

liten
cea tech



PILOT LINE FOR LARGE-AREA PRINTING OF ELECTRONIC AND PHOTONIC DEVICES

Simon Perraud, Ph.D.
Vice president for European affairs

Liten is the research institute of CEA devoted to clean energy technologies



955 researchers



125 million euros annual budget



200+ patent applications per year
200+ publications per year



400+ research contracts with industrial partners every year
120+ ongoing European projects

Grenoble campus



Chambéry campus

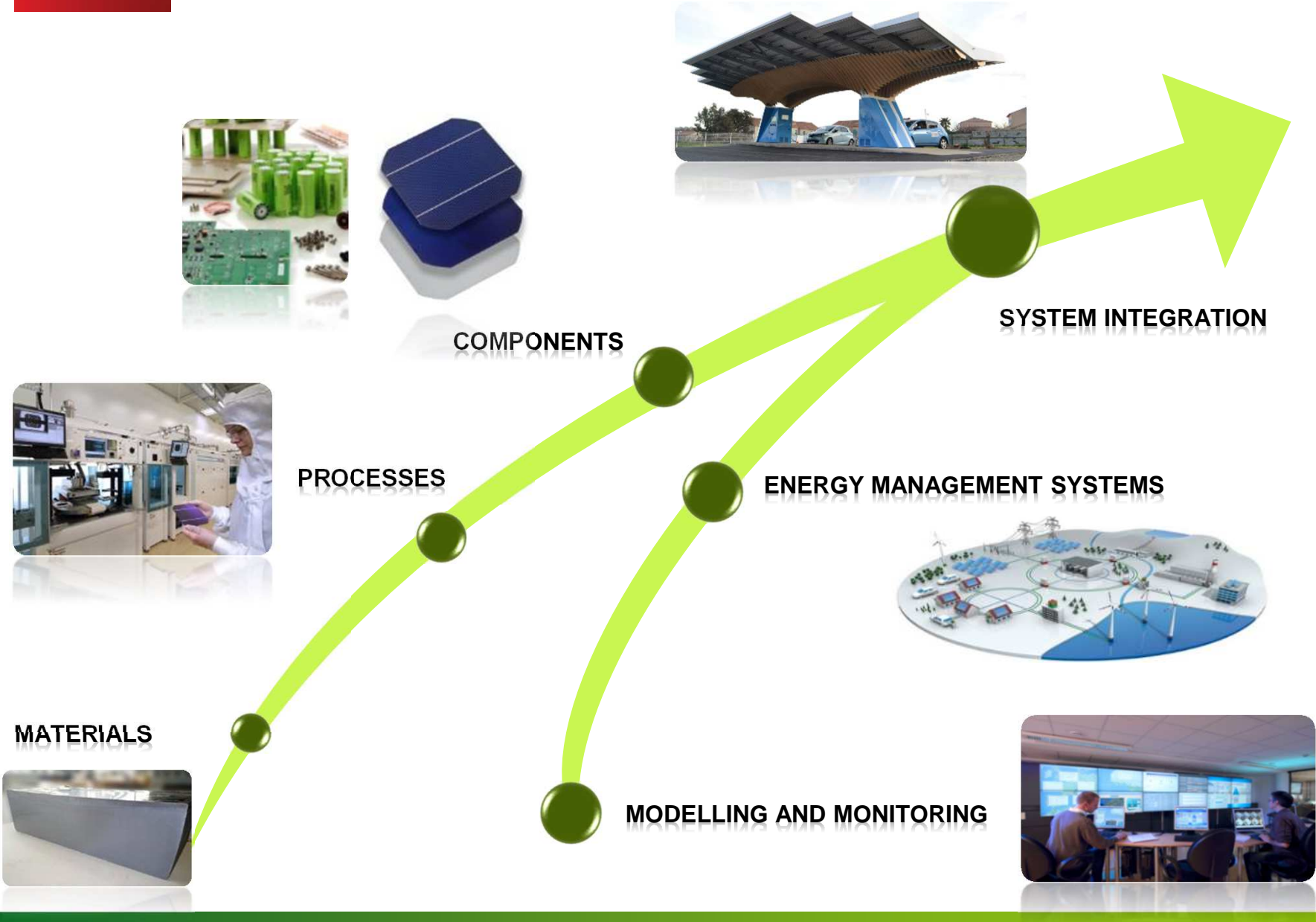


HOLISTIC APPROACH FOR A LOW-CARBON AND CIRCULAR ECONOMY





INNOVATION ALONG THE FULL VALUE CHAIN



RESEARCH ACTIVITIES

Renewable energy sources

- Solar photovoltaics
- Solar thermal energy
- Bioenergy and waste-to-energy

Energy storage

- Batteries
- Hydrogen and synthetic fuels
- Thermal energy storage

Energy efficiency

- Industry
- Buildings
- Electrified powertrains

Energy grids

- Power grids
- Heating and cooling networks
- Multi-carrier energy systems and sectoral integration
- Techno-economic analysis of clean energy technologies

Materials

- Sustainable material management (net-shape manufacturing, raw material recovery, eco-innovation)
- Functional materials (surface functionalization, large-area electronics and photonics, nanomaterials)
- Cross-cutting activities (material characterization, ab-initio modelling, nano-safety)

PILOT LINES AND INFRASTRUCTURES

SOLAR PHOTOVOLTAICS



15 000 m² - 200 pers. - 100 M€

THERMAL TECHNOLOGIES



1500 m² - 75 pers. - 15 M€

BIO-ENERGY AND WASTE-TO-ENERGY



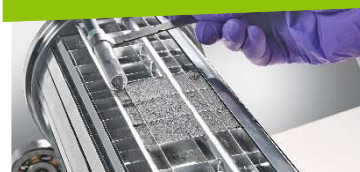
800 m² - 40 pers. - 7 M€

BATTERIES



3000 m² - 100 pers. - 40 M€

HYDROGEN PRODUCTION



820 m² - 40 pers. - 6 M€

FUEL CELLS



500 m² - 40 pers. - 6 M€

ENERGY-EFFICIENT BUILDINGS



40 pers. - 1,5 M€

ELECTROMOBILITY



1500 m² - 20 pers. - 4 M€

SMART GRIDS



300 m² - 100 pers. - 2 M€

POWDER METALLURGY



1400 m² - 50 pers. - 12 M€

LARGE-AREA ELECTRONICS AND PHOTONICS



600 m² - 50 pers. - 9 M€

MATERIAL CHARACTERIZATION



3000 m² - 80 pers. - 30 M€

NANO SAFETY



5000 m² - 150 pers. - 17 M€

OBJECTIVE: develop cost-effective **printing processes** to functionalize **large surfaces** with **electronic** and **photonic functionalities**



50 researchers



9 M€ investment



600 m² clean room



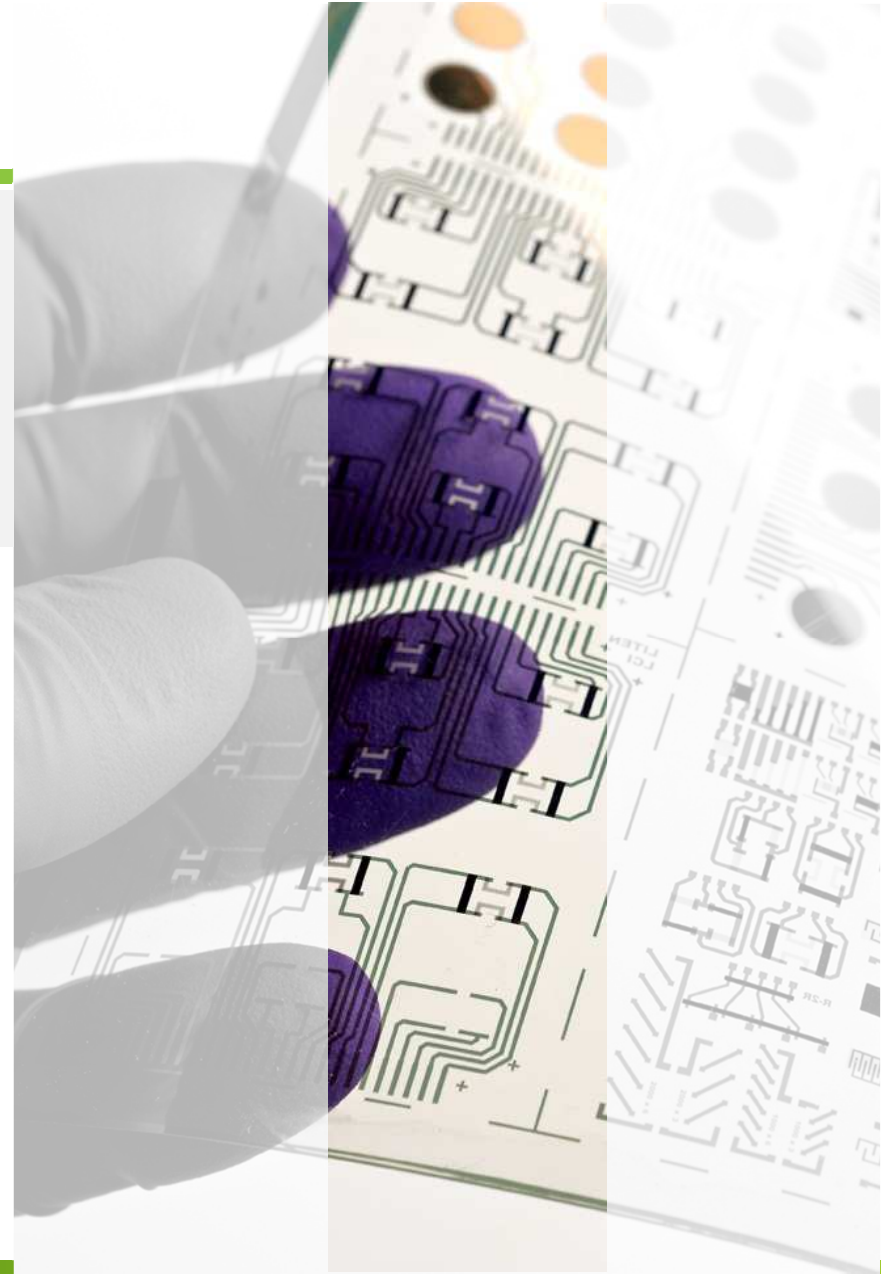
GEN1 (320 mm x 380 mm) sheet-to-sheet printing:
screen printing, gravure printing, flexo printing, inkjet printing,
aerosol jet printing, slot-die coating, ...



50 patents



Arkema, Merck, Incore, Isorg, Trixell, Walter Pack, Symbiose,
Bosch, ArjoWiggins ...



GEN1 (320 mm x 380 mm) sheet-to-sheet printing



LARGE-AREA ELECTRONICS AND PHOTONICS PILOT LINE



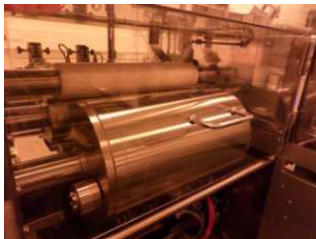
Screen printing

Stencil – screens



Gravure printing

Engraved hard cylinder



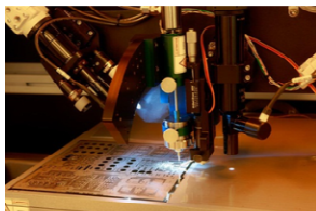
Flexo printing

Cylinder with soft printing plate



Inkjet printing

126-256 nozzles



Aerosol jet printing

Tilted head
Curved surfaces



Slot die coating

Vacuum bake



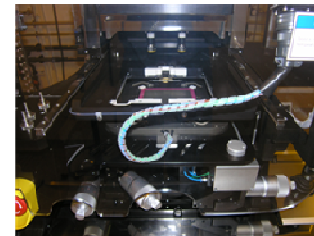
Laser ablation

DUV laser



Photonic curing

Xenon lamps



Nano-imprint

PDMS stamps



2.5D printing

Aerosol jet printing

LARGE-AREA ELECTRONICS AND PHOTONICS PILOT LINE

Piezoelectric actuators
(haptic feedback,
loudspeakers)



Chemical and biochemical
sensors (pH, glucose, lactate)



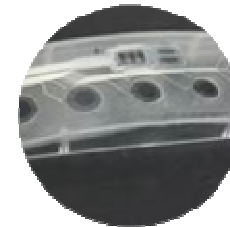
Resistive sensors
(temperature, strain)



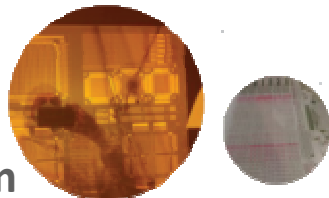
Smart paper
surfaces



Smart plastic
surfaces



Organic thin film
transistors and
passive devices



Photodetectors
X-ray imaging



PictiC

LORIX H2020 PROJECT

PRINTED PHOTODETECTORS FOR X-RAY IMAGING



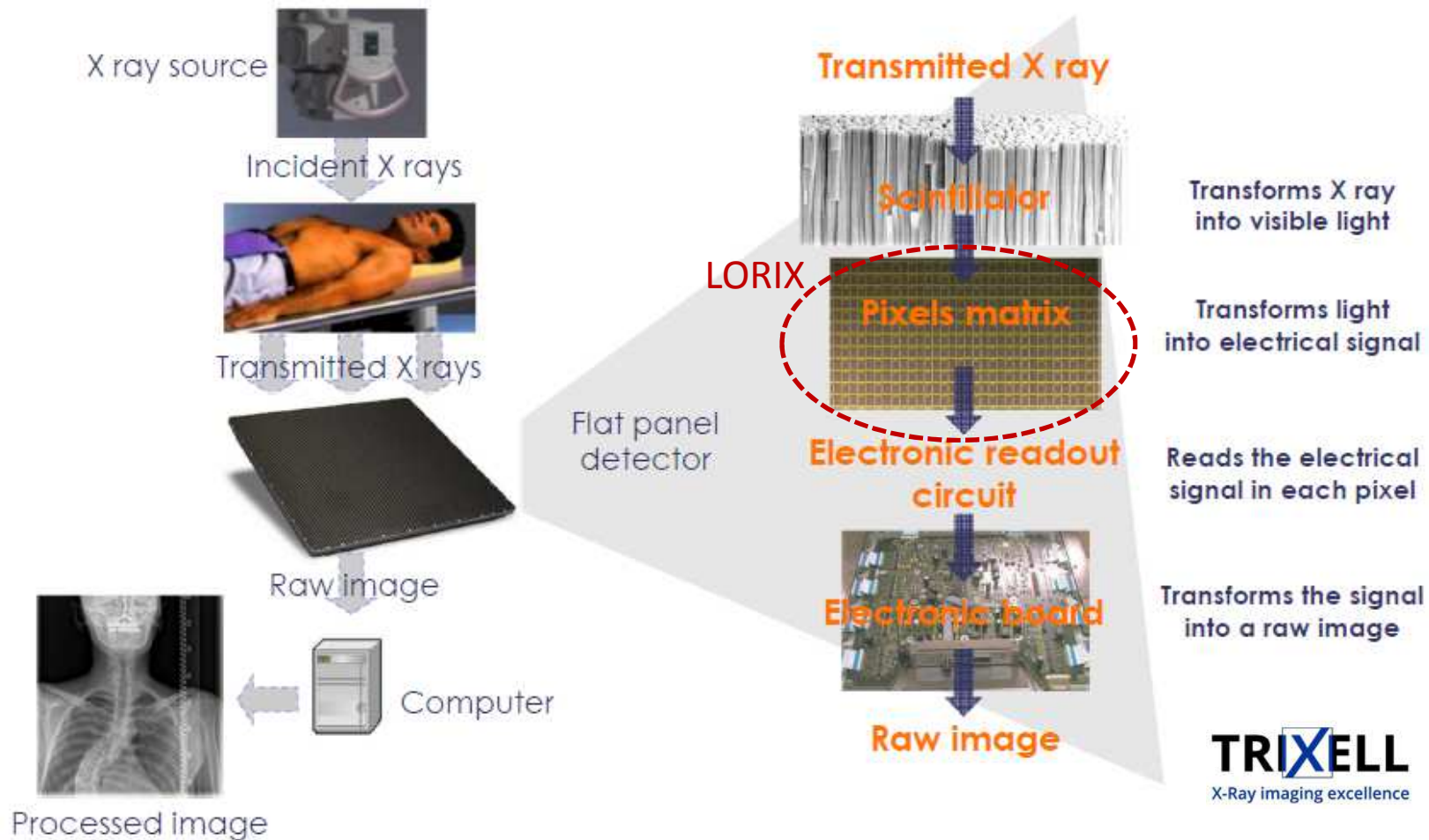
Project ID:

- Title: *Large Organic Robust Imager for X-ray sensing*
- February 2015 – July 2018
- 9.7 M€
- 12 partners
- Coordinator: CEA Liten



LORIX H2020 PROJECT PRINTED PHOTODETECTORS FOR X-RAY IMAGING

Project background: X-ray flat panel detector technology

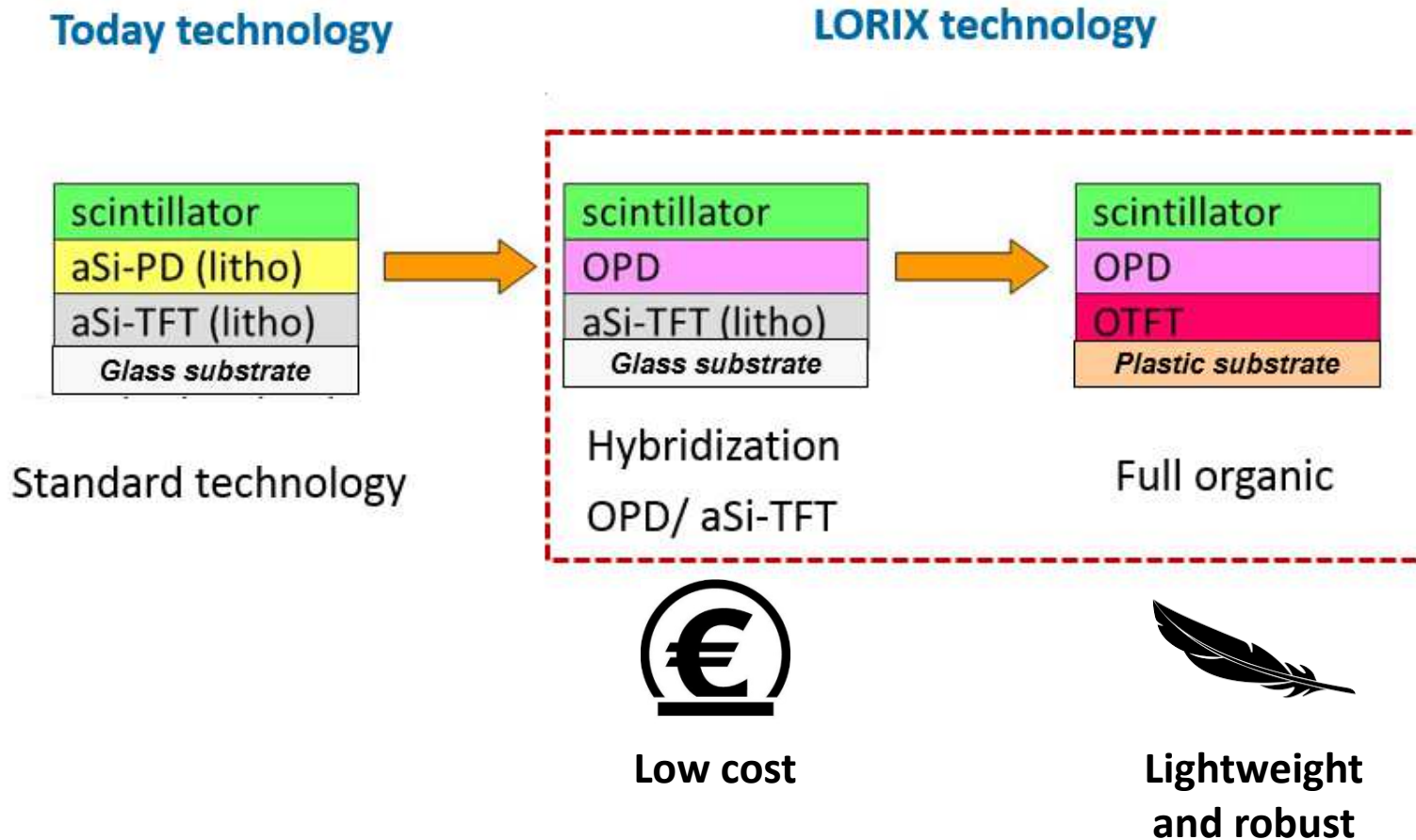


LORIX H2020 PROJECT

PRINTED PHOTODETECTORS FOR X-RAY IMAGING

Project concept:

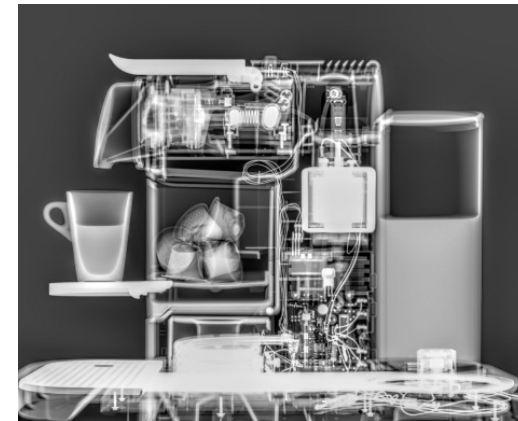
printed organic photodetectors (OPD) for X-ray flat panel detectors



LORIX H2020 PROJECT PRINTED PHOTODETECTORS FOR X-RAY IMAGING

Project applications:

- X-ray imaging for healthcare
- Security
- Non destructive testing



LORIX H2020 PROJECT PRINTED PHOTODETECTORS FOR X-RAY IMAGING

Some project results:



Pilot line upgrade

- Automatic optical inspection for defect detection in OPD matrix
- Atomic layer deposition for OPD encapsulation



OPD flat panel detector prototypes

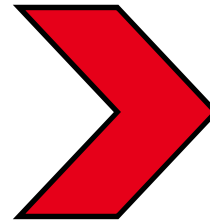
- Similar performances as standard devices



LORIX H2020 PROJECT PRINTED PHOTODETECTORS FOR X-RAY IMAGING

Towards industrialization:

CEA Liten pilot line
GEN1 (320 mm x 380 mm)
Grenoble, France



Isorg production line
GEN4 (650 mm x 780 mm)
Limoges, France





HAPPINESS



Project ID:

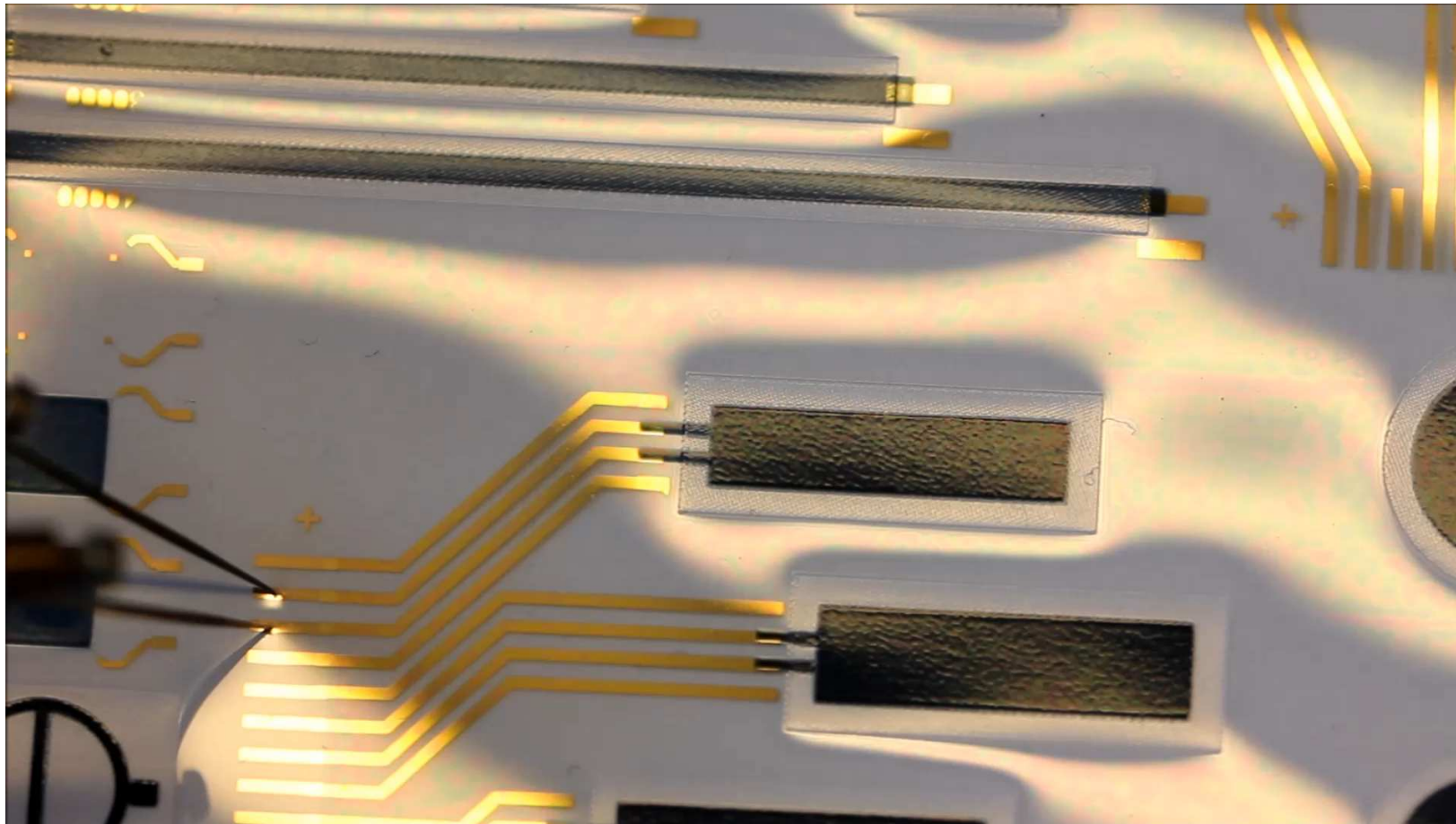
- Title: *Haptic Printed and Patterned Interfaces for Sensitive Surface*
- January 2015 – December 2017
- 3.8 M€
- 8 partners
- Coordinator: CEA Liten



HAPPINESS H2020 PROJECT

PRINTED PIEZO ACTUATORS FOR AUTOMOTIVE DASHBOARDS

Project background: piezoelectric actuator development





HAPPINESS H2020 PROJECT

PRINTED PIEZO ACTUATORS FOR AUTOMOTIVE DASHBOARDS

Project background: trend among automotive suppliers to design smooth and seamless dashboards integrating touchscreens



Project concept:

- Need for eyeless human machine interface on the dashboard touchscreen
- Solution: haptic feedback (=addressing the sense of touch)
 - Finger detection by the dashboard touchscreen
 - Haptic feedback by printed piezoelectric actuators



The present
Traditional Mechanical
Dashboard



The Future thanks to HAPPINESS:
Smooth Tactile Dashboard in
sleeping mode



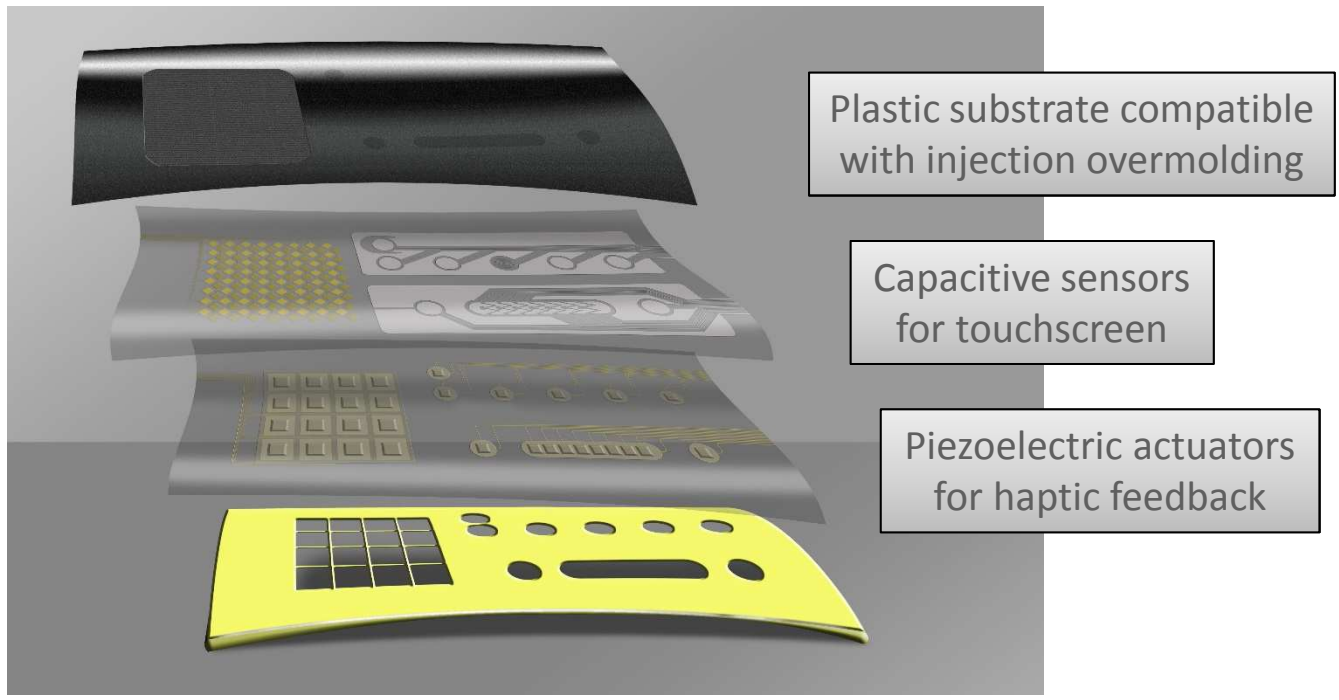
Haptic feedback on reconfigurable
touch sensing area in active mode



HAPPINESS H2020 PROJECT

PRINTED PIEZO ACTUATORS FOR AUTOMOTIVE DASHBOARDS

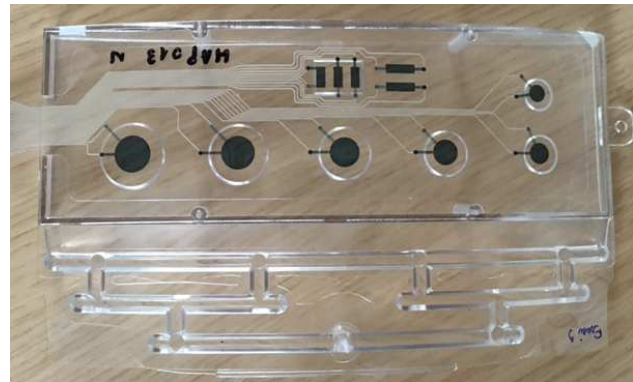
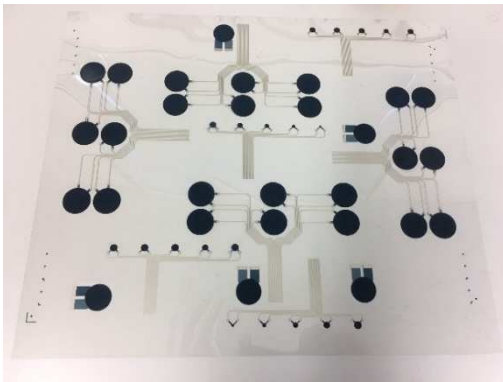
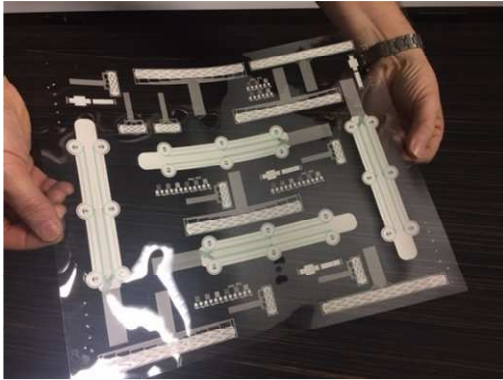
Project concept:





HAPPINESS H2020 PROJECT PRINTED PIEZO ACTUATORS FOR AUTOMOTIVE DASHBOARDS

Some project results:



Sensor and actuator foil printing

Injection overmoulding of foils

Integration into a concept car

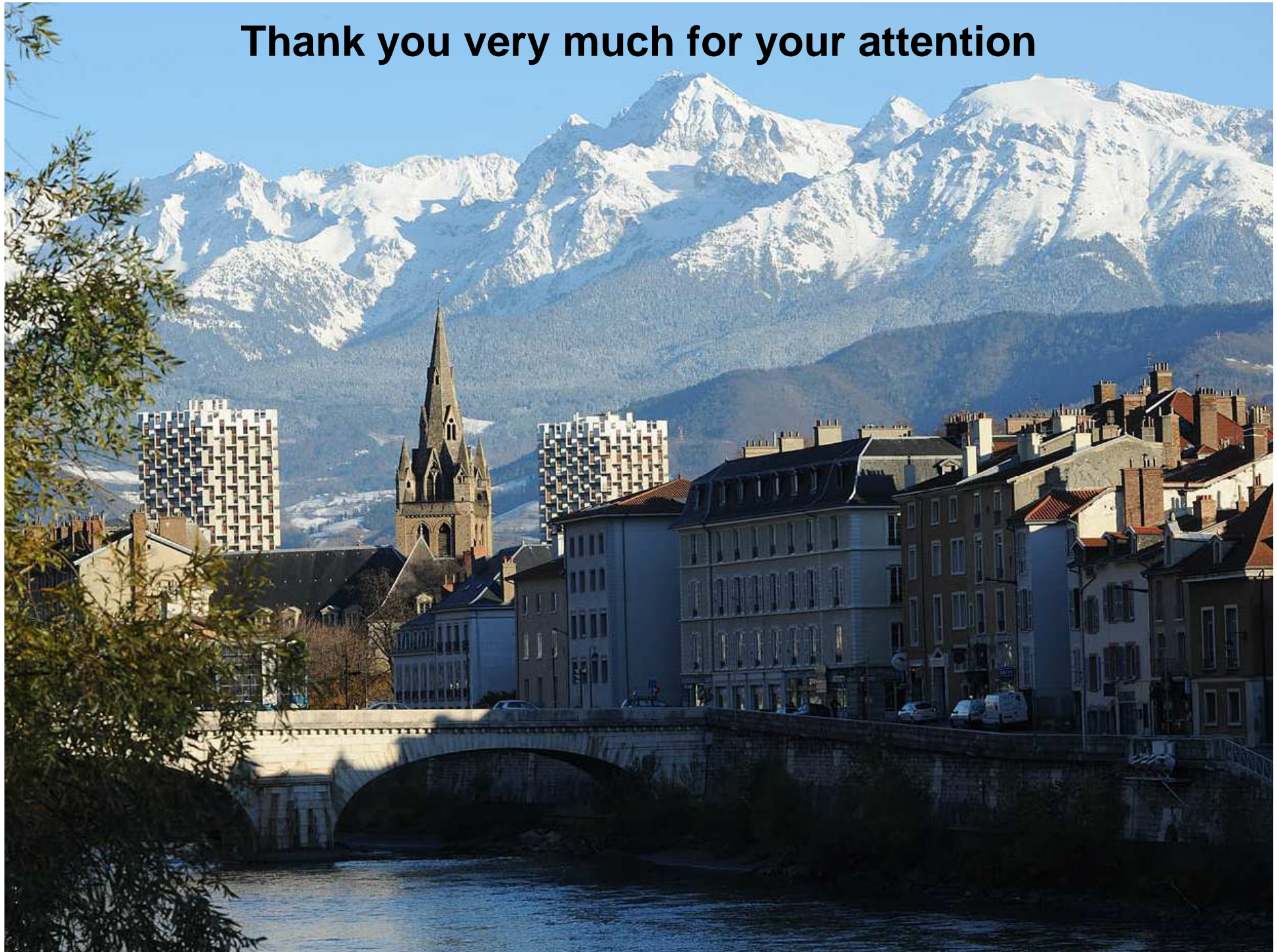





FOR FURTHER INFORMATION

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- HAPPINESS project: Antoine Latour (antoine.latour@cea.fr)

Thank you very much for your attention





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