



# LIFE BITMAPS

Pilot technology for aerobic Biodegradation of spent TMAH Photoresist solution in Semiconductor industries

NEWSLETTER No. 1

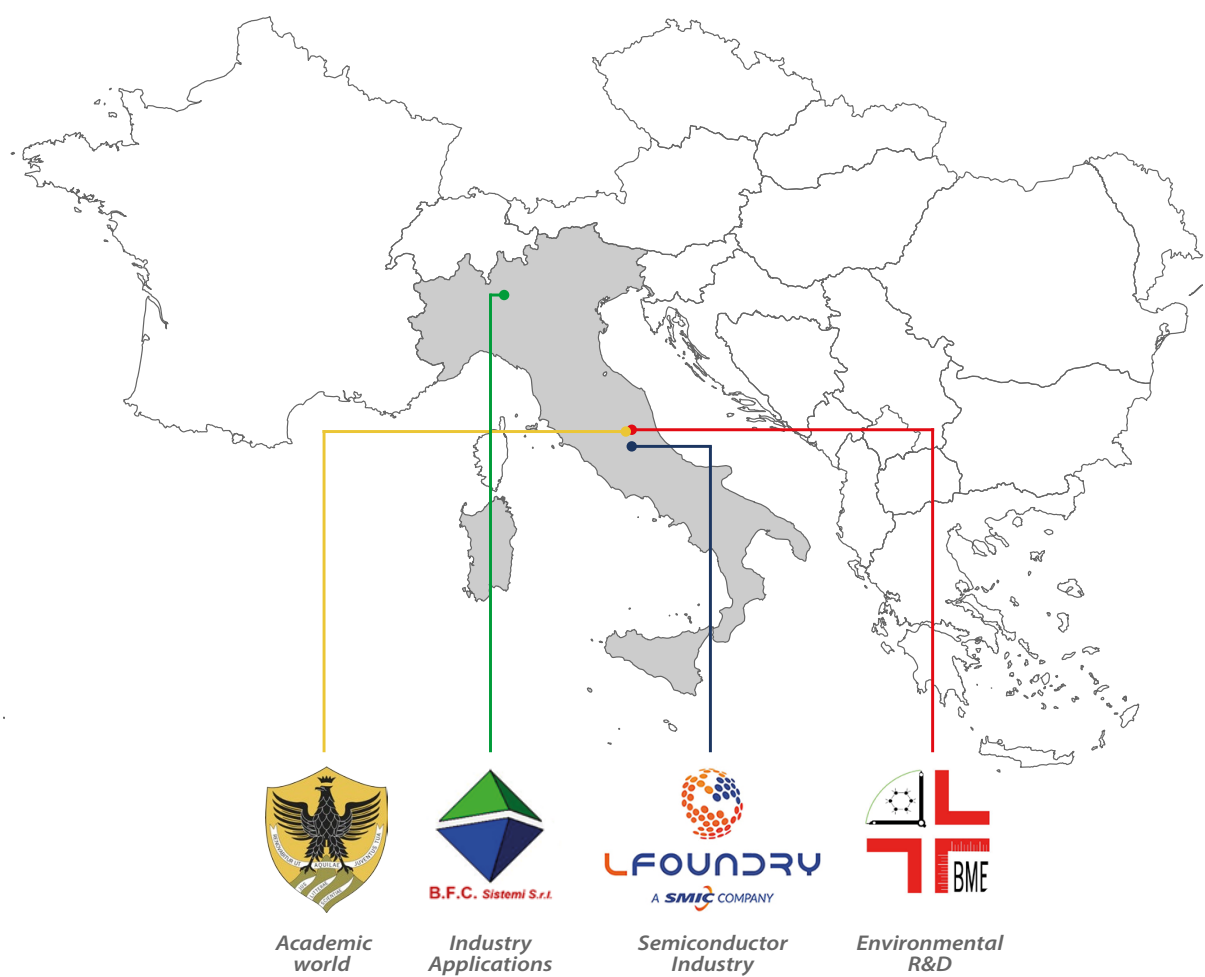
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# The BITMAPS Consortium

The Life Bitmaps consortium combines a variegate expertise from the academic world via technologic environmental development through the semiconductor application sector. Made up of four entities operating in the industry (semiconductor and mechanical engineering), private and public sector met each other for the common focus on waste-water treatment solutions.

All the partners originate from Italy.

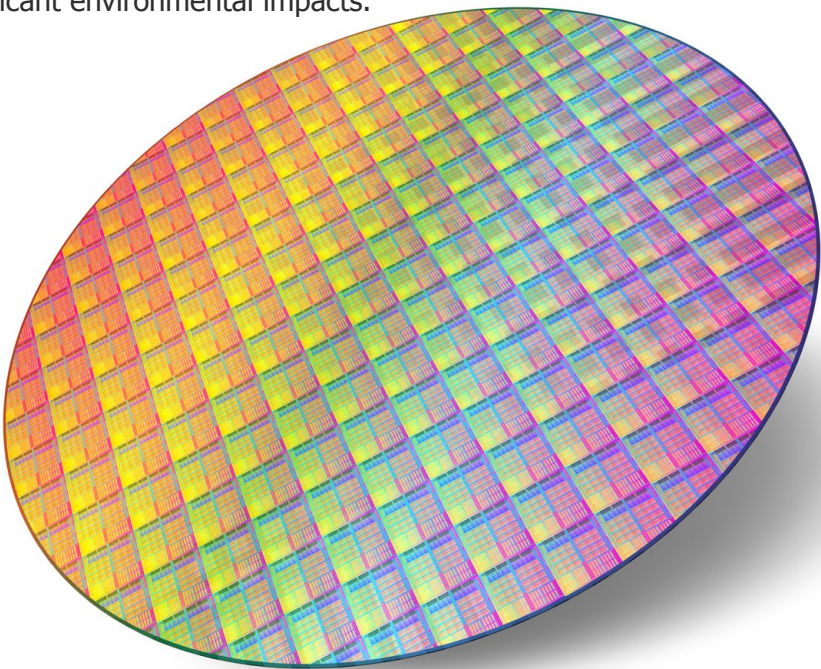


# The Project

BITMAPS is a project financed by the EU Commission under the LIFE's 2015 call on ENVIRONMENT AND RESOURCE EFFICIENCY sub-programme. BITMAPS promotes water resource management according to the European Union's Water Framework Directive (WFD) which states that its "ultimate aim is to achieve the elimination of priority hazardous substances and contribute to achieving concentrations in the environment near background values for naturally occurring substances". Some of these substances, are synthetic organic chemicals that come from industrial activities like TMAH (Tetramethylammonium Hydroxide) used by semiconductor manufacturers as a developer and an etchant. Due to their toxic properties, the industrial streams containing TMAH and PR have to be treated in order to protect the water ecosystem. Current approaches to treatment of wastewater containing TMAH entail high costs for companies and significant environmental impacts.

The LIFE BITMAPS project aims to build and operate a pilot plant that will demonstrate a new and never-before attempted process for the treatment of effluents from electronics and semiconductor manufacturing.

The project will contribute to the implementation of the WFD by introducing more efficient treatment technologies that will help reduce TMAH pollution at source. By recycling wastewater, it will also demonstrate the application in practice of the circular economy priority of water reuse and savings in industrial processes. Moreover, in proposing a more efficient, effective and innovative solution for industrial wastewater treatment, the project will also contribute to one of the priority areas of the European Innovation Partnership on Water.





#### BITMAPS high level ambitions:

- Contribute to reach the ultimate aim of the European Water Framework Directive (2000/60/EG) that is "to achieve the elimination of priority hazardous substances and achieving concentrations in the environment near background values for naturally occurring substances".
- Prove that the proposed process could replace the state-of-the-art technologies for the TMAH removal as they are less effective and consume great amounts of reagents.
- Help filling the gaps in the regulatory scenario by providing tangible results to local and EU policy makers to introduce shared regulations on TMAH emissions.
- Increase the awareness among the European E&S industry about the problem influencing industrial investments in safer and eco-innovative technologies.
- Demonstrate, at industrial scale, the biodegradation of TMAH to non-toxic biomass plus NH<sub>3</sub> by using some specific savage microorganisms selected during the previous R&D phase.
- Prove the cost sustainability of the process, in a LCC perspective, also taking into account the actual annual operating costs for the PR/TMAH concentrated disposal.
- Set up a more efficient water management approach proving that it is possible to reduce the net water consumption by saving water of the currently used ionic exchange process, and evaluate the total reuse of treated wastewater in the company's industrial plant.
- Promote the project through dedicated dissemination and networking means and activities.
- Pave the way for replication and transfer of the results to E&S Sector.

#### Plan & Objectives

The Project path and the associated objectives is drawn here below:

- Design, construction and validation of a semi-industrial pilot plant enabling the treatment of spent photoresist/tetramethylammonium hydroxide (PR/TMAH), and other mixed solutions generated by the E&S (Electronic & Semiconductor) manufacturing processes.

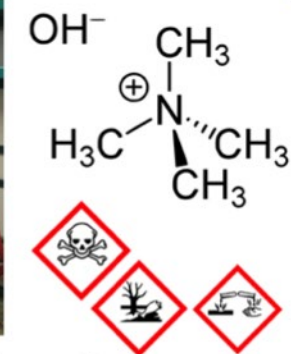
## Results & Environmental indicators

Obtained results:

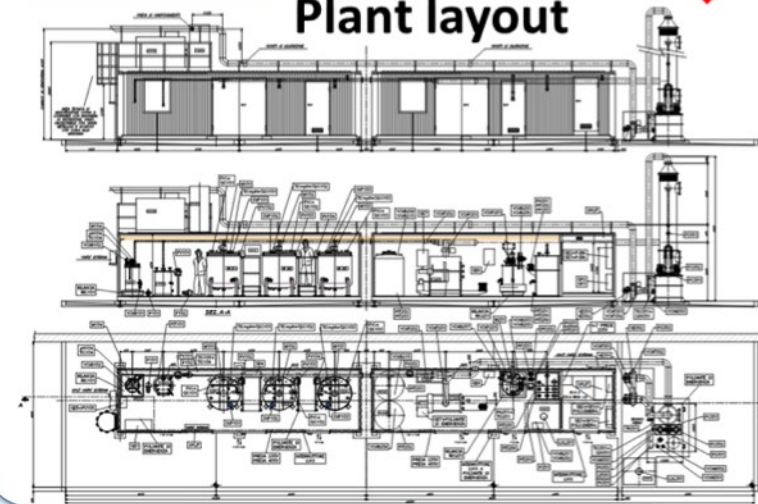
- 1 Refer to Objectives 2-3 of Environmental Indicator Table
- From lab-scale apparatus to pilot scale plant

### Biological degradation tests Aerobic conditions Liquid waste containing TMAH

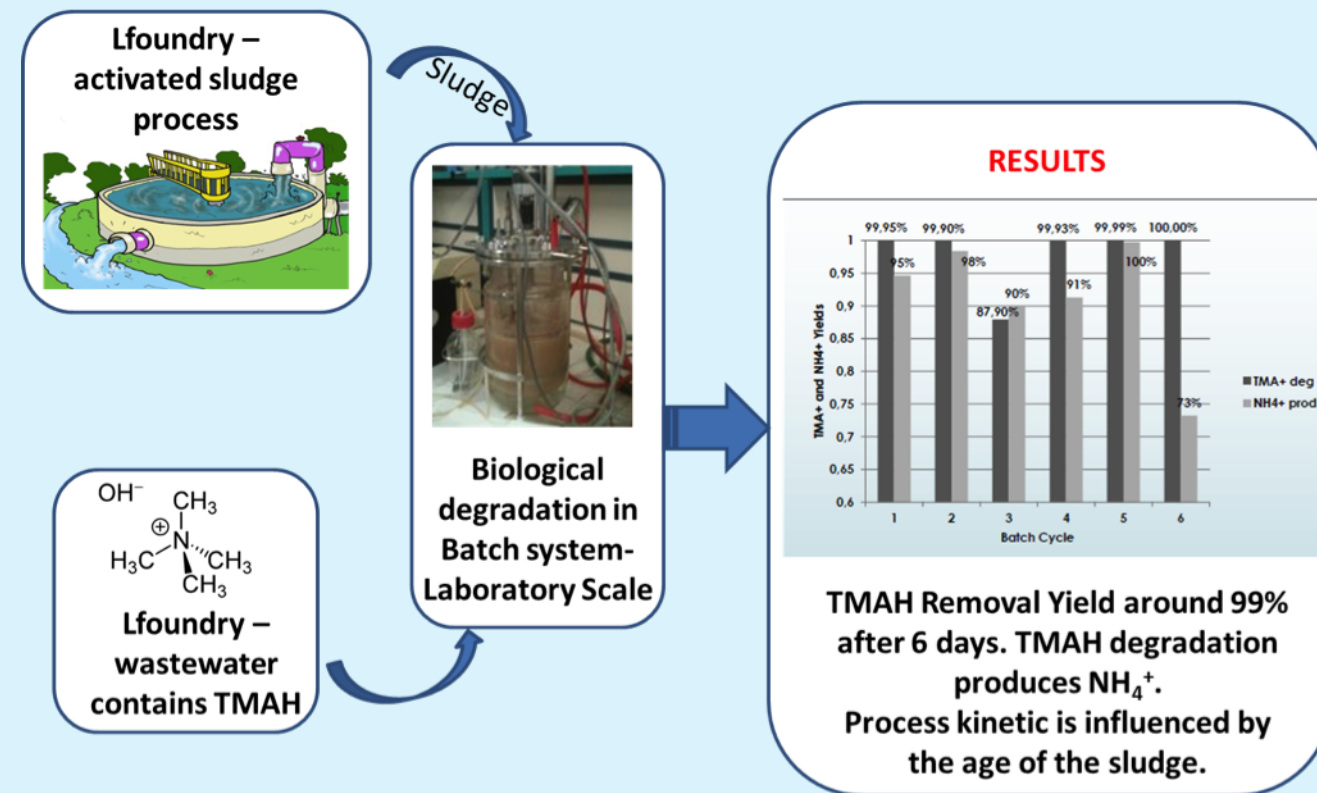
**TMAH is a quaternary ammonium salt, very toxic**



### Plant layout



- From laboratory experimental tests the TMAH removal yields are about 99%



## Environmental indicators according to LIFE Program

LIFE KPI								
Objective	Indicators	Estimated Impact (absolute values) At the beginning of the project	Estimated Impact (absolute values) At the end of the project	Estimated Impact (absolute values) 3 Years after the end of project	Unit	Brief explanations of assumptions used for the calculation	Objective	Indicators
2. Water (Including the Marine Environmental)	2.3 Pressure or Risk addressed	2.3.5 Resource efficiency - water	2.3.5.2 Water abstraction/diversion	1.49	1.35	1.35	Mm3/year	Recycle and reuse of a part of main wastewater stream coming from the Wafer Fab focusing on water with low polluting content
3. Waste	3.1 Waste Management		Liquid Waste CER 11.01.12	1,336	1,295	25	ton/year	Reduction of Liquid Waste to disposal (TMAH, NH4+, SEZ) as output of a full scale plant using the technology of the project pilot plant for wastewater treatment
			Liquid Waste CER 11.01.11*	766	756	0	ton/year	
5. Environmentals and health (Including chemicals and noise)	5.1 Chemicals	5.1 Chemicals Released		107.9	6.2	6.2	kg/year	TMAH concentration reduction at the final discharge, is the first goal of LIFE Bitmaps project; The target is to reduce the TMAH concentration at final discharge point from 7 mg/l to 0.4 mg/l

# Kick-Off Workshop Event

The LIFE BITMAPS kick off workshop event named "Sinergie tra Ricerca ed Industria" was held in L'Aquila on may 31th 2017 organized by UNIVAQ.

Speakers from the sector were invited to contribute to the round table, representing national and EU industry associations of the E&S sector. Governance bodies (Ministry of Environment, Ministry of Economic Development) and local authorities (e.g. Regional Counsellor for the Environment) were invited to participate. Total number of participants was around 70 people.

During the roundtable the participants were asked to give contributions and feedbacks on how the industrial wastewater systems and policies could be improved through the reception of Best Available Technologies.



Picture 1 - Speakers at the BITMAPS kick-off workshop event



# BITMAPS News

*April 2018*

Plant assembly and installation is on-going and will be completed in April 2018 at the LFoundry site in Avezzano. Experimentation phase will start immediately in order to pursue the project's objectives.



Picture 2 - Process reactors (R101, R102, R103)



Picture 3-4 - Containers for the Pilot Plant »



# Upcoming Water Events in Europe

## EIGHTH WORLD CONGRESS AND EXPO ON RECYCLING

June 25-26, 2018 Berlin, Germany.  
<http://recyclingexpoconference.blogspot.it/>

## SCIENTIFIC CONFERENCE ON MEMBRANES AND MEMBRANE PROCESSES IN ENVIRONMENTAL PROTECTION, MEMPEP 2018

June 13-16, 2018, Poland  
<http://mempep2018.systemcoffee.pl/index2.html>

## IDA INTERNATIONAL CONFERENCE ON WATER REUSE AND RECYCLING: MAKING EVERY DROP COUNT

June 24-27 2018, Valencia, Spain  
<http://idadesal.org/water-reuse-conference-2018/>

## EWAS3 INTERNATIONAL CONFERENCE (2018)

June 27-30, 2018, Lefkada Island, Greece  
<http://ewas3.civ.uth.gr/>



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## NANOTECH FRANCE 2018

June 27-29, 2018, Paris, France - International Conference and Exhibition  
<http://www.setcor.org/conferences/Nano-tech-France-2018>

## EUROMEMBRANE 2018

July 9-13, 2018, Valencia, Spain  
<http://euromembrane2018.org/>

## DESALINATION FOR THE ENVIRONMENT: CLEAN WATER AND ENERGY

September 3-6, 2018, Divani Caravel Hotel, Athens, Greece  
<http://idadesal.org/events/desalination-for-the-environment-clean-water-energy/>

## INTERNATIONAL CONFERENCE: WATER SCIENCE FOR IMPACT

October 16-18, 2018, Wageningen, The Netherlands  
<https://www.wageningenwaterconference.com/>

## ECOMONDO - GREEN AND CIRCULAR ECONOMY

November 6-9, 2018, Rimini (Italy)  
<https://www.ecomondo.com/>

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