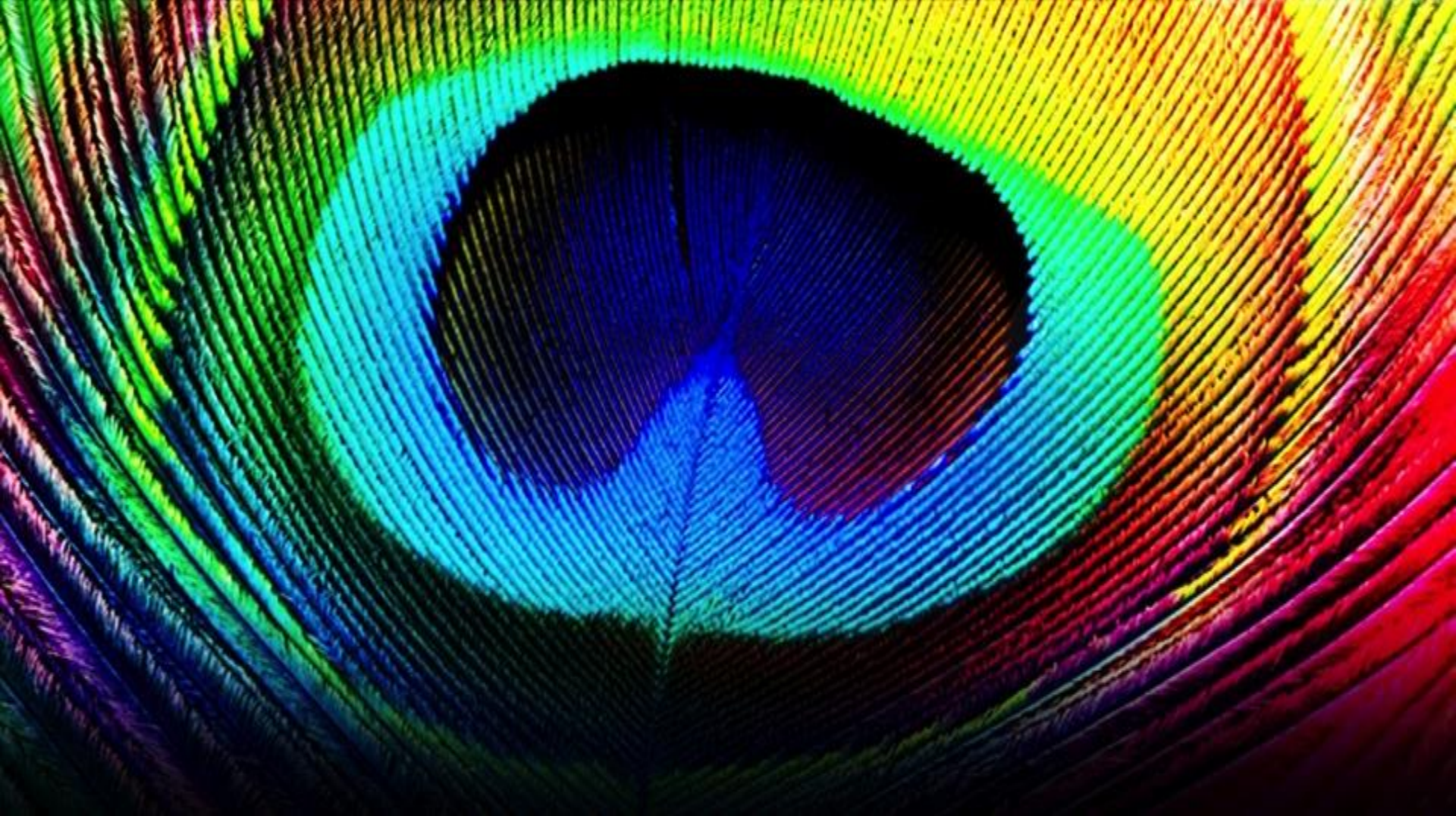


Applications & Advantages of Quantum Dots

September, 2015

QD VISION

Overview

- Introduction
- Image quality and why color matters
- What are quantum dots
- Quantum dot applications & adoption
- The future of color: Rec. 2020
- Conclusions

QD Vision – the Leader in Quantum Dot Technology

- **Founded in 2005, operations in Lexington, Massachusetts, USA**
- **MIT roots with many staff from MIT**
- **Over 250 patents and patents pending**
- **Launched the world's first Color IQ™ quantum dot displays in 2013**
- **World's largest quantum dot manufacturing facilities**
- **Currently developing products with the top Chinese TV and Monitor manufacturers**

In the Display Industry, when we think about image quality……

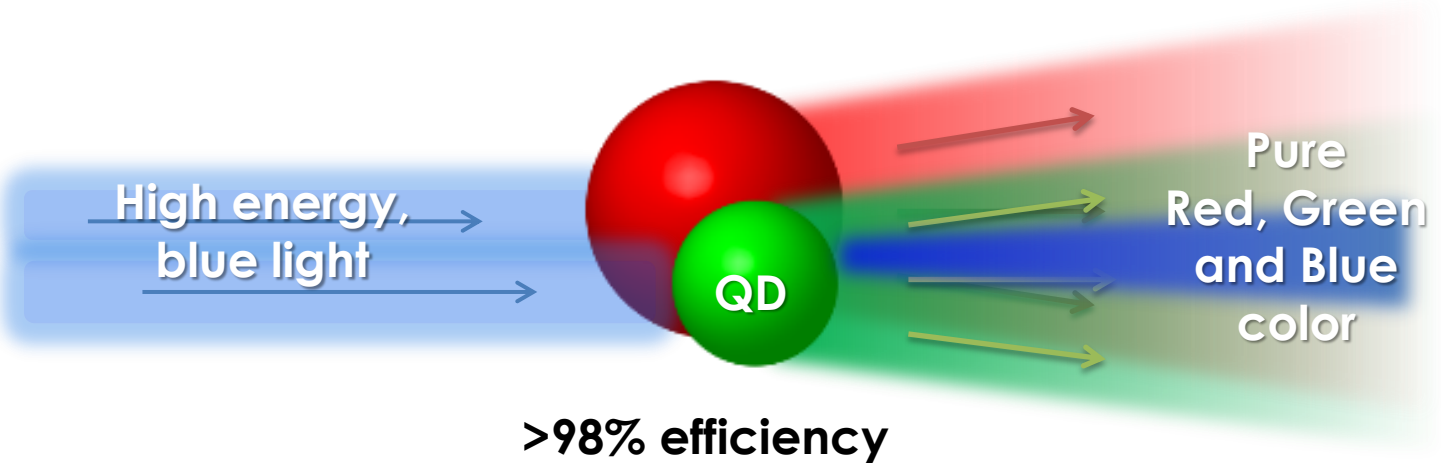
… we think
resolution

… we think
contrast

… we think
brightness

… but consumers think,
COLOR.

What are Quantum Dots?



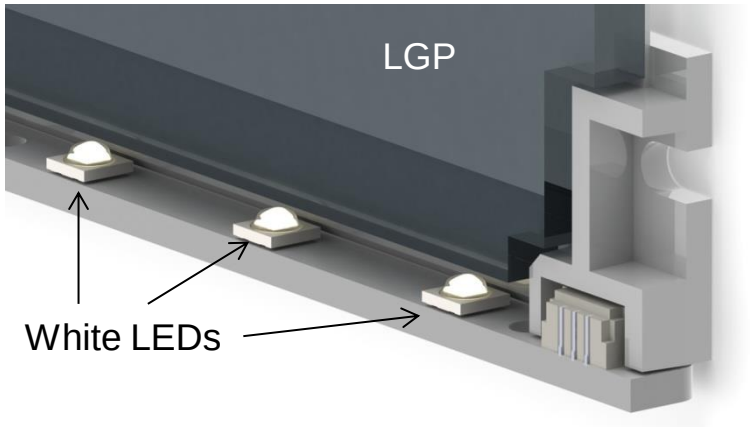
>98% efficiency

Quantum Dots are engineered nanomaterials that emit pure colors, which means your displays can now show more colors than ever before

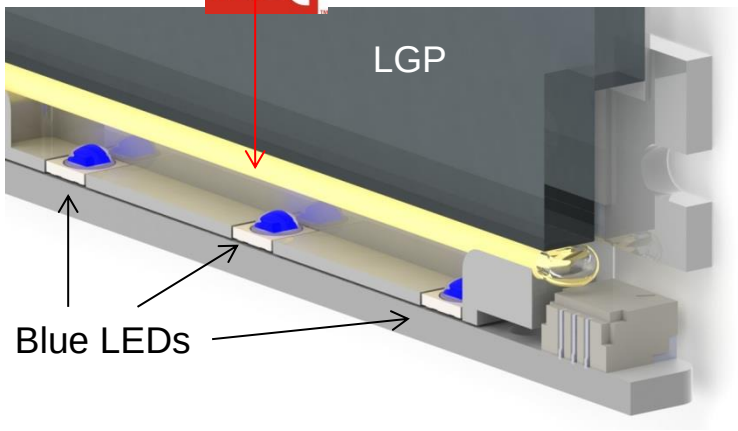
Color IQ™ Optical Component

- Color IQ optical components containing light-emitting semiconductor nanocrystal Quantum Dots (QDs).
- Improves typical LCD TV Color performance by 50%
- Best available Color-Efficiency combination
- QDs are tuned for optimized spectra, narrowband light emission
- Highly efficient, scalable manufacturing process

Current White LED Solution

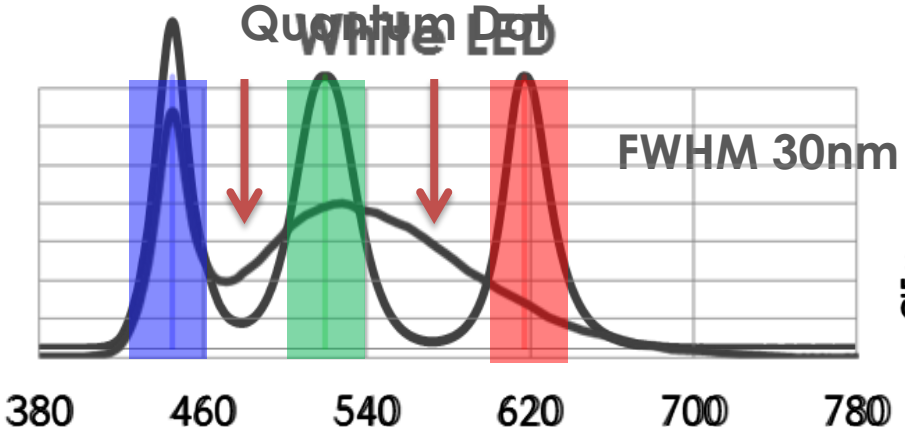


Color IQ Solution

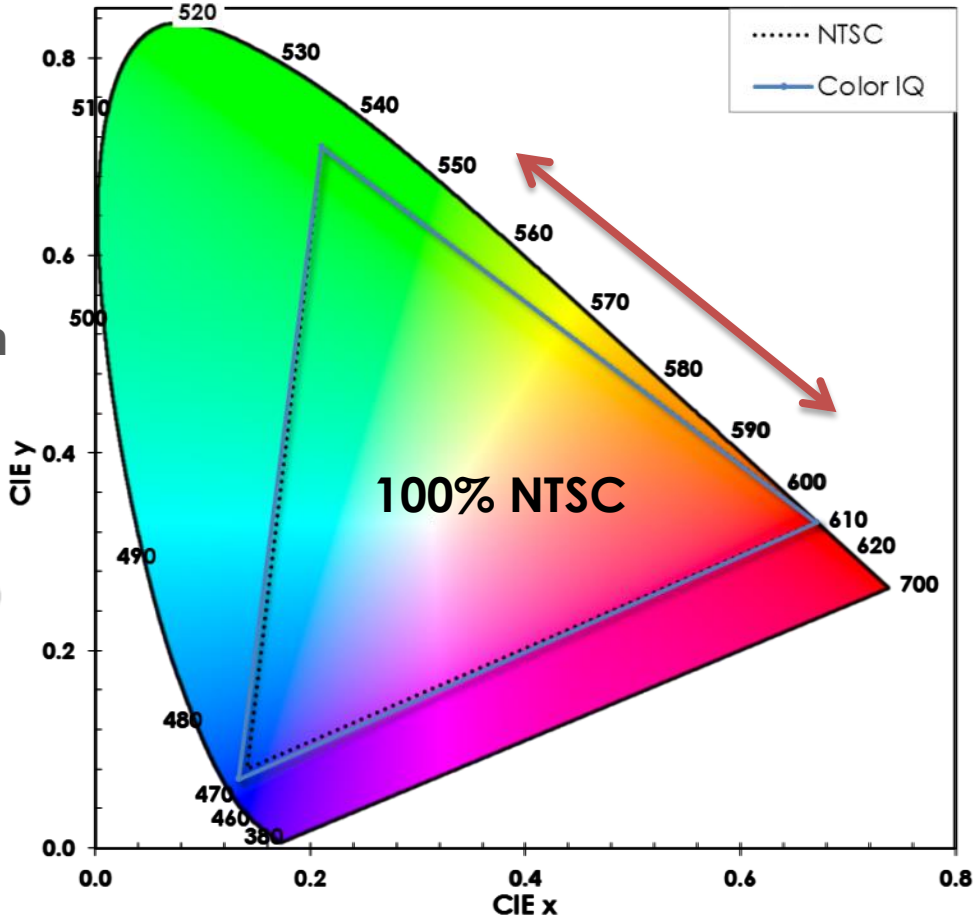


Color IQ™ Optics deliver OLED color at LCD cost

Color IQ™ Solution Enables LCD Full Gamut



Tunable, pixel level QD emission
separates RGB channels
achieving full gamut



Color IQ™ optics are the most cost effective LCD Full Gamut solution

Quantum Dot Applications

- Achieving > 100% NTSC LCD in televisions
- Achieving Rec. 2020 today with the TCL H9700 55” television
  - >90% u’v’ overlap
  - >90% u’v’ area
- Achieving 99% Adobe RGB in monitor displays

CES Coverage Highlights

THE WALL STREET JOURNAL. | TECH

TV Makers Set a New Strategy

'Quantum Dot' Technology Offers Vibrant Colors, Leaving Crisp OLED Images on Hold

VentureBeat

"Why the quantum dot is the hottest TV tech going"

ConsumerReports.org

"5 TVs from CES 2015 that our testers want to review"

THE VERGE

"Why quantum dots are showing up on more TVs at CES 2015"

PCWorld

"Best of CES 2015: The gadgets and gear that wowed us most"

IEEE SPECTRUM

"CES 2015: What the Heck Are Quantum Dots?"

ECN

"Photo of the Day: CES 2015"

SOUND &VISION

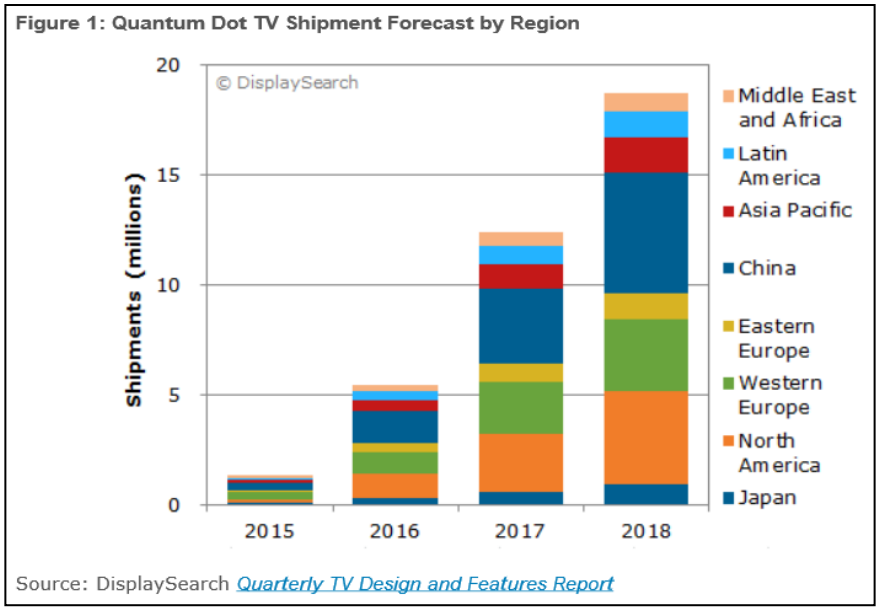
"QD Vision IS Quantum Dots"

Quantum Dot Adoption is Accelerating

Companies Demonstrating Quantum Dot Displays in 2015

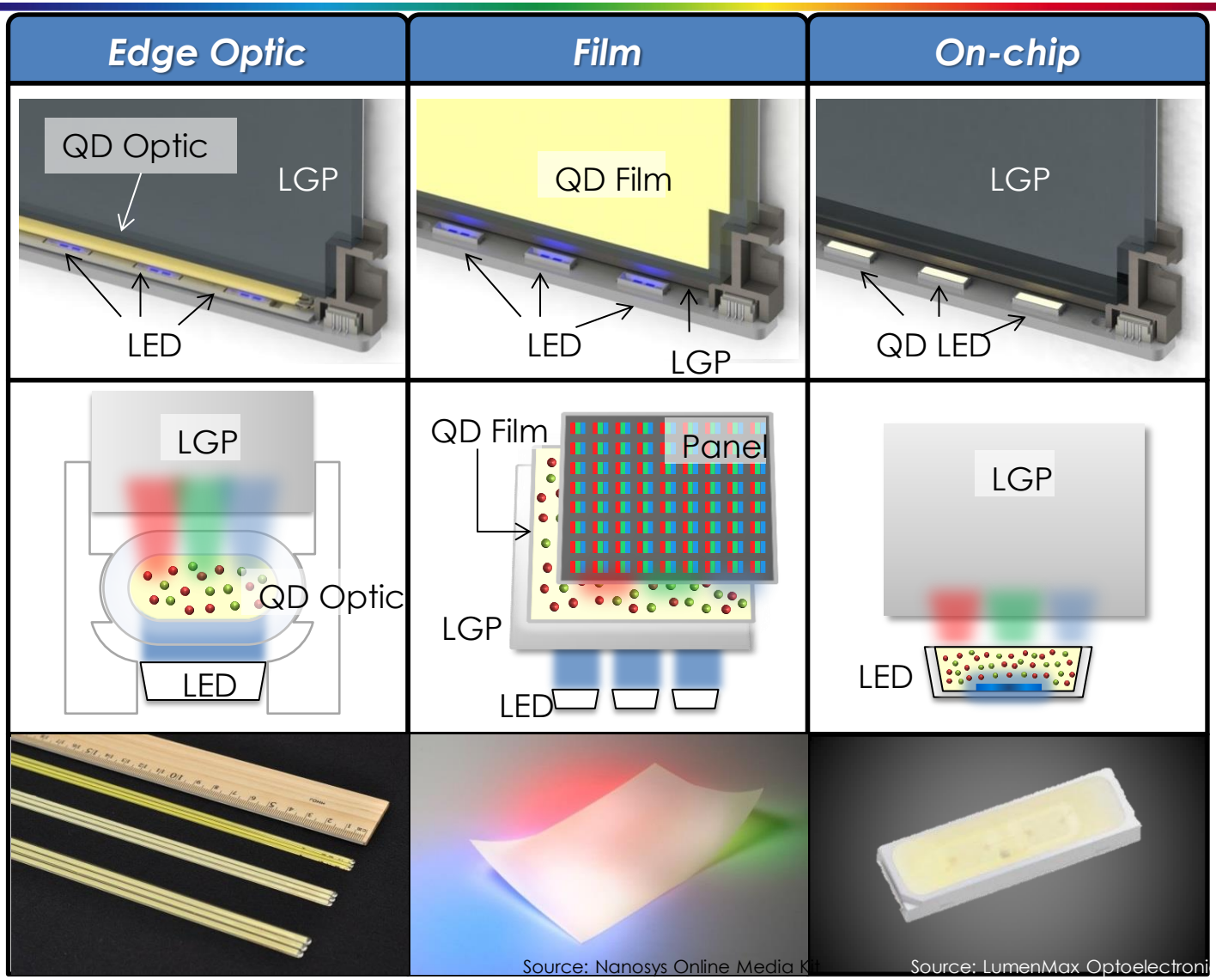
KONKA, LG, SAMSUNG, TCL, Hisense, Skyworth, SHARP, PHILIPS, AOC, CHANGHONG 长虹

"***We forecast by 2025, 60% of TVs will have quantum dots in them;*** *51% of monitors will adopt quantum dot.*"
- Dr. Jennifer Colegrove, CEO, Touch Display Research Inc.



"TVs using QD technology will become available in 2015, with 1.3 million shipping worldwide. ***Shipments of quantum dot TVs are expected to grow to 18.7 million in 2018.***
- DisplaySearch *Quarterly TV Design and Features Report*

Three Form Factors for all Sized Displays

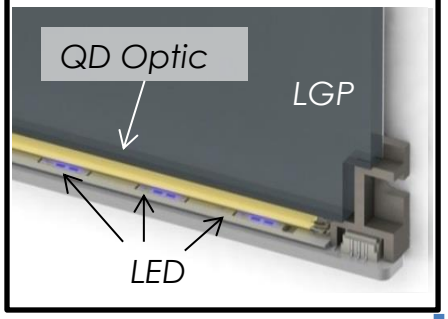


Two Commercialized Form Factors for Displays

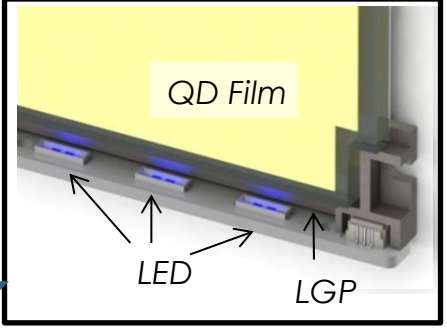
Large Area

Mobile

QD Edge Optic



QD Film



Sony FHD/UHD TVs

Sony and TCL TVs

Hisense, Philips, & Konka TVs, Philips & AOC Monitors

Many more to come!

2013 **2014** **2015**

Amazon Kindle

ASUS Zenbook NX500

Samsung SUHD TVs

Color IQ delivers the world's best color

COLOR IQ™ is

life-like	50%+ more color than traditional LEDs	高保真
affordable	a fraction of the cost of film	低价格
energy-efficient	uses 25% less energy than OLED	高能效
future-proof	the only one with a path to Rec. 2020	未来保证

Two Material Choices for QDs

CdSe Quantum Dots

- Shown to have no negative impact on health
- Most energy-efficient material
- Shown to have positive net effect on environment
- Award-winning green chemistry processes
- Proven reliability in the market
- Exemption to EU RoHS adopted

InP Quantum Dots

- Class 1b carcinogen
- Lower energy efficiency
- No environmental benefit
- Less efficient synthetic process
- Reliability of products unproven
- On candidate list for RoHS ban

Color IQ™ Quantum Dots Are Better for the Environment

- The European Union (EU) agrees that the energy saved over the life of a Color IQ television results in a net reduction in Cadmium to the environment
- There's less Cadmium in 500 QD televisions than in a single AA NiCad battery
- EU regulators (RoHS) are planning to add Indium Phosphide – the heavy metal used in "Cd-free" solutions - to their list of monitored chemicals

"The evaluation showed that the use of quantum dots in displays has indeed a positive overall impact due to their low energy consumption,"
– RoHS 2 Directive for Electrical and Electronic Equipment

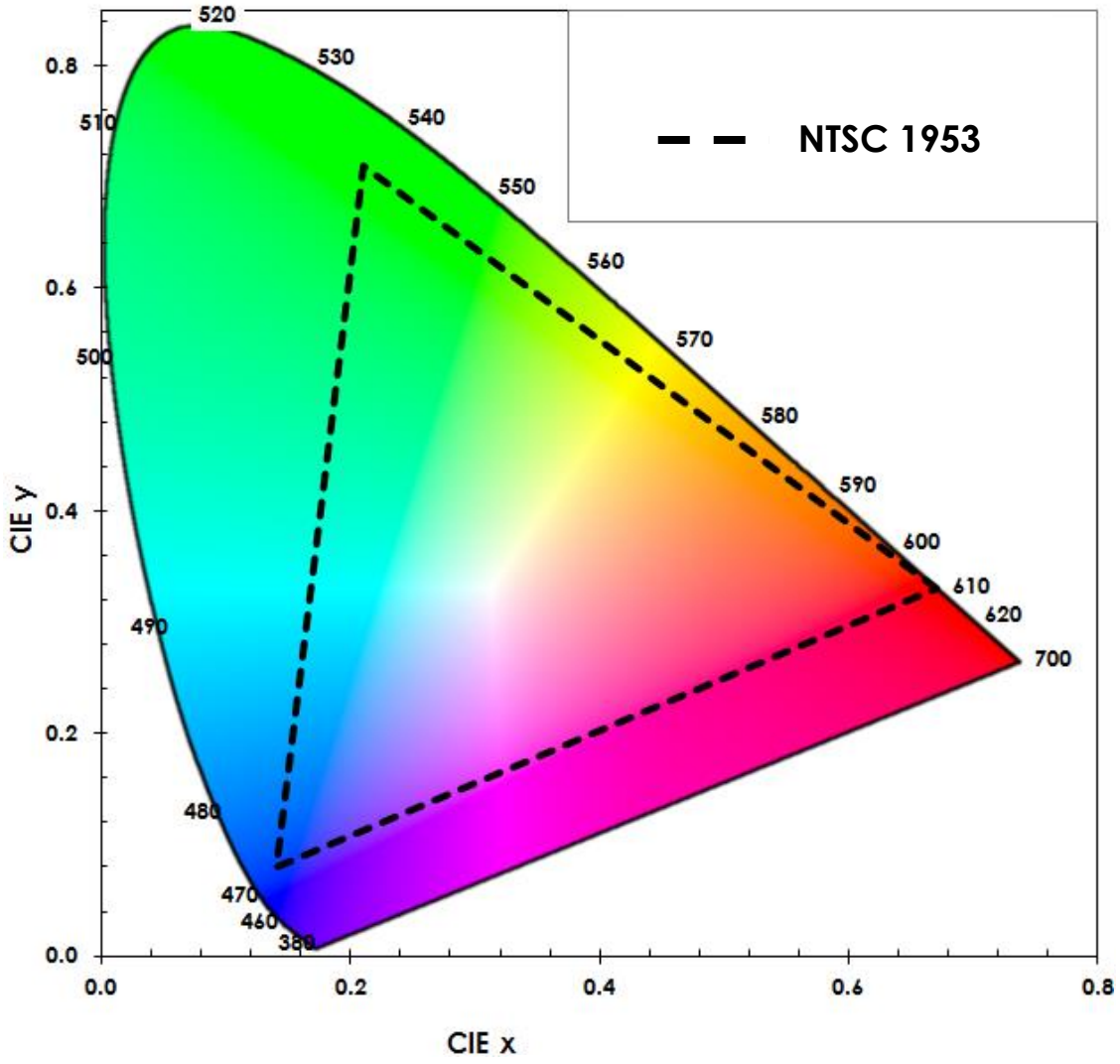
Color IQ Future: Rec. 2020

ITU Rec. 2020:
Posted on August 23, 2012

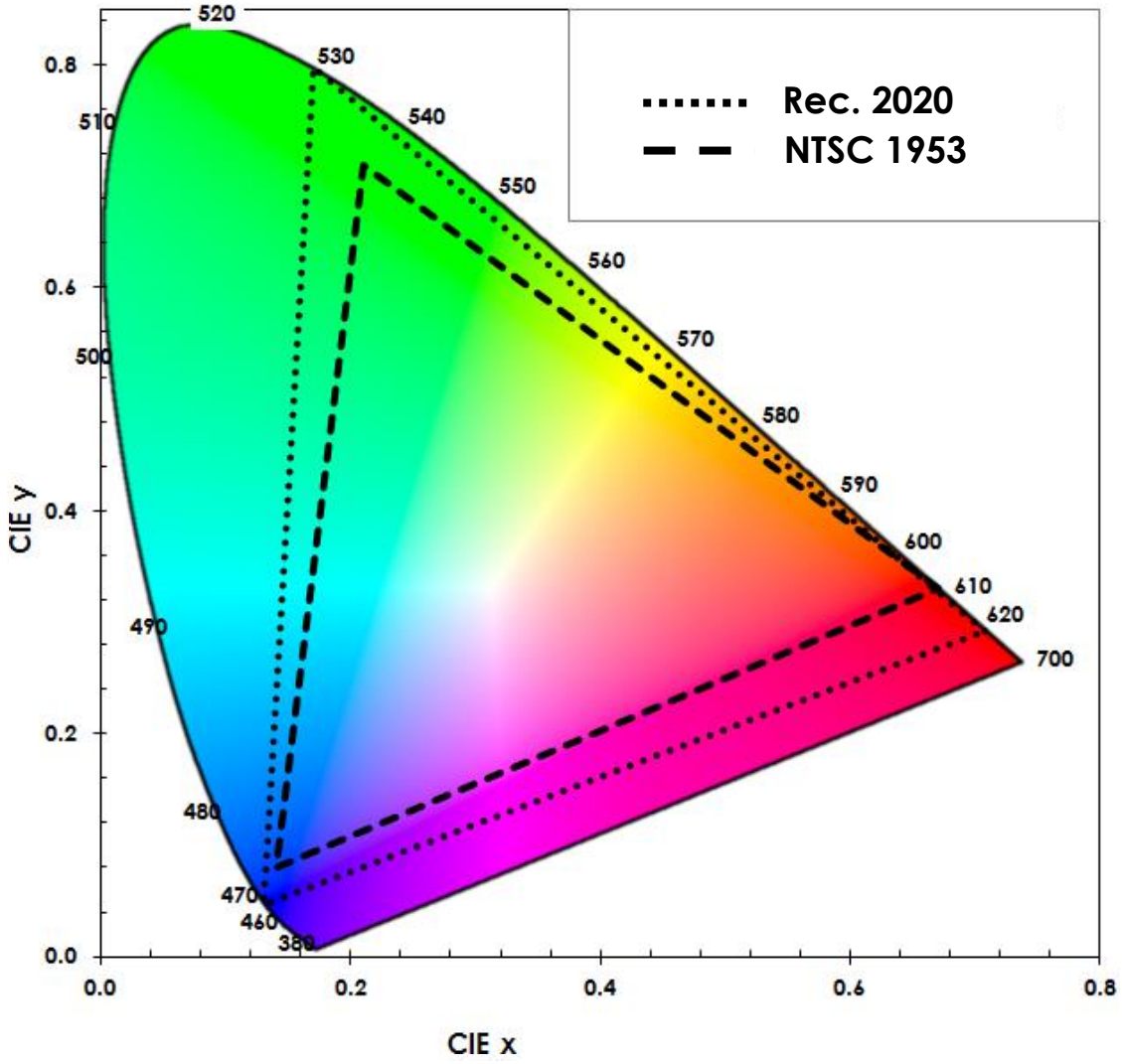
Specifications:
- ***Two 16:9 resolutions: 4K & 8K***
- ***Frame rates from 24-60 and up to 120 Hz***
- ***Bit depth from 10 or 12 bits***
  - ***10-bits = 1 Billion colors***
  - ***12-bits = 68 Billion colors***

- **No one has a Rec. 2020 product commercially available today**
- **At this time, QD Vision is working closely with a strategic customer to build a Rec. 2020 solution**
- **We are targeting mass production in 2016**
- **Today, QD Vision is creating quantum dots that can deliver Rec 2020 color**
- **We are working with one of the largest color filter material manufactures to advance the dyes used in LCD CFAs**

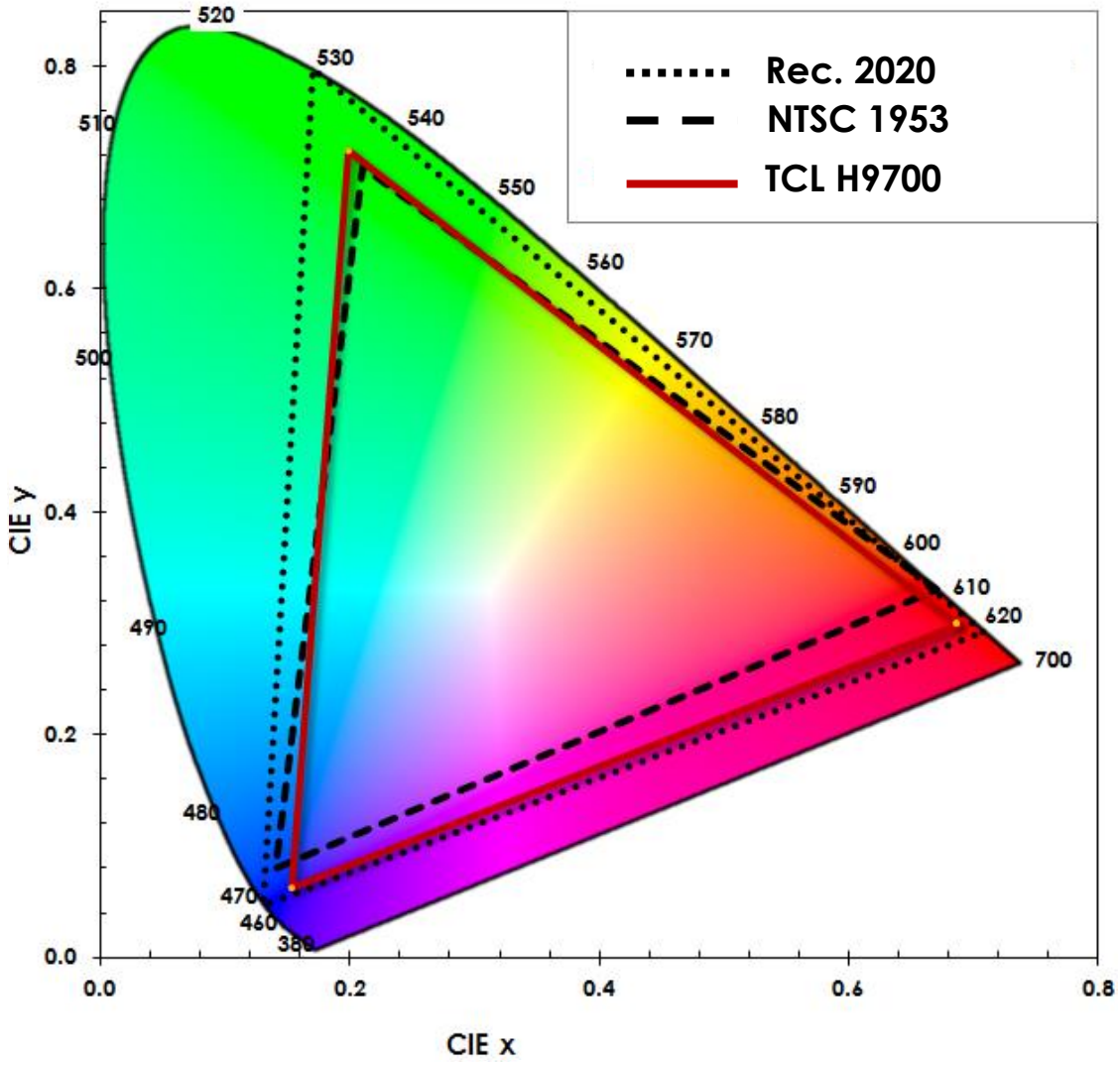
Towards Rec. 2020



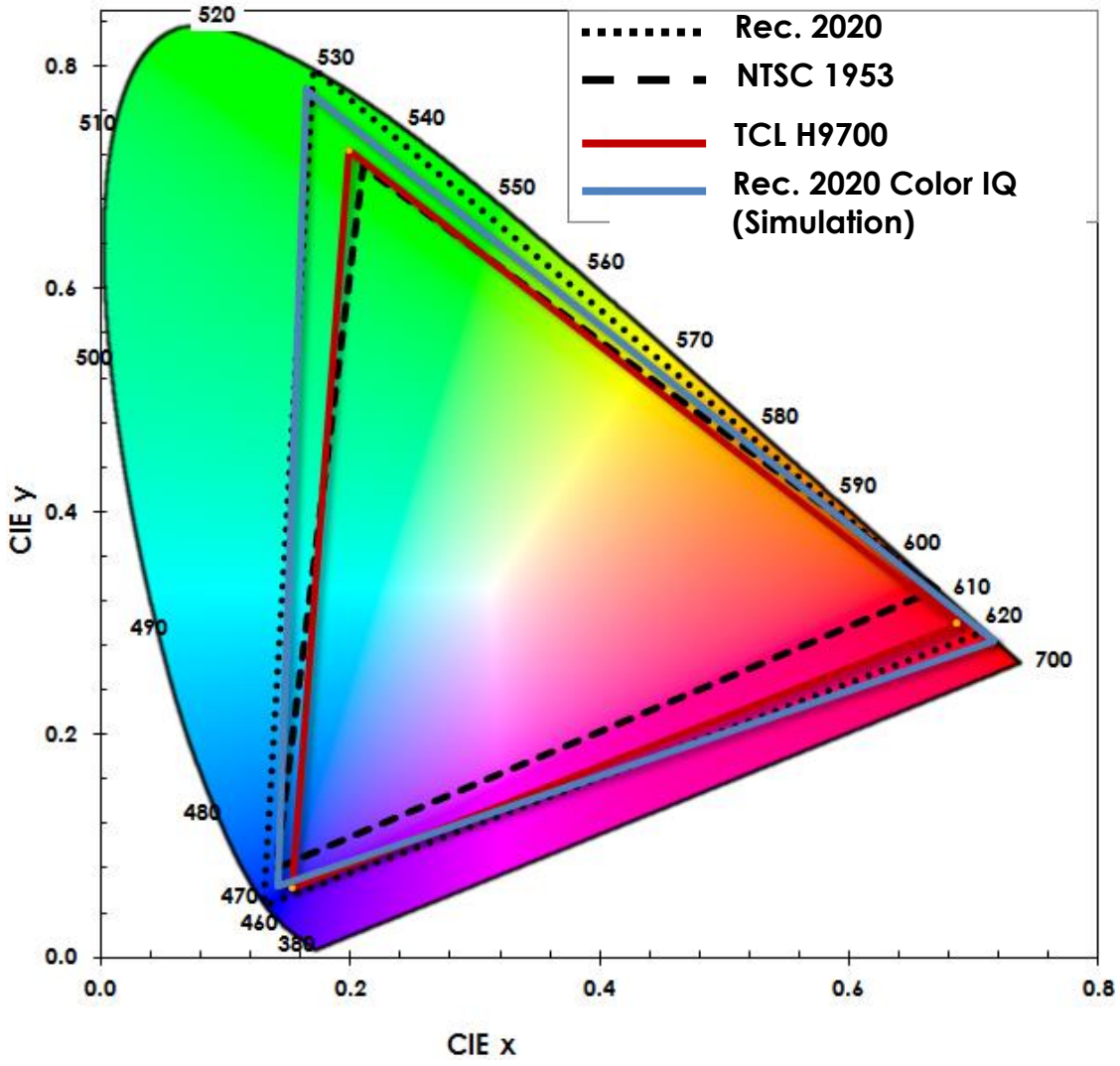
Towards Rec. 2020



Towards Rec. 2020



Towards Rec. 2020



Conclusions

- Adoption of QDs continues to accelerate with many products are coming to the market in 2015
- QD TVs are emerging as the new standard for best-in-class display performance:
  - Best color gamut
  - Best efficiency
  - Lowest cost
- Color IQ solution delivers the world's best color

Thanks for your attention.

Xie, Xie

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