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Title: Soft costs knowledge pathways in the US solar photovoltaic ecosystem

Abstract: An enduring puzzle in the US solar industry is that despite substantial reductions in the cost of photovoltaic hardware, soft costs (defined here as all non-hardware costs) have not done the same (US DOE, 2012). In fact, soft costs now account for the majority of the total cost of installed solar systems, despite decades of efforts by firms and policy-makers to reduce these costs. In this study, we address the question: How do firms gain the knowledge required to address soft costs? We use a multi-method approach to address this question, combining explorative inductive multiple-case study with responses gathered by survey. Cases were developed for 15 actors from across various roles within the industry, including residential and commercial installers (8), distribution intermediaries (3), and business software vendors (4). We conducted extensive interviews with executives at each firm (76 interviews in total) and supplemented this information with archival resources such as press releases, news coverage, analyst reports, and internet articles. This data was synthesized into a comprehensive case for each actor, detailing the activities conducted within each firm, the drivers of soft costs within that firm, and knowledge flows (e.g., new technologies, best practices, etc) within and across firms. We then compared across these cases to identify common patterns in cost and knowledge dynamics. The survey probed respondents about hiring patterns, information sharing (which, to whom, and how), and information distribution activities. Our study provides a unique perspective about how solar soft cost knowledge is generated and acquired, and how knowledge moves between firms (or doesn't). The information system itself is visualized using Sankey-style knowledge flow mapping. Distribution methods are visualized across conceptual learning processes. Our data reveal heterogeneity in a) the types of knowledge, and b) the pathways of knowledge flow between the actors in the industry. For example, we observe that distributors and suppliers play a key role in the dissemination of new technologies as well as general management knowledge for smaller firms. We show that firms vary predictably across soft cost subcategories, with significant implications with respect to critical knowledge spillovers vis-Ã -vis soft costs. Overall, these results contribute preliminary insights into the knowledge dynamics of the solar industry, the persistence of soft costs over time, heterogeneity across firm types and regions, and the effective design of policy to support the solar industry.