"Actions Needed for Realizing Carbon Neutrality in Heat and Transport"

Systematic Classification of Heat Demand for Industrial Processes and Systematic Overview of Mobility and their Future Decarbonization

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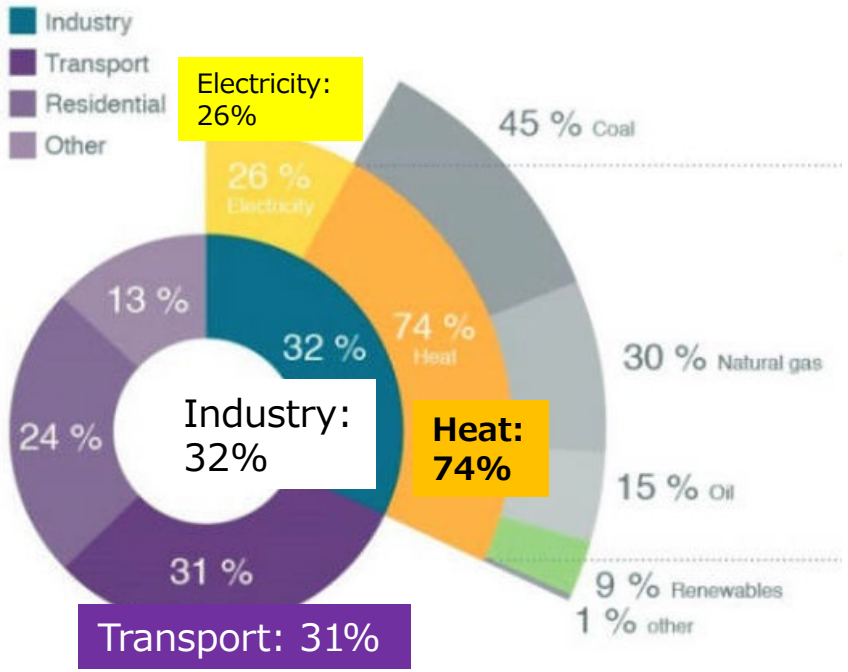
Importance of Industrial Process Heat and Mobility

- **Industry uses 32%** **of total energy consumption worldwide.**
- **Heat Demand of Industrial Process is 74%** **of Industrial Usage.**
  Equivalent to about half of total generated electricity for the case of Japan (40% for the Industry, 75% is heat demand)
- **Transport uses 31%** of total energy consumption worldwide.
  Equivalent to about half of total generated electricity for the case of Japan (26% for transport)



Note: EJ = exajoule.

Energy Consumption of World

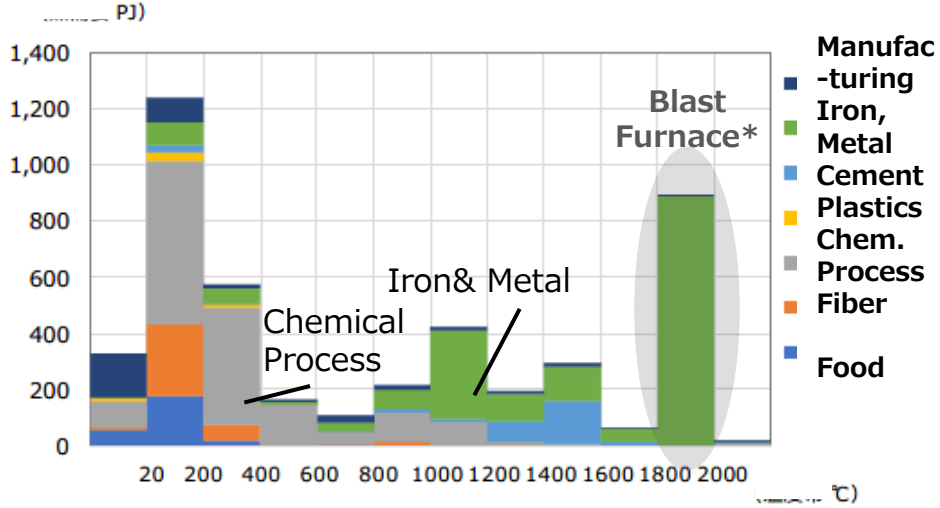
Source: IEA Insight Series Renewable Energy for Industry

Contents

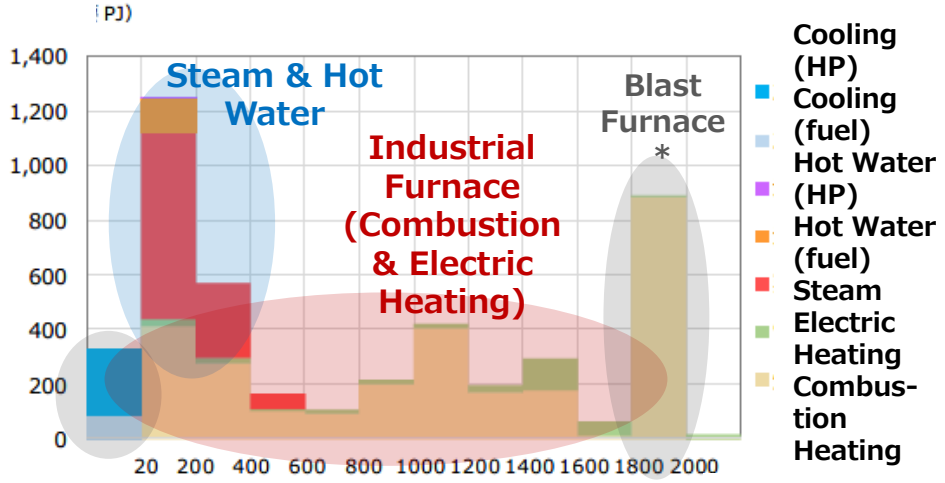
1． Heat Demand of Industrial Process

- 73% of the total heat demand has been due to **“Industrial Furnace”**
  (According to the analysis of the questionnaire by METI, Japan)
- Many types of industry need wide range of temperature.
  【Temperature Range & Heating Methods】
  - High Temp. Range（1200℃～） :【Main】Combustion, Electric Heating
  - Middle Temp. Range（400～1200℃）:【Main】Combustion
  - Low Temp. Range（20～400℃） :【Main】Combustion, Steam & Hot Water
  - Cooling（~20℃） :【Main】Heat Pump

Temperature Distribution depends on Types of Industry



Heating Methods for Temperature Range



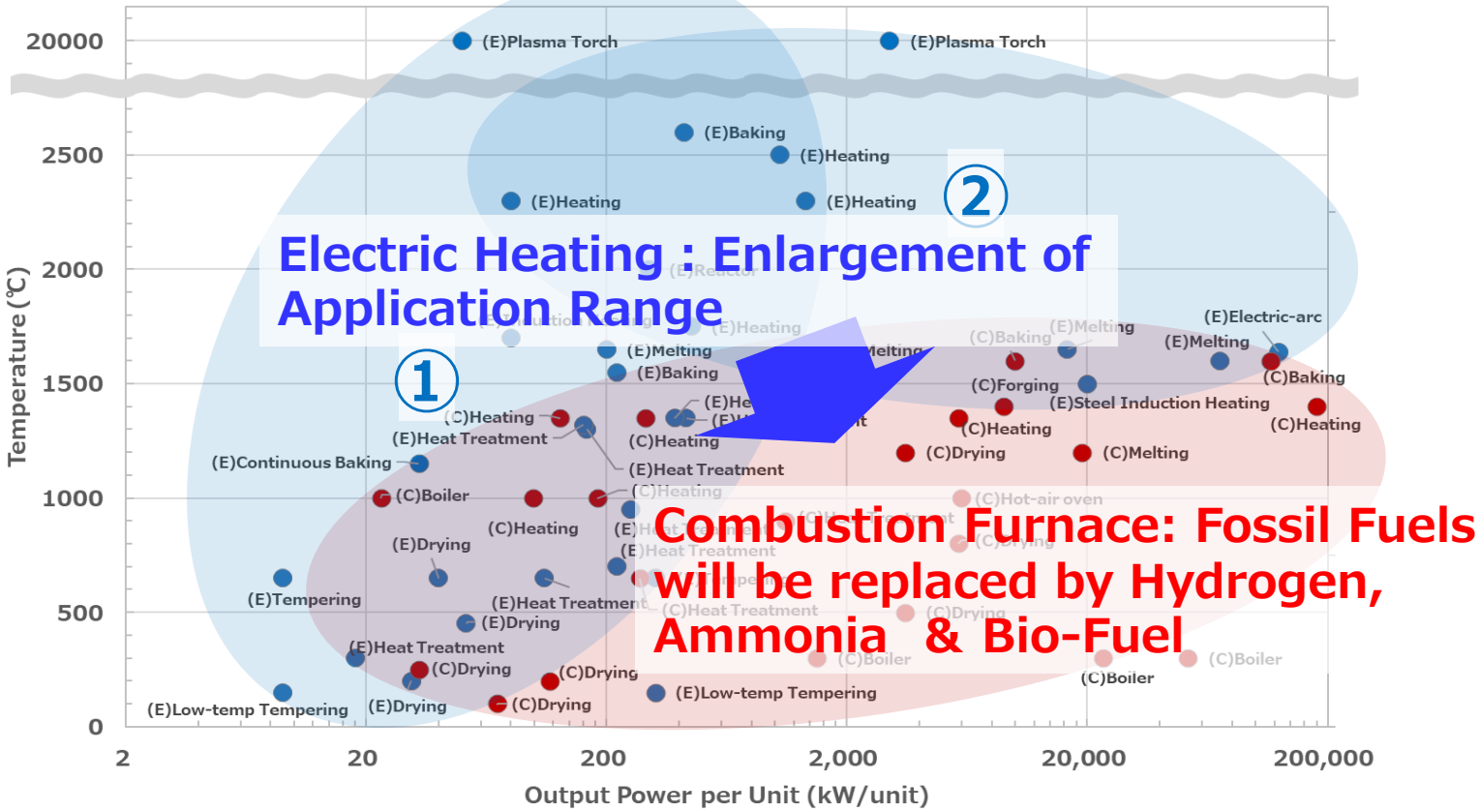
【Source】METI,2019

*Blast Furnace has been in the stage of research & development for utilizing hydrogen and electricity by steel companies.

Current Status & Future Direction of Industrial Furnaces

- Industrial Furnaces have been systematically categorized according to the temperature and the output power.
- **Characteristics of Current Usage (Range of Output with Temp.Range):**
- **Combustion Furnace: Wide Range of Output(20kW~200MW) with Temp. below 1600℃**
- **Electric Furnace: ① Below 2 MW (Relative Low Output Range) with Wide Range of Temp.**
  ② Wide Range of Output(50kW~100MW) with High Temp. above 1500 ℃

Systematic Categories of Industrial Furnaces



【Source】NEDO TSC

Steam and Hot Water Supply

Steam Supply(～200℃):

Replacement of Fossil Fuel Combustion

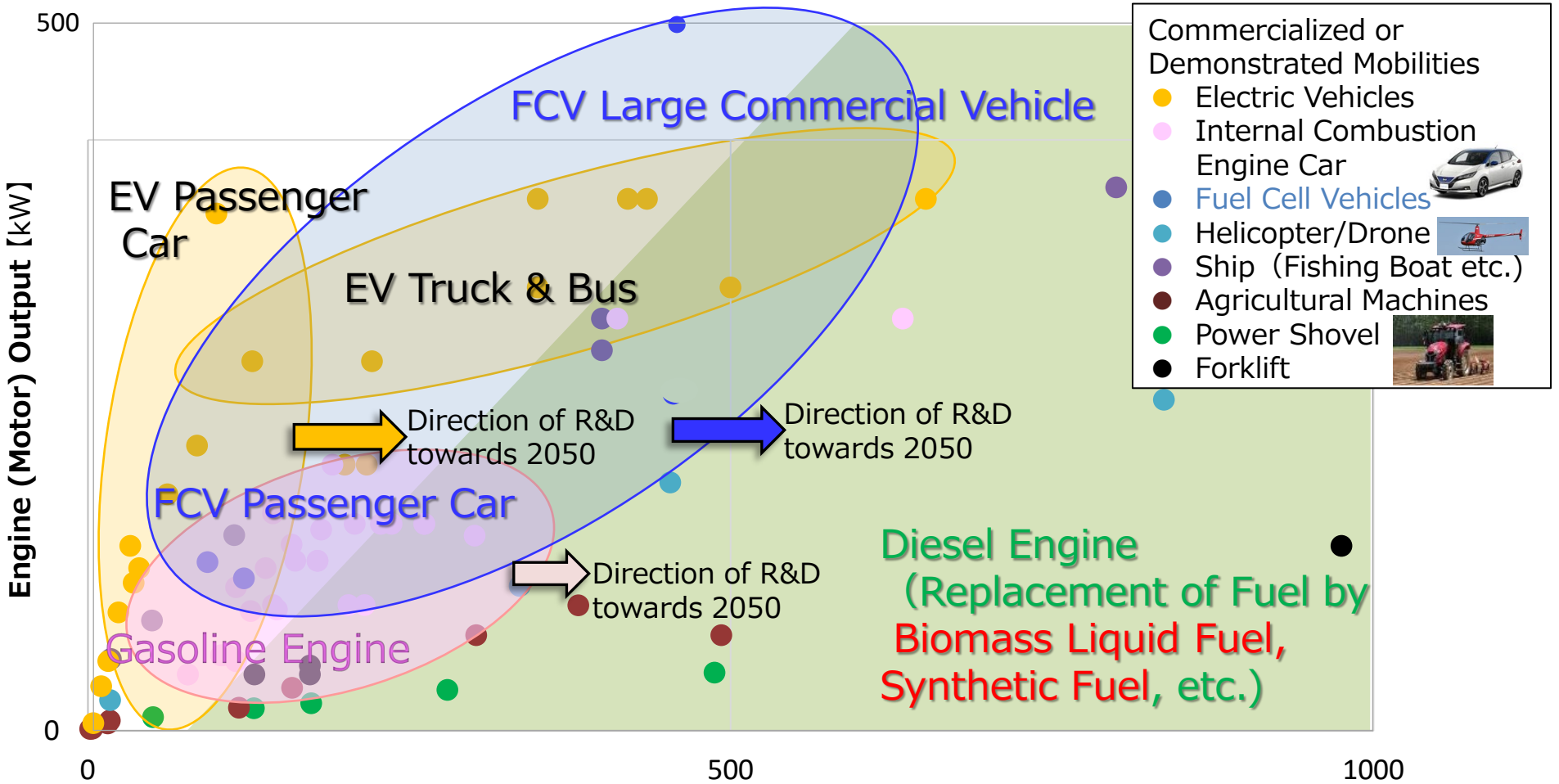
1. **Hydrogen Fuel Cell :Thermal Output**
2. **High Temperature Heat Pump utilizing waste hot water (COP=3 Target)**
3. **Hydrogen Boiler**

Hot Water Supply (～100℃) :

Replacement of Fossil Fuel in case of using Fossil Fuel Combustion by **Heat Pump System**
(In some cases Heat Pump System has been utilized already)

2. Overview of Application Fields of Various Kinds of Mobilities

- From the viewpoints of the relationship between outputs of engine or motor and the total amount of stored energy, the application fields of various kinds of mobilities have been classified.
- EV will cover the field of Gasoline engine. FCV will cover till larger stored energy field. Large diesel engine field will be replaced by biomass liquid fuel, synthetic fuel as well as EV & FCV.



※Amounts of necessary stored energy are estimated under the assumption: ・EV= Battery, ICE Gasoline Efficiency30%, Diesel 40%, FCV 51% Sources: Based on HP(each company) NEDO Technology Strategy Center created (2020)

Conclusions

- To reduce the large amount of CO2 emission from industries, the heat demand for industrial processes has been systematically classified to show 3/4 of the total heat demand is due to "Industrial Furnaces". As for the industrial furnaces, combustion furnaces utilizing fossil fuel should be replaced by the combustion furnace utilizing hydrogen, ammonia, bio fuel or alternatively by electric heating.

- As for the mobility, the application fields of various kinds of mobilities have been classified from the viewpoints of outputs of engine or motor and the total amount of stored energy. As for the future direction of R&D towards 2050, EV will cover the field of Gasoline engine. FCV will cover till larger stored energy field. Large diesel engine field utilizing fossil fuels will be replaced by biomass liquid fuel and synthetic fuel as well as EV & FCV.