INREP

Towards Indium free TCOs

13 Partners
7 Countries
30 Researchers and engineers
4 Applications
5 **Physical properties of interest:** transparency, electrical conductivity, work function, texture, chemical stabilitty thermal stability

INREP is a three-year Horizon 2020 collaborative research project with the objective to develop and deploy valid and robust alternatives to indium (In) based transparent conductive electrode materials as electrodes.

CHALLENGE OF GROWING DEMAND FOR ELECTRONICS CONTAINING TCOS

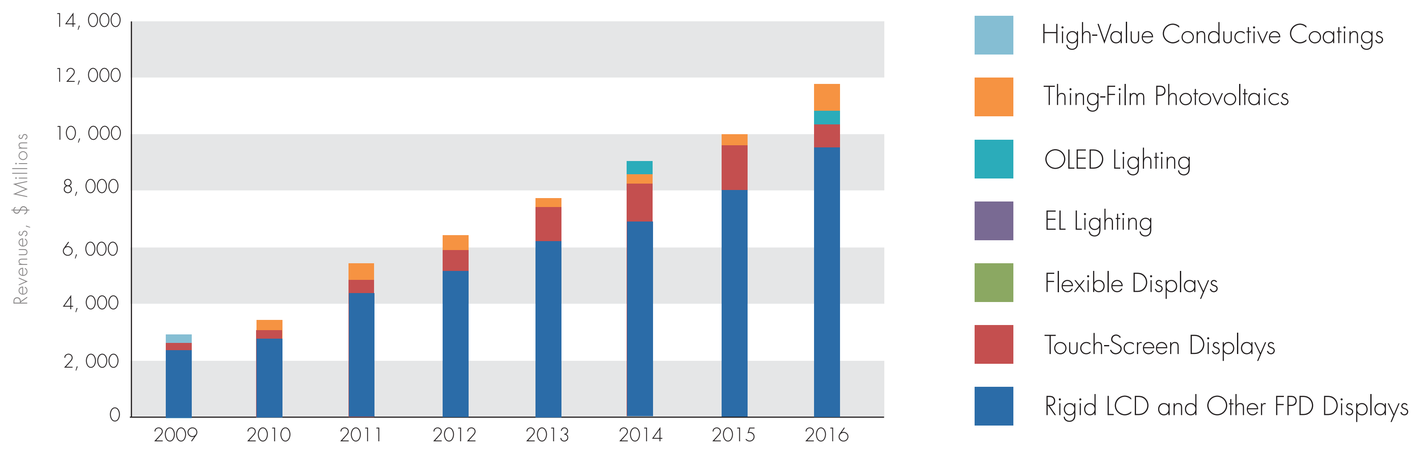
In-based materials, mainly ITO, are technologically entrenched in the commercial manufacture of components like LEDs (both organic and inorganic), solar cells, touch-screens, these cumulative markets having mulplied by a factor of 4 in 5 years.

INDIUM VARIATION BETWEEN 2000 AND 2010 :

+800% IN COST

+350% IN WORLD PRODUCTION

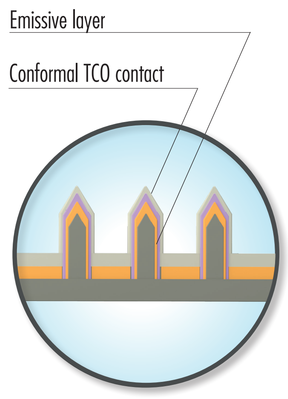
IN-BASED MATERIALS IN DAY-TO-DAY PRODUCTS



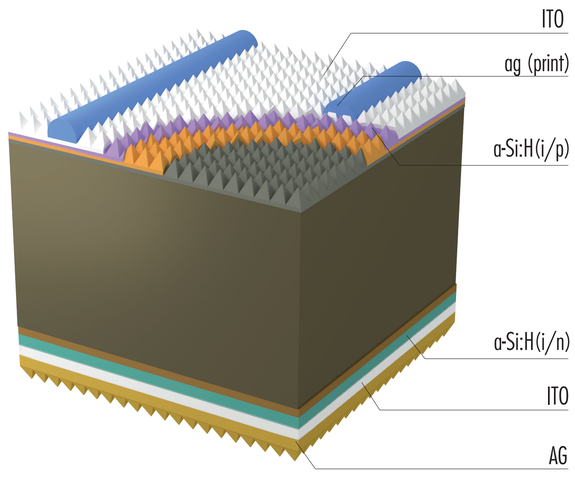
TECHNICAL CHALLENGE

INREP brings together a unique multi-disciplinary consortium to meet a double challenge: creation of TCOs and their deposition technologies with the optimum opto-electrical properties for the economic and safe manufacture of opto-electronic components.

LED STRUCTURE



HIGH EFFICIENCY PV CELL



PROJECT AIMS AND APPLICATIONS

The project aims at a complete assessment of the relevant properties of the proposed TCOs, including the impact of deposition technique, and by doing so, devise optimum processes for their application in selected, high value application areas: organic and inorganic light emitting diodes (OLEDs and LEDs), solar cells and touch-screens.

HIGH EFFICIENCY PV CELLS:

To develop In-free TCO films with carrier concentration in the range $3x10^{19}$-$3x10^{20}$ cm^{-3} with an electronic mobility greater than 20 cm^2 $(Vs)^{-1}$ to enable its dual use as a front and back electrode in SHJ solar cells. This will allow for a relative cost reduction of 5% and efficiency gain of 2%.

GaN BASED LEDs:

To establish processes for realizing conformal TCO coatings with sheet resistivity below $5x10^{-4}\Omega cm$, transparency above 88%, contact resistance below $2x10^{-5}\Omega cm$ for large area planar LEDs and LEDs incorporating high aspect ratio (H/W greater than 2) nanostructures, without detriment to the Cost of Ownership.

ORGANIC LEDs:

To develop In-free TCO material with sheet resistance below 10 Ω/□ and visible absorption below 5%. Developed film roughness should lead to leakage current below 10^{-3} mA/cm^2 without detriment to the Cost of Ownership.

TOUCH-SCREEN MONITOR:

To develop In-free transparent electrodes with a sheet resistance below 100 Ω/□, a transparency higher than 90% in the visible wavelength range, and a haze factor below 2%, without detriment to the Cost of Ownership.

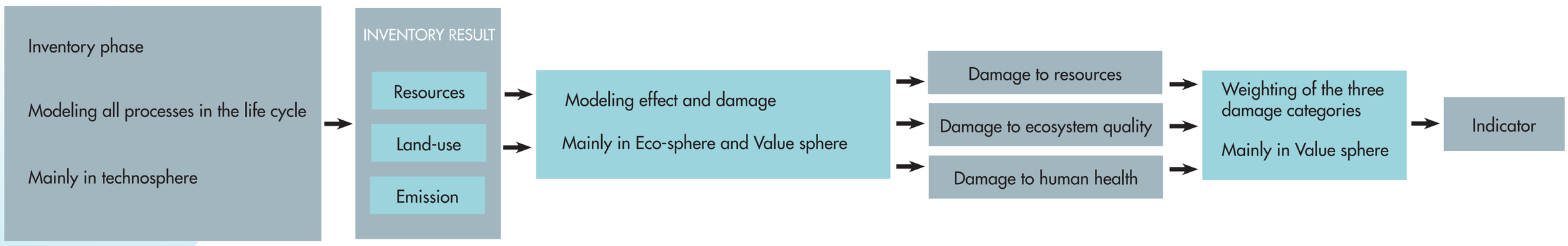
RELATED EQUIPMENT AND PROCESS DEVELOPMENT :

To establish processes and up-scaled equipment, to a minimum 30x30 cm^2 process area, that simultaneously reduce cost and increase technical effectiveness of TCOs deposited by low damage techniques.

LIFE CYCLE ASSESSMENT (LCA)

To perform life cycle assessments of the environmental impact of the developed TCO materials and cost of ownership analyses of their formation technologies over the entire period from application in manufacturing, through component operation into waste management.

RELATIONS BETWEEN DIFFERENT PHASES OF LCA



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In a nut shell: Project title: Towards Indium free TCOs - Grant Agreement number: 641864 - Project type: Research and Innovation Action - Start date: 1st February 2015 - End date: 31st January 2018 - Duration : 36 months - Total budget : - EUR 6 197 149.50 - EU contribution : EUR 4 999 4333.00 - Total manpower : 590.40 person-months - EC Project Adviser : Dimitrios Biliouris - Project Coordinator : Duncan Allsopp (Univeristy of Bath) -Technical Coordinator: Sylvain Nicolay (CSEM)

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