ISCTE Business School
Instituto Universitário de Lisboa

Strategic Management

about how to struggle for Survival and Sustainable Development for JA Solar

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Project submitted as partial requirement for the conferral of

Master in Management

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Oct., 2013

ISCTE Business School
Instituto Universitário de Lisboa

Strategic Management about How to Survive and Sustainable Development for JA Solar

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Abstract

Solar PV experienced the enormous development in 2010 & 2011, aggressive capacity built-up, especially in China, led to excessive production capacity and supply as well as the intense competition, drove prices falling further and made the margins smaller and smaller for manufacturers in 2012.

Established on May 18, 2005, JA Solar is a leading manufacturer of high-performance PV wafers, cells and modules. JA Solar was fast expansion from 2005 to 2011 with 4 global sales offices, 6 factories and 2 R&D centers in China. Since surplus supply, falling price, extreme competition, JA Solar met the challenges. In addition, 29.18% of anti-dumping and anti-subsidy taxes carried out in USA in 2011 for the Chinese PV products exporting to USA market. Moreover, anti-dumping and anti-subsidy extended to Europe… JA Solar is suffering a lot from the heavy pressures and struggles to survive.

Firstly, this thesis indicates the data collects of the global PV market situation, including Europe, Asia-Pacific (APAC) region (Except China), the Middle East & North Africa (MENA) region & Africa and PV market situation in China at the end of 2012, briefly presents JA Solar and the bottleneck problems they faced. Secondly, the case study of JA Solar, focus on environmental analysis, including macro-environment, sector, main markets & competitors' analysis. Thirdly, offers the internal analysis, consisting of the competitive advantage and SWOT analysis.

Finally, goes ahead the TOWS analysis and propose the strategic choices for survival and sustainable development for JA Solar.

Key words: Solar PV, PV, Strategic Management, Sustainable Development.

JEL Classification: Business Administration M1, International Economics F2

Resumo

A energia solar fotovoltaica teve um enorme desenvolvimento em 2010 e 2011. O aumento substancial da construção de unidades fabris, sobretudo na China, levou a um aumento excessivo da capacidade de produção e da oferta, bem como a uma intensificação da concorrência. Consequentemente, os preços e as margens dos fabricantes têm vindo a descer significativamente.

Inaugurada a 18 de Maio de 2005, a JA Solar é um dos principais produtores de "wafers", células e módulos PV de elevada performance. A JA Solar teve uma rápida expansão entre 2005 e 2011, chegando aos quarto escritórios de vendas internacionais, seis fábricas e dois centros de Investigação e Desenvolvimento na China. Com o acumular do excesso de produção, a queda dos preços e a concorrência agressiva, a JA Solar começou a sentir os desafios do sector. Em 2011, os Estados Unidos impuseram 29.18% de impostos aos produtos PV importados da China, como uma medida anti-dumping e por forma a fazer frente aos subsídios de que os fabricantes chineses beneficiavam. Mais tarde, estas medidas anti-dumpig e anti-subsídios começaram também a ser implementadas na Europa. Estas medidas revelaram-se uma pressão enorme para a JA Solar que enfrenta grandes dificuldades para sobreviver.

A presente tese foca-se, em primeiro lugar, em dados recolhidos sobre a situação do mercado global de PV, incluindo na Euroa, Ásia-Pacífico (APAC, excluindo a China), Médio Oriente e Norte de África (MENA) e África. É também descrita a situação do mercado Chinês de PV, relatando o caso da JA Solar e os seus problemas de "bottleneck". Em Segundo lugar, é apresentado o caso de estudo da JA Solar, com um foco na análise do ambiente macro, do sector, dos principais mercados e da concorrência. Em terceiro lugar é apresentada a análise interna, que consiste na análise das vantagens competitivas e na análise SWOT. No final, é explicada a análise TOWS e uma proposta de escolhas estratégicas para sobrevivência e desenvolvimento sustentável da JA Solar.

Palavras-chave: Energia Solar Fotovoltaica, PV, Gestão Estratégica, Desenvolvimento Sustentável .

Classificação JEL: Administração de Empresas M1, Economia Internacional F2

Acknowledgements

Firstly of all, I would like to express my sincere thanks to ISCTE Business School and University of Electronic Science and Technology of China (UESTC). Since project cooperation between two universities, as an exchange student, I am honoured to come to Lisbon, enjoyed 1.5-year studying in ISCTE and experienced the special and different life in Portugal.

Secondly, I am deeply appreciated my supervisor, Professor, Nelson Antonio. He is a kind and friendly gentleman with the patience, not only achieved the academic attainment, but also became the experts in term of the Chinese culture and education. In spite of his busy job, he is willing and generous to provide the guidance of my thesis.

Thirdly, I am particularly grateful to Professor Virginia Trigo for her kindly help for my visa preparation and my staying in ISCTE. She is so nice to care my studying and help to solve the problems I met.

Moreover, I am so heartfelt appreciated Prof. Pedro Falcao for his provider to upgrade me to the unique energy MBA program, so that I have the opportunity to learn a lot of knowledge about energy area.

In addition, thanks a lot for all the professors presented my courses and the project managers, thanks their hardworking and instructions to me.

Meanwhile, I am thankful all the classmates with their kind friendship and help during my studying and staying.

Finally, I want to express my special acknowledgement to my family, thanks their supports to my studying abroad.

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List of Abbreviations

JA Solar: JA Solar Holdings Co., Ltd.

REN 21: Renewable Energy Policy Network for the 21st Century

EPIA: European Photovoltaic Industry Association

PV: photovoltaics

BIPV: Building-integrated photovoltaics

W: Watt

GW: gigawatt (1GW=1000MW=1,000,000 KW)

MW: megawatt (1MW=1000 KW)

KW: kilowatt

MT: metric ton (1MT = 1000 KGS)

FiT: feed-in tariff

Chapter 1 Overview

1.1 Research Background

With the limitation of the traditional energy, such as fossil fuels, and warmer climate, more and more organizations, companies and people concerns about the renewable energy. Solar PV has the characteristics of unlimited resource of solar energy, availability everywhere in the world, no air emissions and more than 20 years technical lifetime, became one of the major renewable energy and the number-one renewable source of electricity generation in Europe covering 2.6% of the electricity demand and 5.2% of the peak electricity demand nowadays.

1.1.1 Research background -PV all over the world

Though it is still a good year for solar PV installers, distributors and consumers in both 2011 and 2012, PV cell and module manufacturers are very hard to struggle for survival as they are difficult to make the profit due to excessive supplying compared to the demand and the falling price. Aggressive capacity built-up in 2010 and 2011, especially in China, led to excess of production capacity and supply as well as the intense competition, drove prices falling further in 2012 and made the margins smaller and smaller for manufacturers.

The average price of crystalline silicon solar modules was down by 30% or more only in 2012 while PV system prices are also falling, although a little slower and vary as per the different locations. From the 2nd quarter 2008 to the same period in 2012, German residential PV system costs fell from USD 7.00/W to USD 2.20/W, price lower by 3 times; by contrast, average prices in U.S.A was down to USD 5.50/W.

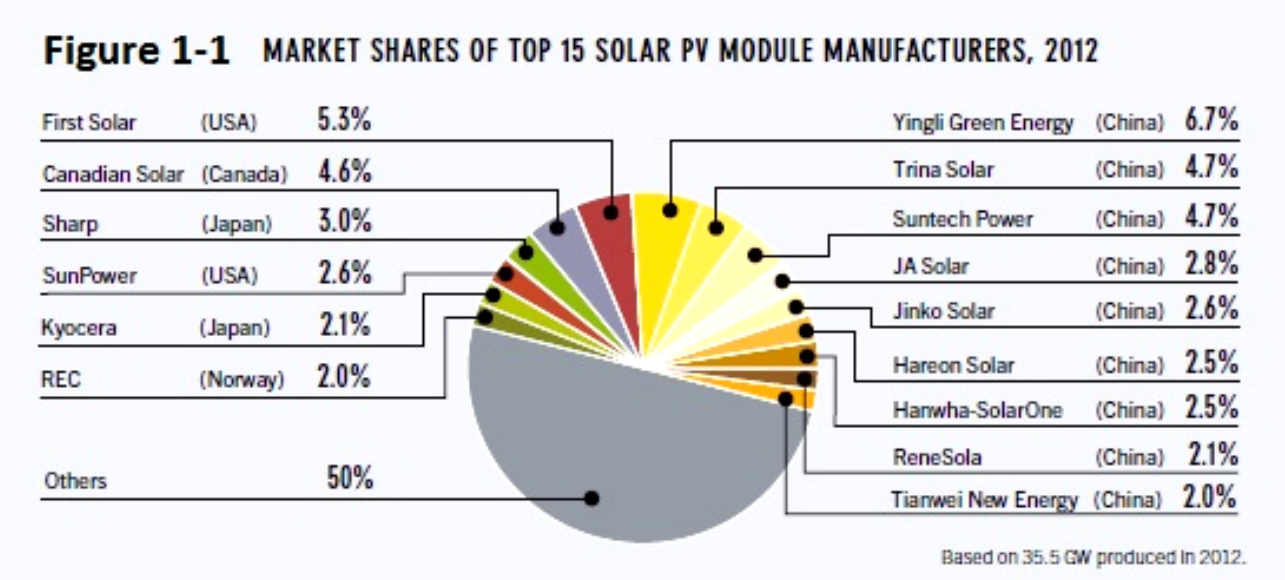
Approximately 31.9 GW of crystalline silicon cells and 35.5 GW of modules were produced in 2012, slightly went down from 2011. In spite that many factories were closed, module production capacity increased by more than 10 GW in 2012 (from below 60 GW in 2011 to over 70 GW at the end of 2012). China’s manufacturing capacity alone exceeded the demand in global market. Just to compare 2010 and 2011, about 33.1 GW of

crystalline silicon cells and 34.8 GW of modules were produced in 2011, while about 21.2 GW and 20.5 GW, respectively, in 2010.

The leadership in module manufacturing transited from the United States, to Japan, then to Europe, finally to Asia during the past decade. By 2012, Asia occupied 86% of global production (up from 82% in 2011), with about 67% produced in China alone. European share continued to drop from 14% in 2011 to 11% in 2012, Japanese share fallen from 6% to 5% and the U.S. share remained at 3%.

1.1.2 Research background – PV in China

As what I mentioned above, Chinese PV manufacturers are suffering a lot by the excessive production capacity, surplus supply, dropping price& little profit and extreme competition because of enormous investment into PV solar sector. China's manufacturing capacity alone exceeded the overall global market demand. Even the leading Chinese companies, for example Yingli and Trina, had the idle plants and struggled to stay afloat.



Source: GLOBAL STATUS REPORT，Renewables 2013, REN21 c/o UNEP

In 2012, there are 9 companies from 15 top solar PV module manufacturers are from China, producing about 10.86 GW, accounting for 30.86% of global modules (35.5 GW). Yingli (China) jumped ahead of both First Solar (USA) and Suntech (China) and ranked

first position, Suntech fell to fourth after Trina Solar (China). Much shifting in the ranks among the other top players, details are as following figure. (Please see Figure 1-1)

In May 2012, USA announced the new policy to take 29.18% minimum of anti-dumping and countervailing duty for the PV cells and modules from China because Solyndra (USA), Evergreen Solar and Spectra Watt announced bankrupt in 2011. This new policy means USA market is almost close to the Chinese PV factories as Chinese PV cells and modules are not competitive in price with the duty and tax inclusion.
Moreover, the anti-dumping and countervailing duty was extended to Europe…

The current consumption of PV products in the Chinese domestic market is less than 10% of the manufacturing capacity. Moreover, most of them are the government's behavior, this means government provided the subsidies and incentives to the projects to support the solar PV industry.
In addition, till now the main market of the Chinese PV products is still oversea markets, especially European markets, exporting up to 90% or more of the whole PV production capacity in China. Meanwhile most of equipments & machines and some silicon raw material are imported from USA and European Countries. The high dependence degree to overseas markets made the China PV industry in trouble.

By the end of 2012, 10 Chinese largest manufacturers borrowed about 20 billion USD from the Chinese state-owned banks. Under 8 Chinese Bank's pressure, Wuxi Suntech Solar (the subsidiary under Suntech Power Holdings Co., STP), the number one of market share among Chinese PV manufacturers in 2011, declared to bankruptcy on 21. Mar. 2013. According to the report, Wuxi Suntech Solar owed the debt up to 2 billion USD.

1.1.3 Brief Introduction of JA Solar & the difficulties faced

Established on May 18, 2005, JA Solar is a leading manufacturer of solar PV cells, modules and wafers, which convert solar radiation into electricity for residential, commercial, and utility-scale power generation. Based in Shanghai headquarter with six manufacturing operations in China, JA Solar is dedicated to manufacture, design and

develop the PV cells and modules worldwide under the brand name “JA Solar” and committed to develop and provide high efficiency renewable energy to relieve the limitation of traditional energy resources.

In April 2006, JA Solar started the mass production of solar cells.

On February 7, 2007, JA Solar was publicly listed on NASDAQ (NASDAQ: JASO).

Since 2009 JA Solar expanded the business to downstream of value chain, the PV modules, including mono-crystalline and multi-crystalline PV cells & modules.

In the fourth quarter of 2009, JA Solar also began to manufacture silicon wafers, went to the upstream of value chain, to achieve more vertical integration.

In 2011, JA Solar acquired all the shares in Silver Age Holdings Limited, (abbr. Silver Age), who owns 100% share of Solar Silicon Valley Electronics Science and Technology Co., Ltd., (abbr. Solar Silicon Valley), a leading producer of mono-crystalline silicon wafer based in Sanhe, Hebei Province, China. By this acquisition, JA Solar further boosted the wafer manufacturing capability to ensure the wafer supply and reduce the costs and meet the group’s internal demand. By December 31, 2012, JA Solar had a silicon wafer manufacturing capacity of 1.0 GW per annum.

By 2010, JA Solar became a leader in solar cell production and shipments all over the world. In 2011, the company shipped 1.69 GW, an increase of 15.8 % with 1.46 GW shipped in 2010. According to the annual industry report published by SolarBuzz in March 2012, JA Solar ranked first in China and second globally in terms of cell production in 2011.

By December 31, 2012, JA Solar had the cell manufacturing capacity of 2.5 GW per annum; moreover, the average conversion efficiency rates of mono-crystalline and multi-crystalline solar cells were 19.15% and 17.5%, respectively. As we know, the performance of solar cells is primarily measured by the conversion efficiency rate, which means the percentage of sun radiation converted into electricity.

JA Solar sold 1.46 GW, 1.69 GW and 1.70 GW of PV cells and modules, respectively, in 2010, 2011 and 2012. Though the sales quantity is increased, total revenues was decreased from RMB11.8 billion in 2010 to RMB10.7 billion in 2011 and RMB6.7 billion (equal to US$1.1 billion) in 2012 as worldwide solar market condition deteriorated and

due to a decline in the average selling price per watt of PV products. The average unit selling price (per watt) of PV cells decreased from 8.7 RMB in 2010 to 5.7 RMB in 2011 and 2.8 RMB in 2012, meanwhile the average selling price (per watt) of PV modules decreased from 11.5 RMB in 2010 to 8.9 RMB in 2011 and 4.5 RMB in 2012.

With an effort to vertically integrate the up and downstream of PV value chain, JA Solar began to provide EPC service in the third quarter of 2011, which broadening the customer bases and diversify the revenue incoming. Moreover, new technology innovation and product differentiation is crucial and increasingly important for JA Solar.

1.2 Research Issues and framework

1.2.1 Research Issues and Objective

As mentioned above, JA Solar not only faced the excessive production capacity, surplus supply, dropping price & little profit and extreme competition, but also the heavy pressure of anti-dumping & and countervailing tariff in both USA and European market.

The big challenge faced by JA Solar is how to struggle to survive under the heavy pressure of anti-dumping & and countervailing duty in both USA and European market? How to have technical innovation and reduce the cost to differentiate the products from the competitors and to explore more markets in both international and domestic markets? How to reduce the various kinds of risks to maximize the profit for survival and sustainable development? How to have the competitive advantages to keep the major player in this industry? What's the long-time and short-time strategic goal for JA Solar to keep advanced during the fierce competition? Diversified further both up- and downstream for the industry value chain?

To find out the solutions and alternatives to these questions are the main objective of this thesis.

1.2.2 Research contents and framework

This thesis takes the theory of strategy management as a basis, through collecting the data in the global PV market, including Europe, Asia-Pacific (APAC) region (except China), the Middle East & North Africa (MENA) region & Africa, then PV market situation in China at the end of 2012; Briefly presents JA Solar and the bottleneck problems they faced, combines with the case study of JA Solar, focus on environmental analysis and the internal analysis, including macro-environment, sector, main markets & competitors' analysis, competitive advantage and SWOT analysis. Finally, goes ahead the TOWS analysis and propose the strategic choices for survival and sustainable development for JA Solar.

The structure of the thesis is as follows,

Chapter 1, introduces the research background and brief presentation of JA Solar, then comes up with the research issues and puts forward to the outline of the framework and research method.

Chapter 2 is the relevant theoretical literature review about the strategic management.

Chapter 3 is consists of the global PV market and industry situation at the end of 2012, including in Europe, Asia-Pacific (APAC) region (except China) and American, then introduces the PV market & industry situation in China.

Chapter 4, presents the JA Solar and the case study of JA Solar, from the environmental analysis of JA Solar, including analysis of Macro-Environment (PESTEL Framework), analysis of the Sector (Five Force framework), main markets analysis, main Competitors Analysis, to the internal analysis, including competitive advantage and SWOT Analysis; then conclude the current business model.

Chapter 5, proceeds TOWS analysis, proposes the strategic choices of JA Solar, including the business-level Strategy and corporate-level strategy choices, updates the revised new business model.

Chapter 6, makes the conclusion, clarifies the limitation of this thesis and provides the suggestions for future study.

1.3 Research Methodology

The thesis takes the theory of the strategy management as a basis.

Firstly, through data collection and analysis methods, presents the global PV market & industry situation and PV market & industry situation in China by the end of 2012.

Secondly, provides the environmental analysis of JA Solar, including PESTEL analysis of Macro-Environment, five force framework analysis of the Sector, main markets & major competitors' analysis.

Thirdly, offers the internal analysis of JA Solar, including the competitive advantage analysis, SWOT analysis and conclude the current business model.

Finally, puts forward to TOWS analysis and propose the strategy choices for survival and sustainable development for JA Solar, update the revised new business model.

Chapter 2 Relevant Theoretical Literature Review

- Strategy Management

Gerry Johnson, in Exploring Corporate Strategy with My Strategy Lab: Text and Cases, Financial Times/Prentice Hall; 8 edition, referred that “Strategic management includes understanding the strategic position of a organization, making strategic choices for the future, and managing strategy in action”.

Wheelen, T.L. e J.D. Hunger (2008), Strategic Management and Business Policy, 11th edition, Pearson Prentice-Hall, referred that “Strategic Management is a set of managerial decisions and actions that determines the long-run performance of a corporation”.

Strategic management is a level of managerial activities, analyzing resources and performance in both internal and external environments, assessing the competitors and markets, specifying the mission, vision and objectives within the organization or company, setting goals and tactics to meet all existing and potential competition, making managerial decisions and actions that determine the long term performance of a business enterprise, providing overall direction to the enterprise developing policies and plans, and then allocating resources to implement the policies and plans, projects and programs, then reevaluates each strategy annually or quarterly or regularly to determine how it has been implemented and whether it has succeeded or needs replacement by a new strategy to meet new technology& entrants or competition, or changing economic or social, financial, or political environment."

As the matter of fact, the strategic management drew from earlier thought and texts on “strategy” dating back thousands of years, originated in the 1950s and 1960s. Among the numerous early contributors, the most influential were Philip Selznick, Alfred Chandler, Igor Ansoff, and Peter Drucker, with the following details,

- In 1957, Philip Selznick put forward to have the organization's internal factors match with the external environment. This main idea was formatted into what we now call SWOT analysis by Learned, Kenneth R. Andrews, and others at the Harvard Business School General Management Group. Strengths and weaknesses of the company are evaluated as per the opportunities and threats in its external environment.
- Alfred Chandler emphasized the importance of coordinating management activities under an overall strategy. The managers handle the interactions between functions and spread information back and forth between departments. Moreover, Chandler also stressed the

significance on taking a long-run perspective. In his great work Strategy and Structure in 1962, Chandler indicated that a long-term coordinated strategy was necessary to provide a company structure, direction and focus. Briefly said “structure follows strategy.”

- Based on Chandler's contribution Igor Ansoff added concepts and invented a vocabulary by development a matrix which compared strategies for market penetration, product development, market development and horizontal and vertical integration and diversification.
- Peter Drucker was a prolific strategy theorist and author of dozens of management books during his whole career spanning five decades. He stressed on targeting well-defined objectives is valuable to management which evolved into his theory of management by objectives (MBO). According to Drucker’s theory, the procedure of objectives setting and progress monitoring towards them should permeate the entire organization.

Strategy theorist Michael Porter argued the strategy target either cost leadership, differentiation, or focus. Porter claimed that a company must only choose one of these three, otherwise, the business would waste precious resources. These are well known as Porter's three generic strategies and can be applied to any size or form of business.

W. Chan Kim and Renée Mauborgne declared, through creating a Blue Ocean Strategy that breaks the trade off by pursuing both differentiation and low cost, an organization or company can achieve high growth and profits

In 1985, Ellen-Earle Chaffee summarized the main elements of strategic management theories by the 1970s with the details as follows,

- Strategic management covers the organization adaptation to its business environment.
- Strategic management has the characteristics of with fluidity and complexity. Changing world creates the ongoing and up-to-date combinations of circumstances which requiring unstructured non-repetitive responses.
- Strategic management has the effects on the entire organization by offering guidance.
- Strategic management involves not only the strategy choices, but also the detailed implementation.
- Strategic management is partially planned, but partially unplanned.
- Strategic management consists of several levels, including the overall corporate strategies, business strategies and international strategies, etc.
- Strategic management is related to both conceptual and analytical thought processing.

Chapter 3 Global PV Market Situation

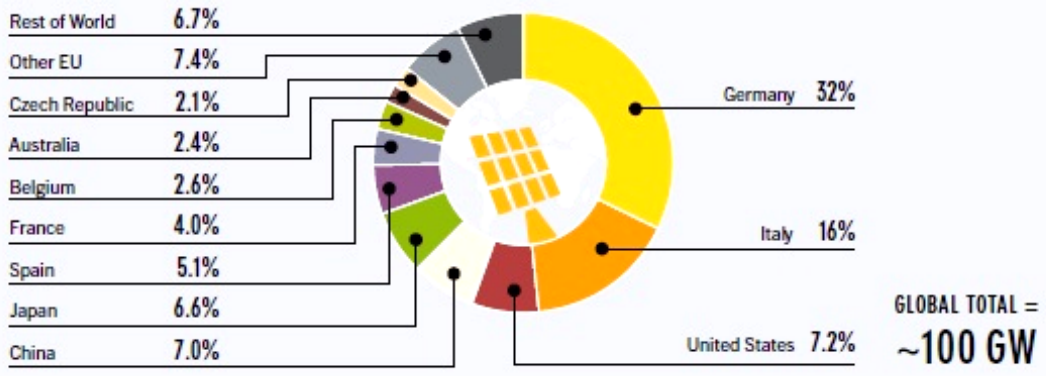
3.1 Global PV Market Situation at the end of 2012

The solar photovoltaic (PV) market has developed during the last decade at a significant fast rate, even during the struggling financial crisis since 2006, is always on the way to be a main source of power generation all over the world. Overall global cumulative operating capacity is reaching the great milestone, up to 100 GW in 2012.

Moreover, PV system price has reduced by more than 50% during the past 5 years, making the big contribution for PV on the way to competitiveness in some markets segments and in some countries.

Driven by adequate Feed-in-Tariffs or the other policy incentives and the price reduction, PV market has progressed rapidly accordingly in many countries in Europe and began to expansive growth outside of Europe, from global cumulative installed PV capacity less than 3 GW in 2003 to approaching 24 GW, 40.7 GW and 71.1GW, respectively, at the end of 2009, 2010 and 2011 and climbing up to 100 GW installed globally in 2012, an amount enabling to generate more than 110 TWh of electricity every year, which is sufficient to support annual electricity supply requests of over 30 million European households. (Please see figure 3-1).

Figure 3-1: Solar PV Global Capacity, Share of Top 10 Countries, 2012

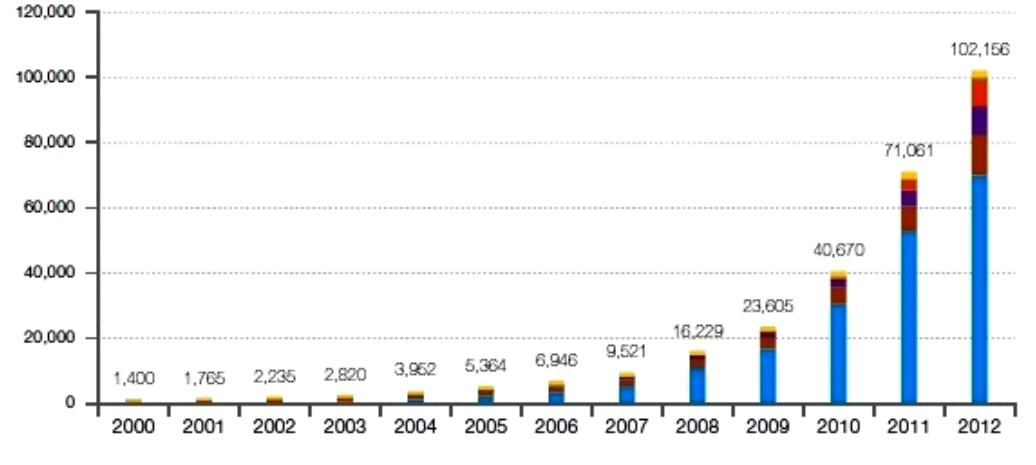


Source: GLOBAL STATUS REPORT，Renewables 2013, REN21 c/o UNEP

In terms of cumulative installed capacity, Europe remains the global leading zone with more than 70 GW by 2012, which represents about 70% of the cumulative PV capacity worldwide. Followed by China (8.3 GW) and USA (7.8 GW), Japan (6.9 GW). Many markets outside Europe, especially in China, USA and Japan, as well as Australia (2.4 GW) and India (1.2 W), only indicated a very small percentage of their enormous potential; several countries from large Sunbelt regions, including Middle East, Africa, Latin America and South East Asia, are on the way to start their development. However, the cumulative installed capacity outside Europe was up to 30 GW by 2012, providing the possibility of the ongoing rebalance between Europe and the rest of the world in future. (pls see figure 3-2 & 3-3 &3-4)

- Figure 3-2 indicates evolution of global PV cumulative installed capacity from 2000 to 2012.
- Figure 3-2 shows evolution of global PV annual installment from 2000 to 2012.
- Figure 3-4 illustrates global PV cumulative installed capacity share in2012.

Figure 3-2: Evolution of global PV cumulative installed capacity 2000-2012 (MW)

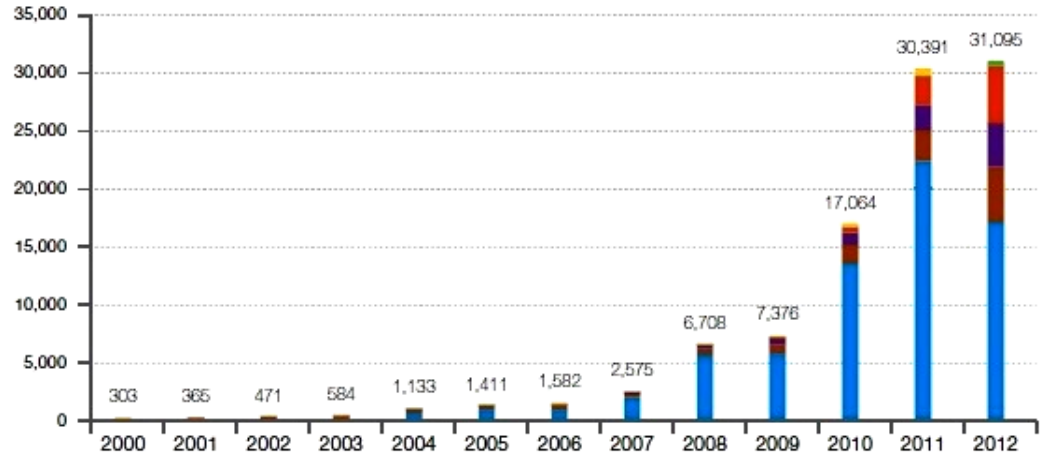


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ROW	751	807	887	964	993	1,003	1,108	1,150	1,226	1,306	1,590	2,098	2,098
MEA	n/a	n/a	n/a	n/a	1	1	1	2	3	25	71	192	601
China	19	24	42	52	62	70	80	100	140	300	800	3,300	8,300
Americas	146	178	225	290	394	501	650	863	1,209	1,752	2,780	4,959	8,717
APAC	355	495	686	916	1,198	1,500	1,825	2,096	2,631	3,373	4,956	7,628	12,397
Europe	129	262	396	598	1,305	2,289	3,281	5,310	11,020	16,850	30,472	52,884	70,043
Total	**1,400**	**1,765**	**2,235**	**2,820**	**3,952**	**5,364**	**6,946**	**9,521**	**16,229**	**23,605**	**40,670**	**71,061**	**102,156**

ROW: Rest of the World. MEA: Middle East and Africa. APAC: Asia Pacific.

Source: EPIA. Global Market Outlook for Photovoltaics 2013-2017, 2013

Figure 3-3: Evolution of global PV annual installations 2000-2012 (MW)

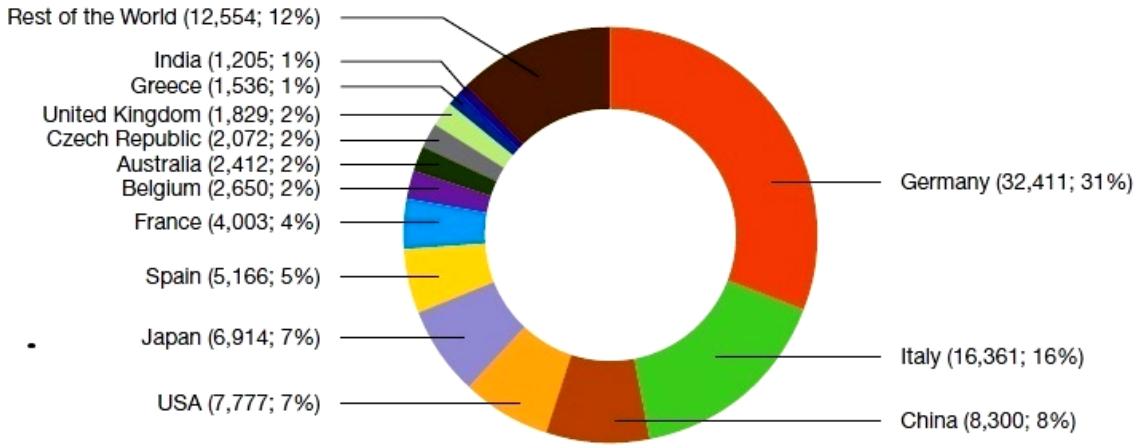


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ROW	88	56	80	77	29	10	105	42	76	80	284	508	-*
MEA	n/a	n/a	n/a	n/a	1	n/a	n/a	1	1	22	46	121	410
China	19	5	19	10	10	8	10	20	40	160	500	2,500	5,000
Americas	24	32	47	66	104	106	150	213	346	543	1,029	2,179	3,758
APAC	117	140	191	230	282	303	324	271	535	742	1,583	2,672	4,769
Europe	56	133	135	202	707	984	992	2,028	5,710	5,830	13,622	22,411	17,159
Total	**303**	**365**	**471**	**584**	**1,133**	**1,411**	**1,582**	**2,575**	**6,708**	**7,376**	**17,064**	**30,391**	**31,095**

ROW: Rest of the World. MEA: Middle East and Africa. APAC: Asia Pacific.

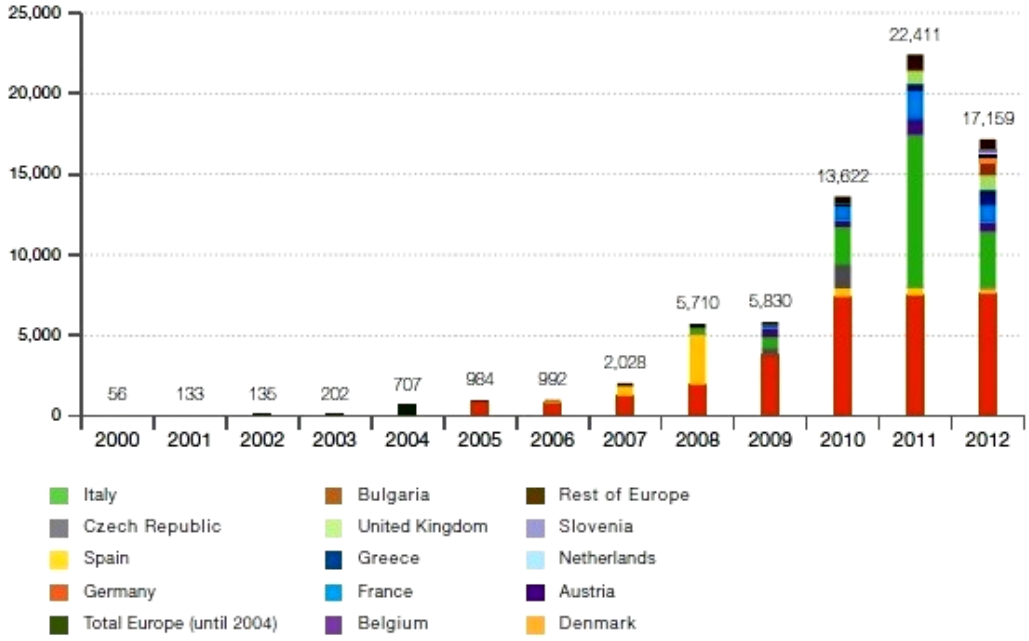
Source: EPIA. Global Market Outlook for Photovoltaics 2013-2017, 2013

Figure 3-4: Global PV Cumulative Installed Capacity Share in2012 (MW; %)



Source: EPIA. Global Market Outlook for Photovoltaics 2013-2017, 2013

Figure 3-5: Evolution of European new grid-connected PV capacities 2000-2012 (MW)



Source: EPIA. Global Market Outlook for Photovoltaics 2013-2017, 2013

3.1.1 Europe

Europe was still the leading market with the recording-breaking performance of 22 GW in 2011, which is driven by the fast PV expansion in Italy and a high level of installations in Germany. But new installed capacities went down to 17 GW in 2012 (pls see figure 3-4), accounting for about 57% of newly installed capacity, this is the first PV market decline in Europe in terms of new connected capacity within the past 12 years, mainly due to reduced incentives, including FIT and general policy uncertainty. However, European PV market in 2012 still exceeded all of the expectation. (Please see figure 3-5)

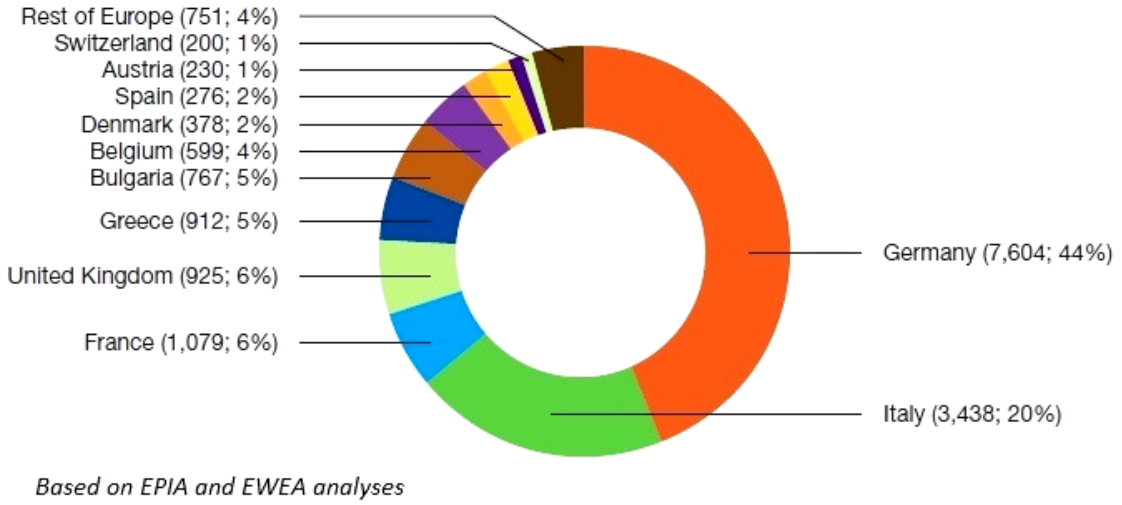
- **Germany:** the top PV market for 7th time in the last 13 years. In 2012, with 7.6 GW, accounting for 44% of European newly installed &connected to grid, slightly over the past two years, resulting in its total cumulative capacity to 32.4 GW, which is contributed by policymakers' continuous efforts to support the PV development and the progressive evolution in market. With PV's levelised cost of Electricity (LCOE)

lower than the price of retail electricity nowadays, at least in the commercial and residential segments in Germany, PV gradually became self-sustainable in 2012 and PV market growth can be partially driven by self-consumption rather than fully dependence on FIT. Solar PV generated 28 TWh of electricity during 2012, up 45% compared to 2011.

- **Italy:** reached a cumulative capacity of 16.4 GW, but 3.4 GW, accounting for 20% of PV connected to the grid in 2012, significantly reduced compared to the major boom in 2011 of 9.45 GW. Having reached the limited FIT financial support, the Italian market will experience the transition from FIT to the post-FIT era, quite faster than all of expectation.

- **France**: scored third rank among European countries in 2012 with 1.08 GW, 6% of PV annual capacities in Europe, mainly contributed by the previous installments but finally being connected to the grid in 2012 together with a limited benefit from new installations. However, compared to 2011 of new 1.76 GW installed, France is still performing lower than its theoretical potential.

Figure 3-6: European PV Market Split in2012 (MW; %)



Source: EPIA. Global Market Outlook for Photovoltaics 2013-2017, 2013

- **United Kingdom**, 925 MW installed in 2012. Even the market growth speed is not impressive, the long-term prospects still quite positive.
- **Greece**, installed 912 MW in 2012, a record level hit by an extremely hard financial recession. Then 2013 is expected to be a good year as well in spite of more restrictive conditions.
- **Bulgaria** undergone a boom in 2012 of 767 MW installments, six-fold capacity rise. But the government reacted with harsh negative policy to slow down the market growth; the market in 2013 will probably quite reduced.
- **Belgium** installed 599 MW, a quite high level, with Wallonia's impressive 269 MW installments in the residential segment market. However, strong political concern over the cost of support schemes will lead to a relatively low market in 2013.
- **Denmark,** big surprise of 378 MW installments, but the boom could be stopped in 2013.
- **Spain**, the government imposed an unexpected moratorium on FITs, crippled the PV market, only 276 MW were connected to the grid in 2012 in Spain, who should be the European leaders. The long-time expected net-metering scheme hasn't introduced by now and there are doubts whether it ever will be. The rumor said the government is afraid to create another boom.
- **Austria** installed 230 MW and **Switzerland** 200 MW, both contributed a little bit to market development, even if the capacities they reached are the efforts of main market growth.
- **Ukraine** had the impressive development in 2011 with almost 190 MW connected, thanks to the construction of two very large power plants by one company. 182 MW were installed again in 2012 and the potential remains interesting.
- **The Czech Republic** finally installed 113 MW, a more important achievement than expected, but very far from the booming levels in 2009 and 2010.
- **Slovakia,** undergone a relative boom at the end of 2011 and the first semester of 2012, then went down to only a few megawatts while the market in Slovenia grew once again, this time to 117 MW.
- **Romania,** brought only 26 MW in 2012, but it is expected the market will be grown in

2013 and indicates a certain untapped potential.

- **Poland,** failed to fulfill expectations in 2012 and the prospects for 2013 remain weak.
- **Russia** remains quite low with only a few megawatts installed and little perspective on the short term.
- **Sweden** sees each year some megawatts being installed but without significant policies and prospects.

3.1.2 Asia-Pacific (APAC) region (Except China)

Regionally, the Asia-Pacific (APAC) region followed Europe, including Japan and China (will talk about China particularly in the following sector), Thailand, Korea, Taiwan and Australia.

- **Japan**, an estimated 2 GW to the grid in 2012, accounting for 14% PV Market share outside Europe in 2012 (please see the figure 3-6). Total capacity rose 35% to over 6.6 GW by the end of 2012, **d**riven by the new feed-in tariff (FIT), solar PV accounted for 90% of capacity certified in the FIT system. The rapid demand increase has led to significant investments in PV and the rush into projects which pushed up land prices.

- **Australia,** expanded rapidly in 2012, with about 1 GW at the end of 2012, accounting for 7% PV Market share outside Europe in 2012 (please see the figure 3-6). By early 2012, an estimation that one in five houses in South Australia had roof-top PV.

- **India,** with capacity increasing more than five-fold to 980MW, accounting for 7% PV Market share outside Europe in 2012 (please see the figure 3-6). The notable development. Similar as some traditional European markets, beginning is a little slow, but the falling cheap PV system prices make it easier to compete with the conventional energy. The potential in future remains huge.

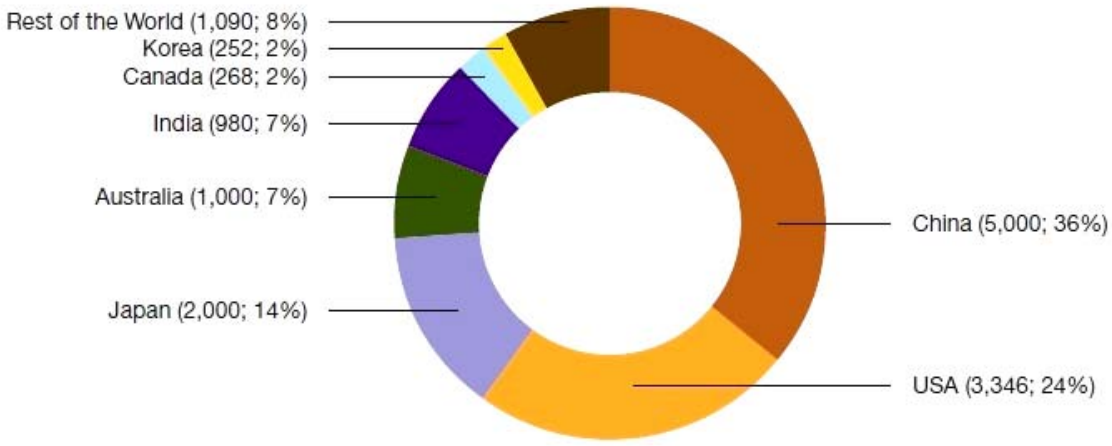
- **Korea,** 252 MW were installed in 2012.

- **Taiwan,** up to 104 MW. This is the first time 100-MW mark.

- **Thailand,** committed to 210 MW with a large pipeline projects,

- **Malaysia,** shown 22 MW new installments. In addition, there are several manufacturers in Malaysia.

Figure 3-7: PV Market share outside Europe in 2012 (MW; %)



Source: EPIA. Global Market Outlook for Photovoltaics 2013-2017, 2013

3.1.3 America

The third leading region is American, have USA and Canada, respectively accounting for 24% and 2% of PV Market share outside Europe in 2012 (please see the figure 3-6), together with the, and the large potential in South America.

- **U.S.A,** capacity came to 3.35 GW in 2012, about 85% more compared to 2011. California had more than 1 GW installments, a record year. On one hand, driven by falling price, innovative financing support and ownership models (such as solar leasing, community solar investments, and JA Solar as third-party financing), PV is spreading to more states. On the negative side, conflicts are emerging about net

metering in future, as utility concerns about future stranded costs of the current generating assets and relative infrastructure. Utility installations were 2.7 GW capacities by the end of 2012, accounting for 54% of capacity. In addition, more than 3 GW is under construction. Although utility procurement is slow, many utilities is trying to accessible to the Renewable Portfolio Standard (RPS) targets.

- **Canada,** steadily developed with 268 MW installments, but expanded slower than the expectation.
- **South America,** Mexico and Peru installed several megawatts. Driven by favorable incentive policies, demand in Latin America is transforming from small off-grid and niche applications to large-scale deployment in the commercial and industrial sectors, especially in Brazil, Chile, and Mexico, a big potential in future.

3.1.4 The Middle East & North Africa (MENA) region & Africa

Elsewhere, the Middle East and North Africa (MENA) region represents for the untapped prospect. In Africa, the electricity demands will increase heavily in the coming years and a number of projects popped-up, which will result in more installations in 2013 and after, indicating the great potential.

Israel remains the only country with the impressive market in the Middle East while **Saudi Arabia** indicated some interest in solar PV development in 2012, driven by rapidly increasing in energy demand, high radiation rates and the desire to free with more crude oil for export.

Namibia and South Africa, had large solar parks on line in 2012. The Chinese companies brought the building projects in at least 20 African countries, with the efforts to encourage the PV exporting business in China.

The Turkish market remains quite low at the moment in spite of its big potential in future.

3.2 Global PV Industry Situation at the end of 2012

Since the enormous investment and overcapacity of production line in PV industry, the string of failures and bankruptcies from many companies in PV industry began in 2011 and still continued in 2012 and 2013， merger and acquisition activities of restructuring among manufacturers was continued in 2012, even large global companies were suffering from the financing. More than 24 PV manufacturers in U.S.A have left the PV sector in past several years, about 10 makers in Europe and 50 producers in China exited business during 2012. 90% of Indian manufacturers closed or filed for debt reformation in India by early 2013.

In Europe, Bosch Solar (Germany) announced to halt producing cells and panels in 2014; Siemens (Germany) announced to go out of the PV business.

In USA, First Solar (USA) moved away from the residential market and transferred to develop of utility-scale PV plants. Both First Solar (USA) and SunPower (USA) had the next step to enter into the Chinese market. GE (USA) ceased their construction of thin film factory in Colorado and announced the decision to return to R&D; several other companies, including Skyline Solar (USA) and GreenVolts (USA), closed their doors and SolFocus (USA) made the decision to sell; but those companies still operated and invested increasing amount of money in building producing facilities in the emerging markets.

In Canada, Canadian Solar is shifting into project development and ownership.

In Africa, the first module-manufacturer (20 MW) in Ethiopia started to operate in the early 2013 and mainly supply to their domestic market.

In Asia, some Asian companies were busy buying next-generation of solar technology from U.S.A. Hanwha Group (South Korea) bought the bankrupt Q-Cells (Germany), the previous top module manufacturer in 2008. Panasonic (Japan) closed production lines and/or suspended plans for new factories; Trina Solar (China) became a provider of total PV solutions management;

Although some manufacturers had the idle production lines or closed, others opened the new facilities and aggressively looking for the new markets, especially in the developing

countries. In 2012, new plants located all over the world, from Europe to Turkey, Kazakhstan to Japan, and Malaysia to the United States.

But most companies remained in the established markets and invested in manufacturing processing improvement to reduce the cost, rather than R&D.

At the moment PV industry is in the phase of commercialization and several big challenges remain, including financing supports required to scale up projects and demonstrating continuous high yield without the sufficient research and development.

3.3 China PV Market Situation at the end of 2012

It is important to note that China climbed to third place in terms of total installed capacity in 2012, ahead of the USA and Japan, two pioneers of PV development before.

China has doubled its capacity in 2012, ending with about 7 GW installments, but still below expectations. By the fourth quarter, China accounted for more than a third of global panel shipments, in response to efforts from Germany government with the aim to create a market for the glut of domestic solar panels.

China market mainly dominated by off-grid and large-scale ground-mounted systems in the western of China which is far from load center. But national policies aim to encourage distributed & building-integrated projects as well.

However, the PV market developed is relatively slow in China, resulted in the in-equilibrium of supplying of PV products and demands from the domestic markets and more than 90% of PV products depends on the exporting business and has the high degree of dependence to the oversea market.

Return to the history, in 2002, the Chinese government carried out the “Electricity Plan to the Western Remote & Rural areas”, having the off-grid PV system and wind power to make these areas have the electricity to utilize. This project motivated the solar PV market in China, PV manufacturing in China started and fast developed.

In Oct, 2003, National Development and Reform Commission and Ministry of Science and Technology mapped out “5-year PV Development Plan” and National Development and

Reform Commission financed 10 billion RMB to promote the application of PV technology and scheduled to install the cumulative capacity of 300 MW PV systems by 2005.

In 2009, the government carried out the “Golden Projects”, through the economic scale of application to motivate the PV to be the main source of electricity generation and make it commercialization and technical development. The PV new installment was 632.229 MW of 275 golden projects in 2009 and 271.72MW of 85 projects in 2010.

In 2011, the government made policy to have the Fit price is RMB 1 to 1.15 RMB depends on the different projects and locations in order to motivate the PV manufacturers to build up the PV stations and promote the development of PV market and to create the market to consume the surplus PV panels.

In May, 2011, carried out the “930” project in Qinghai, offering FIT 1.15 RMB price connecting to the grid and there are 42 projects constructed, up to about 1GW installment capacity. It’s expected to have 1.1GW installments of BIPV projects or electricity generation in Qinghai by 2015, and expected to have annual output 100 billion RMB and make PV to the main industry by 2020.

According to the “China Renewable Energy Development Scheme”, the cumulative of solar power (including Solar Thermal Power) installment is up to 15GW by 2015 and 20GW by 2020. This is the main program and construction.

3.4 China PV Industry Situation at the end of 2012

As for the PV industry, although the PV industry was undergone the consolidation and integration in 2012, manufacturing capacity of module reduced by 25%, from 49GW in 2011 to 37GW in 2012.

In 2012, PV module manufacturing capacity is 37GW, accounting for 51% of global capacity, while actual manufacturing 22GW, taking up 54% globally; the manufacturing capacity of multi-crystalline silicone material climbed to 158,000MT, occupying 43% globally, while actual production 69,000MT, accounting for 32% of global capacity.

Anyway, in consideration to the demands in both China domestic market and the global market, it’s difficult to change the situation in short term that the supply is far more than the

demand. However, one pleasure fact is that 73% of manufacturing capacity coming from the top 20 factories in China.

In view of the past 10 years, PV industry was enormously developed, details as follows,

As I talked above, PV industry was motivated from 2002 in China. During 2002 to 2008, PV industry was enormously developed and the growth rate for the cell production capacity is by about 50%, accounting for from 1.07% of global market in 2002 to 15% in 2008. Main market is Spain, as Spain government carried out the generous solar PV subsidy policy and Spain was ranked firstly of PV consumer market instead of Germany in 2008, up to 70%-90% of PV cell sales from China.

In 2007, PV cell manufacturing in China exceeded than Germany and Japan, ranking the first. Main market is Germany from 2002 to 2007. .

In 2008, the manufacturing continuously increased, up to 2 GW, manufacturing capacity up to 3.3GW of PV cells, accounting more than 30% of the global capacity of 7GW.

From June 2008, the PV industry experienced from peak into the bottom because the financial crisis, the PV market was shrink because of the depressed markets and surplus supply. The price of multi-crystalline silicone material was reduced from US$ 428 per MT in the beginning of 2008 to $120 per MT at the end of same 2008 year, this resulted into more than 350 manufacturers in China went to bankrupt after Oct. 2008. The global leader factory, Wuxi Suntech, stopped the production in the four-quarter in 2008 and unemployed 1/3 of workers to reduce the cost.

In 2009, with the continuous incentive by the China policies, the PV sector developed to the certain extent, recovering from loss into profit in the 4-quarter, the capacity of PV cell is up to 4.3 GW, accounting for 40% of global capacity.

The production capacity of multi-crystalline silicone material in China is up to 4000 MT, 10,000 MT and 30,000MT, respectively, in 2008, 2009 and 2010.

In 2010, PV industry in China went to the peak season again after the short winter in 2009 driven by the German Fits policy. All the factories was crazy busy producing a lot of orders from oversea and manufacturing is up to their capacity and most of factory couldn’t deliver the products on time, so new expansion plans were carried out which resulted in the oversupplying in 2011 and 2012.

Chapter 4 Presentation and analysis of JA Solar

4.1 The Presentation of JA Solar

4.1.1 Core Value, Vision and Organizational Structure

Core Value

JA Solar is committed to create sustainable value by manufacturing high quality of solar PV products and technology innovation to efficiently and economically utility of sun radiation all over the world.

JA Solar core values are integrity, continuous emphasis on quality and passion for team work.

Vision

Make JA Solar leading supplier of PV solar products to the rapidly growing global renewable energy market.

Organizational Structure (Please see figure 4-1)

- · JA Hebei, established in May 2005 in Ningjin, Hebei Province, engaging in the manufacturing of solar cells;
- JA Fengxian, established in November 2006 in Fengxian, Shanghai, specializing in the manufacturing of solar modules;
- JA Yangzhou, established in November 2007 in Yangzhou, Jiangsu Province, engaging in the manufacturing of solar cells;
- · JA Yangzhou R&D, established in March 2009 in Yangzhou, Jiangsu Province, specializing in research and development of solar cell technology;
- · JA Lianyungang, incorporated in October 2008 in Lianyungang, Jiangsu Province, is engaging in the manufacturing of silicon wafers;
- · JA Yangzhou PV Engineering, incorporated in November 2009 in Yangzhou, Jiangsu Province, specializing in providing EPC services;

- · JA Wafer R&D, incorporated in November 2010 in Lianyungang, Jiangsu Province, specializing in R&D of silicon wafer technology;
- · JA Hefei Renewable Energy, incorporate in March 2011 in Hefei, Anhui Province, engaging in general investment and manufacturing of solar power products; and
- · JA Hefei Technology, incorporated in July 2011 in Hefei, Anhui Province, specializing the manufacturing of solar power products.
- In October 2011, established JA Solar Investment China Co., Ltd. for general corporate and investment purposes.
- In November 2011, JA Solar completed acquisition of 100% equity interest in Silver Age, which was then 70% owned by Jinglong BVI, our largest shareholder, the balance 30% owned by the third party. Silver Age owns Solar Silicon Valley, a leading producer of mono-crystalline silicon wafer based in Sanhe, Hebei Province, China.
- In January 2013, JA Solar completed the acquisition of 65% equity in Ningjin Songgong, is primarily engaged in production of solar grade mono-crystalline silicon ingot.

Figure 4-1: Organization of JA Solar

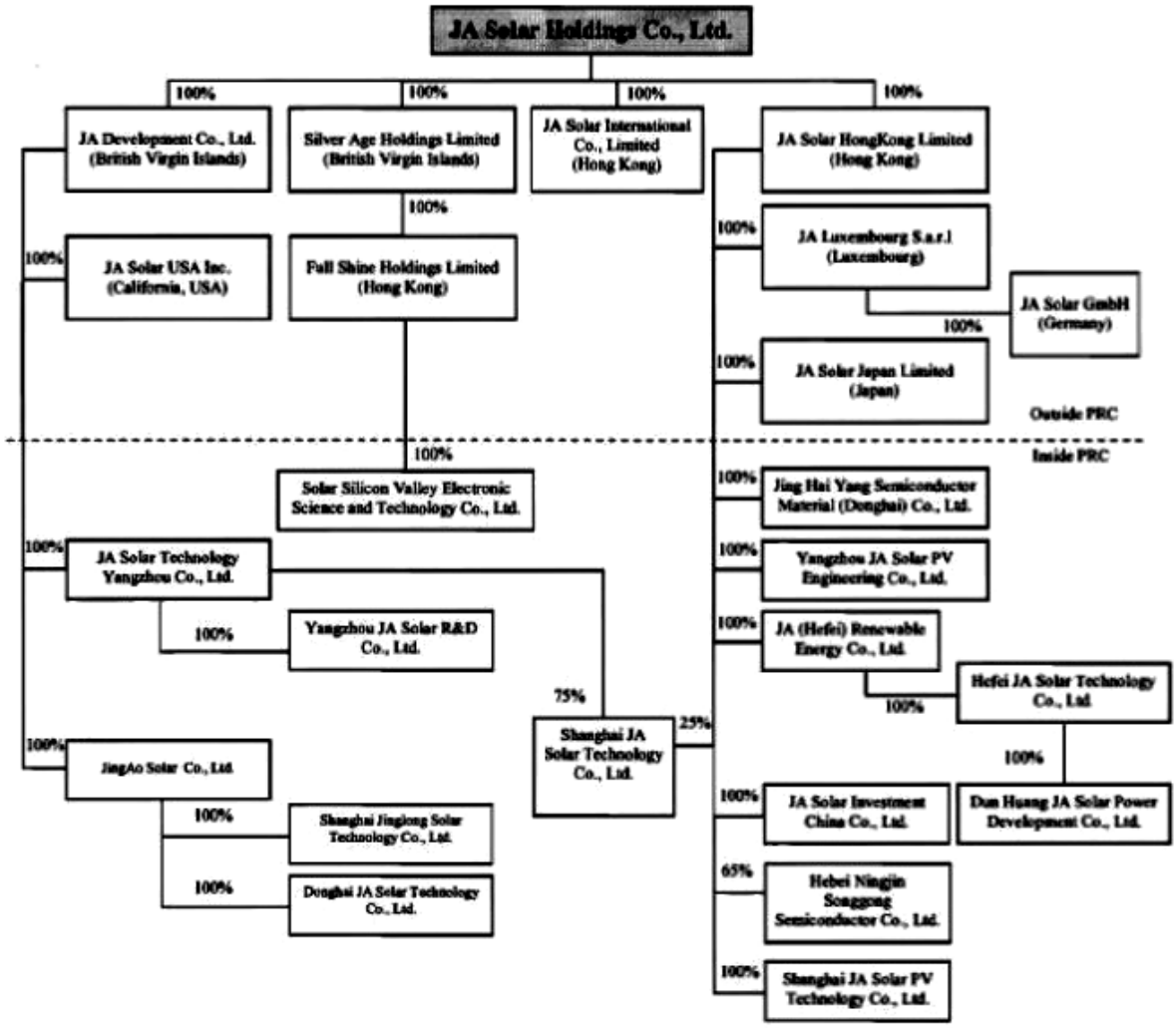
As of December 31, 2012, the Company's subsidiaries include the following entities:

	Date of Incorporation/Acquisition	Place of Incorporation	Percentage of Ownership
JingAo Solar Co., Ltd. ("JA Hebei")	May 18, 2005	PRC	100%
JA Development Co., Ltd. ("JA BVI")	July 6, 2006	BVI	100%
Shanghai JA Solar Technology Co., Ltd. ("JA Fengxian")	November 16, 2006	PRC	100%
JA Solar USA Inc. ("JA USA")	April 13, 2007	USA	100%
Shanghai JA Solar PV Technology Co., Ltd. ("JA Zhabei")	June 22, 2007	PRC	100%
JA Solar Technology Yangzhou Co., Ltd. ("JA Yangzhou")	November 19, 2007	PRC	100%
JA Solar Hong Kong Limited ("JA Hong Kong")	December 10, 2007	Hong Kong	100%
Jing Hai Yang Semiconductor Materials (Donghai) Co., Ltd. ("JA Lianyungang")	October 11, 2008	PRC	100%
JA Solar Yangzhou R&D Co., Ltd. ("JA Yangzhou R&D")	March 12, 2009	PRC	100%
JA Luxembourg S.a.r.l. ("JA Lux")	June 26, 2009	Luxembourg	100%
JA Yangzhou PV Technology Co., Ltd. ("JA Yangzhou PV")	November 23, 2009	PRC	100%
JA Solar GmbH ("JA GmbH")	February 17, 2010	Germany	100%
JA Solar International Co., Limited ("JA International")	May 28, 2010	Hong Kong	100%
Shanghai Jinglong Solar Technology Co., Ltd. ("JA Jinglong")	July 5, 2010	PRC	100%
Donghai JA Solar Technology Co., Ltd. ("JA Wafer R&D")	November 4, 2010	PRC	100%
JA (Hefei) Renewable Energy Co., Ltd. ("JA Hefei Renewable Energy")	March 30, 2011	PRC	100%
Hefei JA Solar Technology Co., Ltd. ("JA Hefei Technology")	July 8, 2011	PRC	100%
JA Solar Investment China Co., Ltd ("JA Investment")	October 31, 2011	PRC	100%
Silver Age Holdings Limited ("Siliver Age")	November 30, 2011	BVI	100%
Full Shine Holdings Limited ("Full Shine")	November 30, 2011	Hong Kong	100%
Solar Silicon Valley Electronic Science and Technology Co., Ltd. ("Solar Silicon Valley")	November 30, 2011	PRC	100%
JA Solar Japan Limited ("JA Japan")	July 12, 2012	Japan	100%
Dunhuang JA Solar Power Development Co., Ltd ("JA Dunhuang")	July 23, 2012	PRC	100%

(Source: 2012 annual report)

The following diagram illustrates corporate structure, including the principal subsidiaries.

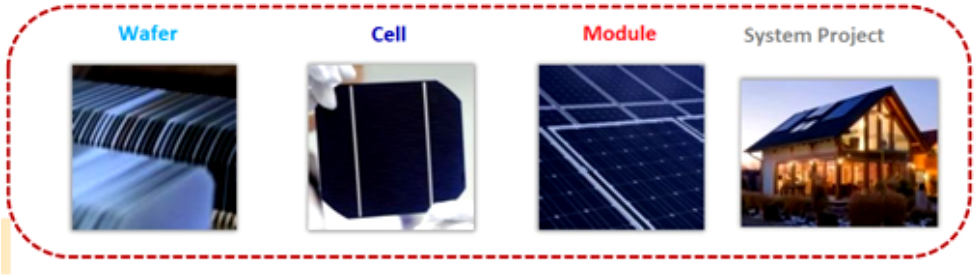
Figure 4-2: Corporate structure



(Source: 2012 annual report)

4.1.2 Main Products and Services

JA Solar primarily engaged in the design, development, manufacturing and sales of solar PV products based on crystalline silicon, including various kinds of cells and modules to meet the different requirements from the customers, from on-grid systems to off-grid systems, from commercial use to industrial utility, from residential to public utility use. In addition, JA Solar had the ability to manufacture as per the customers' requested specifications or artwork. Moreover, JA Solar can offer the processing trade services and EPC services for solar PV projects.



(1). Solar Cells

PV systems use the cells to convert the solar radiation into electricity. The cell consists of one or two layers of a semi-conducting material, when lights radiates on the cells, they create an electric field across the layers, causing the electricity to flow.

Cell is the elementary component of photovoltaic (PV) system, just looks like kinds of household battery.

The performance of a PV cell is measured by efficiency to convert sunlight into electricity. A typical commercial solar module has an efficiency of 15%, in other words, about one-sixth of the sunlight works in the system and converted into electricity. Therefore, efficiency improvement and cost reduction is the key to success in the PV industry.

JA Solar currently produce and sell a variety of mono-crystalline, multi-crystalline solar cells and the conventional solar cells.

JA Solar is dedicated to technology innovation and introduced a mono-crystalline solar cells named “SECIUM” in 2010, “MAPLE” in 2011, the new Cypress series in 2012, separately, which have higher and higher conversion efficiency each by each. Moreover, the Cypress series cells have the advantage of excellent weldability and lower encapsulation power loss contributed by high-voltage, low-current electrical performance parameters, elaborated current rating and positive tolerance/

(2). Solar Modules

A solar module is to assemble several solar cells together and form the panel with the interconnected electrical circuit and encapsulated by a lamination processing into a durable and weather-proof panel.

JA Solar produce both multi-crystalline and mono-crystalline PV modules ranging from 245W to 255W and from 260W to 275W, respectively. PV modules contributed about 55% of whole shipments in 2012.

(3). Silicon Wafers

Silicon wafers are the most important raw materials to produce solar cells, including mono-crystalline and multi-crystalline silicon wafers.

Currently JA Solar produce multi-crystalline silicon wafers with dimensions of 156*156mm & an average thickness of 180 microns and mono-crystalline silicon wafers with dimension of 125*125mm and an average thickness of 185 microns.

(4). Processing Trade Service

To maximize the utilization of the producing capacity, JA Solar can also provide the processing trade service. As per the different requests from the customers, JA Solar may make money only by the processing fee to manufacture the products with the material provided, or alternatively, JA Solar may purchase raw materials from our customers, such as poly-silicon or silicon wafers, to make the raw materials into solar cells or solar modules, and then sell back to the customers.

(5). Engineering, Procurement and Construction Services (EPC Services)

JA Solar are capable of PV project development, EPC services provider to the independent power project and systems owners, for example, public utility companies. Under the EPC agreement and the projects development, JA Solar is able to design the PV system, deploy the solar modules, procure the rest spare parts of system, construct the project system, and connect the system to the grid, all in one service.

To meet the customers' satisfaction and secure the market opportunities, JA Solar remain the ability to provide any combination of EPC service.

4.1.3 Management Team

- **Baofang Jin, Executive Chairman and Chief Executive Officer.**

Graduated from Hebei Broadcast and Television University in 1996, served as CEO since January 2003, Mr. Jin is keen on PV manufacturing for more than 10 years. Mr. Jin also serves as a vice-chairman of the Chinese People's Political Consultative Conference of Ningjin County.

- Min Cao, Chief Financial Officer.

Mr. Cao is CFO since July 2011, MBA graduate from Fudan University, he had rich experience in finance, capital and security.

- Jian Xie, Chief Operating Officer.

Mr. Jian Xie is chief operating officer since January 2010, master graduate from Guanghua School of Management at Beijing University in 2004, is good at corporate finance and investment banking.

- Yong Liu, Chief Technology Officer.

Mr. Yong Liu is the chief technology officer since December 2010, master graduate from University of Science and Technology of China, 12-year rich experience in semiconductor technology area and R&D.

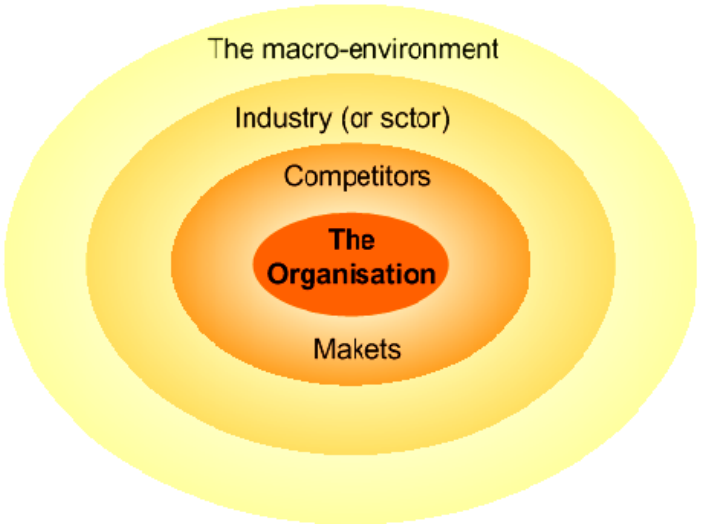
4.2 Environmental analysis of JA Solar

The environment is the base for the company, providing company the means of survival and development. It creates opportunities and it presents threats, as what is said "Opportunity always comes together with the risk."

So it's crucial to try the utmost to analyze the macro-environments as cautiously as possible to anticipate and reduce the risk of influence environmental change in spite that the future can never be predicted precisely and the environments keep changing and such complex.

This section offers frameworks to analyze the complicated and changing environment with a range of "layer" as the following figure,

Layer of business environment



- The macro-environment is the top-level layer, makes up of broad environmental factors which have the effect upon on JA Solar, more or less extent.

- Industry or sector, second general environment, consists of companies manufacturing the same or similar products and services.

- Competitors and markets are the closest and most proximate layer surrounding JA Solar. It's very important to identify the different kinds of competitors.

4.2.1 Analysis of Macro-Environment (The PESTEL framework)

The PESTEL framework indicates there are six main types, political, economic, social, technological, environmental and legal, have the impact on JA Solar, which provides a comprehensive list of influences of JA Solar.

To get a whole picture of the external factors, it is important to analyze how these factors are changing, drawing on the implications to JA Solar. Moreover, many of the factors are linked and joined together, simultaneously impacted each other.

- **Political**

Changes in international trade policies and business barriers may adversely affect the ability to export PV products to certain countries and customers, or import raw materials from certain countries.

(1) The U.S. Department of Commerce and the U.S. International Trade Commission announced that PV cells made in China, whether assembled into modules or not, together with the modules which exported to the U.S.A, would be subject to anti-dumping and countervailing taxes, with 29.18%, an average effective net rate, consisting in a net antidumping duty margin of 13.94% and a subsidy rate of 15.24%. JA Solar sold a small portion of PV cells and modules to the U.S. market, which contributed to 3.6% of total revenues in 2012. This policy will have the effect on JA Solar further exploration to USA market.

(2) In August, 2013, European Commission announced a decision to accept the undertaking offered by Chinese exporting producers of solar panels, as well as a regulation exempting these participating companies from the payment of provisional anti-dumping duties. As a result, those Chinese companies taking part in the price undertaking will be exempted from paying any anti-dumping duties on 6 August,

otherwise the companies still need to pay the anti-dumping duties that have been announced on 5 June 2013.

(3) Trade practices and barriers will have the negative influence on JA Solar.

(4) On 8 and 9 March 2007, the European Council adopted the ambitious environmental targets during the Copenhagen meeting so-called "20-20-20 targets", as follows,

To reduce emissions of greenhouse gases by 20% by 2020;

To increase energy efficiency to save 20% of EU energy consumption by 2020;

To reach 20% of renewable energy in the total energy consumption in the EU by 2020;

To reach 10% of bio fuels in the total consumption of vehicles by 2020;

To fulfill these goals, more and more organizations, companies and people pay more attention on the development of renewable energy, including the PV solar energy, this is promotion to the development of PV solar.

(5) The government policies and regulations, such as Fits, are different from countries to countries, resulted in the development of PV in the different countries are not in the same scenarios and steps. Please see the details in attachment “Annex-1”.

(6) The Middle East, Africa and North Korea are unrest and the possibility of a war in Iran, led to the volatility in oil and other markets.

(7) The tensions relationship between China and Japan is concerned to the influence to the PV business.

- **Economic**

(1) The global economic recession in 2008 had a negative effect on the JA Solar sales as PV deal is sensitive to the economy, some countries cancelled or decrease the incentive supports. The recovery from expression was uneven and faced new challenges, such as the European sovereign debt was increased in 2011 and the economy slowdown in China in 2012.

(2) The expansionary monetary and fiscal policies adopted by central banks and financial authorities are considerable uncertainty in the world's leading economies.

(3) The continuous global financial slowdown may adversely affect to access the capital market and meet JA Solar operational capital liquidity needs and cause the lack of the financing available to the solar PV projects.

(4) Macro-economy, such as credit markets, the supply and prices of other substitute energies and global economic development, also impact the demand for PV products. For instance, a decrease in oil, coal or natural gas prices may reduce the demand for solar PV.

(5) Compared to US. Dollar and Euro, RMB exchange rate is keep increasing which resulting in the cost in USD exchanged from RMB is relatively higher and more difficult for exporting. The following table indicates the exchange rates between US. Dollar and RMB since 2008.

Table T4-1: Exchange Rate 2008-2013

Period	Noon Buying Rate			
	Period-End	Average [1]	High	Low
	(RMB per U.S. Dollar)			
2008	6.8225	6.9193	7.2946	6.7800
2009	6.8259	6.8295	6.8470	6.8176
2010	6.6000	6.7696	6.8330	6.6000
2011	6.2939	6.4475	6.6364	6.2939
2012	6.2301	6.3093	6.3879	6.2221
October	6.2372	6.2627	6.2877	6.2372
November	6.2265	6.2338	6.2454	6.2221
December	6.2301	6.2328	6.2502	6.2251
2013				
January	6.2186	6.2215	6.2303	6.2134
February	6.2213	6.2323	6.2438	6.2213
March	6.2108	6.2154	6.2246	6.2105
April (through April 12, 2013)	6.1914	6.1991	6.2078	6.1914

Source: Federal Reserve Statistical Release

(6) Solar PV became the main industry in terms of investment, with USD 140.4 billions invested, accounting for more than 57% of total new investment in renewable energy

and approximately 96% of investment of USD 135.1 billion in the solar industry went to solar PV sector.

Investment continuously dominated by developed economies, including Germany, Italy, the United States and Japan, four largest investors in solar PV capacity in 2012, taken up 63% of the total investment (reduced from 80% in 2011). With USD 31.3 billion, accounting for 22% of global investment, China accounted for the largest share in 2012 (Compared to investment of USD 17.8 billion in 2011, investment in 2012 was rocketed up). The overall solar power investment in developing countries sharply increased by72% to USD 51.7 billion, while investment in developed markets fell 31% to USD 88.7 billion. (Please see figure 4-3)

Figure 4-3: Top Five Countries

ANNUAL INVESTMENT/ADDITIONS/PRODUCTION IN 2012

	New capacity investment	Hydropower capacity	Solar PV capacity	Wind power capacity	Solar water collector (heating) capacity[1]	Biodiesel production	Ethanol production
1	China	China	Germany	United States	China	United States	United States
2	United States	Turkey	Italy	China	Turkey	Argentina	Brazil
3	Germany	Brazil/Vietnam	China	Germany	Germany	Germany/ Brazil	China
4	Japan	Russia	United States	India	India	France	Canada
5	Italy	Canada	Japan	United Kingdom	Brazil	Indonesia	France

TOTAL CAPACITY AS OF END-2012

	Solar PV	Solar PV per capita	Wind power	Solar water collector (heating)[1]	Solar water collector (heating) per capita[1]	Geothermal heat capacity	Geothermal direct heat use[3]
1	Germany	Germany	China	China	Cyprus	United States	China
2	Italy	Italy	United States	Germany	Israel	China	United States
3	United States	Belgium	Germany	Turkey	Austria	Sweden	Sweden
4	China	Czech Republic	Spain	Brazil	Barbados	Germany	Turkey
5	Japan	Greece	India	India	Greece	Japan	Japan/Iceland

(Source: Key finding, Renewables 2013Global Status Report, EPIA)

- **Social**

(1).As per EPIA, PV Solar industry is expected to create 1,360 thousand jobs globally, including 300,000 jobs in China, 312,000 jobs in Europe, 90,000 jobs in USA and 112,000 jobs in India in 2013. (Please see table T4-2)

Table T4-2: Jobs Worldwide GSR 2013

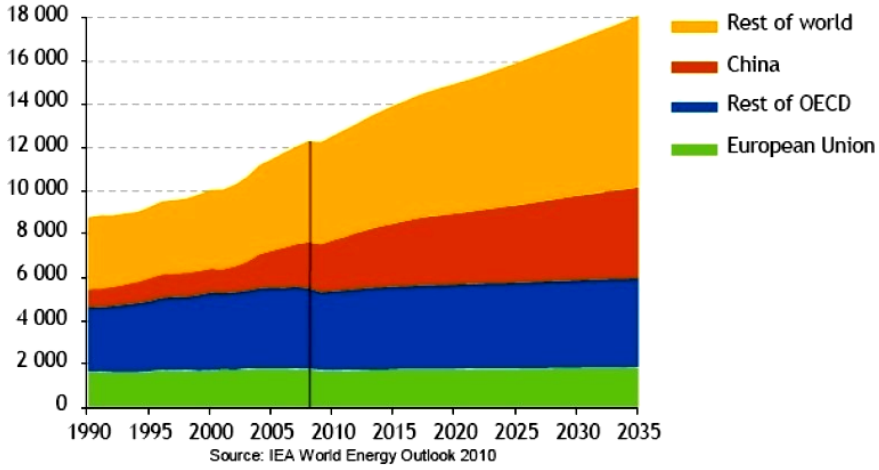
Estimated direct and indirect jobs in renewable energy worldwide, by industry

Technologies	Global	China	EU-27	Brazil	United States	India	Germany	Spain
	Thousand Jobs							
Biomass[a]	753	266	274		152[f]	58	57	39
Biofuels	1,379	24	109	804[e]	217[g]	35	23	4
Biogas	266	90	71			85	50	1
Geothermal[a]	180		51		35		14	0.3
Hydropower (Small)[b]	109		24		8	12	7	2
Solar PV	1,360	300[d]	312		90	112	88	12
CSP	53		36		17		2	34[i]
Solar Heating/ Cooling	892	800	32		12	41	11	1
Wind Power	753	267	270	29	81	48	118	28
Total[c]	**5,745**	**1,747**	**1,179**	**833**	**611**	**391**	**378[h]**	**120**

(Source: Key finding, Renewables 2013Global Status Report, EPIA)

(2). Worldwide energy demand is on the rise. As per IEA World Energy Outlook 2010, energy demand in Europe keep stable, but the consumption in China keeps increasing year by year. (Please see figure 4-4)

Figure 4-4: World Energy Demand



- **Technological**

(1) Innovation in technology and differentiation in products are increasingly important, and successful manufacturers have diversified both up- and downstream, with expansion into project developments or establishment of strategic partnerships.

(2) R&D is crucial to the leader of PV industry, but speed of technology innovation takes long time and spends a lot of money.

- **Environmental**

(1) PV market and industry trends are influenced to JA Solar. Sector-wide oversupply of solar PV products resulted in a substantial decline in prices. Moreover, many European countries reduced incentive supports, for example, feed-in tariff, which caused public utility companies to pay higher costs for solar PV than the conventional energy.

(2) The competition in PV sector will be continuously and further intensified.

(3) With the dropping prices, PV moves to expand to new markets, to Africa and the MENA region, Asia, Latin America. Community-owned BIPV system and self-generation systems continued to develop in 2012, while the number and scale of large PV projects also increased.

- **Legal**

JA Solar must comply with the different laws in the different countries.

4.2.2 Analysis of Industry & Sector (Five Force Framework)

The previous section viewed how the forces in the macro-environment might impact on JA Solar strategies. However, the influence is the general factors and tends to be on the surface in the more prompt environment by changing the competitive forces surrounding JA Solar. A significant aspect for JA Solar is the competition within their industry and sector or the market.

This section will focus on the industry analysis with Porter's five forces framework.

Porter's five forces framework contributes to JA Solar by identifying the attractiveness of PV solar industry in accordance to five competitive forces: the threat of entry, the threat of substitutes, the power of buyers, the power of suppliers and the extent of rivalry between competitors. These 5 forces together make up of an industry's "structure".

- **The threat of entry**

  How difficult it is to enter the PV solar industry obviously influences the degree of competition and the new entrant to enter in. The higher the threat of entry, the less it is for the new entrant. For purpose to reduce the threat of new competitors, an attractive industry should have higher barriers to entry, which need to be overcome firstly by new entrants firstly if they schedule to start and compete in PV solar industry. Typical barrier are as follows:

  (1) **Economic scale and cost advantages**

JA Solar had 6 large factories, 2 R&D centers, 4 sales offices as the network, set up the effective and cost-efficient production means. Through the acquisitions, joint ventures and vertical integration, JA Solar became the major player in PV industry.

With cutting-edge manufacturing equipments, JA Solar manufacturing capacities for silicon wafers, solar cells and solar modules were 1.0 GW, 2.5GW and 1.8 GW respectively per annum, which makes JA Solar significantly benefit from economic scale, because JA Solar enjoyed the discounts on purchases of raw material, cost reductions during the mass production of standardized solar cell and modules, advantages of spreading the fixed costs on large production quantity and share the sales, marketing and advertising costs over the large outputs.

The economic scale takes time and large investment, which is difficult to new entrants.

***(2)* Severe competition**

Numerous PV manufacturers went to bankruptcies and consolidation was increased, even big players became insolvent, shutting down manufacturing facilities, or leaving the industry altogether in 2011 and early 2012. Therefore, the competition in PV Solar industry is too fierce for the new entrant to enter in.

***(3)* Capital-intensive industry and technology**

To start the PV solar industry, large amount of investment is requested, the equipment and machine are very expensive. Moreover, the innovative technology is crucial to this industry to keep the competitive advantage. All these mean it is the capital-intensive industry and makes new entrants difficult to come in.

***(4)* Government regulations and policies uncertainty**

Regulations and rules from the different governments in various countries and unions play a huge role in term of the development of PV industry. More incentive supports, further faster growth and development. This makes PV industry in high risk on the government’s activities.

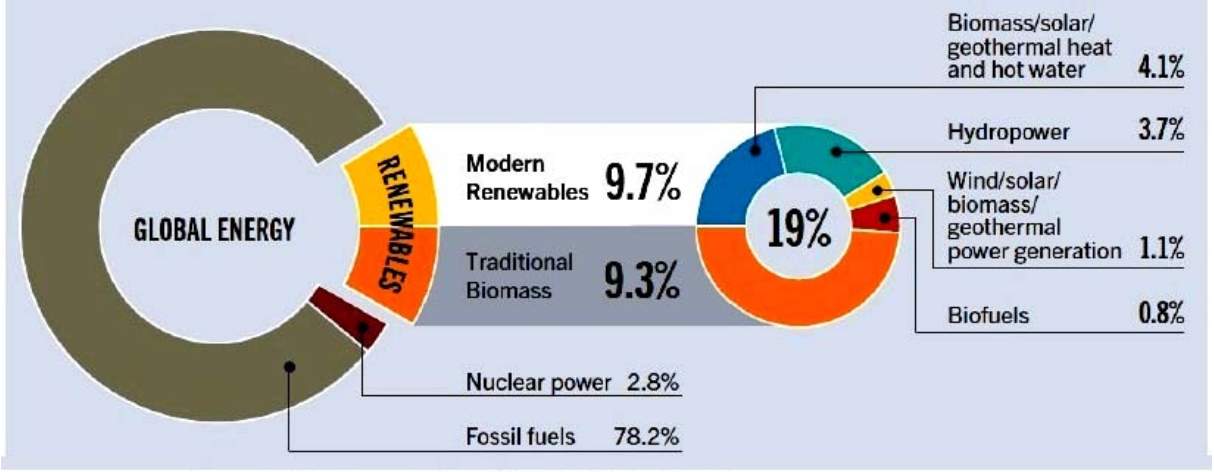
In consideration to above points, the risk of new entrants is not much in the coming future.

- **The threat of substitutes**

Substitutes are the products that provide a same benefit or similar beneficial to the customers. Management always concentrates on their rivalries in the industry and neglect the threat posed by the substitutes. Substitutes can reduce demand quantity in PV solar sector as the clients have the opportunity to switch to alternatives.

Figure 4-5 indicates the estimated renewable energy share of global final energy consumption with substitutes.

Figure 4-5: Estimated Renewable Energy Share of Global Final Energy Consumption, 2011



Source: REN21 Renewables 2013 Global Status Report

As per REN 21 “Renewables 2013 Global Status Report”, by the end of 2011,

(1) Fossil fuels: still dominate the in global energy market, accounting for 78.2%.

(2) Nuclear power is second in global energy market, account for 2.8%.

(3) The Renewable energy, including,

a) Hydropower

b) Hydropower:

c) Wind power:

d) CSP (Concentrating Solar Thermal Power)

e) Solar Thermal Heating and Cooling

f) Biomass

g) Biofuels

h) Geothermal

Taking accounting into the resources limitation of fossil fuels, renewable energy including PV, is a crucial to the world-wide energy mix. By the end of 2011, renewable energy provided an estimation of 19% of global final energy consumption.

- **The power of buyers**

The buyers are customers of JA Solar. With the large investment, PV solar industry experienced the high-speed development through 2007 to 2011 year, faced the excessive supplying nowadays, which caused the buyer's bargaining power increased and the selling price dropped accordingly because of many choices of the similar products supplied.

Thanks to broad sales network globally, high quality of products, friendly service, high reputation and trademark available, JA Solar still have the fair negotiation power with the buyer.

- **The power of suppliers**

Suppliers are those who provide JA Solar raw material and equipments to manufacture the products or services.

(1) Previously, as the manufacturing of silicon raw material is requested the high technology and not easy to imitate, silicon raw material is mainly produced by the main and few players in USA and Europe who are very powerful and own the strong authority to decide the price and sign the annual purchase order,

With the ongoing efforts, some Chinese companies already developed technology to produce and reduced the price since 2009 which significantly benefit to the decrease of the price in PV cell and mould worldwide. Nowadays, the PV solar manufacturers have more choice to the suppliers and get more negotiation power.

(2) Europe keep the leadership in PV solar equipment manufacturing and export to many

Chinese PV companies, accounting for approximately 49% of the global PV equipment manufacturing industry and have the substantial contribution of European PV industry.

The main players in equipments and machines supply in Europe and USA are RENA, Schmid, Baccini and Despatch, they are all famous and large companies. Thanks to the fast expansion and large equipments importing, JA Solar remain the medium power to negotiate with them.

(3). As for the accessories, spare parts and some machines which are offered by the Chinese domestic market, JA Solar have the big power to negotiate the price because large purchasing quantity annually.

- **The extent of rivalry between competitors.**

As I talked above again and again, the competition in PV Solar industry is high fierce and severe. 2011 and early 2012 were marked by numerous bankruptcies and increasing consolidation, with even big players becoming insolvent, shutting down manufacturing facilities, or leaving the industry altogether.

(1) Solyndra was one of several U.S. firms, along with Germany's Q-Cells (once the world's top manufacturer) and many others, declared insolvency or pulled out of the industry in 2011 and early 2012.

(2) Following the reduction of policy support in some key markets in early 2012, BP Solar withdrew after 40 years in the solar PV industry, and First Solar announced its withdrawal from Europe

(3) Under 8 Chinese Bank's pressure, WuXi Suntech Solar (one subsidiary under the Suntech Power Holdings Co., STP), the No. 1 of market share of the Chinese PV products manufacturer in 2011 declared to the bankruptcy on 21. Mar. 2013. According to the report, WuXi Suntech Solar owed the debt up to 2 billion USD.

To conclude, the five forces framework offers useful insights into the drivers in the PV solar industry and the environment. As per Porter's theory, an attractive industry structure is one that offers good profit potential. Where the five forces are high, industries are not attractive to compete in.

4.2.3 Main Market Analysis

JA Solar established the business relation with the diverse clients in various global markets, including Germany, Belgium, Italy, United Kingdom, the United States, Australia, Hong Kong, Japan, Singapore and the domestic Chinese market, selling the cells and modules to module manufacturers, system integrators and project developers.

JA Solar will continuously expand the sales in the international markets as well as the domestic market and maintain the long-term friendly relationship with existing customers.

Historically, JA Solar mainly focus on the China domestic market, developed friendly cooperative relationship with a number of leading Chinese individual electricity generators and utility companies, such as China Power Investment Corporation, China Guangdong Nuclear Solar Energy Development Co., Ltd. and China Three Gorges New Energy Corporation, etc.

Since 2010, with the marketing efforts and hardworking from JA Solar overseas office together with the improved large manufacturing capacities, JA Solar have substantially extended the sales to oversea customers. By December 31, 2010, 2011 and 2012, approximately 48.9%, 48.3% and 54.1%, respectively, of revenues were from oveasea markets. Table 4-3 summarizes the net revenues from different geographic markets.

Table T4-3: Notes to Consolidated Financial Statement of JA Solar

Segment information

The Group operates in a single business segment that includes the design, development, and manufacture of PV products.

The following table summarizes the Group's net revenues generated from different geographic locations:

	Year Ended December 31 (In thousands)				
	2008	2009	2010	2011	2012
	RMB	RMB	RMB	RMB	RMB
China	4,162,037	2,789,798	6,010,415	5,546,700	3,086,589
Outside China:					
Spain	613,483	57,516	81,597	—	—
Germany	144,936	396,922	2,126,975	2,110,751	1,265,827
Rest of the world	537,854	534,317	3,541,793	3,075,403	2,366,649
Total outside China	1,296,273	988,755	5,750,365	5,186,154	3,632,476
Total net revenue	5,458,310	3,778,553	11,760,780	10,732,854	6,719,065

(Source: 2010 & 2012 Annual report)

4.2.4 Main Competitors Analysis

The PV industry is intensive competition and rapid evolution.

JA Solar mainly compete with integrated manufacturers, for example, Yingli Green Energy, Trina Solar, Jinko Solar, etc. as well as specialized manufacturers of solar cells, for instance, Gintech Energy Corp., Motech Industries Inc. and Neo Solar Power Corp, etc. (as the figure 1-1 in Chapter 1)

The competition is expected to continuous increasing, may result in further price reductions, margins decrease or loss of market share. Some competitors became vertically integrated, from upstream silicon & wafer manufacturing to the downstream solar power system.

Moreover, new potential entrants to the PV market which offering new technological solutions. Many of the competitors are trying to develop or currently producing based on innovation PV technologies, including thin film, ribbon, sheet and nano technologies, which may have the low ultimate cost.

At last the entire PV industry also faced competition from conventional and non-solar renewable energy. Due to the relatively high costs compared to the other energy sources, solar PV is still on the way to be competiveness.

4.3 Internal Analysis of JA Solar

Above section discussed above is helpful to understand the factors in the macro-environment, industry and competitor/market environments of JA Solar. The crucial next step is to draw from the environmental analysis to specific strategic opportunities, threats and the competitive advantage for JA Solar, which is extremely valuable when talking about the strategic choices in the following chapter.

4.3.1 Competitive Advantage Analysis of JA Solar

- **Large-Scale Manufacturing Capacity and Facilities**

By December 31, 2012, with advanced manufacturing equipments, JA Solar manufacturing capacities for silicon wafers, solar cells and solar modules were 1.0 GW, 2.5GW and 1.8 GW respectively per annum.

JA Solar vertically integrated the value chain of PV solar industry to manufacture PV cells, modules, wafers in China through 6 wholly-owned subsidiary factories with the size and ownership as the following table T4-4,

- 2 Cell factories are located in Ningjin, Hebei Province & Yangzhou, Jiangsu;
- 2module manufacturing facilities are in Fengxian, Shanghai & Hefei, Anhui;
- 2 silicon wafer manufacturing are located in Lianyungang, Jiangsu & Sanhe, Hebei.

Table T4-4: Size & Ownership of 6 Factories for JA Solar

Location	Space (in square meters)	Usage of Property	Owned or Leased
Ningjin, Hebei	106,582	Factory	Leased
Yangzhou, Jiangsu	466,200	Factory and R&D center	Owned
Fengxian, Shanghai	204,262	Factory	Owned
Lianyungang, Jiangsu	219,909	Factory and R&D center	Owned
Hefei, Anhui	379,616	Factory	Owned
Sanhe, Hebei	104,740	Factory	Leased

Source: 2012 Annual report

The table T4-5 below indicates the relevant information regarding current manufacturing capacity in 6 manufacturing facilities.

Table T4-5: Manufacturing Capacities of 6 Facilities for JA Solar

Product	Facilities location	Rated manufacturing capacity per annum in 2012 (in MW)	Rated manufacturing capacity per annum expected in 2013 (in MW)
Solar cell	Ningjin, Hebei	900	900
	Yangzhou, Jiangsu	1,600	1,600
	Total Rated Capacity	2,500	2,500
Solar module	Fengxian, Shanghai	1,300	1,300
	Hefei, Anhui	500	500
	Total Rated Capacity	1,800	1,800
Silicon wafer	Lianyungang, Jiangsu	500	500
	Sanhe, Hebei	500	500
	Total Rated Capacity	1,000	1,000

Source: 2012 Annual report

In February 2011, JA Solar concluded an investment agreement with the Management Committee of Hefei High-Tech Industrial Development Zone, (or Hefei Committee), to establish the Hefei manufacturing center. Under this agreement, JA Solar agreed to develop an integrated solar power product manufacturing center in the Hefei High-Tech Industrial Development Zone, with a long-term target manufacturing capacity of 3.0 GW of solar power products, including silicon wafer, solar cells and solar modules. JA solar module manufacturing facility in Hefei has commenced operation in the second quarter of 2012.

Since the business growth, JA Solar may introduce or upgrade new manufacturing equipment with higher conversion efficiency rates. During the fourth quarter of 2012, JA Solar disposed of outdated production lines of solar cells and solar modules in the factories in Ningjin, Hebei and Fengxian, Shanghai, respectively, each by 300 MW, which incurred impairment loss for property, plant and equipment of RMB397.8 million (US$63.8 million) in 2012, accounting for 5.9% of our total revenues.

- **2 High-Tech R&D Center in China**

In R&D centers in JA Solar, the teams are dedicated to develop breakthrough technologies as well as updating the reasonable manufacturing procedure to decrease the manufacturing cost, and improving the solar cells efficiency during the mass production. Leveraging on its strong PV research and development capabilities, JA Solar always focuses on improving the unique module assembly processing and cell manufacturing technology and try the utmost to maintain the low cell-to-module power loss with the hope to obtain the full benefits from the advanced cell efficiencies.

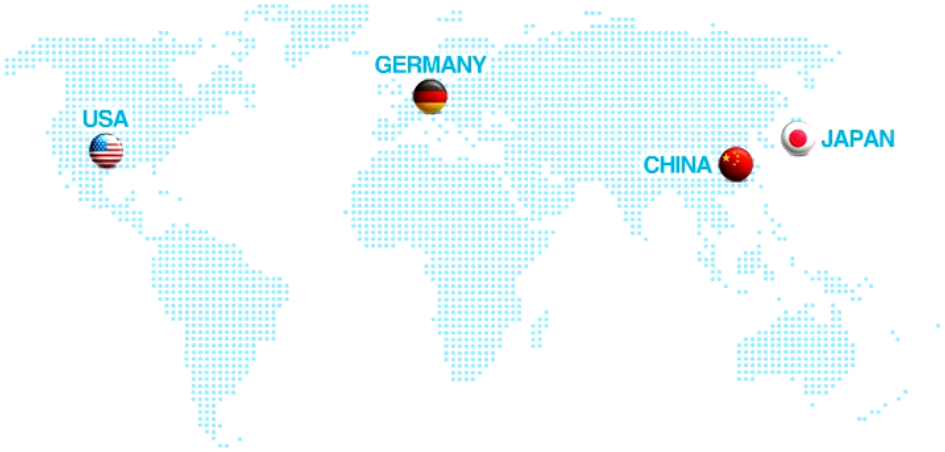
Meanwhile, JA Solar R&D team is committed to research and develop the next generation of PV technology to further reduce PV module cost and significantly enhance energy conversion efficiency, keep the competitive advantage and maintain the leading position in the market in terms of economical and environment-friendly efficiency.

- **Strong Global Sales Network**

Headquartered in Shanghai, China, JA Solar owns a global sales and marketing footprint with

a network of 3 overseas sales offices across key markets, including European office in Munich, Germany, Japanese Office in Tokyo, and US sales office in Silicon Valley, California, selling the solar PV products worldwide mainly by the direct sales forces and market-focused sales agents. (Please see the figure 4-6)

Figure 4-6: 4 Sales Offices Worldwide



(Source: JA Solar website)

- **Frequently Marketing Activity**

Marketing activities in JA Solar are to attend trade shows, conferences and sales training, held the product launch events, advertisements and public relations campaigns.

Marketing team is responsible for collecting market data and information to support sales team. By mutual efforts and closely working between different teams, JA Solar expand more markets.

Table T4-6 Exhibition List for JA Solar attended or scheduled to attend.

- **Intellectual Property**

JA Solar rely on a combination of patent, trademark and copyright. By now, JA Solar had a total of 65 patents and 56 pending patent applications in China.

In order to have the reputation and brand, JA Solar currently maintain 12 trademark registrations in China, including the main one, Chinese characters “晶澳” and “JA Solar”, also maintain eight trademarks outside China.

Table T4-6: Exhibition List

Date	Event	Booth	Location
10/21-10/24 /2013	Solar Power International 2013	2625	Chicago, USA
09/16-09/19 /2013	New Energy JORDAN Exhibition & Conference	unconfirmed	Amman International Motor Show Exhibition Centre
09/12-09/14 /2013	Renewable Energy India Expo	7.39	India Expo Center, Greater Noida(NCR)
06/19-06/21 /2013	Intersolar Europe 2013	A3,440	Munich,Germany
05/14-05/16 /2013	SNEC 2013	N1- 519	Shanghai, China
02/27-03/01 /2013	PV EXPO 2013	E48-26	Tokyo, Japan
01/15-01/17 /2013	World Future Energy	7345	Abu Dhabi
12/05-12/07 /2012	2012 PV Japan	P09-504	2012 PV Japan
11/07-11/09 /2012	6th Renewable Energy India 2012 Expo	2.58	NATIONAL CAPITAL REGION OF DELHI, INDIA
10/22-10/24 /2012	2nd APVIA	Booth:G60	Singapore
09/25-09/28 /2012	27th EUPVSEC	B22(hall3.1)	Frankfurt, Germany
09/10-09/13 /2012	Solar Power International 2012(SPI)	2400	Orlando, USA
08/21-08/22 /2012	East Solar	B5	Melbourne
07/12-07/14 /2012	Inter Solar North America	7359C	San Francisco
06/13-06/15 /2012	Inter Solar Munich	A3.160	Munich, Germany
05/16-05/18 /2012	SNEC	W3-310	Shanghai, China
05/09-05/11 /2012	SOLAR EXPO	C12.2	Verona, Italy
04/03-04/05 /2012	ENR	J80	France
03/20-03/22 /2012	ECOBUILD	N4150	Excel Centre, London, UK
02/29-03/02 /2012	PV Expo	E32-31	Tokyo, Japan

Source: JA Solar website

4.3.2 SWOT Analysis of JA Solar

SWOT summarizes the strengths, weaknesses, opportunities and threats tend to have the impact on the strategic choices and development in JA Solar, which can also be helpful as the foundation to come out with strategic options and evaluate the future actions.

The goal is to clarify the extent to which strengths and weaknesses are related to, or enable to handle the changes occurred in the business environment.

Strengths: (same as "Competitive Advantage Analysis of JA Solar" mentioned above)

Weaknesses:

- Though expansion the business all over the world and set up 4 oversea offices, JA Solar herself is the Chinese private company and very young, only 8 years old and the experiences and management is not such sufficient.
- Operations in 4 different countries, JA Solar internal have the different cultures conflicts, need to deal with the multi-culture conflict carefully.
- JA Solar need to reply on the cost reduction, technology innovation, energy efficiency, etc to lower the cost and have the margin nowadays.
- Technology innovation, research and development is hard and take long time, spends much money.

Opportunities:

- There are large potential both in the international market and the Chinese domestic market.
- Technology innovation will be led the products differentiation to the other competitors and more cost efficiency.
- In the whole value chain of PV solar industry, the profit is relatively higher on the silicon material manufacturing (the up-stream) and the system installation (the down-stream), JA Solar can think about to go down and up further.
- More and more organizations, companies, people worldwide concern about the environment protection and the renewable energy. The resources of traditional energy are limited, but resource of solar energy is unlimited and solar radiation is available everywhere in the world.
- For the second year, PV was the number one of new renewable source of electricity generation installed in Europe in 2012. As far as now be concerned, in Europe, PV covers 2.6% of electricity demand and 5.2% of peak electricity demand.
- PV systems can connect to the grids in many countries, consumers can sell the electricity to their national grid and earn money. Grid parity broadens the residential and commercial markets.

Threats:

- Solar PV sector is the one depends on the government policies and the incentive support schemes, the markets and sales will vary accordingly. Therefore, the risk is relatively high and uncertain.
- Now Solar PV supply excessive more than the demands and the price dropping down extremely again and again, the profit is little, the company faced the problems of survival.
- PV cells and modules from China are subjected to the high anti-dumping tax and countervailing duty in USA and Europe.
- The current consumption of PV products in China domestic market is less than 10% that of the whole manufacturing capacity. Moreover, most of projects belong to the government behavior that government provided the subsidies and incentive to the projects to support the PV industry. In addition, most of the machines & equipments, silicon raw material are imports, so PV has the high degree of dependence to the overseas markets.
- The financial crisis and economy recession made some countries have the limited amount to support PV sector and the consumers are scare to make the investment on PV.

4.4 Current Business Model of JA Solar

JA Solar is producing the PV wafers, cells, modules and assembly them into the whole systems mainly by two kinds of contracts.

- **Sales contracts**. Work with module manufacturers to sale solar cells; with systems integrators, project developers and distributors to sale solar modules.
- **OEM or Processing** Trade Agreement. Under this arrangement, poly-silicon or silicon wafers provided by customers, JA Solar proceeds the manufacturing, finally sold cells or modules back to the same customers, who will sell those products under their own brands. In addition, JA Solar can use own solar cells to make the modules for a limited number of strategic customers.

To explore more markets, JA Solar established 4 sales offices. By the mutual efforts of manufacturing and sales teams, broaden the markets shares.

Chapter 5 Strategic Choices of JA Solar

This chapter will focus on TOWS analysis and the basic strategic choices: what strategy should go ahead for JA Solar?

5.1 The TOWS Analysis

TOWS matrix is used to indentify options to address a different combination of internal factors (strengths and weakness) and external factors (opportunities and threats).

Table T5-1: TOWS Analysis

		Internal Factors	
		Strengths (S):	**Weaknesses (W)**
		1). Large-Scale Manufacturing Capacity and Facilities; 2). 2 High-Tech R&D Centers; 3). Strong Global Sales Network; 4). Frequently Marketing Activity; 5). Intellectual Property;	1). Young private company, lack of management experience; 2).Weak culture management; 3). Falling price & Little margin; 4). Technology innovation, R&D is hard, takes time & money.
External Factors	**Opportunities (O)**	**SO** "Maxi-Maxi" Strategy	**ST** "Maxi-Mini" Strategy
	1).Large markets potential; 2). Products differentiation & cost efficiency; 3). Up-and-down-stream value chain opportunity 4). More concerns renewable energy; 5) PV is no.1 of new renewable source of electricity generation in Europe in 2012; 6). Grid parity broadens residential &commercial markets.	1). Cost-leadership strategy, including saving in input cost, l Economics of scale, re-allocate the resources, efficient product & processing designs. 2). Differentiation Strategy, including technology innovation & service-oriented manufacturing Strategy. 3).Related diversification strategy; 4).Forward Integration Strategy.	1). Value-adding activities of corporation Parent; 2). Cooperate with the famous universities and the research organization.

	Threats (T)	WO "Mini-Maxi" Strategy	WT "Mini-Mini" Strategy
External Factors	1). Rely on policies & high risk; 2). Oversupply& dropping price; 3). High anti-dumping tax made uncompetitive; 4). Little domestic market consumption. 5) Economy recession caused less incentive & consumer investment.	1). Diversified markets is the key to sustain at a low risk; 2). First mover advantage.	(None)

(Source: Self-conclusion)

Remarks:

- SO means to use strengths of JA Solar to seize the opportunities during the business;
- WO means take the advantage of opportunities arising by overcoming weakness;
- ST means to use strengths of JA Solar to avoid threats;
- WT mean to minimize weakness and avoid threats.

Therefore, the above table T5-1 already analyzed all the opportunities available, the threats to avoid and the relevant strategies to go ahead.

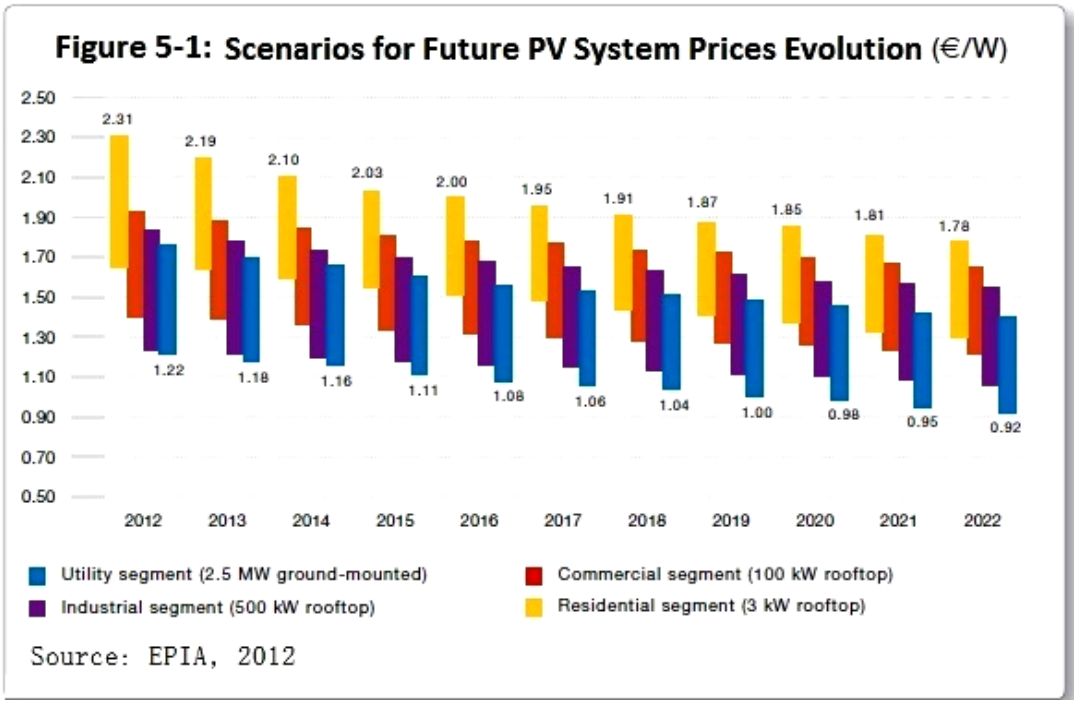
5.2 Business-level Strategic Choices

This section talks about the basic strategy choice for JA Solar on the level of business unit adopt in the market and the generic competitive strategies, including two strategies, one is cost-leadership strategy, the other is differentiation strategy.

5.2.1 Cost-leadership strategy

Cost-leadership strategy concerns to be the lowest-cost company in PV solar energy industry.

As per EPIA's reports of "Connect the Sun" and "Solar Photovoltaics on the Road to Large-scale Grid Integration", with the improvement of the grids, at both distribution and transmission level, solar PV will play a main role in European electricity mix. It's expected that PV are in the position to cover up to 25% of electricity demand in Europe in 2030, contributing to de-carbonization of electricity mix, which will be driven notably by the competitiveness trends and future system price evolution. As shown in Figure 5-1, PV system prices are expected to fall from up to 2.31 €/W in 2012 in the residential segment to as low as 1.30 €/W in 2022.



Therefore, the cost reduction in PV is so crucial and significant in the coming few year. I suggest five key cost drivers available to deliver the cost leadership, as follows,

- **Global Strategic Purchasing**, JA Solar should establish one global purchasing team in Shanghai headquarter to serve the group with the strategic sourcing and supply **c**hain management, combined the overall purchasing requests together from the different subsidiaries, then the purchasing quantity and resources will be increased,

JA Solar should have more power to negotiate the prices with the suppliers and all the subsidiaries will benefit from the strategic purchasing and supply chain management.

- **Strategic Cooperative Alliance with the main suppliers,** to reduce cost further, JA Solar should establish the long-term and friendly cooperative partnership with the main suppliers, working together to improve the accessories and spare parts supplied, solve the main technical barriers and make the technology advanced, with the mutual efforts, to the mutual benefits. In addition, to keep the technology secretly, JA Solar should sign confidential agreement with the partner.

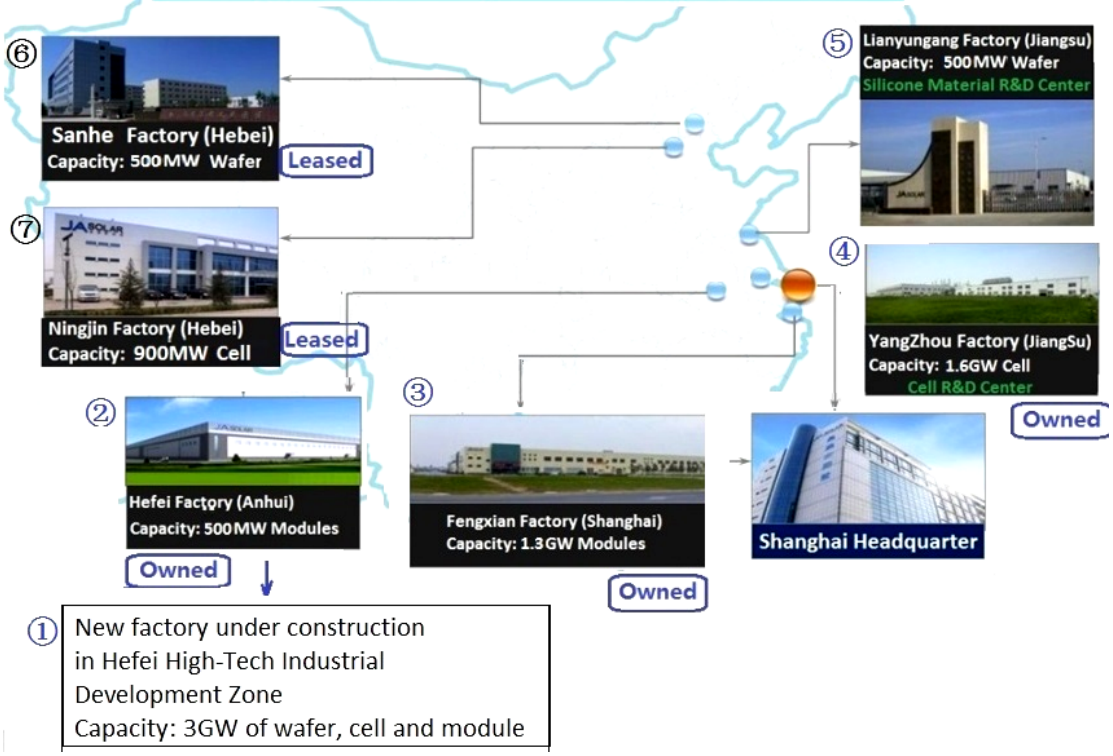
- **Other Input cost,** including the raw materials and labor costs, are always very important. JA Solar seek competitive advantage by re-locating an integrated solar PV product manufacturing center in the Hefei High-Tech Industrial Development Zone, where the human resource cost is relatively lower compared to the Yangtze River Delta and Pearl River Delta areas.

- **Economies of scale,** means how much increase the manufacturing scale will reduce the average operation costs in a particular period. With the advanced manufacturing equipments, JA Solar manufacturing capacities for silicon wafers, solar cells and solar modules were 1.0 GW, 2.5GW and 1.8 GW respectively per annum by December 31, 2012. Moreover, the new factory under the construction in Hefei High-Tech Industrial Development Zone, which will have manufacturing capacity of 3.0 GW of PV Solar products, including silicon wafer, cells and modules. At that case, JA Solar enjoy to become one of the largest PV solar corporation worldwide and will benefit the company from significant economies of scale, as JA Solar are able to obtain the discounts from raw material and spare parts purchasing, to share the fixed costs with large production quantity, to have the advantage of spreading marketing and advertising costs from a large volume of output, to reduce handling cost during standardized mass production.

- **Re-allocate the facilities and resources**

After the completion of the new factory in the in Hefei High-Tech Industrial Development Zone, JA Solar will enjoy herself to be the leader in PV industry with the total capacity 8.3GW. Please see figure 5-2, the map of factory location.

Figure 5-2: Factory Location Map in China



Source: JA Solar Market Report 2012

However, to have an effect on the cost efficiency, high effective operation and further cost reduction to come true the real economic scale, JA Solar should re-allocate all the resources as per the locations of the different factories available and make the reasonable utility and plan in details, as my summary in the following sheet. Moreover, figure 5-2 “the factory location map” & Table T5-2: Re-allocation Strategy provide the whole picture for the factory’s locations.

- **Product & Processing designs** also affect cost. Efficiency in products design and the processing procedure is one of the key to have the factory more outputs with the same inputs, which is one factor to make the economic scale.

Table T5-2: Re-allocation Solution

	Factory	Capacity	Re-allocation Solution
①	New factory in Hefei High-Tech Industrial Development Zone	3GW, including silicon wafer, solar cells & solar modules.	To focus on PV system customers. As the factory integrates main PV industry chain with the products including wafer, cells & modules in same factory (wafer and cell is respectively the raw material to produce the cell and module). It's good choice to concentrate on JA's current final products, modules, without any transportation cost to transmit the wafer, cell to the cell and module factory.
②	Hefei factory (AnHui)	500GW Modules	The factory is close to new factory under construction in Hefei High-Tech Industrial Development Zone, so can share everything together and can reduce the cost accordingly.
③	Fengxian Factory (Shanghai)	1.3 GW Modules	To commit themselves to the customers requested the modules and the factory is in the rural of Shanghai, is close to Shanghai loading port and convenient to the export business.
④	Yangzhou Factory	1.6GW Cell	Mainly serve to customers buying the cell. Yangzhou is not so far to Shanghai loading port, it's easy to go ahead the export business.
⑤	Lianyungang Factory	500MW Wafer	Should deliver their products, wafer to No. ④ Yangzhou Factory, who need it as the raw material because they are close and located in same Jiangsu province, it's easy and economically to transport.
⑥	Sanhe Factory (Hebei)	500MW Wafer	Act as the raw material factory to No. ⑦ cell factory because they are close and located in same Hebei province, it's easy and not cost much to transport.
⑦	Ningjin Factory (Hebei)	500MW cell	To become the cell shipment factory to the both oversea and domestic customers. The factory is close to Tianjin port. Moreover, can position this factory as the cell manufacturing backup.
Remark: For #⑥ and #⑦ factories, since only these 2 factories are leased the facilities, if the manufacturing capacity for ①-⑤ factories are enough to handle the business in the next 5 years, it will be good alternative to move the machines and equipment to the new factory and stop these 2 factories to save the both rent and the operation cost.			

Moreover, JA Solar can interact with the customers and oversea colleagues exclusively through the web-based methods and system work, rather than rely on phone call only, to reduce the daily operation cost.

5.2.2 Differentiation Strategy

For Porter, the main alternative to cost-leadership is differentiation, which is related to unique dimensions to provide the various kinds of clients for the value-added service and products and benefit self the price premium accordingly.

- **Technology Innovation Differentiation**

Technology innovation is one of the key factors to survive and success in the PV industry and all the competitors are seeking for the break-through to reduce the cost and have more advantage to distinct themselves.

On August 1, 2013, certified by Yangzhou Opto-Electrical Products Testing Institute, the multi-crystalline silicon ("multi-Si") PV cells by JA Solar was reached a sector-leading conversion efficiency, 18.3%, which is a real testimony to the exceptional performance in R&D team and represent the key stage of their efforts to satisfy the increasing demands from the customers and project partners for high-performance PV solar products. The superior conversion efficiency contributes to increase power generation per square foot and decrease the installation cost per watt, which is the significant value to clients and the development of this industry. Therefore, this record-breaking technology builds up the good reputation and credit of JA Solar, something like the first mover advantage.

On May 14, 2013, JA Solar announced to donate solar modules to 3 top universities, including Peking University, Tsinghua University and Beijing Jiaotong University for their participation in the 2013 Solar Decathlon China, hosted by both the National Energy Administration of China and the U.S. Department of Energy, which often called the "Olympics of the Solar Industry," challenges the participants to combine architectural design, energy efficiency, and cutting edge solar energy technology together and apply

them to residential buildings. As per the speech addressed by Mr. Baofang Jin, executive chairman and CEO of JA Solar, "JA Solar is delighted to contribute to the Solar Decathlon, we hope to inspire the smart students to drive the new technical boundaries, which is our long-time goal and the core culture".

Such being the case, in consideration that the technology innovation is so crucial in their business and JA Solar have the good relation with the famous universities in China, I think JA Solar should think about to establish the long-time strategic cooperation with 2 or 3 famous universities to make the researches and studies together with their R&D teams, by the mutual efforts, to the mutual benefits.

- **Service-oriented manufacturing Strategy**

Service–oriented manufacturing strategy mainly emphasizing on concept to try their utmost to meet the customer satisfaction by providing the products and service under both upstream and downstream of PV industry value chain in a manufacturing context of JA Solar, this means except for the manufacturing the products of wafer, cell and module, the strategy also associated with the whole procedures from the products research and development, package design to after-sales service, and from the concept of “manufacturing & selling products” to assist the client to achieve “customer value”, this is the upgraded new idea and the trend for the large manufacturing company, like JA Solar.

So JA Solar should focus more on the customer service, for example, send the salesmen from the 4 sales local offices to customer offices/project spots, have one seat there and specially serve to the specific client. In that case, the salesmen will provide more efficient and friendly services and will know more information about the detailed customer requests or needs, and feedback to JA Solar on time, then company will offer the customers more solutions and alternatives for the customer’s reference…with this kind of the high efficient service, JA Solar can meet more and more customer’s satisfaction, build up the trust and high reputation and achieve the value-add effect.

This is the real “software” and differentiation competitive advantage and definitely contributes to long-time goal in JA Solar.

Moreover, according to the industry value chain opinion, the differentiation on service–oriented manufacturing is the end generated more profits to the company, as well as the company’s primary strategic choice. For more details, please refer to the corporation strategy.

5. 3 Corporate-Level Strategy

5.3.1 Related diversification Strategy

Last section above was involved with choices at the level of single business or JA Solar’s company units. This section is concerned about choices both of products and markets for JA Solar to enter.

The Ansoff product/market growth matrix offers a straightforward way to generate four basic directions for corporate strategy. Please see figure 5-3 for an adapted version.

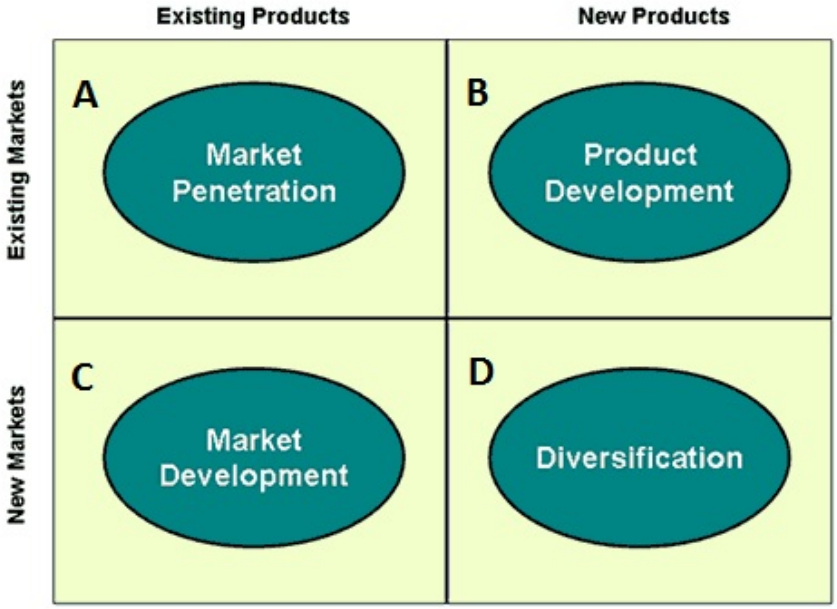
- JA Solar was established in 2005 with the PV cell manufacturing and the domestic market selling, started the business with the product to the existing market (in zone A area).

- To achieve more vertical integration, JA Solar expanded the business to both the downstream of value chain, solar modules and upstream, silicon wafers in 2009. Moreover, through the acquisition of Silver Age Holdings Limited in 2011, JA Solar further boosted the wafer manufacturing capability to meet the group’s internal demand. In this step, JA developed the new products to both existing market and new market (in zone B area).

- JA Solar built up four global sales offices, headquarter in Shanghai, China, Munich Germany, Europe, California USA, and Tokyo Japan, respectively in 2007, 2010,

2011 and 2012. JA Solar sold worldwide, 1.46 GW, 1.69 GW and 1.70 GW of solar power products, respectively. This stage belongs to market development (in zone C area).

Figure 5-3: The Ansoff Product/Market Growth Matrix



Source: Adapted from H.I Ansoff, Corporate Strategy, Penguin, 1988, Chapter 6.

The strategy choice next step for JA Solar should be related diversification, which involves increasing the series of products and market and diversify in products and services with relationships to the existing business.

As per report from EPIA, PV system prices have declined by more than 50% over the past five years, bringing PV close to competitiveness in some countries and in some market segments. Driven by adequate Feed-in-Tariffs or similar incentives, the PV market has developed accordingly in many countries in Europe and it has begun significant growth in the emerging markets outside of Europe, such as Australia, Japan, China, Saudi Arabia and across the Middle East and North Africa (MENA) region since 2010, where JA Solar should explore as the potential new markets in the next step.

5.3.2 Forward Integration Strategy

Forward Integration Strategy refers to growth into activities in term of outputs of JA Solar current business.

As per EPIA, “Economic benefits of solar Photovoltaics, the PV Value Chain” published on 24th September 2012, indicated the following fact, “Around €14.3 billion is created by European installation services” in 2012.

“Installation services” belongs to the down-stream integration, which JA Solar should go ahead to the forward integration, as it is the potential and big business in future and it perfectly make up with the current manufacturing capacity, complement and concordance each other.

In view of the different situations in various markets, JA Solar should take the different strategies. In the international markets, JA Solar can acquire or sign the partnerships with the local installment service companies, working together for the local PV projects, this will be benefits each other to explore fast and more markets. On one hand, the local installment service companies are familiar with the local markets and had the good relationship with the local governments; on the other hand, JA Solar can offer the good quality products to support the PV system; by hard working together, it is a good choice to explore the oversea markets.

In term of the domestic markets, as the main player and leader in PV sector, JA Solar have the enough power to acquire one installment services company, mainly working on the projects in the Chinese market. Moreover, JA Solar can cooperate with First Solar (USA) or SunPower (USA) or other USA or European company who want to enter into the China market as mentioned in chapter (page 16). As the USA or European company can invest large money on the projects and had the high technology for projects development, meanwhile JA Solar had the branded products to provide the PV system and is acquainted with the China local markets and local governments. By cooperate together,

or establish the joint venture, take the advantage each other and have the differentiation competitive advantage to win the other competitors and explore more China domestic markets.

5.3.3 Diversified Market Portfolio Strategy

Since the regulations and incentive policies in different countries are different, the trading disputes are always changing from time to time, PV industry is always in a high risk conditions. To reduce the risk to survive and sustainable development, JA Solar should explore more and more markets with diversified market portfolio and the top utilities geographical business mix.

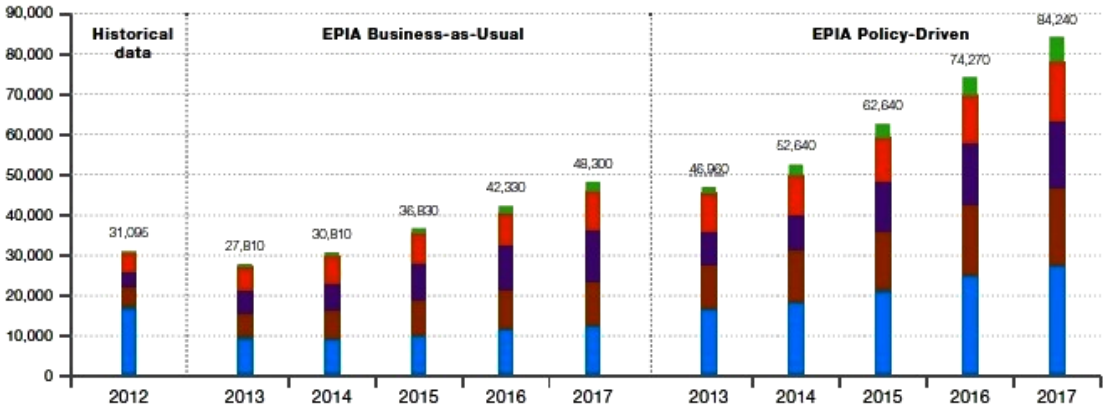
- **Global PV market Potential**

  The growth in Europe and policymakers' ability to maintain market conditions at an acceptable level is the main key for the market evolution in the coming next five years.

  As per EPIA's report (please see the figure 5-4), in the policy-driven scenario, it is expected to steadily grow about 16-17 GW in Europe in 2013, then develop slowly again to approximately 25-28 GW totally, and the new markets outside Europe will be developed fast, contributing to about 59 GW installments in coming five years from 2012, Such being the case, the global market can reach more than 84 GW in 2017. The new markets are helpful to ensure main development in 2013 and strengthen market development in the following years. EPIA expects the APAC region (excluding China) will add 10 -20 GW each year by 2017. According to the announcement by Chinese authorities, China alone can have 10 GW PV capacities to be installed every year.

Moreover, according to the market analysis in chapter 3 and the annex-1 attached, the European markets, such as Germany, France, Austria, Czech Republic, Denmark, Italy, Netherland, Poland, Portugal, Romania, Switzerland, Turkey and U.K. In addition China, Australia, India and Israel markets have indeed undergone some PV growth since 2010, several other countries are expected to develop quickly in both 2013 and 2014, such as Mexico, South Africa and Chile. Furthermore, the Middle East and North Africa (MENA) region represents of the untapped big potential or commencing PV markets, such as Israel, Arabia, Namibia and South Africa.

Figure 5-4: Evolution of global annual PV market scenarios per region until 2017 (MW)



	2012	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
MEA	410	660	920	1,300	1,900	2,400	1,500	2,700	3,400	4,500	6,050
China	5,000	6,000	7,000	8,000	8,000	10,000	10,000	10,000	11,000	12,000	15,000
Americas	3,758	5,720	6,660	8,790	11,210	12,730	8,090	9,100	12,500	15,390	16,590
APAC	4,769	5,730	6,940	8,660	9,510	10,360	10,590	12,480	14,290	17,000	19,050
Europe	17,159	9,710	9,290	10,080	11,710	12,810	16,780	18,360	21,450	25,380	27,550
Total	**31,095**	**27,810**	**30,810**	**36,830**	**42,330**	**48,300**	**46,960**	**52,640**	**62,640**	**74,270**	**84,240**

Source: Global Market Outlook for Photovoltaics 2013-2017

- **Market Potential in Europe**

Three possible scenarios of PV electricity penetration to both 2020 and 2030

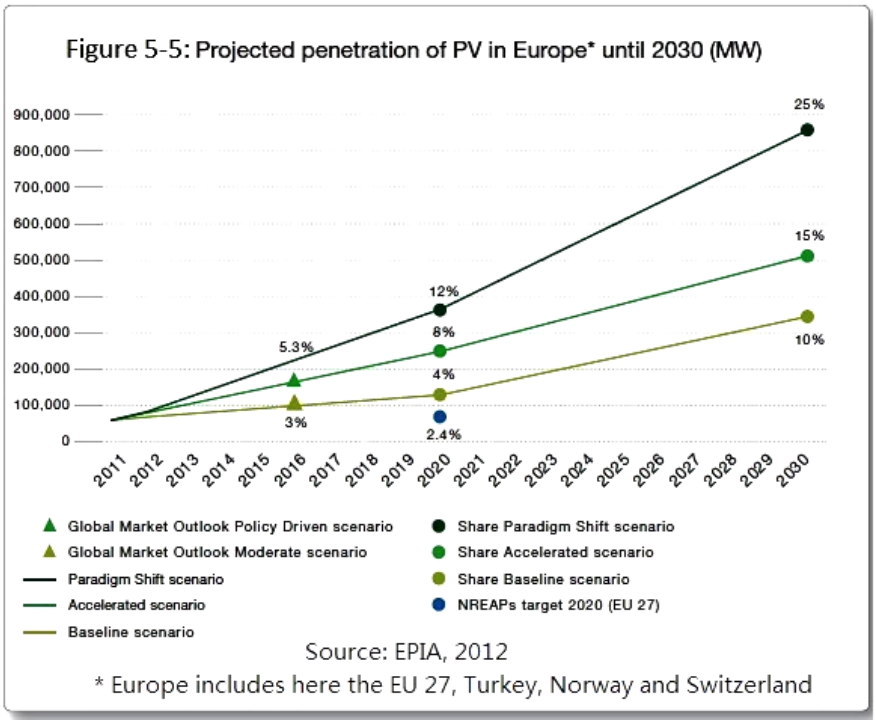
As per EPIA's report "Connecting the Sun: Solar photovoltaics on the road to large-scale grid integration", published in 2012, indicated three possible scenarios of PV electricity penetration to both 2020 and 2030. (Please see Figure 5-5),

- The baseline scenario is based on a business-as-usual case, assumes with 4% of European electricity demand generated by PV in 2020 (this equal to about 130 GW of cumulative capacity) and 10% in 2030,

- The accelerated scenario is based on current market trends, with PV catching up to 8% of the electricity demand in 2020 (this represents about 200 GW of cumulative capacity), and goals to 15% in 2030;

- The paradigm shift scenario supposes that all barriers are removed and PV market is free to develop and trade in all countries, then expects PV can provide up to 12% of demand in Europe by 2020 (this represents about 390 GW of cumulative capacity), and 25% by 2030.

Therefore, as per the above assumption and 2012 year-end 100GW installed capacity, we can concluded there are 30GW minimum and 290GW maximum assumed to be installed by 2020 in Europe.



Source: Global Market Outlook for Photovoltaics 2013-2017

In addition, Annex-4 and Annex-5 further illustrate the potential capacity in Europe.

- **Market Potential in China**

From the terrain of the whole China market, solar radiation is abundant with overall annual radiation of 930-2330 kwh/m2. Most of the areas have averagely daily radiation about 3-4 kwh/m2. Generally speaking, there are two-thirds areas plentiful of solar radiation. (Please see the Annex-3).

The top richest radiation areas with daily radiation more than 5.1 kwh/ m2, including north of Ningxia and Gansu, eastern & western Tibet, western Qinghai, etc. Particularly western Tibet, daily radiation up to 6.4 kwh/m2, ranks number two in the world, only followed Sahara Desserts; followed by the second abundant areas, having daily radiation more than 4.1-5.1 kwh/ m2, consisting of northwest of Hebei, northern Shanxi, southern Inner Mongolia, south of Ningxia, middle Gansu, eastern Qinghai, & southeast of Tibet, southern Sinkiang, etc.

Although China is the big market of energy generation and consumption with 1.3 billion populations, the energy deployment and technology still lag behind Europe and USA. 70% of energies are generated from the coals, the energy resource per capita is lower than half of the worldwide level. The high utility of the fossil fuels caused the environmental pollution and higher carbon emission. The government concerned about the environmental problems and paid more attention to the renewable energies, otherwise as per the development of current emission, China will become the number one with the high greenhouse gas emission by 2015 and carbon emission will account for 28% of total global emission2020. Therefore, it’s emergency for China to deploy more and more renewable energy and protect the environment nowadays.

According to the speech of Mr. Sicheng Wang, researcher from Energy Research Institute (ERI) under National Development and Reform Commission (NDRC) P.R. Chin, during the 2013 Solar Decathlon China, Chinese government made the decision to promote the PV industry in the future 38 years. The government planned to install 10GW in 2013, but

the actual installment by the end of year is expected to be 6-8GW; the government schedule to have 10GW per year in the coming 3 years and up to 15GW installment each year by 2020, then reach 30GW per year…and hope to install 1000GW by 2050 and the government budget to finance 10 billion RMB as the electricity subsidy. The potential of Chinese market is large and on the way to development and to be competitive compared to the fossil fuels.

However, the government hasn't announced the final FIT electricity price. Moreover, there is still some technical problems to have distributed PV system connected the grid in China and need to figure out in future.

5.3.4. Value-adding activities of corporation Parent

- **Envisioning**

As the parent company, JA Solar should provide a clear overall vision and strategic intent for their global sales offices and the individual factories, which can guide and motivate the sales offices and the factories to maximize corporation-wide performance through commitment to a common purpose.

- **Coaching and facilitating**

JA Solar need to help the sales office managers and factories managers strategic capabilities, by coaching them to improve their skills and confidence or providing the corporate-wide management courses which are effective means to bring the managers together to learn the strategy skills as well as offering the opportunity to build the relationships each other and multicultural management Moreover, they can also share the important working information and special knowledge on PV sector via the internal network. In addition, they can hold some team building event or PV knowledge training to build up the team work spirits and specialization skill.

- **Central services and resources provider**

JA Solar Shanghai headquarter should work as the central providers of capital for investment and central services, such as treasury, tax and human resources. Moreover, the headquarter should have greater leverage, such as combining the purchases of the

individual factories together and increases the bargaining power of shared inputs, just as I talked about previously.

- **Proper Intervening**

Finally, JA Solar corporate parent can also intervene with their global sales offices and the individual factories in order to ensure appropriate performance. The headquarter should be capable of close monitoring their subsidiaries performance and improve performance either by assisting the managers or by replacing weak managers. The parent company should challenge and develop the strategic ambitions of global sales offices and the factories and set up the working goals to encourage and perform even better.

5.4. Strategic Continuity and Continuous Improvement

As the matter of fact, the strategy is not rigid and subject to revise when the environment and competitive advantage changes, but it is a main direction for JA Solar to follow and develop; moreover, the strategic continuity strongly contributes to a sustainable competitive advantage. To make it successfully, JA should improve continuously the way they define and implement their strategy; Strategic continuity and continuous change should occur simultaneously. They are not inconsistent.

5.5 Updated Business Model of JA Solar

Based on the above strategic choice and currently development, JA Solar is the top manufacturer of PV products, including the wafer, cell, modules.

With the related integration and R&D, JA Solar is expected to have more products with the innovative technology and expand more markets.

With the forward integrate to EPC services (Engineering, Procurement and Construction) for PV installment.

Therefore, suggest the updated business model as follows,

- Firstly, JA Solar get the demand requests from the commercial or utilities companies or system developer.

- Then JA Solar can design the PV system and attend the customers' bid with the reasonable modules JA manufacturing and accessories JA purchasing to meet the customers' special demand with the lowest costs as JA well knew their products and good service.
- Thirdly, JA Solar communicate with the customer efficiently and friendly to make sure to provide the reasonable products with the rational price and meet the customers' satisfaction.
- On the other hand, JA Solar are capable of continuously improving their products through promptly getting the customers' updated demands and the trend of PV industry, make the relevant R&D with the new technology as per the market & industry trends.
- After winning the bid, JA Solar arrange the factories to make the mass production and purchasing the relevant spare parts or accessories from the suppliers for the whole system use
- The factories make the production and deliver accordingly.
- JA Solar installed the system and connect to the grid.

Such being the case, JA Solar becomes to the solution expect of the whole value chain of PV sector, with the advantages as following examples,

- JA Solar get the final and true customer demand information to avoid to produce too much stock because of the lack of the actual demand quantity or to misunderstand to increase too much manufacturing capacity with large investment.
- Moreover, JA Solar make the differentiation with more competitors and remain the leader in PV sector.
- JA Solar broaden the customer bases and meet more customers' satisfaction, meanwhile continuously develop.

Chapter 6 Conclusions

This thesis takes the theory of strategy management as a basis, combined with the case study of JA Solar. In this chapter, we will go ahead to summarize the study results, find its creative contributions as well as clarify the study limitations and future research suggestion.

6.1 Conclusions

The survival and sustainable development of Solar PV plays an important role in renewable energy and became the main source of electricity generation. However, PV industry experienced the oversupply, excessive production capacity, dropping price, extreme competition during these 3 years, especially in China PV industry, faced the heavy pressure of anti-dumping & countervailing duty from USA and Europe, many factories shut up and went bankruptcy or leave this industry.

JA Solar is one of the main Chinese PV factories, suffering a lot from the current industry situation and struggle to how to reduce the costs and risks to survive and sustainably develop. It's very tough and emergency for them to find the alternatives to proceed.

This thesis first cites the relevant figures to illustrate the global PV market situations and PV market situation in China at the end of 2012, collecting the detailed data of main markets in Europe, Asia-Pacific (APAC) region (Except China), the Middle East & North Africa (MENA) region & Africa and in China, respectively, by the end of 2012, evidencing the overall market situation that Europe still dominates the PV market, followed by China, USA and Japan; Australia, India and Israel markets have undergone some PV growth since 2010; Mexico, South Africa and Chile are expected to develop quickly in future.

Then briefly introduced JA Solar and the bottleneck problems they faced (as I talked in the beginning of this chapter) to put forward the main objective of this thesis is to find out the solutions and strategic choice to survive and sustainably develop.

Followed by the case study of JA Solar. The presentation of JA Solar as the start and proceed the environmental and internal analysis.

As for the environmental analysis, mainly focus on the macro-environment, sector, main markets & competitors' analysis, details are as follows,

- Macro-environment analysis: with PESTEL framework analysis, find out the regulations

and incentive policies, trade practices and barriers are main factors driven PV into the high risk industry; in economic aspect, global economic recession is the main reason for the governments to reduce the incentive supports and large investment in this industry led to the excessive supply capacity.

- Have Five Force Framework to analyze PV sector, shows up the increased buyer's power and intense rivalry between competitors, the strong conflict between PV and the traditional energy and decreased of supplier power.

- Main markets and competitors analyses that each accounting for about 50% of revenues for oversea markets and China, and main competitors with integrated manufacturers, such as Yingli Green Energy, Trina Solar, Jinko Solar, etc.

In term of internal analysis of JA Solar, wrap-up the SWOT analysis, as follows,

Table T6-1: SWOT Analysis

Strengths (S)：	**Weaknesses (W)**
1). Large-Scale Manufacturing Capacity and Facilities; 2). 2 High-Tech R&D Centers; 3). Strong Global Sales Network; 4). Frequently Marketing Activity; 5). Intellectual Property;	1). Young private company, lack of management experience; 2).Weak culture management; 3). Falling price & Little margin; 4). Technology innovation, R&D is hard, takes time & money.
Opportunities (O)	**Threats (T)**
1).Large markets potential; 2). Products differentiation & cost efficiency; 3).Up-and-down-stream value chain opportunity 4). More concerns renewable energy; 5) PV is no.1 of new renewable source of electricity generation in Europe in 2012; 6). Grid parity broadens residential &commercial markets.	1). Rely on policies & high risk; 2). Oversupply& dropping price; 3). High anti-dumping tax made uncompetitive; 4). Little domestic market consumption. 5) Economy recession caused less incentive & consumer investment.

Source: Self-conclusion

Finally conclude the following strategic choices and update the new business model for JA Solar to go ahead,

(1) Cost-leadership strategy, mainly including,

- Set up the one global strategic purchasing team, to combine the overall purchasing requests from the different subsidiaries together and increase the negotiation power with the vendors.

- Establish the Strategic Cooperative Alliance with the main suppliers to improve the manufacturing procedure and workmanship and reduce the cost.

- Re-allocate the facilities and resources to make every factory and facility have the own competitive advantage and own position in the group to maximize their efficient utility rate and reduce the cost.

(2) Differentiation Strategy

- Technology Innovation Differentiation is key factor to make JA Solar differentiate from the competitors and survive & succeed in this sector and maintain the leader in this sector;

- Service-oriented manufacturing Strategy is the main trend to provide the customer the value-add benefits.

(3) Related Diversification Strategy, involves increasing the series of products and market and diversify in products and services with relationships to the existing business.

(4) Forward Integration Strategy, covering the “Installation services” is the big and potential segment market for JA Solar to go ahead. JA Solar should acquire or cooperate with the local service company to explore the overseas markets and should

work with the USA or European PV companies who want to enter in the China markets to have the advanced technology and compete with the competitors and win more domestic market.

(5) Diversified Market Portfolio Strategy, the main method to have more and more geographical business mix to reduce the risk from the governments' regulations and uncertain policies in different countries.

(6) Value-adding activities of corporation Parent, with the efforts to facilitate the envisioning, coaching, more functions of central services and resources provider and proper intervening, illustrates that JA Solar parent company can create more value to the subsidiaries and have more synergy and cooperation with the colleagues together.

As to the updated business model, JA Solar becomes to the solution expect of the whole value chain of PV sector, including the vertically integration of manufacturing PV cells, modules and wafer, research and development, PV system design and attend the bid of PV projects, EPC (Engineering, Procurement and Construction) services for PV installment.

6.2 Limitation of Study

The main limitation of this study is the research conducted and based on one case study, regardless how representative she is, the conclusions can't be generalized.

Moreover, due to the limitation of study time, research level and research conditions, the thesis may have the limited insightful research in depth and scope.

6.3 Suggestions for Future Study

The thesis has tried to provide further insight into the understanding of the challenges during the PV industry development both globally and in China domestic market in the past 10 years and predicts the different market development scenarios. But the market always changing from time to time, especially for the PV industry, different regulations and incentive policies in different countries will promote the PV development or may ruin their existing growth. Further studies are needed to continue depends on the changing scenarios and markets situations in the coming years.

Bibliography

***Exploring Corporate Strategy*:** Text and Cases, Gerry Johnson, Financial Times/Prentice Hall; 9th edition, 2011

GLOBAL STATUS REPORT，***Renewables 2012,*** REN21 c/o UNEP

GLOBAL STATUS REPORT，***Renewables 2013,*** REN21 c/o UNEP

Global Market Outlook for Photovoltaics 2013-2017，***EPIA,*** Gaetan Masson, Marie Latour, Manoel Rekinger, Ioannis-Thomas Theologitis, Myrto Papoutsi

A Solar Holdings Co., Ltd. (JASO) –***Annual and transition report of foreign private issuers pursuant to sections 13 or 15(d),*** Filed on 04/30/2012, Filed Period 12/31/2011, Thomson Reuters Accelus

A Solar Holdings Co., Ltd. (JASO) –***Annual and transition report of foreign private issuers pursuant to sections 13 or 15(d)***, Filed on 04/26/2011, Filed Period 12/31/2010, Thomson Reuters Accelus

A Solar Holdings Co., Ltd. (JASO) –***Annual and transition report of foreign private issuers pursuant to sections 13 or 15(d),*** Filed on 04/26/2013, Filed Period 12/31/2012, Thomson Reuters Accelus

Photovoltaic remuneration policies in the European Union, Carlos J.Sarasa-Maestro, Rodolfo Dufo-Lopez, Jose L. Bernal-Agustin, ***Energy Policy***, April 2013

An analysis of a medium size grid-connected building integrated photovoltaic (BIPV) system using measured data. D.H.W. Li, S.K.H. Chow, E.W.M. Lee, ***Energy and Buildings,*** 1 February 2013

Large scale integration of photovoltaics in cities, Aneta Strzalka, Nazmul Alam, Eric Duminil, Volker Coors, Ursula Eicker, ***Applied Energy***, 9 January 2012

Solar energy: Markets, economics and policies, Govinda R. Timilsina, Lado Kurdgelashvili, Patrick A. Narbel, ***Renewable and Sustainable Energy Reviews,*** 2 October 2011

A review on global solar energy policy, K.H. Solangi, M.R. Islam, R. Saidura, N.A. Rahimb, H. Fayaz, ***Renewable and Sustainable Energy Reviews,*** May 2011

The status of renewable energy in the GCC countries, W.E. Alnaser, N.W. Alnaser, ***Renewable and Sustainable Energy Reviews***, 1 March 2011

The analysis on photovoltaic electricity generation status, potential and policies of the leading countries in solar energy, Furkan Dincer, ***Renewable and Sustainable Energy Reviews***, 9

September 2010

Quantifying rooftop solar photovoltaic potential for regional renewable energy policy, L.K. Wiginton, H.T. Nguyen, J.M. Pearce, ***Computers, Environment and Urban Systems***, 12 January 2010

Economic analysis of different supporting policies for the production of electrical energy by solar photovoltaics in western European Union countries, Luigi Dusonchet, Enrico Telaretti, ***Energy Policy***, February 2010

The potential to exploit use of building-integrated photovoltaics in countries of the Gulf Cooperation Council, H.M. Taleb, A.C. Pitts, ***Renewable Energy***, 21 August 2008

Photovoltaics and renewable energies in Europe, Arnulf Jager-Waldau, ***Renewable and Sustainable Energy Reviews,*** 11 November 2005

Survey of photovoltaic industry and policy in Germany and China, Thilo Grau, Molin Huo, Karsten Neuhoff, ***Energy Policy***, 7 June 2012

Former east Germany gains solar boost, Ralph Kappler, ***Renewable Energy Focus***, May/June 2008

Photovoltaic techno-economical potential on roofs in regions and islands: The case of the Canary Islands. Methodological review and methodology proposal , Julieta Schallenberg-Rodrıguez, ***Renewable and Sustainable Energy Reviews,*** 4 January 2013

Energy and economic analysis for large-scale integration of small photovoltaic systems in buildings: The case of a public location in Southern Spain, D.L. Talavera, E. Munoz-Cerón, J. de la Casa, M.J. Ortega, G. Almonacid, ***Renewable and Sustainable Energy Reviews***, 15 September 2011

Analysis of the photovaltaic solar energy capacity of residential rooftops in Andalusia (Spain), by J. Ordonez, E. Jadraque, J. Alegre, G. Martinez, ***Renewable and Sustainable Energy Reviews,*** September 2010

Overview of the photovoltaic technology status and perspective in Spain, V. Salas, E. Olias, ***Renewable and Sustainable Energy Reviews***, 25 March 2008

Scalable methodology for the photovoltaic solar energy potential assessment based on available roof surface area: Further improvements by ortho-image analysis and application to Turin (Italy), Luca Bergamasco 1, Pietro Asinari, ***Solar Energy***, 14 September 2011

Residential plants investment appraisal subsequent to the new supporting photovoltaic economic mechanism in Italy, Antonio Focacci, ***Renewable and Sustainable Energy Reviews***,

21 April 2009

Review of the performance of residential PV systems in France，Jonathan Lelouxa, Luis Narvarte, David Trebos，***Renewable and Sustainable Energy Reviews,*** 22 November 2011

Tradable green certificates in Flanders (Belgium), Aviel Verbruggen, University of Antwerp, Energy Policy 32 (2004) 165–176, 2003

Spaces for sustainable innovation Solar photovoltaic electricity in the UK, Adrian Smith, Florian Kern, Rob Raven, Bram Verhees Adrian Smith, Florian Kern, Rob Raven Bram Verhees, ***Technological Forecasting & Social Change***,2 February 2013

Revised feed-in tariff for solar photovoltaic in the United Kingdom A cloudy future ahead, Firdaus Muhammad-Sukki, RobertoRamirez-Iniguez, AbuBakarMunir, SitiHajarMohdYasin, Siti HawaAbu-Bakar, ScottG.McMeekina, BrianG.Stewart, ***Energy Policy***, 17 October 2012

Whole systems appraisal of a UK Building Integrated Photovoltaic (BIPV) system Energy, environmental, and economic valuations, Geoffrey P..Hammond, Hassan A. Harajli, CraigI.Jones, AdrianB.Winnett, ***Energy Policy,*** 15 November 2011

Life cycle cost analysis of a multi-storey residential Net Zero Energy Building in Denmark, Anna Joanna Marszal*, Per Heiselberg, ***Energy***, 4 August 2011

Photovoltaic energy mini-generation: Future perspectives for Portugal, Duarte Carvalho , Joao Wemans, Joao Lima, IsabelMalico, ***Energy Policy***, 1 June 2011

Economic performance and policies for grid-connected residential solar photovoltaic systems in Brazil, Martin Mitscher, Ricardo Ruther, ***Energy Policy,*** 25 July 2012

Economic performance of grid-connected photovoltaics in California and Texas (United States): The influence of renewable energy and climate policies, Deepak Sivaraman, Michael R. Moore, ***Energy Policy***, 15 July 2012

The need of subsidy for the implementation of photovoltaic solar energy as supporting of decentralized electrical power generation in Brazil, Jose LuzSilveira, CelsoEduardoTuna, Wendell de Queiroz Lamas, ***Renewable and Sustainable Energy Reviews***, 28 December 2012

The potential of building-integrated (BIPV) and building-applied photovoltaics (BAPV) in single-family, urban residences at low latitudes in Brazil, Ísis Portolan dos Santos, Ricardo Rüther, ***Energy and Buildings***, 28 March 2012

Regulatory potential for increasing small scale grid connected photovoltaic (PV) deployment in Australia, Deepak Sivaraman , RalphE.Horne, ***Energy Policy***, 10 November 2010

Overview of the photovoltaic technology status and perspective in Turkey, Furkan Dincer,

Renewable and Sustainable Energy Reviews, 6 August 2011

The sunrises in the east (of Africa): A comparison of the development and status of solar energy markets in Kenya and Tanzania, Janosch Ondraczek, ***Energy Policy***, 9 February 2013

Trade-off between environmental and economic implications of PV systems integrated into the UAE residential sector, Hassan Radhi, ***Renewable and Sustainable Energy Reviews***, 20 March 2012,

Renewable energy policy options for Abu Dhabi: Drivers and barriers, Toufic Mezher, Gihan Dawelbait, Zeina Abbas, ***Energy Policy,*** 15 December 2011

Renewable energy: Progressing towards a net zero energy island, the case of Reunion Island, Jean Philippe Praene, Mathieu David, Frantz Sinama, Dominique Morau, Olivier Marc, Renewable and Sustainable ***Energy Reviews***, 1 October 2011

Solar photovoltaic in Malaysia: The way forward, Firdaus Muhammad-Sukki, AbuBakarMunir, Roberto Ramirez-Iniguez, Siti Hawa Abu-Bakar, Siti Hajar Mohd Yasin, ScottG.McMeekin, BrianG.Stewart, ***Renewable and Sustainable Energy Reviews***, 28 June 2012

Development of renewable energy in Malaysia strategic initiatives for carbon reduction in the power generation sector, Abd Halim Shamsuddin, SciVerse ScienceDirect, July 2012

Solar energy in Malaysia: Current state and prospects, S. Mekhilefa, A. Safari, W.E.S. Mustaffa, R. Saidur, R. Omar, M.A.A. Younis, ***Renewable and Sustainable Energy Reviews***, 19 October 2011

Solar energy outlook in Malaysia, Shing Chyi Chua, Tick Hui Oh, Renewable and Sustainable ***Energy Reviews***, 23 September 2011

Review on Malaysia's national energy developments Key policies, agencies, Shing Chyi Chua, Tick Hui Oh, ***Renewable and Sustainable Energy Reviews,*** 13 July 2010

Analytical performance monitoring of a 142.5 kWp grid-connected rooftop BIPV system in Singapore, by Stephen Wittkopf, Selvam Valliappan,, Lingyun Liu, Kian Seng Ang, Seng Chye Jonathan Cheng, ***Renewable Energy,*** 8 May 2012

Determinants of success for promoting solar energy in Rajasthan, India, Shreemat Pandey, Vijai Shanker Singh, Naresh Pal Gangwar, M.M. Vijayvergiad, Chandra Prakash, Deep Narayan Pandey. ***Renewable and Sustainable Energy Reviews***, 28 April 2012

Analysis on the development and policy of solar PV power in China, Sufang Zhang, Yongxiu He, on ***Renewable and Sustainable Energy Reviews***, 9 February 2013

Identifying the environmental support and constraints to the Chinese economic growth—An application of the Emergy Accounting method, Bo Lou, SergioUlgiati, South China University of Technology, Guangzhou, P.R. China, Parthenope University of Napoli, Italy, ***Energy Policy***, 4 January 2013

Renewable energy in China An integrated technology and policy perspective, Xiliang Zhang ***Energy Policy***, 18 October 2012

China's Renewable Energy Law and its impact on renewable power in China: Progress, challenges and recommendations for improving implementation, Sara Schumana, AlvinLin, ***Energy Policy***, 11 September 2012

Climate change adaptation on the Qinghai–Tibetan Platea: The importance of solar energy utilization for rural household, Yiping Fang , YanqiangWei, ***Renewable and Sustainable Energy Reviews,*** 23 November 2012

Co-benefit of polycrystalline large-scale photovoltaic power in China, Da Zhang, Songlin Tang, Bao Lin, Zhen Liua, Xiliang Zhang, Danwei Zhang, ***Energy,*** 7 April 2012

The Chinese electricity access model for rural electrification: Approach, experience and lessons for others, Subhes C.Bhattacharyya, SanusiOhiare, ***Energy Policy,*** 24 July 2012

Economical assessment of large-scale photovoltaic power development in China, Da Zhang, Qimin Chai, Xiliang Zhanga, Jiankun He, Li Yue, Xiufen Dong, Shu Wu, ***Energy***, 3 March 2012

Estimation of environmental effect of PVNB installed along a metro line in China, Minan Gu, Yongsheng Liu, Jingjing Yang, Lin Peng, Chunjiang Zhao, Zhenglong Yang, Jinhuan Yang, Wengjian Fang, Jin Fang, Zhenjie Zhao, ***Renewable Energy,*** 28 March 2012

How and when China will exceed its renewable energy deployment targets, Aldo Santalco, LUISS BusinessSchool,Rome,Italy, Fudan University School of Management, Shanghai, China, ***Energy Policy***, 28 September 2012

Lessons from photovoltaic policies in China for future development, Mo-lin Huo, Dan-weiZhang, ***Energy Policy***, 22 May 2012

New energy bases and sustainable development in China: A review, Zeng Ming, XueSong, Ma Mingjuan, Zhu Xiaoli, ***Renewable and Sustainable Energy Reviews***, 31 December 2012

Towards net zero energy design for low-rise residential buildings in subtropical Hong Kong,K.F. Fong, C.K. Lee, ***Applied Energy,*** 29 January 2012

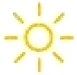
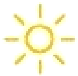
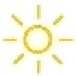
Annex-1 Support schemes in Europe and prospects for PV

- European PV support schemes assessment (early 2013 status)

	General political support situation	Political support environment
Austria		Clear FiT evolution in 2013. Existing reasonable cap still limiting market growth.
Belgium		Changing environment due to increased grid costs and the end of attractive past support. Reduced support to PV for all segments. Streamlined administrative processes. Reduced political support. Support levels in Flanders also reduced in some segments to maintain a market. In Wallonia, very high levels until 2012, leading to a complete review of the scheme.
Bulgaria		Very unstable environment with repeated FiT decreases in 2012 combined to retroactive grid fees that have now been revoked by the Supreme Court. Investment environment very unsecure.
Czech Republic		FiT limited to very small applications (< 30 kWp), triggering a small market. Clear evolution of FiTs. Still a very strong adverse lobbying from conventional stakeholders, including grid operators. Retroactive law passed in 2010, another one expected in 2013. Grid operator blocking new licencing.
Denmark		Net-metering under revision since November 2012. No market expected until new scheme is approved by the EC. Lower support due to a move from yearly to hourly net-metering; but should be open to larger segments.
France		Clear FiT evolution in 2013 for systems up to 100 kWp. Improved transparency on tendering schemes for larger systems. Doubling of yearly objective at the beginning of 2013, but actual support potentially not sufficient to reach objective. Adverse lobbying from conventional stakeholders. Willingness to limit development to control cost. Slow administrative processes still in place.
Germany		Clear FiT evolution in 2013. Restrictions on utility-scale installations to reduce market. Federal elections year making the future of support beyond 2013 unsure with a willingness to reduce cost of FiTs, including retroactively. Simple and lean administrative process. Risk coming from grid operators to finance the grid and overall cost of the support to RES.
Greece		Clear FiT evolution in 2013. Past committed projects to develop market. Adverse financial environment limiting development of new projects. Residential PV favoured over large-scale PV plants. Licensing of new large projects frozen since August 2012, retroactive taxation adopted in Q4 2012, huge delays for producers' payments.

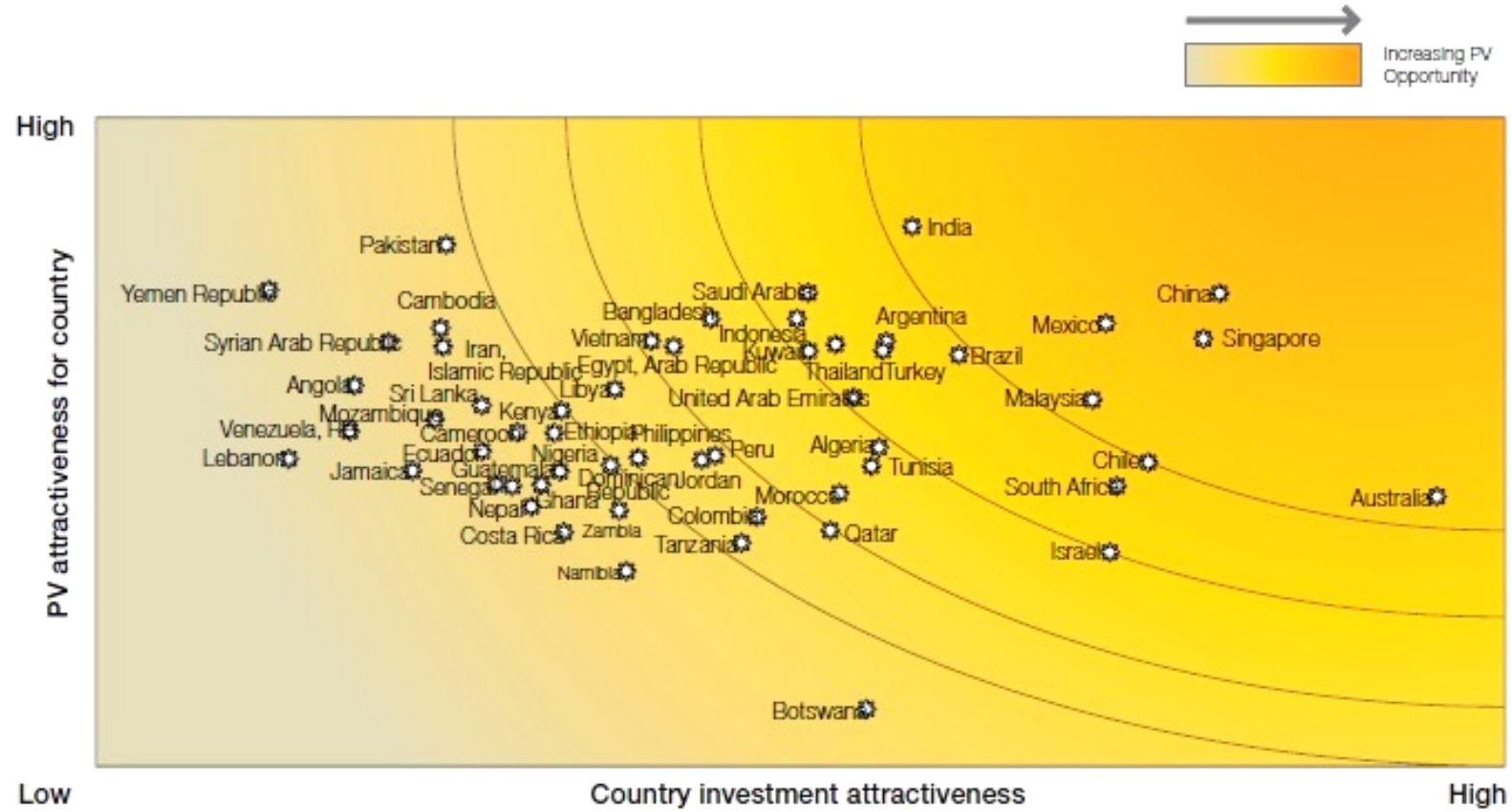
Source: Global Market Outlook for Photovoltaics 2013-2017

【Continued】 **Annex-1 Support schemes in Europe and prospects for PV**

Italy		New FiT scheme since August 2012 with short lifetime due to cap on overall support system cost. No visibility after financial cap reached (probably mid-2013). Willingness to limit development to control costs with the introduction of a register. Improving administrative processes. No direct support after financial cap is reached, leading to a market contraction.
Netherlands		Net-metering and high electricity prices allowing for a residential market to develop rapidly together with an investment grant. Adequate support for a market close to grid parity in the residential segment.
Poland		New FiT and Green Certificate scheme under discussion for over a year; long decision process still ahead, probably until 2014. Possible lack of investor confidence due to lack of formal government decision.
Portugal		Clear FiT evolution for small - to medium-size market segments. Financial crisis limiting market growth. Administrative process simplified for smaller segments. No visibility for larger segments. Competitiveness in the residential segment in sight, so market could develop soon without support schemes anyway.
Romania		Favourable conditions for large-scale systems, support expected to be reduced in the future. Improved legal environment in 2012. FiT for small-scale systems pending approval. Could lead to an overheated market if support not adapted timely.
Slovakia		Very low FiT and heavy administrative barriers. No profitability expected from any investment. Ongoing review of support for small-scale system which could be adopted by the end of 2013.
Spain		Support to PV frozen at the beginning of 2012 and not reintroduced. Overall Spanish electricity tariff cumulative deficit (multi-billion-euro debt) blocking any new development. Net-metering scheme long awaited. Few projects starting independently from support schemes (self-consumption for commercial system with high self-consumption rate, large scale plants to sell on the electricity market), within an unclear regulatory framework. Heavy and slow administrative processes. Many attempts to revitalise the utility-scale segment without incentives, but no significant development so far.
Switzerland		Clear FiT evolution in 2013. Expected increased cap to be adopted this year. Long waiting list progressively being cleared. Market to remain stable this year or even increase.
Turkey		Net-metering scheme for systems up to 500 kW. Large-scale project expected to be approved in 2013. Administrative process unclear. Market should take off in 2013 or 2014.
United Kingdom		Drastic reduction of FiT in 2012. Support scheme regularly adapted now. Green Certificate (GC) scheme for larger systems expected to be reviewed to align itself with FiT levels for smaller-scale installations. Clear and lean administrative processes. Road to competitiveness still long

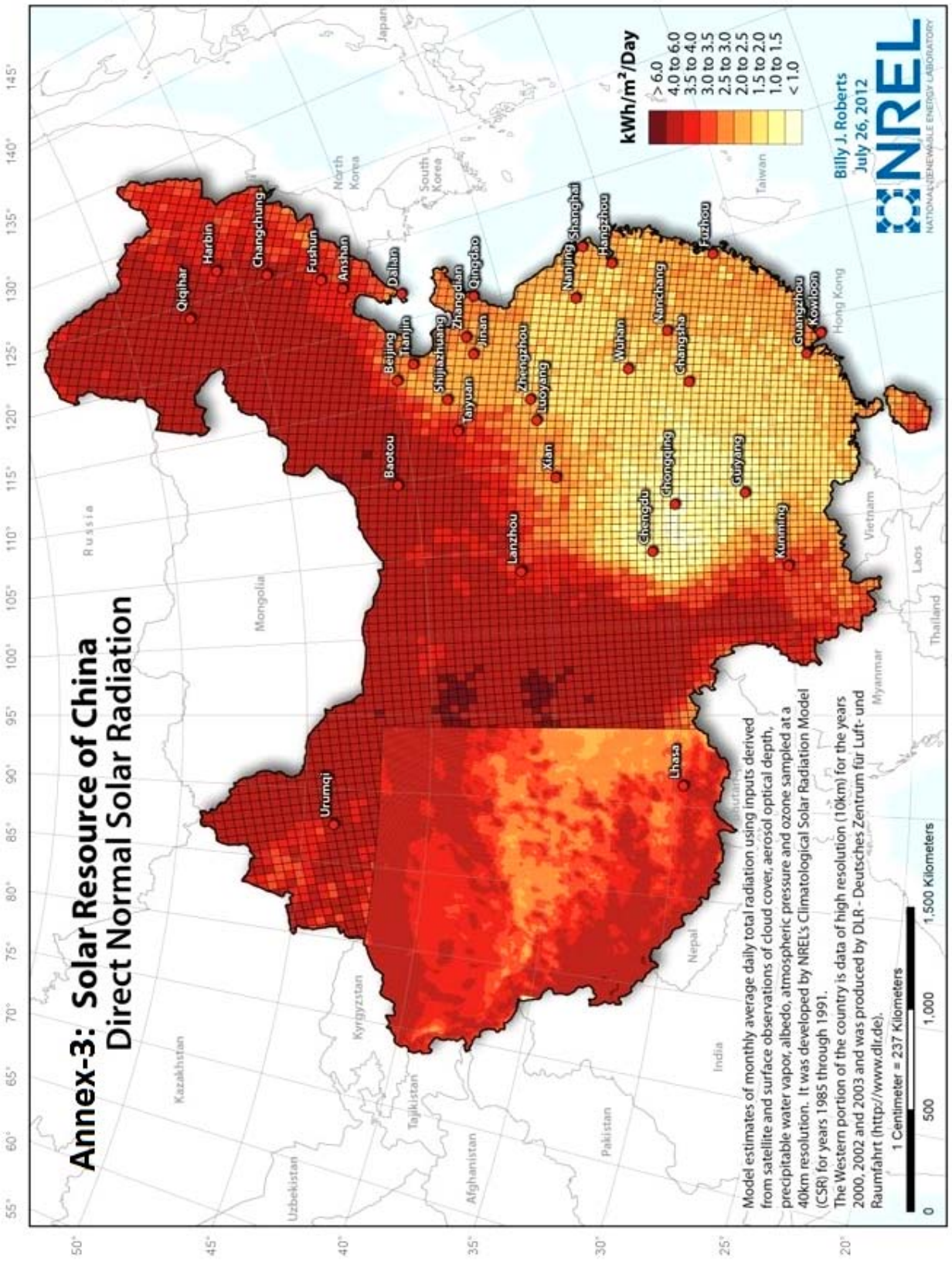
Source: Global Market Outlook for Photovoltaics 2013-2017

Annex-2 PV opportunity mapping of Sunbelt countries*



* Following countries are not shown on the mapping due to poor availability of data: Chad, Côte d'Ivoire, Congo Democratic Republic, Cuba, Iraq, Madagascar, Mali, Myanmar, Somalia, Sudan, Uganda.

Source: EPIA, Unlocking the Sunbelt Potential of Photovoltaics, 2010


Annex-3: Solar Resource of China
Direct Normal Solar Radiation
kWh/m²/Day
> 6.0
4.0 to 6.0
3.5 to 4.0
3.0 to 3.5
2.5 to 3.0
2.0 to 2.5
1.5 to 2.0
1.0 to 1.5
< 1.0
Billy J. Roberts
July 26, 2012
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
Model estimates of monthly average daily total radiation using inputs derived from satellite and surface observations of cloud cover, aerosol optical depth, precipitable water vapor, albedo, atmospheric pressure and ozone sampled at a 40km resolution. It was developed by NREL's Climatological Solar Radiation Model (CSR) for years 1985 through 1991.
The Western portion of the country is data of high resolution (10km) for the years 2000, 2002 and 2003 and was produced by DLR - Deutsches Zentrum für Luft- und Raumfahrt (http://www.dlr.de).
1 Centimeter = 237 Kilometers
0 500 1,000 1,500 Kilometers
Urumqi
Lhasa
Harbin
Qiqihar
Changchung
Fushun
Anshan
Dalian
Beijing
Tianjin
Shijiazhuang
Zhangdian
Qingdao
Jinan
Taiyuan
Zhengzhou
Luoyang
Xian
Baotou
Lanzhou
Nanjing
Shanghai
Hangzhou
Fuzhou
Wuhan
Nanchang
Changsha
Guangzhou
Kowloon
Chongqing
Chengdu
Guiyang
Kunming
Russia
Mongolia
Kazakhstan
Kyrgyzstan
Tajikistan
Uzbekistan
Afghanistan
Pakistan
India
Nepal
Myanmar
Thailand
Laos
Vietnam
North Korea
South Korea
Japan
Taiwan
Hong Kong

Annex-4: NREAPs vs. Reality of PV markets in the EU 27 (MW)

	Cumulative installed capacity in 2012	NREAPs' 2020 target for PV	Necessary yearly market until 2020	Target reached in…	Market in 2011	Market in 2012
Austria	418	322	n/a	reached in 2012	92	230
Belgium	2,650	1,340	n/a	reached in 2011	996	599
Bulgaria	908	303	n/a	reached in 2012	105	767
Czech Republic	2,072	1,695	n/a	reached in 2010	6	113
Denmark	394	6	n/a	reached in 2010	10	378
France	4,003	4,860	107.1	2013-2014	1,756	1,079
Germany	32,411	51,753	2417.8	2016-2020	7,485	7,604
Greece	1,536	2,200	83	2013-2014	426	912
Hungary	4	63	7.4	2013-2015	2.5	n/a
Italy	16,361	8,000	n/a	reached in 2011	9,454	3,438
Netherlands	266	722	57	2014-2016	58	125
Poland	7	3	n/a	reached in 2012	1	4
Portugal	244	1,000	94.4	2016-2020	47	49
Romania	30	260	28.7	2013-2016	1.6	26
Slovakia	523	300	n/a	reached in 2011	321	15
Slovenia	198	139	n/a	reached in 2012	46	117
Spain	5,166	8,367	400.2	2016-2020	472	276
Sweden	19	8	n/a	reached in 2011	4	8
United Kingdom	1,829	2,680	106.4	2013-2014	813	925
Rest of EU 27*	62	360	37.3	2016-2020	22	7
Total EU 27	**69,100**	**84,381**	**1910.12**	**2013-2014**	**22,117**	**16,672**

*** Rest of EU 27 includes Cyprus, Estonia, Finland, Ireland, Latvia, Lithuania, Luxembourg and Malta.**

Source: Global Market Outlook for Photovoltaics 2013-2017

- **National Renewable Energy Action Plans (NREAPs) vs. real PV markets**

Annex-4 compares between the official National Renewable Energy Action Plan target for PV by 2020 and the cumulative installed capacity at the end of 2012 in most European countries, the difference means the capacity needed to be installed by 2020. Moreover, the necessary yearly market to reach this 2020 target (linear projection) is for reference. So there are overall about 15 GW in Europe should be installed by 2020. Germany (about 2 GW), Spain (about 3 GW), France (860MW) and United Kingdom (about 800MW) still remain the main players.

Annex-5: PV Potential in the EU 27 until 2020 vs. 2012 Reality (MW)

	Potential cumulative installed capacity in 2020	Type of scenario	Potential annual market until 2020	Actual newly connected capacity in 2012
Austria	4,000	Accelerated	448	230
Belgium	7,000	Accelerated	544	599
Bulgaria	3,000	Accelerated	262	767
Czech Republic	4,000	Accelerated	241	113
Denmark	1,000	Accelerated	76	378
France	30,000	Accelerated	3,250	1,079
Germany	80,000	Paradigm Shift	5,949	7,604
Greece	8,000	Accelerated	808	912
Hungary	2,000	Accelerated	249	n/a
Italy	42,000	Accelerated	3,205	3,438
Netherlands	8,000	Paradigm Shift	967	125
Poland	5,000	Accelerated	624	4
Portugal	3,000	Accelerated	344	49
Romania	5,000	Accelerated	621	26
Slovakia	3,000	Accelerated	310	15
Slovenia	1,500	Accelerated	163	117
Spain	18,000	Accelerated	1,604	276
Sweden	1,000	Accelerated	123	8
United Kingdom	22,000	Paradigm Shift	2,521	925
Rest of EU 27*	1,850		226	20
Total EU 27	**249,350**		**22,534**	**16,672**

*** Rest of EU 27 includes Cyprus, Estonia, Finland, Ireland, Latvia, Lithuania, Luxembourg and Malta.**

Source: Global Market Outlook for Photovoltaics 2013-2017

Potential vs. market reality for PV deployment in Europe

Annex-5 indicates the potential per country by 2020. In consideration how the markets have been grown by now and EPIA expected how the markets can continue to develop in the coming decade if appropriate policy measures are carried out and barriers are removed, one of three scenarios has been chosen in each country.

Blue digits show the countries which underperformed and in red words indicate the countries exceeded this annual predicts. Anyway, the whole European market was at an appropriate level, but the results are not in the position to be sustainably balanced.