → To be scrapped	1.18	37
	Takahama No. 1 (Fukui) → Life to be prolonged	0.83	42
	Takahama No. 2 → Life to be prolonged	0.83	41
	Takahama No. 3	0.87	32
	Takahama No. 4	0.87	32
	Mihama No. 3 (Fukui) → Life to be prolonged	0.83	40
Other utilities	Japan Atomic Power Tokai No. 2 (Ibaraki)	1.10	38
	Kyushu Electric Power Genkai No. 2 (Saga)	0.56	36
	Shikoku Electric Power Ikata No. 2 (Ehime)	0.57	35
	Tokyo Electric Power Fukushima Daini No. 1 (Fukushima)	1.10	35
	Tokyo Electric Power Fukushima Daini No. 2	1.10	33
	Tohoku Electric Power Onagawa No. 1 (Miyagi)	0.52	33
	Kyushu Electric Power Sendai No. 1 (Kagoshima)	0.89	33
	Tokyo Electric Power Fukushima Daini No. 3	1.10	32
	Tokyo Electric Power Kashiwazaki-Kariwa No. 1 (Niigata)	1.10	32
	Kyushu Electric Power Sendai No. 2	0.89	31
	Japan Atomic Power Tsuruga No. 2 (Fukui)	1.16	30
	Tokyo Electric Power Fukushima Daini No. 4	1.10	30
	Chubu Electric Power Hamaoka No. 3 (Shizuoka)	1.10	30

Stand Okt. 2017

Estimated Renewable Share of Total Final Energy Consumption, 2017



Note: Data should not be compared with previous years because of revisions due to improved or adjusted data or methodology. Totals may not add up due to rounding.

Source: Based on OECD/IEA and IEA SHC.

(1000kg Wasserstoff ~ 33,33MWh Energie)

H₂ Bedarf

12Mio. Tonnen ~ 400TWh Japan 2040
1200TWh EU + GB 2040

H₂ in Deutschland:

Planung 2022:	100 – 200TWh	2040
neu seit 25. Juli 2023:	95 – 130 TWh	2030
	400 – 500TWh	2045

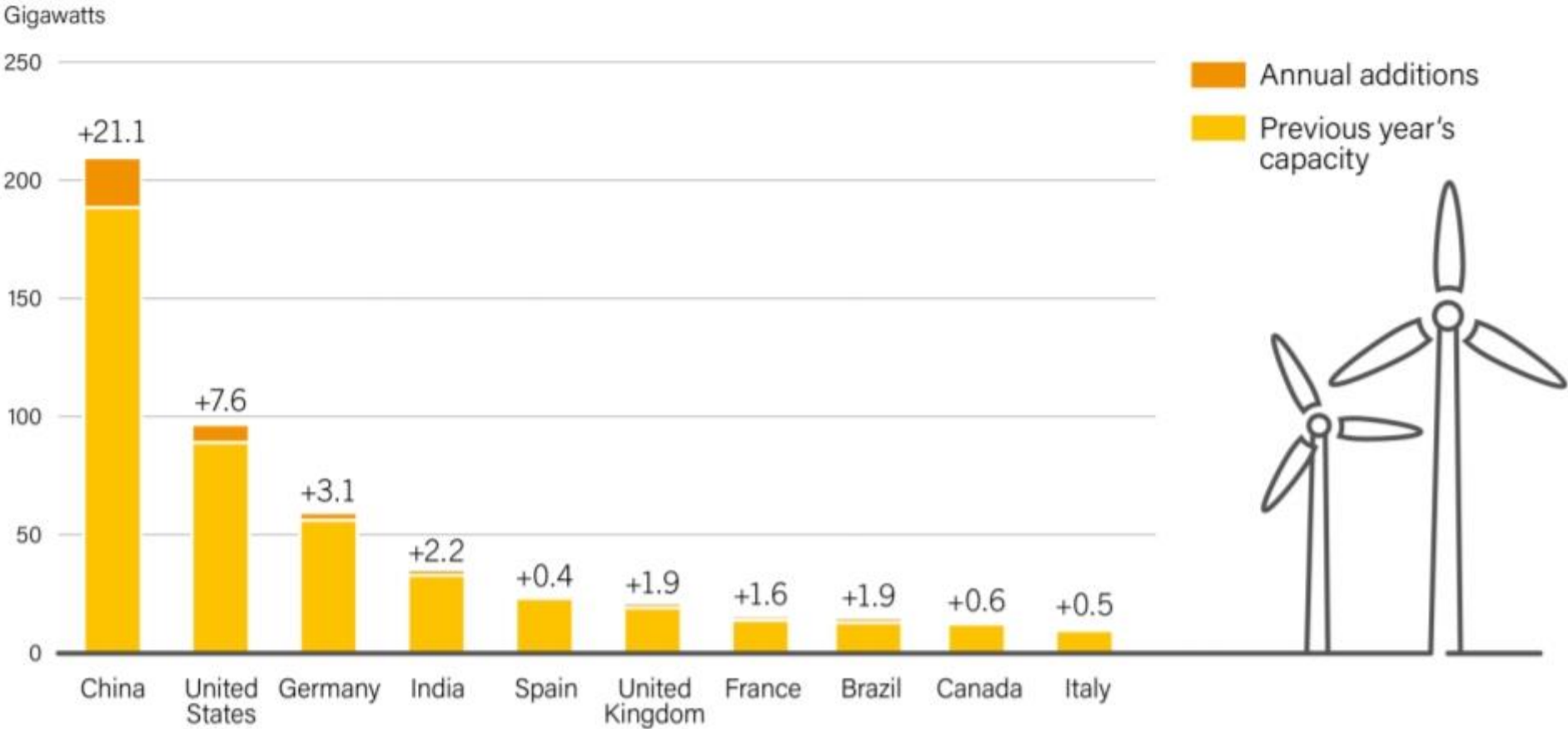
Primärenergieverbrauch 2020

(**Peta** (P) Präfix für 1 Billiarde = 1.000.000.000.000.000 = 10¹⁵)

Welt:	160PWh	
Deutschland:	3,5PWh	(2,2% Weltverbrauch)
Japan:	4,7PWh	(2,9% Weltverbrauch)

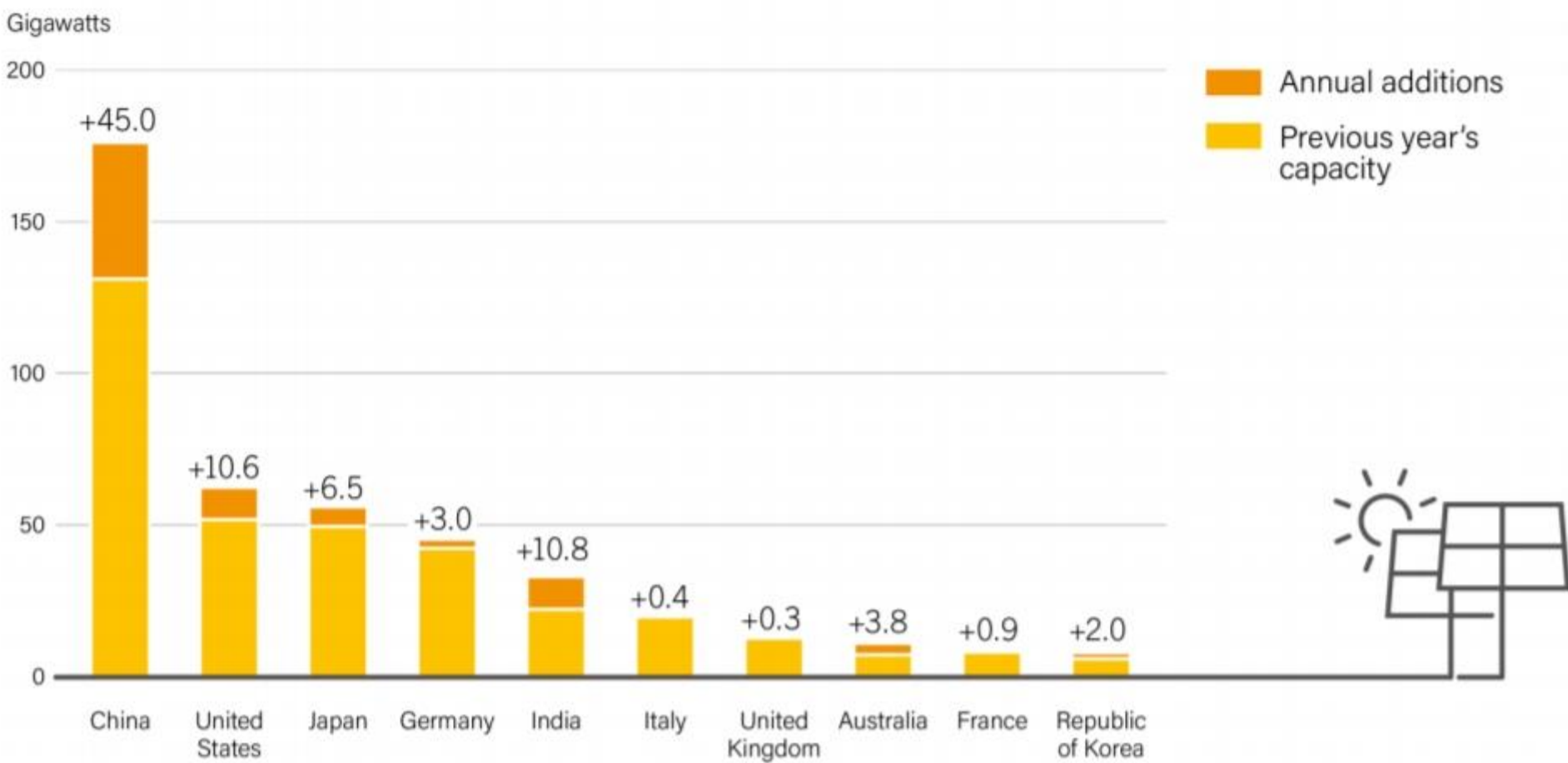
Elektroenergieverbrauch D in 2021: 0,49PWh (15%)

Wind Power Capacity and Additions, Top 10 Countries, 2018



Note: Additions are net of decommissioning.

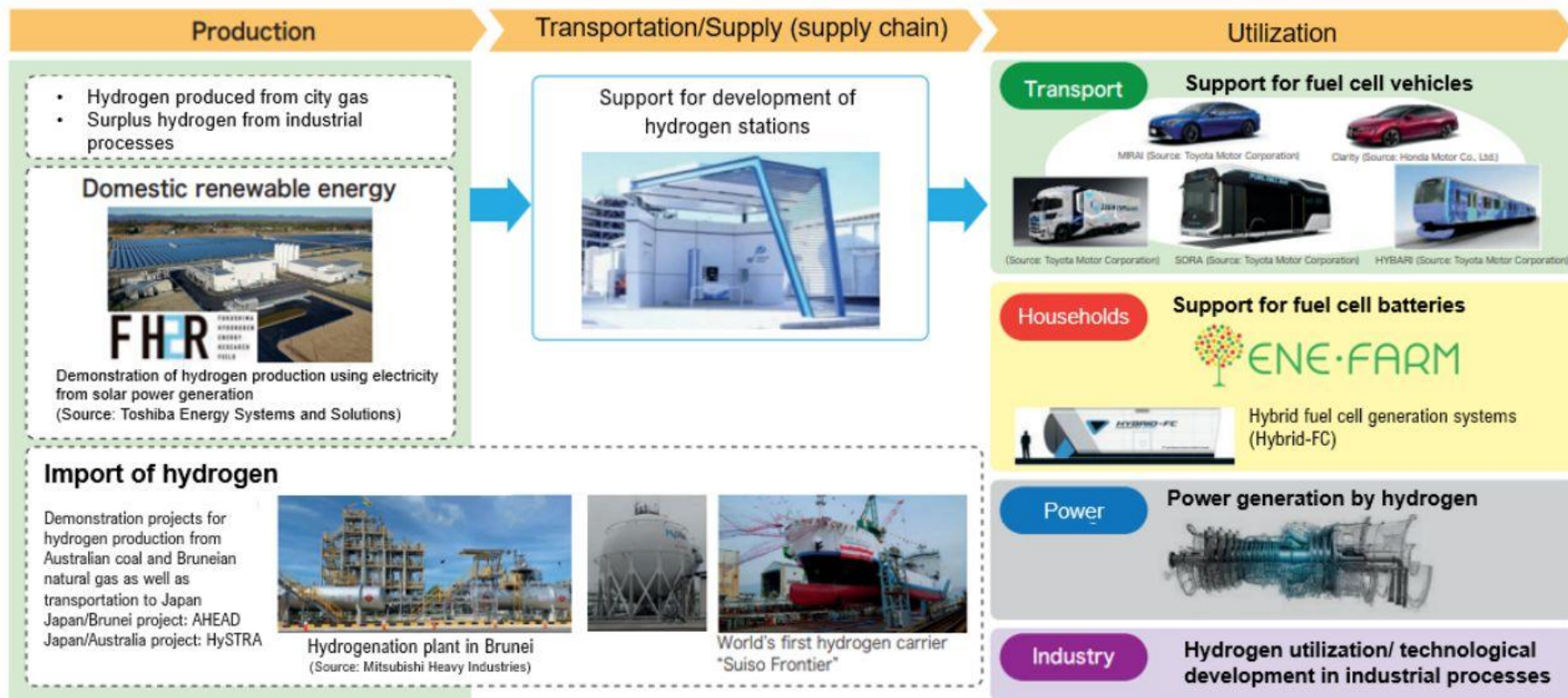
Solar PV Capacity and Additions, Top 10 Countries, 2018



Note: Data are provided in direct current (DC).
Data for India are highly uncertain.

METI: Efforts toward realizing a hydrogen-based society „Wasserstoffgesellschaft“

Status 2020



https://www.enecho.meti.go.jp/en/category/special/article/detail_172.html



Mission/ Background

● Japan's Responsibility for Energy Transition

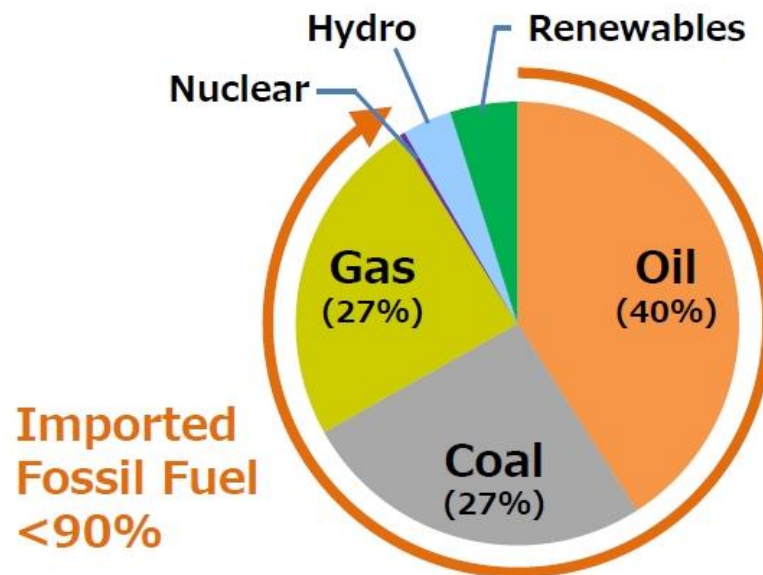
⇔ Energy trilemma

- ✓ **E**nergy security
 - ✓ **E**nvironment (Sustainability)
 - ✓ **E**conomic affordability (Cost)
- } **3"E" + Safety**

● Measures;

- ✓ Energy saving
- ✓ Renewable energy
- ✓ Nuclear energy
- ✓ CCS + Fossil fuels
- ✓ **Hydrogen**

Japan's Primary Energy (FY2016)



Direction of Activities to Realize a “Hydrogen Society”

Production

Transportation and supply (supply chain)

Use

Domestic fossil fuels

City gas
LP gas

Reforming

Byproduct
hydrogen

Future

Overseas unused energy

Brown coal

Gasification

CCS

Byproduct
hydrogen

Overseas
renewable energy

Water
electrolysis

Renewable energy

Solar power

Water
electrolysis

Wind power

*Use hydrogen as a means of energy storage (absorb fluctuations in intermittent RES)

— City gas pipeline/LPG supply network —
— Liquefied hydrogen lorry —
... Hydrogen pipeline ...

- Installation of 113 stations nationwide
- Promotion of regulatory reform for cost reduction



Hydrogen station

- Demonstration of the world's first international hydrogen supply chain in 2020

Large-scale hydrogen ocean Transportation network



- Demonstration of large-scale power-to-gas @Fukushima/aiming for use in the 2020 Tokyo Olympic and Paralympic Games

- 2,900 vehicles installed
- 40,000 vehicles by 2020

Fuel cell vehicles
(FCV, FC bus, etc.)



- Entered service in Tokyo in March 2017
- 100 buses by 2020

Transportation

- Over 270,000 units installed

Fuel cell cogeneration
(e.g. Ene-Farm)

Reforming



- For Business and Industry use, some models have already been launched in 2017

Power generation

Future

Hydrogen power generation
(CO₂-free thermal power plants)



- Combined heat and power supply using hydrogen cogeneration in Kobe in early 2018

Use in the industrial sector
(Power-to-X)

Other

Ongoing Projects (Supply-side)

International H₂ Supply Chain

Japan-Brunai Pilot Project

2020~ **AHEAD**

Off-gas



Steam Methane Reforming



Hydrogenation*
(TOL→MCH)



Chemical Tanker



Dehydrogenation*
(MCH→TOL)



* Image

Toluene → Methylcyclohexane

Japan-Australia Pilot Project

2020~ **HySTRA**

Brown Coal + CCS



Gasification



Liquefied H₂ Carrier*



Loading Facility*



Power-to-gas

Fukushima Renewable H₂ Project

2020~ **FHER**



Power-to-Gas Plant*



Electrolysis System
(Alkaline)



Ongoing Projects (Demand-side)

H₂ Mobility

H₂ Station Network

2013~

*113 Stations
by November 2018



H₂ Applications

2016~



FC Bus

× 100 in 2020



FC Truck Demo

H₂ Power Generation

H₂ Co-generation Demonstration Project



Hydrogen Gas
Turbine (1MW class)

2018~



Joint Venture for H₂ Infrastructure Development

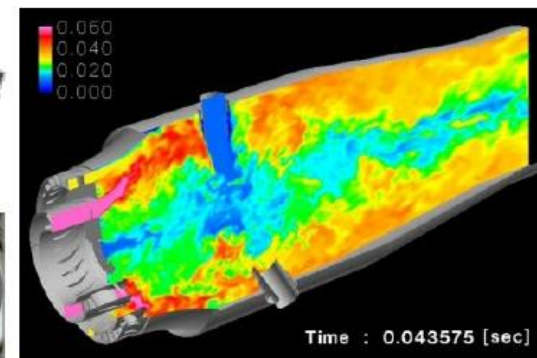
2018~



R&D of H₂ Burner Systems



For Power
Generation
<500MW



Burning Simulation
(H₂ + CH₄)

Japan reverses nuclear energy phase-out policy amid global fuel shortages, climate change

Posted Thu 22 Dec 2022 at 11:07am



<https://www.abc.net.au/news/2022-12-22/japan-nuclear-energy-phase-out-reversal/101803800>

➤ Energievielfalt

- Japan als Inselstaat benötigt Energievielfalt, um eine stabile Stromversorgung zu gewährleisten;

➤ Fukushima Trauma

- Die Kernkrafterzeugung ist wichtig, aber das Trauma des Unfalls von Fukushima erschwert den Bau und Ausbau konventioneller Kernkraftwerke (Leichtwasserreaktoren);

➤ Hochtemperaturreaktor

- Dringender Bedarf an der Kommerzialisierung unfallfreier gasgekühlter Hochtemperaturreaktoren;

➤ HTGR-Technologie

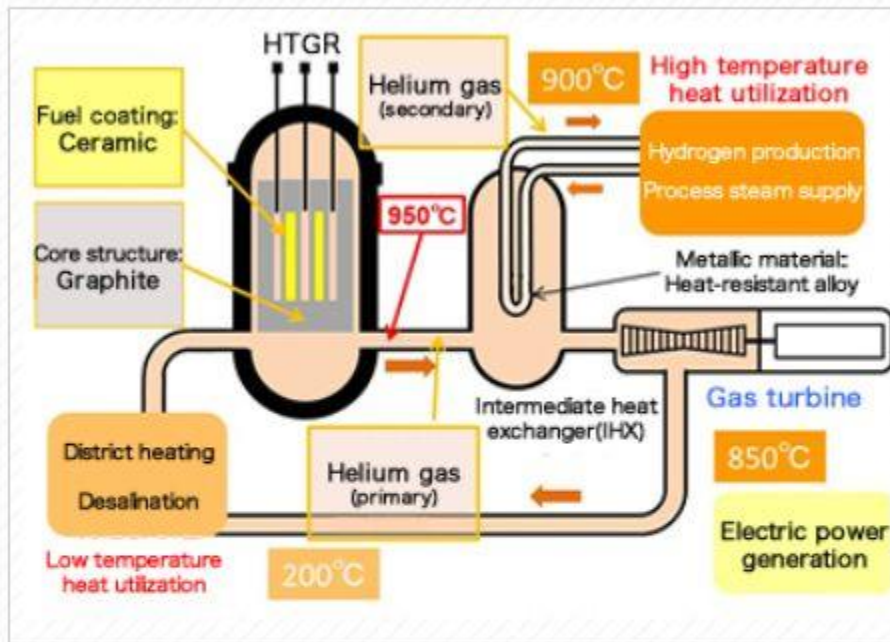
- Japan weltweit führend.

<https://www.sankei.c20210203-3EICBGIMXVPHTNBS35GRHPEGZUom/article/>

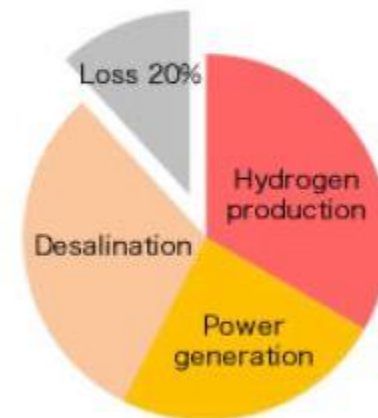
2021-02-03



What is High Temperature Gas-cooled Reactor (HTGR) ?



- Helium gas cooled reactor with outlet coolant temperature of 950°C.
- 80% of reactor thermal power can be utilized by a cascade energy system for hydrogen production, power generation and desalination.



Japan Atomic Energy Agency
Oarai Research &
Development Institute

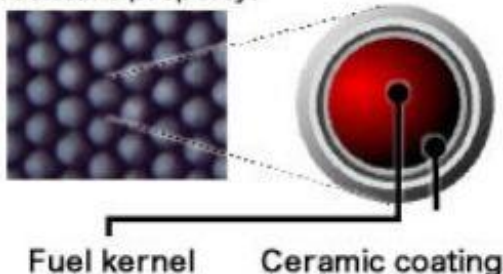


Superior inherent safety



Ceramic coated particle fuel

Hard to melt due to extremely heat-resistant property.

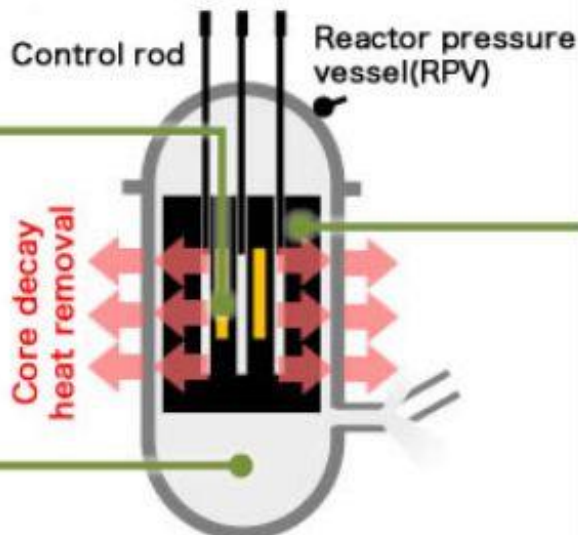


Fuel kernel

Ceramic coating

Helium coolant

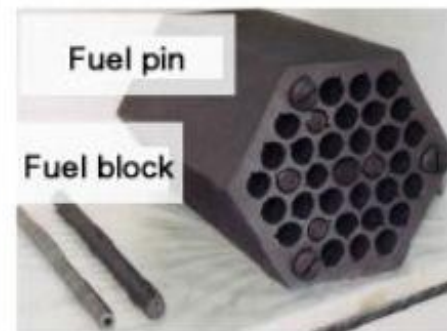
No hydrogen/vapor explosion due to chemical inertness and absence of phase change of helium.



Radionuclides can be retained within the plant by inherent reactor shutdown and core cooling without any equipment or operator action in case of loss of coolant accident or station blackout.

Graphite moderator

Capable to keep the fuel temperature below the allowable limit due to high heat capacity and large thermal conductivity of graphite.



Fuel pin

Fuel block



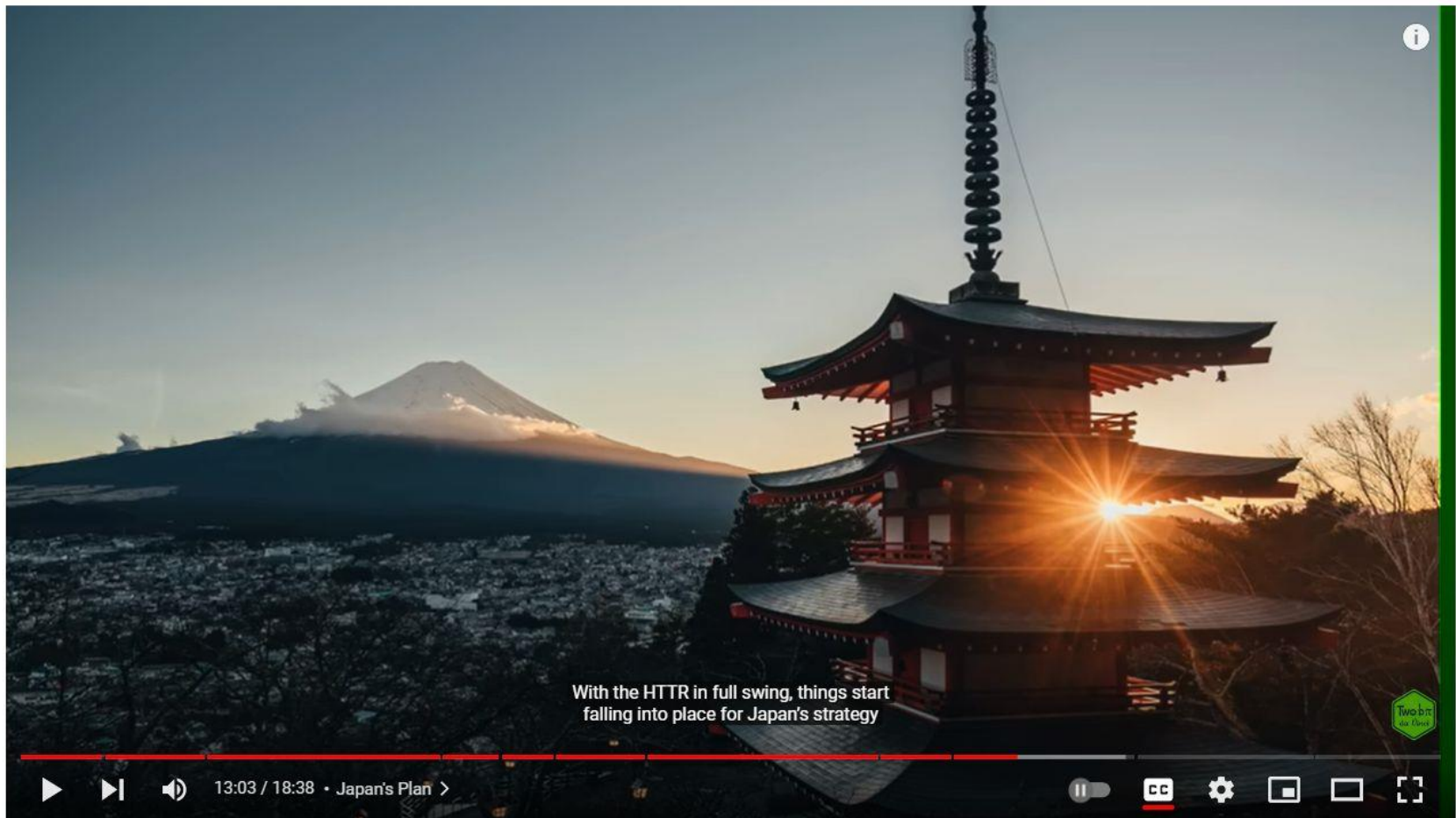
Advanced HTGR

- Gasgekühlter Hochtemperaturreaktor „High Temperature Engineering Test Research Reactor“ (HTTR, Oarai, Präfektur Ibaraki) im Prinzip **frei vom Risiko einer Kernschmelze**.
- **950 Grad Celsius**, dreimal höher als die von gewöhnlichen Druckwasserreaktoren.
- Gasturbine zur Stromerzeugung, aber wichtiger: **IS (Jod-Schwefelsäure)-Prozess** durch zyklisch ablaufende thermochemische Zersetzung von Wasser → **Wasserstoffherzeugung**.
- Industrialisierung von **IS (Jod-Schwefel)-Prozess** schwierig, aber schon vor zwei Jahren kontinuierliche Wasserstoffproduktion von 150 Stunden, was Standard für den Langzeitbetrieb darstellt.

<https://www.sankei.com/article/20210203-3EICBGIMXVPHTNBS35GRHPEGZU>

2021-02-03





With the HTTR in full swing, things start
falling into place for Japan's strategy

Japanese RED Hydrogen Breakthrough Will DESTROY Oil & Gas!

https://www.youtube.com/watch?v=_uTZWaJU6ho



想定外

sō tei gai

das Denken – permanent - außerhalb

unvorstellbar

On the path to decarbonisation: Japan enacts its first legislation on hydrogen and CCS

Alert

25 June 2024

9 min read

Julien Bocobza | Masahiro Tanabe | Joey Chan | Saori Takahashi



On 17 May 2024, the Japanese parliament approved two energy-related bills into law:

- the Hydrogen Society Promotion Act¹; and
- the CCS Business Act.²

These are Japan's first laws relating to the business of hydrogen and the business of carbon capture and storage ("CCS"), respectively. The double approval by the Diet reaffirms the Japanese government's commitment to energy transition.

Both laws were promulgated in the official gazette on 24 May and will come into effect as follows:

- the Hydrogen Society Promotion Act will come into effect on a date to be specified by a cabinet order but no later than November 2024; whilst
- the CCS Business Act will come into effect on a date to be specified by a cabinet order but no later than May 2026 (though selected portions of the law will come into effect on an earlier date).

<https://www.whitecase.com/insight-alert/path-decarbonisation-japan-enacts-its-first-legislation-hydrogen-and-ccs>

CCS Business Act

Hintergrund

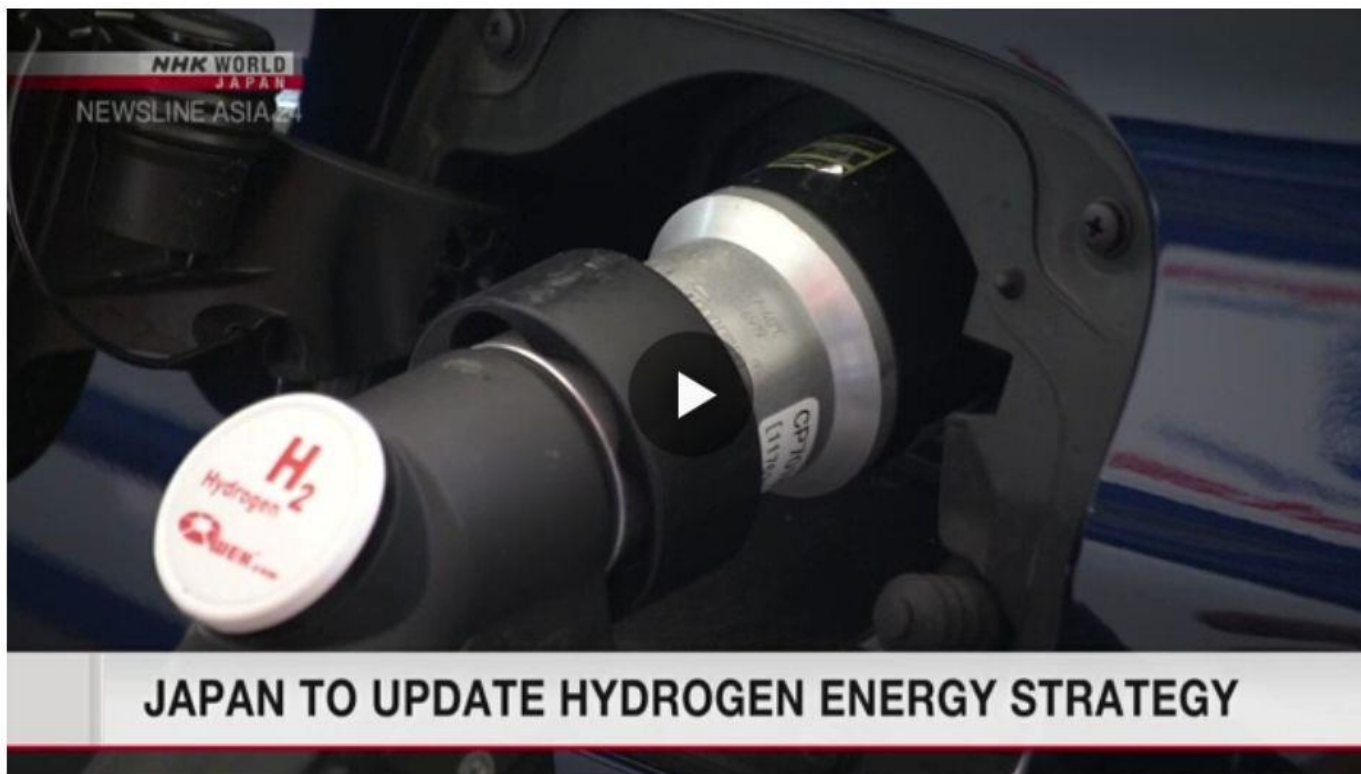
Der CCS Business Act zielt darauf ab, die Nutzung von CCS in Japan zu fördern. Im Januar 2023 stellte METI das Konzept der CCS Long-term Roadmap (die „CCS Roadmap“) vor, um die Entwicklung von CCS-Technologien für den kommerziellen Einsatz zu beschleunigen, und setzte sich insbesondere das Ziel, bis 2030 eine CO₂-Speicherkapazität von 6 - 12 Millionen Tonnen pro Jahr und bis 2050 von 120 - 240 Millionen Tonnen pro Jahr zu erreichen...

{ Anmerkung: CO₂-Emission in 2022: ca. 1 Mrd. t; in D: ca. 600 Mio. t }

Lizenzierungssystem

METI wird für die Vergabe der neu eingeführten Lizenz für CCS-Projekte verantwortlich sein. Die Lizenzvergabe erfolgt durch öffentliche Ausschreibungen wie folgt:

METI wird „bestimmte Zonen“ für Gebiete festlegen, in denen es bestehende oder potenzielle Reservoirs gibt ...



Japan to update hydrogen energy strategy in push for carbon neutrality

Tuesday, April 4, 3:45



Wasserstofftankstellen



Anzahl in Japan (davon in Tokyo): **164 (23)** Plan: **1000** bis 2030
(2023)

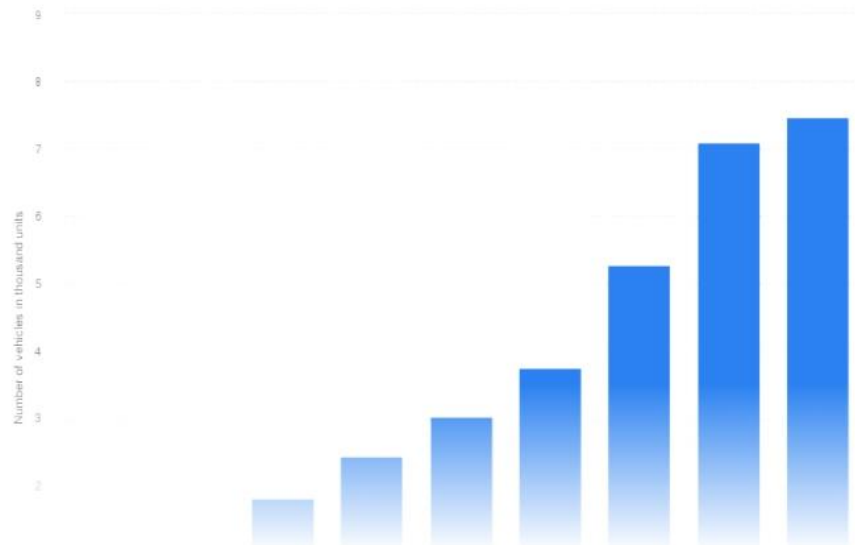
Anzahl in Deutschland: **93** Plan: **100** bis 2025
(2022)

Anmerkung:

- SAE J2600 (Society of Automotive Engineers) und sein ISO-Äquivalent für die Wasserstoffdüse und die FCEV-Fahrzeugaufnahme sind im Wesentlichen identisch und für 35MPa und 70MPa weltweit harmonisiert.

Number of fuel cell electric vehicles (FCV) in use in Japan from 2015 to 2023

(in 1,000 units)



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Release date

October 2023

Region

Japan

Survey time period

2015 to 2023; as of March 31 of each year stated

Special properties

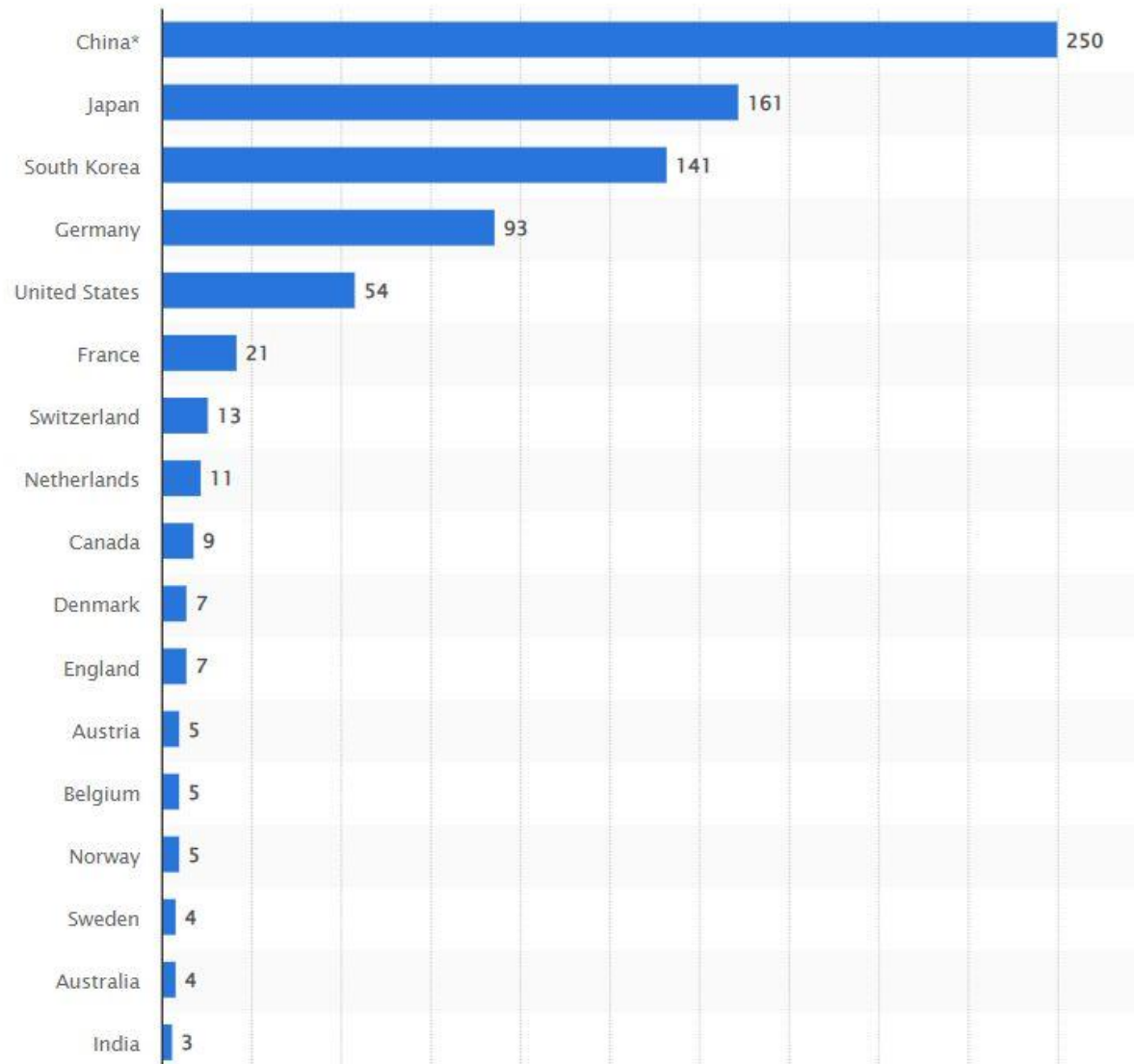
not including light motor vehicles

Supplementary notes

Figures have been rounded.

Figures prior to 2023 are from previous reports.

Number of hydrogen fueling stations for road vehicles worldwide as of 2022, by country



H2 Tankstellen in Japan und Deutschland



- 1 kg Wasserstoff
 - in Japan ca. 1650 Yen
 - bei H2 Mobility 16,25 Euro
- Reichweite: ca. 100km/kg;

Scientists want the Paris Olympics to dump Toyota's Mirai as an official car. Here's why



By [Angela Dewan](#), CNN

🕒 3 minute read · Published 8:18 AM EDT, Thu July 11, 2024



<https://edition.cnn.com/2024/07/11/climate/toyota-mirai-paris-olympics-car-hydrogen-climate-intl/index.html>

Beispiel für nicht systemischen Ansatz

Spread and Development Trend of ENE-FARM and Residential Fuel Cells

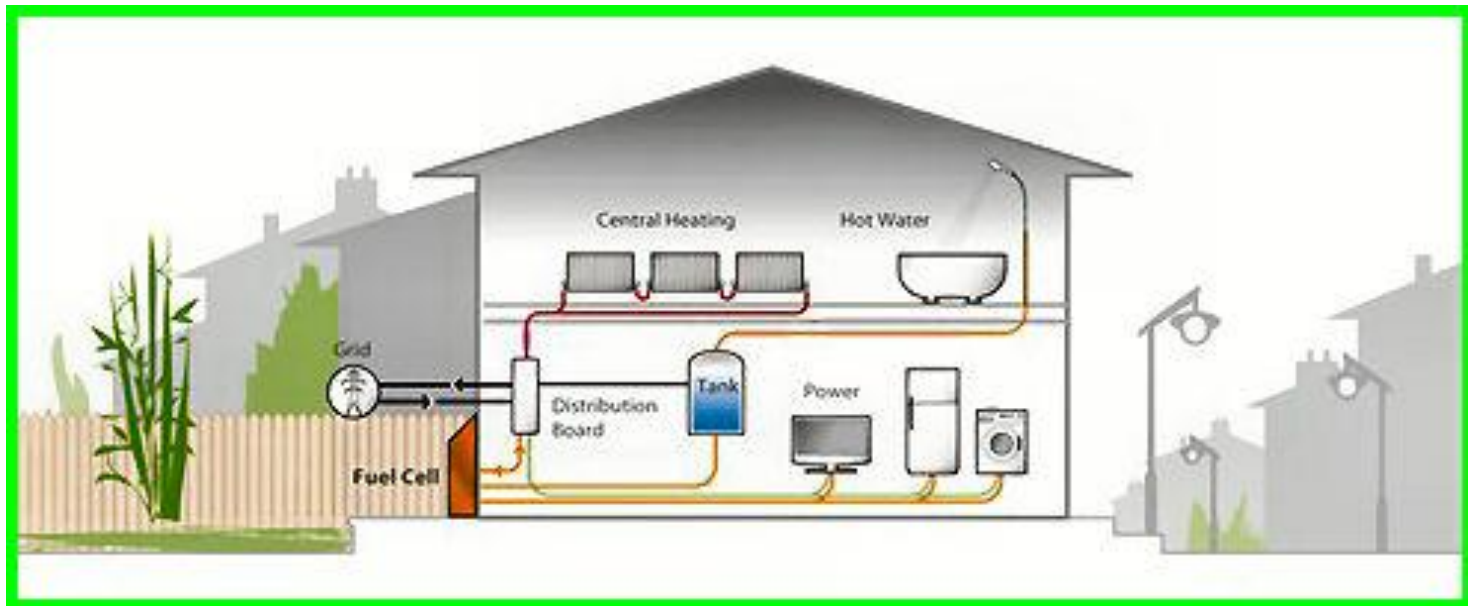
ENE-FARM

STROM UND HEISSWASSER

PANASONIC UND TOKYO GAS

Brennstoffzelle für zu Hause

Cogeneration | “Kraft-Wärme-Kopplung”

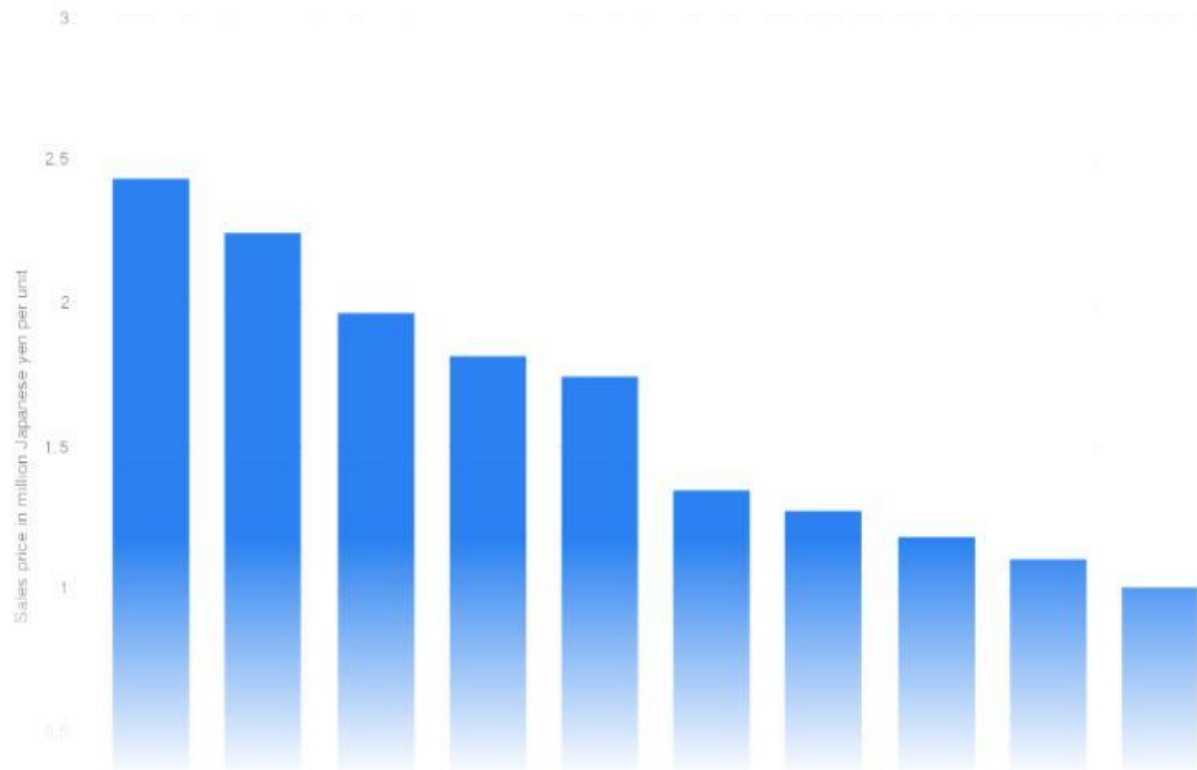




- Entwicklung seit 2009, METI-Projekt ENE-Farm
- In Japan über 400,000 Einheiten in Betrieb, in Deutschland 5700 (Quelle: KfW bundeseigene Förderbank)
- 5.300.000 Einheiten bis 2030, also 10% aller Haushalte in Japan.
- Brennstoff Stadtgas (Methan), Wasserstoff über “Reformer” erzeugt, 40% weniger CO₂ Ausstoß
- Wechsel von Gasheizung auf Brennstoffzellenheizung einfach;
- Kooperationen: Panasonic u. Viessmann; Bosch - AISIN Seiki SOFC Japan
- **Neu:** 6. Generation mit Wasserstoffbetrieb ab 2021; 5kW; **97% Wirkungsgrad**;
 Kosten: ca. 1 Mio. Yen (7000 Euro) Quelle: WASSERSTOFF FÜR
BRENNSTOFFZELLE ZUHAUSE

Sales price of ENE-FARM systems for solid oxide fuel cells (SOFC) in Japan from fiscal year 2011 to 2020

(in million Japanese yen)



[Additional Information](#)

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[Show source](#)

World's Smallest High Efficiency Household Fuel Cell Cogeneration System "Ene-Farm Mini" Developed

by FuelCellsWorks, 2019-10-14

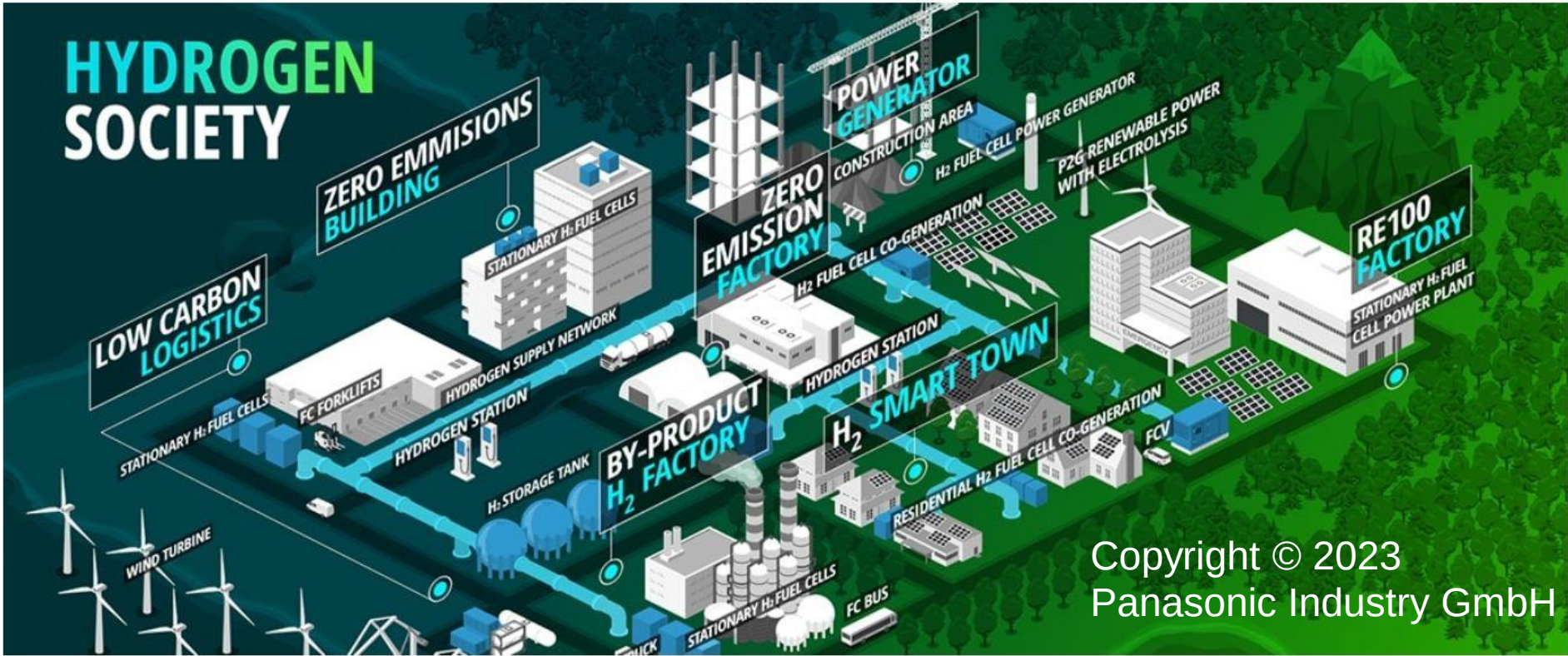


Dainichi



Hydrogen Fuel Cells for Heat and Electricity

Read more [here](#).



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Panasonic Industry GmbH

International Institute for Carbon-Neutral Energy Research



持続可能な低炭素社会に向けた水素のポテンシャル 世界はPower to Gas からPower To Xへ

*Das Potenzial von Wasserstoff für eine nachhaltige Gesellschaft mit
geringem Kohlenstoffausstoß*

*Internationales Forschungsinstitut für CO₂-neutrale Energie der Kyushu-
Universität*

九州大学 カーボンニュートラルエネルギー国際研究所
WPI 招聘教授

Katsuhiko Hirose



World Premier International
Research Center Initiative



KYUSHU UNIVERSITY



ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

**“End of stone age was
not due to the lack of stone”**

Die Steinzeit ging nicht zu Ende, weil es keine Steine mehr gab.

**The technological innovation and new idea
change the society.**

**石器時代が終わったのは
石が無くなったわけではない！**

技術革新と新しいアイデアが社会を変えるのだ。