



# Speculative thinking about the future of LED and OLED lighting industries

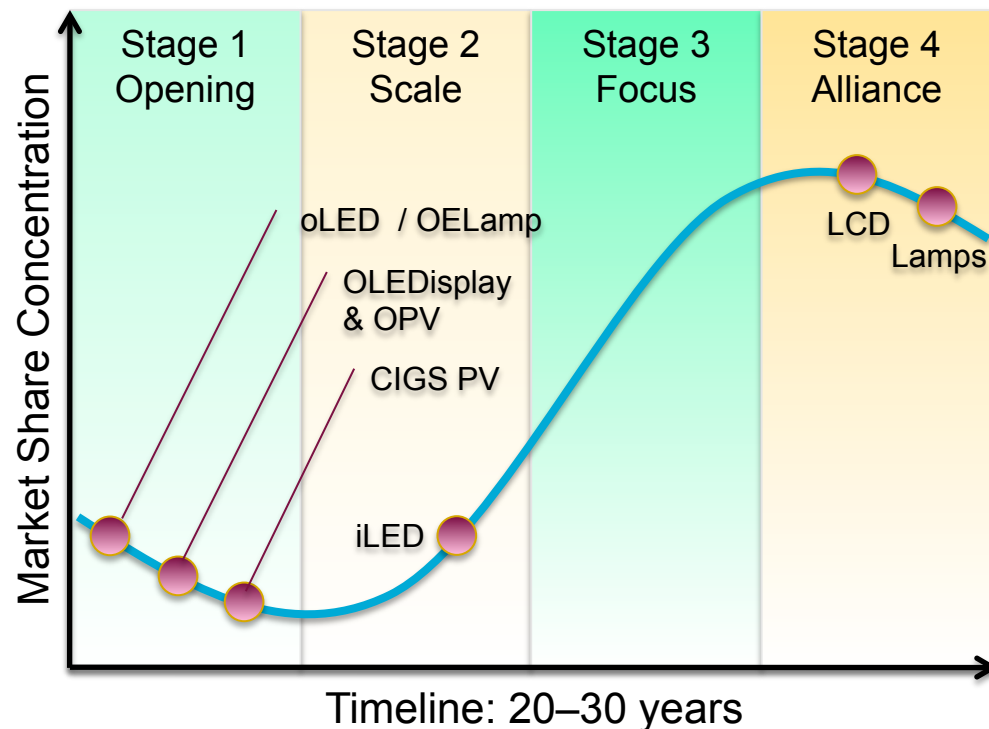


September 2011

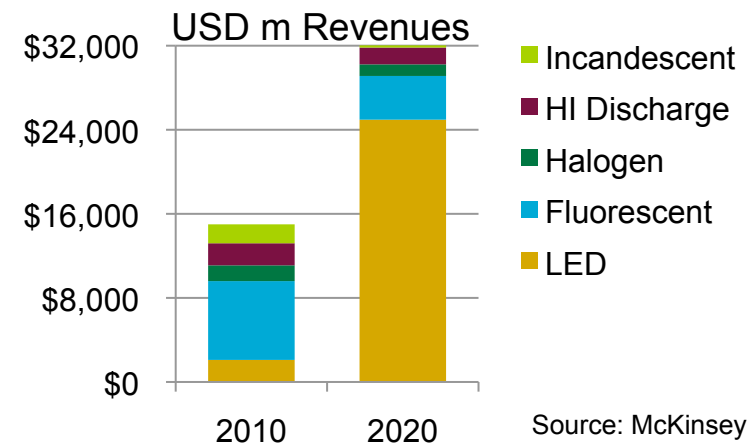
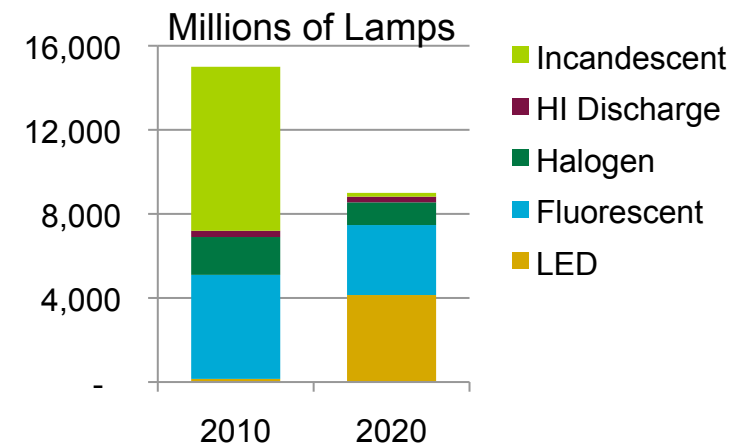
[Ian.Hendy@hendyconsulting.com](mailto:Ian.Hendy@hendyconsulting.com)

LED and OLED lighting markets are at different stages of maturity: LED is getting to scale. OLED lighting is just getting started and not yet included in most forecasts

Stages of the Industry Endgame progression



Source: A.T. Kearney, 2002 and HCL analysis

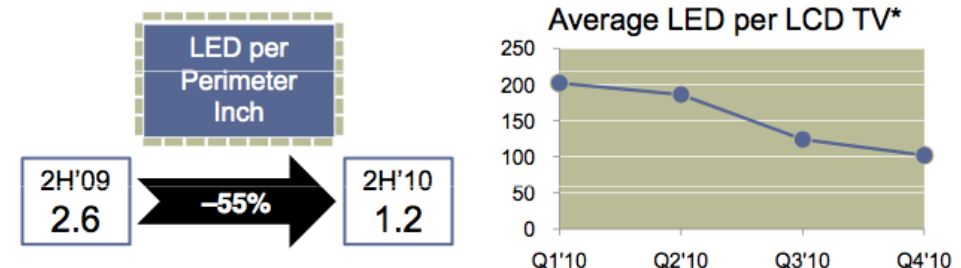


Source: McKinsey Global Lighting Model, 2011

## LED industry has grown in automotive and display markets, but with display demand falling, excess supply will spill over to general lighting

- Display backlighting demand has driven LED so far, but this is changing
- LED usage per TV is now decreasing and display panel makers have established their own sources/alliances
  - AUO — Lextar
  - CMI — CMLT/ GIO
  - LGD — LG Innotek
  - Samsung — Samsung LED
- As a result, companies have put in place excess capacity and this will provide stimulus to the general lighting market
- Chinese firms are beginning to pile in at all parts of the value chain, in what may be a replication of the dynamics of the photo-voltaic industry

### LED-lit Costs Will Be Lower



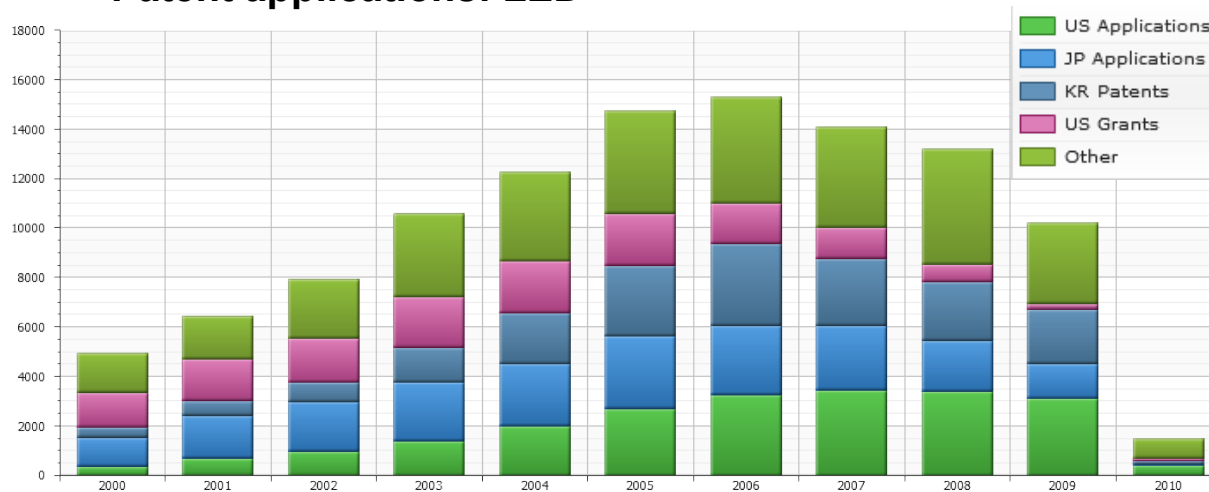
### Rewind and Reshape the Value Chain

TV Brand	Panel Maker	LED Supplier	Related JV
Samsung	Samsung LCD	Samsung LED	Samsung Micro.
LG	LG Display	LG Innotek	Wooree
TPV (OEM) AOC	AU Optronics	Lextar	Everlight, Epistar
Hon Hai (OEM)	Chimei Innolux	Formosa Epitaxy	AOT, Chi Lin

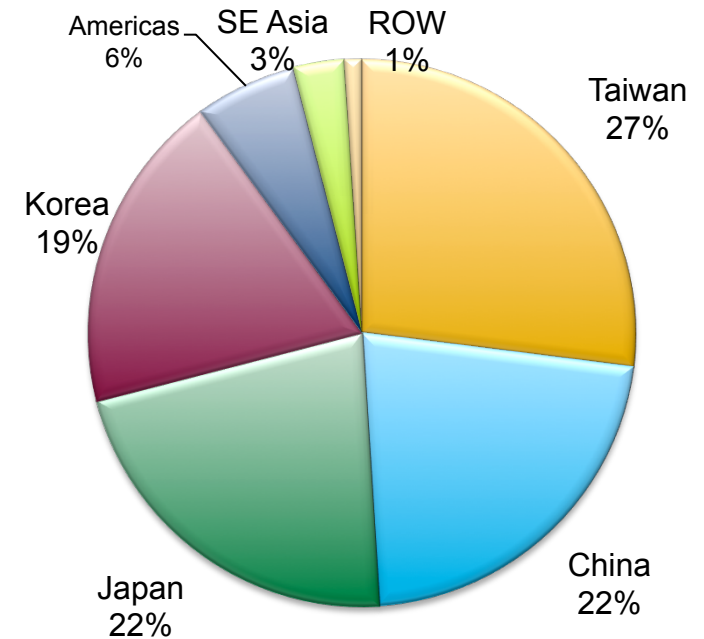
Source: Our consulting partner BizWitz LLC presentation to Strategies In Light, 2011

## Patent filings also suggest that the LED technology development phase is over and now truly into “scaling up”

Patent applications: LED

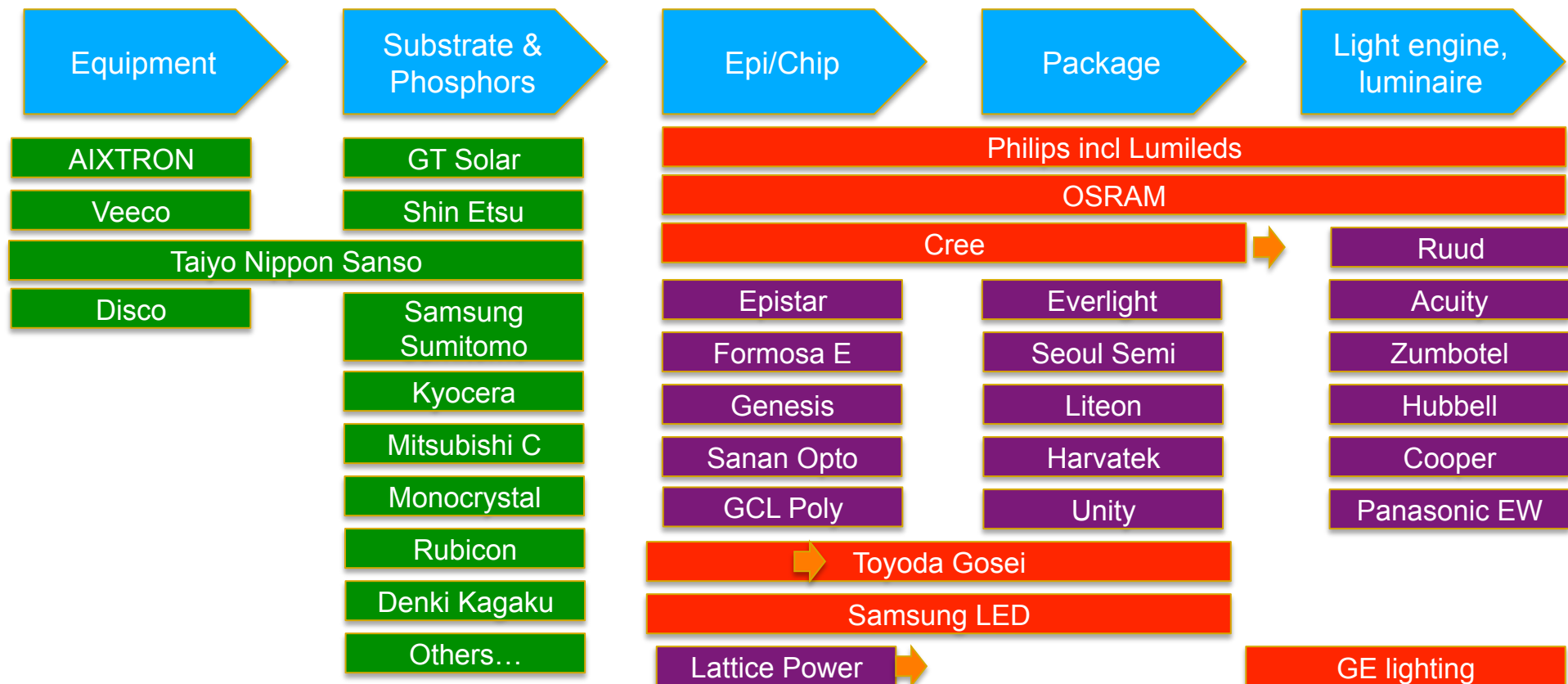


LED wafer capacity (2" equivalents)



- Patent searches show that the peak of IP registrations was already back in 2006
- New patent registration now is around colour management, thermal management and lighting fixture control
- SEMI counts 77 LED fab projects underway in 2011 and it expects 72 new projects will get underway in 2012
- Current investments supported heavily by government policies (especially rebates for investments in wafer capacity in China)
- LED wafer capacity is already 93% in Asia with China becoming more and more important

# LED market map and value chain: Selected players



- 2 main firms dominate the MOCVD business
- Strong economics based on barriers to entry. Long term regional copying of equipment may occur

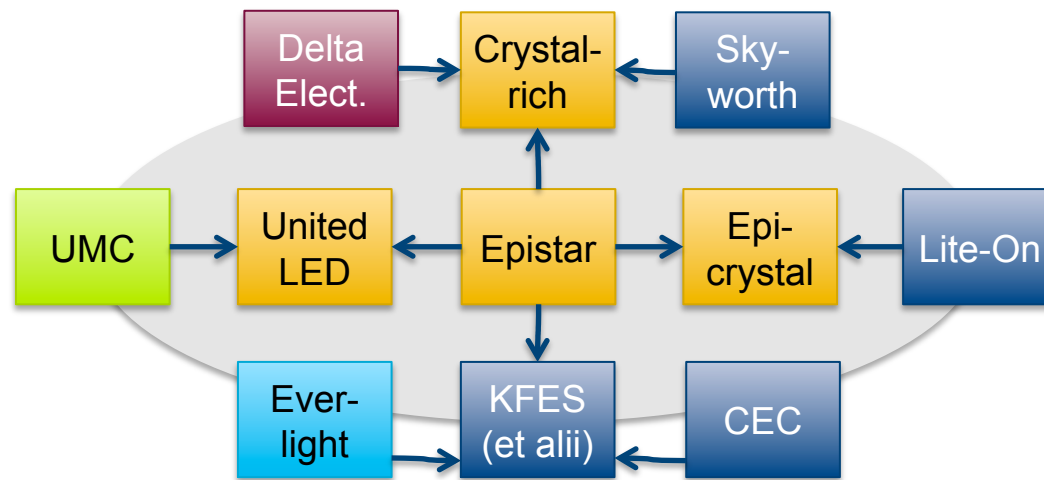
- Medium barriers to entry and fairly high operating margins here have led to a number of new entrants
- Op margins 40% range but may fall with new entrants

- Fairly heavily IP protected
- Operating margins in the 25% range
- Players moving to scale rapidly but new Chinese also

- Fragmenting very rapidly and operating margins likely to fall
- Op margins in the 15% range

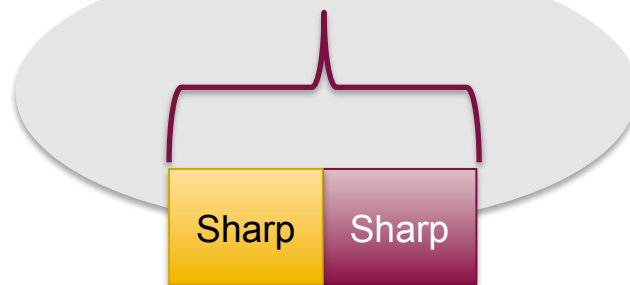
- Barriers to entry are not high but not many players have global reach and scale
- Op margins in the 10% range

What is amazing is the speed of transformation of the LED industry in terms of players forming ventures and relationships:

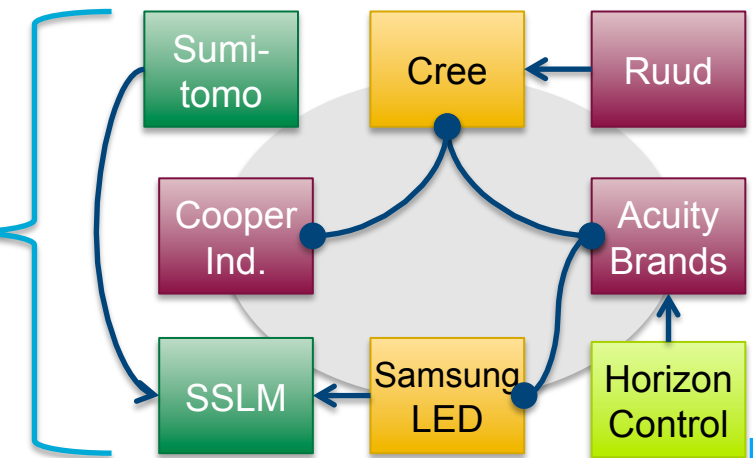


Epistar illustrates JV development matrices in Greater China

Sharp illustrates display to LED to fixture value creation



Forward Integration



## Key LED players: Selected companies

	Philips	OSRAM	Cree	Nichia	Epistar	Everlight
	Europe and USA			Japan	Taiwan	
Profile	The leader in the lighting industry but with large exposure to legacy technologies also	Subsidiary of Siemens that is being considered for IPO	US pure play LED player. Recent forward integration in to channel in USA	Mainly family owned old Japanese firm and one of the first players in LED	Epi/chip making firm from Taiwan. Recent JV with Toyoda Gosei	LED packaging firm in Taiwan with revenues of \$600m
Strategy	Maintain global position during the transition	Technology leader in new lighting space	Forward integrating to help market development (Ruud acquisition)	Phosphors, nitride LEDs and fine chemicals	Customer intimacy based approach for lighting, backlighting and LED signboards	Handset and backlighting focus. Relatively limited exposure to general lighting
Product line up for SSL	LumiLEDs in house position plus purchased LEDs.	Have bets in both LED and OLED lighting. LED is the more serious position	LED only with emphasis on street lighting, retail and general lighting	LED only with recent move into BLU. One of the major IP leaders in the industry	Biggest InGaN chip maker in Taiwan. Balanced sales across market segments	Largest Taiwanese LED packaging firm
Technical and manufacturing capabilities	Deep technical strengths in lighting but hollowed out in knowledge for Semi/OLEDs	Recent investment in OLED capacity in Germany and LED capacity in Panang	One of the technical leaders in LEDs	Deep competencies and IP in LED. High technology positioning	One of the leaders in direct red LEDs. Patents for AC LEDs	Analysts see Everlight as technology laggards in high brightness LEDs
Market position and customer base	Dominant market position in luminaires globally	One of the stronger players in the market for now	Strong pure play LED player in the USA. Very profitable	Strong channels as one of the main established players. Pursues patent claims	Strong customer portfolio with focus on backlighting. Moving towards general lighting	Strong electronics customer base but early stages for general lighting
Summary	The elephant of the lighting industry but also trying to manage massive internal change	One of the innovators off the block	Potential regional leader. One of the most profitable players. Keeping up with capacity	One of the old standing leaders of the industry. Risks falling behind on capacity	Profitable leading Taiwanese chip maker. One of the faster movers to lighting	Capable player focusing more and more on general lighting



## Key LED players: Selected companies

	Seoul Semi	Samsung LED	LG Innotek	Lattice Power	Sanan Opto
	Korea			Chinese new entrants	
Profile	Korean LED packaging company with strong lighting business	Joint venture of Samsung electronics and SEMCO	One of the LG group of companies. Focused on LEDs and components	Chinese recent player focused on epi/chip manufacturing	New player in China investing large amounts into chip/epi. Public company in China
Strategy	Focus on backlighting and general lighting. JV with POSCO for industrial lighting	3 market emphasis for now: Backlighting, automotive and general lighting	LG Innotek supports LG group companies in mobiles and related component	Commercialise silicon based GaN lighting LEDs delivered through high scale	One of the Chinese new entrants focusing on full colour HB LEDs
Product line up for SSL	LED packaging firm with chip/epi subsidiary Seoul Opto	Chip and packing LED set up. Different Samsung company is leader in AMOLED display	LED only at this point although have/had a mobile display business	LED chip/epi now but with plans to forward integrate into packaging	Includes blue and red LEDs. They believe their technology similar to Epistar
Technical and manufacturing capabilities	Arice branded AC general lighting LEDs with strong efficiency	Samsung group has all the competencies needed to make a success	Broader capabilities than many LED companies given multi technology exposure	Working on GaN on Silicon as a technical approach	Aiming for 144 MOCVD reactors by end of 2011 and will move up sales ranks
Market position and customer base	Relationships with many Korean/Asia electronics players plus GE & Philips	Clearly a very strong relationship with the Samsung group companies plus Acuity brands	Primary relationship with LG group companies which may limit growth	New Chinese entrant but with big plans	New entrant to LEDs but investing heavily. Also play in Solar
Summary	Strong position in general lighting. One to watch	A very real threat to the current state of the market	Quite a capable firm and could be one to watch. LG group emphasis may limit growth	Chinese players in LED need to be monitored closely	Bullish investment plans make this one company to watch

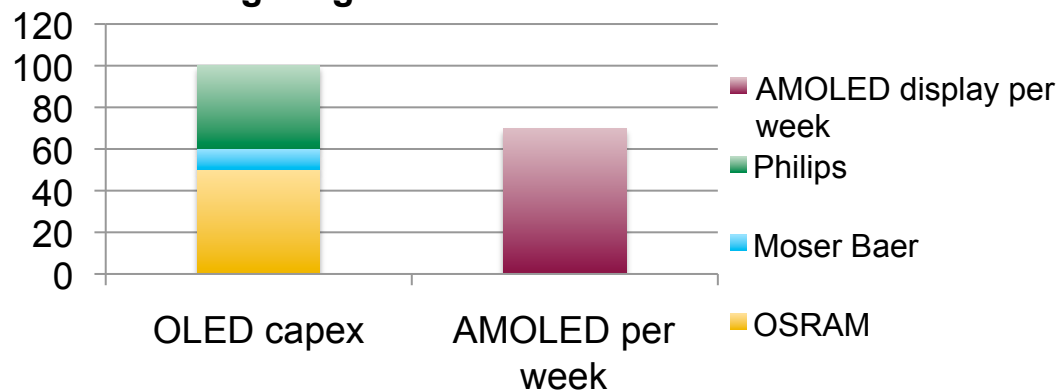


# OLED lighting by comparison has only just begun...

## Product offerings 2011

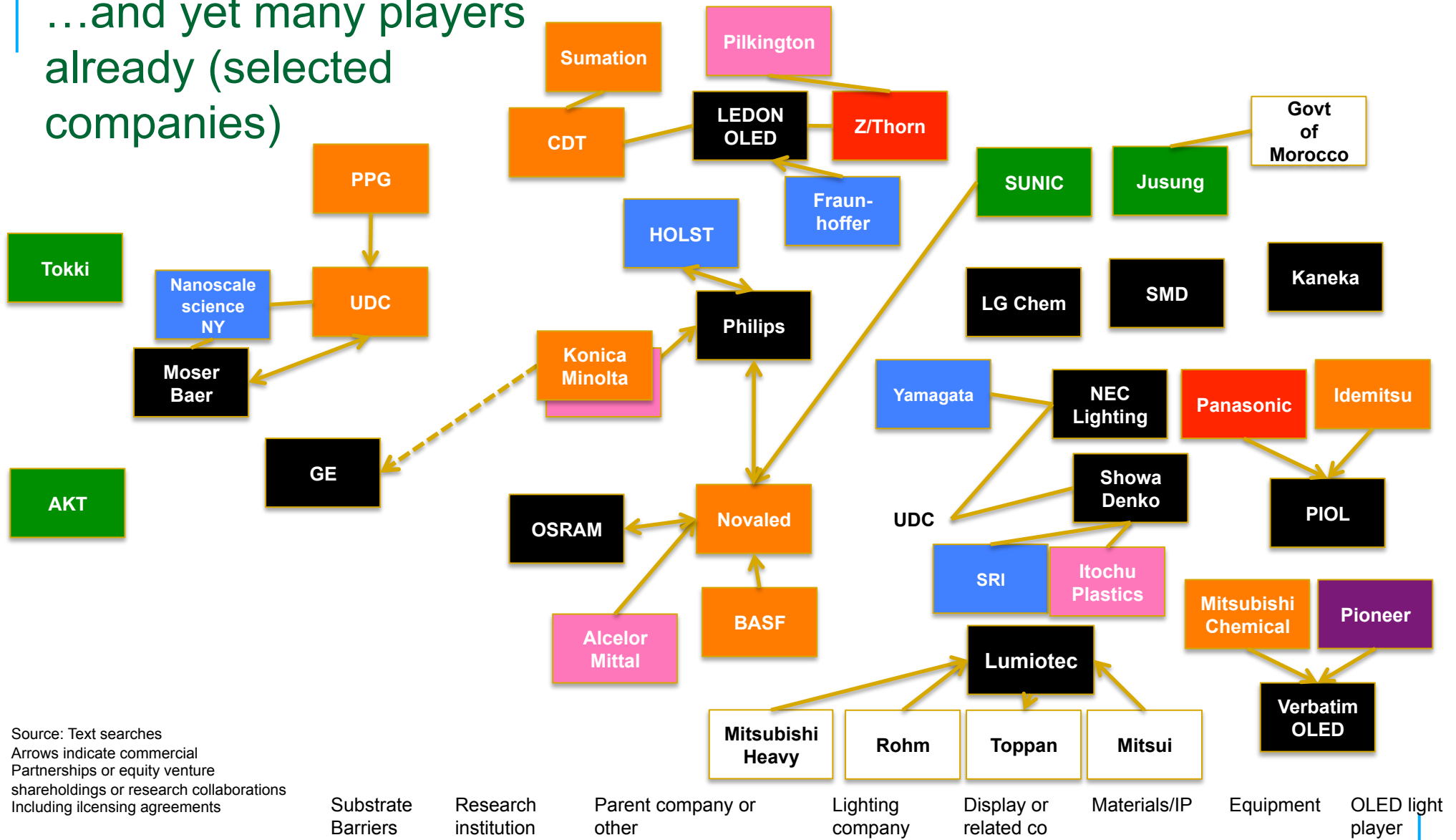
Company	Efficacy (lm/W)	Area (cm <sup>2</sup> )	Price (€)	Features
Philips Lumiblade	20	10 - 60	77-269	Various colors, sizes, shapes
Philips Lumiblade Plus	45	50	120	Highly efficient
Lumiotec 2011	11	100 - 300	115-350	Various colors, sizes, shapes
Osram Orbeos	23	50 (circular) 65 (rectangular)	240	Various shapes Mirrored or Diffuse
LG Chem	45-60			Highly efficient; Q1 2012 Availability
Fraunhofer Tabola		25 - 115		Transparent version
Verbatim Velve	28	200		Color tunable
Kaneka	20			Various colors

## Recent investment announcements, capex €m for OLED lighting



- 4 companies shipping product already and 4 more coming to market soon
- The current lighting players are the first to market but the next round of players coming through are ones with no background in the lighting arena
- Companies like LG Chem and Verbatim OLED (given backing of Pioneer) are quite credible players for the market place
- However, worth saying that current investment levels are “a drop in the ocean” compared to investments in the flat panel industry that is spending €10m a day on capex for AMOLED displays in 2011
  - Investments by Philips, OSRAM and Moser Baer represent less than 2 weeks spending for AMOLED displays
  - Any threat of any entry by one of the AMOLED display players (SMD, LGD) must be taken very seriously

...and yet many players  
already (selected  
companies)



# Key selected OLED lighting players

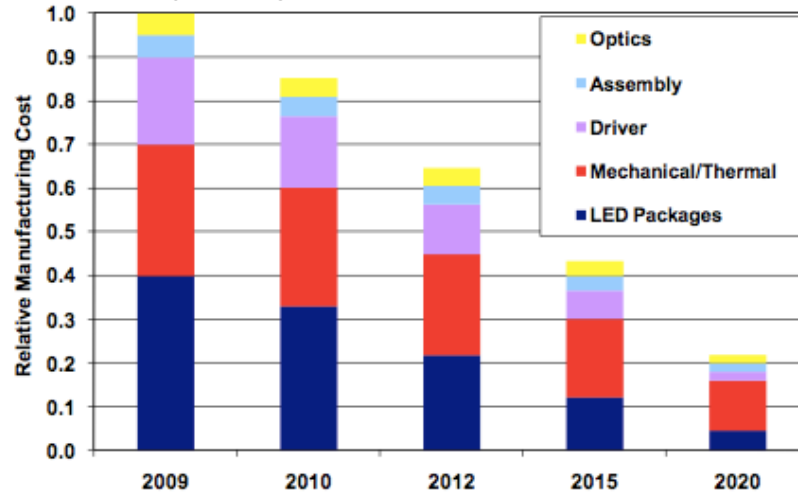
	GE	Philips	Konica Minolta	Moser Baer	Lumiotec
Profile	The global number 3 in lighting solutions with strong USA position	The lead player in the global lighting industry	Imaging and film company with recent moves into barriers and OLED materials	Indian publicly quoted firm with history in optical storage, solar and entertainment	OLED lighting vehicle of 4 major Japanese co: Rohm, Mitsui, Toppan, Mitsubishi
Strategy	GE lighting business was up for sale. GE playing catchup in LEDs	Manage the transition to new lighting technologies	See this as an investment into green technology	See OLED lighting as potential new growth area. Recent investment in NY state	Early leader into OLED lighting manufacturing (60k panels/day)
Product line up for SSL	Have R&D in both LEDs and OLED lighting (on web). Behind on market traction	Both LED and OLED plays. One of the early players into OLED	Blue phosphor material and developments in barrier film	OLED lighting focus with relationship with UDC	5-10 different product sizes so far but at relatively lower efficiency
Technical and manufacturing capabilities	R&D in OLED is one of the leaders but behind on LED traction	All of the lighting skills but emphasis on capex and on deposition/coating has declined	Have an interesting set of competencies for OLED lighting market	High tech electronics orientation given optical storage background	Japanese parents represent many of the important competencies
Market position and customer base	Strong channel access as one of the lighting majors	Strong market position as the lighting leader with many recent acquisitions	Do not have channel access. Have agreement with Philips	No channel access	Beginning to build profile and channel access. Also launched 2 luminaire products
Summary	Seem to be going through "commitment" issues	Trying to defend current position. Shyness to invest capex may become an issue	Interesting firm with some of the key competencies for this market	New entrant but securing DoE support through UDC	Parents are serious players if the competencies are correctly deployed

## Key selected OLED lighting players

	<b>Verbatim OLED</b>	<b>LEDON OLED</b>	<b>Panasonic Idemitsu OLED (PIOL)</b>	<b>LG Chem</b>	<b>SMD</b>
<b>Profile</b>	Collaboration of Mitsubishi Chemical and Pioneer for LEDs and OLEDs	Established new venture by Zumtobel (in collaboration with Fraunhofer)	A joint venture of PEW (now Panasonic) and Idemitsu Kosan	Korean multinational with positions in display polarisers and glass IP	\$3bn display company and the market leader for AMOLED displays
<b>Strategy</b>	Colour tunable OLEDs for hospitality, auto and aviation as example segments	OLED lighting play	OLED lighting only vehicle. Idemitsu Kosan is proven player in OLED materials	Claim to be entering the OLED lighting market in 2012	Create the future in AMOLED displays
<b>Product line up for OLED</b>	14x14cm OLED lighting squares. Positioned as colour tunable	OLED lighting	OLED lighting only venture	Claim to be entering the OLED lighting market in 2012	Current OLED display leader with deep competencies
<b>Technical and manufacturing capabilities</b>	VELVE OLED lighting range moving to mass production in 2011	Fraunhofer capabilities are reasonably strong but they are a research body	Capabilities of Panasonic and Idemitsu together are potentially strong	Between LGD and LG Chem this is a very strong force	The strongest technical position in OLED
<b>Market position and customer base</b>	Beginning to build up lighting channel access by touting new products	Relationship with Zumtobel/Thorn is important	Panasonic even has a current lighting business with strong Japanese position	No channel access into lighting channels as yet	No channel access into lighting channels so far
<b>Summary</b>	Pioneer strength at OLEDs brings credence to this partnership	Ability to move to mass production will be critical to determine success	A strong potential combination	Again another firm to watch very carefully	Perhaps even more so than LG Chem this is also a firm to watch

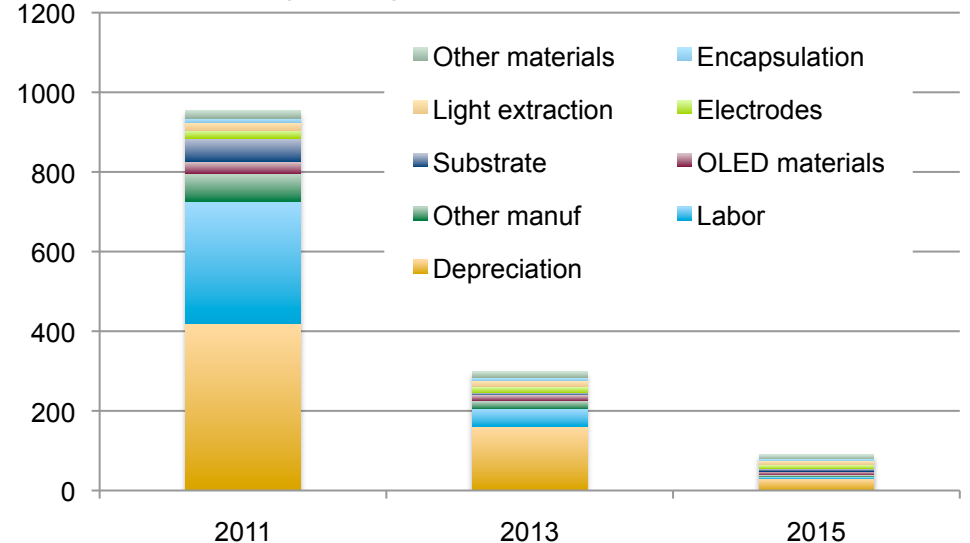
Cost structure depends on many breakthroughs coming at the same time. LED estimates are credible. OLED estimates are aggressive

**Cost trajectory for LED luminaires, index**



- LED lighting already established on a cost reduction path based on markets that already exist
- Current emphases on managing LED thermal packaging and improving phosphor uniformity
- Integrated functional intelligence (into the chip) is under discussion; may need new socket specifications

**OLED Cost trajectory in \$/m<sup>2</sup> based on DOE estimates**



- OLED lighting will not reach the targets shown here, since the DOE assumptions suggest that OLED lighting factories come on line very quickly after the equivalent first display lighting facility of equivalent size. This is possible theoretically but unlikely in practice
- The resulting business is a very materials-intensive business. “Dressed substrates” and other materials solutions (encapsulation) become critical factors.

## We assume the following givens in the 10 year outlook on solid state lighting:

- LED SSL has reached sufficient scale and trajectory to make us comfortable saying that it will become the leading source of light
- Additional capacity that was targeted for the display backlighting arena will spill over into lighting applications, especially since the unit usage in backlighting is declining and TV demand is maturing
- Economics for many parts of the LED supply chain will start to decline in the near future
  - Most defensible positions may develop in material supply, which could have a global footprint
  - Equipment supply may become regionalized over time but yields high margins in the meantime
- Some leaders may continue to accrue value from to their fundamental IP positions
  - The first round of cross-licensing is nearly complete, benefitting Philips, OSRAM and Nichia in LED companies like Universal Display or Idemitsu in OLED
  - The next round of negotiation/confrontation will concern control electronics and fixture systems
- We assume government support for energy-saving SSL will be sustained or increased in most regions
  - The key variable is the degree of support for R&D and industrial policies that drive investments in underlying parts of the value chain (fabrication, packaging, assembly, et cetera)
  - A second regional variable is regulatory flexibility that supports evolution of intelligent lighting systems and competitive construction-integration platforms (versus reactionary vested interests)
- Meaningful differentiation between LED and OLED value propositions remains uncertain, so far

## Overall industry roadmaps: Each market's strategy themes will evolve

	Now	2015	2020	2025	
LED Value proposition	Legacy Replacement	Fixture Enhancements	System Enhancements	Platform Upgrades	
LED Tech Driver	Thermal & Packaging	QD & Colour Control	Functional Integration	Platform Architecture	
LED Industry phase	Pre-shakeout Surge	Shake-out & Leadership	Scale-Specialization	“Smile Curve”	
LED Investment	4” Wafer transition	6” Wafer transition	Logic & Integration	Regional Design	
OLED Display	OLED TFT Gen 5.5 to Gen 8		OLED TFT > IGZO commoditization		Quantum Dot display?
OLED SSL Value proposition	Luminaire Innovation		Surface Integration	Conformal-Flexible Transition	
OLED SSL Tech driver	Emission Material Set	Light Management	Substrate-barrier Material Cost Reduction		
OLED SSL Industry phase	New Entrants	Pre-shakeout Surge	Quest for Differentiated Scale Opportunities		
OLED SSL Investment	Pilot Fabs	Larger Gen Scale-up		Transition to Web Process Integration	

Winners in OLED lighting manufacture will have core competencies in coating/deposition/printing, equipment management, electronics integration, capital risk taking and OLED materials. OSRAM, Philips and GE are not obvious winners based on competencies today. Others better positioned

	Philips, GE, OSRAM	Konica Minolta	LG Chem (& LG group)	SMD	Touch panel companies	Colour filter firms (JPN)	BLU & Film firms
Channel competency	✓						
Coating/ Deposition		✓	✓	✓	✓	✓	✓
OLED materials		✓	✓	✓			
Electronics integration	✓		✓	✓	✓	✓	✓
Capital risk taking			✓	✓	✓	✓	✓
Equipment management		✓	✓	✓	✓	✓	✓

Winners in OLED lighting may be very different firms to today's lighting majors



## Key uncertainties or risks that we see:

	Description of shock or uncertainty	How this changes the future
<b>Role of brand and channel in SSL</b>	Not clear to us that the current leaders retain long term control over channels (both industrial and consumer) once SSL is established worldwide.	Channel structure and deployment by geography will remain risk factors: will current market structures persist (fragmented in Europe and consolidated in the USA, for example) or will new Asian brands become established through new structures?
<b>Market penetration or differentiation of OLED</b>	We offer a range of scenarios for the OLED lighting opportunity, from OLED lighting remaining insignificant to it capturing modest demand.	We believe that backlight-related technologies (e.g. Sharp's fixture) threatens a key point of differentiation for OLED SSL. The potential for conformable or flexible surfaces may become more important factors.
<b>Government Policy</b>	We assume all governments will have policies to stimulate SSL adoption but that some will have more meaningful industrial plans/incentives.	The material, tool and packaging systems for OLED may remain distinct from LED-based SSL. Thus there is potential for different policy preferences between governments that could foster local champions.
<b>Technology Innovation</b>	Nanomaterial innovation may be more disruptive than chip-process invention. QD or solution processes could enable flexible LED and OLED.	Substitution of quantum dots for conventional phosphors may change the value proposition of some material suppliers and ignite more IP battles between SSL firms. Transition to solution-based or other web processes could affect fixture design and system integration.
<b>System Integration</b>	We wonder if a Wintel-like hegemony might arise from positive feedback loops for a given SSL control platform.	Longer SSL operational lifetimes will make system-brands and feature upgrades key value drivers. This could lead to regional or global de facto standards that favor one brand (value chain, e.g. Apple).

# Our view of the LED and OLED lighting industry future: Scenarios

	Base Case	Tech Race	Regional Regulation	Asian Games	Brand Values
LED outlook	LED penetration >50% by 2020 in all segments (but lagging in offices)	LED and OLED each develop distinct value propositions	Government policies drive localisation and divide value chains by geography	China piles into LED as it did in PV, driving prices down and other regions out of business.	Massive investments in Asia commoditise lighting components. EU and US integrators have a field day.
OLED outlook	OLED lighting finds a niche in premium illumination products	OLED lighting creates a new market position for exciting light surfaces	Japanese, Taiwanese Korean and Chinese policies back domestic OLED champions	OLED lighting fails to take off in the face of LED lighting expansion and cost reduction.	OLED lighting remains a specialty show-piece for a few global brands
Impact on players	Chinese epi/chip companies integrate forward to challenge Cree, Nichia, Philips	Market turmoil: new channels and disruptive products. Demand limits price erosion in places.	Channel players win in consolidated geographies. Materials suppliers may become localized	Chinese companies become B2C and B2B brands and displace today's majors.	Chip/epi and packaging players lose value; channel players gain value.
Impact on profits	Value destroyed in many markets. Chip/epi licensing and OLED materials retain value	Pockets of high value shift back and forth between two distinct value chains	Profit pools move in line with the impact of the regulation. Poor profits for most?	Prices fall everywhere and consumers benefit. Some Chinese firms win with scale.	Channel partners take the lion share of the value. Everyone else suffers.
Winners	LED: Equipment (medium term), chip/epi mfg + licensing income. OLED: materials	Philips, OSRAM, Nichia, UDC as IP players; LG, Samsung or Sharp play in LED and OLED	Materials and substrates and channel players in consolidated markets	Materials and substrates; equipment players in medium term	Acuity, Cree, Cooper, Panasonic, Philips, Zumbotel, etc

In the “**Base Case**” scenario: LED lighting moves to the mainstream and current lighting incumbents share with leading LED players. OLED lighting is there but a niche technology comparatively

	Base case
<b>LED outlook</b>	LED penetration >50% by 2020 in all segments (but lagging in offices)
<b>OLED outlook</b>	OLED lighting finds a niche in premium illumination products
<b>Impact on players</b>	Chinese epi/chip companies integrate forward to challenge Cree, Nichia, Philips
<b>Impact on profits</b>	Value destroyed in many markets. Chip/epi, licensing and OLED materials retain value
<b>Winners</b>	LED: Equipment (medium term), chip/epi mfg + licensing income. OLED: materials.

- Market: Growth for both LED and OLED lighting . OLED lighting is niche
- Investments: Investments around Asia LED foundries but some additional investments in other geographies (balanced outlook)
- Players: Chinese LED players and some of the Koreans push forward. Cree, TG and Nichia lose ground to more aggressive players. LG Chem, SMD, Japanese OLED consortia and Taiwan touch panel companies challenge the starting positions of GE, Moser Baer and OSRAM in OLED lighting. IP holders cash in in the medium term
- Themes
  - Regulation drives consumers who are forced to upgrade
  - Market structures remain broadly in tact from today, though some Korean and Taiwanese firms rise up the ranks and make channel agreements
  - Efficiency gains for both LED and OLED light
  - Technology innovation but in the background
  - Slow migration of today’s sockets and architectures to new formats
- Prices: continue to decline at 15-20% per year
- Winners: LG Chem, UDC, Panasonic Idemitsu, Veeco
- Losers: GE, Moser Baer and Japanese LED players in general who lose out to Korean, Taiwanese and Chinese competition



In the scenario 2 “**Tech race**”: Innovation in light lifts many boats and creates opportunities in many parts of the value chain. Only consumers pay suffer through regulation into new higher price lighting technologies

	<b>Tech race</b>
<b>LED</b>	LED and OLED each develop distinct value propositions
<b>OLED lighting</b>	OLED lighting creates a new market position for exciting light surfaces
<b>Impact on players</b>	Market turmoil: new channels and disruptive products. Demand limits price erosion in places.
<b>Impact on profits</b>	Pockets of high value shift back and forth between two distinct value chains
<b>Winners</b>	Philips, OSRAM, Nichia, UDC as IP players; LG, Samsung or Sharp play in LED and OLED

- Market: Market booms with new lighting offerings and the ability to create new occasions and new moods for lighting. Government legislation supports conversion to new technologies
- Investments: Continue in MOCVD for LEDs but also in OLED fabs. OLED fabs are sheet fed leading to web-based fabs for OLED lighting later
- Players: Players in all parts of the value chain make investments and are buoyed up by the overall growth in the market. Konica Minolta and Japanese/ Taiwanese touch/colour filter players enter the OLED lighting market and battles among phosphorescent and fluorescent materials players intensify
- New technologies appear for colour shifting (e.g. quantum dots), for heat management (LED) and outcoupling of OLED lighting. New architectures for smart lighting appear
- Themes:
  - Creating light; Planar light through use of optical films and light conversion from point sources to planar
  - Experimentation with colour
  - New technology in all parts of the value chain
  - Smart lighting with new control approaches
- Winners: Materials and substrate companies are constant winners in all our scenarios. IP holders also do well in growth markets. Equipment companies do fine also. Konica Minolta, LG Chem and SMD may also do well in OLED lighting
- Losers: Prices on the whole a little higher so consumers end up paying more



## Scenario 3: “**Regional Regulation**” would lead to distinctly different markets in each geography with local players for each technology

	<b>Regional Regulation</b>
<b>LED</b>	Government policies drive localisation and divide value chains by geography
<b>OLED</b>	Japanese, Taiwanese Korean and Chinese policies back domestic OLED champions
<b>Impact on players</b>	Channel players win in consolidated geographies. Materials suppliers may become localized
<b>Impact on profits</b>	Profit pools move in line with the impact of the regulation. Poor profits for most?
<b>Winners</b>	Materials and substrates and channel players in consolidated markets



- Market: Develops differently in each geography with regional differences in market regulation driving more regional value chains
- Investments: Become heavily directed by regional and governmental policies and local product standards
- Players: Cree invests and builds up a strong position with Acuity and Hubbell in the USA, GE strengthens its USA business but loses in other geographies. Philips and OSRAM dominate Europe and Zumtobel plays number 3. Korean, Taiwanese, Japanese firms dominate their respective countries
- OLED lighting is important only in geographies with strong governmental support. Korea, China and Japan are potential examples based on regulatory behaviours we have seen in the past
- Themes:
  - “USA consumers forced to adopt new energy saving light technology. California legislation drives higher efficiency lighting”
  - Buy local
- Winners: Companies that are strong in their respective geographies. Some space for new companies to be important given today’s global market structure
- Losers: Consumers, and many of the players in the manufacturing chains. Global lighting companies will see their footprints shrunk back to strong regional positions and will lose some scale advantage as a result

Scenario 4: “**Asian games**” represents a massive change to the status quo but a believable outcome (similar to PV) where massive oversupply drives collapse of all players not in China and we begin to see the emergence of Asian global brands

	Asian Games
LED	China piles into LED as it did in PV, driving prices down and other regions out of business.
OLED	OLED lighting fails to take off in the face of LED lighting expansion and cost reduction.
Impact on players	Chinese companies become B2C and B2B brands and displace today's majors.
Impact on profits	Prices fall everywhere and consumers benefit. Some Chinese firms win with scale.
Winners	Materials and substrates; equipment players in medium term



- Market: Over investment by China in the LED value chain destroys value for the market place. Big winners are consumers. A number of Chinese firms have dominant scale and make some small economic value. OLED lighting fails to make it to scale.
- Investments: Chinese LED companies put in place huge investments in LED packaging supported by additional investments in chip capacity. As a result economics in all these sectors decline
- Players: Companies like Lattice Power and Sanan Opto make massive investments, other Chinese players too and build global brands which begin to get traction through distributors in all markets
- Themes:
  - Lattice power, Seoul Semi (“Ariche”), Neo Neon are the hot new brands for LED lighting
  - Light is cheaply and mass available
- Pricing: Collapses rapidly
- Winners and losers: MOCVD reactor makers win, consumers win, the few large Chinese firms win. Some IP owners will make returns but their businesses will become more about the IP streams than about the manufacturing that goes with it
- Losers: investors in the OLED lighting value chain, today’s global lighting majors. Western and Japanese LED companies

Scenario 5: “**Brand values**” represents mass commoditisation of lighting componentry, chips, packages and OLED modules. Only lighting brands with strong channels win

	Brand Values
LED	Massive investments in Asia commoditise lighting components. EU and US integrators have a field day.
OLED	OLED lighting remains a specialty show-piece for a few global brands
Impact on players	Chip/epi and packaging players lose value; channel players gain value.
Impact on profits	Channel partners take the lion share of the value. Everyone else suffers.
Impact on winners	Acuity, Cree, Cooper, Panasonic, Philips, Zumtobel, etc



- Market: Asian players make massive investments in LED capacity and OLED lighting as a result fails to achieve any scale and dies away. In this scenario though, local brand and channel companies reap the rewards of the low component pricing
- Investments: Massive investments in LED Chip and packaging lead to radical fall in component cost
- Players: Philips, OSRAM, GE, Acuity, Zumtobel and others reap the major rewards in this scenario
- Themes:
  - Managing light systems is key competence
  - “All about the luminaire”
  - Adaptive light and new light uses
  - Specific channel knowledge including regulation critical
- Pricing: Component pricing collapses so only the companies with brand and channel make a decent return
- Winners: Acuity brands, Philips, Zumtobel, Cooper, Hubbell. Some IP owners may also make returns but their businesses may become increasingly reliant on the IP moneys
- Losers: Investors in the OLED lighting value chain, LED chip and package makers



## Summary and implications:

- The lighting industry is about to experience massive change as it moves from incandescent and compact fluorescent to new forms of solid state lighting
- The rules of the game and the key competencies needed to play are different: semiconductor prowess, understanding of capital and equipment deployment, phosphors, coatings and new digital architectures
  - A replacement game becomes potentially a PC-like platform game where consumers need to be convinced every few years of the new need to upgrade
- At this early stage, being definitive about the outcome is difficult. We believe that scenario analysis is a very powerful tool in talking about the future
  - Companies can then seek to look at their strategy decisions in each case
- Throughout this thinking the parallels with the PC, photovoltaic and display industries are inferred: we believe it is important for lighting companies to learn lessons from high technology behaviours in other similar markets



## Our services:

Recent projects in  
AMOLED equipment  
and IGZO processes

### Growth strategy

- Market entry strategy
- Business unit strategy
- Growth strategies for new technologies

### Performance improvement

- Product portfolio management
- Cost reduction
- Price strategies

### Equipment and Capex

- LCD/OLED factory capex decisions
- Investment decisions for new technologies
- Strategies for equipment makers

### Sourcing strategy (Purchasing)

- Sourcing strategies, especially LCD and medical detectors
- Make/buy decisions

### Technology strategy and technology assessment

- Market and commercial strategies for new technology businesses
- Market tracking services for corporates monitoring technology

### Partnering and alliances

- M&A candidates and assessments
- Alliance formation support
- Post merger integration planning

### Professional advisory and business planning

- Specialist insights for bankers, equity investors and other consultancies
- Reviews of business plans and models

### Strategies for materials providers

- Strategy support for materials providers in the FPD, SSL, and PV markets
- IP and pricing plans