Building a Biorefinery Business

Strategies for Successful Commercialization

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Strategies for Successful Commercialization

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Motivation and research question

As an integral part of an emerging sustainable bioeconomy, biorefineries can provide an important pathway to ensure efficient use of biomass resources. Broad deployment of biorefineries is needed for these benefits to materialize. However, commercialization and large-scale diffusion of biorefineries requires more than the introduction of new technology. It also demands sociotechnical changes that involve a variety of actors, interests and institutions. Despite the envisioned benefits of biorefineries, their practical implementation remains low.

The ways in which firms operate play a crucial factor in the commercialization of new technologies. Without dynamic adaptation of new strategies and business models, market introduction is generally not achieved. However, firms do not innovate in isolation, but are exposed to the wider socioeconomic context within which they operate. This environment often imposes barriers and constraints that need to be addressed for commercialization efforts to be successful.

In the context of biorefineries, a common point of discussion revolves around 'if and how' public policy measures can be used to facilitate commercialization. However, how biorefinery firms respond strategically to policy intervention, if at all, has not been investigated comprehensively. Specifically, there is a lack of studies focusing on these issues at company level. This study investigates how these strategic responses are applied in practice by firm-level actors. The aim is to explore and analyze which barriers to commercialization can be successfully overcome by biorefineries, and which may require support from additional actors within the system, such as policy makers.

The study's central research question is: *what kinds of biorefinery commercialization strategies have been successfully applied in practice and how?*

Methodology

A qualitative research approach is applied, combining a single case study with complementary expert interviews. The research applies triangulation of both data sources and collection methods. Data was collected via a literature review and a series of semi-structured interviews. The case study examines the U.S. based biotechnology company Amyris, Inc. Complementary expert interviews were conducted with Lanzatech (USA), Novozymes (Denmark), POET (USA), Storaenso (Finland/Sweden), Sunpine (Sweden), and Verbio (Germany).

The analysis and discussion of the results obtained is guided by an analytical framework that integrates insights from three frameworks: The Technological Innovation System (Bergek *et al.*, 2008; Hekkert *et al.*, 2007), a business model framework (Table 1), and the Multilevel Perspective (Geels, 2002). The focus is on the analysis of strategies and business model configurations used as responses to biorefinery commercialization challenges. These are analyzed in relation to their effect on the so-called Functions of the Innovation System (Hekkert *et al.*, 2007).

Unlike more structural definitions that concentrate on the delineation of specific elements of a business model, the representation of a business model as a system allows for a more dynamic perspective on interconnections between components beyond firm boundaries (Andreini & Bettinelli, 2017). This definition emphasizes the upstream and downstream activities of a firm, particularly how the firm interacts and connects with its network. The following elements are usually found in most business model definitions – albeit with some variation or different terminology (Andreini & Bettinelli, 2017; Morris *et al.*, 2005):

Table 1: *Structural Elements and Descriptions of a Business Model.*

Elements	Description
Value proposition	The products and services offered to customers
Customer interface	The overall interaction with customers, including customer relations, customer segmentation and distribution channels
Infrastructure	The company's inner structure for their value chain, including assets, know-how and partnerships
Revenue model	The relationship between the costs and revenues of the value proposition

It is recognized in the literature that business model innovation, i.e., the development of new business models or the adaptation of existing ones, can help facilitate the deployment of new technologies (Boons & Lüdeke-Freund, 2013). Successful business models allow the entrepreneur or firm to overcome uncertainties and incompatibilities with existing institutions. As an example, this may be through the transfer of risks and reduction of transaction costs by distributing them across supply chain actors (Boons & Lüdeke-Freund, 2013).

Results

It was found that a range of strategic responses to commercialization challenges were applied by the entrepreneurs. Most of the firms analyzed within the study, started with a focus on biofuels due to favorable policy environments. Thus, biomass resources were initially mobilized for biofuels pathways. However, over time the market conditions for cellulosic biofuels changed and company strategies shifted towards product diversification and strategies to reduce exposure to oil price fluctuations as well as dependency on policy support. To achieve this, a step-wise development has proven viable as resource mobilization and market formation are gradually and incrementally developed. In that context, collaboration across the supply chain has served as a catalyst to positively influence the functions of the innovation system. A strong degree of flexibility with regards to feedstock, products, and processes was found to be highly beneficial in terms of successful commercialization.

The analysis further suggests that if biorefinery emergence is to be accelerated, policy makers must develop a much clearer vision and establish related targets to promote the bioeconomy. Further, policy needs to take a much broader spectrum of bioproducts into account, including biofuels and biomaterials. Especially in relation to biofuels, initial market formation needs to be clearly policy-driven. Thus, a revision of the current policy approaches is needed to provide a stable and reliable investment climate, the lack of which has thus far constrained continuous development of the field.

Despite a difficult policy setting, an important finding of the study is that a number of biorefinery businesses have shown it is possible to apply strategic responses to overcome challenges and position themselves within the present market, independent of policies. Thus, when building a biorefinery business it is crucial to decide the kind of strategy and corresponding business model to implement. Careful attention needs to be paid to the ability to mobilize biomass resources and to establish supply and demand structures at the same time. A collaborative approach, leveraging resources and building a web of favorable system components, has proven a viable strategic approach towards developing and commercializing biorefineries. This is in-line with literature stating that the business model needs to be configured to achieve an alignment with the evolving socio-technical environment, reacting to dynamic changes on the system levels (e.g., institutional framework and regime structures) (Bolton & Hannon, 2016).

Table 2: *Key success factors*

	Dimensions	**Key Success Factors**
Strategy	Focus	Partnerships, product portfolio differentiation and cost competitiveness as integral part of the strategic approach to seek independence from oil prices and policy support.
Business Model	Networks, partnership and collaboration	Cooperation widely applied and highly important; positively affects all functions; horizontal cooperation (between competitors) hardly takes place.
	Product portfolio	Diversification strategy widely applied, with a step-wise process over fuels
Supply Chain	Degree of Integration	High degree of vertical integration, especially upstream; horizontal collaboration/integration hardly seen; international biomass trade not yet critical

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Disclaimer

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