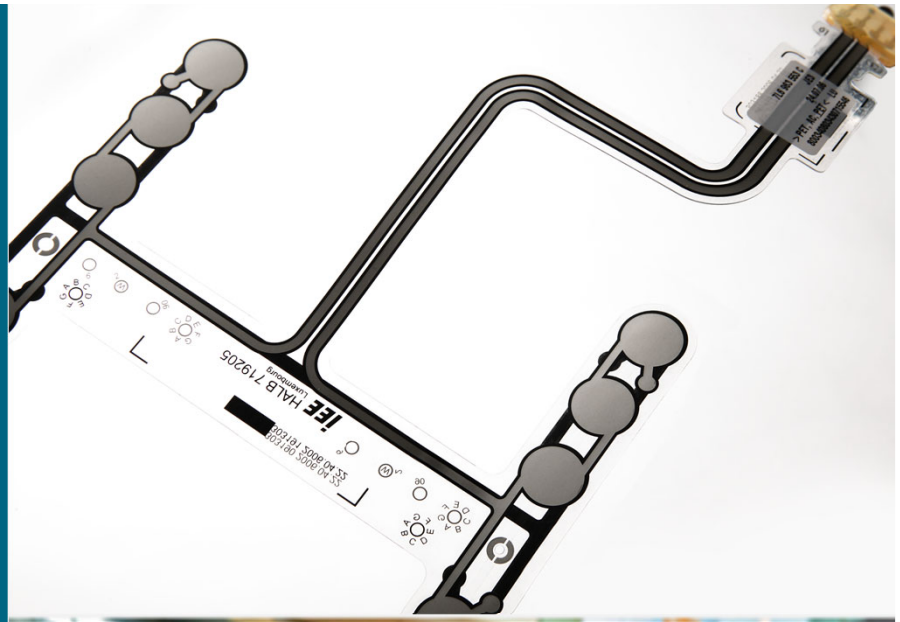


Image source: Messe München, IEE

OE-A Roadmap Automotive

Dr. Klaus Hecker

Functional Print Cluster
Workshop: Applications of Printed Electronics to the Mobility Sector,

July 1, 2020, Webinar

OE-A
Frankfurt, Germany
www.oe-a.org
klaus.hecker@oe-a.org

A working group within

Outline

Introduction OE-A

Introduction Printed Electronics

OE-A Roadmap for Organic and Printed Electronics

Organic and Printed Electronics Applications in Mobility

OE-A – Global industry association for organic and printed electronics

Driven by more than 200 international member companies & institutes from Europe, America, Asia, Africa, and Australia

Primary activities include:

- Working Group Meetings & Networking Events
- Market & Technology Information
- Advocacy
- Demonstrators
- LOPEC: Conference & Exhibition

www.oe-a.org

OE-A members represent the entire value chain of organic and printed electronics:

- Component & Material Suppliers
- Equipment & Tool Suppliers
- Device Manufacturers
- Producers/System Integrators
- End-Users
- Universities & R&D Institutes

A working group within VDMA

Image source: Schreiner

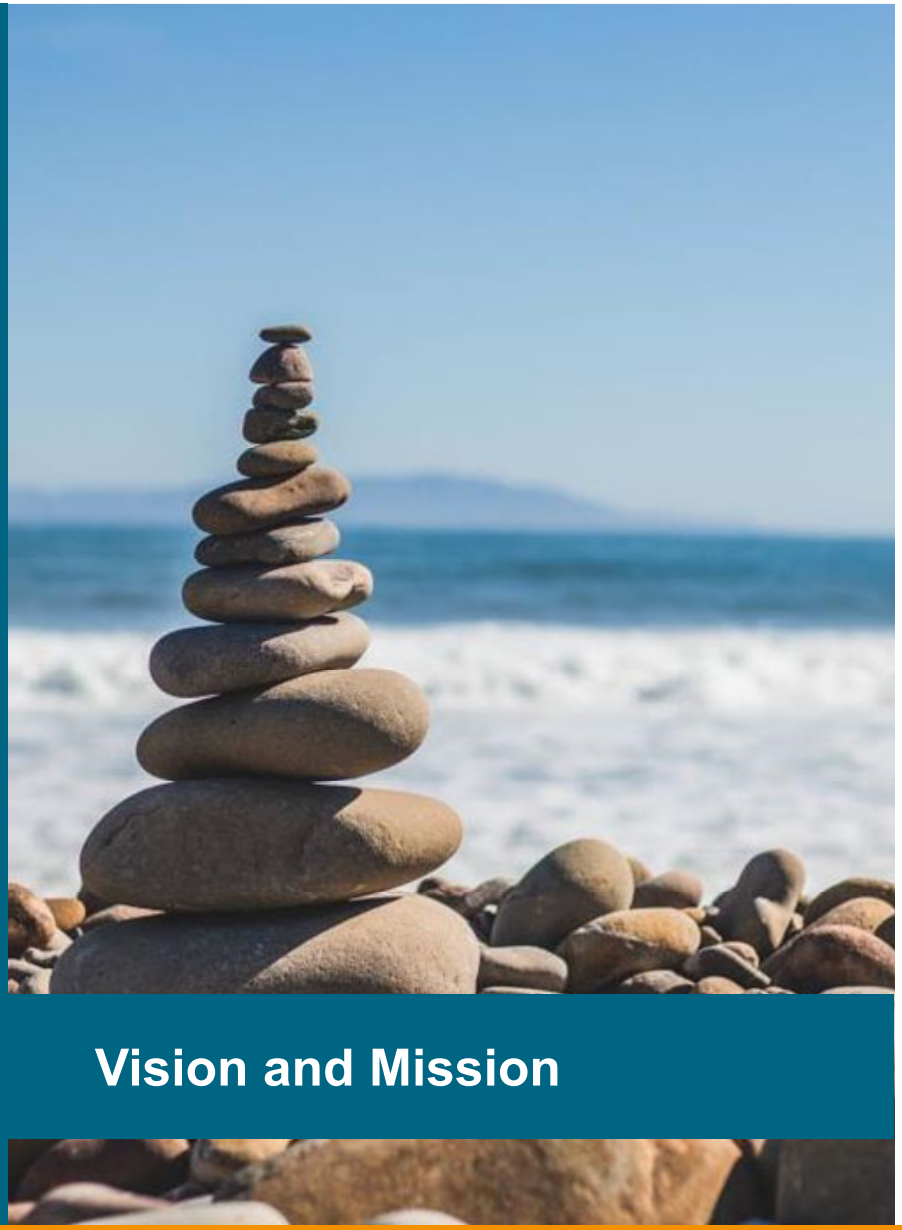


Image source: Unsplash

Vision and Mission

Vision

Flexible, organic and printed electronics are widely implemented for the benefit and value of society and industry.

Mission

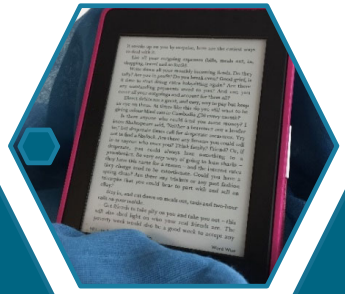
OE-A facilitates an international network, fosters and advocates the flexible, organic and printed electronics community, and seeks cooperation with other markets and technical communities.

Image source: OE-A

Working Groups

- Roadmap
- Demonstrators
- Hybrid Systems
- Sustainability
- Encapsulation
- Education
- Women in PE

Printed Electronics in Everyday Life



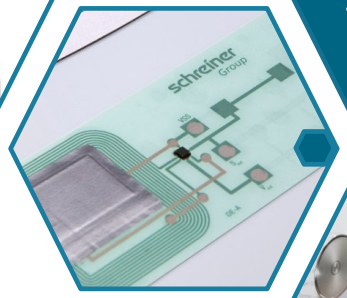
E Ink displays

OLED displays

Glucose sensors

BIPV

Smart packaging for pharma-ceuticals



White Goods

NFC tags

OLED tail-lights

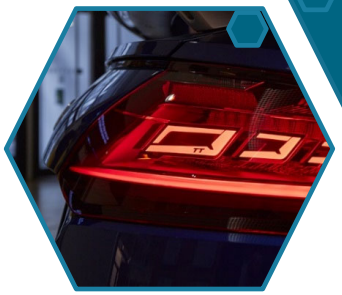


Image source: Thinfilm, Samsung, OE-A/RC, FreeImages.com/Michaela Kobyakov, Heliatek, Messe München

Key Benefits

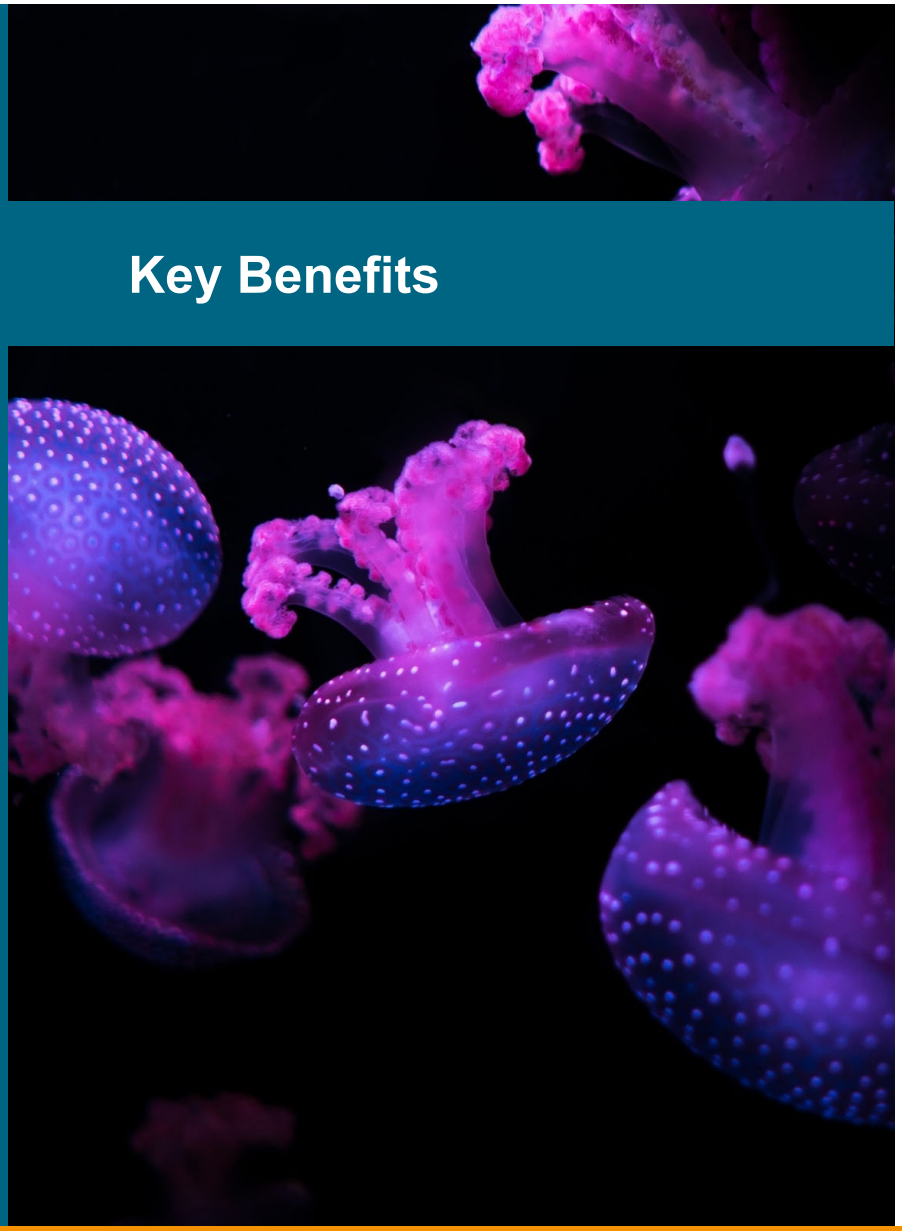


Image source. Unspalsh

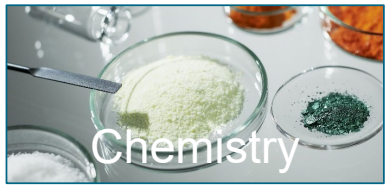
Organic and Printed Electronics is …

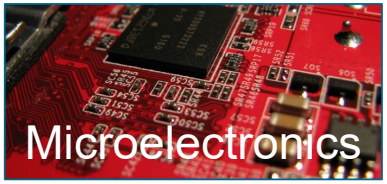
- » Thin
- » Lightweight
- » Flexible

Enabling technology for …

- » Conformable Sensors
- » Efficient lighting
- » Energy harvesting
- » Resource-efficient production

Interaction of Several Fields





- Automotive
- Consumer Electronics
- Healthcare
- Internet of Things
- Printing & Packaging
- Smart Buildings

Printed Electronics

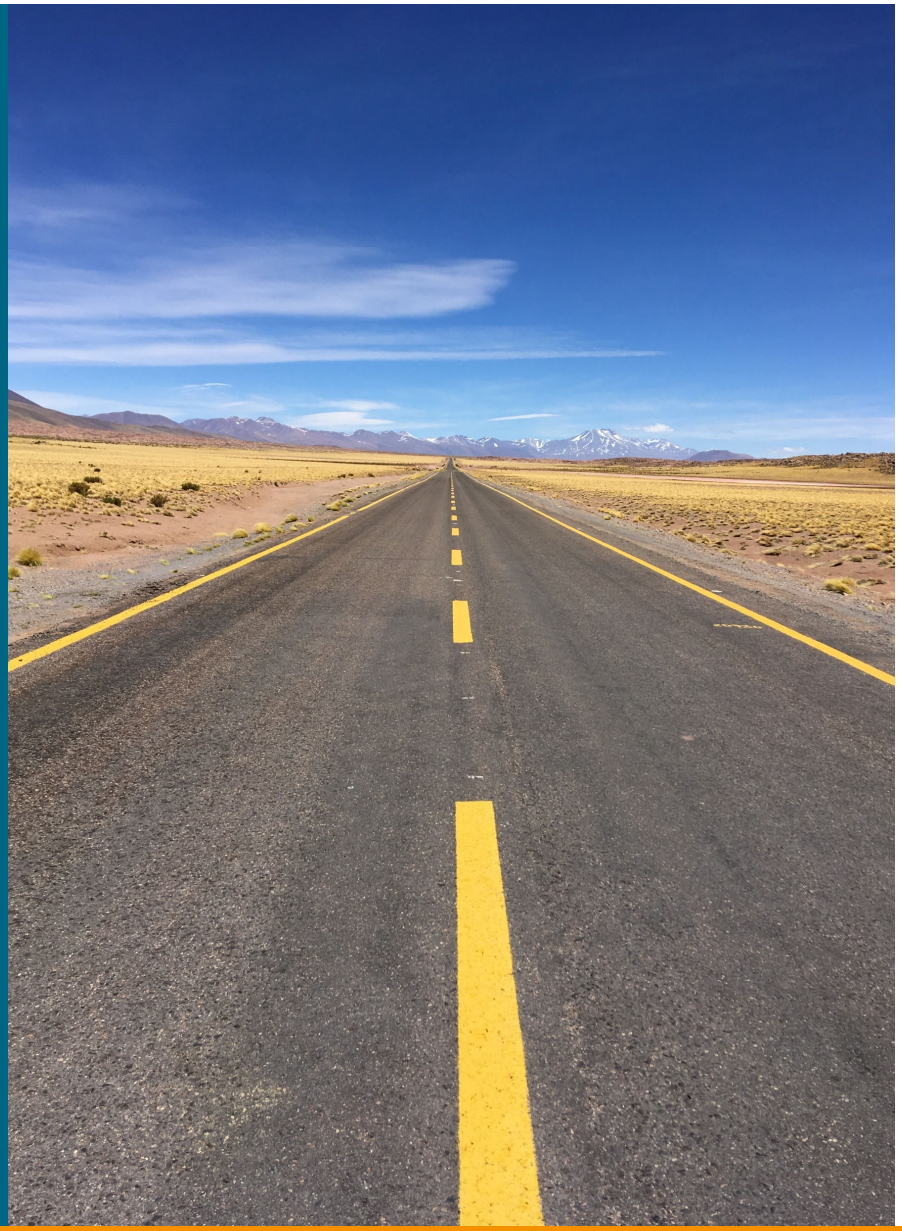


Image source. Unspalsh

OE-A Roadmap for Organic and Printed Electronics

OE-A Roadmapping Activities

- To develop a common opinion about what kind of products, processes and materials will be available and when, as well as of the key issues needing to be addressed
- Joint effort of the experts from OE-A member companies and institutes
- Roadmapping as review / outlook of the industry

OE-A Roadmap for Organic and Printed Electronics at a glance

Publication and Circulation

- Every 2 – 3 years
- Publication of 8th edition in April 2020
- White Paper free of charge for OE-A members
- White Paper for sale for non-members
- Executive summary free of charge

Main goals

- Short, medium & long-term forecasts for important industry sectors and applied technologies
- Identification of key challenges
- Decision aid for the industry

Target audience

- Industry and academia (benchmarking)
- Governments / funding agencies (funding programs, (regional) development strategies, etc.)
- Investors (investment strategies)
- OE-A members
- Standardization

OE-A Roadmap, 8th Edition

OE-A Roadmap – Facts and Figures

- More than 130 pages of content
- Based on the work of more than 250 experts
- Available for members free of charge
- For non-members: available for 2,490 € (+ VAT)

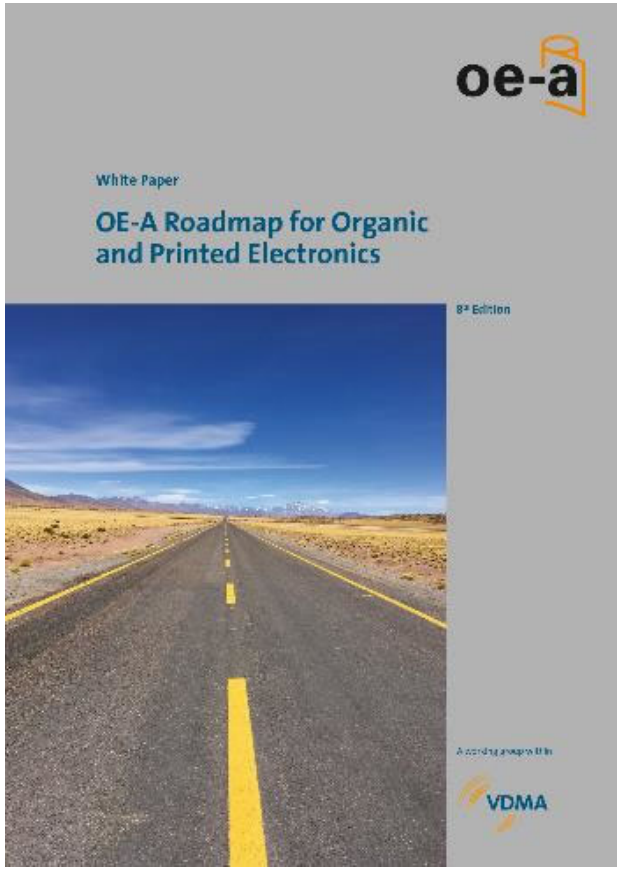
What is NEW in the Roadmap?

- Updated content for all application clusters and enabling technologies
- A completely NEW chapter dedicated to six key industry sectors, including individual Roadmaps for each sector

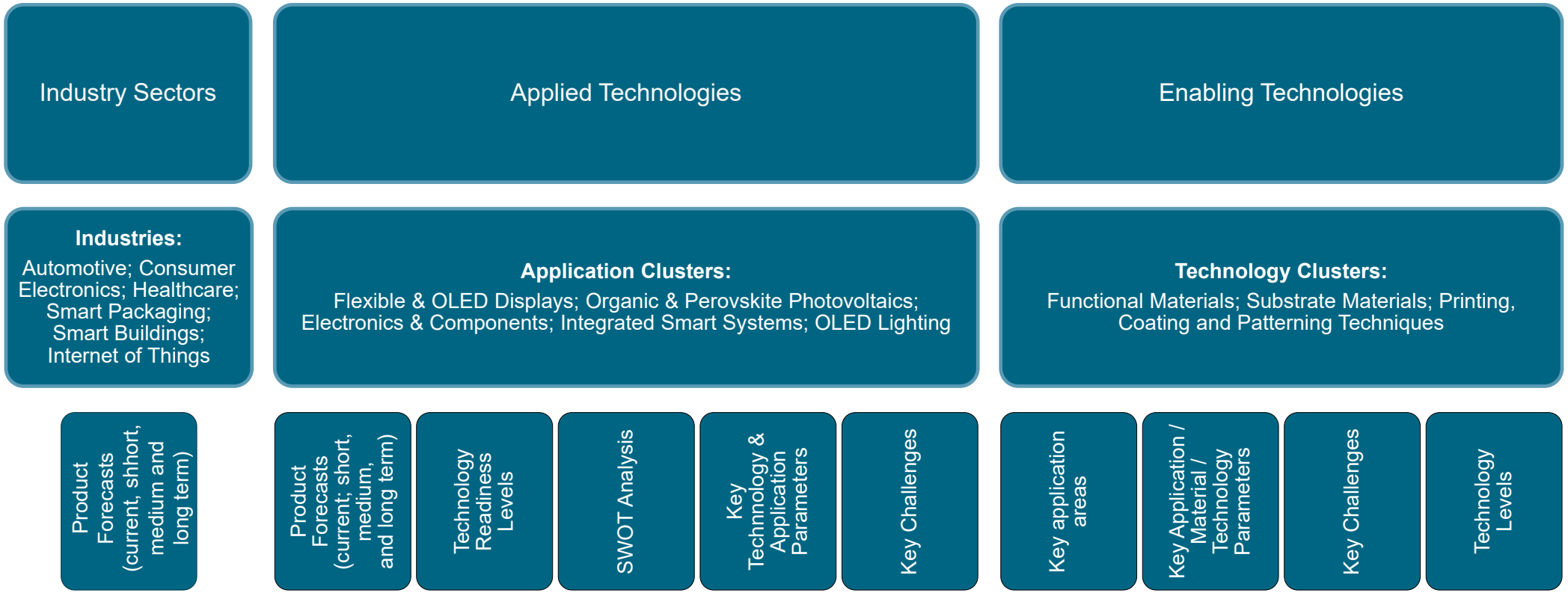
Editorial Team

- Donald Lupo, Tampere University, Stephan Kirchmeyer, COPT Center, Klaus Hecker, OE-A, Jan Krausmann, OE-A

For further questions please contact: jan.krausmann@oe-a.org



White Paper Structure, 8th Edition



Organic and Printed Electronics Solutions in Important Industry Sectors

Automotive	OLED lighting for rear lights and interior human-centric lighting; flexible and OLED displays for side mirror replacement and HMI; sensors for seat occupancy and hands-on detection; Seamless integration of touch sensors for HMI; In-mold electronics for new interior design; Printed heating foils for electric vehicles	
Consumer Electronics	Foldable & flexible displays for smart phones / tablets / wearables; Curved touch surfaces with sensing & signage for white goods; Smart wearables and textiles; OLED lighting; Rollable TV	
Healthcare	Smart medical packages for therapy monitoring; Patches for therapy and vital parameter monitoring; Sensors for On- and Off-body biomarker diagnosis; OLEDs for light therapy; Smart wound treatment and bandages	
Printing & Packaging	Low-cost & low-power displays for price labels; Smart labels for brand protection and cross-media interaction; smart packaging with autonomous sensors; printed and hybrid NFC & RFID; Lighting	
Smart Buildings	Sensors for material monitoring, energy management (climate, smart windows) and wellbeing (humidity, gas); energy autonomous sensors; Heating elements; BIOPV; OLED lighting;	
Internet of Things	Optimized maintenance of buildings, machinery parts and in the mobility sector by structural health monitoring; energy autonomous devices; smart labels for logistics and consumer protection; Environmental monitoring;	

(c) OE-A

Image source: Messe München, Samsung, VTT, Ynvisible. Heliatek, Schreiner

OE-A Roadmap, 8th Edition

Forecast for Market Entry of OPE Applications

Short, medium and long term forecasts for key industry sectors

- Automotive
- Consumer Electronics
- Healthcare
- Printing & Packaging
- Smart Buildings
- Internet of Things

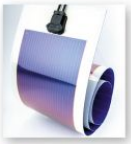
OE-A Roadmap, 8th Edition

Forecast for Market Entry of OPE Applications

Short, medium and long term forecasts for application clusters

- » Flexible & OLED Displays
- » Organic Photovoltaics
- » Electronics & Components
- » Integrated Smart Systems
- » OLED Lighting

OE-A Roadmap for Organic and Printed Electronics Applications 2020

	Existing 2020	Short Term 2021-2023	Medium Term 2024-2026	Long Term 2027+	
	Foldable displays for phones; Reflective EPD	large flexible OLED-Displays; rollable TV; curved display for automotive interior	In-mold electronic (IME) Displays;	Flexible QD-Displays; flexible µLED-Displays	**Flexible & OLED Displays**
OPV	OPV objects; portable chargers; OPV-R2R products	Opaque OPV for BIPV; Large area OPV foil; OPV power supply	Semitransparent OPV for BIPV; OPV for autonomous sensors	Color and shape on demand; OPV on "all" surfaces (e.g. wallpaper, mobile devices) combined with thin film battery	
	Printed devices: memory, RFID antenna, primary battery, active backplane, piezoelectric elements; Sensors: glucose, pressure, temperature, humidity; printed phone case integrated antenna; thin flexible Si-chips	light sensor; stretchable conductors / resistors; 3D touch sensors; OTFT backplanes for low energy displays and OPD; 3D & large area flexible electronics; active touch sensors	Printed secondary ion battery; printed super caps; gesture sensors	Complex stretchable electronics; Printed complex logic;	**Electronics & Components**
Integrated Smart Systems	Smart label sensors (humidity, temperature); Sensors for blood analysis; NFC labels; Hybrid systems (printed components + flexible ICs); HMIs (sensors)	Ambient monitoring (e.g. humidity); sensors embedded in molded parts (automotive); on-skin human monitoring patches for sports; ambient intelligence (connected); Sleep disturbance monitoring;	On-skin human monitoring patches in clinical environment; Single article tagging (food)	Smart labels with geo localization; Breath analyzer for medical prevention	
	Flexible white OLED modules; rigid red OLEDs for automotive applications	Flexible red OLEDs (segmented) for automotive applications; transparent OLEDs; OLEDs for interior lighting of automotive	3D OLEDs; OLED signage; OLED for medical applications	OLED for aircraft and railway interior application	**OLED Lighting**

(c) OE-A

Image source: FlexEnable, Heliatek, IEE, Schreiner, Emde Design

Automotive

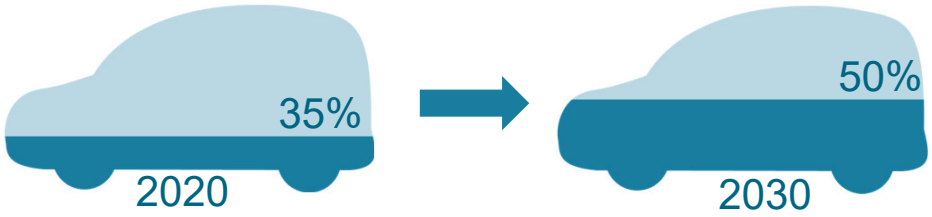
Image source: IEE Source: IDTechEx

Printed Electronics in Automotive

- Automotive industry as one of the main end-user sectors
- Organic and printed electronics (OPE) as an enabler for new applications
- Market driven by transition to electric vehicles and autonomous driving
- Overall printed electronics market in automotive expected to grow to 5.5 bn US$ in 2026

Printed Electronics in Automotive
Great potential for printed electronics components

“Potential applications include antennas, body parts, cockpits, loudspeakers, mounted structures and sensors. Flexible electronics can be incorporated into bumpers, head-up displays, instrument panels, seats, tires, windows and many other auto parts.”



Electronics content in car‘s total production costs

Image source: OE-A

Source: Assembly

Printed Electronics Applications in Automotive

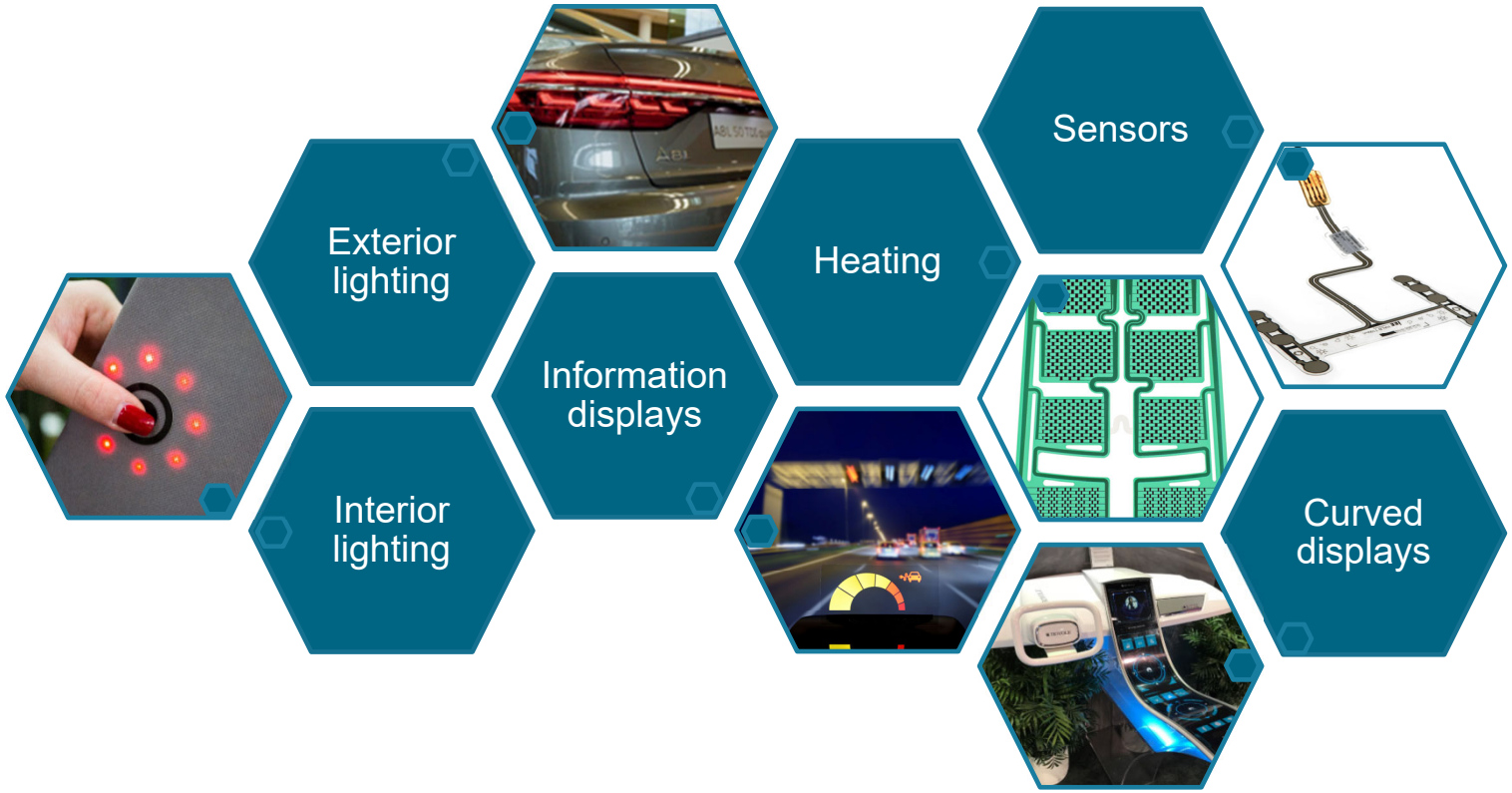


Image source: OE-A, Messe München, Lyteus, IEE

Image source: Messe München

Automotive Applications OLED Lighting

Existing

» Tail lights

Short Term (2021 – 2023)

» Interior/Human-centric lighting

» Flexible OLED lighting

» Turn indicators

SWOT Analysis for OLED Lighting

Strengths	Weaknesses
• Freedom of design (area, thin, lightweight, bendable, segmented lighting area) in combination with light quality • Nontoxic materials • Low driving voltage	• High production costs • Limitations in manufacturing process • Lack of stretchability
Opportunities	**Threats**
• Less energy used for lighting • 1.5 to 3 dimensional freeform • Mechanical integration (e.g. lamination) • R2R manufacturing • Increased importance of lighting and signage for autonomous driving • Lightweight; using flexible substrates	• Sensitive materials • Standardization open • Flexible LED lighting and µLED technology

Image source: Novares Source: Global Market Insights March 2019

Automotive Applications Displays

- The global market for automotive interior displays will grow from $15B in 2018 to $30B in 2025
- Most of the growth in the automotive display market will be driven by:
  - Larger displays
  - More displays per vehicle
- Displays inevitably need to be integrated into surfaces that are neither rectangular nor flat
- OLCD as a promising technology for large display applications in automobiles

Image source: OE-A, Lyteus

Automotive Applications Displays

Short Term (2021 – 2023)

- Wind-shield integrated head-up displays
- OLED displays as side mirror replacement

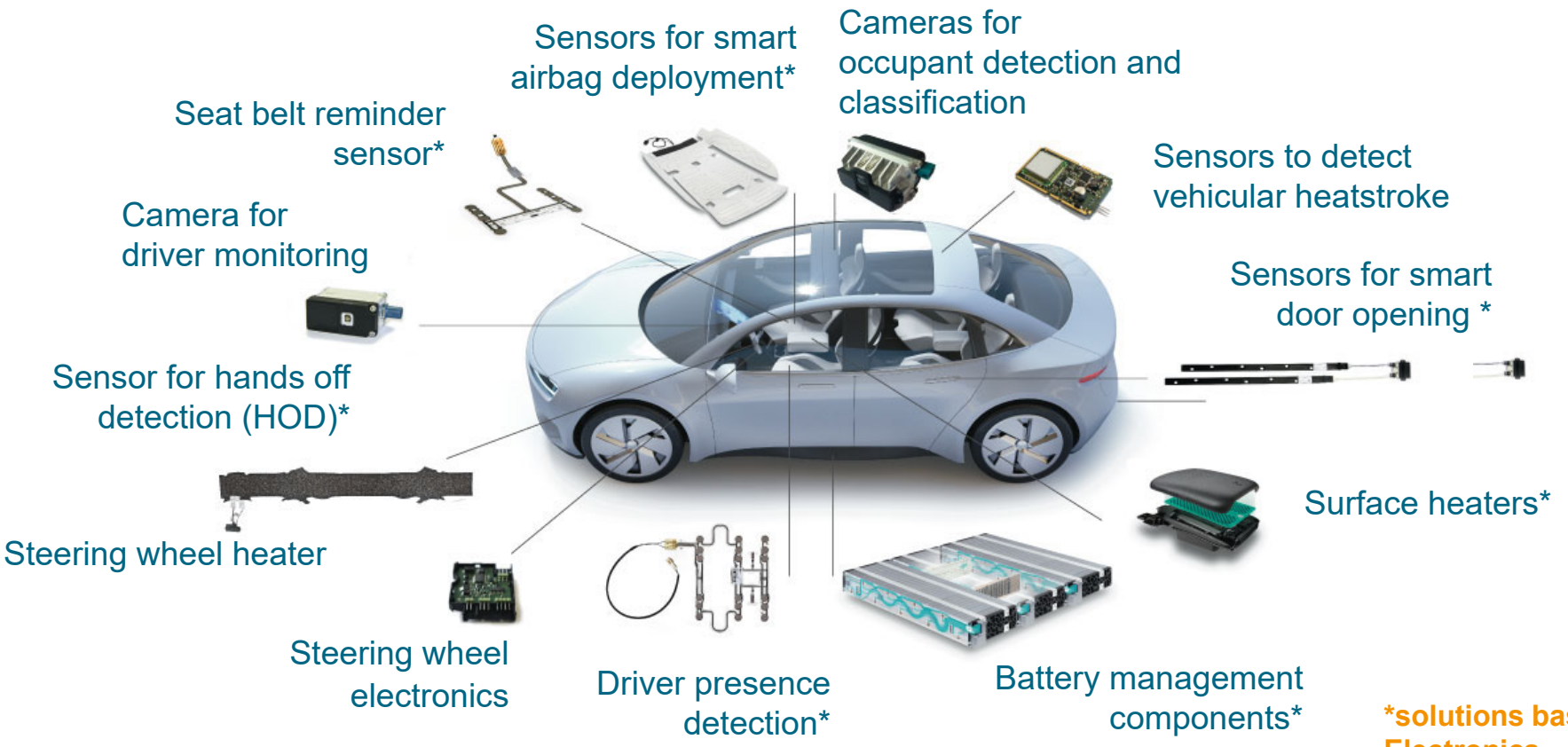
Medium Term (2023 – 2025)

- Curved displays

SWOT Analysis for Flexible OLCDs

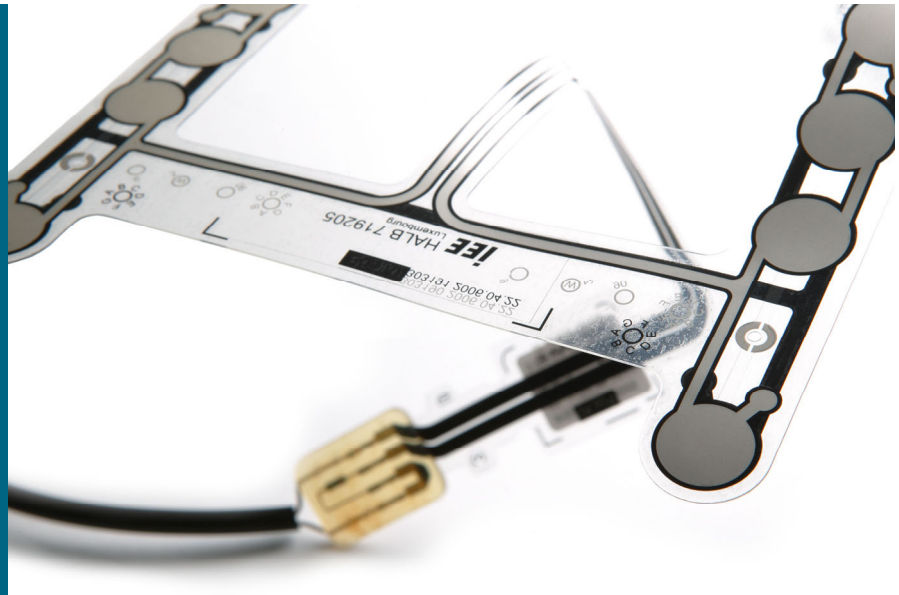
Strenghts	Weaknesses
• Robust/flexible/unbreakable • Conformable/in-moldable • Lightweight/thin • Good lifetime • Low cost (a-Si lines can be used)	• Still backlight required • Not as flexible as OLED
Opportunities	**Threats**
• Conformability (e.g. automotive) • Applications where weight is critical (e.g. large area, aerospace, automotive) • Low cost • Non rectangular displays	• OLED technology for small displays • MicroLED displays

Sensing Applications for Car Safety



*solutions based on Printed Electronics

Image source: IEE



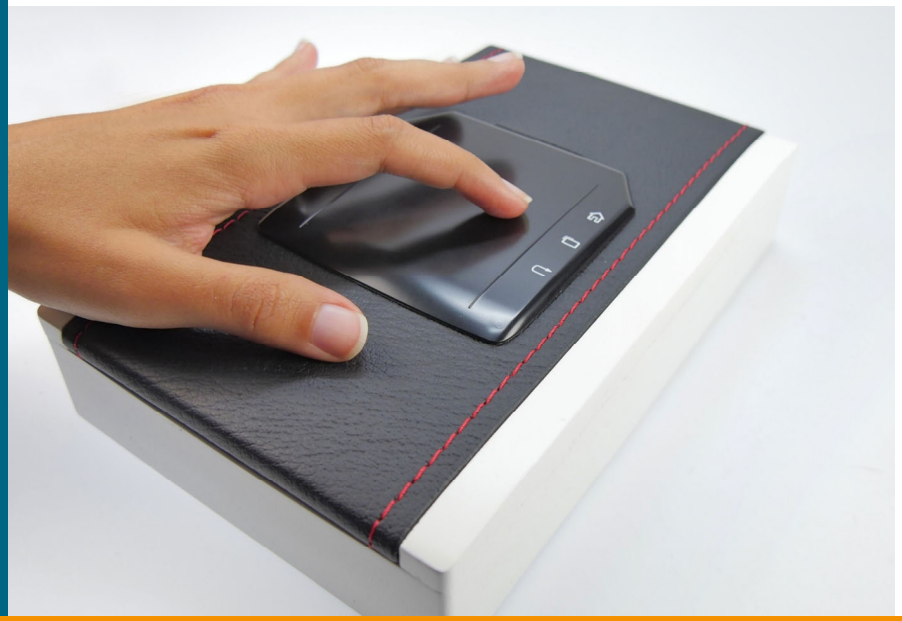


Image source: IEE, PolyIC

Automotive Applications Sensors

Existing

- Sensors
  - Touch surfaces for HMI
  - Hands off detection
  - Seat occupancy detection
  - Radar antennas

Short and Medium Term (2021 – 2025)

- Seamless integration of touch sensors for smart HMI functions
- 3D and flexible surface integrated sensors

Applications in Avionics

Organic and Printed electronics solutions enable numerous applications in avionics

- Low-power displays
- NFC/RFID functionality
- Flexible supercapacitors
- Printed bird strike sensors for planes
- Humidity/Temperature sensors
- Gesture sensors (smart surfaces)
- OLED lighting
- Electrochromic windows

Event Schedule 2020 Europe

OE-A Meeting Europe

» **October 13-14, 2020**, Tampere (FI)
Hosted by Tampere University
Special Topic: Smart Objects

electronica 2020

» **November 10-13, 2020**, Munich (DE)
OE-A will have an exhibition booth and will host free seminars on organic, flexible and printed electronics (3 x 2hr, afternoon)
Joint Pavilion “Printed Electronics by LOPEC”, Hall B4 (automotive)

OE-A Calendar of Events (Europe, North America, Asia): www.oe-a.org/events

LOPEC 2021, March 23-25
ICM Munich, Germany

The central marketplace for Organic and Printed Electronics, in cooperation with Messe Munich

- » 2,500+ attendees
- » 150+ international exhibitors
- » 180+ presentations

Exhibition

- » Largest industry exhibition in the field
- » On-site production on demo line

Conference

- » Business, Technical, Scientific Conference
- » Pre-conference seminars

10% discount for OE-A members

LOPEC
DRIVING THE FUTURE OF PRINTED ELECTRONICS

www.lopec.com

Image source: Messe München

Event Schedule 2021 (Jan.-Apr., preliminary)

CES 2021

» **January 6-9, 2021**, Las Vegas, NV (US)
Joint pavilion of OE-A members at Tech West, Sands Expo, Level 2, Halls A-D, Booth # 52953 + 53153 + 53353

General Assembly / OE-A Meeting Europe

» **March 22, 2021**, Munich (DE)

LOPEC 2021

» **March 23-25, 2021**, Munich (DE)

drupa

» **April 20 – 30, 2021**, Düsseldorf (DE)
OE-A will have an exhibition booth (at VDMA Printing and Paper machines) and will host free seminars on organic, flexible and printed electronics on April 23 & 28 at the drupa cube

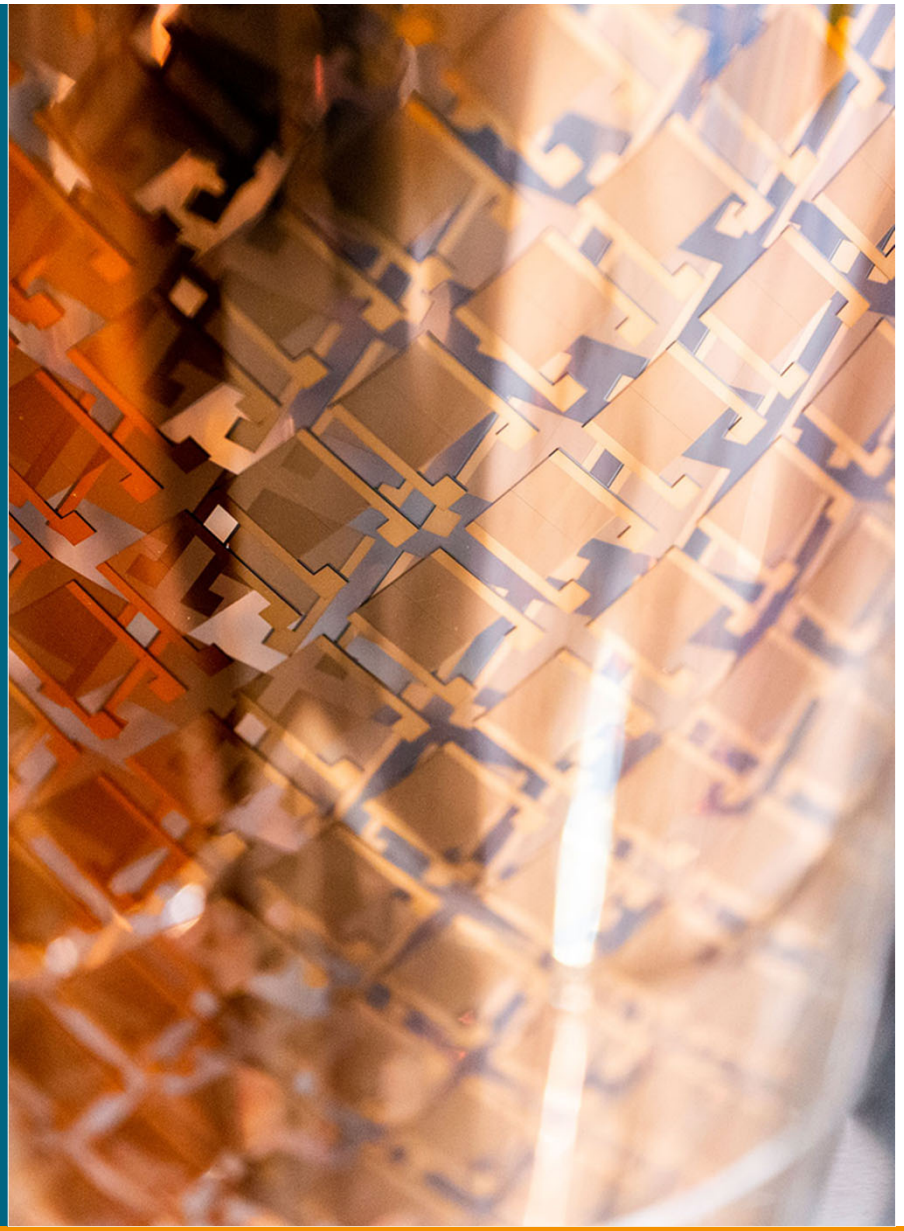


Image source: Messe München

Printed Electronics Insights Webinars Series

- **Special Topic: Automotive**
  June 16, 2020, 16.30 – 17.45 (CEST)
- **Special Topic: Smart Buildings**
  June 23, 2020, 16.30 – 17.30 (CEST)
- **Special Topic: Smart Packaging**
  August 06, 2020, 16.30 – 17.45 (CEST)
- **Special Topic: Diversity in Tech**
  August 27, 2020, 16.30 – 17.45 (CEST)
- **Special Topic: Internet of Things**
  September 17, 2020, 16.30 – 17.45 (CEST)
- **Special Topic: Healthcare**
  October 01, 2020, 16.30 – 17.45 (CEST)

Image source: Messe München

Summary

- OE-A Roadmap: Short, medium & long-term forecasts for key industry sectors and applied technologies
- Numerous automotive applications of OPE established
- Great potential for OPE arising from increased value-add of electronics in future automobiles
- OE-A provides the international industry platform and supports the companies in managing the transition to business

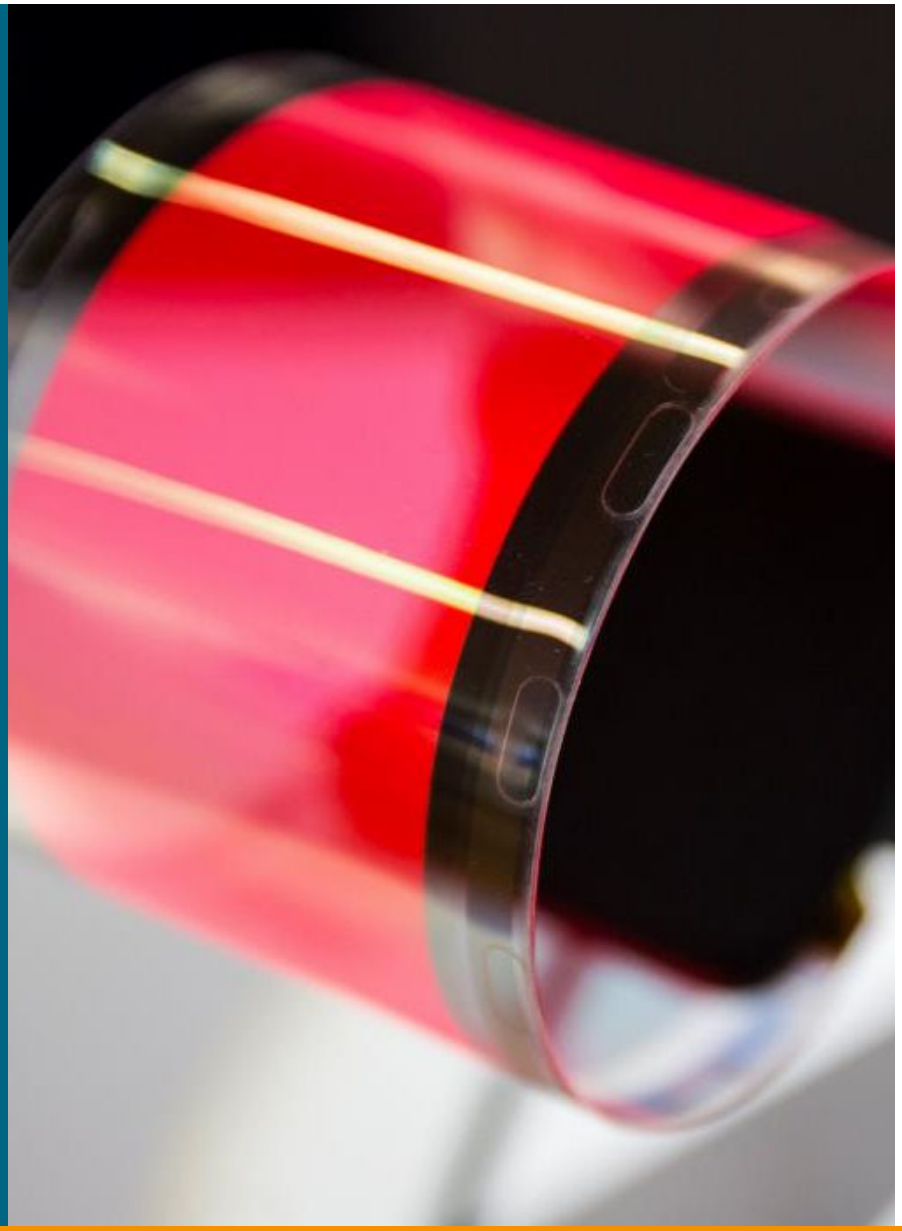


Image source: Messe München

Thank you!

Dr. Klaus Hecker

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OE-A (Organic and Printed Electronics Association) – A working group within VDMA

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