LYON, France – December 9, 2019: Amidst the flurry of MicroLED activities and its huge investments, US$800 million to date, and at least US$100 million in 2019, a new term also emerged in early 2017: MiniLED.

“MiniLEDs are better distinguished from MicroLEDs by a combination of size, application, architecture and manufacturing infrastructure,” explains Zine Bouhamri, PhD Technology & Market Analyst, Displays at Yole Développement (Yole). And he adds: “MicroLEDs require major technology breakthroughs and disruptions in assembly and die structure, as well as a significant overhaul of the manufacturing infrastructure. MiniLED chips only require incremental evolution of standard LED chips with very similar architectures and can be manufactured in the same fabs with only minor upgrades”.

Over the last few years, an unprecedented variety of display technologies has emerged, including OLEDs, quantum dots, dual cell LCDs, MiniLEDs and MicroLEDs. Companies all seek to better deliver the new advanced features required to stimulate demand and pricing in various display end-markets. This poses a challenge for panel makers, as multiplying technology development paths can be costly. However, one key benefit of MiniLEDs is that they leverage proven technologies, allowing minimal capital expenditure and faster development timelines… Yole releases a dedicated technology & market report dedicated to the MiniLED technologies and market, MiniLED Displays 2019. This analysis presents recent MiniLED technology status and trends including chip, assembly and driving levels. It proposes an updated adoption roadmap and volume forecast for displays and epilayers and details on potential upsides such as LED cinemas or automotive lighting.
What is the exact definition of MiniLEDs? Why is there a confusion between Micro and MiniLEDs? What are the benefits of MiniLED technologies? What will be the role of MiniLEDs, especially within the high end display market segment? Who will successfully adopt this technology? The market research & strategy consulting company proposes today a snapshot of the MiniLED industry.

MiniLEDs can be categorized into two main display application segments: LCD backlights and direct view displays. Each segment involves mostly distinct technological requirements and ecosystems.

“For LCD backlights, MiniLEDs are a way to narrow the gap with OLEDs, delivering higher brightness and better control of local black levels compared to standard LCD panels”, announces Pars Mukish, Business Unit Director, Solid-State Lighting & Display from Yole. “While not as perfect as OLEDs’ pixel-level dimming, MiniLED LCDs definitely narrow the gap as shown by the many prototypes presented by a wide variety of display makers. At Yole, we estimate that MiniLED benefits stand out mostly in three major applications: TVs, monitors and automotive displays.”

TVs are the most promising market volume opportunity, and are likely to drive MiniLED shipments. And it has already started with TCL being the first player to commercialize a MiniLED TV in its 8-series line-up since October 2019. The technology could help LCDs bridge the gap and regain market share against OLEDs in the high-end, large size, most profitable segments. “This opportunity is all the more enticing to panel and display makers which haven’t yet invested in OLED technologies,” details Zine Bouhamri from Yole. “They see the potential to extend their existing LCD fabs’ and technologies’ lifetimes, and boost their profitability. Significant adoption is however not expected until the industry further reduces chip sizes and develops more efficient assembly processes in order to reduce cost. Reducing chip sizes also involves changes in the BLU design and a possible transition from printed circuit boards to glass as a substrate.”

For high-end monitors where OLEDs have yet to overcome challenges in terms of availability and lifetime, MiniLED LCDs could deliver excellent contrast and high brightness at lower cost… Tablets, smartphones as well as some automotive applications might be a business opportunity for the MiniLED makers.

As an example, the leading player, Apple is expected to adopt the technology in its next iPad Pro. This would send favorable signals to the market and competition, empower the supply chain’s equipment development and availability, and possibly enable faster adoption in other applications.
For direct view LED displays, MiniLEDs used in conjunction with COB\(^1\) architecture could enable higher penetration of NPP\(^2\) LED displays in multiple applications, hence increasing the serviceable market. Die size could evolve continuously toward smaller dimensions, possibly down to 30-50\(\mu\)m, in order to reduce cost. Adoption in cinema is still limited but even modest adoption rates would generate very significant upsides.

Last but not least, MiniLEDs are also making their way into lighting applications. In this field, advanced automotive front lighting systems such as smart headlamps could also represent a real upside for MiniLEDs in the mid-to-long term.

What about the competitive landscape? According to Yole’s display team, MiniLEDs are a strategic defensive opportunity for Taiwanese display makers. They haven’t invested in OLEDs. Meanwhile, their position in LCD panel manufacturing is challenged by rapidly increasing Chinese capacity, which is pushing prices downward. MiniLEDs are an opportunity for differentiation and increased added value. But Chinese makers are also working on MiniLEDs among multiple other technologies such as WOLEDs\(^3\), inkjet printed OLED and electroluminescent quantum dots. Korean companies appear to be mostly moving out of LCDs and focusing all investment on OLEDs. However, for the time being, LG still needs to generate cash from its LCD operation to fund its WOLED ramp up and MiniLEDs could present an opportunity to increase added value from its LCD products.

Upstream in the supply chain, MiniLEDs should benefit chip and BLU/module/panel players and allow some to move up the value chain. As MiniLED applications are mostly constructed in COB processes, there is a risk that LED packagers may be squeezed out of the supply chain. The most exposed are reacting by either moving up the supply chain or by developing new innovative packages or modules that could allow them to remain relevant and even to surf the MiniLED wave…

---

\(^1\) COB: Chip On Board
\(^2\) NPP: Narrow Pixel Pitch
\(^3\) WOLED: White OLEDs
A detailed description of the MiniLED Display report is available on [i-Micronews.com](https://www.i-micronews.com).

Yole’s display team is organizing a dedicated online event on December 17 at 5:00PM CET. This webcast, titled “MiniLED and MicroLED Displays: Evolution or Revolution?”, proposes a valuable program to get a deep understanding of each technology, their different challenges, supply chains, market potential and applications.

Speakers are: Eric Virey, PhD. Principal Analyst, Technology & Market, Sapphire & Display and Zine Bouhamri, PhD. Technology & Market analyst, Display at Yole. To attend this webcast, click, [MiniLED & MicroLED](https://www.i-micronews.com).

In addition Yole’s analysts are part of a selection of key conferences & trade shows all year long to present results extracted from the technology & market reports. Save the next dates in your agenda right now to make sure to meet our experts:

- **Emerging Technologies 2020** (Jan. 14-15, Shanghai, China) with 3 presentations from Yole’s display team:
  - “Next generations TV technologies: how could microLED, QD and improved LCD challenge OLED”
  - “Display and Optical Vision Systems for AR, VR and MR”
  - “MicroLED getting closer to prime time? A reality check”

- **Electronic Displays Conference** (Feb. 26-27, Nuremberg, Germany) with a new presentation from Zine Bouhamri, titled “Status of the microLED industry”.

All presentations are then after available on [i-Micronews.com](https://www.i-micronews.com). Stay tuned!
ABOUT THE REPORTS

MiniLED Displays 2019

MiniLED prosumer applications are on their way – and industrial direct-view LED displays are strengthening their development. – Powered by Yole Développement

About the authors:

- **Pars Mukish** holds a master degree in Materials Science & Polymers (ITECH - France) and a master degree in Innovation & Technology Management (EM Lyon - France). Since 2015, Pars has taken on responsibility for developing SSL and Display activities activities as Business Unit Manager at Yole Développement (Yole). Pars is part of the Photonics, Sensing & Display division at Yole. Previously, he has worked as Marketing Analyst and Techno-Economic Analyst for several years at the CEA (French Research Center).

- As a Technology & Market Analyst, Displays, **Zine Bouhamri**, PhD is a member of the Photonics, Sensing & Display division at Yole Développement (Yole). Zine manages the day to day production of technology & market reports, as well as custom consulting projects. He is also deeply involved in the business development of the Displays unit activities at Yole. Previously, Zine was in charge of numerous R&D programs at Aledia. During more than three years, he developed strong technical expertise as well as a detailed understanding of the display industry. Zine is author and co-author of several papers and patents. Zine Bouhamri holds an Electronics Engineering Degree from the National Polytechnic Institute of Grenoble (France), one from the Politecnico di Torino (Italy), and a Ph.D. in RF & Optoelectronics from Grenoble University (France).

- **Eric Virey**, PhD. serves as a Principal Display Market and Technologies Analyst within the Photonics, Sensing & Display division at Yole Développement (Yole). Eric is a daily contributor to the development of the Display activity at Yole, with a large collection of market and technology reports on display technologies, Quantum Dots, MicroLEDs, TFT backplanes as well as multiple custom consulting projects: business strategy, identification of investments or acquisition targets, due diligences (buy/sell side), market and technology analysis, cost modelling, technology scouting, etc. Eric has spoken in more than 50 industry conferences worldwide over the last 10 years. He has been interviewed and quoted by leading media over the world including: The Wall Street Journal, CNN, Fox News, CNBC, Bloomberg, Financial Review, Forbes, Technology Review, etc. He is also a regular contributor to various display industry media and organizations. Previously Eric has held various R&D, engineering, manufacturing and business development positions with Fortune 500 Company Saint-Gobain in France and the United States. Eric Virey holds a PhD in Optoelectronics from the National Polytechnic Institute of Grenoble. He is currently based in Portland, OR.

As well as:

- **MicroLED Displays 2019**
- **Next Generation 3D Displays 2019**

ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and image sensors, Compound Semiconductors,
RF Electronics, Solid-state lighting, Displays, software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics, Batteries & Energy Management and Memory.

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

For more information, visit [www.yole.fr](http://www.yole.fr) and follow Yole on [LinkedIn](http://www.linkedin.com) and [Twitter](http://www.twitter.com).

- Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)
- Reports: David Jourdan (jourdan@yole.fr)

Yole Group of Companies – Public Relations: Sandrine Leroy (leroy@yole.fr)

####