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Materials R&D Center

UMONS innovation Center

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> 80 scientific experts

> 120 with subsidiaries NANO4 & IONICS

UMONS Innovation center

> 140 scientific partners

25 projects/year

250 customers
19 patents
...

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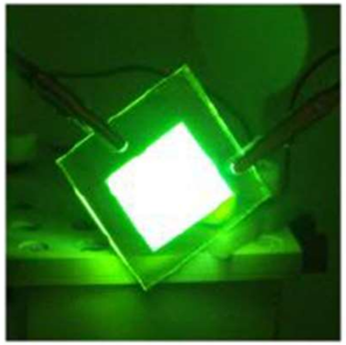
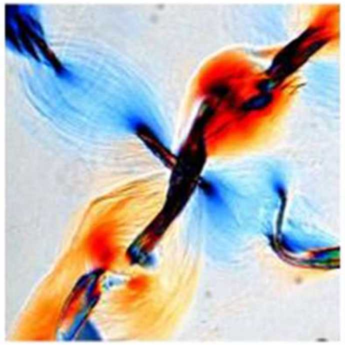
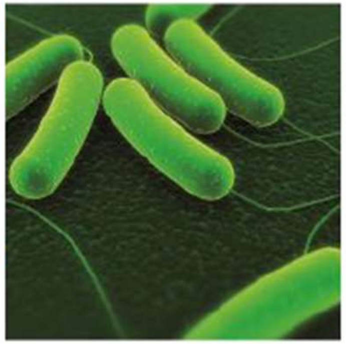


Advanced Materials for Energy Applications



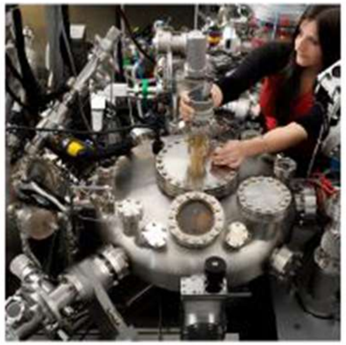
Innovative and Sustainable Polymeric Materials



Cells for Materials and Materials for Cells

Multifunctional Surfaces

Life Cycle Thinking



Characterization Platform

R&D RESEARCH AXES

- White biotechnology, (bio)polymers & (bio)composites
- Sol-Gel & Wet coatings, Metallization
- Plasma technologies
- Electrochemistry, Corrosion
- Organic electronics, Chemical sensors
- Life cycle thinking

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Interreg project WBDurapaint

Renewable resources
Polyols from vegetal oils

Waterborne & bio - based
Polyurethanes and Epoxy for Coatings

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Background of the project

VOC reduction
1999/13/CE
VOC content restrictions
2004/42/CE
Chemicals prohibition and restrictions
REACH

Current environmental concerns

Need of decrease in use of petrochemicals

→ **Arrival of waterborne & biobased paints on the market**

Previous project *Revorgreen* showed several current limitations:

- Low biobased part (20-30 %)
- Waterborne coatings do not match the specifications of solventborne or powder coatings
- Biobased resins involve modifying and adapting formulations to match the level of performances
- Biobased or not, current polyurethane coatings are still made from toxic compounds (isocyanates)
- Emissions of VOC from waterborne coatings can be even more harmful because insidious

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Objectives of the project

- Developping new waterborne coating systems with high performances and low environmental impacts
  - → No toxic compounds
  - → Very low volatil organic compounds (VOC) emissions
  - → Enough performances to match the specifications of building and transportation fields
- Two ways of development : **epoxy**-based and **non-isocyanate polyurethane**-based coatings
  - → Various applications targeted (wood, metal, floor, indoor or outdoor)

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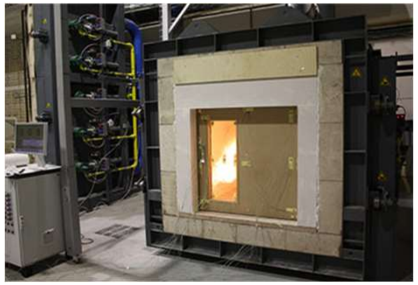
Consortium

Flamac has developped unique and versatile **high-throughput experimentation platforms** to screen new materials and chemical products highly efficiently.

These include **automated synthesis, formulation, application and characterisation platforms**, boosting new product development and shortening time-to-market considerably

CREPIM is one of the major European Laboratories for development and the approval of **materials covered by fire regulations.**

CREPIM **develops, tests and certifies the fire performances** of materials and assemblies for all concerned areas featuring the mass transportation sectors, in the building, electrical, and textile sectors.



Materials and Transformations Unit (UMET) brings the science of materials activities together from Université de Lille

Associate operators

IAR

VOM

Interreg France-Wallonie-Vlaanderen
WBDuraPaint
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Development of NIPU binder

Strategy

Biobased binder for corrosion preventive coatings

In aqueous phase

Lowering VOC emissions
Lowering solvents use

Challenge
Hydrophobic polyurethane must be dispersed into water

Non-isocyanate polyurethane

Avoiding toxic compounds from classic synthesis
~~Isocyanates (+ Phosgene)~~

Challenges
New paths must be explored
Further formulation must be adapted

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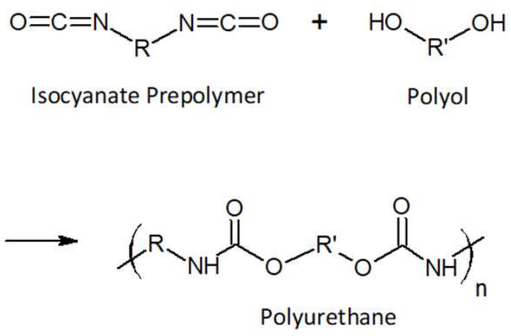
Development of NIPU binder

Chemistry of NIPU

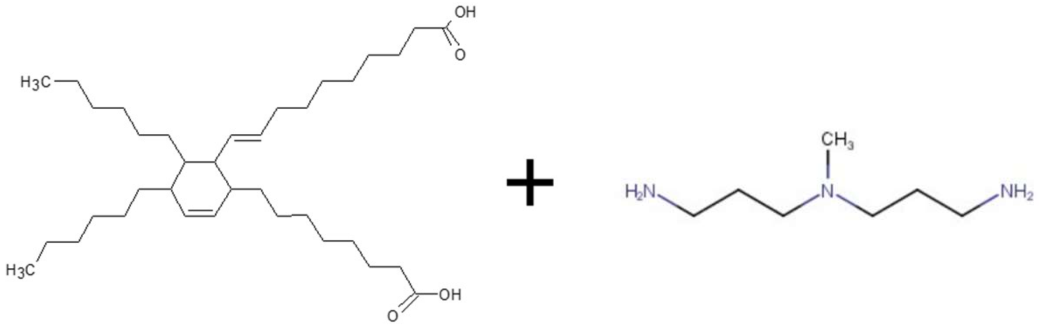
Classical way leading to PU

Diol + Diisocyanate



Way leading to NIPU

Step 1
Synthesis of prepolymer oligoamide



From vegetable oil

Input of biobased carbonated chain

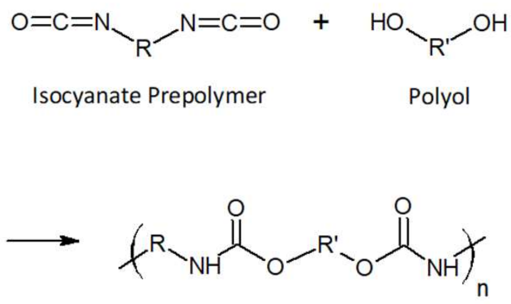
Diamine with tertiary amine

For further water dispersion

Development of NIPU binder
Chemistry of NIPU

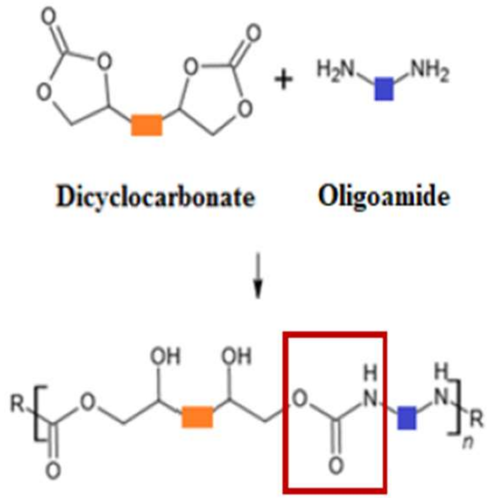
Classical way leading to PU

Diol + Diisocyanate



Way leading to NIPU

Step 2
Polyaddition



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Development of NIPU binder

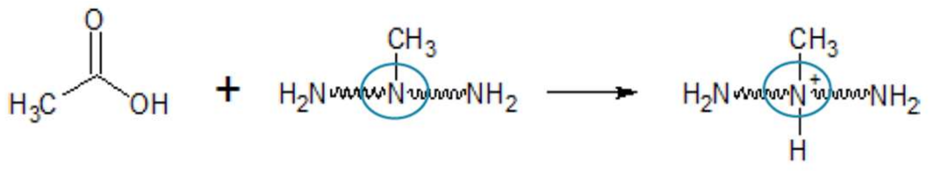
Dispersion in water

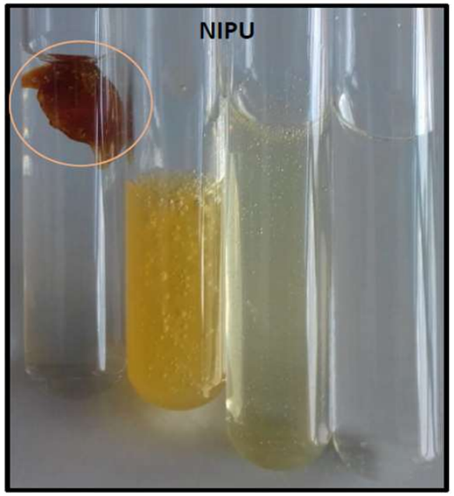
If a compound is not soluble in water, two ways to disperse it
External emulsifier
Internal emulsifier

Internal emulsifier = Hydrophilic chemical group
Bestowing dispersibilty properties on the hydrophobic compound

Goal → Developing NIPU's amphiphilic nature

Work focuses on **cationization** of tertiary amine





Anionization has been ruled out

Use (and future emissions) of Triethylamine

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Development of NIPU binder

Synthesis routes

Bulk polymerization

- Obtaining solid NIPU
- **No need of organic solvents**
- **Need to heat quite strongly to reduce viscosity (> 180 °C)**
- **Difficulties to cationize the NIPU for further dispersion**

Polymerization in solution – "Acetone process"

- Obtaining NIPU slightly solubilized in organic solvent
- Dispersion in water under high rate stirring followed by elimination of solvent and obtaining emulsion
- **Ease of dispersion**
- **Lower temperatures of work (~ 120 °C)**
- **Use of organic solvent, traces can be found in final product**

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Development of anticorrosive additives

Chemical modification of clays

Treatment of different types of clays with anticorrosive agents

Clays

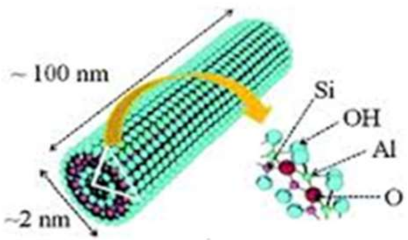
Hydrotalcites
Halloysites
Bentonites

Reinforcement of mechanical properties
High **barrier** properties

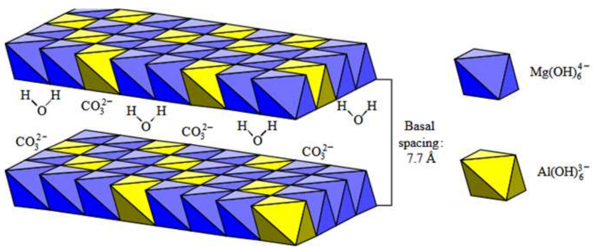
Anticorrosive agents

Benzotriazole
Cerium chloride
Sodium benzoate

Compounds aim for protection of both **aluminium** and **steel** substrates



Structure of halloysites



Structure of hydrotalcite

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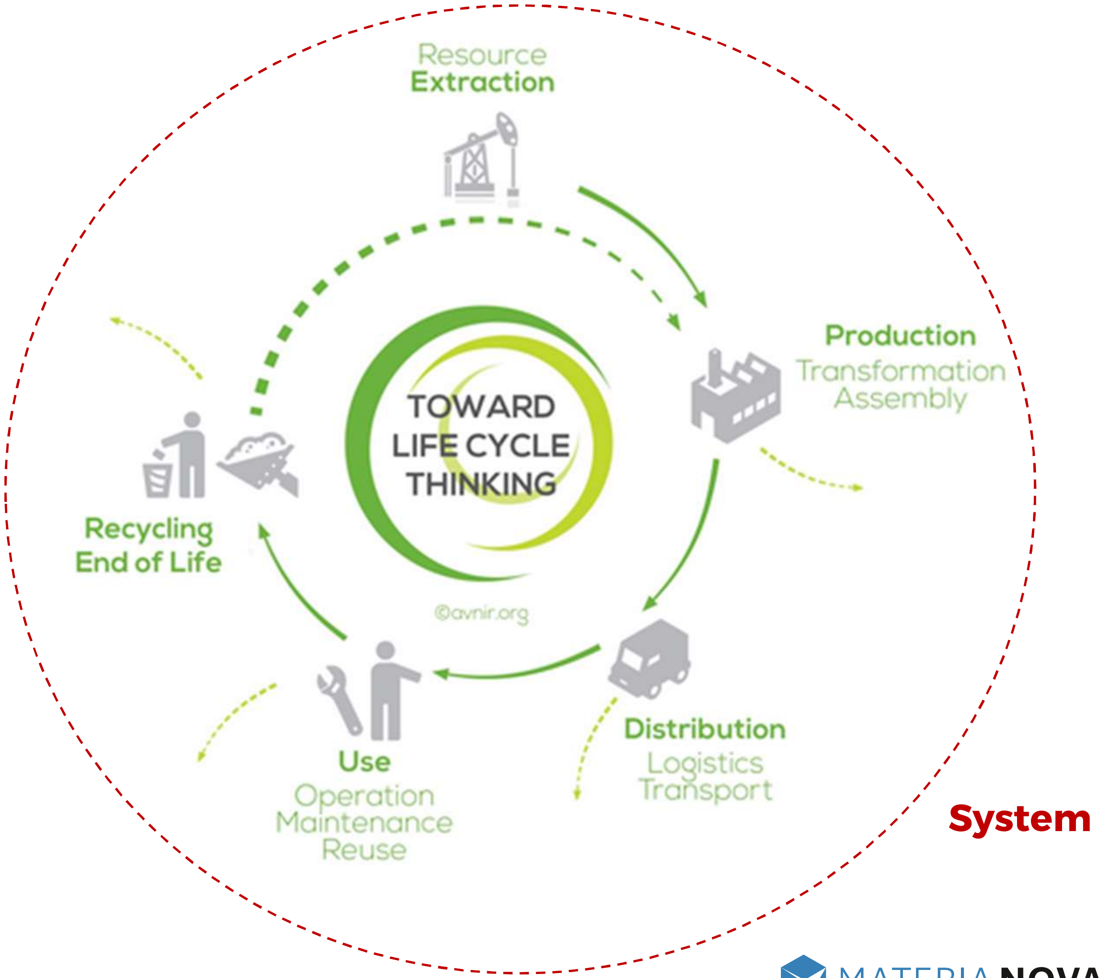
Ecodesign thanks to Life Cycle Assesment

LCA in short

Methodology for assessing the impacts of a product or a process on the environnement, considering its whole life cycle (from craddle to grave)



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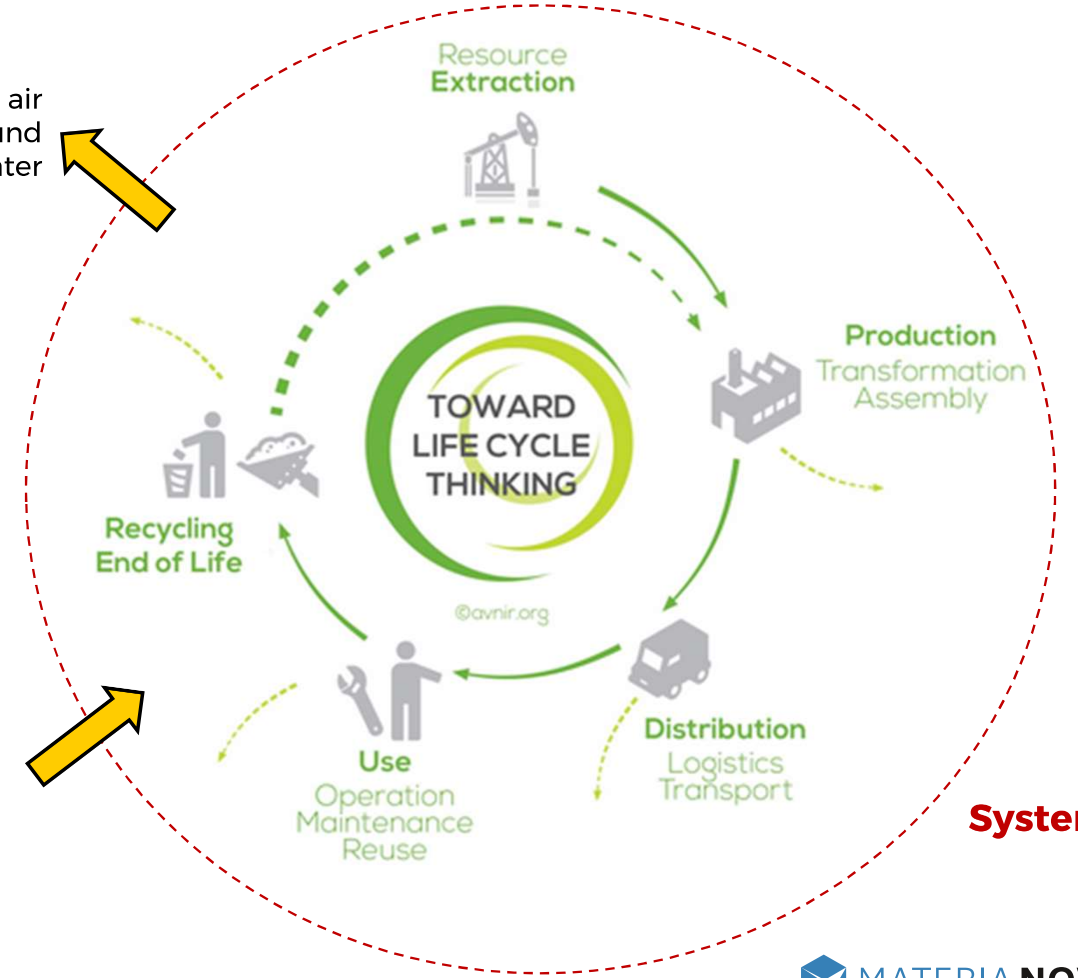
Ecodesign thanks to Life Cycle Assesment

LCA in short

Emissions to air
Emissions to ground
Emissions to water

Making inventory of **all** exchanges between the system and the ecosphere (environment)



Raw materials
Energy
Land use

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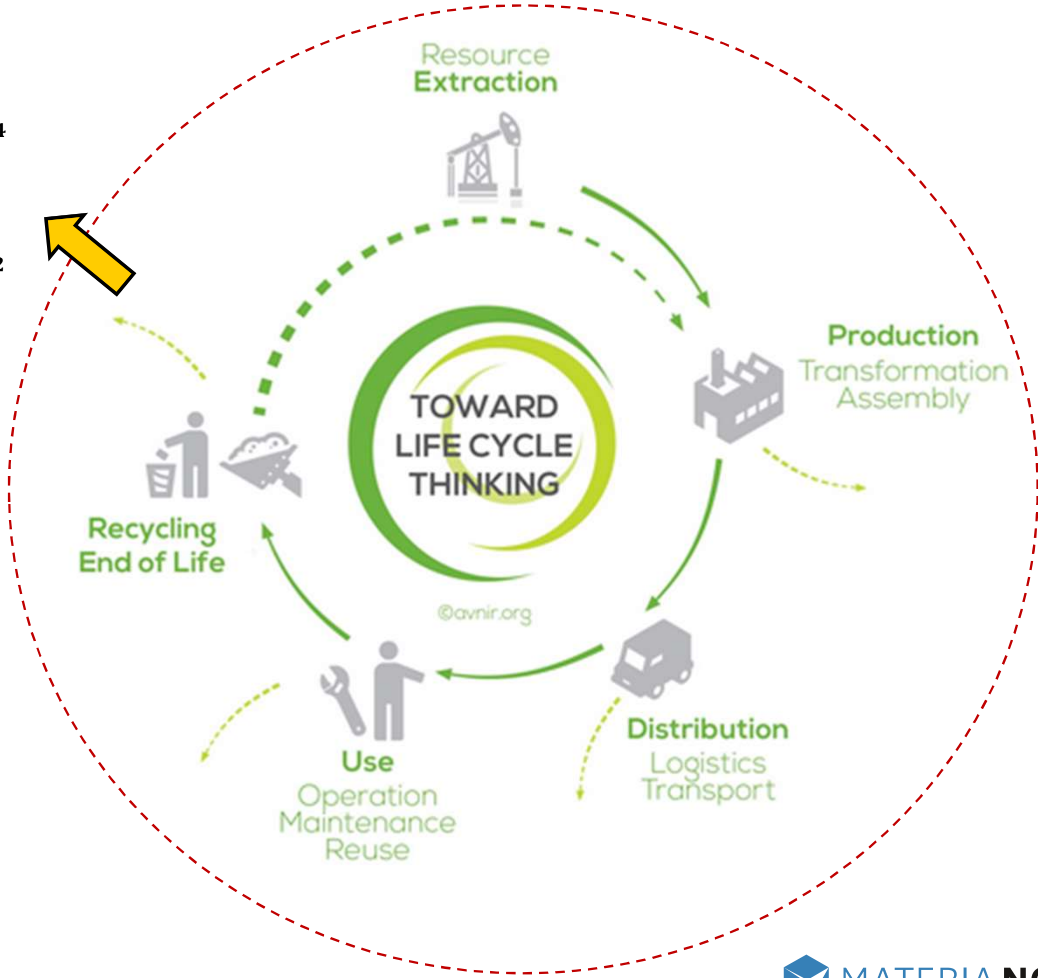
Ecodesign thanks to Life Cycle Assesment

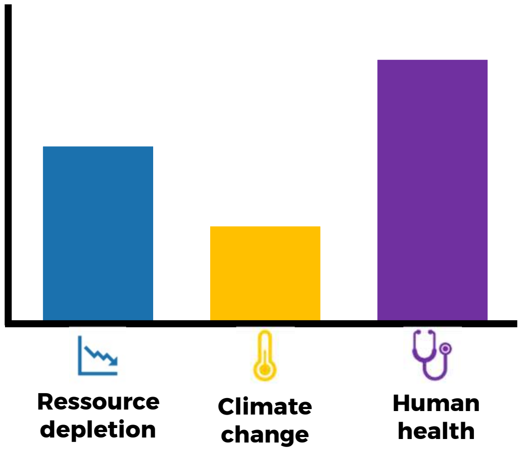
LCA in short

Climate change ⎤
Ozone depletion ⎦ — CH_4

Climate change — CO_2



Establishing links between those flows and **impacts indicators**



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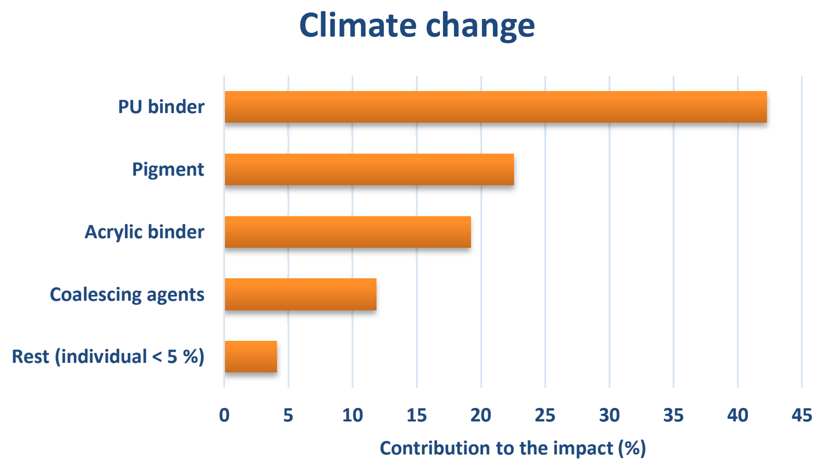
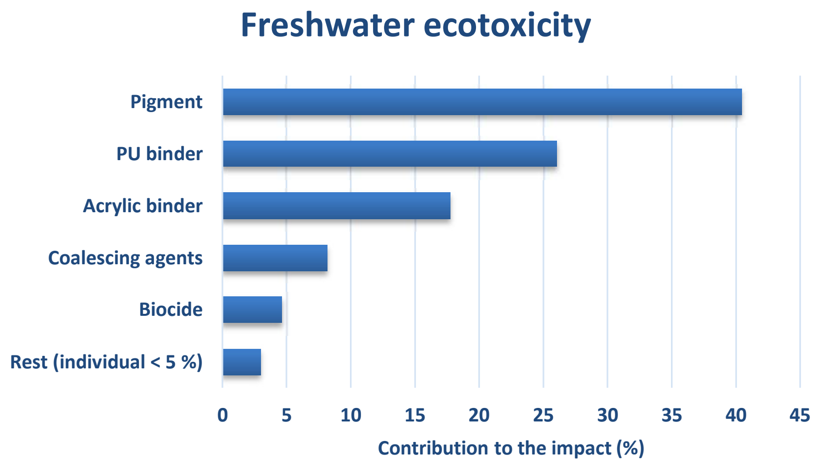
Ecodesign thanks to Life Cycle Assesment

Application example in coatings field

Identifying hotspots for raw materials

Exemple for 2 impact indicators for a PU commercial paint





→ Early LCA enables the choice of new compounds to be validated from an environmental point of view

→ LCA enables the comparison of differents products with the same function : concept of functionnal unit

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Future of the project

Commercial waterborne PU paint

WBDurapaint Modified paint

Development and incorporation of antifire additives

Partial substitution of the resin

Formulation adaptation (rheology…)

Incorporation of anticorrosive additives

Environmental validation

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Future of the project
Characterization platform

Accelerated aging

Electrochemistry characterization

Coating characterization

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Thank you for your attention
Any questions ?

Contacts
Loan TERRIEN – loan.terrien@materianova.be
Tangi SENECHAL – tangi.senechal@materianova.be

We thank again the INTERREG program for financial support