

LABORATORY OF CELLULAR BIOENERGETICS

Directed by David PIGNOL

A part of the Life Sciences Division of the CEA

Molecular mechanisms of bacterial adaptation to environmental conditions

Models



Photosynthetic bacteria



Magnetotactic bacteria



Radiotolerant bacteria

Constraints → Responses

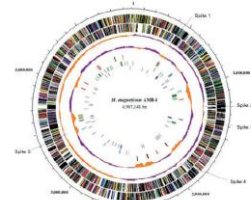
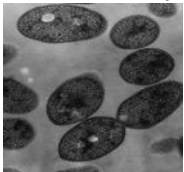


Light, oxygen, magnetic field, UV, radiations

- Photosynthetic apparatus
- Magnetotactic apparatus
- DNA repair machinery
- **Metallic stress responses**

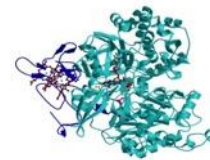
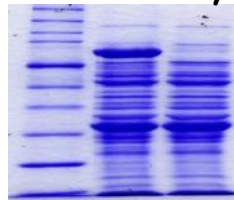
From the gene to the function

Microbiology/
biodiversity



Genomic/genetics

Biochemistry



Crystallography

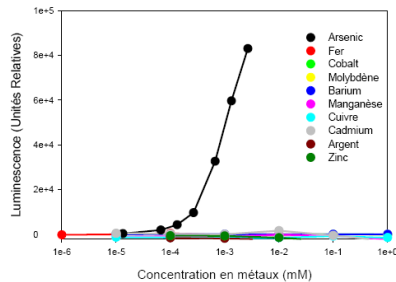
Biophysics



Biotechnology

Biotechnology

Biodetection



FINANCÉ PAR
ANR

COMBITOX

**In line multiplex prototype
for the biodetection of toxic
compounds**

Bioremediation

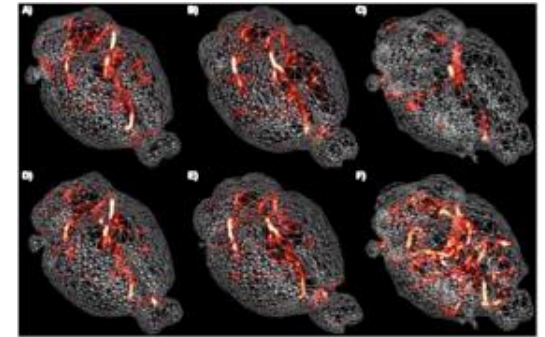


LIFE-PHYTOBARRE

LIFE12 ENV/FR/000530

**An innovative process
phytosanitary waste
treatment plant
and implementation of
new uses for farmers**

Health technology



FINANCÉ PAR
ANR

MEFISTO

**Targeted biological
nano-magnets for
theranostic**

COMBITOX

Objective: development of an autonomous prototype for the continuous monitoring of waters using biosensors



Bioavailable fraction



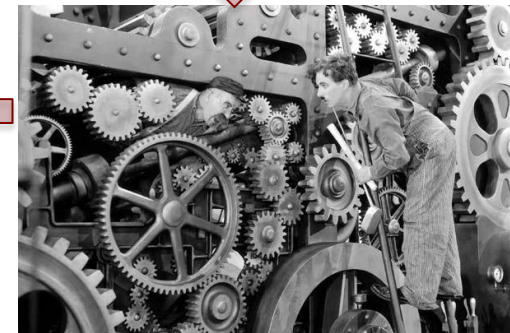
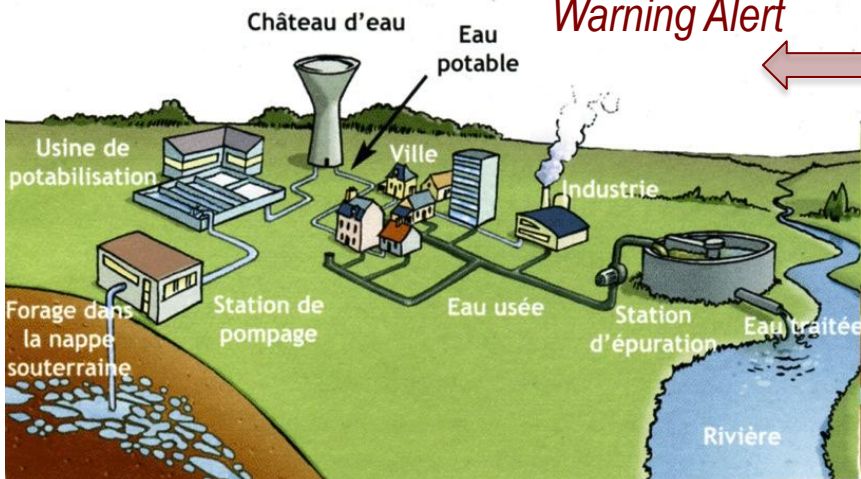
*Heavy Metals (Hg, As, Cd, Co, Ni)
Toxines (microcystine, ochratoxine)
Pathogenic bacteria (coliforms)*



Different types of biosensors developed in academic laboratories



Warning Alert



A prototype adapted to different biosensors, autonomous, reliable, easy to use ... Cheap?

The challenge: a multiparametric system on-line



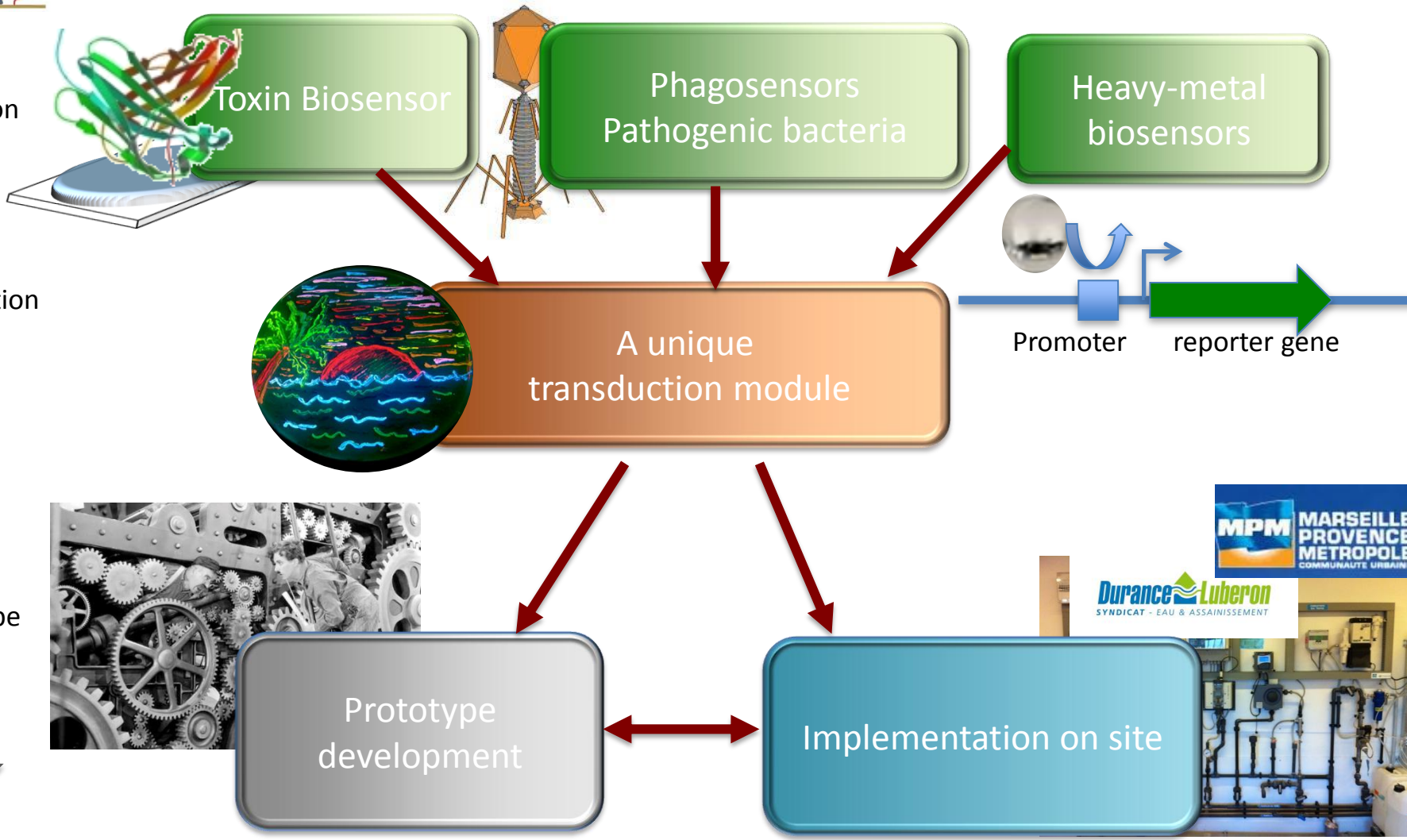
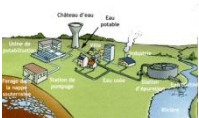
LABO

Detection

Transduction

Prototype

FIELD



LIST OF OUR AVAILABLE METALS BIOSENSORS

Metal	Biosensor	Sensitivity	Specificity
Ni	<i>RcnR</i>	5μM	+++
Co	<i>RcnR*</i>	<1μM	+++
As	<i>ArsR</i>	<1μM	+++
Cd	<i>CadR</i>	5μM	+++
Hg	<i>MerR</i>	10 nM	+++
Zn	<i>Czc1</i>	40 μM	+++
Cu	<i>czcR3</i>	5 μM	+++
Survive	<i>rpoD</i>	Constitutive luminescence	



LIFE-PHYTOBARRE



LIFE-PHYTOBARRE

An innovative process phytosanitary
waste treatment plant
and implementation of
new uses for farmers

LIFE+ 12 ENV/FR/000530

10/2014 – 03/2017



Europe's agricultural sector is linked with the pollution of surface waters, groundwaters and seas by nutrients and pesticide residues. Decreasing the dispersal of these pollutants is a priority for environmental programs and regulations in France (i.e. ECOPHYTO 2018) and Europe (the Water Framework Directive and Directive 2008/105/EC on environmental quality standards in the field of water policy).

Pollution of water mainly occurs through
 (i) passive diffusion as a result of spreading products on crops,



and (ii) active pollution caused by washing machinery and tractors - most of the time at the same location.



Principle of the project

A biological process able to metabolise phytopharmaceutical molecules, based on the use of selected photosynthetic bacteria in lagooning system.

The process has been implemented over a five-year period on a test site and findings indicate a degradation efficiency of more than 90% of the phytopharmaceutical residues.

Aims

- Production of a technological solution that it is easy to use and maintain
 - Development of a solution that efficiently reduces pollution risks from farms working with different crops and phytosanitary products, as well as in various geographic locations and climates.
 - Different communication tools including videos will be used to highlight the technology's opportunities and benefits for farmers to improve waste management systems.
- 3 components**
- Biotechnology
 - Sociology
 - Communication



Biotechnological component

Four demonstrators were inoculated with selected photosynthetic bacteria
The degradation of pesticides is measured by regular analysis



Sociological component

Users information; sociological survey

Interest of farmers for the process

Number of visitors to the demonstrator sites

- Number of people at the public meetings

Monitoring of social impacts on local agricultural community

Mapping the evolution of uses (diffusion of innovation)

Statements of sociological indicators of the innovation integration

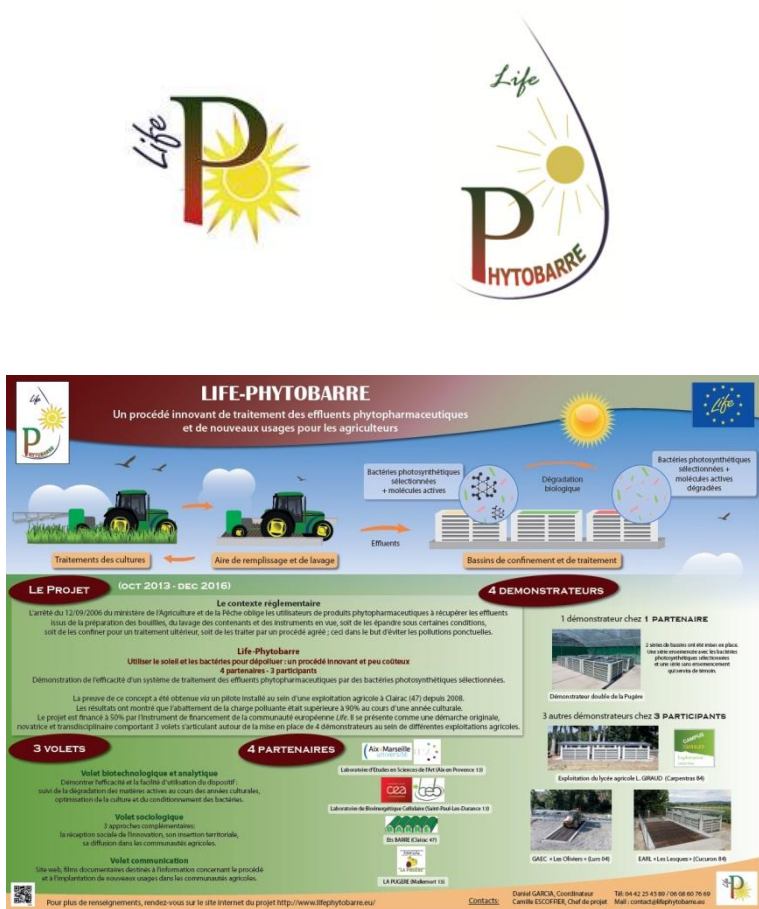
Changes and evolution of social representations
towards the agricultural community

Evolution of the speeches about the community during project progress

Interviews



Website: <http://www.lifephytobarre.eu/>



3 documentary films will be produced during the three years of the project. Two films will address the sociological aspect, before and after installation of the demonstrators. The third film will discuss the use of phytopharmaceutical products, from the last century to today

Information panel

Expected results

The project aims to achieve the following results:

- To demonstrate the new technology effectiveness;
- To change farmers' behaviour through a series of awareness-raising events and activities. These will target agricultural communities, local authorities, agricultural colleges, schools, and universities, as well as farmers directly;
- To help European farmers to safely treat 360-800 tonnes of phytosanitary products on an annual basis.

COMBITOX

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LIFE-PHYTOBARRE

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