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Retrofit of Airconditioning to Improve Indoor Air Quality for Safety and Efficiency

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Indoor Air Quality And Energy Efficiency

Poor air quality has been a concern in India for quite some time and has become even more important in light of the COVID-19 pandemic. Polluted air causes problems for both people and the planet. Air pollution is the largest environmental killer, causing one in nine deaths world-wide. In developing countries, approximately eight million deaths are attributed to air pollution annually. It is now well established that poor indoor air quality in buildings causes health problems and general discomfort for occupants. 91% of the world's population, urban and rural, lives in places with air that does not meet World Health Organization (WHO) guidelines for key pollutants.

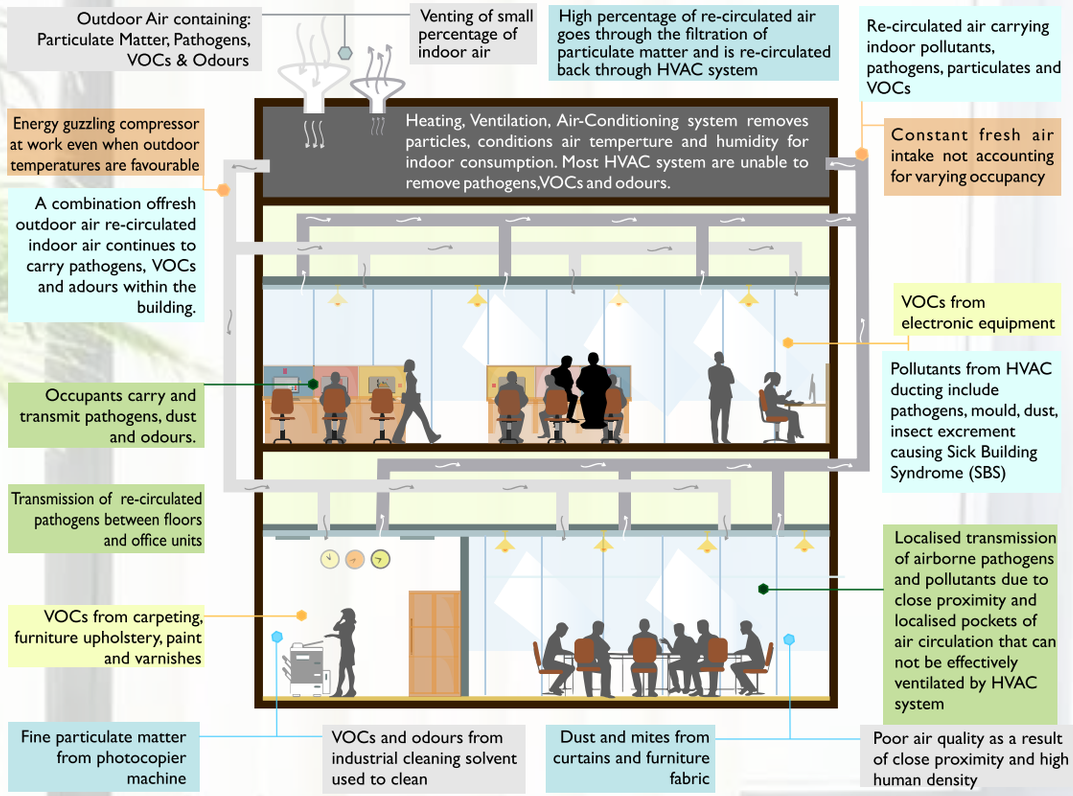
As people return to their offices and public spaces, maintaining good indoor air quality is essential for reducing pathogen spread and ensuring safety and well being of occupants. The concentration of pollutants inside the buildings can lead to problems like headaches, allergies, asthma, and other respiratory conditions.

New buildings need to factor this in at the design stage. Most existing buildings in India are not equipped to establish and maintain healthy indoor air quality and need to be upgraded. Such retrofit measures, like increasing outside air and additional filtration in the air conditioning system, typically come at the cost of therml comfort of occupants and increased energy use.

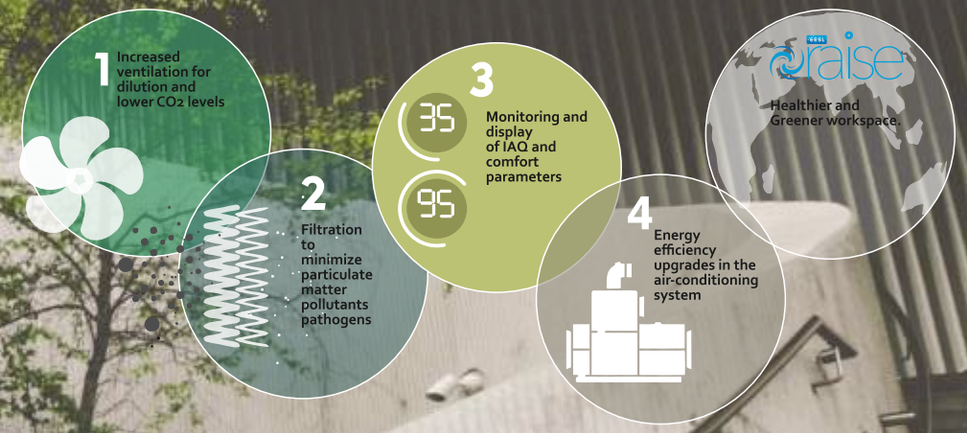
Good indoor air quality for a healthy environment:

1. Adequate ventilation with introduction and distribution of clean air.
2. Controlled contaminant and pathogens
3. Maintaining comfortable temperature and humidity levels

Factors effecting air quality in offices



As public buildings open up, retrofitting air conditioning systems that address COVID-19 is of paramount importance. It presents an opportunity to implement energy efficiency measures integrated with those for enhancing air quality. An integrated approach will ensure that the air-conditioning system contributes towards an improved air quality at lowered energy consumption.



Measures for Good Indoor Air Quality

Healthy And Energy Efficient Buildings Initiative

To address concerns about indoor air quality and energy efficiency, EESL, in partnership with U.S. Agency for International Development's (USAID) MAITREE program, has developed a program on ***Retrofit of Airconditioning to Improve Indoor Air Quality for Safety and Efficiency (RAISE)*** as a part of the Healthy and Energy Efficient Buildings initiative. This initiative is aimed at making workplaces healthier and greener. These retrofits will focus on enhanced indoor air quality (IAQ), thermal comfort, and energy efficiency (EE) in the air conditioning system.

Currently, there is no standardized approach to retrofitting for COVID-19 response. EESL corporate office in Scope Complex was implemented as a pilot to test the integrated approach. Based on the experience of the initial pilots, EESL has developed retrofit specifications, for nation-wide scale-up of this initiative. The pilots also helped with evaluating the effectiveness and cost benefits of various technologies including their short and long-term impacts on air quality, comfort, and energy use.

The key measures implemented in the retrofit approach are represented in the figure above.

Post pandemic, as public buildings open up, EESL is taking up the challenge of ensuring healthy and energy efficient buildings. RAISE aims at retrofitting existing buildings for both enhanced energy efficiency and indoor air quality. Centrally air-conditioned and public buildings, government and private hospitals, hotels, airports and metros, which must meet a high standard of air quality and resilience, need to be prioritized.

EESL has added RAISE to the range of other energy efficiency technologies that it offers as an Integrated Energy Efficiency Services Model (IEESM). The IEESM has demonstrated success by integrating various energy efficiency services together for a better value proposition along with reduction of transaction costs for the customer.

raise Approach

1 Integrated Energy Efficiency

Existing buildings often have air conditioning systems that are inefficient. An integrated energy efficiency approach would include upgrade of air conditioning systems such as air handing units, chilled water systems, etc for enhanced energy efficiency as well as cooling performance. Filtration technology would be selected to ensure that the cooling and energy performance of the air conditioning system is enhanced. The filter pressure drop would be designed to be as low as possible while maintaining the desired filtration efficiency. Some of the energy efficiency measures include:

a. Introduction of variable frequency drives and outside air economizers
b. Replacement or upgrading high-side air conditioning systems such as chillers and pumps.
c. Advance control for temperature and humidity
d. Measures to reduce fan static.
e. Integration of demand-controlled ventilation.

2 Increased Ventilation

Ventilation systems must consider the building's occupancy, design, and usage, to control the amount of outside air in order to dilutes the air and prevents the buildup of indoor pollution and pathogens. Sensor controlled automation of fresh air dampers will enable demand-controlled ventilation and increase outside air intake as required. Some of the retrofit measures for enhanced ventilation include:

a. Installation of new ventilation systems.
b. Pre-treatment of fresh air.
c. Installation of automated dampers.
d. Increase capacity of fresh air in central systems.

3 Enhanced Filtration

Enhanced filtration would include installation of state-of-the-art filters in the HVAC system to trap pollutants from indoor sources and to remove pollutants from outdoor air sources before they reach the building's occupants. Some of the measures include:

a. High efficiency media and electrostatic filters for air handing units
b. Ultraviolet Germicidal Irradiation in air handing units
b. Standalone ceiling mounted and portable air filters for high density spaces

4 Monitoring, Controls and Display

Monitoring and communicating indoor air quality and comfort parameters in real time to occupants is required to increase awareness and build confidence amongst occupants regarding the health and safety of the workspace environment. Sensors can provide insights on the air quality inside the building. Measuring particle counts, carbon dioxide concentration and volatile organic compounds helps track quality of indoor air and communicate it to the occupants in real time. Some of the interventions include:

a. Installation of high-quality, certified, and calibrated monitors in the breathing zones
b. Monitoring of ambient air for reference and comparison with indoor air
c. Installation of an online dashboard and display screens.
d. Periodic and comprehensive IAQ testing for particulate matter, organic, and inorganic pollutants

Pilot Projects

Pilot projects focussed on enhancing the indoor air quality, thermal comfort, and energy efficiency in the air conditioning system. The results of the pilot retrofits have been very encouraging. The air quality in the offices has dramatically improved with upto 98% reduction in pollutants.
Along with proactive measures to clean and disinfect surfaces, maintaining social distancing and wearing masks, ensuring and communicating the improved air quality in the office to the employees has also allayed their anxiety about COVID-19 spread, and returning to the office.

Ministry of Power and Ministry of Home Affairs offices

The offices of the Honourable Minister and Secretary at the Ministry of Power (MoP), , Shram Shakti Bhawan; and office of Home Secretary, North Block, in New Delhi were taken up as pilot projects. After an initial audit and study of the buildings, air filtration systems were installed along with air quality sensors to monitor and display the real time air quality to the occupants.

EESL office at Scope Complex

Four floors of the EESL office in New Delhi, were retrofitted as a pilot. The building is predominantly served by a central air conditioning system with additional split ACs in some areas .The retrofit started with the installation of a network of state-of-the-art air quality monitoring system in June 2020.

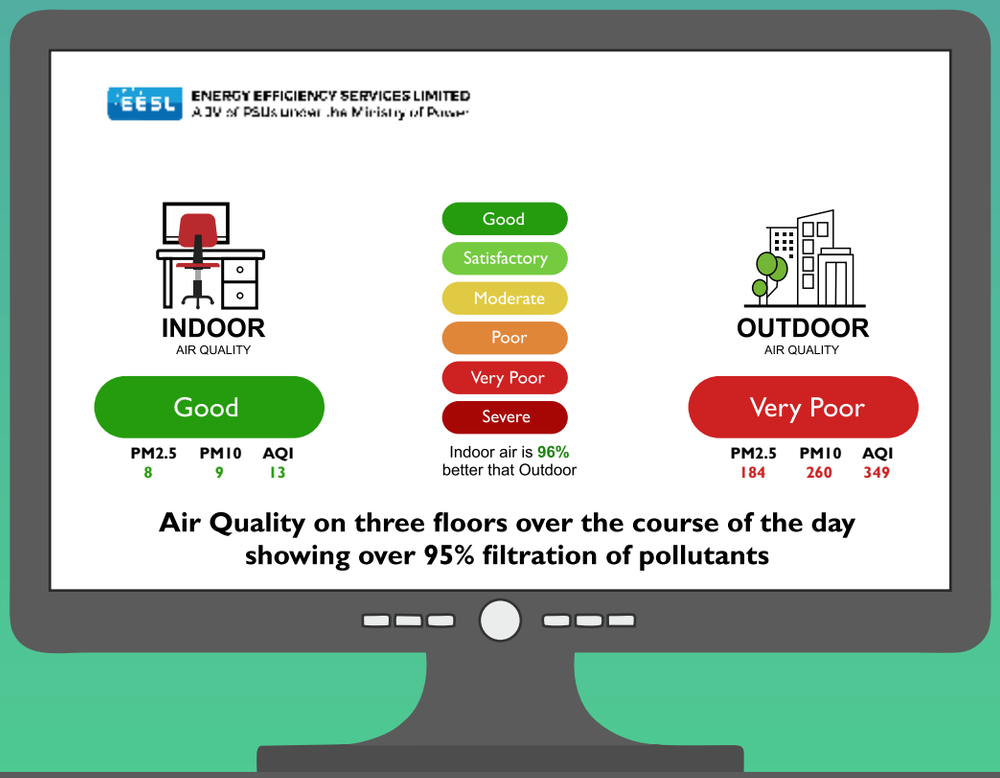
Retrofit measures implemented:

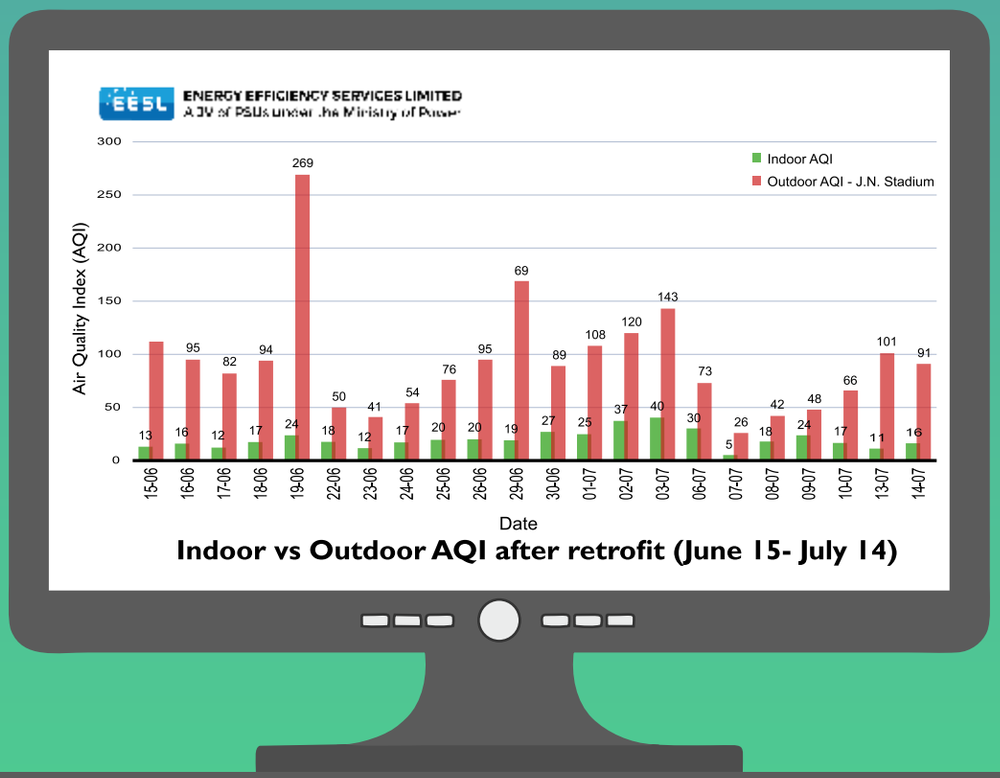
1. Increased ventilation for dilution and lower CO_2 levels
    a. Fresh air system retrofit for increased outside air
    b. Automation for demand-controlled ventilation and economizer operation*
    c. Treated fresh air unit to offset the additional cooling load*

2. Filtration to minimize particulate matter, pollutants, and pathogens
    a. High efficiency electrostatic filters in the air handling units (AHU)
    b. Ultraviolet Germicidal Irradiation in the AHU
    c. Portable air purifiers for spot application in small enclosed offices
    d. Ceiling mounted ESP and HEPA filtration units for conference rooms*

3. Monitoring and display of IAQ and comfort parameters
    a. Network of high-quality RESET certified air quality monitors on all floors
    b. Online dashboard and TV display screens on every floor
    c. Comprehensive IAQ testing*

* in progress





About EESL

Energy Efficiency Services Limited (EESL), under the administration of Ministry of Power, Government of India, is working towards mainstreaming energy efficiency and is implementing the world's largest energy efficiency portfolio in the country. Driven by the mission of Enabling More – more transparency, more transformation, and more innovation, EESL aims to create market access for efficient and future-ready transformative solutions that create a win-win situation for every stakeholder. EESL has pioneered innovative business approaches to successfully roll-out large-scale programs that allow for incentive alignment across the value chain and rapidly drive transformative impact. EESL aims to leverage this implementation experience and explore new overseas market opportunities for diversification of its portfolio. As on date, EESL has begun its operations in UK, South Asia and South-East Asia.

About USAID MAITREE Program

USAID led Market Integration and Transformation Program for Energy Efficiency (MAITREE) is aimed at accelerating the adoption of cost-effective energy efficiency as a standard practice within buildings, and specifically focuses on cooling. MAITREE is a part of the US-India bilateral Partnership between the Ministry of Power and USAID. MAITREE works with a range of government, public, and private sector partners. It supports large-scale energy efficiency deployment in the country through cutting edge technology, innovative business models, and end-user engagement. Environmental Design Solutions [EDS] is the implementing partner for MAITREE.

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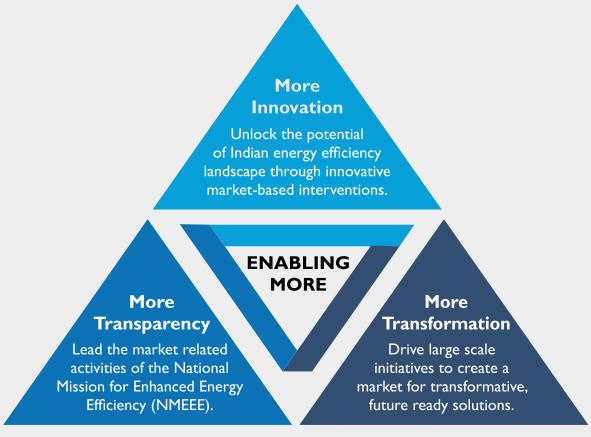

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