COOLING DOWN

Impact of cooling on electricity demand and infrastructures

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- **Worldwide**: temperatures are rising
- **Europe**: temperatures are rising twice as fast as the global average leading to more frequent heatwaves

01. How cooling affects the electricity demand

Dealing with cooling driven peak electricity demand

02. A rising cooling demand

Analysing the key drivers of the cooling demand?

03. Cooling impact on the energy infrastructure

How to avoid stress on power grids

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How cooling affects the electricity demand

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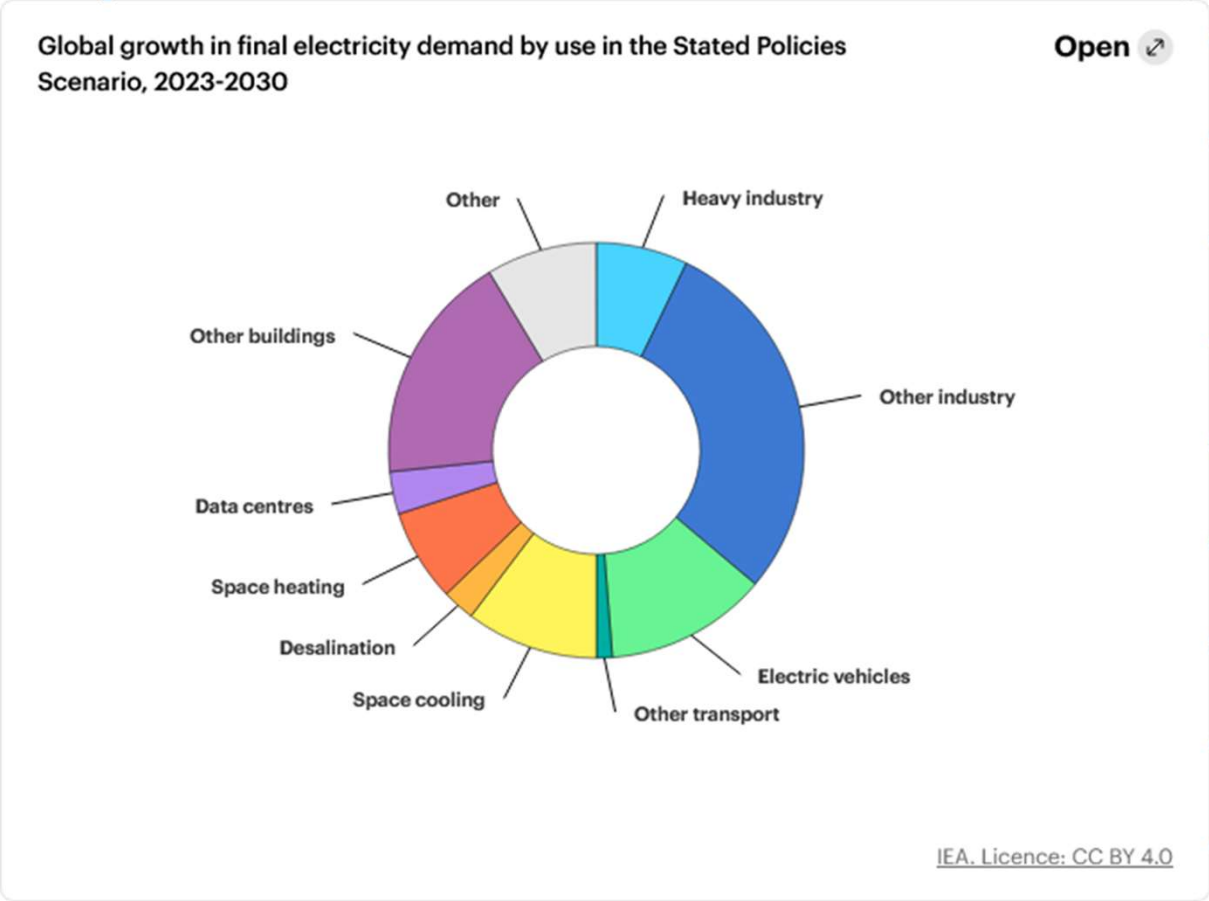
Electricity demand trends

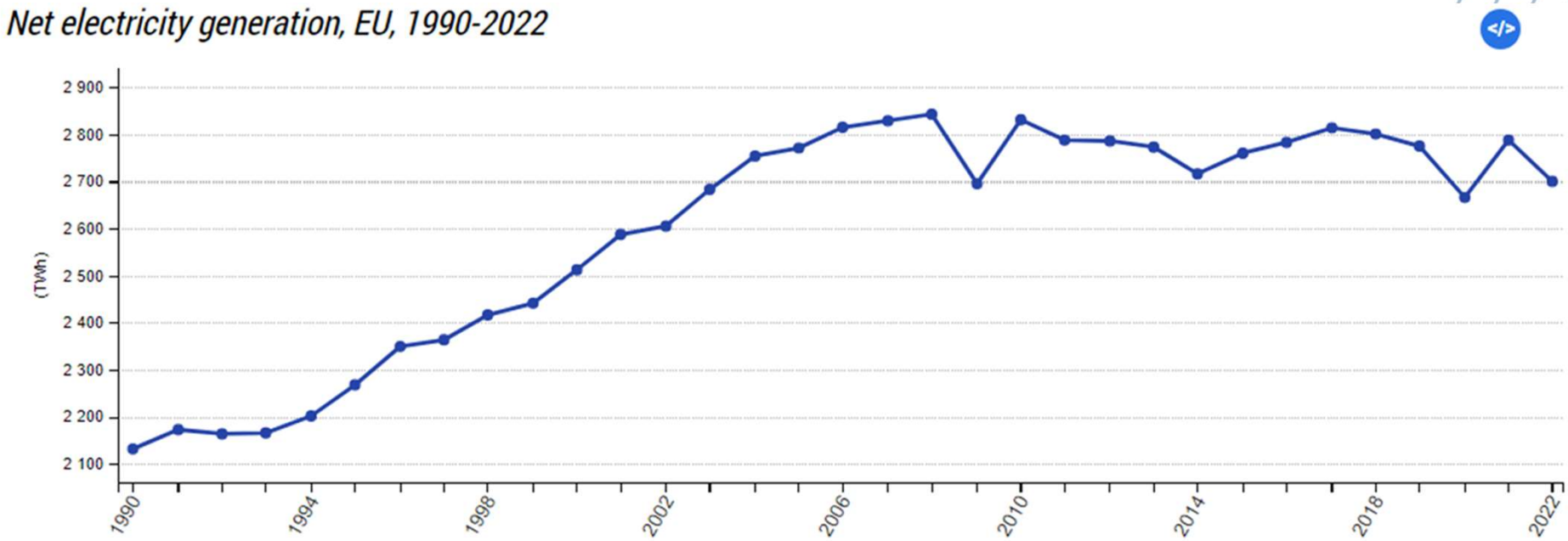
- 2023: Total global electricity demand about 26,000 TWh.
- 2030: Projected to exceed 30,000 TWh due to continued electrification, particularly in emerging markets.



Growing global electricity demand: RES play a crucial role

Electricity generation trends

While the general electricity generation is stagnating…



Source: Eurostat (online data code: nrg_ind_peh)

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Cooling driven peak electricity demand

- Roughly **2 billion AC units** are now in operation around the world, **making space cooling one of the leading drivers of rising electricity demand in buildings and of generation capacity additions to meet peak power demand**. Residential units in operation account for nearly 70% of the total.
- In 2024, global electricity consumption in buildings increased by 5%, with the heightened demand for air conditioning being a key contributor.
- Shifts and intensification of **peak electricity demand**:

  Traditionally, peak electricity demand in Europe occurred during winter due to heating needs. However, with the escalating use of cooling systems, **summer peaks are becoming more pronounced**.

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A rising cooling demand

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Outlook for CDDs by country/region BI Scenario

Cooling Degree Days (CDDs) in the IEA Baseline Scenario are used to project the energy demand for cooling.

CDDs are crucial for understanding **how climate change will impact future energy consumption patterns**

	2016		2050		
	CDDs	Million persons	CDDs	Million persons	Change in CDDs over 2016
United States	764	328	973	392	27.4%
European Union	292	511	343	505	17.5%
Japan	909	127	1 040	108	14.4%
Korea	762	51	844	51	10.7%
Mexico	868	123	1 188	156	36.8%
China	1 051	1 384	1 169	1 351	11.3%
India	3 084	1 327	3 486	1 705	13.0%
Indonesia	3 390	261	4 051	322	19.5%
Brazil	1 846	210	2 314	238	25.4%
South Africa	714	55	746	66	4.6%
Middle East	2 337	232	2 516	354	7.6%
World	1 905	7 422	2 388	9 714	25.4%

Notes: CDDs shown here are calculated on the basis of a temperature of 18°C; historical population distributions were used to calculate the weighted CDDs in 2016 and expected population growth rates (without taking into account potential shifts in population distribution from migration patterns) were used to calculate future trends. "China" = the People's Republic of China.

Sources: CDDs from IEA analysis derived using NCAR (2004), Community Climate System Model, Version 3.0, www.cesm.ucar.edu/models/ccsm3.0/; population: UNDESA (2017), *World Population Prospects: the 2017 Revision*, https://esa.un.org/unpd/wpp.

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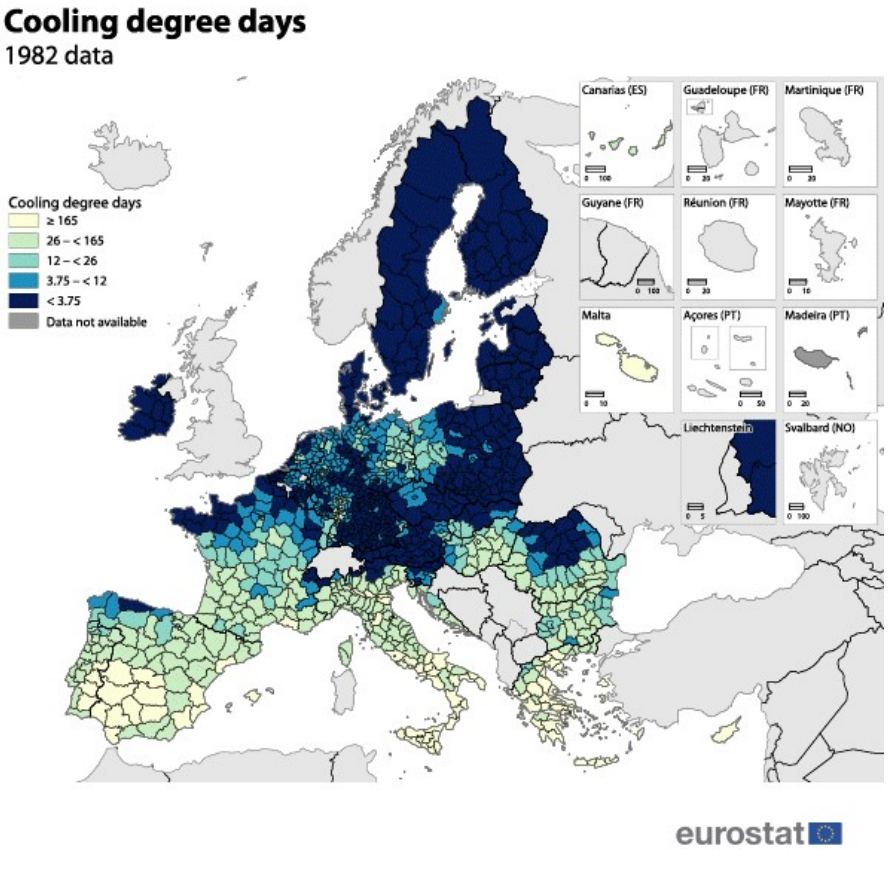
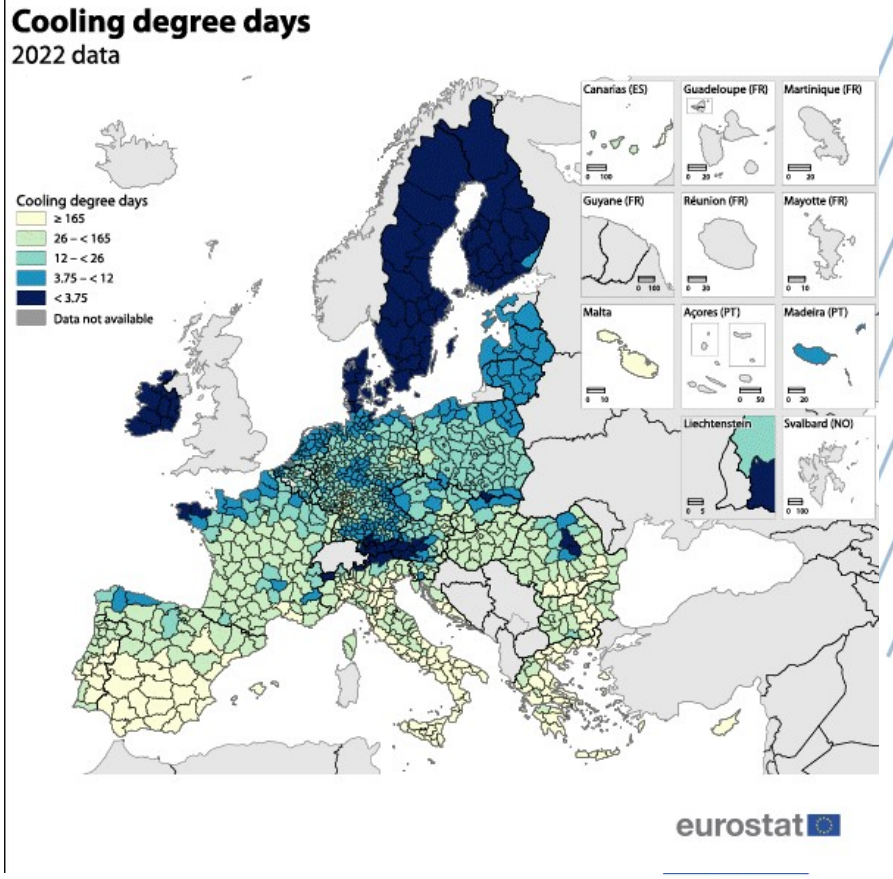
Need for cooling in buildings: an increasing demand

The need for cooling buildings in Europe has increased by a factor of 4 between 1979 and 2022





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Key drivers of Cooling Demand

- **Climate: Rising global temperatures and heatwaves**:

  The influence of climate on cooling demand is influenced by temperature and other factors such as humidity and building performance also play a role. High T = High air capacity to hold water

  Extreme weather events heighten the need for cooling solutions to maintain comfortable indoor environments.

- **Population growth and urbanization**:

  Urban settings, characterized by dense infrastructure and limited green spaces, often experience the **"urban heat island" effect**, where temperatures are higher than in surrounding rural areas, thereby increasing the demand for cooling.

- **Increased adoption of Air Conditioning (AC) Units**:

  The recent surge in temperatures has led to a significant **increase in the adoption of AC units** in residential, commercial, and industrial sectors.

- **Insulation practices**:

  Several buildings lack adequate insulation to keep out heat during summer months, further driving the need for mechanical cooling solutions.

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Need for cooling in buildings: an increasing demand

Higher energy consumption for space cooling **particularly affects peak electricity demand, especially during hot days, meaning power outages might occur**.

Without a move towards the best available products, and improvements in the performance of the buildings in which they operate, **electricity demand for space cooling in buildings could increase by as much as 40% globally by 2030**.

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Cooling impact on the energy infrastructure

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Impact on energy infrastructure

- **Strain on power grids during peak cooling periods**

  The increased demand for electricity during hot periods places considerable stress on power grids. This strain can lead to operational challenges, requiring utilities to ensure sufficient generation capacity and grid stability during peak times.

- **Increased risk of blackouts and voltage fluctuations**

  Elevated electricity demand for cooling heightens the risk of blackouts and voltage fluctuations.


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LE TEMPERATURE ELEVATE PROVOCANO DISAGI IN DIVERSE CITTÀ ITALIANE, DAL CAPOLUOGO LOMBARDO A ROMA, TORINO E ANCONA

di Maria Carla Rota

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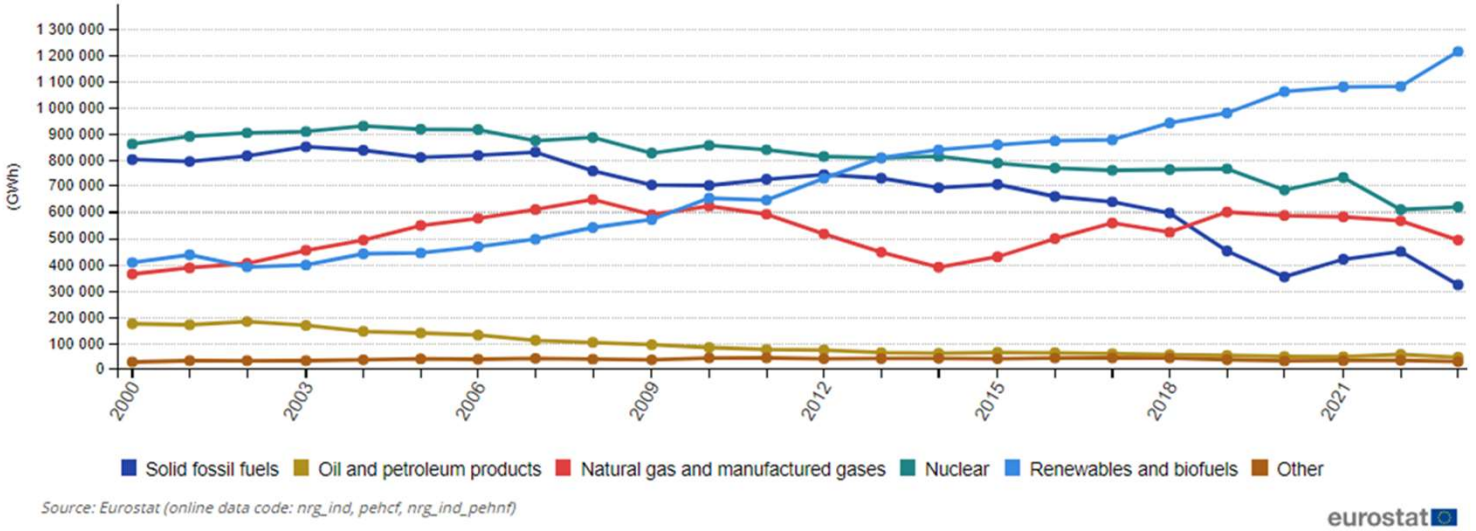
Decarbonisation of the power sector: where are we?



Source: Eurostat (online data code: nrg_ind, pehcf, nrg_ind_pehnf)

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Need for more efficient solutions not overloading the grids…

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The need for a holistic approach

The goal of cooling policies : meet the legitimate needs of consumers for thermal comfort while using the smallest amount of energy and keeping emissions and costs to a minimum.

- **Integrating cooling into policies on sustainable buildings**
- **Boosting the energy efficiency of cooling equipment**
- **Improving the energy performance of buildings**
- **Improving cooling technology through research and development**

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The need for a holistic approach

ENERGY INFRASTRUCTURES

Need for enhanced grid flexibility and energy storage solutions

To accommodate the growing and variable demand for cooling, there is a pressing need to enhance grid flexibility. This includes

- **integrating energy storage solutions** and
- **demand response programs** to manage peak loads effectively.
- **investing in renewable energy sources can help meet the increased electricity demand sustainably**.


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