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Influence of air temperature on electric consumption in Moscow

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For the first time for mid latitudes and with the use of long-term data of Moscow State University Meteorological observatory a dependence of electric power consumption E on the air temperature T has been studied for each separate day for the period from 1990 to 2015 (totally – 9496 values). As a result, it is shown that the relation is in general decreasing in conditions of cold Moscow region: energy consumption as a rule reduces with a rise of the temperature. However, in time of severe frosts the energy consumption increasing goes to nothing due to special measures for energy savings whereas during heat wave episodes of extremely hot weather (especially in summer of 2010) an opposite tendency appears to the energy consumption increase with the increase of the air temperature due to additional consumption for the air conditioning. This relation between E and T is statistically significant with extremely high confidence probability (more than 0.999). The optimum temperature for the energy saving is 18 ˚C. The air temperature limit values in Moscow during last decades have been discussed. Daily-averaged T varied from –28.0 ˚ in January of 2006 to +31.4 ˚ in August of 2010 so a range of this parameter is almost 60 ˚. Catastrophic heat wave in 2010 appeared as a secondary summer maximum of the electric consumption annual course.

The relation between E and T for separate years demonstrates strong weekly periodicity at the dynamics of E daily values. As a result statistical distribution of E daily values for separate years is bimodal. One its mode is connected with working-days and another one – with non-work days (Saturday, Sunday and holidays) when consumption is much less. In recent time weekly cycle at the electric consumption became weaker due to total fall of industry in Moscow. In recent years the dependence of energy consumption on the air temperature generally became stronger – probably due to changes of its structure (growth of non-industrial users' contribution).

A relation of energy consumption with the relative humidity is absent whereas a relation of energy consumption with the water vapor pressure e indirectly reflects a dependence of this parameter on the air temperature. Use of multiple and partial correlation between E, T and e confirmed an absence of direct relation between energy consumption and water vapor pressure.

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