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Towards alternative trajectories? Reconfigurations in the Dutch electricity regime

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Abstract

In the early 2000s Dutch electricity companies are increasingly investing in technologies that enable them to replace coal with biomass. Replacing large amounts of coal (up to 40%) requires the companies to invest in technological trajectories alternative to the ones they have supported over the past decades. This paper aims to understand why these incumbent firms in the Dutch electricity regime are developing alternatives. The second aim of the paper is to provide a way for assessing the potential of innovations. The paper does so by bringing together insights from literature on (socio-) technical regimes and insights from literature on technological and market niches (strategic niche management). The main conclusion is that both niche processes (at the level of experimenting with alternatives) and changes in the incumbent regime are necessary for understanding the innovation journey of a new technology. A two-by-two matrix is developed that can be used for both analysis and governance purposes.

Keywords: Socio-technical regime; Strategic niche management; Technological trajectories; Biomass

1. Introduction

On October 15th 2004, the Dutch energy company Essent proudly announced that they were about to bring a new technical system into operation. The new system included well-developed technical components, such as storage capacity, conveyor belts, new milling equipment and several small adjustments to the power plant, but also a radically new power production facility, i.e. a 30 MWe biomass gasifier. In full operation, Essent could replace up to 20% of coal with biomass, a variety of organic sources like wood pallets or nutshells. By replacing coal with biomass, Essent was able to produce renewable energy in a conventional power plant and sell the 'green power' on the emerging market for renewable electricity. The co-firing plant was also accompanied with changes in the fuel supply chain: biomass was imported from remote countries like Canada, South Africa and the Baltic states. In the near future Essent expected to upgrade the system to replace up to 40% of the coal (Bierkens, 2004).

Essent was not the only company to co-fire biomass and coal; most other Dutch companies had also implemented co-firing equipment in the past or had far-reaching plans for the near future, ranging from simply building storage capacity to the construction of radically new innovations like gasification or pyrolysis. The total energy produced in these plants was still a fraction of total electricity demand in the Netherlands (about 1.2%), yet its rapid development and implemen-

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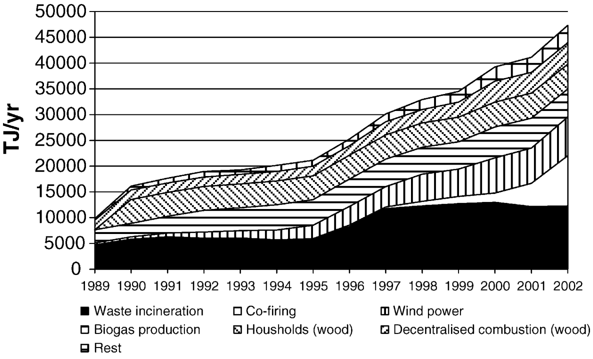

Fig. 1. Renewable energy production in the Netherlands by technology. Based on data from Joosen et al. (2003).

tation (compared to other renewable energy technologies) in the 1990s is striking. Energy production from biomass in traditional coal plants was not considered an option before the early 1990s; by 2002, co-firing became the second-largest renewable energy technology in the Netherlands, even surpassing wind power (Fig. 1).

The companies involved in the projects were part of a social network that had dominated electricity production for several decades. The companies had invested huge amounts of money in building a socio-technical system around large, fossil fuel fired power plants, a system that could still be optimised through incremental innovation. Yet, they were investing in a radically different trajectory. This article aims to understand why these firms have decided to do so, and under which conditions co-firing (and innovations in general) may become a success. In other words, this paper addresses the question how an alternative trajectory might branch off from an existing one, and under which conditions that alternative trajectory might be successful. To address these questions, I will discuss literature dealing with incremental and literature dealing with radical change. In particular, I will discuss literature focussing on (socio-) technical regimes (emphasising the patterned and continuous character of technological change), and literature focussing on (technological) niches (emphasising the importance of distinct selection environments and the co-evolution of technology and markets necessary for radical change). Both streams of literature are synthesised in a matrix that can be used for analysing the co-firing case study as well as assessing the potential of innovations.

The article continues with discussing relevant insights from the literature (Section 2), which are used for analysing the case study in Section 3. Finally, in Section 4 I draw conclusions.

2. Conceptual framework

2.1. Structured nature of technological change: socio-technical regimes and trajectories

Many evolutionary studies on technological change emphasise that technological change is often incremental rather than radical, by referring to the mechanisms of variation, selection and retention. Variation refers to the creation of new designs by engineers and scientists in R&D laboratories or research institutes[1]. Selection refers to users choosing the design that they prefer: variations are judged in a selection environment. Retention, finally, refers to the mechanisms that retain the reproduction of successful variations. Engineering routines, for example, are considered an important retention mechanism.

The cycle of variation, selection and retention often results in incremental innovation once a dominant design has emerged (Abernathy and Utterback, 1978)[2]. Engineers and developers will put most efforts into improving that design, and variety in technological designs decreases. Routines and search heuristics become shared across the engineering community and across firms, resulting in a specific pattern of technological change. Dosi (1982) called the set of shared routines (or “normal problem solving activity”) a ‘technological paradigm’ and the emerging pattern a ‘technological trajectory’. Nelson and Winter (1977) introduced the concept of ‘technological regime’: technicians’ beliefs about what is feasible or at least worth attempting. They referred to the emerging pattern as ‘natural trajectories’.

Rip and Kemp (1998) and Geels (2002, 2004) have broadened the regime concept[3]. Rip and Kemp argue that Nelson and Winter put too much emphasis on the embedding of retention (routines) in the minds of engineers. They introduce the concept of ‘rules’ and define a technological regime as:

‘the grammar or rule-set embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems – all of them embedded in institutions and infrastructures’.

[1] In research on firm population, variation and selection refer to the organisational structures and strategies of firms rather than technological designs. See for example Duysters (1995:20).

[2] A dominant design emerges, when the firm that introduced the innovation grows or when other engineers and firms imitate the design.

[3] See also Kemp (1994), Rip (1995) and Van den Ende and Kemp (1999).