



CLIMATE CHANGE, THE INDOOR ENVIRONMENT, AND HEALTH

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Triangle ASHRAE Chapter

CLIMATE CHANGE IS HAPPENING



- Our Earth is warming.
- Earth's average temperature has risen by 1.4°F over the past century, and is projected to rise another 2 to 11.5°F over the next hundred years.
- Small changes in the average temperature of the planet can translate to large and potentially dangerous shifts in climate and weather.



CLIMATE CHANGE IS HAPPENING 2



- Rising global temperatures have been accompanied by changes in weather and climate.
- Many places have seen changes in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves.
- Oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising.



HUMANS ARE LARGELY RESPONSIBLE FOR RECENT CLIMATE CHANGE

- Over the past century, human activities have released large amounts of carbon dioxide and other greenhouse gases into the atmosphere.
- The majority of greenhouse gases come from burning fossil fuels to produce energy, although deforestation, industrial processes, and some agricultural practices also emit gases into the atmosphere.



HUMANS ARE LARGELY RESPONSIBLE FOR RECENT CLIMATE CHANGE 2

- Greenhouse gases act like a blanket around Earth, trapping energy in the atmosphere and causing it to warm. This phenomenon is called the greenhouse effect and is natural and necessary to support life on Earth.
- However, the buildup of greenhouse gases can change Earth's climate and result in dangerous effects to human health and welfare and to ecosystems.



CLIMATE CHANGE AFFECTS EVERYONE

- Our lives are connected to the climate.
- A warming climate will bring changes that can affect our water supplies, agriculture, power and transportation systems, the natural environment, and even health and safety.



CLIMATE CHANGE AFFECTS EVERYONE 2

- Some changes to the climate are unavoidable.
- Carbon dioxide can stay in the atmosphere for nearly a century, so Earth will continue to warm in the coming decades. The warmer it gets, the greater the risk for more severe changes to the climate and Earth's system.



CLIMATE CHANGE AFFECTS EVERYONE 3

- We can reduce the risks we will face from climate change.
- By making choices that reduce greenhouse gas pollution, and preparing for the changes that are already underway, we can reduce risks from climate change. Our decisions today will shape the world our children and grandchildren will live in.





EFFECTS ON THE SOUTHEAST

- Coastal communities in the Southeast will likely face sea level rise, increased hurricane intensity, and storm surge, among other climate change impacts.
- Higher temperatures, longer periods between rainfall events, and greater demand for water will likely strain water resources in the Southeast.





EFFECTS ON THE SOUTHEAST 2

- Incidences of extreme weather, increased temperatures, and flooding will likely impact human health.
- Higher temperatures will likely affect the growth and productivity of crops and forests in the region.



BUT CLIMATE & INDOORS?

- Why study the effect of climate change on the indoor environment and health?
- *“What's the best way to deal with climate change? Staying inside works fine for me.”*

*-- Stephen Colbert,
The Colbert Report,
28 February 2011*



NO, REALLY, WHY STUDY THIS?

- Indoor environments can be significantly impacted by climate changes such as large changes in rainfall and snowfall, extreme temperatures, and changes in storm severity.
- Buildings will be altered for energy efficiency, and to help protect us from some of the changes associated with climate change.



AND SO...

- These changes impact the air quality indoors.



Poor indoor air quality can lead to an increased risk of asthma and other respiratory and health problems.





THE COMMITTEE ON THE EFFECT OF CLIMATE CHANGE ON INDOOR AIR QUALITY AND PUBLIC HEALTH

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KEY FINDINGS FROM LITERATURE



- 1 - Poor indoor environmental quality already creates health problems. It impairs the ability of occupants to work and learn.
- 2 - Climate change may make existing indoor environmental problems worse and introduce new problems.
- 3 – We can improve public health while mitigating or adapting to alterations in indoor environmental quality induced by climate change.





FIVE AREAS OF CONCERN

- Indoor Air Quality
- Dampness, Moisture, and Flooding
- Infectious Agents and Pests
- Thermal Stress
- Building Ventilation,
Weatherization, and Energy Use





- Climate change can affect indoor levels of pollutants.
 - Changes in outdoor levels (due to atmospheric chemistry or circulation changes) will affect levels indoors.
 - Building energy cuts could lead to less ventilation. That would raise exposures to secondhand smoke and other indoor pollutants.

INDOOR AIR QUALITY 2

- Poisoning from exposure to carbon monoxide emitted from portable electricity generators may increase if power outages increase (heat wave shut-offs, or bad weather knocking out lines)



SOLID FUEL STOVES



- Indoor use of solid-fuel stoves (more common in less developed countries) is associated with demonstrable adverse health effects.
- Switching to lower-emissions units would yield substantial health benefits AND decreased greenhouse gas production.



DAMPNESS, MOISTURE, FLOODING



- Excessive indoor dampness is a determinant of the presence or source strength of several potentially problematic exposures.
- Damp indoor environments favor house-dust mites and growth of mold and other microbial agents;
- Standing water supports cockroach and rodent infestations; and
- Excessive moisture may initiate or increase chemical emissions from building materials and furnishings.

DAMPNESS, MOISTURE, FLOODING 2

- Damp indoor environments are associated with the initiation or exacerbation of a number of respiratory ailments.
- Dampness problems and water intrusion create conditions favorable to the growth of fungi and bacteria and may cause building materials to decay or corrode; this can lead to off-gassing of chemicals.



DAMPNESS, MOISTURE, FLOODING 3

- Extreme weather associated with climate change may lead to water damage indoors.
- Mold-growth prevention and remediation activities may introduce fungicides indoors, which can lead to adverse exposures of occupants



DAMPNESS, MOISTURE, FLOODING 4

- Well-designed and properly operating heating, ventilation & air-conditioning (HVAC) systems can ameliorate humid conditions, but...
- Poorly designed/maintained systems may introduce moisture and create condensation on indoor surfaces.



INFECTIOUS AGENTS AND PESTS

- Weather and climate variability influence the incidence of many infectious diseases.
- Climate change may change infectious diseases by, for example, affecting the geographic range of disease vectors.
- However, it is difficult to draw general conclusions.



INFECTIOUS AGENTS/PESTS 2



- The ecologic niches for pests will change in response to climate change.
- Decreases in populations in some locations may lower the incidence of allergic reactions, but those with allergies may be sensitized to other airborne allergens.
- Exposure to pesticides may change as people respond to infestations of pests like termites whose geographic ranges have changed.

THERMAL STRESS



- Extreme heat & cold have several well-documented adverse health effects.
- The elderly, those in poor health, the poor, and those in cities are more vulnerable to both exposure to temperature extremes and the effects of exposure.
- Those populations experience excessive temperatures almost exclusively in indoor environments.

THERMAL STRESS 2

- Air conditioning provides protection from heat...

but is associated with higher reported prevalence of some ailments, perhaps because of contaminants in HVAC systems.

- AC may also protect against exposure to high concentrations of outdoor pollutants.



THERMAL STRESS 3



- Other possible climate change effects:
 - Buildings with natural ventilation will need AC
 - Buildings with AC will need to use it more often, reducing natural ventilation.
- People in buildings w/o AC will be exposed to extreme heat more often. ●

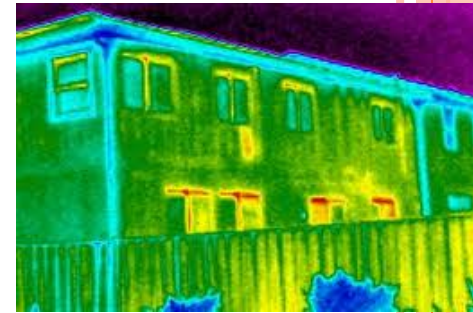
THERMAL STRESS 4

- Several technologies and building-design and -siting approaches can provide control of the indoor environment with lower energy costs and greater health benefits than systems typically in use today.



BUILDING VENTILATION, WEATHERIZATION, & ENERGY USE

- Leaky buildings are common and cause energy loss, moisture problems, & migration of contaminants.
- Poor ventilation in homes, offices, & schools is associated with occupant health problems or lower productivity.
- However, the information base is limited, & studies in hot and humid climates are lacking.



BUILDING VENTILATION, WEATHERIZATION, & ENERGY USE 2

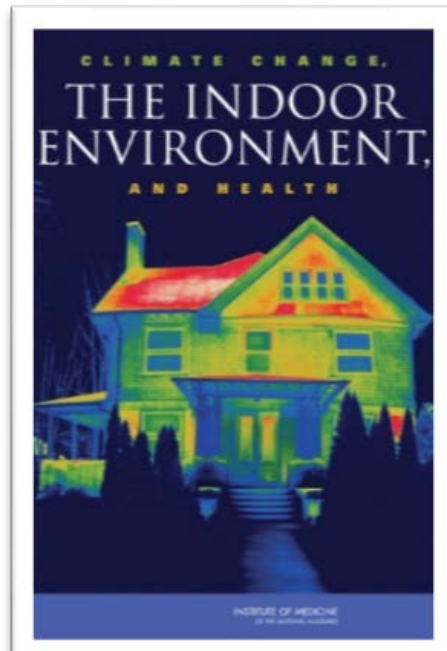
- Energy-efficiency (weatherization) measures called for by climate change may limit the exchange of indoor air with outdoor air.
- Introduction of new materials and weatherization techniques may lead to unexpected exposures and health risks.



OKAY, WHAT CAN WE DO?

o aka

“Priority Issues for Action and Recommendation”





RECOMMENDATIONS 1

- EPA should work with agencies such as CDC to assist health and emergency-management agencies to identify populations at risk & implement measures to prevent or lessen the problems.
- EPA and other agencies should develop or refine testing standards to evaluate emissions from materials, furnishings, & appliances & to promote their use.

RECOMMENDATIONS 2

- EPA should expand and accelerate efforts to ensure that building weatherization work improves indoor environmental quality
- EPA (with DOE, ASHRAE, and building-code organizations) should facilitate the revision & adoption of building codes (regionally appropriate with respect to climate-change projections) that promote the health and productivity of occupants.



RECOMMENDATIONS 3

- EPA and others should join to develop model standards for ventilation in residential buildings and foster updated standards for commercial buildings and schools. The standards should:

- Be based on health-related criteria.
- Account for effects of weatherization and of retrofits



RECOMMENDATIONS 3.1

- Address how to maintain proper ventilation throughout the life of the system.
- Contain fail-safe provisions for sufficient outdoor air to sustain occupant well-being in case of ventilation-system breakdown or extended power outage.
- Achieve the objectives mentioned above in an energy- and cost-efficient manner.





RECOMMENDATIONS 4

- EPA and other agencies should create a public-health surveillance system to gather information on how outdoor conditions, building characteristics, and indoor environmental conditions affect occupant health.



RECOMMENDATIONS 5

- EPA should educate the public on these issues.
- Efforts should include materials tailored to those creating, renovating, and maintaining our buildings, and to occupants of single-family and multifamily residences, and contain specific advice on actions to reduce the effects of climate change on the indoor environment and improve health.



RESEARCH ISSUE – NO OWNERSHIP

- Responsibility for the issues that make up indoor environmental quality do not fall neatly under any federal department or agency.
- Because no entity has the lead, research needs go unrecognized and unmet.
- One approach: for EPA to initiate action within the US Global Change Research Program to address the effects of climate change on IEQ & on health and productivity of occupants.





AND STILL MORE...

- EPA should spearhead an effort across the federal government to make indoor environment and health issues an integral consideration in climate change research and action plans and, more broadly, to coordinate work on the indoor environment and health.



ADDITIONAL INFORMATION

- A webpage providing information and links concerning the study:

<http://www.iom.edu/Activities/PublicHealth/ClimateIndoorAir.aspx>

- The report is available at:

<http://www.iom.edu/climatechangehealth>

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