HOW TO BUILD A SMART AND EFFICIENT AIR-CONDITIONING SYSTEM

Smart air-conditioning systems help reduce energy bills and keep indoor air quality in buildings and homes clean and safe. These smart air-conditioning systems are energy efficient, disease resilient, and climate friendly.

Key Takeaways

1. The Asian Development Bank (ADB) is piloting an energy-efficient and disease-resilient smart centralized air-conditioning system.

2. Collaboration and innovation help make smart air-conditioning systems a widespread reality, fostering healthier, more efficient indoor environments.

3. Building a smart air-conditioning system requires (i) optimizing energy efficiency, (ii) maintaining indoor air quality, (iii) using climate-friendly refrigerants, and (iv) leveraging smart technologies.

Upgrading Air-Conditioning Technology

In September 2020, ADB initiated a program to implement disease-resilient and energy-efficient centralized air-conditioning systems for its developing member countries.

The program explored the application of smart technologies and flexible components in the design of air-conditioning systems. This smart air-conditioning system is now being piloted in Sri Lanka.

> *By adopting a holistic approach that combines architectural design, advanced technologies, and efficient systems, buildings can become more energy-efficient and environmentally responsible.*
>
> David Morgado
> Senior Energy Specialist, ADB

Building a Smart Air-Conditioning System

In building a smart air-conditioning system, the design focused on four major factors:

1. Optimizing energy efficiency in specific buildings
2. Maintaining indoor air quality for disease resilience
3. Using climate-friendly refrigerants
4. Leveraging on advanced digital technologies

Optimizing energy efficiency. Optimizing energy efficiency requires thorough knowledge and familiarity with the building's architecture, informed by climate considerations of the specific building location. Consulting with professionals, and considering local regulations and incentives can help make informed decisions to optimize energy efficiency in smart air-conditioning systems. The most effective approach to improving energy efficiency considers the climate, building design, and specific cooling requirements of a given location. To optimize energy efficiency:

- Ensure that the air-conditioning system components are appropriately selected, designed, and sized for the building and climate zone.
- Implement variable speed components, such as in pumps and compressors, that vary cooling delivery based on needs, operating at lower speeds when the demand is lower. This results in better energy efficiency and more precise temperature control.
- Introduce zoned cooling within the building. Building zones with independent thermostats allow for more precise control over cooling in specific areas and prevent overcooling of unused spaces.
- Choose high efficiency systems that provide the same cooling output. Typical metrics that indicate efficiency of air-conditioning systems are energy efficiency ratio, seasonal energy efficiency ratio, and the coefficient of performance.
- Adopt energy recovery systems that help maintain good indoor air quality. These systems exchange heat and moisture between incoming and outgoing air, ensuring fresh air while retaining temperature and humidity levels.




Maintaining indoor air quality and achieving disease resilience. Designing and operating air-conditioning systems with disease resilience and indoor air quality in mind requires a multidisciplinary approach, involving engineers, architects, building owners, and health experts. Maintaining good indoor air quality involves a combination of proper design, building practices, ventilation strategies, and ongoing maintenance. Implementing these strategies will help create indoor environments that prioritize the health and well-being of occupants, particularly during times of disease outbreaks. To maintain indoor air quality to prevent disease transmission:

- Minimize or eliminate indoor sources of pollutants, such as tobacco smoke, volatile organic compounds from cleaning products and furnishings, and emissions from building materials.
- Adopt high-efficiency air filtration systems, active or passive, to capture particles like dust, pollen, and allergens, improving indoor air quality. Regular filter maintenance is necessary to ensure their effectiveness.
- Ensure proper ventilation to bring in fresh outdoor air and remove indoor pollutants. Mechanical ventilation systems can help maintain adequate air exchange rates.
- Ensure sufficient clean outdoor air supply. Minimize air recirculation to limit the potential for disease transmission. Proper airflow patterns prevent the recirculation of contaminated air within indoor spaces.
- Maintain appropriate indoor humidity levels (typically between 30% and 60%) to help prevent mold growth and dust mites. Humidity control also contributes to occupant comfort and prevents respiratory issues.
- Ensure air-conditioning systems are well-maintained, including cleaning ducts and changing filters. Inspect for any issues that could affect air quality and energy use.

Using climate-friendly refrigerants. Opting for refrigerants that minimize greenhouse gas emissions and ozone depletion will not only mitigate climate change but also ensure a healthier, more sustainable future.

- Improve the design of cooling systems to minimize the use of refrigerants.
- Use eco-friendly refrigerants with lower environmental impacts, zero ozone depletion potential, and very low global warming potential, compared to traditional options like chlorofluorocarbons and hydrochlorofluorocarbons.
- Reduce leaks in air-conditioning systems.
- Recover, recycle, reclaim, and properly dispose of refrigerants to minimize environmental impact.

Leveraging on advanced digital technology. Smart air-conditioning systems leverage advanced technologies and connectivity to enhance the efficiency, comfort, and control of indoor climate management. These systems utilize sensors, automation, and remote-control capabilities to provide more precise and user-friendly cooling solutions. Choose a smart air-conditioning system that aligns with your specific needs and preferences.

- Adopt programmable thermostats that optimize energy usage based on occupancy patterns.
- Install air quality monitoring systems that can track pollutant levels.
- Use building automation and sensors to make air-conditioning systems adaptive to various conditions.



The Future of Air-Conditioning

The future of smart air-conditioning systems is poised to revolutionize indoor climate management, emphasizing energy efficiency, disease resilience, and smart technology integration. Initiatives like the one spearheaded by ADB pave the way for transformative developments, as evidenced by the ongoing pilot project in Sri Lanka.

Through collaborative efforts and a commitment to innovation, the vision of smart air-conditioning systems can become a widespread reality, fostering healthier, more efficient indoor environments.

THE PROJECT

Regional Support to Build Disease-Resilient and Energy-Efficient Centralized Air-Conditioning Systems

Supported under Technical Assistance 6563: Regional Support to Build Disease Resilient and Energy Efficient Centralized Air-conditioning Systems

Financed by:
Clean Energy Fund under the Clean Energy Financing Partnership Facility
and
High-Level Technology Fund

Visit our website for more information: https://www.adb.org/projects/54210-001/main

Primary image designed by Freepik. Additional images sourced from the documentation detailing the advancement of the ADB smart centralized air-conditioning systems project in Sri Lanka.