

# Emergence of green business models: The case of algae biofuel for aviation



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## HIGHLIGHTS

- We develop a framework that enables the emergence of green energy business models.
- We present a case study on the algae based biofuel system for airline industry.
- The green business models in energy are global in nature and are next practice platforms.
- New market mechanisms and policy measures lead to sustainable energy business models.
- Innovation, flexibility and sustainability are the basic enablers of the framework.

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## ABSTRACT

Emergent business models seek to take advantage of new market mechanisms driven by technological changes, particularly those related to the production and delivery of clean or sustainable energy. Such business models often function at the intersection of various industries, with global views, and the resulting systems have distinct social, political, environmental, economic, technological, and business dimensions. Such holistic systems are not only difficult to develop but also require support from a broad range of actors with effective regulations and policies in place, such that the firm functions within a framework that integrates various factors. This study substantiates such a framework by detailing the nascent algae-based bio-fuel industry that caters to the aviation sector while arguing that businesses in the energy industry can emerge as a next-practice platform that drive a sixth wave of innovation. The framework begins with three basic enablers, innovation, flexibility, and sustainability, and explains how value from renewable energy technologies can be created and captured sustainably and innovatively with new market mechanisms implemented by firms with green business models.

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## 1. Introduction

Changing market dynamics, such as increasing oil prices, growing recognition of the environmental impacts of global warming (Borghesi, 2008; Campbell, 2004; de Almeida and Silva, 2009; Goodstein, 2004; Zhao et al., 2009), technological innovations in energy and environmental fields (Popp et al., 2011), and altered consumer attitudes toward green products and services (Wüstenhagen et al., 2007), encourage firms to change their existing business models too (Christensen et al., 2012; Teece, 2010). According to Johnson and Suskewicz (2009), governments and businesses need to balance four components to help green

industries evolve: enabling technological systems, an innovative and customized business model, a market adoption strategy that assures a foothold, and favourable government policies. The key to progress, particularly during economic crises, is innovation. Therefore, various firms have adjusted their business processes, to the extent that they even redefine their value proposition. Yet problems occur when new technologies cannot find immediate applications in the market or do not fit with the company's existing business model (Christensen and Bower, 1996). In particular, to take advantage of many new technologies, firms need business models that function at the intersection of various, global industries. Such innovative business models can emerge only when the regulatory framework and relevant politics support their development though (Richter, 2013).

In particular, renewable energy-based business models have the capacity to lay foundations for a sixth wave of innovation (Moody and Nogrady, 2010). Their emergence, as new market

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mechanisms (Aasrud et al., 2009), has been fraught with social, policy, regulatory, environmental, and business model challenges. We attempt to define a framework for their emergence, and we substantiate our proposed framework with a case study in the bio-fuel industry (Strahan, 2008). With this method, we adopt a structured approach to deriving and explaining green market dynamics and how the value from renewable energy technologies can be created and captured sustainably and innovatively by green business models. In seeking a clear description of green business models, we argue that innovation, flexibility, and sustainability are three basic enablers. The proposed framework has implications for strategic decision making, for both firms that pursue green energy business models and policy makers.

## 2. Description of green business models

Firms with new green business models seek to reduce costs, wastage, and environmental impacts, while also creating value with superior products and services. They redefine established production, logistics, and marketing methods, informed by green managerial practices (Haden et al., 2009). The innovative exploitation of new market mechanisms and markets, to allow such firms to emerge or go green, is a function of the business model, technological innovation, and policy initiatives.

### 2.1. New market mechanisms

The historical record of some economic indicators indicates cyclic regularity, marked by phases of gradual increases in the value of certain indicators, followed by phases of decline; the period of these apparent oscillations are approximately 50 years (Kondratieff, 1984). Since the industrial revolution, five long waves of innovation have emerged: waterpower, steam, electrification, mass production, and information and communication technologies. Moody and Nogrady (2010) argue that the sixth wave will be resource efficiency, because continually growing populations will create increasing resource scarcity and dangerously high pollution, waste, and climate change levels. Growth without increased resource consumption requires systemic breakthroughs in efficiency, including new business models

that can deliver mobility, heating, cooling, and lighting with far fewer resources or pollution. The new cycle (sixth wave of innovation; Fig. 1) thus should be characterized by profound changes in political, economic, and technological fields; to be competitive in these ever-changing environments, firms need to be flexible enough to respond effectively to changes. The global economic crisis also has intensified these challenges, which span both industries and countries. One consequence of the crisis has been the loss of jobs in the private sector, which must be replaced by new, productive jobs in future growth sectors and sustainable industries.

Business models represent a firm's underlying core logic and strategic choices, which enable it to create compelling value propositions for delivery to customers, with advantageous cost and risk structures that can capture resultant value (Magretta, 2002; Zott and Amit, 2007). With an appropriate business model, entrepreneurs can explore a market and bring their innovation (including a new product, new venture, and the network that supports it) into existence. New business models emerge to take advantage of new market mechanisms, which in turn are driven by technological changes, particularly in the production and delivery of clean and sustainable energy. A market mechanism refers to the process by which a market solves resource allocation problems, such as deciding how much of a good or service should be produced. It also offers an alternative to allowing decisions to be made by government. But it is not a perfect system for sustainability, because government policies and regulations define the market mechanisms for developing sustainable industries. New market mechanisms (Aasrud et al., 2009) put forward by the UN climate change conference offer a prime example.

In line with current literature, we describe green business models as those that exploit new market mechanisms and markets to create and capture value by innovatively sustaining their external environment. Strategic choices for business model designs, in terms of markets, customers, and value propositions, thus are made in such a way as to maximize environmental benefits, beyond the level achieved with traditional business models.

### 2.2. Enablers of green business models

The evolution of green industries requires a balance among four components: an enabling technological system, innovative

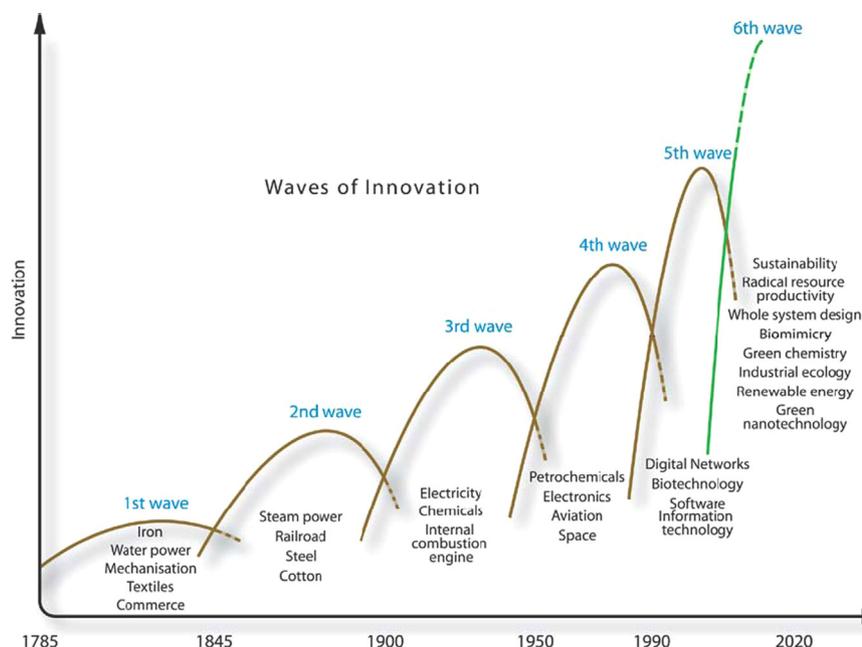


Fig. 1. Kondratiev cycles and waves of innovation (Hargroves and Smith, 2005).

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