Abstract submitted to the ADAPTtoCLIMATE Conference, Nicosia, Cyprus, 27th & 28th March, 2014

# Increased Electricity Demand for Space Cooling under Climate Change Condition in the Eastern Mediterranean and Adaptation Measures

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Keywords: climate change, space cooling, enhanced energy needs, adaptation measures

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Current studies indicate that anticipated changes in climatic conditions will have particularly severe manifestations in the Eastern Mediterranean. Such changes will be exacerbated in urban settings, where warming trends will be even more enhanced than in the surrounding countryside. Paired with extreme summer droughts, the impacts of such changes will include an enhanced need for space cooling. This will imply growing electricity demands, which, in the case of many countries in the Eastern Mediterranean (including Cyprus), are almost exclusively derived from fossil-fuel fired power plants. Such undesired consequences can only be avoided through adequate and effective adaptation measures aimed to reduce the need for energy consumption from fossil fuel sources.

This study, is based on numerical climate model projections of temperatures in the larger cities of Cyprus (Kyrenia, Nicosia, Pafos, Larnanca and Famagusta). This enabled calculations of Cooling Degree Days (CDD) and the Warm Spell Duration Index (WSDI) for each city throughout the 21st century. In addition, the increasing/additional energy demand needed for space cooling **CLOAD** as well as a parameter **ratio**, i.e., the cooling load of each year divided by mean cooling load of reference period 1951-2000 have been computed. **CLOAD** depicts the required energy for space cooling needed to ensure acceptable indoor comfort. In these calculations, we consider only the enhanced cooling load caused by increasing air temperature and neglect any additional heat sources, i.e., radiative heat intake by the building or internal heat sources. Thus **CLOAD** can be considered a conservative estimate of the increased space cooling/electricity need.

Our results show that **CLOAD** will be substantial, e.g., in the case of Larnaca, it will increase by 22 kWh/m$^2$/year for 1950 to 2100, while the **ratio** between annual cooling needs for 1950-2100 and the mean cooling load of reference period 1951-2000 amounts to a 2,3-fold energy need. In order to estimate the increased energy costs related to such enhanced cooling needs, we assume a simple, one-family home measuring 6 m (width) × 4 m (height) × 10 m (length), i.e., with an externally exposed area of 228 m$^2$. Using the current price for household energy, i.e., ~€0,177/kWh (estimate including various additional fees and VAT) and given the external area of 228m$^2$, this amounts to an increase costs per kWh of additional electricity needed by €40,356/kWh/year. Thus, the additional energy costs for such a home in 2100 compared to present costs will be a substantial € 888.

Even though these numbers cannot be more than rough estimates, they underline the usefulness, if not the need to consider adaptation measures that will reduce the adverse effects of climate change on energy needs/costs. Such measures include (but are not limited to):

- an enlargement of green areas in urban settings,
- the use of “cool” materials, in particular of highly reflective and low absorptive coatings and pavements,
- shading and the orientation of buildings and windows,
- the use of cool sinks for heat dissipation,
- an appropriate layout of urban canopies involving the use of solar control,
- techniques to enhance air flow/ventilation in buildings.

Aside from the economic consequences of the enhanced energy need for space cooling, employing such adaptation measures will have additional positive repercussions, e.g., they will help to reduce greenhouse gas emissions that accompany electricity generation in conventional power plants. This –in turn- will contribute to mitigation measures aimed to limit anthropogenically caused climate change and thereby serve multiple purposes.