We consider an energy management system that controls a cluster of price-responsive demands. Besides these demands, it also manages a wind-power plant and an energy storage facility. Demands, wind-power plant, and energy storage facility are interconnected within a small size electric energy system equipped with smart grid technology and constitute a virtual power plant that can strategically buy and sell energy in both the day-ahead and the real-time markets. To this end, we propose a two-stage procedure based on robust optimization. In the first stage, the bidding strategy in the day-ahead market is decided. In the second stage, and once the actual scheduling in the day-ahead market is known, we decide the bidding strategy in the real-time market for each hour of the day. We consider that the virtual power plant behaves as a price taker in these markets. Robust optimization is used to deal with uncertainties in wind-power production and market prices, which are represented through confidence bounds. Results of a realistic case study are provided to show the applicability of the proposed approach.