
P3
save energy
keep track
anticipate
lower cost
save time
stay tuned
improve performance
feel secure
Holst Centre
Open Innovation by IMEC and TNO

Holst Centre

Open Innovation by imec and TNO

Open innovation

Ultra-low-power, wireless & Flexible electronics

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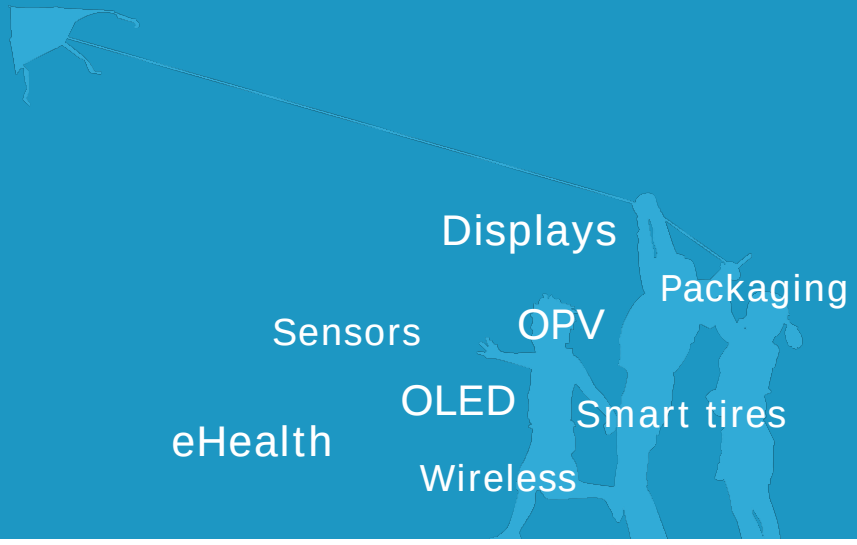

Open Innovation on the High Tech Campus Eindhoven

- ***Site-sharing*: >100 companies, >10000 researchers**
- ***Facility-sharing*: >8000m² cleanrooms, analysis equipment**
- ***Program Sharing:* Holst Centre**

Holst Centre: Open Innovation in action

Who we are

- Independent R&D institute founded in 2005 by imec (BE) and TNO (NL)
- Own staff 210 researchers
- Located at the High Tech Campus in Eindhoven, The Netherlands

What we do

- Enabling technologies for **flexible electronics** and **wireless autonomous microsystems, based on long term roadmaps**
- In close collaboration with **leading industrial partners** along the value chain

Holst Centre: Bridging the gap from R&D to production

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Open Innovation by imec and TNO

R&D

First prototypes

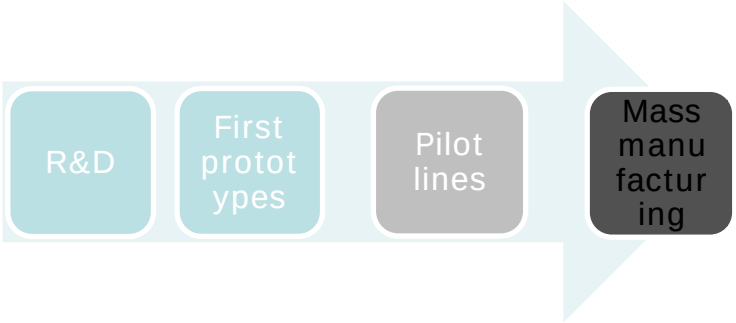
Pilot lines

Mass manufacturing

- Exploratory research, linking to academia
- Validation of new technology together with partner companies
- Demonstrators
- TRL 2-4

- Upscaled process development
- Determine manufacturability
- Sufficient samples for testing in industrially relevant environment (TRL 5-7) and (Customer) validation

Holst Centre: Bridging the gap from R&D to production



Primary goals:

1) **Creating R&D ecosystems in NL and EU**
   - Aligning roadmaps of key players
   - Supported by NL and EU funding
2) **Designing & building up pilot scale facilities and process capabilities at Holst Centre**
   - Increasing functionality, throughput, yield
   - Approaching TRL7
   - Offering pilot line services to Holst Centre partners
3) **Validating pilot lines with industrial cases at relevant volumes**

e.g. R2R moisture barrier film tool & process

- Production speed up to **4 m/min, PEN or PET plastic** web width **400 mm,** Total production so far **> 40 km**
- Pin hole density **< 0.1/cm²,** Extrinsic WVTR = **10^{-6} g/m²·day** at 20°C/50% RH for R2R barrier with **single** inorganic **layer**
- **Outperforms** all **commercially available** moisture barrier films in protection of OLEDs, OPV,…
- **Transferred to companies**

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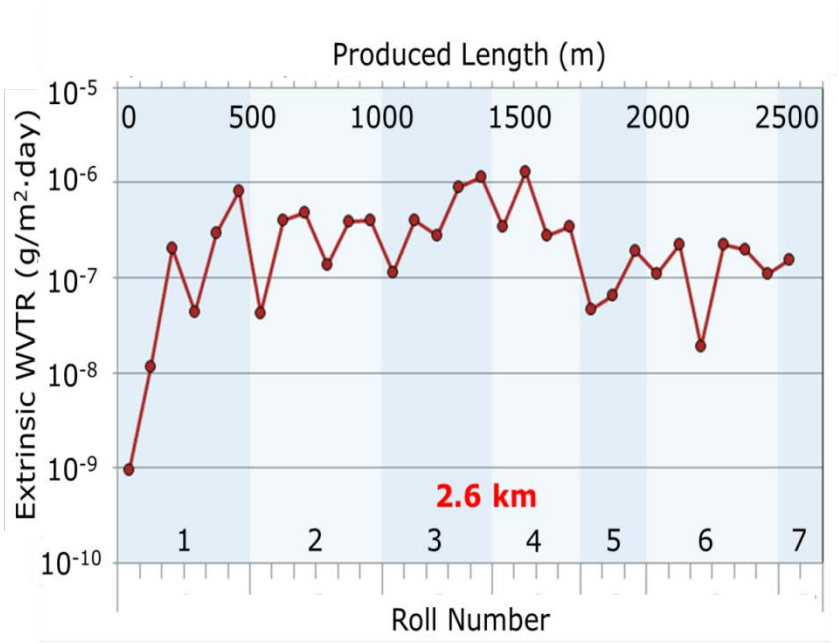
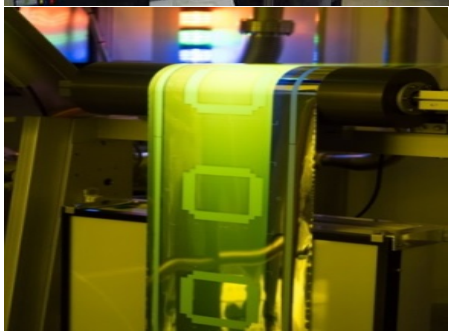
ROLIC technologies

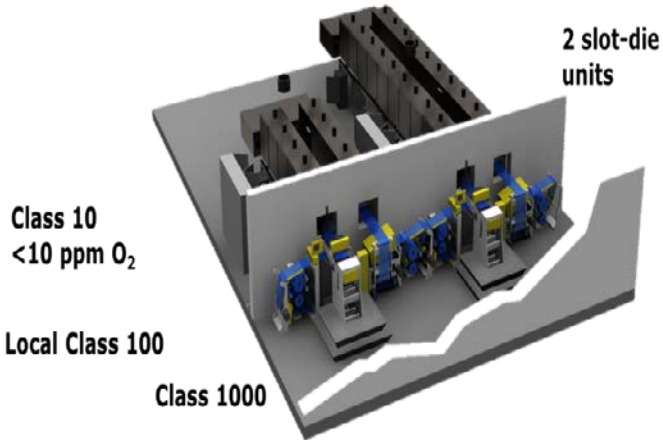
MEYER BURGER



e.g. R2R solution processing of active layers and electrodes for OLEDs and OPV

- Coating speeds up to **30 m/min**, web width 400 mm, coating **width 300 mm**
- **Two coating stations combined** in one pilot line, including drying ovens
- Web handling without ever touching the top side
- Closed ovens: **Class 10, O_2 and H_2O < 10 ppm**
- Slot-die coated layers of **100 - 30 nm** with thickness variation only **± 5 nm**
- Intermittent coating for patterning of layers with stabilisation within 5 mm





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Rexroth
Bosch Group

VDL

Building pilot line ecosystems in NL and EU Consortia

- **Teaming up with leading companies and research institutes**
- **Defining, Building & Exploiting pilot lines both regional and European**

PI-SCALE

SHAPING THE FUTURE IN OLED LIGHTING

www.pi-scale.eu

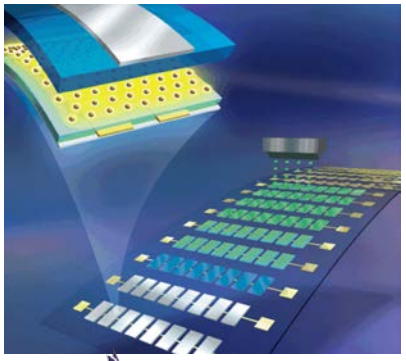
Fraunhofer FEP, Holst Centre, cpi, BOM, M-SOLV, DuPont Teijin Films, VTT, emdedesign, FlexEnable, Coatema, Pilkington, Audi, REHAU, AMIRES, European Commission

Flexible OLEDs

InSCOPE

Holst Centre, imec, Philips, cpi, Bosch, KONE, gsk, VTT, cea, liten, AMIRES, European Commission

Hybrid Electronics

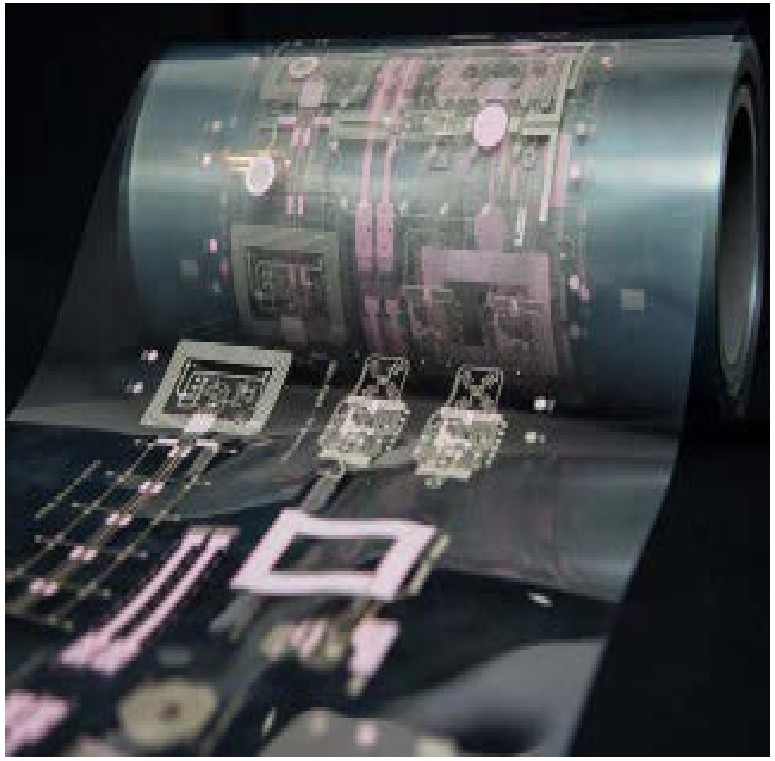


Fontys, MAXXIMAP, by-wire.net, ATOGEAR, debuelse, spgprints, DOMICRO, Maastricht University, faes, METAFAS, MEYER BURGER, LIFESENSE, HIGH TECH CAMPUS EINDHOVEN, BOM, INTERMAN, Holst Centre, OPZuid

Thin Film Transistors

Technology platforms and pilot lines

Pi-Scale: Flexible OLEDs



InScope: Hybrid Electronics

OpZuid: Thin Film Transistors

Example: Project PI-SCALE – Flexible OLEDs

- **EU project receiving funding from the European Union's Horizon 2020 research and innovation programme (grant agreement No. 688093)**
- **Flexible OLED pilot line services:**
  - Test and scale up new product ideas with customised designs
  - Assistance with processes to seamlessly integrate flexible OLEDs into products and to combine with other flexible electronics
  - Test new materials, substrates and processes

Example: Project PI-SCALE – Flexible OLEDs

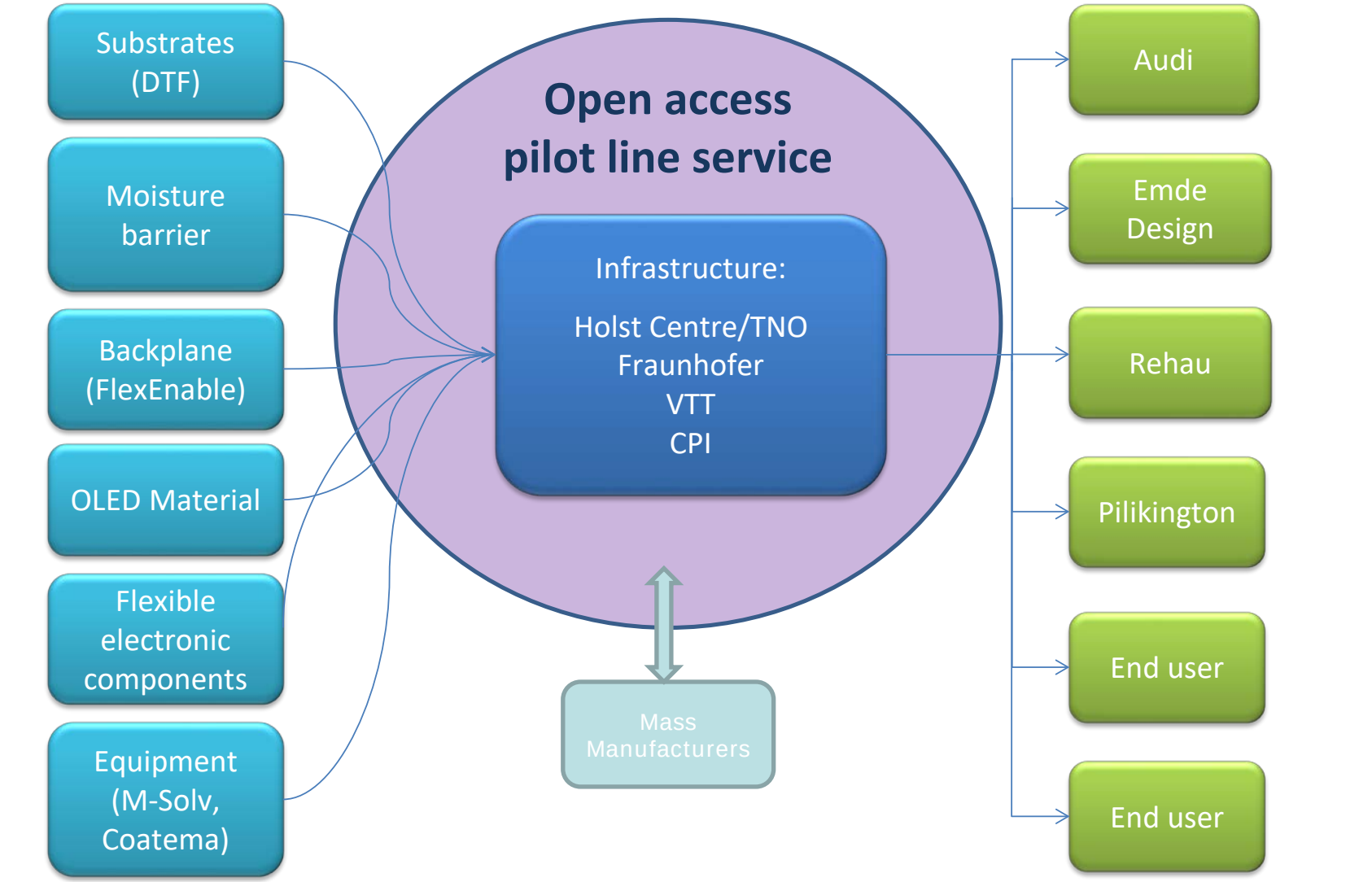
- **Create an independent, open access service for fabrication of flexible OLEDs to bridge the gap between R&D and mass production which is sustainable after finish of the EU project**
- **Help to establish a sustainable industry around flexible OLEDs in Europe by increasing access to and awareness of this technology by scaled-up prototyping, hands-on workshops, design handbook and connection to regional development agencies**

Distributed pilot line

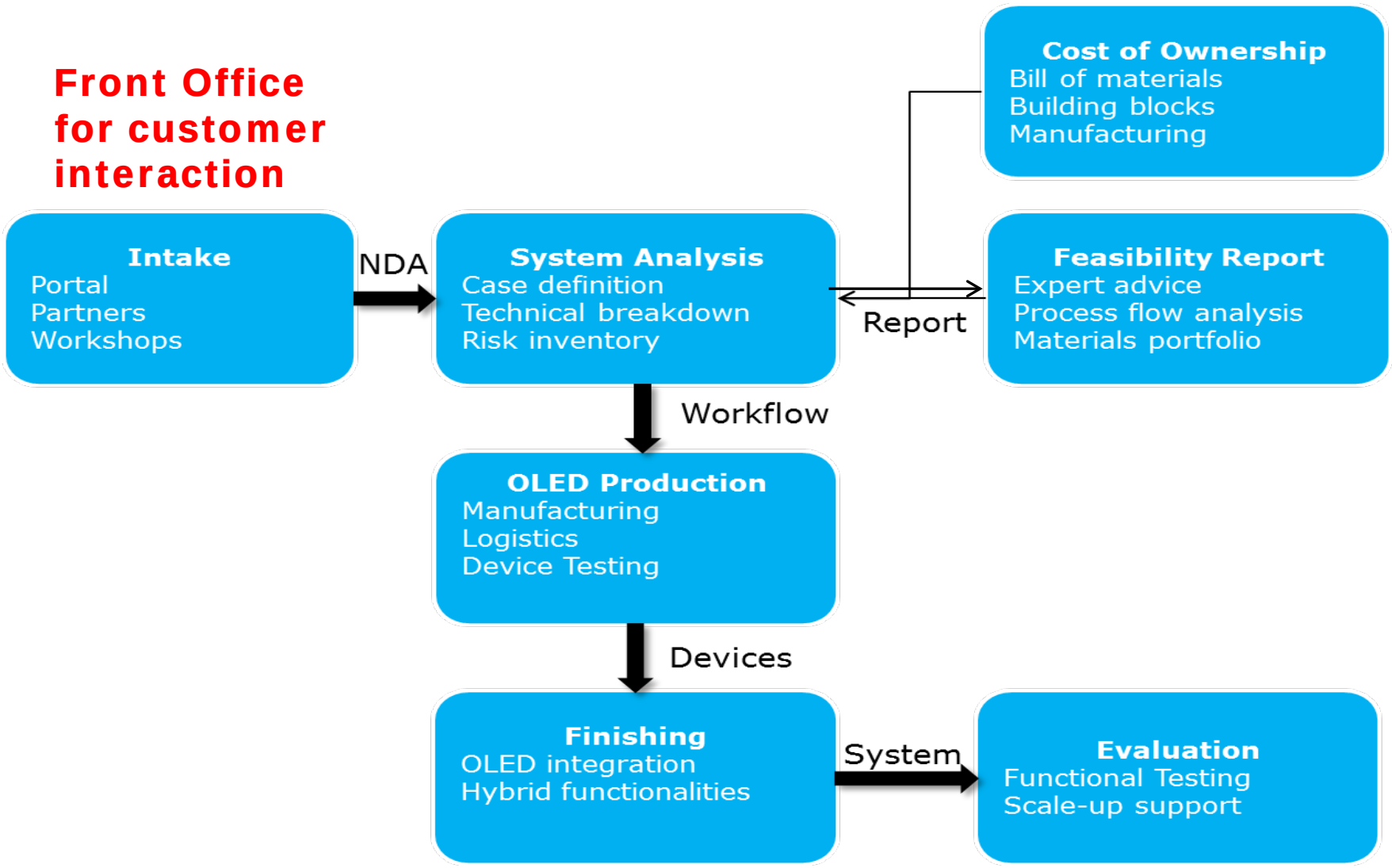
PI-SCALE brings together existing European infrastructure into a

European flexible OLED pilot line

Pi-Scale - Pilot line Services



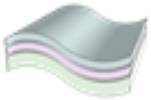
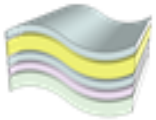
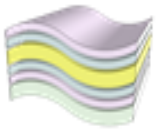
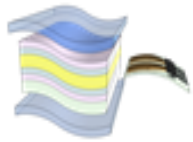
Pi-Scale Pilot line operations



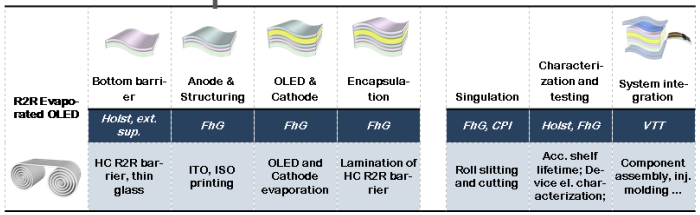
Pi-Scale: Distributed pilot line process flows

Most mature process flows

Process flows under development

e.g.								
R2R Evaporated OLED	Bottom barrier	Anode & Structuring	OLED & Cathode	Encapsulation	Singulation	Characterization and testing	System integration	
	Holst, ext. sup.	*FhG*	*FhG*	*FhG*	*FhG, CPI*	*Holst, FhG*	*VTT*	
	HC R2R barrier, thin glass	ITO, ISO printing	OLED and Cathode evaporation	Lamination of HC R2R barrier	Roll slitting and cutting	Acc. shelf lifetime; Device el. characterization;	Component assembly, inj. molding ...	

R2R evaporated OLED



Make the optimum combination of available know-how & infrastructure

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Fully roll-to-Roll evaporated OLEDs

R2R moisture barrier

+

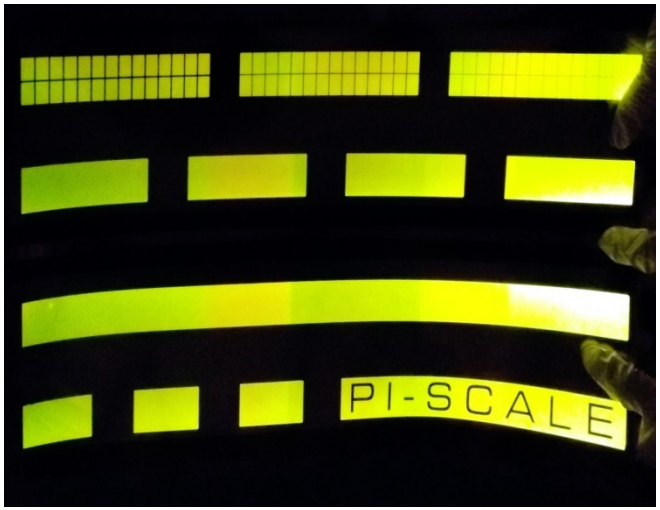
R2R OLED evaporation

+

R2R lamination of barrier film

Barrier film
Adhesive
OLED
Anode
Flexible glass

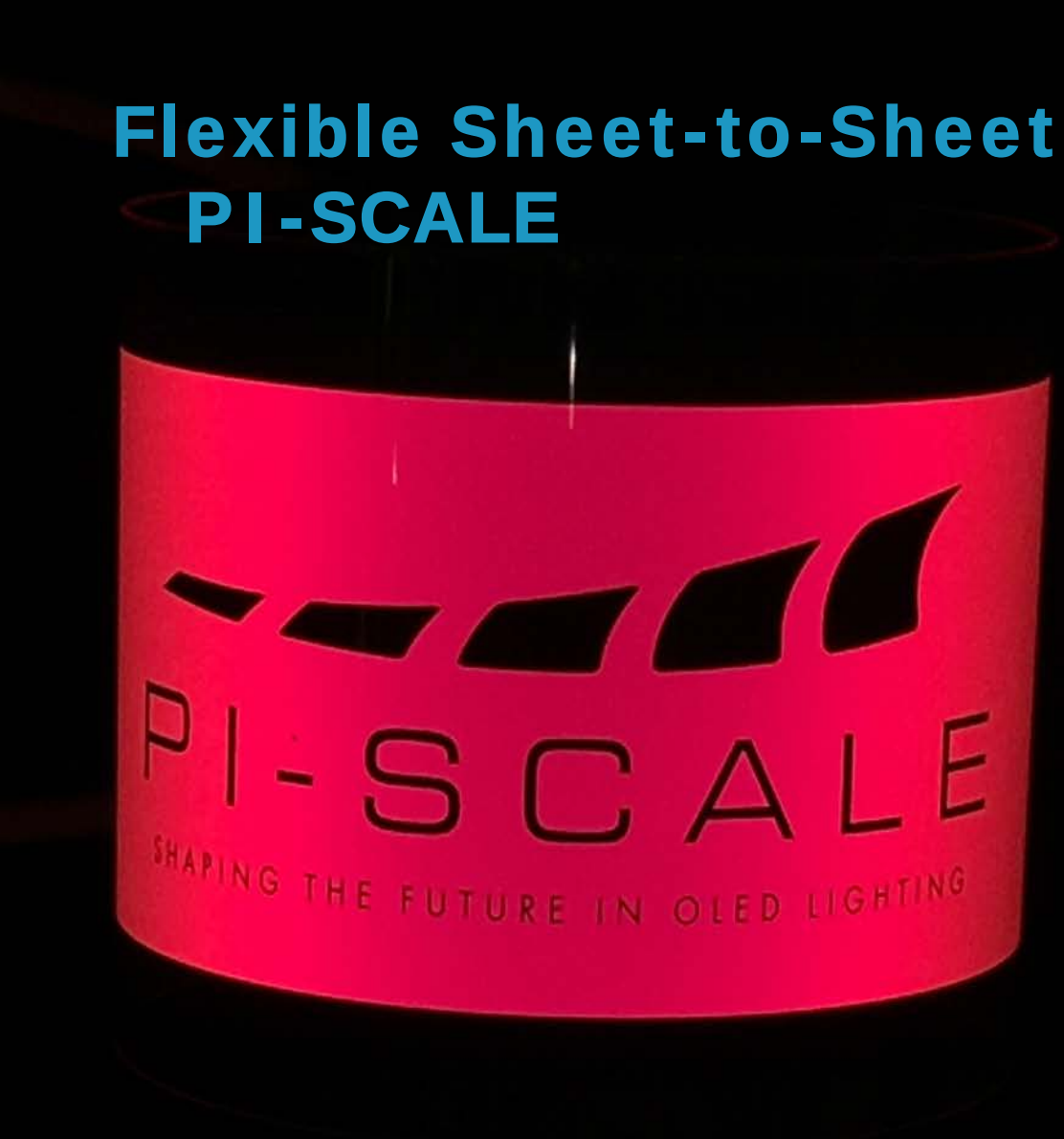
30 cm wide



15 m length in one run

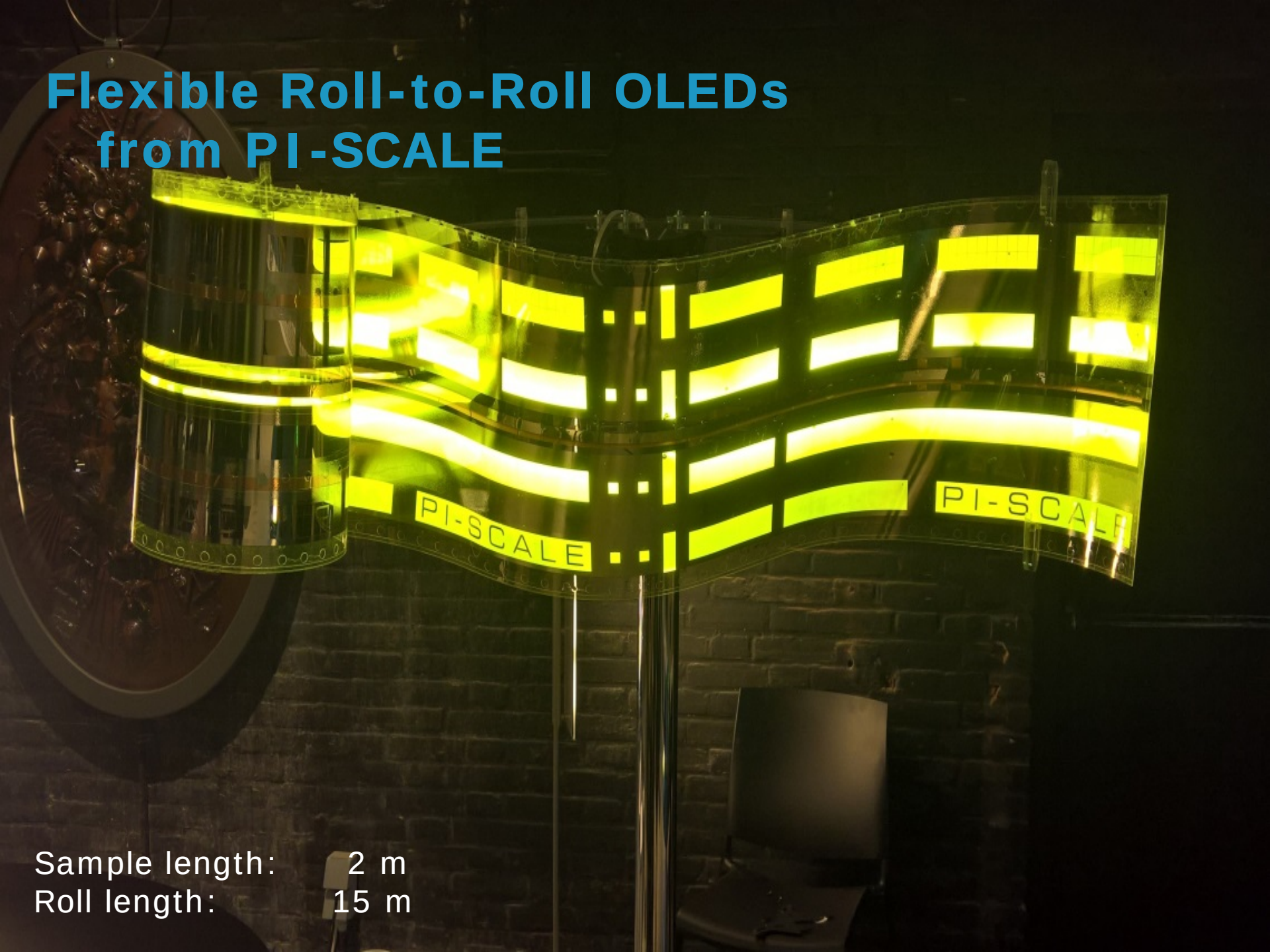
- Combining know how & infrastructure of European RTO's
- Combine best in class
- Performance & Features beyond current commercial offering

Flexible Sheet-to-Sheet OLEDs from PI-SCALE



Substrate size: 0.2 x 0.2 m

Flexible Roll-to-Roll OLEDs from PI-SCALE



Sample length: 2 m
Roll length: 15 m

Features offered

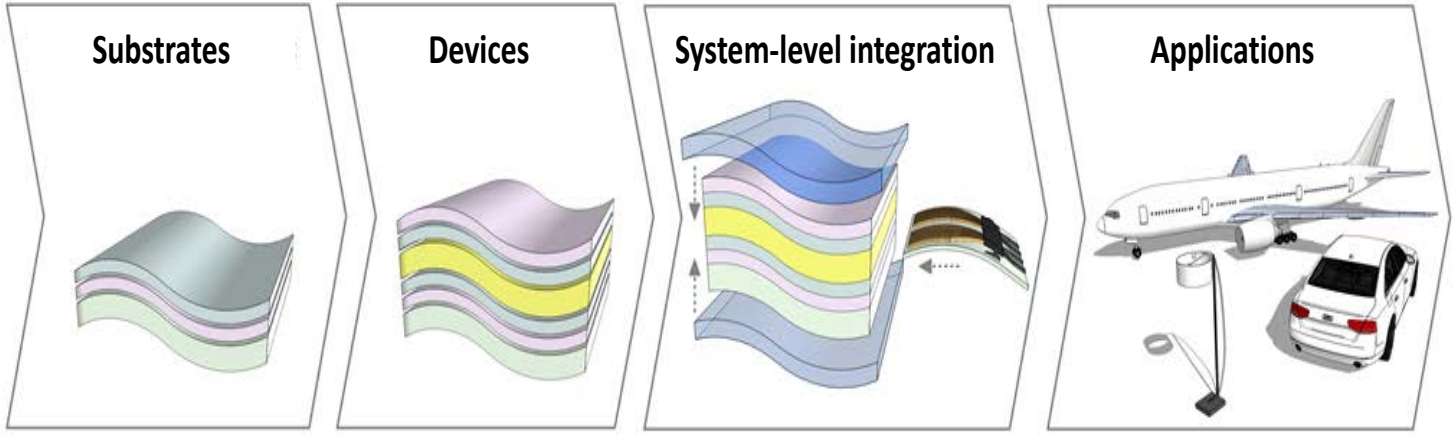
2017

- **Highest flexibility**
  - Bending radius down to 10 mm
- **Most colors**
  - Red, Green, Blue, Orange, Yellow, Magenta, Cyan, White, …
- **Ultra-thin**
  - Thickness 0.2 mm
- **Any shape and design**
  - Fully customized

2018

- **Any size**
  - Length >15 m

Making the pilot scale facilities and capabilities more mature



One point to connect to:

- Suppliers of materials & Equipment
- Knowhow of RTO's on manufacturing & integration
- Mass manufacturers & end-users

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SHAPING THE FUTURE IN OLED LIGHTING

Reaching out to Partners in Open Innovation

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