Introduction to BASMATI

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Basmati

Bringing innovAtion by Scaling up nanoMATerials and Inks for printing

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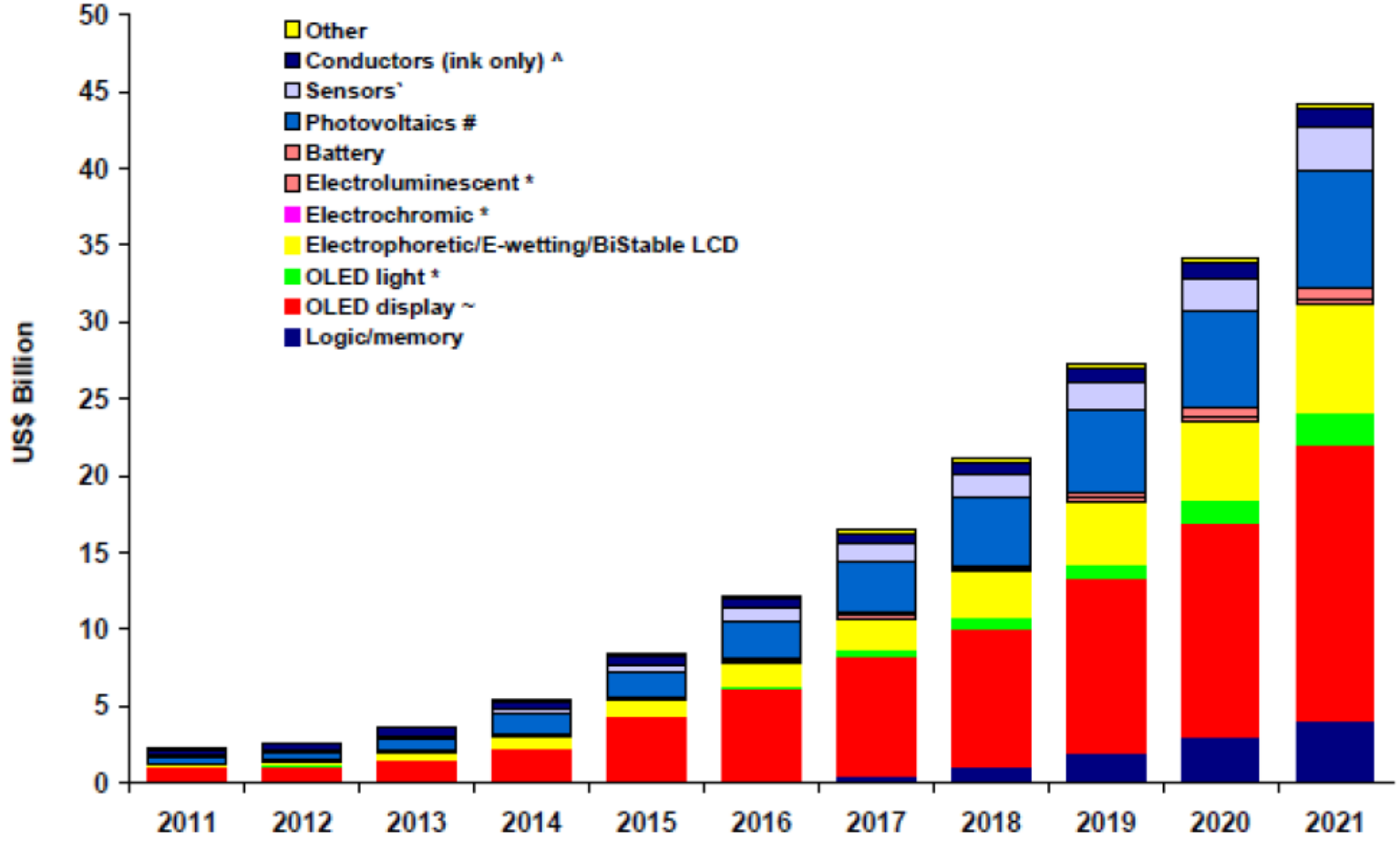
Bringing Innovation by Scaling Up Nanomaterials and Inks for Printing

THE BIGGER PICTURE - FUNCTIONAL INKS

Printed electronics forecast



Key enabling technology

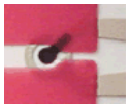
- Screen printing & inkjet printing would enable low cost, high throughput production of high added value electronic applications
  - Examples: OLEDs, sensors, RFID tags, thin film batteries

RFID tags

Main barrier

Ink availability

- controlled properties
- reproducible
- industrial scale



Bio sens

e systems

Smart packaging

Thin-film transistor

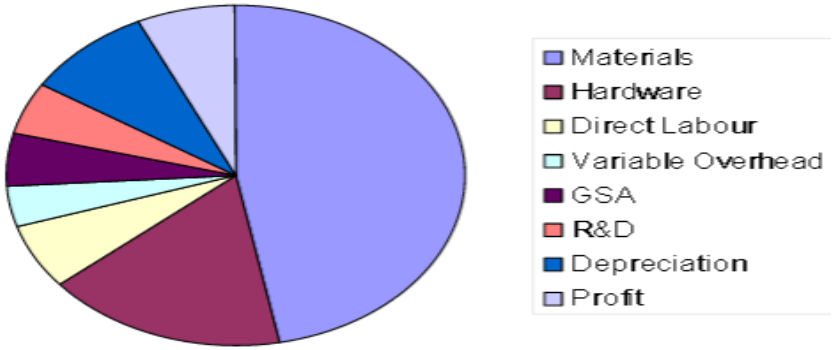
Functional inks

- Inks are generic components, essential for printed devices

- Actual commercial inks present **barriers** preventing market uptake:
  - The cost of available inks is still high
  - Main commercial inks are not compatible with high definition printing technologies (inkjet)
  - Production capacity is limited and technology/applications manufacturers are not guaranteed to be supplied
  - Risk of non-compatibility with REACH forcing unprepared suppliers to change their manufacturing processes.

Conductive inks

- Dominated by Ag-based inks
  - **Great oxidation control**, contrary of other conductive materials.
  - **High cost** is an important **barrier** to the market uptake.



- **BASMATI** goal ➔ reduce cost of conductive inks
  - Control oxidation of low cost metallic particles (Cu, Ni)
  - Lower density of these metals

  ➔ **Lower cost: up to - 50% compared to existing printed products**

Electrochemical inks

- Increasing demand for thin, small-footprint, and flexible devices
  - smartcards, RFID tags, implantable medical devices, microelectronic devices, flexible displays and e-papers

    ➔ enabled by thin-film and printed batteries

- Barriers for flexible energy storage at industrial scale, notably:
  - Low energy storage capacity → low performance of active material
  - Low production capability → printing process performances + limited availability of electrochemical inks

- **BASMATI**

  ➔ low cost - high performance inks for printed energy storage

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POSITION OF BASMATI

Abstract

H2020 Call: NMP-05-2014

Industrial-scale production of nanomaterials for printing applications

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- ➔ **Pilot lines** for nanoparticle synthesis and ink formulation

- ➔ **Functional** nanomaterials
- ➔ **Conductive** and **electrochemical** inks
- ➔ Case study: **Printed thin film batteries**

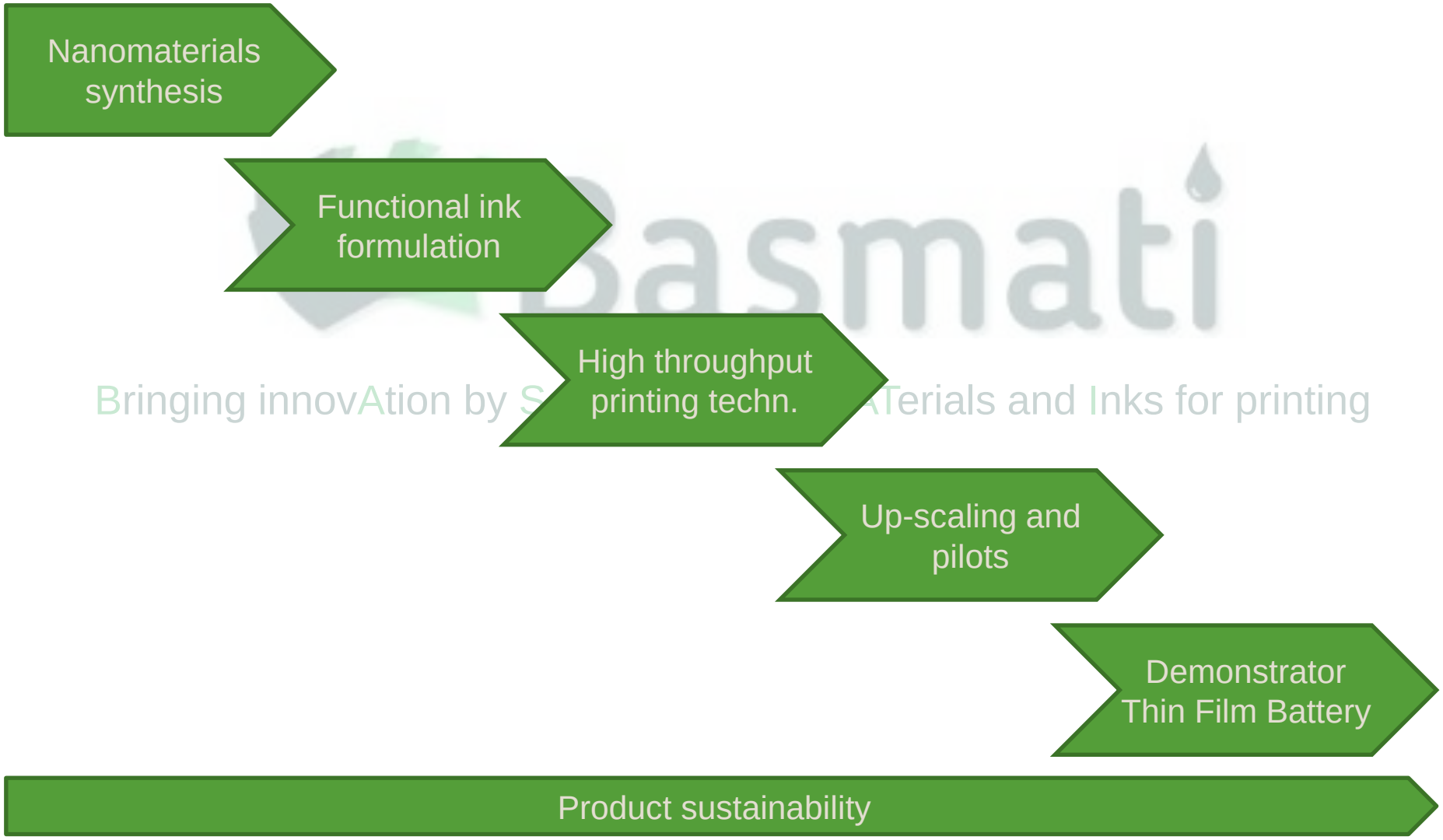
- ➔ **Nanosafety** is integrated in the different project steps

Objectives

- Development of **large volume production** processes for:
  - Conductive inks based on metallic nanoparticles (Cu, ~~Al~~, Ni)
  - Electrochemical inks (based on $LiFePO_4$ [LFP] and $LiNiMnCoO_2$ [NMC])
- Pilot production to offer **full compatibility** with low-cost, high-throughput processes
- **Pilot lines** will be realized by the project (~150-350 kg ink per batch)

- Special attention for **nano-safety guidelines** at every step of the process.
- Moreover, during ink formulation, the use of **water instead of organic solvents** will be investigated so as to meet REACH requirements.

Entire value chain



Entire value chain

Nanomaterials synthesis

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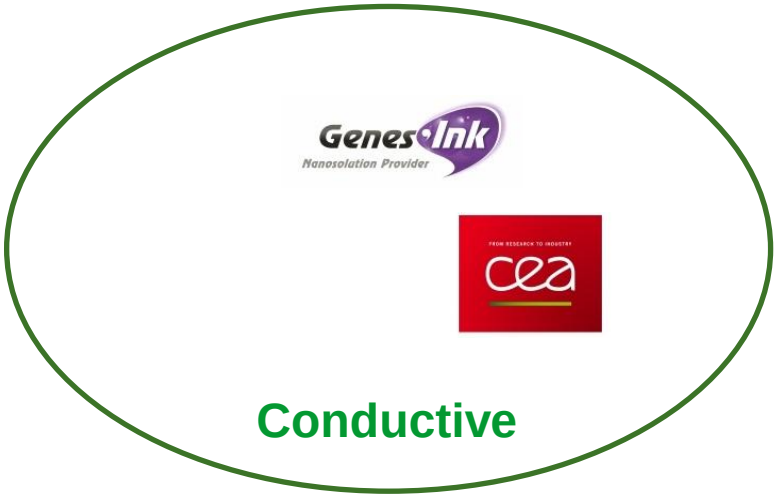

Entire value chain

Functional ink formulation

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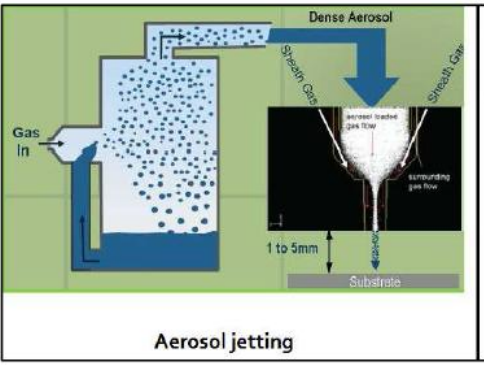
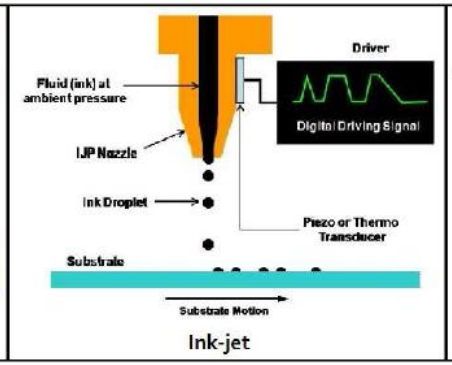
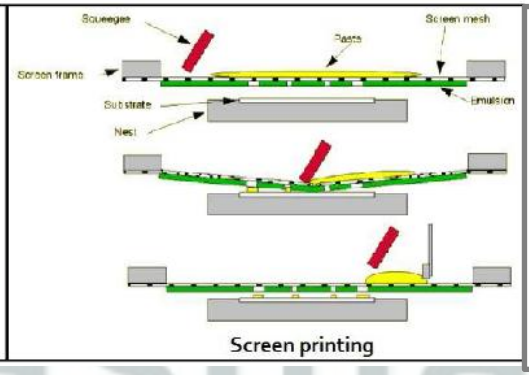
Entire value chain



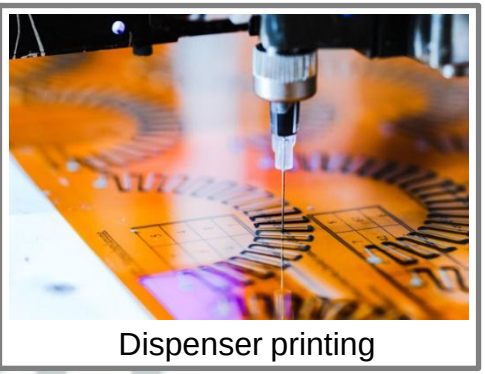
Aerosol jetting



Ink-jet



Screen printing


Dispenser printing

High throughput printing technologies

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microdrop TECHNOLOGIES

LEITAT Technological Center

GWENT GROUP

cea

LTFN

Entire value chain

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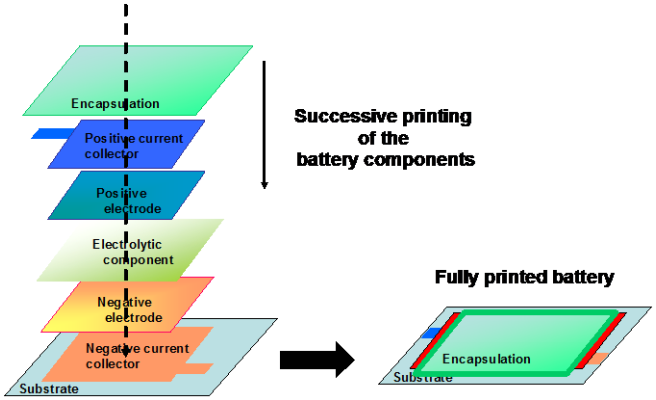
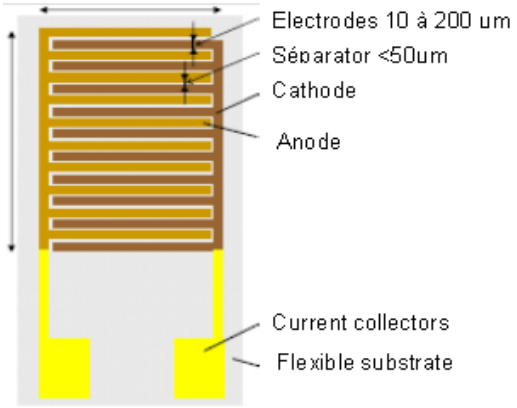
Entire value chain



Stacked batteries



Interdigitated batteries

cea

LEITAT Technological Center

VARTA THE BATTERY EXPERTS

Demonstrator
Thin Film Battery

Entire value chain

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Product sustainability

Most important bottlenecks

- Nanoparticle control
  - size, size distribution, shape
- Ink control
  - rheology (liquid), crystallinity and morphology (dried), stability
- Process compatibility
  - ink deposition technology, drying process, interaction with substrate
- Nano-safety
- Technology upscaling

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WORK PLAN

Generic approach

→ Development of functional inks with nanoparticles of existing materials

- Directed by the requirements concerning functional product properties *and* printing behaviour.

- In each development phase, focus on:
  - required functional product properties **AND**
  - printing behaviour of the ink.

  → Avoid sub-optimization and non-solutions

Work packages