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Strategies for U.S. OLED Lighting Manufacturing

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UDC Business Model

IP innovator, technology developer, patent licensor and materials supplier for the rapidly growing OLED markets

Over 3,500 OLED Patents Issued & Pending in China, Europe, India, Japan, Korea, Taiwan and the United States

Produced by PPG Industries, Inc., device-qualified and sold commercially by UDC since 2003



Over 20 years and ~ \$300M of Research & Development

World-class PHOLED Materials Supply

- Discovery and basic research driven by UDC R&D Chemistry and Device Engineering
- Process-developed for high-quality and cost-effectiveness by PPG
- Manufactured using state-of-the-art processes and equipment by PPG at Monroeville, PA and Barberton, OH facilities
- Product-qualified with ISO9001:2008 compliant quality management systems
- Exclusive relationship since 2000 to provide UDC with an assured supply of high-purity proprietary PHOLED materials for its partners



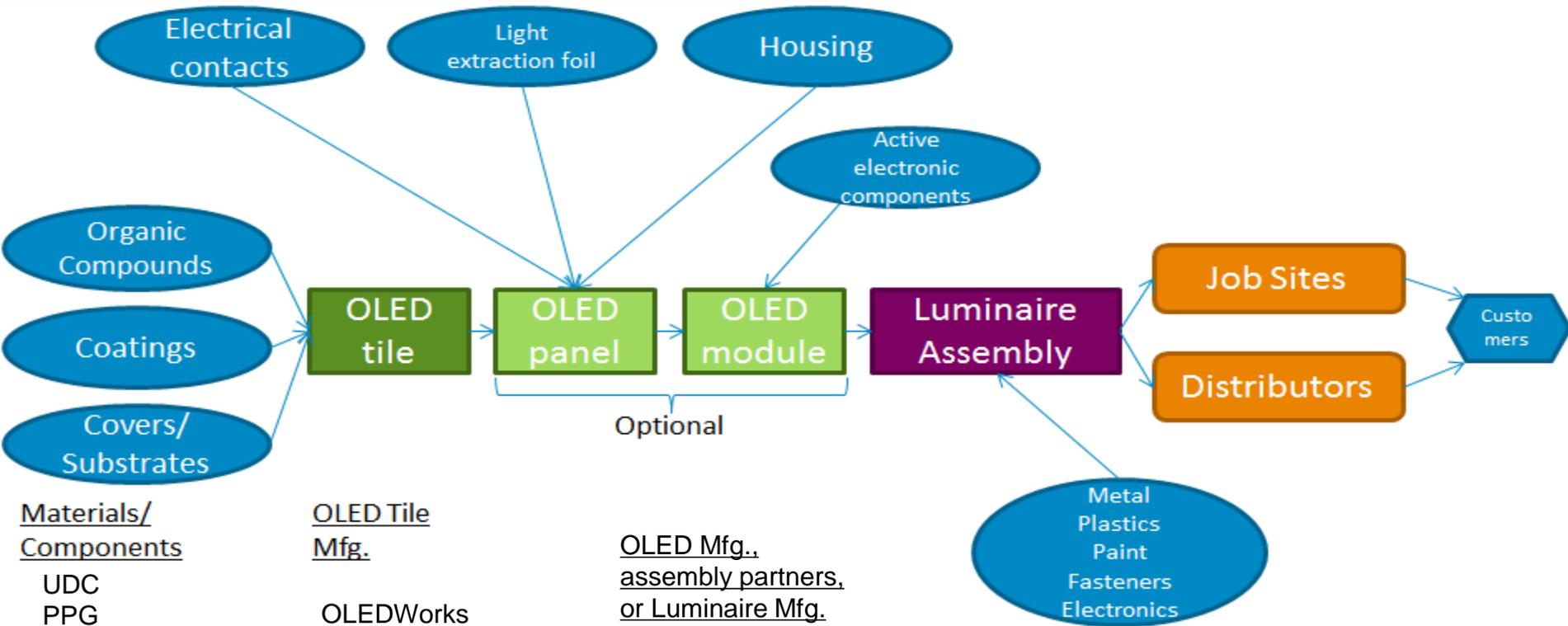
Questions

- How can companies keep manufacturing in the U.S.
- Is the move to flexible OLEDs real ?

US OLED Lighting Domestic Manufacturing

- US has a strong OLED Lighting business – we are active at all levels of the supply chain
- Luminaires, panels, components (materials, substrates, outcoupling, barrier films) and manufacturing equipment

US OLED Supply Chain



Materials/Components

UDC
PPG
EMD Millipore
Corning
Guardian
Alcoa
Plextronics
Cambrios
DuPont
3M
Ferro
DOW
Pixelligent

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OLED Tile Mfg.

OLEDWorks

OLED Equip. Mfg.

Trovato Mfg.
Veeco
Colnatec
nTact
Kateeva
Kurt Lesker
LC Technologies

OLED Mfg., assembly partners, or Luminaire Mfg.

Mbraun USA
KLA Tencor
Photo Research
LabSphere
Keithly
Filmetrics
JA Woollam
AMAT

Luminaire Mfg.

Acuity Brands
GE Lighting
WAC Lighting
Cooper Lighting
Osram Sylvania
Lite Control
Armstrong
Innosys

US OLED Lighting Domestic Manufacturing

- Lighting is local – US firms have advantage of being close to US consumer
- US has great technology and innovation
- OLED lighting does not have an expensive backplane, as do displays, and is based on thin films which have strong US base
- Generally we are not labor intensive
- Use IP to protect your business, and be the best
- Focus and have a compelling product
- Leverage DOE resources (money, roadmap, contacts)

Are flexible OLEDs real ?

- YES
- Plastic displays are gaining market share (Watches and Galaxy S6 Edge etc)
- Foldable display products soon..
- Large new investments in plastic OLED manufacturing
- Thin film barriers are viable, although lower cost is desirable
- Substrate requirements for lighting easier than displays (e.g. Temperature)

Opportunities for flexible OLEDs

- OLED lighting on plastic (or flexible glass) offers a unique value proposition and design freedom that really differentiates OLEDs from all other forms of lighting
- Many opportunities in supply chain:
 - Barrier films, outcoupling, materials, equipment
- Many opportunities in product design and applications

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Thank you.