Chapter 13
Explaining the Lack of Dynamics in the Diffusion of Small Stationary Fuel Cells

Bert Droste-Franke
Europäische Akademie Bad Neuenahr-Ahrweiler GmbH, Germany

Jörg Krüger
Ruhr-Universität Bochum, Germany

Stephan Lingner
Europäische Akademie Bad Neuenahr-Ahrweiler GmbH, Germany

Thomas H.W. Ziesemer
Maastricht University, The Netherlands

ABSTRACT

Fuel cell technology is using the reaction of hydrogen with oxygen to water in order to produce electricity and heat. It promises a high electrical efficiency even in small devices, which can be installed close to the consumer. This approach seems to be an impressive idea to contribute to a viable future energy supply under the restrictions of climate change policy. Major reasons currently hampering the diffusion of such technology for home energy supply in Germany are analyzed in this chapter. The barriers revealed include high production costs as well as economic and legal obstacles for installing the devices so that they can be operated in competition to central power plants and beside others in tenancies.

1. INTRODUCTION

The technical principle of the fuel cell was discovered in the early 19th century and has been applied since about 1960 in US aerospace projects. Using electricity and heat directly produced during the reaction of hydrogen and oxygen to water, suggests a simple, efficient, and environmentally friendly methodology for cogeneration. Such options are particularly demanded for low-carbon energy systems.

However, although technologies for the application of fuel cells for mobile and stationary energy supply have been developed for several

DOI: 10.4018/978-1-4666-1978-4.ch013

years, the devices are still in the pilot phase. This includes the application of Small Stationary Fuel Cells (SSFC) for house energy supply via combined heat and power production, which is particularly interesting because of the large heat market in that area, the technical possibility to build small fuel cell devices with high electrical efficiency, and the required replacement of aged power plants within the next years representing about one third of the installed electric power in Germany.

In the following, the reasons for the lack of dynamics in the diffusion of SSFC plants are analyzed, mainly in the case of Germany. In order to tackle relevant environmental, economical, and legal aspects from different perspectives, the methodology of interdisciplinary technology assessment was applied which is introduced in Section 2. In order to find the best way for implementing SSFC in concurrence to other energy technologies from an environmental perspective, the technical efficiency and environmental aspects are discussed in Section 3. Additionally, obstacles and chances of the fuel cell are analyzed (Section 4). Beginning with aspects of electricity networks and resource use (Section 4.1), the economic market situation of SSFC is determined (Section 4.2), and the regulatory framework is scanned (Section 4.3) to identify barriers for the diffusion of SSFC. Section 5 finally concludes with recommendations for the technological development and the market implementation of SSFC.

2. METHODOLOGY

The analysis starts with the description of the interdisciplinary methodology of technology assessment applied to the case of fuel cell-based energy innovations. This approach is driven by the question why fuel cell technology is entering contemporary systems of stationary electricity and heat production so slowly—despite its potential for energy efficiency—which is clearly an *interdisciplinary* one. As explained in this chapter, related obstacles turn out to be economic, technological, and legal problems. These barriers have to be overcome in order to improve the environmental quality of future energy supply by introducing fuel cell-based systems, among other environment friendly options. Finally, appropriate and reliable solutions are to be worked out with respect to the relevant levels of political decision making and acting, thus enabling their implementation.

Following this outline, the core disciplines are: engineering, economics and jurisprudence. They should be complemented by sound competences covering necessary sustainability issues and related policy aspects as well as profound experience in Technology Assessment (TA). The latter is indispensable because interdisciplinary work requires specific methods and structures which will improve *appropriate integration* of the above-mentioned disciplines (Decker & Grunwald, 2001). The successful integration promises additional cognitive and practical benefits for the excellence and meaningfulness of the interdisciplinary effort instead of merely adding disciplinary views as a whole with low coherence and possibly inconsistent results.

Other central prerequisites of interdisciplinary work are *excellence* and *neutrality*. The regular study should be based on efforts by relevant experts that are preferably renowned scientists from universities and independent research institutions. Nevertheless, this experts approach may be blamed for being blind for public demands, especially by advocates of participatory TA (Aune, et al., 2002; Simonis, et al., 2000). However, many participatory TA projects often suffered from specific structural and methodological deficits, thus leading to poor results with short-lived validity (Hanekamp, 2001; Gethmann, 2002). Instead, the relatively long planning and amortization periods of energy infrastructures and possible locked-in dilemmas of the future require sufficient orientation on mid-term to long-term scales as well as forward-looking decisions on related energy ques-