MARKET ANALYSIS OF SECOND-GENERATION BIOETHANOL IN VIETNAM:

IMPLICATION FOR BUSINESS OPTIONS



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Lahti University of Applied Sciences Master Programme in International Business Management

IVA, VO TRIEU LE THAO:

Market analysis of 2-G Bioethanol Business in Vietnam Implication for Business options

Master's Thesis, 103 pages, 09 appendices

Winter 2011

ABSTRACT

With the country's moonsoon weather, Vietnam has ideal conditions for agriculture such as rice, sugar cane, maize, and has long been well-known for being the second largest exporter of rice in the world. Recent achievements in second-generation bioethanol ("2-G", also known as cellulosic ethanol) open up a possiblity to utilize these huge agricultural residues of 45.6 million ton per year for bioethanol production.

The purpose of this study was to investigate the interconnection between market needs, the market potential, unmet needs and favorable conditions for 2-G bioethanol companies to market their technologies and "seize this white space" in Vietnam. Another aim was to examine the different potential strategic customer groups from bioethanol production's upstream to downstream and opportunities to develop vertical integration in order to optimize the ethanol value chain.

Qualitative method was applied in this study. The data were collected through questionnaires and in-depth interviews with key stakeholder groups to to elaborate an insight into Vietnamese bioethanol market

Two strategic options serve as the main recommendation for international companies with 2-G bioethanol technology to enter Vietnamese market and tackle the 3.05 million ton worth of the country's ethanol market pie. These options include: a Technology Licensing to local customers plus optional agreements on bio-tech sales and services; and a Joint Venture with local Petroleum Distributors in which the foreign technology partner jointly establishes production in Vietnam.

Key words:

Bioethanol, Second-Generation Biofuels, Cellulosic Ethanol, Biomass, Vietnam, Emerging Market, Target Market

PREFACE

This study is my thesis for the conclusion of my Master program at Lahti University of Applied Sciences. After having completed the study, it turns out to be an emotional moment for me, looking back at the last one year and a half in Finland. I want to take this chance to write a little note for everyone around me, to let them know how much I appreciate them and everything they've done for me.

First, allow me to thank my supervisor, Dr Brett Fifield for his confidence in me and for never letting my brain get rusty, even for a minute. I'd like to thank Keith O'Hiobhaird, my second reader, for all the time he spent with me and my everchanging thesis text. As always, meeting him with his stories blows away my worriness and makes me have more passion in everything I do.

I also would like to extend my special thanks to Ms Phuong Kieu for her precious advice. I wouldn't have landed up in this interesting bioethanol research topic without her.

I'm grateful for my family with their unconditional love, and that they have guided me to be who I am today. And thank my friends and ex-colleagues who still stay in touch with me all the way from Vietnam. Your love, your support gives me motivations to live life to the fullest.

Last but not least, I'd like to thank Linh Nguyen, An Tran, Thao Phan and all my Master classmates, my journey in Finland would have been much harder without you. I will cherish all the up and down we've been through and wish us all a great success ahead after school.

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ABBREVIATIONS

1-G ethanol First-generation bioethanol

2-G ethanol Second-generation bioethanol

AFTA ASEAN Free Trade Area

ASEAN Association of South East Asian Nations

BOD Biochemical Oxygen Demand

CDM Clean Development Mechanism

CER Certified Emission Reduction

COD Chemical Oxygen Demand

DNA Vietnam Designated National Authorities

FDI Foreign Direct Investment

GSO General Statistics Office

JICA Japan International Cooperation Agency

MARD Ministry of Agriculture and Rural Development

JV/ JVE Joint Venture Enterprise

Ml/y Million liter per year

MoF Ministry of Finance

MoIT Ministry of Industry and Trade

MoNRE Ministry of Natural Resources and Environment

MoST Ministry of Science and Technology

MPI Ministry of Planning and Investmen

MToE Million Tonnes Of Oil Equivalent

ODA Official Development Assistant

PDP Process Design Package

PVN PetroVietnam, Vietnam National Oil and Gas Group

PVOil Petrol Vietnam Oil Corporation

SBV State Bank of Vietnam

TRIPS Trade-Related Aspects of Intellectual Property Rights

VCCI Vietnam Chamber of Commerce and Industry

VND Vietnam Dong

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1 INTRODUCTION

This study is set out to exploit the market opportunities of second-generation bioethanol in Vietnam by leveraging cutting-edge technologies. The introduction part of the thesis will present the background of this study, pointing out the reasons for choosing this subject. There will also be short discussion about the environment where the ethanol industry is evolving and what kinds of challenges or opportunities it might have in the future. Furthermore, an explanation of the objectives, questions and limitations of this study are given and a brief introduction to the theoretical background and the research approach chosen.

1.1 Background

The world is running out of oil. There is a global competition to find out all possibilities of replacing fossil fuels to ensure sustainable development for the future. Being among the 3 Asian economies that achieve faster growth in 2011, not to mention an economic growth of 7% or higher in 10 years (Stockplus, 2011; SCB, 2011), Vietnam is not far away from this energy balance puzzle. Vietnam is a country in Southeast Asia, bordered with China, Laos, Cambodia, Thailand and Eastern Sea. The main land area is 331,690 km², which is quite similar to that of Finland (with a population of 5 million); however, the population is nearly 90 million people, ranking 13th in the world.

Given the rapid economic development, Vietnam is coming into the stage to demand substantial amount of material and energy to construct the nation, develop socio-economic infrastructure and improve living standard (APEC Work Group, 2007). Consequently, power generation, sales of technologies, environmental project and implementation of these major infrastructure projects are among the most promising opportunities on the commercial activity list of U.S. Department of Commerce, as they associate with growth in Vietnam (U.S. DoC, 2011).

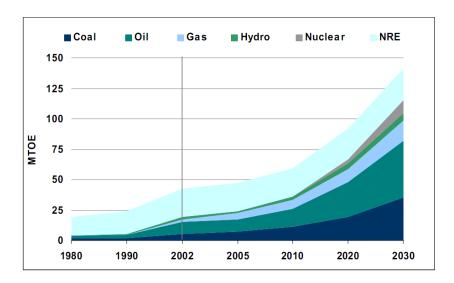


Figure 1-1: Vietnam's Primary Energy Demand (cf. IEEJ, 2006; APERC Analysis, 2006)

Figure 1-1 shows that Vietnam will increasingly become dependent on fossil fuels, while the total estimated crude oil reserves at 2.7 billion barrels is only enough to satisfy domestic demand up to 2030 (ADB, 2009). According to Petro Vietnam – the national Oil & Gas Group, in 2010 the output fell about 6 percent to 15 million metric tons, due to aging oilfields. The petro deficit in Vietnam is 12.4 million tons in 2010, increasing to 21.2 million tons by 2020, not to mention that the outstanding issue of the border in the South-China Sea could prevent the country from future development in offshore drilling in the central part of Vietnam.

To reduce the dependence on fossil fuels, we do not need any magic wand to cast a spell, as the world has seen the shifts from fossil fuels to biofuels, or bioethanol in Brazil and the U.S., notably.

"The gradual move away from oil has begun. Over the next 15 to 20 years we may see biofuels providing a full 25 percent of the world's energy needs. Biofuels are being developed for wide-scale use in many countries due to their known benefits."

Alexander Muller, Assistant D-G for the Sustainable Development Department,

FAO

So, what is bioethanol?

Simply put, bioethanol is a fuel with a high octane number and a low tendency to create knocking in spark ignition engines. Oxygen in its molecule permits low-

temperature combustion with reduction of CO and NOx emissions. Low-percentage ethanol-gasoline blends (5%-10%) can be used in conventional sparkignition engines with almost no technical change. (IEA, 2011)

Based on the feedstock used for production and the technologies used to convert that feedstock into fuel, bioethanol technologies can be classified into two groups. Technologies that normally utilize the sugar or starch portion of plants (e.g., sugarcane, sugar beet cereals and cassava) as feedstock are known as first generation bioethanol ("1-G") (Rutz and Janssen, 2007; OECD-FAO, 2008). On the other hand, just as in Grimm's fairy tale where straw were turned into gold by the manikin, now the technology development enables another miracle of producing bioethanol from straw, or biomass in general. Bioethanol produced using cutting-edge technologies employs dedicated enzymes that convert this lingo-cellulosic biomass (e.g., agricultural and forest residues) are called second **generation** ("2-G"), or **cellulosic ethanol** (Worldwatch, 2007). In this regard, any competition with food production is eliminated (CDM, 2011). Second generation bioethanol business will operate on a triple bottom line basis to protect the environment by reducing the global warming effect, empower the local communities by utilizing the agricultural residues while still producing profit (Chempolis, 2011). In fact, the Japanese nuclear accident in March, 2011 makes people more concerned about the development of clean power. People are attracted by cellulosic ethanol because of its advantage of the widespread raw materials without pollution.

Bioethanol in Vietnam: The status quo

Vietnam has been producing ethyl alcohol for many years (76 million liters in 2005), it has been consumed primarily by the alcoholic beverage and pharmaceutical industries. In November 2007, Decision 177/QD-TTg on biofuels development strategies from 2015-2025 was passed to set out the production target of 250,000 tons of biofuels and 1.8 million tons by 2025. This is the crucial supporting framework to expedite the industry development.

As a result of this enabling environment, by the end of 2011, Vietnam will have four ethanol fuels manufacturing facilities (No. 1-5 in Figure 1-2) with a total designed capacity 300,000 tons per year (Khang Nguyen, 2011), using cassava as input materials, which are of the 1-G ethanol manufacturing technology.

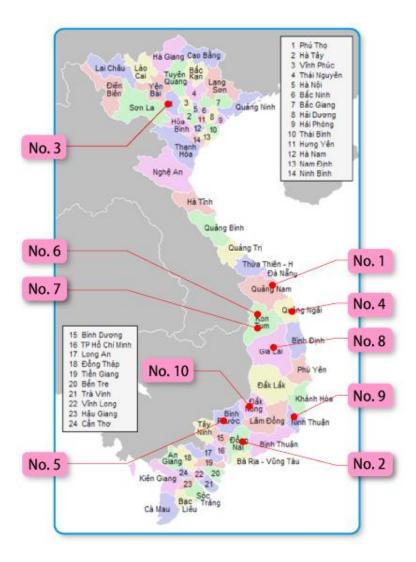


Figure 1-2: 1-G Ethanol plants in Vietnam (Asia Biomass, 2010)

The price of cassava has climbed by 50 per cent since early this year, and the price is expected to rise further in the near future, according to the Ministry of Agriculture and Rural Development (MARD, 2011). Due to this rapid increase in cassava prices at the marketplace, the ethanol plants are expected to generate humble profits (Vietnam Business News, 2011a). Moreover, this is a problem because cassava could cause food-versus-energy debate and serious land erosion. In addition, the plants have to use other fuels like coal, which also can cause environmental pollution, for operations.

The key to success of future energy needs is to achieve energy without conflict of interests for water, land, food (Hedon, 2010). Recent deals illustrate a trend of moving away from 1-G technologies towards the next bioethanol generation, cellulosic ethanol, made from the sugar in cellulose that Vietnam can take a dramatic leap forward with the technological breakthroughs at this point.

Why Vietnam?

In Vietnam and also in other neighboring countries, there is a lot of cellulosic biomass available that can be used as fuel for ethanol production. As the world's second largest rice exporter, Vietnam produces about 40 million tons, and the same amount of rice straw (39 million tons). A study conducted by Man Tran, Vietnam owns the availability of cellulosic biomass (agricultural residues: rice straw, bagasses, and can leaves) at 45.6 million tones (Man Tran, 2007), which otherwise are now burned or dumped causing river pollution.

Burning agricultural residues causes acrid hazes, and too often, disrupts lives of local residents. Hoang Trung Hai, the Vietnam's Deputy Prime Minister raised concerns on slash-and-burn technique to clear residues after crop harvesting, a perennial problem for years in Vietnam, and Ministry of Natural Resources and Environment (MoNRE) has been assigned to be in charge of response to this haze problem (MTND, 2011).

This study, therefore, aims to elaborate an insight into Vietnamese bioethanol market, information about the segments for 2-G ethanol technologies, and an understanding of dynamic factors within the whole industry value through examining the stakeholders, their functions/ linkages and the strategies to be able to access as well as to compete in the market. Simultaneously, the related scientific efforts and favorable conditions for bioethanol business must be achieved and involved in order to reinforce the potential and its prospects as a promising business opportunity. This approach focuses on the relationships and behaviors rather than simply on tangible solutions to technology constraints.

1.2 Research objectives, questions and limitations

The primary objective is to define most attractive routes to the potential business opportunities. Foreign bioethanol players can take the formulated strategic options into account when setting their own strategy to enter the market with their 2-G bioethanol conversion technology breakthroughs.

The main research question:

What are the most attractive routes to Vietnamese 2-G bioethanol market?

Sub-research questions:

- What is the market demand for Bioethanol production and potential from biomass?
- How favorable is Vietnam's legal environment for biofuels development in general and bioethanol in particular?
- What are the business opportunities that lie along Bioethanol value chain in Vietnam?
- Who are the most important stakeholders to operate business in the industry?
- Based on the interconnectedness of the above factors, what could be the business models to enter and compete in Vietnamese 2-G bioethanol industry?

Limitations

Among the different options for bioethanol production, this study will be focused on the 2-G bioethanol as a fuel additive for fossil fuels (specifically gasohol) for transport and respective market segments. Due to the time contraints, the researcher could not investigate all potential feedstock for cellulosic ethanol but with focus more on the agricultural residues, which currently appear to be the most interesting with biggest volumes available in Vietnam.

Another challenge is, data related to historical prices and supply and demand for biomass is less clear than cassava available for producing first generation bioethanol. Also Ethanol 5% blend gasoline distribution has just been launched for less than 1 year (2010) on a pilot scale. This makes a thorough analysis difficult. The study is explorative in nature, which means that the research approach is relatively broad perspective and paves the way for more specific and technologically project-based research.

1.3 Research approach, methodologies and empirical study

The qualitative research method is chosen for this study due to the subjective nature of the research and little available historical data. This method will be implemented to forecast demand into future and identify the most profitable 2-G

bioethanol business option in Vietnam. In this study, the researcher conducted a 3-phase study following the research framework below:

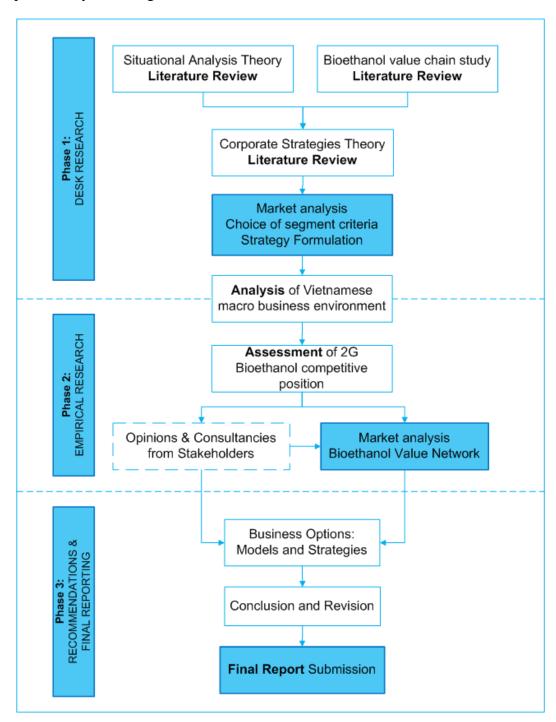


Figure 1-3: The Research Framework

Phase 1 of the study was a desk study with the following objectives:

- To learn about the global bioethanol trend and its context in Vietnam.
- To study the macro-economic factors including laws and regulations in Vietnam concerning biofuels.

Phase 2 of the study was the empirical research with the following objectives:

- To assess the intensity of competition; and evaluate potential market segments.
- To measure customers/ partners' expectations; and to determine how they will best be met
- To define the expectation towards cooperation and/or partnership
- To figure out other relevant stakeholders necessary for market access

The study is based on four weeks of field research in the target market and extended interview with other relevant stakeholders of the industry in Vietnam and Finland. Stakeholders of the bioethanol sector have been interviewed at the national level, with concentration on the first 5 companies operating 1-G ethanol and potential new participants in the industry from the ethanol upstream to downstream. The purpose is to understand the industry, as well as different ways of organizing the value chain and pursue a wide range of different policies to get the activity started.

Qualitative information was also collected on different socio-economic and environmental aspects (consulting from institutions, Ministry of Natural Resources and Environment (MoNRE), Ministry of Industry and Trade (MoIT) etc.) Means of semi-structured interviews are employed, which could enable detection of potentials, risks and tradeoffs.

Phase 3, the final phase is conducted for adaptation, final reporting and publication. In this phase of the research, the results of the interviews will be used to adjust and structure of the proposed business options and to finalize the market analysis with relevant insights provided by stakeholders. Then the final report is drafted and presented.

1.4 Theoretical framework

The study was inspired by Porter's Competitive strategy formulation within an international context. The model concentrated upon the role of the industry concentrated upon the role of the industry environment in determining strategy (competitive strategy) and the use of the value chain as a vehicle for analyzing

opportunities for competitive advantage and for configuring a firm's system of activities considering the country level sources and international business movement (Porter, 1990; Grant, 1991).

Adapting to of this project, the theoretical framework can be modeled in a sequence of theories as below:

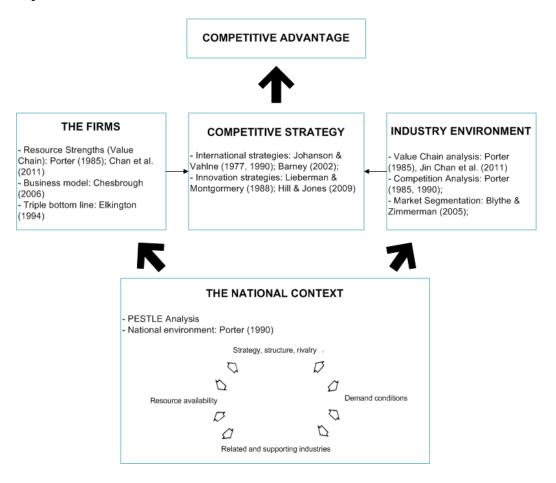


Figure 1-4: The Theoretical Framework (Adapted from Grant, 1991)

The uncertain world around an organization, the business environment, has always been a challenge for a company for its diversity of influences, the interconnected complexity of separate issues such as politics, economics to technological factors etc.

Johnson et al (2006) introduced a framework of a series of environment layers with the aim of helping to identify key issues and ways of coping with complexity and change. The starting point can be provided by PESTLE framework to identify the key drivers of macro environmental change.

The next industry layer covers the environment within a group of organizations that produce relatively similar products or services. Each organization employs

different ways to connect its different activities in a value chain, and itself inteteracts other organization in a broader concept of industry value network. Porter's Five Forces (1990), Value Chain (1985), Value network and vertical integration (Barney, 2002; Johnson et al., 2008; Chan et al., 2011) theories were applied to analyze the layer. As a result, not only how competitive and dynamic changes within and around the industry are revealed, but also implies different strategies to sustain a company's own competitive advantage by taking the diffusion S-curve into consideration.

According to Lieberman & Montgomery (1988), in certain industries, the robust first mover stands chances to gain the control over the market against late-entry competitors. Hill & Jones (2009) added that its dominance is significantly reinforced with the appropriate innovation strategies in an international context, which are "going it alone", "enter into an alliance" or "licensing the innovation".

An appropriate international strategy balances the equations of resource commitments plus risk and the return trade-off. In making the decision about which strategy to use, Dunning (2001) emphasizes consideration of ownership advantages controls, location advantages, which are controls of cutting-edge 2-G bioethanol technologies and the advantages Vietnam can offer in terms of feedstock supply and strategic location for profitable businesses.

Chesbrough (2006) builds up a bridge between these technical inputs and economics outputs through his Business Model in Capturing Value from Innovation. It serves as a tool to evaluate strategies by assessing the Customer Value Proposition, the Value Network, Revenue stream and respective competitive strategies.

Ultimately, the bottom line of a cleantech business, apparently 2-G bioethanol business should be able to perform a sustainable business, going beyond the traditional measures of profits, return on investment (ROI) and shareholder value to include environmental and social values. Elkington (1994) framework hence is employed to measure this triple bottom line of identified business opportunities.

1.5 Structure of the study

This study is comprised of four chapters in addition to this introduction.

In the second chapter, the literature review is presented discussing different tools to analyze the market attractiveness, industry competitiveness and strategy formulations for value capture.

Chapter 3 introduces the description of the chosen research approach and the methods to analyze and interpret the data.

The fourth chapter presents a panorama of the bioethanol market in Vietnam, relevant influencing factors and stakeholders by presenting findings from the empirical research. Lastly, the recommendations and conclusions are presented in chapter 5.

2 LITERATURE REVIEW

Bio-ethanol, or biofuels in a broader sense, has attracted substantial studies. There is a growing body of literature related to biofuels, which has been primarily preoccupied with policy instruments, environmental impacts and greenhouse gas emission reductions, food and poverty interactions, and technology advances.

With an ambition to figure out attractive routes for these technology breakthroughs to markets, the researcher tries to take knowledge from bio-ethanol industry and bring together with corporate strategies.

In this chapter, only a selection of the relevant literature is presented here adopting conceptual structures, focusing on addressing below questions:

- On the basis of which theories, models and concepts derived from strategic management and industrial organization literature, can Vietnamese bioethanol market be analyzed?
- Which theories with regard to firm strategy are relevant to take into consideration when formulating business options in Vietnam for international bioethanol producers?

Many of the more recent studies are motivated by technology feasibilities, this section will walk through (i) the technology routes and their trends, (ii) chosen market analysis tools, which will be followed by Chapter 3 to introduce the research approach/ method. Chapter 4 will be further detailed into the Vietnamese bioethanol market current scenario and analysis using tools introduced in this chapter.

2.1 SECOND-GENERATION BIOETHANOL PRODUCTION

This section examines in detail the technology feasibility and economics of bioethanol production based on utilization of biomass (specifically, non-food raw materials for producing cellulosic ethanol). This endeavor examines two areas. First, previous studies of favored 2-G conversion technology routes and bioethanol industry trend are introduced. Second, the application of value chain

analysis for bioethanol from biomass will be conducted, with the purpose to point out the most attractive opportunities lying along the industry value chain.

2.1.1 2-G Production technologies

Currently there are two technology routes for cellulosic ethanol production:

Biochemical conversion process: Hydrolysis uses acid and enzymes to break down the cellulose releasing simple sugars, which is then followed by Fermentation and Distillation process to separate ethanol (Appendice A).

Thermochemical process route includes production of syngas using gasification of the biomass from a controlled oxygen supply, cellulose, hemicellulose, and lignin. The syngas is converted to ethanol through Fermentation or Catalytic synthesis. (BioZio, 2011)

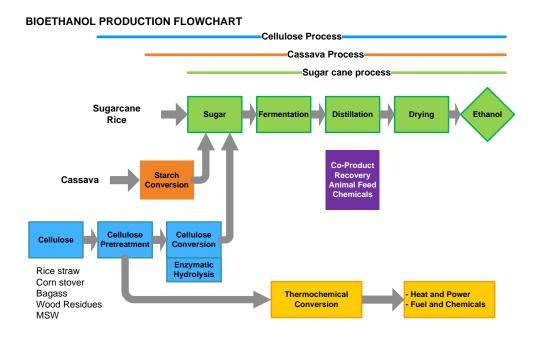


Figure 2-1: Bioethanol Production Flowchart (adapted from cf. Plantoils, 2011)

World trend of 2-G Bioethanol technologies

Much progress was made during the recent years in R&D massive investments. Significant hurdles are overcome that enable 2-G bioethanol to take off at commercial scale from 2013. Above all, reducing the enzyme cost is the key to commercializing 2-G bioethanol. It is more feasible to develop enzymes to fit the

process rather than a process to fit the enzyme. The advanced technology helps to optimize the production process with higher sugar recovery, higher ethanol yields, along with reduction in enzyme dose (Novozyme, 2011).

These achievements may ultimately prove that enzymatic conversion process is currently more efficient based on cost reduction, carbon emission rates and other factors. In addition, the possibility to convert hemicelluloses into ethanol besides celluloses would contribute to increase the ethanol production capacity as much as 50% (Biofuels, 2010).

2.1.2 2-G bioethanol value chain

The bioethanol value network can be divided into three distinct stages, which are (i) the upstream agro-commodity stages, (ii) the midstream ethanol manufacturing stages, and (iii) the downstream transport fuel stages (Chan et al, 2011). The result is a larger stream of activities known as the value system. There are three driving forces influencing on this industry structure, namely: permeable industry boundaries, security of supplies and access to the retail market. These forces encourage a trend towards vertical integration as observed in recent development in the industry. (Chan et al, 2011).

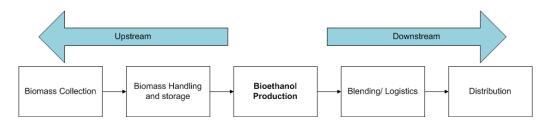


Figure 2-2: Bioethanol industry value chain

2.1.2.1 Vertical intergration trend of bioethanol industry

A comprehensive review of all aspects of the bioethanol supply chain to identify critical interdependent activities and their sequencing, based on which a firm can define which business functions it will be in and which business functions it will not be in. The decision, known as a firm's vertical integration choice, helps to define the strategic reason for the existence of a firm (Barney, 2002). Johnson et

al (2009: 182) states that vertical integration describes either backward or forward integration into adjacent activities in the value network. Backward integration refers to development into activities concerned with the inputs into the company's current business (i.e. they are further back in the value network). Forward integration refers to development into activities which are concerned with a company's outputs. A firm's decision for a certain level of vertical integration depends on:

- The governance structure a firm opt for,
- The level of uncertainty for further vertical integration, and
- The competitive advantage the firm has in different sections of the value chain. (Barney, 2002)

The availability and favorability of supply and distribution in the industry will determine the rationalization of value network linkages needed for a foreign firm's local operations and the vertical integration of other units within the business network. It is important to understand the whole process and how the linkages and relationships should be managed to improve customer value. According to Johnson et al. (2009), four key issues could be mentioned are:

- Which activities are centrally important? A firm has to decide whether to retain direct control of centrally important capabilities (for example, controls of its own input sources) or not
- Where are the profit pools? Some parts of a value network maybe inherently more profitable than others because of the differences in competitive intensity.
- Partnering: who might be the best partners in the parts of the value network? And what kind of relationships should be developed with each partner? When a foreign company relies more on local resource procurement or emphasizes the local market, it is more vulnerable to industrial linkages with suppliers and distributors. Entry modes involving partners turn out to be the superior choice when the company needs but lacks industrial linkages in the host country. Some of the choices such as

joint venture, technology licensing etc. will be discussed further in the "Business model" section.

Although this impact is firm-specific, depending upon the firm's objectives, competencies and strategies, relationships with local suppliers and local distributors are influential on product quality, on-time delivery, and competitive power, which in turn affect profitability, sales growth and asset efficiency. Each firm can now be seen as a department and the whole bioethanol chain as a large enterprise.

2.1.2.2 Upstream activities: Biomass collection

Feedstocks are one of the main costs of bioethanol production. As Hamelinck and Faaij (2006) point out feedstock costs account for 45-58% of total production costs for 2-G bioethanol, depending on conversion efficiency and applied technology. In order to enable advanced 2-G bioethanol development and market penetration, it is a great advantage to develop technology with the use of multiple feedstocks, also advancements are needed in harvesting, collection, storage, and pre-processing for multiple feedstocks. In the context of Vietnamese market, the country has abundant source of wood waste and agricultural residues (rice straws, bagasses, corn stover, cassava stem) to make ethanol (Appendice B).

Factors that affect feedstock sourcing cost are:

- Feedstock price: Agricultural and forest residue, energy crops, and the
 plant matter in garbage or landfills may all have different costs. Compared
 with those used for 1-G biofuels, cellulosic feedstocks are reported to cost
 less and be more readily available (cf. Carriquiry et al., 2010)
- Location: Where the biomass can be sourced, both in supply and infrastructure support.
- Transportation: the plan of most companies is to locate their bio-refinery very close to the source of the biomass. This will reduce transportation costs, increasing profit margins. But this means that cellulosic ethanol production will be very regional, so that there will be room all across the

country for many different cellulosic ethanol producers to flourish in different regions (Hassan, 2008).

The development of an efficient and secure biomass supply chain is pivotal for 2-G bioethanol industry. Biomass can be collected by the following players:

- Farmers or cooperatives of farmers
- Commodity traders
- Food and Beverage industries

2.1.2.3 Midstream activities: Bioethanol production process

According to Gereffi (1999), the industry value chain can be categorized into two different commodities: Buyer-driven and producer-driven. "Producer-driven commodity chains are those in which large, usually transnational, manufacturers play the central roles in coordinating production networks (including their backward and forward linkages). This is characteristic of capital- and technology intensive industries such as automobiles, aircraft, computers, semiconductors, and heavy machinery" (Gereffi, 1999). Bioethanol industry belongs to this commodity chain, and so as the theory goes, bioethanol manufacturers stand as the central role to exploit the market opportunities. This is the central stage of producer-driven value chain, involving manufacturers, technology suppliers, engineering and biotech (enzymes).

Factors contributing to the cost:

- Biomass feedstock and proximity of the bio-refinery location to the feedstock source and markets
- Details of the technology and how it is implemented: (i) Achievement of better ethanol concentrations before the distillation, (ii) lower costs for enhanced enzymes for breaking down ligno-cellulose into simple sugars, saving energy consumption and reducing GHG emissions; and (iii) improved separation techniques (Tilmisina & Shrestha, 2010)
- Size of the bio-refinery and economies of scale

Depending on the location, some EUR 60-100 million would be needed to build a cellulosic ethanol plant with the capacity of around 50,000 tons per year (VIR, 2011).

2.1.2.4 Downstream activities: Bioethanol distribution

Distribution is the transfer of the fuel from the biorefinery to the point of retail sale. A network of trucks, trains, barges, blending and storage terminals, and possibly, pipelines, must be able to handle significant volume safely and economically. Actors in this stage include:

- Petroleum distributors
- Ethanol Commodity traders (for blending with fossil fuels, beverages, cosmetics, industry etc.)
- End User is the purchase of biofuels by the consumer for use in either traditional vehicle at less than 20% level blends

Ethanol fuel mixtures have "E" numbers which describe the percentage of ethanol fuel in the mixture by volume, for example, E85 is 85% anhydrous ethanol and 15% gasoline. E85 is commonly used in the U.S. and Europe for flexible-fuel vehicles. Low ethanol blends, from E5 to E25, are also known as gasohol, though internationally the most common use of the term gasohol refers to the E10 blend. In Vietnam, the blend ratio is E5 until 2017.

2.1.3 The Value Chain analysis

Within the firm, Porter (1985) defined a systematic means of displaying and categorizing activities, which can be grouped into primary and secondary value chain activities (as shown in figure 2-3). At each stage of the value chain there exists opportunities to contribute positively to the firm's competitive strategy by performing some activity or process in a way better than the competitors (Hollensen, 2004). The goal of primary activities is vital in developing a competitive advantage.

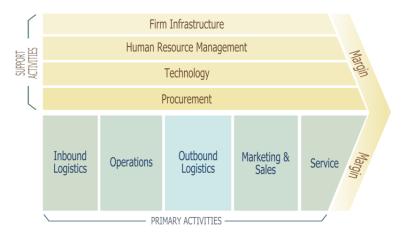


Figure 2-3: Segment Interrelations displayed on value chain (Porter, 1985: 260)

The value chains Porter described were contained inside a vertically integrated company, with primary and secondary activities yielding margins based on the value added. This systemic approach towards intra-plant and intra-firm efficiency began to spill over into thinking about inter-firm linkages during the 1980s. The interrelation creates possibilities for the company to take bigger shares in the market, expand the business into new market or opportunities to reduce costs by collaborative arrangements between different organizations in the value system (Hollensen, 2004). The reality is that the value chain becomes a value network, a group of interrelated entities which contribute to the overall creation of value through a series of complex relationships (Blythe & Zimmerman, 2005).

The logic of this is that firms should concentrate on those resources which they possessed which were relatively unique, provided a valuable service to customers and which were difficult to copy, and that they should collaborate with other firms in the value chain of an industry (Kaplinsky & Morris, 2000: 10). Convergence is where previously separate industries begin to overlap in terms of activities, technologies, product and customers (Johnson et al, 2005). As mentioned earlier in the vertical integration trend of ethanol industry, the boundaries of this industry is changing by convergence of previously separate "industries" between agriculture, oil and gas.

2.2 SITUATIONAL ANALYSIS

Situational analysis offers fresh paths into a full array of data sources so that the researcher is able to confront the problem of "where and how to enter". This

method enables assessment and evaluation of a market landscape including three areas: internal environment, micro environment and macro environment. The situational analysis should include past, present and future aspects. It should include a history outlining how the situation evolved to its present status, and an analysis of trends in order to forecast where it is going (NetMBA, 2011).

"Nobody knows the future, but they can prepare for possible alternatives"

(cf. Johnson et al, 2009)

There are several tools which can be used to add structure to the situation analysis: using tools such as: PESTLE, SWOT, Porter's 5.

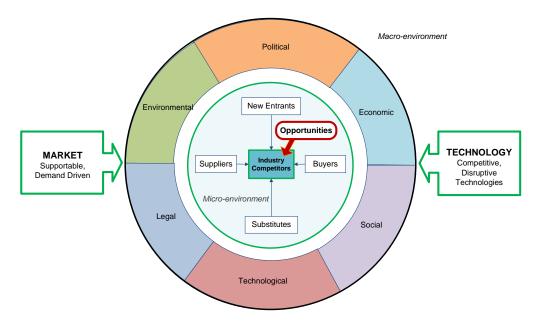


Figure 2-4: Situational Analysis Framework

2.2.1 Macro environment

Macro environment includes all the factors that change on a day-to-day basis with great effects on the business but which we have no control over as an organization i.e. VAT rate, environmental tax.

PESTLE framework categorises environmental influences into six main types, which could be used to analyze the macro environment; moreover, a company could apply this analysis in conjunction with a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis to assess the situation. However, in the context of identifying different business options for bioethanol business, instead

of developing strategies for a specific company, the analysis will examine more of opportunities and threats in the industry.

PESTLE stands for "Political, Economic, Sociological, Technological, Legal and Environmental" factors. The analysis of these environmental influences should answer below key questions:

- What environmental factors are affecting the organization?
- Which of these are the most important at the present time, and in the next few years?

Political and Legal factors

The influences include political direction, trade restrictions, taxes and legal issues, including both formal and informal rules under which the industry operates to evaluate the risks in the target market as well as the elements that can be leveraged. Some political features should be taken into consideration such as: the political stability, the degree of corruption, relations/ agreements between the target country and others that can be leveraged.

Legal issues, for example, tax policy, foreign direct investments, environmental regulations and other legal documents of supporting policies are examined.

Economic factors

Economic environment is analyzed through key figures including GDP, the rate of the growth and inflation, interest rates, wage level, exchange rates and taxation levels. These factors have major impacts on how businesses operate and make decisions. Exchange rates affect the costs of exporting goods and the supply and price of imported goods in an economy.

Sociocultural factors

The norms and values of the market area are considered. It is important to understand not only the demography of the country but also the social influences inside the society. The cultural factors include many layers: the national culture, business culture, organizational culture and the culture of individual behavior. (Lee & Carter, 2009)

Technological factors

This factor can lower barriers to entry, reduce minimum efficient production levels, and influence outsourcing decisions. Some technological factors include: R&D activity, equipment, technology incentives and rate of technological change (QuickMBA, 2011). This factor is always influenced by a very rapid development; hence, can be challenging to assess.

Environmental factors

The last influence, environmental, considers all issues related to natural conditions and such "green issues" as pollution and waste (Johnson et al, 2005). It plays a bigger role in the macro environment picture as the concern for climate change has been rising these recent years, especially in the context of evaluating the business opportunities of such environmental technologies as bioethanol business.

The PESTLE factors, however, are of limited value if they are merely seen as a listing of influences. It is important to identify a number of key drivers of charge, which are forces likely to affect the structure of an industry, sector or market. (Johnson et al, 2005) In the 2-G bioethanol business, key drivers might be technological change, availability of low-cost feedstock, conventional fuel shortage, economic growth and political stability.

2.2.2 Micro environment

Micro environment analysis is a detailed study of the areas within the immediate competitive environment that the organization has some controls over. One key tool to analyze the micro environment is Porter's 5 forces. Porter indicated that the strength of the five forces varies from industry to industry, and can change as an industry evolves. The five-force model helps to draw a picture of the structure and competition in an industry that suggests organization managers to figure out what fundamental forces shape strategic conduct, how strong each force is, what forces are driving changes in the industry, what strategic moves rivals are likely to make, and what the key factors are for future competitive success.

Supplier Power

According to Porter (1990), suppliers can exert bargaining power over participants in an industry by threatening to raise prices or reduce the quality of purchased

goods and services. In order to compete in the market, a firm must assess the supplier power and benchmark with competitors' in the industry.

Buyer power

Buyers compete with the industry by forcing down prices, bargaining for higher quality or more services, and playing competitors against each other- all at the expense of industry profitability (Porter, 1990).

New entrants

New entrants to an industry bring new capacity, the desire to gain market share, and often substantial resources. Prices can be bid down or incumbents' costs inflated as a result, reducing profitability. (Porter, 1990) Threat of entry will depend on the extent to which there are barriers to entry.

Substitutes

All firms in an industry are competing, in a broad sense, with industries producing substitute products (Porter, 1990). Substitution reduces demand for a particular "class" of products as customers switch to ther alternatives (Johnson et al, 2009).

Table 2-1: Determinants of Five forces



2.3 STRATEGY FORMULATIONS

In the following sub-chapter, various generic strategies are discussed, which could be used as inputs for the formulation of strategic options for bioethanol business in Vietnam. There are two themes running through the choice of strategic options (Johnson et al, 2008). The first is critical timing, or decision as to when to be first-mover or fast second in innovation, and if an innovation will reach its tipping point, the point where demand takes off. The second is the relationships between organizations and their customers and other stakeholders in the industry.

2.3.1 Sustaining competitive advantage

As introduced in the background of this study, commercial ethanol business in Vietnam has just been launched at small scale since 2008, the 2-G technologies in Vietnam are still in their infant stage of academic research. However, the recent technology achievements performed by a bunch of next generation ethanol producers are definitely accelerating the market development to meet the nation's growing demand and Biofuels Master plan.

Being a first-mover in the market, the firm is entitled to different advantages as well as disadvantages. Johnson et al. (2008) discussed that successful innovations often diffuse according to an S-curve pattern. The shape of the S-curve reflects a process of slow adoption in the early stages, followed by a rapid acceleration in diffusion, and ending with a plateau representing the limit to demand. The height of the S-curve show the extent of diffusion, the shape of the S-curve shows the speed (Johnson et al, 2008: 333)

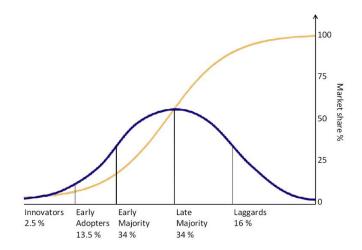


Figure 2-5: The Diffusion S-Curve (12Manage, 2011)

The S-curve concept seems to promote leadership in innovation. By jumping these three-curves early, while the core business continues to thrive, companies lay the

foundation for a successful leap to a new financial S-curve later – and for lasting greatness by executing a series of these moves. First movers get the easy sales of early fast growth and can establish a dominant position.

Lieberman & Montgomery (1988) stated that first-mover advantages arise from three primary sources: technological leadership, preemption of assests and buyer switching costs. In 2008, Johnson et al (2008) more specifically analyze the five potentially robust first mover advantages while Hill & Jones (2009:227) highlighted a number of disadvantages for the first-mover.

Table 2-2: Pros and cons of being a first-mover

Advantages Disadvantages - Experience curve: first movers' rapid - Signicant pioneer costs accumulation of experience with the innovation related to develop gives them greater expertise than late entrants technology and distribution channels, and - Scale benefits: first movers establish earlier educate customers, which than competitors the volumes necessary for mass can be time and cost production consuming - Pre-emption of scarce resources: late movers - *Uncertainties* in a new will not have the same access to key raw market in terms of value materials, skilled labor or components. proposition, shifts in - Buyer switching costs: exploited by technology, demand establishing a technological standard, locking in forecast etc. their customers with priviledged or sticky - Locking itself in inferior relationships or obsolete technology - Reputation can be enhanced by being first, since consumers have little "mind-space' to recognise new brands

Source: (Johnson et al, 2008; Hill & Jones, 2009:227)

It is highly important to keep in mind that superior reputation and customer lockin provides a marketing advantage and gain the control over the market in order to consolidate their position against late-entry competitors.

2.3.2 International strategies

Entering new markets can be risky. A mode of entry into an international market is the channel which an organization employs to gain entry to a new international market. This section, further to the situational analysis, market mapping and segmentation, will go through three studies on market entry options, which will help to build a strategy to maximize the possibilities of success.

2.3.2.1 Modes of entry

The first is the gradual involvement or Uppsala model which believes that firms enter international business at first using low resource commitment modes such as licensing or exporting towards some forms of investment. As the firm gains more knowledge and experience, it moves to higher levels of market entry alternatives in terms of resource commitment and accepts higher levels of risk (Hollensen, 2004).

Basically, there are three basic ways to enter foreign markets: exporting, investment or contract.

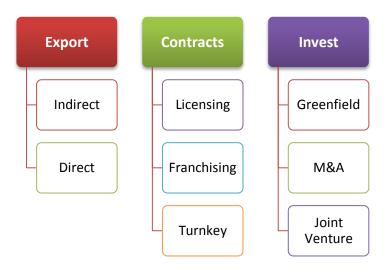


Figure 2-6: Modes of entry

Export

There are also different ways to export a product or service, namely indirect and direct exporting. Indirect exporting means selling a product through an intermediary within the same domestic market. Direct exporting means selling that product to an intermediary located in a foreign market.

Investment

Using investment, a firm may choose to follow a wholly owned venture (Greenfield or acquisitions) in which it owns all aspects of a business entity or

establish a joint venture. Sherman & Shapiro (2008), in their report on leveraging a company's intellectual property, argues that Joint Ventures and Strategic Alliances are new sources for opportunities and revenue streams.

Joint Ventures are typically structured as formal entities where two or more "parents" create a newly-formed and jointly-owned partnership, corporation which will have its own independent management structure and will have a specific set of medium- or long-term business objectives. (Sherman & Shapiro, 2008)

There are many reasons why companies set up Joint Ventures to assist them to enter a new international market:

- Access to technology, core competences or management skills.
- Gain entry to a foreign market
- Access to distribution channels, manufacturing and R&D
- Conforming to government regulations

Strategic alliances refer to any number of collaborative working relationships where two independent companies become interdependent by entering into a formal or informal agreement. The relationships are commonly referred to as: (i) teaming; (ii) strategic partnering; (iii) alliances; (iv) cross-licensing; and (v) cobranding. (Sherman & Shapiro, 2008)

Contracts

The third major form of market entry is contract, which takes many forms: Licensing, franchising, turnkey contracts and contract manufacturing.

- In *licensing*, a company, as a licensor, permits another in the target country use its intangible property (brand or expertise) and possibly for technical assistance for a fee, usually a royalty on sales. Licensing a technology outside is essentially hiring external resources to create value for that technology or intangible property (Chesbrough, 2006).
- *Franchising* related to licensing, takes place when a franchiser grants a franchisee the right to do business by providing branding, concepts, expertise in exchange for a similar fee.

• *Turnkey contracts* are major strategies to build large plants, often include the training and development of key employees where skills are sparse. The company would not own the plant once it is handed over.

2.3.2.2 Entry timing and Innovation Strategies

The Uppsala model has not escaped criticisms, many other studies tend to reinforce the idea that many firms do not follow a step-by-step process, but instead just choose the most proper strategy even if they have no past international experience. The necessity to establish economies of scale quickly or to capture market share have led to immediate acquisitions by firms (Blythe & Zimmerman, 2005), particularly within new industries and high-technology-based sectors.

Further to the previous discussion on First-Mover advantages and disadvantages, in an international context, the appropriate entry mode will make or break the firm's goal to sustain long-term competitive advantages. According to Hill and Jones (2009: 228), there are three basic innovation strategies available for exploiting the firm's lead to capitalize advantages and simultaneously reducing the risks associated with first-mover disadvantages:

- "Going it alone" Develop and market the innovation itself
- "Enter into an alliance" Develop and market the innovation jointly with other companies through a strategic alliance or joint venture; and
- "Licensing the innovation" License the innovation to others and let them develop the market.

Table 2-3: Strategies for Profiting from Innovation (Hill & Jones, 2009: 230)

Strategy	Does the Innovator have the required complementary assets?	Likely height of barriers to imitation	Number of capable competitors
Going it alone	Yes	High	Very few
Enter into an alliance	No	High	Moderate number
Licensing the innovation	No	Low	Many

Complementary assets are assets required to exploit a new innovation and gain a competitive advantage: manufacturing facilities, marketing know-how, an adequate sales force, access to distribution systems, and support network. Height of barriers to imitation includes factors that prevent rivals from imitating a company's distinctive competencies and innovations, for instance, patents. Although ultimately any innovation can be copied, the higher the barriers are, the longer it takes for rivals to imitate, and the more time the first mover has to build an enduring competitive advantage. Capable competitors are companies that can move quickly to imitate the pioneering company. These factors can be assessed through Porter's Five Forces, which was introduced previously in this study.

When a firm is to enter a new market it can choose either of the above mentioned alternatives or any combination of them. In making the decision about which strategy to use, Dunning (2001) identified three important considerations: ownership advantages (controls), location advantages and internationalization consideration.

In the context of such emerging markets as Vietnam, control provides two key benefits. First, it safeguards key resources from leakage, such as patent theft. Second, it allows internal operational control essential to a firm's success in emerging markets. However, high level of control also means high costs compared to trying to attain lower levels of control and thus, higher returns are required to break even. (cf. Johnson & Tellis, 2008).

2.3.3 Business model

The term business model was brought forward during the boom of e-business in the mid 1990s. A business model is a conceptual tool which combines the value that a company offers to one or several segments of customers and the combination of the firm and its network of partners for creating, marketing and delivering the value and relationship capital in order to generate profitable and sustainable revenue and profits. Due to the complexity of the industry, an appropriate business model for entering the bioethanol competition might not bring the same earth-shaking effects as other products like the famous Gillette razors, yet the value of a technology depends on its business model. The same

technology taken to market through different business models will yield very much different amounts of value.

Johnson et al. (2005) states that a business model describes the structure of product, service and information flows and the roles of the participating parties. This includes potential benefits and sources of revenue to each of the parties. The value chain framework can be used to identify business models.

Analyzing business model makes it clear to position different market players in relation to one another in a complex industry environment. In their book, The Role of the Business Model in Capturing Value from Innovation, Chesbrough and Rosenbloom (2002) state that "the business model provides a coherent framework that takes technogical characteristics and potentials as inputs, and converts them through customers and markets into economic inputs." The business models guide the selection and filtering of technologies and the way they are packed into particular offerings for a chosen target market.

They complemented the following aspects: articulating a value proposition for the customers and identifying a market segment and, furthermore, formulating a competitive strategy. This can be done, for example, by adopting, licensing, cooperating with other existing companies and their technologies to add value to your existing product or manufacturing process (Chesbrough, 2006). Which method to enter a potential international market was discussed further in the previous section, the international strategies.

The firm's realization of economic value from its technology depends on its choice of business model, rather than from some inherent characteristics of the technology itself (Chesbrough, 2006), as illustrated in the figure below:

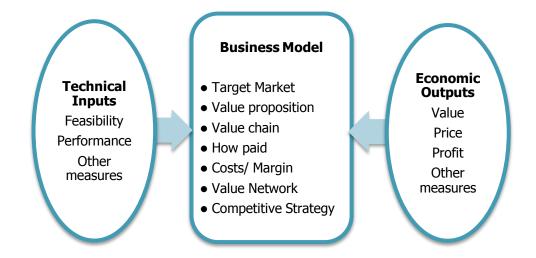


Figure 2-7: The Role of Business Model (Chesbrough, 2006: 69)

2.3.4 Business sustainability assessment: The triple bottom line

John Elkington (1994) strove to measure sustainability during the mid-1990s by encompassing a new framework to measure performance in corporate America. There are various definitions developed for 'sustainability' concept, one of them taken from Bruntland Commssion defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". According to Gibbs and Humphries (2009:299), sustainability is emerging as an issue for investors, too, as the unsustainable business poses a threat to their investment. In addition, legislative bodies, such as the European Union (EU) and national governments, are increasingly looking at business to take responsibility for the environmental impacts of their activities.

The 'triple bottom line' (TBL) is rapidly gaining recognition as a framework for measuring business performance (IISD, 2010). This accounting framework went beyond the traditional measures of profits, return on investment, and shareholder value to include environmental and social dimensions. By focusing on comprehensive investment results - that is, with respect to performance along the interrelated dimensions of profits, people and the planet - triple bottom line reporting can be an important tool to support sustainability goals.



Figure 2-8: Business sustainability assessment

2.4 Summary of the theoretical framework

The chapter deals with other notions that are important for understanding the market analysis process performed by the researcher. It mainly discusses the theories related to the market's macro and micro influencing factors, value chain and value network of bioethanol industry, internationalization strategies and business model. The writer also takes consideration of the triple bottom line analysis as the purpose was to find out business opportunities of environmental technologies. The researcher believes these pieces of information are useful to understand the process of analyzing a market that a foreign company plans to operate in. All these theories have been implemented in the empirical part of this research.

3 RESEARCH APPROACH

In this section, the researcher will first introduce and compare the different research methods presented by different authors in order to support the selected approach/ process. Consequently, the employed process will be introduced in more detailed in terms of collecting, analyzing and presenting data.

3.1 Evaluations of different approaches

The approach focused on three key areas based on the provided framework around which the information is organized to be collected:

- How does the bioethanol industry work in Vietnam?
- What are the drivers and barriers to growth?
- What are the market expectations and how they can be met?

Broadly speaking, there are two types of research methodology: qualitative and quantitative. The researcher uses qualitative methodologies, and the following section will give the reason behind this research method selection as well as the process of doing it.

Quantitative (Establishing Statistical Reliability)

This process utilizes detailed questionnaires often distributed to large numbers of people. Quantitative research collects a huge amount of data, which can often be generalized to a larger population and allow for direct comparisons between two or more groups.

By using quantitative or scientific research methods, the level of flexibility would not be the same and the in-depth information would be difficult to convey quantitatively. Quantitative method cannot adequately describe the situation about the bioethanol business in Vietnam.

Qualitative (Gathering Insights)

A good qualitative study can help us "understand a situation that would otherwise be enigmatic or confusing" (Eisner, 1991: 58). This relates to the concept of a good quality research when reliability is a concept to evaluate quality in quantitative study with a "purpose of explaining" while quality concept in qualitative study has the purpose of "generating understanding" (Stenbacka, 2001: 551).

In case of this research, more in-depth study is needed, it is important to make the respondents see new insights and perspectives of the bioethanol business, thus the qualitative research method is employed. The researcher wants to get the respondent's perspective about their demand for technologies from production pretreatment, bioethanol manufacturing and distribution as well as co-operations with foreign partners. This could be perfectly done if the researcher is able conduct interviews with the stakeholders and getting their perspectives. The questions often ask not only for information and opinions but also allow the interviewer to probe the richness of emotions and motivations related to the topic.

3.2 Qualitative method

Qualitative analysis can be described as a process of extracting and presenting the key ideas and concepts. In a general sense, qualitative data is or can be transformed into words rather numbers. (Lee & Ling, 2009) In order to ensure the value of the findings, Lee and Lings (2008:209) introduced the rigor of qualitative research, which includes such tools as qualitative sampling, interviewing, focus group, observation, documentary sources of data.

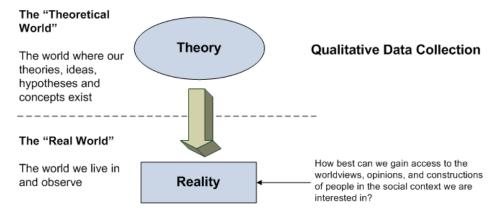


Figure 3-1: The place of qualitative data collection (adapted from Lee & Lings, 2009:209)

The technique used to gather this data is individual in-depth interview. In the case of this study, the researcher conducted semi-structured interviews whereby certain topics were covered by the interviewer.

3.3 Methods for gathering of data

Data collection is divided into two parts: primary data and secondary data. The secondary data is collected during the desk research, before the actual research is done in the target market. The primary data is gathered by the researcher in the target market.

3.3.1 Secondary data

The researcher collects secondary data like published material and official records from public portals such as Vietnam's Ministry of Industrial and Trade (MoIT), governmental policies/ regulations etc. and other prestigious institutes such as JICA amd other university websites. Further, the previously documented materials are gathered through books, internet, journals and newspapers are also included in the secondary data.

For Internet material, the search engine Google was used and in Lahti University's database electronic documents were found at EBSCO, and books, reviews and journals at Nelli portal.

3.3.2 Primary data

For the empirical part, the data will be collected by going to the field, "talking to people, either face-to-face, by means of the telephones, or by written questionnaire" (Jankowicz, 1995: 184).

The process of data gathering began by listing down the interview questions. These questions are matching with research questions to establish research questions/ interview questions matrix (research questions were listed along the horizontal axis and interview questions down the vertical axis), this is a checklist

allowing a visual coverage overview of the research questions via the interview schedule, in conjunction with the desk research. The examined companies were not selected randomly, rather they were chosen because they offered a variety of different approaches to exploring opportunities in this emerging country's bioethanol business. Particularly, companies in sugar industry, alcohol-ethanol producers, ethanol producers and ethanol distributors were selected from upstream, midstream and downstream respectively from bioethanol value chain.

Public sectors, NGOs and consultancy agencies were also included in the sample, as these organizations play an important role in facilitating cleantech business, an area where there has always been challenges to development.

The researcher sent individual emails to prospective participants describing the purpose of the study, inviting their participation, and requesting a convenient date and time for an interview. The researcher then sent confirming emails together with questions to the individuals who agreed to be interviewed, either face-to-face or via telephone/ skype. Most of the interviews took place between June and August 2011, some further contacts were made during September 2011.

The respondents were chosen after determining the initial value network analysis, which reveals the related stakeholders. The researcher, then, divided the stakeholders into five different categories based on the varied roles and interviewed representatives from each category. Interview questions will be prepared in light of the research objectives:

- (1) to verify the legal framework and incentives for production of ethanol gasoline,
- (2) to understand the expectation and criteria of potential buyers/ partners before making procurement or collaboration decisions,
- (3) to identify some potential funding options
- (4) and to evaluate the business model options for foreign 2-G bioethanol companies.

Listing below is the standard pieces of information to be obtained from each group:

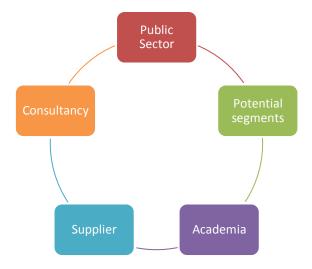


Figure 3-2: The Roundtable on Ethanol

- (1) Academia (Vietnam National University, Industrial Policy and Strategy institution) with the following information
 - On-going studies on ethanol development
 - Opinions on bioethanol industry development: Domestic available technologies and what to expect from international cooperation.
- (2) **Potential market segments** (Sugar companies, 1-G Bioethanol producers, PVOil) to estimate business spaces
 - Potential feedstocks for 2-G bioethanol production and intention for forward integration
 - Current production capacity to supply the biofuels demand; technology pedigree and intention to upgrade into 2-G.
 - Intention for backward integration and markets for production outputs

(3) 2-G Bioethanol Producers

- Taking proven results of activities to market in terms of output price and technology compatibilities with natural conditions of the Vietnam
- Discovery of ability to meet the market demands

(4) Public sector (MoIT, MoPI, local authorities)

- Understanding the favorable conditions for Renewable energy from host country; Mandate roadmap to gasohol
- Procedure to enter Vietnam market

(5) Consultancies (Bank, CDM, NGOs)

- Banks: Providing investment and operational funding
- CDM: Verified the benefits for CO2 reduction emission
- NGOs (Vietnam Chamber of commerce, Finpro) Supports for renewable business from home country, on-going projects.

Data collection from these participants as a roundtable discussion could bring about market structure validations, new business model concepts, new linkages and an expanded understanding of new dynamics in the mix of business and sustainable development.

3.4 Method for analysis: validity and reliability

The challenge throughout data collection and analysis was to make sense of large amounts of data, reduce the volume of information, identify significant patterns etc. Merriam (1998) cautions researchers to make data analysis and data collection a simultaneous activity to avoid the risk of repetitious, unfocused and overwhelming data.

While the credibility in quantitative research depends on instrument construction, in qualitative research, "the researcher is the instrument". The terminology that encompasses both reliability and validity, such as credibility, transferability, and trustworthiness is used in qualitative research (Golafshani, 2003). In the other words, should the study be carried out by different research employing the same research framework, the same results and implication will be made.

Concurrent with the collection and analysis of archival materials, interviews and discussions with relevant stakeholders were recorded. At the end of each interview, the interviewee was asked to return by emails any missing information and asked to contact further regarding the same topic (possibilities to uncover perceptions that might not have been revealed through the interviews). The research is credible if the findings are supported by the evidence (Mayor et al, 2005: 362).

4 EMPIRICAL RESEARCH

4.1 MACRO ENVIRONMENT OF VIETNAMESE MARKETS: PESTLE ANALYSIS

As proposed in the literature review, PESTLE framework is selected to describe the highest-level layer of environmental factors that can impinge on 2-G companies in Vietnamese bioethanol business. The analysis enables the identification of key drivers of change, based on which the organization might need to adjust its strategies in the market.

4.1.1 Political factors

Since the adoption of the renovation policy in 1986, Vietnam has gained tremendous achievements in all sectors including economics, social development and culture. Significant reforms were undertaken in the first half of the 1990s with a view to reshaping the former closed command economy into a relatively open, market-based economy. The Communist Party of Vietnam is currently the only legal political party in Vietnam.

According to an annual survey of Japanese-affiliated firms operating in Asia, political stability (61.1 percent of respondents), low wage labor (38.9 percent) and market size (38 percent) are Vietnam's strengths as an investment location. (cf. Ketels et al, 2010) Foreign investors currently doing business and having intention to do business in Vietnam are protected by the law of Vietnamese government.

Trade policies

Since 1995, Vietnam has attempted to make economic transition towards a market economy and actively participated in international trade. In July 1995 Vietnam became a member of the Association of South East Asian Nations (ASEAN) and the ASEAN Free Trade Area (AFTA).

Vietnam has positioned itself as the market leader in a few areas lately, mainly agriculture products, exporting: rice, coffee, pepper, fish, clothing, textile, shoes and leather.

Vietnam became a member of WTO in 2007 as the 150th member of the body, committed to comply with WTO rules in different sectors:

- Agriculture: Vietnam still maintains an import quota system to protect several agricultural products including sugar, eggs, cigarettes, and salt.
- Banking: Foreign firms and individuals are allowed to purchase up to 30% of shares in banks. Foreign banks can establish wholly foreign-owned subsidiary.
- Export restrictions: Vietnam maintains export controls on some products such as rice, and some wood products and minerals in a way that conforms to WTO agreements.
- Intellectual Property Rights: Vietnam complies with the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement since 2007.

ASEAN Cooperation on Biofuels

The ASEAN Cooperation on Energy (2010-2015) has established functioning network, enhances commercialization of biofuels and develops harmonized specification for biofuels. In accordance with this regional agreement, Vietnam's Ministry of Science and Technology (MoST) also issued E100 TCVN 7716:2007 as the national standards on E100 gasoline in 2007, reinforcing the regional trade of ethanol.

The commitments with above regional and global organizations above are critical forces and motivations to reinforce Vietnam's policy stability, pledging itself to a long-term focus on biofuels.

Protectionist sentiment of distribution services

Vietnam will not open the distribution service sector for retail sales to foreign companies for goods such as gasoline, pharmaceuticals, magazines, books, DVD, tobacco, rice, sugar, precious metals, newspapers, processed oil and crude oil. However, according to VCCI, the Government allows PVOil to establish a new entity with the foreign parties of Nghi Son oil refinery to distribute its own

products, on the condition that Vietnam's party holds limited ownership of 51% (VCCI, 2011a). It implies an easing on the control of the Government on those special distribution sectors.

Social welfare policy

Vietnam has ratified all ILO labor standards. Vietnam's Labor Code was adopted by the National Assembly in 1994 with multiple amendments. The Labor Code governs both Vietnamese and foreign employees. Employees can be classified as either fixed-term or indefinite term employees.

Commitment to Bioethanol industry

In response to growing concerns about potential adverse environmental effects due to expanding biofuels production, GVN adopted its "Scheme on development of biofuel up to 2015, with a vision to 2025" through Decision No. 177-2008-QD-TTg in November, 2007 (*see appendice D*), "deciding on the future production and use of biofuels. The ethanol production targets are set up to 2015 as following:

Table 4-1: Vietnam's Ethanol production target (2007-2025)

Period	Gasohol E5 (ton/year)	Contribution to fuel demand			
The Scheme on Development of Biofuels (2007-2015)					
2007-2010	100,000				
2010- 2015	5,000,000	1%			
2015- 2025	1,800,000	5%			

Source: MoIT, 2011

Gasohol mandates

The Ministry of Industry and Trade (MoIT) is in charge of developing the Renewable Master Plan, according to which ethanol blending mandates are stated. The proposal of ethanol blending mandate nationwide (following the Biofuels Master Plan) are submitted to the Prime Minister for approval on October, 2011. According to the Draft, petroleum product distributors are required to add ethanol (ethyl alcohol) into their fuel as per the below schedule:

Table 4-2: Ethanol blending mandate draft (2013-2017)

Milestone	Ethanol ratio	Required regions				
MoIT' Ethanol blending mandate draft						
July 1, 2013	E5	The North: Ha Noi, Hai Phong The Central: Da Nang, Quang Ngai The South: Ho Chi Minh City, Can Tho, Ba Ria – Vung Tau				
July 1, 2015	E10	The North: Ha Noi, Hai Phong The Central: Da Nang, Quang Ngai The South: Ho Chi Minh City, Can Tho, Ba Ria – Vung Tau				
January 1, 2017	E10	Nationwide				
Ethanol blending fuel activities prior to this schedule are highly encouraged.						

Source: (MoIT, 2011)

4.1.2 Economic factors

It has been ten years, and the BRIC countries no longer offer any early mover advantage for investment. Vietnam, as a part of newly named CIVETS group of countries - Colombia, Indonesia, Vietnam, Egypt, Turkey and South Africa - are being touted as the next generation of tiger economies (Greenwood, 2011).

Table 4-3: Vietnamese Economy Fact sheet 2010 (State.gov, 2010; Eximbank, 2011)

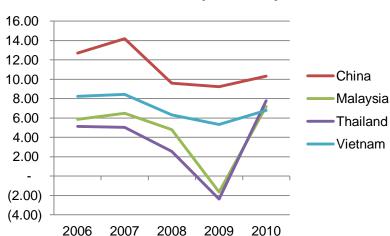
Vietnamese Economy Fact sheet 2010

- GDP (2010): 87 billion EUR (US\$102 billion).
- Real growth rate (2010): 6.8%.
- Per capita income (2010): 872 EUR (US\$1,168).
- Inflation rate: 9.19% (average monthly consumer price index of 2010, year-on-year)
- National currency: Vietnam Dong (VND)
- Exchange rate: VND/EUR = 29,760.00 (vietnam's eximbank rate)

GDP and growth rate

Vietnam is a true emerging market, offering ground floor and growing opportunities for foreign exporters and investors. The economic growth rate has been among the highest in the world in recent years, expanding at an average about 7.2 percent per year during the period 2001-2010, while industrial production grew at an average of about 12 per cent per year during the same period. With the registered GDP growth rate of 6.8 per cent (2010), Vietnam was

one of only a handful of countries around the world to experience such steady levels of economic growth.



GDP, % increase on previous year

Figure 4-1: GDP growth of Vietnam (data extracted from IMF database 2011)

The government has confirmed its commitment to economic growth and is targeting 2011 GDP growth at 6.5 per cent. (U.S. DoC, 2010)

Financial markets

Under Prime Ministerial Decision No. 146/2003/QD-TTg dated July 17, 2003, foreign organizations and individuals are allowed to purchase issued shares of listed companies or issued bonds in Vietnam Stock Exchange. Investors must be registered with the Vietnam Stock Exchange through custody organizations.

Foreign investment

Two of the most important foreign investment sources which can be named are Foreign Direct Investment (FDI) and ODA (Official Development Assistant). New commitments of FDI saw an 18 per cent decline in 2010, following the direction set in 2009, though disbursed FDI increased by 10 per cent. However, the industrial/manufacturing, real estate/tourism and construction sectors continued to attract a major share of new capital flowing into the country, while utilities projects – electricity and gas production and distribution – gained increased interest from investors in 2010. (U.S. DoC, 2011: 3)

Over US\$12 billion (about EUR 8.5 billion) of untied ODA funding has been committed to Vietnam, primarily for infrastructure development such as

transportation, energy and industry, agriculture, education, environment, science and technology (MPI, 2007). Companies doing business in energy and environmental factors could participate in these projects by developing core strategies and capabilities for bidding on ODA projects (U.S. DoC, 2010).

The Vietnam Dong and Inflation

The State Bank of Vietnam (SBV) manages monetary policy in a flexible manner to temper inflation and stabilize economic growth, which is not an easy task to maintain the balance equation under the World's economy turmoil since 2008.

Inflation

Moving forward, inflation remains a main risk to Vietnam's economy, which the Government is addressing by balancing growth targets with price stability measures. This challenge will not be easy to meet. Fuel price is one of the two key inflation drivers, besides food price. An energy/fuel price rise in Vietnam always draws on the "crowd effects" of immediate price escalations, from food to travel costs, and all other commodities. The hike in fuel price is based on worldwide oil price, which is unargurably out of the government control, yet some initiatives have been strongly taken to reduce the country's dependence on oil by shifting to the Vietnamese fuel free market, and recently the mandate of gasohol uses.

Vietnam Dong depreciation

Vietnamese economy has long been dependent on the US Dollar. At the beginning of 2011, the US Dollar shortage caused an 8.5% currency devaluation against the US dollar (WSJ, 2011). Overall, Dong depreciation will have a negative impact on FDI, regardless of which sector it presents. Therefore, in the Import plan 2011, Giau Nguyen - the former Governor of State Bank of Vietnam (SBV) – stated that SBV and MoIT were discussed to diversify forex currencies in payment and encourage import by such currencies as Euro, Singaporean Dollar etc. to reduce the country's historically dependency on US Dollar (Phapluat, 2010).

If the Government comes up with effective solutions and unveils its measure to stabilize the forex rates of Euro/Dong, GB Pound/Dong and prevent suddent movements of forex rate, it may strengthen the trade and business cooperation that use currency other than US Dollar. However, the researcher believes this is not likely a short-term perspective.

Considering the current scenario of Vietnam Dong's depreciation, at the start, the foreign 2-G provider may limit the resource commitment to a cooperation (i.e. JV) with intangible resources (the 2-G Process Design Package (PDP) and managerial skills, for example), which are easily transferred across the company's operations. The value of these resource commitments is assessed in Vietnam Dong, however, the returns can be generated elsewhere, be it in Vietnam Dong or other currencies. Therefore, hypothetically, this scenario is not necessarily a disadvantage to setting up a 2-G Bioethanol at this scenario.

Unemployment rate

The 2010 annual report from General Statistics Office (GSO, 2010) declared the unemployment rate among Vietnam's workforce was 2.88 percent in 2010. The unemployment rate in urban areas was 4.43 percent and that of rural areas at 2.27 percent, which were a slight decrease of 0.02 percent as compared to 2009.

Fuel demand

According to the "National energy development strategies for Vietnam up to 2020, outlook to 2050" from the MoIT, the average growth rate of consumption of petroleum products in Vietnam from 2000 to date is about 6-8% and is forecasted to grow by around 8% until 2020.

Even though the country is a crude oil exporter, Vietnam has only one oil-refinery (Dung Quat Oil-Refinery) at the moment and still depends on imported fuel. The fuel consumption in 2010 was 16.3 million tons, of which about 11.6 million tons (71%) are imported. In 2020 and 2050, this figure will reach at around 29-31.2 million tons/year and 90-98 million tons/year respectively.

4.1.3 Sociology

Population demographics

Vietnam has a large, young population of nearly 86 million (2009) with an average age of 27 (GSO, 2010; Greenwood, 2011). This means the investors in Vietnam will benefit from the abundant of young labor force, the fast-rising domestic consumption, and less heavily dependent on external demand.

According to the GSO (2010), the country has 46.21 million people of working age with year-on-year rise of 2.12 percent, allocating in agro-forestry and fishery sector, industry sector and service sector at 48.2 percent, 22.4 percent, and 29.4 percent respectively.

Buying behavior

As always, culture has much influence on the buying behavior in the market. The Vietnamese like to see the success stories of others, therefore the use of success stories could prove to be very effective. The lack of successful projects, very often, could create barriers to convince the new customers or to get repetitive business.

Consequently, branding, service and relations are efficient tools to bridge to customers. However, these are yet the strength of bioethanol companies at the current technology evolution since bioethanol industry is new in the market, plus the competition from established global brands is fierce. Companies with big profile such as India's Praj who has provided the 1-G technologies in 50 plus countries including Vietnam will have a great advantage to apply their success for the new 2-G innovations.

Another element a foreign company should pay attention to is the decion-making process in Vietnam. Different companies employ different decision process. In most of the cases, the procurement processes are not decentralized. Directors or perhaps technical managers in the potential customers are the people actually making the procurement decision.

Consumerism

The recent inflation makes Vietnamese consumers more price sensitive. The people feel their household purchasing power has been reduced and find ways to squeeze their budget on daily spending such as shopping, food and fuel etc. It implies great business opportunities for ethanol/ gasohol produced at competitive cost.

Level of education

The general educational level is good and the wage level is low, the supply of skilled workers, however is low. However, Vietnam has an excellent technical

workforce and modern IT infrastructure, which explains the active presence of many high technology companies such as Cisco, IBM, Microsoft, Oracle and HP etc. (Treutler & King, 2007).

4.1.4 Legal factors

With the purpose to leverage the supporting law and mitigate the risks when setting up the international business, the researcher focuses on legal documents and regulations regarding: (i) Legislation on doing business in Vietnam; (ii) The country incentives for biofuels business; and (iii) Regulations in accordance with international law practice

4.1.4.1 Legislation on doing business in Vietnam

To ensure that its laws allow for national treatment of foreign-invested enterprises in accordance with the World Trade Organization, the National Assembly of Vietnam adopted the Law on Investment No. 59/2005/QH11 and Law on Enterprises No. 60/2005/QH11 which apply to all enterprises (both foreign and domestic) established by domestic and/or foreign investors from November 29, 2005.

Foreign investors can invest in Vietnam in three forms:

- Joint Venture Enterprise (JV),
- Business Cooperation Contract (BCC) and
- Enterprise with 100% Foreign Owned Capital

A JV is a Vietnamese legal entity, jointly established in Vietnam by two parties or several parties on the basis of a joint venture contract or agreement. In some sectors, Vietnam has limits on the percentage of ownership in which a foreign party may hold in a joint venture.

Land-use rights

A foreign investment project has a limited term, if a foreign-invested company has land-use rights, it will only hold such for a time period corresponding with the term of the investment project (e.g., 50 or 70 years) (Treutler & King, 2007). Land-use rights are typically contributed to joint venture projects by the Vietnamese party and constitute the capital contribution of the Vietnamese party. Decsion No. 177/2007/QD-TTg stipulated that Biofuels production enterprises are entitled to the highest land rent and land use incentives for 20 years.

The administrative process

Despite the governemnt's commitment to improving the country's business and investment climate, like many other developing countries, corruptions and cumbersome legal system remain challenges to foreign investors. The Corruption Perceptions Index 2010, for example, indicates that Vietnam is still among the highly corrupt nations with rate 2.7/10 (TI, 2011).

Despite of this, Ketels et al (2010)'s Doing Business provides silver lining on the country's effort to improve its administrative infrastructure.

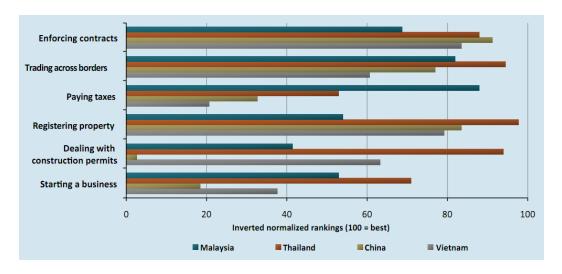


Figure 4-2: Selected Doing Business Indicators for Vietnam and comparison countries, 2009 (Ketels et al, 2010:84)

Figure 4-2 presents a comparison of Vietnam's performance to that of three comparison countries. Overall, Vietnam is doing better than China, especially on construction permits, however, much improvement is still required to reduce time dealing with administrative procedures e.g. paying taxes or closing a business etc.

• **Starting a Business:** Vietnam eased company start-up by creating a one-stop shop that combines the processes for obtaining a business license and tax license and by eliminating the need for a seal for company licensing.

 Dealing with Construction Permits: Vietnam made dealing with construction permits easier by reducing the cost to register newly completed buildings by 50% and transferring the authority to register buildings from local authorities to the Department of National Resources and Environment.

4.1.4.2 Intellectual Property Law

Trademarks

Vietnam employs a first-to-file trademark filing system. As a result, foreign companies who fail to register their trademarks first in Vietnam may have little recourse against Vietnamese companies who register identical or confusingly similar trademarks first, unless the foreign company can prove that its trademark is well-known or can show clear bad faith. License agreements must be registered in Vietnam. It takes roughly 12-18 months to register a trademark.

Enforcement

Intellectual property rights can be enforced by various authorities, such as police, market management authorities and various inspectors. Counterfeit goods may be seized and destroyed by authorities. Foreign companies in Vietnam have established the Vietnam Anti-Counterfeiting and IP Protection Association (VACIP).

4.1.4.3 Incentives for Biofuels projects

Policy measures that support biofuels industry include supply and demand stimulation, formal targets for biofuel usage, mandates to blend biofuels with standard gasoline or diesel, tax advantages, or other industrial promotion measures (Clark, 2007; Kojima et al., 2007)

Further to the Scheme on Biofuels and the draft mandates to blend bioefuels introduce in section 4.1.1, Vietnam also clearly states supporting incentives as for biofuels development.

Renewable energy development target

Decision No.1855/QD-TTg issued by the government has (i) set targets for RE installation percentage (3% - 2010, 5% - 2020), (ii) prioritized the allocation of concessional credits from the development support fund, ODA capital and other foreign bilateral loans for energy projects, and (iii) formulated long-term environmental and standards in conformity with regional and world environmental standards and the country's economic conditions.

In addition, the decision highlights the policies to attract petroleum product trading companies to enter into joint venture developing oil refineries so as to link production with consumption and regulate profits between production and business activities.

Environmental protection tax

The Law on Environmental Protection (Amendment on 12 December, 2005) provides regulations, policy formulation and measurement for environment protection. Article 33 stipulates that development of clean energy and renewable energy is one measure for environmental protection. The Article states that "organizations and individuals investing in the development and use of clean energy and renewable energy shall be granted preferential taxes, funding support, and land for building production facilities". The preference for bio-energy industry are strengthened through the newly passed law on environment protection tax 2010, ethanol gasoline are free for environmental tax amount of 1-4,000 VND per liter as conventional gasoline.

Special investment incentives for Biofuels production

In the 2007-2015 period, investment in biofuels production is classified as a domain eligible for special investment incentives. Biofuel production enterprises are entitled to income tax exemption or reduction for biofuel products according to the Government's Decree No. 24/2007/ND-CP of February 14, 2007, detailing the implementation of the Law on Enterprise Income Tax. In addition to the entitlement of the highest land rent and land use incentives for 20 years, raw materials, components, machinery and equipment to be used in scientific research and technological development for biofuel production are exempted from import tax. Raw materials, components, machinery and equipment used for biofuel production are eligible for the lowest import tax rate.

The positiveness of supporting legal framework sets forth clearly orientated views, decentralized management at each level, and environmental protection responsibilities.

4.1.5 Technological factors

Total government spending for R&D

Vietnam has initially started applied research on biofuel production and consumption, and has gained some positive results. Also it has invested its scientific and technological potential for the production and consumption of biofuel. Its contingent of biologists are being trained and supplemented. The R&D funding from the Scheme on Biofuels alone for the 2007- 2015 period is VND 259.2 billion (EUR 9 million)

Fuel blending and distributing enterprises have set up petrochemical facilities which provide favorable conditions for acquiring modern technologies for biofuel production which can partly replace imported fossil fuel.

Focus of technological efforts

In response to the Government's Biofuels master plan, Bioethanol has attracted many research programs conducted by institutes and associations supporting different industries:

- Industry associations: Vietnam Sugarcane and Sugar Association, Vietnam Beer-Alcohol-Beverage Association (VBA)
- Food Industries Research Institute (FIRI): to develop technologies of agriproducts, food processing, specially apply biotechnology in food industry, includes food and beverage.
- Research collaboration between Petrolimex and Vietnam's top universities such as Hanoi University of Technology, Hochiminh City University of Technology (Vietnam National University).

Among those, many recent studies shift to the next generation biofuels utilizing biomass, for instance, a joint research project "Intergation of local agriculture with biomass industry" under Japan's JICA-JST support to set up a pilot plant to produce bioethanol from rice straw (Tuan Phan, 2011).

Transportation network

Transportation network underdevelopment is considered an inhibitor for increased ethanol production from remote areas. According to several studies, the biomass should be sourced within the proximity of 100-300 kilometer.

Vietnam has a total of 49 seaports, 17 of which are relatively large and named as the keys to economic development along the 3,200km-long coastline (VMA, 2008).

Petroleum distribution

Ethanol pipelines have not been available. MoIT's Decision no. 2412/QĐ-BCT defined a straightfoward budget for developing oil and gas distribution system from 2010-2025:

- Investment capital for fuel distribution system in the period of 2011- 2015 is VND 41,187 billion (EUR 1.4 billion).
- Capital need for fuel distribution system in the period of 2016- 2020 is VND 47,466 billion (EUR 1.6 billion).

Big enterprises producing and trading petroleum, in which State enterprises are the core and key to strengthen the organization and distribution centers according to the supply region all over the country.

4.1.6 Environmental factors

Environmental factors are extremely important in this environmental technology project. Examining the environmental factors could reveal the natural potential Vietnam as well as what good this 2-G ethanol business could do to satisfy the country's need.

Natural conditions

As mentioned in the very first section of the project, Vietnam appears to have the natural resources required to grow different kinds of agricultural crops efficiently.

These natural conditions enable Vietnam to develop various kinds of agricultural crops, which can serve as raw materials for 2-G bioethanol production.

Table 4-4: Potential availability of agricultural residues for 2-G bioethanol in selected South East Asian countries

Crop	Residue type	Indonesia	Malaysia	Japan	Vietnam
Rice	Straw, husk	90	4	19	60
Wheat	Straw, husk	-	_	1	-
Sugarcane	Leaves,	15	-	1	8
	bagasse				
Corn	Stalks, cobs,	13	0.1	0	4
	leaves, husk				
Total residues		117	4	21	71
(Mt per year)					
Cellulosic ethanol*		35	1	6	21
(Billion liters per year)					
(Million ton per year)		27.6	0.79	4.74	16.5

Source: (cf. IGES, 2009)

Notes: *Using a conversion rate of 303 L/t of cellulosic residue material. Conversion rates can very from feedstock to feedstock and thus this should be considered as a rough estimate. Crop yield for 2005 was sourced from the FAOSTAT database. Residues were obtained from harvest index values and biomass distribution in the above ground mass from different sources.

In addition, Vietnam also has great potential of wood feedstock and wood residues, which are equivalent to 8.78 MToe (Nguyen Khai, 2009).

Environmental issues

On the other hand, Vietnam is heeding Climate Change warning with a predicted sea level rise, which would affect the Red River and Mekong Delta, both rice-producing areas, the worst. 35 million motorbikes (MoT, 2009) and 1.3 million automobiles are one of the leading causes of pollution in Vietnam's cities (ENN, 2008).

With the advanced characteristics of 2-G generation bioethanol, it can safely emphasize the environmental benefits in its marketing. Environmental impacts are decreased by utilizing crop residues for energy.

4.2 COMPETITIVE ANALYSIS OF VIETNAMESE BIOETHANOL MARKETS

This section describes the Five Forces of Vietnamese bioethanol market structure as proposed in chapter 2. As the researcher believes the global technology movements towards technology diffusions and gasohol usage is also have great impacts to change the name of the bioethanol game, the competitive analysis was analyzed and compared between the two different timeframes:

- From 2007-2015: The birth of ethanol industry in Vietnam
- From 2015-2025: The mature ethanol industry in Vietnam

Through the timelime 2007-2025, the boundaries of ethanol industry is changing by convergence of previously separate industries: ethanol and gasoline. The strong action to switching from fuel to gasohol with specific blending ratios, as highlighted in the previous section, triggers these two industries to overlap in terms of linkages, activities, technologies, products and customers. Besides the supply-side convergence driven by this external factor, Johnson et al (2006:77) indicated that the real test of change is from the customers, be it direct ethanol producers who desires their products to the next level of conversion efficiency, ethanol quality and environmental values; or indirect gasoline endusers who wish to fill their vehicles with economical yet clean fuels.

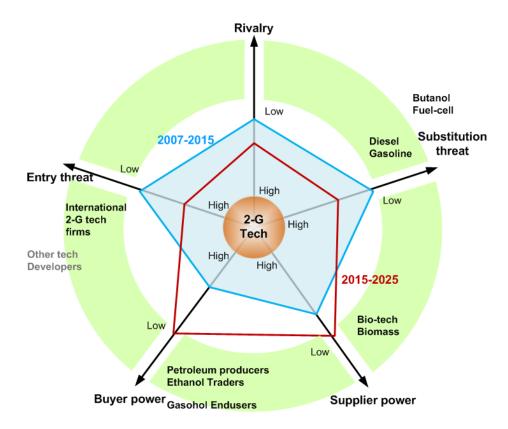


Figure 4-3: Competitive radar plot of Vietnam's bioethanol industry (adapted from Johnson et al., 2008)

4.2.1 Buyer Power

Three buyer groups of bioethanol industry can be categorized into 2 groups: direct buyers and indirect buyers.

Direct buyers

The group includes: Domestic petroleum distributors, Ethanol traders and Foreign petroleum distributors. The volume per buyer is relatively high, usually through agreements of annual supply. Before 2010, the majority of ethanol production was exported for different industries such as alcohol-beverages, cosmetics etc. due to the blurry plan of national E5 gasohol distribution, the bioethanol producers instead more focus on export (about 50% of production capacity), either directly or through ethanol traders.

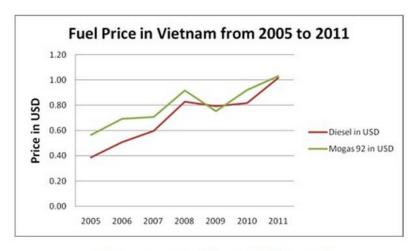
From 2010, Domestic Petroleum distributors became the main buyers to procure up to 50 percent of ethanol production. Petro Vietnam Central Biofuels Joint Stock Co. (under the control of Petro Vietnam and its subsidiary PVOil), and Vietnam National Petroleum Corporation are the first two buyers of ethanol to

blend with gasoline at the current ratio of 5%, and sell this gasohol through their network of petrol stations.

Generally speaking, Vietnam fuel distribution is a closed market under strict monitoring by the government through price ceiling and the price stabilizing fund, which could raise the questions of monopoly in the near future. Bioethanol producers, theoretically, should be wary of the strong bargaining position of these large volume buyers. However, recent biofuels master plan and biofuels blending schedule creating a relatively high possbilities of backward integration to bioethanol industry and demands for innovative integrated bioethanol production solutions, specifically, cutting-edge bioethanol conversion technogies, equipment, installation and commissioning, maintainance and upgrading services. This fact increases the interrelation between fuel and bioethanol industry.

• End-users (vehicle owners)

This is an indirect buyer group for the bioethanol business. They buy E5 or E10 gasohol from petrol stations for their own vehicles, however, they have the major impact as key drivers to the market development in Vietnam. Fuel is the indispensable element of the Vietnamese lives and all economic activities, given the giant volume of motorbikes (roughly 20 millions, 2009) and cars (1 million, 2009) moving on the road.



(Fuel Price Trends in Vietnam from 2005 to 2011)

Figure 4-4: Fuel price in Vietnam from 2005-2011 (VNOnline, 2011)

Although the fuel price in Vietnam (at level of 21,800 VND per liter, equals 78 Euro cent) is still lower than many countries, the average income increase of the

Vietnamese, however, has not kept up with the significant rise in price in recent years. Therefore taking conventional gasoline as benchmark for commercial ethanol, Tuat Phan (2011b) asserted that it is currently a "golden chance" for bioethanol industry and ethanol-blended gasoline to compete in the local market (Laodong, 2011). The output price is then, inarguably, competitive in export market as well.

In addition, the government's initiative towards gasohol usages may bring about businesses of flexible fuel vehicles to blossom in Vietnam, followed by higher ethanol blending possibilities (15% or higher ratios) and higher market demand for production facilities and ethanol products.

Under the MoIT's newly proposed ethanol blending ratio (period 2011-2017) drafted in October 2011, these petroleum distributors could be under pressure to ensure ethanol quantity satisfying the retail fuel requirements. Given the context of the same or even higher ratio of ethanol blending regulations in other ASEAN countries, China etc., the buyer power would be weaken in the period 2015-2025. Consequently, **the buyer power** could shift from **medium-high** to medium-low.

4.2.2 Supplier Power

In general, a bioethanol producer relies on quite narrow range of different suppliers, such as feedstock suppliers, bio-tech suppliers and energy suppliers (electricity, water). The researcher assumes that the 2-G technology provider have partnered with such suppliers as bio-tech suppliers to form their integrated solutions for the target market. Reduction of operation cost is one of the technology competences. Thus it leaves the supplier force analysis with the supply of biomass in Vietnam.

Supplier concentration and Differentiation of Inputs

Suppliers have a powerful position to current 1-G bioethanol producers in Vietnam because the plants are designed for only a specific kind of feedstock or molasses and cassava to be specific. The major feedstock for bioethanol is from cassava. The perspective of a sustainable supply of cassava is not quite bright. Announcing the plan to reduce the cassava planting area down to around 490,000

hectares from 2011-2015, MARD aims to increase the productivity up to 19 ton/ha, which in reality is at 17.2 ton/ha. It results in total productivity of 8.12 million ton (MARD, 2011), of which amount for ethanol makes up only less than 14%.

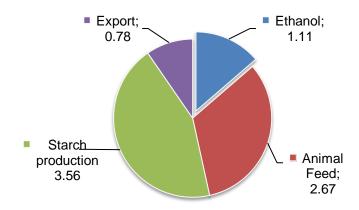


Figure 4-5: Distribution of Vietnamese cassava production, in million ton (Adapted from MARD, 2011; Yen Tran, 2011)

Current 1-G bioethanol producers would have to compete with food and feed production. Considering new plants are brought into operations by end of 2011, the supply constraints of 1-G bioethanol industry is predicted and bioethanol producers would likely have to compete for feedstock as the suppliers have the power to sell their products to the highest bidder.

This is not the case for 2-G Bioethanol industry when it is prioritizing multifeedstock value chain from different kinds of biomass (Rice hulls, rice straws, corn stalks, bagasses etc.). In addition, biomass is basically the agricultural residues from thousands of farmers, both in cooperatives and independently. The residues are not their main incomes. 2-G Bioethanol producers can partly control this power position of the supplier by:

- Applying long term supply contracts
- Setting up a cooperation in which farmers own a share of the firm, contracts with feedstock traders or individual producers (sugar factories, alcohol producers etc.)

The bargaining power of suppliers is also weakened in multi-feedstock value chain by the relatively lower switching costs for switching to the use of different feedstock types for 2-G bioethanol producers.

Threat of forward integration

The farmers or biomass collectors are certainly able to adopt the forward integration, however, it is not likely that they have enough capital and resource base to establish a cooperative bioethanol organization in large-scale.

Importance of volume to supplier

The bioethanol producer is dependent on feedstock supply, as it is its most important input required for production. In agriculture with relatively low margins per unit, achieving economies of scale in production is important. Thus the importance of producing in high volumes is high for the biomass suppliers, the bioethanol producers can only effectively deal with suppliers in its vicinity, for the transportation costs may limit the options to source for farther distances.

To sum up, despite the abundant source of agricultural residues in Vietnam, the bargaining position of feedstock suppliers can be moderate to high, varied case-by-case. The bioethanol producers that own raw materials and agricultural residues (sugar industry, for example) have much more power to reduce the supplier power.

4.2.3 Threat of substitutes

All firms in and industry are competing, in broad sense, with industries producing substitute products (Porter, 1990). Bioethanol competes with the use of substitute products, which have a similar end-use, limit the price and profitability of bioethanol depending on their price performance and availability.

Conventional gasoline

Conventional gasoline in Vietnam (92-octane or 95-octane) without ethanol-blend is the main substitions to gasohol in Vietnam. Its price can be used as a benchmark for ethanol output price. E5/ E10 gasohol at price less than VND 20,800-21,720 (70-73 Euro cent) will result in higher consumption of ethanol.

Diesel

Diesel price in Vietnam usually is slightly lower than gasoline. Currently price ranges from VND 20,400- 21,100 (68.5- 71 Euro cent)

In the long term developments, some products might pose a threat for ethanol and gasohol: Fuel cell technology, electricification for transport, Hydrogen, Biodiesel. Biodiesel is a booming industry in the world, especially Europe. However, most of biodiesel projects in Vietnam have been stopped at pilot phase due to both high price feedstock (i.e. waste fats are being sourced at 19,000 VND (EUR 0.65) – Phuong Do, 2011), almost close to the market price of diesel (VND 21,100 or EUR 0.71). Other campaigns to develop jatropha plantation for feedstock is competing with land area for the real food crop. Other advanced forms of biofuels (such as bio-butanol) are not likely to be substitutes with bioethanol in near future as it is still at very early stage of R&D.

The threat of substitutes is relatively low in the short term. As the mandated blending and market support measures remain in place, there is a growing market for bioethanol production. Increasing oil price aids this development.

4.2.4 Threats of Entry

Potential entries by new firms provide additional constraints on measuring the market power by current industry participants. Unlike fossil fuels, natural gas or coal with large-capacity plants to take advantage of economy of scale in terms of exploitation and processing, which only allows giants such as national corporations or big multinational companies, the 2-G bioethanol industry does not work that way. Different types of business entities are able to collaborate and participate in the field, including SMEs (PVOil, 2011a).

These dynamics make it extremely unlikely that a single ethanol producer could engage in price fixing or other anticompetitive behavior. The benchmarking price would be the total costs leading to lower price E5 gasoline than conventional fossil source.

The main competitors are big international 2-G players, some can be named as below:



• Fierce competition from Asia

Qteros-Praj alliance (2-*G*): Praj Industries Ltd. was the technology provider for many of Vietnam's 1-G ethanol plants with strong customer database. They have a certain achievement development and commercialization milestones in 2012 for 2-G technologies.

China: Guangdong Zhongke Tianyuan New Energy Science and Technology Co., Ltd (Ethanol/Butanol integrated solution provider); Novozyme-COFCO alliance (2-G technologies)

Japan: The Japanese companies have strong connection to Vietnam market through JICA's R&D projects

Considering the limited presence of entry barriers in the bioethanol industry, the threat of entry is relatively high in the period 2015-2025. Due to the capital requirements, skills, land acquisitions and complexity of value chain, **the threat of substitute** products, immature 2-G bioethanol technology, **is relatively low in the short term.**

New entrants, which introduce a new successful 2-G production technology, could become the frontrunners of the Vietnamese bioethanol industry. The experience incumbent 1-G ethanol plants have gained, from which they derive an advantage, could become irrelevant as soon as a new and more efficient technology for biomass feedstocks is introduced.

It is supported by Hill & Jones (2009)'s first-mover theory discussed in sustaining competitive advantage theories. The bioethanol frontrunners gain the control over

biomass, plant capacity with equivalent patented technologies and designs as well as agreements for output (PVOil, 2011b) will be able to take a lead in the market.

4.2.5 Competition Intensity

In order to market 2-G bioethanol technology in Vietnam, a firm has to find its way to deal with other global 2-G producers; as well as current 1-G bioethanol producers.

1-G bioethanol production

Scientific studies reveal that the raw materials might not be enough for the registered 1-G bioethanol plants in Vietnam (competition with cassava for export and animal feeds), which could possibly turn out to be a demand to upgrade to 2-G bioethanol (Appendice B).

The 2-G Bioethanol wave

In the Global Status Report 2011, REN21 reported the trend of advanced biofuels industry (2-G Biofuels) as the diversity of players continue to increase including 1-G ethanol firms, traditional oil companies, major aviation companies, and young, rapidly growing firms. Some of the cases could be examined in Vietnam are:

Among the 1-G ethanol technology providers who transform into 2-G, the earlier mentioned Praj Indutries Ltd., case is a typical example. They have the strong partnership with bio-tech companies, sub-contractors. Their biggest advantage is the base of ethanol cutomer who seek solutions to add co-located cellulosic ethanol facilities to the existing ethanol infrastructure, reducing dependence on traditional feedstock (corn, cassava) and using diversified feedstocks.

Golden State Biofuels is another example. In 2009, they signed a 49-year exclusive agreement with Vietnam's government to invest 150 million EUR (more than 200 million USD) to construct and operate 10 ethanol plants throughout Vietnam. The plants will use equipment manufactured in the US to produce ethanol from rice hulls. Each ethanol plant will be a self-contained modular unit with design capacity to produce 5,000 gallons a day (20,000 liters). The units will

be easy to assemble and have state-of-the-art environmental protection equipment. (Kessler, 2009)

Summary of the industry competitiveness in Vietnam

The combined impact of the industry five forces implies that 2-G bioethanol producers are in a dynamic competitive environment. The bargaining power of suppliers and buyers are all relatively high, putting the bioethanol producer in a tough position. Such a power balance may result in vertical integration, indicating that biomass collection, bioethanol technology provider/production and blending could become integrated in a single firm. Low production costs from appropriate production technologies and effective supply chain are an important factor for success in the industry.

Bioethanol has relatively low rivalry with few competitors and faces low substitution threats. The threat of entry is relatively low, but both buyer and supplier power are moderate-high. Such a power balance may result in vertical integration, indicating that biomass collection, bioethanol technology provider/production and blending could become integrated in a single firm. Overall, this looks moderately attractive industry to invest in.

Given the dynamic nature of this high-pace developing industry, during the future period of 2015-2025 with increasing demand for bioethanol as fuel additives, both buyer and supplier power will be easing. The industry competitors will increase, however, "early entrants" may overcome future rivalry by partnership with key domestic play and emerge with overall dominance. In addition, patenting of advanced technologies could make-or-break the competitive advantage of a producer in the near future. The perspective could be extremely attractive for those 2-G companies confident of becoming the dominant players.

This chapter will be followed by a comprehensive analysis of Vietnam's bioethanol value network with identification of the local stakeholders and potential customer segments for cutting edge 2-G bioethanol technologies.

4.3 DIAGNOSIS OF THE BIOETHANOL INDUSTRY IN VIETNAM THROUGH RESEARCH FINDINGS

In the following section, the research continues diagnosing the market employing the value chain analysis with the purpose to identify the industry linkages and the relevant elements within the national context. The factors reveal the potential business options will be emphasizes and explained further in the next chapter, discussing different business options and respective models.

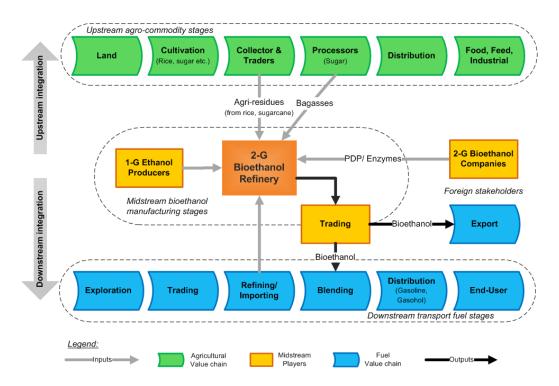


Figure 4-6: Bioethanol Value Network in Vietnam (adapted from Chan, 2011)

The diagnosis of bioethanol industry ethanol in Vietnam through the lens of Value network reveals the vertical integration movements and identifies strategic customers for the advanced 2-G bioethanol technologies. Once adopting these technological breakthroughs at early stages, provided that these strategic customers have their own competences in either upstream and/or downstream stages of bioethanol value chain, and effectively compete in bioethanol industry in Vietnam from supplying raw materials to distributing the output ethanol to markets, domestically and even regionally.

The following sections will describe the critical linking points between agricultural (upstream), bioethanol production (midstream) and ethanol/gasohol

distribution (downstream) thoroughly. As a result, foreign 2-G companies can find the answer to these questions:

- Who can have the strong control over the immature biomass collection activities? What are the expectations with respect to processing these untapped goldmines?
- Who are currently in the bioethanol competition in Vietnam? What are the unmet needs?
- Who can strongly play a role to distribute the bioethanol output? What is
 the system and is it likely to establish the alliance to increase "my"
 coverage of bioethanol value chain in Vietnam?

4.3.1 Availablity of biomass for 2-G ethanol production in Vietnam

Biomass energy supplies a major part of total amount of energy consumed in Vietnam. That said, in many cases, biomass energy sources are used inefficiently. This is a great potential for improvements with regard to energy saving, financial benefit and environment. Therefore, it is necessary to provide the related information on energy efficiency technologies, energy conservation measures or improvements made elsewhere, outside and inside the country to help the local people use energy efficiently, improve their standard of living and also contribute to the environmental emission reduction.

Classification of technical potential biomass energy sources in Vietnam can be divided into 5 main categories: Crop residues, Wood residues, Municipal Wastes, Oil trees and Livestock waste (*see Appendice B*). Crop residues and wood residues are considered the most feasible path to commercialize cellulosic ethanol. Due to the time constraint and data availability of this study, only crop residues will be discussed in the scope of this study.

As estimated in table 4-2, residues from Vietnam's staple crops of rice, maize, sweet potatoes etc. amount to about 16.5 million ton. Some by-products (dry straw and dry stalks) are used by burying or composting them as organic fertilizer for cultivation separately and on a small scale.

100% 100% 15% 60% 60% 16.5 **MTOE** 60% 18% 20% 20% Potential from Potential from Bagasses Rice residues by area By area Rice straw ■ Rice hulls ■ Bagasse Others

ETHANOL POTENTIAL FROM AGRICULTURAL RESIDUES IN VIETNAM

Figure 4-7: Feedstock availability from Agriculture residue (Data from Khai Nguyen, 2009; MoIT, 2011a)

■ South Eastern

■ Mekong Delta

■ Nothern Midland ■ Central Highlands

In order to have further understanding of the feedstock distribution, the following sections will walk through the two major sources that make up more than 80% of agriculture residues.

Results from this analysis could suggest good locations for setting up 2-G bioethanol productions, which can influence the decision of who-to-partner or where to market the appropriate technology.

4.3.1.1 Rice residues

■ Red River Delta

According Dr. Tuan Phan (2011), rice straw might be used for different purposes such as piled or spread in the field, incorporated in the soil, or used as mulch for the following crop. However, a lot of them have been burned *in situ* in Vietnam, causing a waste of energy and evironment pollution. If 30-50% rice straw could be used for bioethanol production, it is big enough a material source for bioethanol production on commercial scale, as also demonstrated by a study of IGES (2009). Rice residues can be sourced within proximity of 300 kilometers at VND 300/kg, as per estimated by JICA-JST "Integration of local agriculture with biomass industry" project.

According to Dr. Tan Pham, Deputy Director of the Sub-Institute of After-harvest (MARD), there is not only a high loss-after-harvest ration (13.7%) but also a huge loss of rice residue up to 50%. Farmers just collect them and then either heap them on the field or burn them directly.

In the Mekong delta area (12% the country area), the amount of rice straw is over 20 million ton/year contributing to more than 50% of Vietnam's rice output (BiWare, 2004; Devi, 2011). Most straws and hulls are being wasted, used inappropriately or simply treated after harvesting, which do not require any investment, and in the case of burning farmers can use the resulting ash as a mixed ground layer in order to increase the porosity of the soil. However, the burning of straw and dry stems emits GHGs and also causes smoke and environmental pollution.



Figure 4-8: Burning rice straw (Devi, 2011)

Due to limiting factors such as disease burning, poor straw conditions etc., not all of the farm-based residues that are grown would be available for harvest. Dang et al. (2010) in their paper state the amounts of rice straw in the Mekong Delta alone available for energy production in 2010 and 2020 would be 15.9 and 14.3 MT. In addition, they assumed that 100% of processing-based residues can be used,

results in the available amount of rice husk as 4.4 and 4.0 MT in 2010 and 2020 respectively.

Crop residues, in general, are characterized by seasonal availability (e.g. 3 months for rice), high levels of moisture and nutrients, and ease of decomposition. They may play a major role in sustainable energy if they are treated by the proven methods, according to Quyen Huynh (2011). It is a critical process to ensure to continuous and stable supply of raw materials for 2-G bioethanol production. In returns, the development of 2-G bioethanol industry will boost up the market and trading system for agricultural residues.

If taking half of the agricultural residue volume for 2-G ethanol production (20 million ton per year) at the current available process conversion efficiency, Vietnam still has the biomass potential equivalent to 6.5 million ton, or about 65 2-G ethanol plants with capacity of 100 MT/year (calculation details attached *in Appendice B*).

4.3.1.2 Bagasses from sugarcanes

A study carried out by CIE/WB on "Vietnam Sugar Program" identifies three classes of farms according to what sized mills they supply and called these small, medium and large farms.

Table 4-5: Operating sugar mills in Vietnam (MARD, 2009)

Sugar mill scales	No. of mills	Sugarcane Crushing capacity
Large scale	6	> 350,000 tons
Medium scale	9	150,000- 350,000 tons
Small scale	25	< 150,000 tons
Total	40	12.3 million ton (Annual)

Farms produce cane for processing, for drinks and other farm products such as rice, cassava, sweet potatoes etc. The distribution of different scale mills are illustrated in the figure below:

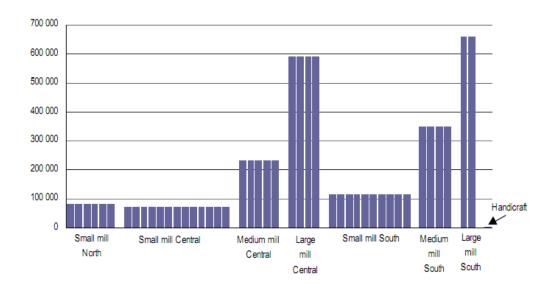


Figure 4-9: Average annual cane crush for varying sized mills (CIE, 2003)

The sunshine levels are adequate in the Central and the South but limit potential of sugarcane yields in the North. At the conference in Ho Chi Minh city reviewing the sugarcane crop year 2010-2011, the Chairman of Sugar Association declared the the yield of sugar cane was 16.4 million tones, the nationwide cultivated area was 271,00 ha and the productivity was 60.6 tons per hectare (VCCI, 2011b). The development orientation of the industry also shows plans to expand the sugarcane materials areas in the South to Binh Phuoc province and neighbouring Cambodia (Vietnam Business News, 2011b).

Sugar mills currently purchase sugarcane from farms based on long-term purchase agreement. There are still risks of breaching the contracts by the farmers in Vietnam whenever there are more profitable crops that are more profitable than sugarcane. In general, farms supplying larger sugar plants appear to perform better than farms supplying small mills, due to better extension efforts conducted by the larger mills through supporting finances, crops, fertilisers, watering and techniques, and "floor purchasing price" commitments. On the other hand, the area with better agronomic conditions than other crops may have attracted larger mills to the areas (CIE, 2003). Thus the stable supply of baggasse is insecured without the partnership with local sugar plants.

Besides the main residue sugarcane tops and leaves which are normally used as cattle feed or burnt in the field, other by-products of sugar mills are molasses (3-5%), ethanol, bagasse (30%), sludge (1.5-3%) and raw sugar (typically goes on to be refined). A small amount of ethanol is produced using traditional process (*see*

section 4.3.2 for further details). Most sugar factories burn all the bagasse they generate, even at very low efficiencies. Only 8 of the sugar mills installed cogeneration system using bagasse to generate steam and electricity necessary for sugar production and provides surplus electricity to the power grid through Electricity of Vietnam (EVN).

- Sucrerie de Bourbon Tay Ninh Sugar Mill (Tay Ninh Province), installed
 the largest cogeneration system in Vietnam. Its capacity is 24MW (12MW
 x 2) and 9-10MW is used for the sugar mill and the rest is sold to the
 power grid.
- Others are Lam Son Sugar Mill (Thanh Hoa Province), La Nga Sugar Mill (Dong Nai Province), Cam Ranh Sugar Mill (Khanh Hoa Province), Gia Lai Sugar-Thermal Power Plant (Gia Lai Province), Ninh Hoa Sugar Mill, Son La Sugar Mill (Son La Province),

The model, however, shows some disadvantages to reach its goals for the following reasons:

Firstly, without the pricing framework, electricity price is defined by EVN at VND 900/kWh (3 Euro cent/KWh) at spot price, lower than the offer price for hydropower plants and imported from China price 5.8cent/KWh (4.25 Euro cent/KWh). Therefore, the sugar mills cannot afford to invest in updated technologies, which in turns lead to low efficiency. Most of the mills produce 50kWh per bagasse ton, only a half of the productivity with new technologies from Germany, Switzerland etc. (EERE, 2011). Some of the plants who have invested in new technologies are suffering from lost profit and are not willing to make more investments.

Secondly, the investment unit cost is too high. In general, a power plant which generates electricity from bagasse costs USD 1,000-2,000 (EUR 731- 1,463) for every kW of installation. A sugar refinery with the capacity of 3,000 tons a day can have a 30MW electricity plant with the investment capital of USD 30-60 million (EUR 22- 44 million).

Thirdly, in accordance with the AFTA commitment, Vietnam had to reduce the import tariff from 30% in 2007 down to 5% in 2010. While the sugar price is fluctuating and heavily influenced by global sugar supply-demand, Vietnamese

Sugar industry becomes more vulnerable to other 60 sugar-producer nations, especially its neighbor Thailand, therefore the domestic plants cannot increase the price of sugar. The by-products of this industry in Vietnam, which is abundant in volumes, are in need of a new model to maximize the profits and offset the loss for sugar mills due to market price fluctuation. Considering the fact that these potential has not been fully utilized, the write believes this is a perfect timing to introduce 2-G ethanol process design packages to these companies.

All in all, Vietnam is an agriculture-based economy with abundant supply of agricultural residues for ethanol production. The results indicate that Vietnam has the potential for producing large amounts of feedstock-flex cellulosic ethanol from these residue sources. There is potential to produce even more if residues from other agricultural crops, timber mills, forests, grasslands and organic waste from urban and rural areas are included.

Currently, the biggest sources, rice residues are yet to have the systematic sourcing. Agro-processors in Vietnam have long term contracts to procure cassava and sugarcane, and possibly binding with the collection of residues (rice residues). With increasing pressure biofuel mandates, the market for ethanol and hence the demand for feedstock is poised to grow at an exponential pace.

Even though biomass is regionally distributed in Vietnam, the role of feedstock supply can be fulfilled by the local agro-processors and medium-to-large-scale sugar plants (15 mills). They seem to be the most ideal partners due to the coverage of agricultural area as well as the mutual benefits shared with the success of 2-G ethanol industry:

- **First,** the sugar industry provides a cellulosic based waste stream that can be converted into ethanol and they have the expertise to handle large amounts of biomass.
- **Second,** producers in the sugar industry are searching to diversify the utilization of sugarcane residues and by-products to produce.

The availability of agricultural residues implies business opportunities in the Mekong Delta (12% the country area) - a famous delta in Asia for agricultural production that accounts for more than 50% Vietnam's rice output and more than 60% fruits production annually (BiWare, 2004). 2-G Ethanol production

established in this area could benefit from the saving of sourcing and transportation cost, as highlighted in the bioethanol value chain analysis in chapter 2.

4.3.2 Current status of Ethanol production in Vietnam

The bioethanol industry is not a new industry in Vietnam, but rather one serving the beverage and industrial markets. The new demands for ethanol gasoline open up many spaces within in the industry. There are two trends which firms evolve in the value chain to establish bioethanol market in Vietnam. Some predominantly operate in downstream are integrating upstream and vice versa.

4.3.2.1 Traditional ethanol processors

The first trend that can be observed is downstream integration into the manufacturing stage by traditional food and beverage processors, or sugar mills and alcohol-beverage producers in Vietnam, to be specific. The firms utilize their resources such as biomass feedstock supply (sugarcanes, molasses and rice), plant locations close to the material areas, technological knowhow of feedstock storage and pre-treatment. The MoIT's seminar for status quo of bioethanol development in Vietnam, there are 11 operating ethanol plants (MoIT, 2011b; *see appendice F*).

Prior to 2009, ethanol production technologies in Vietnam from carbonhydrates (starch and sugar) are generally old and inefficient:

- Equipment is out-of-date and has low capacity (most of it produces less than 25 million liters per year) and low energy efficiency.
- Conversion rates and productivity are low and the cost of operation is high relative to productivity.
- At the same time, skilled human resource in this industry is still weak (Cuong Nguyen, 2009).
- Low efficient waste treatment

Binh Tay JSC is a typical ethanol producer from the Alcoholic-Beverage and Brewery Industry. The plant converted ethanol from rice, molasse, and cassava with capacity of 6 million liter per year (4,800 ton), using a technology from Krep Spechim, France) (MoIT, 2011b). In 2009, due to the construction of Ho Chi Minh City East-West Highway project, the ditches system where it directly discharged the wastewater was blocked, causing water flooding and smelly odors (VTC, 2009).

Some of these traditional ethanol plants were either forced to dissolve or their investment certificates were withdrawn. At the end of 2010, Quang Ngai Sugar JSC's ethanol plant was dissolved (Dantri, 2011). The ethanol plant was found to have discarded 20,575 m3 of untreated wastewater into Tra Khuc River from 5/2009 to 4/2010. The river was heavily contaminated, affecting fishing and poultry in Quang Ngai area.

In 2011, the People's Committee of Binh Dinh province officially suspended the Binh Dinh Alcohol-ethanol plant from production due to incapable waste treatment system causing pollution. The company used molasses, cassava as its feedstock. (Phapluat, 2011a)

4.3.2.2 1-G Ethanol producers

Pilot and commercial production has been increasing in the last 5 years in which 2009 can be considered as the year of the biofuel industry kick-off in Vietnam. During 2009, many 1-G ethanol plants were built in Quang Nam, Phu Tho, Quang Ngai (Dung Quat), Binh Phuoc and Dong Nai, depending on cassava as a feedstock. Investments in these plants come from both public and private sectors. Besides, bioethanol production has opened up market demands for agricultural and other wastes which were not commercialized before.

By end of 2011, there are 5 first-generation ethanol producers with a total installed capacity of 365,000 tons per year - enough for mixing 7.3 million tons of E5 (Cuong Nguyen, 2011).

Table 4-6: Operating 1-G bioethanol plants in Vietnam (Tuat Phan, 2011b)

No.	Plants	Technology	Capacity (Ml/y)	Location	Note
1	Greenfield JSC	China	125	Quang Nam	Operating
2	Tung Lam Ltd., Co.,	China	70	Dong Nai	Operating
3	Phu Tho Bioethanol plant	Alfa Laval (Sweden), Delta-T (US)	100	Phu Tho	To operate by end of 2011
4	Dung Quat Bioethanol plant	Delta-T (US)	100	Quang Ngai	To operate by 2011
5	Binh Phuoc Bioethanol plant	Praj (India)	100	Binh Phuoc	To operate by 2012

Dai Tan Ethanol plant, Greenfield JSC

Vietnam's largest ethanol plant, Dai Tan ethanol plant, invested by Dong Xanh (Greenfield JSC) produced "ethanol", or "absolute alcohol" (99.5%) with percentage of water in alcohol under 0.5 percent to blend with conventional gasoline as E5 gasoline for transportation. It uses cassava as its raw materials, which it purchases from 20,000 nearby farm households. The plant area is 18 ha, with a capacity of 100 thousand ton/year (equivalent to 125 million liter/year). By-products are liquid CO2 (20 thousand ton/year) and microorganism fertilizer (40 thousand ton/year) that can be utilized to replace coal for burners and sold to farmers respectively. The circulation boiler uses 50-60 percent of biogas. In addition, the plant has a modern wastewater treatment system which can filter 99.8 percent of BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) out of waste water before emitted to the environment. (VEN, 2010; Asia Biomass, 2010; Thai Luu, 2011)

Binh Phuoc Ethanol plant

The plant has total capital of US\$100 million, including articles: warehouse system of cassava input, grinding division, fermenting division, distilling and water extracting division to gain alcohol of 99.7 percent, division processing water input with capacity of 10,000 cubic metres per day; sewage treatment division to ensure that sewage released into the environment meets standard A; tank to contain output, and others. (VCCI, 2011c)

OBF Company, the plant owner, is a joint venture company between ITOCHU Corporation (49 percent), Petrolvietnam Oil Corporation (PVOil) (29 percent) and LICOGI Joint Stock Company 16 (22 percent). Technologies from PRAJ Industries Ltd. (India), were selected for the plant construction.

By-product raw CO2 (140 ton/day) are sourced by Messer, a German industrial gas producer and trader for processing pure CO2 for domestic use and export. Apart from this revenue stream, the plant also benefits from CERs (Certified Emission Reduction) and microorganism fertilizer.

Shortcomings

High-cost yet low efficient waste treatment

High-cost yet low efficient waste treatment: According to Lam Son JSC chairman, the waste treatment cost makes up one-third of the VND 300 billion ethanol revenue (EUR 10 million) while the technology investment cost was only USD 1.8 million (EUR 1.32 million).

Even though 1-G bioethanol plants have made great advances in comparison to tradition ethanol from rice, it seems that there are spaces for further improvement of feedstock flexibility and the waste treatment. 1-G ethanol plants in Vietnam have not run at full capacity in order to actually reach the realized production of 300,000 ton/year. The reason, as stated by the Director of Dai Tan Ethanol Plant, were the incapability of the wastewater treatment system. The plant is supposed to operate at 70-75% of its capacity in order to protect the environment (cf. LDTD, 2011).

Future feedstock supply constraints

As analyzed earlier in section 4.2.5 for the industry competitiveness, there is a raising concern regarding a sufficient supply of cassava for the registered ethanol plants. Therefore, it could be seen as opportunities for 2-G technology providers to provide solutions to either upgrade or co-locate with existing facities.

2-G ETHANOL DEMAND FORECAST 4000 3500 3000 3.05 MT 2-G Bioethanol (scenario 2) 2500 2-G Bioethanol (scenario 1) 2000 ■ 1-G Bioethanol 1500 Biodiesel 1000 1.15 MT 500 O 2010 2015 2020 2025

Figure 4-10: 2-G Ethanol Demand Forecast (2015-2025)

Apart from these potential demands for new cutting edge technology, Decision no. 2412/QD-BCT passed on May, 2011 indicated that depending on the market demand, the capacity of raw material source and efficiency of operation of the plants built and energy security objectives, food security, the environment, new bioethanol manufacturing plants would be considered for additional investment from the government.

4.3.3 Markets of ethanol and gasohol production in Vietnam

In this section, the market for ethanol, both domestic and export opportunities will be introduced to reinforce the market size. In order to do so, not only the current distribution of petroleum and gasohol in Vietnam will be investigated, but also the information of Vietnam's ethanol importers should be gathered.

4.3.3.1 The petroleum and gasohol distribution system

The petroleum distribution in Vietnam is operating through 11 distributors, notably 80% of the market are occupied by the 2 major SoEs: Vietnam National Petroleum Corporation (Petrolimex) and two subsidiaries of PVN (PVOil and Petec). Petimex has 800 gasoline stations with coverage from Khanh Hoa (Southern Central of Vietnam) to Ca Mau (Southernmost of Vietnam).

Vietnam's Petroleum distribution market share

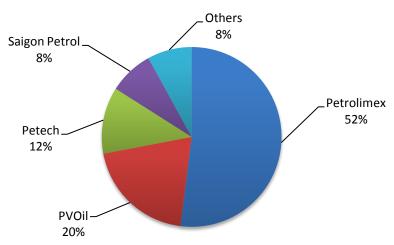


Figure 4-11: Vietnam's Petroleum distribution market share (Petec, 2011; Petrolimex, 2011; VCCI, 2011b)

The launch of gasohol

On the demand side, biofuels are not widely used in Vietnam yet, as the sales and distributions of E5 gasoline has just been lauched from August 2010 (Cuong Nguyen, 2011). Currently, roughly 30-50% of ethanol output is distributed domestically through distribution network of Petrolimex and PVOil. Greenfield JSC, for example, sells 50% of their production capacity to PVB through purchasing guarantee contracts.

The domestic demand consumes roughly 50% of ethanol production, which is set to increase dramatically according to E5 and E10 gasohol mandates by the government. The E5 gasohol had a retail price VND 500-2,000 per liter less than the cost for a liter of straight 92-octane petrol. PV Oil was reportedly stepping up efforts to achieve the target of having 100 per cent of its filling stations sell biofuel E5 in 2011, according to a PV Oil representative. Thereby, the number of such filling stations by PV Oil alone expects to reach 400 in 2011. However, current state-owned distributors (PVOil and PETEC) are capable of distributing only 50% of E5 (about 2.37 million m3) and yet to cope with the government's projected ethanol blend gasoline mandates. During current pilot phase, there are only 40 gas stations providing E5 gasoline, with expectation to increase up to 4,000 gas stations in 2012 to meet the ethanol-blend mandate nationwide.

Apart from the Government's budget for developing oil and gas distribution system from 2010-2025 (see section 4.1.5), there is still space for private sectors to actually participate in the value chain and to distribute the remaining 2.43 million m3 (Tuat Phan, 2011). This could be done by establishing alliance with big State-owned enterprises producing and trading petroleum, who are the core and key to strengthen the organization and distribution centers according to the supply region all over the country.

The researcher believes that the convergence of tradition fuel/gasoline industry is taking form and will start accelerating under the influence of the world's movement towards cleaner fuels. Apparently, from these strategic customers' perspective, the growing bioethanol industry is viewed as a potential opportunity instead of a competitive threat. The petroleum distributors and its Oil & Gas parents are very likely to reap the first-mover advantages to lead the ethanol industry.

Vietnam has not opened the gasoline distribution market for foreign investors (Shell's proposal to acquire 25-30% percent shares in Petec was declined in July 2011 – FT, 2011). However, according to VCCI, the Government allows PVOil to establish a new entity with the foreign parties of Nghi Son oil refinery to distribute its own products, on the condition that Vietnam's party holds limited ownership of 51% (VCCI, 2011b).

Therefore, it is likely that a strategic cooperation with fuel distributors in bioethanol could pave the way to access the gasohol and fuel retailing of this market of 86-million population.

4.3.3.2 Global and regional perspectives of ethanol trade

With the harmonized standard, according to the Chairman of Greenfield JSC, half of its ethanol products are exported to such markets as Phillippines, Japan, Korea, Indonesia and Australia.

According to an interviewed source, the export price is currently at USD 970/ton (EUR 710/ton), while the benchmark price of cellulosic ethanol in China in 2010 is only EUR 600/ton (Chempolis, 2011).

Besides the major uses for blending with fossil fuels for transportation, ethanol is consumed domestically or export for other industries in Vietnam: Alcoholic beverages, Beauty and Healthcare, other industrial uses.

Summary

The empirical studies of the market proved that there are actually capable local customer segments from bioethanol's upstream to downstream who can afford to adopt vertical integration strategy and establish 2-G bioethanol generation in Vietnam. The strategic segments are clearly identified through the following factors:

- Strategic similarity between the vertically-related activities: demands for alternatives to increase profits based on available resources, be it having abundant sources of feedstock, possibility of co-locate or access to downstream distribution channels that otherwise be inaccessible.
- Cooperation and joint ventures with these companies can lead to expansion of core competencies and possibilities to capture bigger piece of the ethanol market pie, in Vietnam and regionally.

This study scope only analyzes the connection with downstream players to actively control ethanol output sales, it does not deal with the access to retailing gasoline distribution in Vietnam through this cooperation, however, the researcher believes it could be an interesting space to be investigated and discussed in further studies.

5 DISCUSSIONS

5.1 2-G Bioethanol Business models in Vietnam

Through findings from the empirical research, in this section, the researcher will present the answer to the final research questions: "Based on the interconnectedness of the above factors, what could be the business models to enter and compete in Vietnamese 2-G bioethanol industry?" The choices of strategies will be supported with stakeholder mapping as well as the suggestion to mitigate risks, paving ways for a smooth journey to the market.

5.1.1 Customer Value Proposition

Different potential customer groups of the 2-G bioethanol business have relatively different expectation against technologies that apparently influence their decisions whether to procure the solutions or not. In this section, most concerned problems and requirements from these groups will be discussed. Based on these findings from the empirical research, how the unique technology solutions/ Process Design Package (PDP) could genuinely meet the market needs will be revealed afterwards, implying critical success factors to attack the Vietnamese bioethanol market.

Based on the position in the bioethanol value network, there are three focused customer groups in which the development of a cellulosic ethanol industry might take place in Vietnam: Agricultural processors, traditional and 1-G ethanol producers and Petroleum distributors.

Overall, the suitable technologies enable ethanol producers to utilize the abundant low-cost agricultural residues in Vietnam and covert into ethanol in an environmental-friendly way. Table 5-1 highlights the problems and expectations from each strategic customer, which strongly influences their procurement/cooperation decision.

Table 5-1: Customer Value Proposition of 2-G Bioethanol Technologies

Strategic customers	Customers' Problems/ Expectations	Value Proposition
Sugar Producers	Utilize sugar production's wastes/ by- products, residues in local areas Ethanol produced at competitive price High-value by products Low operating costs Possibility to produce enzymes locally Environmental values	Multi-Feedstock High-yields of Ethanol
Traditional & 1-G Ethanol Producers	Ethanol produced at competitive price Effective waste treatment and management systems Lessen dependence on cassava High yields of ethanol from feedstock	Energy self-sufficient
	 Possibility to co-locate with current facilities Other environmental values 	Low effluent
Petroleum Distributors	Ethanol produced at competitive price Capacity to produce Ethanol meeting demands & GVN's Gasohol mandates Ethanol produced at TCVN quality	Ethanol quality
	Environmental values	Upgradable

Core competencies

The key value proposition of this latent technology offer is unique compared to the available ethanol production solutions on the market. Moving into a biofuels industry that is emergent to Vietnam and companies in the host country, the 2-G technology provider offers:

- An effective way to utilize different low cost agriculture residues
- High-yields conversion of ethanol
- Low operating costs, and energy efficiency
- Low environmental impact (effluent free).

In addition, technology providers commit to supply the distinctive enzyme kits to enhance the PDP efficiency. The customers will benefit from any innovations to drive down the enzyme cocktail costs. This offering, in turn, creates "sticky relationships" that enables the 2-G technology provider to increase the buyer switching costs, and lock in its customers in the long run.

5.1.1.1 Upstream Agricultural processors- Sugar Producers

The biomass trading market in Vietnam has not been fully established, therefore, it is a challenging mission to ensure high commitments of sustained feedstock supply from farmers and commodity traders.

The sugar producers who have the control over biomass feedstock are quite actively searching for proven 2-G technologies. At the moment, 15 producers with large and medium scale seem to be capable of adopting 2-G bioethanol technologies. The criteria which appear to be the most important to them are:

- Cutting edge solutions to utilize its biomass sources (bagasses, sugarcane tops and leaves) effectively; and to convert to ethanol from other agricultural residues within their vicinity in order to overcome shortage of feedstock due to seasonal productions
- Low operating costs, self-sufficient energy facilities and high-value byproducts in order to to offset the plant's main sugar products' volatile price, hence improve the sugar plant overall performance.
- Environmental-friendly solutions to meet national legal regulations

This group is more cautious in capital investment decisions than the other two segments, in other words, is more sensitive to the solutions price. However, convincing cash generating scenarios from by-products sales and energy savings that result in yielding a positive net present value (NPV) of the project will be more decisive to their procurement decisions.

5.1.1.2 1-G ethanol producers

The second segment includes 13 1-G ethanol producers. In Vietnam, this group can be originally from both ethanol upstream (Tung Lam Co., Ltd, Greenfield JSC) or downstream (Joint Ventures with PVOil). What make them stand out are the experience in ethanol production at hand and the networking to foreign ethanol buyers, especially to such regional markets ASEAN, China, Japan, Korea, and Australia etc.

As highlighted while analyzing the status quo of Vietnamese ethanol production (section 4.3.2), many current ethanol production facitilies in Vietnam do not have the capable waste management and treatment that allow them to run at full capacity. Morever, the traditional or 1-G ethanol producers are limited with a single input feedstock, either from rice, cassava or molasses. The use of those feedstocks is under endless food-versus-fuel debates as well as feedstock supply constraints.

These potential customers would be seeking to add value to their operating holdings in 1-G ethanol by adding cellulosic ethanol capabilities to their existing fleet. They are small in number yet could have great demands of following technological solutions:

- Upgrade their production to incorporate additional biomass feedstocks due to the raw material supply constraint; or
- Add co-located cellulosic ethanol facilities to their existing ethanol infrastructure.
- Invest a new facility where they can stretch to secure input biomasses

When 2-G technologies are still at technology development phase in their technology diffusion life cycle, one challenge could be easily observed at the moment in 1-G investment trend is that this group has preference for low-cost systems. The majority of equipments were procured from China.

5.1.1.3 Downstream Petroleum Distributors

Last but not least, Petroleum distributors can be considered not only potential segments for 2-G technologies but also the most influential drivers to this market growth. They control the domestic gasoline and gasohol distribution. They are entitled to different government support packages for improving retail distribution systems (Decision no. 2412/QD-BCT, details discussed *in section 4.1.5*) and developing ethanol industry to use as fuel additives (Decision 177/2007/QD-TTg, details discussed *in section 4.1.1*).

The budget for capital investment, hence, is relatively more generous than other customer groups. Instead, the production capacity, conversion efficiency and output price competitiveness have more influence on the procurement decision.

One more point is that all companies in the group are SoEs. Bioethanol producers form partnerships downstream, which open opportunities to capture the market as well as to develop enzymes business in Vietnam.

5.1.2 Recommendation for Business Development Strategies

Based on the identified strategic customers, the research identified two possible market routes to the market: Technology licensing versus Joint Venture.

5.1.2.1 Technology licensing

The first strategic option is performed through a formalized written technology licensing agreement between international 2-G ethanol conversion technology leaders ("2-G provider") and Vietnamese licensees, which grant these strategic customers the right to utilize a PDP for 2-G production from biomass pretreatment to wastewater treatment. The offerings include two core values:

- A patent of 2-G process engineering
- Bio-processing technology
- Technical advice and assistance, including the supply of component, and materials essential to the manufacturing process

In addition, the 2-G provider can take into consideration one or more of the following additional offers:

- Continuous supply of proprietary enzymes to a local licensee as part of the agreement, enabling the licensor to improve the efficiency of technology and opportunities to reduce cost for customers
- Rights of constantly improvising and upgrading: The licensee is able to build on the information supply by the 2-G bioethanol licensor, who is interested in grantbacks and will possibly lower the royalty rate in return

for product improvements and potentially profitable new replicate businesses.

• The use of a trademark

Revenue streams

The 2-G provider's main source of income is from its licensing operations and involves a combination of the following elements:

- A lumpsum not related to output, paid at the beginning of an agreement for the initial transfer of special knowledge, machinery, parts, and so on.
- A minimum royalty fee a guarantee that at least some annual income will be received by the licensor; or
- A running royalty normally expressed as a percentage of normal selling price or as a fixed sum of money for units of ethanol output.
- Sales revenues from enzyme cocktail supply

There are many reasons standing behind the selection of technology licensing. Licensing is the proposed fastest way for the 2-G provider to establish local production in Vietnam market without much pressure on capital investment. The researcher found that this choice of entry mode is superior to contract manufacturing (BOT) in that:

- It is usually for longer term and involves much greater responsibilities for 2-G providers because more value chain functions have been transferred to the licensee by the licensor.
- The 2-G licensor will remain technologically superior in its production development

Figure 5-1 below provides a comprehensive picture constrasting the business model of this strategic option against that of the alternative strategy, setting up a Joint Venture.

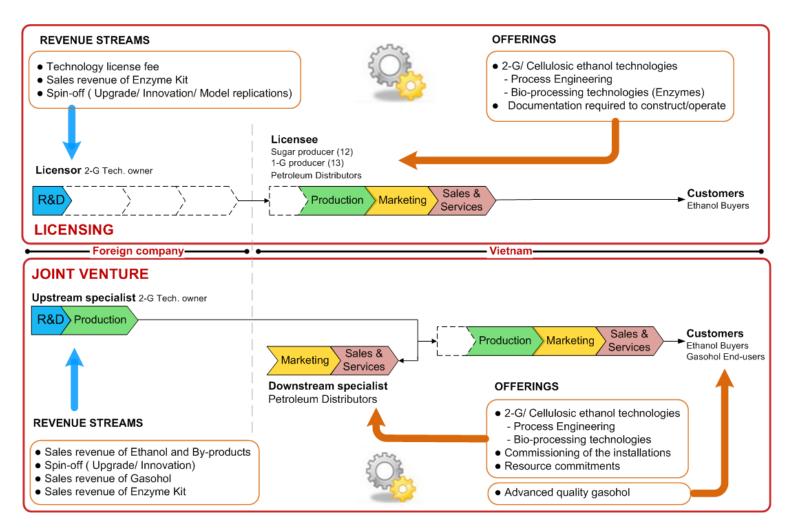


Figure 5-1: 2-G Bioethanol Business Model in Vietnam (adapted from Hollensen, 2004: 309)

5.1.2.2 Setting up an International Joint Venture

Resource commitments and Ownership structure

A joint venture (JV) is a mechanism for combining complementary assets owned by the 2-G provider and local petroleum distributor partners. Transferred assets to a legally independent entity are:

- The Vietnamese partner to a JV may make its contribution of capital in Vietnamese currency, land-use rights, natural resources, building facilities, industrial property, and other technical services.
- The 2-G provider may make its resource commitments of capital in foreign currency (or Vietnamese currency generated from any previous investment activities in Vietnam), equipment, machinery, building facilities; or such "soft resources) as industrial property rights, technical know-how, technical processes, and technical services. The 2-G provider might want to commit more intangible resources at the moment due to Vietnamese current macro-environment situation (as argued earlier in section 4.1.2).

The 2-G provider is responsible for designing, engineering and building the facility. Both parties jointly develop a business plan to ensure cellulosic biomass supply and operate 2-G bioethanol production from multi-feedstock. The Vietnamese partner will be responsible to operate the plant and facilitate the sales with its associated companies.

Risk-return tradeoffs

Even though establishing JV requires more commitments into the Vietnam market, involving more risks, still it's worth considering trade-offs. Specifically, the strategic objectives of JV typically include:

• To retain more control and value: The 2-G provider decision of downstream integration grants itself access to Vietnamese Petroleum distributors' new distribution network and retains profits from both 2-G bioethanol producers and ethanol/gasohol buyers (domestic and export).

- To combine complementary resources to further improve the technological efficiencies for South East Asia region's biomass, develop production/ distribution facility.
- To benefit more from the government's support: As a business entity in Vietnam, the 2-G provider is entitled for such benefits as waive of environmental tax, income tax reduction, import tax reduction, preferential land use rights (see section 4.1.4). Furthermore, the 2-G provider could gain more opportunities to win a bid for a government contract thanks to its relationship with the local petroleum distributor partner.

Revenue streams

The ethanol sales, by-products fertilizers and CERs Revenues are the main revenue streams that the JV can benefit from the investment incentives and having higher control over the value chain.

From ethanol sales

The produced ethanol is sold and distributed to the partner petroleum companies. In addition to the Biofuels Master Plan 2007, MoIT has recently proposed a draft to Vietnamese Prime Minister on the new gasohol mandates in October 2011. According to this proposal, effectively from Jan 1, 2013, E5 gasohol distribution is mandatory in Ha Noi, Ho Chi Minh City, Hai Phong, Da Nang, Can Tho, Quang Ngai and Ba Ria- Vung Tau. (see section 4.1.1)

• From energy saving and sales of by-products

Based on different biomass-to-ethanol conversion technology routes, different types of waste will be collected. As briefly introduced in chapter 2, recent scientific R&D projects enables to promote enzymatic process commercially. The waste stream from distillation is processed in such technologies as anaerobic digester to produce additional streams: biogas/ power steam and fertilizers. The former enable the ethanol plant to self-supply energy, while the latter can be sold back to the farmers, which is also a considerable income for the JV.

• Clean Development Mechanism (CDM)

Selling CER is an option to gain more revenue stream. It is one of the flexible mechanisms under the Kyoto Protocol. It allows industrialized countries to invest

in emissions-reducing projects in developing countries in order to fulfill their own emission reduction targets, and provide great opportunities for Vietnam investors to develop sustainable projects, to use modern technology and to contribute to protect global environment. (Innovasjon Norge, 2009)

Until May 2010, Vietnam had 26 CDM projects approved (with a total 13,818,529 tCO2 equivalent). The switch from carbon-intensive fuels to biofuels is one of the eligible technologies under the CDM, as are the cases of 5 operating 1-G ethanol plants. Therefore, 2-G bioethanol that replaces fossil fuels could be promoted through the scheme.

5.1.3 Stakeholder management of bioethanol business in Vietnam

Once the 2-G technology provider decides the strategic option to enter the market, it should be able to deal with the related stakeholders, those groups who depend on the 2-G bioethanol technology owner and on whom, in turn, the organization depends. Through the stakeholder mapping, the company may determine whether it should respond to a particular stakeholder, or to broader stakeholder interests. Underlying this exercise, implications for business development strategies and counter plans against risk factors related to the bioethanol business via both options can also be revealed.

The stakeholders that influence 2-G bioethanol projects in Vietnam are:

- Direct stakeholders: Potential strategic customers (currently prioritized sectors such as sugar mills, alcohol plants due to the supply pool of agricultural residues and their expertise in ethanol markets); petroleum distributors; 1-G producers and foreign ethanol buyers.
- Environmental stakeholders: Public sectors, competitors, Industry associations, supporting organizations, international bodies and civil society.

In Table 5-2, a summary of stakeholders' roles and identified risks is presented together with corresponding management strategies.

Table 5-2: Stakeholder roles of bioethanol business in Vietnam

Stakeholders	Involvement	Type of impacts	Perceived attitudes/ Risks	Potential impact	Management Strategies
1- DIRECT STAF	KEHOLDERS				
(1-1) Customers/	Strategic partners				
Sugar producers	 Own cellulosic by-products Have farming contracts with farmers, produced ethanol with old technologies 	Positive	Expect technologies to utilize their by-products/ agriculture residues in local areas	High	Propose optimal PDPs; Convince by cash generating scenarios from by-products sales & energy savings that result in yielding a positive NPV
Petroleum distributors	Have controls over gasoline/ gasohol distribution system	Positive	Forward integration to secure the adequate ethanol supply for blending with conventional fuel	High	Propose optimal PDPs; Convince by demonstration plants/business cases with benchmark ethanol costs
1-G ethanol producers	Have facility to adopt 2-G technologies	Positive	 Profits from alternatives to reduce dependence on cassava; Reduce waste treatment costs 	High	Propose optimal PDPs; Convince by demonstration plants/business cases

Foreign ethanol buyers	Source ethanol from Vietnam markets	Positive	Benefits from ethanol resale or gasohol distribution in their markets	Medium	Utilize the local partners' network and build up customer database (Less impact if licensing strategy is applied)
(1-2) Collaborator	rs/ Partners				
Petroleum distributors	Partner to distribute ethanol products as fuel additives	Positive	Ethanol blend quality when ethanol cheaper	High	Building strong relationship
Alcohol producers	• Have farming contracts with farmers, produced ethanol with old technologies	Positive	More focus on ethanol for wine production	Medium	Approach to exploit opportunities for 2-G technology application or partner to supply the biomass source
Biomass traders	Source and collect biomass/ agriculture residues in Vietnam	Positive	Profits from selling agriculture residues	Medium	Involve early to build up strong network for securing feedstocks
Biofuels Association	Represent on a collaboration of biofuels producers in Vietnam	Positive	Develop biofuels industry in Vietnam	High	Building strong relationship

2- ENVIRONMENTAL STAKEHOLDERS

(2-1) Public sectors

MoIT – Ministry of Industrial and Trade	 Assume the prime responsibility for organizing state budget plans Draw up projects eligible for investment incentives and a mechanism for applying these incentives Set up a system of supply and distribution of biofuel products; Popularizing benefits of biofuels 	Positive	 Support biofuels industry as per the Government's Biofuels Master plan Risk: Rigorous process for incentives/supporting policy 	High	Build strong relationship, seek supports/favors for the cutting edge 2-G technologies
MoST – Ministry of Science & Technology	 Promulgate legal documents on intellectual property, technical standards and regulations applicable All foreign licensors are required to be registered with MoST 	Positive	Participate to implement preferential policies for R&D, biofuels production	High	Stay updated with new regulations and projects
MPI & MoF – Ministry of Planning and Investment Ministry of Finance	 MPI- Issue certificates for foreign investments; Implement tendering & organize information network for PM's approved projects Allocate funds (ODA, Nongovernment aids), long-term funding plans, policies on tax and investment incentives 	Positive	Support biofuels production for investment incentives Risk: Intransparent information network for tendering	High	Stay updated with new regulations and projects

MARD – Ministry of Agriculture and Rural Development	Organizes the application of policies on incentives	Neutral	Supports for production of biomass materials for biofuel production.	Medium	Stay updated with new regulations and projects; Pro-actively get involved in establishing biomass collection markets
MoFA – Ministry of Foreign Affairs	Push ahead foreign economic activities, global, regional and bilateral economic institutions	Neutral	Organize international cooperation in biofuel development	Low	Stay updated with new regulations and projects
Provincial People's Committee	Represent the Government to implement laws and regulations	Positive	Generate income from taxations;	High	Building strong relationship, especially provinces in the South of Vietnam for their advantages in feedstock availability and infrastructure
(2-2) Competitors	S				
2-G technologies	• Provides alternatives 2-G solutions	Negative	Loss of market share	High	Monitor, prepare counter plans; maintain competitive advantages
Substitute technologies	• Future technology breakthoughs to	Negative	Loss of market share	Low	Monitor, prepare counter plans
Other local ethanol producers	• The local ethanol plants who are not partners	Negative	Loss of market share	High	Monitor, prepare counter plans

(2-3) Industry associations							
Vietnam Sugarcane and Sugar Association	Represent on a collaboration of 40 sugar mills in Vietnam	Positive	Support the growth of Vietnamese sugar industry	High	Get connected with sugar producers to exploit opportunities for 2-G technology application through the association channel		
Petro Vietnam/ Petrolimex	• Wholly owned by the Vietnamese central government, have power in petroleum distribution	Positive	Risks of having preferences on specific technology partners	High	Building strong relationship; else technology licensing is a more appropriate strategy		
Vietnam Alcohol- Beverage- Brewery Association	Represent on a collaboration of enterprises in Alcohol-Beverage-Brewery industry	Positive	Support the growth of VBA's members	Medium	Approach Alcohol producers to exploit opportunities for 2-G technology application through the association channel		
(2-4) Supporting of	organizations						
VCCI – Vietnam Chamber of Commerce and Industry	 Settle disputes through Vietnam International Arbitration Centre Coordinate with clients in establishing and protecting effectively intellectual property rights in Vietnam (VCCI-IP) 	Neutral	Support cooperation and promotion of commerce, investment and science-technology activities	Medium	Utilize the network to connect local enterprises; advertise through their channels		

DNA - Vietnam Designated National Authorities	• National focal point of Clean Development Mechanisms	Neutral	Risk: Kyoto Protocol not extended	Low	Involve in the business early to take advantage of CDM
Bank sectors/ Venture capital	SeaBank, Vietnam Development Bank	Neutral	Risk: Rigorous procedure	Medium	Figure out the procedure to access funds
(2-5) Civil Society	,				
Media	• Forum of Energy/ Biomass Promotion, Ethanol development (Asiabiomass Website: Promote E-Newspaper	Neutral	Rumors against gasohol	Low- Medium	Gain media supports for 2-G technologies and gasohol
Local residents	• Farmers participate in biomass collection and work in ethanol plant facilities	Positive	More job opportunities and cleaner environment thanks to the utilization of agriculture residues	Medium	-
Institutions	Universities of Technology (Ha Noi, Ho Chi Minh city);	Positive	Initiate joint research for applications of biofuels in Vietnam	Low	Gain references from the institutes to reinforce the compatibility of the technologies in Vietnam
End-users	Gasohol purchasers from petroleum distribution network	Neutral	Enjoy lower price fuel Risk: Resist to purchase gasohol due to quality concerns	High	Influence their attitudes through media channels
(2-6) Internationa	l bodies				

WB/ADB *	Support through such programs as Global Enviroment Fund, Climate Investment Funds (CIFs)	Neutral	Allocate EE-Sustainable Energy Finance Program of USD 155million and other programs	Low	Take advantage of ODA funding for biofuels, biomass development
Foreign governments **	Assist and sponsor projects in a new/emerging market through bilateral agreements	Neutral	Open pathways for their companies to access Vietnamese markets	Low	Stay updated for new programs to participate
RSB- Roundtable on Sustainable Biofuels	Support international trade of biofuels	Positive	Introduce global biofuels standards	Medium	Gain RSB Certificates

^{(*) (**)} See appendice H for potential programs that could be beneficial to 2-G providers.

Figure 5-2 proposes the strategies to leverage the stakeholder management in order to tackle Vietnamese bioethanol industry for 2-G technology providers.

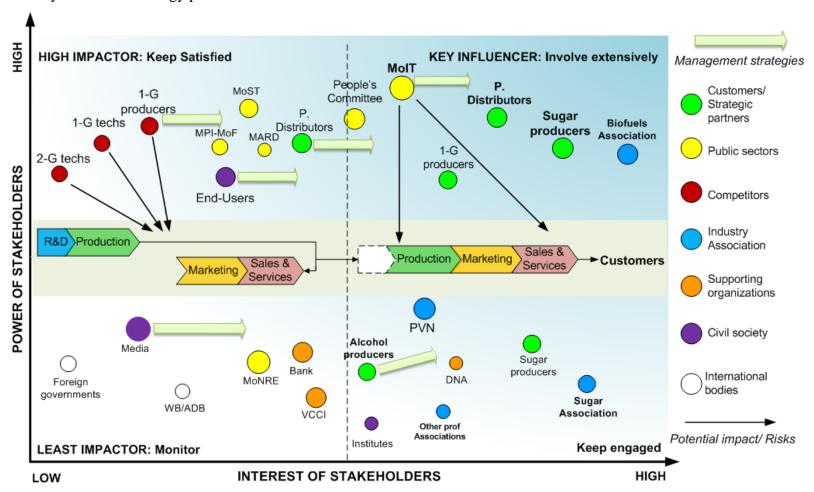


Figure 5-2: Vietnamese bioethanol stakeholder management strategies

5.2 Sustainability assessment

The recent study conducted by Japan's IGES concurs that "waste-to-biofuels or so-called 2-G biofuels based on cellulosic biomass have considerably more potential than 1-G biofuels and are more consistent with sustainable development principles". So, does cellulosic ethanol create the social, economic and environmental benefits as its advocates promise?

5.2.1 Economic benefits

Creating an indigenous renewable electricity resource and contributes to the national economy by reducing imported fossil fuels.

Low-cost feedstocks

The residual biomass used for cellulosic ethanol is available at very low prices (rice residues in Vietnam can be sourced at VND 300/ton). With the continuous reduction in operating costs for other stages of cellulosic ethanol production, cellulosic ethanol could soon start having total costs that are competitive with starch ethanol. This presents a strong business case for cellulosic ethanol. (Biozio, 2011) Considering the increasing dependence on fossil fuel import, Vietnam can benefit from the improved balance of trade and energy independence.

The advanced technology allows increasing more than 40% of the sales revenue while reducing operating cost from high utilization of cellulose, fermantation of glucose, full recovery of chemicals, production can be self-sufficient in terms of energy.

High-value by products: At the end of the production process, fertilizers can be sold back to the field.

Up-scale ethanol market size: The advanced technologies for ethanol production assist Vietnamese ethanol industry to team up with the Global Biofuels Standards, thus grants access to the international ethanol trade.

5.2.2 Environmental benefits

The access to bio-based economy will improve human/environmental health and quality of life for 90 million Vietnameses. The environmental benefits of cellulosic ethanol, according to science, will far surpass that of 1-G ethanol.

Reduction of pollution and reduction in usage of non-renewable energy

2-G Bioethanol contributes to pollution reduction in two ways:

Firstly, it creates value from waste and residues in Vietnam, which are otherwise being dumped directly to rivers (Mekong Delta as an example, the researcher brought up in the market analysis) or burnt on fields causing haze and severe air pollution, especially in the north of Vietnam (Tuat Phan, 2011).

As per information made available by Dr. Dung Nguyen from Ha Noi University of Agriculture, the ratio of burnt rice straw is as high as 20-80% (in major agricultural areas near Ha Noi, Hai Phong, could be up to 90%). The amount of CO2, CH4 and COx emissions in the Red River Delta alone is 4.7 million ton/year, 1- 3.9 million ton/year, 37- 113 million ton/year respectively.

Secondly, cellulosic ethanol may reduce pollution by as much as 80%, compared to that of 1-G ethanol at only 30%. It takes less oil to produce it, and it takes less water to produce it. And also significant is that a byproduct of creating cellulosic ethanol is the extraction of lignin, a substance in plant matter that holds cell walls together. The lignin can be burned to produce power, so that cellulosic ethanol plants can use biomass instead of coal for power and further reduce pollution.

Reduction of methane emission which is a potent GHG

Biofuels can help reduce greenhouse gas emissions and other harmful emissions, and allow the transfer of emission quotas through CDM projects (IEA, 2009).

Reduction in odour, a nuisance associated with the open lagoon system;

2-G ethanol production introduces the state-of-art wastewater treatment and biogas recovery system which is not yet commonly applied in Vietnam's industrial sector. The proposed project activity will facilitate the transfer and employment of modern and environmental friendly technologies for industrial wastewater treatment as well as the usage of renewable energy to displace fossil fuel consumption in the industrial sector.

5.2.3 Social benefits

No food versus fuel competition

Cellulose can be found in agricultural wastes, which are naturally occurring byproducts of farming those crops. While 1-G ethanol feedstock such as cassava, rice and corn present a food or fuel dilemma owing to the feedstock also being used for food, 2-G ethanol uses non-food biomass and thus does not affect the food chain. (Hassan, 2008)

New jobs creation

The ethanol plant will employ approximately 100 employees and generate many more ancillary jobs in the local community. The construction of the project will create employment for local workers; and improve the technical skills of workers via training to operate the plant processes and facilities.

As we have seen there are no barriers to increase employment and increased energy security for the region, nor are there any technical barriers or conflicts with land rights or competition with food resources. (Lane, 2011)

5.2.4 Roundtable on Sustainable Biofuels (RSB)

The Roundtable on Sustainable Biofuels (RSB) is a multi-stakeholder organization hosted by the Swiss Federal Institute of Technology in Lausanne (EPFL) with goals to making real the world's commitment to Biofuels sustainability.

RSB develops and provides Global Sustainability Standard for socially, environmentally and economically sustainable production of biomass and biofuels so that the Biofuels industry can adapt to a single standard and be assured of access to regulated markets around the globe.

The **RSB** Global Standard Certificates provide credible and verifiable sustainability claims for the actors of the biomass/biofuel market. It is supported by more than 120 member organizations based in more than 30 countries from all continents and representing a wide range of stakeholders, including farmers, oil companies, investors, NGOs, UN agencies, governments and research institutes. The RSB Certificates are recognized by the European Union under the Renewable Energy Directive (RED). (RSB, 2011)

ASEAN members are actively partipating as members of RSB: Singapore, Malaysia, Philippines, Cambodia, to name a few. The researcher believes the coming ASEAN Summits and ASEAN Energy Cooperations are going to stimulate ASEAN members to fully recognize and apply RSB standards, including Vietnam, which eventually will integrate itself to the World Biofuels/ Ethanol market.

5.3 Conclusions

To summarize the key findings of this study: Vietnam provides some attractive characteristics for cellulosic ethanol locales.

First, it has a large biomass potential of 21 billion liters of ethanol equivalent (16.5 million ton per year) and hungers for advanced technology that enables the conversion from waste to black gold fuel energy, which greatly contributes to the nation's energy balance and security in the long run.

Second, there are different local capable customer segments who can adopt the cutting edge technologies and are potentially able to vertically integrate with the international 2-G bioethanol companies to expand production. They are:

- 15 medium-large scale sugar companies who have know-how in handling large amounts of agricultural residues.
- 13+ ethanol producers who have the production locations and apply 1-G and traditional ethanol conversion technology.
- 12 petroleum distributors who have control over the petroleum and gasohol distribution system, under the pressure of the nation's ethanol blending mandate by 2013.

Under the condition of new achievement in 2-G Bioethanol production, *core values* from the customer point of view are conversion efficiency, multi-feedstock, low operation costs and the fact that environmental values can be met through effective strategic options: technology licensing and joint venture. The choice much depends on the foreign technology providers and their willingness to commit resources in Vietnam market.

By partnering with local firms, the 2-G technology companies can overcome the challenge of market uncertainties, at the same time, being the first mover could gain back different benefits from "building brand reputation" of the technologies which can be applied for the whole SEA regions. Furthermore, being involved in ethanol production through JV, preferably in the South of Vietnam due to the availability of feedstocks and infrastructure, the 2-G technology companies can successfully integrate downstream and leverage cooperation to actively access the distribution of produced ethanol in Vietnam, adjacent markets (China, Japan, Philippines etc.) and farther to the EU.

The 2-G bioethanol business in Vietnam is not kept within the bounds of a specific technology (i.e. enzymatic hydrolysis). On the contrary, it is a white space for any innovations that could fulfill the unmet demands of strategic customers. Those demands have been pointed out in this study.

Recommendations for further studies

This study opens up questions for further research. The research problems can be divided into two categories: One issue concerning the technology challenges and the other concerning the markets in Vietnam.

The technological research could be:

- 1. What innovations/developments can be done to bring the 2-G ethanol price further down?
- 2. What is the possibility of co-location of a 2-G bioethanol facility and a power plant for utilization of lignin?

The questions from the marketing point of view could be:

- 1. What kind of marketing plans and processes might the competitors use?
- 2. What is the perspective of enzyme business in Vietnam?

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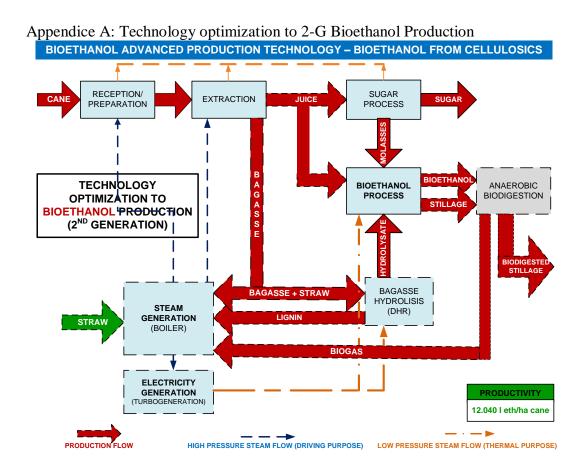
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- Thai Luu (2011), Chairman of Greenfield JSC, Chairman of Vietnamese Biofuels Association, interviewed by the author, 29.06.2011
- Trung Vu (2011), Marketing Director of Tung Lam Ltd. Co., interviewed by author, dated 11.06.2011
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- Tuat Phan (2011a), Head of interview by the author, recording from the interview, 17.06.2011

APPENDICES



Source: ECEN, 2011 (http://www.ecen.com/eee74/eee74e/liquid_biofuels.htm)

Appendice B: Ethanol Production Potential Estimation in Vietnam

Biomass sources available in Vietnam are categorized into crop residues, wood residues, municipal wastes, oil trees and livestock wastes (Tran & Lai, 2005). The residues from crop residues, wood residues and municipal wastes are considered potential feedstock for ethanol production. In this study's scope, the researcher focuses on the crop residues due to the possibility of feedstock collection as well as their wide availability across the country.

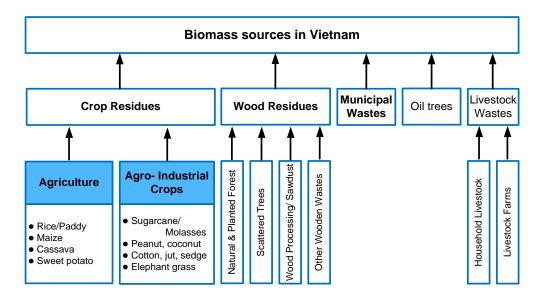


Figure: Biomass Sources in Vietnam (Tran & Lai, 2005)

The below table describes the availability of cassava as a feedstock for 1-G bioethanol production, which is kept within the bounds of productivity (17.2 ton/ha), arable land (less than 500,000 ha- MARD, 2011) and the relative price for ethanol production versus cassava export price and animal feed.

Table: Vietnamese Bioethanol Industry versus 1-G feedstock constraint

Characteristics	Vietnam	Comments
Feedstock	Molasses, cassava	Cassava is the main crop for ethanol production
Total ethanol production	550 Million liters/ year	(end of 2011, estimation at full capacity)
Amount of cassava required	1.3 Million ton (2011)	A 100 million liter/year plant requires roughly 240 million tons (Dung Quat, 2011)
Projected amount for ethanol	1.89 Million ton	Real available amount: 1.1 million ton (Petro Times, 2011; MARD, 2011)
Total arable land	496,000	hectares (Petro Times, 2011; MARD, 2011)
Total area used for ethanol crop	500,000	Hectares (Petro Times, 2011; MARD, 2011)
Ethanol cost	500 VND (1.8 Euro cent)	Lower than conventional gasoline (PVOil, 2011)
Market for ethanol	Blend with fossil fuel; Export	

Table: Crop residue availability and the potential ethanol production

By Area	Rice residues (thousand ton)		Ethanol production potential (Liter)		Sugarcane	Bagasse	Ethanol production
	Scenario 1	Scenario 2	Scenario 1	Scenario 2	(Thousa	nd ton)	potential (Liter)
Red River Delta	6,803.4	3,401.7	2,826,268,428	1,413,134,214	110.8	33.24	14,009,662.80
Nothern Midland	3,081	1,540.5	1,279,909,020	639,954,510	1,337.9	401.37	169,165,413.90
Central Coast	6,154.1	3,077.05	2,556,536,222	1,278,268,111	5,262.8	1,578.84	665,433,694.80
Central Highlands	1,047.3	523.65	435,069,366	217,534,683	2,110.1	633.03	266,803,154.10
South Eastern	1,333.3	666.65	553,879,486	276,939,743	2,409.9	722.97	304,710,165.90
Mekong Delta	21,569.8	10,784.9	8,960,526,316	4,480,263,158	4,715.3	1,414.59	596,207,247.30
Nationwide (Liter)	39,988.9	19,994.45	16,612,188,838	8,306,094,419	15,946.8	4,784.04	2,016,329,338.80
Nationwide (Ton)			13,123,629.18	6,561,814.59			1,592,900.18

<u>Note:</u> Scenario 1 of ethanol potential from rice residues: Potential production from total residues. Scenario 2: Ethanol production from rice residues considering availability for collection (less than 50% of total residues)

As per a study conducted by Nguyen Khai, ethanol production potential from other sources such as maize residues, sweet potato residues etc. is around 1.8 million ton per year. The production potential in two scenarios is correspondingly:

- Scenario 1: 16,516,529.36 ton per year
- Scenario 2: 9,954,714.77 ton per year

In addition, Vietnam also has great potential of wood feedstock and wood residues, which are equivalent to 8.78 MToe (Nguyen Khai, 2009).

Conversion:

Specific gravity of ethanol = 0.79kg/L

Table: Ethanol conversion rate by feedstock

Material	Liter per ton
Rice residue	415.42
Bagasse	421.47
Maize straw	427.14

Appendice C: Vietnam's 2-G bioethanol domestic demand estimation

	2010	2015	2020	2025				
Decision 177/2007/QD-TTg, 2007 (Case 1)								
Biofuels Master Plan	0.40%	1%	-	5%				
Biofuels amount	120.00	250.00	-	1,800.00				
(thousand ton)								
MoIT's Draft on Ethanol blend mandate, 2011 (Case 2)								
Biofuels Blend Ratios	-	5%	10%	10%				
Biofuels amount	120.00	1,197.50	3,520.00	3,700.00				
(thousand ton)								
Fuel demand	16,300.00	23,950.00	35,200.00	37,000.00				
Biodiesel	40.00	40.00	150.00	150.00				
1-G Bioethanol	80.00	210.00	500.00	500.00				
2-G Bioethanol (case 1)	0	-		1,150.00				
2-G Bioethanol (case 2)		947.50	2,870.00	3,050.00				

Appendice D: Summary of Vietnamese Government's supporting framework for Biofuels

Policy- Legal documents	Main contents
Decision No. 177-2008-QD-TTg dated 20 November 2007: "Project on Biofuels Development for Period up to 2015, Outlook to 2025"	The main objective of this project is to develop biofuels, one renewable energy type for substituting a part of traditional fossil fuels, contributing in ensuring energy security and environmental protection. The main contents are as follows: - In period 2011-2015: Mastering technology and manufacturing additives for production of biofuels - By 2015: Ethanol and biodiesel will be 250,000 tons, accounting for 1% of gasoline and diesel demand of the whole country. - By 2025: Ethanol and biodiesel will be 1.8 million tons, accounting for 5% of gasoline and diesel demand of the whole country.
Decision No. 1885/QD-TTg dated 27 December 2007: "Strategy on Vietnam National Energy Development up to 2020, and outlook to 2050"	Share of RE is 3% of total primary energy supply in 2010; 5% (2020), and 11% (2050). Solutions on financial mechanisms: - To study the establishment of energy development fund to provide support for investment in the development of new and renewable energies and the implementation of public-utility projects. - To prioritize the allocation of concessional credits from the development support fund, ODA capital and other foreign bilateral loans for energy projects such as those on the exploration and development of new and renewable energies and bio-energy. - To formulated long-term environmental and standards in conformity with regional and world environmental standards and the country's economic conditions.
Decision no. 2412/QD-BCT: "Planning of developing production, distribution system of gas and oil in the 2010 – 2020 period with orientation toward	Orientations for development: - To set up and upgrade the large distribution systems of contact enterprises with the State capital - To develop a network of direct gasoline retail of enterprises and systems of general agents, agents with system of rear depots, retail stores to each locality, commune/ward

2025"	 Orientations for development of biofuels: to implement and improve the existing biofuel plants which are invested for construction to meet demand for gasoline blending E5, E10, B5, B10, and proceed to export. After 2015, depending on the market demand, the ability of raw material source and efficiency of operation of the plants built and energy security objectives, food security, the environment that the other bio-ethanol and biodiezen manufacturing plants would be considered for additional investment.
QCVN 1: 2009/BKHCN: National technical regulation on gasoline, diesel fuel oils and biofuels	Ethanol standard: TCVN 7716:2007 Octane number value (RON): TCVN 6776: 2005
Decision No. 130/QD- TTg 2007 Policies, financial mechanisms for CDM projects	Article 6. Rights and obligations of contractors and implementers of CDM projects: + Having incentives: on tax, land use, land rent, fixed asset depreciation, investment credit. + Subsidy for products from CDM projects in prioritized areas. + Financial support in formulation, development of project in accordance with laws.
Law on Environmental Protection Tax 2010	This Law provides for taxable subject, un-taxable subject, taxpayers, tax base, tax declaration, tax calculation, tax payment and environmental protection tax refund. Absolute rates are specified in the tariff for Gasoline, oil, grease from VND 300- 4,000/liter.
Law on Environmental Protection 2005 Regulations, policy formulation and measurement for environment protection	Article 33 stipulates that development of clean energy and renewable energy is one measure for environmental protection. The Article states that "organizations and individuals investing in the development and use of clean energy and renewable energy shall be granted preferential taxes, funding support, and land for building production facilities"

Appendice E: Lists of registered ethanol projects

Capacity Ethanol plant Location (Mly) Tan Phat JSC 50 Kon Tum Dak To-Kon Tum Kon Tum 65 Bioethanol plant Milestone Bioethanol plant Dak Lak 3 N/A Thao Nguyen Bioethanol 100 Gia Lai 4 plant Thai-Viet Bioethanol JSC 62.7 Ninh Thuan Bioethanol Vietnam JSC Dak Lak N/A 6 7 Quy Nguyen JSC 35 Binh Phuoc Ninh Binh Bioethanol plant 260 Ninh Binh

Appendice F: Lists of traditional ethanol plants

	Ethanol plant	Capacity (Mly)	Location
1	Quang Ngai Alcohol plant	3	Quang Ngai
2	Tuy Hoa Alcohol plant	6	Tuy Hoa
3	Binh Dinh Alcohol plant	3	Binh Dinh
4	Hiep Hoa Alcohol plant 6 I		Long An
5	Nagajuna Alcohol plant	6	Long An
6	Song Con, Nghe An Alcohol Plant	1.2	Nghe An
7	Phan Rang Alcohol Plant	2	Phan Rang
8	Hoa Binh Alcohol Plant	3	Hoa Binh
9	Long My Phat Alcohol Plant	6	Hau Giang
10	Son Hoa Alcohol Plant	8	Phu Yen
11	Binh Tay Alcohol Plant	6	HCMC
	Total	50.2	

Feedstock: Rice/Molasses

Appendice G: Lists of Sugar mills in Vietnam

Sugar Company	Location	Capacity (ton/day)
Lam Son Sugar JSC	Thanh Hoa	7000
La Nga Sugar JSC	Dong Nai	2500
Binh Dinh Sugar JSC	Binh Dinh	3500
Nghe An Tate and Lyle Sugar JV	Nghe An	
Vietnam-Taiwan Sugar Co., Ltd	Thanh Hoa	6000
Nagarjuna International Co., Ltd.	Long An	3500
KCP Industry Vietnam Ltd (Son Ha)	Phu Yen	5000
Bourbon Tay Ninh Sugar Ltd	Tay Ninh	8000
Bourbon Gia Lai Sugar Ltd	Gia Lai	1500
Son Duong Sugar Company (*)	Tuyen Quang	2000
Nong Cong Sugar Company (*)	Thanh Hoa	2000
Tra Vinh Sugar Company (*)	Tra Vinh	2800
Tuy Hoa Sugar Company (**)	Tuy Hoa	
Dong Xuan Sugar Company (**)	Phu Yen	1000
Hiep Hoa Sugar Company (**)	Long An	2400
Quang Phu Sugar Plant (***)	Quang Ngai	2500
An Khe Sugar Plant (***)	Gia Lai	5000
Pho Phong Sugar Plant (***)	Quang Ngai	2000
Kon Tum Sugar Plant (***)	Kon Tum	1800
Hoa Binh Sugar Company	Hoa Binh	800
Cao Bang Sugar Company	Cao Bang	
Tuyen Quang Sugar Company	Tuyen Quang	
Son La Sugar Company	Son La	1000
Song Lam Sugar Company	Nghe An	500
Song Con- Nghe An Sugar Company	Nghe An	2500
Dac Nong Sugar Company	Dac Nong	
333 Sugar JSC	Dak Lak	
Ninh Hoa Sugar Company (****)	Ninh Thuan	3000
Phan Rang Sugar Company	Phan Rang	
Tri An Sugar Company	Bien Hoa	
Tay Ninh Sugar Corporation	Tay Ninh	1000
Tay Ninh Raw Sugar Plant (****)	Tay Ninh	

Ben Tre Sugar Company	Ben Tre
Vi Thanh Sugar Plant, Can Tho	Hau Giang
Phung Hiep Sugar Plant, Can Tho	Can Tho
Soc Trang Sugar Plant	Soc Trang
Kien Giang Sugar Plant	Kien Giang
Thoi Binh Sugar Factory	Ca Mau
Cam Ranh Sugar Factory (****)	Khanh Hoa
Binh Thuan Sugar Company (**)	Binh Thuan

(*Decision no. 28 /2004/QĐ-TTg*)

(*) Vietnam General Sugar Corporation No.1(**) Vietnam General Sugar Corporation No.2

(***) Quang Ngai Sugar Corporation (****) Khanh Hoa Sugar Corporation (****) Bien Hoa Sugar Corporation

Appendice H: Lists of donor and potential funding

The donors, such as World Bank (WB), Asean Development Bank (ADB), International Monetary Fund (IMF), bilateral commitments, etc. not only give loans or financial supports but also provide technical assistance, or guides on operation of the company or projects in the field of renewable energies.

ODA& Multilateral agreements

Vietnam is involved in a number of regional technical assistance and investment projects for the Greater Mekong Subregion (GMS) and is one of the largest recipients of resources from ADB's highly concessional Asian Development Fund (ADF), with an indicative ADF allocation of USD 736 million (EUR 538 million) for 2011–2012 (ADB, 2011). The ADB Board of Directors has approved a regional technical assistance project (2011-2014) that will be funded by a USD 4 million (EUR 3 million) grant from the Nordic Development Fund (joint multilateral development institution of Denmark, Finland, Iceland, Norway, and Sweden) along with counterpart financing of USD 600,000 (EUR 440,000) from the governments of Cambodia, Laos and Vietnam. ADB will administer the grant and carry out the project in the three countries, this could be a push to the formulation of biomass markets and weaken the power of buyer, at the same time, organize the grain and cereal to produce biofuels (AsiaBiomass, 2011). The

outcome of this project will be efficient operation of pilot biomass utilization projects. 2-G Ethanol producers will gain benefit from this project.



Figure 0-1: The Mekong River and its basin (AsiaBiomass, 2011)

Bilateral programme budgets from developed countries

Of the 150 million euro worth of ODA capital granted by the German government to Vietnam in 2010-2011, 33 percent of the capital will be poured into the energy sector and climate change. This has caught more attention from foreign investors when considering investment plans in Vietnam. Other active sponsors in Vietnam are Japan, Denmark, Norway, United Kingdom etc.

Venture capital/ Bank sectors

HSBC Global Asset Management launched the first fund specifically targeting CIVETS group, namely GIF CIVETS fund in May 2011. The reason given by HSBC is the rising levels of foreign direct investment across the CIVETS group, low levels of public debt and sovereign credit ratings improving investment grade. (Greenword, 2011)

During the development phase of 1-G ethanol production, there are signs of interest from bank sectors in bioethanol industry. The main investors of three installed bioethanol plants in Phu Tho, Quang Ngai and Binh Phuoc (total capacity 300 million liter/ year, total investment 270 million USD) are Petro Vietnam group members, SeaBank, and Itochu Corp (Japan) (MoNRE, 2011a). Therefore, the shared capital from the bank sectors (Bank for Investment and Development Vietnam) could be an additional source of financing to elaborate 2-G bioethanol industry in Vietnam.

Appendice I: Interview questionnaire



Company Name: Interviewee: Place: Form of company: Title: Date/Time:						
1.	How would you describe your company: - Small (10-200 employees, register capital <20 billion VND) - Medium (200-300 employees, register capital 20-100 billion VND) - Large (over 300 employees, register capital >100 billion VND) Number of employees:					
2.	Which of the following areas is your company operating in? Biomass sourcing and handling (What kinds of residues are?) Ethanol production Blending Fuel/Gasohol distribution Others, please specify:					
3.	Which of the following areas do you? Biomass sourcing and handling 2 nd generation bioethanol production technologies Mixture and distribution management Consultancy and management services Others, please specify:					
3.	How would you describe your role in the decision making in buying energy source/ form in your company? ☐ I make the decision myself - Is there a threshold of purchase that can be done by individual? ☐ I am part of the decision making process – Who are in the team? ☐ I know the process well and sometimes participate in it - what kind o decisions have been participating in lately? ☐ I am not part of the process but I am familiar with the process / is it a clear process?					
4.	Please rate the following statements regarding to the importance of criteria	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree	
	Price competitive in comparison with 1 st ethanol generation					
	High conversion rate					

	High value by-products						
	Low operating cost						
	The production is environmental-friendly						
5.	OPEN DISCUSSION ISSUES						
	 How does your company find out about suppliers? Are the suppliers active in marketing or does the company itself take initiative? What would be the recommended supplier in the area? How many offers do you ask before making a decision? (Bidding process). 						