



Response of electricity demand to temperature and solar radiation in Italy

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The dependence of Italian daily electricity demand on cooling degree-days, heating degree-days and solar radiation is investigated by means of a regression model applied to twelve consecutive two-year intervals in the 1990-2013 period. The cooling and heating degree-days records used in the model are obtained by i) estimating, by means of a network of 92 synoptic stations and high-resolution gridded temperature climatologies, a daily effective temperature record for all urbanised grid-points of a high-resolution grid covering Italy, ii) using these records to calculate corresponding grid-point degree-days records and iii) averaging them to get National degree-days records representative of urban areas. The solar radiation record is obtained with the same averaging approach, with grid-point solar radiation estimated from the corresponding daily temperature range. The model is based on deterministic components related to the weekly cyclical pattern of demand and to long-term demand changes and on weather-sensitive components related to cooling degree-days, heating degree-days and solar radiation. The model establishes a strong contribution of cooling degree-days to the Italian electricity demand, with values peaking in summer months of the latest years up to 211 GWh/day (i.e. about 23% of the corresponding average Italian electricity demand). This contribution shows a strong positive trend in the period considered here: the coefficient of the cooling degree-days term in the regression models increases from the first two-year period (1990-1991) to the last one (2012-2013) by a factor 3.5, which is much greater than the increase of the Italian total electricity demand. The contributions relative to the last 3 two-year periods are nearly constant, suggesting a possible slowing-down of the positive trend, which may be a consequence of the present day economic crisis. The projections of cooling degree-days, heating degree-days and solar radiation under climate change scenarios will be presented.