



The project has received funding from the LIFE Programme of the European Union under GA number LIFE19 ENV/GR/000100



InnoVative photocatalytIc paintS for healthy enviroNment and eNErgy Saving «VISIONS»

PROJECT LOCATION: Greece

BUDGET INFO

Total amount: 1,403,752

% EC Co-funding: 757,763

DURATION: Start: 07/09/20 - End: 06/09/23



Project Coordinator:

**Dr. Thomas Maggos, Research Director
Head of Atmospheric Chemistry & Innovative Technologies Lab/NCSR "Demokritos"**



The project has received funding from the LIFE Programme of the European Union under GA number LIFE19 ENV/GR/000100



PROJECT'S IMPLEMENTORS:

Coordinating Beneficiary:

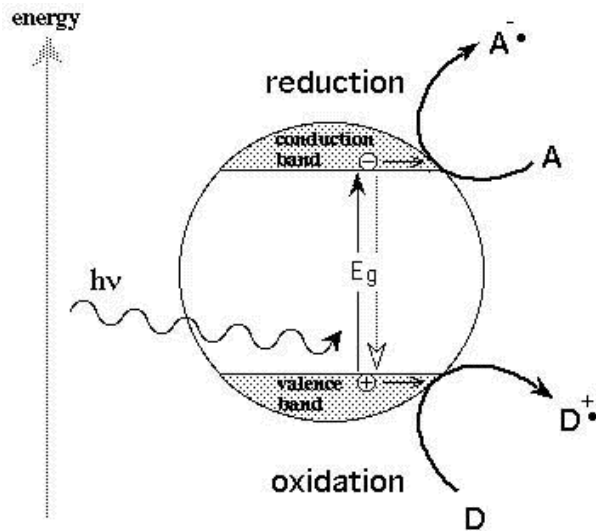
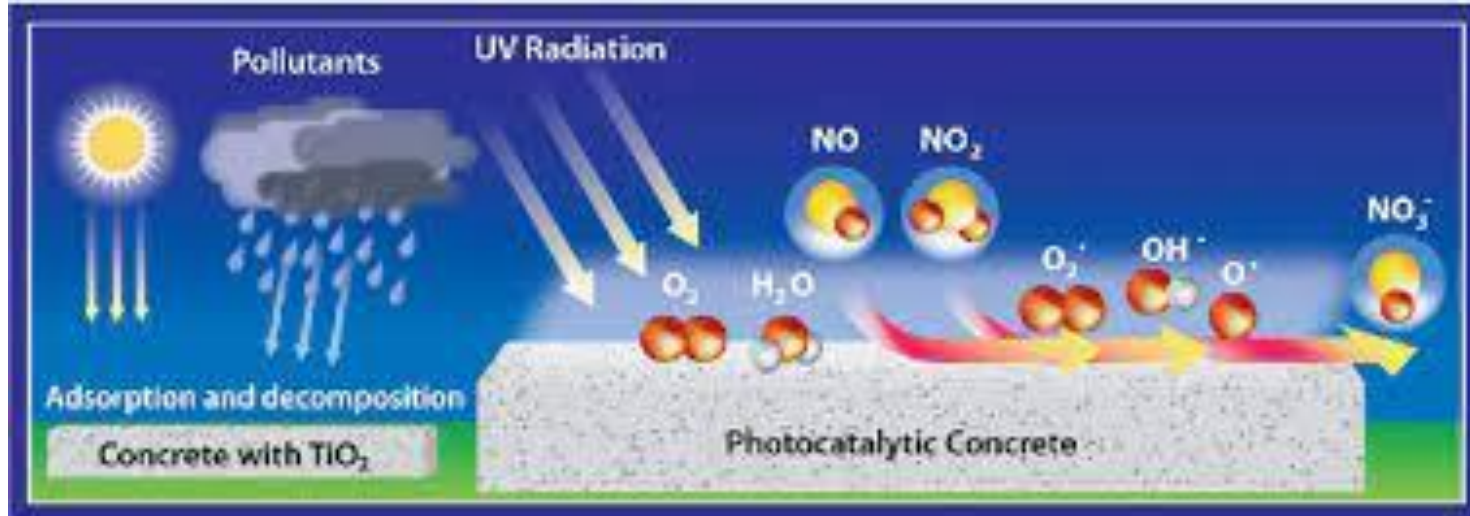


National Center for Scientific Research "Demokritos"

Associated Beneficiaries:

- *Aristotelio Panepistimio Thessalonikis*
- *Foundation for Research and Technology - Hellas*
- *MICHOPOULOS I. & CH. G.P.*
- *VITEX*





- Με την επίδραση ακτινοβολίας σχηματισμός στην επιφάνεια του καταλύτη ζεύγους θετικών οπών και ελεύθερων e⁻
- Συμμετοχή αυτών σε αντιδράσεις με μόρια δότες και δέκτες e⁻ αντίστοιχα
- Σχηματισμός ισχυρών οξειδωτικών όπως ανιονικών ριζών οξυγόνου (·O₂⁻) και ριζών υδροξυλίων (OH[•]) τα οποία έχουν την δυνατότητα οξείδωσης οργανικών και ανόργανων ενώσεων.



ΠΕΔΙΑ ΕΦΑΡΜΟΓΗΣ ΦΩΤΟΚΑΤΑΛΥΤΙΚΗΣ ΔΡΑΣΗΣ ΤΙΟ₂

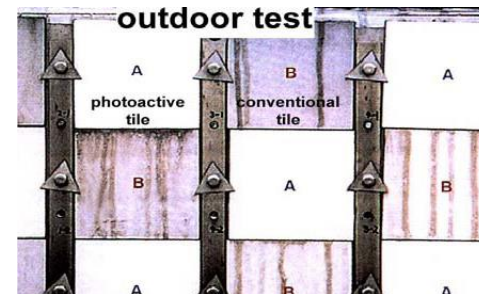
Αντιθρομβωτική Δράση



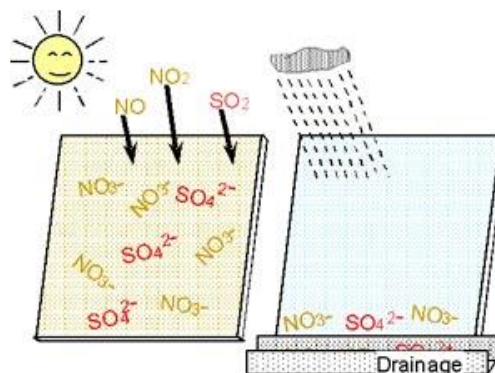
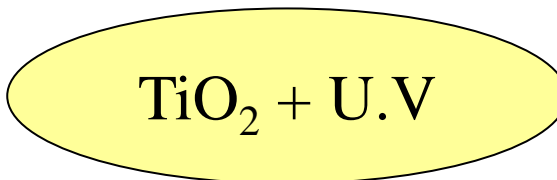
Αντιβακτηριδιακή Δράση



Αυτοκαθαρισμός Υλικού



Επεξεργασία Υδάτων



Αντιμετώπιση Αέριας Ρύπανσης





OBJECTIVES & SCOPE

The main scope of the project is the production of an innovative photocatalytic paint, which aims at improving the quality of the indoor environment while it will enable significant energy savings in buildings

The project main objectives are:

- **Optimization and Upscaling of the novel photocatalytic powder**
- **Semi-industrial production of innovative photocatalytic paints** (VISIONS Photo-Paints)
- **Real scale application** of the VISIONS Photo-Paints in a set of existing **Demo-Houses** and in **public building (HNA)**.

Key actions to achieve VISIONS objectives

Action 1-FORTH (Sep.20-Feb.21)

Optimization and upscaling of synthesis root of the novel photocatalytic powder



Action 2-VITEX (Feb.21-Aug.21)

Semi-Industrial production of Photo-Paints by mixing the optimized powder with 3 different kinds of paints



Action 3-NCSR (Sep.20-Dec.22)

Application of the 3 types of Photo-Paints in:

1. Demo-Houses
2. Hellenic Naval Academies buildings



Action 6-NCSR (Sep.22-Aug.23)

Establishment of a spin-off company



Action 5- EVOLUTION (Aug.21-Dec.22)

Development of a Decision Support System (DSS)



Action 4-AUTH (Sep.20-Dec.22)

- Computational Fluid Dynamics (CFD)
- Life Cycle Assessment (LCA)
- Cost Efficiency Analysis (CEA) & Cost Benefit Analysis (CBA)



Implementation Actions (Actions B)

Action B1. Optimization and Upscaling of synthesis route of the novel photocatalytic powder (FORTH)

Subaction. B1.1 Optimization and Upscaling (FORTH)

Optimization: Completed

FORTH prepared 30 optimized powders. Among them the 4 most promising powders in terms of air pollutants degradation were further evaluated for their physicochemical properties and photocatalytic efficiency and 1 (V20) was selected for the VISIONS photopaint production



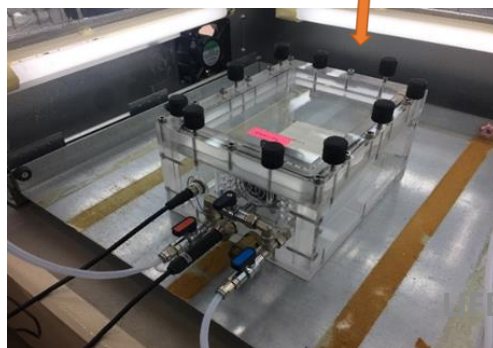
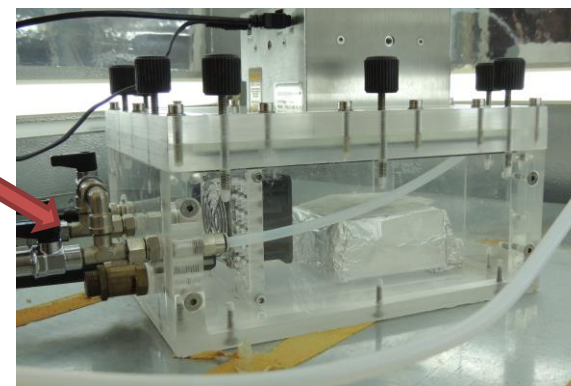
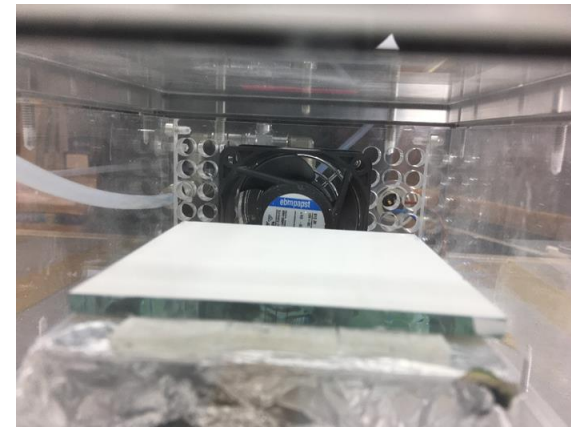


The project has received funding from the LIFE Programme of the European Union under GA number LIFE19 ENV/GR/000100



Lab - scale tests

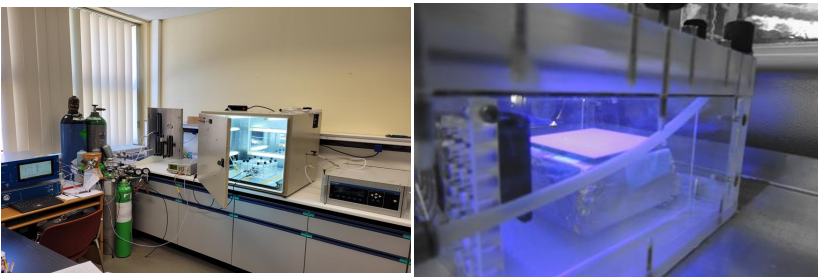
Detailed information on the efficiency of the optimized powders and paints to photocatalytically degrade air pollutants such as Nitrogen Oxide (NO) & Volatile Organic Compounds e.g toluene (VOCs) in the gaseous phase are provided





Action B.2 Semi-Industrial production of Photo-Paints (VITEX) (Lab tests)

More than 20 paint formulation were tested in NCSRDL labs



and finally VITEX produced:

- **Organic Paint (tested in DEMO houses)**
- **Inorganic Paint (tested in DEMO houses)**
- **Hybrid Paint – Production failed due to stability issues**

Action B.3 Real Scale Applications (NCSR-D)

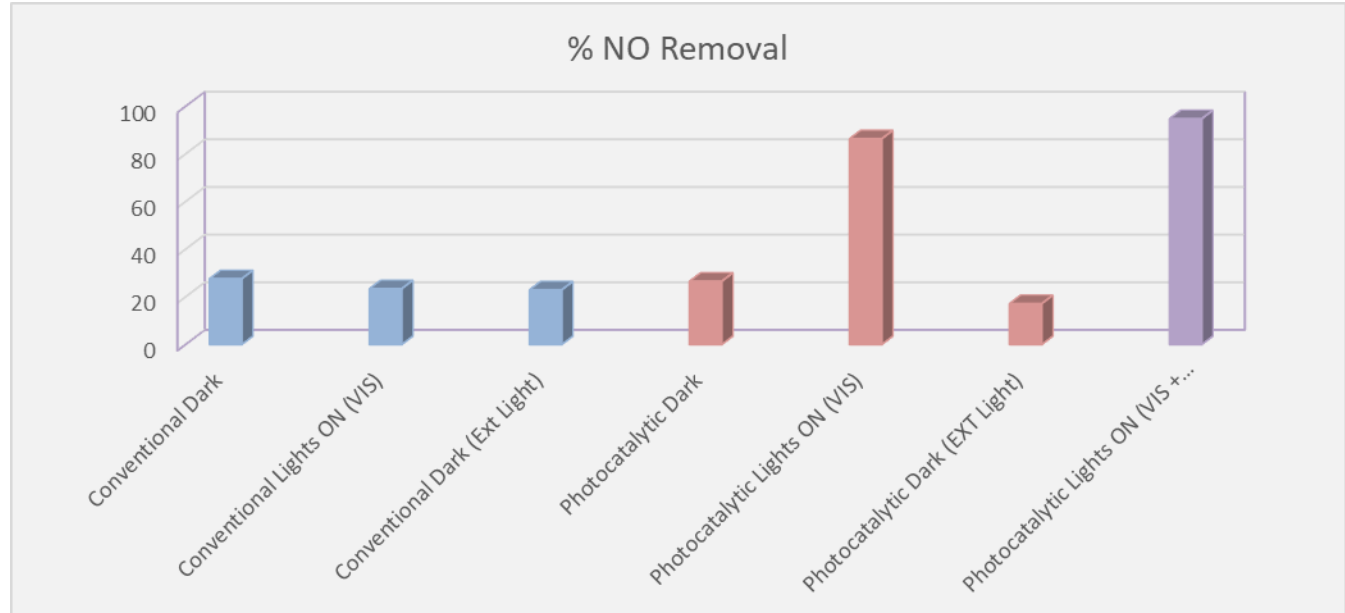
Subaction B3.1 Application of Photo-Paints in Demo-Houses prototype demonstrator (FORTH)





Results

V=30 m³, A=40 m²



| | % NO Removal | r _{NO} | Vd |
|--|--|-----------------|--------------|
| NO Removal Conventional | 24.6 | 0.034 | 0.005 |
| NO PhotoRemoval (VIS) | 61.7 (36.8 Inorganic) | 0.072 | 0.021 |
| NO PhotoRemoval (VIS+Ext Light) | 70.1 | 0.094 | 0.025 |

$$PPD (\%) = (C_{in} - C_{fin} / C_{in}) \times 100$$

$$r_{NO} (\mu\text{g}/\text{m}^2\text{s}) = (C_{in} - C_{fin}) \times V / A \times t$$

$$Vd = r_{NO} / C_{in NO}$$



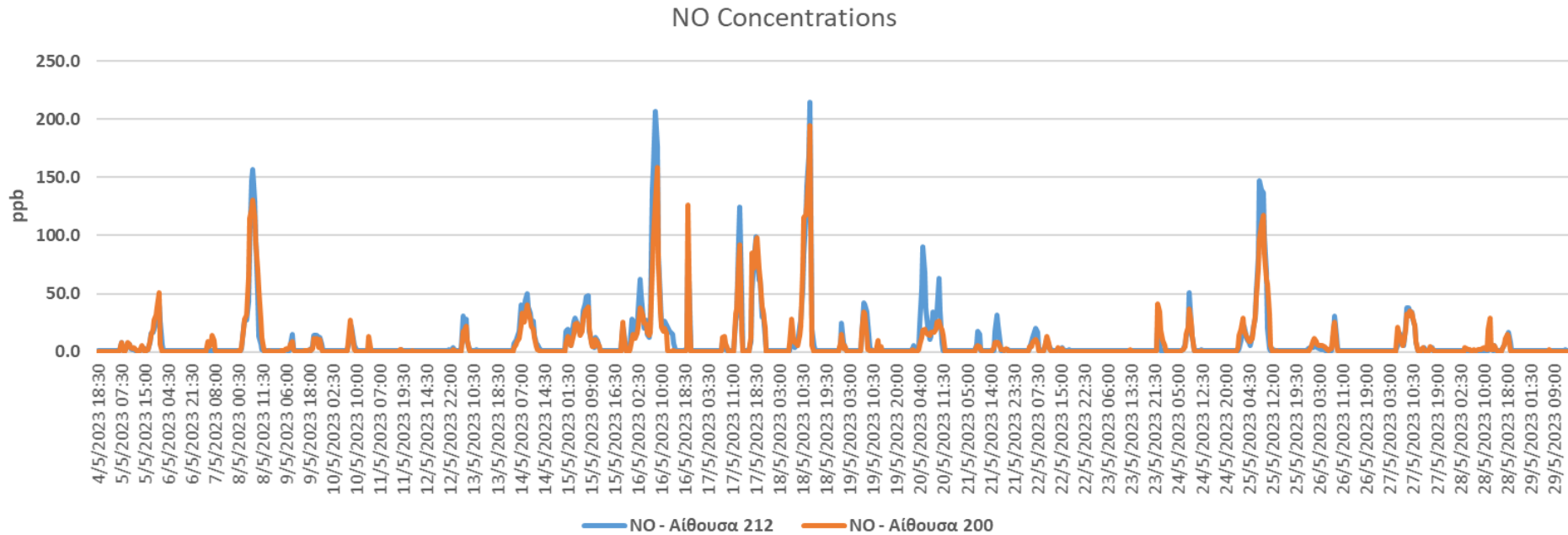
The project has received funding from the LIFE Programme of the European Union under GA number LIFE19 ENV/GR/000100

Subaction B3.2 Application of the most promising Photo-Paint in real life conditions. The case of Hellenic Naval Academy (HNA) Buildings





Indicative Preliminary Results



| Date: 4-24/5/2023 | Average | SDTV | Max |
|-------------------|---------|------|-----|
| NO - Room 212 | 9.60 | 23.5 | 215 |
| NO - Room 200 | 7.51 | 20.2 | 190 |

21.8% reduction of NO



The project has received funding from the LIFE Programme of the European Union under GA number LIFE19 ENV/GR/000100



Instruction and Password Page

WELCOME TO LIFE VISIONS
Decision Support System

When it comes to deciding which materials to use, we have the answers

Type Of Premises
 Determine the use type of the premises in your test case. You do not have to be completely accurate. Certain categories can relate to the preferred given in the form. Choose one of your test covers standards.

Mechanical Ventilation Usage
 Mechanical ventilation systems circulate fresh air using ducts and fans, rather than relying on airflow through small holes or cracks in a home's walls, roof, or windows.

Daily Usage
 Certain habits can determine the outcome, as some of them, are drastically changing factors for Air Quality and substances in the atmosphere. Two of them are included in the form: Gas Usage, and Indoor Smoking.

Determine Your Usage
 In order to continue, you have to share your daily indoor routine of certain categories such as using a gas stove, smoking, having mechanical ventilation, etc.

[Click here to Begin](#)

Find Your State's Zone

In the map on the right, you can find the Zone indication for each state of Greece. The zone where the test case is, is obligatory for a result to be issued.

- Kilgymell: Zómi A
- Kilgymell: Zómi B
- Kilgymell: Zómi F
- Kilgymell: Zómi G

[Click here to Begin](#)

This content is password protected. To view it please enter your password below:

Password:



Form Page and Results

Complete The Form

| | |
|---------------------------------------|---------------------------------------|
| Mechanical Ventilation usage: | State's Zone: |
| <input type="text" value="Yes"/> | <input type="text" value="A"/> |
| Type of Premises: | Smoking indoors: |
| <input type="text" value="Offices"/> | <input type="text" value="Yes"/> |
| Gas Usage: | City's Zone: |
| <input type="text" value="No"/> | <input type="text" value="Suburban"/> |
| Construction Year: | Square Meters: |
| <input type="text" value="2005"/> | <input type="text" value="350"/> |
| <input type="button" value="SUBMIT"/> | |



Expected Impacts

The expected impacts are divided in 4 main sectors:

1. **Environment**: Significant **improvement of IAQ** could be achieved by the degradation of air pollutants (NO_x, VOCs). A **degradation of up to 40% for NO_x and 15% of VOCs** from the application of the **VISIONS Photo-Paint** under **real world conditions** is expected.
2. **Energy**: Ventilation and HVAC systems are the major energy consumers in buildings. As a result of the expected improvement of the indoor air quality and the thermal comfort of the users, **both the needed amount of time for operating artificial ventilation and the required ventilation rate** will be reduced. It is foreseen that for a 1000 m² building area a reduction of 10% in energy demand could be feasible.

In this way, VISIONS forms a cost-efficient technological solution to further enforce the environmental and socio-economic impacts of the energy consumption of the building sector

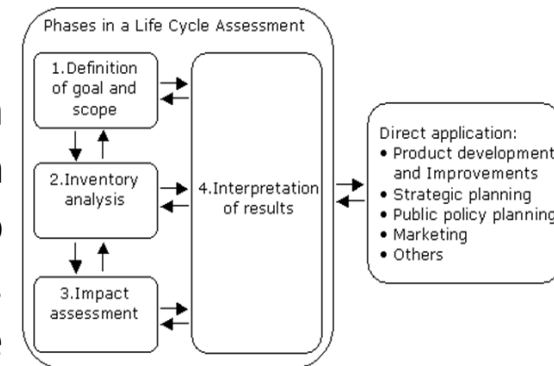
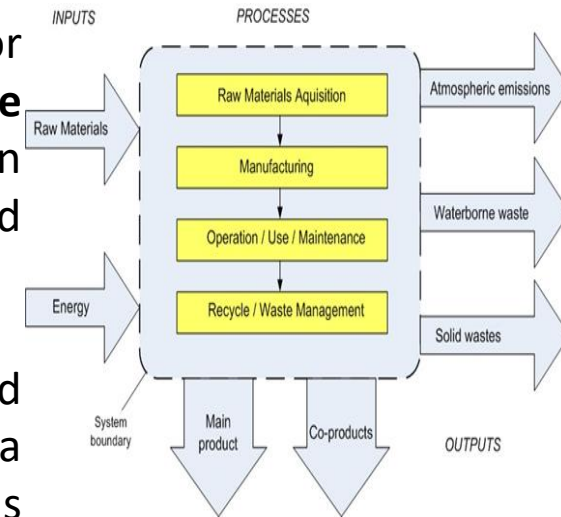


Expected Impacts

3. Innovation: Optimization & application of powders for industrial building coatings capable for air de-pollution **by visible light without producing any harmful by-products**, comprises an innovation and originality at a European level. Both optimized powder and Photo-Paint **could be patented**.

4. Economy: **Demonstration of the effectiveness** of the said application will set the platform for a wider application to a number of indoor environments (homes, schools, hospitals) thus contributing on a decisive manner on IAQ with both environmental and health benefits.

The replication of the present results to other producers in European countries is expected to **create an added value chain of environmental and commercial benefits** as it is expected to penetrate 40% into the ecological interior paint market. Quantification of the economic impact of VISIONS will be achieved through the CEA, CBA and LCA.

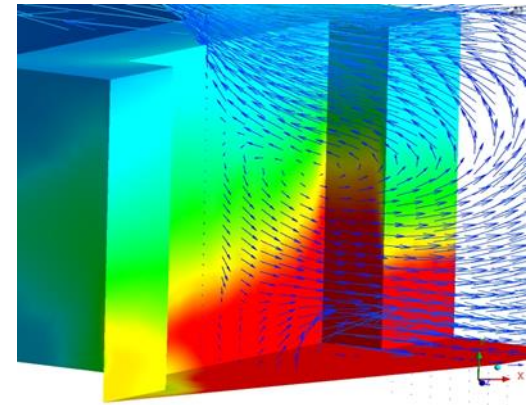




The comparative advantage of VISIONS outcome is not only the innovative product (VISIONS photo-paint) but also the full set of IT tools that accompanies it.

To that end the proposed actions give a clear and **integrated answer** to the real needs of the market in terms of:

- **the innovative photo-paint**
- **recommendations** (how to use these materials and techniques),
- **design tools**
- **simulations** of possible **air pollution and energy consumption** abatement under real conditions.





The project has received funding from the LIFE Programme of the European Union under GA number LIFE19 ENV/GR/000100



<http://lifevisions.gr/>

LIFE VISIONS Facebook page

The project Facebook page is available as [LifeVisions](https://www.facebook.com/LifeVisions). (@LifeVisionsGR)

LIFE VISIONS Twitter account

The project Twitter account is available as [LifeVisionsGR](https://twitter.com/LifeVisionsGR), (@gr_visions)

VISIONS - LIFE19 ENV/GR/000100

Καινοτόμα Φωτοκαταλυτικά Χρώματα για Υγιές Περιβάλλον και Εξοικονόμηση Ενέργειας / Innovative photocatalytic paints for healthy environment and energy saving

Βελτιστοποίηση περιβαλλοντικής εξοικονόμησης ενέργειας

Κύριο αντικείμενο του έργου είναι η παραγωγή μιας καινοτόμου φωτοκαταλυτικής βαφής, η οποία στοχεύει στη βελτίωση της ποιότητας του εσωτερικού περιβάλλοντος, ενώ θα επιτρέψει σημαντική εξοικονόμηση ενέργειας στα κτίρια.

Προϋπολογισμός: 1.403.752€ (Ποσοστό συγχρηματοδότησης 54%)

Διάρκεια υλοποίησης: 07/09/2020 - 06/09/2023

Εταίροι του έργου:
Συντονιστής: Εθνικό Κέντρο Έρευνας Φυσικών Επιστημών «ΔΗΜΟΚΡΙΤΟΣ» Ίδρυμα Τεχνολογίας και Έρευνας (ITE)
Αρτοποιητικό Πανεπιστήμιο Θεσσαλονίκης
VITEX A.E.
EVOLUTION PROJECTS PLUS

www.lifevisions.gr | @LifeVisionsGR | @gr_visions

Email: tmaggos@ipta.demokritos.gr (LIFEVISIONS Coordinator)