

The heat transition

RE Heat

Dr. Herena Torio

Agenda

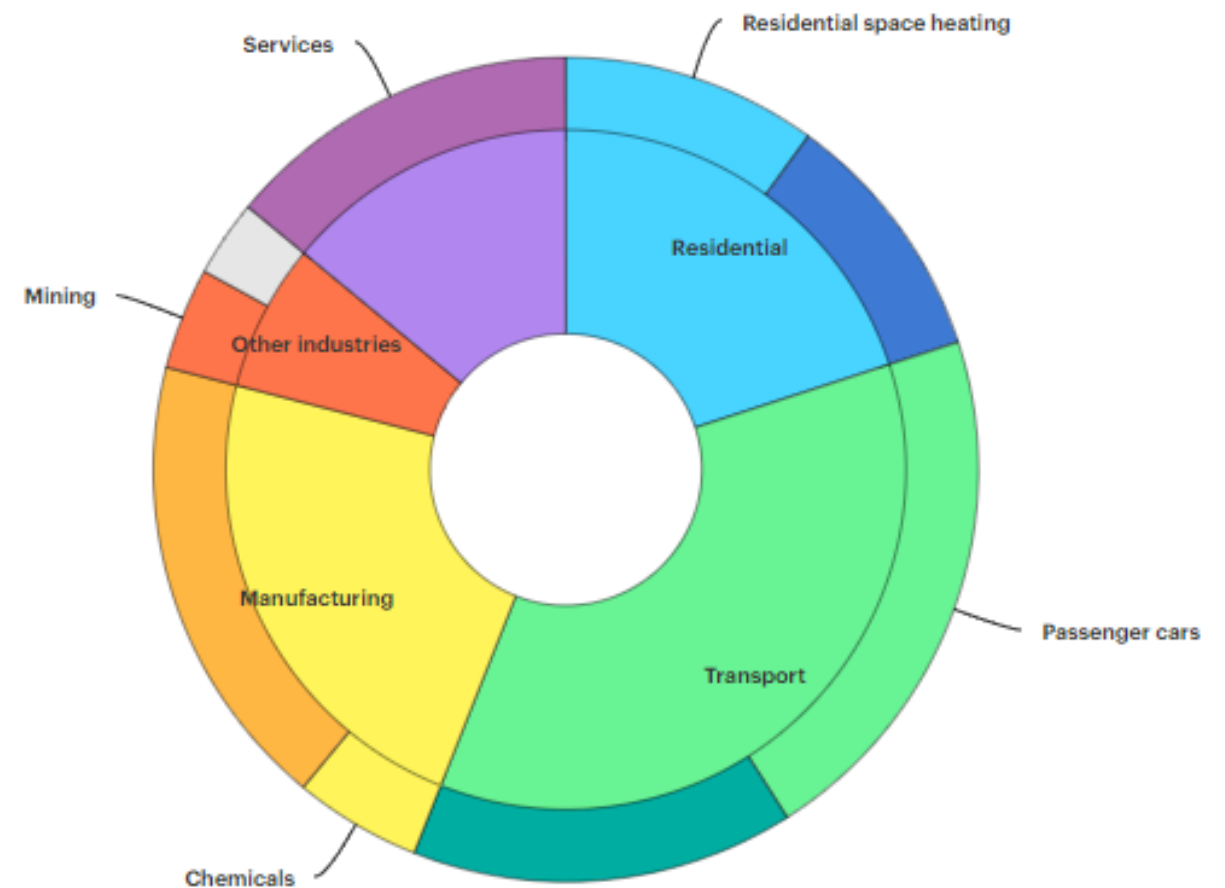
- Current situation and goals
- How to get there?

The Heat Sector Current status

Heat pump, annual growth rate in sales

- Space and water heating account for almost 50% of global energy use in buildings.
- Worldwide, around 40% of households require space heating during part of the year (making up to 70% of total residential energy demands!).

Global & main shares within the sectors



Source: Largest end uses of energy by sector in selected IEA countries, 2018 – Charts – Data & Statistics - IEA/ <https://www.iea.org/data-and-statistics/charts/largest-end-uses-of-energy-by-sector-in-selected-iea-countries-2018-2>

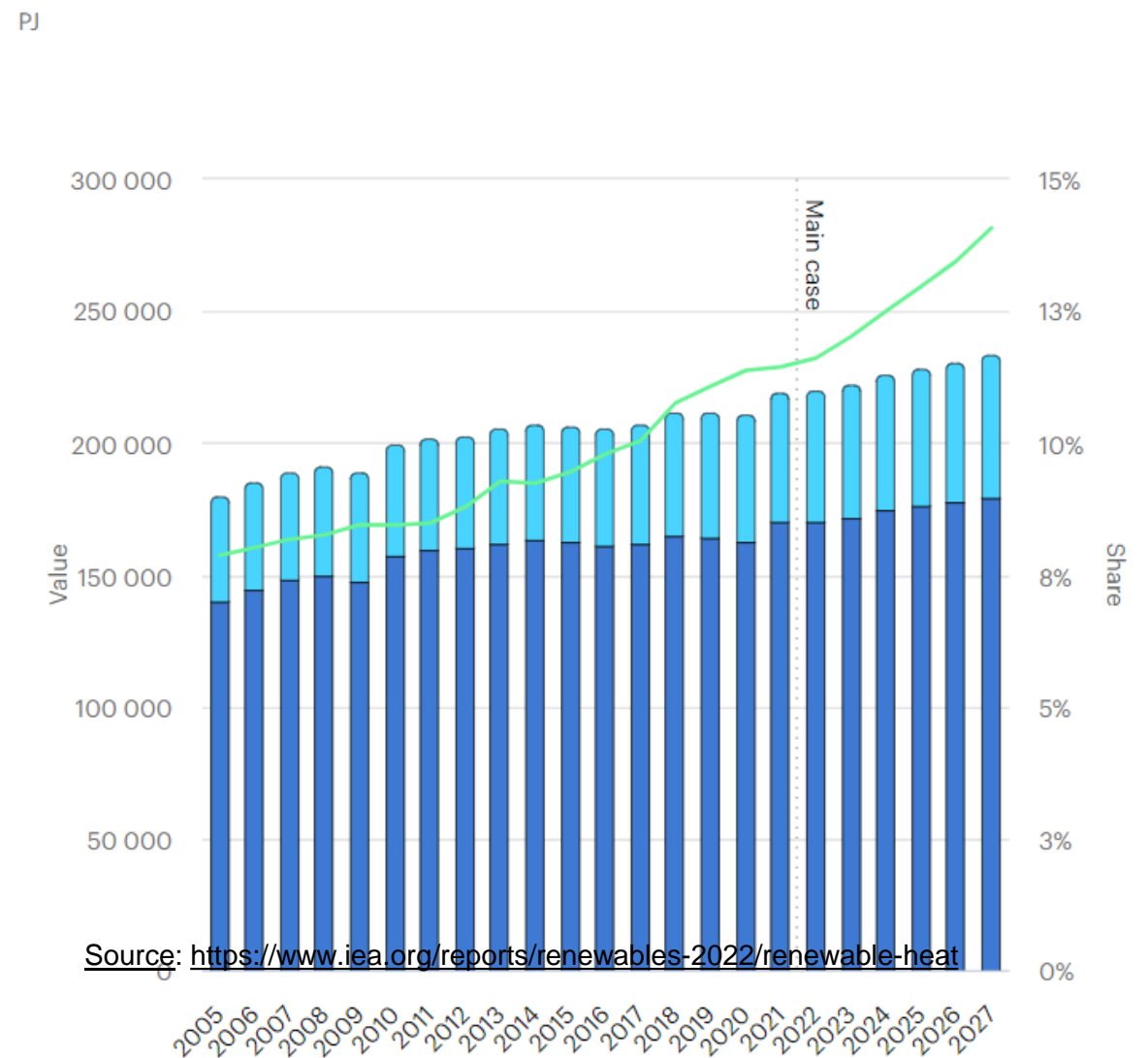
The Heat Sector

Current status

- Heat is the world's **largest energy end use**, accounting for almost half of global final energy consumption in 2021, significantly more than electricity (20%) and transport (30%).
- Industrial processes** are responsible for **53%** of the energy consumed for heat, while another **44% is consumed in buildings**
- Remains heavily fossil fuel dependent:** The supply of heat, which contributed more than 40% (13.1 Gt) of global energy-related CO₂ emissions in 2020,
- RE share in the sector small and rather constant over the last three decades

Global heat consumption and RE share in the sector

Total heat consumption, World, 2005-2027



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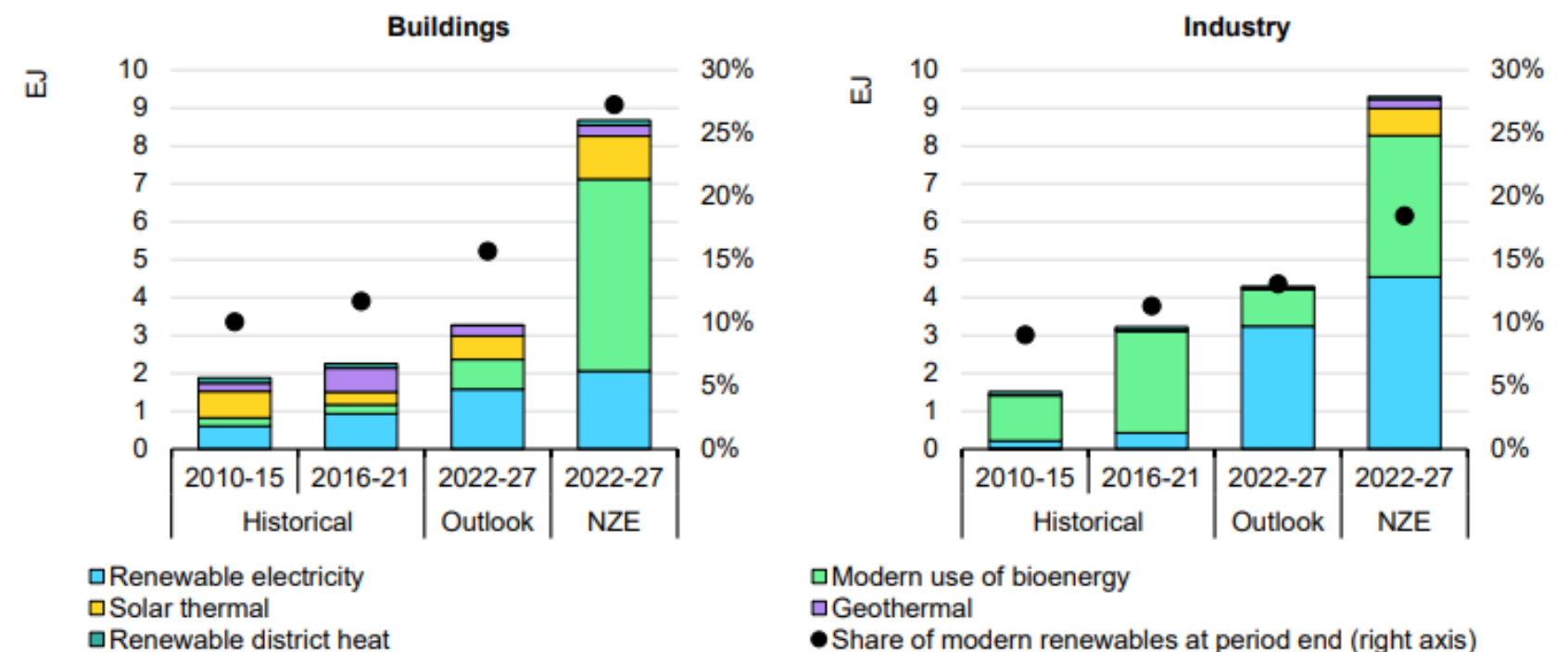
How to get there?

Scenarios for increased RE share in heat demands

Trends

- Increase in bioenergy use
- Increase in **RE electricity** for heating purposes: **how?**
- Solar thermal is a relevant technology, even for industry!

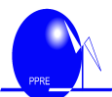
Figure 3.1 Global increase in renewable energy consumption and share of total heat demand in buildings and industry, 2010-2027



IEA. CC BY 4.0.

Note: NZE = Net Zero Emissions by 2050 Scenario.

Source: IEA (2022), [World Energy Outlook 2022](https://www.iea.org/reports/world-energy-outlook-2022).



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Source: <https://www.iea.org/reports/renewables-2022/renewable-heat>

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How to get there?

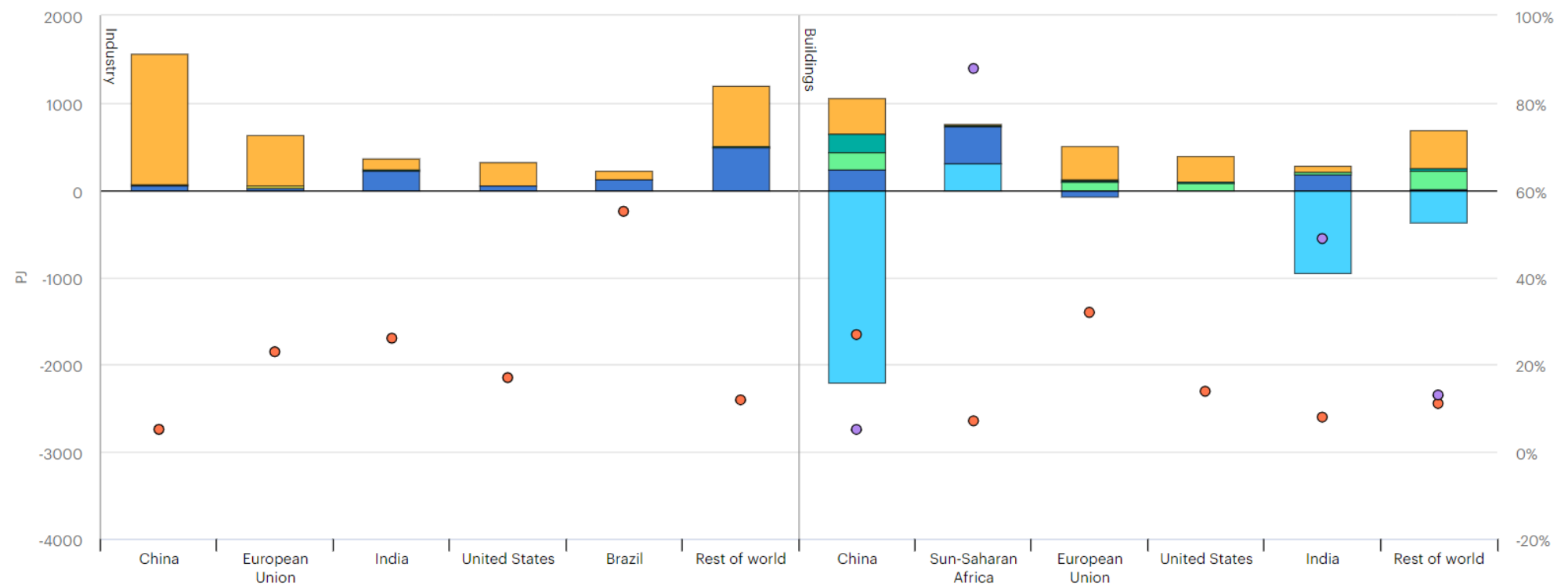
Scenarios for increased RE share in heat demands by region

Trends

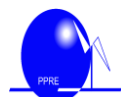
- Industry: electricity and bioenergy
- Buildings: - decrease in biomass use
- increase in solar thermal and RE electricity









Change in renewable heat consumption in industry and buildings and share of renewables in selected regions, 2022-2027

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 Traditional use of biomass
  Bioenergy
  Solar thermal
  Geothermal
  Renewable district heat
  Renewable electricity
  % modern renewables in heat at end of period
  % traditional use of biomass at end of period

Source: <https://www.iea.org/reports/renewables-2022/renewable-heat>

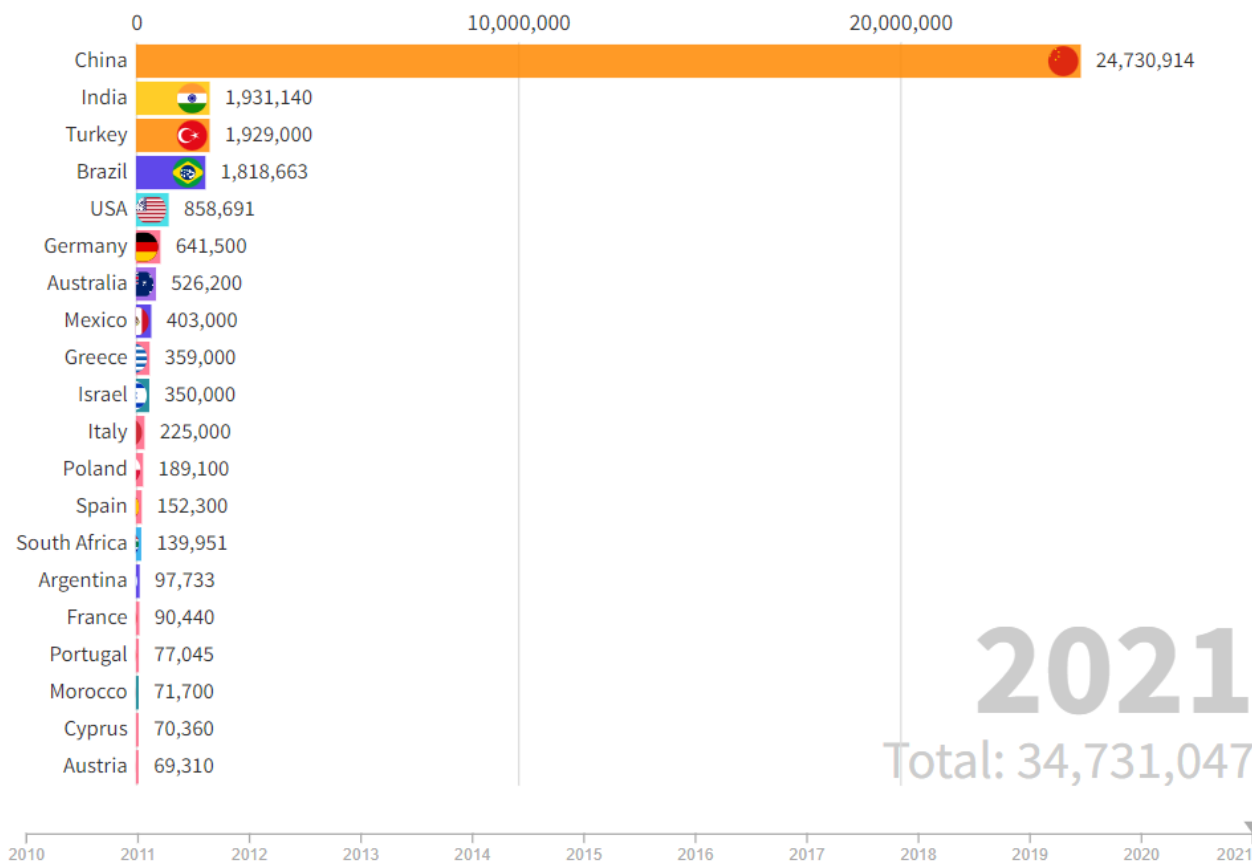
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How to get there?

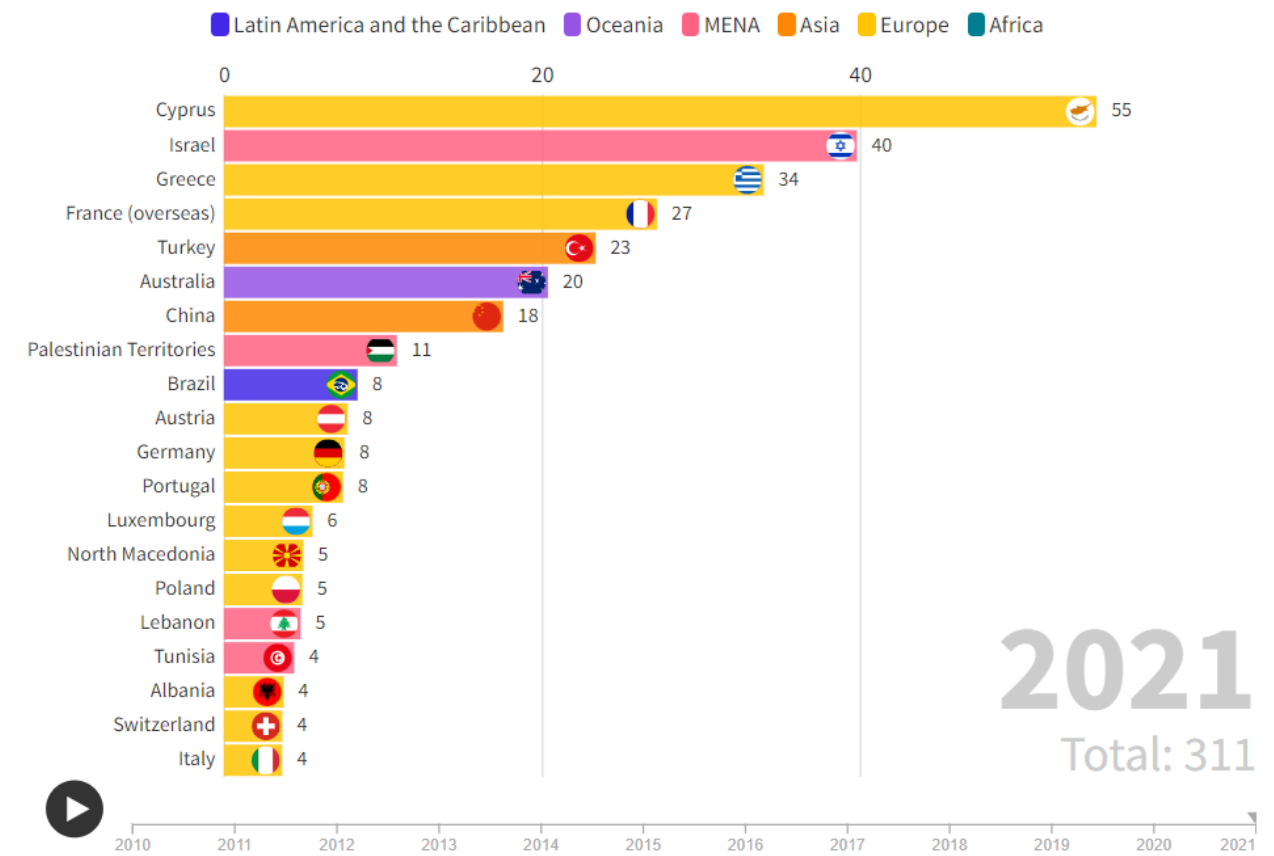
Solar thermal heat

- China is the greatest solar collector installer!
- Decentralized DHW supply is (still in 2021!!) a major use for solar thermal systems! → cost-competitive systems for small applications

Solar thermal water collectors 2010-2021 (m²)



Solar thermal capacity installed (kWth per 1000 inhabitants)

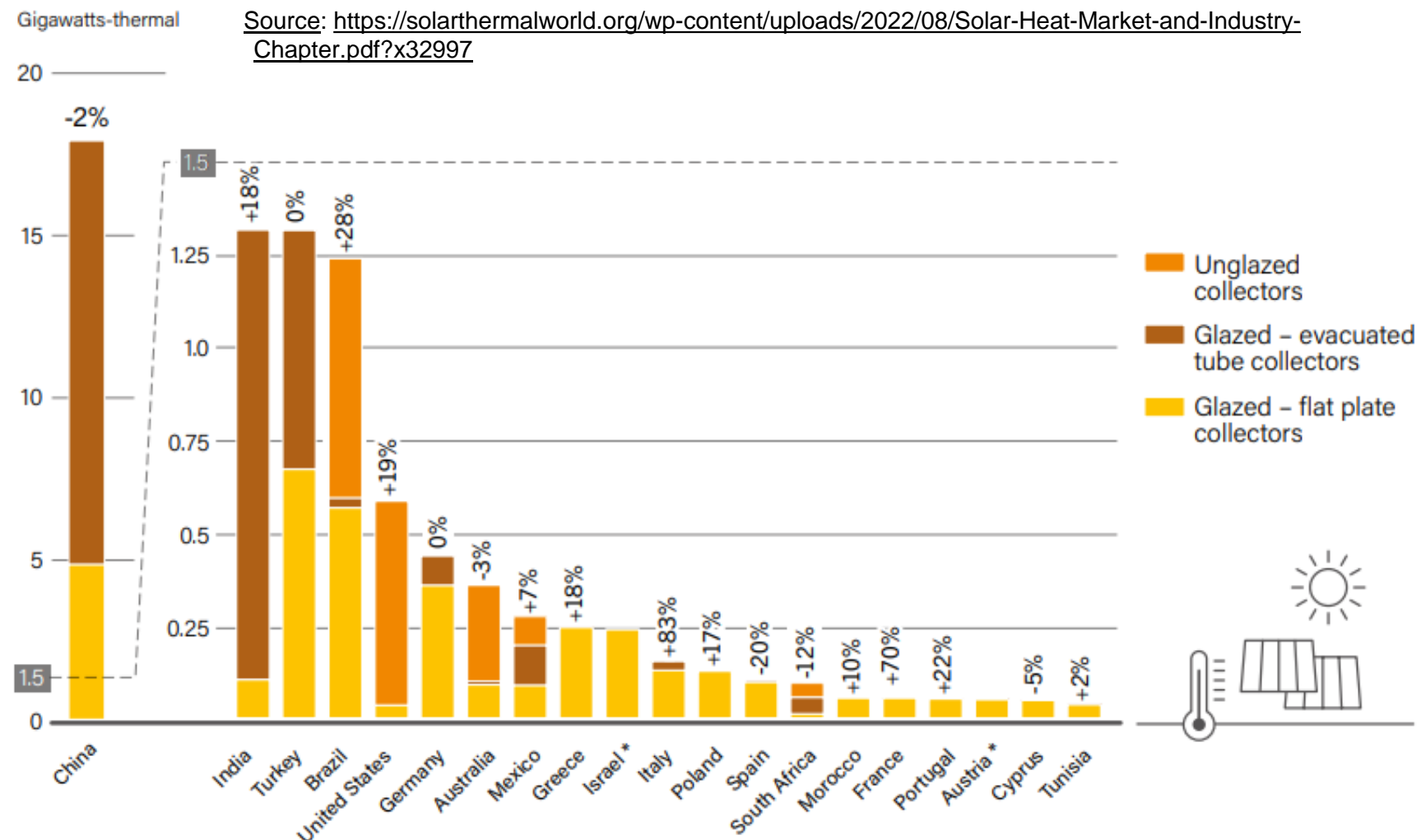


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How to get there?

Solar thermal heat

- China is the greatest solar collector installer!
- Types of collectors installed



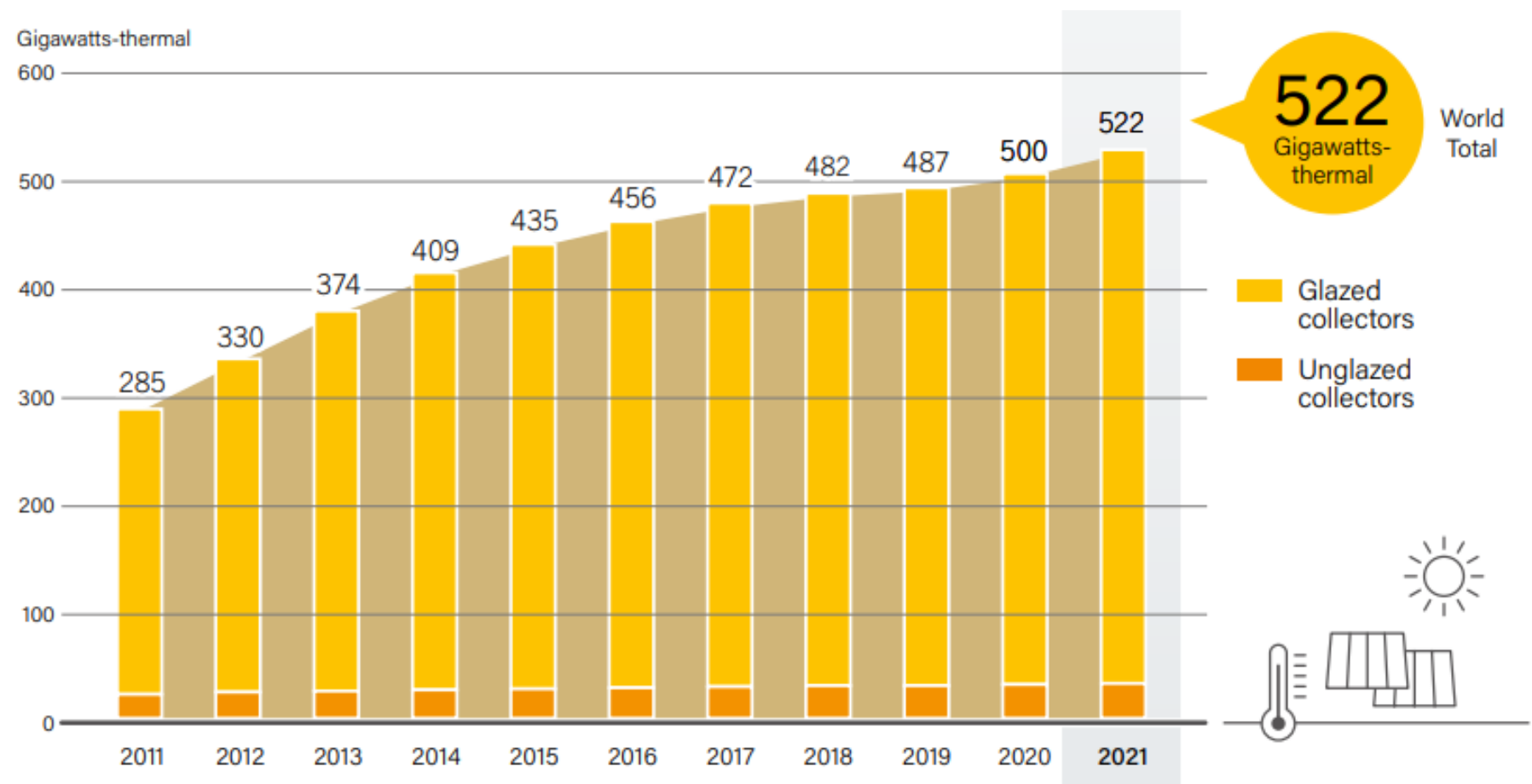
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How to get there?

Solar thermal heat

- Installed capacity by collector type
- Comparison to other REs

Source: <https://solarthermalworld.org/wp-content/uploads/2022/08/Solar-Heat-Market-and-Industry-Chapter.pdf?x32997>



Source: Based on IEA SHC. See endnote 5 for this section.

Note: Data are for glazed and unglazed solar water collectors and do not include concentrating, air or hybrid collectors.

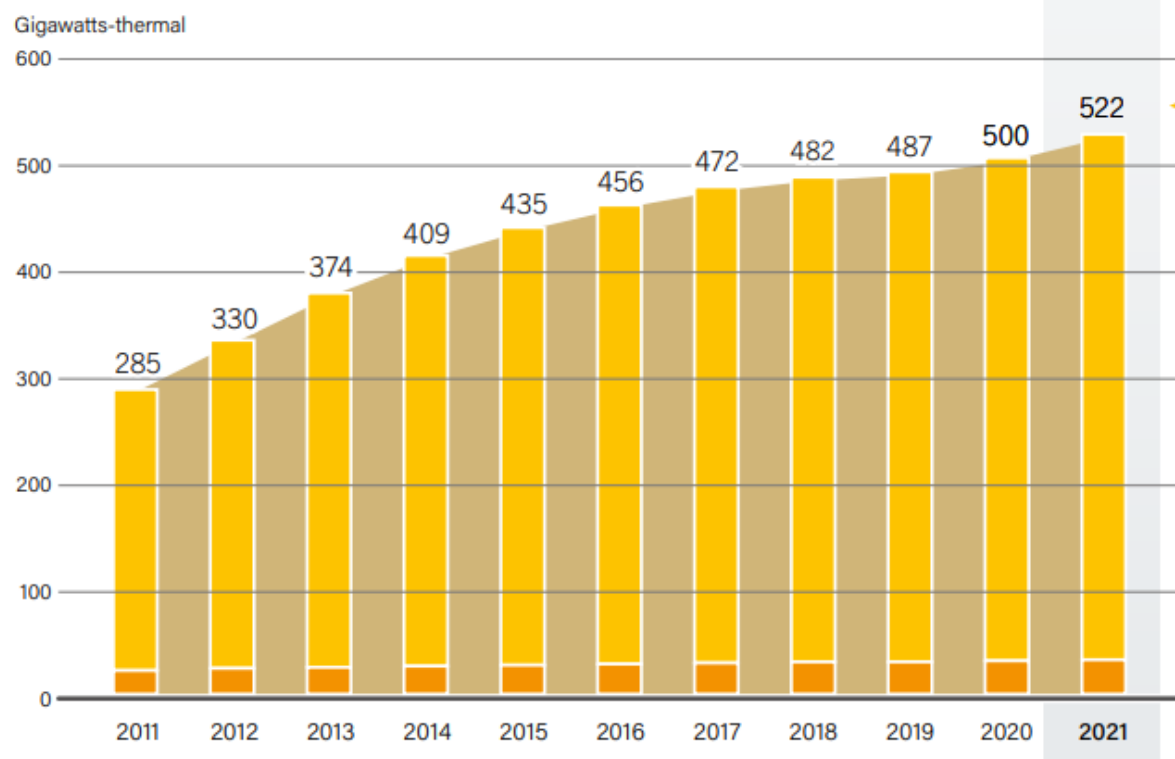
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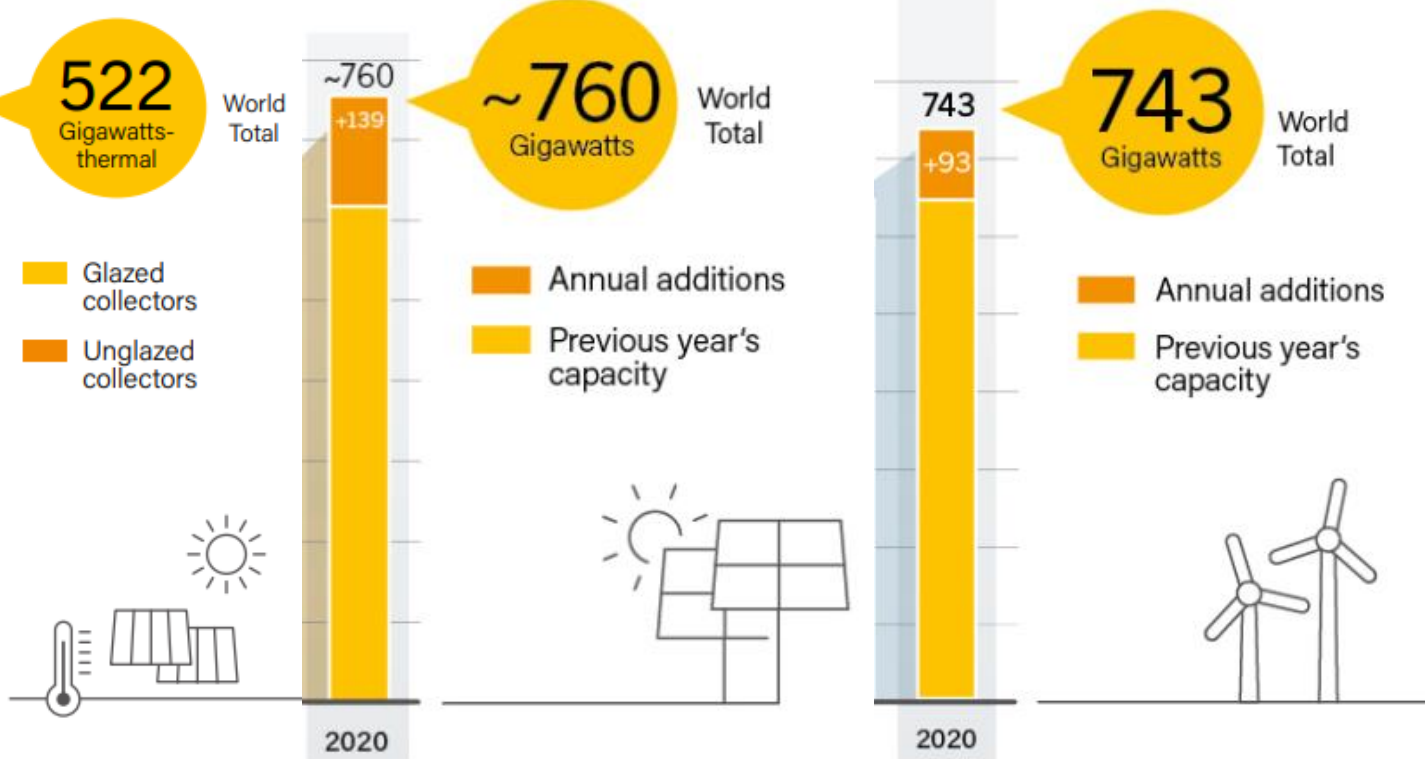
- Installed capacity by collector type
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Source: <https://solarthermalworld.org/wp-content/uploads/2022/08/Solar-Heat-Market-and-Industry-Chapter.pdf?x32997>



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Note: Data are for glazed and unglazed solar water collectors and do not include concentrating, air or hybrid collectors.



Photovoltaic

Wind

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How to get there?

Solar thermal heat

- Installed capacity by collector type
- Capacity factor of Solar thermal

Source:

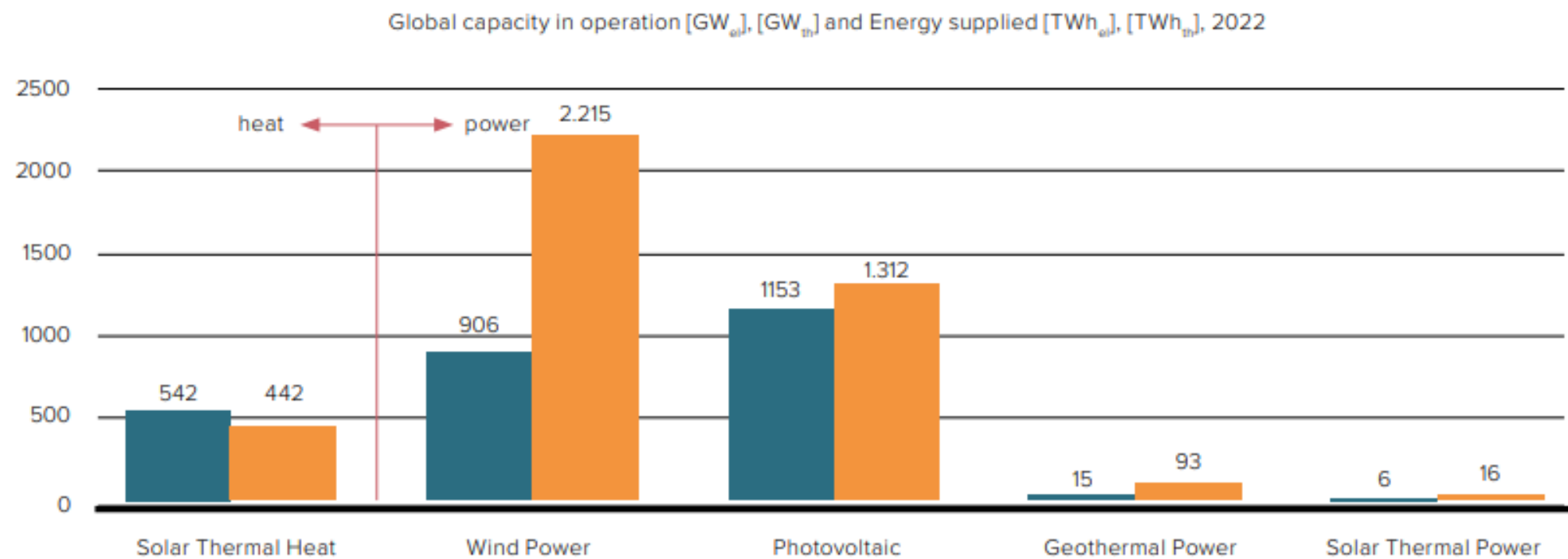


Figure 5: Global capacity in operation [GW_{el}], [GW_{th}] 2022 and annual energy yields [TWh_{el}], [TWh_{th}]

Sources: Solar Thermal: AEE INTEC, Wind Power: Global Wind Energy Council (GWEC), Photovoltaic: IEA Solar PV (<https://www.iea.org/reports/solar-pv>), Geothermal Power (<https://statista.com>), Solar Thermal Power: IRENA Renewable Energy Capacity Statistics 2022

■ Total capacity in operation [GW_{th} , GW_{el}]
■ Energy supplied [TWh]

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Solar thermal heat

Main applications

- Decentralized DHW supply is (still in 2021!!) a major use for solar thermal systems! → cost-competitive systems for small applications

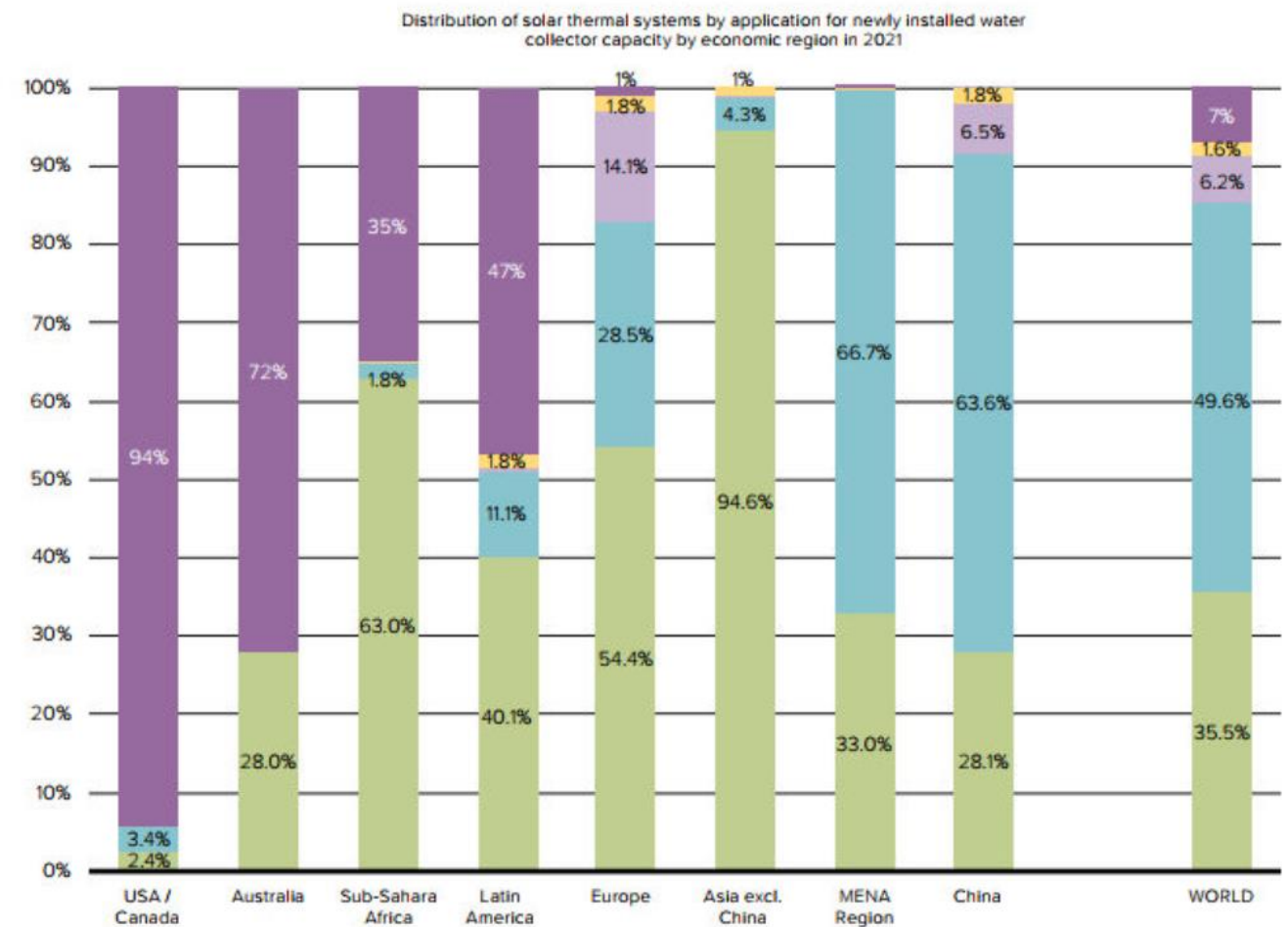
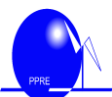


Figure 52: Distribution of solar thermal systems by application for newly installed water collector capacity by economic region in 2021

Sub-Sahara Africa: Botswana, Burkina Faso, Ghana, Kenya, Lesotho, Mauritius, Mozambique, Namibia, Nigeria, Senegal, South Africa, Zimbabwe
 Asia w/o China: Bhutan, India, Japan, South Korea, Taiwan Thailand
 Latin America and the Caribbean: Barbados, Brazil, Chile, Mexico, Panama, Uruguay
 Europe: EU 27, Albania, North Macedonia, Norway, Russia, Switzerland, Turkey, United Kingdom
 MENA countries: Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Tunisia

Swimming pool heating
 Other (solar district heating, solar processheat, solar cooling)
 Solar combi-systems (DHW and space heating for single-family and multi-family houses)
 Large DHW systems (multi-family houses, tourism and public sector)
 Domestic hot water systems for single-family houses

Source: <https://www.iea-shc.org/solar-heat-worldwide>



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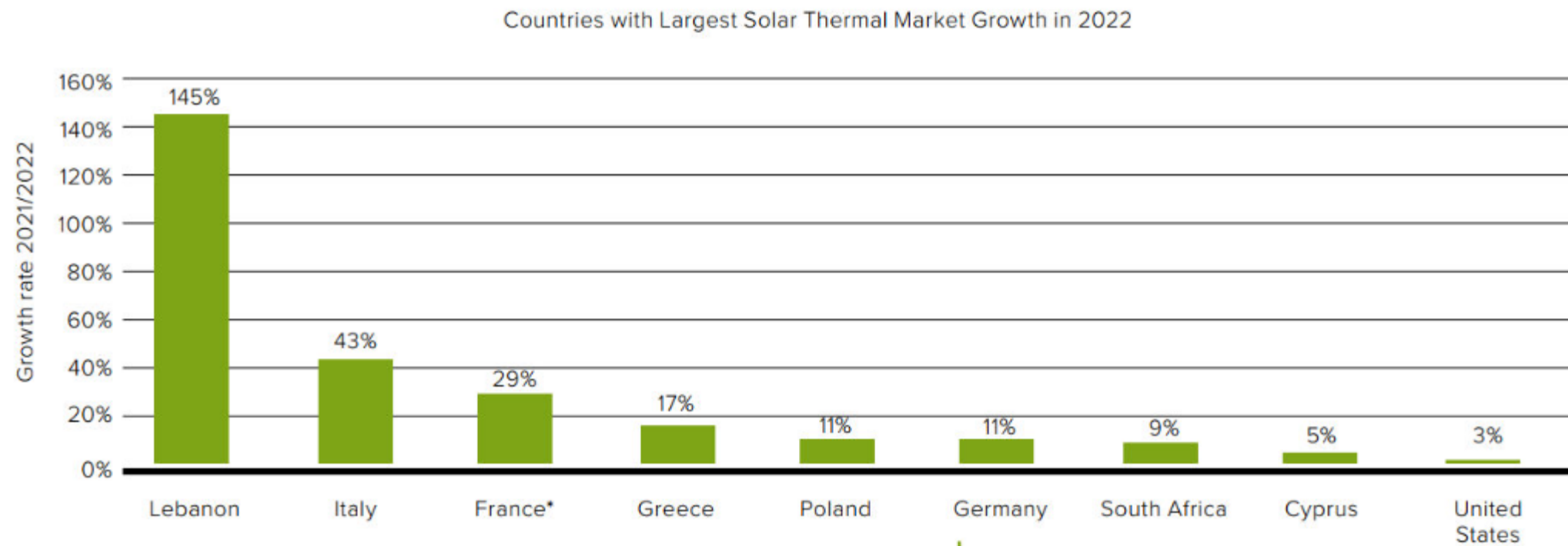
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Decentralized DHW supply is (still in 2021!!) a major use for solar thermal systems!

Growth by countries in the solar thermal market:

- Lebanon: due to inflation and fuel prices



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But not only small is beautiful... ☺ → large systems represent **14%** of all installed area!

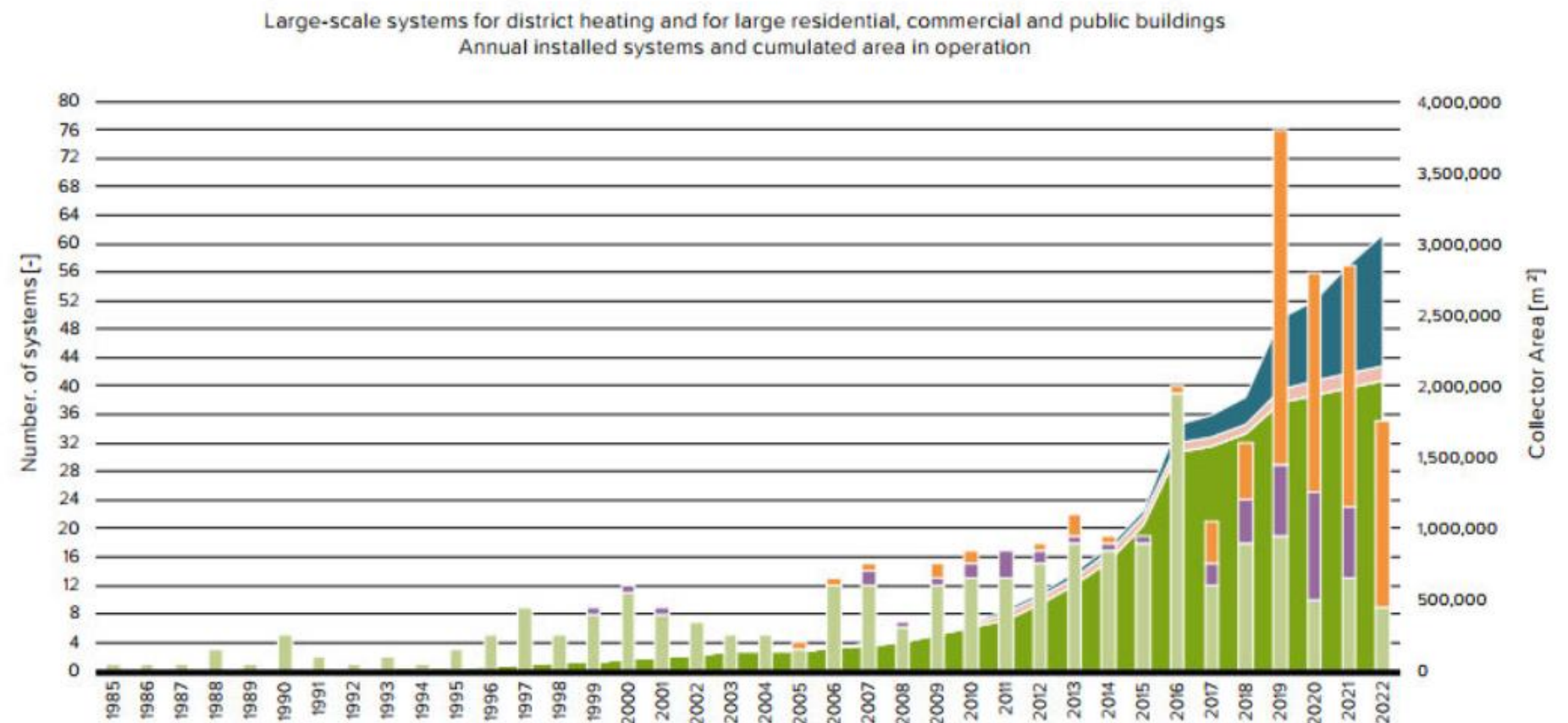


Figure 8: Large-scale systems for solar district heating and large residential, commercial and public buildings worldwide – annual installations and cumulated area in operation in 2022

Data sources: Daniel Trier - PlanEnergi, DK, Jan-Olof Dalenbäck - Chalmers University of Technology, SE, Sabine Putz - IEA SHC Task 55, AT, Bärbel Epp - solrico.com/, DE, AEE INTEC, AT, Janusz Starościk - SPIUG, PL, Zheng Ruicheng, China Academy of Building Research, CHN.

■ Cumulated collector area in operation in Europe [m²]	■ Cumulated collector area in operation "Other countries" [m²]
■ Cumulated collector area in operation in China [m²]	■ Number of systems installed in Europe [-]
■ Number of systems installed in "Other countries" [m²]	■ Number of systems installed in China [-]

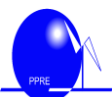
* Other countries:

MENA countries: Dubai, Jordan, Kuwait, Morocco, Saudi Arabia, Tunisia, UAE

Latin America: Brazil, Colombia, Mexico

Asia excl. China: Cambodia, Japan, Kyrgyzstan, India, Russia, South Korea, Thailand, Turkey

Plus: Australia, Canada, South Africa, USA



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Solar thermal heat

But not only small is beautiful... ☺ → large systems represent **14%** of all installed area!

Decarbonizing the heat sector in neighborhoods and cities

325 solar district heating systems generate 1.8 GWth at costs between **20-50 €/MWh**

By country:

- DK leading
- CHN catching up quickly

Cost competitive:

Gas prices around 50-70\$/MWh

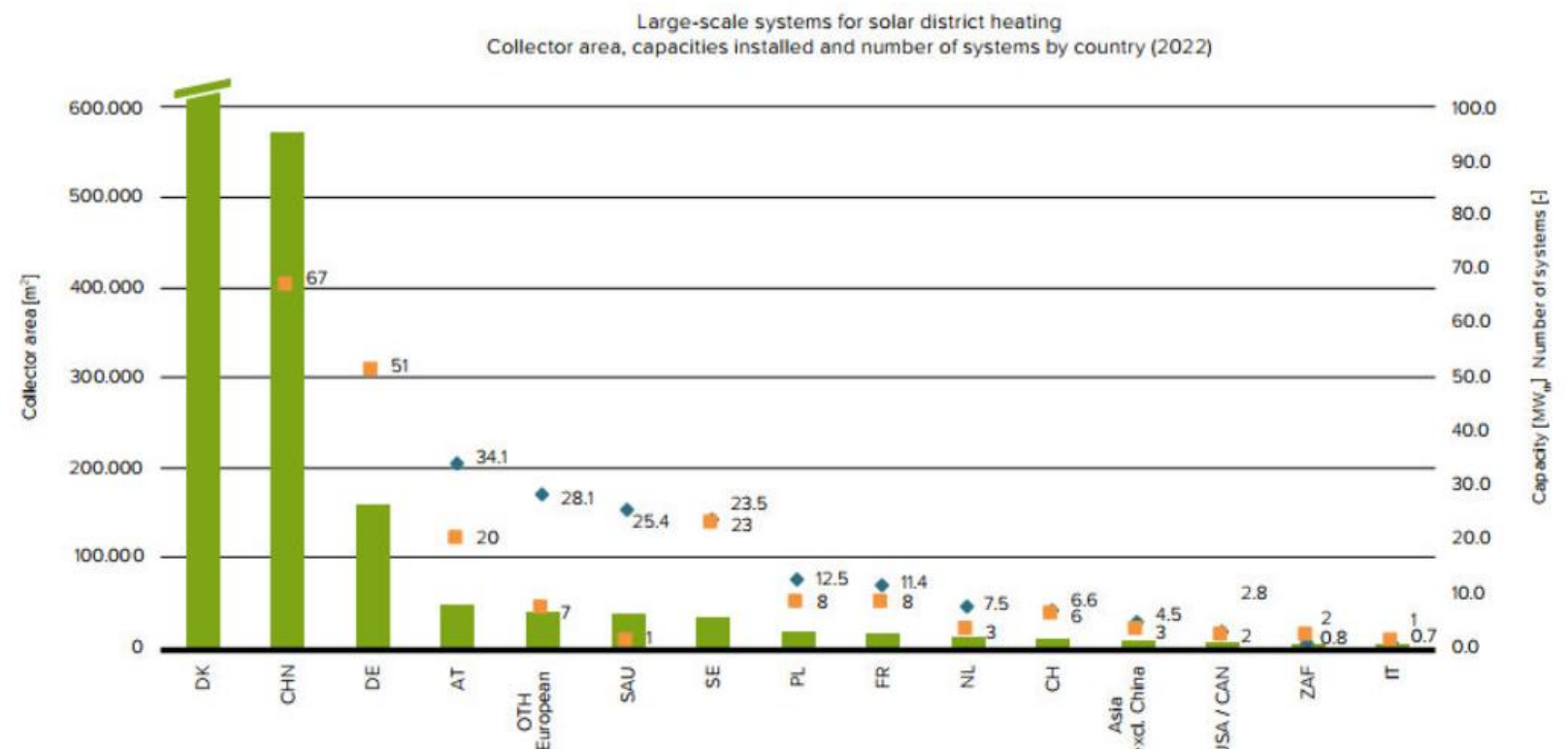


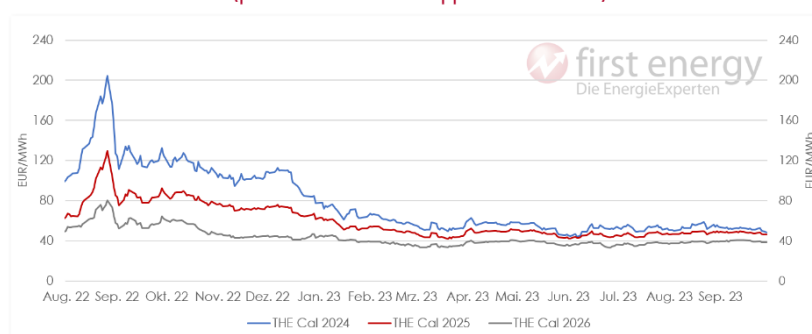
Figure 9: Large-scale systems for solar district heating – capacities and collector area installed and number of systems by the end of 2022

Data sources: Daniel Trier - PlanEnergi, DK, Jan-Olof Dalenbäck - Chalmers University of Technology, SE, Sabine Putz - IEA SHC Task 55, AT, Bärbel Epp - solrico.com, DE⁹.

⁹ Usually, countries report single systems that are documented regarding project name, country and installed collector size. In 2021 and 2022 China reported total collector area and average system size for solar district heating systems.

DK: Collector area: 1,606,591 m²
Capacity: 1,124 MW_{th}
Number of systems: 123
CHN: Collector area: 571,464 m²
Capacity: 400 MW_{th}
Number of systems: 67

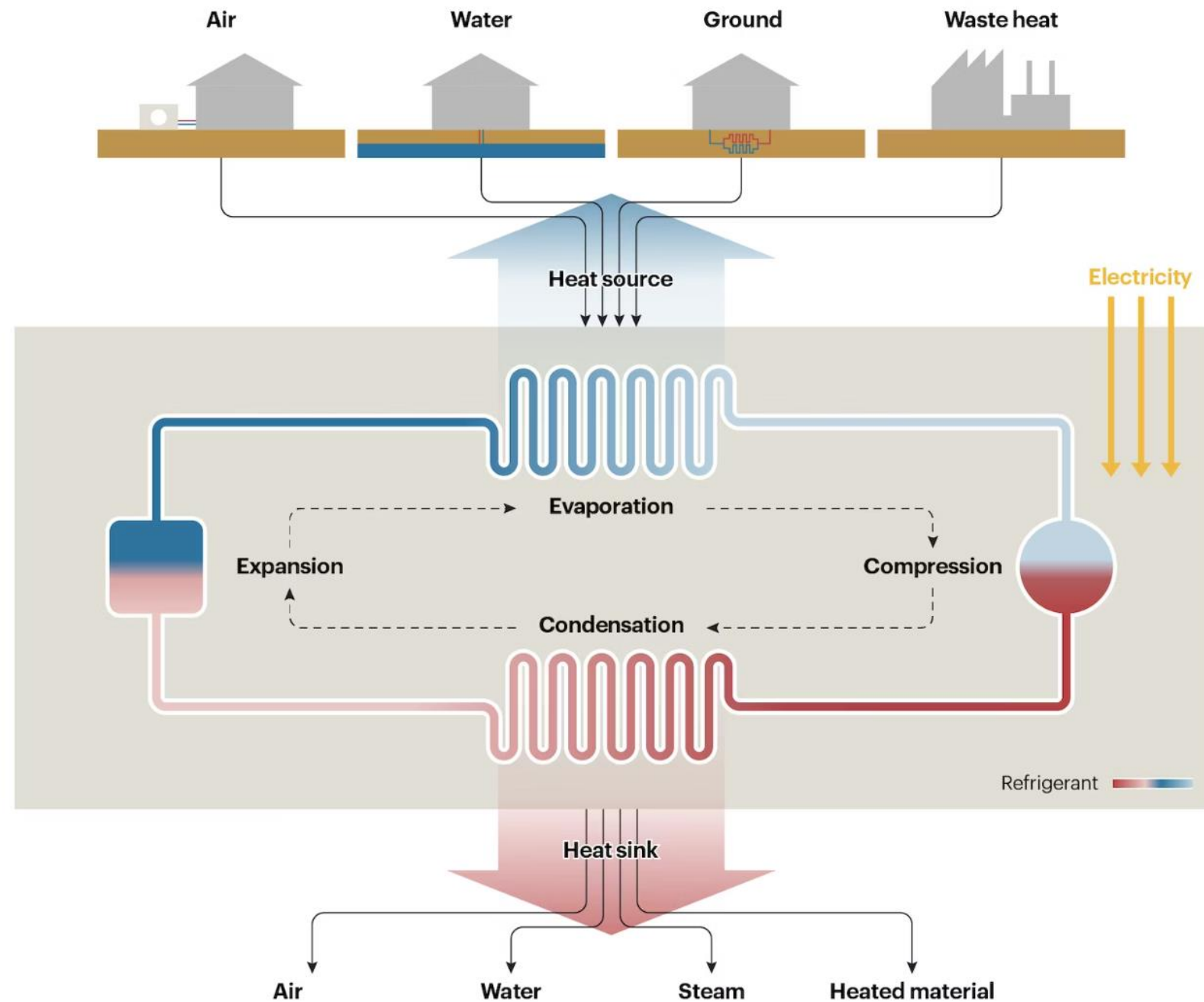
Gaspreisentwicklung - EEX Erdgas-Jahreskontrakte (power future THE | powermarket)



The Heat Transformation How to get there?

Heat pumps

Source: <https://www.iea.org/reports/the-future-of-heat-pumps/how-a-heat-pump-works>



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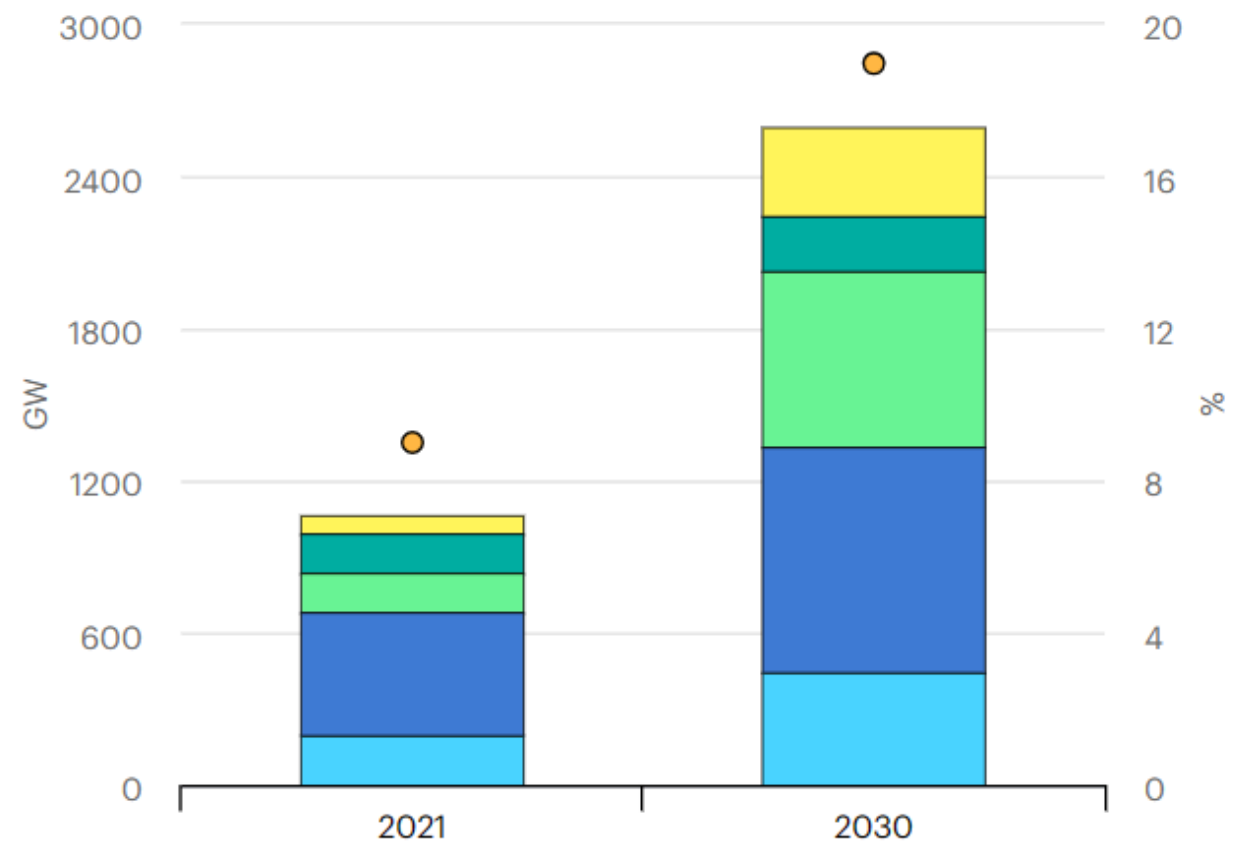
Heat pump, annual growth rate in sales

Heat pump capacity in buildings by country and region in the Announced Pledges Scenario, 2021-2030

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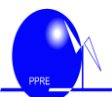
For comparison -
Installed capacity (GW, 2021):

- Wind: 743
- PV: 760
- Solar th.: 544



Source: <https://www.iea.org/energy-system/buildings/heat-pumps>

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● Europe ● North America ● China ● Japan and Korea ● Rest of world
● Share of heat pumps in global heating demand

The Heat Transformation

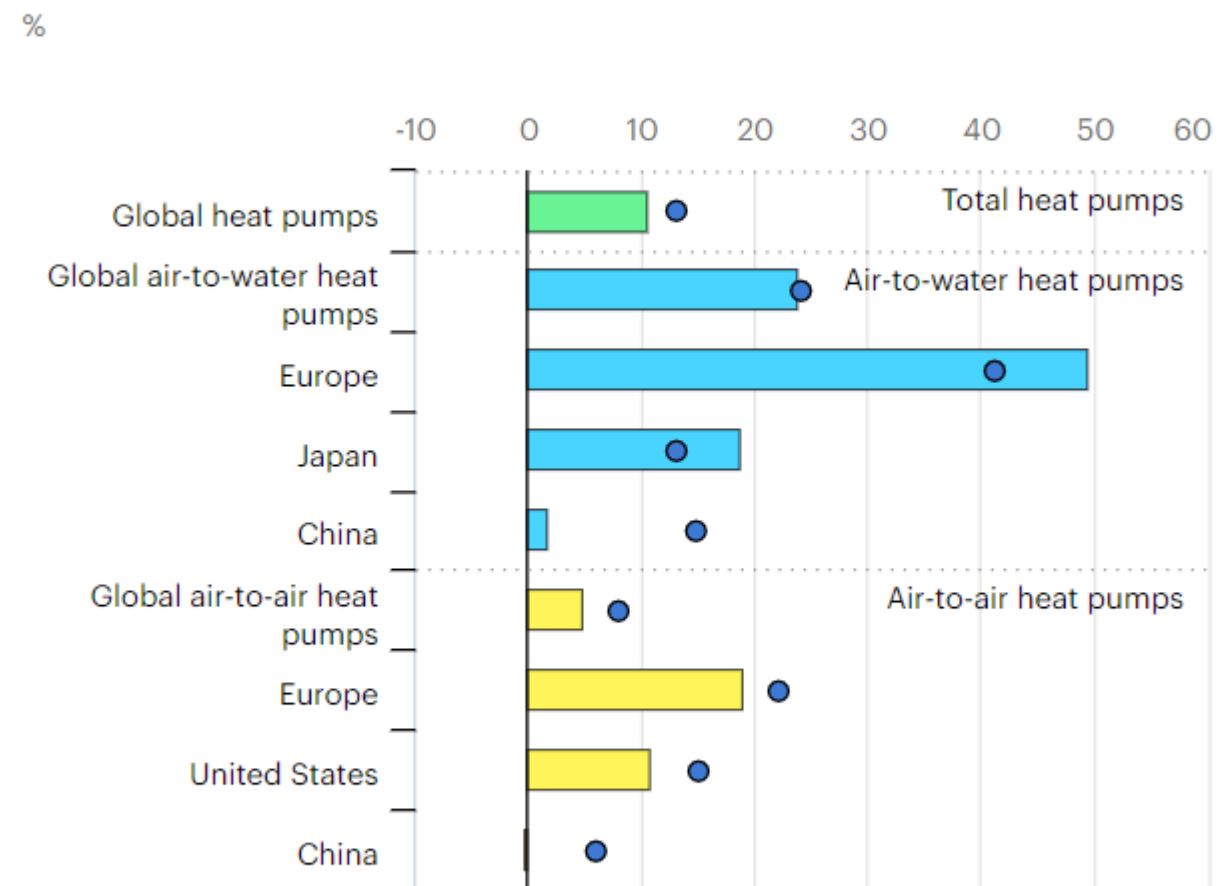
How to get there?

Heat pump, annual growth rate in sales

2021 (dots) and 2022 (bars)

Annual growth in sales of heat pumps in buildings worldwide and in selected markets, 2021 and 2022

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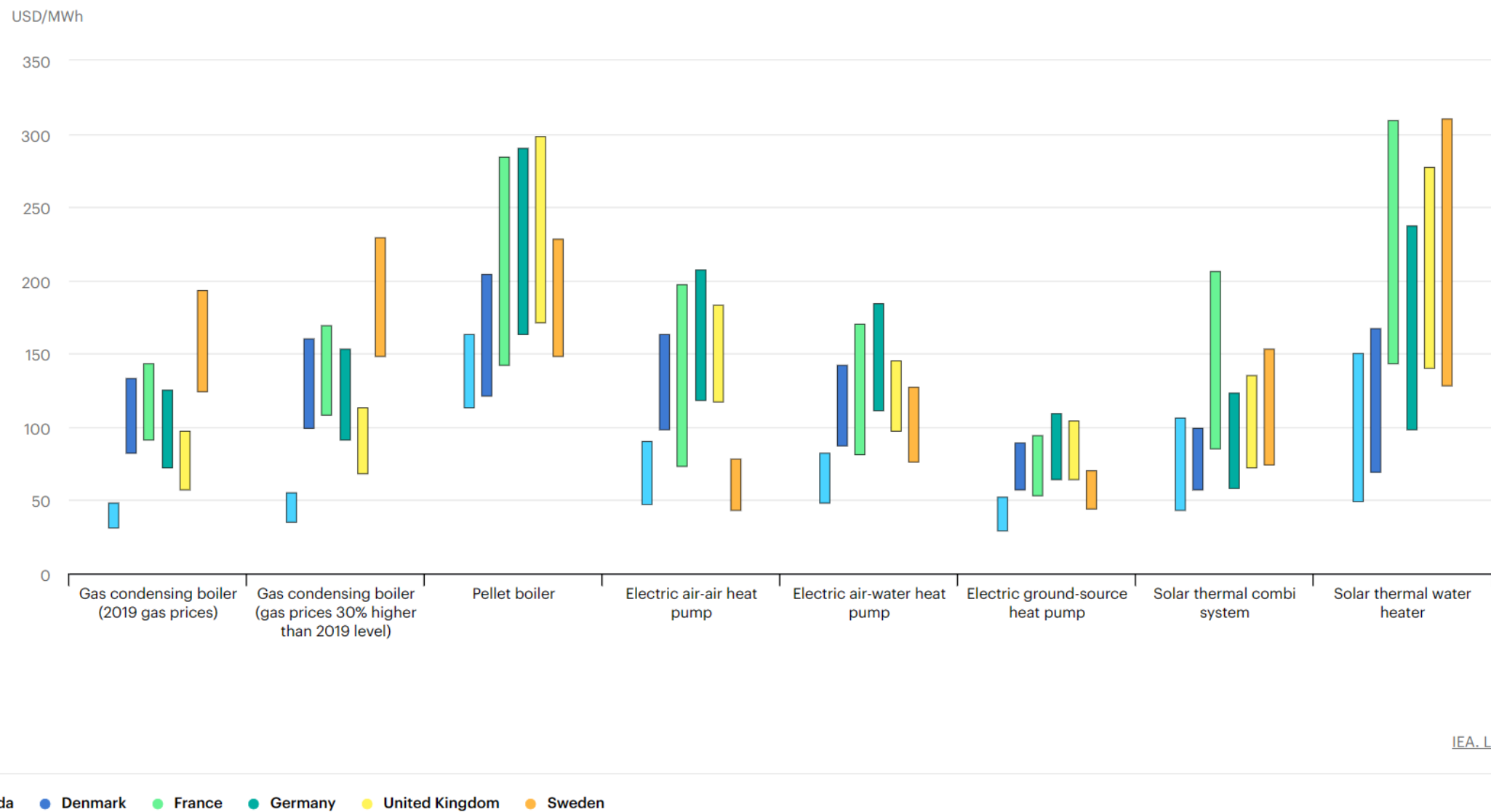
Source: <https://www.iea.org/energy-system/buildings/heat-pumps>

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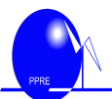
LCOH

Cost of energy for different heating technologies and countries

Source: <https://www.iea.org/data-and-statistics/charts/levelized-cost-of-heating-lcoh-for-consumers-for-selected-space-and-water-heating-technologies-and-countries>



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The heat transition: in a nutshell

1. Heat is a major energy demand – both in industry and buildings, around 50% in 2021
2. Heat demands are largely supplied with fossil fuels, around 10% - though rising slowly
3. Technologies for change:
 - Solar thermal, great installed capacity and cost competitive
 - Heat pumps, huge capacity to be installed; connection to the RE power sector

References

IEA 2023. Renewables 2022 Analysis and forecast to 2027. Link: <https://iea.blob.core.windows.net/assets/ada7af90-e280-46c4-a577-df2e4fb44254/Renewables2022.pdf> Last accessed: Oct. 2023

SHC 2022 (W.Weiss): SOLAR HEAT WORLD WIDE, Global Market Development and Trends 2022 Detailed Market Figures 2021, Link: <https://www.iea-shc.org/Data/Sites/1/publications/Solar-Heat-Worldwide-2023.pdf> Last accessed: Oct. 2023