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**MARKET ENTRY AND INFRASTRUCTURE CHALLENGES FOR THE FUEL CELL INDUSTRY:
LESSONS ON ECONOMIC AND SOCIAL ACCEPTANCE FROM COMPARATIVE ENERGY TECHNOLOGIES**

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Overview

The fuel cell industry, a \$1.1 billion industry in OECD countries, faces enormous challenges in entering the transportation and power generation markets, including the need for hydrogen infrastructure systems. This paper examines the economic and social costs of addressing such challenges by comparing challenges faced by the fuel cell industry to those faced by several previous breakthrough energy technologies. Lessons are derived from the earlier market introductions of incandescent lights, fluorescent light bulbs and natural gas turbines, all of which faced comparable infrastructure challenges. Results of this study show the importance of concurrent innovations, standard-setting, and critical enablers.

Methods

Study methods include estimations of hydrogen infrastructure costs in OECD countries and comparison of those estimates to entry barriers faced by previously successful energy technologies. To represent two ends of the energy industry spectrum, comparisons are made to power generation and energy consumption. Specifically, we compare market entry and infrastructure challenges to those faced by the introduction of natural gas power generation turbines and light bulbs (both incandescent and fluorescent), all of which achieved market success and market penetration only after overcoming significant energy infrastructure challenges. In addition to economic costs, hydrogen infrastructures face social and policy barriers, which are also considered in historical context.

Results

The study demonstrates compelling similarities among the market entry challenges faced by fuel cells, light bulbs, and gas turbines. Like fuel cells, which face entrenched competition in a power generation industry based on an entirely different fuel, incandescent light bulbs faced entrenched and incumbent firms that used a different technology and infrastructure (gas lamps and gas pipelines). An electricity distribution infrastructure was needed – and successfully created – in order to service these light bulbs. Later, the introduction of fluorescent lights had the benefit of an electricity infrastructure, but required significant energy savings in order to justify their high initial capital costs. Similarly, the successful introduction of natural gas turbines in the 1990s required a combination of several converging forces to achieve their record market penetration rates, including innovative material design, favorable fuel infrastructure policies and market deregulation.

Conclusions

The study demonstrates that fuel cell and hydrogen-based economies may be viable if three key challenges can be overcome as they were for previous energy industry success stories. These challenges include finding niche markets until technologies are proven, achieving competitiveness through both cost reduction and favorable public policies, and reshaping

economic or supply market conditions. Critical enablers for the fuel cell industry have analogs in previous energy technologies.

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