Supply Chain Sustainability: The Bio-Fuels Market

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Abstract

Research into biofuel technology and innovative supply chain practices are helping to resolve sustainability problems in supply logistics and mass transportation. Biofuels provide a viable alternative to the use of fossil fuels and can be produced and replenished because the fuel is from plants and plant derived materials. Applications in aerospace, automotive, and electrical power production are the prime targets of biofuels development; the fuels have applications in many industries around the world. Global supply chain practices provide sustainable development of biofuels storage, transportation, agriculture, and other industries. All of these industries require partnerships between unlikely stakeholders such as aircraft jet engine manufacturers, farmers, and refiners, the fuel wholesalers. New business models and collaborative efforts create supply chain support for sustainable biofuel development, infrastructure, and pathways to make biofuels practical and affordable for everyday use. As the biofuels industry grows and matures, new technology and business practices coupled with regulation will emerge. It will become increasingly important to measure integration of supply chain methodologies as biofuels become popular and as they replace current fossil fuels infrastructure. Additionally, current oil refiners must change their drilling and harvesting of fossil fuels and transfer infrastructure over to creation and refining of biofuels for a sustainable future. This activity can be measured through the balanced scorecard methodology and will be necessary as biofuels help create a sustainable future in global transportation and other industries.
Supply Chain Sustainable Innovation of Bio-fuels

Introduction

Research into innovative alternative synthetic fuels sources for multi-purposes such as automotive, aerospace, and commercial energy is relatively limited but is not a new topic. In 1956, George Granger Brown projected that the world would increase its production of heat and power to 16 times the rate it was using over 70 years (p. 17). Even in the 50s, researchers forecasted the need for a sustainable fuel source to power transportation, industry, and homes. Brown could see that the United States, India, the United Kingdom, Germany, and Russia needed to increase production and find alternate methods of energy. He concluded that the expansion of populations and increased energy consumption will likely continue at the same rate over the next hundred years and would clearly demand large new additional sources of energy (Brown, 1956, p.17).

In 1975, Alan Manne projected the need for alternative sustainable fuel sources as an outcome of research he conducted in the refining industry and its impact on the environment. Manne argued that by examining the mixes of fuels and energy sources we are to use over the next 50 to 75 years, our needs for energy would outstrip our supplies of petroleum and natural gas. We must therefore develop synthetics to take their place. These synthetics, which will first come from coal and from advanced technologies will be needed so soon that the immensely costly R&D must start now (Manne, 1975, p.123). Manne asked important questions such as what quantity of energy will we consume in the next 50 to 75 years?, From what sources will it come?, Can science provide us with new sources of energy and new fuels?, And, if so, what will they be and when will we get them?, How far can we stretch our natural resources to meet our
energy demands?, What do the dramatic changes in our energy sources mean for U.S. businesses? (Manne, 1975, p.123). These were important questions then just as they are important questions today.

Today, bio-fuel is an important means of reducing greenhouse gas emissions and increasing energy security by providing a viable alternative to fossil fuels on a global scale. Bio-fuel industries are expanding in Europe, Asia, and the Americas. The most common use for bio-fuels is in automotive transport. The question is, how we integrate current supply chain and logistic systems to transform industry to biofuels? Biofuels can be produced from any carbon source that can be replenished rapidly (Ahman, Atif, Hafeezullah, 2007, p.25). Since bio-fuels can be replenished rapidly, a priority should be placed on supply chain management practices such as safety stock, protections against uncertainties and anticipation inventories. These practices will assist in sustainability of bio-fuels as an economical alternative to fossil fuels.

Research into sustainable supply chain innovation originates in many industries, the aviation and automotive industries are just two that benefit from sustainable development (SD). Sustainable development plays a part in innovative ways to transition into development of “green” earth-friendly aircraft power plants. Other industries could benefit from the aerospace industries innovative deployment of biofuels. Questions that could guide further inquiry into this topic are what technological innovations will sustain ground and air transportation in the future? How is sustainable innovation transforming space exploration?

When taking a systems view of supply chain sustainability of bio-fuels demonstrates the central challenges, new business models, collaborations, and integration measurements that are required to building bio-fuel sustainable solutions. An argument can be made that bio-fuels will sustain aerospace and other industries, and will transform the current refining industry. In theory this is
true but costs of inventory, pipeline inventory, economic production and purchase of bio-fuel commodities all play critical roles in determining bio-fuel viability. Schroeder, Goldstein and Rungtusanatham (2013) argue that owning to ordering costs, quantity discounts, and transportation costs, it is sometimes economical to purchase in large lots even though part of a lot is held in inventory for later use (p.373).

Evolution of Aerospace Bio-Fuels

A consortium of companies is working the need for bio-fuel in the aviation industry. The fuel is desirable to help lower the impact of exhaust gasses and provide a renewable and sustainable fuel for the air transportation industry. According to Ott (2003), sustainable development is development that reaches or maintains a sustainable state (p.60). Research into bio-fuels is sustainable development innovation primarily supporting transportation sustainability needs. Bio-fuel is a distinct liquid or gas transportation fuel derived from biomass. It can also be used directly for heating or power; that is why it is called biomass fuel (Ahmad, Atif, Hafeezullah, 2007, p.25). The aerospace industry requires sustainable fuel sources for its propulsion systems to ensure the industry can meet the growing need for commercial, military, private and cargo air travel in the future.

Aerospace and automotive companies are inspired to invest in research and development of bio-fuels to support the sustainability of their perspective industries. In 2010 the U.S. National Aeronautics and Space Administration (NASA), hosted a Green Aviation Summit, which addressed the issues of air-traffic fuel consumption and infrastructure demands. In past years, outcomes from the annual green aviation summit resulted in the development of winglets, which are vertical attachments to aircraft wings that save fuel. The summit has also resulted in
implementation industry standard fuel consumption practices such as shutting off auxiliary power units as aircraft are parked at airport gates boarding and offloading passengers.

The 2010 summit addressed reduced fuel consumption and reduced jet engine emissions and bio-fuel development for the industry. Both NASA and private sector companies are exploring alternative fuels. A big push to create aviation biofuel is underway at Washington State University (Pullman, Washington, USA), where the collaborative sustainable aviation fuels Northwest Project will work on a renewable jet fuels derived from biomass sources, which consume carbon dioxide and offer greater energy content than traditional fuel (Jenvey, 2010, p.8).

NASA’s near-term sustainability goals are to create aircraft that burn 33% less fuel than the current best performing models by 2015. NASA’s goal is to improve aircraft fuel efficiency by 50% by 2020, with greater efficiencies by 2025. Reduction of ozone emissions are projected to be reduced by 20% by 2015, 50% by 2020, and more than 50% by 2025 (Jenvey, 2010, p.8).

Central Challenges

To achieve a sustainable supply chain for bio-fuels takes people making the move to the industry. Anthony, Duncan and Siren (2015) argue that innovation is not process-driven, it’s people-driven. However, we do need institutional set up that fosters innovation (p.22). In order to attain a future supply chain in aerospace will take numerous companies, countries, and industries. Supply chain management innovation must overcome many central challenges to move forward. Many of these challenges are currently in work across a broad spectrum of industries and in stakeholder communities. Infrastructure, costs, integration, production
limitations, regulations, funding, and research and development are the common challenges associated with development of sustainable bio-fuels and bio-fuel innovation.

Stakeholders are located in the public, private, and nonprofit sectors. Farmers, aerospace companies, government entities, investors, and research professionals required to advance biofuels into the future that will overcome many of the roadblocks to use sustainability that stakeholders face today. Koen, Bertels, Elsum, Orroth, and Tollett (2010) indicates that although large, incumbent firms have demonstrated an ability to succeed at breakthrough technology innovation, they too often fail at business model innovation that requires them to move into new market spaces (p.48). This point speaks to the inability of companies to get their arms around many of the complex issues that are central to innovative bio-fuel development and integration. Aerospace companies are good at what they do, farmers are good at what they do, but many other issues need addressing to build sustainable bio-fuel pathways.

**Infrastructure**

Investing in existing infrastructures is part of the solution to bring about transformation to sustainable bio-fuel in the aerospace industry. There are sustainable solutions, which are functional for existing refining and supply chain infrastructures to help integrate into a bio-fuel business. For example, companies offer suppliers incentives to become environment conscious. Companies use tools such as enterprise carbon management, carbon and energy footprint analysis, and life cycle assessment to help companies identify the sources of waste in supply chains (Nidumolu, Prahalad, Rangaswami, 2009, p. 59).
These companies bring their existing infrastructure into biofuels research and development and have incentive to innovate. Since aerospace stakeholders heavily invest in their industry, they use incentives to bring other advantageous infrastructure into the biofuels industry.

**Production Limitations**

Biofuels are derivatives of plant oils, which require harvesting and processing in multi-steps. According to Morse (2009) biofuel production can be increased through a process called synthetic genomics which is engineered algae to produce a bio-crude which can be processed into gasoline, jet fuel and diesel (p.66). The Federal Aviation Administration (FAA) is leading the Commercial Aviation Alternate Fuels Initiative (CAAFI), which targets certification of a 50% mixture of synthetic and conventional aviation fuel by 2010 and to certify 100% synthetic bio-fuel by 2013 (Interavia, 2008, p.7). Raw materials, a small number of developers, bio-fuel yield are all production barriers, on which the industry and stakeholders concentrates. Others organizations such as CAAFI require further research in order to make bio fuel technology sustainable. Boeing and Airbus are both working to attract more investment capital for infrastructure and innovation in bio-fuels to provide a medium-term solution. Virgin Atlantic and GE, have provided funding to perform flight-tests with a mixture of bio-fuel and jet-A.

**Regulation**

Air-traffic CO2 emissions trading has become an instrument in which standard regulations and market trading are starting to form in Europe. Air transportation CO2 emissions is estimated to triple by 2050, and the European emissions trading scheme (ETS) has proposed improving aircraft emission standards by 90% from 2006 levels by 2022 (Interavia, 2008, p.7). Airlines and individual aircraft operators would have to consent to compulsory purchase permits
to fly within Europe. The idea is gaining traction in the United States. These regulations have
direct impact on bio-fuel development by forcing more investment for faster development. In
addition, the spinoff affects will promote algae research and development. Algae could provide
up to 300 times more fuel than soya-based processes because of their high oil content (Interavia,
2008, p.7). It remains to uncertain if the bio-fuel industry will be regulated to the degree in which
current oil refining is subject to comply with.

The Boeing Company has worked to corroborate with bio fuel research companies in
sustainable development work in bio fuels for aviation. The company has developed such a bio
fuel to ensure aircraft manufacturing sustainability with applications that far exceed aerospace
needs. Aerospace companies are currently testing the fuel as cradle-to-grave sustainable
innovation so that companies can be lead integrators and stakeholders that stay abreast of bio-
fuel regulation.

Building New Business Models

Companies engaged in development and deployment of biofuels must build new business
models that are a product of rethinking the company’s value proposition. Old business models
value proposition netted revenue through providing goods and services as a consumption-based
business. New business models will provide eco-friendly goods and services through partners
that have similar sustainability strategies and goals. Developing a new business model requires
exploring alternatives to current ways of doing business as well as understanding how companies
can meet customers’ needs differently (Nidumolu et al., 2009, p.123). The key to this point is
how well company leaders question how the current business model facilitates a contributing to
sustainable new product innovation, partnering with companies as adjacencies to the companies
green strategies, and how old business models contribute to helping the company lead in sustainability. According to Kanter (2006), innovation involves ideas that create the future. But the quest for innovation is doomed unless managers who seek it take to learn from the past given the right balance between exploiting (getting the highest returns from current activities) and exploring (seeking the new) requires organizational flexibility and a great deal attention to relationships (p.83). In a new business model, companies must consider becoming eco-friendly as a standard cost of doing business. Companies will need to develop new strategy, new structure, and new processes to build sustainability pathway in bio-fuel innovation.

**Strategy**

Strategy within a company must change to help companies partner with adjacency industries. General Electric focused tackling environmental issues, making sustainability key in all business divisions and strategies, waste management changed their business strategy to earn profit by transforming waste products into recyclable products. Dell, Cisco, and Hewlett Packard developed sustainability strategy to become leaders in sustainable innovation. To develop innovations that lead to next practices, executive must question the implicit assumptions behind current practices. This is exactly what led to today's industrial and services company (Nidumolu et al., p.123). Using the Balanced Scorecard (BSC) to measure bio-fuel development is a practical approach to integration of biofuel in mainstream industries.

**Measuring Bio Fuel Development**

**Balanced Scorecard Approach**

The balanced scorecard is an optimal performance measuring system for tracking and assessment of bio fuel development. Measuring a specific bio project through its development is
consistent with what Pateman (2008) describes as the monitor and learning aspect of the balanced scorecard methodology (p.13). The process of aligning the BSC to reflect sustainability performance to corporate goals, strategy, and objectives is not new; several companies such as Honeywell, General Electric, and Boeing use it. Honeywell for example, has developed a renewable energy scorecard that helps customers make informed decisions as they acquire renewable energy tools.

The scorecards design helps leaders analyze the variables for any given location to pinpoint technology with the most significant environmental and economic advantages. The scorecard was valuable for organizations that were motivated by potential economic benefits in addition to good environmental stewardship. The tool evaluated six proven renewable technologies including solar, wind, biomass and geothermal and provided a good provides a simple payback for each (Spiegel, 2008, p.68). Honeywell’s BSC example is one model that demonstrates the necessity to measure bio-fuel and biomass integration. The measurement of CO2 reduction and the potential buying of environmental credits are part of the environmental sustainably broader scope, which requires a broad view of all strategies and business objectives.

Fiksel and Bakshi (2008), sustainability researchers at the center for resilience at the Ohio State University, demonstrate the need for assessing sustainability of transportation biofuels. The researchers demonstrate that public policy, natural resources, engineering, science, arts, and business can work together to improve resilience of industrial systems in the environment in which they operate (p.2). The work the researchers are conducting validate the need for measuring common sustainability initiatives in industry. Fiksel and Bakshi’s research and assessment of lifecycle trade-off mapping for alternative fuels coupled with the short-term continuity and long-term sustainability suggest new pathways for biomass and alternative fuel sources.
Current research that includes measurement of supply chain sustainable practices through stakeholders in industries particular to biofuels may provide understanding of how to best utilize the BSC to measure their direct role in sustainability. For example, the aerospace and airline industries have many stakeholders that contribute to sustainability in the industry. These include jet fuel refiners, and suppliers that manufacture aircraft parts that the industry consumes. There are many other stakeholders, who are adjacent to the industry, which are stakeholders in their other markets. The suppliers and stakeholders have a domino effect in other industries. If the aerospace and airline companies promote industry assessment and measurement standards using the BSC, adjacent industries are more likely follow suit.

The communities, policymakers, regulatory agencies, third-party suppliers, and other countries are all stakeholders. In addition, a host of other adjacent markets, industries, and activities serve as stakeholders that could benefit from measurement through the BSC. Using the BSC methodology in measuring direct sustainability of biofuels is important to capture stakeholder’s contributions and engagement in development and maintenance of biofuels. The premise at this point is the BSC methodology for measuring adjacencies that comprise independent factors and variables will provide a broader picture of how bio-fuel integrating industries are affecting biofuels sustainability and other industries as a whole. Many of these adjacent industries in stakeholders may be out of integrating industries direct control; however, influence on these industries may help break down barriers in an industries biofuel sustainability journey.

**Stakeholders View**

A sustainability-oriented company is one that develops over time by taking into consideration the economic, social, and environmental dimensions of its processes and performance… in this perspective, value creation processes abroad and shared and meets, in
different ways, the stakeholder expectations. For this reason, it is possible to make a shift, generally adopted notion of value, and introduced the concept of stakeholder value (Perrini, Tencati, 2006, p.298). These authors advocate a sustainability evaluation and reporting system (SERS). The SERS is an integrated methodology aimed at monitoring and tracking from a qualitative and quantitative viewpoint the overall corporate performance according to a stakeholder framework (Perrini, Tencati, 2006, p.296). The SERS differs from the BSC in the area of communication of strategic value related to company objectives linked with stakeholders. This would allow companies to evaluate their strategies and change them as stakeholder values change. The key difference with the SERS as it relates to the BSC is that stakeholders receive reports on performance and have input to outcomes. This methodology assists with stakeholder adoption, and links communication between stakeholders in sustainability innovation with decision makers who make performance and outcome decisions concerning performance.

**Implementation**

Implementing any measurement device requires cooperation and adoption throughout any corporation. In the case of implementing measurement devices among partners in biofuels technology transparency and assess ability become key issues. The sharing of data and alignment of strategies become important to all organizations that are working together to bring biofuels to the mainstream of society. Current partnerships such as Boeing and biofuel refiners are examples where the implementation of measuring instruments such as the BSC are beneficial to sustainability objectives for each of the companies involved. Corporations throughout the world are adopting the balanced scorecard to help them implement corporate strategy. Organizations use the BSC to implement a sustainability strategy and to link corporate sustainability objectives with appropriate corporate actions and performance outcomes (Epstein, Wisner, 2001, p. 1). The
overarching point Epstein and Wisner makes concerns linking corporate sustainability strategy. Linking strategy becomes increasingly important to companies as they work to overcome challenges to integration, funding, partner and alliance performance, and stakeholder values.

Conclusion

Building a sustainable supply chain management future in biofuels is not a new topic. Alternative fuels for automotive and aircraft applications have been a consideration in every decade since the mid-1950s. Questions begin to emerge as to what alternatives would be in place to provide sustainability for future generations. With the expectation that passenger and commercial air travel will triple over the next four decades it is imperative that bio-fuel technology and innovative practices arrive on the market speedily. Aerospace companies, automobile manufacturers and other stakeholders such as bio-fuel refiners, and farmers are now collaborating to develop biofuels. The stakeholders are the trailblazers of the bio-fuel frontier.

As development of bio-fuels moves forward it becomes increasingly important to measure key supply chain milestones, sustainability objectives, progress of innovation, and the milestones associated with charting the bio-fuels sustainability pathway. Epstein and Wisner (2001) argue that using the balanced scorecard for environmental and social performance measurement is one way to tie performance metrics for sustainability to accompany strategy. That said, each business is likely approach sustainability differently, as they build their own pathway to a sustainable future in bio-fuels innovation.
References


