



SEOUL SEMICONDUCTOR

Trends in the industry and a perspective from Asia

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February 2, 2017

Some things change, some stay the same...

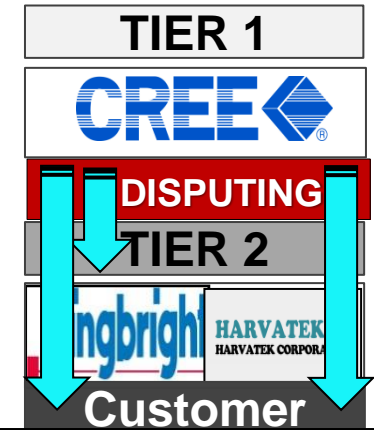
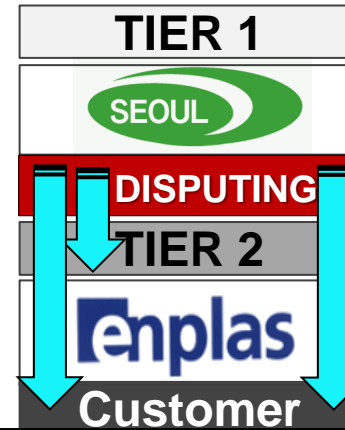
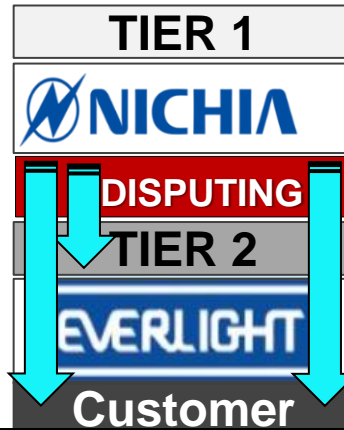
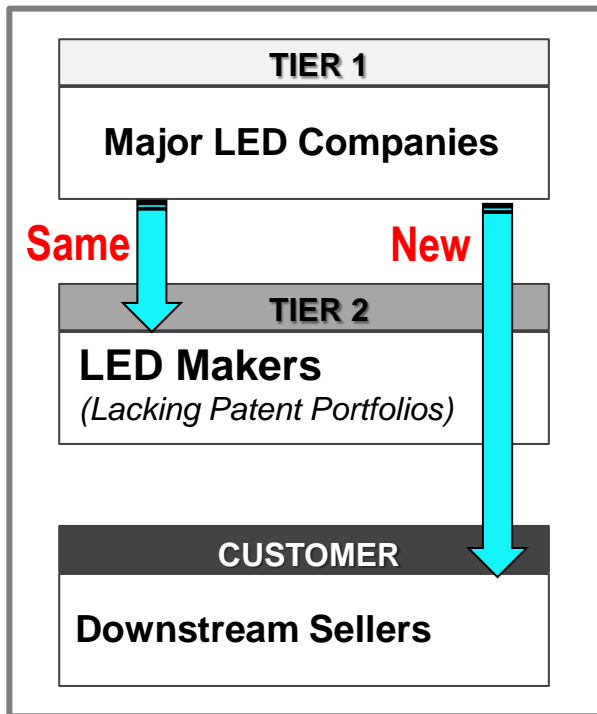
Changed:

- IP
- IoT is a real thing
- Spectral modification looks promising
- Two tiers of quality
- Supply chain uncertainty
- Regulatory help
- UV applications beginning to take shape

Same:

- IP
- Binning
- Drive for lower cost

Recent IP Enforcements



January 10, 2017 - 11:35 — judy.lin | 2491 pageviews

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Nichia Files Four New Patent Infringement Suits against U.S. TV Makers and LED Distributors

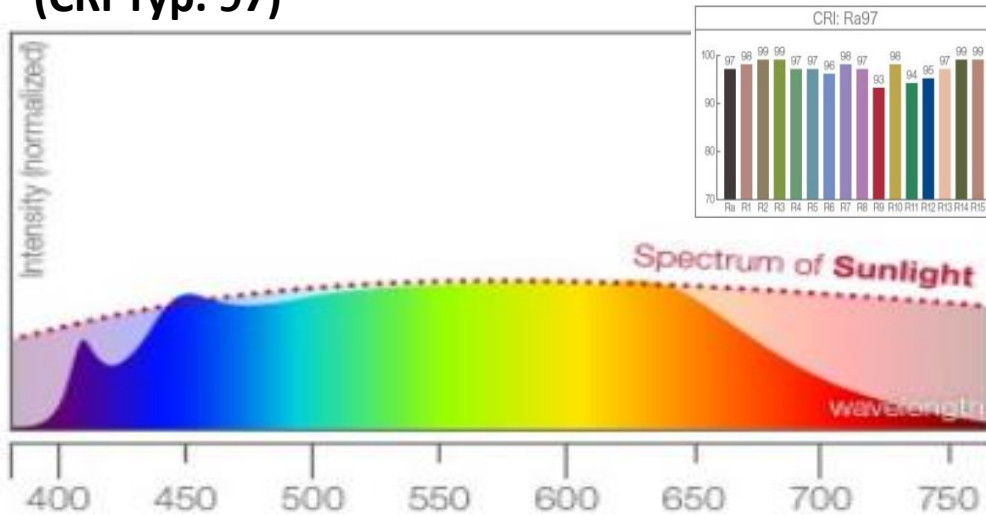
On Dec. 27, 2016, Nichia Corporation ("Nichia") filed four patent infringement lawsuits in the United States District Court for the Eastern District of Texas. The defendants in the lawsuits are (1) TTE Technology, a US-based LCD TV distributor, and its parent company, TCL Multimedia Technology Holdings Limited, a Chinese manufacturer of LCD TVs; (2) VIZIO, a US-based LCD TV maker; (3) **Lowe's Home Center LLC ("Lowe's")**, a US-based retailer of [LED lighting](#) and other products, and Lowe's affiliated U.S. distributor, LG Sourcing, Inc.; and (4) Feit Electric Company, Inc., a US-based [LED](#) lighting manufacturer and distributor. In these lawsuits, Nichia asserts that defendants have infringed Nichia's U.S. Patent No. 9,490,411. Nichia seeks an injunction prohibiting the defendants' sale and distribution of infringing products. Nichia also seeks damages for defendants' infringement.

Matching Nature Spectrum With LED

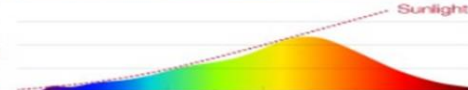
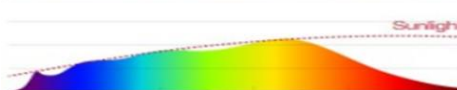
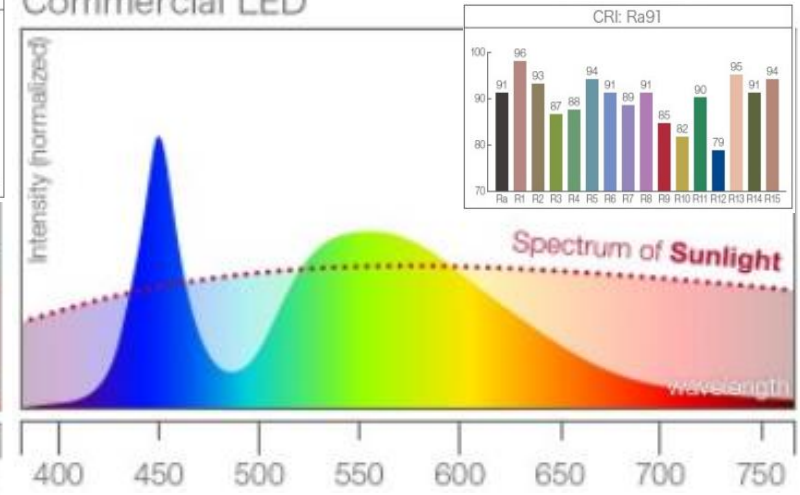
Spectrum closer to the natural sunlight

Under Development

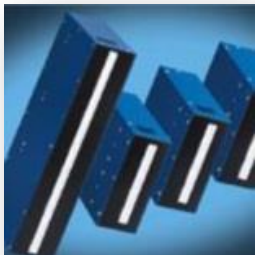
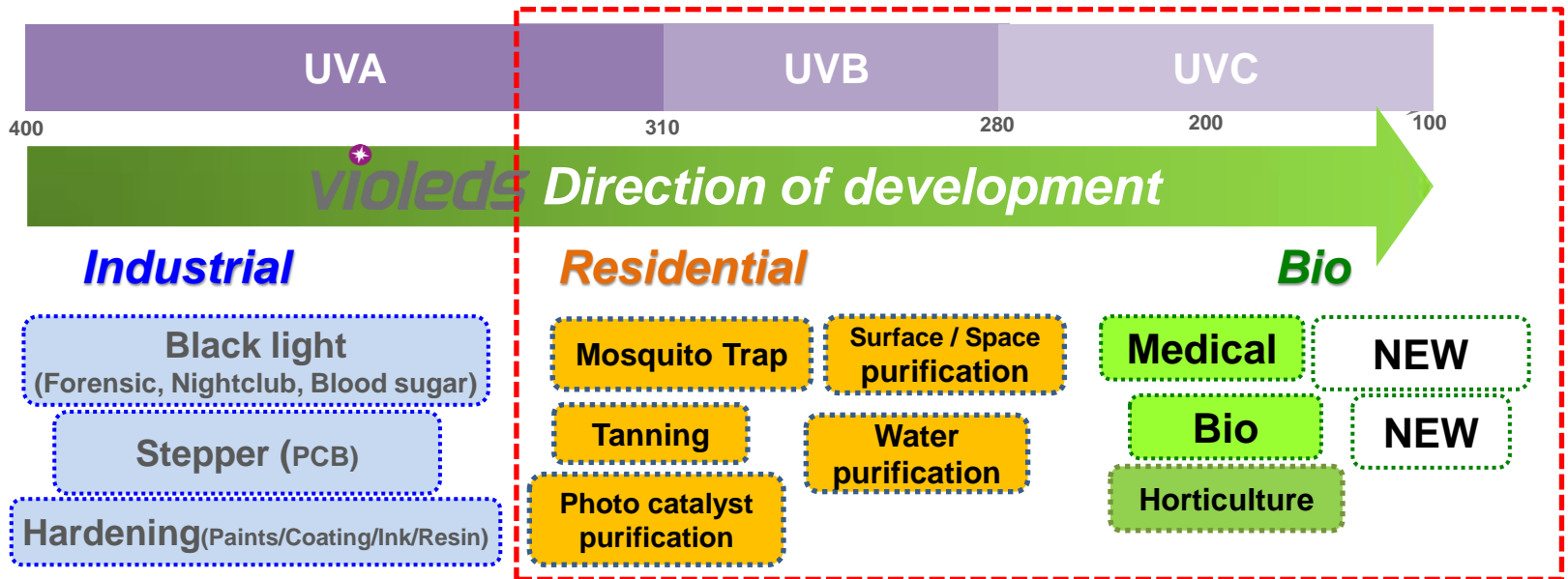
(CRI Typ. 97)



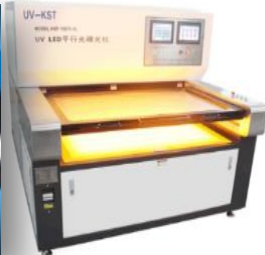
Commercial LED



UV LED Roadmap Coming Together



Curing



Exposure Equip.



Printing



Multi Surface Disinfection



Insect Trap



Water Disinfection for Automotive



Air Purifier

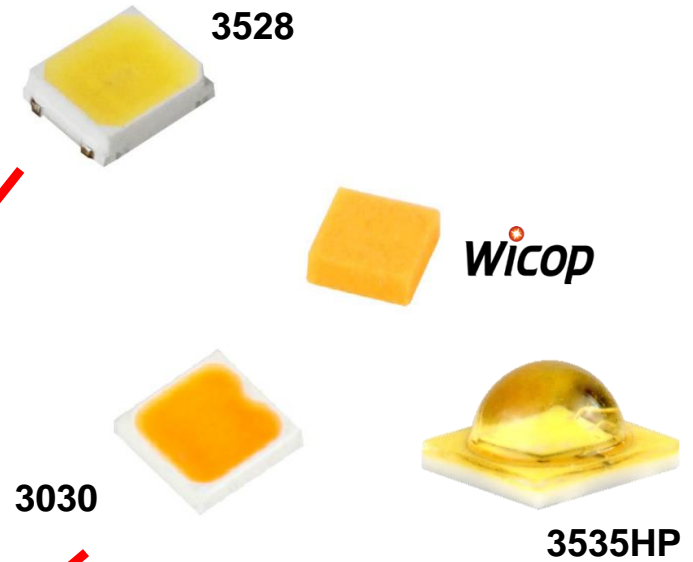


Bio / Medical Device



Two Tiers of Quality?

- Different performance (LPW)
- Different Lumen Maintenance
- Different LED solution
- Different cost



DesignLights Consortium™ Product Qualification Criteria (FINAL 11/1/2016)

Technical Requirements Table, V4.1
Table 1: Technical Requirements: Luminaires

#	Category	General Application	Minimum Light Output (lm)	Requirements					Primary Use***	Distribution
				DLC Standard			DLC Premium**			
			Minimum Efficacy (lm/W)	Minimum Warranty (years)	CCT / CRI / L70	Minimum Efficacy (lm/W)	Minimum Warranty (years)	CCT / CRI / L90 / L70		
1	Outdoor	Outdoor – Low Output	250-5,000	90	5	≤5700 / ≥65 / ≥50,000	110	5	≤5700 / ≥65 / >36,000 / ≥50,000	<ul style="list-style-type: none"> • Outdoor Pole/Arm-Mounted Area and Roadway Luminaires • Outdoor Pole/Arm-Mounted Decorative Luminaires • Outdoor Full-Cutoff Wall-Mounted Area Luminaires • Outdoor Non-Cutoff and Semi-Cutoff Wall-Mounted Area Luminaires • Bollards • Parking Garage Luminaires • Fuel Pump Canopy Luminaires • Landscape/Accent Flood and Spot Luminaires • Architectural Flood and Spot Luminaires • Stairwell and Passageway Luminaires • Specialty: _____
2		Outdoor – Mid Output	5,000-10,000	95			115			
3		Outdoor – High Output	10,000-30,000	100			120			
4		Outdoor – Very High Output*	≥30,000	100			120			

Supply Chain Consolidation

Year /Month	Buyer	Target	Buyer's Ventures	Target's Ventures	Acquired Stake	Status
2016.12	Grand Chip Investment	Axitron	Chinese Investor	MOCVD Maker		Halted
2016.11	IDG Capital (incl. MLS)	Osram Ledvence	Consortium	LED application		Under review
2016.03	San'an Opto	GCS Holdings	LED chip	Wafer Foundry		Halted
2016.03	MLS	Super Trend Lighting	LED packaging, application	Filament Bulb	80.00%	
2015.09	MLS	Kaistar Lighting	LED packaging, application	LED chip, packaging	10.91%	
2015.07	Xinda	Glory Sky	LED packaging, application	LED packaging	75.00%	
2015.07	Kaistar Lighting	Bridgelux	LED chip	LED chip, packaging	100.00%	
2015.06	Refond	LT Photoelectricity	LED packaging	LED packaging	85.00%	
2015.06	Nationstar	Invenlux Technology	LED chip, packaging	LED chip	62.50%	
2015.04	Go Scale Capital	Lumileds	Private Equity Firm	LED packaging	80.10%	Halted/Apollo Capital acquired 2016.12
2015.04	Hua Tian Technology	MIC LED Light	Industry Outsider	LED packaging	51.00%	

Source: Recent Acquisitions and Megers in Chinese LED industry by LEDinside, Sept., 2015 & Various Sources

Musical Channels



Apr 28, 2016



May 4, 2016



July 21, 2016

- Old Order
- New Order

Regulatory Help



Obama set to block sale of German LED equipment maker to China

Published on: December 2, 2016

By Mark Halper

Contributing Editor, LEDs Magazine, and Business/Energy/Technology Journalist

Aixtron develops deposition gear in California. Its acquisition by Fujian Grand Chip is in doubt out of national security concerns.



Another day, another Chinese takeover of a Western LED technology company in doubt, as US President Barack Obama looks set to block the acquisition of German manufacturing equipment maker Aixtron SE by a unit of Fujian Grand Chip Investment Fund LP, out of national security concerns.



October.28, 2016 - 14:43 — judy.lin | 4499 pageviews

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German Government Puts Chinese Consortium Acquisition of Osram's LEDVANCE on Hold

The German government has temporarily halted Chinese consortium headed by strategic investor IDG Capital Partners (IDG) to acquire Osram's general lighting business LEDVANCE, and have put the deal under review. [Reuters](#) cited German magazine WirtschaftsWoche recent report.

IDG and lighting partner Forest Lighting (also known as MLS) proposed acquisition of Osram for EUR 400 million (US \$439.58 million) has been delayed over financial issues, according to the magazine this could delay the business transaction for another three to four months before it would be cleared by German authorities.

News-Spot | Business | Company News | Jan 27, 2016

Philips and GO Scale Capital led Consortium Terminate Lumileds Transaction

Royal Philips announced that Philips and GO Scale Capital have terminated the agreement pursuant to which the consortium led by GO Scale Capital would acquire an 80.1% interest in Lumileds.

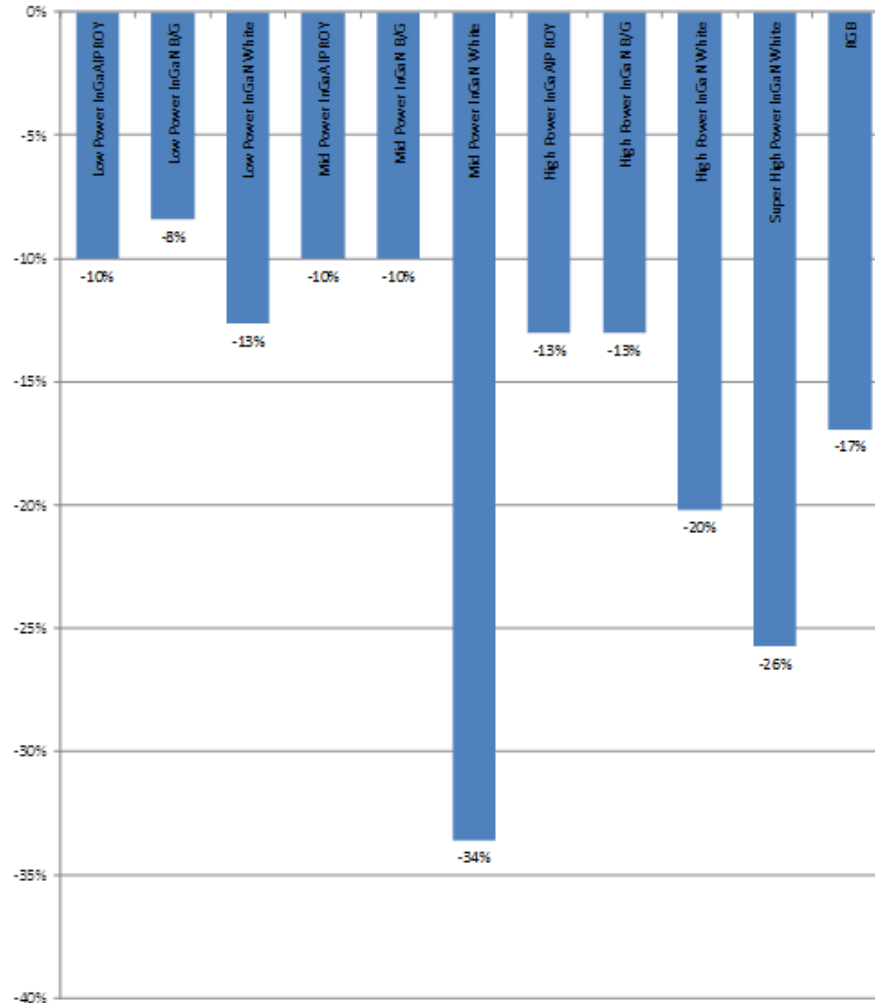
- Parties withdraw CFIUS filing and terminate agreement, because of inability to resolve CFIUS' unforeseen concerns
- Philips is engaging with other parties that have expressed an interest in the Lumileds business
- Termination of the agreement does not impact Philips' separation process

Despite the extensive efforts of Philips and GO Scale Capital to mitigate the concerns of the Committee on Foreign Investment in the United States (CFIUS), regulatory clearance has not been granted for this particular transaction.

Price Continues to Decline

ASP Declines, 2014-2015

Figure 2.5.4 ASP Declines, 2014-2015



But We May Be Finding a Bottom...

December 5, 2016 - 17:53 — ivan | 4758 pageviews

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Chinese LED Package Price Surge at Record Rate

Early in May, Luxlite, Epistar's sole distributor in China, has sent out an announcement of price adjustment, listing a number of reasons for price increase, including continually increased raw materials and manpower costs.



(Official announcements from Luxlite, Smalite and Rishang regarding the rise of LED package price)

Chinese LED chips manufacturers San'an Opto and HC Semitek followed suit Epistar's lead in raising LED chip prices, which was considered as an early sign of recovery from the heated price war since 2014. Major LED package manufacturers including Smalite, Honglitrionic, Xuyu Optoelectronics, and SAMSUNG have announced to raise price this week.

<http://www.ledinside.com/node/26718>



Cost Savings Through Manufacturing

Vietnam



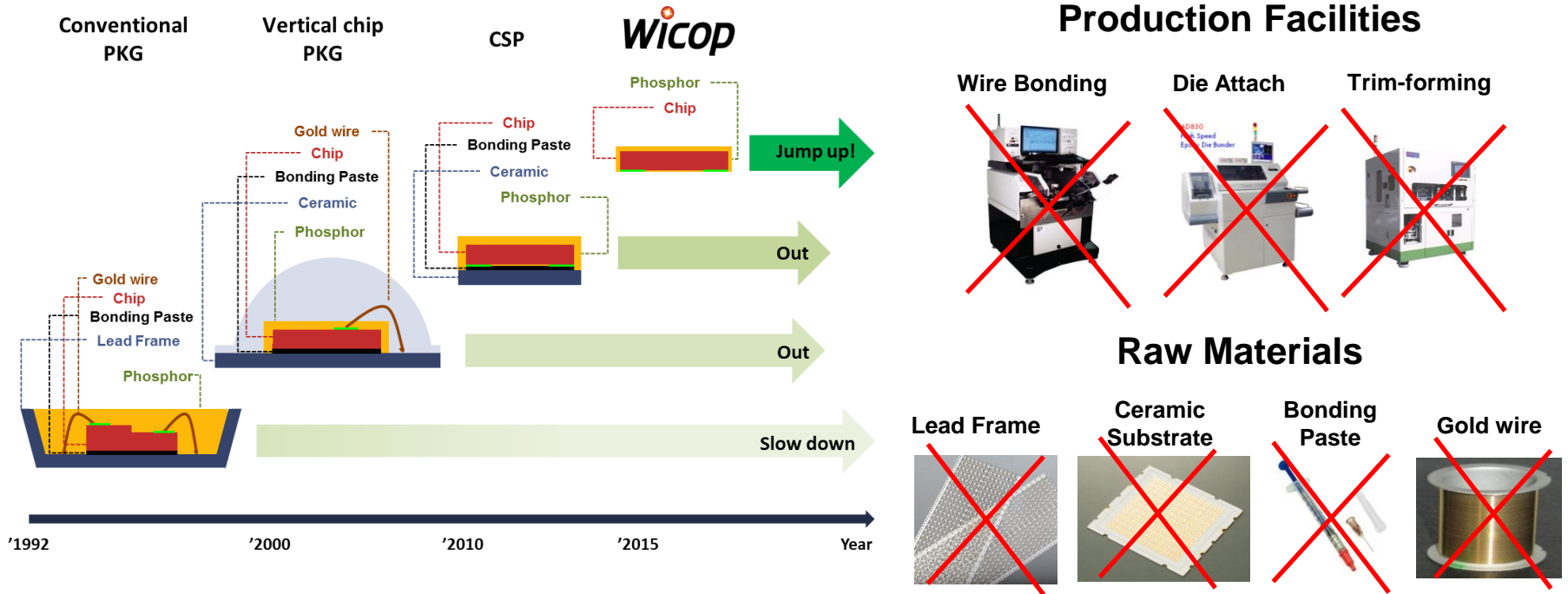
- World-class manufacturing cost basis
- Chip P&T and packaging
- Opening March 2017

Cost Saving Through Innovation

Wicop



Next Generation of LED – Truly Packageless



- **Drops in to standard 3535 HP sockets**

- Significantly brighter, lower cost
- 18% smaller
- Standard pick and place recipes
- Great thermal performance
- No change in TIR optic
- >100% better color over angle ($u' - v'$)
- +9K hrs LM80

Summary

- **Many changes**
- **Many constants**
- **Cost reductions have been breathtaking but the low hanging fruit may soon be gone**
- **Uncertainty in the supply chain**
 - **Consolidation has started in China**
 - **Several of the major LED suppliers are making major structural changes;**
 - **Distribution channel is maturing**
- **Innovation will continue to be the real engine to enable new cost points and new applications**
- **The companies, shareholders who pay for that innovation should be repaid for their investment**