

## **Packaging typically accounts for 20% to 60% of the packaged LED total cost**

“Packaging typically accounts for 20% to 60% of the packaged LED total cost and therefore represents the single largest opportunity for cost reduction”, says Yole Développement LED Packaging Report, from Yole Développement

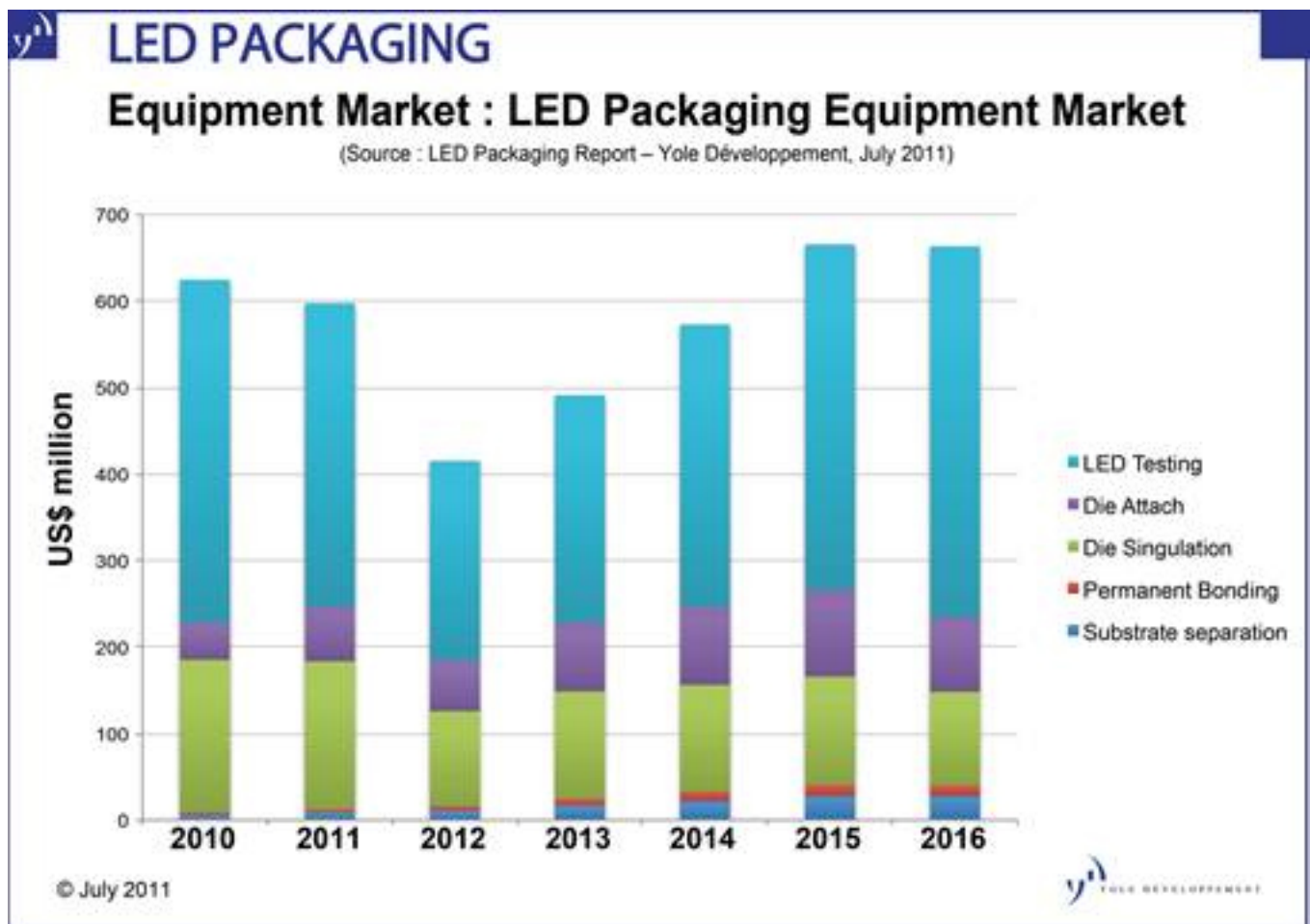
Lyon, France – Sept. 14, 2011 – Yole Développement announced its report LED Packaging. “More than \$2B will be invested over the 2011-2016 period in new equipment for LED packaging (LLO , permanent bonding, singulation and testing)”, says Eric Virey, Yole Développement.

LED packagers are still using mostly retrofitted equipment from the IC industry and relying on existing technology solutions and materials to improve LED cost of ownership and performance. While this has allowed LED manufacturers to benefit from decades of research and development and investments in the IC industry, it also constrains the industry into the space defined by existing technology platforms that are not optimized for the specific needs of LEDs. But the industry has now gained enough momentum and reached a critical mass to entice equipment and material providers into developing dedicated solutions for LED manufacturing. Many dedicated solutions are emerging from existing and new players that will allow significant reduction in LED manufacturing cost through improved yields, throughputs and material efficiency.

LED packaging equipment over-investment in the last 2 years leading to a short down-cycle starting in 2012

No LED manufacturers want to get caught short of capacity when the general lighting market scheduled to reach \$20B by 2020 takes off. Thus, an unprecedented investment cycle started toward the end of 2009 and will extend through early 2012. This cycle initiated in Korea is now essentially fueled by subsidies and other incentives in China, as the country is aggressively trying to position itself as a future leader in solid state lighting. New entrants are investing massive amounts of money in order to displace existing manufacturers. This will lead to a world averaged overcapacity that will briefly exceed 50% for some tools (ie: capacity utilization rate of <50%) by mid-2012.

This in turn will cause a 12-18 month down cycle for most equipment makers corresponding to the absorption of this overcapacity as well as some consolidations that will bring the industry back to more usual utilization rates of 80%. This down cycle will extend through mid-2013. Then we expect a new investment cycle to kick in to respond to further increase in increasing demand for general lighting. This might lead to another shorter excess investment to be absorbed in 2016.



**Material and component suppliers will enjoy a smoother ride with regular growth at a CAGR of 27.6% between 2011 and 2016**

Package substrate makers will see the fastest growth with a CAGR of 45% through the period. Phosphors will experience strong price pressure but still enjoy double digit growth with a CAGR of 12%. With the intensifying competition, players try to differentiate themselves by proposing an increasingly wide variety of technology options for LED packaging. Substrate material options as well as assembly and interconnection techniques abound as many workarounds to the limiting patents of the established players.

New players from the general semiconductor markets propose new solutions based on their respective capabilities. Similarly to IC packaging, new technologies for LED packaging add up to the existing ones without completely phasing them out. And there's still a lot of room for innovation that could allow capturing more added value. For such products however, it remains paramount that the solution offers an overall reduction in cost of ownership (\$/lumen) to LED manufacturers.

Yole Développement's report reviews the major challenges associated with the key LED packaging process steps, and insights are shared on the pros and cons of the various technology options and their future forecasted trends.

It focuses especially on the most recent technologies and market trends for high power LED and packages and arrays and provides quantification for various materials and equipment associated with each of those key steps. Trends are

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analyzed in detail including emerging technologies like Silicon substrates, Wafer level packaging, COB etc...

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