



LCDs – A high hurdle for new large display technologies

Information Day 2013 – A Deep Dive into the LC&OLED Business

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Agenda

LCD and OLED displays: Status quo

Strengths of LCDs versus strengths of OLED displays

Market projections for LCDs versus OLED displays

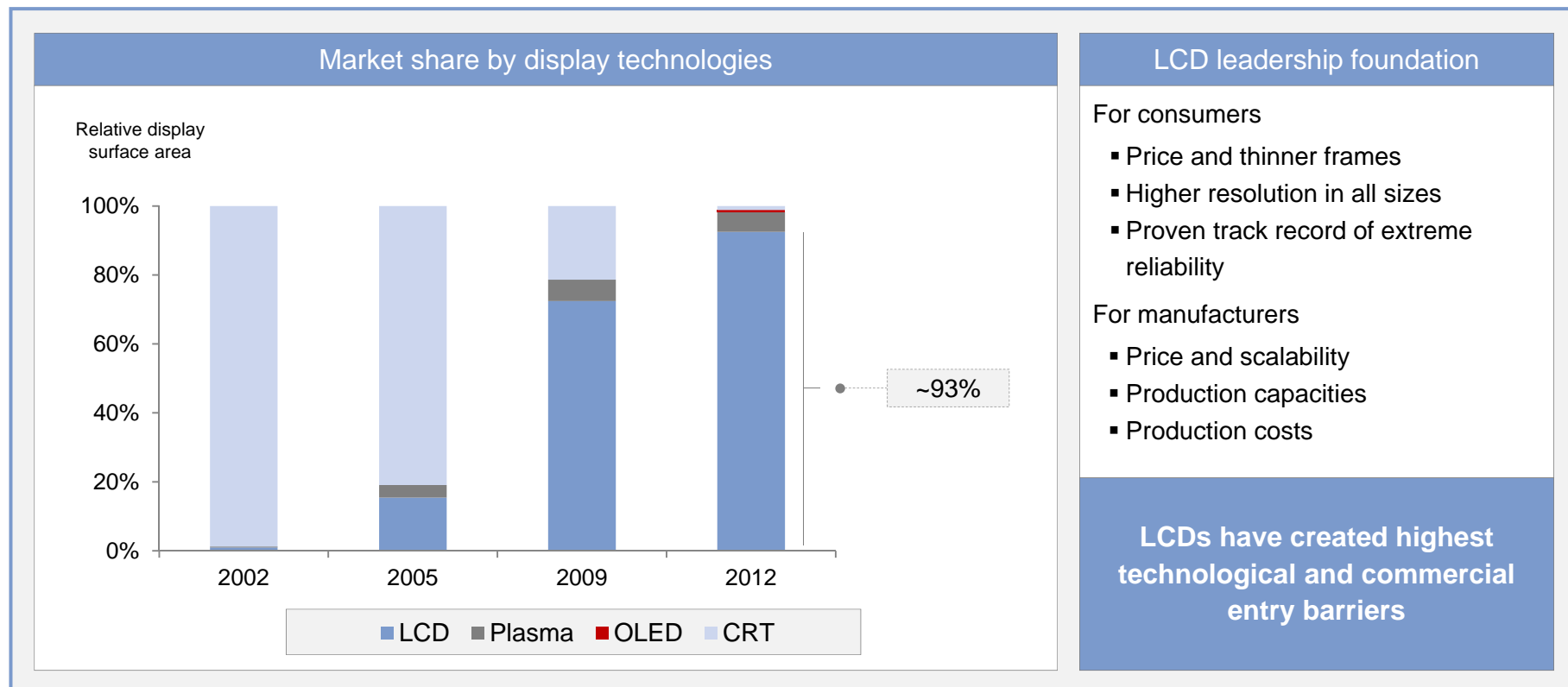
Summary

LCDs and OLED displays are fundamentally different

| Setup of a Liquid Crystal Display | Setup of an Organic Light Emitting Diode display |
|---|--|
| | |
| <ol style="list-style-type: none"> 1. Backlight (CCFL or LED) emits white light 2. Color filters transform white light into RGB colors 3. Liquid crystals block or enable light transmission | <ol style="list-style-type: none"> 1. OLEDs convert electric energy into RGB light, a separate OLED material is needed for each color |
| <p>Liquid crystals selectively modulate light</p> | <p>OLEDs directly generate light</p> |




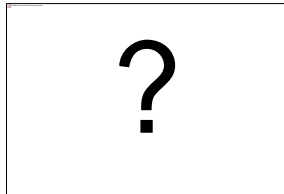
Acronyms: ITO = Indium Tin Oxide; TFT = Thin-Film Transistor; CCFL = Cold Cathode Ion Source; LED = Light-Emitting Diode; RGB = Red-Green-Blue

LCDs have squeezed all other large display technologies nearly out of the market



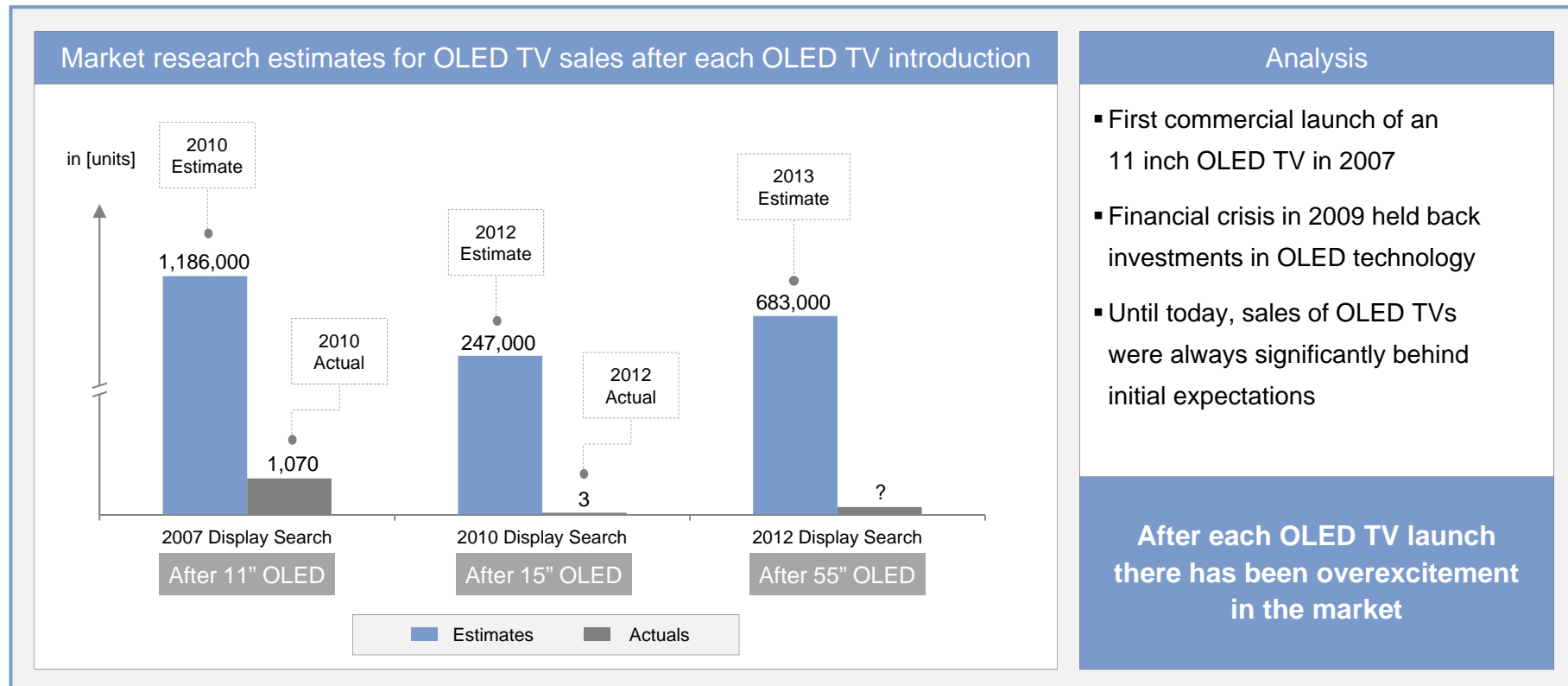
Source: DisplaySearch, Quarterly Worldwide Flat Panel Forecast Reports

Despite the launch of an 11 inch device already in 2007, OLED TVs are still very expensive rarities

| 11" Sony | 15" LG | 55" LG | 55" |
|---|--|---|---|
|  |  |  |  |
| 2007 | 2010 | 2012 | 2014 |
| Price of OLED TV | Price of OLED TV | Price of OLED TV | Price of OLED TV |
| ~ \$80 per square inch | ~ \$25 per square inch | ~ \$10 per square inch | ~\$5 per square inch |
| Price of LCD TV | Price of LCD TV | Price of LCD TV | Price of LCD TV |
| ~ \$4 per square inch | ~ \$1.5 per square inch | ~ \$1 per square inch | < \$1 per square inch |
| The progress in OLED TV development is still uncertain | | | |

Source: DisplaySearch, Quarterly Global TV Shipment and Forecast Report, Q1 2013

Past market research overexcited, underestimating challenges in commercial production



Source: DisplaySearch

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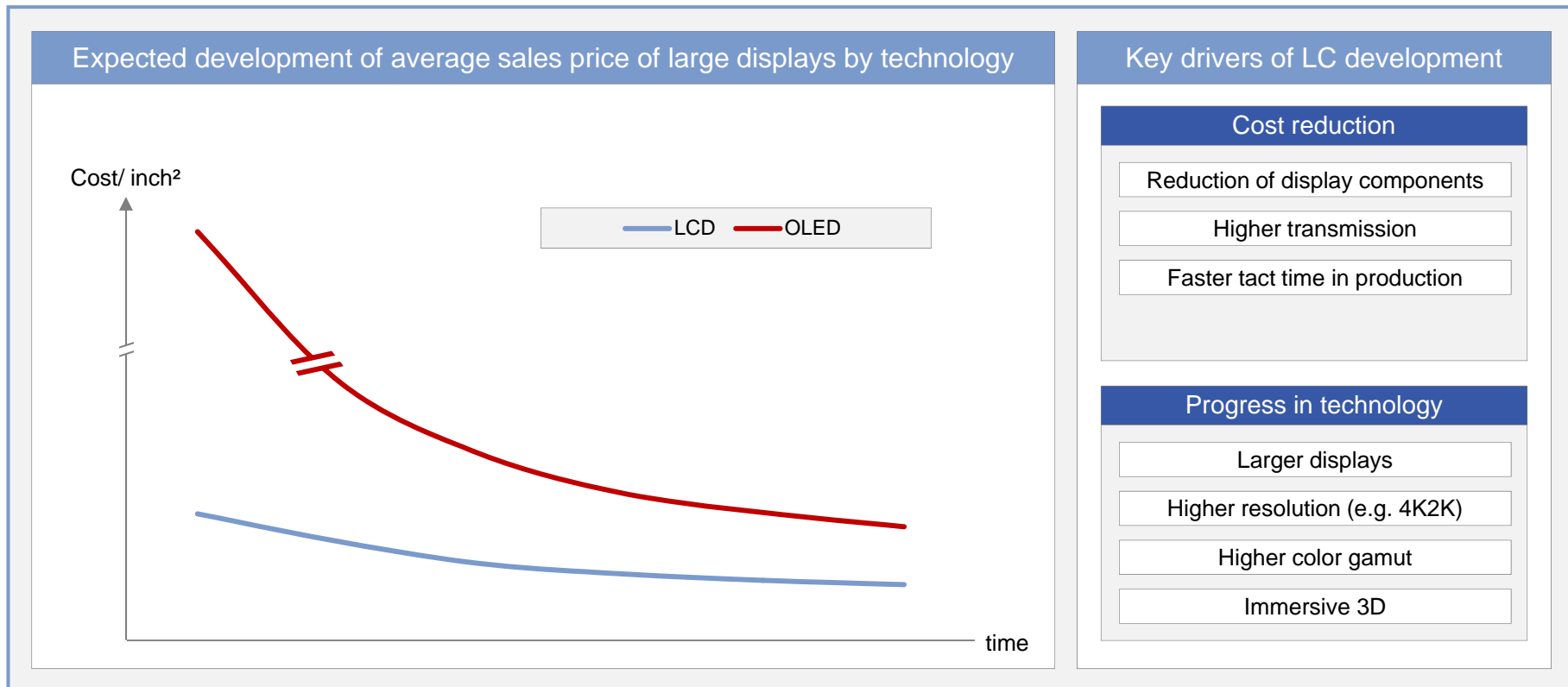
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Future advancements of LCDs will further raise commercial as well as technology barriers for OLED



*Based on white OLED

Though OLED TVs may lower the cost gap to LCDs, significant technology barriers remain

| Agenda of technology development in the display industry | | | |
|--|--------------------------------|------------|----------|
| Display trend | Technology Requirements | Status for | |
| | | LCD TV | OLED TV* |
| Larger displays | Scalable production technology | ● | ● |
| Higher resolution (4K2K) | 4x higher pixel density | ● | ● |
| Higher color gamut | Narrow emission light source | ● | ● |
| Immersive 3D | Holography | ● | ● |

● mass production
 ● technologically possible, not available yet
 ● technologically impossible



*RGB OLED

High quality and low cost of LCD TVs limit significant near-term cannibalism from OLED



*Based on white OLED

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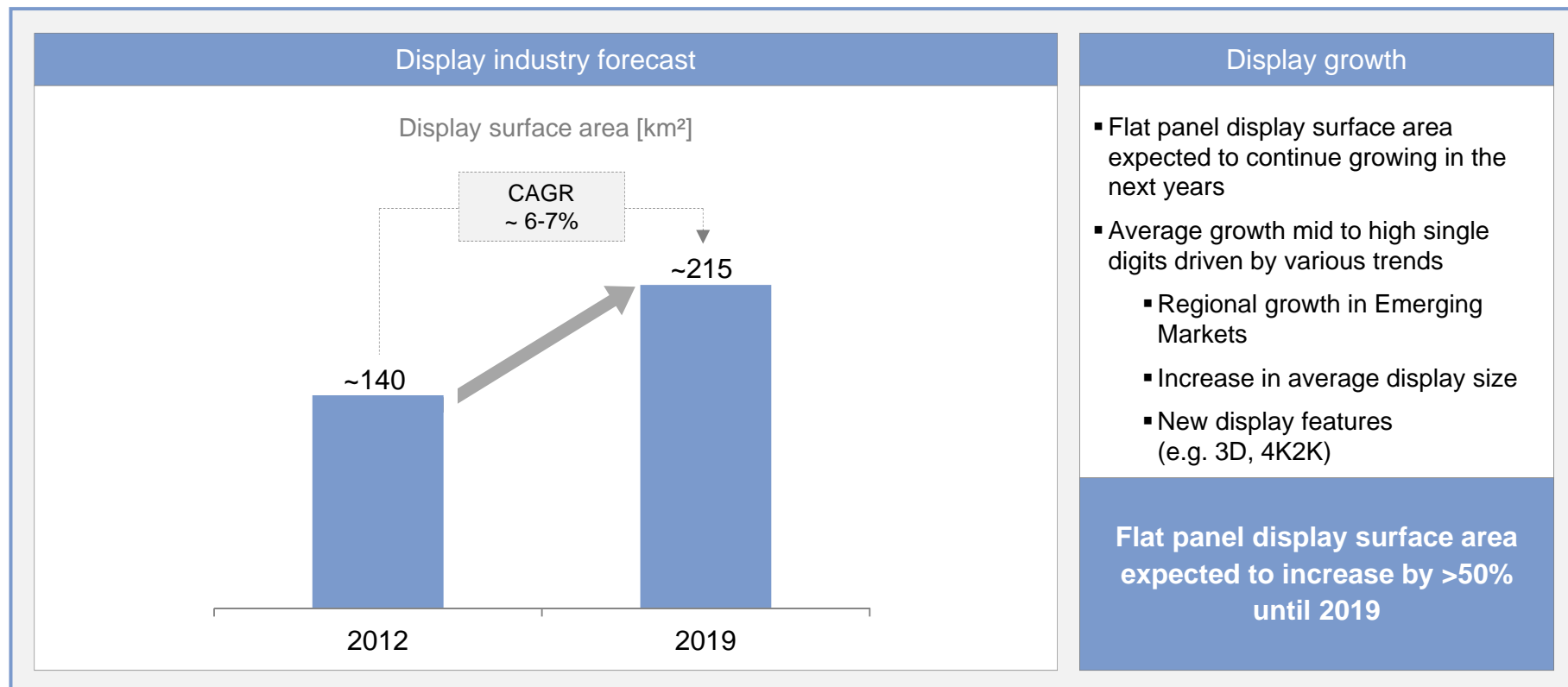
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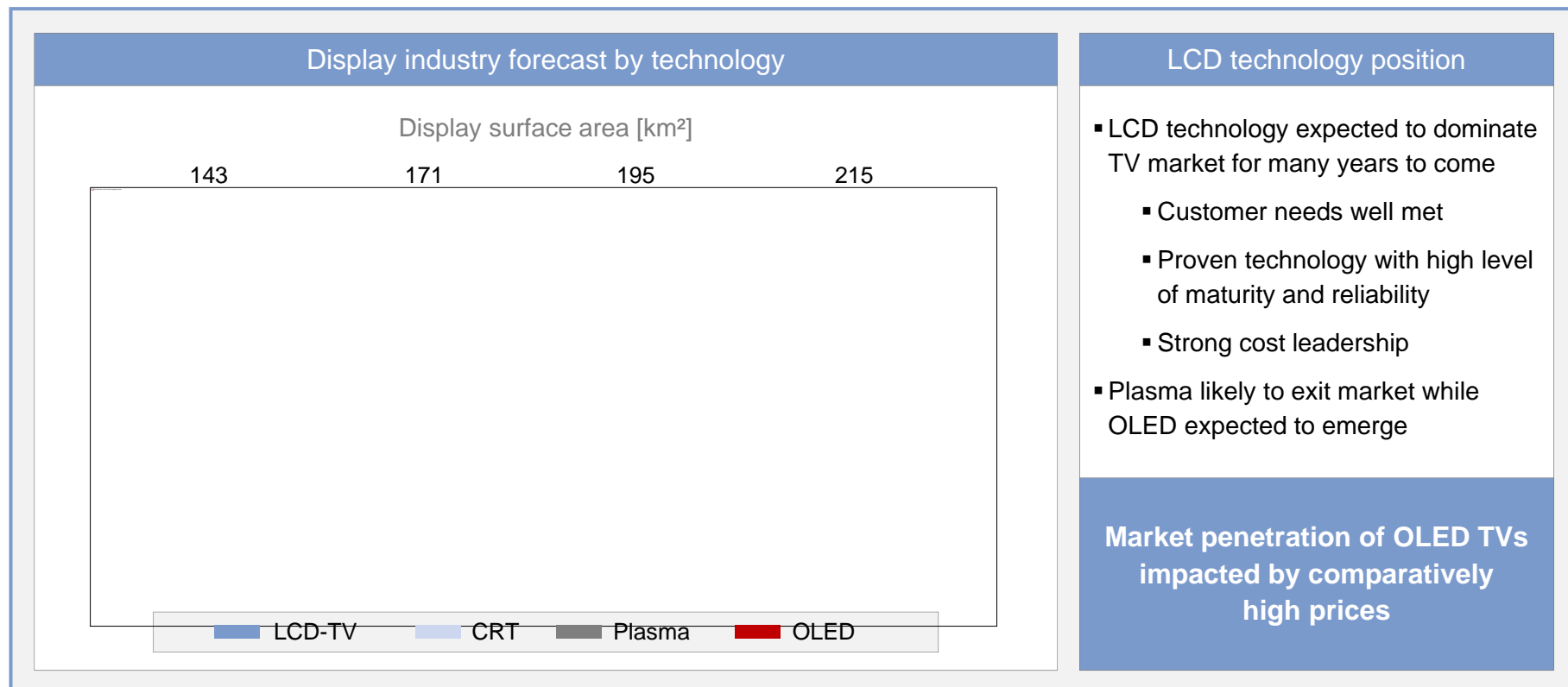
Summary

The overall display market is expected to continue growing in volumes



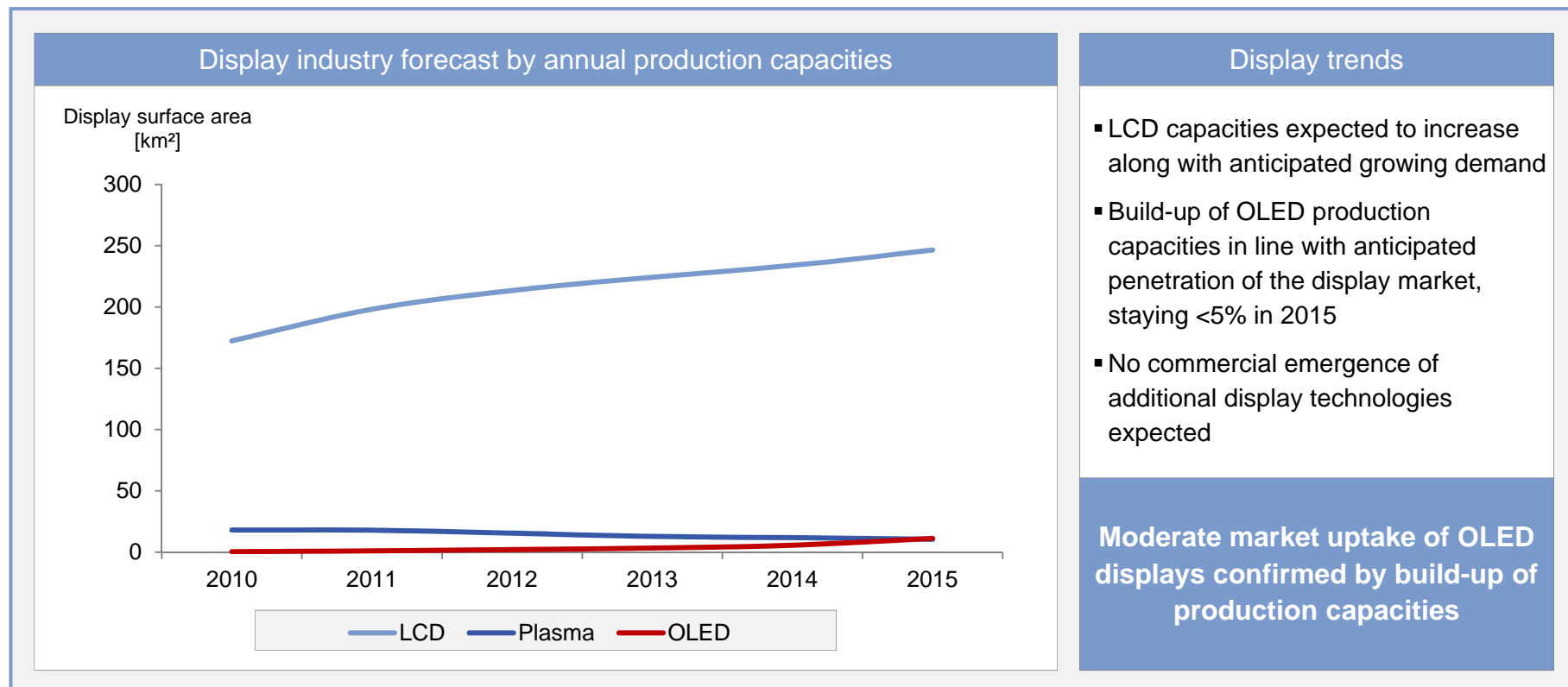
Source: DisplaySearch, Quarterly Worldwide Flat Panel Forecast Report, Q1 2013; CAGR = Compound Annual Growth Rate

LCD expected to remain the dominant display technology until 2019 and beyond



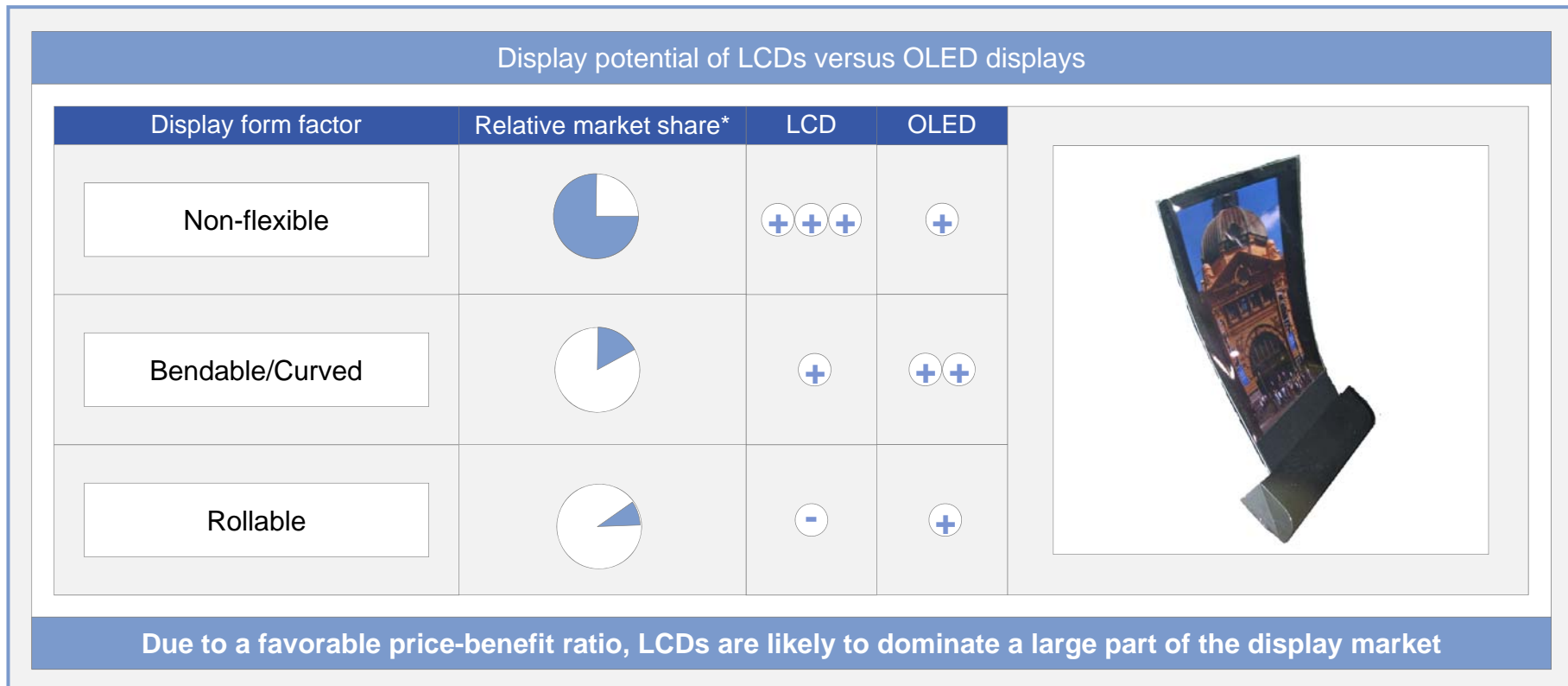
Source: DisplaySearch, Quarterly Worldwide Flat Panel Forecast Report, Q1 2013

Relative to LCD, production capacities of OLED displays will remain at moderate levels mid-term



Source: DisplaySearch, Quarterly FPD Supply/Demand & Capital Spending Report, Q1 2013

OLED can provide a unique selling point in rollable displays



*Company estimate

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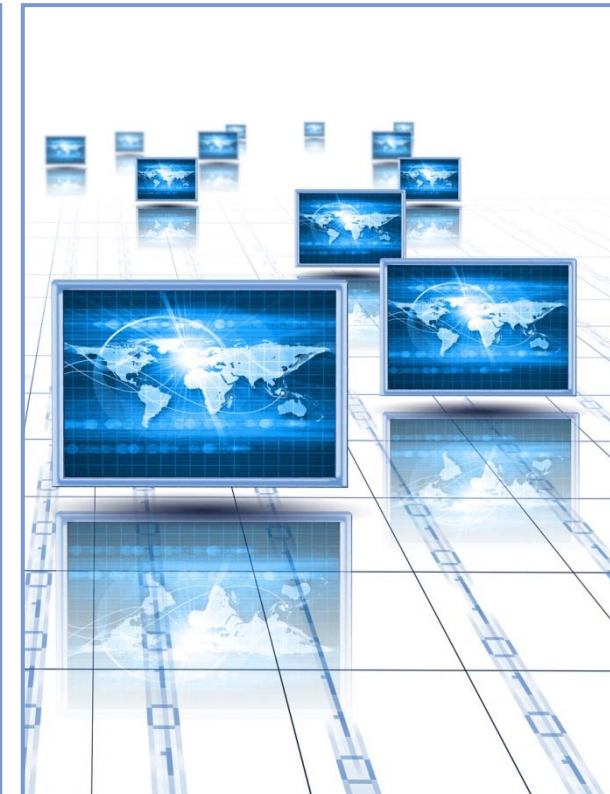
Summary

OLED displays are much more likely to enlarge the display market mid-term rather than replace LCDs

LCD is likely to remain the dominant display technology at least until 2020

OLED needs to overcome significant technology challenges to gain substantial display market share

OLED has its highest potential for differentiation in applications where LCD is not used



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