EV Shift for Carbon Neutrality: Win-Win Solution by Japan-India Collaboration?

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Abstract

In recent years, green innovation and finance are in priority measures globally to cope with the 2050 carbon neutrality goal. Facilitating green innovation involving transformation of its economic model is critical to achieve economic development with environmental constraints, particularly for developing countries such as India. This talk will provide an overview of green innovation developments in Asian countries, focusing on the impact of EV transformation, starting in China, on global car industry. In addition, potential collaboration between Japan and India to cope with this challenge is discussed.

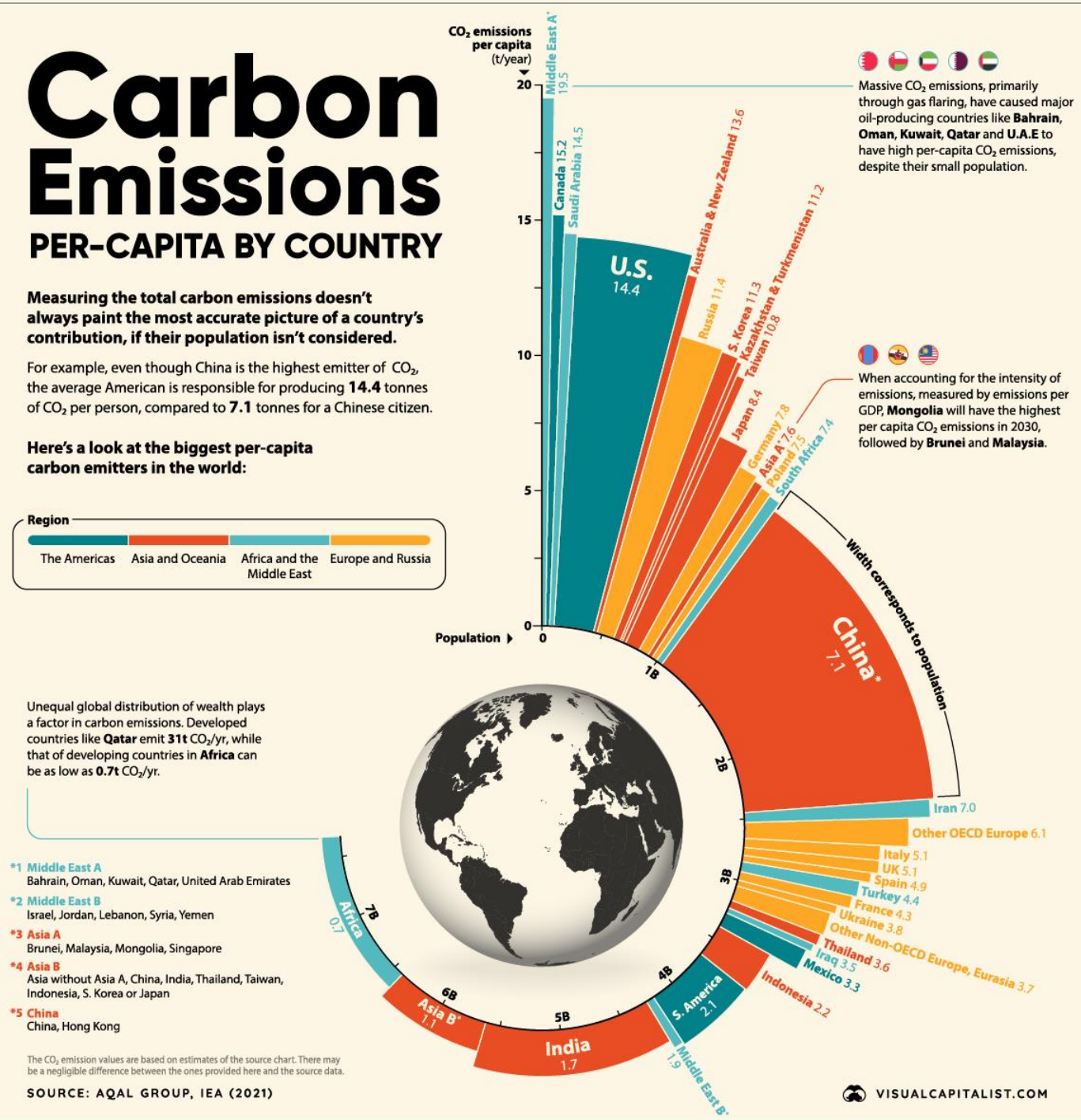
Carbon Emissions

PER-CAPITA BY COUNTRY

Measuring the total carbon emissions doesn't always paint the most accurate picture of a country's contribution, if their population isn't considered.

For example, even though China is the highest emitter of CO_2, the average American is responsible for producing **14.4** tonnes of CO_2 per person, compared to **7.1** tonnes for a Chinese citizen.

Here's a look at the biggest per-capita carbon emitters in the world:



Region

The Americas | Asia and Oceania | Africa and the Middle East | Europe and Russia

Unequal global distribution of wealth plays a factor in carbon emissions. Developed countries like **Qatar** emit **31t** CO_2/yr, while that of developing countries in **Africa** can be as low as **0.7t** CO_2/yr.

*1 **Middle East A**
Bahrain, Oman, Kuwait, Qatar, United Arab Emirates

*2 **Middle East B**
Israel, Jordan, Lebanon, Syria, Yemen

*3 **Asia A**
Brunei, Malaysia, Mongolia, Singapore

*4 **Asia B**
Asia without Asia A, China, India, Thailand, Taiwan, Indonesia, S. Korea or Japan

*5 **China**
China, Hong Kong

The CO_2 emission values are based on estimates of the source chart. There may be a negligible difference between the ones provided here and the source data.

SOURCE: AQAL GROUP, IEA (2021)

VISUALCAPITALIST.COM

Policies towards carbon neutrality

Table 1: Summary table of range of policy instruments either implemented or planned in sel AIXG countries

	Voluntary Approach	Taxes		Trading	
		Energy[7] or CO_2	Industry specific	Emissions	Renewable energy or energy efficiency
Australia	✓			✓*	✓
Austria	✓	✓			✓
Belgium	✓	✓			✓
Canada	✓			✓	
Czech Republic	✓			✓	
Denmark	✓	✓		✓	✓
Estonia	✓	✓			
Finland	✓	✓			
France	✓	✓**	✓	✓	
Germany	✓	✓		✓	
Italy	✓	✓			✓
Japan	✓				
Netherlands	✓	✓		✓	✓
New Zealand	✓				
Norway	✓	✓	✓	✓	
Slovakia				✓	
Sweden	✓	✓			✓
Switzerland	✓	✓		✓	
United Kingdom	✓	✓		✓	✓
United States	✓			✓*	✓*

* At State level only
** Plans currently suspended

OECD, 2003

Taxes and/or Trading Scheme
-> Mainly European countries

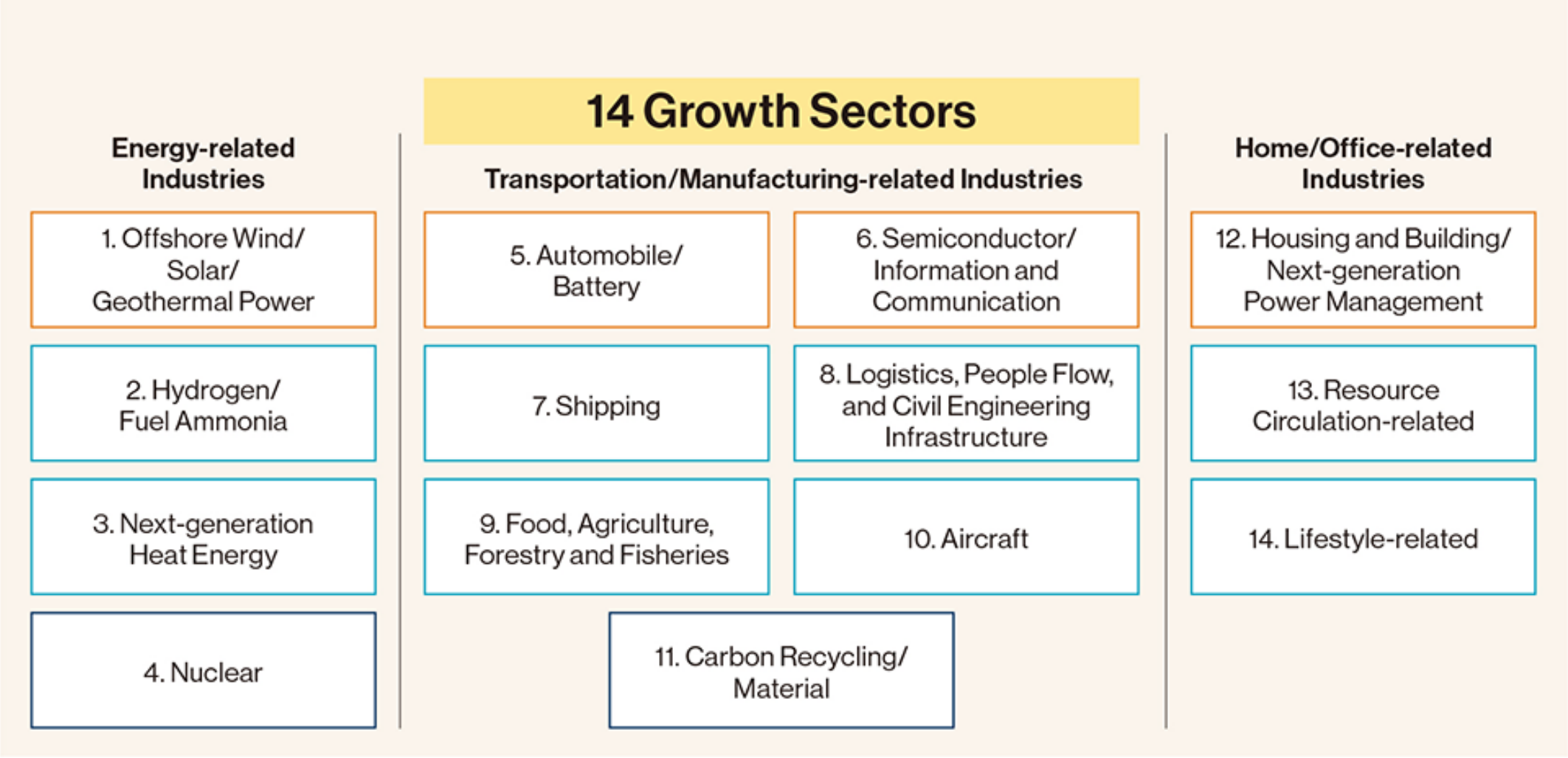
Voluntary Approach
-> US (varies by state)
-> Japan (target setting by sector, and micro policies)

Ad-hoc approach
-> China, India, Thailand…

And variety of private initiative, ex.
Apple's Supplier Energy Efficiency Program

Impacting global business environment

Japanese Government : Green Growth Strategy for the carbon neutrality in 2050



Green and Growth by innovation?

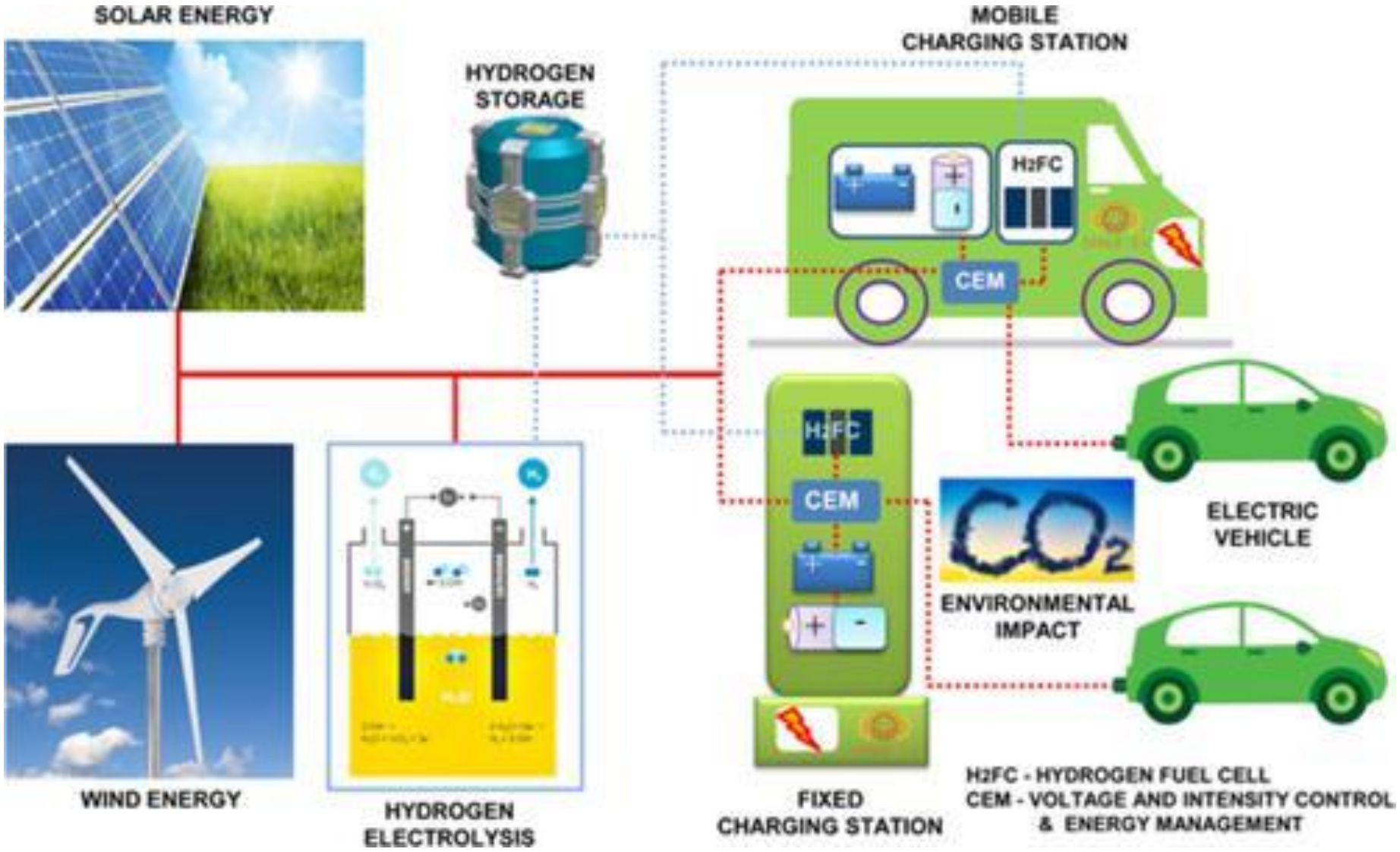
- Classical arguments: Environmental protection -> leading to “innovation and productivity growth” -> Porter Hypothesis
- Carbon neutrality, GHG emission reduction ?
  - Systemic nature : not single regulation (such as SOX, NOX abatement)

    -> Life Cycle Assessment (LCA) concept is important

    -> Ecosystem strategy in a given framework condition (NIS)
  - Global nature : vs. local problem (in air pollution issues, again)

    -> Technology provision (Globalization) and local implementation (Local implementation)

Not only EV but a whole ecosystem is critical



Constantin Filote, Raluca-Andreea Felseghi, Maria Simona Raboaca, Ioan Aşchilean (2020), Environmental impact assessment of green energy systems for power supply of electric vehicle charging station, *International Journal of Energy Research, 2020-07-13 , DOI:10.1002/er.5678*

Technology side : Measuring Green Innovation by Patent Information

	By IPC
Renreable Energy(*)	
Photovoltic	○
Solar heat	△
Wind　power	○
Geothermal	×
Hydro power	○
Marine Energy	○
Biomass	×
Non Carbon Energy(*)	
Nuclear Power	○
Fuel Cell	○
Hydrogen Tech	×
Ammonia	△

	By IPC
Energy Saving Tech(*)	
Building (****)	
Thermal Insulation	△
A/C	△
Hot water supply	○
Lightning (LED etc)	△
Efficient Motor/Inverter	×
Co-generation	×
Water supply, sewage system	×
Electric mobility(EV etc)(***)	○
Heat-Electricyty Conversion Tech	○
Smart Grid	×

	By IPC
Battery, Energy Storage(*)	
Secondary battery	○
Mechanical energy storage	×
Thermal energy storage	○
Capaciter	○
CO2 reduction in non energy field	
Chemical product from biomass	×
CO2 reduction in iron process	×
Recycling	×
Green house gas, capture, reduction etc(**)	
For CO2 (such as CCS)	×
For non CO2 (such as Freon)	×

*Y02E: Climate change mitigation technologies related to energy generation, tranmisssion and distribution

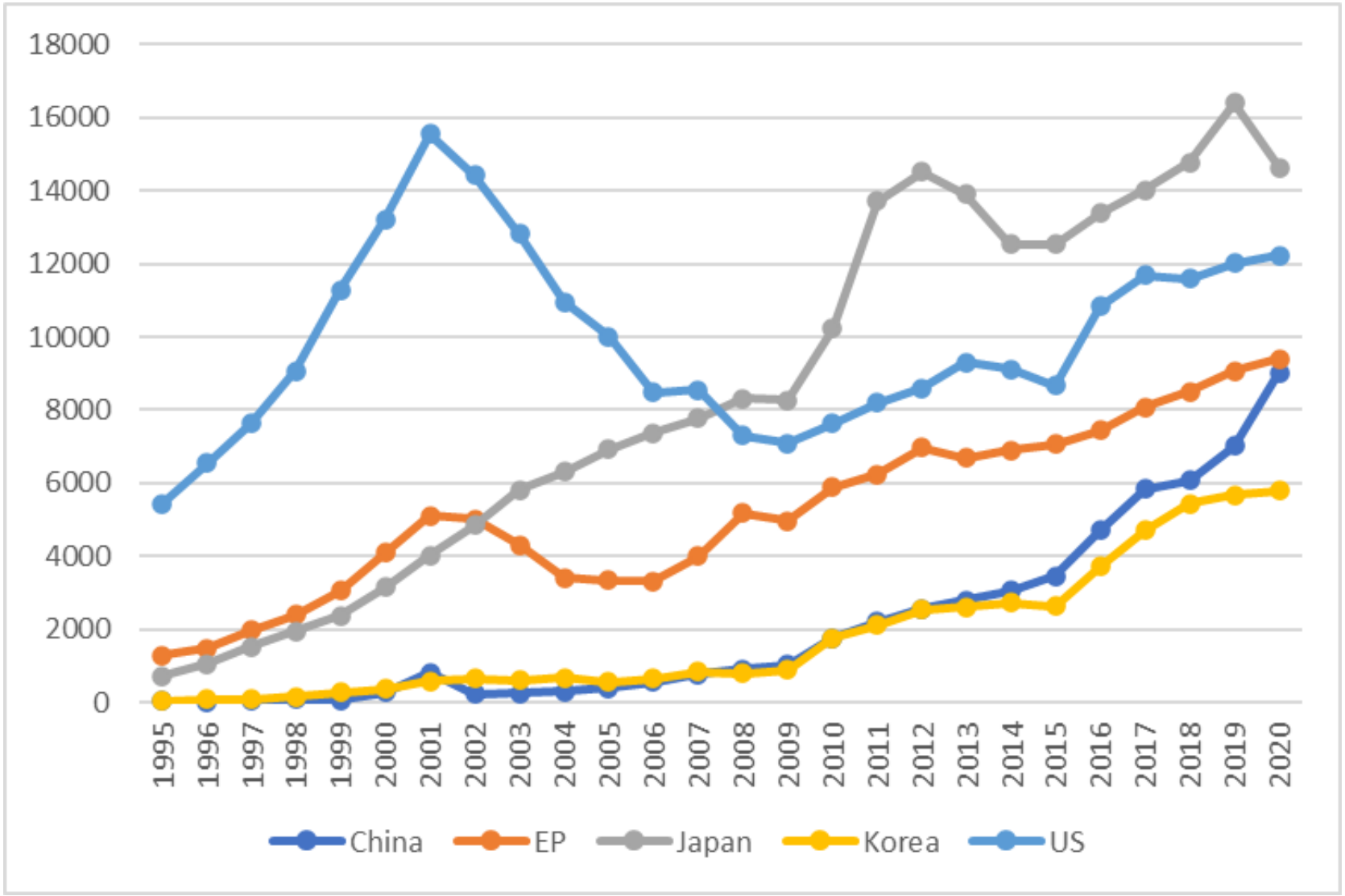
**Y02C: Capture, storage, sequenstration of disposal or greehouse gasses

***Y02T: Climate Change mitigation technologies related to TRANSPORTATION (more extensive)

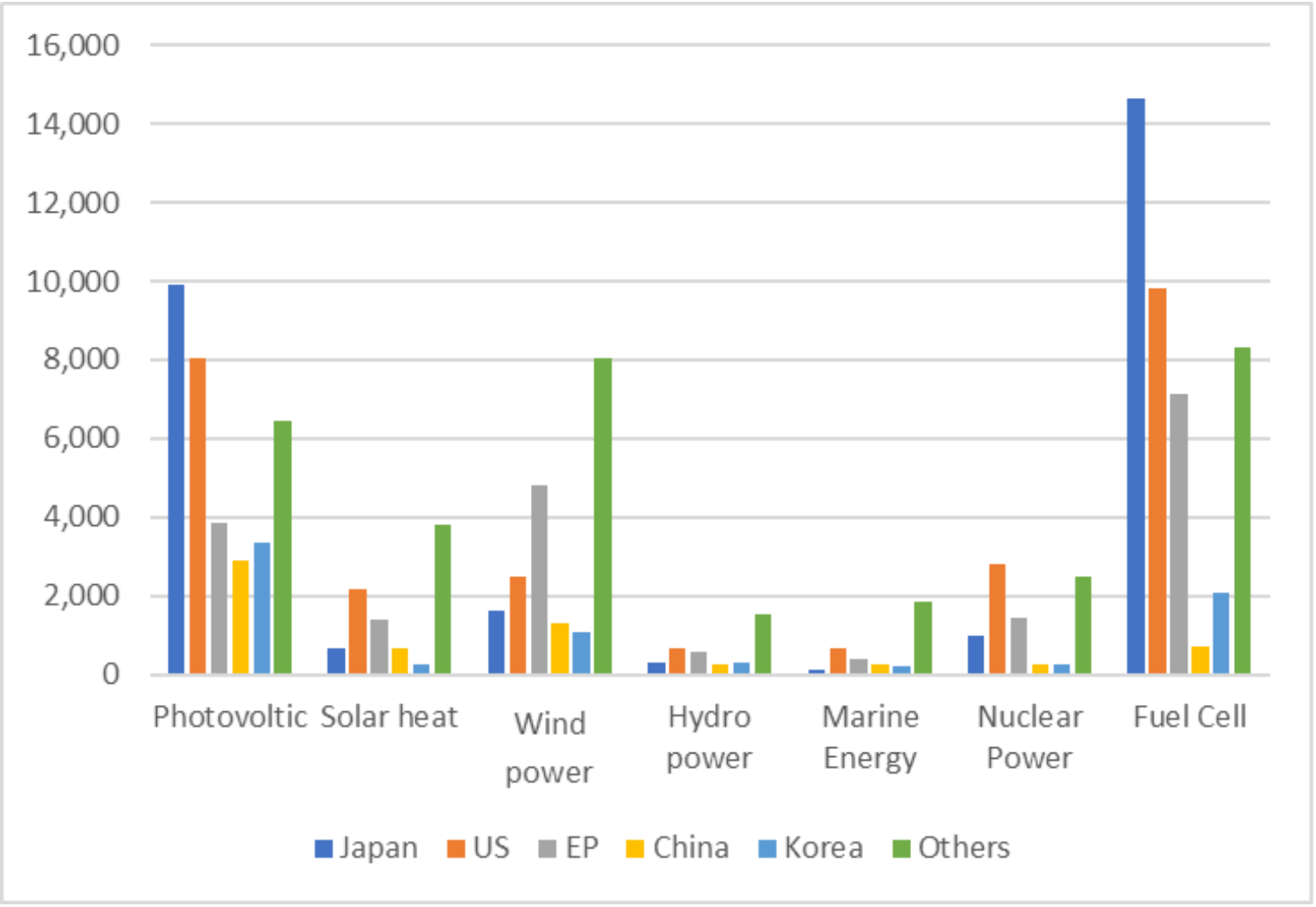
***Y02B: Climate Change mitigation technologies related to BUILDING (more extensive)

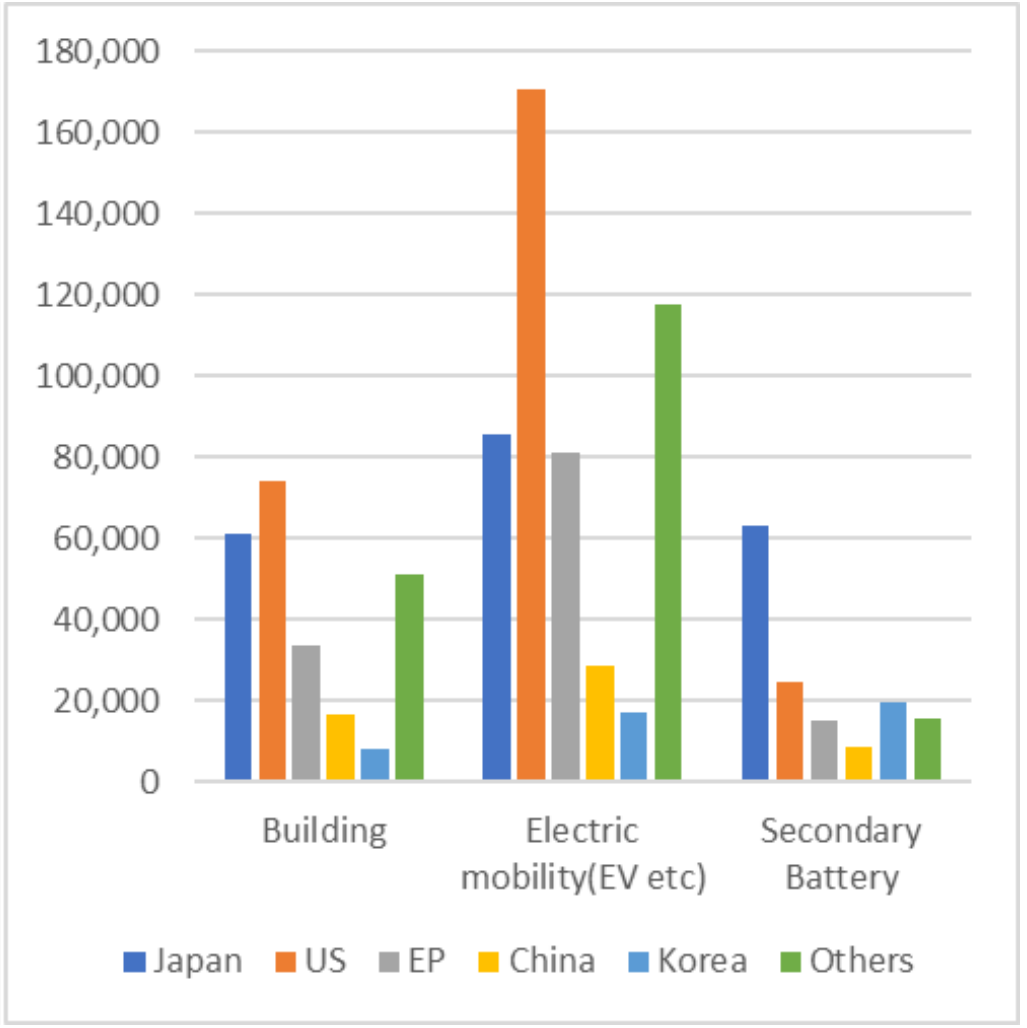
Mainly Used by OECD/WIPO report based on CPC, not available in our data (only IPC available)

Trend of Green Innovation Patents (WIPO-PCT international applications)



Green Innovation Patents by type





Eco-patents in India and ASEAN countries (domestic patent applications)

	ID	MY	PH	SG	TH	VN	IN
Photovoltic	91	429	138	365	177	120	1,603
Solar heat	0	0	3	4	0	2	125
Wind　power	71	58	90	58	93	138	2,695
Hydro power	63	68	64	40	89	83	492
Marine Energy	61	31	59	32	11	30	272
Nuclear Power	66	40	26	31	23	61	305
Fuel Cell	76	133	39	272	125	59	1,202
Building	2,169	2,649	2,001	4,356	2,744	1,946	9,334
Electric mobility(EV etc)	4,670	5,437	4,537	9,659	5,790	4,347	23,051
Secondary Battery	284	349	159	498	421	229	2,206
Total	7551	9194	7116	15315	9473	7015	41285
Domestic applicants share	8.2%	13.0%	-	3.1%	17.8%	6.5%	27.6%

Significant presence of MNEs : Identification of “domestic”

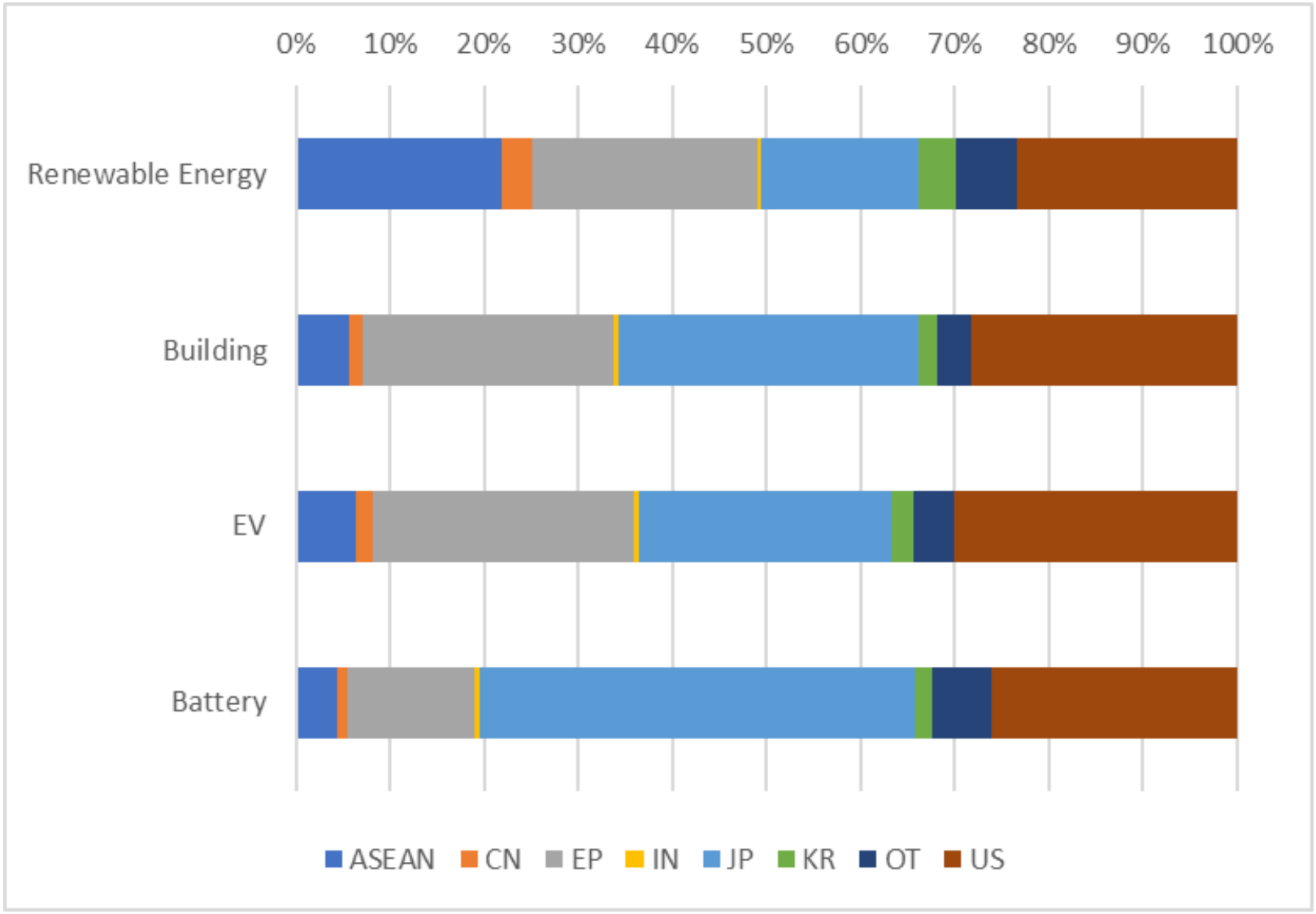
	Foreign ownership (ex. Japanese firm)	Domestic ownership (ex. Thai firm)	Domestic public research (incl. university)
Foreign invention (inventors outside Thailand)	Export to the market	Export competitiveness (not relevant except for China)	
Domestic invention (inventors inside Thailand)	Local R&D (FDI for R&D)	Local competitiveness	Public support to local innovation system

Geocoding results

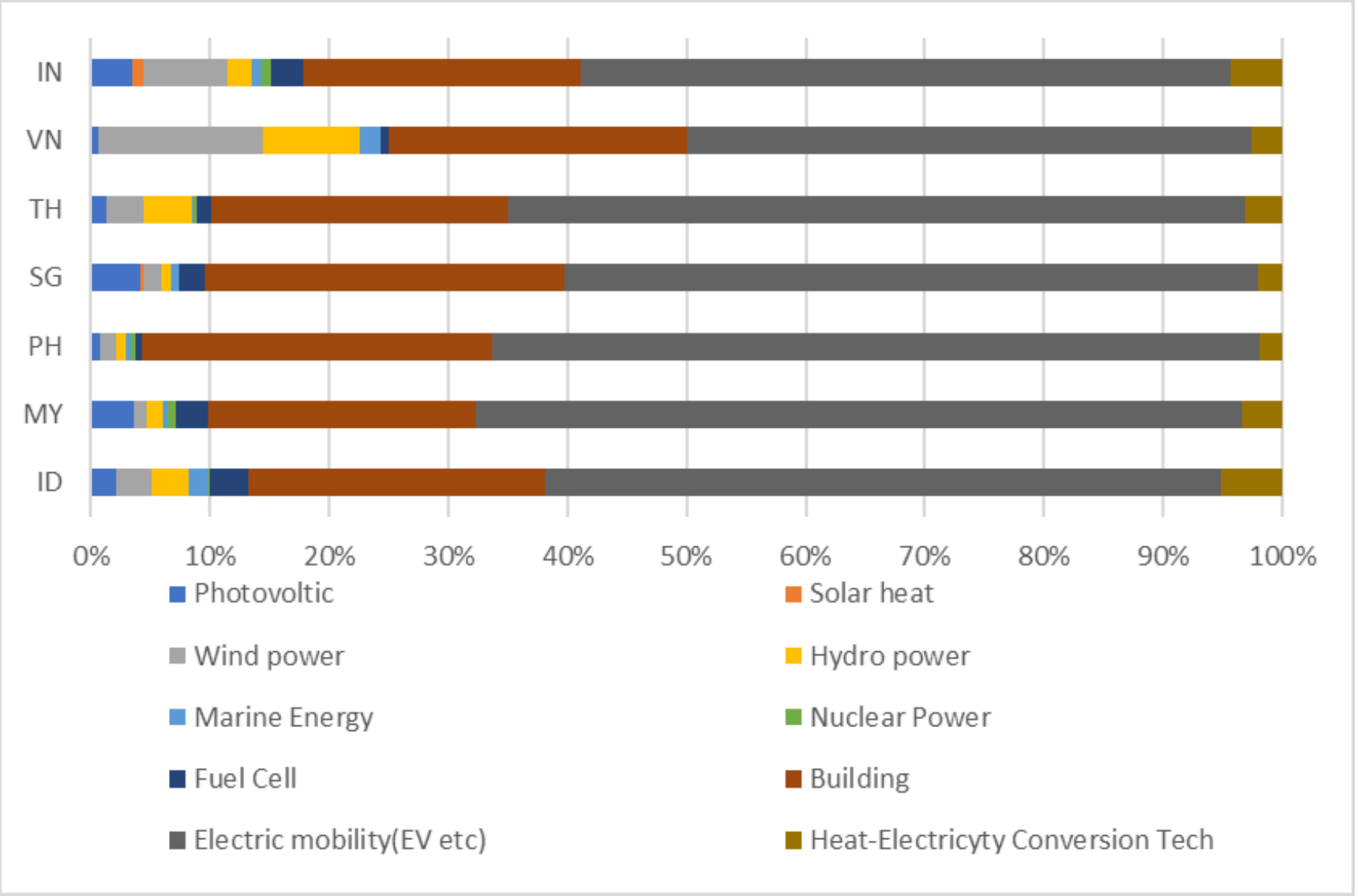
Technology spillovers

- Identification by applicant type (firm level data match)
- Identification by patent type (international application such as PCT route)

Presence of MNEs



Domestic Applicant Patents by Country

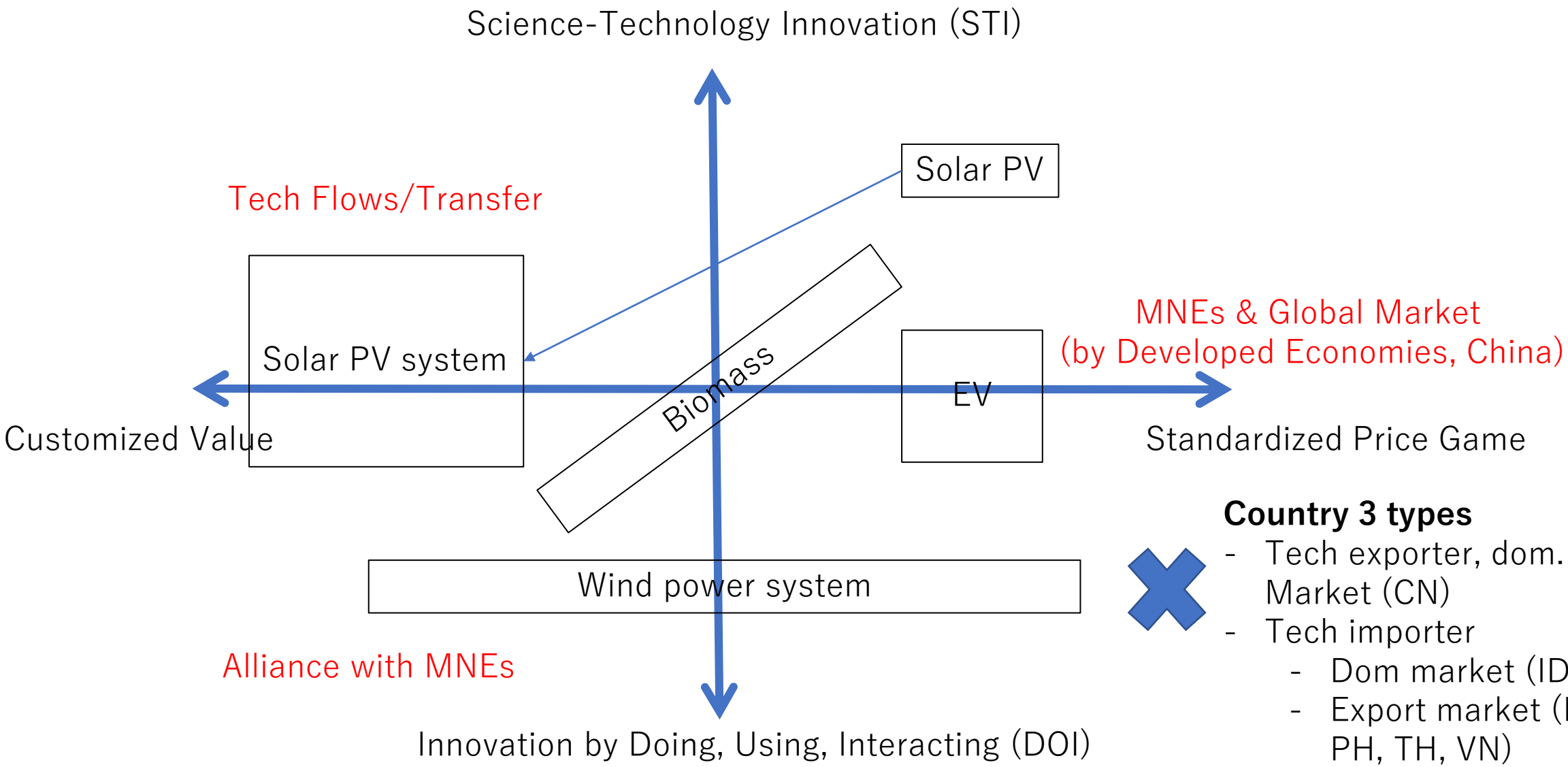


Implementation of renewable energy (GWh)

	Hydro		Wind		Solar		Bioenergy	
	in 2020	2020/2012	in 2020	2020/2012	in 2020	2020/2012	in 2020	2020/2012
China	1,355,210	1.55	467,037	4.53	261,659	59.58	98,978	4.12
India	164,678	1.24	63,522	2.75	54,666	56.07	21,987	0.91
Indonesia	24,428	1.90	8		176	3.67	12,382	1.39
Japan	87,548	1.05	8,970	1.85	79,087	11.96	27,995	2.14
Malaysia	25,907	2.80	0		471	58.88	2,541	1.60
Philippines	7,192	0.70	1,026	13.68	1,370	59.57	1,366	5.72
Thailand	5,017	0.55	3,522	207.18	3,049	3.68	30,692	2.65
VietNam	73,495	1.31	1,803	43.98	16,660	3332.00	322	0.85

- Local Implementation is important source of technology
- Global (patented) technology in JP : not always used actually

JSPS Green Innovation Project (2023-27)

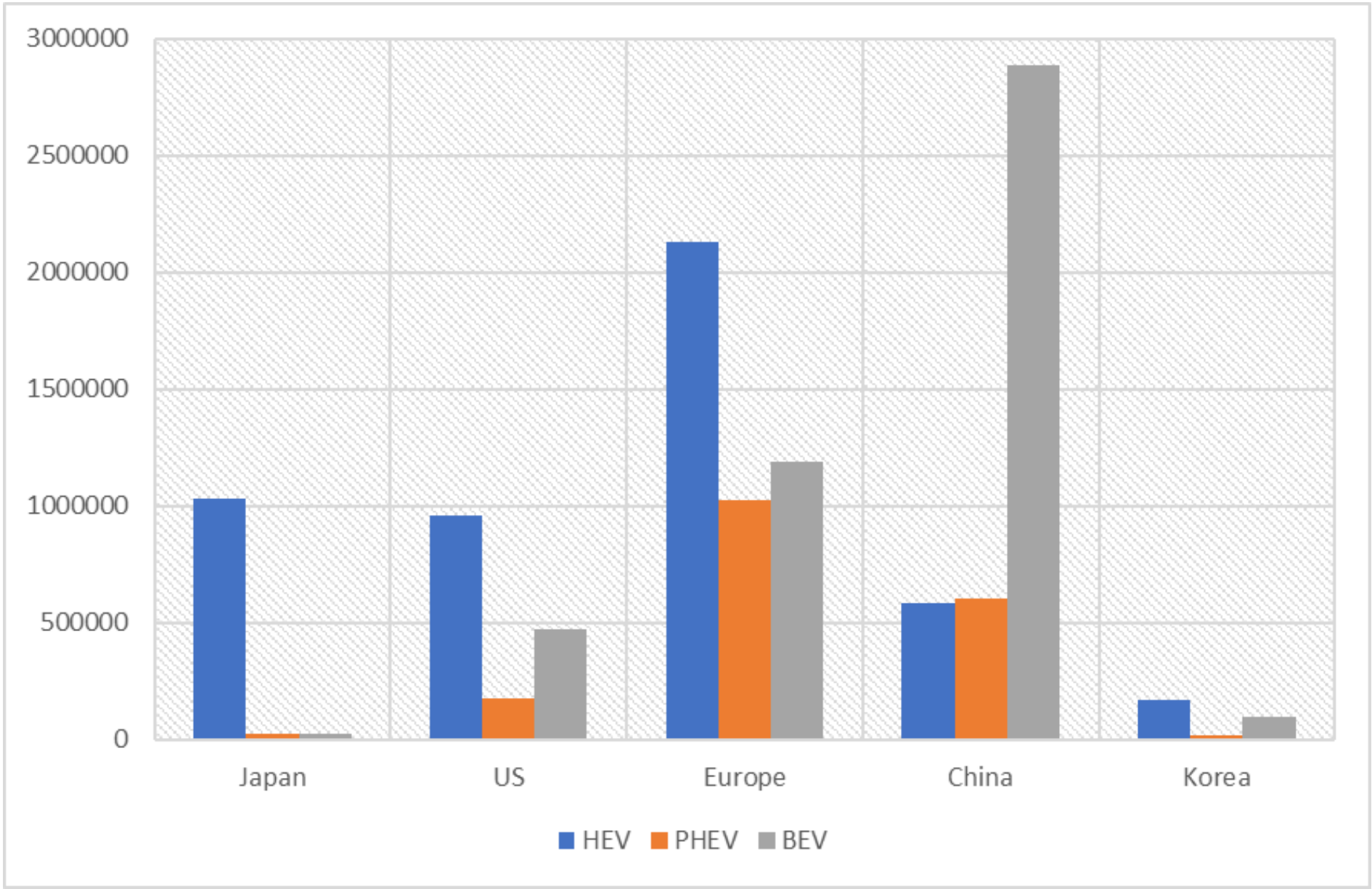


Country 3 types

- Tech exporter, dom. Market (CN)
- Tech importer
  - Dom market (ID,IN)
  - Export market (MY, PH, TH, VN)

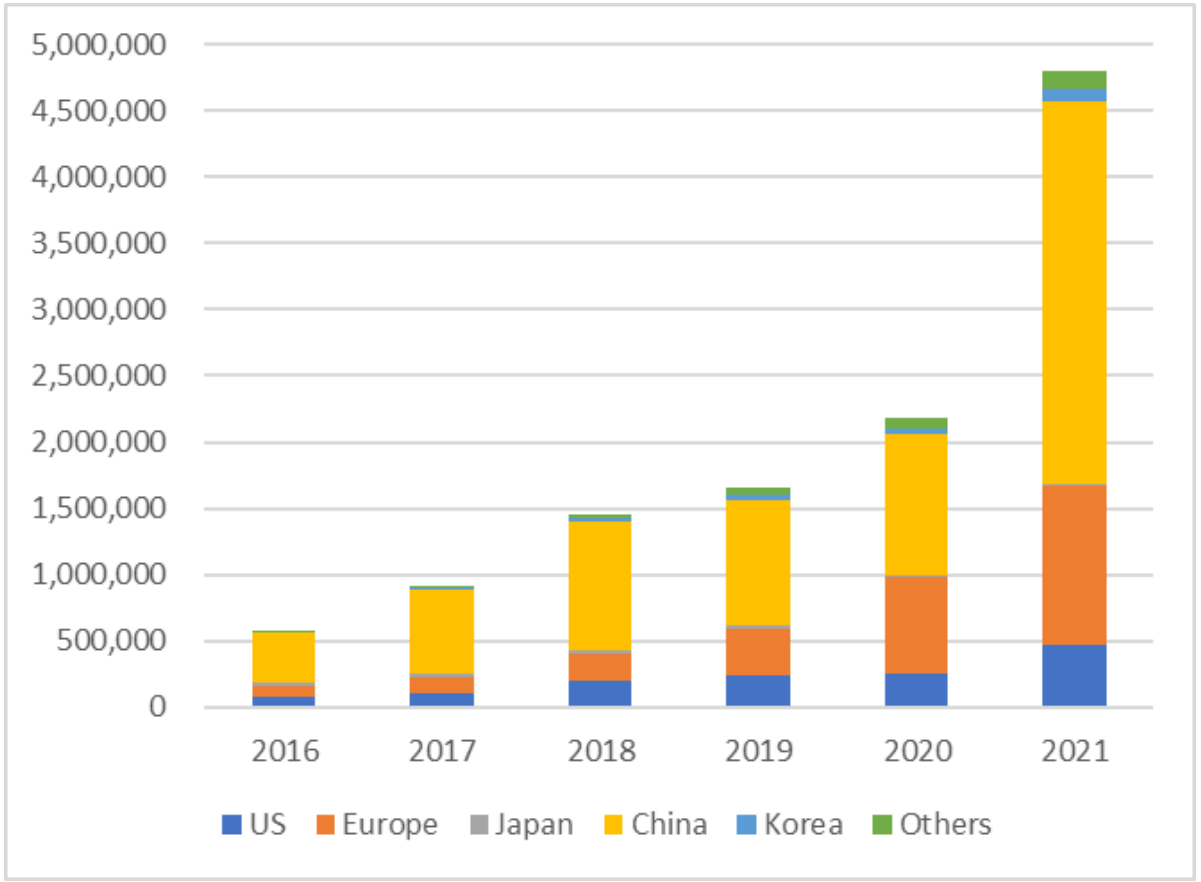
Binz, C. and Truffer, B. (2017), Global Innovation System- A conceptual framework for innovation dynamics in transnational contexts, Research Policy 46(2017)1284-1298

Number of Car Sales (HEV, PHEV, BEV) in 2011

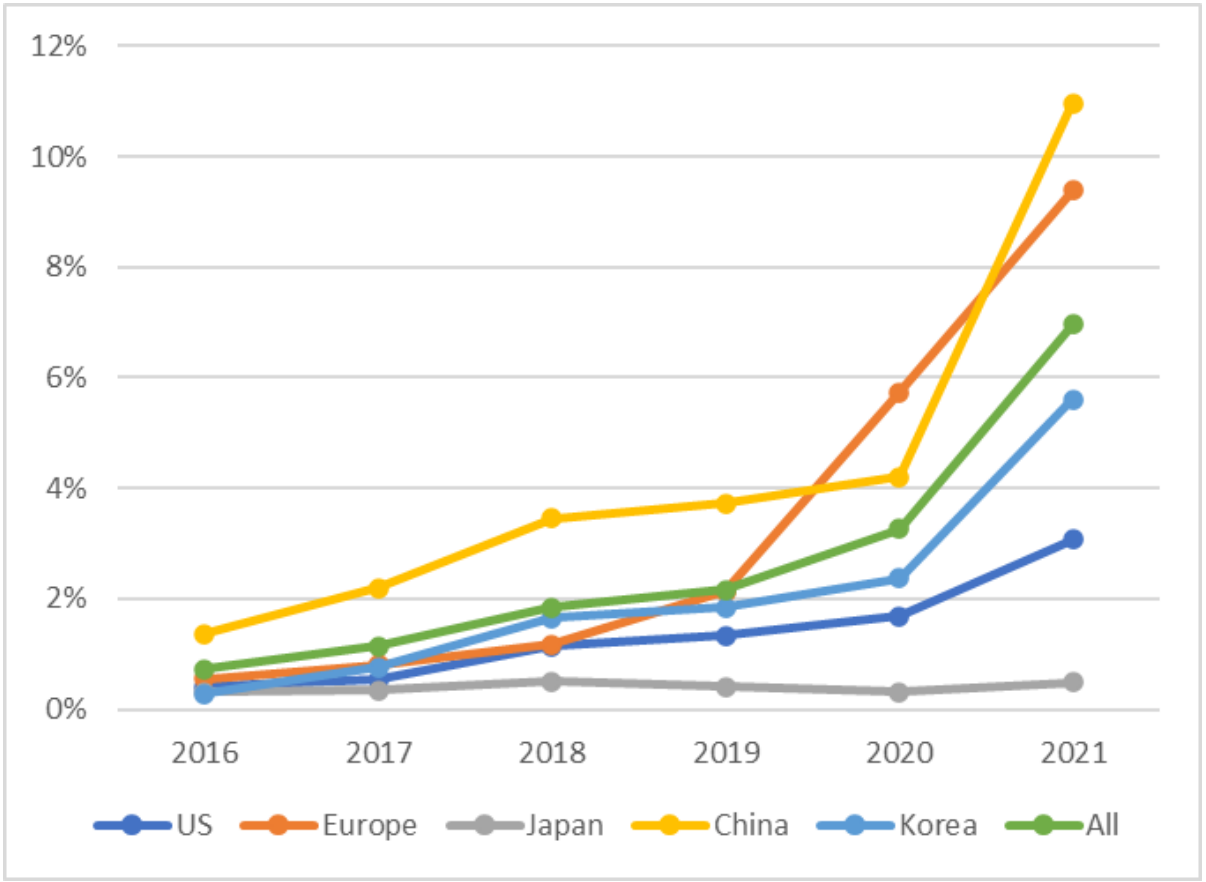


BEV (Pure EV) market in the world

Market Size



Share in the total car market



BEV manufacturers (top 10+ Nissan)

	2016	2021	Share	Main Market
Tesla	73,551	795,694	16.6%	US, China, Europe
Wuling		396,241	8.3%	China
BYD	32,624	296,275	6.2%	China
VW	13,087	251,020	5.2%	Europe
Ola		133,313	2.8%	China
Trumpchi		129,021	2.7%	China
Hyundai	2,931	127,724	2.7%	US, Europe
ChangAn	5,096	102,667	2.1%	China
Kia	5,819	99,168	2.1%	US, Europe
Xpen		96,684	2.0%	China
(Nissan)	48,401	61,406	1.3%	US, Japan

Shift to ZEV in global markets

Compulsory regulations

- US : BEV/PHEV/FCEV 50% of all cars by 2030, California State, NY State : ZEV 100% by 2035
- Europe : Germany: PHEV/BEV/FCEV installment of 15mil by 2030, France : BEV/FCEV 100% by 2040, UK BEV/FCEV 100% by 2035
- China : NEV (mainly PHEV or above) 50% by 2035
- Japan : EV (no ICEV) 100% by 2035
- India : EV 30% by 2030
- Korea : BEV/FCEV 33% by 2030

BEV World Market Share : 6.8% (2021) -> more than 30% in 2035?

Evolution of Passenger Vehicles in 2035

ICEV(82%) 73m

HEV(8%) 5m

PHEV(3%) 2m

BEV(7%) 5m

w/ ICEV (60%) 65 mil

EV w/o Charge Infra (18%) 20 mil

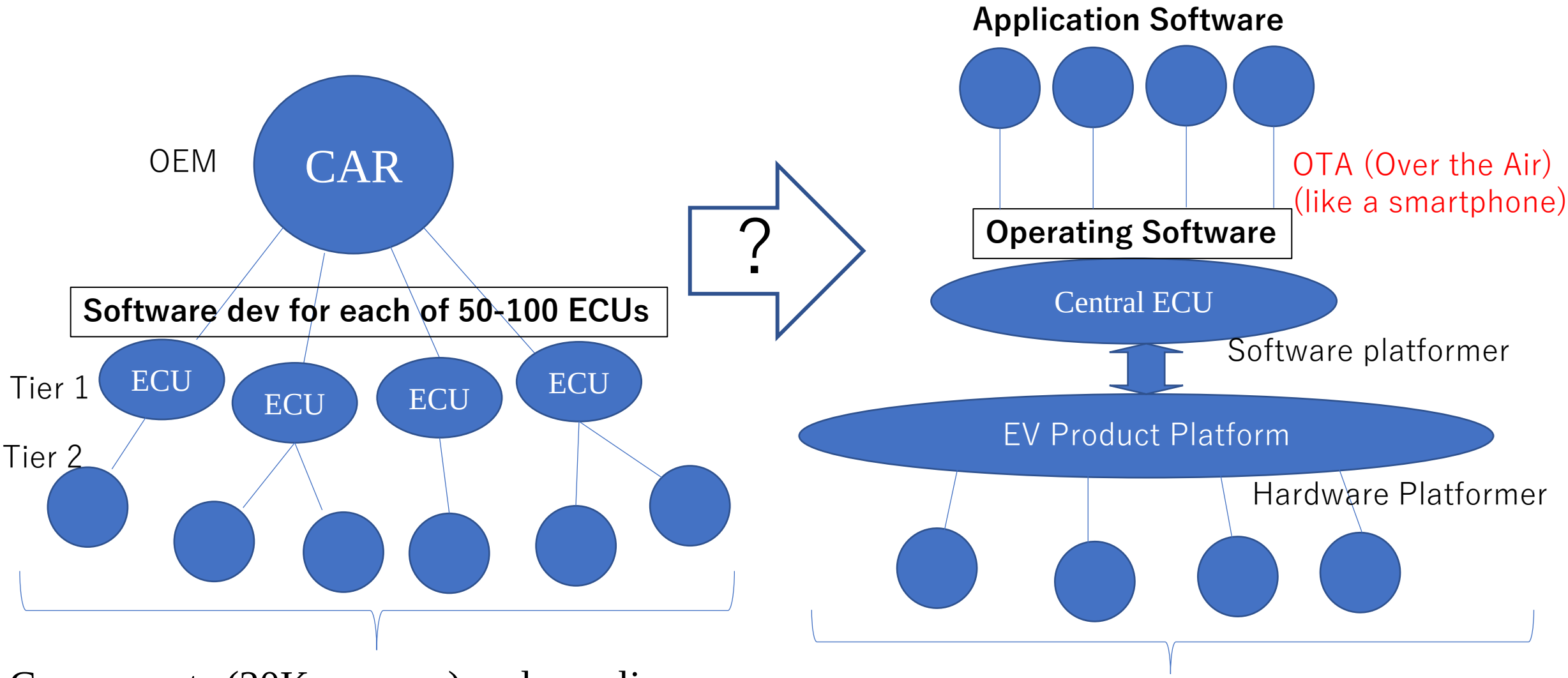
EV w Charge Infra (22%) 25 mil

What will happen from ICEV to BEV?

More importantly

1. Lower the hurdle of manufacturing : Integrated Car Manufacturer (OEM) -> Decoupling of “design” and “manufacturing” (like IDM -> Fabless + Foundry in semiconductor industry)
2. Tangible (car as a product) -> Intangible (software, design)
3. Water fall style software development model -> Agile software development
4. Changing nature of customer valuation (product -> service)
   - Mobility as a service (MAAS), instead of car as a product (ride hailing service, autonomous driving)
   - And, car is not only for mobility, but more? (Apple car? Connection with IoT device)

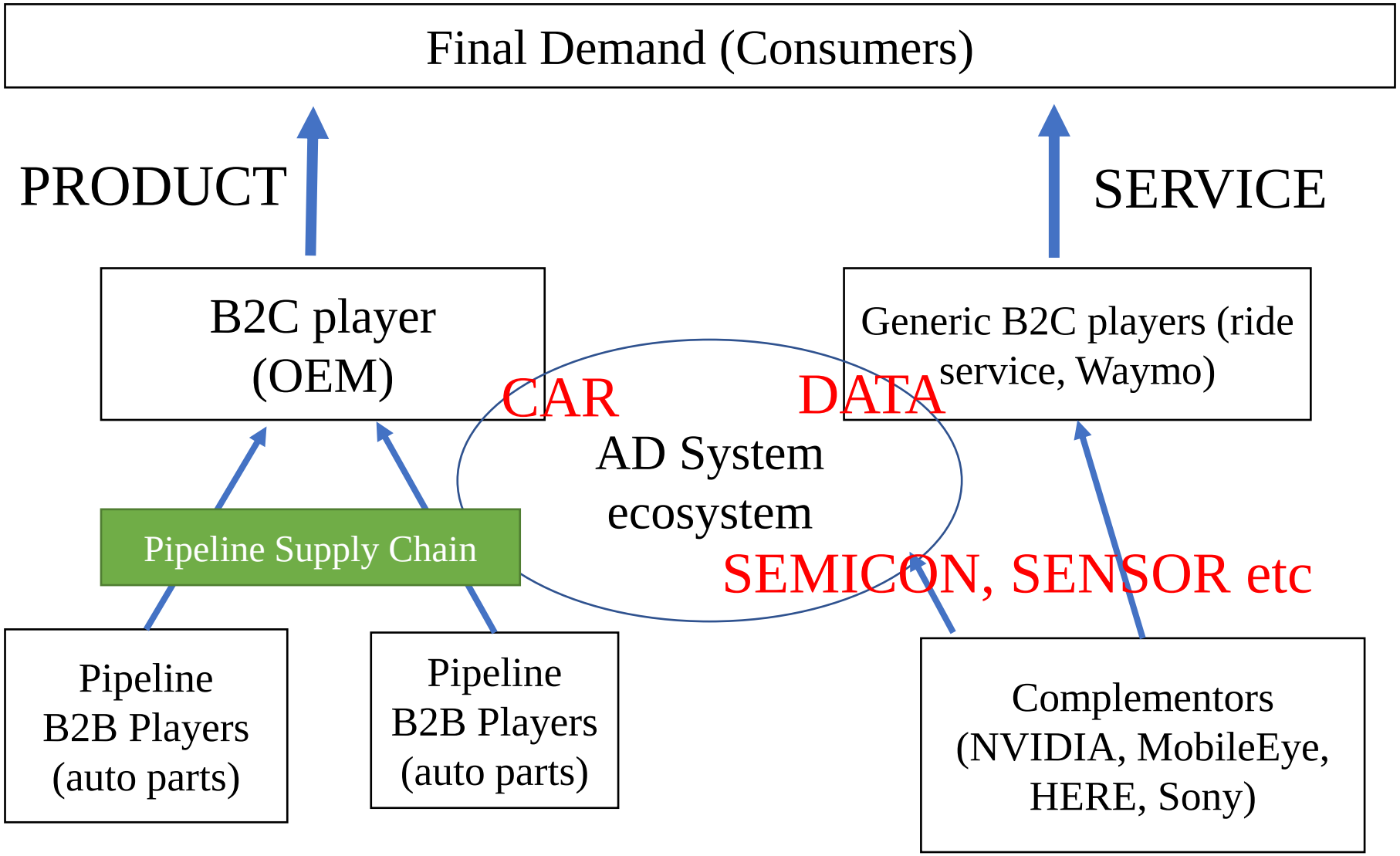
Integrated -> Platform based architecture (1, 2, 3)



Components (20K or more) and suppliers

Components (10K or less) and suppliers

MAAS (Mobility As A Service) and Autonomous Driving (4)



Win-win solutions by Japan-India cooperation?

Renewable energy system

- Local implementation > Technology in general (DOI mode innovation)
- But some technology driven (STI mode innovation) product/service, can be complement each other (JP tech on building management system, flexible solar panel etc.)

EV

- Lagging behind China for both countries, and JP firms dominates both market and technology for ICEV (HEV too)
- Great opportunities for India in terms of mini-EV (such as Wuling Hongguan in rural China)
- Commoditizing product -> more chances for India software firms business development with global car makers : Win-win for JP firms for low cost strategy for (remaining) ICEV market