



AUTOMOTIVE **INDUSTRY**

GLOBAL AND THAILAND'S OUTLOOK

Ninnart Chaithirapinyo, Chairman of Hydrogen Thailand Club

TSAE EV Alliance | November 22, 2023



AGENDA

- Global Automotive Industry
 - Thai Automotive Industry
 - Future Trends
- Hydrogen As New Alternative

GLOBAL AUTOMOTIVE INDUSTRY

Thailand ranked #10 in global production for 2022



(Units : Million)

1.	China	27.02
2.	U.S.A	10.06
3.	Japan	7.83
4.	India	5.45
5.	Korea	3.75
6.	Germany	3.67
7.	Mexico	3.50
8.	Brazil	2.36
9.	Spain	2.21
10.	Thailand	1.88
11.	Indonesia	1.47
12.	France	1.38

Total Global Production
85 M Units in 2022

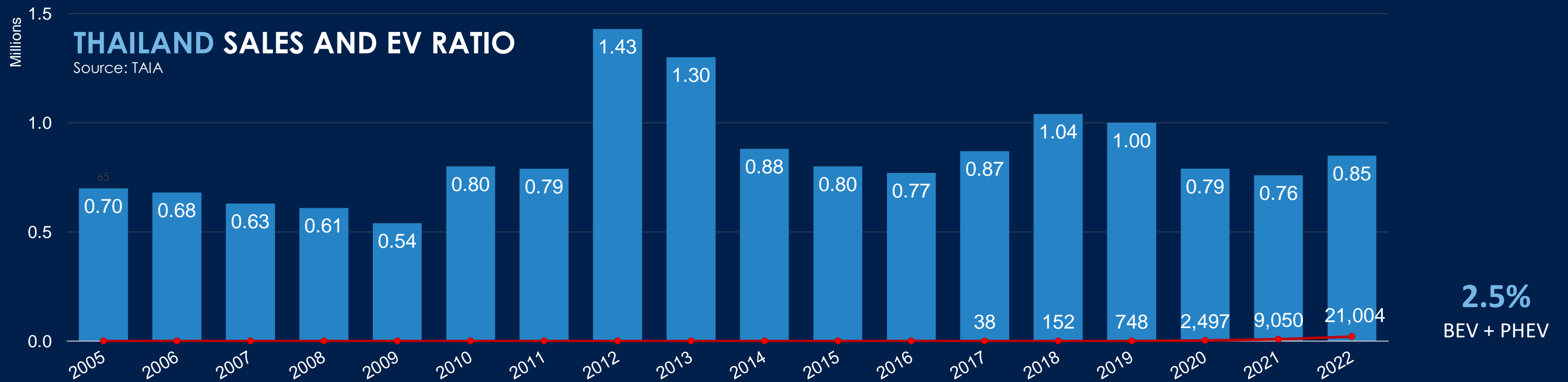
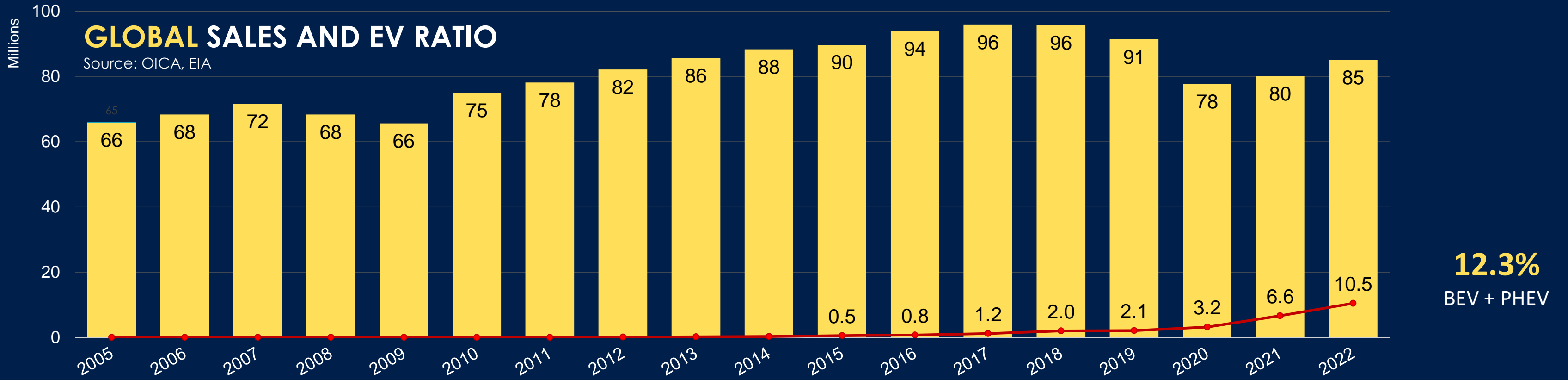
EXCLUDING BYD, GWM, TESLA



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*this is not an exhaustive list

ELECTRIFICATION ACCELERATES

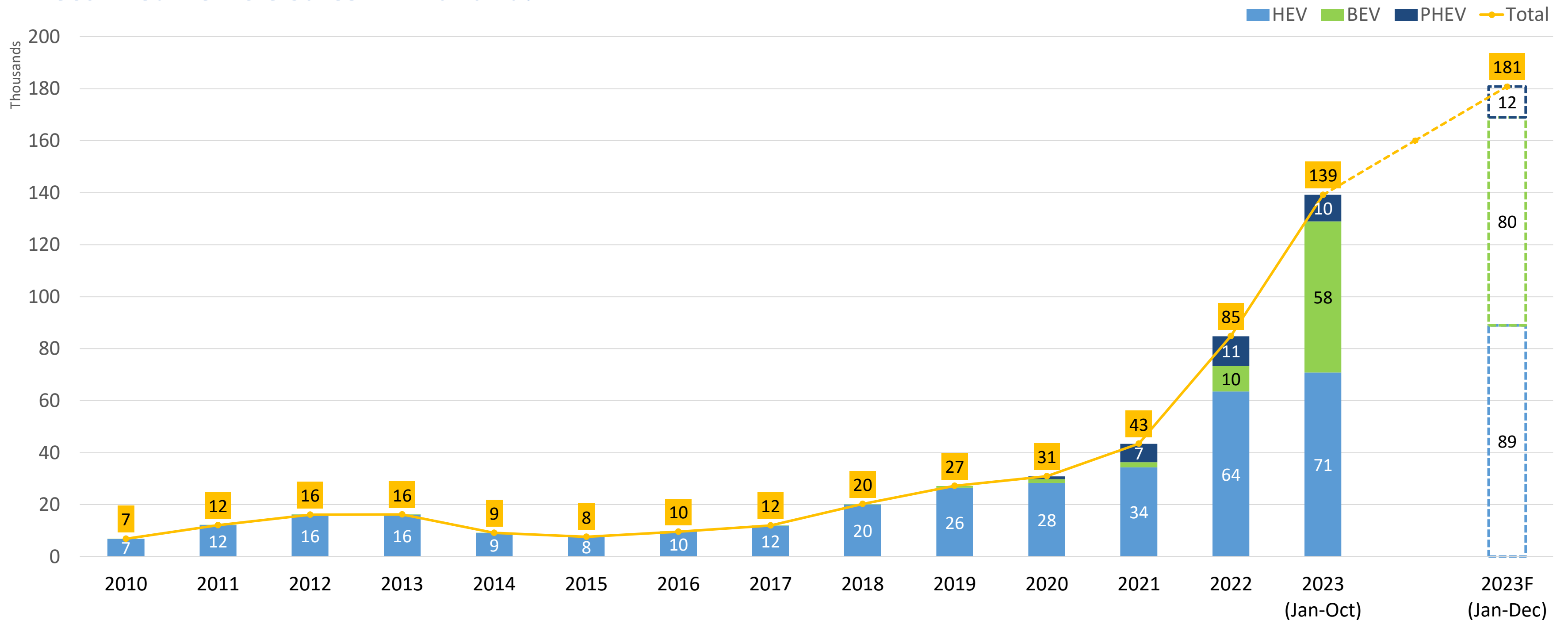




ELECTRIFICATION ACCELERATES

In 2023, annual sales for all electrified vehicles are expected to reach nearly 200,000 units. HEVs will still be the leader but BEVs are catching up fast.

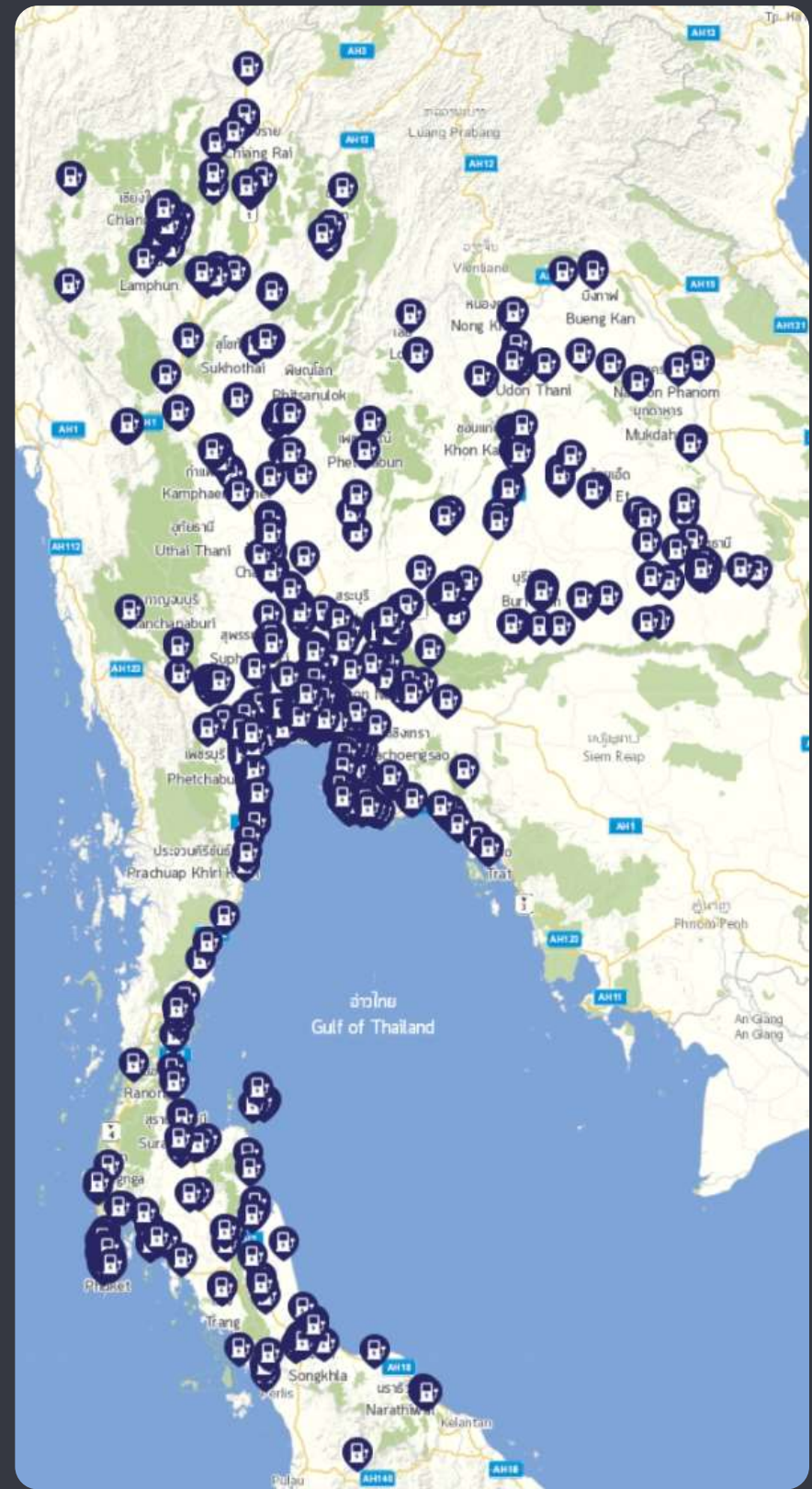
Electrified Vehicle Sales in Thailand:



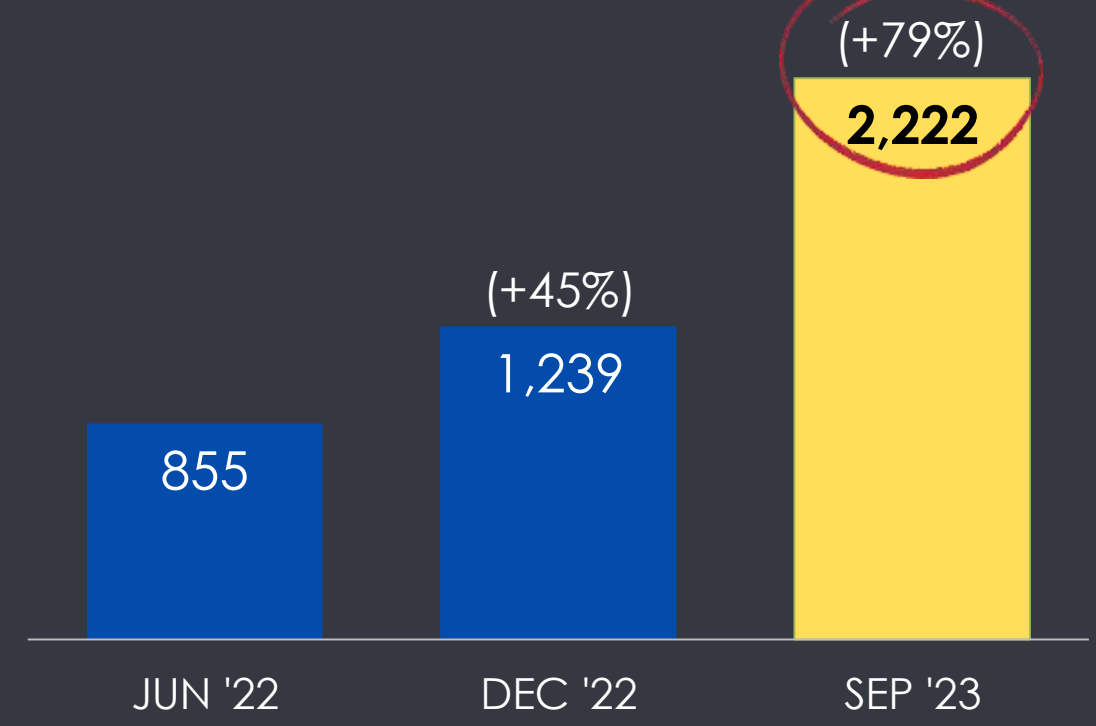


Growth of Charging Station

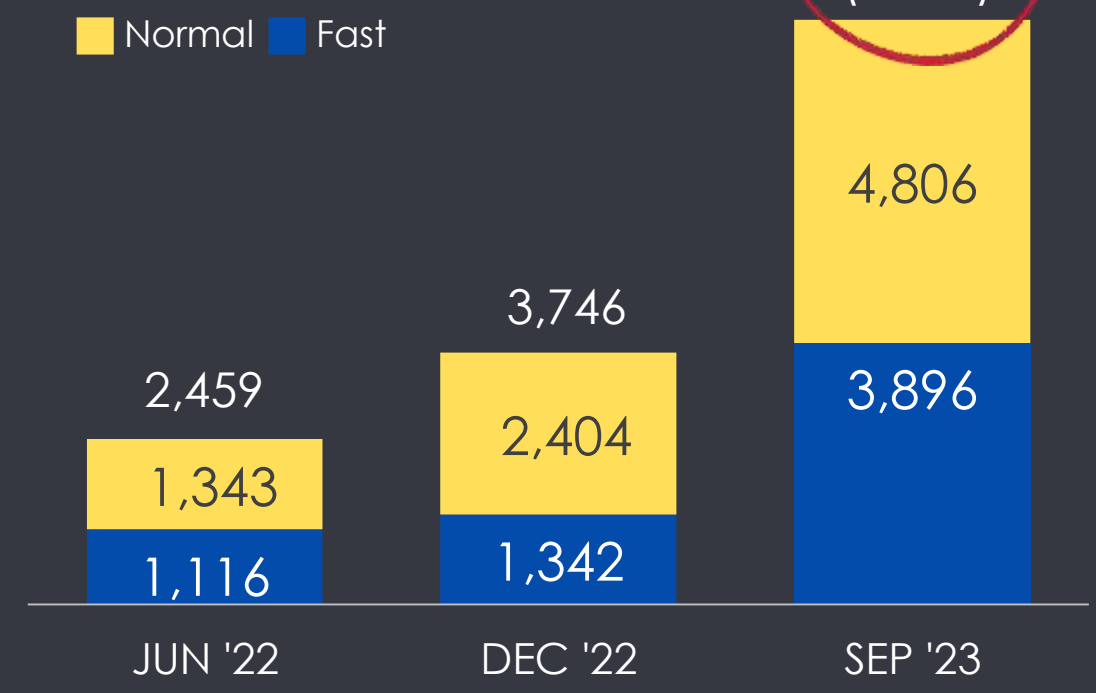
Service Providers ผู้ให้บริการ	Number of Locations จำนวนแห่ง	DC	DC	AC	ALL
		DC CCS 2	DC CHAdeMO	AC TYPE 2	TOTAL
STATIONPLUS	555	1047	1	652	1,700
EANYPHERE	538	1515	-	1,824	3,339
PEA	217	378	316	164	858
EV	212	103	1	588	692
evolt	200	55	14	456	525
EleX	117	149	7	119	275
ALTERVIM	100	204	-	102	306
noodoeEV	68	-	-	161	161
onion	60	7	1	424	432
HAUP	45	4	4	63	71
mea	36	17	9	130	156
Galvanic	29	15	1	56	72
GWM	20	44	-	-	44
CHOSEN	19	2	2	49	53
PUMP CHARGE	6	-	-	18	18
TOTAL	2,222	3,540	356	4,806	8,702



Charging Stations



Chargers



Source: TAIA, EVAT (as of September 2023)

SOME CHALLENGES OF BEVs

01 Rapid change in battery technology, risk of sunk cost in investment. But tend to be able to charge at 800-900 volt = faster charging.

02 Low resale price and less competitive without govt.'s subsidies, offering 8-year guarantee to solve customer's worry.

03 Limited public charging station (low margin); high cost of home charging installation **(80 – 100 K THB)**

04 High battery cost (40% of car price) and high insurance premium fee but total cost of ownership is competitive due to lower electricity cost:

- BEV home charging 0.8 THB/km | public 1.5 THB/km
- ICE 3-4 THB/km • FCEV 3 THB/km

05 BEV customer observation on what influence the purchase: 10% environment | 40% trendy image | 50% energy cost saving

06 Electricity supply might not be enough, leading to blackout:

- Current capacity → 53,000 MW
- Peak 28,000 → 34,000 MW



Better not focus only on catching up with the trends, but the country benefits as well.

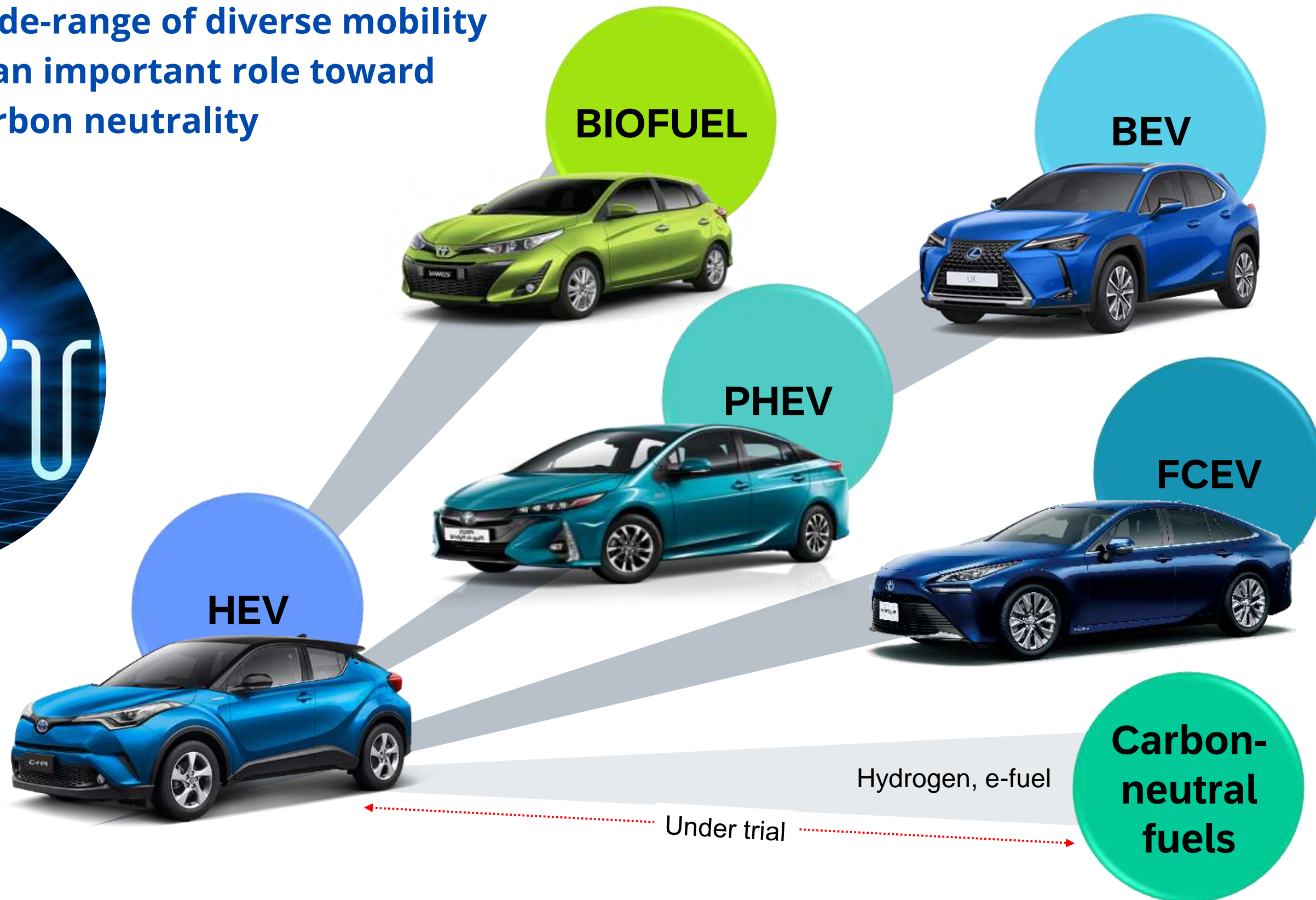
07 Other issues:

- Low ground clearance, bad for flood/ rough road surface.
- Long waiting time for parts
- Complicated electronics/electric system, difficult and expensive maintenance
- Bigger tire, compared to ICE (expensive)



Multi-Pathway towards Carbon Neutrality

Wide-range of diverse mobility is an important role toward carbon neutrality



Electrification

Hydrogen

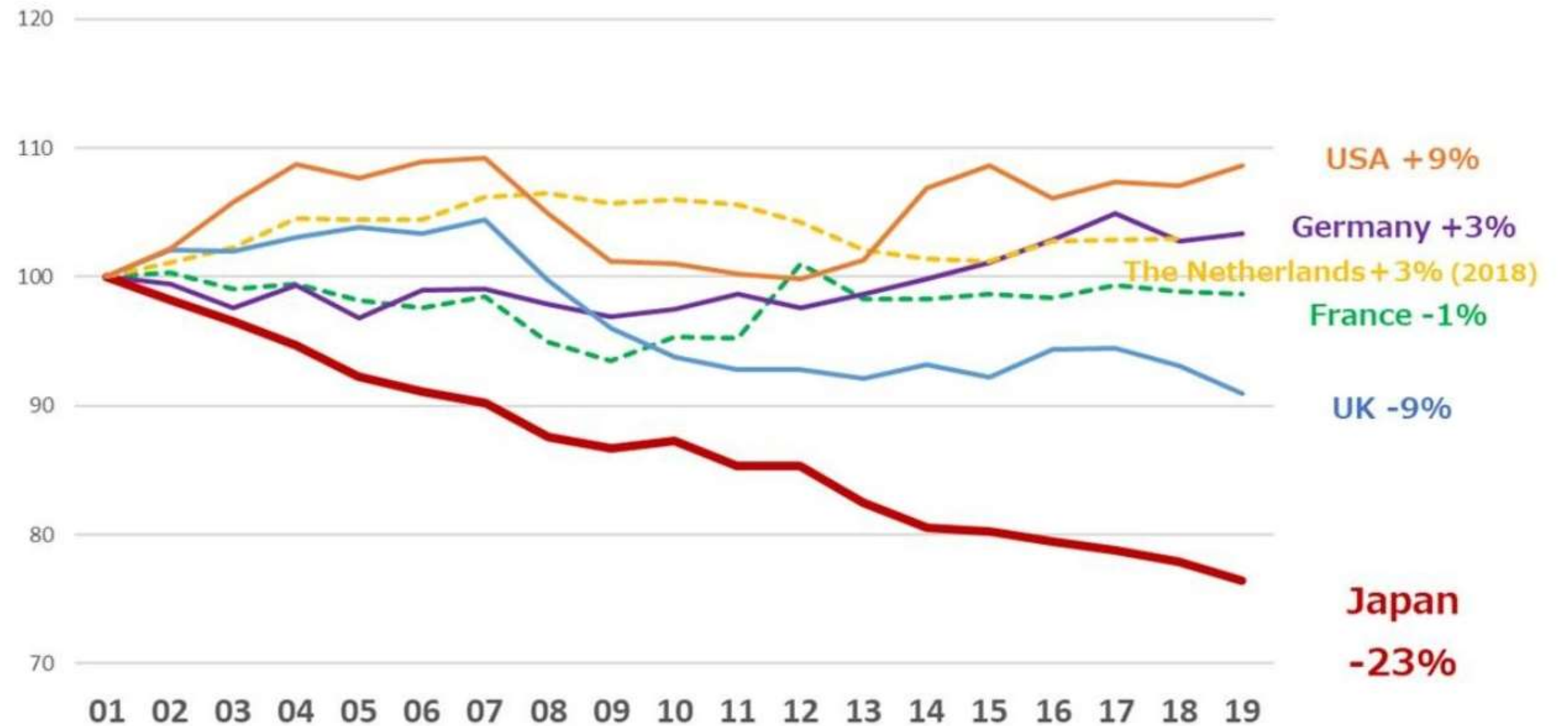
Engine-powered



JAPAN ACHIEVEMENT UNDER MULTIPLE PATHWAYS

International comparison of CO₂ emissions by automobiles

The reduction of CO₂ emissions by 23% is significantly larger than other countries. The Japanese automotive industry has an advantage in having led the reduction efforts.



Significant CO₂ reduction over the last two decades, where HEV accounts almost 50%, providing accessible electrification and scale.





BEVs and AVs Observation in China

NIO has a production base in Shanghai with market share. But, home charging can be challenging due to expensive parking spaces. So, battery swap is popular.

- Since 2022, there are several companies testing and deploying autonomous or "robot" taxis in Shenzhen, China. (Autonomous Level 4).
- ITS World Congress in Suzhou had limited participants and exhibitors from Europe and America. Most were Chinese companies. The trend is changing from devices to solutions.
- Robot maids designed for floor cleaning have become commonplace in China, particularly in high-traffic areas such as malls and hotels.
- QR code payments are widespread and more convenient than in Japan, reflecting a tech-savvy approach and cashless society with Alipay (highly recommend True Money).



SITE VISIT IN CHINA



SITE VISIT IN CHINA



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SITE VISIT IN CHINA



SITE VISIT IN CHINA



License plate:

- Green = BEV, PHEV
- Blue = ICE, HEV



SITE VISIT IN CHINA

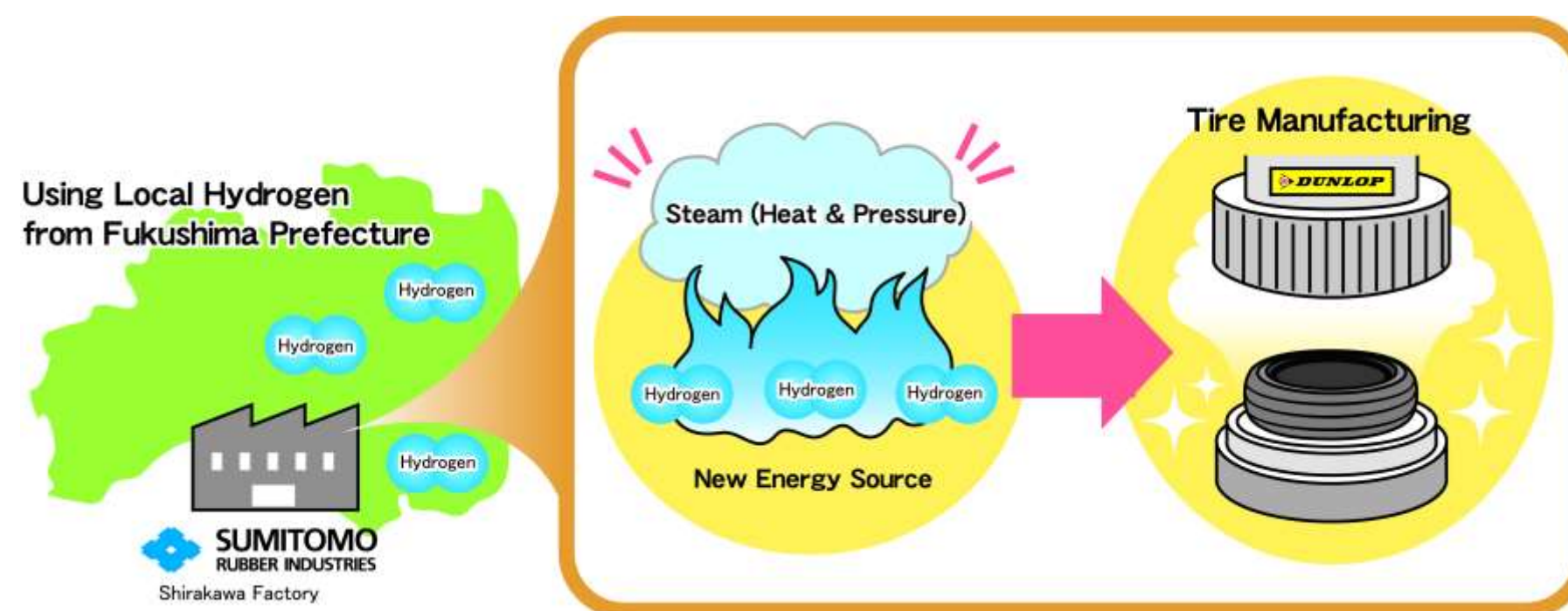




REALIZATION OF HYDROGEN SOCIETY IN JAPAN



- Government subsidized $\sim 2/3$ of investment and expense to replace LNG with H_2 in heat generation.
- H_2 is used for heating instead of coal/LNG.



- CO_2 is used to produce dry ice and carbonate drinks.





NEDO JAPAN

New Energy and Industrial Technology Development Organization

- Partnership of Gov't, Private, Academics (Under METI)
- To advance industrial technology, esp. energy-related, through private sector research and development, promoting efficiency and stability in energy supply for economic and industrial growth.



SOURCES OF HYDROGEN



**Solar
Energy**

Reverse
electrolysis
→ H₂
→ O₂



**Plastic
Waste**

Chemical recycle
→ H₂ + N₂ = NH₃
→ CO₂



**Biomass
Conversion**

Gasification
process
→ CH₄



SITE VISIT IN JAPAN



SITE VISIT IN JAPAN



SITE VISIT IN JAPAN - JERA

TEPCO



CHUBU
Electric Power



Jera

Completed the consolidation of value chains in April 2019 after expanding the scope of consolidation four years after establishment in April 2015

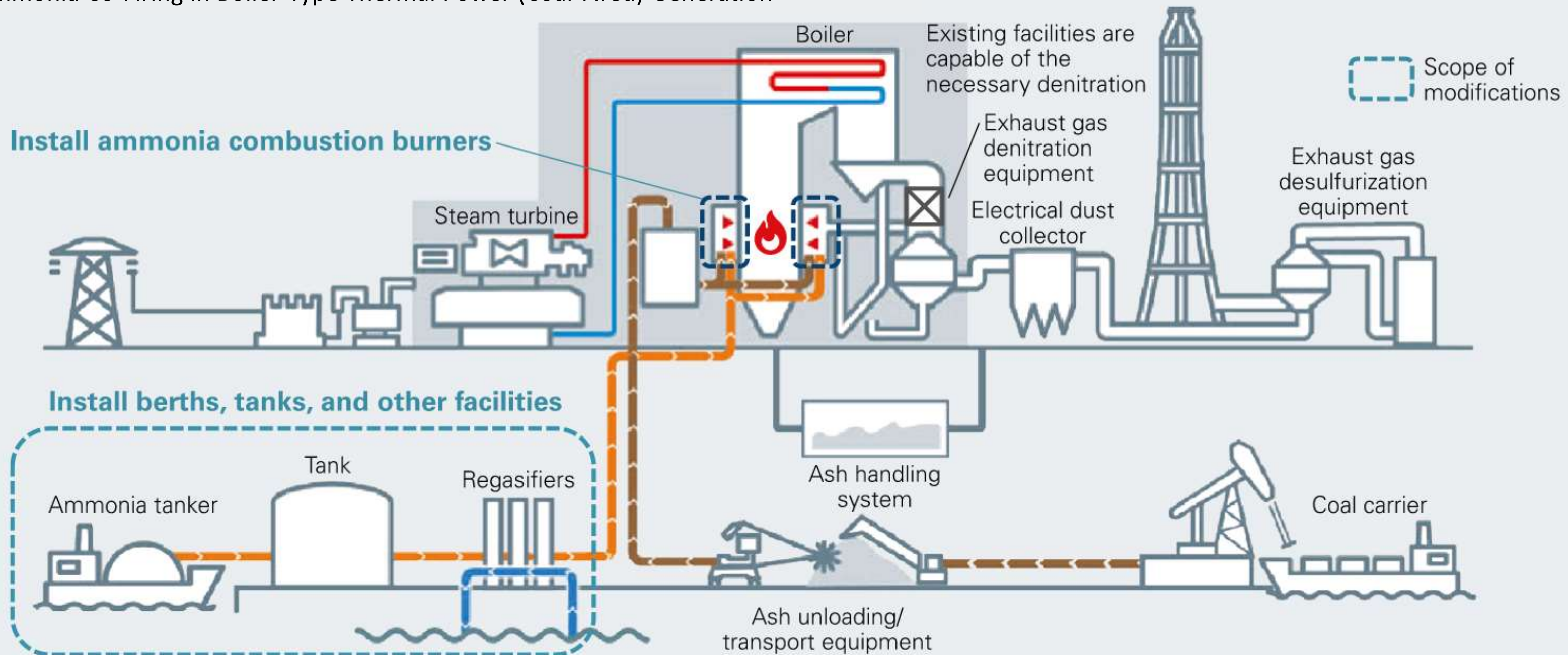
April 2015	October 2015	July 2016	June 2017	May 2018	April 2019
JERA established	Fuel transportation and fuel trading businesses consolidated	Fuel upstream and procurement, overseas power generation, and energy infrastructure businesses consolidated	Joint-venture agreement concluded to consolidate existing thermal power generation businesses	Absorption-type company split agreement concluded to consolidate existing thermal power generation businesses	Existing thermal power generation businesses consolidated



SITE VISIT IN JAPAN - JERA

JERA ZERO CO2 EMISSION

Ammonia Co-Firing in Boiler-Type Thermal Power (Coal-Fired) Generation



SITE VISIT IN JAPAN - DENSO



固体高分子電解質膜型水電解システム

Polymer Electrolysis Membrane (PEM) Electrolyzer System

- 水の電気分解で水素を製造
Hydrogen is produced by water electrolysis
- FCEV MIRAIの燃料電池スタックを転用した水電解スタック
PEM electrolyzer stack uses the same technology as Fuel Cell stack for FCEV MIRAI
- 水電解スタックや整流器、純水製造装置をコンパクトに収納
Compact system including PEM electrolysis stack, rectifier and water purification apparatus
- 1時間におよそ8kgの水素製造能力@400kW
Approximately 8kg hydrogen is produced per hour @400kW

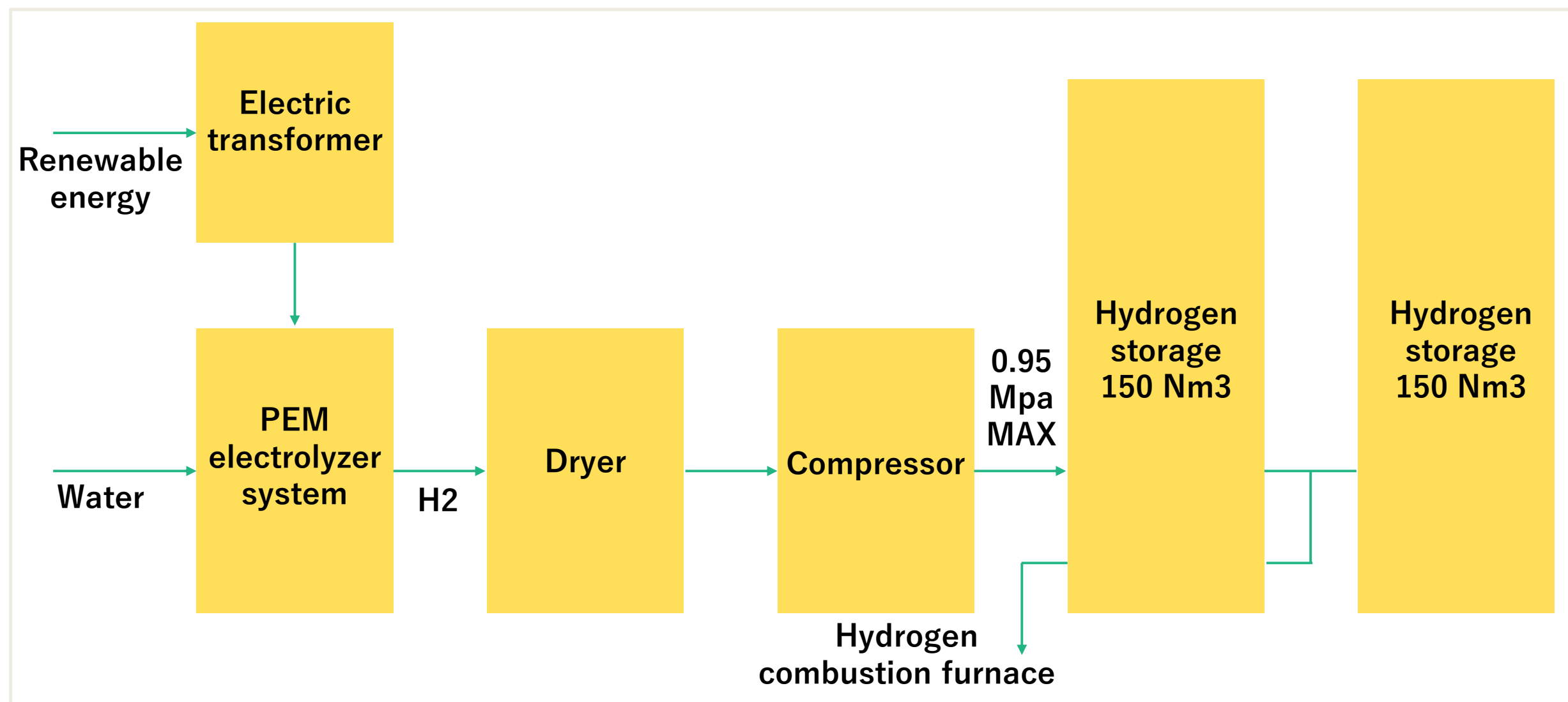
① 純水製造装置 Water purification apparatus
 ② 気液分離機 Gas/Water separator
 ③ 純水循環ポンプ Water circulation pump
 ④ イオン交換器 Ion exchanger
 ⑤ 整流器 Rectifier
 ⑥ 水電解スタック PEM electrolysis stack

換気ファン Ventilation fan
 室内空調機 Air conditioner
 整流器 Rectifier
 水電解制御盤 Control panel
 水素出口 Hydrogen outlet
 水電解スタック PEM electrolysis stack
 純水製造装置 Water purification apparatus
 気液分離機 Gas/Water separator

水電解装置システム概要図
PEM electrolyzer system overview

水電解装置コンテナ
PEM electrolyzer system package

DENSO Fukushima : Carbon Neutrality Technologies (Electrolyzer)



- DENSO Fukushima Corporation began to operate the electrolyzer to produce hydrogen in March 2023.
- The water electrolysis system developed by Toyota Motor Corporation produces hydrogen with the renewable energy generated in DENSO Fukushima.
- Proton Exchange Membrane (PEM) electrolyzer stack uses the same technology as Fuel Cell stack for FCEV MIRAI
- Approximately 8 kg of hydrogen is produced per hour at 400 kW electrolyzer capacity
- The project receives financial support from NEDO at 2/3 of total expenses

SITE VISIT IN JAPAN - RESONAC



SITE VISIT IN JAPAN - RESONAC

Demonstration Project with JR East

RESONAC

Started in September 2022, RESONAC supplies plastics-derived low-carbon hydrogen at Kawasaki plant, using coastal lines such as JR EAST's Tsurumi Line.

Fuel Cell Train 'HYBARI'



Demonstration filling low-carbon hydrogen from plastics to 'HYBARI'



SITE VISIT IN JAPAN - RESONAC

RESONAC's Efforts for resource recycling

RESONAC

Promoting resource recycling



Steel Recycling



Aluminum Recycling



Plastics Recycling



Because... Energy consumption ↓ & Environmental load ↓



SITE VISIT IN JAPAN - RESONAC



JAPAN MOBILITY SHOW 2023, TOKYO





CONCLUSION

- **Economy of Speed & Economy of Scale (with business alliances)**
- **Carbon Neutrality and PM 2.5 Reduction**
- **Carbon Credit Market**
- **Aero Dynamic Design & Minimum Vehicle Weight**





THANK YOU!!

IN THE FUTURE TECHNOLOGY IS DEVELOPING VERY FAST