H2 part in Japanese energy policy: 180703

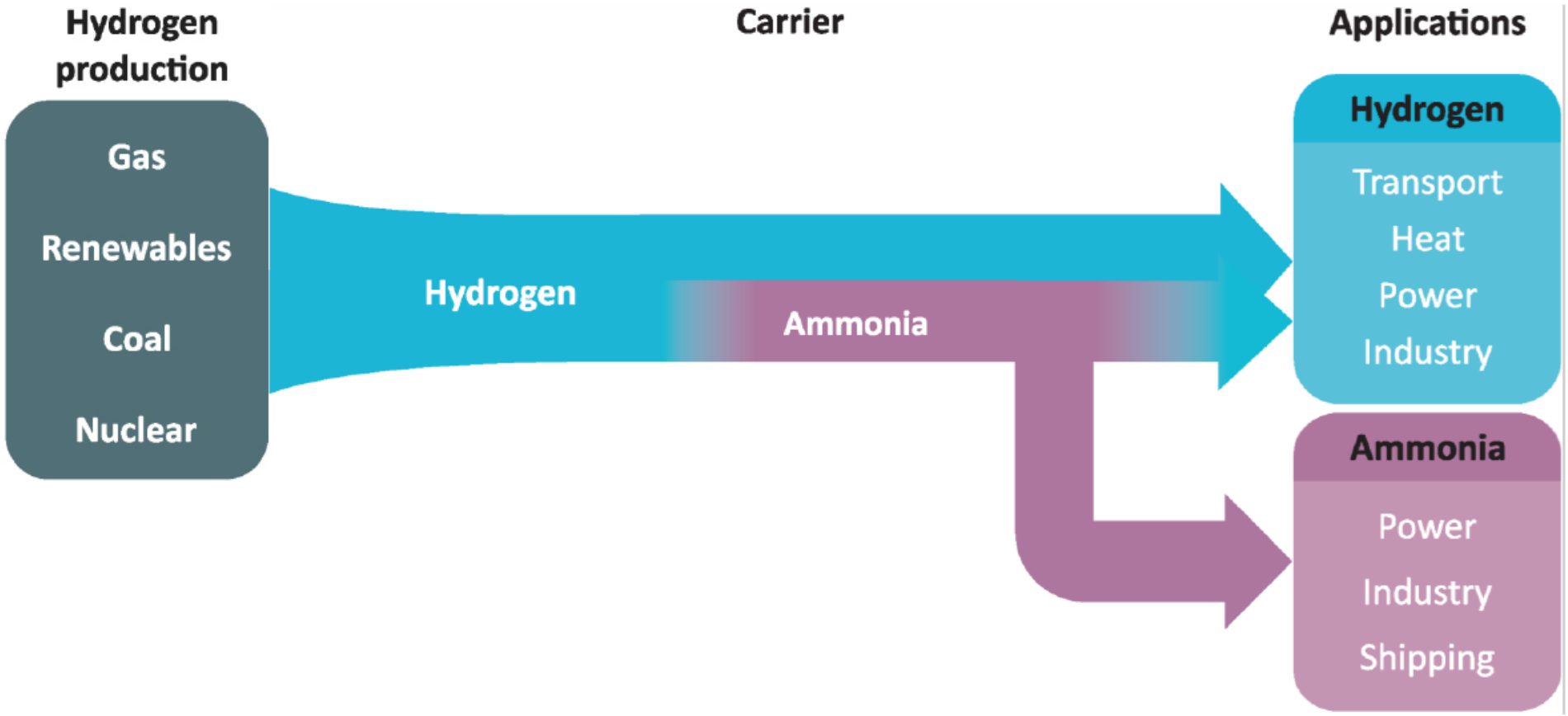
- **6. Hydrogen society**
- 1) Energy saving through H2 fuel cell
- 2) FCV & hydrogen station
- 3) Hydrogen supply chain & power generation

  Liq. H2, MCH, **Ammonia**, and CH4 as hydrogen carrier; **3**0¥/m3 (17¥/kWh), **3**00kt-H2, &/or **3**Mt-NH3 import by 20**3**0.
- 4) P2G technology, electrolysis unit (<50k¥/kW) by 20
- 5) Hydrogen tech. demo at Olympic 2020
- 6) Intern. Activity; IPHE, IEA, IRENA, 2019 sumit.

Tokyo Statement, 181023 Tokyo, Japan
Chair's Summary of Hydrogen Energy Ministerial Meeting

- **The Ministers and Delegates (19 countries, EU, and IEA)** responsible for hydrogen energy within their respective countries met in Tokyo, to promote cooperation on research, development and deployment of hydrogen technologies within their societies. Together, they shared the view that hydrogen can be a key contributor to the energy transitions underway to a clean energy future and an important component of a broad-based, secure, sustainable and efficient energy portfolio.
- **1. Collaboration on Technologies and Coordination on Harmonization of Regulation, Codes and Standards**
- **2. Promotion of Information Sharing, International Joint Research and Development Emphasizing Hydrogen Safety and Infrastructure Supply Chain**
- **3. Study and Evaluation of Hydrogen's Potential across Sectors Including Its Potential for Reducing Both CO2 Emissions and Other Pollutants**
- **4. Communication, Education and Outreach**

Hydrogen has many production sources and applications



Hydrogen can be produced from different sources & has multiple applications, including in transport, industry, buildings & power generation; when produced from fossil fuels, coupling with CCUS maximises CO_2 benefits

Session 6: **Ammonia Markets (B)**
Introducing a new traded energy commodity

What is happening now that will foster implementation?
Cross-national cooperation in the development of ammonia energy trade relationships
Early discussion of national and/or international systems for green ammonia certification

Keys for world market (queries to each country)

1. How is the “green” evaluated? (Consumer)
2. How is energy industry going to change to ammonia? (Producer)

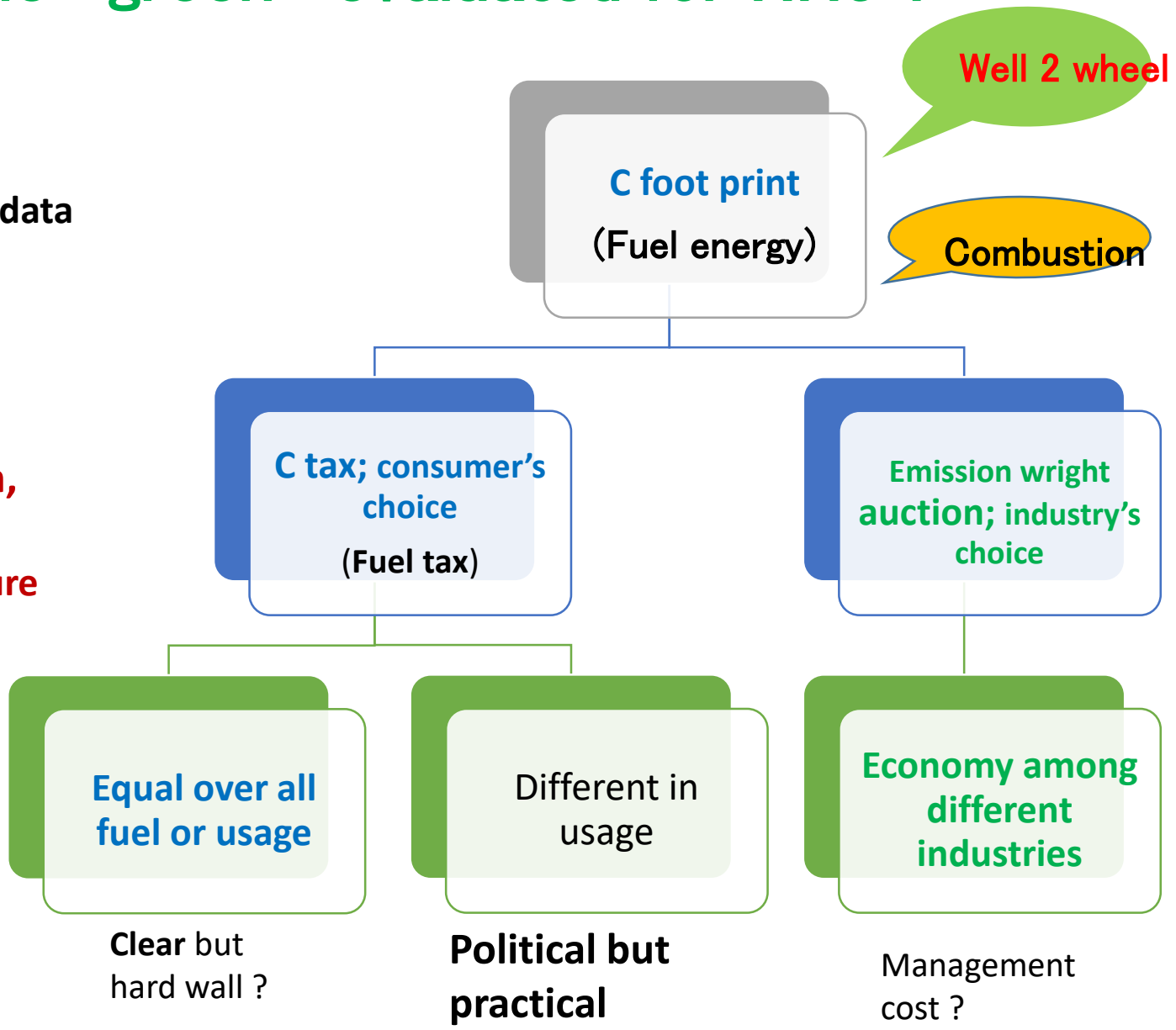
By Ken-ichi Aika, Tokyo Inst. Tech. 181101

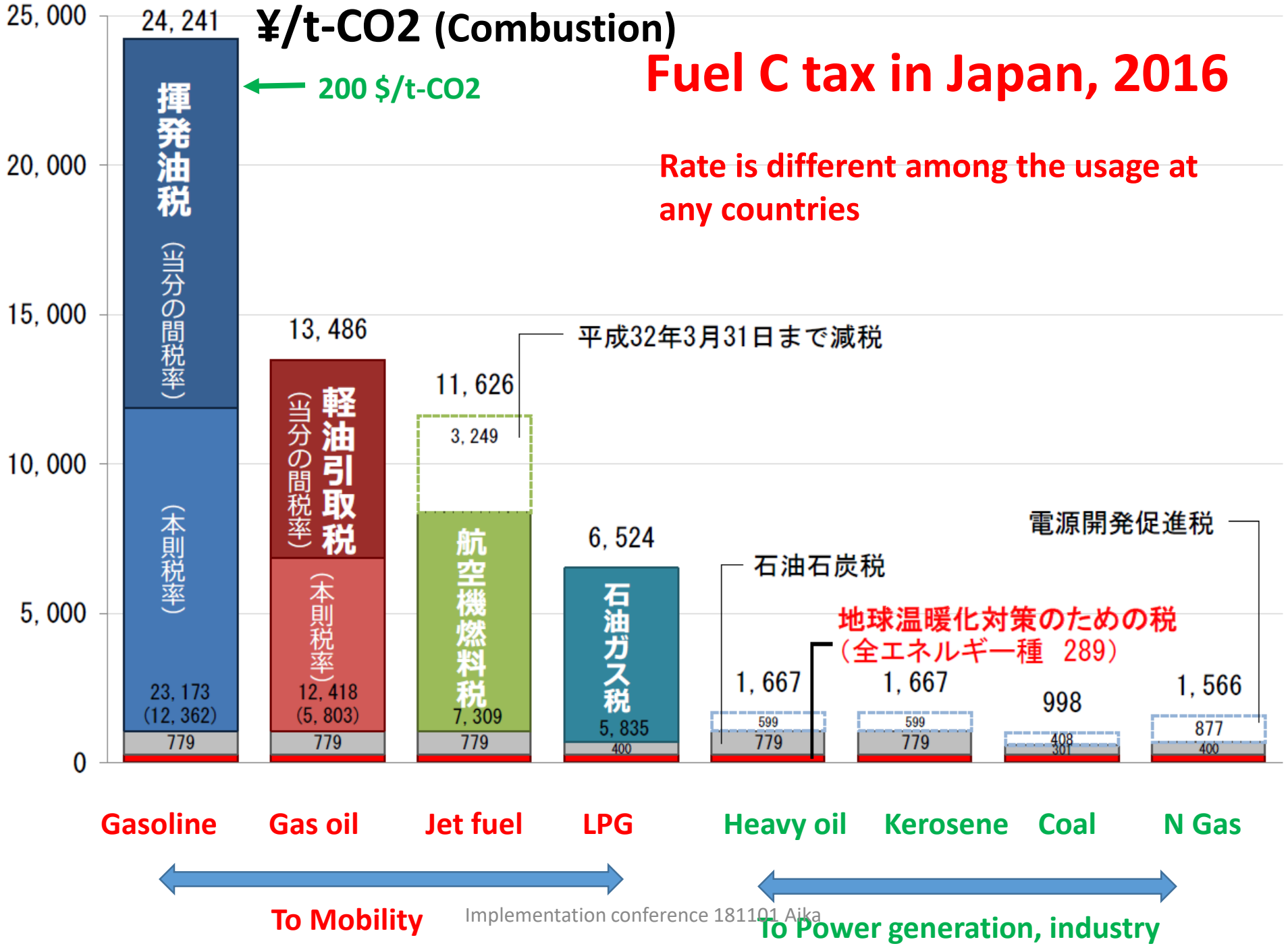
1. How is the “green” evaluated for NH3 ?

Green data

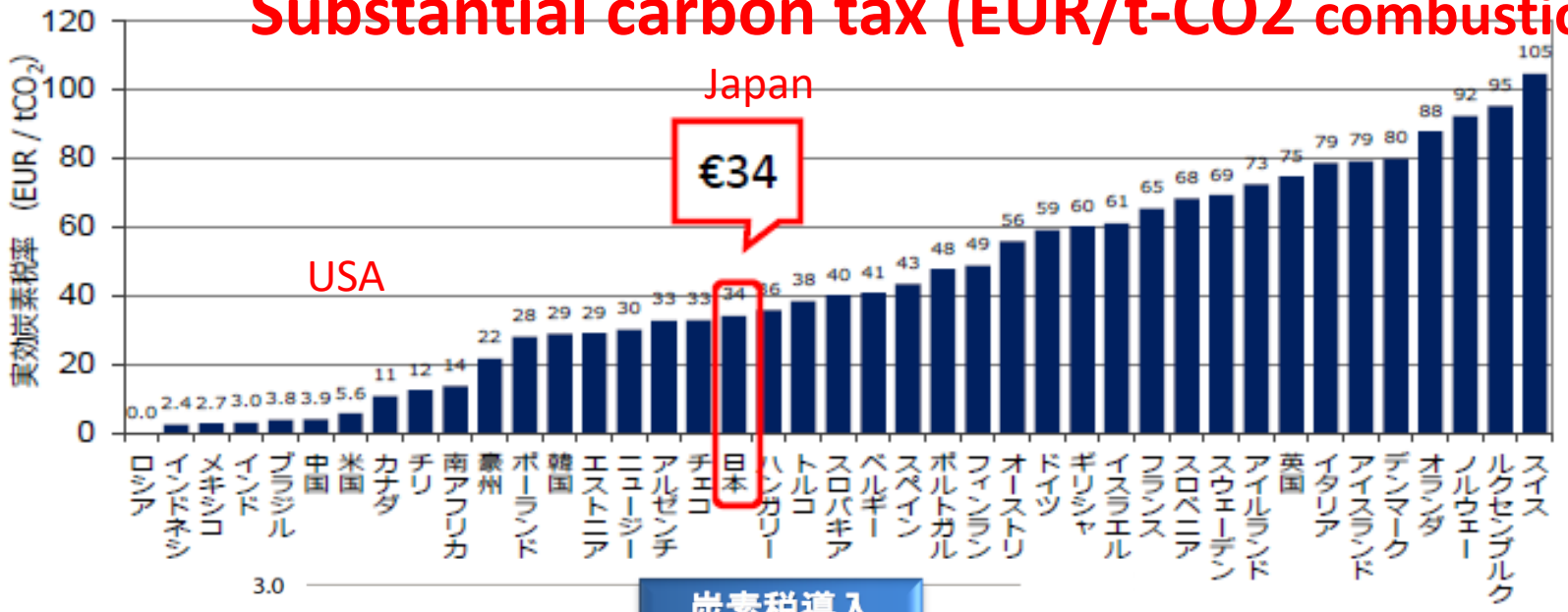
Combustion data

Legislation,
C pricing
For the future



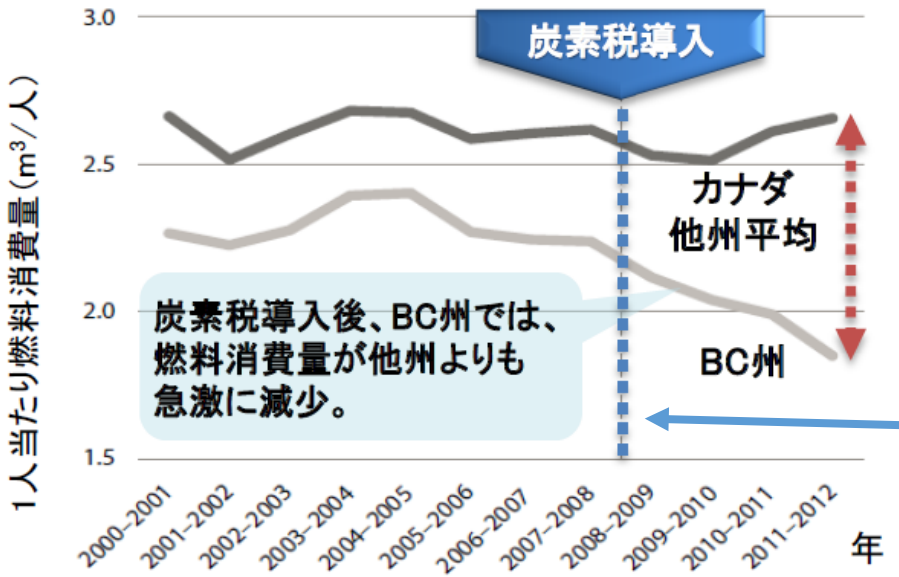

¥/t-CO2 (Combustion)
200 $/t-CO2
Fuel C tax in Japan, 2016
Rate is different among the usage at any countries
25, 000
20, 000
15, 000
10, 000
5, 000
0
24, 241
揮発油税
（当分の間税率）
（本則税率）
23, 173
(12, 362)
779
13, 486
軽油引取税
（当分の間税率）
（本則税率）
12, 418
(5, 803)
779
11, 626
3, 249
航空機燃料税
7, 309
779
平成32年3月31日まで減税
6, 524
石油ガス税
5, 835
400
石油石炭税
電源開発促進税
地球温暖化対策のための税
（全エネルギー一種　289）
1, 667
599
779
1, 667
599
779
998
408
301
1, 566
877
400
Gasoline
Gas oil
Jet fuel
LPG
Heavy oil
Kerosene
Coal
N Gas
To Mobility
To Power generation, industry

Substantial carbon tax (EUR/t-CO2 combustion)



Swiss
Luxembourg
Norway
Netherland
Denmark

Fuel m3 /Head

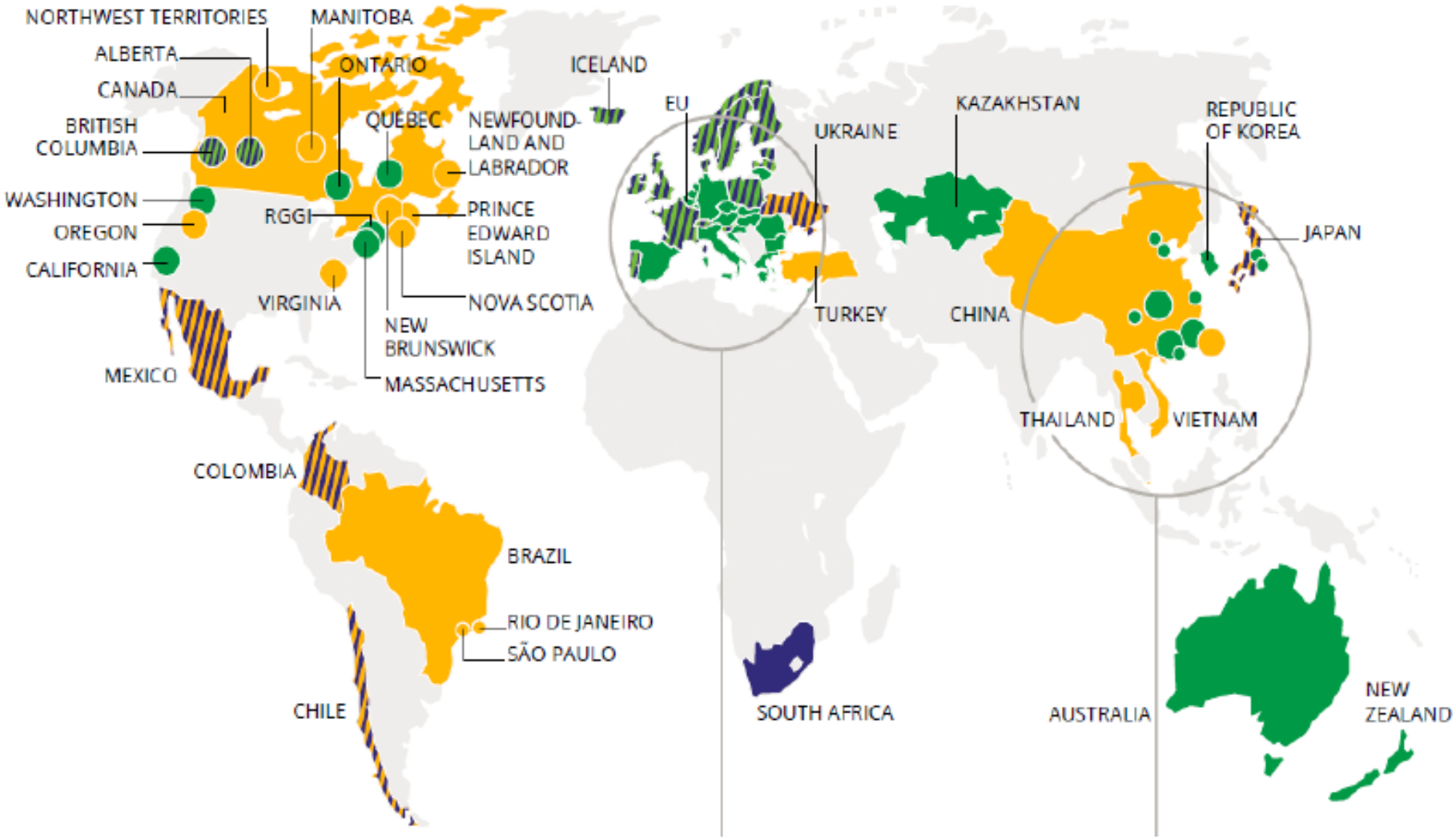


Other Canada

World movement

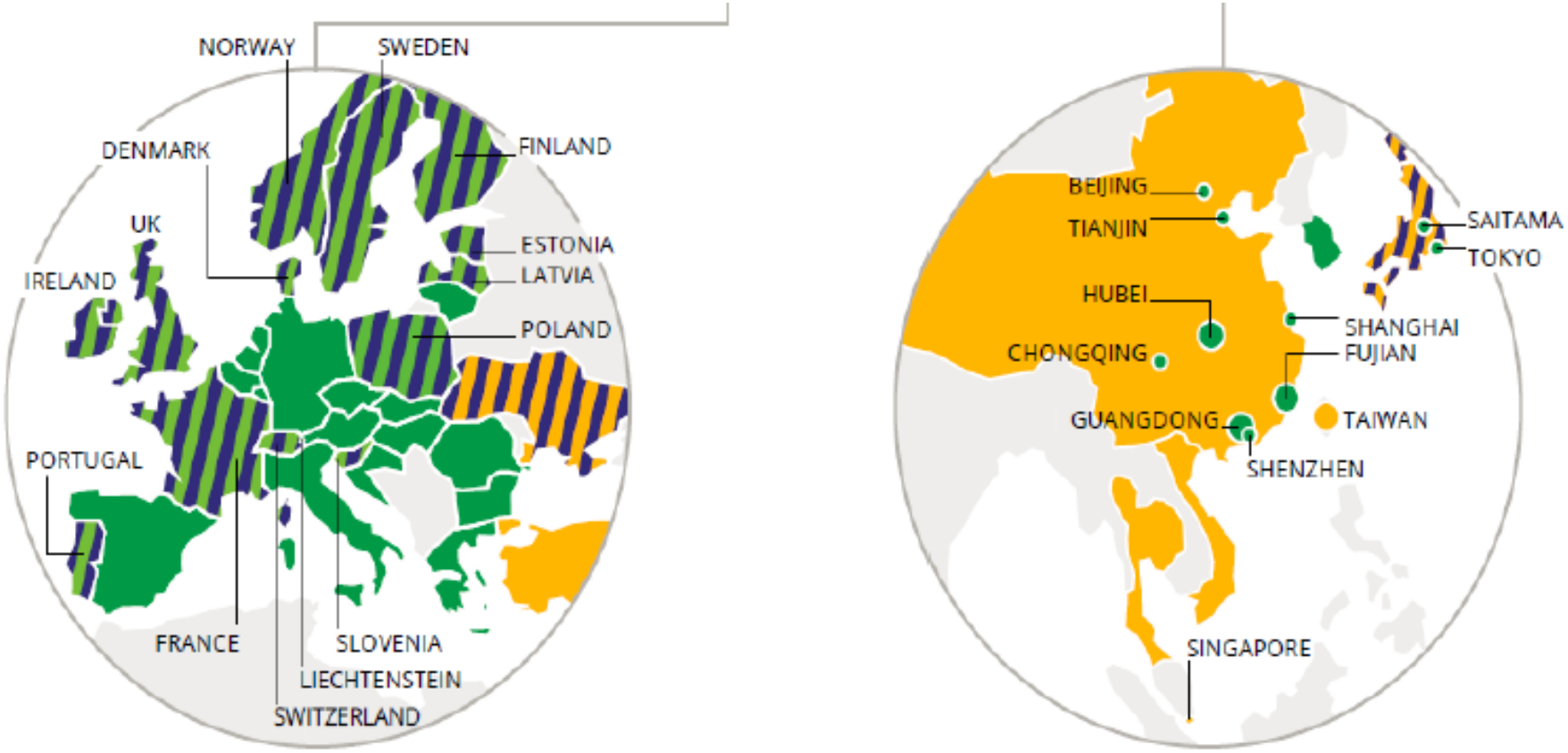
Carbon tax effect

（出典）Elgie and McClay (2013)「BC's Carbon Tax Shift Is Working Well after Four Years」（Canadian Public Policy / Analyse de Politiques, Vol. 39, Special Supplement on Environmental Policy in Canada, S1-S10）Figure 1より作成。



World Bank, Ecofys and Vivid Economics（2017）「State and Trends of Carbon Pricing 2017」

- CO2 Auction decided or going on
- CO2 Auction + C tax decided or going on
- C tax decided or going on
- C tax decided or going on and CO2 Auction under consideration
- C tax or CO2 Auction under consideration

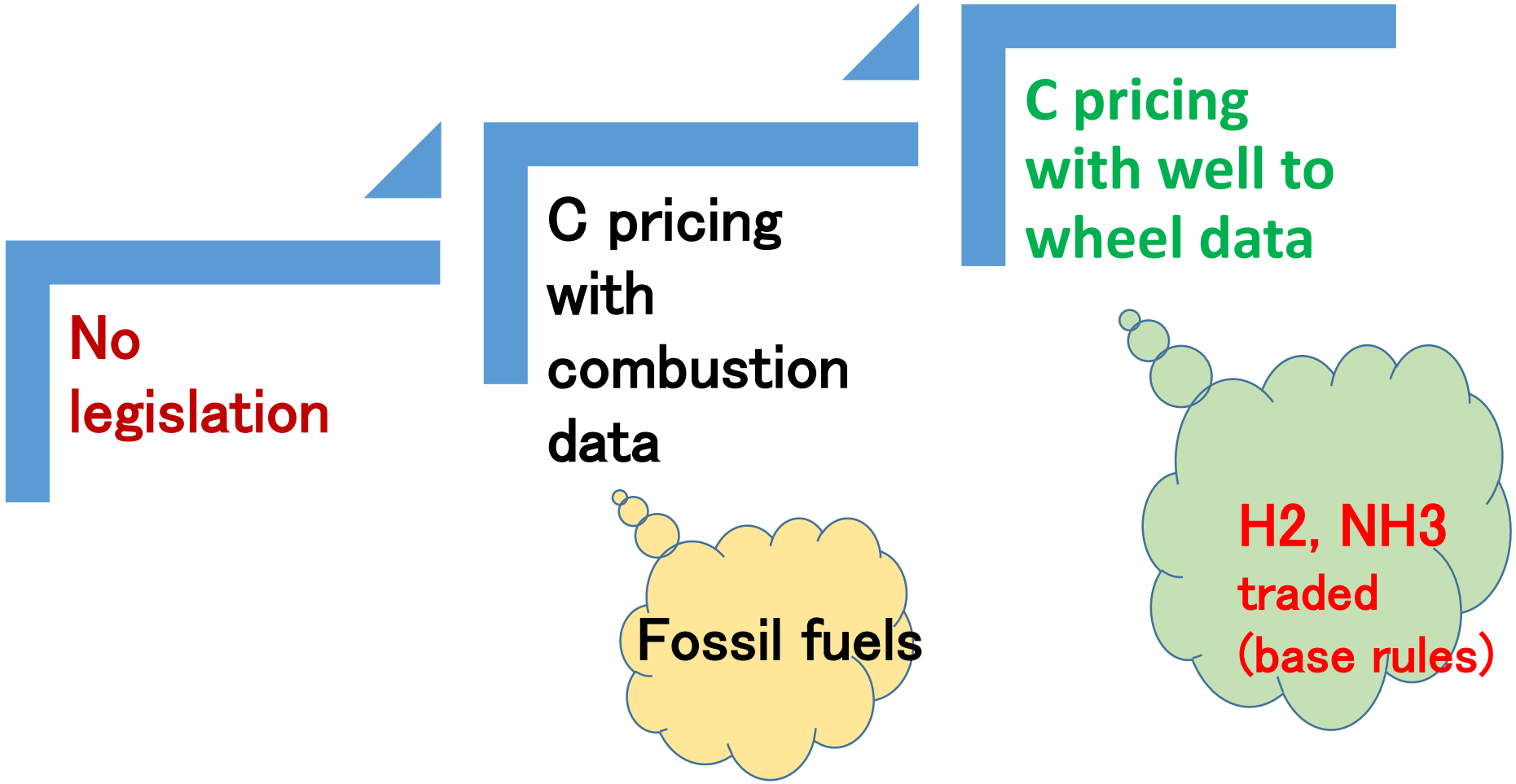


排出量取引制度のみ：導入済／導入決定
炭素税のみ：導入済／導入決定
排出量取引制度又は炭素税：検討中
排出量取引制度及び炭素税：導入済／導入決定
炭素税：導入済／導入決定、排出量取引制度：検討中

World Bank, Ecofys and Vivid Economics（2017）「State and Trends of Carbon Pricing 2017」

CO2 Auction decided or going on
CO2 Auction + C tax decided or going on
C tax decided or going on
C tax decided or going on and CO2 Auction under consideration
C tax or CO2 Auction under consideration

Overcoming two steps !

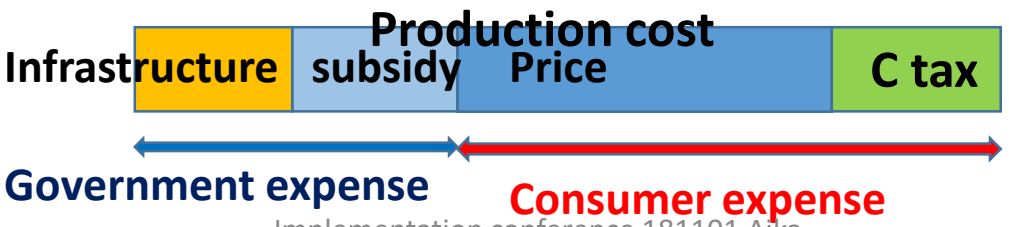


(Partly from Ministry of the environment, carbon pricing committee report; Jul 18)

- C-tax shall start when innovation of de-carbonization technology which also solves the economic & social issue is recognized. **"De-coupling"**

- The stile: C tax (relating C amount) mixed with subsidy (not relating C) because of the history.

- Arranging infrastructure is necessary.
- Policy protecting carbon leakage (competition against low cost goods releasing much CO2 by the other countries).



Foreseen by K. Aika

Distance between “green” and “economy” : not far away but they would not stick ??

Tokyo metropolitan gov. practiced **eco-labelling** (air cond., refrigerator, TV) **2005-06: Disposed !**

Price is shown out of the label.
“De-coupling”

Energy efficiency

A year elect. bill

The government separated “green” from “economy”. “De-coupling”

Consumer judged the two indexes separately.

The eco-labelling is said to be the successful eco-policy.

How to relate “green” to policy?

- Ans: Complicated and hard, but must be prepared.

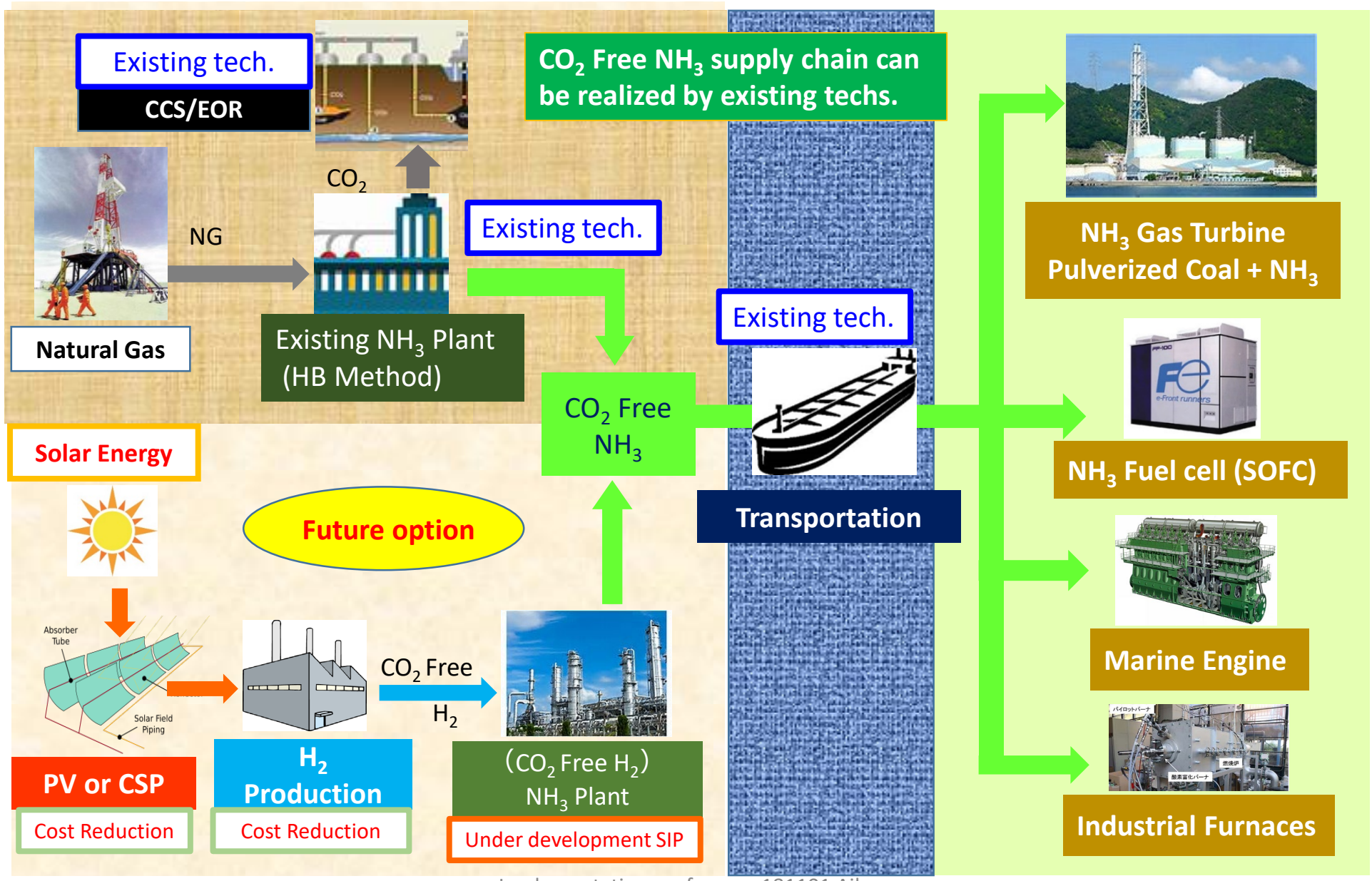
- Our first mission is to gather green data (**LCA, CFP, Well to wheel**) especially in ammonia economy (including cost **FS**).
- Public institutions work and communicate each other.
- Support to increase the number of specialist of LCA and FS.

2. How is energy industry going to change to ammonia? (Producer)

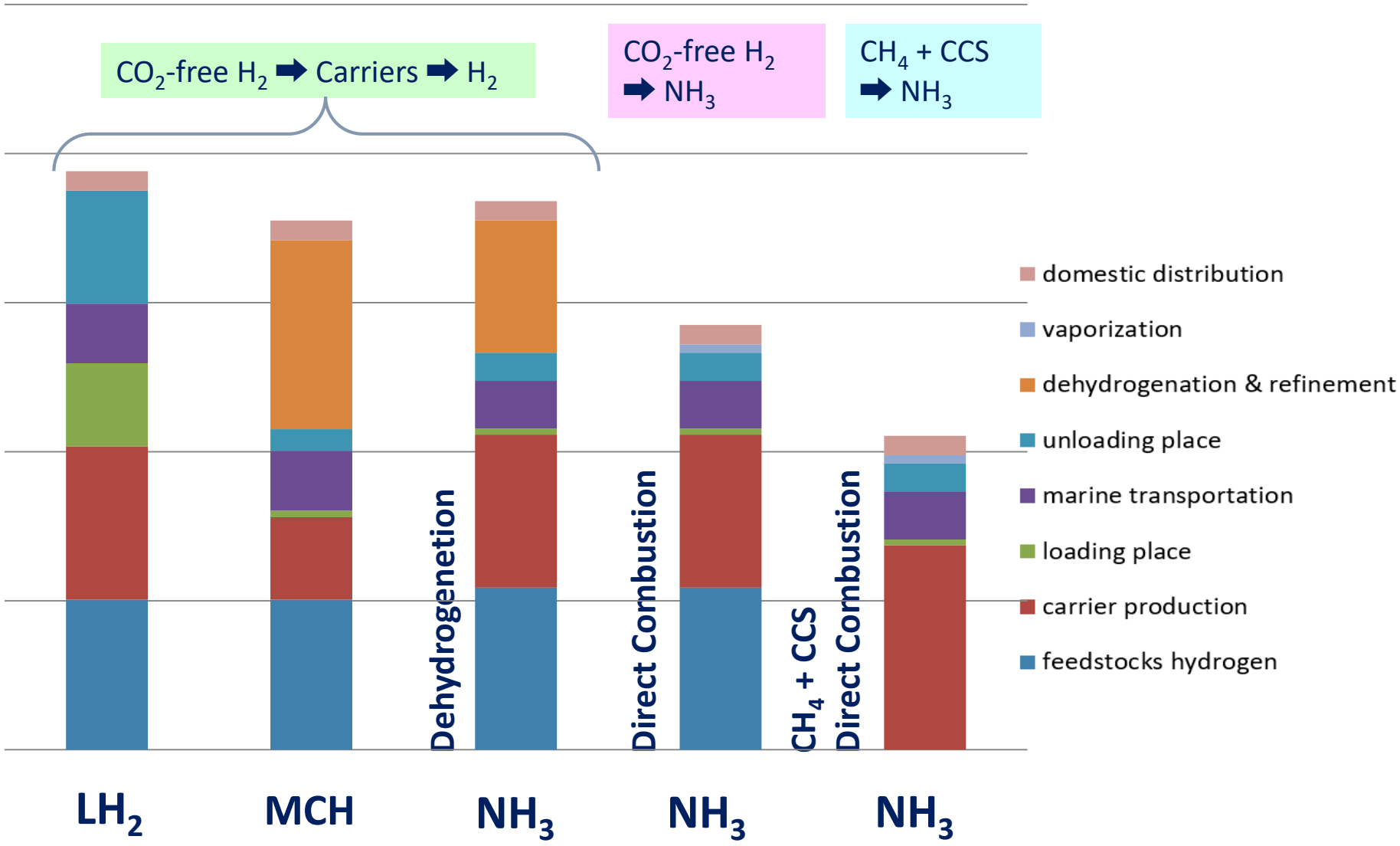
- The world looks like to go chaos !
- Keep peace > **avoid chaos** > stable energy cost
- **Keep oil and coal countries stable** (i.e. Japan imports 40% oil from Saudi, 64% coal from Australia) > Understand economic change from fossil fuel to hydrogen (&/or NH3) export.

- How is the situation at the CO2 free ammonia producing countries? By EOR or Renewables? Policy? Economic incentives? "Open to discussion"

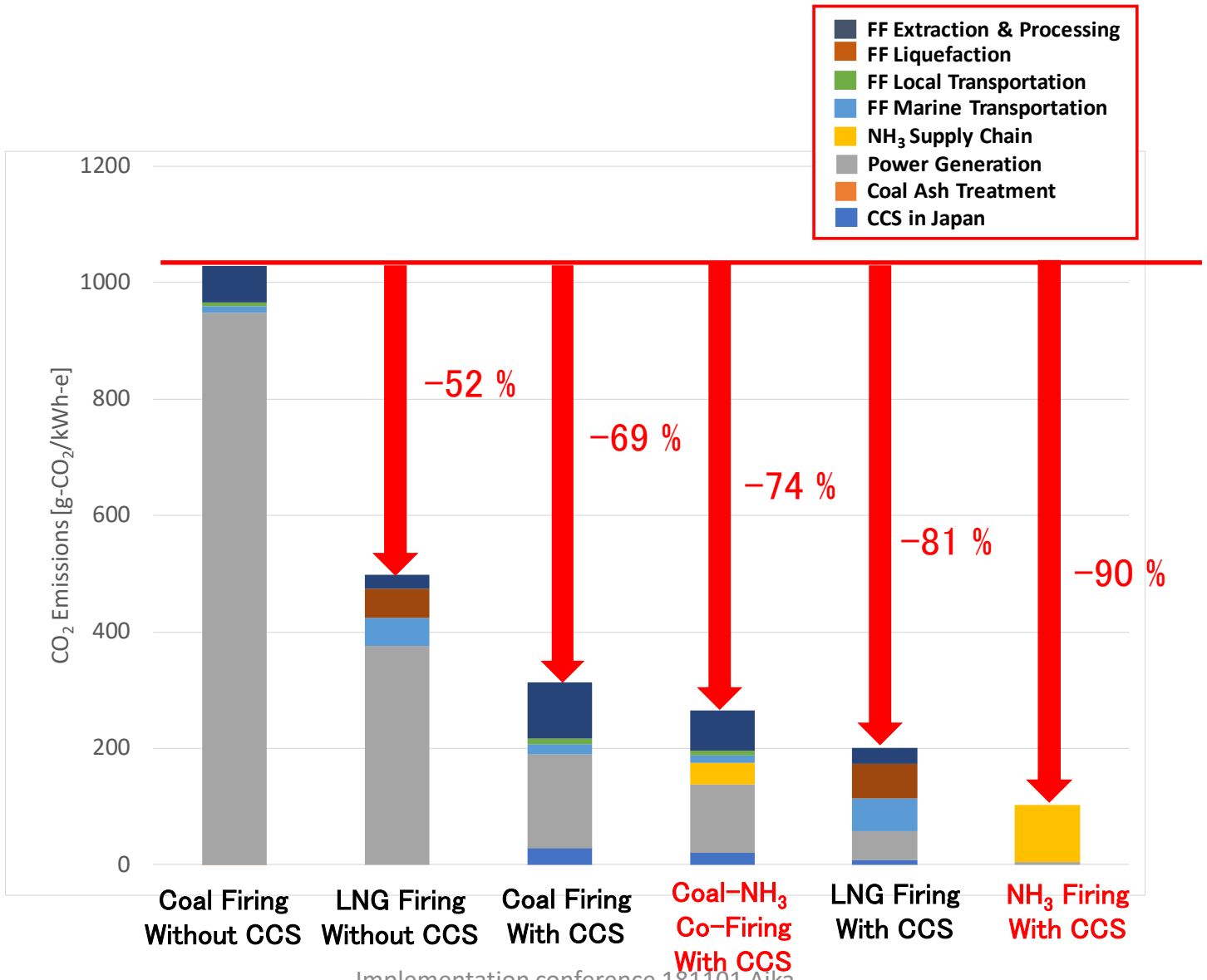
Development of CO_2 free Ammonia Value Chain



Cost Comparison (per hydrogen unit) of Energy Carriers



Comparison in Terms of Life Cycle CO_2 emissions



Calculated using the method presented by AIST at the 13th Int. Conf. on EcoBalance , October 11 2018, Tokyo, Japan

Ammonia energy association: acts as open information center

- Cases of consumer and producer (government and/or company) **value chain sets** shall be open; stimulating the next steps.

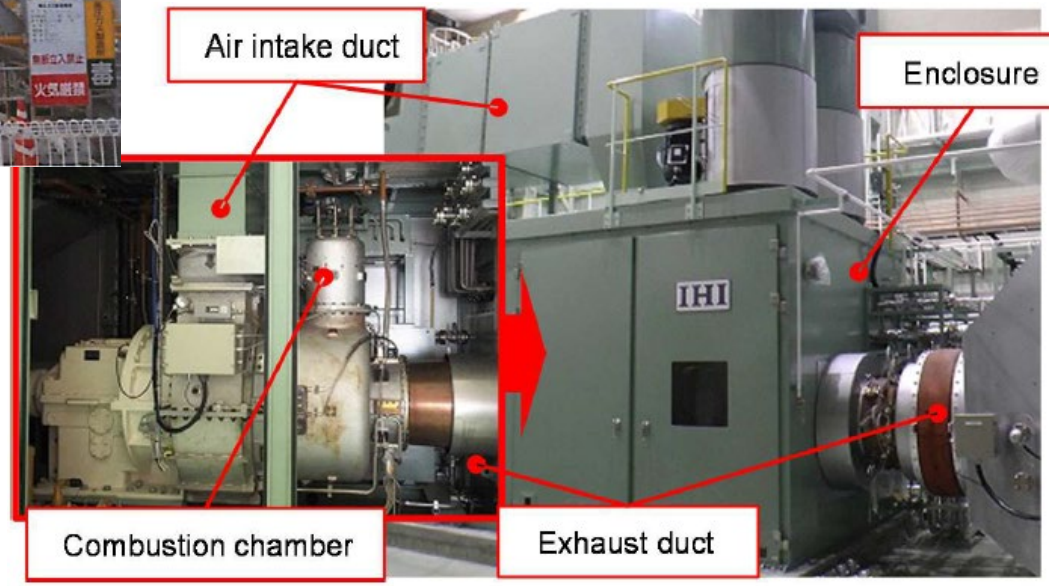
- **Demonstration of semi commercial plants and goods**
- for (hydrogen and) ammonia production.
- for ammonia power plant, industrial farness, ammonia fuel cell, ammonia mobile, etc.

- **FS and LCA** > Economic and social reliability > Long term contract.
- Discuss about brown and green ammonia
- Relation to ammonia fertilizer (effect on under developing countries)

Renewable energy power plant at Fukushima AIST

NH3 synthesis plant at Fukushima AIST

NH3 gas turbine at IHI



発電実証設備の
（左：IM270ガスタービンエンジン

Thanks for your attention

- Open to discussion leaded by Vrijenhoef, Fujimura, and Pettersen.