

## Abstract

The move to green energy is challenging, as the energy grid needs to be kept stable, and traditional power plants help maintain stability. Demand Response (DR) is one solution to this, as it allows fluctuations in the energy grid to be mitigated by the demand-side changing their usage patterns. In Denmark, the retail sector consumed 9.344 TJ in 2013 alone, which equates to about 8% of the total industry sector consumption. This usage makes them compelling for DR integration. This Ph.D. thesis seeks to mitigate the barriers for Smart Grid Integration of the Retail Sector by applying a software approach. To do so, Building Operating Systems (BOSs) are used as a means to integrate said retail stores into the smart grid, to partake in DR activities. Retail stores' motivations to participate in the grid is explored, as well as their concerns to do so. As costs and impact on sales are their main concerns, solutions are explored to mitigate these barriers. First, an Activity Tracking Service (ATS) is built to create better decision points for DR applications. Second, this is followed by an initiative, in the form of the Service Abstraction Layer (SAL), to increase the portability of services and applications, thereby making certain implementations are made once, instead of being re-implemented for each building. This reduces the cost of DR application implementations. Third, the Service Support System (SSS) and the Ontology based Package Manager (OPM) are built and demonstrated as solutions to reducing deployment costs of BOSs, by creating the tooling for automatic configuration of services, and deployment of drivers, services, and applications. Lastly, the impact of the above systems to the building sector ecosystem is discussed in detail, and highlight several incentives for all stakeholders to participate. The Ph.D. thesis' contributions show significant reductions to BOS related costs, which in turn makes investments in BOS solutions more feasible when considering them for DR.