

Air-Conditioning and Indoor Air Quality after 2030 (Topic Facilitator: Raj Gopal)

Summary

1. The EPA report (EPA 430-F-16-051) on ‘What Climate Change Means for Wisconsin’ dated August 2016 makes the following conclusions concerning summer temperatures and air quality.

*”Seventy years from now much of Wisconsin is likely to have 5 to 10 more days with temperatures above 95⁰F than it has today”

*”Hot days can be unhealthy-even dangerous. High temperatures can cause heat stroke and dehydration, and affect people’s cardiovascular and nervous systems. Northern cities like Milwaukee are vulnerable to heat waves, because many houses and apartments lack air-conditioning and urban areas are typically warmer than their rural surroundings. For example, heat waves killed 91 people in Milwaukee County in 1995 and 11 people in 1999. Heat stress is likely to increase as climate change brings hotter temperature and more humidity. Certain people are especially vulnerable, including children, the elderly, the sick and the poor”. “Changing the climate can harm air quality and amplify existing threats to human health. Higher temperatures increase the formation of ground-level ozone, a pollutant that causes lung and heart problems.....As the climate changes, continued progress toward clean air will become more difficult...”

2. Union of Concerned Scientists of USA report their findings (www.ucsusa.org/mwclimate) in July 2009 based on research by scientists from Texas Tech and University of Illinois. Their conclusions for Wisconsin, using their historical baseline data (1961-1990) and projecting the trend for three time frames, 2010-2039, 2040-2069 and 2070-2099, read in part:

*”.....our analysis focused on the extreme heat projected for the state’s largest city, Milwaukee, and the number of days each year likely to exceed 90⁰F and 100⁰F. During the historical baseline Milwaukee averaged only nine days per summer with highs over 90⁰F. That number rises substantially in the next several decades to more than 15 and toward the end of the century under the higher emissions scenario; the city is projected to experience more than 55 days over 90⁰F...”

* “As for the more dangerous days over 100⁰F, Milwaukee averaged less than one such day each summer during the historical base line. But toward the end of the century under the higher-emissions scenario, the city is projected to face more than 22 such days....”

3. “Climate Change Projections for Wisconsin,” Michael Notaro, Center for Climate Research, University of Wisconsin, Madison, October 2009, MATC Global Warming Teach-In.

*Wisconsin Initiative on Climate Change Impacts (WICCI) used IPCC models for climate change impact mapping for Wisconsin using granular grid and statistical approach. Used observed data from 1950-2006 and IPCC climate scenarios from 2000 to the end of the twenty first century (2090) starting from no change in Global Surface Temperature warming than the one predicted at 2000 (+0.6⁰C) to warming in 2090 +1.8⁰C, with the next scenario warming in 2090 to +2.8⁰C and with the final scenario warming in 2090 to +3.6⁰C. The warming predicted for 2025 for all scenarios is +1⁰C. Adaptation and mitigation are recommended to lessen the severity of the warming.

* “Projected change in the frequency of Hot Days >90⁰F per year for mid- 21st century (1980-2055) is 1.5 to 3 weeks more and for late 21st century is 3 to 6 weeks more.”

*”Fewer cold surges and more heat waves.” “More frequent heavy precipitation events.” “A wetter winter-spring is more certain than a drier summer.”

4. “Is Climate Variability Increasing?”, J.C. Sprott, Chaos and Complexity Summer Topic Presentation, June 11, 2019.

* Refer to the Reading for the topic

* The analysis is based on data obtained for daily mean temperature and daily precipitation for the 79-year period 1940-2019 for Madison and Milwaukee. The intent of the analysis is not to project temperature and precipitation trends beyond 2019 rather what type of trend they exhibit with regards to cooling and warming and changes in precipitation when analyzing the dataset.

* “In summary, Madison, has become slightly warmer and significantly wetter over the past 79 years, and these trends are accelerating. This change has not led to more temperature variability, but it has led to more extreme rainfall events, but no more than one would expect for a generally wetter climate. Thus there is some support for the claim that climate change is causing more variability in the weather, but the effect is mostly in the amount of rainfall and is largely absent in or even contradicted by the deviations of temperature from the mean.”

3. New York Times Article, “The World Wants Air-Conditioning. That Could Warm the World”, May 15, 2018

(<https://www.nytimes.com/2018/05/15/climate/air-conditioning.html>)

*”..there is growing concern that as other countries adopt America’s love of air-conditioners, the electricity used to power them will overburden electrical grids and increase planet-warming emissions...is predicted to soar from 1.6 billion units today to 5.6 billion units by midcentury...Those emissions would contribute to global warming, which would further heighten the demand for air-conditioning....And when it gets hot, forgoing air-conditioning can be deadly. The heat wave that plagued Chicago in 1995 killed more than 700 people, while the 2003 European heat wave and 2010 Russian heat wave killed tens of thousands each...Twenty-one percent of the total world electricity

growth is coming from the need to meet the growth of air-conditioner electricity demand.”

4. Refrigerant Impact on Global Warming in Occupant Thermal Comfort Air-Conditioning in Residential, Commercial, Industrial and Vehicles

*Today’s refrigerants have varying degrees of Global Warming Potential (GWP). As an example, R-134a (tetrafluoroethane) used in vehicles has a GWP of 1300. Current GWP of HFC refrigerants range from 2,000 to 4,000. HFC-32 has a GWP of 677 while HFC-152A has a GWP of 138. Currently, research is underway to come-up with refrigerant blends that can be used for retrofit and new construction facilities that will meet toxicity, efficiency, GWP and flammability requirements.

5. Impact of Energy Efficiency Standards such as ‘ASHRAE 90.1 for Buildings Except Low-Rise Residential Buildings’, International Energy Conservation Code (IECC) and Others

* All the codes have mandated continuous energy efficiency improvements for air-conditioning units all the way from room air-conditioners to electric chillers, building envelopes, system components, central air-handling unit fans etc. over the past decade with the result very little room is left for energy efficiency improvements except maybe in old building stock. This has resulted in measurable decrease in building cooling loads and lower design capacity of air-conditioning units such as chillers for office buildings and central air-conditioning units for residential homes. Hence, these equipments will not be able to meet future capacity requirements for the predicted hot summers. However, adding additional cooling capacity with new air-conditioning equipment to meet the predicted hot summer temperatures for Wisconsin as well as globally will only exacerbate the ability to limit global warming.

As we can see from the above summary, the need for more air-conditioning due to the predicted trend for hot summers in the future poses a conundrum. Is there an answer? I don't have one. I invite all my Chaos colleagues to join me in having a spirited discussion. See you all at the Terrace on July 23, 2019 at noon.