BUSINESS STRATEGY FORMULATION FOR A MALAYSIAN INDUSTRIAL GASES COMPANY IN PV (PHOTOVOLTAICS) SECTOR

by

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ABSTRAK

Kajian ini dilaksanakan untuk membina satu strategi perniagaan bagi syarikat industri gas tempatan iaitu Oras Skytis Malaysia (OSM) untuk dikekalkan dalam sektor Photovoltaics (PV) dari perspektif Malaysia. Pemahaman terhadap kajian terdahulu dilaksanakan untuk mengenalpasti proses pembentukan strategi. Kemudian pengumpulan data dilaksanakan melalui temuduga bersemuka dengan tujuh orang wakil dari sector OSM dan PV. Sebagai rujukan tambahan dokumen dalaman OSM dan kajian industri dilakukan dalam kajian ini. Data yang dikumpulkan dianalisa menggunakan proses pembentukan strategi iaitu analisis dalaman, analisis luaran, analisis SWOT dan tindakan strategik melalui analisis TOWS. Walaubagaimanapun strategi yang terbaik selalunya akan gagal tanpa perlaksanaan yang sempurna. Oleh itu *Balanced Scorecard* telah digunakan sebagai panduan terhadap perlaksanaan strategi dalan kajian ini. Sebagai kesimpulan kajian ini mencadangkan OSM mengamalkan Strategi Intensif yang focus kepada Pembentukan Pasaran. Strategi yang dicadangkan adalah berasaskan kepada perspektif Malaysia dan ia boleh menjadi panduan yang berguna untuk kajian akan datang dalam industri gas tempatan.

ABSTRACT

The aim of this research is to formulate business strategy for a local industrial gases company, Oras Skystis Malaysia (OSM), to sustain in Photovoltaics (PV) sector from Malaysia perspective. A literature review was conducted to identify strategy formulation processes. Then, data collection through face-to-face interviews with seven interviewees; they are from OSM and PV sector. In addition, OSM's internal documents and its industry study were assessed among the research. Gathered information/data were analysed with strategy formulation processes; they are internal analysis, external analysis, SWOT analysis and developed series strategic actions through TOWS analysis. However, perfect strategies always fail due to poor implementation. Hence, The Balanced Scorecard has been extended to guide the strategies implementation in this study. Conclusion of the study suggested OSM to practice Intensive Strategies, which focus on Market Development. The proposed strategies are developed from Malaysia perspective, and it serves as a useful guide for other further studies on the industrial gases industry in local market.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Ten years ago when someone mentioned about "energy company", the first impression that came out in most of our mind are oil giants like ExxonMobil, Chevron, Shell, PETRONAS, and other utilities companies such as General Electric (GE) in United State, RWE in Europe, and TNB in Malaysia. Today, the green era has given birth to a broad new renewable and clean energy industry worldwide.

One of the rapid growing green energy industries is Photovoltaic (PV) industry. PV industry is an industry that produces solar panel which used to convert sun light to electricity. PV industry is an emerging industry and it's under the spotlight in both global and local markets. It has been boosted the expansion of its supply chain and creating new opportunities for service providers ranging from chemicals, industrial gases, and etc. According to the research done by Trifen Group (TFG)[1] – a major world industrial gases player, although the current financial situation is uncertain, but they still having an optimistic forecast to the PV industry. Derive from their study, the sales revenue that yields from gases use in solar industry will be increased by at least 30 percent in year-on-year basis or possibly even more.

[1] The real company name has been substituted with a fictitious name for privacy purpose.

The PV industry started and emerged from a niche industry until today a significant power providers in some of the developed countries like Germany, US, Japan and Spain; Malaysia government is aiming to attract more foreign investors in PV industry into the local market. According to Datuk Jalilah, Director of Malaysian Industrial Development Authority (MIDA), *Malaysia could be the solar hub in ASEAN, adding that a key consideration would be the tariff the national electricity company - Tenaga Nasional Bhd would pay for solar power that would be transmitted to the national grid* (MIDA, 2010). Base on the outcome of MIDA in encouraging PV investors into Malaysia, it is forecasted that PV manufacturer may contribute up to four per cent (4%) of the country's Gross Domestic Product (GDP) in 2010 (Bernama, 2010). Besides, It has been reported that local PV industry received RM12 billion to RM14 billion in foreign direct investment from 2007 to 2009 (Poh, 2010).

Due to the high consumption of industrial gases in PV industry, the industrial gases providers are also enjoying significant market growth worldwide and similarly in Malaysia. In general, industrial gases are costing averagely around twenty percent (20%) of the total production cost in producing a solar panel (Kostwald, Mahrenholtz, & Tolia, 2008). In Malaysia, the industrial gases industry is more than 1 billion Ringgit business. It can be considered as an oligopoly business, which it is a capital intensive and there are only few big players in the local market; they are 1) Malaysia Sauerstoff-Trifen (MST)[2], 2) Luftrodukt Malaysia (LTM)[3], and 3) Oras Skystis Malaysia (OSM)[4]. Before the

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[2] The real company name has been substituted with a fictitious name for privacy purpose.

[3] The real company name has been substituted with a fictitious name for privacy purpose.

established of LTM and OSM, MST is believed that it was almost monopolizing all industrial gases business by covering up to 90% of total local market share. However, the aggressiveness of LTM and OSM have caused MST to face stiff competition and currently, its market share is believed dropped to 60%. For the three players mentioned to sustain and grow their business in Malaysia, they are competing fiercely in PV market. It is because of the potential and huge amount of revenues from the PV industry; especially OSM which was established in Malaysia less than three years.

Although OSM has just established in Malaysia, however, the history of its parents company: Oras Skystis (OSG)[5], a European company, in Malaysia can be traced almost a century back. In 1927, Oras Skystis started its business to supply gases to the electronics, petrochemical, steel and other industries in West Malaysia. In 1960s, Oras Skystis joint ventured with a British base gas company – British Sauerstoff (BSC)[6], to form Malaysia Sauerstoff, who has been a market leader in Malaysia until today. However, the joint venture was dissolved due to the anti-competition policies from U.S. and European Community (EC) after the acquisition of BSC by the Trifen Group, a German company in 2007. Today, Malaysia Sauerstoff has become a fully subsidiary of the Trifen Group, and called Malaysia Sauerstoff-Trifen (MST). Then, Oras Skystis established another company called Oras Skystis Malaysia (OSM) in May 2007 to serve local market needs.

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[4] The real company name has been substituted with a fictitious name due to the non disclosure agreement.

[5] The real company name has been substituted with a fictitious name due to the non disclosure agreement.

[6] The real company name has been substituted with a fictitious name for privacy purpose.

Today, OSM, the new player in Malaysia market, is facing fierce competition from existing players especially in the PV sector. Thus, strategies formulation has becoming very critical for OSM to weather the battle; as per Ohmae's statement *"Without competitors, there will be no need for strategy, for the sole purpose of strategic planning is to enable the company to gain, as efficiently as possible, a sustainable edge over its competitors"* (Ohmae, 1982)

1.2 Problem Statement

OSM has targeted to be the second largest industrial gases supplier in Malaysia in 2015, where the market share coverage has to be increased from 2% to 30% in five years time. As a newly established company, this aim can be considered as an aggressive mission. To achieve this mission, numerous of roadblock is pending for OSM, either in expanding its business or sustaining current contracts.

As a newly established company, OSM is having many disadvantages if compare to existing players, MST and LTM. OSM is lack of resources to compete with MST and LTM; these companies already enjoying numerous advantages such as scope of economy, brand awareness and networking. Furthermore, lack of new foreign investment in Malaysia, due to recent economy crisis in 2009, has also caused hefty pressure to OSM. In order to expand and sustain operations in local market, OSM has to explore a green field for a new means of profit by deploys new strategy to increase its market share. One of the most prospect industries is the PV sector.

Derive from the study of Kostwald, Mahrenholtz, & Tolia, contracts from PV industry is sufficient for a gas company to gain a significant amount of market share and revenue (Kostwald, Mahrenholtz, & Tolia, 2008). In addition, PV industry is a green field in local market that has low barriers from the existing competitors, and it also provides a fair platform for OSM to compete with others regardless resources, networking and brand awareness.

It is impossible to develop market leading core competencies if one not understands the market. OSM has to devise a strategy plan to outstanding itself to secure more contracts in PV industry than its competitors due to the attractiveness of revenue from the industry. Furthermore, this also avoid OSM from repeat the similar mistake where previously made by Yahoo! --- underestimated the potential of search engine market and its revenue from ads; consequently, this has caused Yahoo! handover billions of dollars market and leading position to Google.

To formulate business strategy for OSM in PV business, environmental scanning process, SOWT Analysis, TOWS Analysis and Balanced Score Card are used along this case study.

1.3 Research Question

This study is aims to answer the following questions:

a) What are OSM's current strategies?

b) Who are OSM's competitors especially in PV industry?

c) What is the Nature Characteristic of PV industry?

d) What are the potential opportunities and threat attributed to PV industry in the industrial gas sector in Malaysia?

1.4 Scope and Limitation of the Study

This study will focus on the strategy formulation process for OSM to compete in PV industry. Due to time and resource constraints, the study will only concentrate in Malaysia although there are many potential for Oras Skystis Group (OSM's parent company) to explore in other regions.

Even it will serves as a good reference for other studies and/or future expansion from strategy formulation to strategy implementation and so forth.

1.5 Overview of Case Study

This thesis studies and discusses business strategy formulation for OSM, an industrial gases company in Malaysia, in PV sector. The study performs various analyses from difference perspectives to determine the market and company conditions. And, also attempts to determine existing challenges and constraints facing by the company in PV sector. Strategies on market development were proposed at the end of this study.

The thesis divided into nine chapters and each individual chapter provides details discussion as below:

- **Chapter 2 – Literature Review**. In this chapter a comprehensive reviews from past studies by researchers related to concepts and definitions of strategy, and process of competitive strategy formulation were presented.
- **Chapter 3 – Industry and Country Profiles Analysis**. This chapter devoted to discuss the nature and characteristics of industrial gases industry. Supply chain, delivery mode, and global players in the industrial gases industry are also reviewed in this chapter. Additionally, this chapter also discussed outcome from environment scanning on politic, economy, social and technologies.
- **Chapter 4 – Research Methodology.** This chapter presents the detailed research design of the study. It covered the essential elements of case study research, from data gathering, justification of research question and data analysis process.
- **Chapter 5 – Case Write Up: Oras Skytis Malaysia (OSM).** In this chapter, the company background, business strategies, vision and mission and etc. of OSM and its parent company are discussed. Besides, the characteristic and growth of OSM's target customer: PV sector was reviewed. Finally, the challenges of OSM in developing its market in PV sector were summarized in this chapter.
- **Chapter 6 – Case Analysis.** This chapter documents the analysis of the case studies, both internal and external analysis to identify strengths, weaknesses, opportunities and threats (SWOT) facing by OSM in PV sector. Furthermore, Internal and External Factor Evaluations (IEFE) were applied to evaluate and redefine the major SWOT factors.

- **Chapter 7 – Business Strategies Formulation.** This chapter presents the research synthesis. From the case analysis the vision and mission, strategy and goals are synthesized and presented.
- **Chapter 8 – Strategic Implementation Plan.** In this chapter, the implementation plan and action plan were proposed through Balanced Scorecard. The plan was divided to four prospective: Financial, Customer, Learning and Growth and Internal Process.
- **Chapter 9 – Summary.** This chapter provides a brief summary of the study, and the chapter end by discussing the implication for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction: Concepts and Definition of Strategy

The word "strategy" derives from the Greek word stratęgos or "the art of the general"; which derives from two words:

- "Stratos" – Meaning army
- "Ago" – Which is the ancient Greek for leading/guiding/moving (Osama, 2008)

Today, strategy is no longer just for military purpose, but refers to Compact Oxford English Dictionary, Strategy is a plan designed to achieve a particular long-term aim and it is also normally considered as the art of planning and directing military activity in a war or battle.

There was number of authors have given numerous definition to "Strategy". Base on the concept of Strategy, it is origin from military art. Thus, it seems sensible to examine Strategy's definition from military view till business view.

According to Captain B. H. Liddell Hart (1967) an ex-English soldier, military historian and leading inter-war theorist, Strategy is the art of distributing and applying military means to fulfill the ends of policy." This statement is aligning with the origin meaning of strategy: the art of the general". As a general, it is his/her responsibility to think how to lead the troop to win each battle which is the ends of policy. Similarly, Igor Ansoff (1968) has defined strategy simply as "the decision rules and guidelines which guide the process of development of an organization". At here, general role will be taken over by business general who either is CEO, vise president, line manager or entrepreneur. The business manager may need to integrate available resources to achieve the business objectives. However, the definition given by Igor Ansoff is too general and hardly to be use as a guideline by an organization.

Since 1950s when strategy as a subject for business arose, there are several of definitions given on it from different school of thought. Instead of defining strategy, various views or factors have flourished the definition of strategy by researchers or business strategy gurus. Among the modern or current business strategy gurus, Henry Mintzberg and Michael Porter's view on strategy are the most be referred by researchers.

Henry Mintzberg is holding broader view of strategy for Business world. He has mentioned that people use "strategy" in several different ways in his book *"The Rise and Fall of Strategic Planning"*. Basically the most common being these four:

a) Strategy is a plan, a "how" a means of getting from here to there.
b) Strategy is a pattern in actions over time; for example, a company that regularly markets very expensive products is using a "high end" strategy.
c) Strategy is position; that is, it reflects decisions to offer particular products or services in particular markets.
d) Strategy is perspective, that is, vision and direction (Mintzberg, 1994)

Michael Porter, the father of modern strategy, has defined competitive strategy is "about being different". He adds, "It means deliberately choosing a different set of activities to deliver a unique mix of value" (Porter, 2000) in his latest book, an updated and expanded edition of *On Competition* (Porter, 2008) Generally, Porter would not define strategy in general but define competitive strategy. In short, Porter stressed on strategy is about competitive position and differentiating ourselves in the eyes of target market.

2.2 Hierarchy of Strategy

Before crafting the strategy, it is important to know the dimension of Strategy. In fact, an organizational strategy can be divided into four levels, which are Corporate Strategy, Business Strategy, and Functional-area Strategies within each business and Operating Strategies within each business. (Thompson, Strickland, & Gamble, 2008)

Corporate Strategy is the company wide game plan for managing a set of business and considered as the highest level strategy in an organization. It consists of the kind of initiatives the company uses to establish business position in different industries, the approaches corporate executives pursue to boost the combined performance of the set of the businesses the company has diversified into, and the means of capturing cross-business synergies and turning them to competitive advantage (Thompson, Strickland, & Gamble, 2008).

Business Strategy concerns the actions and the approaches crafted to produce successful performance in one specific line of business. The key purpose is to strengthen market position and build competitive advantage (Thompson, Strickland, & Gamble, 2008). And company want to develop competitive advantages that have some sustainability which similar to the purpose of competitive strategy.

Functional-area Strategy concerns the actions, approaches and practices to be employed in managing particular functions or business processes or key activities within a business (Thompson, Strickland, & Gamble, 2008).

Operating Strategy concerns the relatively narrow strategic initiatives and approaches for managing key operating units and specific operating activities with strategic significance (Thompson, Strickland, & Gamble, 2008).

2.3 Competitive Strategy / Business Strategy

A plan for how a firm will compete, formulated after evaluating how its strengths and weaknesses compare to those of its competitors. The competitive strategies is important for an organization to compete with other where the battle field the organization is. And this statement is supported by Kenichi Ohmae: "*Without competitors, there will be no need for strategy, for the sole purpose of strategic planning is to enable the company to gain, as efficiently as possible, a sustainable edge over its competitors*" (Ohmae, 1982)

According to Competitive Strategy guru, Michael Porter has defined competitive strategy is about being different and it means deliberately choosing to perform activities differently or to perform different activities than rivals to deliver a unique mix of value. (Porter, 2008) Base on his study on the competitive strategy, concept of generic strategies:

Cost Leadership, Differentiation and Focus has been introduced (Porter, 2008). Cost leadership strategy is striving to achieve lower overall costs than rival and appealing to a broad spectrum of customers, usually by under pricing rivals. Differentiation is seeking to differentiate the company's product offering from rivals' in ways that will appeal to broad spectrum of buyers. While Focus or market niche is the ability of a company to choose the market segment and either applying differentiation or cost leadership strategy (Thompson, Strickland, & Gamble, 2008).

Derived from Porter's Generic Strategy, Best Cost Provider Strategy has been proposed by numerous of writer. Best Cost Provider Strategy is the ability of the company to give customers more value for their money by incorporating good to excellent product attributes at a lower cost than rivals (Thompson, Strickland, & Gamble, 2008). Porter may disagree on this strategy and assume that this is only a temporary tactic but not strategy; this tactic may be beat by the competitor who is doing excellent base on his four generic strategies. However, succeed of Toyota to be the market leader in 2008 by able to pursue successfully best cost strategy in automotive industry.

One of the latest popular competitive strategies against Porter's Generic Strategy is presented by W. Chan Kim and Renée Mauborgne in their 2004 Harvard Business Review article "Blue Ocean Strategy". Blue Ocean Strategy is emphasized to create value innovation model in the organization. And the organization must look outside from the traditional framework to find new value propositions (Kim & Mauborgne, 2004). Again, this theory has go against Porter's concept which is the firm can only choose either cost leadership or differentiation.

2.4 Competitive Strategy Formulation

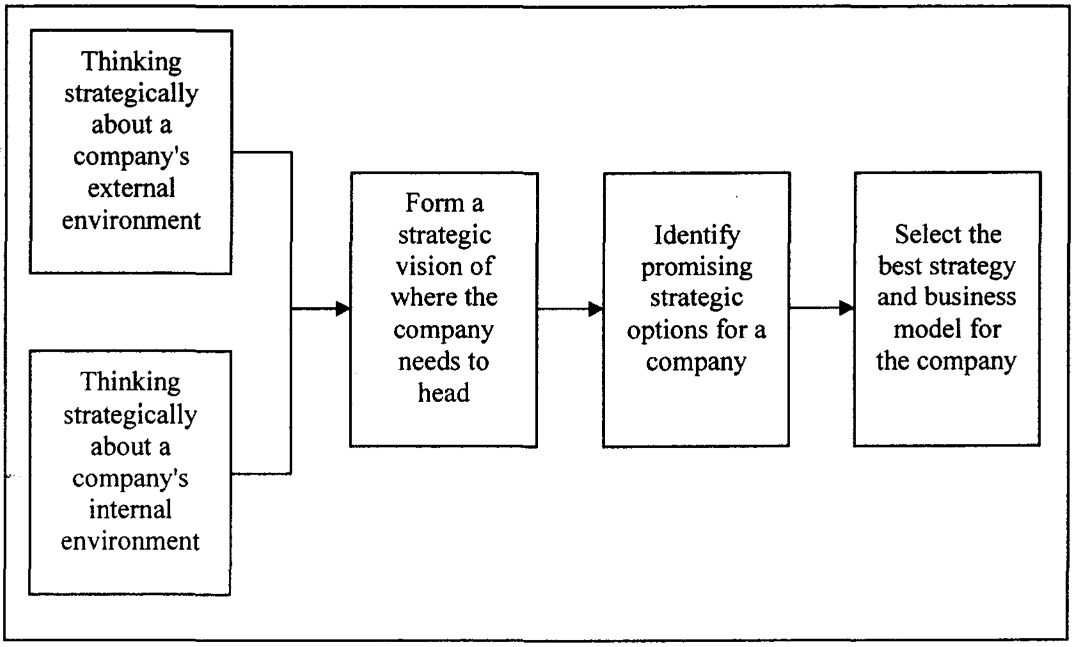

Figure 0-1 From Thinking Strategically about the Company's Situation to Choosing a Strategy.

Source : A.Thompson, Strickland, & Gamble (2008)

Base on Figure 0-1, Strategy formulation is starting from performing situation analysis or environment scanning for both internal and external. By having environment scanning as input, the company needs to set a vision where to head and then the company may select the best strategic options as their competitive strategy for its business model.

Environment scanning is the first priority before strategy formulated, it has been realized by an ancient Chinese military treatise, Sun Tzu, in 6th century B.C. Sun Tzu's famous statement---"*know your enemy, know yourself, and your victory will not be threatened*". There are several of methods used for environment scanning, such as Five-

Force Model by Michael Porter, SWOT (Strength, Weakness, Opportunity, and Strength) Analysis and TOWS (Threat, Opportunity, Weakness and Strength) Matrix.

2.4.1 External Environment Analysis

The most common tool used for external environment analysis is the "Five Competitive Forces Analysis" which is introduced by Michael Porter in 1979. The Five-Forces Diagnostics consist:

a) The bargaining power of buyers
b) The bargaining power of suppliers
c) The threat of new entrants
d) The threat of substitutes
e) The intensity of rivalry

It seems like the Five Force Analysis is too narrowed and may not cover overall aspect for external environment analysis. Thus, Arthur A. Thompson et al. has improved the analysis by introducing seven questions which need to be answered among the external environment analysis process. They are:

a) What are the industries' dominant economic features?
b) What kinds of competitive forces are industry members facing, and how strong is each force?
c) What factors are driving industry changes and what impact will they have on competitive intensity and industry profitability?

d) What market positions do industry rivals occupy – who is strongly positioned and who is not?

e) What strategic moves are rivals likely to make next?

f) What are the key factors for future competitive success?

g) Does the outlook for the industry present the company with sufficiently attractive prospects for profitability?

h) Does the outlook for the industry present the company with sufficiently attractive prospects for profitability? (Thompson, Strickland, & Gamble, 2008)

2.4.2 Internal Environment Analysis

Internal analysis is basically to find out the Strength and Weakness of the company. One of the common tools used for internal analysis is value chain analysis which used by Michael Porter. The value chain analysis describes the activities the organization performs and links them to the organizations competitive position (Recklies, 2009).

Through Value Chain Analysis, the company can identify its core competencies and derive those activities to the firm's competitive advantage. The strength of the Value chain as per Figure 0-2 is the ability to condense a firm's activities based on cost analysis into a generis table which built by five primary activities and four support activities.

Figure 0-2 The Value Chain Analysis position.

Source : Recklies (2009)

2.4.3 Forming Strategic Vision

Strategic vision describes the route a company intends to take in developing and strengthening its business. It lays out the company's strategic course in preparing for the future (Thompson, Strickland, & Gamble, 2008).

According to Gary Hoover in his book, *Hoover's Vision*: "A successful vision has to be clear, consistent, unique and serving" (Hoover, 2002). And below is the description of the characteristic:

a) Clear – simple and articulated in terms that are free of corporate doublespeak
b) Consistent – knowing what you are good at and what is important to you, and sticking to your vision through bad and good periods.

c) Unique – find your own space or niche in the world. The most successful enterprises do one thing, and do it very well.

d) Serving – The only valid reason to the existence of any enterprise is to serve customer either by providing products or services. Enterprises that forget this will perish; those that remember that fact and put it into practice every day have a chance at long-term survival, even prosperity.

2.4.4 Identifying Strategic Options for Emerging Industry

There are various of competitive strategies that used by the companies, but the Five Basic Competitive Strategy options has stood out among of others options and also the five options for a company's first and foremost choices in crafting overall strategy and beginning its quest for competitive advantage (Thompson, Strickland, & Gamble, 2008).

Low cost strategy may help the company to expend the customer group in emerging market who may be categorized in price-sensitive buyer. For example, the renewable energy provider, First Solar Inc. is practicing low cost strategy and it has achieved the lowest manufacturing cost per watt in the industry, $.87/watt for the second quarter of 2009, having broken the $1 per watt cost barrier in 2008 (First Solar, 2009). And this strategy has helped First Solar becomes the largest solar cell producer in 2009, leapfrogging Q-Cells and Sharp for the first time.

For the differentiation strategy in emerging market will be succeed for the product or service which is innovation compare to others. For instance of Apple in portable audio market while it is still in the emerging stage. Through the guide of this strategy, Apple has succeeded to introduce iPod which has created a phenomenon that iPod is now a fashion statement, and any other digital music player is considered "Brand X".

Low cost or differentiation strategy is workable in emerging industry. However, focusing strategy is sensible for the limitation resources to target too broad buyers. And focus differentiation always be practiced for the early stage of launching new product, this early generation product always targeted leading group buyer group who willing to pay for the premium price of new product.

While the best cost strategy is seldom be practiced due to the immature of the technology, and uncertainty of demand in emerging market. The constraint has caused the difficulty to have the balance for cost/value combinations.

2.4.5 Competitive Strategy Evaluation and Selection

To select the best competitive strategy for a business, the evaluation process is playing an important role. It can be through a systematic procedure which has been set by the firm, or simply a decision of the decision maker base on his/her experience.

According to Rumelt, the best business strategy has to fulfill the below four criteria:

a) Consistency – the strategy must not present mutually inconsistent goals and policies.

b) Consonance – the strategy must present an adaptive response to the external environment and to the critical changes occurring within it.
c) Advantage – the strategy must provide for the creation and maintenance of competitive advantage in the selected area of activity.
d) Feasibility – the strategy must not overtax available resources or create unsolvable sub problems (David, 1999).

Rumelt's Four Criteria can be sharpened either by the experience of analyst or the systematic method among the process of selecting strategy. Johnson & Scholes (1999) proposed four methods to select the strategy for a company:

a) Planned approach – the organization's quantified objectives are used as yardsticks to assess the strategic options. The outcome of this approach is always quantified "answers" with all the facts and figures. One of the examples of this approach is sensitivity analysis.
b) Enforced choice – the strategy selection is largely imposed from outside e.g. environment changes. The managers have no roles in the strategy selection and the company risk profile is enlarged.
c) Learning from experience – the strategy evolves as a fragmented process within the operating units as they adapt to the changing environment. There is a possibility that the evolved strategy might lead to inefficiency and strategic drift.
d) Command – the strategic decision is made at the highest level of the organization. It has the advantage of avoiding strategic drift but

communication is crucial in ensuring the success of the strategy (Johnson, Gerry, & Scholes, 1999).

CHAPTER 3

INDUSTRY AND COUNTRY PROFILE

3.1 Introduction

This chapter will be focused on industrial gases industry profile where Oras Skystis Malaysia is one of the major players in this industry. Next, country profile – Malaysia, will be reviewed to provide broader understanding and impact to the industry. Besides, history of the PV industry and its contribution to industrial gases industry will be discussed further.

3.2 The Industrial Gases Industry

It is difficult to have actual figures for the type or amount of gases are used in industry, but the overall market turnover may at least figure this industry's magnitudes involved. In 2006, the value of the global industrial gas business reached 39 billion Euros (Approximately RM 190 billion) (Haring, 2008). In 2008, the world industrial gases market has a turnover of approximately 51 billion Euros (Approximately RM 250 billion) (EIGA, 2010).

Although this is a multi billion business, but there are limited study on this industry to date. Lack of information and publication, most of the outsiders are having doubt on this industry and the confusion between the industry with oil and gas industry always occur.

3.2.1 What is Industrial Gases

According to Römpp Encyclopedia, the term of industrial gases is a collective term for combustible and non-combustible gases generated on an industrial scale, such as hydrogen, oxygen, nitrogen, carbon dioxide, acetylene, ethylene, noble gases, ammonia, water gas, generator gas, city gas, synthesis gas, etc. (Steglich, Fugmann, & Lang-Fugmann, 2001). In addition to that, numbers of different mixtures of gases are provided to meet the needs of specific applications.

Generally, industrial gas is different from gas supplied by oil and gas industry. In short, industrial gases is including petroleum product but on the other hand, oil and gas industry is solely related to the product from petroleum such as natural gas, butane, propane and etc.

In fact, industrial gases touch virtually every facet of our life. Three major atmospheric gases—oxygen, nitrogen, and argon—are highly used in steel production. To reduce brick –making cost, oxygen is used to enhance kiln firing. For the aerospace, Liquid oxygen and liquid hydrogen are acted as rockets fuel. For our day-to-day product such as brewing beer, recycling tires, and toys finishing, Nitrogen is used. For agriculture, ammonia which is synthesized from nitrogen is widely used as fertilizers. Besides, ammonia is also important in the production of nitrous oxide (also known as laughing gas) that is used as an anesthetic in some types of surgery.

Table 3.1 has summarized the major end users for industrial gases, and it can be concluded that Chemical, Metallurgy, Manufacturing and Electronic industries are the four biggest sales revenue contributor to industrial gases companies.

Basically, manufacturing industry in Table 3.1, is the industry processing raw material to finished goods in the large scale where the end product are other than the other 8 groups. This group may represent the industry such as automobile producer, tires, toys, clothing and so on. The gases used in this industry are various and depending on the end product, for example nitrogen is used in tire manufacturer while hydrogen is used in clothing industry.

For Metallurgy industry, the end products are metallic component used by engineering or consumers. The example of this industry is TATA Steel, Ann Joo Steel and Mega Steel. This industry is highly demand on oxygen for their burning process, nitrogen and argon for their cooling process.

For chemical industry such as Shell, BASF, TITAN, PETRONAS and DuPont are producing industrial chemical, plastic, polymer and so on are requiring various type of gases for the chemical process in their production plant. For example, nitrogen is the raw material for BASF to produce ammonia.

Electronic Industry is referring to semiconductor manufacturing and downstream packaging, PCB fabrication and assembly or technologies such as fiber optics/optoelectronics, photovoltaics (PV) or disk-media fabrication. This industry is more knowledge intensive and also having dramatic business cycle compare to