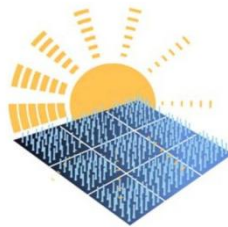


# **European Photovoltaic Cluster General Assembly**

## **Development and demonstration of flexible multifunctional ETFE module for architectural façade lighting (ETFE-MFM)**

**Dr. Armando Menéndez Estrada**  
**ITMA Material Technology**



**25th - 26th May 2016**

**University of Barcelona - Faculty of Physics Av. Diagonal, 647  
08028 Barcelona**



With the support of the European Union

# ETFE-MFM Project

## Development and demonstration of flexible multifunctional ETFE module for architectural façade lighting



Arc River Culture Pavillion, Daegu  
ETFE cushions

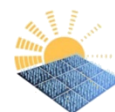
*([www.etfe-mfm.eu](http://www.etfe-mfm.eu))*

*By MdCALmeida Villafuerte - Own work, CC BY-SA 4.0*



The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n° 322459

European Photovoltaic Cluster General Assembly



# ETFE-MFM Project consortium



**The basic idea behind ETFE-MFM is to enhance the use of BIPV in construction industry and to provide new architectural facade lighting possibilities**

- General budget: **3,203,221.00€**
- EU contribution: **2,085,692.00€**
- Project duration: **48 Months**
- Start date: **December 2013**
- End date: **December 2017**
  - TRL: 4-5 > 6-7



# ETFE-MFM Project: Textile architecture

## TEXTILE ARCHITECTURE

- New materials
- Integration of flexible devices
  - LED/OLED integration
  - PV generation
  - Sensors
  - Electronics
- Standarization



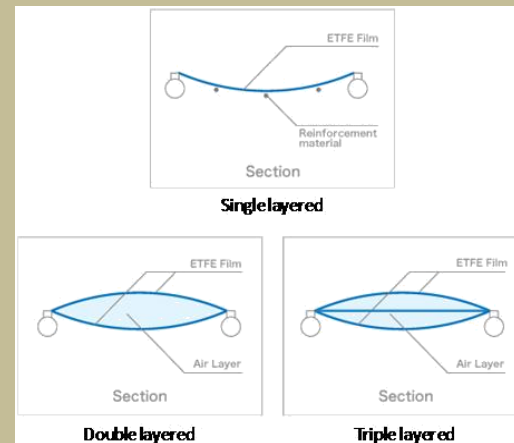
**New façade possibilities**

## ETFE

(Ethylene tetrafluoroethylene)

**ETFE** seems to be **the best candidate** in this new added-value solutions

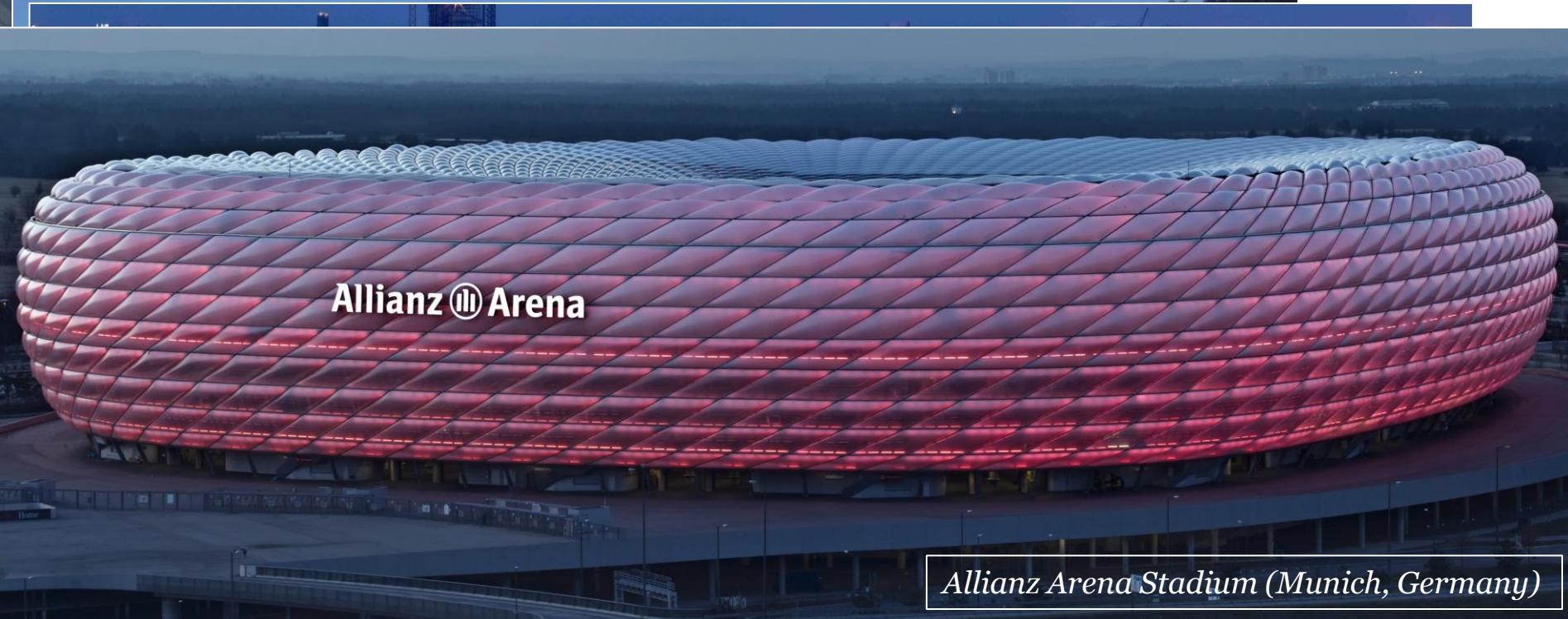
- Transmittance > 95% with controllable haze
- Lifetime x20 (compared to HDPE)
- Good mechanical properties
- Low weight ( $0.15\text{kg/m}^2$ - $0.35\text{kg/m}^2$ )
- Self-cleaning
- Many design possibilities





# ETFE-MFM Project: ETFE architecture

ETFE cushions



*Beijing National Aquatics Centre (Beijing, China)*



European Photovoltaic Cluster General Assembly



# ETFE-MFM Project: state-of-the-art

## ETFE + PV



## ETFE + facade lighting



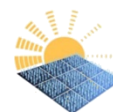
## PV + facade lighting



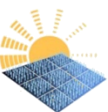
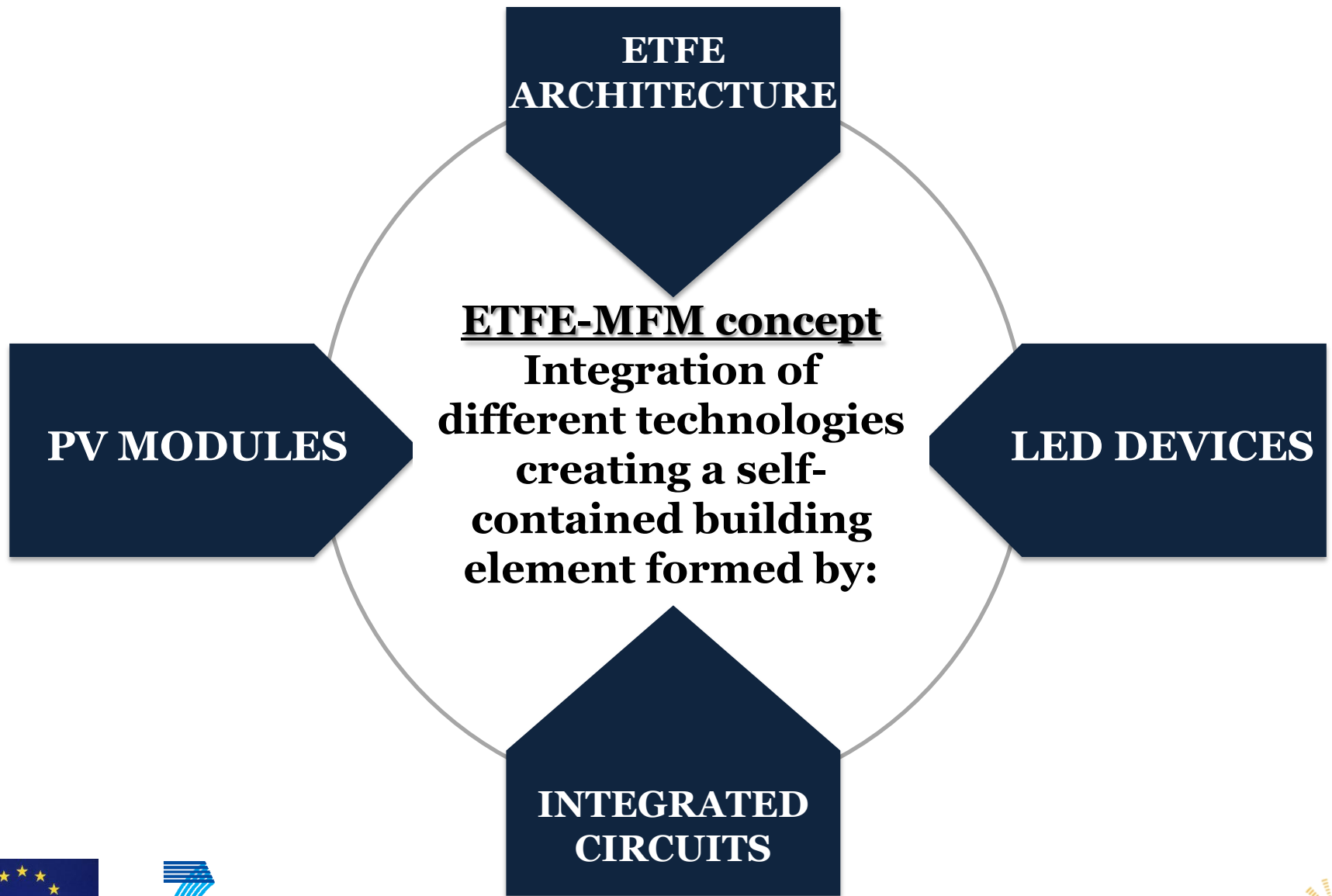
- No real BIPV
- No standardized elements

- High energy consumption
- Lighting devices are not integrated into the ETFE module

- Rigid structures
- LED and PV devices are not integrated into a unique element



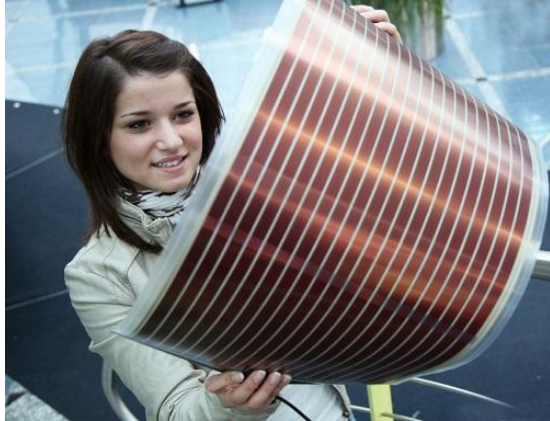
# ETFE-MFM Project objective



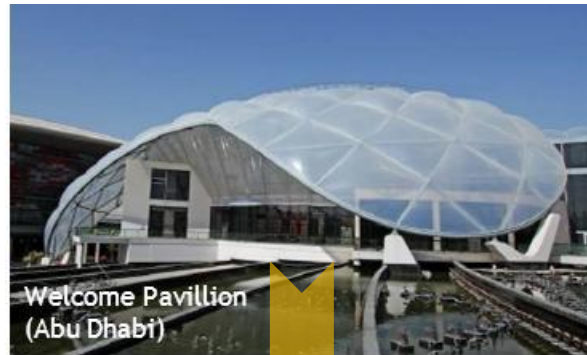


# ETFE-MFM Project objective

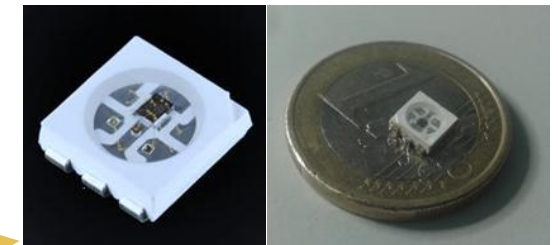
Organic Photovoltaic Technology



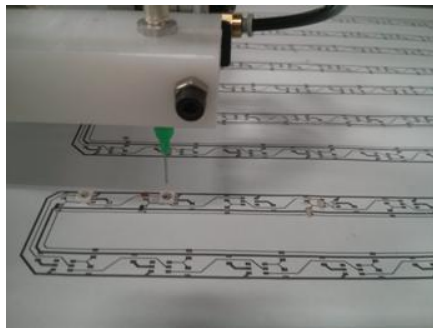
ETFE architecture



LEDs devices  
WS2812 RGB-LED

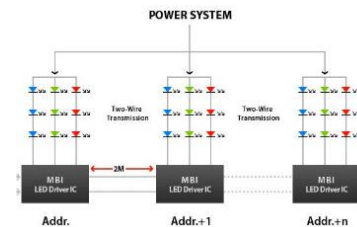
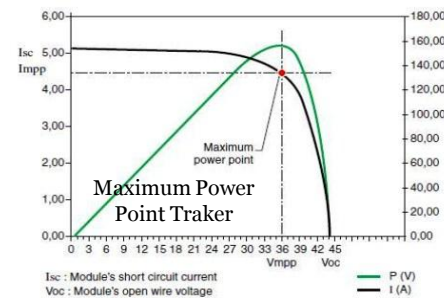


Printed electronics



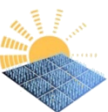
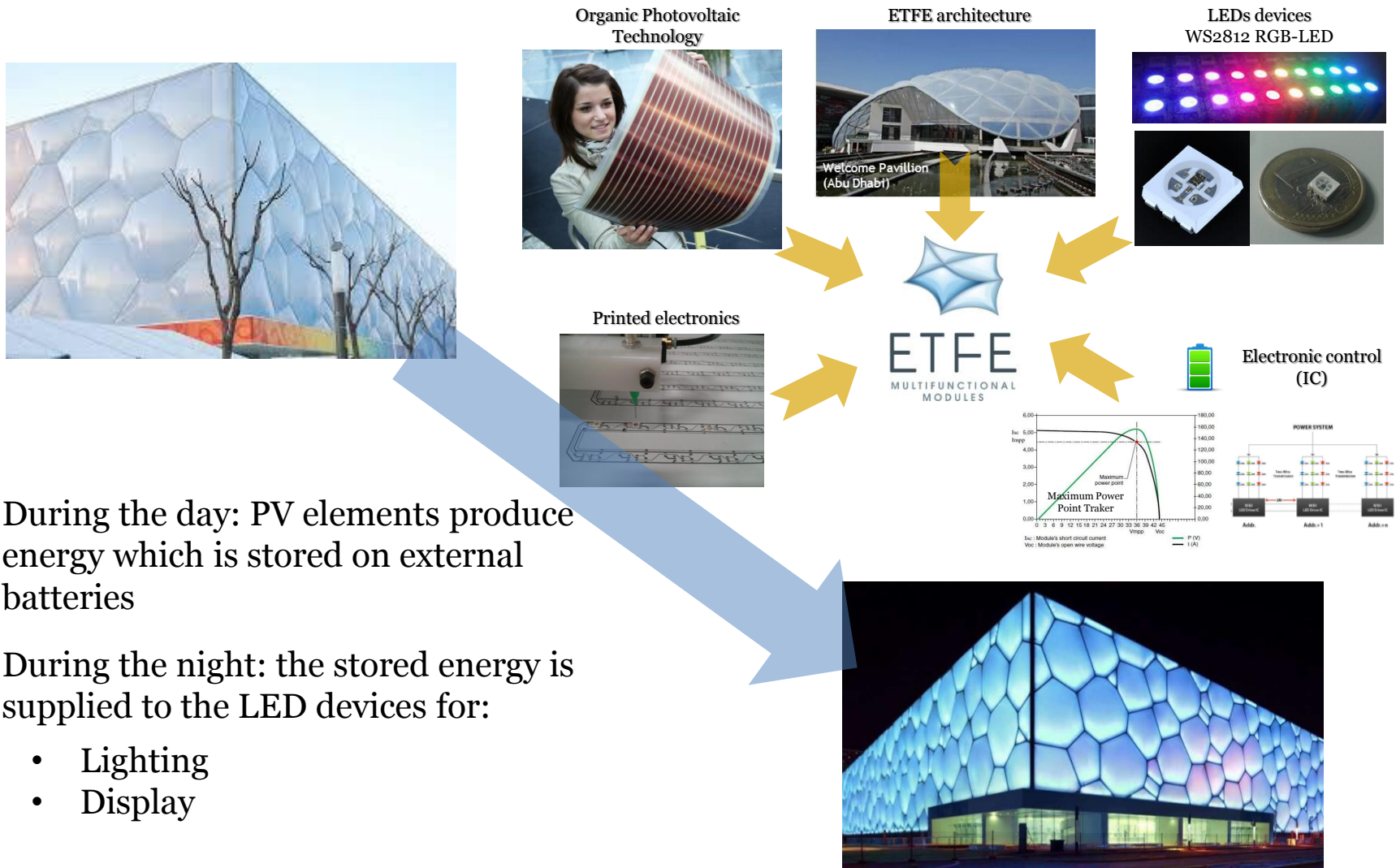
**ETFE**  
MULTIFUNCTIONAL  
MODULES

Electronic control  
(IC)



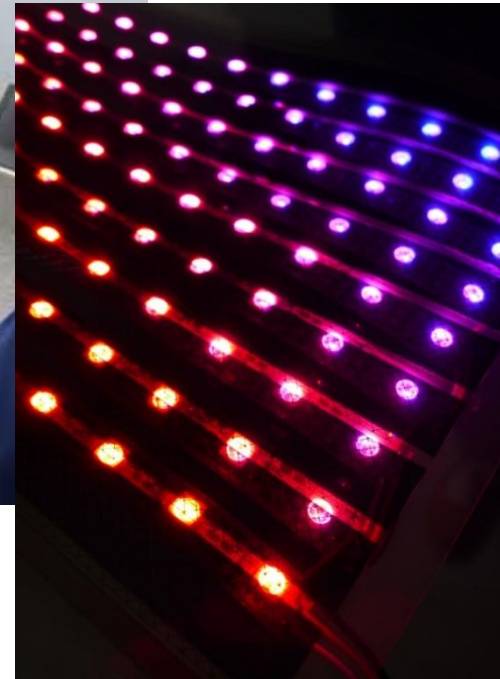
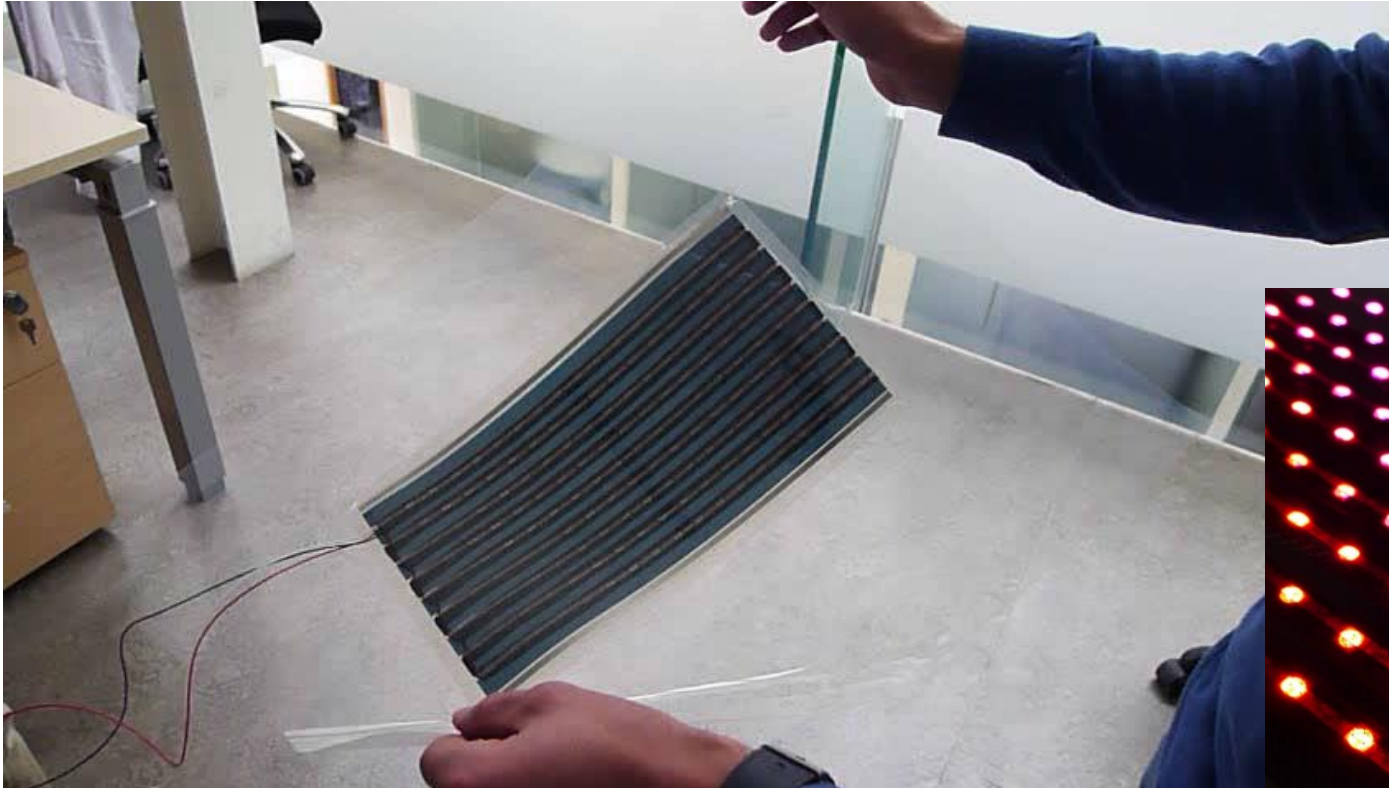


# ETFE-MFM Project objective



# ETFE-MFM Project: first prototypes

## LEDs+OPV in ETFE



### 0.64m<sup>2</sup> Prototype

For validation of manufacturing processes

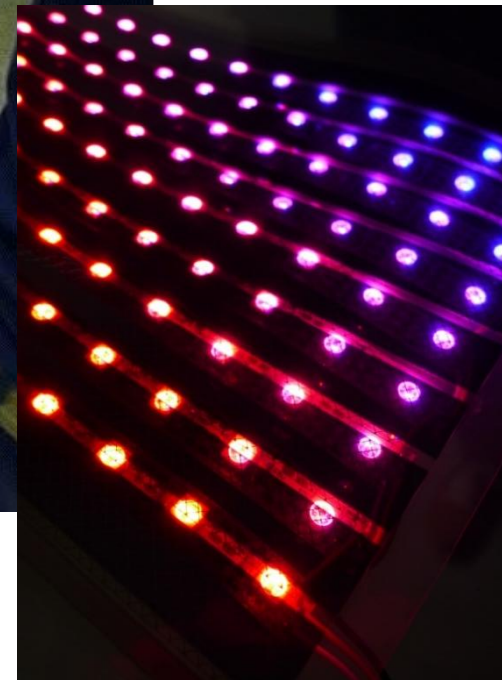
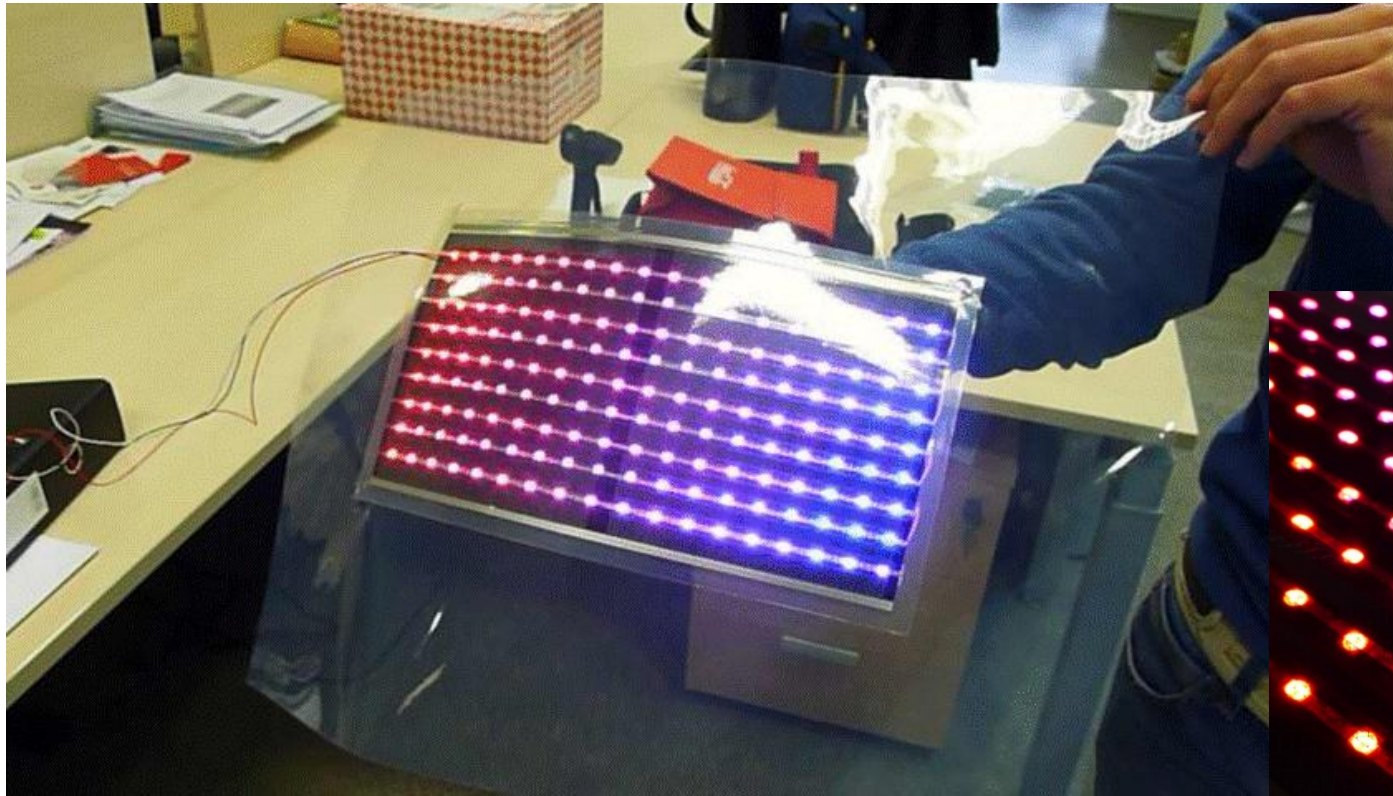
December 2015





# ETFE-MFM Project: first prototypes

## LEDs+OPV in ETFE



### 0.64m<sup>2</sup> Prototype

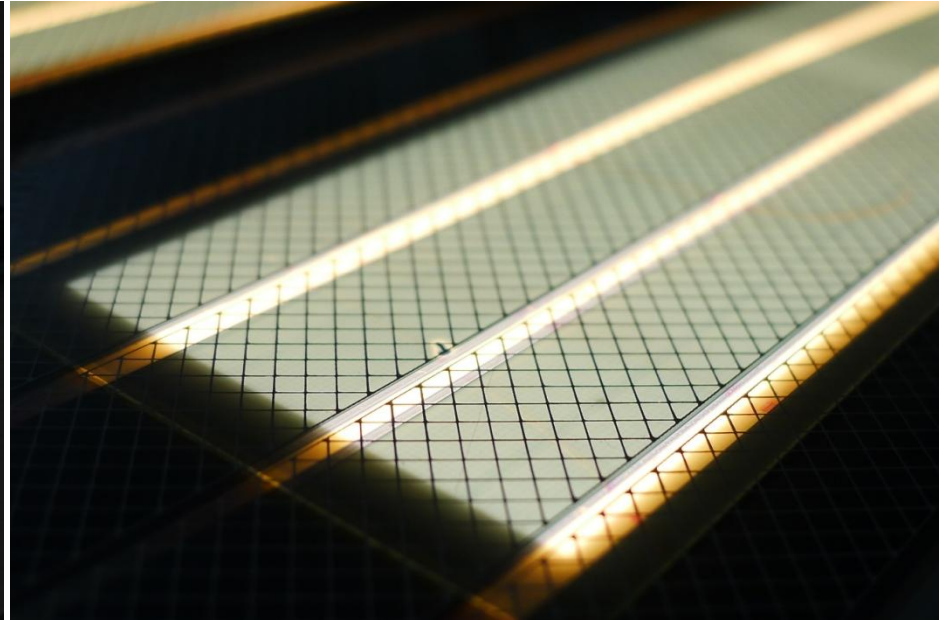
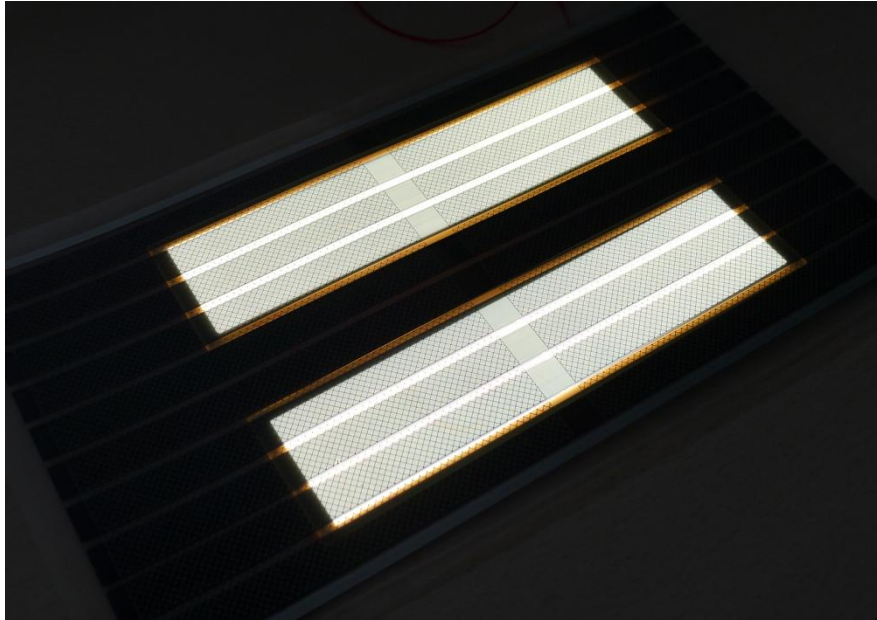
For validation of manufacturing processes

December 2015



# ETFE-MFM Project: first prototypes

## OLEDs+OPV in ETFE



### 0.64m<sup>2</sup> Prototype

For validation of manufacturing processes

December 2015





# ETFE-MFM Project: demonstrators



**0.64m<sup>2</sup> Prototype**

For validation of manufacturing processes

**December 2015**



**2.25m<sup>2</sup> demonstrator**

For initial testing and monitoring  
CENER facilities (Pamplona, Spain)

**June 2016**



**9 m<sup>2</sup> demonstrator**

Integrated in facade at fully operating conditions  
ITMA facilities (Avilés, Spain)

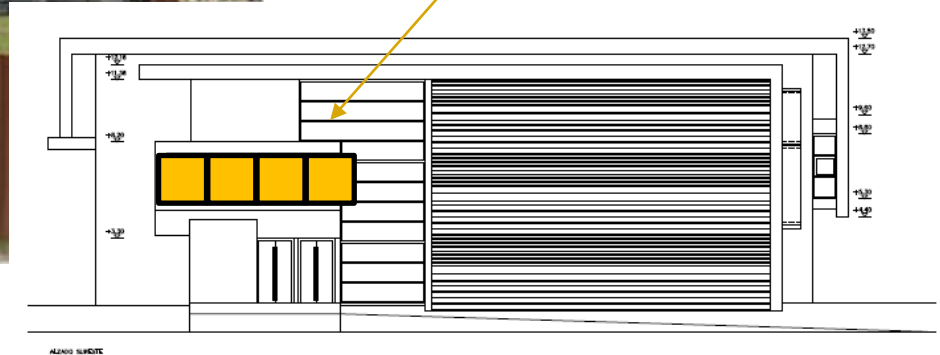
**October 2016**



# ETFE-MFM Project: final demonstrator



**9 m<sup>2</sup> demonstrator**

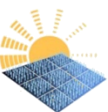


- Structure composed by individual ETFE-MFM modules:
  - 4 modules: (1.5m x 1.5m) each
- To establish a standardized monitoring system for ETFE-MFM
- 12 Months monitoring



# ETFE-MFM Project: CONCLUSIONS

- The specifications for ETFE-MFM system have been established in terms of real market, EU regulations, architectural possibilities, etc...
- The system components (PV, LEDs and flexible IC) have been identified and selected
- The manufacturing process for the development of ETFE-MFM system has been defined A fully operating first mock-up (0.64m<sup>2</sup>) has been manufactured
- The first demonstrator (2.25m<sup>2</sup>) is being manufactured and it will be installed next June for initial testing and monitoring



# **European Photovoltaic Cluster General Assembly**

**Thank you for your attention**

**Dr. Armando Menéndez Estrada  
ITMA Material Technology**

**ETFE-MFM**



With the support of the European Union

