

Critical subsystems for thin-film PV manufacturing equipment

John West, VLSI Research Europe Ltd., Cambridge, UK

ABSTRACT

Sales of critical subsystems used in thin-film PV manufacturing equipment are expected to reach \$324M in 2011, and the outlook is for this figure to grow by 3.74% in 2012 to \$336M. This expectation is going against the trend for the industry as a whole, which is predicted to decline next year as revenues from cell and module manufacturing weaken. The reason for this countermovement is the opportunities available to manufacturers who are willing to invest in the latest thin-film PV equipment to drive down costs and force unprofitable competitors out of business. While the same opportunities exist for crystalline silicon manufacturing, the number of well-resourced companies signalling their intention to invest in thin-film technologies should ensure a positive year for suppliers of equipment and critical subsystems to this segment of the industry.

The critical subsystems market

Critical subsystems are products that have been designed to address specific applications within the semiconductor and related manufacturing industries and actively affect the processing and handling of substrates. They are high-technology and high-value products, and a well-defined group of companies has emerged to serve this market. A defining feature of this market is the level of dependency that equipment companies have on these suppliers for technology developments which enable them to develop the next-generation process tools. The semiconductor industry is clearly the largest market, but in recent years the photovoltaic industry has evolved from being one of several niche thin-film manufacturing industries to become the third-largest market for critical subsystems, just behind the flat-panel display industry. The latter is now fully mature and its growth prospects are limited, so it will not be long before the photovoltaic industry becomes the second-largest market for critical subsystems.

In 2011 the total market for critical subsystems is expected to reach \$7.7Bn, just beating the peak value of \$7.3Bn achieved in 2000. Critical subsystems for all photovoltaic applications will account for just under 10% of the total at \$740M, which is quite an achievement considering the value of critical subsystems sold into the photovoltaic industry was only \$10M in 2000. Of the \$740M likely to be sold this year, \$324M relates to equipment for thin-film PV manufacturing.

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The main subsystem technologies used are fluid management, integrated process diagnostics, process power, thermal management, vacuum subsystems, substrate handling and other subsystem technologies. The largest segment is for

vacuum subsystems, which includes vacuum pumps, pressure gauges and abatement subsystems, and represents 37% of the total in 2011 with a value of \$120M. The next largest segment is for process power subsystems, which includes RF, DC and microwave power supplies, matching networks, and fluorine gas generators, and represents 19% of the market at \$60M.

In 2012 sales of critical subsystems into the thin-film PV manufacturing industry are expected to grow 3.74% to a value of \$336M. The top suppliers of critical subsystems to the PV industry are Advanced Energy, Alcatel (now part of Pfeiffer Vacuum), Edwards, Horiba, and MKS Instruments.

Thin-film manufacturing

The photovoltaic industry, like much of the global economy, is having some difficulties right now and this is forcing change in the industry. There is a strong argument that photovoltaics is now in the third phase of the industry lifecycle, which is all about reducing cost and eliminating unproductive players. This process is becoming clearer as the dominant technologies are emerging and the benefits of economies of scale have been established. The outcome is that smaller players are being acquired or exiting the market and new entrants will be, for the most part, restricted to well-resourced companies. For suppliers of thin-film PV panels this is a very interesting time. Over 30% of PV manufacturers are engaged in the manufacture of thin-film panels, yet as a group they only account for 20% of industry sales. This means that there has to be realignment with the rest of the industry soon. This is already becoming apparent because some of the smaller participants have already exited the market as they run out of time to prove their commercial viability. The highest-profile casualty to date has been Solyndra and, with several others

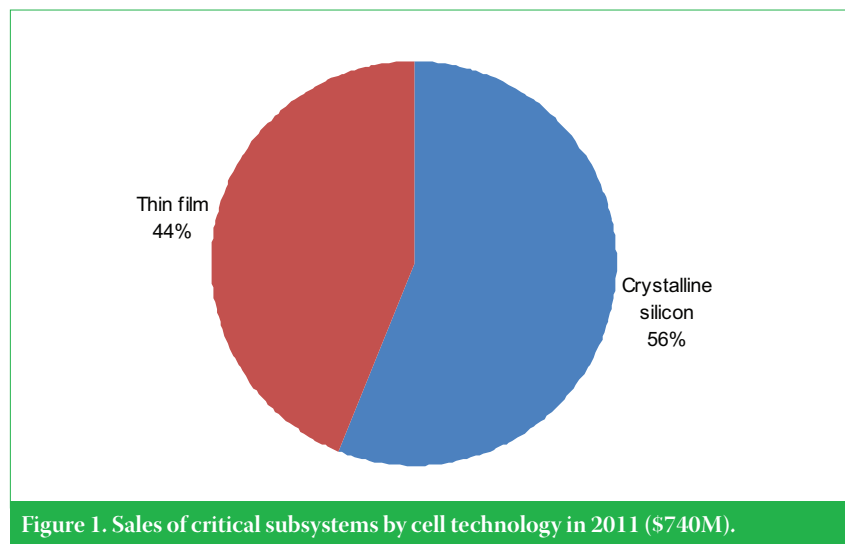


Figure 1. Sales of critical subsystems by cell technology in 2011 (\$740M).

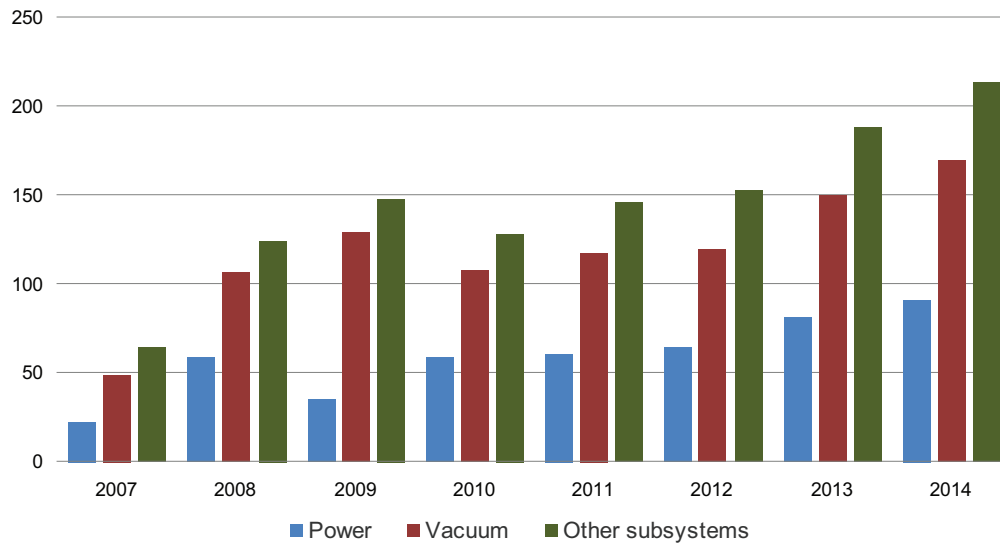


Figure 2. Sales of critical subsystems for thin-film PV equipment 2007–2014 (\$M).

at risk, there could be as much as 400MWp of thin-film capacity retired in 2011.

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While this is sending shockwaves throughout the industry as a whole, it should be noted that First Solar, a thin-film PV manufacturing company, actually has the best track record on profitability of any cell and module manufacturer of any cell technology. This fact has attracted new entrants to the market despite concerns about overcapacity. Last year Solar Frontier came in with a huge 900MWp investment at its CIS fab in Japan, and TSMC are

ramping up capacity of their CIGS fab in Taiwan. In addition GE has announced its intention to expand its CdTe fab to 400MWp in the next few years. The list of well-resourced companies with proven thin-film technology extends to around a dozen companies, all of which are scheduled to invest next year and are likely to be in the market for the long term. This is good news for suppliers of critical subsystems, as the proportion of critical subsystems sales per \$ spent on thin-film PV manufacturing equipment is higher than that for crystalline silicon. As a result the demand for critical subsystems will grow faster than the PV equipment market as a whole.

Thin-film equipment suppliers

The thin-film PV equipment market is split into two major segments: silicon thin film and non-silicon thin film. Currently,

the silicon thin-film PV equipment market is the largest segment, with equipment sales expected to exceed \$1100M in 2011. However, silicon thin-film technology has struggled to compete against the steep price declines of crystalline silicon modules for several years. This is unfortunate as silicon thin-film technology has great potential. It is interesting to note that the industry would have been very different if the silicon thin-film equipment suppliers could have brought their technology roadmap forward by just 18 months. As it is, silicon thin film has been just one step behind the cost curve and for this reason it takes second place to crystalline silicon. Accelerated product development at Oerlikon and other equipment suppliers should put this technology back into contention for 2012, assuming that prices for crystalline silicon modules do not collapse. However,

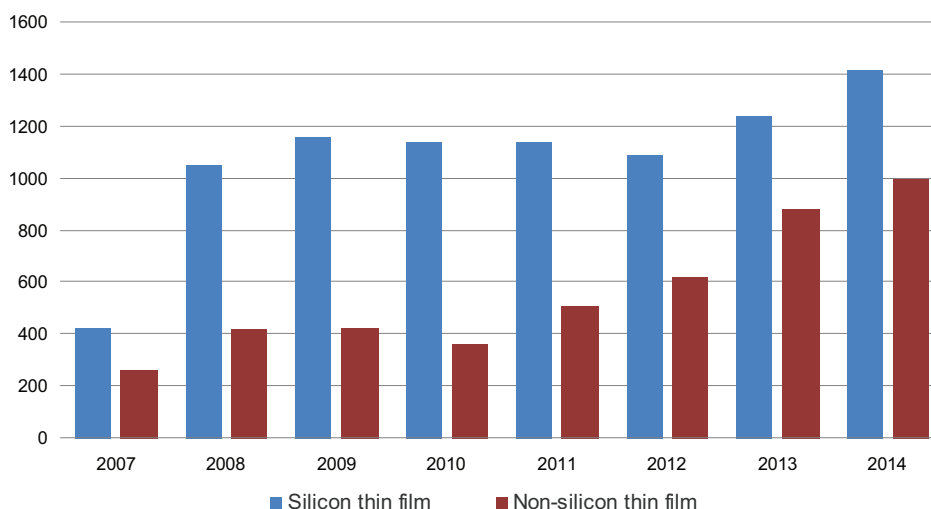


Figure 3. Sales of thin-film PV equipment 2007–2014 (\$M).

demand for silicon thin-film equipment in 2012 is dependent on what happens with Hanwa and its plans to complete the investment in its 1GW plant in China. So far, the first phase has been completed and over \$400M of equipment has been installed. What happens next depends on how successful Hanwa is in ramping up production and finding large customers. The major suppliers of vacuum processing equipment for silicon thin-film manufacturing are Oerlikon Solar, Ulvac, Jusing and Apollo Solar.

The market for non-silicon thin-film PV manufacturing equipment, on the other hand, is relatively small at \$500M. This figure is set to grow in 2012 as First Solar continues to invest and some of the new entrants start to spend heavily. The non-silicon thin-film market is different in that much of the equipment supplied is designed to the panel manufacturer's specifications. This means that there is a relatively large part of the market which is served by captive suppliers. This is something of a problem for equipment suppliers, as it reduces the size of their addressable market, but from the critical subsystems suppliers' perspective this does not matter, as they sell to both captive and merchant markets. The major vacuum processing equipment vendors for non-silicon thin-film manufacturing are centrotherm photovoltaics and Von Ardenne Anlagentechnik.

Conclusion

The photovoltaic equipment industry has undergone explosive growth in recent years to become a significant market which will exceed a value of \$7.3Bn in 2011 (excludes polysilicon, ingot and wafering equipment). Suppliers of subsystems and components have been major beneficiaries, as the growth will result in sales of \$740M this year and has helped to offset their reliance on the semiconductor and flat-panel display industries. While thin-film PV manufacturing equipment makes up only 22% of the cell and module PV equipment market, it accounts for just under half of the demand for critical subsystems. This is because thin-film PV manufacturing is vacuum process intensive and as such requires more critical subsystems per \$ of capital expenditure than crystalline silicon manufacturing.

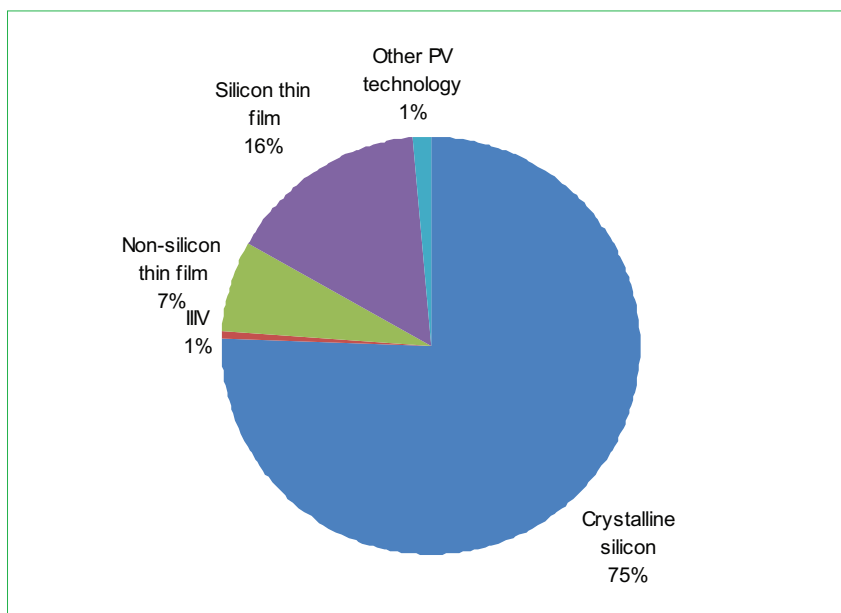


Figure 4. Cell and module manufacturing equipment by cell technology 2011 (\$7.3Bn).

Uncertainty in the financial markets is currently tempering the growth in all the PV markets. End demand for PV cells has weakened, and the reduced access to finance has caused the less profitable PV cell and module manufacturers to pull back on their original expansion plans. However, the winners in this industry will be those companies that continue to invest when the market is weak. This means that 2012 will be the year when upgrading existing capacity, and investing in leading-edge manufacturing equipment, will drive demand rather than pure capacity expansions.

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Forecasting the equipment market is difficult, as demand for cells and modules is primarily driven by government targets. Nevertheless, one aspect of the PV industry has been relatively constant and that is the growth in demand in terms of shipments in MWp. This demand has increased continuously over the past 10 years at double-digit rates, even during the financial crisis in 2009. The message is that demand

for PV modules and panels in MWp is growing and is set to continue to do so throughout 2012. However, this growth comes at a cost, and this cost is lower revenue growth. The dilemma facing the industry is how to stay profitable as prices fall. It is clear that those companies that are not profitable at today's prices are not going to be profitable at next year's prices unless they invest in new manufacturing technology. The likely scenario for next year, despite the threat of falling revenues, is for the profitable and well-resourced companies to invest to stay competitive. Overall, capital expenditure on equipment is expected to fall by at least a quarter in 2012, although demand for thin-film equipment is predicted to grow modestly by around 3%. This in turn will drive growth of 3.74% for critical subsystems used in thin-film PV manufacturing equipment.

About the Author

John West is the managing director of VLSI Research Europe, a firm focused on market research and economic analysis of technical, business and economic aspects within the photovoltaic, semiconductor, nanotechnology and related industries. He has been analyzing the PV capital equipment market since 2006.

Enquiries

Tel: +44 1223 393633
Email: johnwest@vlsiresearch.com