IRENA INNOVATION WEEK 2023

Electrifying heating and cooling in buildings

Organised in partnership with

ehpa
european
heat pump association

15:30-17:00 | 25 September 2023

#IIW2023

IRENA INNOVATION WEEK 2023

Highlights from the Innovation landscape report: **Electrification of buildings**

Juan Pablo Jiménez
Energy Analyst
IRENA Innovation and Technology Centre

#IIW2023

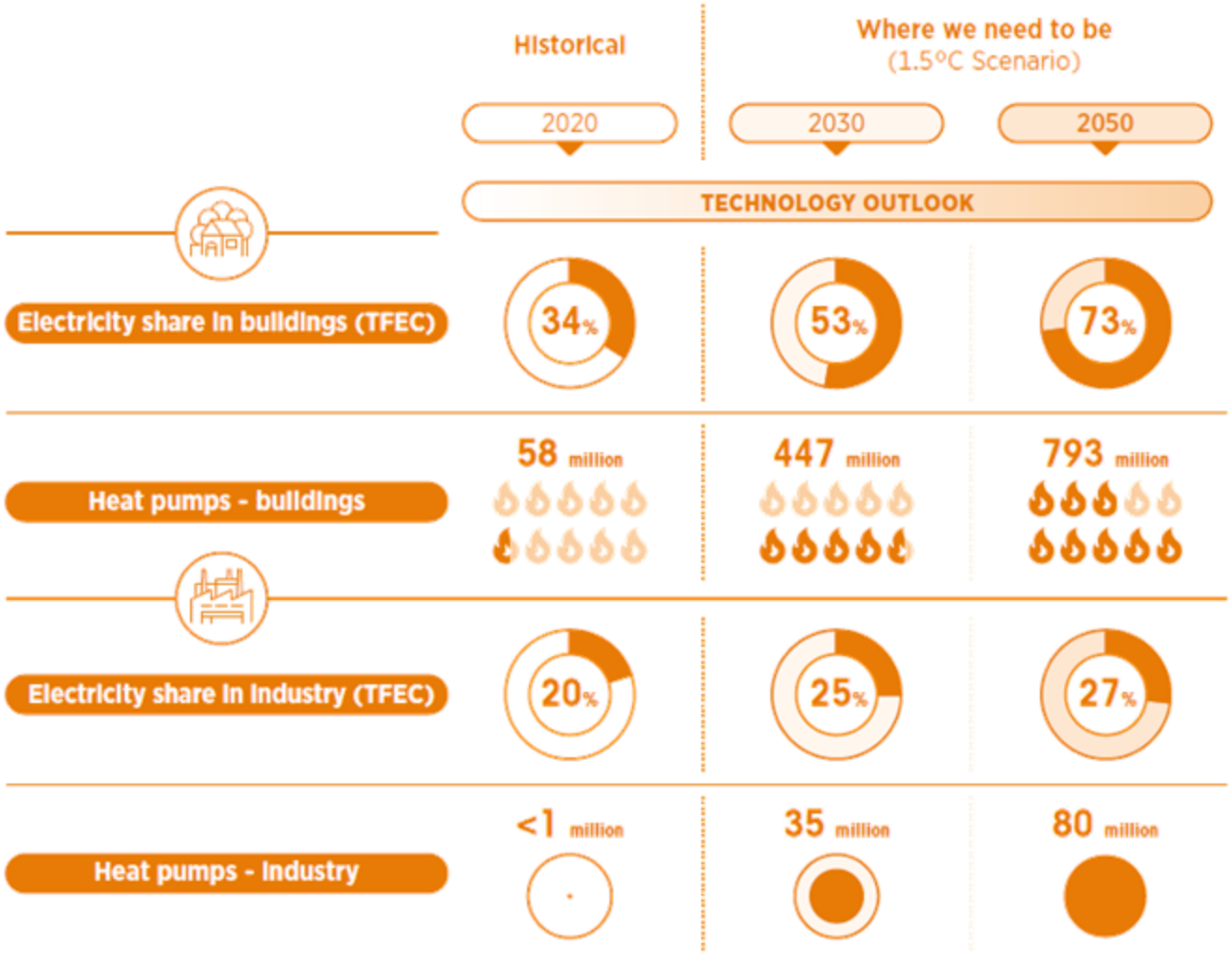
Heat pumps — The jewel in the crown

Why heat pumps are key for the electrification of buildings?

- High efficiencies
- Use of renewable heat
- Provide heat at temperatures required in buildings
- Reverse mode for the provision of heating and cooling

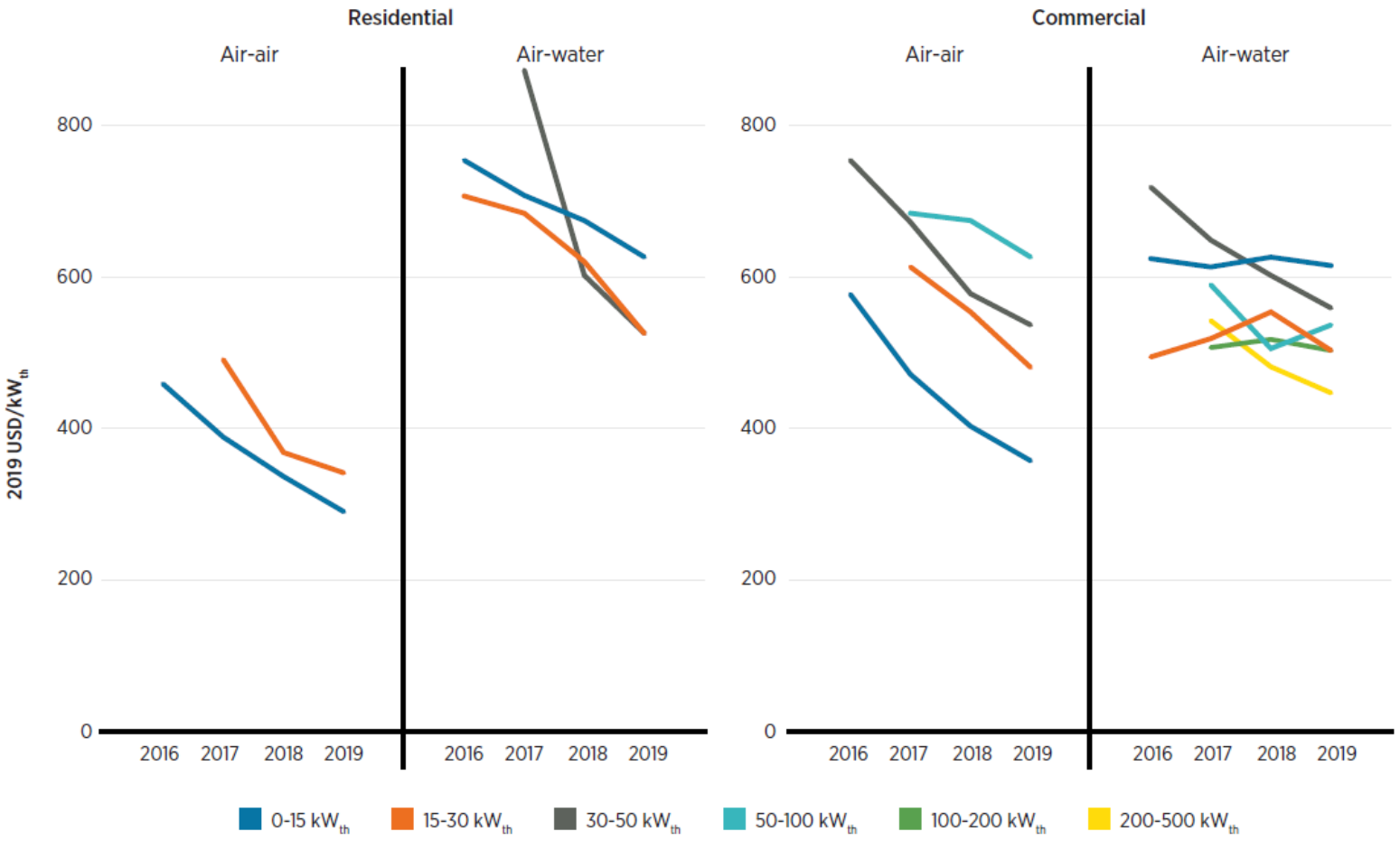
For all these aspects; prospects for heat pumps are huge

Irena (2023). World Energy Transition Outlook



Heat pumps — Cost-competitiveness

Heat pumps have experienced a rapid cost reduction in the past decade



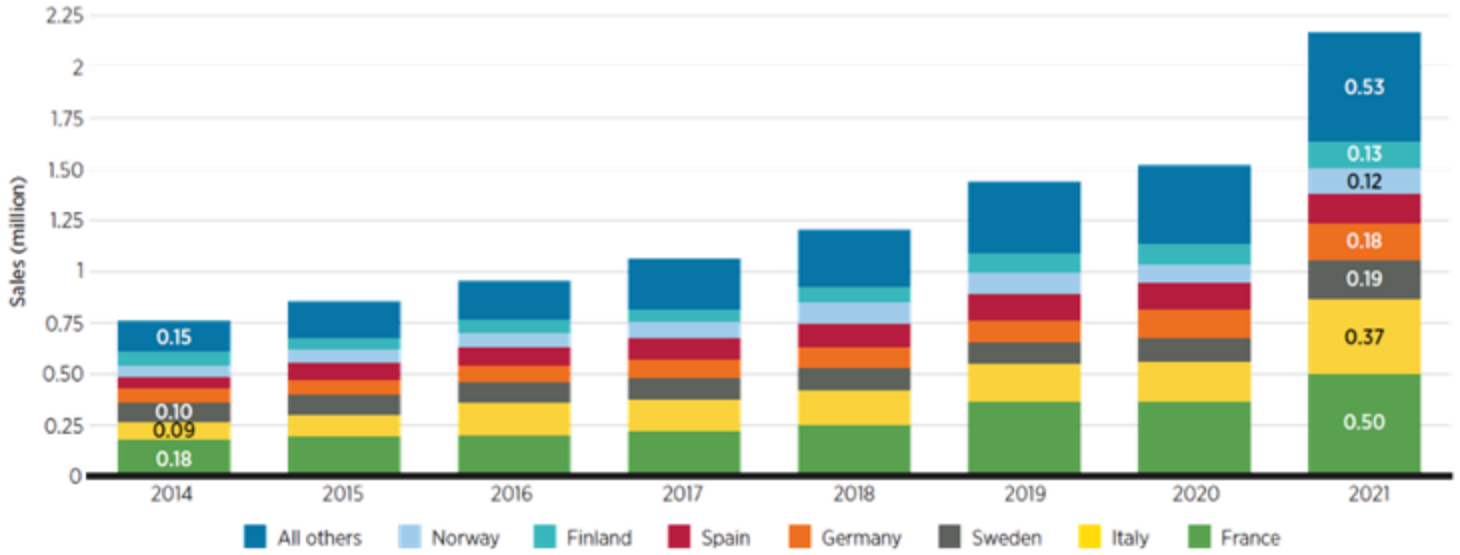
Heat pump cost trends in the residential and commercial sectors for air-to-air and air-to-water systems in **Italy**, 2016-2019

IRENA (2022), Renewable solutions in end-uses: Heat pump costs and markets

Heat pumps — Markets

Heat pumps are experiencing a stunning growth in major markets

- In Europe, heat pumps market increased **34%** between 2021 and 2022
- In 2019, the Chinese market for air-to-water heat pumps saw 1.8 million units sold, up from around 1 million units in 2013.In 2018, 42 million room air conditioners were sold.
- In Japan, already **86%** of households have at least one room air-conditioner unit (average 2.4 per household)
- In the US, sales of air source heat pumps reached almost 4 million in 2021, more than twice the 1.75 million sales in 2010



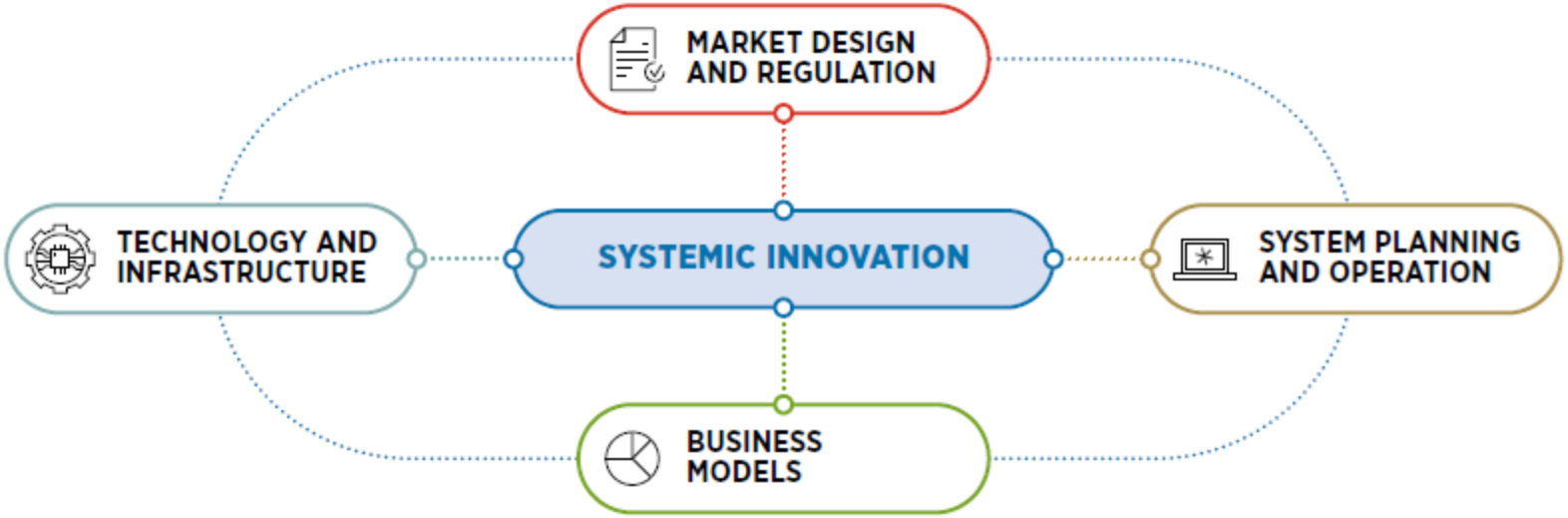
Source: EHPA, 2022.

Heat pumps — But…..

If we want to run heat pumps on green electricity, we cannot simply electrify in any way but pursue a **smart electrification of** the heating and cooling supply and the energy systems as a whole.

What does the smart electrification entail?

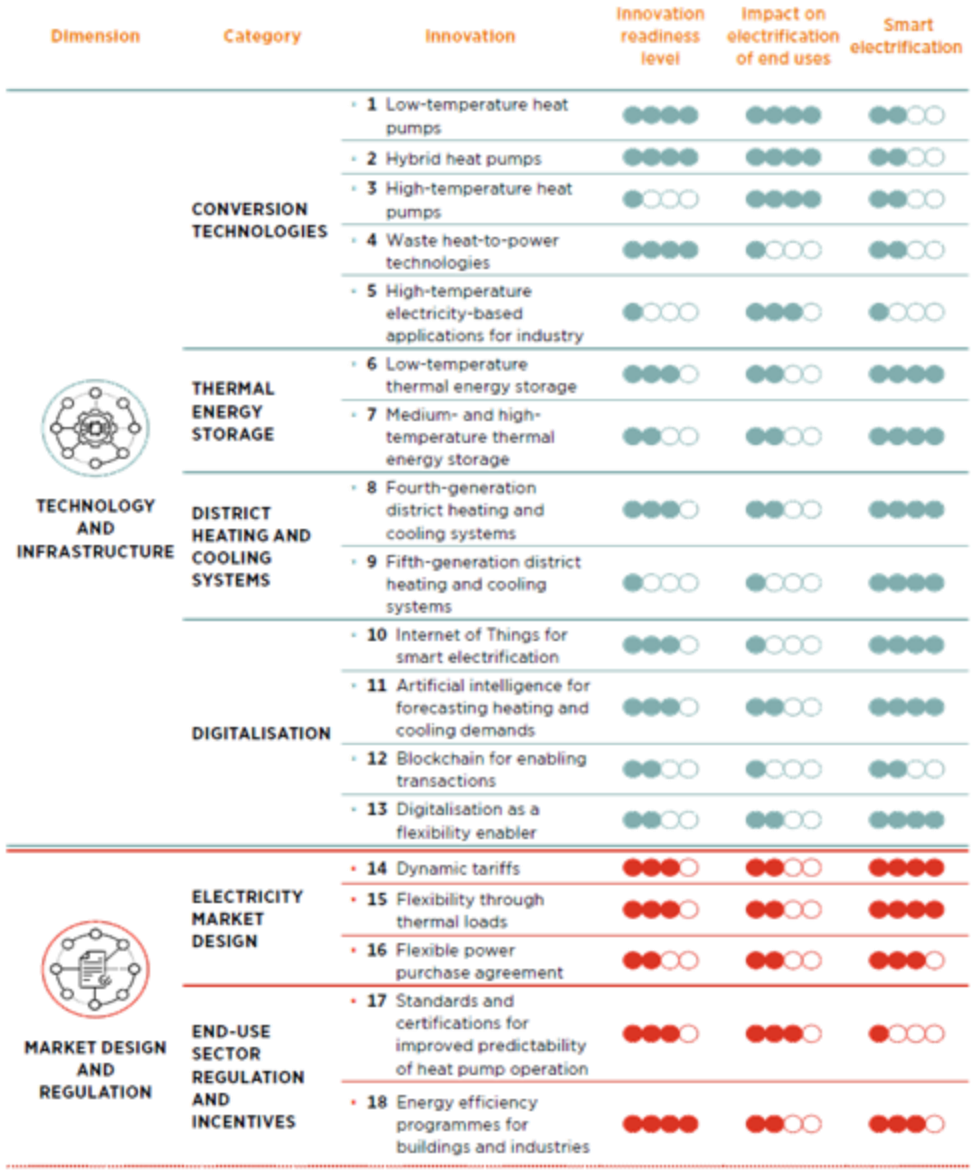
Systemic innovation approach across four dimensions

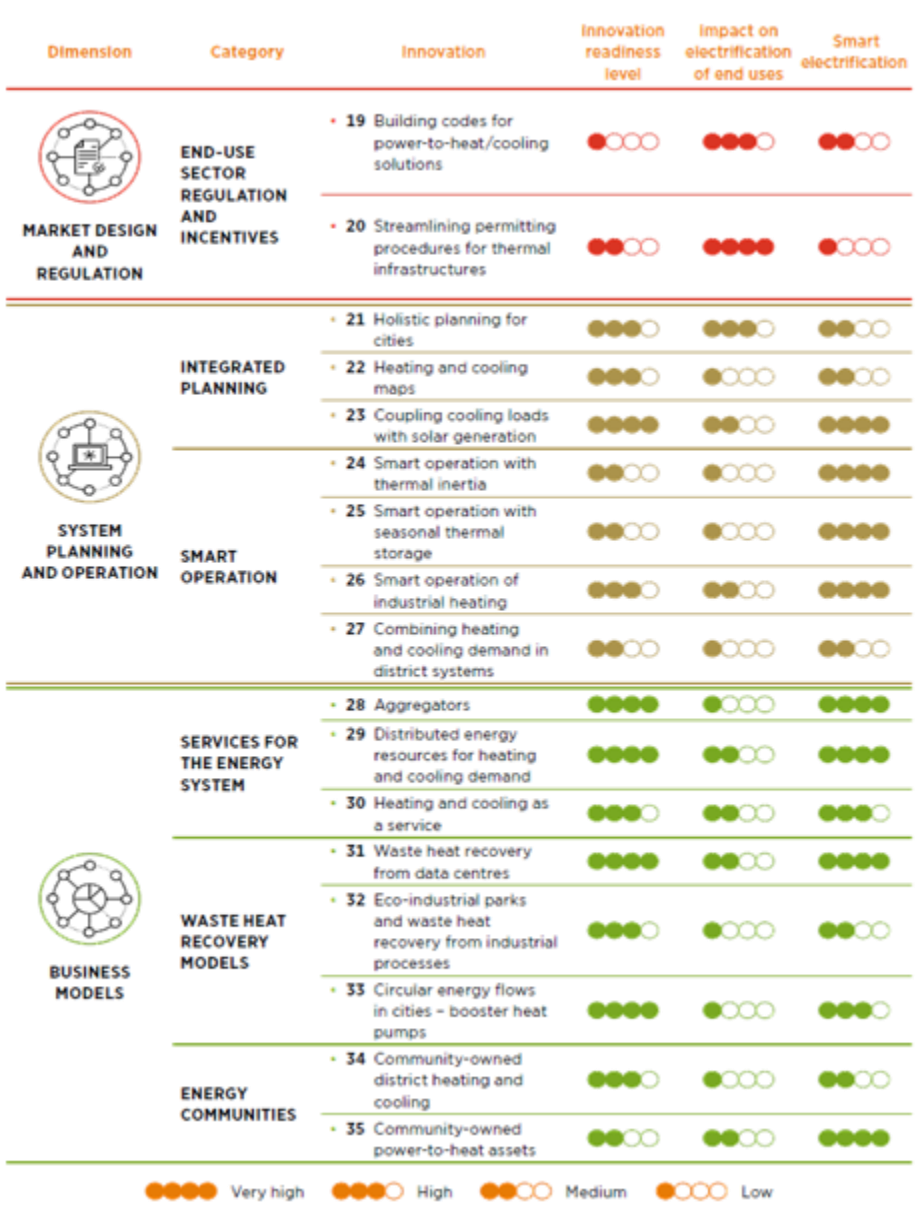


Heat pumps — IRENA's Innovation Landscape Report

- A systemic innovation approach must be at the center of sound smart electrification strategies.
- There is no "one-size-fits-all" solution for smart electrification
- The toolbox includes 100 innovations in that can play a role in transforming and decarbonising the energy use sector with smart electrification strategies

Heat pumps — 35 innovation and toolbox for power-to-heat

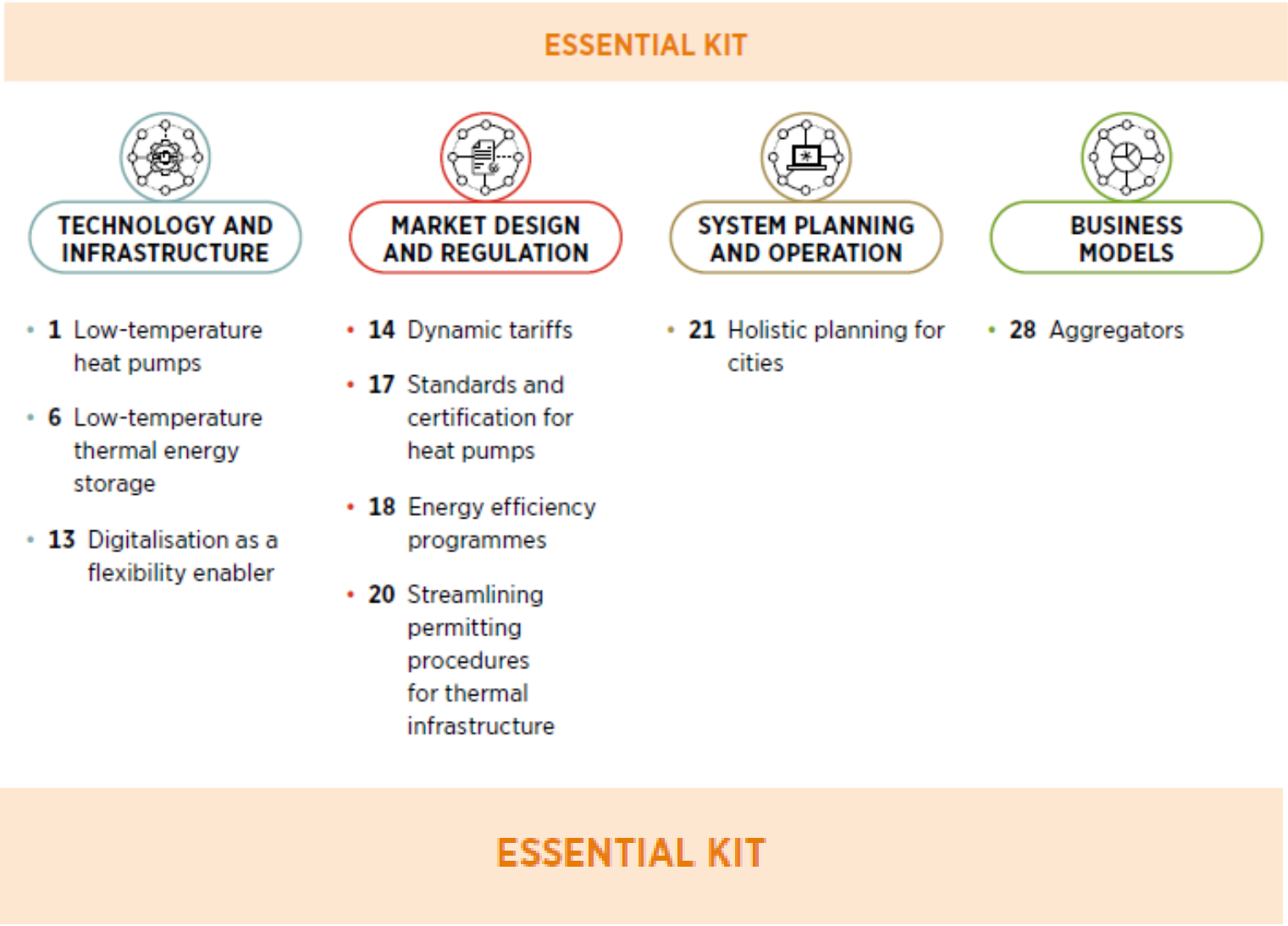




Heat pumps — Focus on buildings

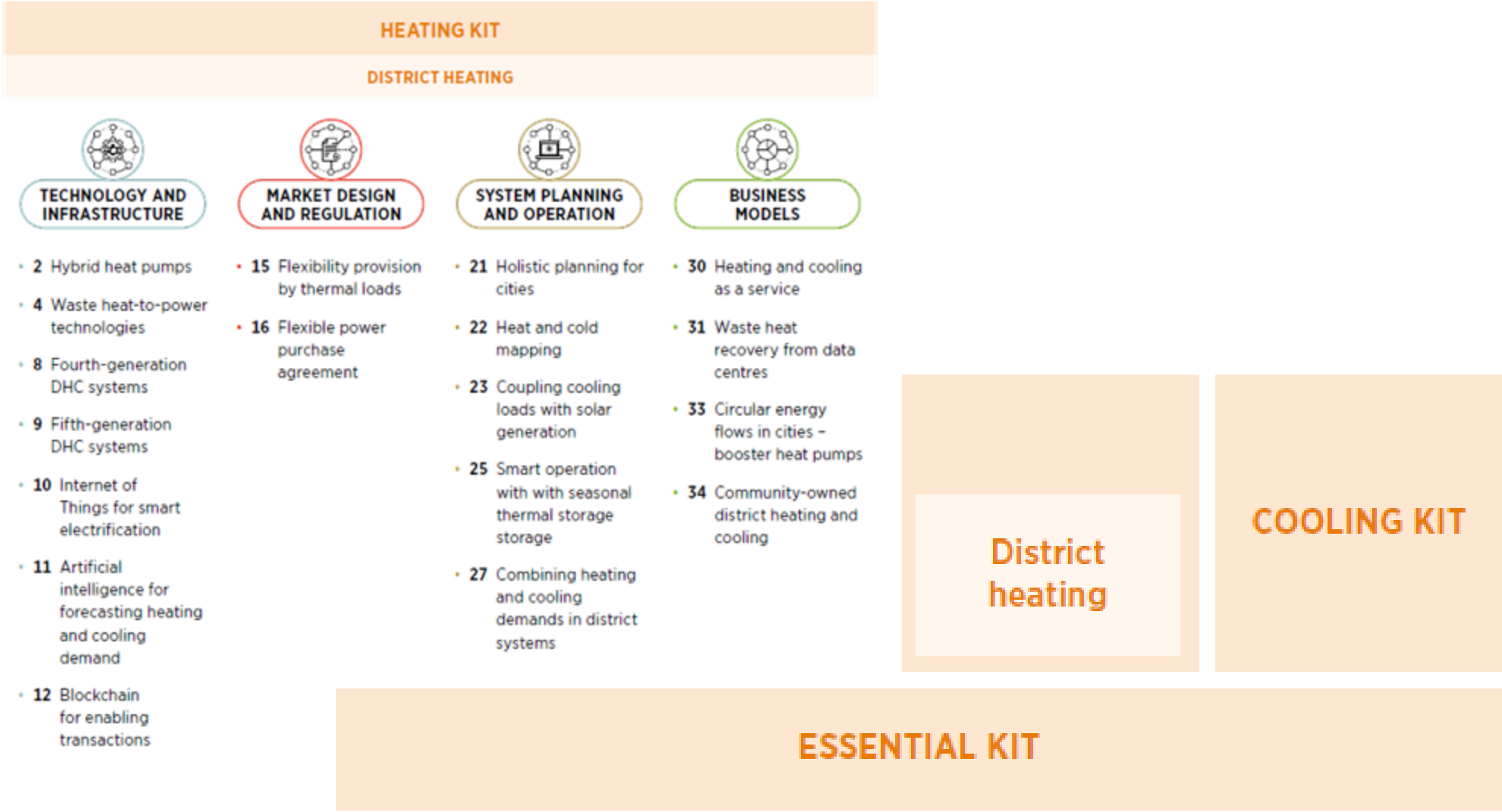
IRENA (2023), Innovation landscape for smart electrification: Decarbonising end-use sectors with renewable power. Pages 98 — 103

Heat pumps — Focus on buildings



IRENA (2023), Innovation landscape for smart electrification: Decarbonising end-use sectors with renewable power. Pages 98 — 103

Heat pumps — Focus on buildings



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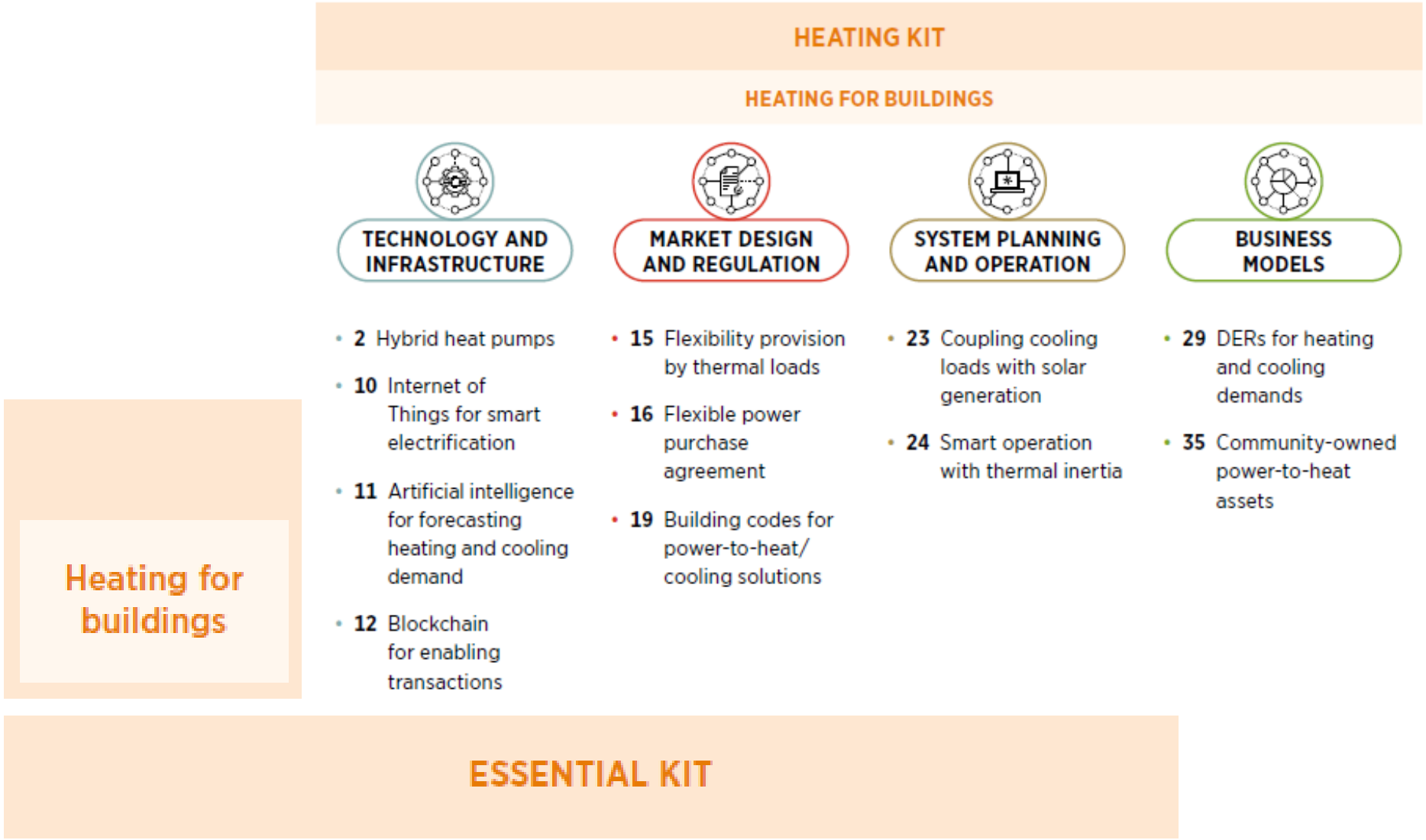
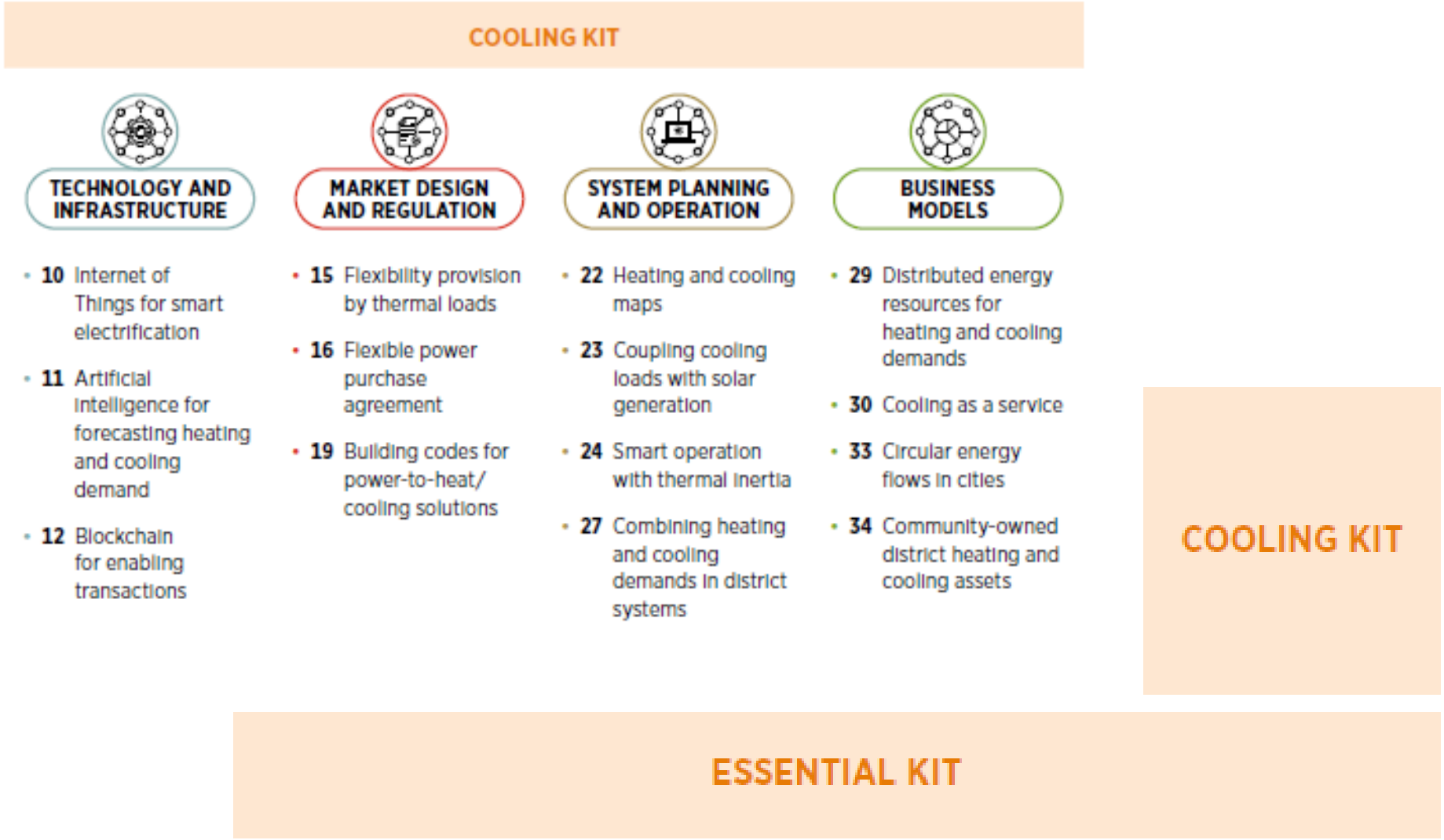
Heat pumps — Focus on buildings



IRENA (2023), Innovation landscape for smart electrification: Decarbonising end-use sectors with renewable power.

Heat pumps — Focus on buildings



IRENA (2023), Innovation landscape for smart electrification: Decarbonising end-use sectors with renewable power. Pages 98 — 103

Heat pumps —Session's aim

Bring together innovative experiences and market knowledge that can help integrate more and more heat pumps in the energy system **without compromising the power system** from a **systemic approach**.

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Accelerated deployment of heat pumps to achieve Japan's net-zero 2050 commitment (Policy, Market & R&D)

Yoichi Fujita
Technical Researcher
New Energy and Industrial Technology Development Organization (NEDO)

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About NEDO

New Energy and Industrial Technology Development Organization (NEDO)

Business details

・NEDO is one of the largest public R&D management organizations in Japan.
・NEDO is promoting and supporting R&D projects and integrating the combined efforts of industry, academia and government.

Minister in Charge

・Ministry of Economy, Trade and Industry

Staff

・1,464 as of 2023/4/1

FY 2022 Budget (1.28 billion USD)

Energy Systems: 472 million USD
Energy Conservation and Environment: 341 million USD
Industrial Technology: 350 million USD
New Industry Creation and Discovery of Technology Seeds: 57 million USD

Japan - Overview

Population : **124.77 million** (**92%** in urban areas)

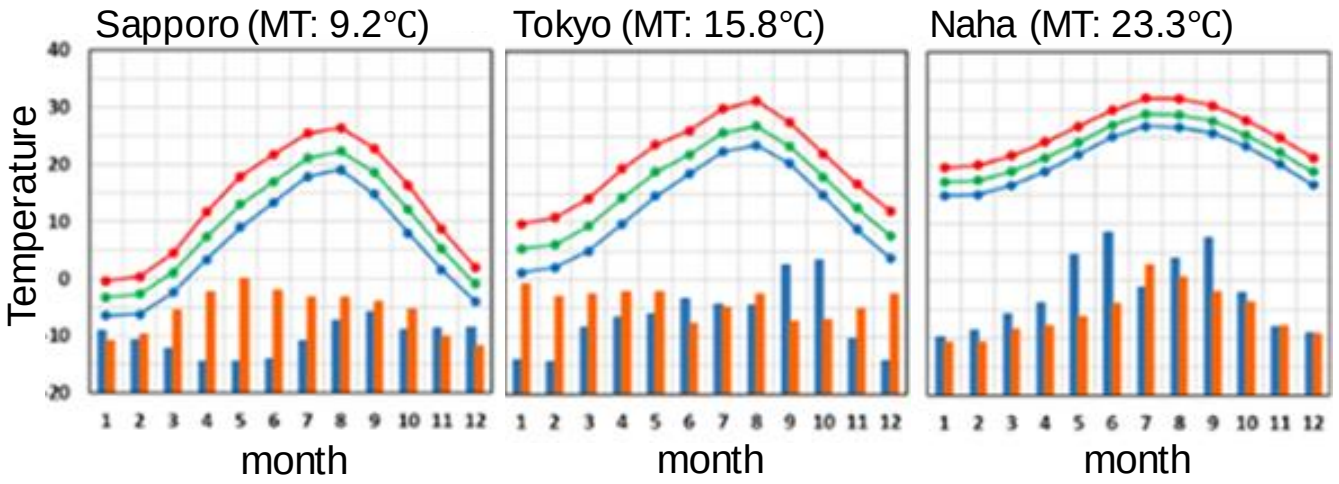
Households : **53.33 million** (1/2/3/4/>5 pers.: 35%/28%/18%/13%/7%)

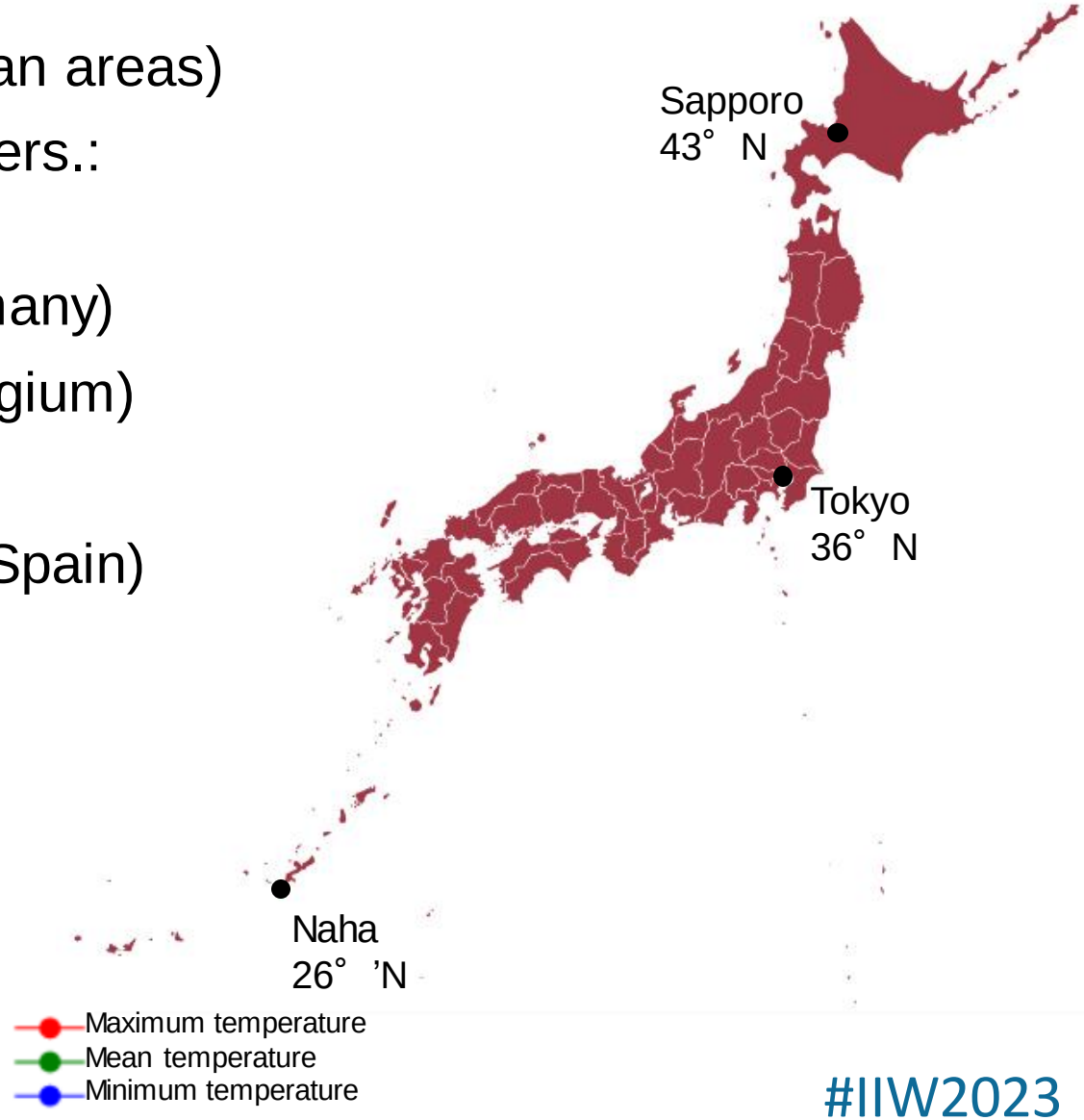
Land Area : **378,000 km²** (≃Germany)

Population Density : **331 people / km²** (≃Belgium)

Rate of multifamily : **46 %**

Mean temperature : **15.8℃** (Tokyo) (≃Madrid, Spain)





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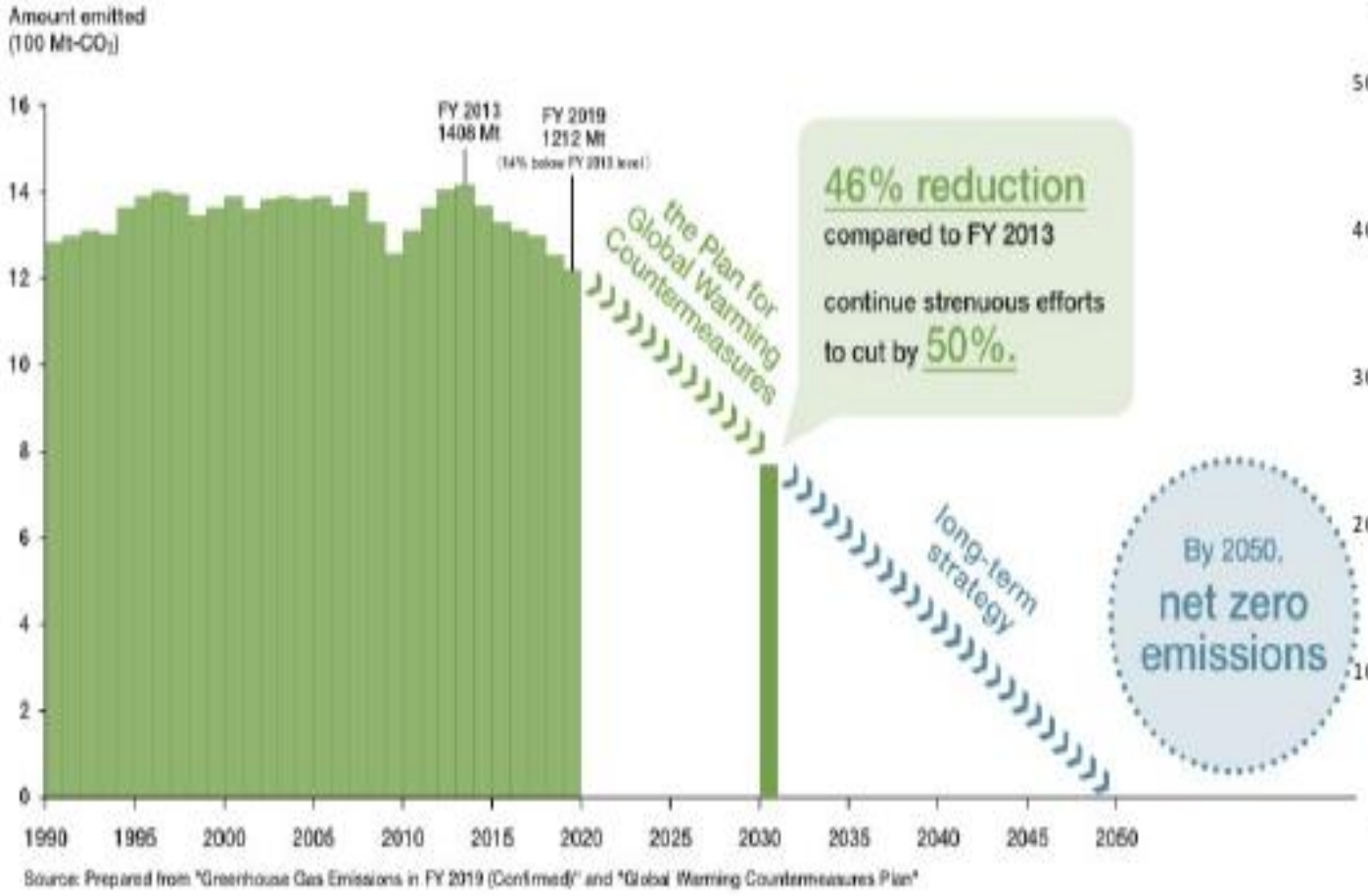
Policy - Decarbonization

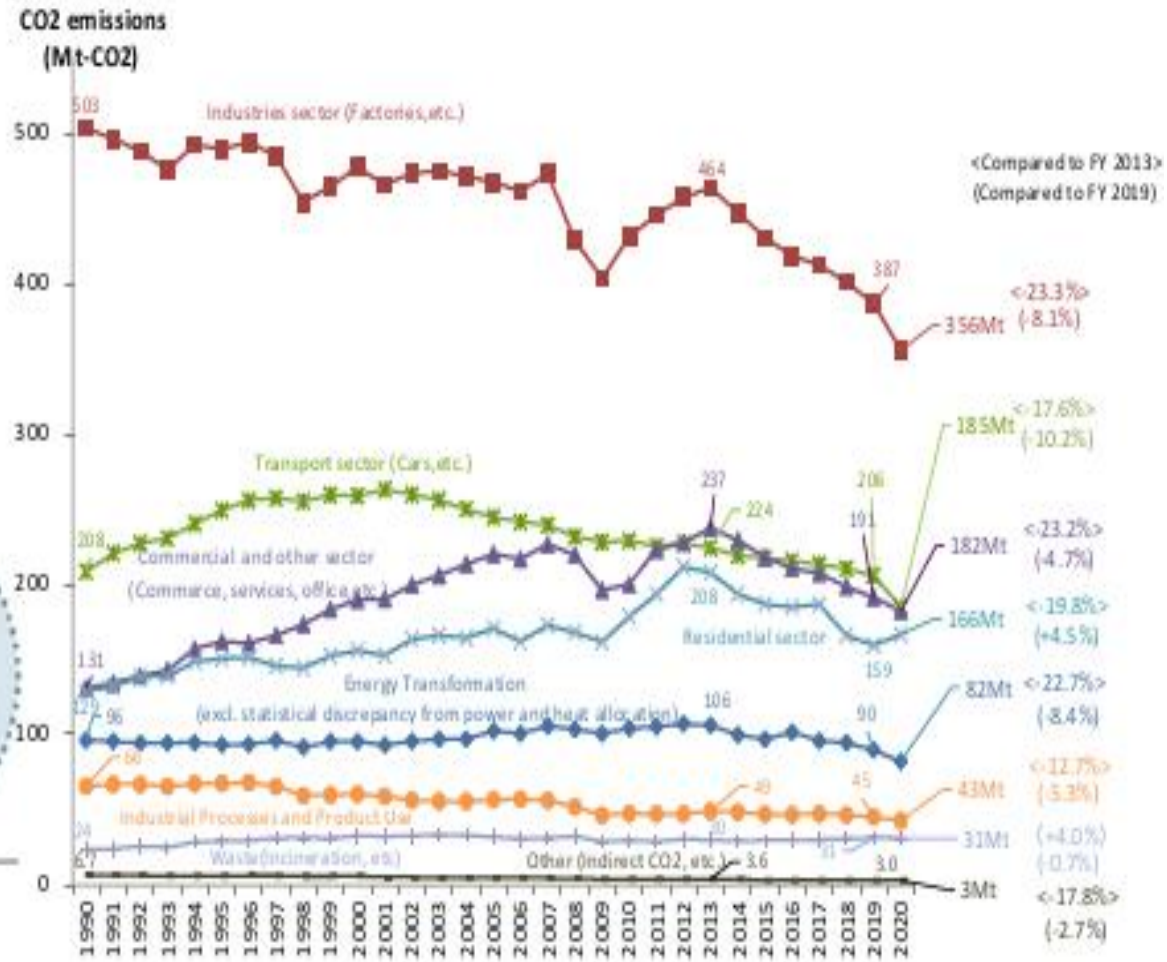
Source
- Japan's commitment: "Climate Actions towards net-zero by 2050", MOEJ
- CO2 emissions by sector: "The GHG Emissions Data of Japan", National Institute for Environmental Studies

Japan's commitment to Net-Zero by 2050



Source: Prepared from "Greenhouse Gas Emissions in FY 2019 (Confirmed)" and "Global Warming Countermeasures Plan"

CO2 emissions by sector (FY1990 - 2020)

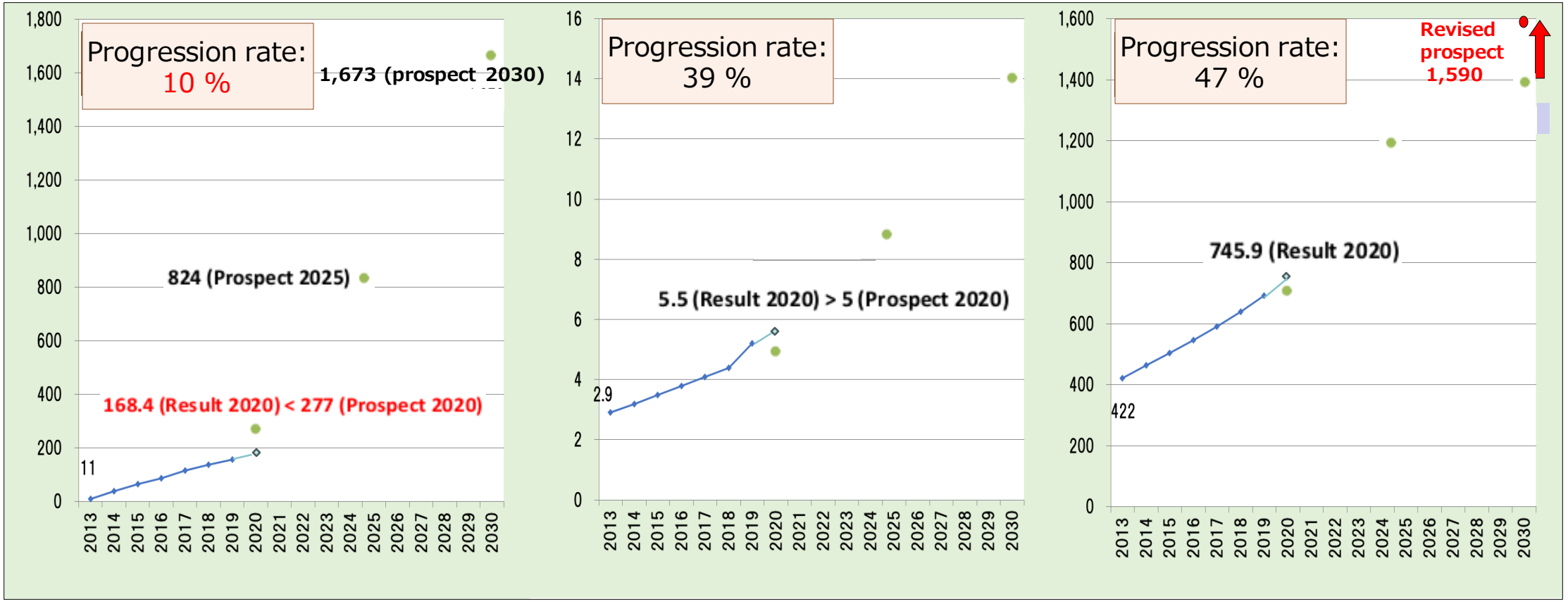


Policy - Decarbonization

Source
- Plan for Global Warming Countermeasures: MOEJ (JP)
- The Sixth Strategic Energy Plan: METI (EN, JP)
- Track record: The document of the Central Environment Council, METI (JP)

Plan for Global Warming Countermeasures and the Sixth Strategic Energy Plan

- Quantitative target are set for Industrial HPs and Commercial and Residential HPWHs



Progression rate = (Result 2020 – Result 2013) / (Prospect 2030 - Result 2013)

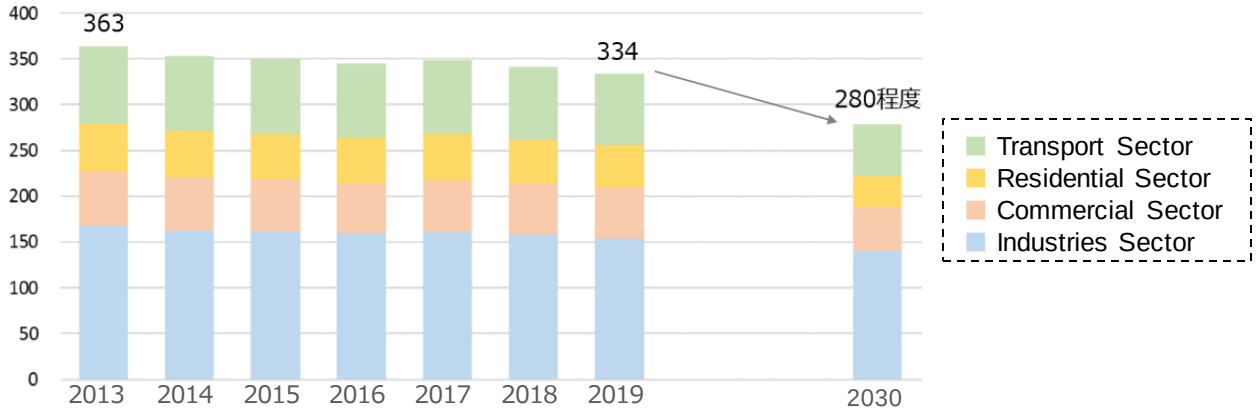
Commercial and Residential HPWHs are going well but countermeasures are required for Industrial HPs

Policy - Energy

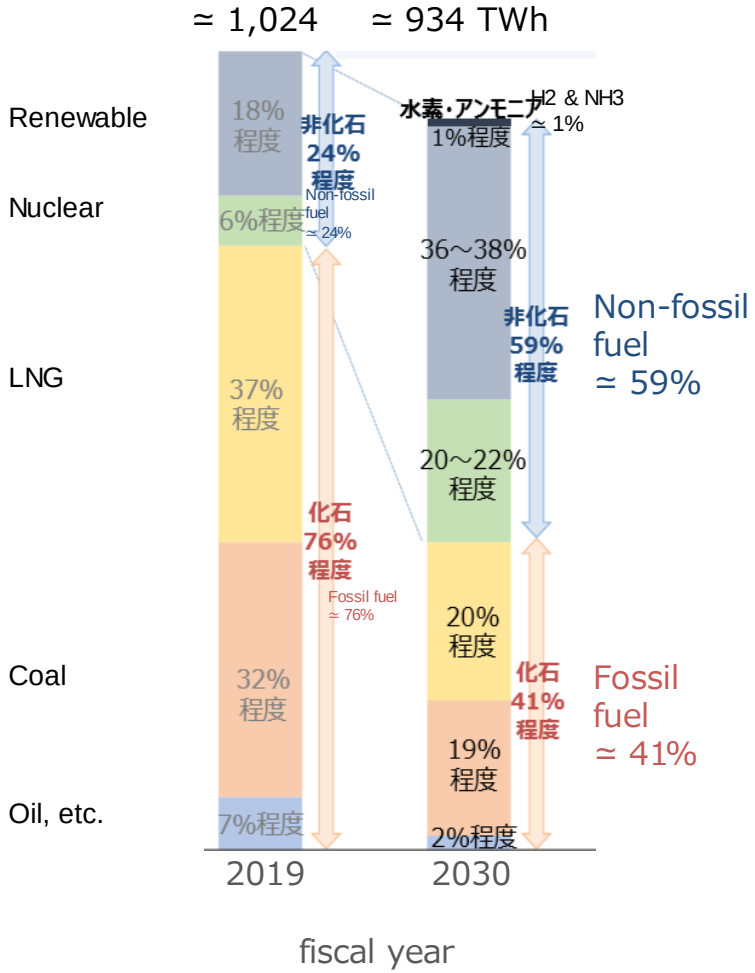
Source
- Energy demand by sector: The document by the METI (P.71) (JP)
- Electricity mix towards 2030: The document by the METI (P.70) (JP)
- Carbon intensity of electricity generation: FY2019 Energy Supply and Demand Report, METI (P.8) (JP)

Energy demand by sector

Final energy consumption (million kloe)

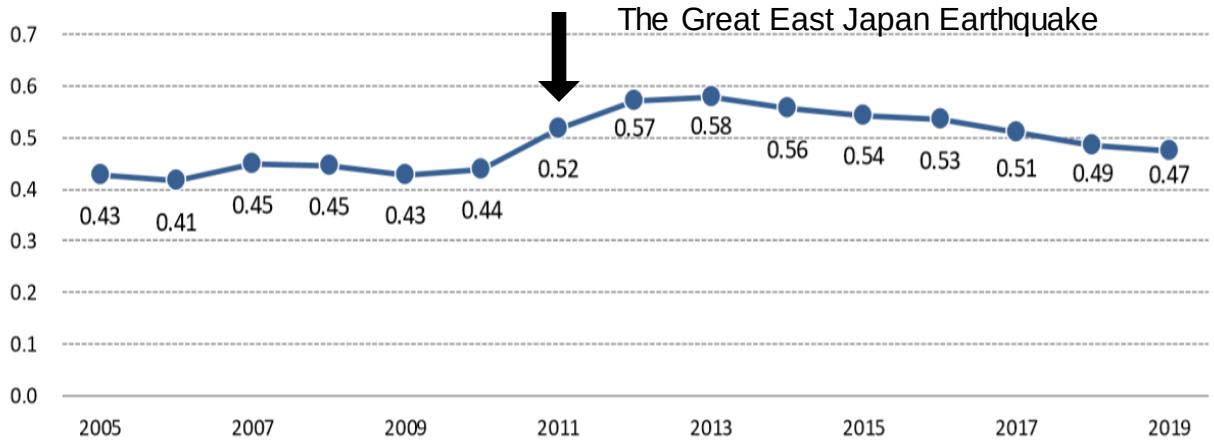


Electricity mix towards 2030



Carbon intensity of electricity generation

Carbon intensity of electricity generation (kg CO2/kWh)



Policy - Energy

Source
- Top Runner Program: Ministry of Economy, Trade and Industry (JP)
- The uniform energy efficiency labels: "Japan's ENERGY 2020", METI

"Top Runner Program"

(Efficiency standards for machinery, equipment and materials)

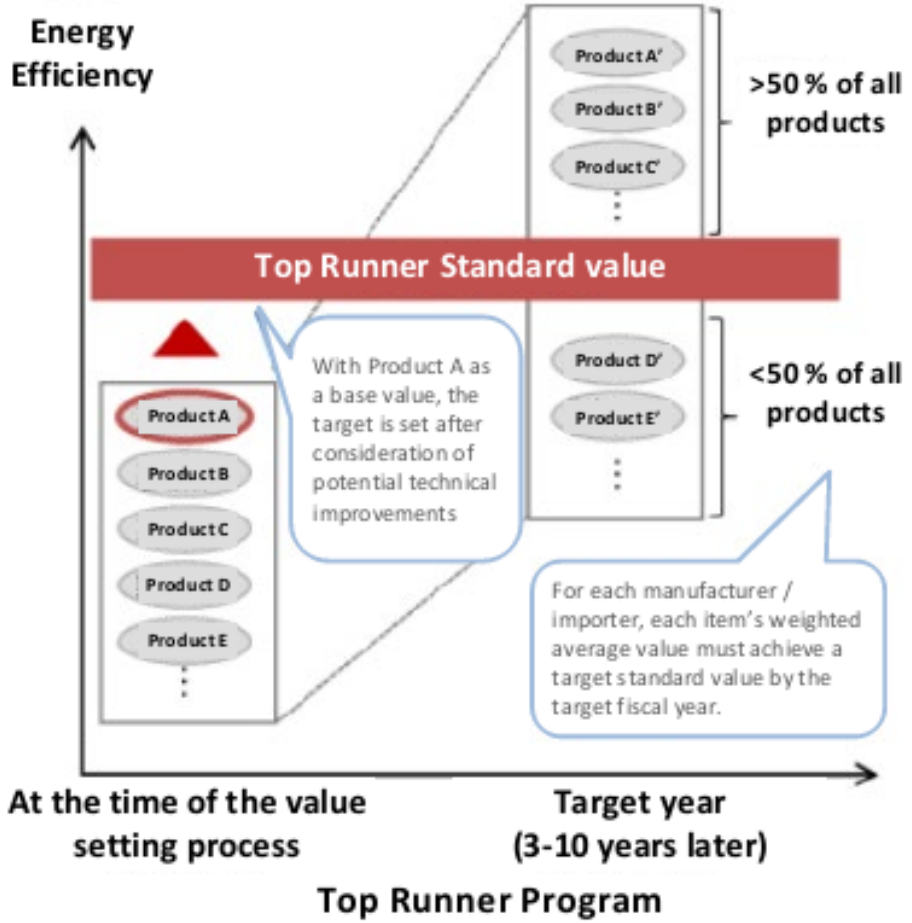
- 32 items are in scope (as of September 2023).

  Air Conditioners, Electric Refrigerators, Electric Freezers, Gas Water Heaters, Oil Water Heaters, Vending Machines, Electric (HP) Water Heaters, Showcases, etc.

"The uniform energy efficiency labels"

(Energy efficiency labeling)

- The evaluation metric of a 41-point scale (1.0, 1.1, …, 5.0) are now being used in retail outlets.
- The items mentioned above (except for vending machines and showcases) are covered as of September 2023.



A new labeling for EcoCute (HWHPs) since Oct. 2021

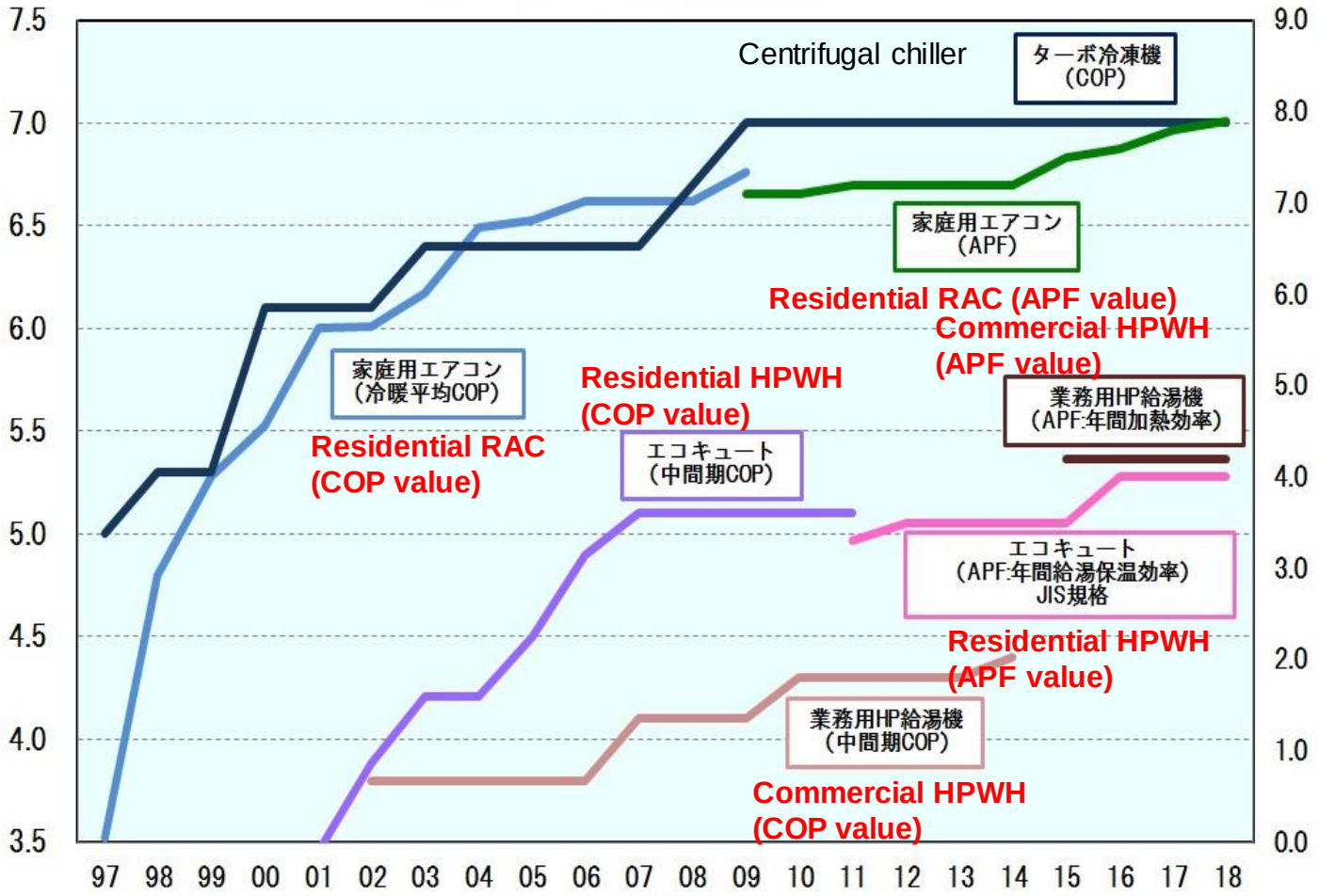
Policy - Awards

Source
- Efficiency improvement of HPs: Heat Pump and Thermal Storage Technology Center of Japan (HPTCJ) (JP)
- Energy Conservation Grand Prize Award: The Energy Conservation Center, Japan (ECCJ)
- Minister of the Environment's Award for Climate Action: MOEJ (JP)

Efficiency has improved due to energy efficiency policies.
Awards are another driver for efficiency improvement

- **Energy Conservation Grand Prize Award**
(Since 1990)
awards excellent energy conservation activities and advanced energy conservation products achieved by technological development at private companies, …

- **Minister of the Environment's Award for Climate Action**
(Since 1998)
awards individuals or groups that have made significant contributions towards preventing global warming



Efficiency improvement of HPs

Policy - Subsidies

Source
- Subsidy for investments for advanced energy conservation project: Sustainable open Innovation Initiative (JP)
- Subsidy for high-efficiency HPs in industrial and commercial sectors: Sustainable open Innovation Initiative (JP)
- Subsidy for "Net Zero Energy Buildings" (METI): Sustainable open Innovation Initiative (JP)
- Subsidy for "Net Zero Energy Buildings" (MOEJ): Shizuoka Environment Resources Association (JP)

Subsidy for investments for energy conservation projects and equipment

METI Ministry of Economy, Trade and Industry

- **A. Advanced equipment** (e.g. HP desiccant humidity control, centrifugal chiller, showcase, MVR, etc.)
- B. Custom-made solutions (e.g. specially designed facility, production line, etc.)
- **C. Specified equipment (e.g. AC, industrial HP, commercial HPWH, refrigerator, etc.)**
- **D. Energy management system and service** (Specified EM service and EMS needed for the service)

Subsidy for residential high-efficiency DHW heaters

METI Ministry of Economy, Trade and Industry

- **HPWHs ("EcoCute")** **50,000 JPY (345 EUR*)**
- **Hybrid HPWHs** **50,000 JPY (345 EUR*)**
- Residential Fuel Cells ("Ene-Farm") 150,000 JPY (1035 EUR*)

* Exchange rate : 145 JPY / 1 EUR

HPWHs ("EcoCute")

Hybrid HPWHs

Residential Fuel Cells ("Ene-Farm")

Subsidy for "Net Zero Energy Buildings"

METI Ministry of Economy, Trade and Industry

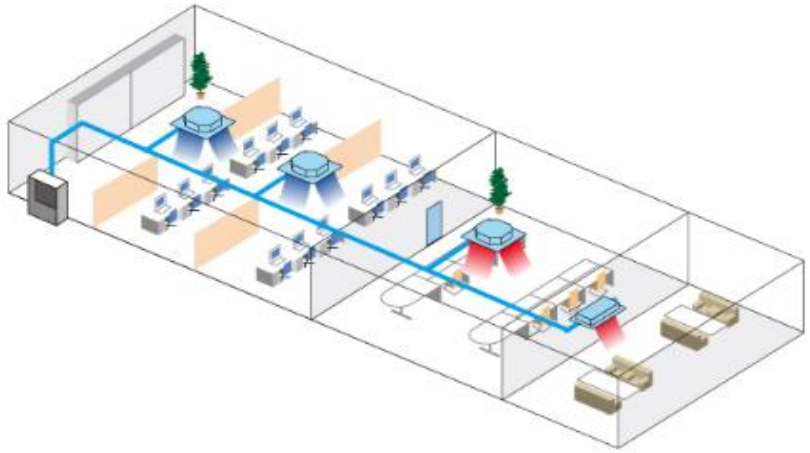
環境省 Ministry of the Environment Government of Japan

- **High efficiency ACs, water heaters, BEMS, etc. installed for "Net Zero Energy Buildings" projects (<50% energy consumption of the reference building)**

Market - Popular Heat pump type in Japan

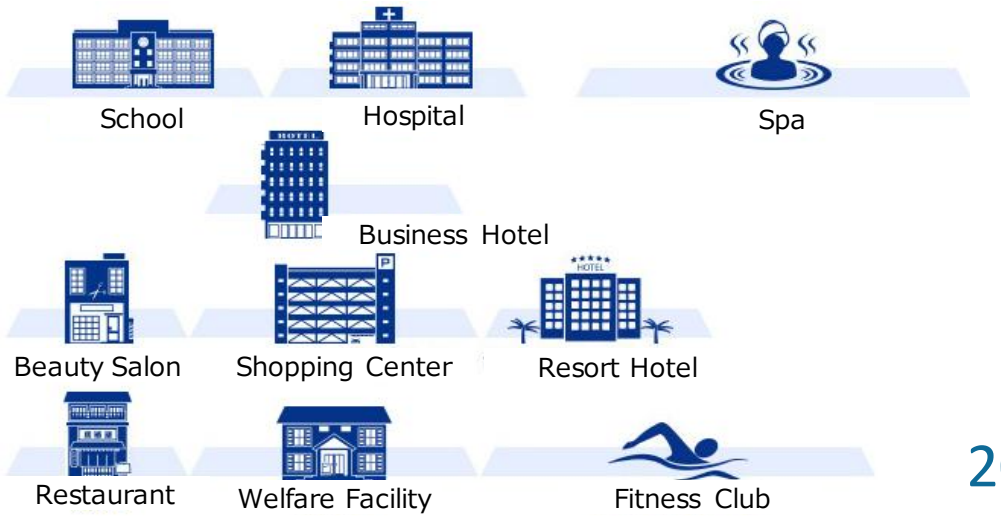
Residential Room Air Conditioners

Commercial Packaged Air Conditioners

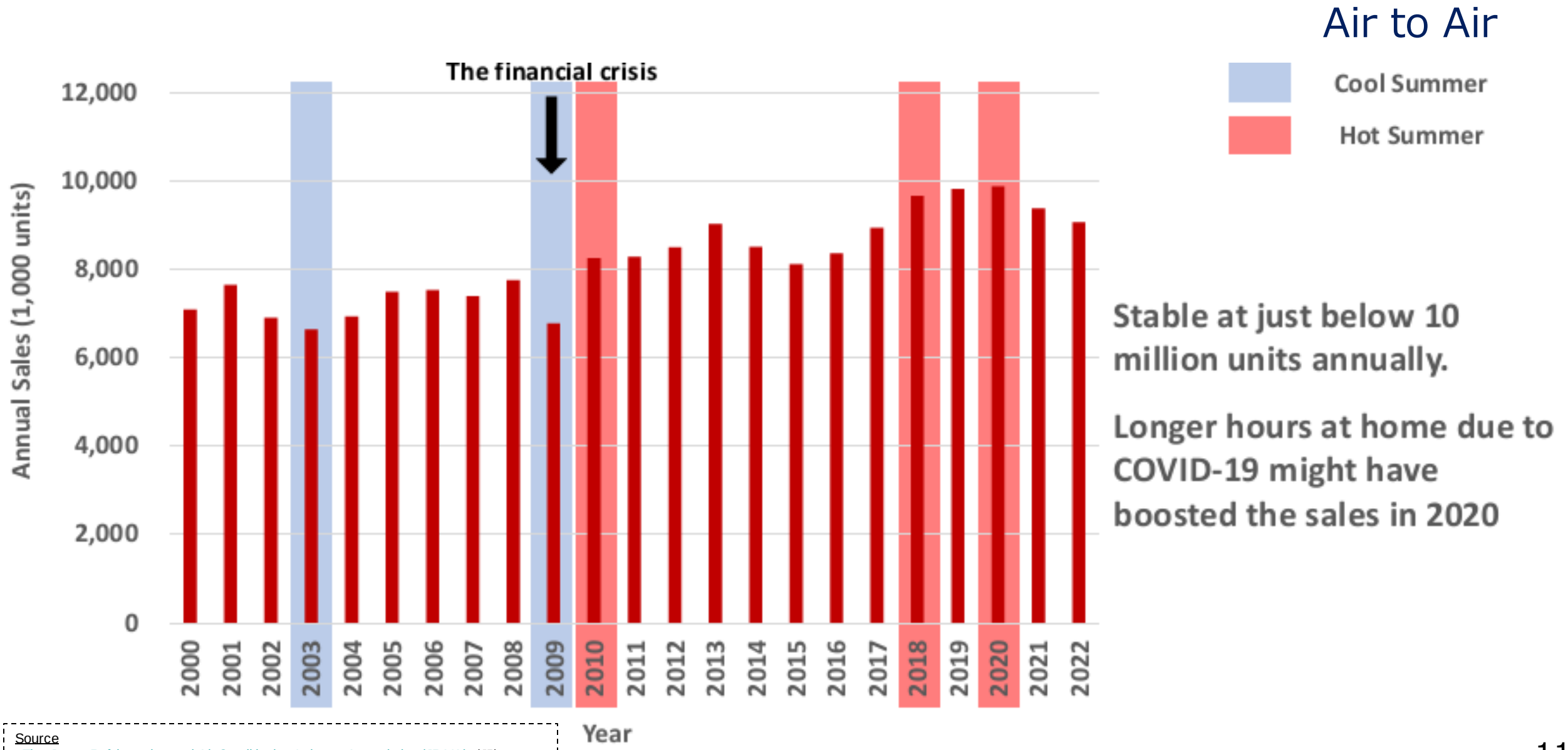


Residential HPWHs (Ecocute)

Commercial HPWHs



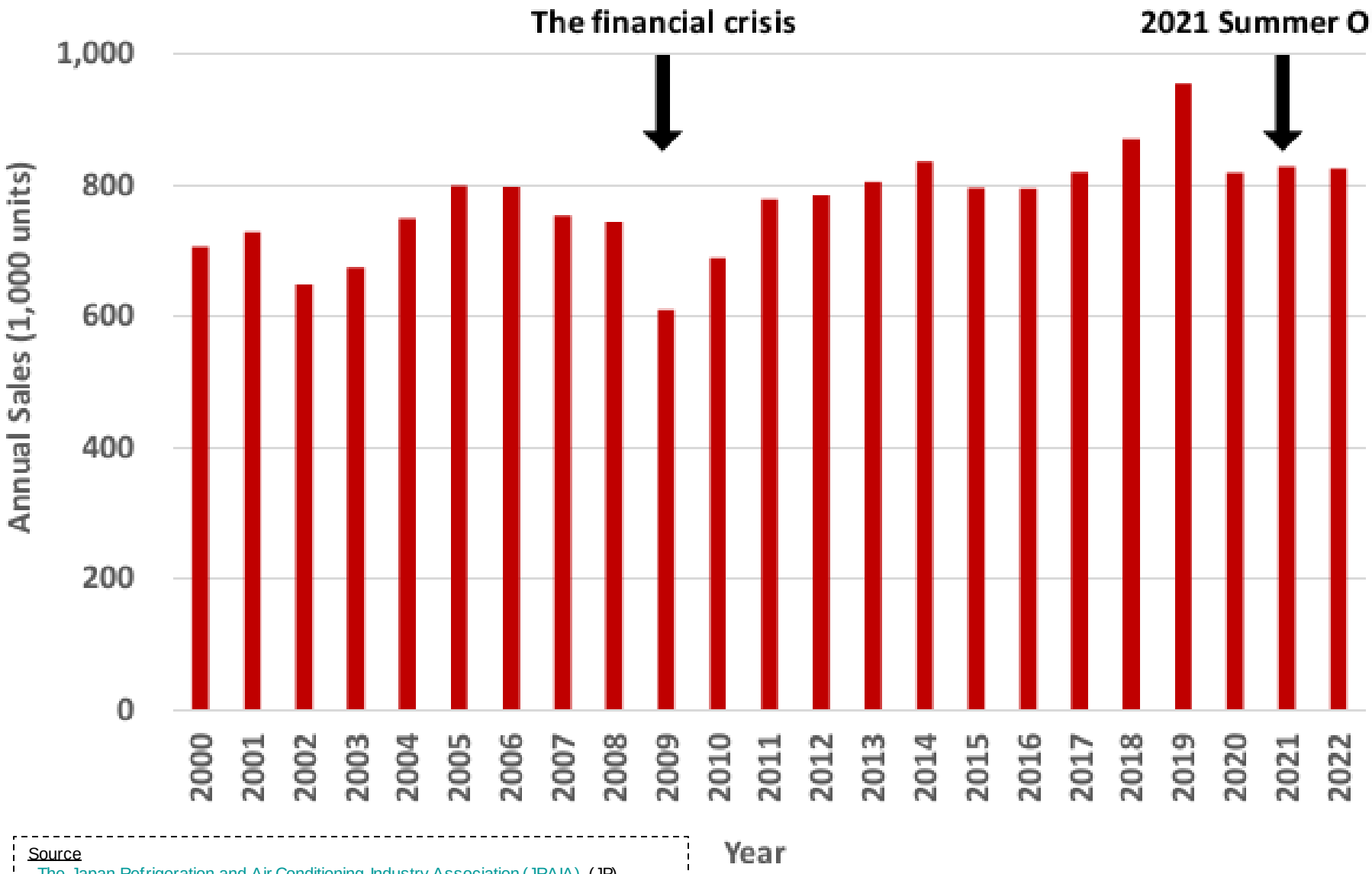
Market - Residential Room Air Conditioners



Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

Market - Commercial Packaged Air Conditioners

Air to Air

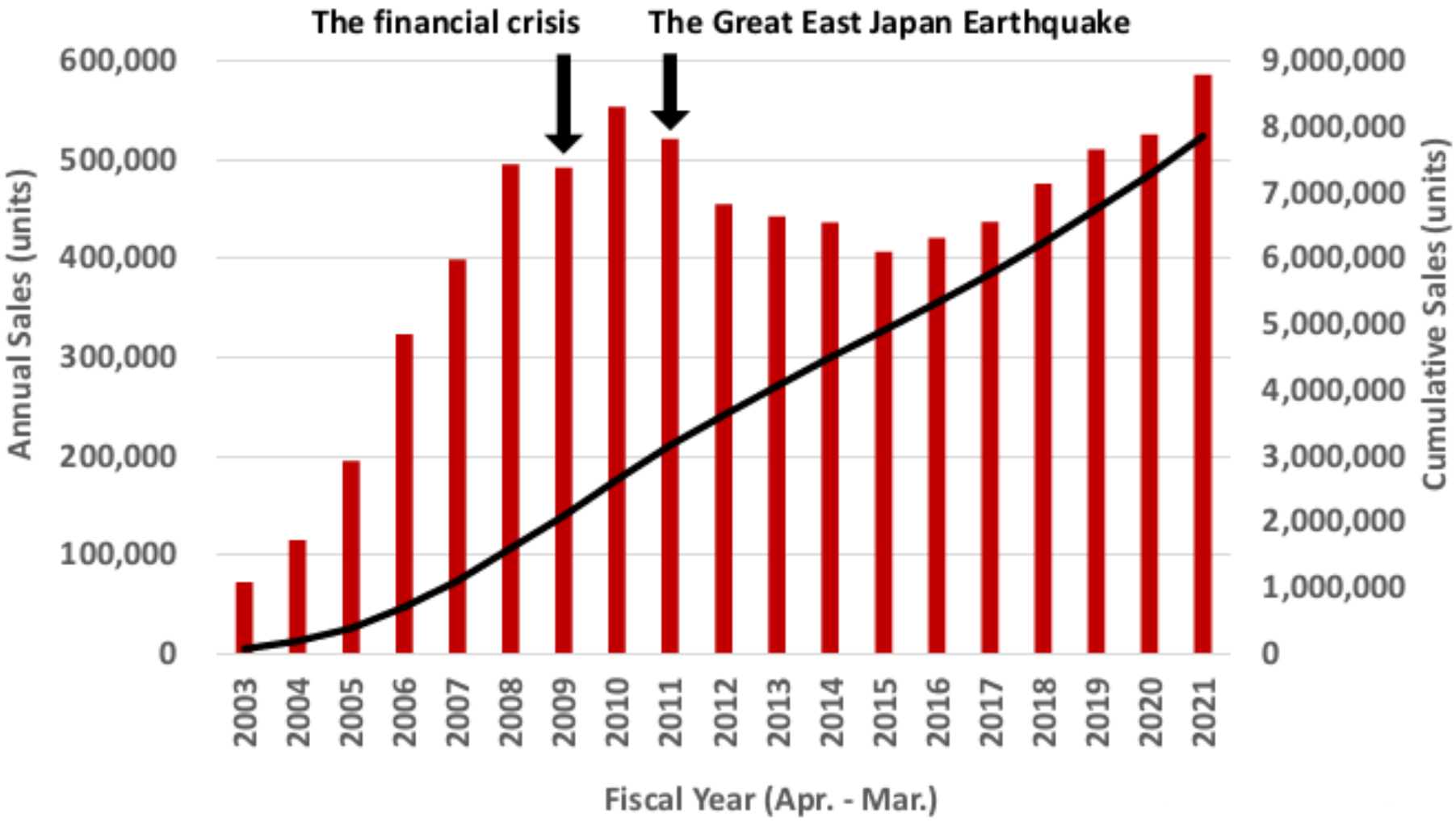


Stable at around 800,000 units annually.

The surge in sales in 2019 might be attributed to the demand for 2021 Summer Olympics held in Tokyo.

Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

Market - Residential HPWH (EcoCute)



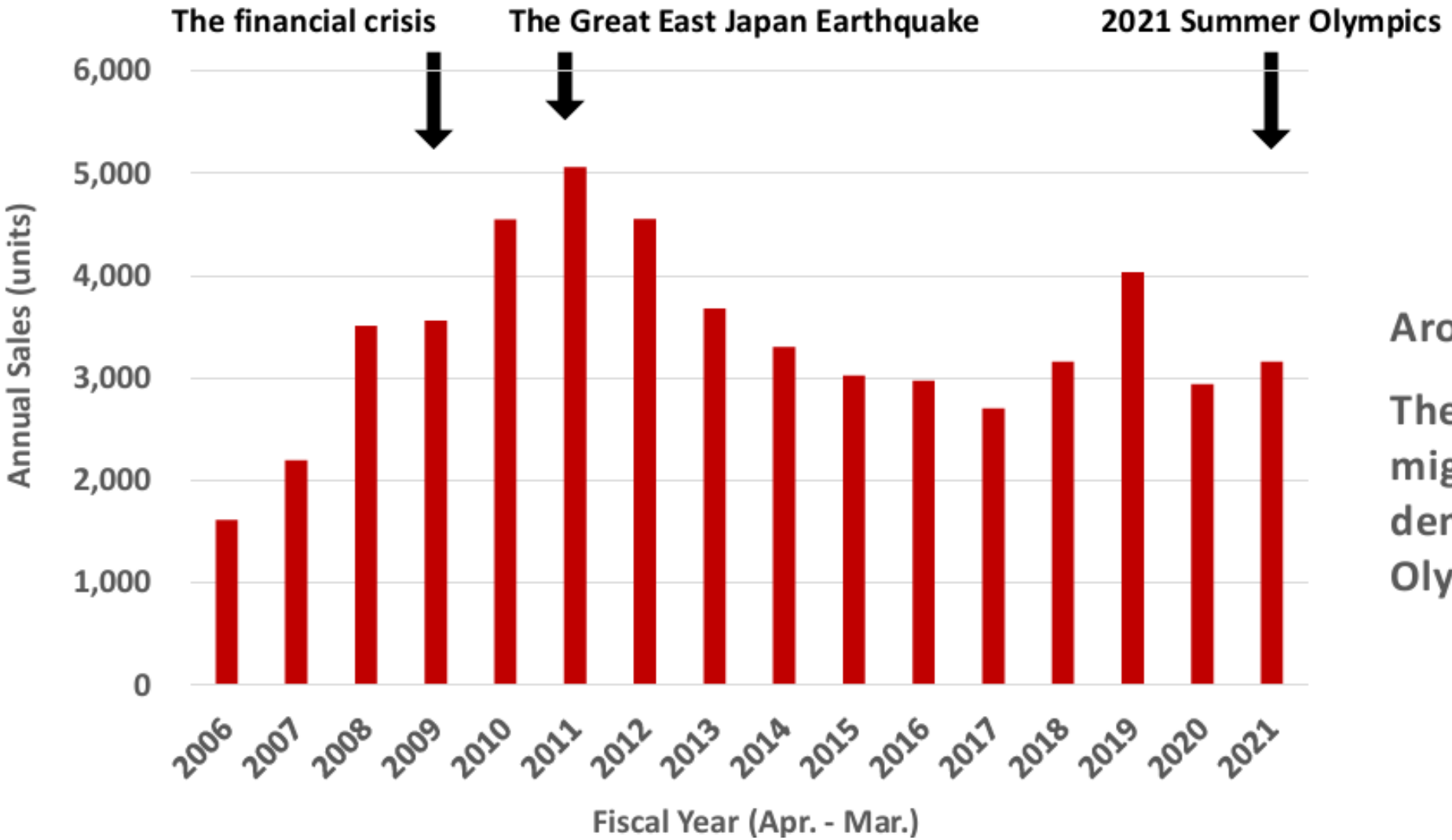
Around 500,000 units annually with an increase of 30,000 units annually.

The cumulative sales will reach 9 million units in fall 2023 at this rate.

Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

Market - Commercial HPWH

Air to Water



Around 3,000 units annually.

The surge in sales in 2019 might be attributed to the demand for 2021 Summer Olympics held in Tokyo.

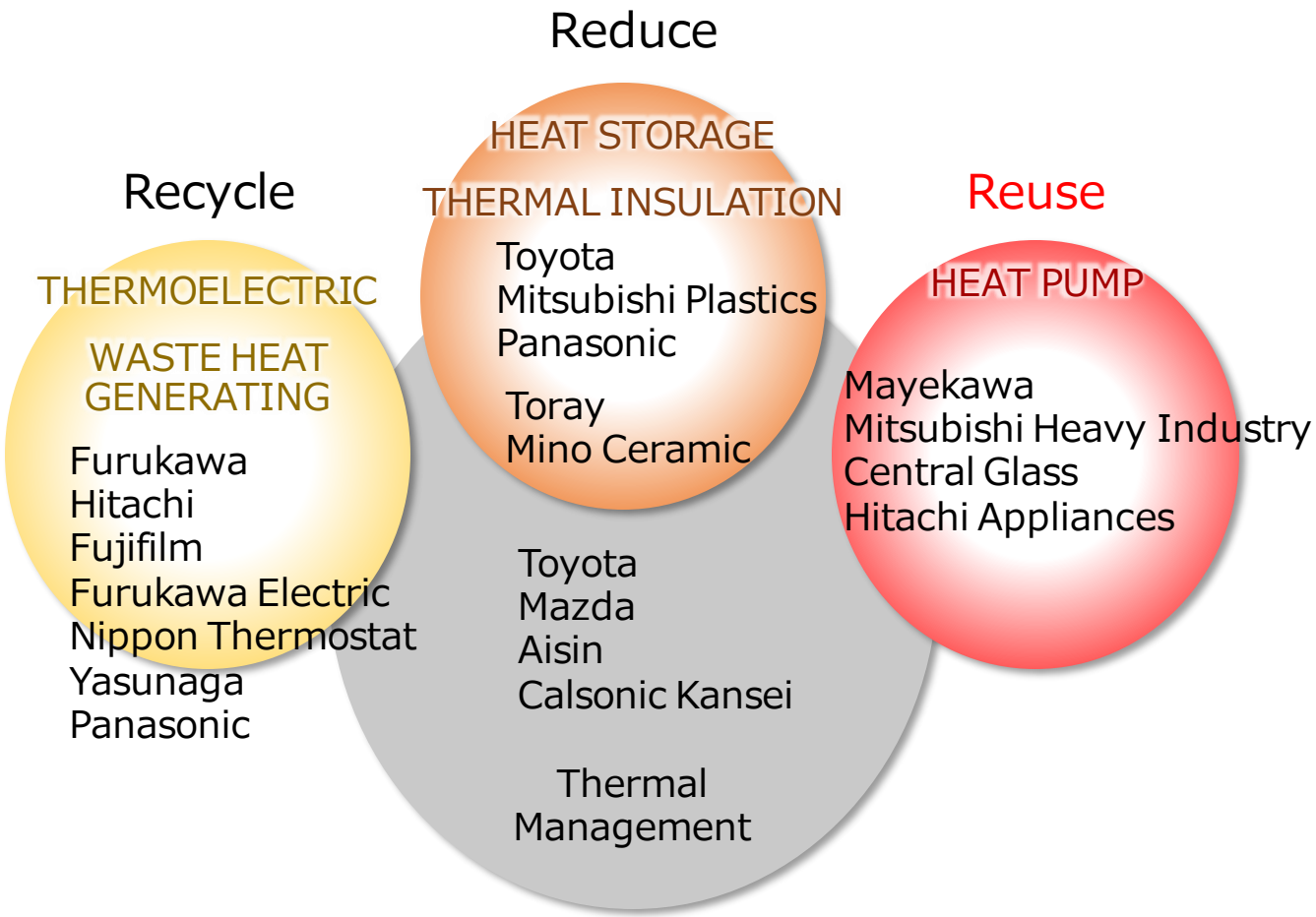
Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

R&D - Utilizing Waste Heat (NEDO)

R&D Project on Innovative Thermal Management Materials and Technologies

(FY 2015 - 2022)

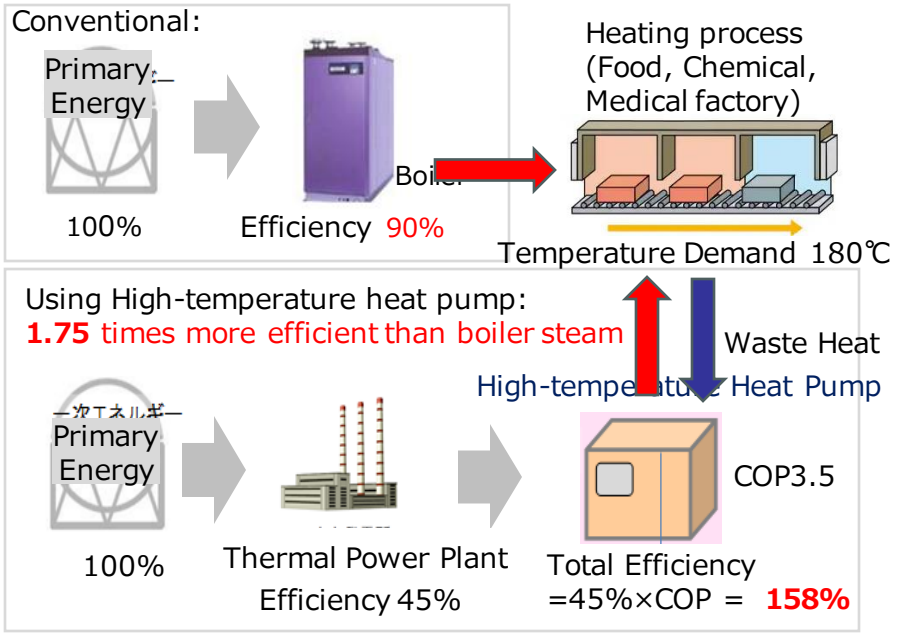
- Budget : 6.8 billion USD
- Technology to effectively **reduce**, **recover** and **reuse** untapped thermal energy
- Crosscutting **heat management** technologies
- HPs can play a role in reusing thermal energy (e.g. high temperature HPs, high-efficiency chiller…)



R&D - Utilizing Waste Heat (NEDO)

High-temperature HP

(Alternative to boilers and firing furnaces)



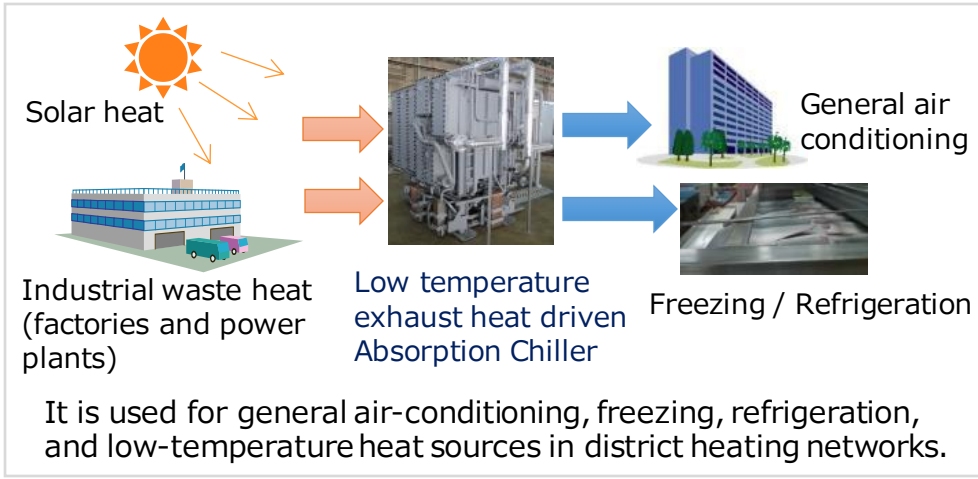
Prototype of Heat Pump

◆ REMARK
・180℃ supply with COP3.5 using unutilized thermal energy around 80℃

・MAYEKAWA MFG. CO., LTD.

Heat Recycle Absorption Chiller

(Driving with low-temperature exhaust heat)



It is used for general air-conditioning, freezing, refrigeration, and low-temperature heat sources in district heating networks.

Double Lift Cycle Absorption Chiller
With World's Highest Efficiency

◆ REMARKs
・The world's highest-efficiency double-lift cycle absorption chiller
・Expands the utilizing temperature (Before: 95→75℃ After:95→51℃)
・4 units had been installed in Germany. (3 in office buildings and 1 in factory)

Productization

Hitachi Johnson Controls Air Conditioning CO., LTD.

Summary

- **Decarbonization:** HPs are seen as one of key technologies to achieving Japan's net-zero 2050 commitment. Quantitative targets for 2030 are set for further deployment of IHPs and commercial and residential HPWHs.
- **Energy:** Cleaner electricity mix including nuclear power is the challenge on the supply side. On the demand side, HP efficiencies have been and will be improving thanks to EE policies like "Top Runner Program" and Awards.
- **Incentives:** Along with a subsidy for IHPs and commercial HPWHs, some subsidies for energy efficiency and ZEB are also applicable to HPs.
- **Market:** Japan's AC market is stable with slight increase in residential room ACs. We need to further deploy IHPs in line with the government's target.
- **Technology** : R&Ds of such as High-temperature HP and Heat recycle Absorption chiller are being carried out in domestic research projects.

IRENA INNOVATION WEEK 2023

Heat pumps as a commodity in the electric grid of the future

Thomas Nowak
Secretary general
European Heat Pumps Association

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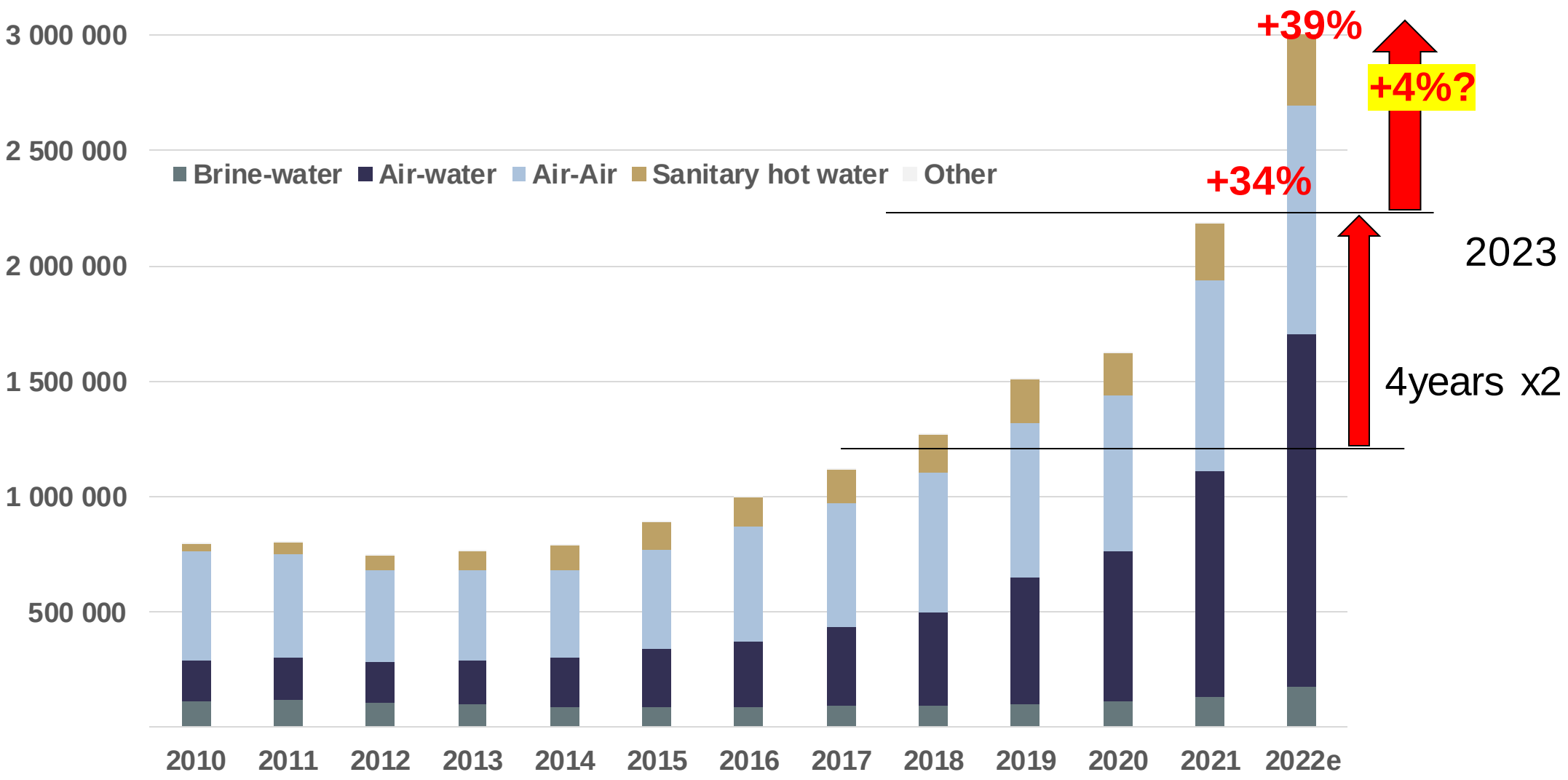
Market growth ‘10 – ’22 | HP stock2022 est.: 19,9 mill. installed



http://stats.ehpa.org

YoY

1%	-7%	3%	3%	13%	12%	12%	13%	19%	6%	34%	39%

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What about end-user demand?

The impact of the all-electric building

Heat pump
Thermal storage

Electric vehicles
Vehicle-to-building/grid

Photovoltaik
Battery storage

Activating end-user interest and investment

$$\frac{\text{Cost of electricity } (ct/kWh_{el})}{\text{Cost of gas } (ct/kWh_{thermal})} \simeq 2$$

From “heat pump accelerator” to “heat pump action plan”

The European Heat Pump Association aisbl / founded 2000

200

Members

Heat pump manufacturers
Component manufacturers
National associations
Consultants
Research & test institutes

22

countries represented

International cooperation

CECA, IEA, IEA HPC, IRENA, HPCJ

Vision

In a fully decarbonised Europe, **heat-pump technologies are the number one heating and cooling solution**, being a core enabler for a renewable, sustainable and smart energy system.

IRENA INNOVATION WEEK 2023

Panel discussion

Moderator

Thomas Nowak

European Heat Pump Association

Panellists

Stefan Moser

European Commission

Ezzeddine Jradi

Emicool

Kazuyoshi Nakano

CRIEPI

Matthias Grapow

MAN ES

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Closing remarks

Thomas Nowak
Secretary general
European Heat Pumps Association

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