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Key to a robust and clean energy system

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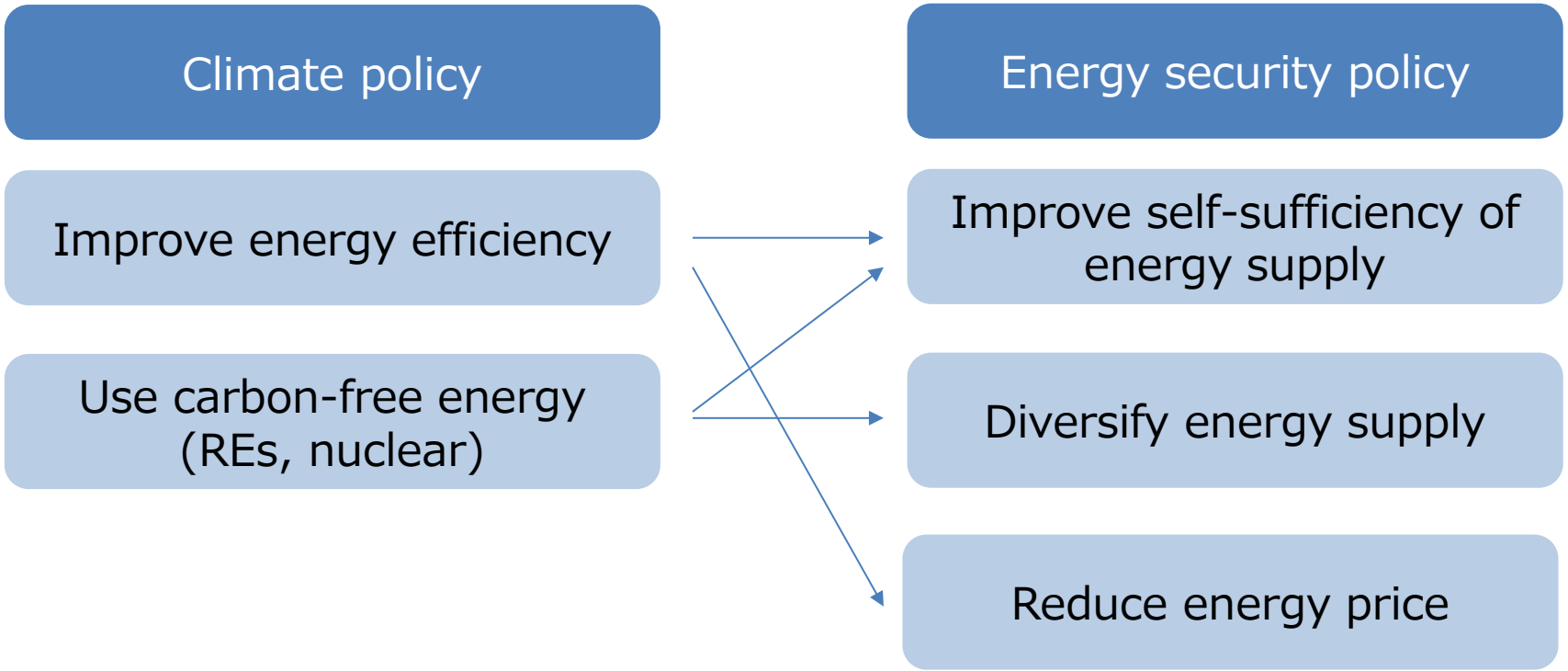
Basics of carbon neutrality

Balance of 3Es

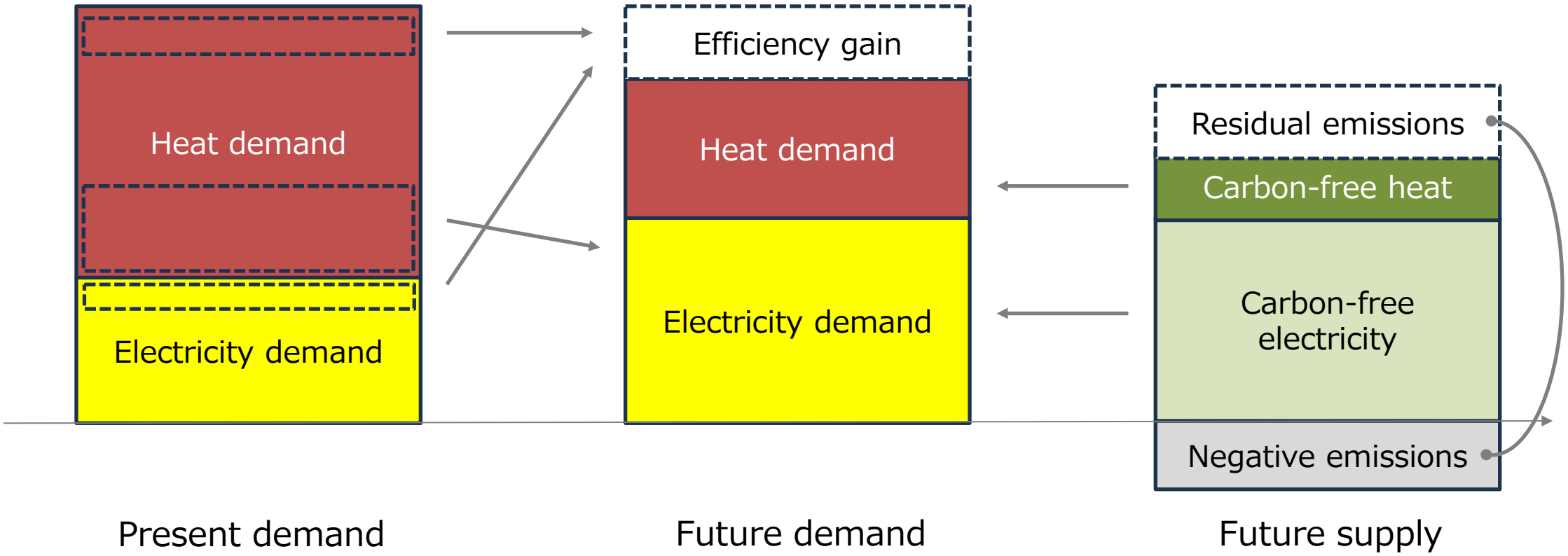
- A country shall find appropriate energy mix.
  - Energy must be available at all times.
  - To provide energy at an affordable price.
  - To provide energy with less environmental impact.

Energy security policy and climate policy are mutually compliment



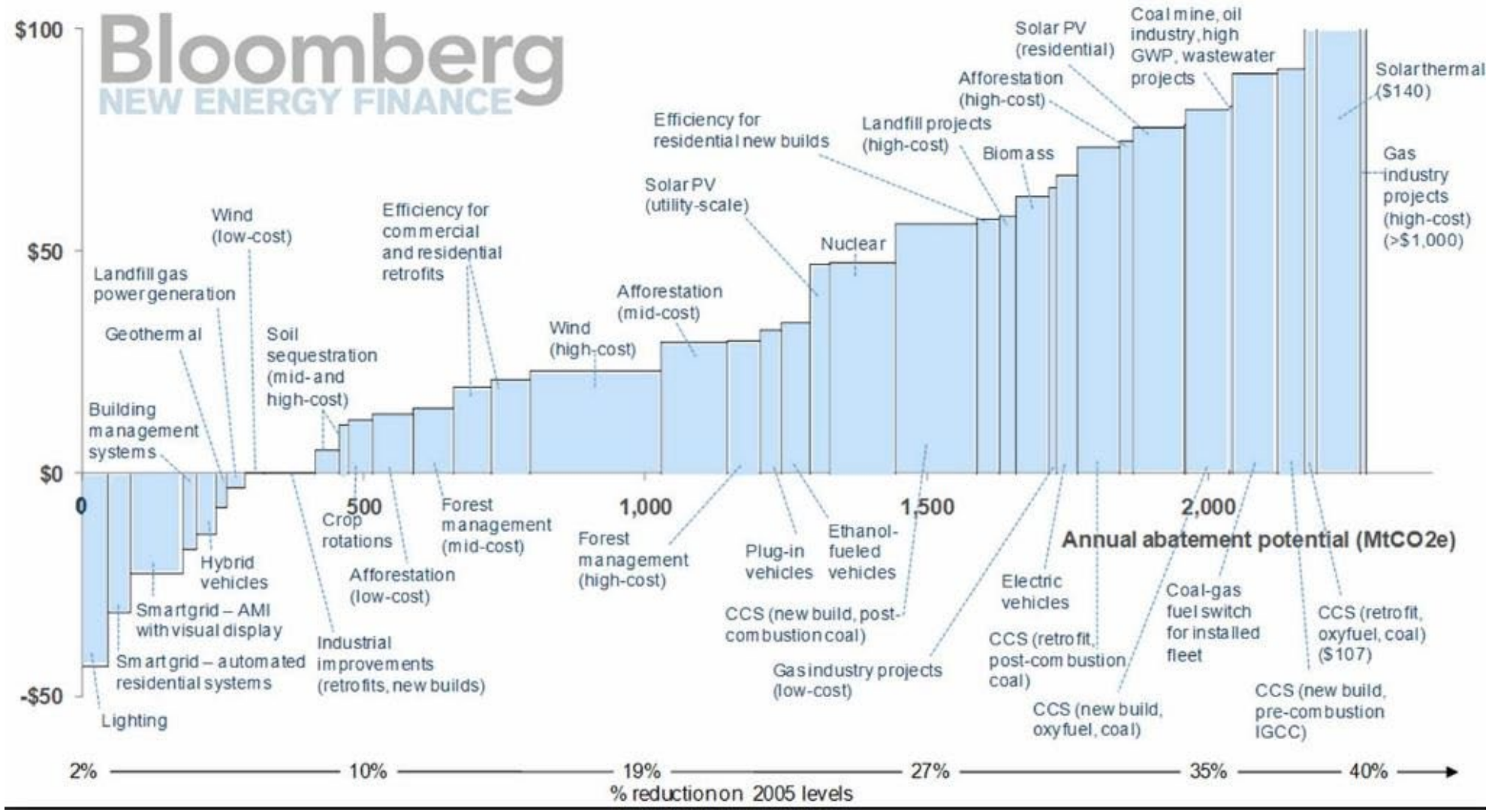
Fundamental approach for carbon neutrality

- Approach toward carbon neutrality consists of 4 pillars.
  - Reduce the energy demand
  - Electrify the energy demand
  - Supply the carbon free energy
  - The negative emissions to offset residual emissions



Energy efficiency is the lowest cost option

Example of marginal GHG abatement cost curve (USA)



Source: Bloomberg New Energy Finance

Electrify the energy demand

Coal stove

Natural gas/oil water boiler

Natural gas/oil cooker

Gasoline/diesel engine vehicle

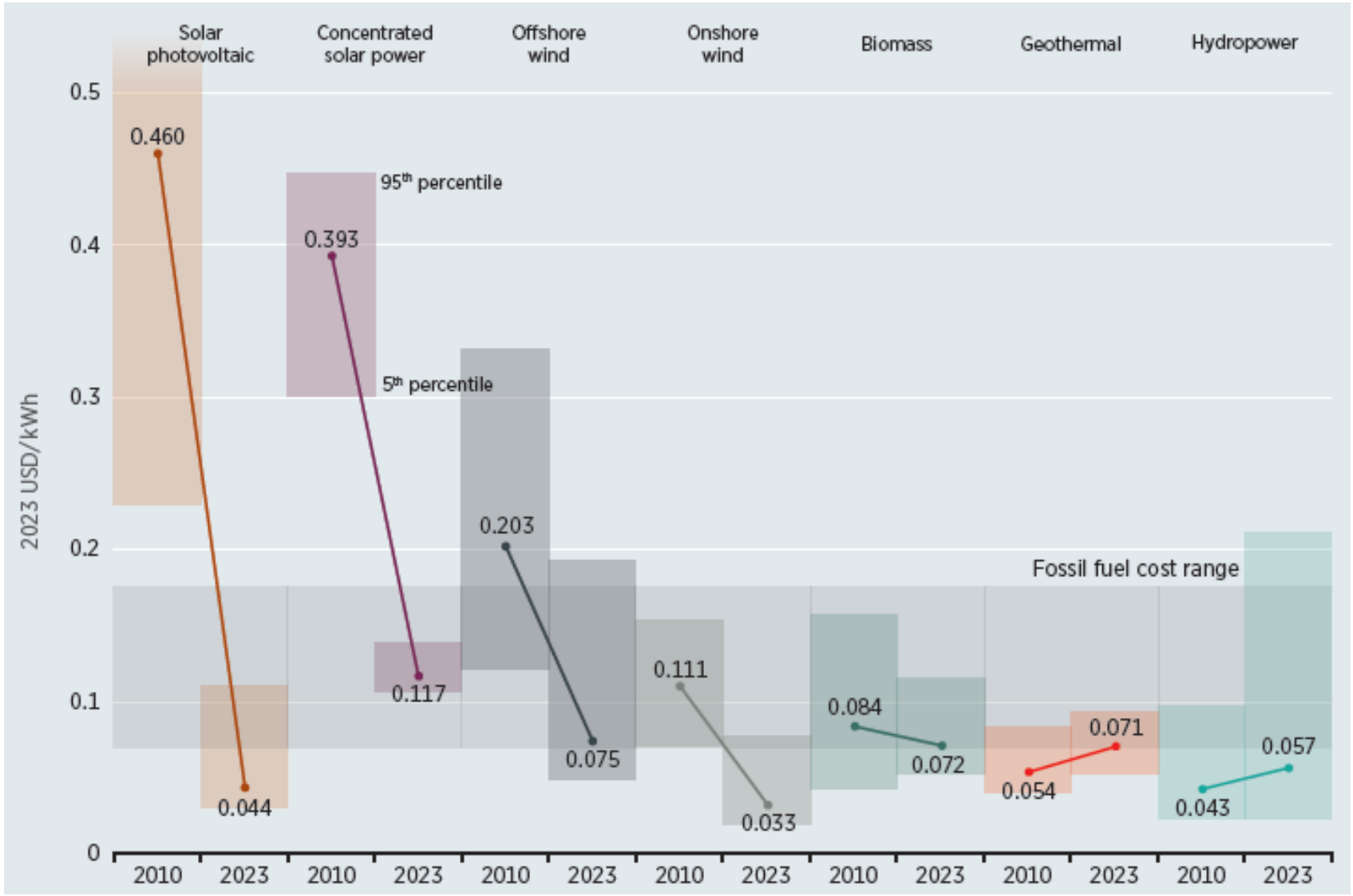
Electric air conditioner

Electric heat pump water boiler

Induction cooker

Battery electric vehicle

Cost of REs become competitive

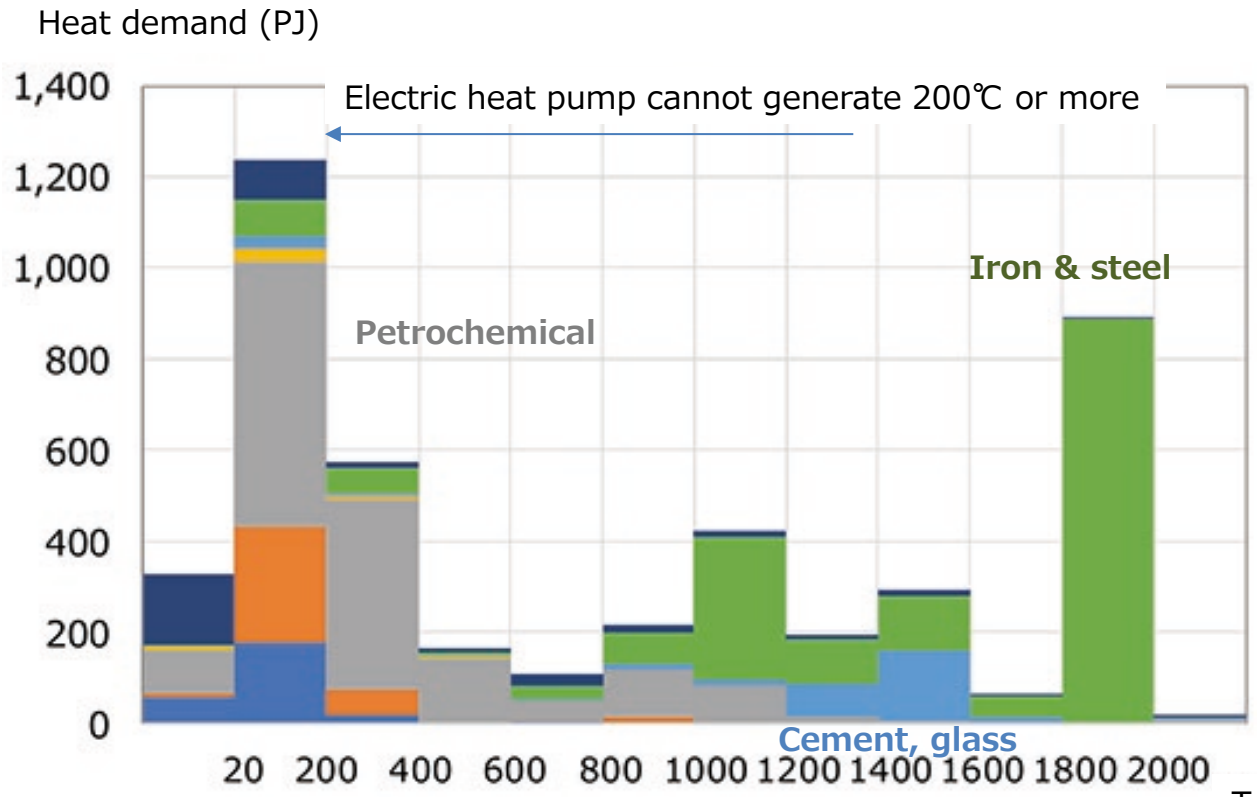


Global renewable power generation cost

Source: IRENA (2024), Renewable power generation cost in 2023

Hard-to-abate energy demand

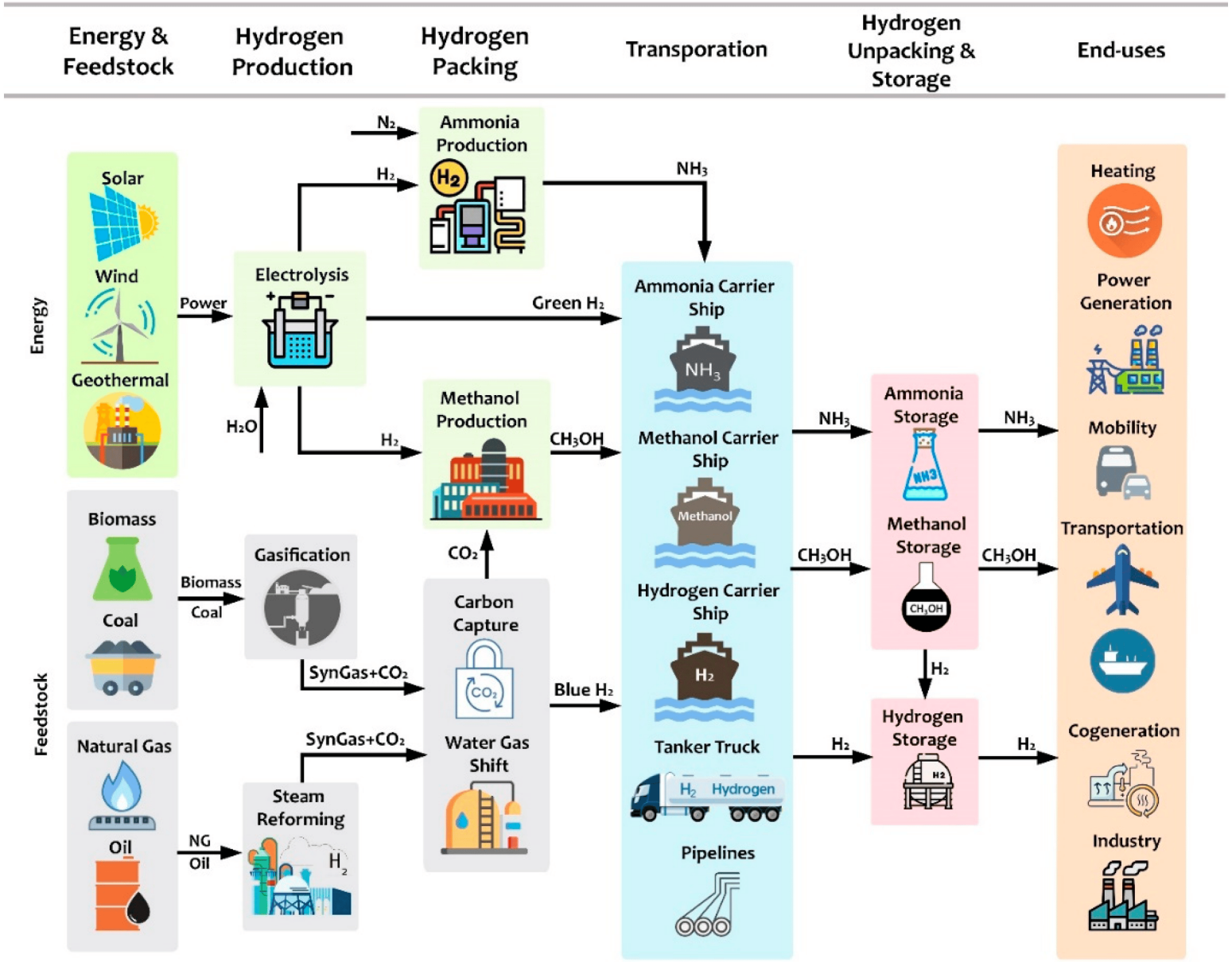
- Electrification is not technologically/economically feasible for some demands.
  - Large amount of high temperature industrial heat: Iron & steel, petrochemical, cement, etc.
  - Carbon is needed in manufacturing product: Iron & steel, petrochemical, cement, etc.
  - Need high energy density: Aviation, long-haul shipping, heavy-duty truck



Industrial heat demand by temperature (2017 in Japan)

Source: METI (2018), Survey on the heat supply-demand and characteristics of hear supply appliances

Hydrogen can be a solution

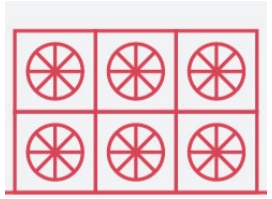


Hydrogen supply chain

Source: Mohsen Salimi et.al. (2022), The Role of Clean Hydrogen Value Chain in a Successful Energy Transition of Japan

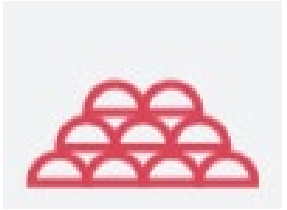
Negative emission technology is a necessity

Typical negative emission technologies



Direct Air Carbon Dioxide Capture and Storage(DACCS)

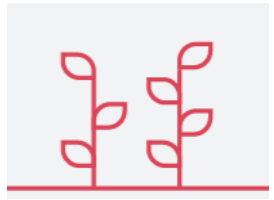
Bioenergy with CCS (BECCS)



Bio char

Enhanced weathering

Afforestation and forest management



Blue carbon

Soil carbon sequestration

Ocean alkalization

Source: IEEK (2023), IEEJ Outlook 2024

My view on your country

- Kirgizstan
- Tajikistan

Energy resources

- Rich in coal resources.
- There is still a large untapped potential for hydro and wind power.

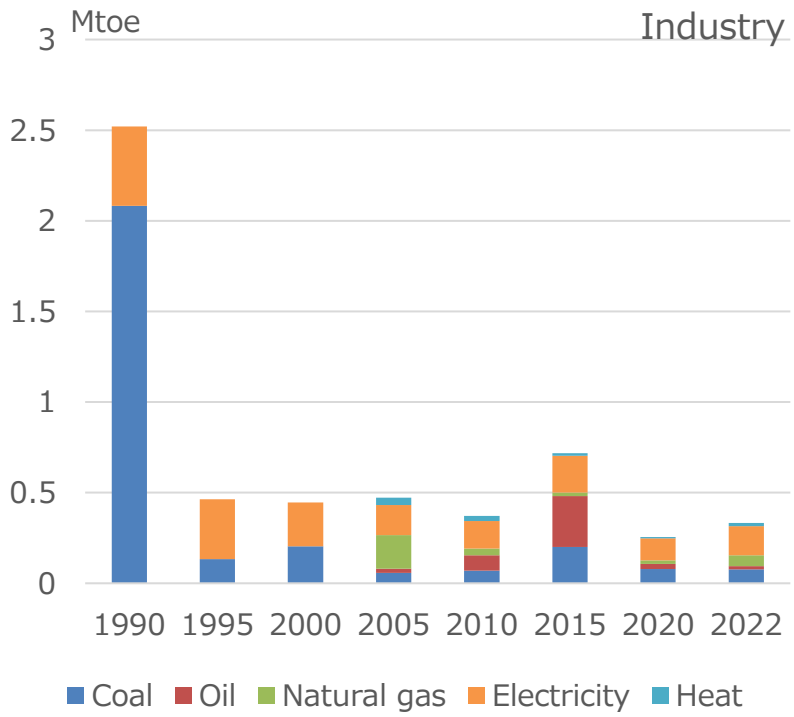
	Resource potential (2020)	Production (2021)	R/P ratio (2021)	Self-sufficiency (2021)
Crude oil	N.A.	N.A.	N.A.	N.A.
Natural gas	5.66 Bcm	N.A.	N.A.	N.A.
Coal	5,700 million ton	N.A.	N.A.	N.A.
Uranium	N.A.	N.A.	N.A.	-
Hydro power	142 TWh/y	13 TWh	-	-
Wind power	140* / 4** TWh/y	0 TWh	-	-
Solar photovoltaic	N.A.	0 TWh	-	-

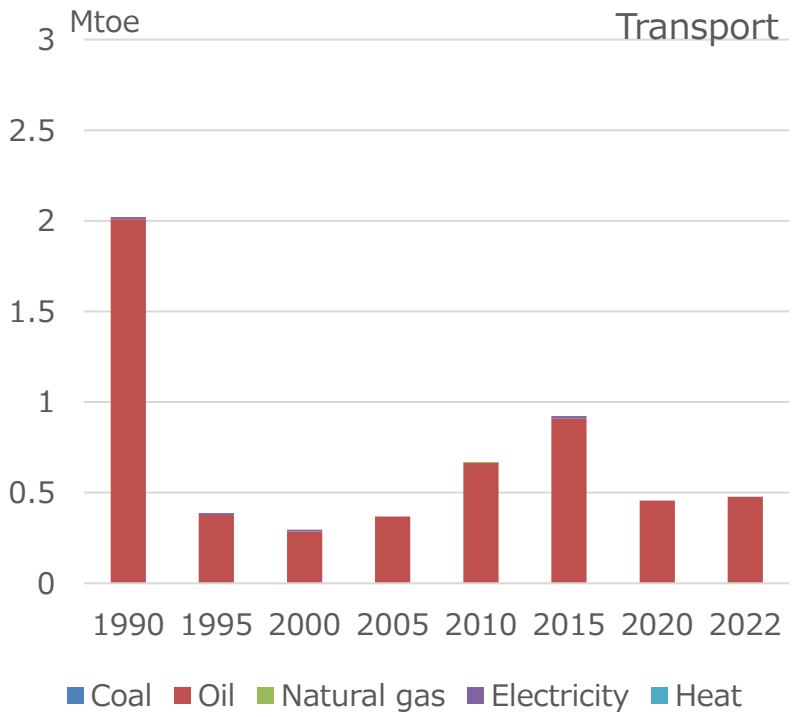
* Technically justified, ** Economically justified
Source: EI (2024) Statistical review of world energy, etc.

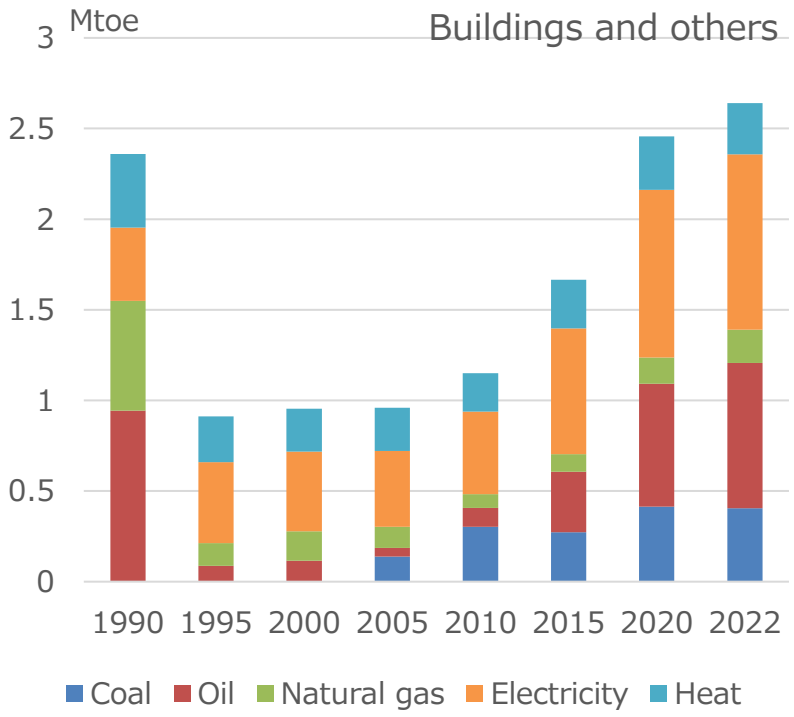
Final energy consumption by sector

- Industrial energy use is small and mainly met by electricity.
- Transport sector energy is dominated by oil.
- Energy demand in buildings increase fast, and electricity and natural gas are the major fuel.

Final energy consumption





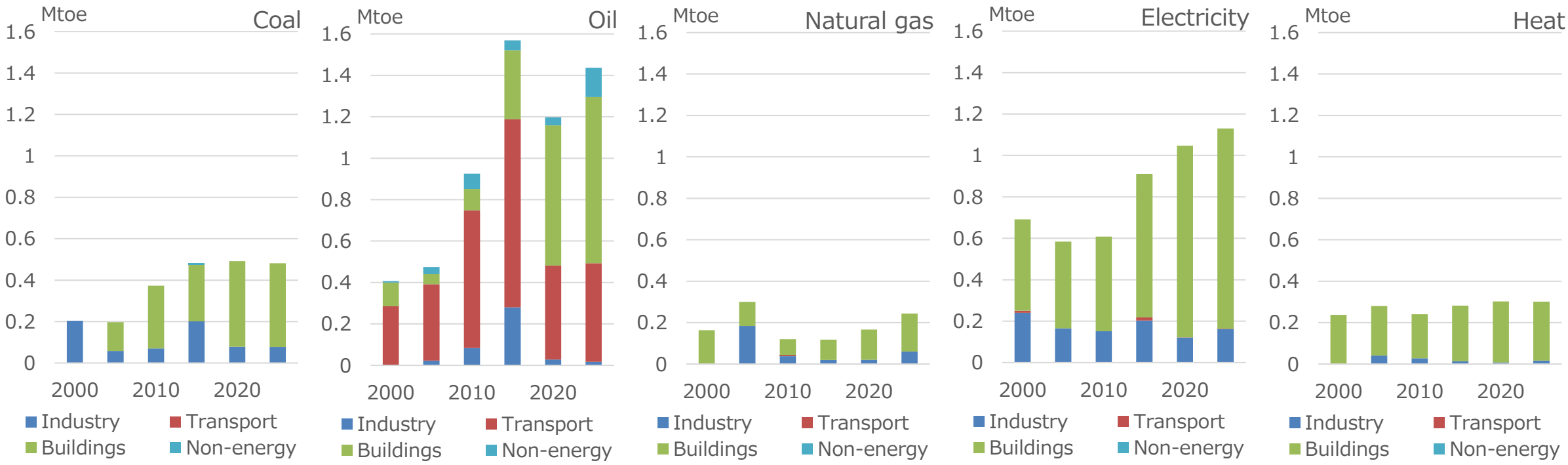


Buildings and others = Residential + Commercial and public services + Agriculture/forestry + Fishing + Final consumption not elsewhere specified
Source: IEA (2024) World Energy Balance

Final energy consumption by energy

- Other than oil, buildings is the largest energy consuming sector.
- Oil is mostly consumed in buildings and transport sectors.

Final energy consumption



Buildings = Residential + Commercial and public services + Agriculture/forestry + Fishing + Final consumption not elsewhere specified
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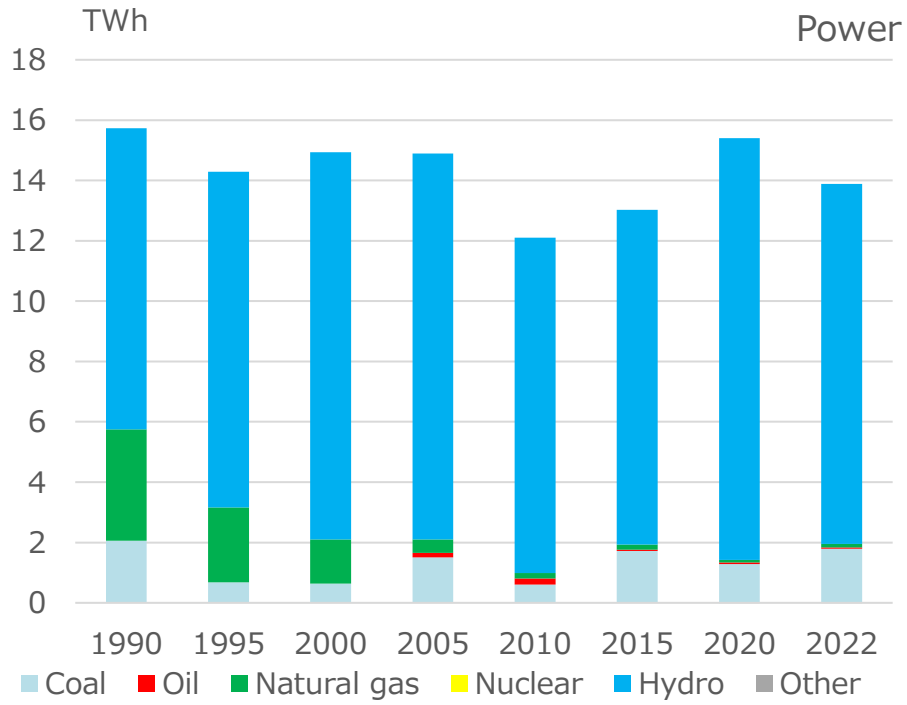
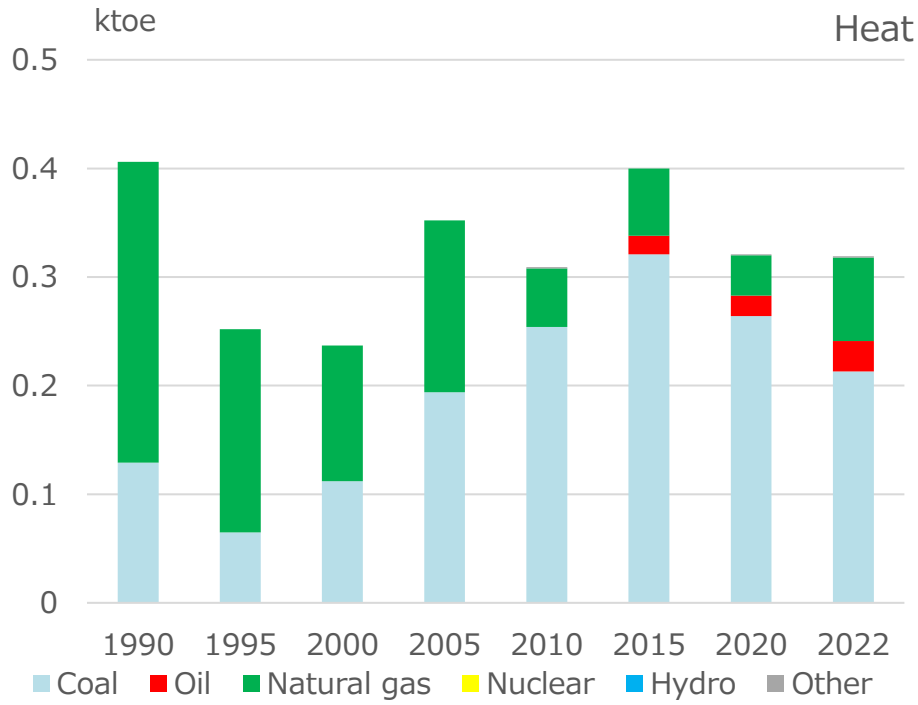
Power and heat generation

- Most of the electricity is generated by hydroelectric.
- Heat is mostly generated by coal.

Power generation



Heat generation



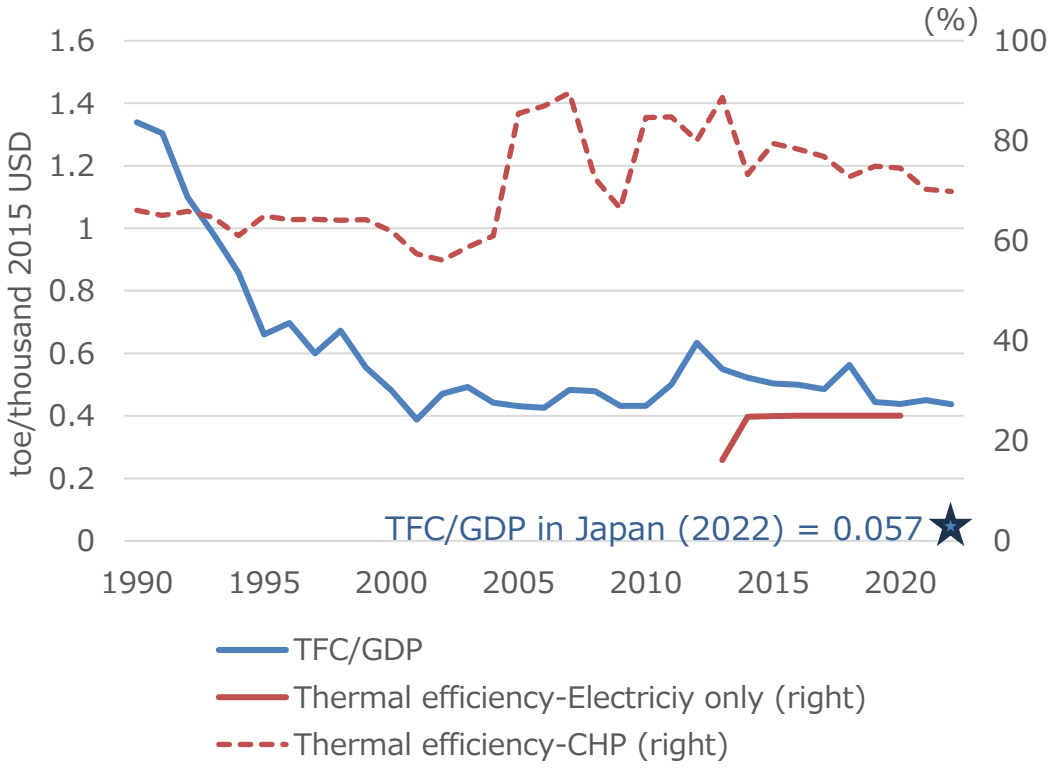
Source: IEA (2024) World Energy Balance

Energy efficiency

- Improvement of end use energy efficiency has been stagnated for more than past 20 years.
- Thermal efficiency of electricity only plant is very low.
- Thermal efficiency of CHP plant is gradually declining.

Energy efficiency indicators

CHP = combined heat and power plant, Power = power generation only plant, TFC = total final consumption
Source: IEA (2024) World Energy Balance



My view on your country

- Kirgizstan
- Tajikistan

Energy resources of Tajikistan

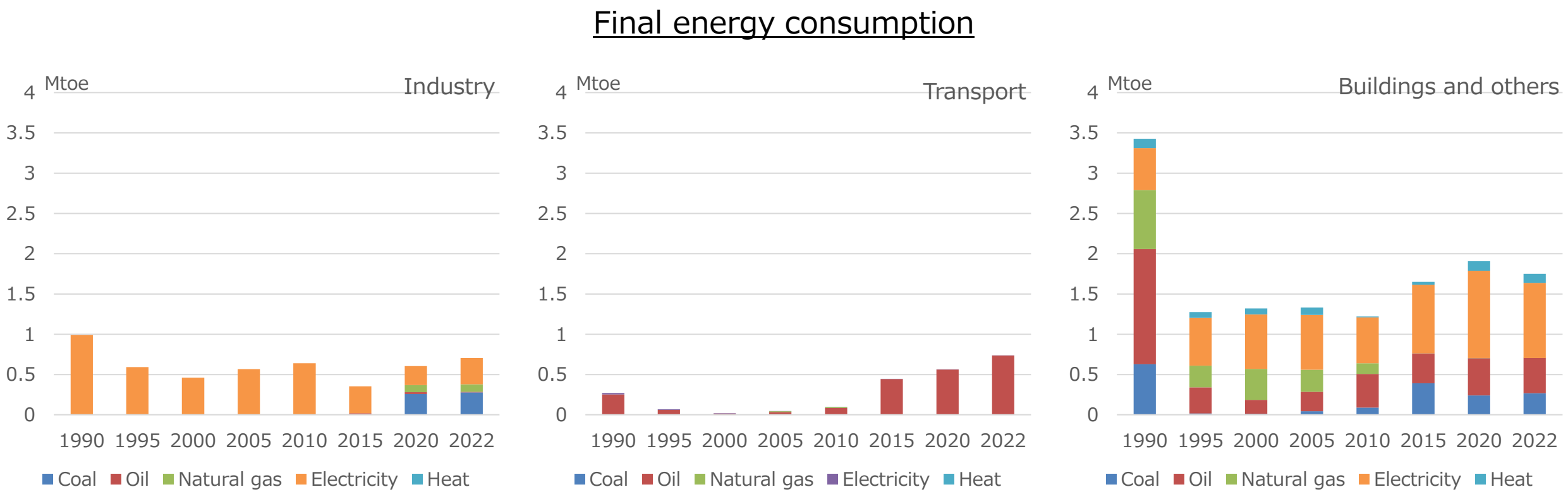
- Fossil fuel reserve is not significant.
- Renewable energy, particularly hydroelectric power, potential has not fully developed.

Item	Resource potential (2020)	Production volume (2021)	R/P ratio (2021)	Self-sufficiency rate (2021)
Crude oil	120 million bbl	N.A.	N.A.	N.A.
Natural gas	0.056 Tcm	N.A.	N.A.	N.A.
Coal	400 million tons	N.A.	N.A.	N.A.
Uranium	N.A.	N.A.	N.A.	-
Hydroelectric	527 TWh/y	18.7TWh	-	-
Wind power	30 to 100 TWh/y	0TWh	-	-
Solar power	25 TWh/y	0TWh	-	-

Source: EI (2024) Statistical review of world energy, etc.

Final energy consumption by sector

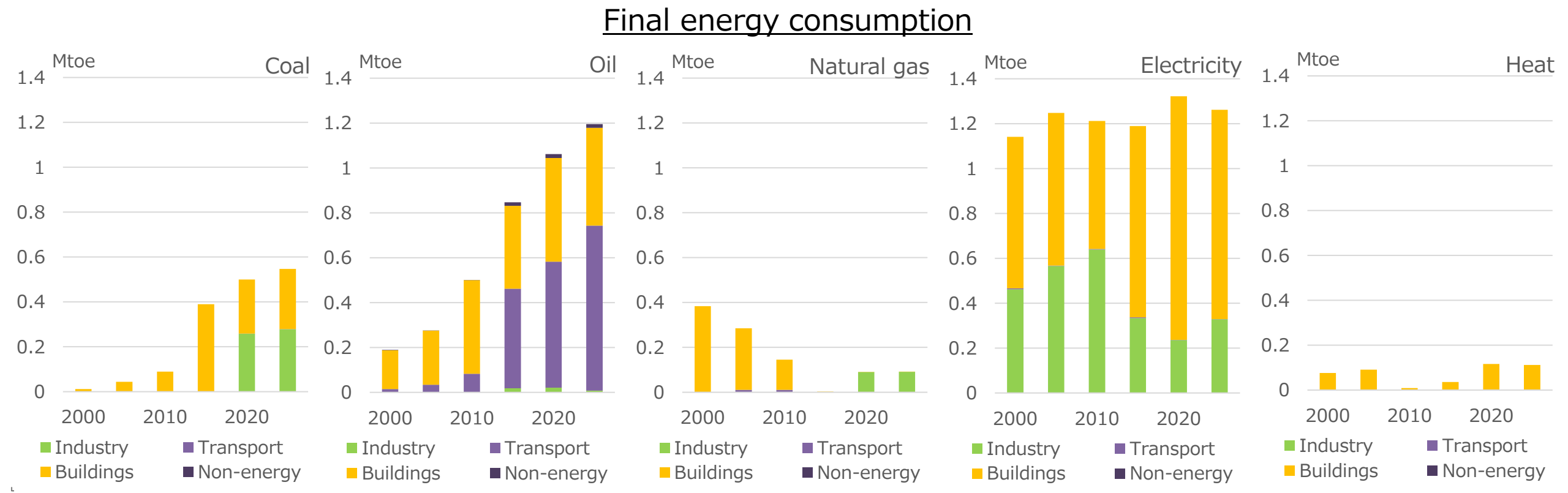
- Industrial energy use is small and mainly met by electricity and coal.
- Transport energy demand is growing which is dominated by oil.
- Energy demand in buildings is the largest, and electricity and oil are the major fuel.



Buildings and others = Residential + Commercial and public services + Agriculture/forestry + Fishing + Final consumption not elsewhere specified
Source: IEA (2024) World Energy Balance

Final energy consumption by energy

- Coal and natural gas are mostly consumed by industry sector.
- Oil is mainly consumed by transport sector and its share is rapidly increasing.
- Electricity is mostly consumed by building sector, but demand has not increased much.



Buildings = Residential + Commercial and public services + Agriculture/forestry + Fishing + Final consumption not elsewhere specified
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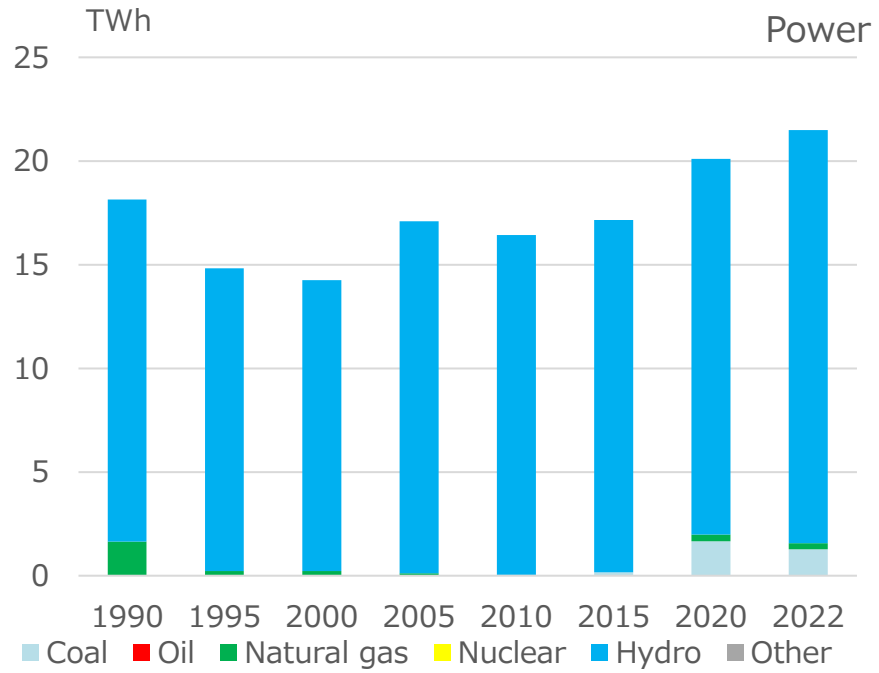
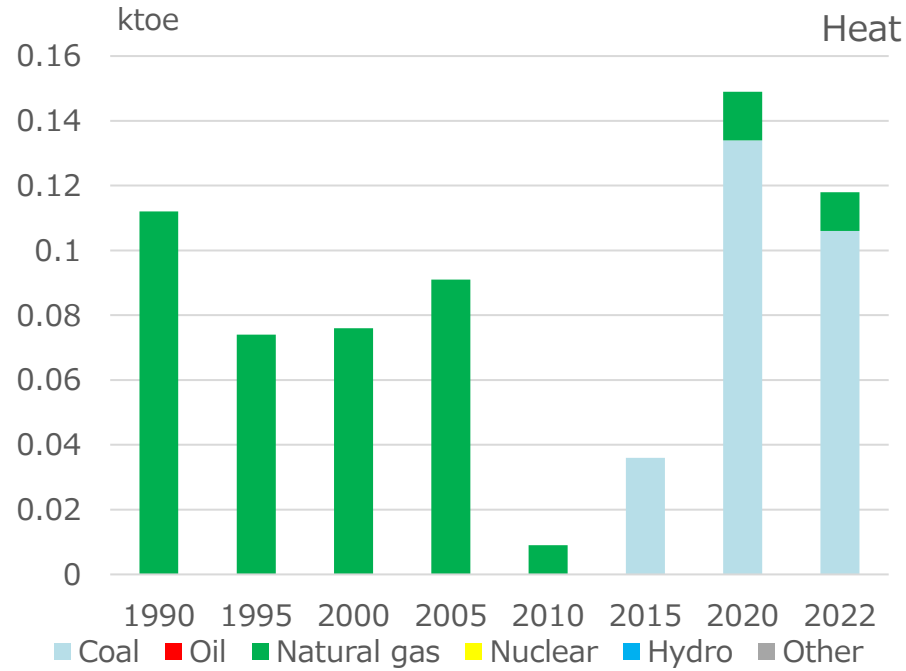
Power and heat generation

- Most of the electricity is generated by hydroelectric.
- Fuel for heat generation has remarkably changed from natural gas to coal.

Power generation



Heat generation



Source: IEA (2024) World Energy Balance

Energy efficiency

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- Thermal efficiency of CHP plant is gradually declining.

Energy efficiency indicators

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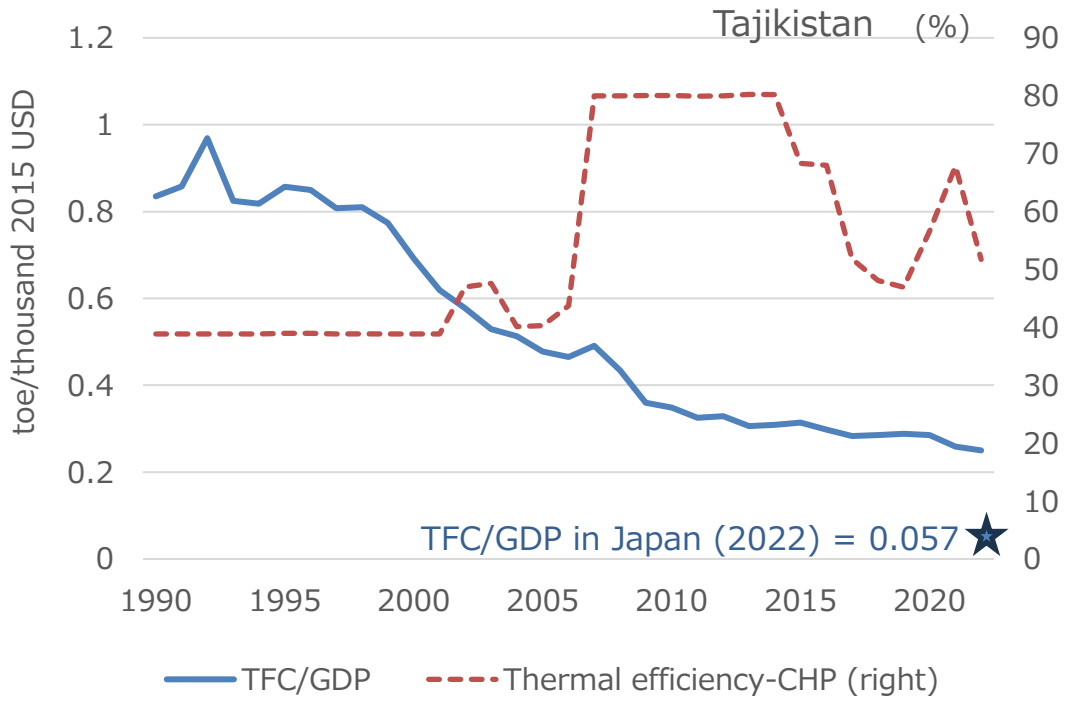


Key to a robust and clean energy system

Suggestions for your country

- Improve end-use energy efficiency to reduce end-use demand.
  - Priority is the building sector. (heat supply, thermal insulation of building envelope, high efficiency appliances)
  - Transport sector follows. (fuel economy of vehicles, transportation mode, lifestyle)
- Electrify demand to make it ready for carbon neutral.
  - Heat pump (space heating/cooling, boilers), cooking, vehicles
- Promote clean and stable electricity supply.
  - VREs (Solar, wind) with hydroelectric power is the ideal combination to supply decarbonized electricity.
  - Strengthen power grid (expand grid capacity, automate to reduce power outage, etc.)
- Explore the potential of carbon sinks to manage the emissions from hard-to-abate sectors.
  - Heavy industries including cement, heavy-duty trucks, aviation

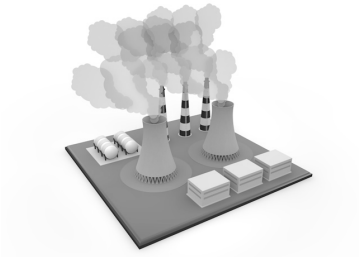
Which option better suits your country?

- Renovate existing district heating system.
- Shift to individual electric heat pump air conditioner.

100

Coal

Heat production loss



Existing fossil-fired CHP

40

Heat

Heat loss

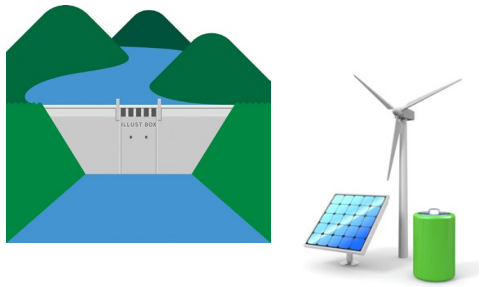
Steam/hot water pipeline

30

Apartment

25

Radiator



Hydroelectric
Renewable electricity

100

Electricity

T&D loss

Power grid

90

Apartment

450

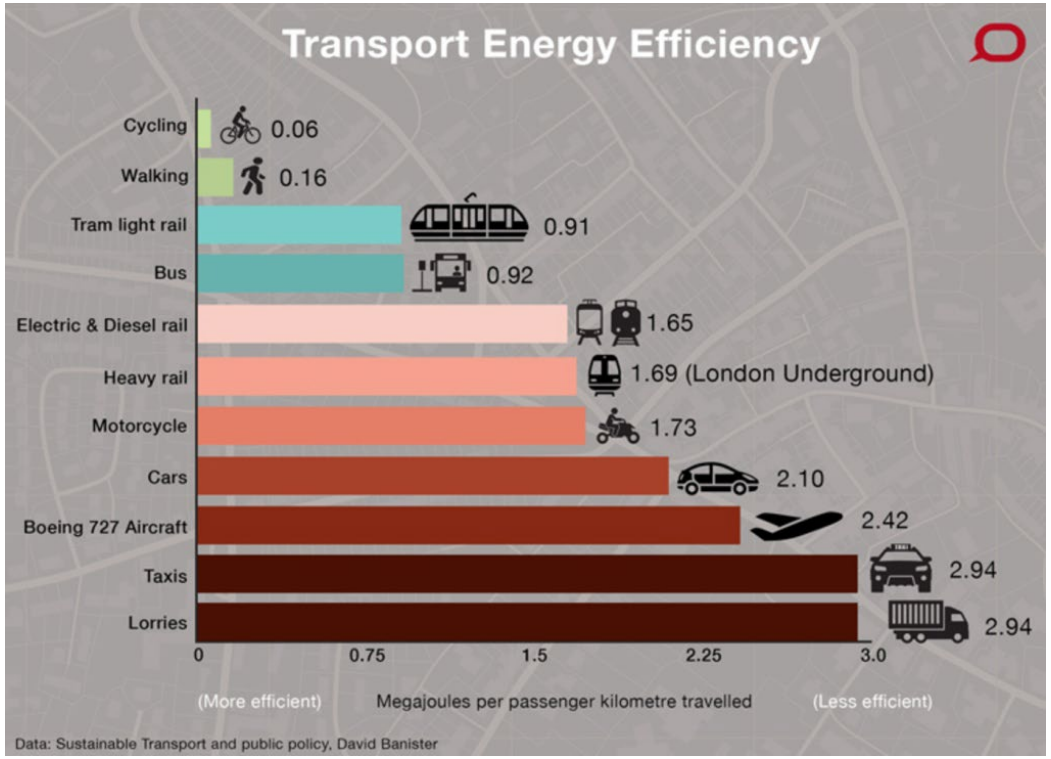
Electric air conditioner

* Assume 5.0 of annual performance factor for heat pump

Apart from fuel economy

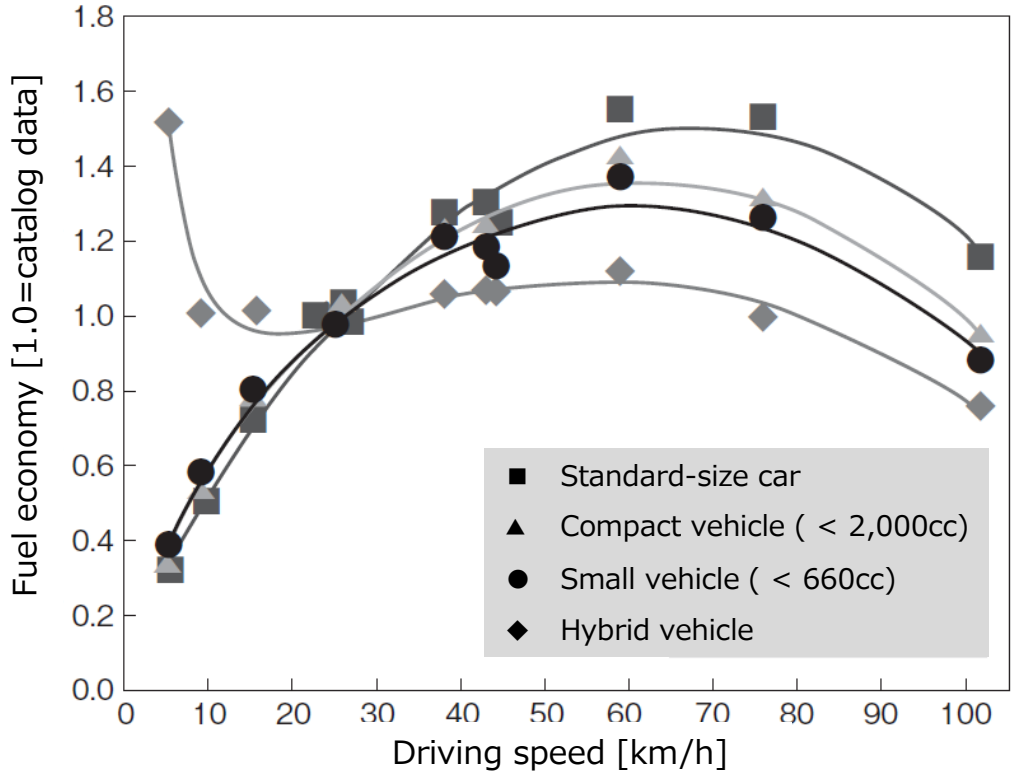
- Transport mode and driving speed matter a lot.

Fuel economy of different transport mode
(mega jour per passenger-kilometer)



Source: Cameron Gordon, Which transport is the fairest of them all?, 22 Apr 2014 (original study was conducted in early 2000s in UK)

Relation between driving speed and fuel economy



Source: EVsmart blog
https://blog.evsmart.net/electric-vehicles/eco-driving/

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