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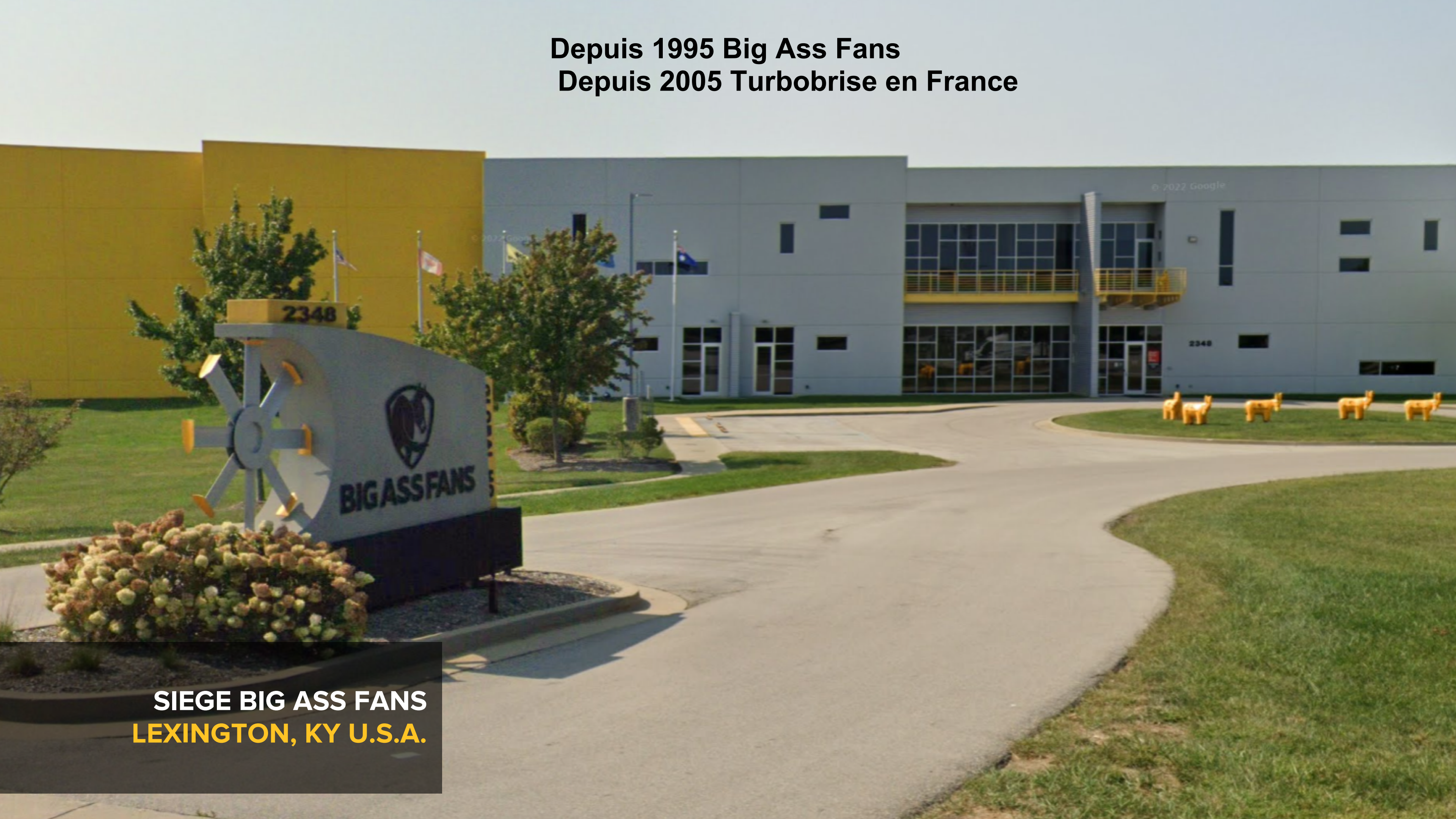

Depuis 1995 Big Ass Fans
Depuis 2005 Turbobrise en France
2348
BIG ASS FANS
SIEGE BIG ASS FANS
LEXINGTON, KY U.S.A.

La recherche au cœur du métier

Centre de recherche unique au monde

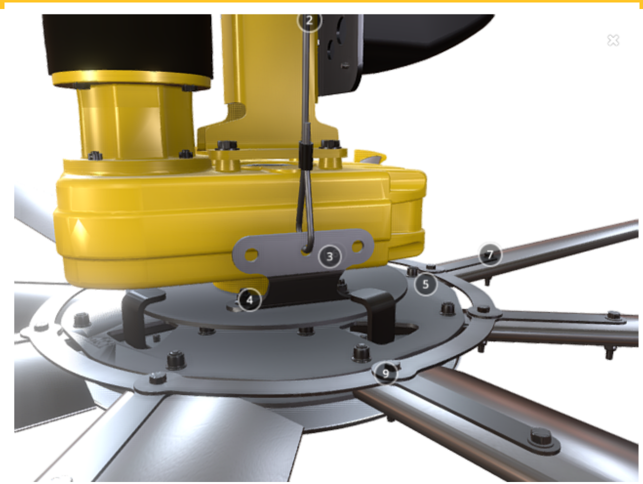
4000m^2 avec un plafond de 18m .

Plus de **50 ingénieurs**

Plus de **300 brevets**

TURBOBRISE

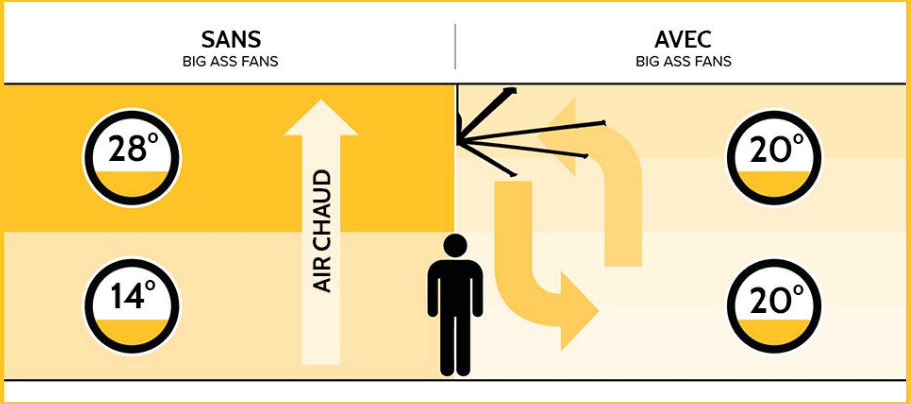
Notre priorité : une sécurité sans faille



Tous nos brasseurs HVLS sont équipés de systèmes de sécurité qui garantissent à nos clients une utilisation en toute sérénité:

- Pièces extrudées ou usinées et non soudées pour éviter les risques de fatigue et de corrosion
- Visserie de qualité aéronautique
- Système de retenue des pales breveté avec câble interne de retenu qui empêche la chute des pales en cas de choc
- Élingues de sécurité pour maintenir le bloc moteur au point d’attache
- Accéléromètre pour arrêt immédiat en cas de choc

Destratification



-30% chauffage

TECHNICAL FEATURE

Impact of HVLS Fans On Airplane Hangar Air Destratification

BY CHRISTIAN TABER, BEMP, HBDP, MEMBER ASHRAE; BRANDON A. STEELE, STUDENT MEMBER ASHRAE

Thermal air stratification results when heated air rises due to its having a lower density relative to ambient air, which results in a thermal gradient from floor tc ing. The heated air typically stagnates at the ceiling of large facilities due to a lac air circulation.[1,2] Air stratification presents an important consideration in facili energy savings for buildings with tall ceilings; elevated air temperature at the ce ing level increases the rate of heat loss through the building envelope. A substar opportunity to reduce annual heating costs for facilities is available by reducing to-ceiling stratification.

Airports present a tremendous air destratification energy savings opportunity because many of the buildings have large, open spaces with high ceilings. Heating airport hangars to meet comfort temperature requirements often consumes large amounts of energy and produces an excessive amount of emissions. Like many other areas of industry,[3] airports are now under pres-

of unwanted cooling across an occupant's skin. F be operated in the upward direction to destratify this typically requires higher operating speeds a as the fan has to push the heated air along the ce down a vertical surface to reach the thermostat l fans lower the average space temperature by mi excess heat at the ceiling, which reduces HVAC s

the eaves and is located in Frankfort, Ky. A 20 ft (6 m) diameter HVLS fan was installed in the center of the facility with a blade height of approximately 27 ft (8 m) from the floor. The primary goal of this study is to measure and evaluate the energy and cost impacts associated with using an HVLS fan for air destratification during the cold weather season.

Temperature Loggers

Air temperatures were monitored using temperature and humidity loggers, shown in *Figure 1*. Three loggers were placed along the back wall of the facility at 5 ft, 15 ft and 35 ft (5 m, 4.6 m and 10.7 m) above the floor. An additional logger was placed in a sheltered location outside the facility to collect outdoor air temperature. Loggers were set to collect a data point once every 5 minutes.

Gas Heaters

Forced air natural gas unit heaters are used to heat the facility. A single heater unit was located at each of the four corners of the hangar near the ceiling. All unit heaters are rated at 250,000 Btu/h (73 kW). A dedicated digital meter was installed on the natural gas supply line to monitor gas consumption for the duration of the study. The space temperature setpoint was 65°F (18°C). The forced air gas heaters used in the hangar

FIGURE 1 (ABOVE) Temperature and humidity loggers used to record air temperature in the facility. Figure 2 (RIGHT) Workers on a lift near the forced air gas heaters inside the hangar.

FIGURE 3 Workers installing an HVLS fan in the center of the hangar. Forced air gas heaters are located in all four corners of the facility.

a noticeable breeze (approximately 30 fpm (0.15 m/s) per ANSI/ASHRAE Standard 55-2017) at the occupant level. *Figure 3* displays the fan location in the center of the facility.

Results & Discussion

TECHNICAL FEATURE

on an alternating weekly operation allowed data

one of the lowest recorded during the week. The relevance of the temperature differential being the highest on a low temperature day is apparent by the gas heaters in the space operating more frequently, consuming more natural gas.

Scenario Two – Fan "On"

The second set of data, *Figure 5*, displays measured indoor air temperatures over the week of November 9 to November 16 in addition to the outdoor air temperature with the fan operating slowly in the downward direction. *Table 2* shows average daily temperatures while the fan was on as well as temperature gradients between 5 ft (1.5 m) to 35 ft (10.7 m) and 15 ft (4.6 m) to 35 ft (10.7 m) above the floor.

In contrast to when the fan was off, the indoor temperatures across all heights were significantly more uniform, as shown in *Figure 5*. The maximum daily average recorded temperature gradient during the study occurred on November 16 at 1.3°F (0.7°F) between 5 ft (1.5 m) to 35 ft (10.7 m). The average outdoor air temperature was one of the lowest during the week at 53°F (11.7°C), meaning on cold days when gas heaters were operating frequently, stratification was greatly reduced when compared to the "fan off" measurements in the

FIGURE 4 Indoor temperature data (°F) collected from November 2 to November 10 at 5 ft, 15 ft and 35 ft (1.5 m, 4.6 m and 10.7 m) above finished floor (AFF) and plotted with outdoor air temperature for comparison.

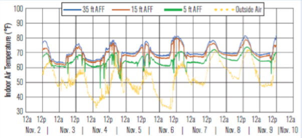


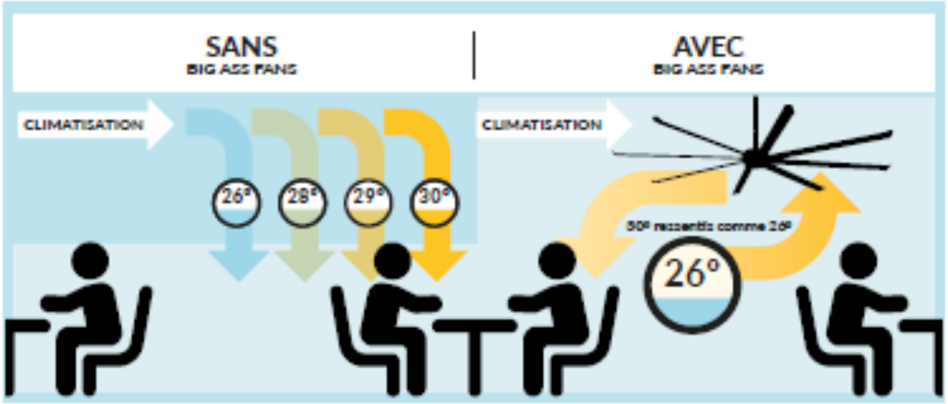
TABLE 1 Stratification results while fan was "off" showing daily average temperatures (°F) from 5 ft, 15 ft and 35 ft (1.5 m, 4.6 m and 10.7 m) away from floor with outside air conditions (OA) for comparison. Temperature differentials (ΔT) from 35 ft (10.7 m) and 15 ft (4.6 m), and 35 ft (10.7 m) and 5 ft (1.5 m) are displayed.

FAN OFF	35 FT	15 FT	5 FT	OA	ΔT (°F)	
DAILY AVERAGES	TEMP. (°F)	TEMP. (°F)	TEMP. (°F)	TEMP. (°F)	35 FT – 5 FT	35 FT – 15 FT
Nov. 2	69.5	66.9	64.2	57.7	5.2	2.6
Nov. 3	68.2	66.9	63.3	50.1	4.9	1.4
Nov. 4	69.2	67.4	62.5	47.4	6.8	1.8
Nov. 5	70.8	69.0	64.1	48.8	6.6	1.8
Nov. 6	72.6	70.8	64.0	47.6	8.5	1.7
Nov. 7	71.9	70.6	66.8	58.9	5.2	1.3
Nov. 8	72.7	71.2	67.8	60.3	4.9	1.5
Nov. 9	70.7	68.9	65.1	51.2	5.7	1.8
Overall Average	70.7	69.0	64.7	52.8	6.0	1.7
Maximum Value	72.7	71.2	67.8	60.3	8.5	2.6

FIGURE 5 Indoor temperature data (°F) collected from November 9 to November 16 at 5 ft, 15 ft and 35 ft

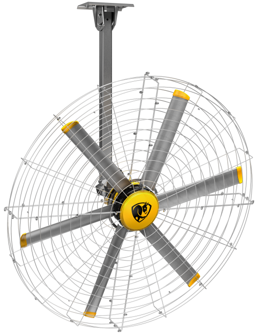
Baisse de T° ressentie plafond

diamètres 1.3m à 9.0m



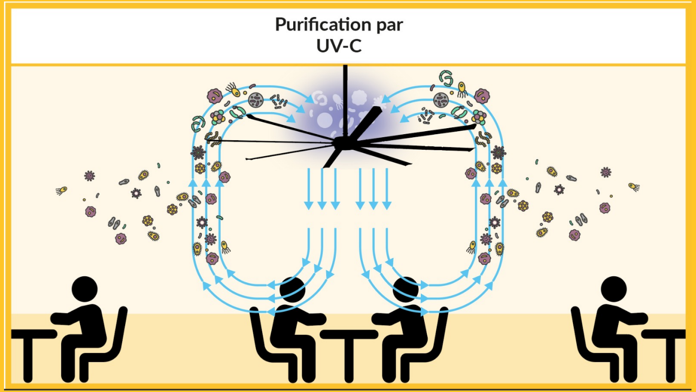
Baisse de T° ressentie directionnel

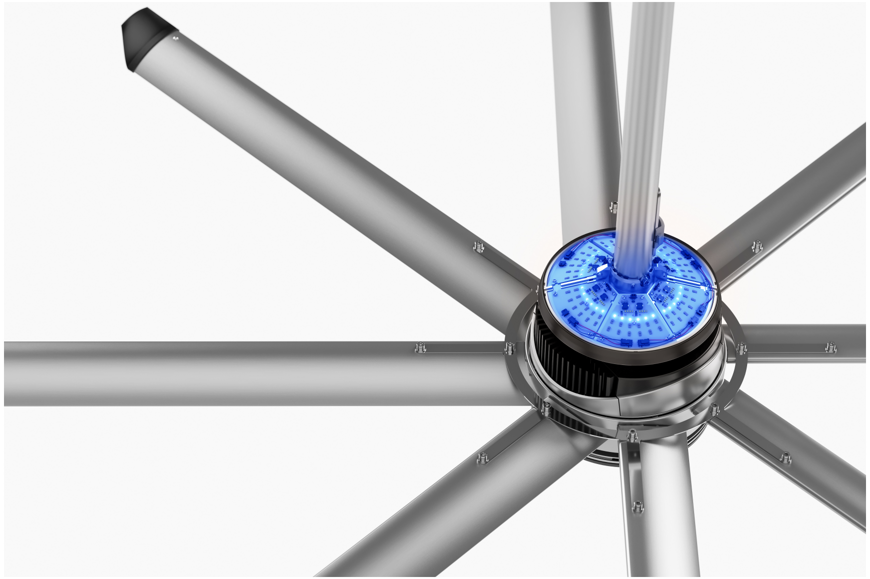
diamètre 0.7 à 2.2m



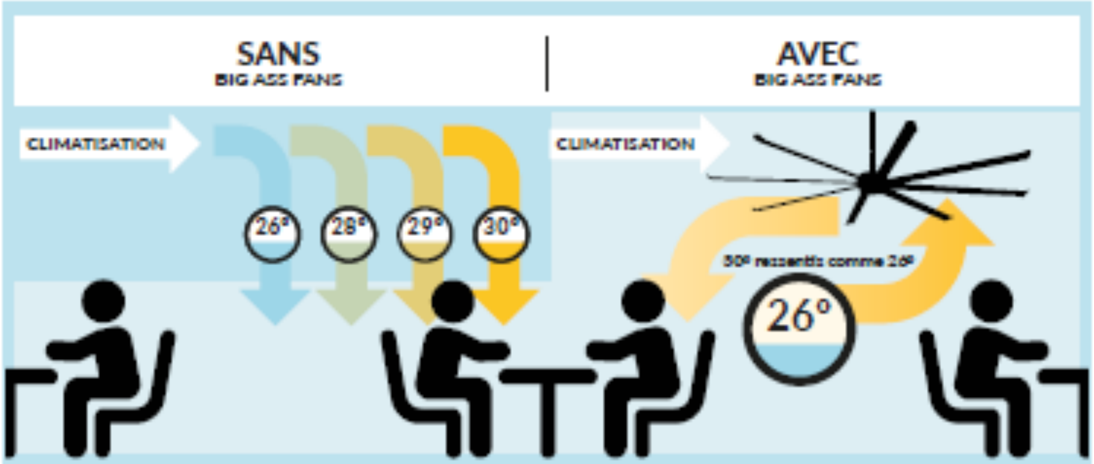
Baisse de T° absolue Ventilation adiabatique

Désinfection de l’air





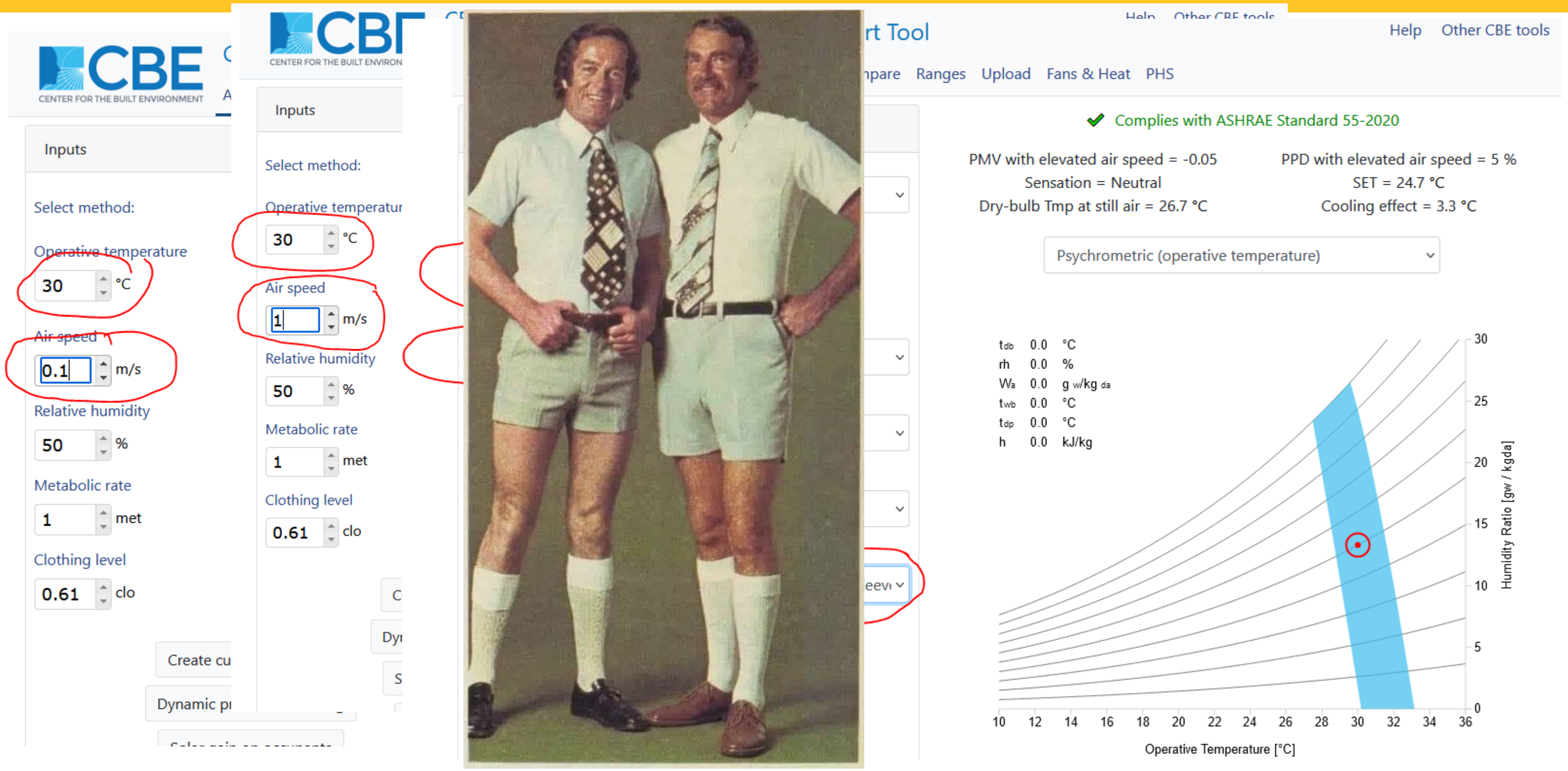
Est-ce quantifiable?



TURBOBRISE

BIG ASS FANS

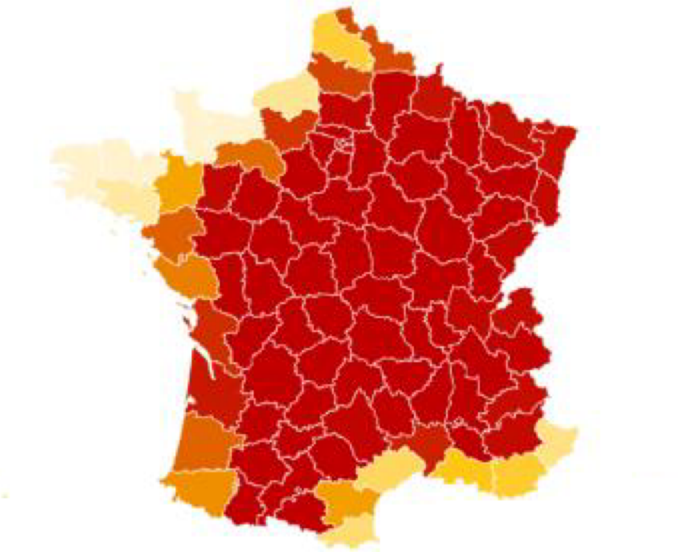
Les abaques du CBE (Centre pour l’environnement bâti – Berkeley)



Préparons nous!

En 2022, près de 60 % des ménages ont souffert de la chaleur dans leur logement. C’est 8 points de plus en seulement 2 ans

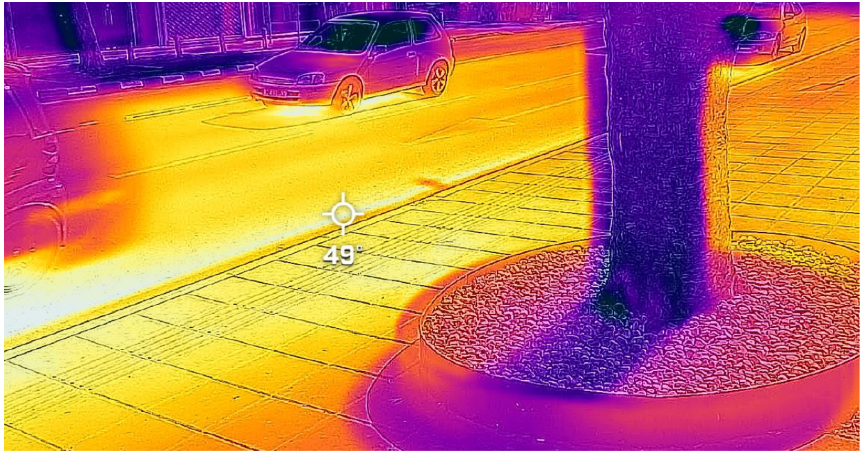
Source Fondation Abbé Pierre



Part des logements exposés à des vagues de chaleur en 2030

Sur-climatisation et réchauffement des ICU

En France d'ici 2050, les vagues de chaleur devraient être deux fois plus fréquentes, plus intenses, et pourraient arriver sur une période étendue de fin mai à début d'octobre.
La réglementation environnementale 2020 (RE 2020) détermine deux seuils de température intérieure maximale : le jour, entre 26 °C et 28 °C et la nuit, 26 °C.
En vieillissant, le corps perd 5 % de sa capacité de thermorégulation tous les 10 ans



En France, le Réseau de Transport de l'Electricité constate qu'en période de canicule, chaque degré supplémentaire entraîne des consommations d'électricité supplémentaires de 500 MW soit l'équivalent de la consommation en électricité de la ville de Bordeaux.

Un climatiseur peu performant (classe A) coûte plus de 130 euros par mois d'utilisation, soit 30 fois plus qu'un ventilateur.

Les bâtiments résidentiels et commerciaux sont responsables d'environ 40 % des émissions de gaz à effet de serre dans le monde dont 5% provient de la climatisation.

CIAT
°C
10
5
15
25
30

Test rafraîchissement hybride

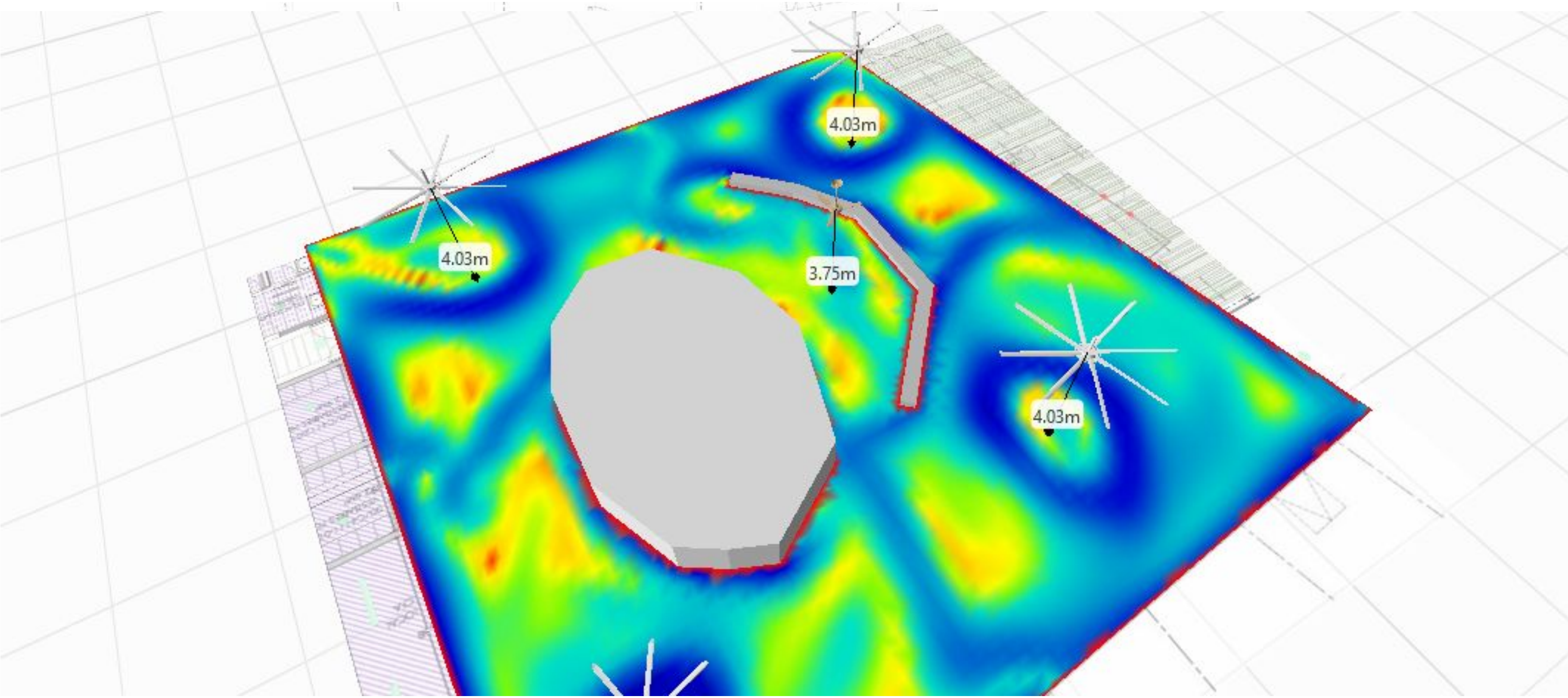
Site : bâtiment Zero Energy Plus de la Building Singapour
Bureaux Open Space
Contrôle 2 fois par jour durant 11 semaines
24°C puis 26.5°C avec BAP + ventilateurs individuels

Rafraîchissement hybride

En combinant brasseurs d'air et climatisation c'est **32% d'économie d'énergie** qui sont atteints selon la récente étude de l'université de Berkeley.

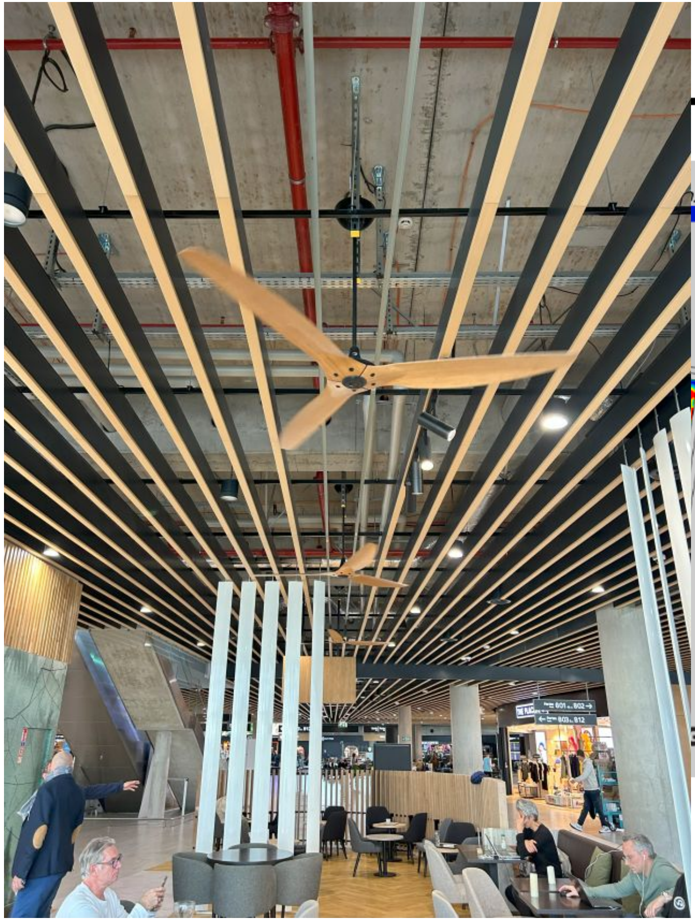
Bonus de cette solution : diminution drastique de l'effet de surrefroidissement (overcooling) qui passe de 33% à 9%

Mieux vaut une bonne étude qu’une mauvaise implantation

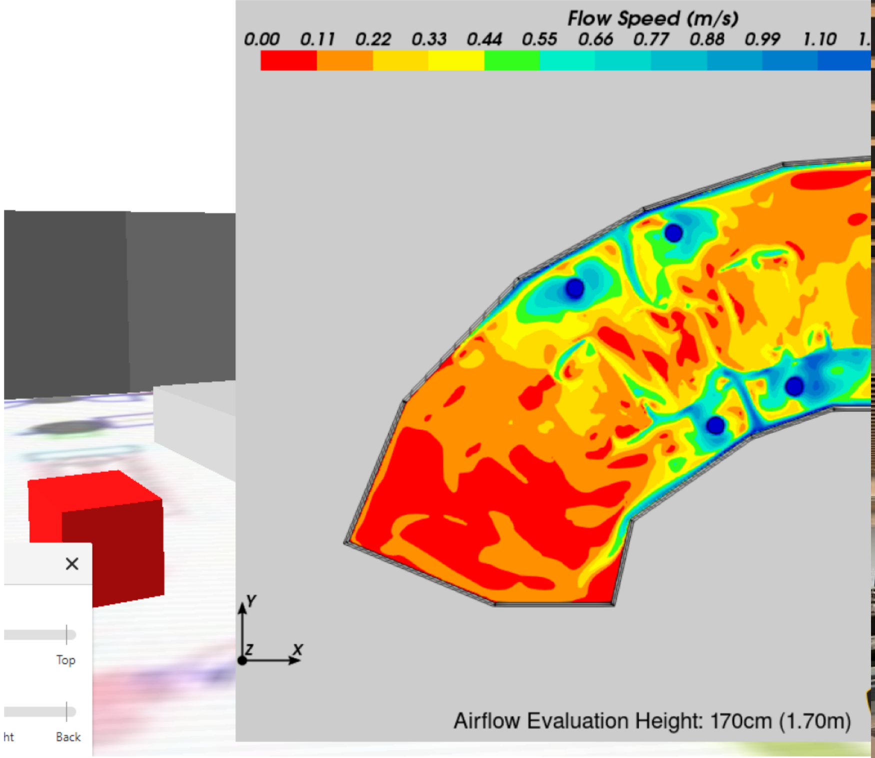


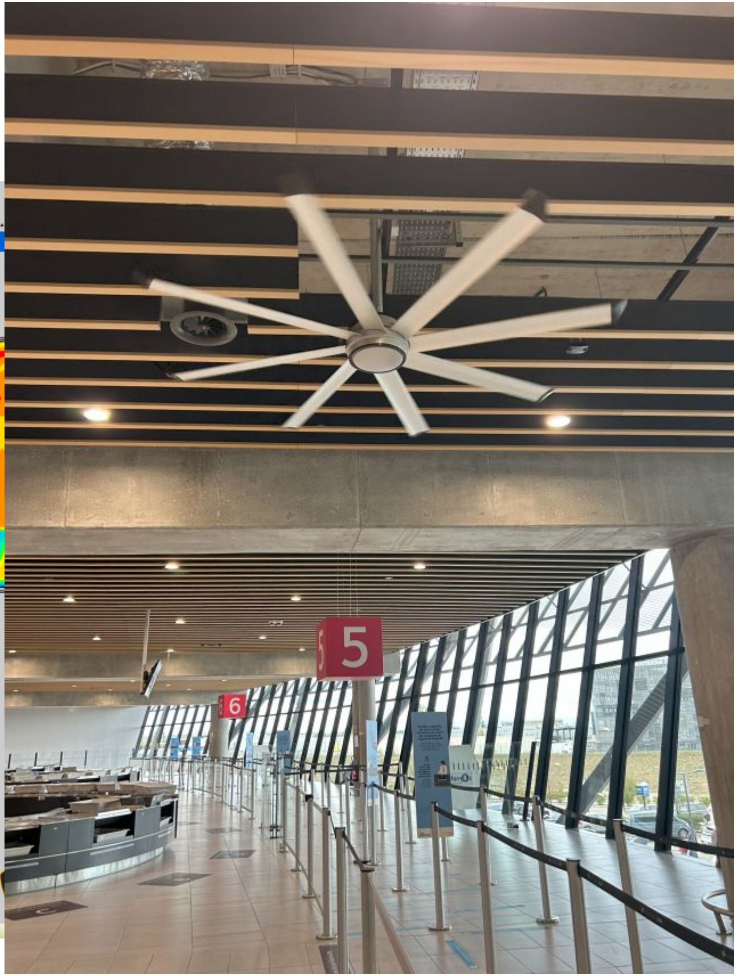
Rafraîchissement hybride - exemples

Aéroport St Exupéry



Aéroport St Exupéry PIF

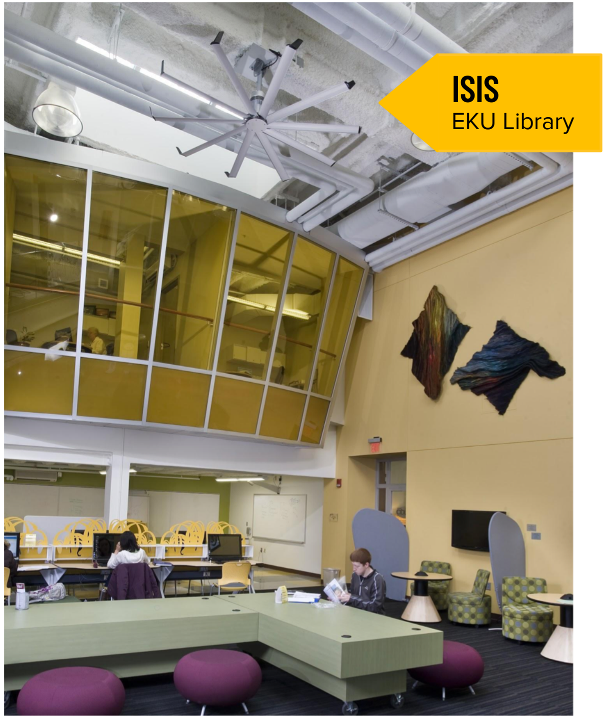




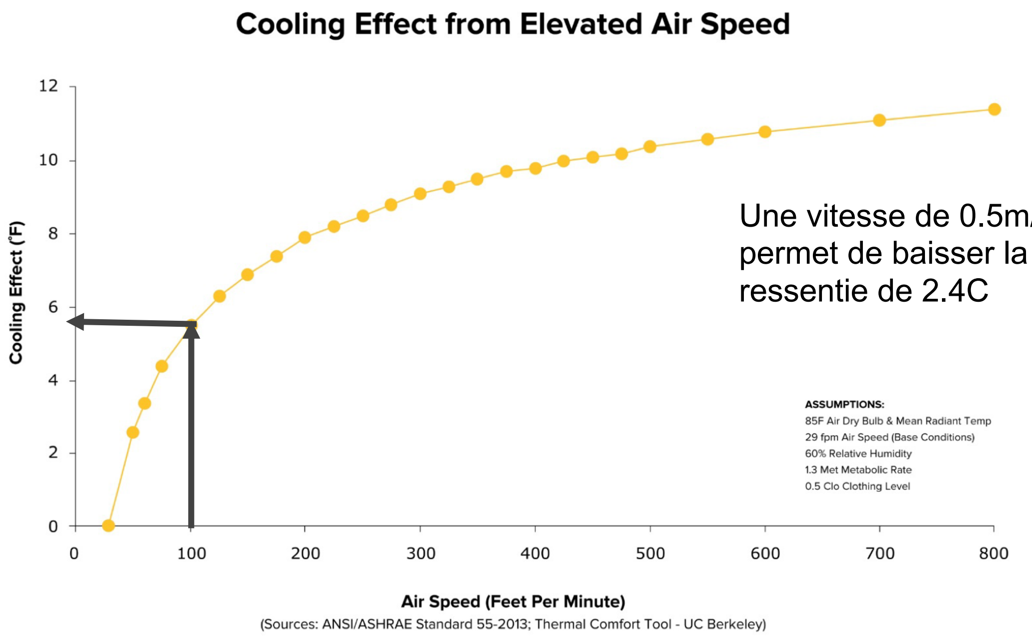
ETUDE DE CAS : RAFRAICHISSEMENT ERP

BIBLIOTHEQUE (Los Angeles)

- Caractéristiques:
  - Sensibilité au bruit
  - Sensibilité à la vitesse de l’air
  - Plafonds hauts
- Objectifs prioritaires:
  - Empreinte carbone
  - Stratification en hiver
  - Limiter l’usage du climatiseur



CONFORT D'ETE



Une vitesse de 0.5m/s permet de baisser la T° ressentie de 2.4C

BIBLIOTHEQUE: OPTION 1

Solution: “Clim classique”

300 m^2

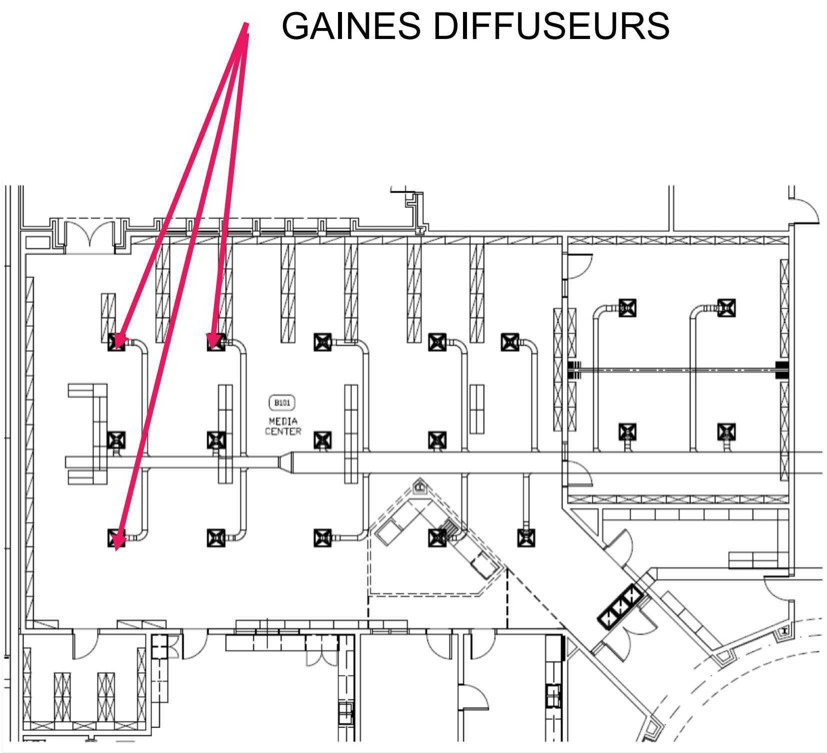
4.5 HSP

Paramétrage:

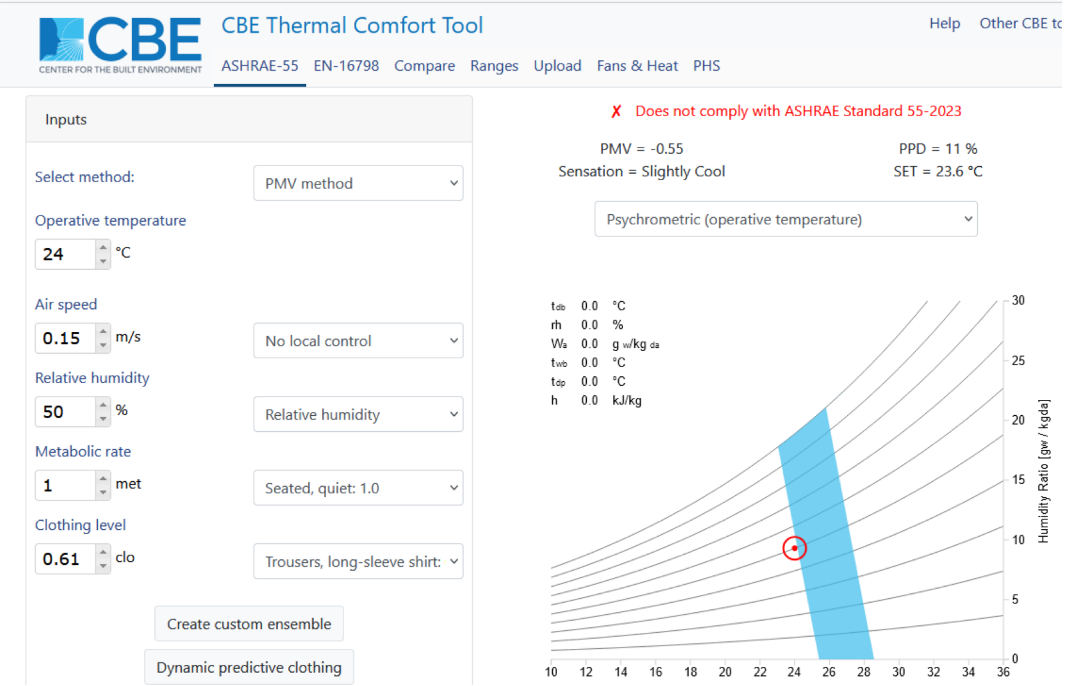
24 °C refroidissement

Investissement brut:

65€/m^2

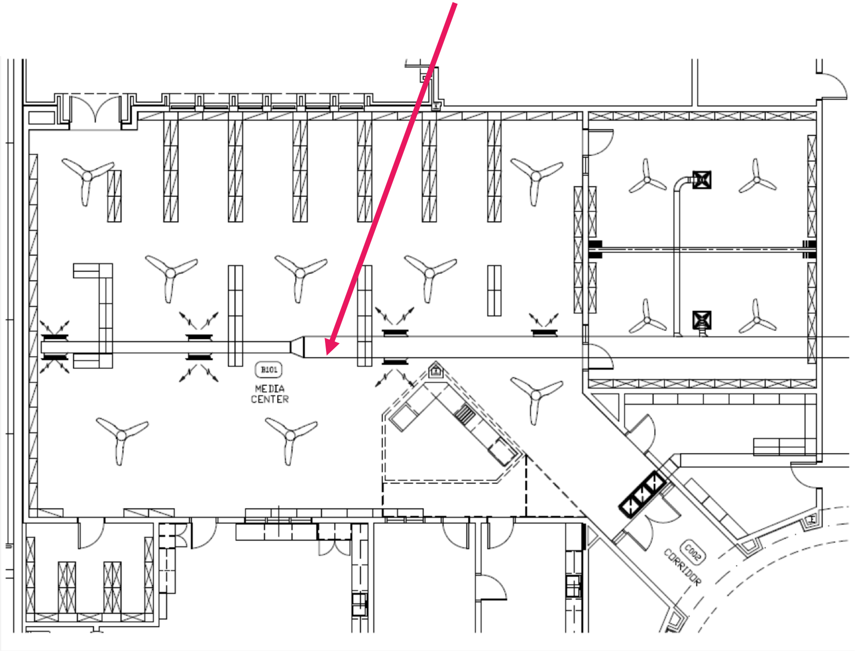


BIBLIOTHEQUE: OPTION 1



BIBLIOTHEQUE: OPTION 2

Seule la gaine centrale est maintenue



Solution: Vitesse d'air élevée

300 m^2

4.5 HSP

Paramétrage:

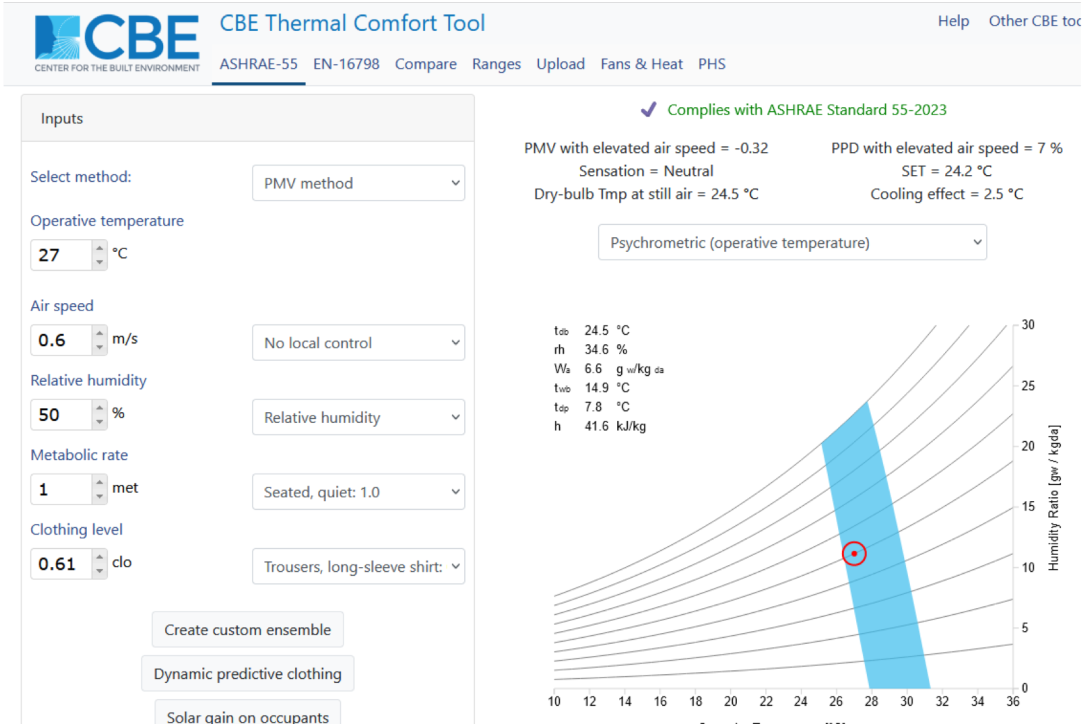
26 °C refroidissement

24°C ressenti

Investissement brut:

61€/m^2

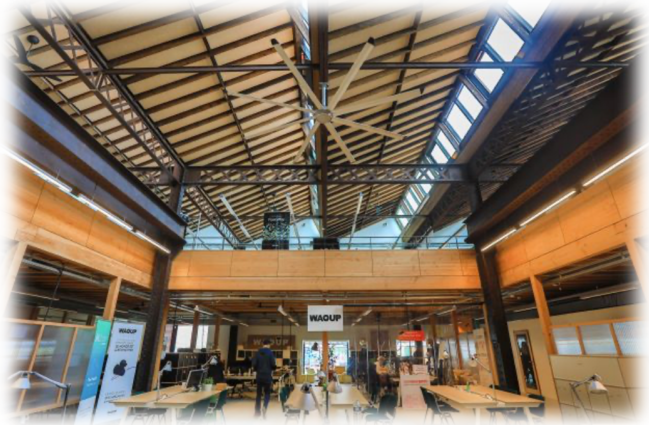
BIBLIOTHEQUE: OPTION 2



BIBLIOTHEQUE: COMPARAISON

Poste	Variation
Investissement et installation	- 6%
Consommation climatisation	- 24%
Coût d’entretien annuel clim	- 9%

Modèles pour ERP



Synthèse rafraîchissement hybride

- Economie sur la consommation de la climatisation et baisse empreinte carbone
- Economie sur l’entretien de la climatisation et augmentation durée de vie
- Baisse de l’over-cooling et gestion individuelle de la T° de confort
- Limitation du ‘choc thermique’
- Economie sur l’investissement au départ : moins de gaines
- Amélioration de la qualité de l’air : moins de risques de voir des saletés bactéries microbes s’installer dans les gaines, meilleure circulation de l’air dans le volume traité

- Challenge : réintroduire une ancienne technologie

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