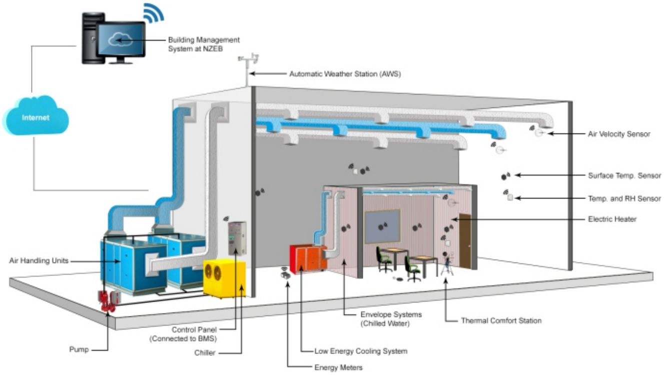
Driving Efficient Low Energy Cooling Technologies Assessment to Technology Tech-Transfer (Delta-T)

India, with population of nearly 1.2 billion, is world's third largest greenhouse gas emitter. It has pledged to reduce carbon emission per unit of gross domestic product up to 35% by 2030 from 2005 level. The building sector is experiencing unprecedented growth leading to higher energy consumption (Govt of India, 2015). India's electricity demand is expected to rise from 775 TWh in 2012 to 2499 TWh by 2030. Estimates by National Institution for Transforming India (NITI Aayog) indicates that the mitigation activities for moderate low carbon development would cost India around USD 834 billion till 2030 at 2011 prices (de Dear, Leow, & Foo, 1991). With an increase in affordability and power supply, the future shall a see a steep rise in demand for air conditioning. By 2030, 60% of commercial space and 40% of residential households in India are expected to be air conditioned. The space cooling systems adopted in developing nations like India have a great impact on the economy as well green-house gas emissions.

The ISO and ASHRAE thermal comfort standards are used to design space conditioning systems, where the systems operate at 22.5 ± 1°C. The ASHRAE 55-2010 standard includes an adaptive thermal comfort model to differentiate the thermal response of occupants in air conditioned and naturally ventilated buildings. However, until now there has been a lack of a contextual model for adaptive thermal comfort for India, even though a large proportion of existing as well as new buildings are either fully naturally ventilated or use natural ventilation for most part of the year, supplemented by air-conditioning.



Aims

- Quantify energy saving potential of smart low energy cooling systems.
- Identify opportunities and develop cost effective scalable energy & environment monitoring sensing and controls systems to integrate with LEC system to enhance performance.
- Develop effective communication tool to work with existing energy models for LEC system design development.

Methodology

Project has been envisaged to work in three distinct but symbiotic activities:

- **Activity A (Field measurements):** To evaluate energy and thermal comfort performance of LEC buildings, a

year round monitoring will be conducted. Total six commercial buildings, two each in Hot-Dry, Warm-Humid and Composite climate zones will be selected based on selection criteria.

- **Activity B (Laboratory experiments):** This activity will develop operational protocol and algorithm for LEC using laboratory experiments. It will use thermal comfort experiments using thermal manikin and low energy cooling tested to investigate interdependency between cooling and comfort. During the process of developing protocol, in association with industry partners, researchers will develop affordable sensors and control systems to increase effectiveness of LEC systems.

  The protocols and algorithm will be developed based on the research experiments to suggest smart cost-effective controls that will enhance performance of LEC systems. The learning of the research experiments especially on cost-effective smart controls will also be applicable to residential LEC systems once algorithms and operational protocols are established.

- **Activity C (Dashboard development):** This activity will develop a visualization and education tool to help architects and engineers take decisions regarding performance of LEC system. The tool will read key design inputs from the users and will output visualization and performance information of LEC system.

Expected Outcomes & Deliverables

The study will be carried out for the period of three years (2017-2020) which will provide following outcomes:

- **Activity A (To evaluate energy and thermal comfort performance of low energy cooled buildings):** Building energy and thermal comfort performance report: A detailed report will be prepared outlining performance of low energy cooling systems in the buildings monitored. Report will also act as a best practice guide for monitoring and operating LEC systems in two separate sections.

  Development of Performance Baseline for LEC Systems: Extensive monitoring (indoor, outdoor, systems, and energy) of six buildings throughout the year will provide unique set of performance baseline for designers and operators to compare.

- **Activity B (Establishment of low energy cooling test bed and deriving protocols):** Establishment of Protocols for LEC System Performance Measurement: While measurement protocols are available for few LEC systems at peak capacity, the multi-point measurements will be developed as part of the project.

  Understanding thermal comfort of Occupants in LEC Systems (Non-compressor based) Spaces: The study will provide extensive understanding of comfort expectations for LEC systems. Quantifying thermal comfort of humans using thermal manikin will provide detailed understanding for conditions delivered by LEC systems.

- **Activity C (Developing Low Energy Cooling Tool):** One of the key barriers in implementing LEC systems is less understanding of system limitations. This tool is designed to make designers more aware of system operation and expected performance to design appropriate LEC systems in the building.

Industry Partners

Schneider Electric

CONTRAVOLTS

Bry-Air®

PiRhoAlpha Research Pvt. Ltd.