24% and MC for electrical peak power by 4% (>10% for winter months). These savings reflected a relatively modest high/low tariff rate ratio of 1.5. Much larger MC savings can be expected to occur under a higher ratio.

We concluded that by combining TABS with an appropriate RBC strategy it is possible to efficiently shift heat (as well as cold) generation to within low cost phases, without having to compensate for storage losses, and with no negative impact on thermal comfort.

6.1.2 Load Shifting Using MPC

The above RBC load shifting study assumed a very simple and regular tariff structure. In the future it is likely that building owners and operators will be increasingly confronted with time-varying pricing, including dynamic price forecasts. Handling of more complex load shifting requirements pushes however the RBC approach to its limit, since simple rules that can deal with arbitrary scenarios are very difficult to develop and tune.

Quite differently, Model Predictive Control (MPC) by design flexibly supports easy inclusion of complex tariff structures, or, more generally, predictions of time-varying price signals in the optimization task (see Section 4.3.3). To test the practicability of this feature we conducted a field experiment where the target building was controlled during two different periods by MPC using two distinct cost functions. The experiment has also been reported in [1].

The first period extended over almost 3 months, from November 11, 2012 to February 4, 2013. During this period we used throughout a constant actuation cost for all actuators. The second period extended from February 5 to February 14, 2013. Here we prescribed a diurnally varying price signal for electricity with two low-price windows extending over 04:00–06.30 and 21:00–01:30, respectively.

During both periods MPC operated under the assumption that heat for the TABS, the conditioning of the supply air and the radiators was produced by a heat pump. Electricity usage by fans was also considered in the MPC cost function.
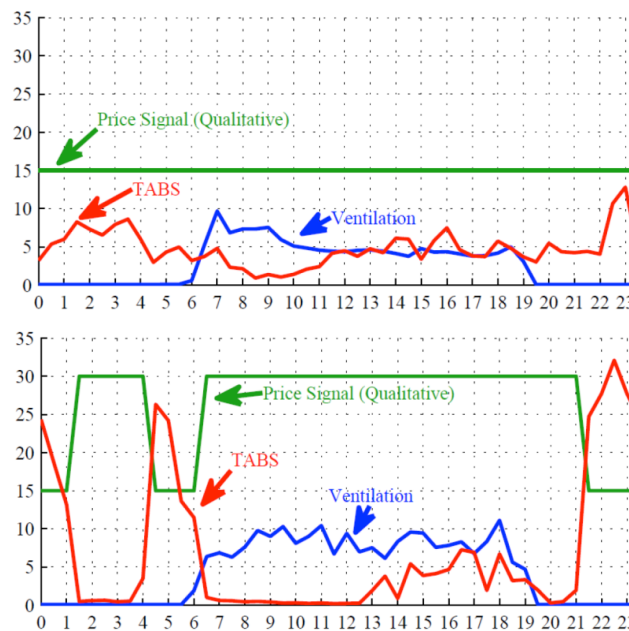

Figure 6-1: Average diurnal cycles of imposed MPC price signals and of measured average specific heating power (in [W/m2]) for TABS and ventilation from the target building. The horizontal axis shows the hour of day. Top: reference case (November 11, 2012 to February 4, 2013); bottom: load shifting experiment (February 5 to 14, 2013).