EXPLORING BARRIERS TO COMPANY ADOPTION OF LOAD SHIFT

Mark Olsthoorn : Grenoble Ecole de Management, Grenoble, 12, rue Pierre Sémard, BP 127, 38003 Grenoble, France
Phone : +33 (0)4 56 80 66 33, e-mail : mark.olsthoorn@grenoble-em.com
Joachim Schleich : Grenoble Ecole de Management, Grenoble, 12, rue Pierre Sémard, BP 127, 38003 Grenoble, France
e-mail : joachim.schleich@grenoble-em.com
Marian Klobasa : Fraunhofer Institute for Systems and Innovation Research, Breslauer Strasse 48, 76139 Karlsruhe, Germany
e-mail: marian.klobasa@isi.fraunhofer.de

Overview

As countries move toward larger shares of renewable energy and build fleets of electric vehicles, the slow diffusion of active electricity load management should concern energy policy makers and users alike. It leads to unnecessarily costly investments and can jeopardize reliability. Active load management can increase capacity factors of existing capacity, reduce the need for new capacity, and alleviate congestion and transmission constraints. In addition, it reduces price volatility, mitigates market power, and lowers electricity prices for end-users (Borenstein, 2005; Faruqui et al., 2007; Faruqui and Palmer, 2011; Joskow, 2012). Despite clear benefits, load shift programs and practices have been slow to diffuse, in Europe as well as in the US (Greening, 2010; Torriti et al., 2010; Kim and Shcherbakova, 2011). Even where incentive structures are in place, barriers prevent energy users to adopt load shift to the extent expected (Kim and Shcherbakova, 2011; Torriti and Grünewald, 2014). However, little is known about which barriers prevent companies from engaging in load shift. This study adopts an end-user perspective and is among the first to empirically assess the relevance of various barriers to load shift in industrial firms. We also investigate which barriers are correlated and how company characteristics affect their prevalence.

Method

Based on the taxonomy of barriers developed in the realm of barriers to energy efficiency (e.g. Sorrell et al., 2004; Schleich and Gruber 2008; Cagno et al., 2013), a questionnaire was developed which translates these barriers into 21 items in the context of load shift. Then, data was gathered through a one-time online survey among business sites of manufacturing firms in Southern Germany, where load shift is pertinent as supply side intermittency is growing fast due to the strong diffusion of solar-PV alongside the phase-out of all nuclear power by 2022 (Klobasa et al., 2013). Manufacturing firms represent a significant source of unused load shift potential (Hartkopf et al., 2012), and one where better familiarity with the concept promises better scale validity. Our level of analysis is the production site. Targeted sectors were food, timber, rubber and plastics, textile/fabrics, paper/publishing/printing, glass and ceramics, mining/minerals, chemicals, metals, electronics, machinery, and automotive. This multi-sector approach serves the exploratory purpose of the study. The survey yielded cross-sectional data with, in addition to barrier scores, firm attributes and patterns of energy use. In our analysis, we first univariately ranked all 21 barriers by stated importance. Second, we employed principal component analysis to find a natural grouping of barriers from the user-firm perspective. Third, we assessed the influence of firm characteristics by bivariately comparing means of split samples in two-sided t-tests. Finally, ordered logit regression were run to explore correlations between stated load shift potential and the barrier factors.

Results

Results of the barrier ranking indicate that interference with the core business processes and products is of major concern. Respondents seem to have reservations about the compatibility of load shift programs with core business operations, or there is little willingness to accept interference with core processes. Second, immediately following the interference barriers, financial and regulatory certainty both rank high on the list of barriers. 'Cost savings too far into the future' ranks lower, hinting that it is more important to know the *what* rather than the *when* of financial and regulatory conditions. Access to capital is hardly perceived as a relevant barrier. Lack of qualified personnel and data security are also relatively unimportant. A principal component analysis splits the barriers into five clear factors, which we label "financial and regulatory risk," "technological risk," "knowledge of and access to options," "internal issue prioritization," and "competences." The findings from bivariate statistical tests suggest that larger companies are more concerned about technical, financial and regulatory risk than smaller ones. Further, companies with a continuous production process report lower barrier scores than companies using batch or just-in-time production. The multivariate results of an ordered logit regression of stated load shit potential on the principal components found that only technological risk significantly affected the potential, thus adding salience to the results of the univariate analysis.

Conclusions

We find that the most important barriers are risk of disruption of operations, impact on product quality, and uncertainty about cost savings. Of little concern are access to capital, lack of employee skills. Companies for which electricity has higher strategic value appear more concerned about technical, financial and regulatory risk than smaller ones. Companies with a continuous production process report lower barrier scores than companies using batch or just-in-time production. Principal component analysis yields five clear groups of barriers, of which only the factor representing technological risk significantly (and negatively) affects stated load shift potential.

Furthermore, our findings suggest, that financial incentives are necessary but may not be sufficient to overcome barriers to load shift. As we found that companies are especially worried about interference with their core processes and product quality, it is important for load shift programs to allow some flexibility for non-compliance in case of unfortunate timing of load shift events, especially for energy-intensive firms. Furthermore, this concern for interference may suggest that although load shift may spread widely, policy makers should not count on deep exploitation of what engineering-economic assessments suggest is the viable potential. Although policy makers may ogle the seemingly large potentials at energy-intensive firms, higher rates of exploitation may be achieved at energy extensive firms.

For the more energy intensive firms, on top of an adequate incentive structure, there may be a need for additional policy instruments or services that provide insurance against unexpected, negative shocks. In such events, the opportunity costs of non-compliance are likely to exceed just the lost incentive payments and could include negative impacts on customer relations. As a consequence, it can be expected that getting to higher capacity factors will face a law of diminishing returns.

At the same time, our results suggest that this need for additional securities may be differentiated by production process. Firms with continuous production processes may have insurance measures built-in already, which shield against excessive opportunity costs and increase flexibility compared to batch and just-in-time processes. Therefore, although unlikely candidates at first thought, firms with continuous production may represent a category where policy makers may find some low-hanging fruit.

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