Transforming Existing Weather Data to Enable Building Energy Performance Simulation Under Future Climate Change

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There is growing concern about the impact of global climate change and its implications for energy use. Many studies have found that global warming would cause a decrease in heating requirements and an increase in cooling requirements. However, engineers still use the Typical Meteorological Year 2 (TMY2, derived from the 1961-1990 National Solar Radiation Data Base) data for building code compliance calculations, sizing building systems, and choosing the heating, ventilation, and air conditioning system. To effectively align building codes with the impact of climate change, there is a need to explore the generation of future weather prediction data in order to better understand the impact of future weather on the building energy consumption. Although Jentsch and his colleagues developed CCWorldWeatherGen program in 2008, the program generates future weather data only under the experiment scenario A2. The program limits the exploration and analysis of climate change impact on building energy consumption.

This study would develop the Climate Change Weather File Generator application which generates future weather data under all four experiment scenarios A1FI, A2, B1 and B2 reported by Intergovernmental Panel on Climate Change (IPCC). The current weather data would be obtained from the National Renewable Energy Laboratory. Although there are a few mathematical methods to downscale and predict the future weather, such as stochastic weather generation, and interpolation weather generation, "morphing" with global circulation models (GCM) data is adopted for this study due to reliability and consistency of current baseline weather data. By applying the morphing algorithm and computing programing, future weather data for the 2050s and the 2080s would be generated for more than 2,100 locations across the world. Then the future weather data would be converted to EPW files for building energy simulation software, e.g. EnergyPlus.

This Climate Change Weather File Generator application would be used to generate climate weather files for building energy performance simulation. This analysis of building energy performance simulation could provide guidance for needed changes in building energy efficiency codes to address the impact of global climate change at the building level. The analysis could also help policy-makers (e.g. state building code council, state energy commission), utility companies, and other stakeholders respond to climate change in various regions and address concerns about the effects of climate change on energy production, distribution, and consumption in the building sector. In addition, it could be used for free online for any scientist and engineer of any majors who is interested in studying the impact of climate change on environment, health, animal, geography, etc. The future research will focus on the mitigation measures of building energy consumption due to the climate change in different states.

Keywords: Global Climate Change, Building Energy Performance, Simulation