# Modeling and optimization of Edge infrastructures and their electrical systems.

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# Context

- Data centers consumed 1-1.3% of the global electricity in 2022 [1].
- A 15 megawatts data center uses as much water as three average-sized hospitals, or more than two 18-hole golf courses[2].
- Edge computing distributes compute power to the edge of the network.
    - Impact: resource duplication and more environmental footprint.

**Main goals**

- Reduce the environmental footprint of data centers.
    - Energy consumption.
    - Carbon emissions.
    - Water consumption.
- Maintain a high level of QoS and low cost.

[1] IEA,Data Centres and Data Transmission Networks, 2021, url: https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks
[2] Fitzgerald, David, Data Centers and Hidden Water Use, Accessed: 2024-06-18,2015, url: https://www.wsj.com/articles/data-centers-1435168386

# Research directions

- Powering single and distributed data centers from renewable energy sources.
  - Based on the main grid: high reliance on the grid.
  - Based on energy storage: costly.

- Improving the collective self-consumption (energy consumed from the local production).
  - Mixing main grid and storage devices.
  - Energy and carbon aware resource allocation.
  - Energy and carbon aware QoS adaptation.
  - Spatio-temporal load shifting.
  - Collective self-consumption rules redefinition.

- Making trade-offs in the cooling system.
  - Comparing dry (i.e. no water loss) and evaporative (i.e. water loss) cooling methods.
  - Improving the energy efficiency of dry cooling.
  - Exploiting both dry and evaporative cooling in dynamic operation.