

FLEX2ENERGY

AUTOMATED MANUFACTURING
PRODUCTION LINE FOR IPVS



Technology development and manufacturing
for 3rd Gen solar cells

Coatema

05/03/25

MEMBER OF ATH

Agenda

1. Introduction
2. 3rd Gen solar technology
3. Flex2Energy project
4. Summary

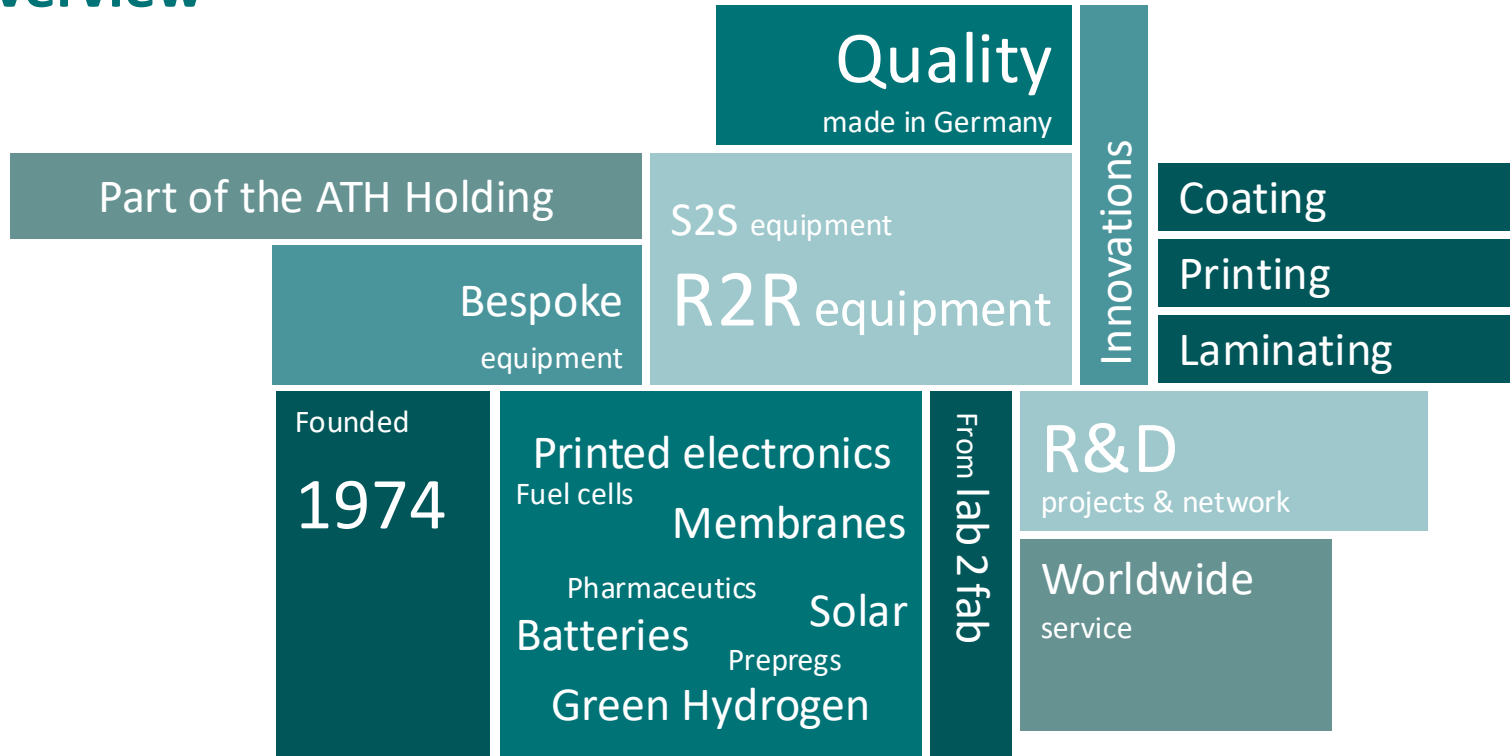


1.

Introduction



Overview



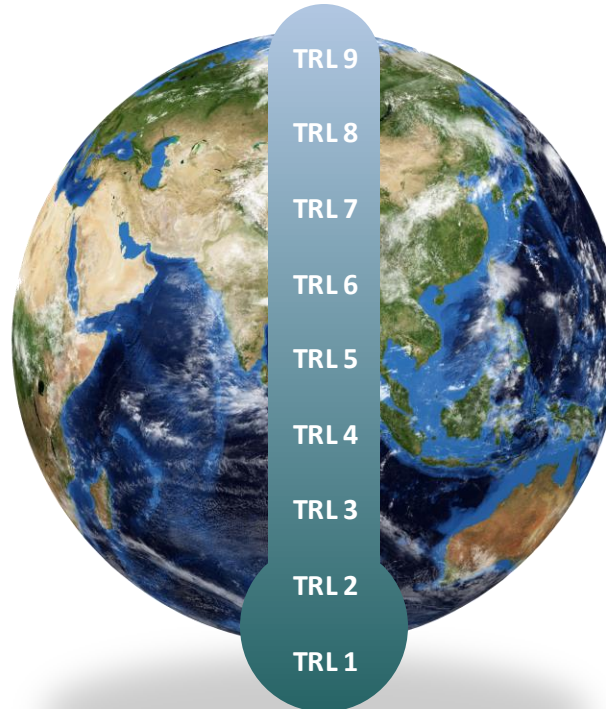
Our markets – Coatema focus areas

Green Hydrogen

Fuel cells

Batteries

Solar



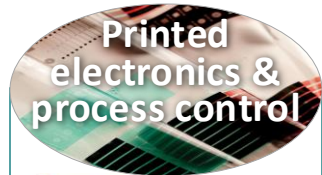
Sustainability

Digital fabrication

Printed
electronics

The next thing

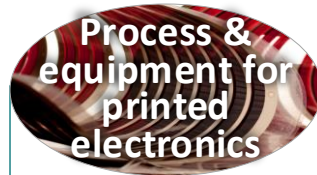
R&D projects overview 2022 – 2024



In-line and real-time digital nano-characterization for flexible organic electronics

NOUVEAU PROJECT

The NOUVEAU project will develop solid oxide cells (SOCs) with innovative La- and PMG-free electrode materials



R2R production line for OPV solar with integrated backend



Development of near-field electro hydrodynamic nanowire printing



Implementation of laser drying processes for lithium-ion battery production



R2R process optimization for solid state batteries



Plasmonically enhanced photocatalysis for wastewater treatment

RetroWin

R2R Process and machinery development for retrofit window films for lower production costs



The WaterProof project aims at developing an electrochemical process that converts CO₂ emission



Creating an open-innovation testbed for sustainable packaging

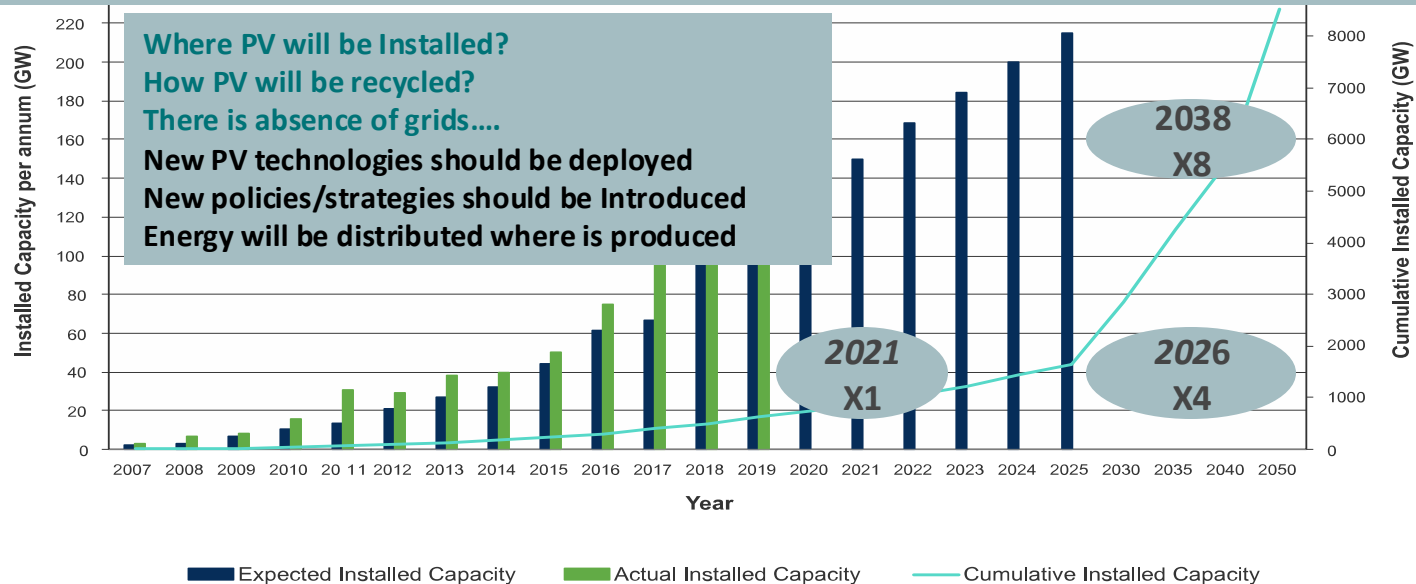
2.

3rd Gen solar technology

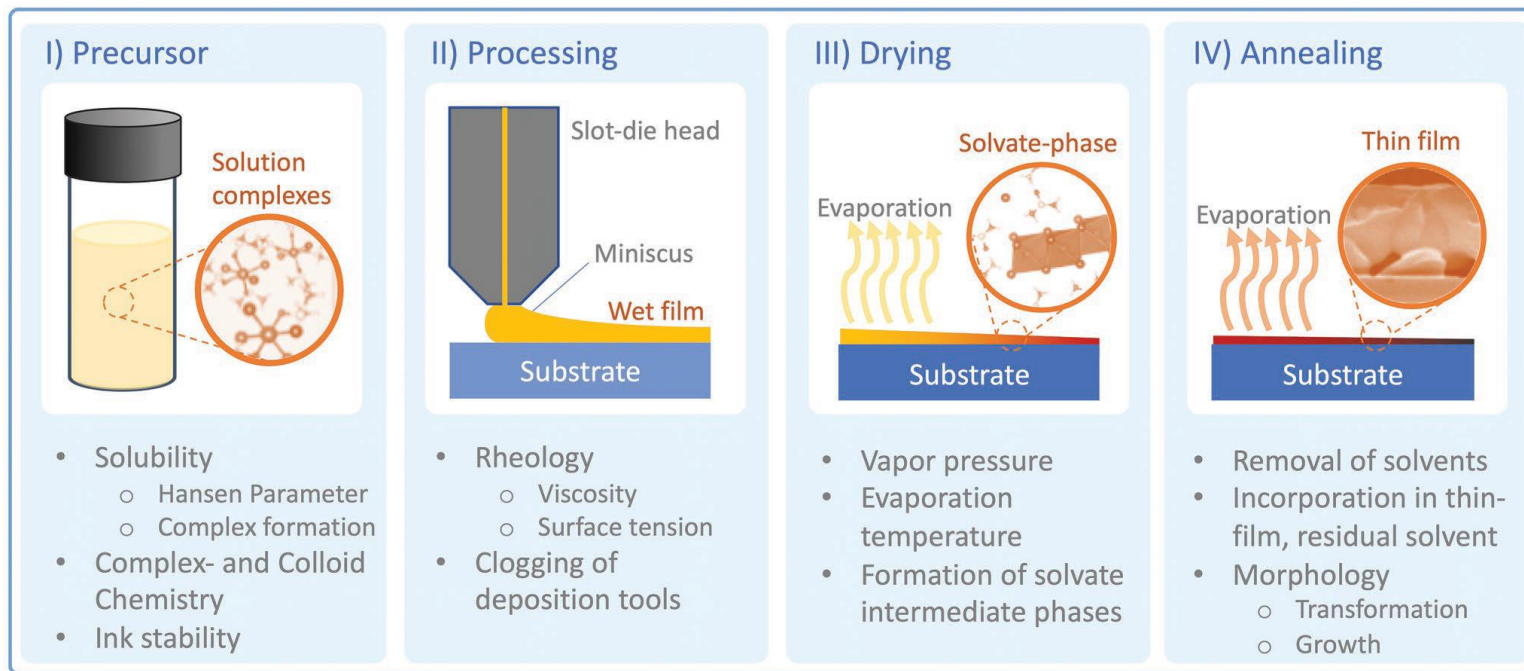


Global Solar PV Installation: 280 GW in 2023, 5000 GW in 2035!

PV Installation: 280GW/2023 (1 unit Land)
 5TW/2035 (18 units Land), >75TW/2050 (>250 units Land)

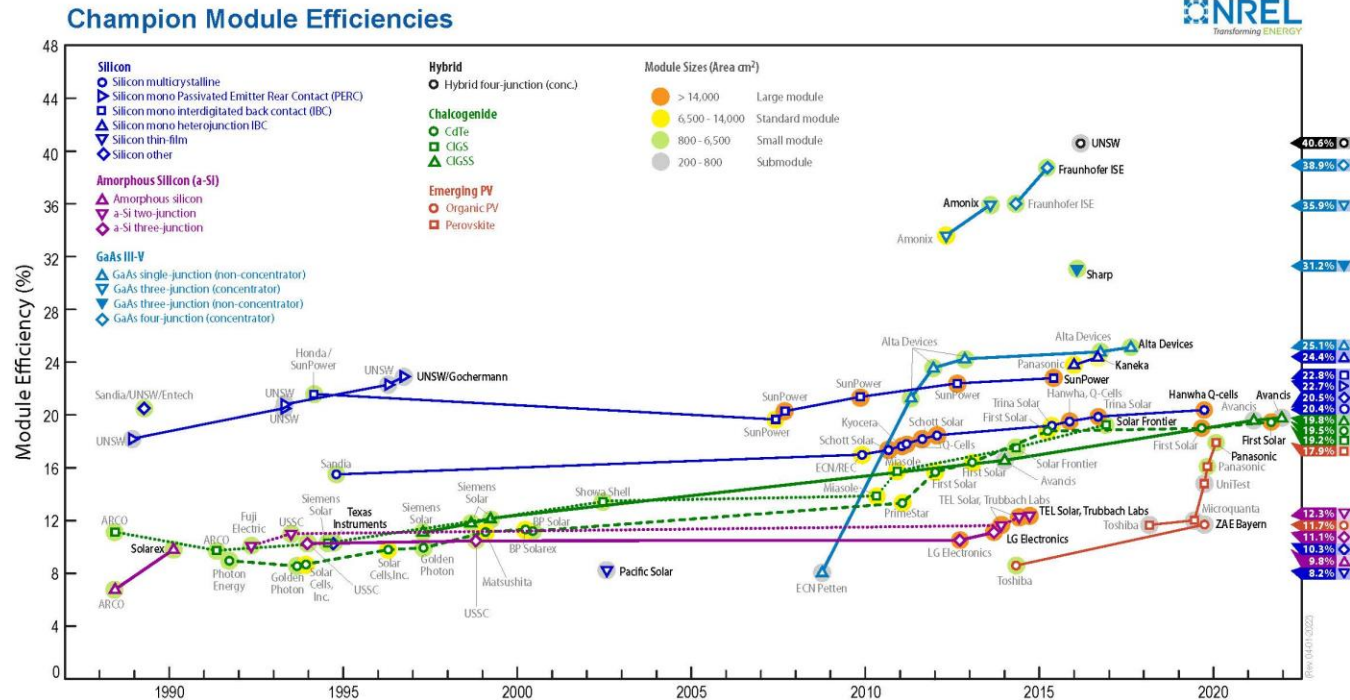


OPV – Thin film processing by slot die coating



Source: Li et al., Adv. Energy Mater. 2023, 2203898

Module efficiency



OPV key points

Novel nanomaterials & thin films
(Printable organic & inorganic semiconductors, conductors, electrodes, high barrier)

Fabrication of devices on flexible substrates
(PET, PEN, PC, paper,...)

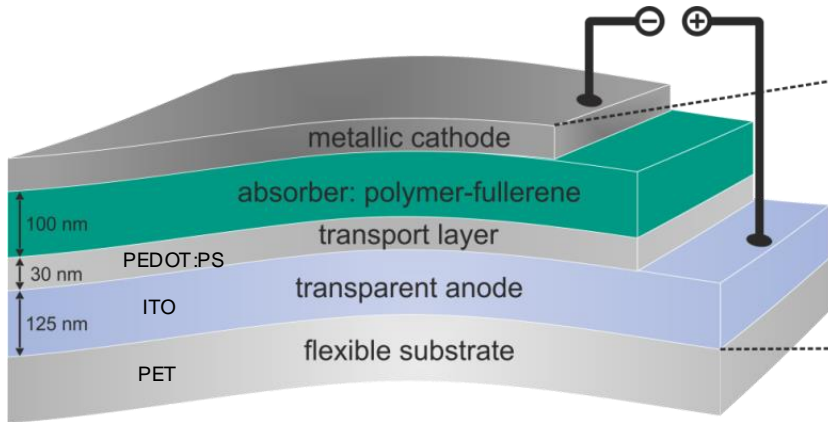
Scalable manufacturing processes
(Printing, OVPD, vacuum, hybrid, etc.)

Pulsed laser structuring tools
for large scale processes and designs

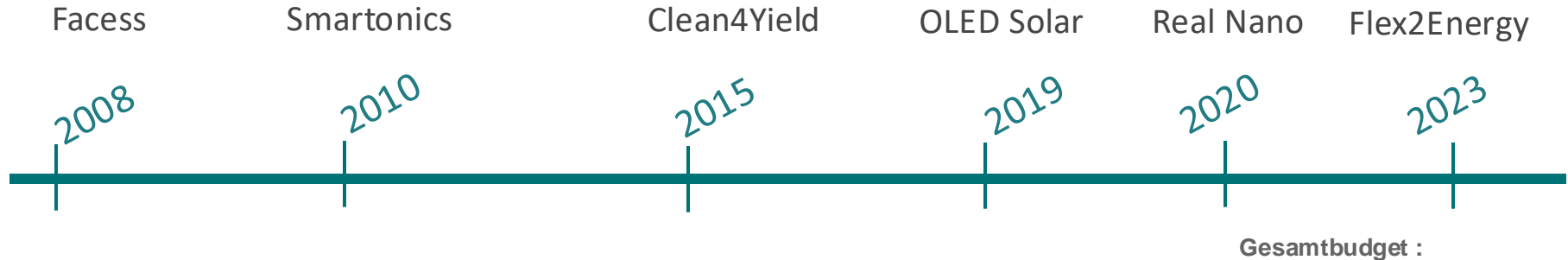
In-line precision metrology tools
for quality control during manufacturing

Integration to large area & low-cost production
(R2R, S2S, OVPD, hybrid)

With high yield, reproducibility & manufacturability
to fabricate high performance and lifetime nano-devices



Process upscaling – Developing 3rd Gen PV at Coatema

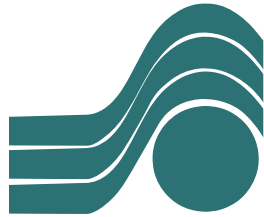


- ✓ 3 BMWF Projects with Ruhr Uni Bochum and ILT: FlexLAS – Photonflex – Effilayers
- ✓ 1 REGAC project – LS09 Registration improvement on the MAXI Line at VTT

3.

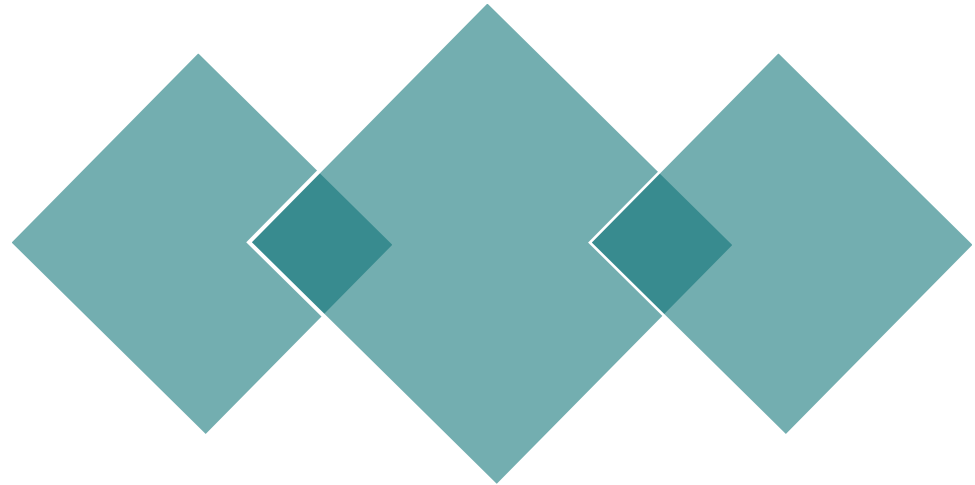
Flex2Energy Project





FLEX2ENERGY

**AUTOMATED MANUFACTURING
PRODUCTION LINE FOR IPVS**



Consortium partners





FLEX2ENERGY
AUTOMATED MANUFACTURING
PRODUCTION LINE FOR IPVS



Title: Automated Manufacturing Production Line for Integrated Printed Organic Photovoltaics (Flex2Energy)

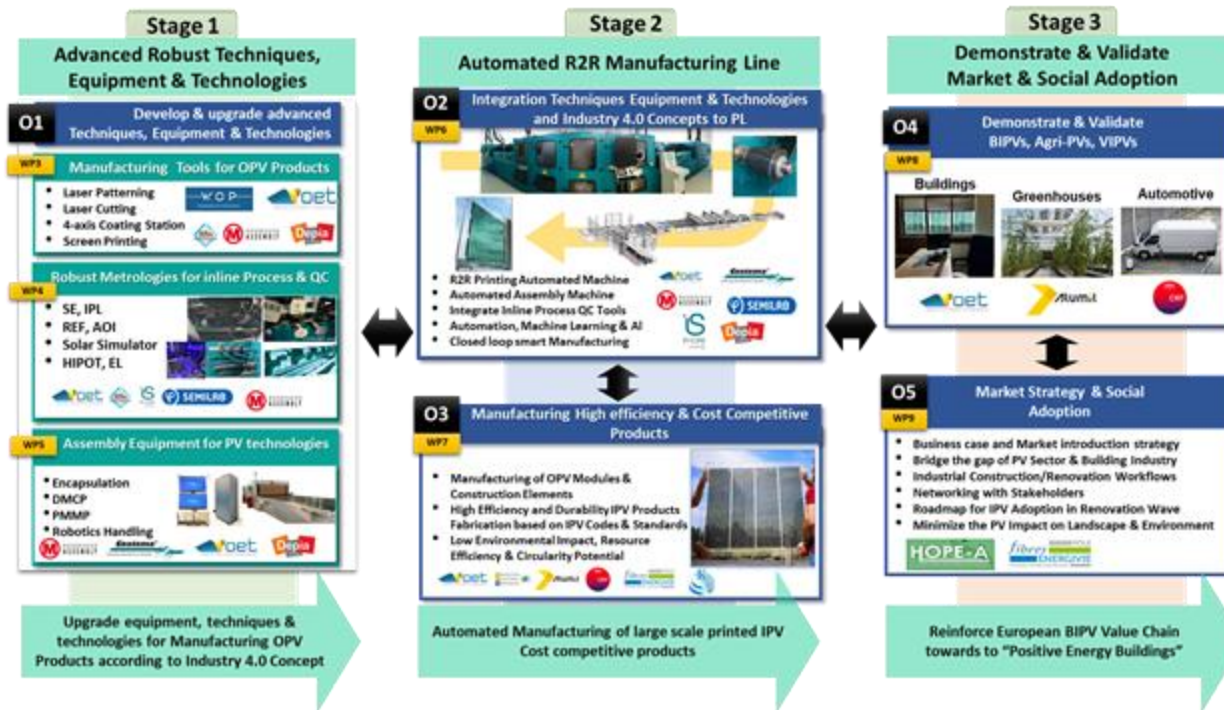
- **Type:** Innovation Action (IA)
- **Work programme:** HORIZON-CL5 2022-D3-01-03
- **Project Number:** 101096803
- **Duration:** 48 Months (01/01/2023 – 31/12/2026)
- **Total Budget:** 21,116,625 Euros
- **EC Contribution:** 15,702,550 Euros
- **EC Project Officer:** Mauricio RICHTER RIOS





Part No.	Participant Organisation Name	Short Name	Country	Nature
1 (Coor)	Organic Electronic Technologies P.C.	OET	GR	SME
2	Nanotechnology Lab LTFN/AUTh	AUTh	GR	HE
3	Coatema Coating Machinery GmbH	COA	DE	IND
4	Mondragon Assembly	MASSGE	DE	IND
5	Semilab Semiconductors Physics Laboratory Co. Ltd.	SEML	HU	SME
6	Workshop Of Photonics	WOP	LT	SME
7	Centro Riserche Fiat	CRF	IT	RES
8	Alumil Aluminium Industry S.A.	ALU	GR	IND
9	Hellenic Organic & Printed Electronics Association	HOPE-A	GR	ASSO
10	Pole Fibres-Energivie	PFE	FR	ASSO
11	In-Core Systèmes	INC	FR	SME
12	Centre Technique Industriel de la Plasturgie	IPC	FR	RES
13	Kiriakidis S.A.	KIR	GR	SME
14	Municipality of Alba Iulia	ALBA	RO	PUBLIC
15	DEPIA Automations	DEPIA	GR	SME
16	Mondragon Asembly Sociedad Cooperativa	MASS	ES	IND
17	Mondragon Assembly SA	MASSO	FR	IND

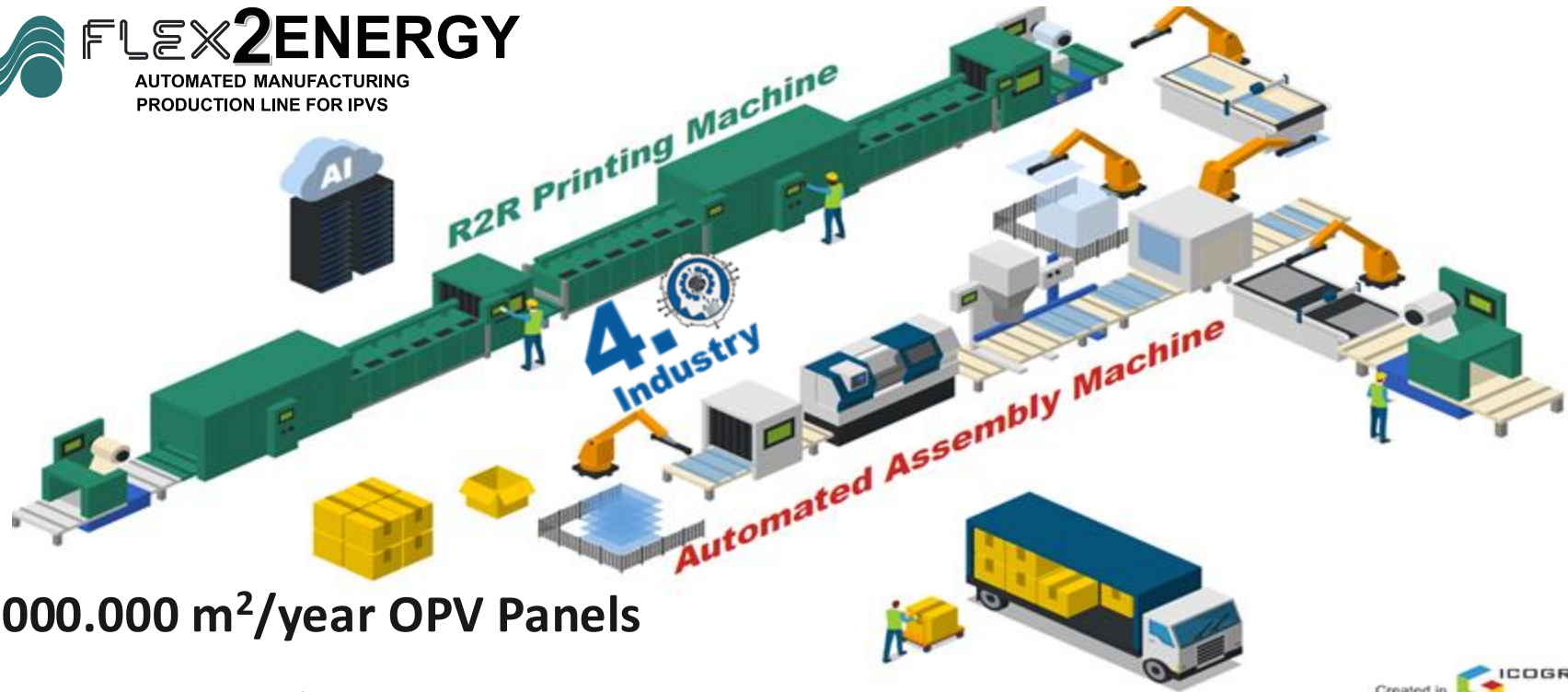
Flex2Energy concept: The 3 stages in relation with the Obs & WPs





FLEX2ENERGY

AUTOMATED MANUFACTURING
PRODUCTION LINE FOR IPV5



- 1.000.000 m²/year OPV Panels
- 100 MW Capacity

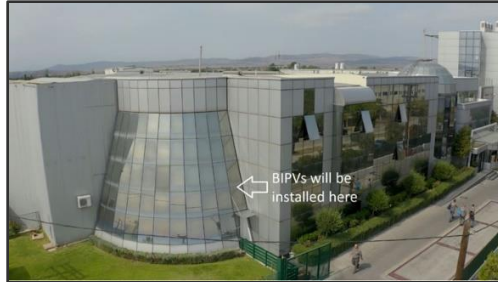
The novel idea of Flex2Energy

- ✓ Revolutionize the renovation & construction wave of the EU's building industry (buildings, infrastructure, greenhouses and automotive) of all kinds of uses and locations
 - Implementation of novel IPV products for energy positive building concept (Fig. 1)
- ✓ Spread novel IPV products through the setup of a strong Innovation Clusters Network (ICN) in green buildings agriculture and transportation to form and connect this Value Chain of 40 ICs across Europe (Construction, Architects, Designers, Engineers, Contractors, Suppliers, end users etc.)
- ✓ Demonstrate, evaluate, spread and ultimately replicate the developed innovations



Fig. 1. F2E automated Manufacturing line for OPVs and IPV products to open the way for energy positive buildings & to minimize landscape

BIPVs



50 m² of BIPVs on the façade of Alumil's Industrial Building (Greece)



100m² of BIPVs (Glass) on the Glass Façade of Alba Iulia Municipality Building (Romania)

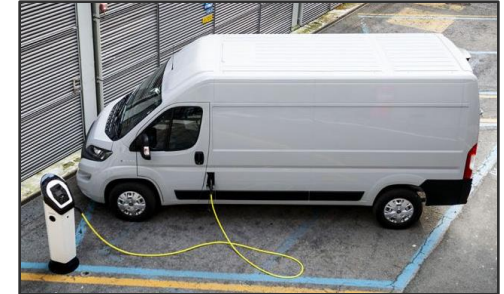
Agri-PVs



200 m² of Agri-PVs on Mediterranean Greenhouse (Med-GH) (Greece)

IPV Demonstrators

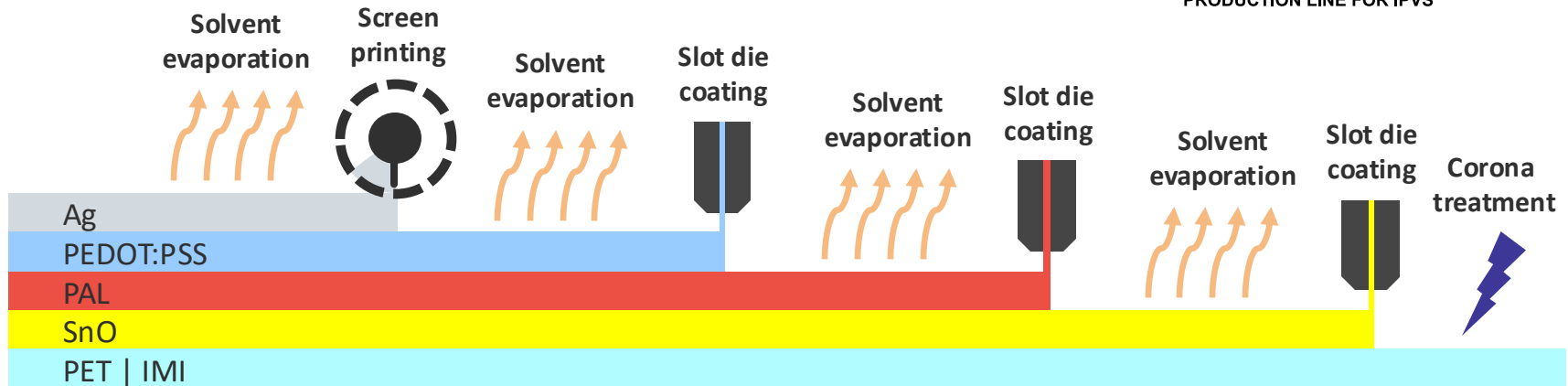
VIPVs



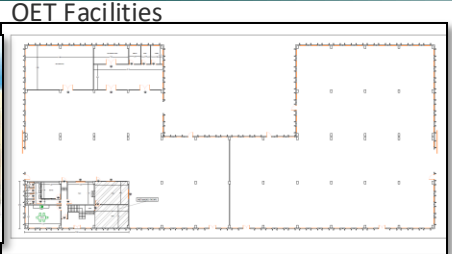
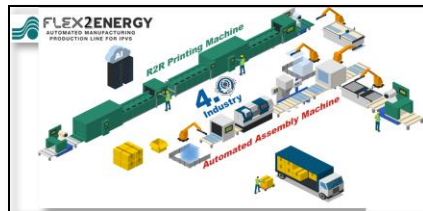
2 Demonstrators

9 m² of VIPVs on FIAT Ducato Electric Vehicle
20m² of IPV's on a Carport providing EV Charging Spots (Italy & Greece)

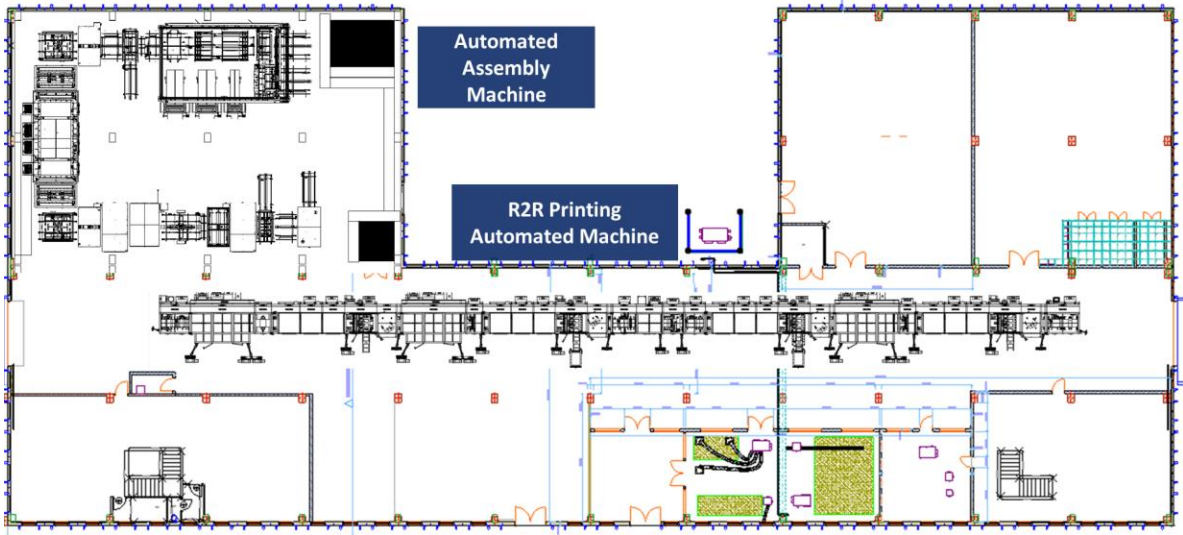
Coatema OPV PV Manufacturing plant – Click&Coat



Automated Manufacturing Production Line For IPVs



3500 m² Production Facilities in one Floor



100 m

Unique advantages of OPVs: Semi-transparent, flexible, low CAPEX

Features to create new applications

- ✓ **Flexible & rollable**
(Processing <130°C on PET substrates)
- ✓ **Large area & light weight** (<0.5 kg/m²)
- ✓ **Can be wearable**
(Non-toxic & Heavy metals free)
- ✓ **Easy to customize & design**
(Colorful, tailorable, patternable)
- ✓ **Transparent**
(Optical transmission >50% available)

Applied in vertical, curved,.... applications

- ✓ **Insensitivity to light incident angle**

Perform efficiently under low-light Intensity

- ✓ **Linear dependency of voc** even under low light intensity
- ✓ **Material's photo-absorption** can match to indoor light spectrum

Scaled-up with a low manufacturing cost (\$/m²)

- ✓ **Low CAPEX**
(Non-class 1000 Classroom, Non-vacuum)
- ✓ **High throughput**
(R2R Printing, e.g. 0.1-1GW/y/Line)

The greenest PV technology

- ✓ **Lowest Energy Payback Time & CO₂-Emission** (<1/10 of Si-PVs)
- ✓ **No etching waste**, the acid or base, be generated



4.

Summary



Summary

- ✓ Coatema delivers the whole OPV/Perovskite lab/pilot & production technology.
- ✓ Reproducible results in every step of scale, have to be reached.
- ✓ Are economies of scale reachable and when and how to we keep technologies and industries in Europe.
- ✓ Standardization of device manufacturing and fully autonomous production is the key for the industry.
- ✓ EU funding is needed to develop strategic markets for an independent Europe.
- ✓ OPV/Perovskite as an alternative development path in Europe with European companies, universities, materials, equipment and products.

Download brochures & presentations



Coatema

Thank you

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