ISO 9001 : 2015

MDC SMART ENGINEERING SERVICES

29 october 2024

National study abstract

« Energy efficiency in datacenters »

atee ASSOCIATION TECHNIQUE ENERGIE ENVIRONNEMENT

RÉPUBLIQUE FRANÇAISE Liberté Égalité Fraternité

ADEME AGENCE DE LA TRANSITION ÉCOLOGIQUE

FRANCE datacenter

Part I

Introduction and overall data

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Methodology and definitions

Audited datacenter pool

Number of datacenter operators participants

50

Number of existing sites audited

162

74

New sites scheduled under 5 years

45,7 %

Growth in number of sites under 5 years

Definitions

kWh cumac :

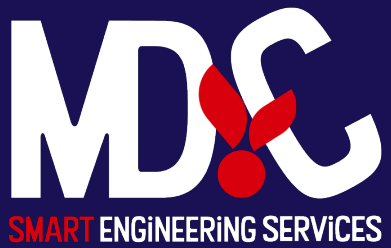
The kWh cumac (“cumulative – actualized”) is the unit of measurement for CEE. This is the energy saving generated by the implementation of the solution eligible for CEE, discounted over the lifetime of the equipment. CEE bonuses are calculated based on the amount of kWh cumac generated by an operation.

PUE (Power Usage Effectiveness) :

PUE is an energy performance indicator specific to data centers, with the ratio:

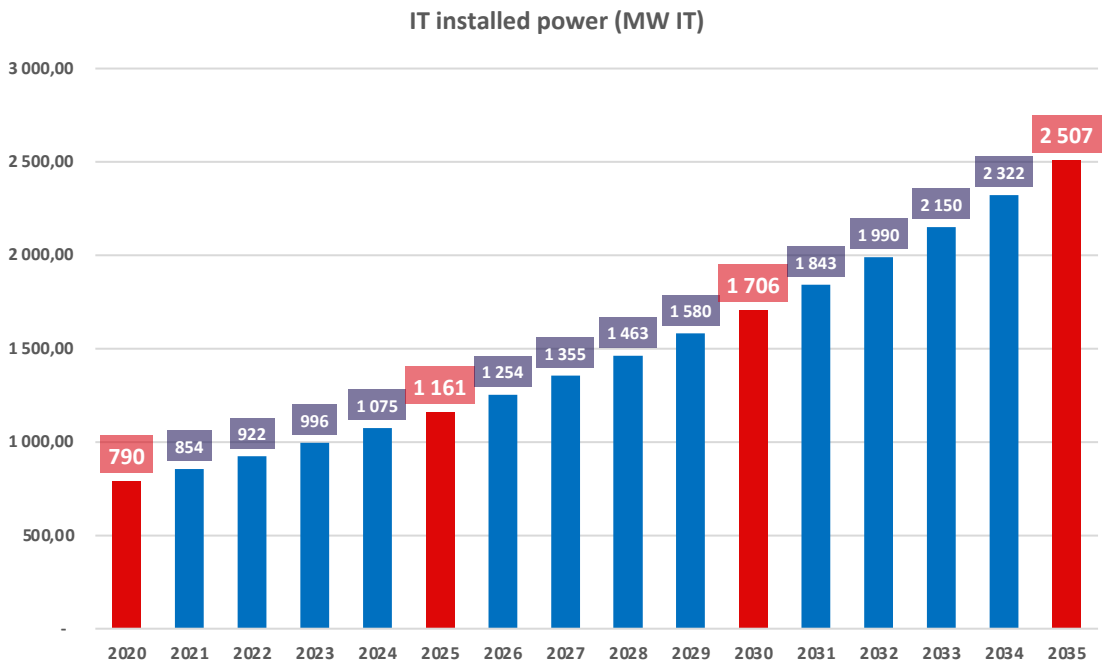
energy dedicated to equipment excluding IT servers / energy dedicated exclusively to IT servers.

IT consumption is always equal to 1, highlighting the "efficiency ratio" of the data center.



A very rapidly growing sector

Evolution of the installed IT power of the Datacenter sector



Evolution of IT power

Installed power of 790 MWIT in 2020

↓

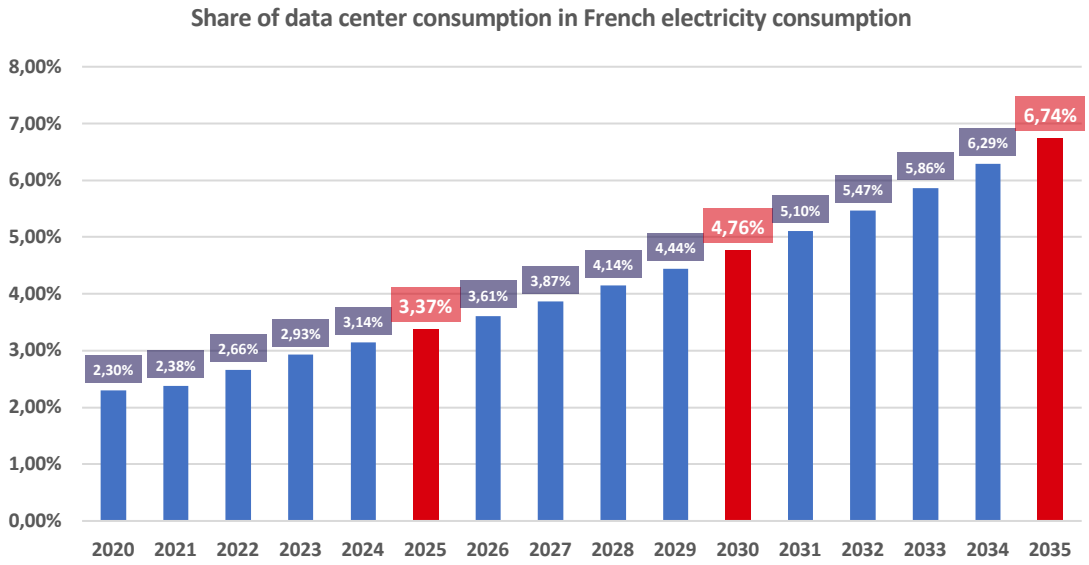
1706 MWIT in 2030

↓

2507 MWIT in 2035

Retour au sommaire

Evolution of the share of data centers in total national electricity consumption

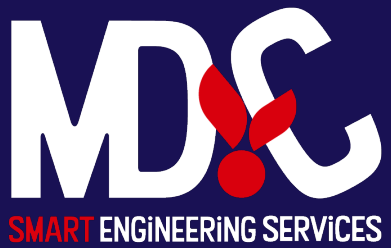


Considering a stable evolution of national electricity consumption and a growth of the sector according to the percentage of growth and the data provided by the actors who participated in the study:

4,76 % of national consumption in 2030

↓

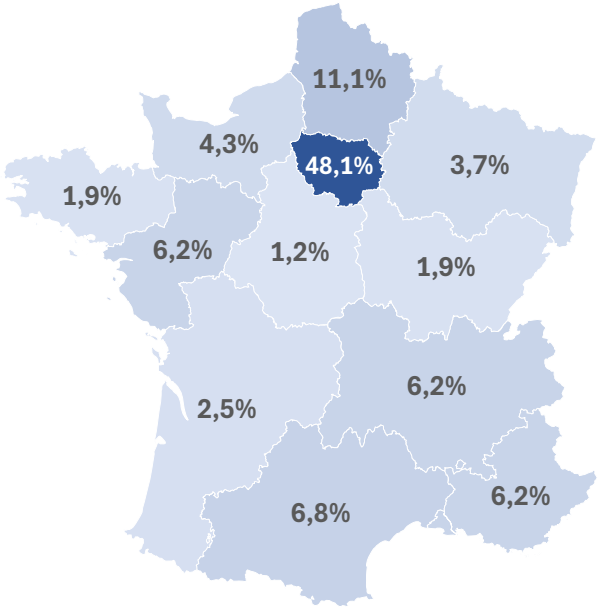
6,74 % of national consumption in 2035



General data and contextual elements

Distribution of Data Centers and IT Power at National Level, Average PUE

Data Center Geographical Distribution (%)



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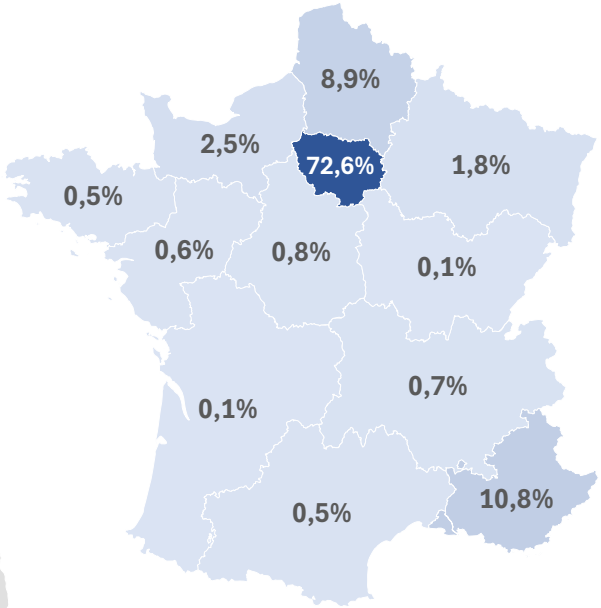
IT Power Geographical Distribution (%)



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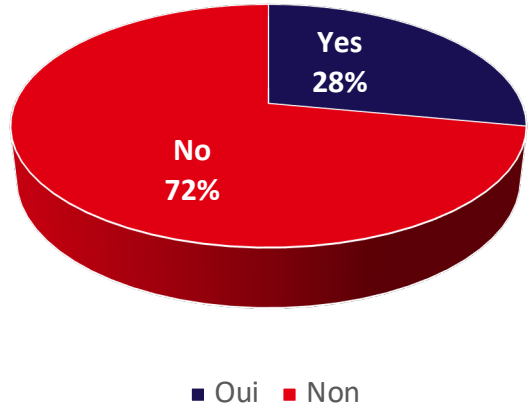
Average PUE

1,5

1. IT Density

Percentage of stakeholders reporting IT power densities above 30 kW/m² for upcoming data hall projects (in both existing and future sites)



With the development of HPC (High Performance Computing), around 1/3 of the players indicate having orders or projects for rooms where the IT density exceeds 30 kW IT/m2

Current IT Density (kW/m²)

3,01*

***Limited to existing sites and excluding future projects**

2. IT Density: Background

Key contextual element for the future evolution of IT densities in France, with some global indicators:

DATA CENTER DESIGN

CyrusOne CEO Eric Schwartz Talks Intelliscale AI Data Centers' 300 kW Racks, And More

CyrusOne's CEO said his company's Intelliscale AI data center build-to-suit announcement's 300 kilowatts per rack "has become a bit of a lightning rod," but that "there's a lot more to building data centers for AI platforms than just getting to density."

Matt Vincent

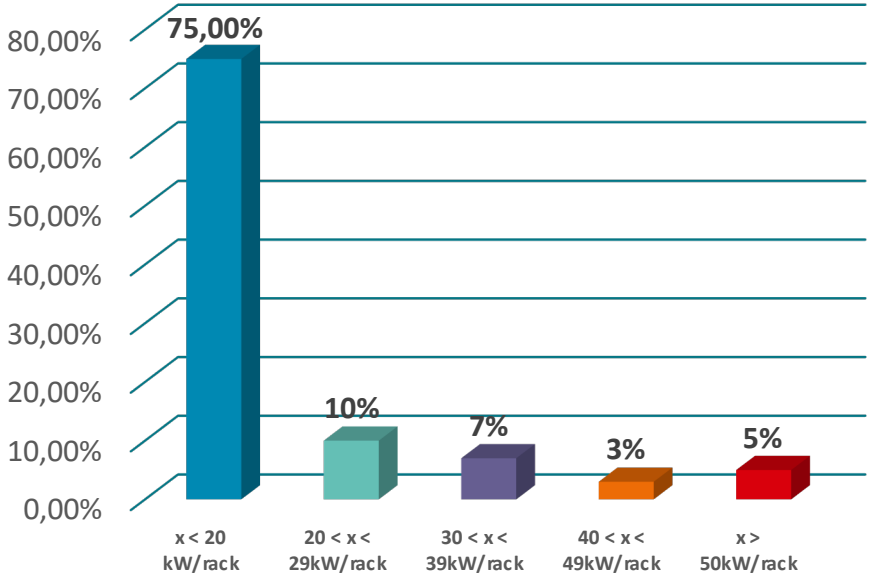
Sept. 30, 2023

CyrusOne Intelliscale AI data center rendering, aerial view.

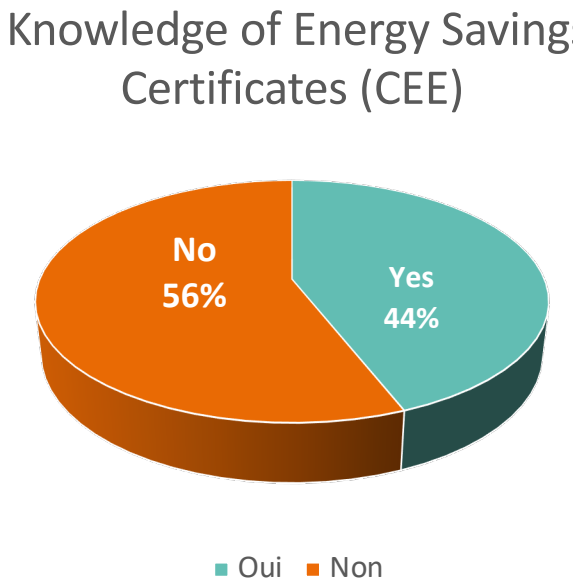
Sources:

- *DC Magazine « La densité des racks explose… jusqu'où ira-t-elle dans le datacenter ? » 02/10/2023*
- *Uptime Institute (2022 survey)*
- *Datacenter Frontier : « CyrusOne CEO Eric Schwartz Talks Intelliscale AI Data Centers' 300 kW Racks, And More » 30/09/2023*

IT Power Distribution in 2022 (Source: Uptime Institute)



Knowledge of Energy Savings Certificates (CEE)



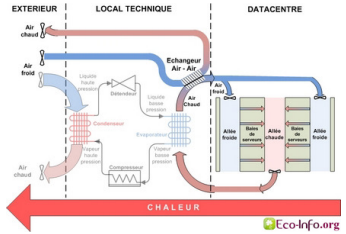
In this context, knowledge of ESCs is understood as:

« A sufficient level of understanding to be able to make use of ESCs in projects, or having benefited from ESCs in previous projects. »

Technologies Considered to Have High Energy Efficiency Potential

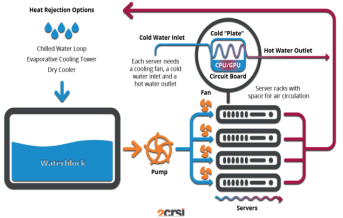
Free-cooling mentioned by:

22%



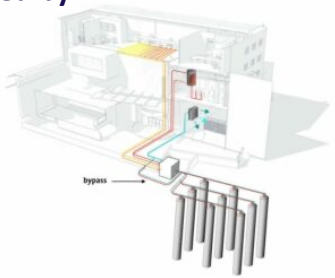
DLC mentioned by:

23 %



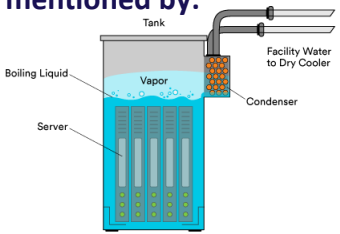
Geo-cooling mentioned by:

17%



Immersion cooling mentioned by:

25%



Part II

Efficient Technologies of Today and Tomorrow for the Data Center Industry

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Compilation of Energy Efficiency Optimisation Perspectives for the Data Center Industry

- Hybrid Free Cooling
- Direct Free Cooling
- Indirect Free Cooling
- DLC
- Immersion Cooling
- Door cooling

- Geocooling
- UPS air handler
- Smart PDU
- Monitoring
- Cascade control
- Heat Recovery

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A. Cooling technologies

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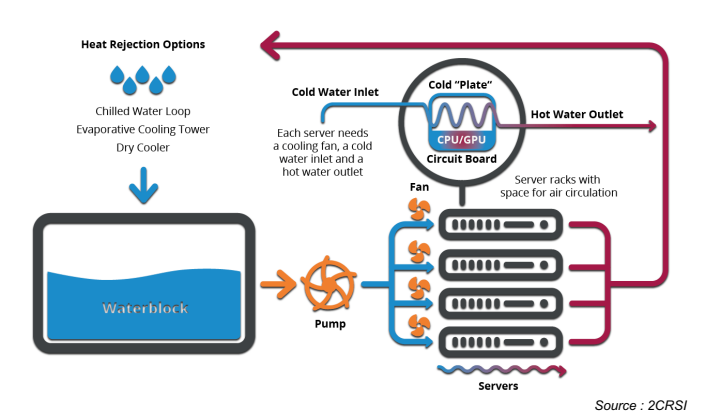
DLC (among which Door cooling)

Technology Overview

Direct Liquid Cooling focuses on cooling only the most heat-sensitive components of the servers (such as GPUs and/or CPUs) using heat exchangers placed directly on these components. By bringing the cooling system closer to the heat sources and reducing the overall cooling volume, chilled water loops can operate at higher temperatures, thereby improving the performance and efficiency of the cooling system



Source : 2CRSI

DLC Average PUE

DLC (Direct Liquid Cooling) enables significantly lower average PUE values compared to air cooling, thanks to its ability to achieve almost 100% free cooling, except in extreme temperature conditions above 42–45°C.

Note: Existing sites using DLC mostly apply it in test environments or for a small portion of their data halls. However, the projects identified as part of this study involve entire sites equipped with this technology.

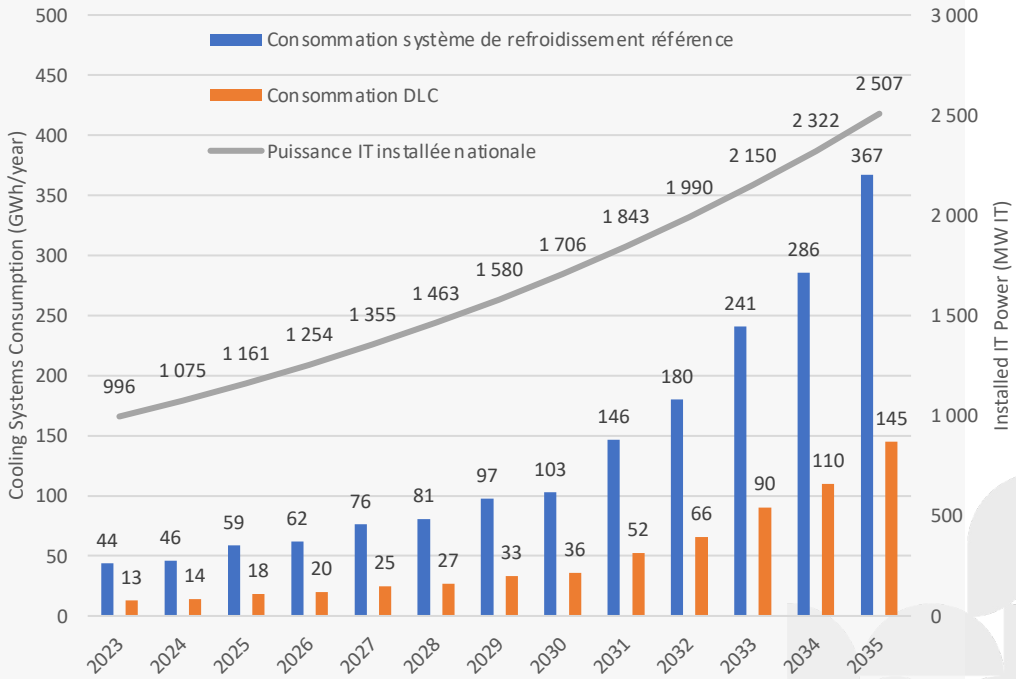
Average PUE

1,15

Energy Savings with DLC

Taking into account the data collected from projects reported by audited stakeholders, if these projects are fully implemented and if the current trend continues:

- **7.4% of total IT power equipped by 2035**
- **An energy savings potential of 3.3 TWh cumac by 2035**
- **Annual energy savings of 353 GWh in 2035**
- **Approximately €23 million in potential Energy Savings Certificates (CEE) incentives by 2035**
- **185 MW of IT power equipped**



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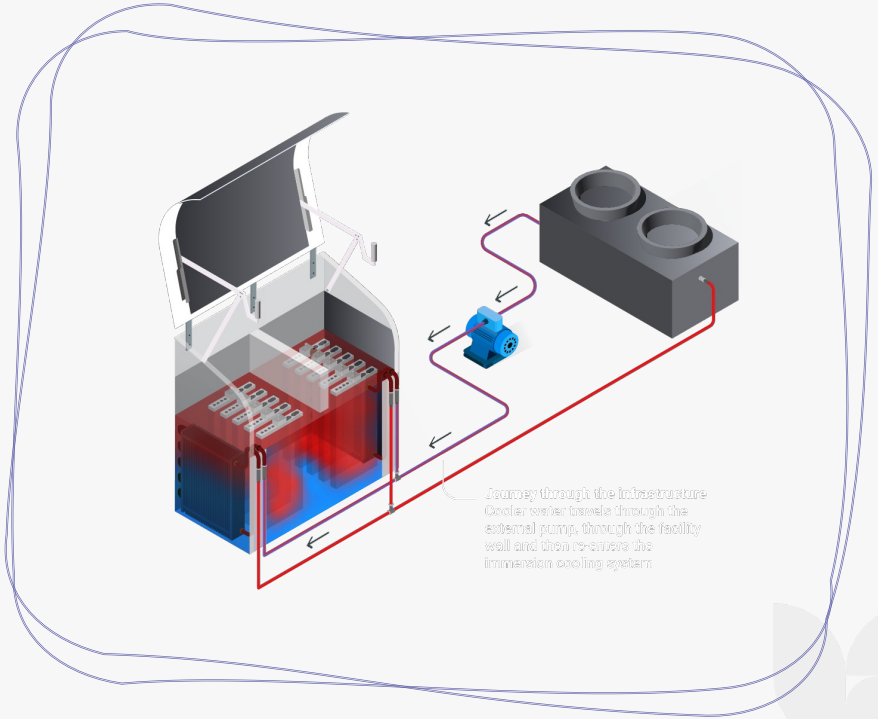
Immersion cooling

Technology Overview

Immersion cooling replaces the traditional cooling medium, which is air, by immersing servers in a dielectric fluid. This dielectric fluid is maintained at the desired temperature through heat exchangers and a chilled water loop. The temperature of the water loops is higher, as the volume that needs to be cooled is significantly smaller and the heat capacity of the fluid is much greater



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Immersion Cooling Average PUE

Immersion cooling enables significantly lower average PUE values compared to air cooling, thanks to its ability to achieve 100% free cooling

Projections based on identified projects and stakeholders' stated intentions to deploy the technology indicate a forecasted share of **8.1% of IT power equipped with immersion cooling by 2035, representing 203 MW of IT power**

Average PUE

1,10

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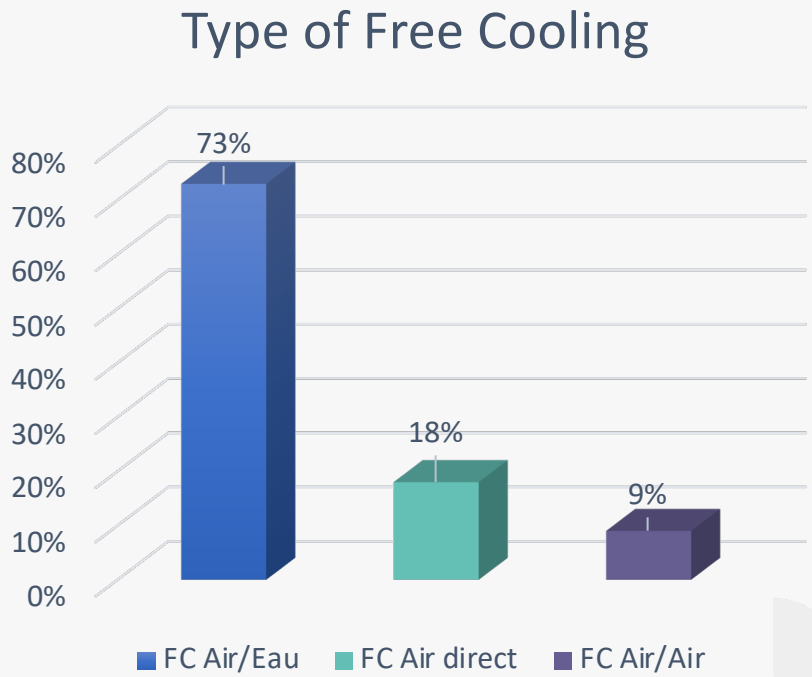
Free cooling

2. Free-cooling

Three types of Free-cooling used today:

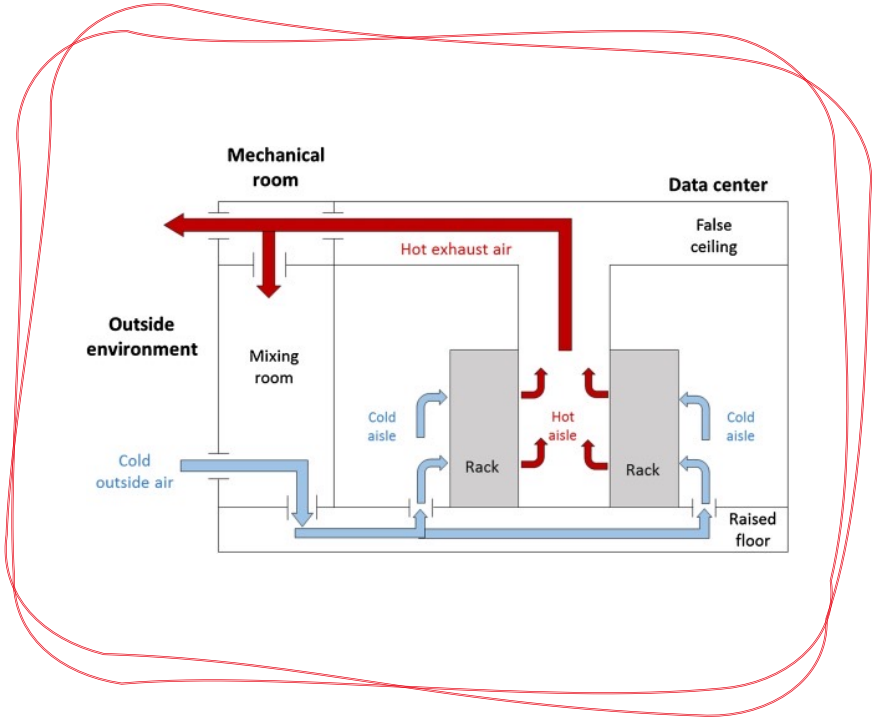
- Air-to-Water Free Cooling
- Indirect Air-to-Air Free Cooling
- Direct Air Free Cooling



Technology Overview

Direct Air-to-Air Free Cooling consists of directly supplying filtered and treated outdoor air into the data halls, whenever external conditions allow, to maintain server temperatures. When outdoor conditions are not sufficient, a chilled water loop, cooled by a chiller, is used to meet the remaining cooling demand.

This is a highly efficient air-based cooling solution, but it is generally limited to small-sized data centers



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1. Hybrid Air-to-Water Free Cooling

Average PUE of Hybrid Air-to-Water Free Cooling

The performance of free cooling depends in particular on the climate zone and the supply temperature of the chillers.

CEE eligibility sheet is currently being developed (ATEE working group) for hybrid free cooling, with preliminary approval from ATEE and ADEME.

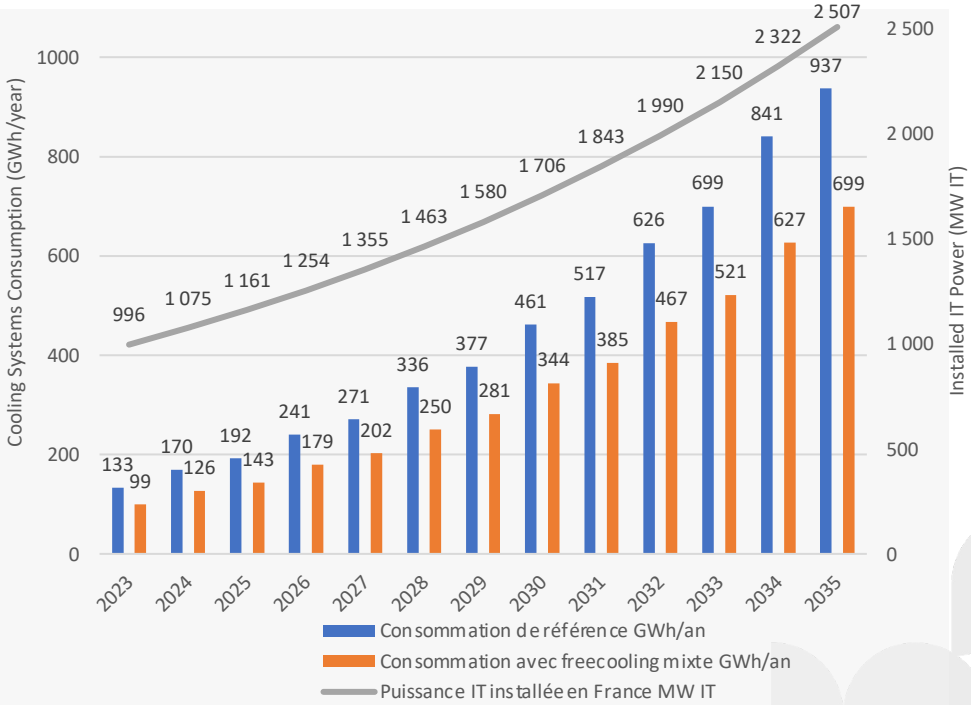
Average PUE

1,35

Energy savings with Hybrid Free Cooling

Taking into account the data collected from projects reported by audited stakeholders, if these projects are fully implemented and if the current trend continues:

- **17.9% of total installed IT power equipped by 2035**
- **An energy savings potential of 2.62 TWh cumac by 2035**
- **Annual energy savings of 240 GWh in 2035**
- **Approximately €18.3 million in potential CEE incentives by 2035**
- **449 MW of IT power equipped**



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B. Control and Management of Power Distribution

Attention : Les calculs et estimations réalisées par MD.C à date sont des estimations basées sur les chiffres fournis par les acteurs dans le cadre de l'étude. Ces estimations peuvent être modifiées par la prise en compte de données complémentaires. La création de fiches CEE nécessite leur validation par l'ATEE, l'ADEME et la DGEC. La présente étude ne constitue en aucun une garantie de délivrance de prime ou de création de fiche pour les technologies citées.

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Monitoring

Technology Overview

Monitoring provides perspective on the performance of the building and equipment, enabling rapid identification of potential consumption drifts and allowing for prompt, targeted action. Some solutions even offer automated energy consumption management

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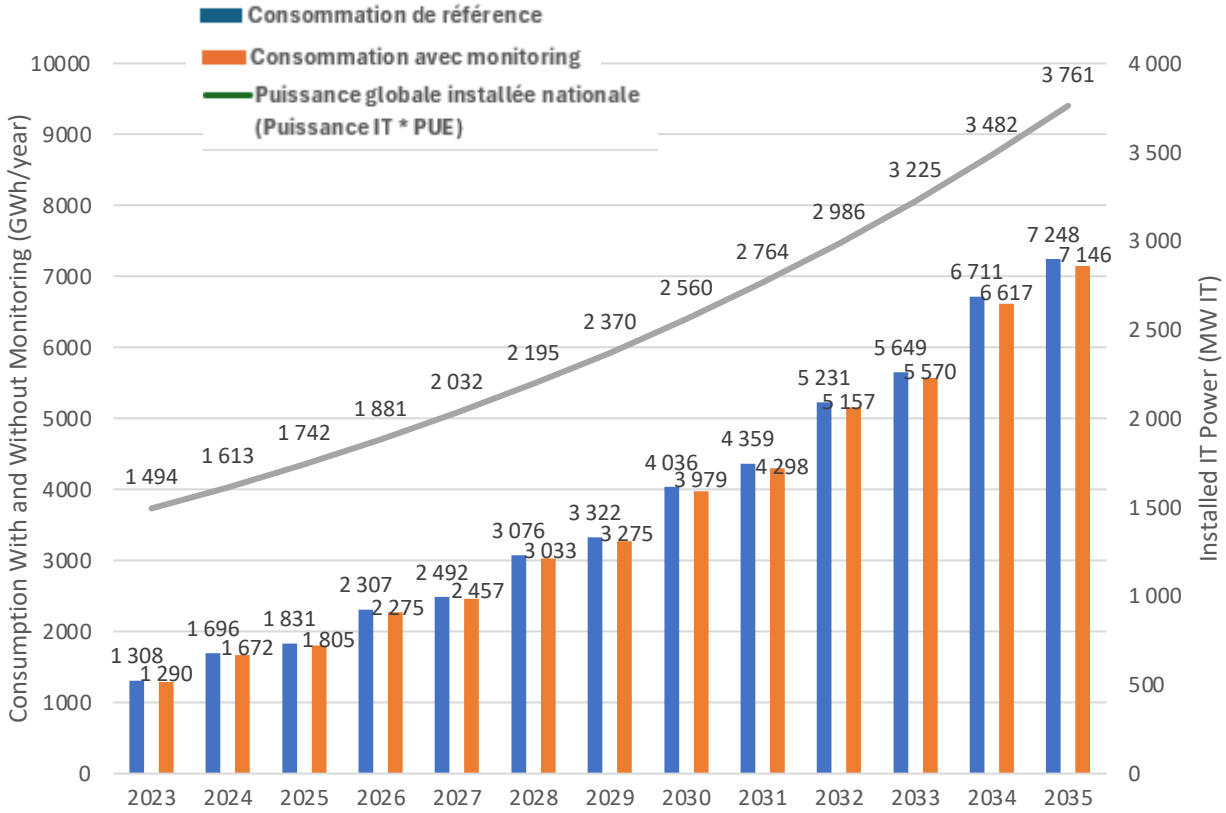
2. Monitoring

Taking into account the data collected from projects reported by audited stakeholders, if these projects are fully implemented and if the current trend continues:

- **22% of total IT power equipped by 2035**
- **An energy savings potential of 557 GWh cumac by 2035**
- **Annual energy savings of 102 GWh in 2035**
- **Approximately €3.9 million in potential CEE incentives by 2035**
- **552 MW of total installed power equipped**



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C. Networks

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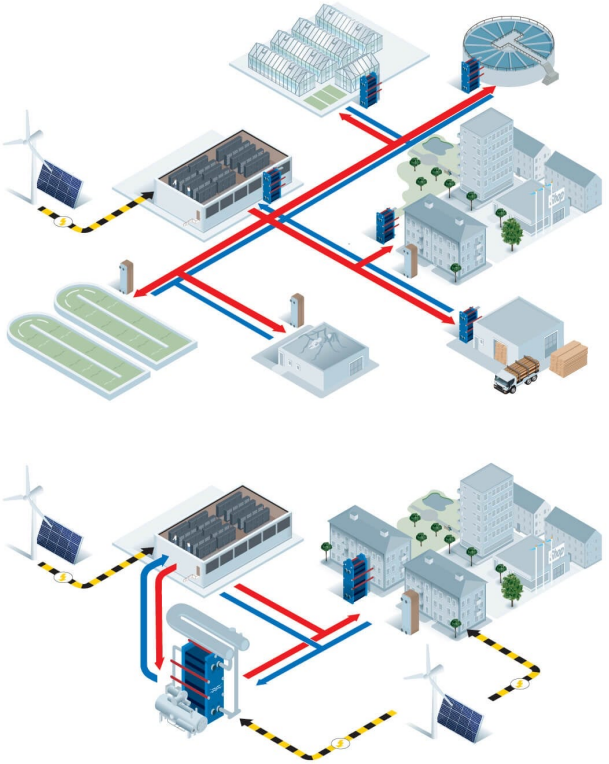
Heat recovery

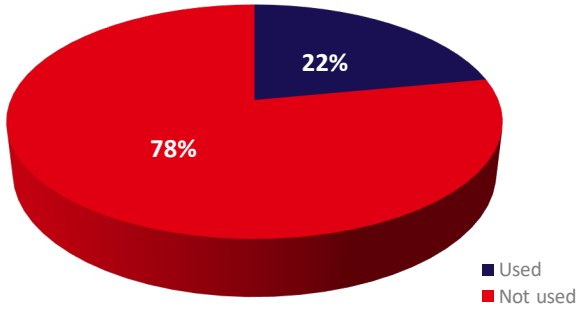
Technology Overview

The recovery of waste heat from data centers for district heating networks currently requires the use of heat pumps to raise the return temperature of chilled water to around 70–80°C, which significantly limits both the feasibility and attractiveness of such projects.

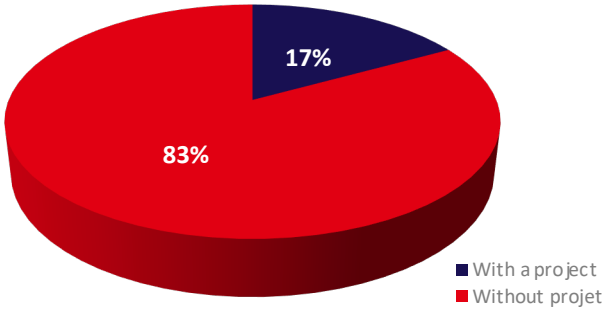
An existing CEE eligibility sheet (RES CH 108) already covers the installation of equipment enabling the supply of heat to a district heating network or a third party.



1. Heat recovery

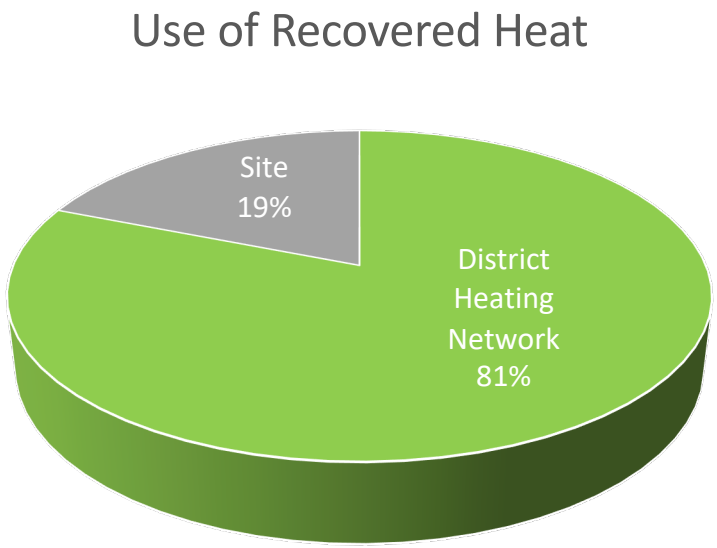


22% of the audited sites benefit from some form of waste heat recovery and reuse



17% of the audited sites that do not currently recover waste heat plan to do so within the next five years

2. Heat recovery



81% of the waste heat recovery from the audited sites (existing and planned) is directed to district heating networks.

3. Heat Recovery: forecast

Année cible	2030			2035		
% du parc impléménté supplémentaire	17%	17%	17%	25%	25%	25%
Puissance IT couverte %	10%	20%	30%	10%	20%	30%
Puissance IT couverte (MW)	29,01	58,02	87,03	53,74	107,48	161,23
% de la puissance IT totale installée récupérée	1,7%	3,4%	5,1%	2,5%	5,0%	7,5%
Gisement (RES CH 108) (MWh cumac)	**1 795 544,45**	**3 591 088,91**	**5 386 633,36**	**3 326 277,79**	**6 652 555,57**	**9 978 833,36**
Prime potentielle associée (€)	**12 568 811,18 €**	**25 137 622,36 €**	**37 706 433,54 €**	**23 283 944,51 €**	**46 567 889,02 €**	**69 851 833,53 €**
Economies d'énergie annuelles (MWh/an)	**127 064,22**	**254 128,43**	**381 192,65**	**235 388,70**	**470 777,41**	**706 166,11**

Important : The deployment of liquid cooling solutions (immersion and DLC) enables the recovery of a greater amount of dissipated power and improves the technical feasibility of heat recovery because:

- **Heat is dissipated directly into the liquid**
- **Loop temperatures are higher (60 to 80°C), matching the temperature requirements of district heating networks**

Partie III

Abstract et overall outlook

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Compilation of Energy Efficiency Optimisation Perspectives for the Data Center Industry

visual summary illustrated with Graphs

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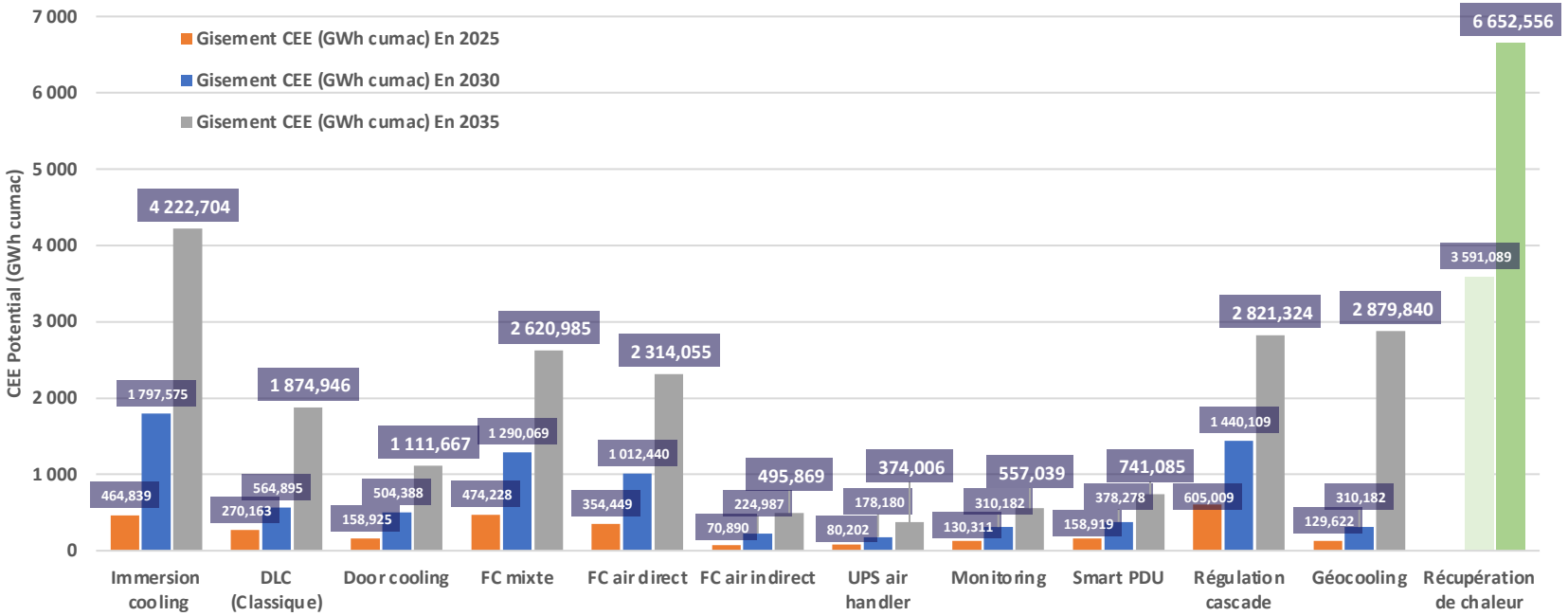
Compilation of Energy Efficiency Optimisation Perspectives in the Data Center Industry – CEE Potential by Technology



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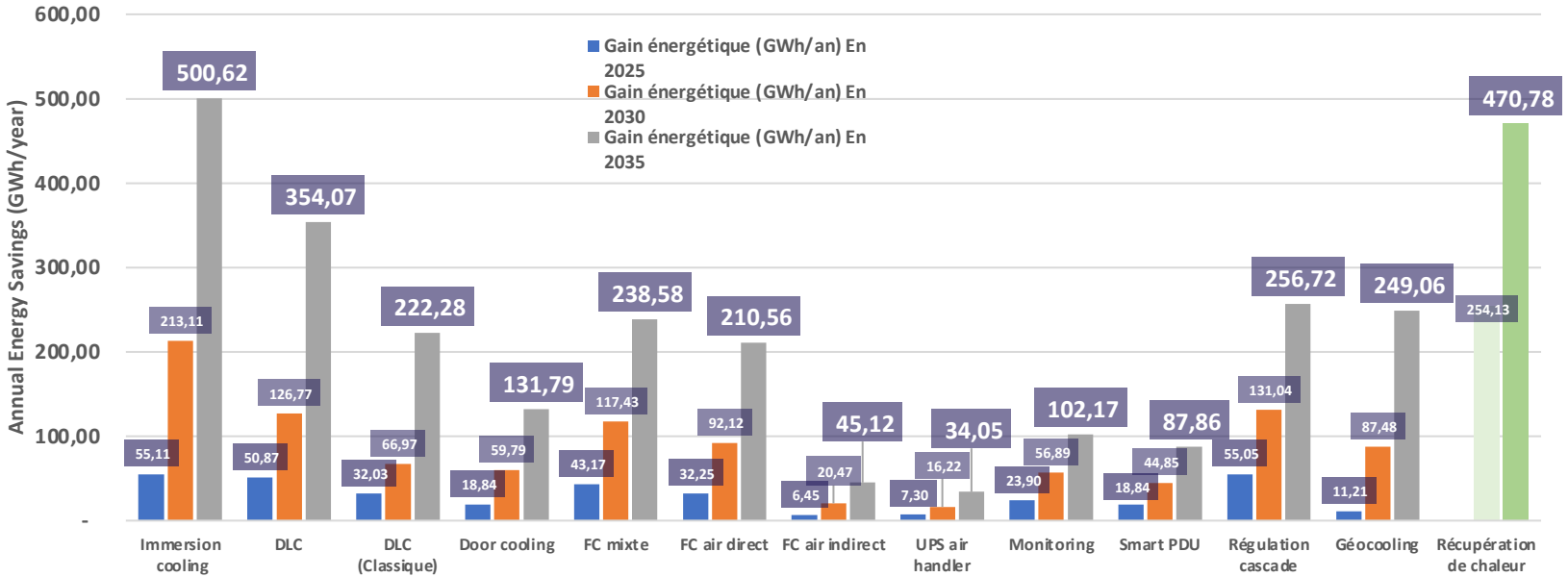
Compilation of Energy Efficiency Optimisation Perspectives in the Data Center Industry – Energy Savings by Technology



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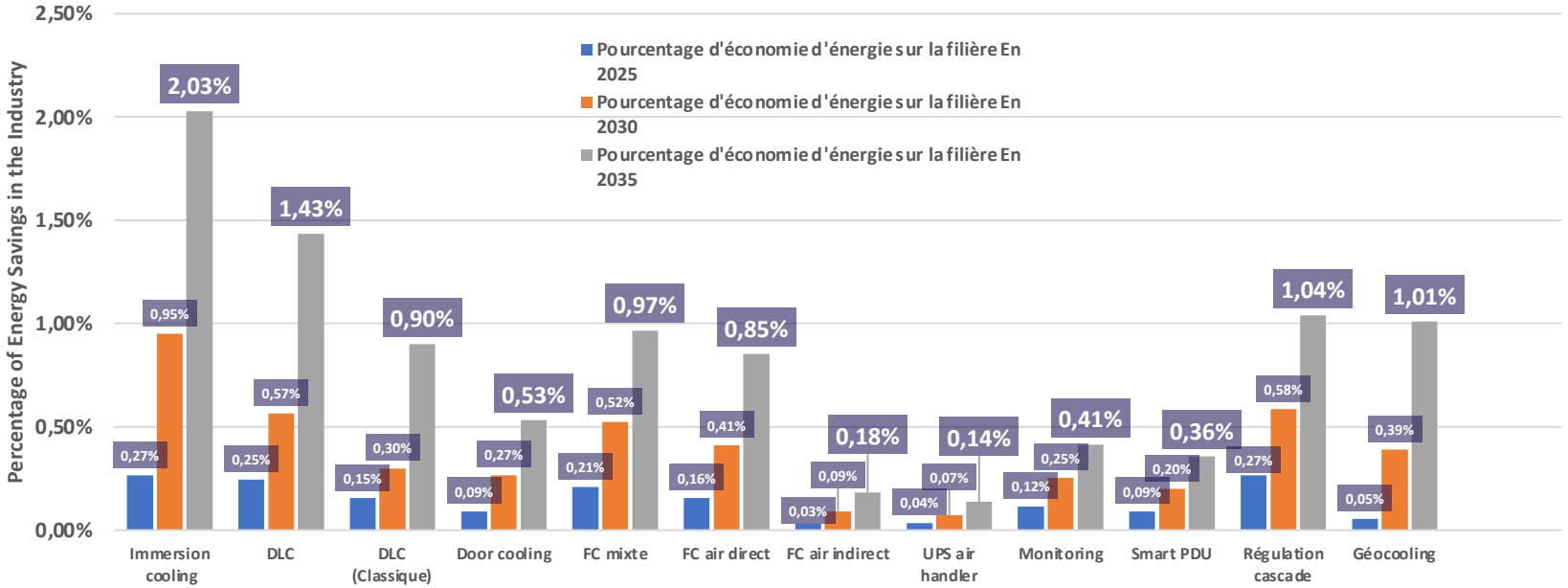
Compilation of Energy Efficiency Optimisation Perspectives in the Data Center Industry – % of Energy Savings on Total DC Industry Consumption



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Compilation of Energy Efficiency Optimisation Perspectives in the Data Center Industry: summary

Estimated Energy Savings Potential Across All Technologies

by 2030	by 2035
8 TWh cumac	20 TWh cumac
906 GWh/year	2 078 GWh/year
4 % Energy Savings on Total Industry Consumption	8,4 % Energy Savings on Total Industry Consumption
€56 million in potential incentives to support the industry in this transition	€140 million in potential incentives to support the industry in this transition

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