PRELIMINARY STUDY OF THE KEY FACTORS TO AFFECT SOLAR INDUSTRY IN TAIWAN

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This study is to explore key factors that affect the development of solar industry in Taiwan by studying literatures as well as designing, dispatching and collecting questionnaires and with the approach of statistical analysis. By taking the solar industry in Taiwan as an example and reorganizing related documents, this paper aims to find out the uncertainty in the development of solar industry and hence analyze the key factors that affect the growth of solar industry in Taiwan. This article is based on the analysis of five major items, i.e. policy, technology, macro-economy, consumers and sustainable development, which are adopted in the design of Likert 5-point scale that is issued to listing companies in Taiwan in the solar industry. Firstly, the study has found that "solar energy plant, module factory tax relief" and "subsidized green power equipment purchase and power repurchase measures" are the two factors showing considerable influence upon the development of solar energy manufacturers, which indicates that policies have a great impact on solar industry development. Secondly, with the analysis of importance factors, it is found that "government policy and solar industry prosperity factors" is of great importance for the solar industry. Finally, with the analysis of influence factors, it is found that "business cycle and product characteristics factors" imposes a significant influence upon the solar industry.

Key words: solar power development, key factors, factor analysis, principal component analysis.

1. Introduction

The faster economy grows, the quicker energy is consumed. The use of non-renewable energy accounts for more than 85% of global energy use, and non-renewable energy is mainly oil-based. According to the International Energy Agency medium - term oil market report, the global oil reservation is expected to be exhausted in approximately 43 years. The use of non-renewable energy leads to environmental pollution and the rise in carbon dioxide concentration, and hence the continuous rise in global temperature (greenhouse effect). If the concentration of carbon dioxide cannot be effectively controlled at below 450PPM, the global temperature will be 2 Celsius degrees higher than that of 1990 and we will be facing of the water shortage crisis. Therefore, attention has been drawn to the renewable energy concern and many countries are currently actively developing renewable energy sources. The most extensively adopted among these energy sources are wind energy and solar energy, which are also showing the fastest growth. The solar energy is especially booming. Germany and Japan are deemed as the biggest and second biggest solar market in the world, respectively. The most mature application of solar energy is found in Japan, which is also the first country in the world to implement solar subsidies (Hui-Wen Huang, 2007).

There is a close tie between solar power and sunshine amount. The solar panels installation remains rather expensive because current technologies are not yet mature. Another influential factor is the tilting angle of solar panels. Under the pressure that non-renewable energy is being rapidly consumed, advanced countries are now actively seeking new energy sources, hoping to find a sustainable, inexhaustible energy source. Energy sources currently under development include wind energy, solar energy, geothermal energy, biomass energy, etc. The solar energy has shown the greatest potential as it requires nothing but a panel placed in the sunshine to generate power. This is why it is favorable in countries with extended duration of sunshine. However, the solar technology is immature at this time as the conversion efficiency of a photovoltaic cell cannot reach the peak value. A tremendous decrease in electricity expenses for every household can be expected once there is a breakthrough in this technology.

1.1 The status of Taiwan

The power supply in Taiwan mainly relies on nuclear and thermal power plants (Shih-Wu Liang, 2014) due to the lower cost in raw materials. As a matter of fact, however, the cost for waste material disposal is often excluded in the power generation cost. Take nuclear energy for example: radioactive nuclear waste is generated from nuclear power plants, and it is always collected and then sealed in a concealed space since there is no available technology to properly handle the radioactive waste, which will remain a threat to the environment in the following hundreds of thousand years. Therefore, we need a better policy to promote the popularization of solar energy (Laird, F. N., & C. Stefes, 2009).

1.2 Taiwan’s development opportunities

Bolsen, T. and F. L. Cook (2008) emphasized that energy is the source of a country’s development and economic power. Due to limited natural resources, Taiwan has been greatly relying on imported energy sources and is therefore prone to the impact of international energy situations. In comparison, green energy enables Taiwan with the opportunity to get rid of Taiwan's dependency to imported energy sources and to stabilize domestic energy demand.

The study of Shih-Hua (2010) pointed out that solar energy is the industry with best prospect. But since the study on solar industry is still at an embryonic stage, the role of government's assist in the industry's development is utmost crucial. The solar-related industrial foundation and technical talents have provided Taiwan with advantages in the industry. Research and development are to be executed step-by-step, the production scale is to be expanded, cost will be lowered and the popularization rate will be raised. Combined with the boost from policy making, Taiwan's solar industry is expected to get a head start in the global solar industry. Aiming to land the opportunity in green energy market, currently Taiwan has decided that seven green energy industries – including solar-related industry – will be the focus of future development. The Bureau of Energy evaluated that the seven green energy industries will become a boost to the GDP in related industries in Taiwan (Yu-Lin Chang, Chung-Jen Fu, and Ho-Yun Weng, 2011).

2. Literature Review

Mats (2000) explained that solar energy comes from the energy generated during the continuous nuclear fusion inside the Sun. In a broad sense, the definition of solar energy covers a lot, including coal, petrol and natural gas in the Earth, which are the legacy from primal times. In a narrower sense, solar energy indicates the radiation energy, photovoltaic conversion and photochemical reaction. With an abundant resource reservation, solar energy can be a green energy source with great development potential.

Materials for solar energy application can be roughly divided into three categories: "silicon," "compound semiconductors," and "other materials." T.M. Chen, Y.C. Chen and, W.Y. Huang (2012) emphasized that silicon materials had occupied 90% of solar market. Content of silicon is the second largest to that of oxygen, and the best conversion efficiency can be found in single crystal silicon, multi-crystalline silicon and gallium arsenide three categories, efficiency of which are 14~24%, 10~17% and 18~30%, respectively (Chun-Chou Tseng, 2008).

2.1 Taiwan solar power repurchases mechanism

Feng-Hua Pieh(2008) emphasized that, in order to promote the installation rate of solar panels, many advanced countries have established multiple incentive policies, one of which is the power repurchase mechanism. In the mechanism, the redundant power can be sold back to the government at an official price, making the public believe that solar panels are a profitable investment and hence the encouraged will to install the panels. The government repurchase price in 2015 is listed below in Table 1

Table 1: Power Repurchase Price in Taiwan

Type of Renewable Energy	Category	Capacity Grade	Power Bulk Purchase Tariff (NTD/unit)	
			2015 yr. (1~6 mon.)	2015 yr. (7~12mon.)
Solar PV	Rooftop	More than 1kW, less than 20kw	6.8633	6.6721
		More than 20kW, less than 100kw	5.7378	5.5760
		More than 100kW, less than 500kw	5.3627	5.2155
		500kW or more	5.1935	5.0537
	Grounded	1kW or more	4.8845	4.7521

Source: Taiwan Power Company

2.2 Taiwan solar power origin

Roger Sathre (2014) argued that the carbon dioxide produced by the combustion of fossil fuels were the cause of global warming, resulting in the greenhouse effect and deterioration of the ecological environment. The study of Peter Abrahamsson Lindeblad *et. al*., (2016) pointed out that the negative impacts of environmental pollution, ecology and climate change, water resources reduction and biological/ecological changes were drawing attentions from countries to the importance of low-pollution, renewable energy, and hence the commitment to development. In order to curb greenhouse gas emissions, the Kyoto Protocol was signed in Japan in 1997. The concept of green energy began to surface. Such an energy source has gradually become a mainstream with its low or even zero pollution and the capability to be reused.

In the past 20 years, rapid growth is seen in Taiwan's technology and economy. But with a rising oil price and a deteriorating environment, Taiwan has begun to attach importance to the development of green energy. Taiwan is located on the Tropic of Cancer and stays sunny throughout the year. With approximately 3000 to 4000 kcal of sunshine every year, it is suitable to solar energy development. But in terms of technology, the popularization to the public is not yet available. As pointed out by the Bureau of Energy, it is estimated that in 2030 there will be 3 million kw (kilowatts) of solar power supply, equivalent to 1 million households' worth of electricity consumption. With the technology advancing every minute, it is believed that Taiwan would gradually become self-sufficient and greet a new era (I-Lun Kao, 2009).

2.3 Recent developments in solar power in Taiwan

Taiwan's early solar manufacturers engaged in developing solar cells and applications for electronic products (such as Sinonar and Motech). In recent years, due to the government's vigorous promotion and subsidies for the solar energy industry, coupled with the short supply of solar energy in the international market, Taiwan began to actively develop solar energy industry

(Han-Ting Wang, 2008). At the same time, the Legislative Yuan passed the Renewable Energy Development Ordinance in 2009. Although only the grade of 1-10Kw were granted a subsidy of 50,000 NTD after adoption of the law, but the repurchase price of solar power had been raised from 2 NTD per unit to 11.1883 NTD by the Taiwan Power Company (Cheng-Ting Chang, 2010).

Taiwan recovered a substantial growth in the year of 2013 and 2014, which were called the two golden years and when mainland China were dealing with anti-dumping investigation from both the US and the EU. However, the balance of supply and demand was not achieved in 2013 and the ratio between supply and demand was estimated to be 1.14:1 approximately. Due to the market remained in a status of short supply, most of the sales were made from stock and the price kept rising (Chien-Han Lin, 2014). The solar installation capacity statistics (Kw) are listed in Table 2 below.

Table 2: Solar Installation Capacity Statistics (Kw)

Year	Solar Installation Capacity (Kw)
2000	0.1
2001	0.2
2002	0.3
2003	0.5
2004	0.6
2005	1.0
2006	1.4
2007	2.4
2008	5.6
2009	9.5
2010	22.0
2011	117.9
2012	222.4
2013	392.0
2014	511.7
2015	810.75
2016	1068.09
2017/May	560.05

Source: www.re.org.tw

As indicated in the table above, an exponential growth was found in the solar installation in Taiwan after the passing of Renewable Energy Development Ordinance. To analyze the solar industry development in Taiwan, it is suggested first establish an understanding in regard to the principle and application, current market conditions at home and abroad, as well as relevant theories of Substance Flow Analysis from home and abroad.

2.4 Solar industry in European Countries and the US

With the rapid economic development, energy use continues to increase. Germany had long been aware that the environmental changes will become worse. The German government had been actively developing "energy transformation". Germany is one of the most successful countries in the world to develop renewable energy, and its solar energy is the most successful renewable energy source. There is a city in Germany renowned for its solar power coverage: "Freiburg". Due to the low latitude, Freiburg is a sunny and bright town in Germany. Local residents are actively pursuing solar energy as a source of power for cities and towns, and strive to make Freiburg into a green town and a sustainable town model (Wen-Shu Chen, 2009).

In 1891, people in Maryland of the United States commercialized the solar water heater. After 10 years of improvement, solar water heaters began to be widely used in 1920 and thus laid the foundation of modern solar industry. Solar industry had started earlier in the US, but the government did not pay attention to the development of this industry, resulting in a solar energy utilization rate lower than that of European countries. In 2011, California was the first to introduce tax relief and investment subsidies, followed by New York and Colorado's proposition to encourage solar installation in households and business buildings.

The development of German solar industry has changed significantly in 2006 and 2008. Compared to 2005, the population of solar energy industry in 2006 increased by 65% and sales increased by 62%. However, compared with 2006, the population grew by 76% in 2008 and sales grew by 70%. This staggering growth is associated with a significant deal of the capital and research invested in the industry. From the 16 million euros invested in 2003 to the 160 million in 2008, it was a tenfold increase in merely 5 years (Jun-Hua Wu, 2011). The past decade was the most rapid development stage of solar industry in the world. In 2012 the cumulative capacity exceeded 100 million kilowatts for the first time. But after the European debt crisis, countries have reduced subsidies for solar industry. The market share of solar gradually declined in 2012, and China replaced Germany as the world's largest annual solar energy installations. In 2013, the global top three in solar installations were China, Japan and the US, and it was clear that the utilization of solar installation had been expanded from Europe to other regions.

2.5 Pushing hands behind solar photovoltaic industry – FiT System

Solar photovoltaic industry has been developed for more than 30 years, but the actual booming period was in 2004 after the revision of "Renewable Energy Law" in Germany. Kung-Mien Ma (2011) pointed out that the Feed-in Tariff (FiT) System had risen thereby. Feed-in Tariff is for governments to develop a variety of fixed renewable energy purchase price based on different renewable energy power generation technology. The spirit of the FiT System is to purchase renewable energy at a higher price than the average market price. The purchase price is set to a reasonable level on the basis of costs from a variety of renewable energy power generation technology.

The FiT System was introduced by Germany in 2004 and attracted many users for its generous purchase tariff. Solar photovoltaic technology was especially popular for it could be easily invested by common households, and by such the Germany rapidly prospered and replaced Japan as the country with top solar installation. Seeing the successful investment in Germany, many European countries commenced their study and investment, and Europe had thus risen to be the most successful and largest market in solar industry (Meng-Chieh Wang, 2011).

3. Methodology

With documentation analysis, this study first established a preliminary research structure, and then a questionnaire was designed based on information acquired from the documentation. Five-point Likert scale was employed. The scores ranged from 1 to 5. Score 5 means extremely high correlation while score 1 means no correlation. The instrument was validated in advance through several personal interviews with solar industry managers on site. Questionnaires were dispatched and collected and then analyzed with the SPSS 17.0 software.

3.1 Objects of study

This study targeted Taiwan and dispatched in total 200 questionnaires. After close follow-up process, 92 questionnaires were recovered with a recovery rate of 0.46. The questionnaires were mainly dispatched in listing companies in Taiwan related to solar industry. Six of the companies were major research subjects, which are categorized based on the field of work and occupational titles as listed in Table 3 below.

Tale 3: Statistics List of Fields of Work and Occupational Titles

Company	Field of Work					Titles						
	Marketing	Product Planning	Policy execution & supervision	Other	Total	Assistant	Manager	Director	Engineer	Team Leader	Other	Total
Gintech	1	3	4	10	18	0	2	0	6	4	6	18
Motech	1	1	3	13	18	1	1	2	3	4	7	18
Gigastorage	1	0	1	6	8	0	1	2	2	2	1	8
Giga Solar	2	4	4	12	22	1	2	0	5	4	10	22
Sino-American	0	1	4	8	13	0	1	0	4	2	6	13
Neo Solar	1	4	1	7	13	0	0	0	4	4	5	13
Total	6	13	17	56	92	2	7	4	24	20	35	92

This study targeted six companies as the research subjects. Statistics analysis based on seniority and departments is listed in Table 4 below.

Table 4: Statistics List of Seniority and Departments

Company	Seniority					Departments				
	0-3/yr	4-6/yr	7-10/yr	11yr or more	Total	Marketing	QA	Financial	Other	Total
Gintech	1	8	5	4	18	5	4	4	5	18
Motech	2	5	6	5	18	3	7	3	5	18
Gigastorage	1	3	2	2	8	0	3	3	2	8
Giga Solar	3	10	6	3	22	4	5	0	13	22
Sino-American	1	4	6	2	13	2	4	3	4	13
Neo Solar	1	9	1	2	13	3	0	1	9	13
Total	9	39	26	18	92	17	23	14	38	92

As shown in Table 4, most research subjects had been working for 4~10 years and were mainly from QA and other departments.

3.2 Research Structure

In this study, the descriptive statistics were used and the questionnaire was designed based on key information from documentation research. From the two dimensions of influence and importance, each factor was studied to find out whether it was crucial in the process of decision making. The research structure of this study is shown in Fig. 1 below.

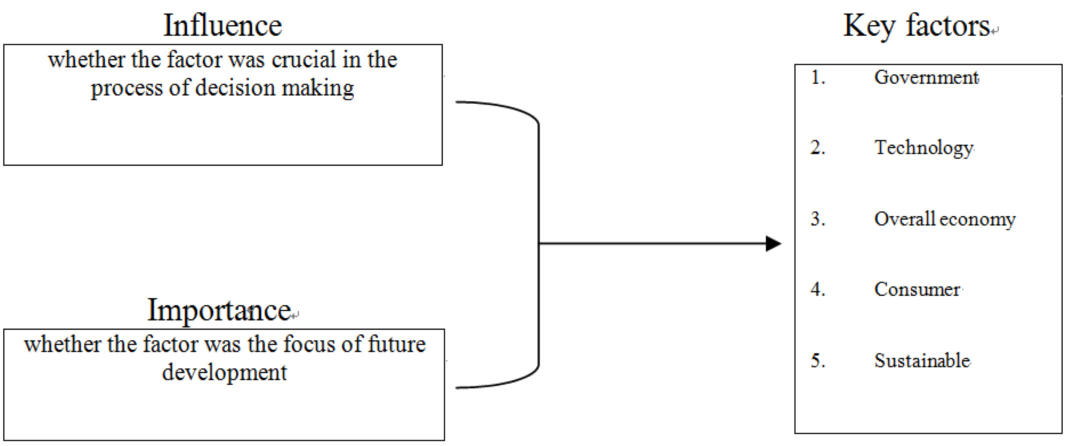

Fig. 1 Research Structure

Documentation analysis: to adopt descriptive statistics, credibility analysis (Cronbach α value over 0.7 indicating high internal consistency) and factor analysis: mainly aiming to find out the structure by referring to documentation, so that a group of co-related variables can be interpreted with a limited number of factors while the maximum amount of preliminary information can be kept. Objective: To summarize and simplify documentation.

3.3. Credibility Analysis

According to the theoretical basis in relevant documentation, the questionnaire adopted the scale or measurement items from former researchers as advised by experts. Based on the scores of the questions answered, the Cronbach'α coefficients of each question were calculated. Nunnally (1978) argued that in an exploratory study, the reliability could be accepted as long as it reaches 0.7. The importance project of Cronbach's Alpha value of the questionnaire was 0.785, which was consistent with Nunnally's argument. It indicated that the questionnaires were highly reliable and could be analyzed therein after. The Cronbach's Alpha value of the influential project is 0.726 and its value is greater than 0.7, indicating that the response to the questionnaire was consistent with the argument of Nunnally (1978). The questionnaires were highly reliable and can be analyzed.

4. Results

4.1 Importance

In this section, the KMO sampling suitability test and Bartltett's test of sphericity carried out. With KMO=0.665(mediocre > 0.6), indicating that it was valuable for the factor analysis to select a common factor. Value of Bartltett's test of sphericity was 721.529, significance = 0.000 < α = 0.01, indicating that the data was very suitable for factor analysis. It was the most commonly adopted method to determine the number of factors with the eigenvalue greater than 1 as the selection criteria.

After the validation, the common factor was extracted from the principal component analysis in the factor analysis. The factor loading > 0.45 and the eigenvalue greater than 1 were taken as the principle of selecting the common factor number. The result was that six main factors were selected, which lead to a cumulative variance explained of 79.862%. And then, through the varimax method of the number of shaft method, reverse the axis of selected factors to better reveal the indication of each factor.

Table 5: Principle component analysis results for solar industry development factors (importance)

	Factor loading	Eigenvalue	Explained variance
Factor 1, government policy and solar industry prosperity factors			
The importance of thin film solar cell power generation costs being lower than polycrystalline solar cells	0.784		
The importance of global solar equipment industry	0.699		
The importance of domestic solar cell industry	0.588	4.477	23.655%
The importance of solar cell power generation in energy proportion Policy	0.581		
The importance of the tax relief system for the production of solar cell enterprises and the subsidy of low interest and loan policies	0.541		
Factor 2, related factors of development of solar cells			
The importance of the development of solar power technology	0.807		
The importance of global solar cell industry prosperity	0.675	2.218	15.243%
The importance of solar cell development costs	0.579		
The importance of long-term stable conversion efficiency of solar cells	0.516		
Factor 3, functional factors			
The importance of accepting low BIPV conversion efficiency	0.745	2.014	12.391%
The importance of increasing the life span of concentrating gallium arsenide products	0.728		
Factor 4, policy support factors			
The importance of green-environmental protection and carbon reduction policy	0.785		
The importance of government on tax reduction planning for R&D funds in companies	0.689	1.757	10.320%
The importance of modifying the legislation and policy of building materials	0.512		
Factor 5, factors related to the promotion and counseling of green energy			
The importance to actively promote the solar energy and enable the public's improved understanding of green energy	0.817	1.641	9.388%
The importance of condenser gallium arsenide solar tracker	0.787		
Factor 6, regulation on the use of photovoltaic energy and green building materials in the government and the households			
The importance of policies on the proportion of solar photovoltaic utilization in public construction	0.858	1.408	8.865%
The importance of modifying the legislation and policy of building materials	0.703		

Factor 1 consisted of mainly 5 variances with close interrelations, including "importance of the tax relief system for the production of solar cell enterprises and the subsidy of low interest and loan policies," "importance of solar cell power generation in energy proportion policy," "importance of thin film solar cell power generation costs being lower than polycrystalline solar cells," "importance of global solar equipment industry," and "importance of domestic solar cell industry." Therefore, the factor was named "government policy and solar industry prosperity factors" and the factor loading was between 0.541 and 0.784, eigenvalue was 4.477 and the explained variance was 23.655%.

Factor 2 consisted of mainly 4 variances with close interrelations, including "importance of the development of solar power technology," "importance of solar cell development costs," "importance of long-term stable conversion efficiency of solar cells," and "importance of global solar cell industry prosperity." Therefore, the factor was named "related factors of development of solar cells" and the factor loading was between 0.516 and 0.807, eigenvalue was 2.218 and the explained variance was 15.243%.

Factor 3 consisted of mainly 2 variances with close interrelations, including "importance of accepting low BIPV conversion efficiency" and "importance of increasing the life span of concentrating gallium arsenide products." Therefore, the factor was named "functional factors" and the factor loading was between 0.728 and 0.745, eigenvalue was 2.014 and the explained variance was 12.391%.

Factor 4 consisted of mainly 3 variances with close interrelations, including "importance of modifying the legislation and policy of building materials," "importance of government on tax reduction planning for R&D funds in companies" and "importance of green-environmental protection and carbon reduction policy." Therefore, the factor was named "policy support factors" and the factor loading was between 0.512 and 0.785, eigenvalue was 1.757 and the explained variance was 10.320%.

Factor 5 consisted of mainly 2 variances with close interrelations, including "importance of condenser gallium arsenide solar tracker" and "importance to actively promote the solar energy and enable the public's improved understanding of green energy." Therefore, the factor was named "factors related to the promotion and counseling of green energy" and the factor loading was between 0.787 and 0.817, eigenvalue was 1.641 and the explained variance was 9.388%.

Factor 6 consisted of mainly 2 variances with close interrelations, including "influence of policies on the proportion of solar photovoltaic utilization in public construction" and "importance of modifying the legislation and policy of building materials." Therefore, the factor was named "regulation on the use of photovoltaic energy and green building materials in the government and the households" and the factor loading was between 0.703 and 0.858, eigenvalue was 1.408 and the explained variance was 8.865%.

4.2 Influence

In this section, the KMO sampling suitability test and Bartltett's test of sphericity carried out**.** With KMO=0.682 > 0.6, indicating that it was valuable for the factor analysis to select a common factor. Value of Bartltett's test of sphericity was 807.435, significance = 0.000 < α = 0.01, indicating that the data was very suitable for factor analysis.

Table 6: Principal component analysis results for solar industry development factors (influence)

	Factor loading	Eigenvalue	Explained variance
Factor 1, business cycle and product characteristics factors			
The influence of prosperity in global solar cell industry	0.872		
The influence of prosperity in global solar equipment industry	0.704	3.939	21.414%
The influence of prosperity in global solar device industry	0.692		
The influence of accepting aesthetics in BIPV products	0.668		
The influence of accepting low BIPV conversion efficiency	0.637		
Factor 2, cost and technology development factors			
The influence of solar power technology development	0.826		
The influence of solar cell development cost	0.819	2.935	18.228%
The influence of power cost of thin-film solar cells being lower than polycrystalline solar cells	0.704		
The influence of extending life span of the concentrating gallium arsenide products	0.692		
Factor 3, globalization factors (overall external factors)			
The influence of long-term stable conversion efficiency of solar cells	0.809		
The influence of high-rising global oil prices	0.762	2.236	13.318%
The influence of prosperity in global solar cell industry	0.736		
Factor 4, government subsidies and building legislation and regulations			
The influence of green-environmental protection and carbon reduction policy	0.791		
The influence of government on tax reduction planning for R&D funds in companies	0.761	1.918	11.992%
The influence of modifying the legislation and policy of building materials	0.585		
The influence of relief and subsidies for solar cell manufacturers and low-interest loan policies	0.492		
Factor 5, power repurchase and tax relief			
The influence of policies to repurchase solar power at stabilized price	0.716		
The influence of relief and subsidies for solar cell manufacturers and low-interest loan policies	0.683	1.757	9.323%
The influence of policies on the proportion of solar photovoltaic utilization in public construction	0.651		

Factor 1 consisted of mainly 5 variances with close interrelations, including “influence of prosperity in global solar cell industry,” “influence of prosperity in global solar equipment industry,” “influence of prosperity in global solar device industry,” “influence of accepting aesthetics in BIPV products,” and “influence of accepting low BIPV conversion efficiency.” Therefore, the factor was named “prosperity cycle and product characteristics factors” and the factor loading was between

Factor 2 consisted of mainly 4 variances with close interrelations, including “influence of solar power technology development,” “influence of solar cell development cost,” “influence of power cost of thin-film solar cells being lower than polycrystalline solar cells,” and “influence of extending life span of the concentrating gallium arsenide products." Therefore, the factor was named "cost and technology development factors" and the factor loading was between 0.692 and 0.826, eigenvalue was 2.935 and the explained variance was 18.228%.

Factor 3 consisted of mainly 3 variances with close interrelations, including "influence of long-term stable conversion efficiency of solar cells," "influence of high-rising global oil prices," and "influence of prosperity in global solar cell industry." Therefore, the factor was named "globalization factors (macroeconomic factors)" and the factor loading was between 0.736 and 0.809, eigenvalue was 2.236 and the explained variance was 13.318%.

Factor 4 consisted of mainly 4 variances with close interrelations, including "influence of relief and subsidies for solar cell manufacturers and low-interest loan policies," "influence of modifying the legislation and policy of building materials," "influence of government on tax reduction planning for R&D funds in companies," and "influence of green-environmental protection and carbon reduction policy." Therefore, the factor was named "government subsidies and building legislation and regulations" and the factor loading was between 0.492 and 0.791, eigenvalue was 1.918 and the explained variance was 11.992%.

Factor 5 consisted of mainly 3 variances with close interrelations, including "influence of policies to repurchase solar power at stabilized price," "influence of relief and subsidies for solar cell manufacturers and low-interest loan policies," and "influence of policies on the proportion of solar photovoltaic utilization in public construction." Therefore, the factor was named "power repurchase and tax relief" and the factor loading was between 0.651 and 0.716, eigenvalue was 1.757 and the explained variance was 9.323%.

From the above results, it was found that the common factor is extracted by principal component analysis. According to the principle that the eigenvalue was greater than 1 as the common factor, 5 main factors were selected, and 74.275% of the total variances were explained.

4.3 Analysis on importance and influence

The ANOVA analysis was implemented on the re-named six factors for abovementioned companies, and the validation value (F) in the "solar energy plant and module factory tax deduction" factor was the largest (4.892), but the significance remained the same (0.001) among the two factors of "solar energy plant and module factory tax deduction" and "green energy power equipment purchase subsidy and power repurchase measures." Therefore, it could be concluded that these two factors were of great importance to the solar companies. Based on the seniority, the ANOVA analysis was implemented on the re-named six factors, it was found that the validation value (F) in the factor of "regulation on the use of photovoltaic energy and green building materials in the government and the households" was the largest (5.18) and showed a significance (0.002), and therefore this factor was considerably influential to the seniority.

The ANOVA analysis was implemented on the re-named 5 factors based on the field of work, and it was found that the validation value F in the "government subsidies and building legislation and regulations" was the largest (4.184) and showed significance (0.008), and therefore this factor was considerably influential to the field of work. The ANOVA analysis was implemented on the re-named five factors for abovementioned companies, and it was found that the maximum validation value F in the "tax and technical capacity" was 13.889 and showed a significance of 0.000, and therefore this factor was considerably influential to the solar manufacturers.

5. Conclusion and suggestion

5.1 Conclusion and results

With a sufficient sunshine, a well-developed semiconductor and electronics industry, as well as government promotion and other favorable conditions in Taiwan, solar energy can now be applied to many levels. As the global solar industry prospects and the Taiwan solar energy industry shows a good technical performance, the prospect cannot be underestimated. Government policy will be the most critical factor if better development is expected in the solar industry in Taiwan, especially a perfect power repurchase mechanism. The rationality and economic considerations of the repurchase mechanism are the facts that government needs to think through and made up its mind so that it would be conducive to the development of Taiwan's solar energy industry.

The ANOVA analysis indicated that the two factors of "solar energy plant and module factory tax deduction" and "green energy power equipment purchase subsidy and power repurchase measures" imposed a considerable influence upon companies in solar industry.

Therefore, the government's policy making will impact the solar industry significantly. On the other hand, the seniority in solar industry varied according to the concept of "regulation on the use of photovoltaic energy and green building materials in the government and the households", while the factor of "government subsidies and building legislation and regulations" showed a different influence upon the field of work.

It can be found in the eigenvalue from importance factor analysis that the Factor 1 had a larger eigenvalue (4.477) and therefore the "government policy and solar industry prosperity factors" were quite influential to the solar industry. The eigenvalue from influence factor analysis indicated that Factor 1 had a larger eigenvalue (3.939) and hence the conclusion that the "business cycle and product characteristics factors" were considerably influential to the solar industry.

5.2 Suggestion

With the rise in the concern of environmental protection in recent years, a solid growth has been seen in solar industry, appearance of which also continues to increase. Currently solar industry has attracted a lot of attention in the market, and an increasing number of products will be developed targeting the combination with solar energy in the future. Considering the existing challenges to the industry and major domains in which most studies were conducted, there are four items in concern: Firstly, the scale economy of the market; Secondly, the improvement of production operations; Thirdly, the continuous R&D investment (including slurry material quality and conversion efficiency upgrade), and; Finally, the power plant development (at home and abroad). These four items require a leading role played by the government, which, in return, will help the solar manufacturers in

Taiwan to gain a firm foothold. The staggering cost of installation and soft domestic demand are currently challenging solar manufacturers in Taiwan. Researchers are expected to continue to further their study in green energy industry. Due to the fact that technology changes rapidly in solar industry and the supply and demand relationship remains unstable in the market, it would be wise to conduct an analysis and a study on related factors again after a certain time in order to validate that the key factors are providing results identical to this study, or even providing us with more findings.

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