Active ASHRAE Research Projects on the 2010-18 Strategic Plan

Goal 1:
Maximize the actual operational energy performance of buildings and facilities.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1603-RP**, *"Role of HVAC Systems in the Transmission of Infectious Agents in Buildings and Intermodal Transportation"* Sponsored by: TC 9.3, Transportation Air Conditioning.
- **1646-RP**, *"Measurements of Pipe Insulation Thermal Conductivity*", Sponsored by: TC 1.8, Mechanical Systems Insulation"

Objective: Sharpen the understanding of the technical, economic, institutional and human factors that contribute to the gap between potential and actual energy performance. Develop additional tools and methods to maximize the actual energy performance of buildings. Document the
energy savings and improvements in performance that can be realized through use of these tools and methods.

Goal 2:
Progress toward Advanced Energy Design Guides (AEDG) and cost-effective net-zero-energy (NZE) buildings.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1651-RP**, "*Development of Maximum Technically Achievable Energy Targets for Commercial Buildings (Ultra Low Energy Use Building Set*)", Sponsored by: MTG.ET, Energy Targets

Objectives: Developing net-zero-energy buildings can produce technologies and designs for improving efficiency of energy use in all buildings. In the United States, the current installed base of about 5 million commercial buildings and 120 million residential dwelling units consumes about 40 quads of energy every year. By 2030, floor space in commercial buildings is expected to grow by 48 percent and residential units will grow by 27 percent.1 Even limited deployment of NZE buildings in this timeframe will have a beneficial effect by reducing the pressure for additional energy and power supply and the concomitant reduction of green-house gas emissions. A further need related to advanced energy designs is development of energy efficiency retrofit systems for the current installed base. While NZE may not always be economically practical, especially for retrofit, aspects of NZE designs will offer significant energy reduction opportunities.

Goal 3:
To reduce significantly the energy consumption for HVAC&R, water heating and lighting in existing homes.

Active ASHRAE Research Project(s) that fall under this plan include: **NONE**

Objectives: The U.S. housing sector consumes approximately 11 quads of energy annually (4.4 for heating, 0.9 for air conditioning, 2.2 for water heating, 2.8 for lights and appliances, 0.5 for refrigeration). The objective is to reduce the energy for low-rise residential space conditioning and water heating while maintaining or improving the homes' comfort and indoor air quality. While current residential energy efficiency measures are well-understood by the industry, the average home is not energy efficient. In addition to developing improved energy
efficiency technologies, improvements are needed in deployment of new and existing techniques. This includes educating and motivating homeowners, facilitating the identification of appropriate measures and properly training contractors to install them and financing retrofit energy efficiency.

Goal 4:

Significantly advance our understanding of the impact of indoor environmental quality (IEQ) on work performance, health symptoms and perceived environmental quality in offices, providing a basis for improvements in ASHRAE standards, guidelines, HVAC&R designs and operation practices.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1491-RP,** "*Literature and Product Review and Cost Benefit Analysis of Commercially Available Ozone Air Cleaning for HVAC Systems*", Sponsored by: Environmental Health Committee (EHC)

Objectives: The objectives for this goal are divided into two priority levels:
1) 1st priority – must address: Quantify the impact of outdoor air (OA) ventilation rates and thermal comfort parameters (air temperature and velocity, radiant temperature, humidity) on the following outcomes:
• high level cognitive, e.g., decision making, performance (highest priority);
• speed and accuracy of simulated office work tasks, e.g., proof reading, typing;
• perceived indoor environmental quality (PIEQ); and
• acute building-related health symptoms.
2) 2nd priority – desirable to address: Quantify the impact of particle and/or gas-phase air cleaning, noise levels and other IEQ conditions or control measures on the same outcomes as listed above.

The objectives stated above clearly imply several hypotheses, for example that OA ventilation rates affect aspects of work performance, health and PIEQ. The research should test these hypotheses. Additionally, to the degree possible, the research should develop information to quantitatively relate the selected IEQ parameters with the identified performance, health and perception outcomes.

Goal 5:

Support the development of ASHRAE energy standards and reduce effort required to demonstrate compliance.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1651-RP**, "*Development of Maximum Technically Achievable Energy Targets for Commercial Buildings (Ultra Low Energy Use Building Set*)", Sponsored by: MTG.ET, Energy Targets

Objectives: The primary objective of this research is to provide knowledge and tools to facilitate the continuing development of ASHRAE energy standards (the 90 series for new buildings and 100 series for existing buildings) and
tools to assist designers in showing compliance.

Goal 6:

Building Information Modeling of energy efficient, high performing buildings. BIM is a rapidly developing field of knowledge which stretches beyond the traditional boundaries of the HVAC&R industry to the wider construction sector.

Active ASHRAE Research Project(s) that fall under this plan include: **NONE**

Objectives
1) Embrace and embed interoperability in the development and execution of ASHRAE Research and the standards, guidelines and technical publications which are based on that research. 2) Develop the information, guidance and examples needed to support the adoption of BIM in the wider technical activities of the Society.

Goal 7:

Support development of tools, procedures and methods suitable for designing low-energy buildings.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1600-RP**, "*Methods to Increase Maximum Velocity of Makeup Air for Atrium Smoke Control - CFD Study*", Sponsored by: TC 5.6, Control of Fire and Smoke
- **1604-RP**, "*Demand Controlled Filtration for Cleanrooms*", Sponsored by: TC 9.11 - Clean Spaces
- **1674-RP**, "*Research to Support the Revision to Ground Source Heat Pumps: Design of Geothermal Systems for Commercial and Institutional Buildings (ASHRAE, 1997)",* Sponsored by: TC 6.8, Geothermal Heat Pump and Energy Recovery Applications

Objectives: Fundamental changes have been made in the way we view our responsibility regarding energy consumption. Over the last few years there has been an increasing awareness of the large potential for energy conservation in the building/HVAC&R sector. This awareness and a fundamental shift in thinking about energy-related and environment-related responsibility are evident in the increasing number of building projects where an incremental effort is being made to achieve superior energy efficiency. The success and prominence of the Leadership in Energy and Environmental Design (LEED) certification program highlights the idea that there is change taking place in this industry. Many practitioners are already
involved in the effort to design energy efficient buildings. Many struggle with some of the more innovative features necessary to push performance levels in the direction of the NZEB. Therefore, the primary objective is to improve the capabilities of engineers to design low energy buildings, by increasing the usability, capability and accuracy of existing tools and developing new tools where needed.

Goal 8:

Facilitate the use of natural and low global warming potential (GWP) synthetic refrigerants and seek methods to reduce their charge.

Active ASHRAE Research Project(s) that fall under this plan include: **NONE**

ASHRAE has a strong interest in promoting the use of safe, environmentally friendly, naturally occurring refrigerants and synthetic low GWP refrigerants. Because of its alignment with sustainability initiatives, ASHRAE will support research, assessment and strategic growth in the use of such refrigerants in refrigeration systems and related technologies with emphasis on efficiency, safety and economic viability. ASHRAE and its members will contribute to improved sustainability of refrigeration and air conditioning technology by conducting research and disseminating knowledge in order to promote the responsible use of sustainable refrigerants. ASHRAE will continue research in developing methods to reduce the refrigerant charge per unit ton of refrigeration. This is in line with the ASHRAE's overall environmental sustainability goal. Reducing charge will reduce the risks associated with refrigerants that are toxic or flammable but have low environmental impact. Low charge also has an economic impact especially with systems that use high cost synthetic refrigerants.

Objectives

1) Effectively incorporate natural and low GWP synthetic refrigerants in Air Conditioning & Refrigeration (AC&R) equipment.
2) Seek optimized equipment to minimize refrigerant charge per unit ton of refrigeration.
3) Study the overall economics of these optimized equipment designs. 4) Study the impacts of different natural and low GWP synthetic refrigerant choices on overall system efficiency. 5) Study safety and health issues related to these euipment/systems.

Goal 9:

Support the development of improved HVAC&R components ranging from residential through commercial to provide improved system efficiency, affordability, reliability and safety.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1600-RP**, "*Methods to Increase Maximum Velocity of Makeup Air for Atrium Smoke Control - CFD Study*", Sponsored by: TC 5.6, Control of Fire and Smoke
- **1646-RP**, *"Measurements of Pipe Insulation Thermal Conductivity*", Sponsored by: TC 1.8, Mechanical Systems Insulation
- **1665-RP**, "*R-40 Stability with HVAC&R System Materials"*, Sponsored by: TC 3.2, Refrigerant System Chemistry. Co-sponsoring Committee: TC 3.3, Refrigerant Contaminant Control

Objectives: The improvement of HVAC&R components is a continuous, never ending process, with the current state-of-the-art being the collective result of much work by numerous organizations and companies over the last several years. There will continue to be opportunities for component improvements, and the projects below have been identified as current opportunities for focused ASHRAE effort.

Goal 10:

Significantly increase the understanding of energy efficiency, environmental quality and the design of buildings in engineering and architectural education.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1634-RP**, "*Guide for Sustainable Refrigerated Facilities and Refrigeration Systems", sponsored by: Refrigeration Committee (REF)*. Co-sponsored by: TC 10.5, Refrigerated Distribution & Storage Facilities, TC 10.1, Custom Engineered Refrigeration Systems
- **1674-RP**, "*Research to Support the Revision to Ground Source Heat Pumps: Design of Geothermal Systems for Commercial and Institutional Buildings (ASHRAE, 1997)",* Sponsored by: TC 6.8, Geothermal Heat Pump and Energy Recovery Applications

Objectives: It is widely understood that engineering and architectural education is where concepts and principles of building systems and design are taught with the intention of fostering successful generations of engineers and architects. However, the two disciplines seldom reach across departments, interact within the curriculum or collaborate
on research projects. Yet, in practice, the collaboration between design team members is essential to the design and delivery process of high-performance buildings. This gap reveals a need to develop information about both disciplines
in order to define resources, tools and opportunities for collaboration. The objectives for the education goal of the strategic research plan period will support the development of research activities and training to lay the groundwork for
achieving net zero energy buildings:

1) Foster research interactions (e.g., design processes) between engineers and architects
2) Increase ASHRAE involvement amongst architecture students
3) Build collaboration between future engineers and architects within the existing curriculum
4) Train engineering and architecture faculty with the latest knowledge, resources and tools

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Goal 11:

Understand influences of HVAC&R on airborne pathogen transmission in public spaces and develop effective control strategies.

Active ASHRAE Research Project(s) that fall under this plan include:

- **1603-RP**, "*Role of HVAC Systems in the Transmission of Infectious Agents in Buildings and Intermodal Transportation"*, sponsored by: TC 9.3, Transportation Air Conditioning

Objectives: Multiple mechanisms of infectious disease transmission involving transport in air include a) droplet transmission (close range) – when the momentum of expelled particles influences exposure; b) medium- to long-range transport and subsequent inhalation of droplet nuclei; c) airborne transport of pathogens to surfaces, or contamination of surfaces by physical contact, followed by resuspension and inhalation, or contact with surfaces. The second mechanism is of primary interest to ASHRAE. Airborne pathogens consist of airborne particles (bioaerosols) generated by persons with infectious disease coughing, sneezing, breathing and talking, that remain airborne for a period of hours to days. Infectious airborne particles range from 1 to 8 μm in diameter, and may contain viable fungi, bacteria or virus suspended in respiratory secretions. Improved HVAC&R system design, maintenance and operation will reduce the incidence of human-generated APT in public spaces such as hospitals, schools, shopping malls, offices and intermodal transportation. It is not clear how these bioaerosols affect disease transmission and how HVAC&R systems and structures/vehicles should optimally be designed and operated to practically reduce the risk of Airborne Pathogen Transmission (APT). Accordingly, specific objectives are:

1) Develop a multi-disciplinary approach and establish collaborations to address the APT problems which impact many TCs within ASHRAE and also are being studied by other professions and organizations such as universities, Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH), National Institutes of Health (NIH) and Federal Aviation Administration (FAA). Such an approach will obtain maximum utilization of research dollars, and allow each profession to focus on its expertise while benefitting from the guidance from others in related issues.
2) Improve understanding of droplet nuclei short and long range transport characteristics, APT in buildings and transportation vehicles, and the role HVAC&R or environmental control systems (ECS) might play through both field and laboratory studies.
3) Promote the development of protocols and methods for characterizing HVAC&R systems and building science factors that impact APT in a simple and cost effective manner.
4) Develop differential pressure controls and space isolation methods and air cleaning and disinfection methods for reducing APT in spaces of interest to ASHRAE membership.
5) Recommend HVAC&R equipment and building science systems that reduce energy consumption while reducing APT for each setting.