

ALTERNATIVE COOLING TECHNOLOGIES

ACTS

*Accelerating Our Transition Towards
A Low-Carbon Built Environment*

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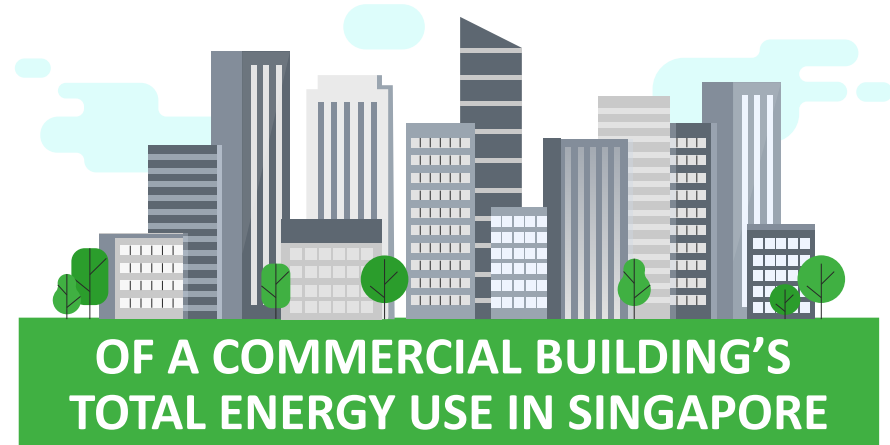
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Cooling Singapore: Why The Future Needs A New Approach

DID YOU KNOW
THAT COOLING ALONE ACCOUNTS FOR
MORE THAN 50%



Every year, inefficient cooling systems cause buildings to lose hundreds of thousands of dollars in avoidable energy spend, often without owners noticing. Most buildings overspend simply because their cooling runs harder than necessary.

Given Singapore's year-round heat and humidity, effective cooling is not a luxury—it's a critical necessity. As our city grows, so will the demand for comfortable spaces.

For many Singaporeans, sustainability feels like something only large organisations can act on. But the truth is, real change starts with the decisions made by building owners, developers, and designers. Cooling systems chosen today will shape Singapore's energy footprint for the next decades.

THE GOOD NEWS?

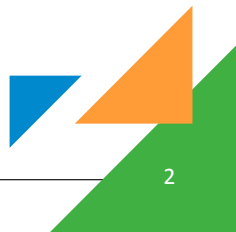
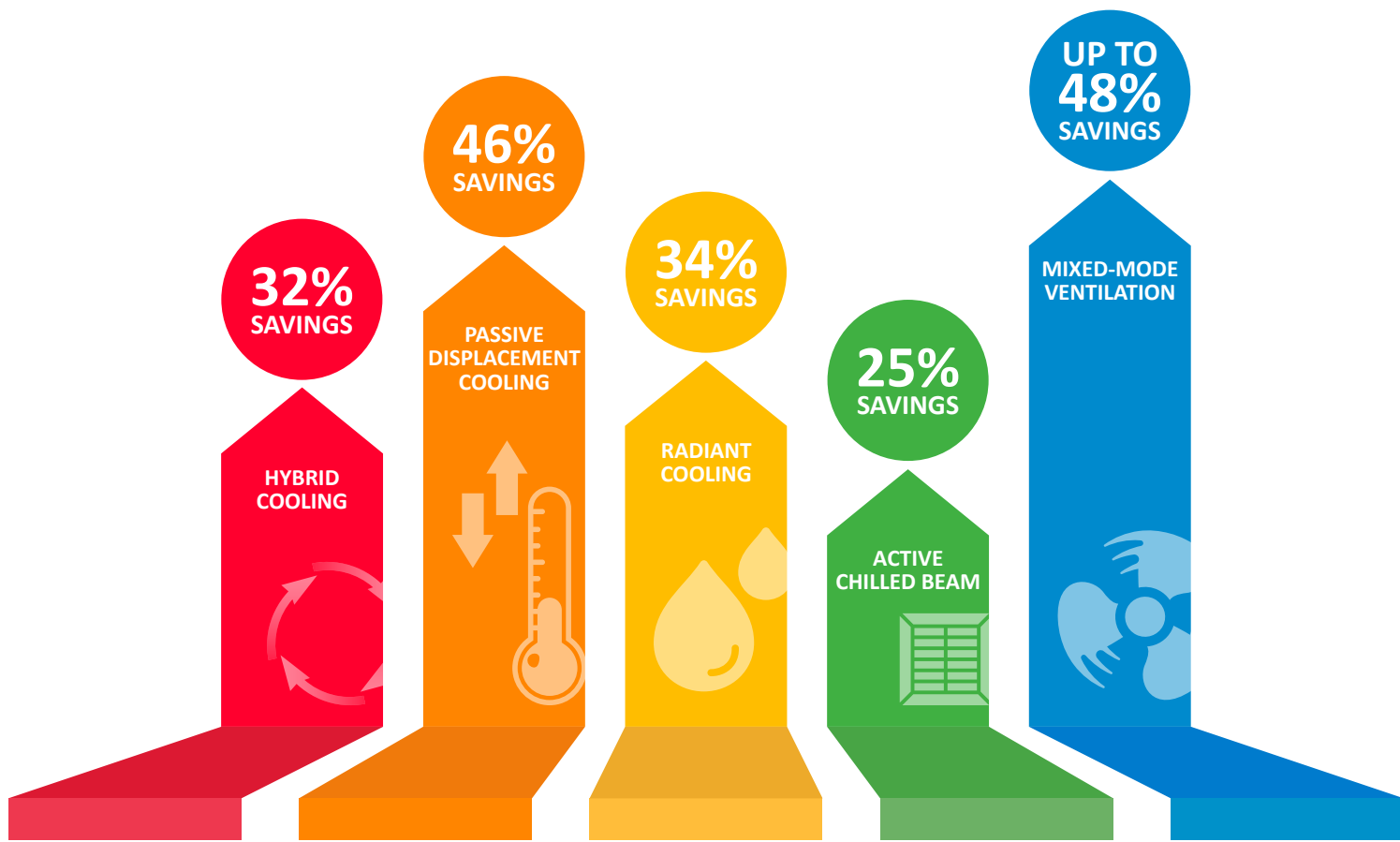
A new generation of cooling solutions known as the **Alternative Cooling Technologies (ACTs)** is already transforming how buildings stay cool. These technologies offer up to 48% energy savings while maintaining excellent indoor comfort and are already being adopted in forward-looking developments.

Singapore's Green Building Masterplan has set bold targets for 2030. To meet them, cooling must evolve, and ACTs are a practical, tested way forward. They balance sustainability, comfort, and operational efficiency.

This handbook introduces these ACTs in a clear, visual, and easy-to-understand way, so you can make informed choices that benefit both building owners and users.



ACTs Have Achieved Energy Savings Of **UP TO 48%** In Actual Building Applications



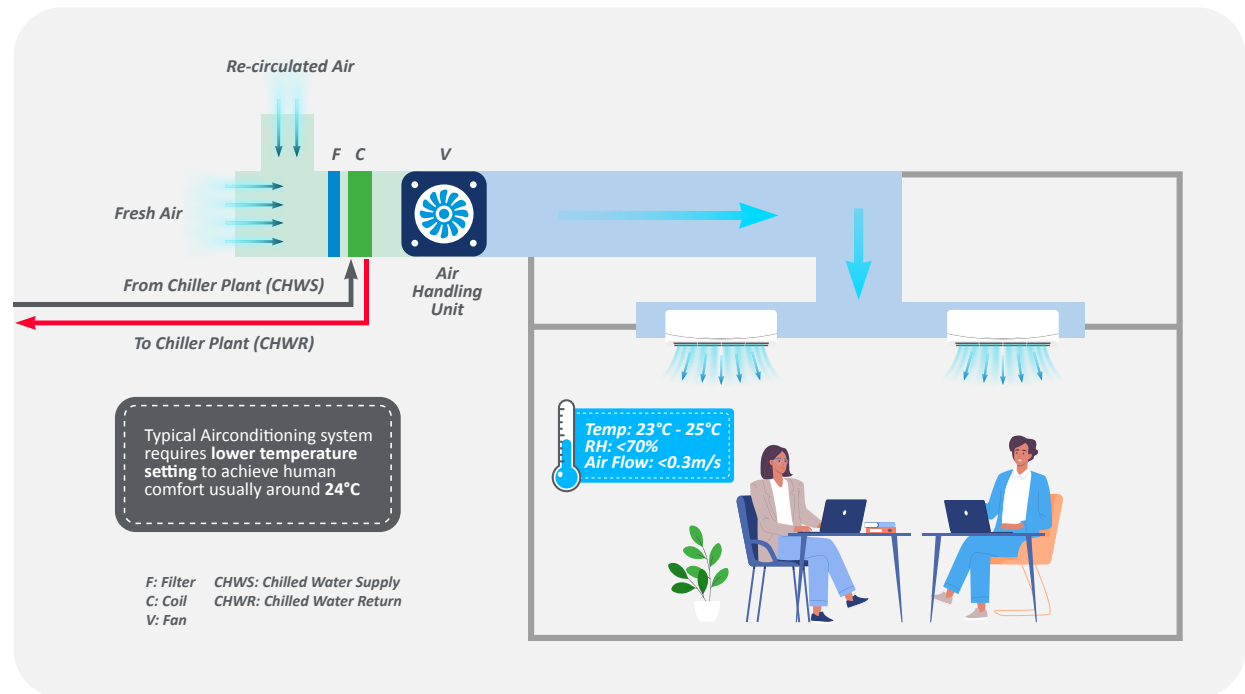
A Simpler, Smarter Way To Cool Singapore

ACTs are alternative methods of cooling indoor spaces that use less electricity and have a lower environmental impact compared to conventional air-conditioning systems.

ACTs move away from traditional ceiling-ducted air systems that rely heavily on air-handling units or fan coil units with variable air volume (VAV) systems. Instead, they use strategies such as higher temperature setpoints, natural airflow, radiant surfaces, or hybrid systems to deliver the same level of thermal comfort with significantly lower energy use.

ACTs reduce noise and overcooling, which in turn support better occupant well-being and a more stable, conducive atmosphere for work and daily activities. This creates healthier, more comfortable, and productive indoor environments.

In short, ACTs are: Energy-efficient, thermally comfortable, and environmentally friendly alternatives to regular air-conditioning, designed to keep people comfortable while using far less energy.

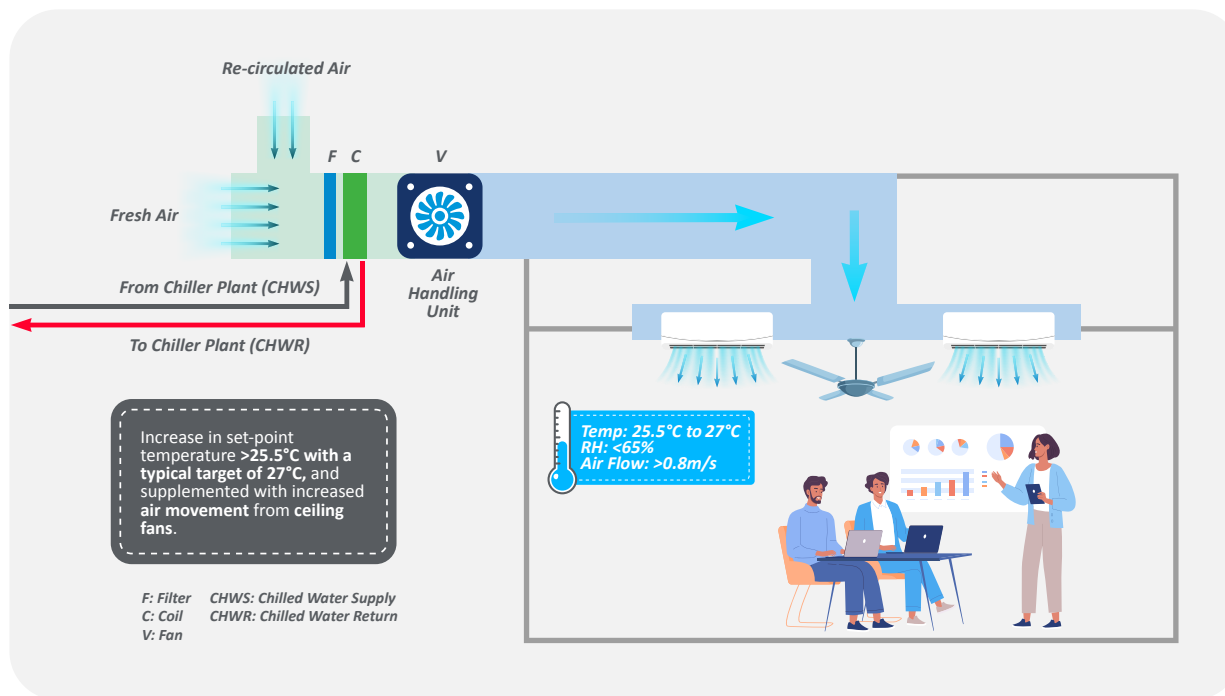


Typical Airconditioning System Set-up

ACT Solutions

There are several types of ACTs, each designed to improve cooling efficiency while maintaining comfort. These solutions work in different ways, from enhancing air movement to using natural airflow, radiant surfaces, or smarter ventilation modes. Together, they offer practical pathways for buildings to reduce energy use without compromising indoor comfort.

The following section introduces five ACT solutions applicable for tropical climatic condition such as Singapore, explaining how these solutions work and showing real examples of where they have been successfully implemented.



Hybrid Cooling System Set-Up

Hybrid Cooling System

Hybrid Cooling System operates at higher indoor temperature set-points, using increased air movement to preserve comfort. Instead of maintaining strict temperatures at 23–24°C, it typically operates within a 25.5°C to 27°C range.

CDL Office@Republic Plaza



Building Name	Republic Plaza
Building Owner	City Developments Limited
Green Mark Rating	GM 2021 Platinum SLE

As part of CDL’s commitment to climate action and low-carbon innovation, CDL has adopted 25°C as its indoor temperature standard across its corporate office at Republic Plaza – balancing energy efficiency with occupant comfort. In support of this, CDL introduced 111 bladeless Hybrid Cooling Fans equipped with vortex technology to enhance airflow and ensure thermal comfort, while reducing reliance on energy-intensive air-conditioning. This initiative, implemented within its corporate office premises, which occupies four floors at Republic Plaza, is estimated to reduce cooling load by up to 10%.

CDL have also piloted the integration of these Hybrid Cooling Fans into the ceiling design at the lift lobbies of its corporate office floors at Republic Plaza and are exploring the expansion to common lift lobbies throughout the building.

To complement this, CDL also implemented a business casual dress code policy in October 2024 to facilitate ease of transition and maintain thermal comfort with the new hybrid cooling fans which were fully installed in April 2025. CDL is encouraged that its recent staff survey showed strong support where 85% of respondents shared that with the new fans and dress code, they continue to feel thermally comfortable at 25°C, affirming the effectiveness of this holistic approach.

Other buildings with Hybrid Cooling now deployed in

- Blk A @ BCA Braddell Campus
- Hotel Ora
- JTC Summit
- Kajima Office @55 Market Street
- Mandai Rainforest Resort
- MAS Building
- MND Complex
- SDE 1, 3 & 4 @ NUS
- Singapore American School (Elementary)
- Takeda Manufacturing Support Building
- Temasek Shophouse
- The Treasury

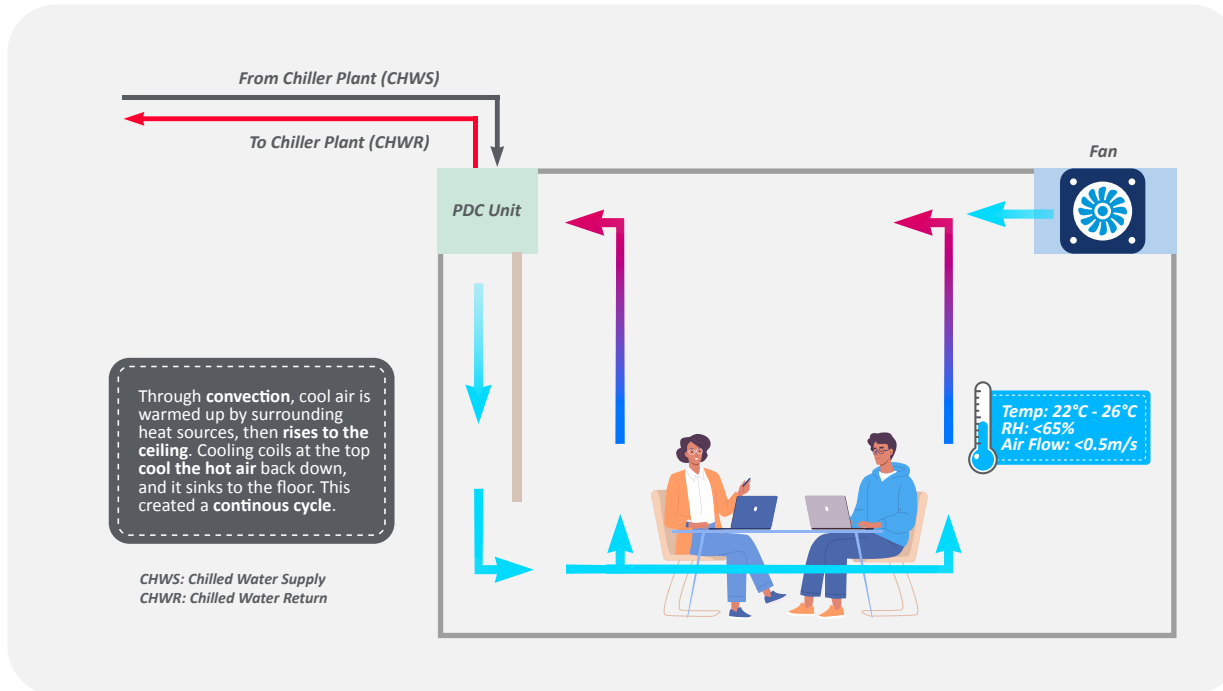
How it works

- Air movement is increased using ceiling or personal fans to counter warmer air
- This helps the body release heat more easily through the skin
- As a result, the body cools faster, heat strain is reduced, and the space feels cooler and more comfortable

Benefits

- High potential for energy savings due to lower cooling demand
- Customisable comfort with fans
- Widely applicable to many building types





Passive Displacement Cooling System Set-Up

Passive Displacement Cooling (PDC)

We all know the simple principle: Hot Air Rises, Cool Air Sinks.

Passive Displacement Cooling (PDC) System uses this natural behaviour to move air through a space without relying on strong mechanical fans.

PSA Tuas Maintenance Base Admin Building



The PSA Tuas Maintenance Base Admin Building wanted a cooling approach that worked with natural airflow rather than against it. By adopting PDC, the building became a live example of how cool air delivered gently at floor level can quietly and efficiently transform comfort in a workspace.

By letting cool air do the work naturally, the building achieved 46% savings in cooling energy compared to a traditional AHU system, proving that a low-airflow approach can deliver both comfort and efficiency.

Other examples of building with Passive Displacement Cooling:

- MOM Service Centre
- Blk D and Blk E@BCA Braddell Campus
- The Hive & The Wave@NTU
- SMU Connexion
- Dulwich College
- JTC Summit

Building Name	PSA Tuas Maintenance Base Admin Building
Building Owner	PSA Corporation Ltd
Architect	ID Architects Pte Ltd
Mechanical and Electrical (M&E) Consultant	PDC Consulting Engineers Pte Ltd
Environmentally Sustainable Design (ESD) Consultant	GreenA Consultants Pte Ltd
Green Mark Rating	GM 2021 Platinum SLE

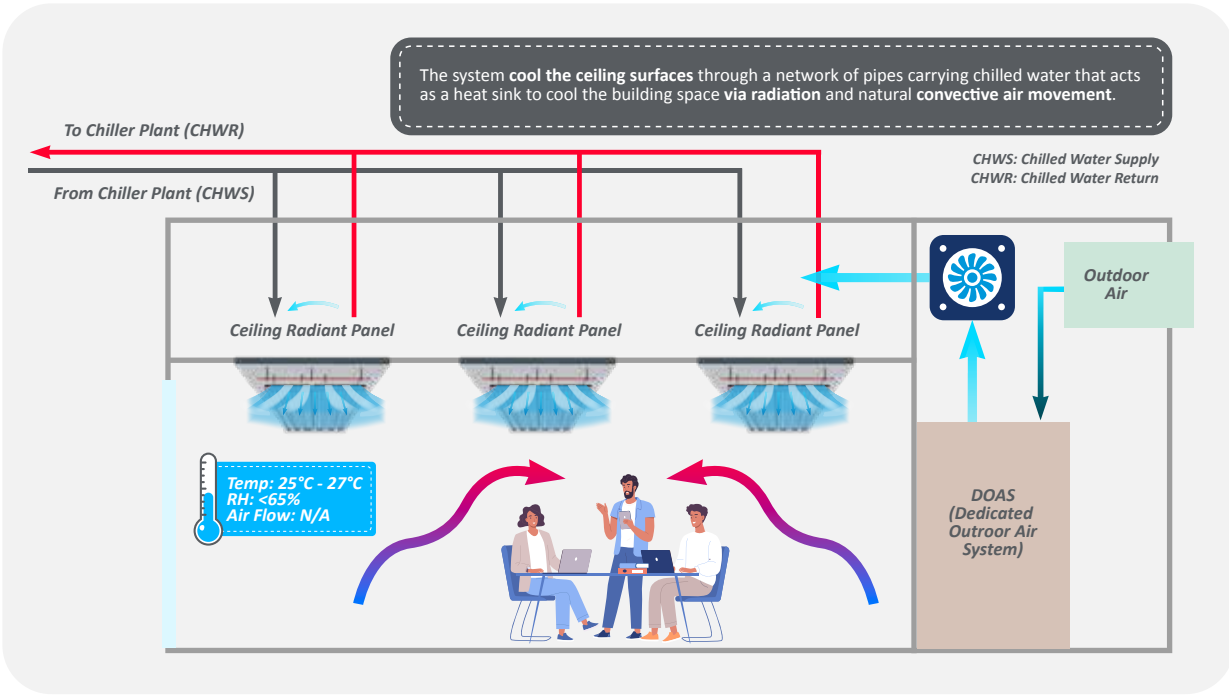
How it works

- PDC uses the natural rise of warm air to circulate and refresh a space, offering an energy-efficient alternative to forced-air systems
- Air from the cooling coils sinks to the floor, removing heat as it goes
- Warm air rises back to the PDC cooling coil naturally, aided by buoyancy

Benefits

- No fan energy needed to supply cooling from air-conditioning system
- Free from undesirable draft, vibration and noise
- No condensation risk since drain pan are integrated with cooling coil





Radiant Cooling System Set-Up

Radiant Cooling

Heat naturally moves from warmer objects to cooler surfaces. Radiant Cooling System removes heat from indoor spaces by circulating chilled water through panels, pipes, or surfaces, absorbing heat and keeping surface temperatures below the room temperature.

ZEB Plus Office (Level 2), Block A@BCA Braddell Campus



Radiant cooling panels were introduced to create a quieter and more comfortable workspace. Instead of blowing large volumes of cold air, the system cools the room through chilled ceiling panels, allowing heat to be absorbed naturally and reducing the need for strong mechanical airflow.

The system delivered notable performance, achieving approximately 34% savings in cooling energy. This demonstrated how radiant surfaces can effectively maintain comfort while lowering overall cooling demand.

Other example:

- Energy Research Institute@NTU (CleanTech One)

How it works

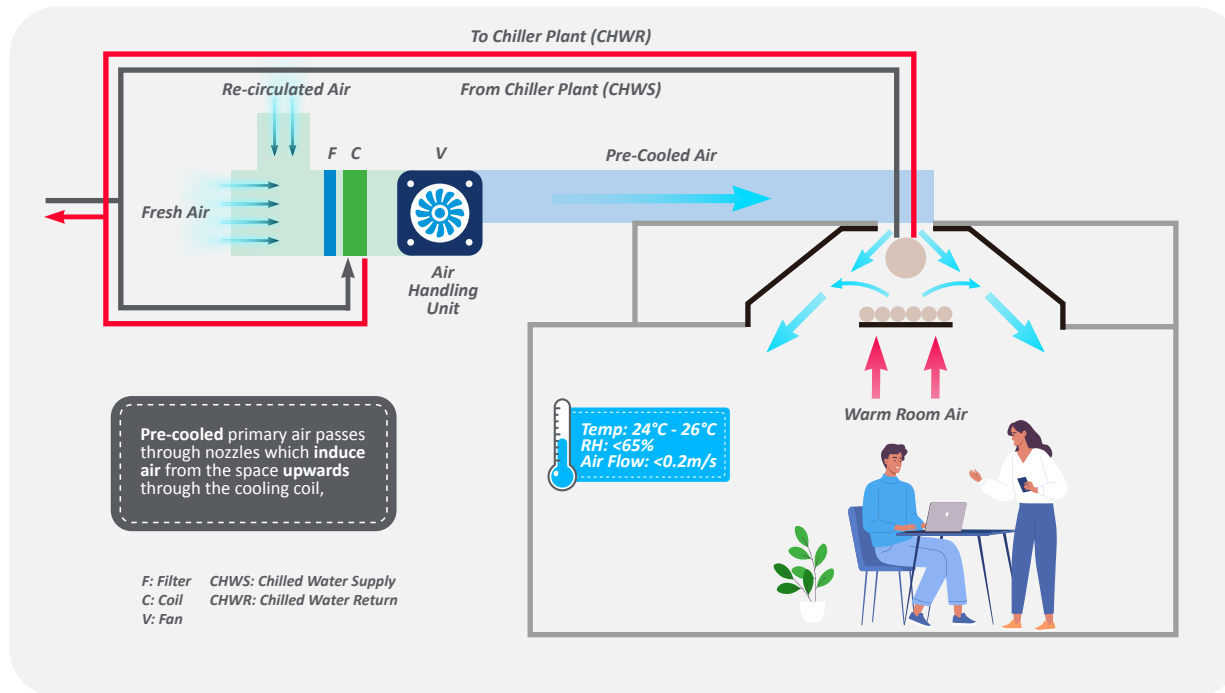
- Heat naturally moves from warmer objects and people to the cooler surfaces, similar to feeling cool near a cold window
- Heat is also removed as air near the cool surfaces becomes denser, creating gentle air movement

Benefits

- Very high energy efficiency as water is a much more effective heat transfer medium than air
- Silent, low-airflow comfort
- Less mechanical space required

Building Name	ZEB Plus Office (Level 2), Block A@BCA Braddell Campus
Building Owner	Building and Construction Authority
Architect	KAIA Architects
Mechanical and Electrical (M&E) Consultant	CCA & Partners Pte Ltd
Environmentally Sustainable Design (ESD) Consultant	Building and Construction Authority
Green Mark Rating	GM HW 2018 Platinum





Active Chilled Beam

Active Chilled Beam systems provide both cooling and ventilation to indoor spaces through specially designed ceiling-mounted units called chilled beams.



Shaw Tower@100 Beach Road



For the newly redeveloped Shaw Tower, active chilled beams (ACB) were selected to meet the stringent energy efficiency targets required for BCA Green Mark Super Low Energy Building (SLEB) certification. Since air-conditioning accounts for over a third of office building electricity consumption, the design team adopted a hybrid approach combining ACBs in perimeter zones with VAV air handling in interior areas, offering the lowest life cycle cost whilst achieving energy targets and providing elegant aesthetics.

The ACB system delivers substantial energy savings by using minimal conditioned primary air to induce larger volumes of room air over chilled water coils, requiring 50-70% less ducted air than traditional systems. Operating with warmer chilled water (15°C to 19°C), the Shaw Tower’s cooling system is projected to achieve 50% energy savings compared to buildings meeting minimum code requirements, whilst providing superior thermal comfort and requiring minimal maintenance.

Active Chilled Beam has also been deployed in:

- NUS University Town (CREATE Building and Education Resource Centre)
- Labrador Tower
- Paya Lebar Green South

Building Name	Shaw Tower
Building Owner	Shaw Towers Realty Pte Ltd
Architect	Aedas Pte Ltd
Mechanical and Electrical (M&E) Consultant	Beca Carter Hollings & Ferner (S.E. Asia) Pte Ltd
Environmentally Sustainable Design (ESD) Consultant	Beca Carter Hollings & Ferner (S.E. Asia) Pte Ltd
Green Mark Rating	GM 2021 Platinum SLE

How it works

- The system has chilled beams with cooling coils that circulate chilled water (usually 14–16°C)
- High-speed air from a central unit is sent through nozzles in each beam
- This airflow pulls room air over the chilled coils, cooling it before it returns to the space

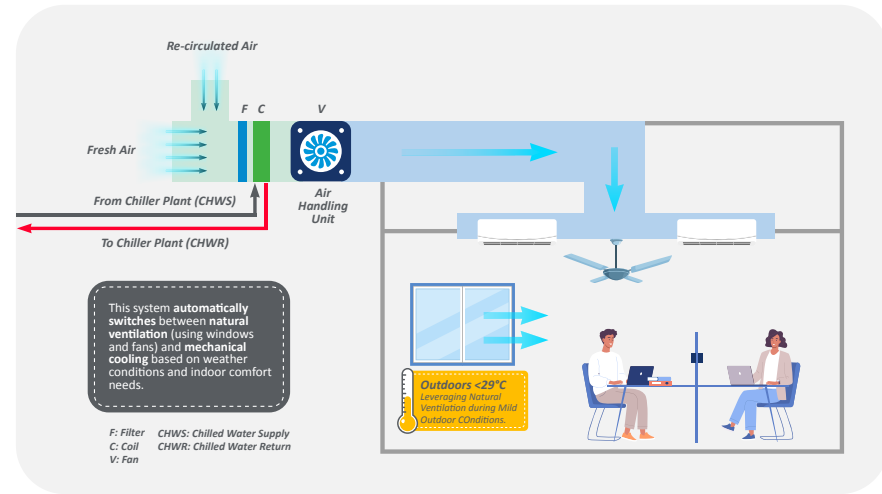
Benefits

- Water-based cooling = higher efficiency
- Minimal ductwork needed
- Low noise, consistent comfort
- Requires less ductwork than conventional systems, saving ceiling space.

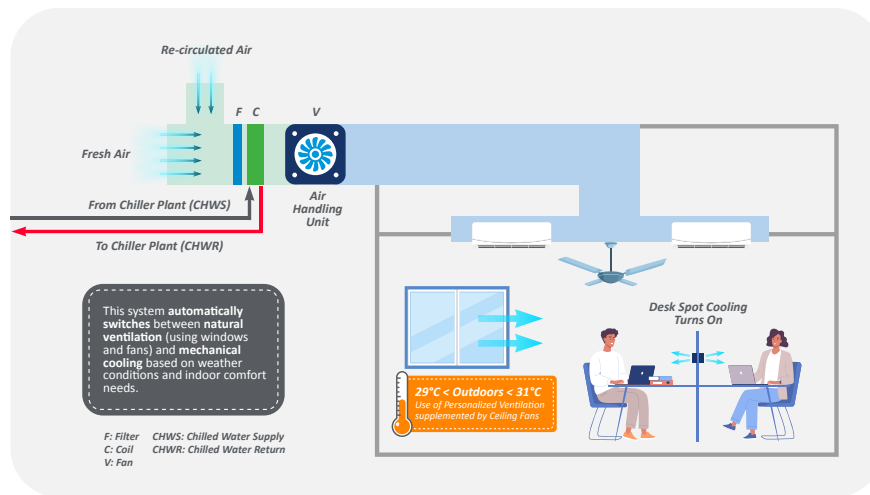


Block E (SLE)@BCA Braddell Campus

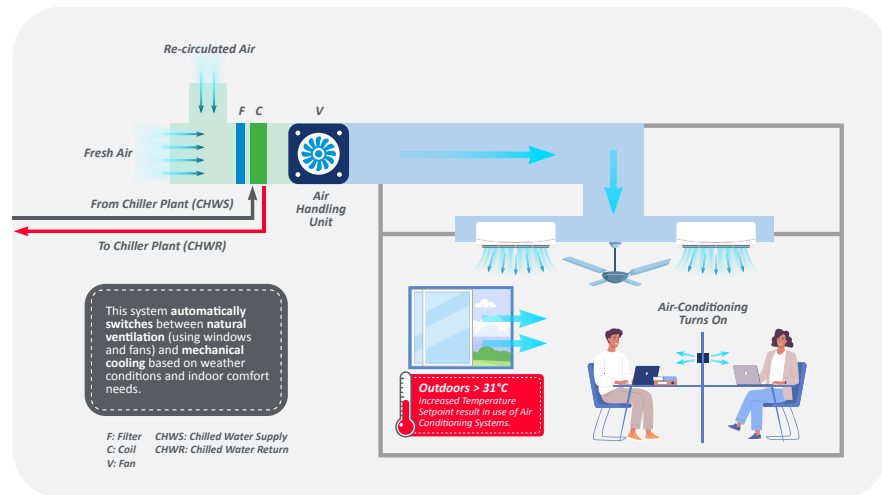
Mixed-Mode Ventilation allows for smart switching between natural ventilation and mechanical ventilation systems to optimize indoor air quality, thermal comfort, and energy efficiency.



Mixed Mode Ventilation (MWV) System (Fan-Assisted Natural Ventilation)

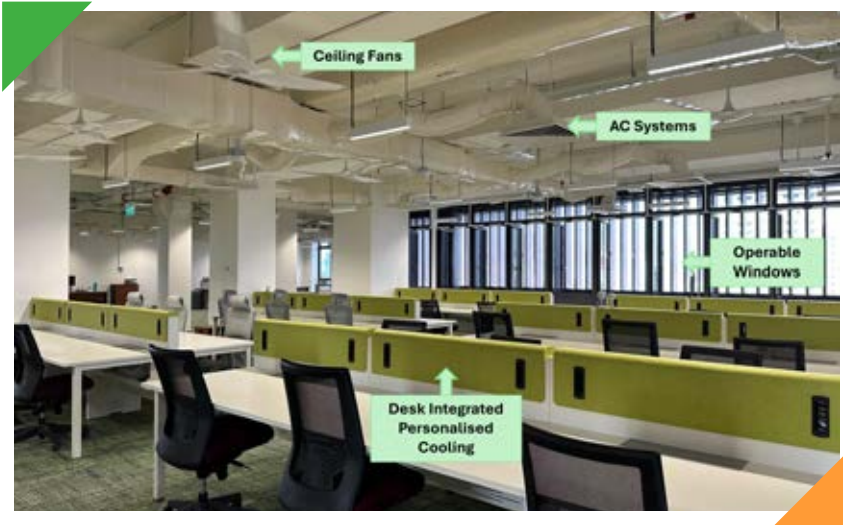


Mixed Mode Ventilation (MWV) System (Desk Spot Cooling)



Mixed Mode Ventilation (MWV) System (Desk Spot Cooling)

Block E (SLE)@BCA Braddell Campus



Mixed-Mode Ventilation was introduced to allow the workspace to adapt naturally to changing outdoor conditions. By combining operable windows, ceiling fans, desk spot-cooling, and air-conditioning, the system automatically shifts between natural ventilation and mechanical cooling. This creates a flexible environment that maintains comfort while reducing unnecessary energy use.

Testbedding result at BCA Braddell Campus showed promising outcomes, achieving a 48% reduction in cooling energy compared to a similar office at SDE4@NUS. This demonstrated how switching intelligently between different ventilation modes can deliver substantial savings without compromising comfort.

Other building type to be considered for upcoming testbedding includes school and healthcare.

How it works

Mixed-Mode Ventilation operates through three modes, depending on outdoor weather conditions:

- **Natural Mode** – When outdoor conditions are favourable (mild temperatures, good air quality), the building uses natural ventilation, relying on open windows and ceiling fans while mechanical systems stay off or run minimally.
- **Mechanical Mode** – When outdoor conditions are unsuitable (hot weather, poor air quality, insufficient wind), the system shifts to mechanical cooling to maintain comfort and air quality.
- **Mixed Mode** – When conditions are in-between, both natural and mechanical systems work together. This ensures comfort while reducing the need for full mechanical cooling.

This allows the ventilation system to continually optimize comfort and energy use by selecting the mode most suited to the prevailing environment.

Building Name	Block E (SLE)@BCA Braddell Campus
Building Owner	Building and Construction Authority
Tenant	Azendian Solutions Pte Ltd
Project Lead	National University of Singapore
Project Collaborator	Singapore Institute of Technology Kajima Corporation Surbana Jurong Consultants Pte Ltd







Summary: What This Means For Building Owners





Energy Savings, Better Comfort, Future Readiness

As Singapore works toward a more energy-efficient and climate-resilient built environment, the role of smarter cooling becomes increasingly important. Buildings that adopt ACTs are not only reducing their energy use today but are also preparing themselves for future operational demands, rising temperatures, and stronger sustainability expectations from tenants, investors, and regulators

Buildings of the future will be:

- ✓ Cooler 
- ✓ More energy-efficient 
- ✓ More cost-effective to operate 
- ✓ Better for people and the environment 

ACTs Help You Achieve:

- ✓ Up to 48% cooling energy savings 
- ✓ Improved long-term operational efficiency 
- ✓ Better comfort and ventilation 
- ✓ Alignment with Singapore's Green Building Masterplan 



Most importantly, you don't have to sacrifice comfort to be sustainable. ACTs show that both can co-exist and that smarter cooling is already possible today.

Solutions	Best For	Energy Savings	Noise Level	Key Benefits	Sites Implementing This Solution
Hybrid Cooling	Offices, Classrooms	25 – 35%	Low	Easy to implement in existing buildings	ZEB Plus@BCA Braddell Campus. SDE1,3 &4@NUS
Passive Displacement Cooling	High ceiling spaces, Offices	40 – 50%	Silent	No fan energy required	PSA Tuas, NTU
Radiant Cooling	Offices, Labs	25 - 30%	Silent	High efficiency	ERIAN Office@Cleantech One ZEB Plus@BCA Braddell Campus
Active Chilled Beam	Classrooms, Offices	20 - 65%	Low	Less ductwork	CREATE Building@NUS Shaw Tower, Labrador Tower
Mixed-Mode Ventilation	Offices, Institutional Buildings	48%	Low	Maximises Natural Airflow	Block E(SLE)@BCA Braddell Campus

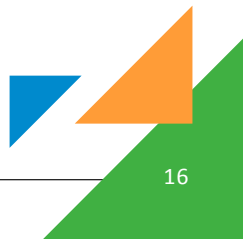
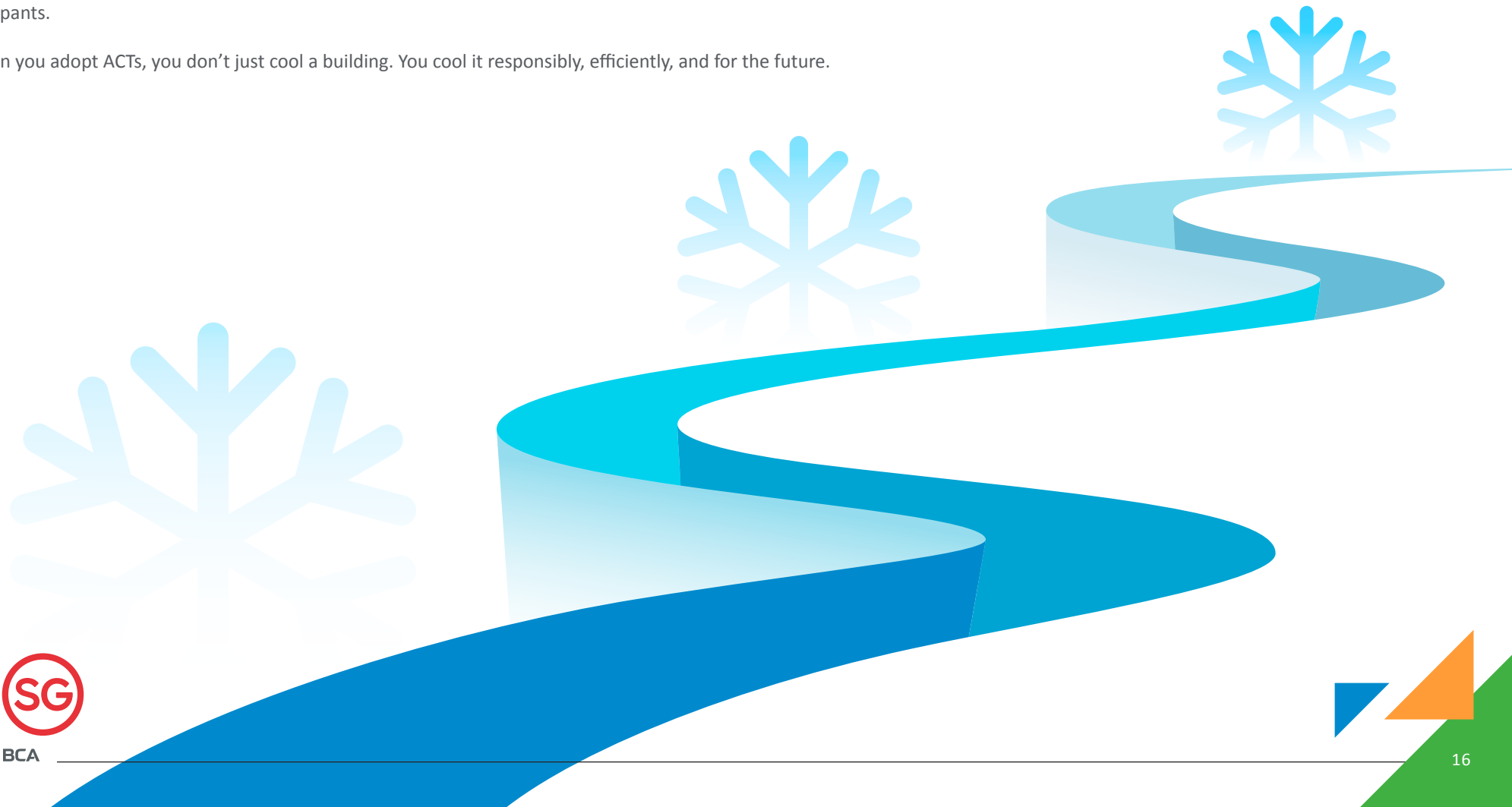


A Cooler Path Forward

Singapore’s journey towards a low-carbon built environment requires bold steps, not just from individuals, but from building owners, developers, and professionals who shape the spaces we live, work, and play in.

Adopting Alternative Cooling Technologies is one of the most impactful ways to contribute to this change. Because every building that chooses to cool smarter helps reduce Singapore’s overall energy use, lowers carbon emissions, and improves the experience for its occupants.

When you adopt ACTs, you don’t just cool a building. You cool it responsibly, efficiently, and for the future.



References

Click on any of the reference below for more detail and to get a copy of the document

- SS 530:2024 Code of practice for energy efficiency for building services and equipment [Singapore Standards](#)
- SS 553:2026 Code of practice for air-conditioning and mechanical ventilation in buildings [Singapore Standards](#)
- SS 554:2026 Code of practice for indoor air quality for air-conditioned buildings [Singapore Standards](#)
- TR 102:2022 Code of practice for passive displacement cooling (PDC) for air-conditioning application [Singapore Standards](#)
- TR 141:2025 Hybrid cooling system for air-conditioning [Singapore Standards](#)

SS - Singapore Standard; TR - Technical Reference





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