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Weather sensitivity of electricity consumption in coastal Megacities of Western Africa

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The transition to a low carbon economy requires the massive development of renewable energy including wind, solar, hydro. Their weather dependence makes the power system highly sensitive to weather variability. The weather sensitivity of the power system obviously also results from the weather sensitivity of electricity consumption. As highlighted in a number of regions worldwide, electricity consumption can have a significant dependence on air temperature, relative humidity, wind speed or daylight time.
In the present work, we explore the weather sensitivity of electricity consumption for coastal megacities of western Africa. This analysis, which additionally allows to partition weather-sensitive- factors and weather-independent-explanatory factors (GPD, week day type, season), is based on sub-daily electricity consumption data collected for the recent years in three coastal megacities of western Africa (Lomé (Togo), Abidjan (Côte d'Ivoire) and Cotonou (Benin)) from national electricity services and on concomitant weather data from the meteorological synoptic stations of each city.
To explore how weather variability has driven the electricity consumption in the last years, we consider Cooling-Degree-Days (CDD). It is used as a proxy of the energy demand for building cooling purposes. The explanatory power of CDDs estimated from different temperature indices, including humidex and heat index is investigated.
Statistical analysis is done by using a multiplicative decomposition of consumption data over sub-periods where the consumption was estimated to have a relatively homogeneous evolution behavior. For the three cities and for the temperature indices considered, CDDs are able to explain the large seasonality in consumption and especially the consumption peak observed in spring and the lower consumption in August. Air temperature is the key explanatory factor. Relative humidity also adds for some city some additional prediction skill.
The relationships identified for the three megacities could provide the basis for a first guess prediction model of electricity consumption in this area, as required for a better management of the power system in the region. Apart from socio-economic considerations, this analysis also allows to give some insight on the way climate warming may increase the electricity demand in the region.

Reference. Kondi Akara G., Diedhiou, A., Hingray, B. 2016. Weather sensitivity of electricity consumption in Cotonou, and Abidjan, two coastal Megacities in Western Africa. International workshop on « evolving energy models in emerging economies. Post COP21, Ahmadabad, Gujarat, India, 12-14 Déc. 2016. 16p