ECODISM Project

Goals and main outcomes

Jean-Louis Bravet

Coordinator

Saint-Gobain Sekurit

TRA Conference, April 24th, Ljubljana, Slovenia

Bonds that debond…
an ecoconception of cars for further environmental friendly dismantling

ecodism

A European Project supported within the Sixth Framework Programme for Research and Technological Development

ECODISM goals and main outcomes

Contents

- What is Ecodism ?
- Ecodism & ELV context
- Main achievements, and their impacts
- Conclusions

ECODISM goals and main outcomes

- Contents

➢ What is Ecodism ?

➢ Ecodism & ELV context

➢ Main achievements, and their impacts

➢ Conclusions

ECODISM goals and main outcomes

Definition and Objectives

"Ecological and Economical development of innovative strategy and process for clean maintenance and dismantling and further recycling of vehicle parts"

Objectives

The main objective is to provide to the automotive industry and to car dismantlers effective technologies and methodologies for cost-effective, environmental friendly dismounting adhesive joined parts or componants.

- Facilitate maintenance of glazing, plastics/composites, and aluminum parts.
- and dismantling of those part, leading to ASR Reduction

ECODISM goals and main outcomes

General Information

Project Acronym:	ECODISM
STREP Number:	516333
Coordinator:	Saint-Gobain Sekurit; Jean-Louis Bravet
Partners involved:	5 industrials 2 RTD Performers 3 SMEs 1 End-User company 1 Consulting company
Start Date of contract:	01/01/2005
Duration:	36 months
Total Budget:	2.3 M€
Funding:	1.2 M€

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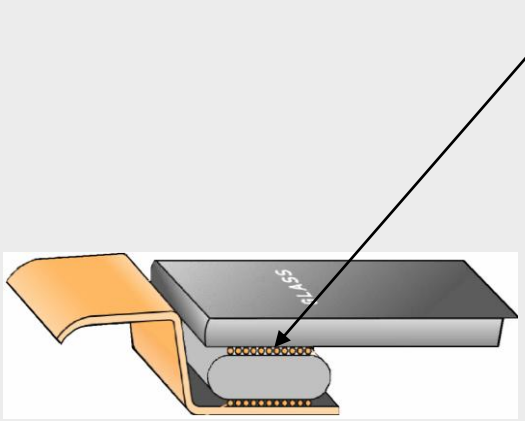
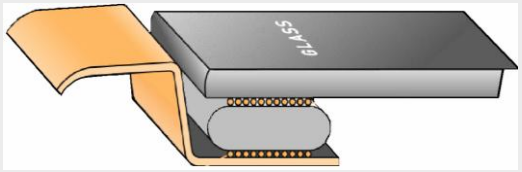
How does that work ? (glazings example)

1) Designing of adhesive system by embedding active species in the primer layer (or adhesive bead)



ECODISM goals and main outcomes

2) The system stays dormant during the whole vehicle life (expected 15 years)



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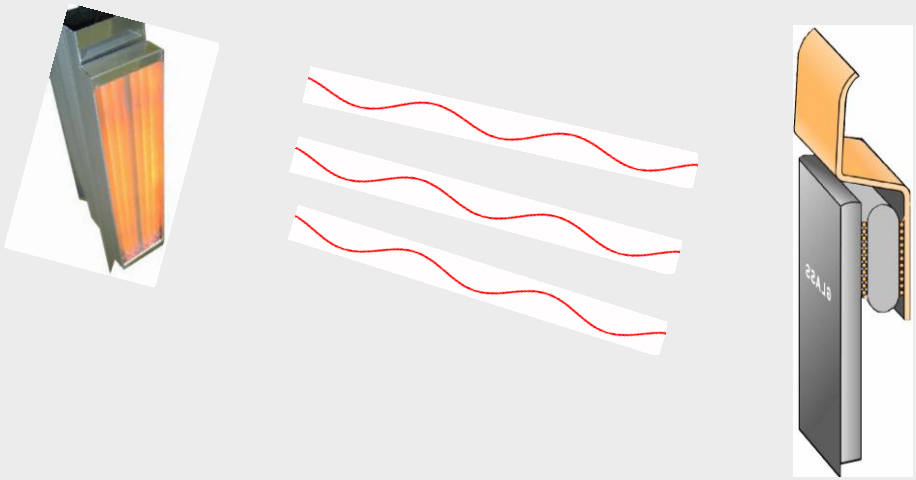
3) At end of life, quick radiative sollicitation during dismantling stage



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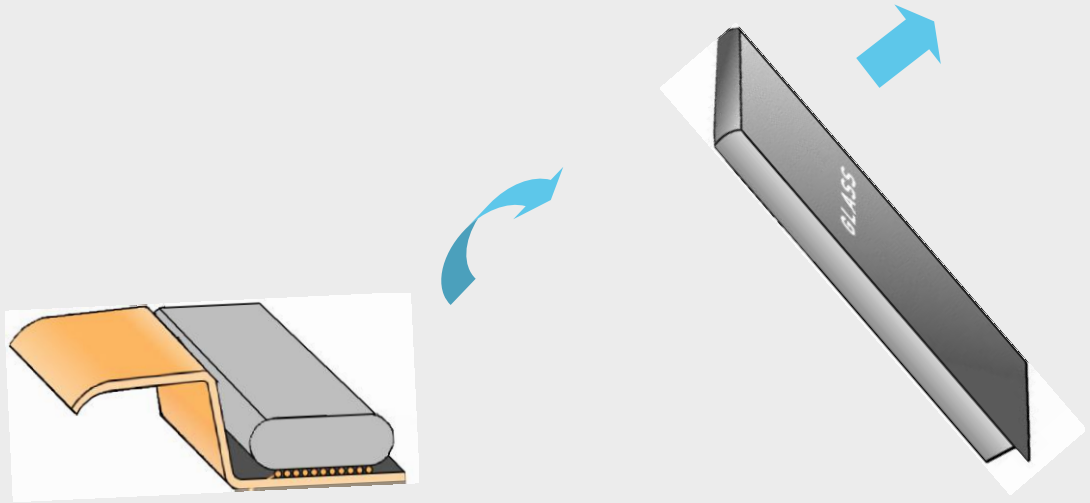
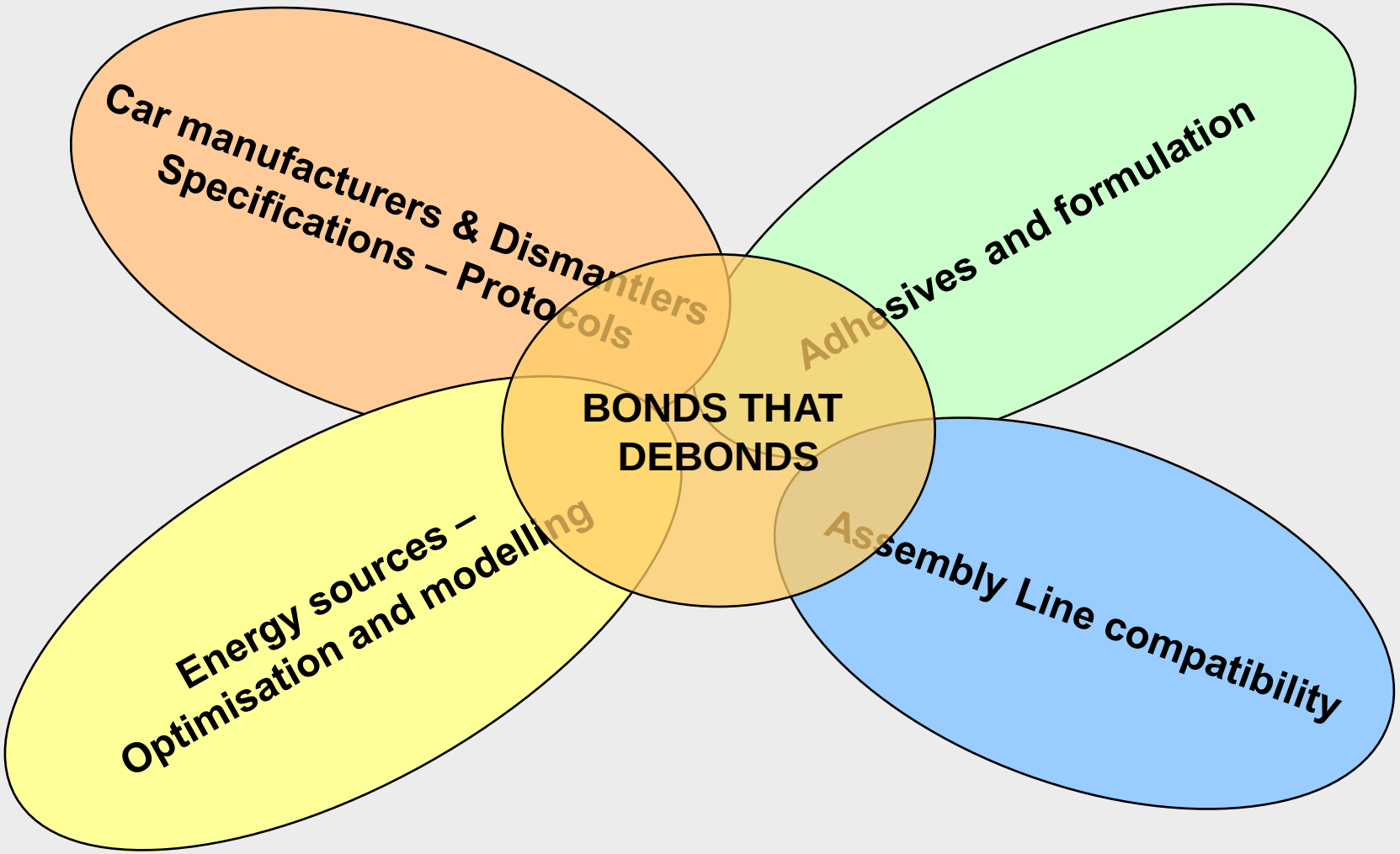
4) Will provide easy dismantling within short time (1-2mn)



ECODISM goals and main outcomes

Research Axes



ECODISM goals and main outcomes

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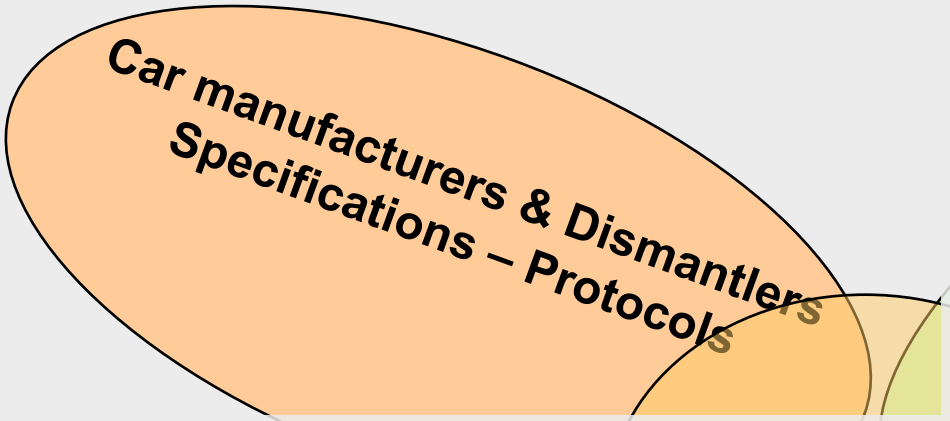

SGS

FIAT

Plastic Omnium

INDRA

Specifications & protocols:

- Materials to bond (example: Glazing / Painted metal sheet, Composites / Composites, Glazing / Plastics, Aluminum / Aluminum)
- Geometry
- Application methods of adhesives
- Dismantling (specifications, protocols) and
- LCA / LCC

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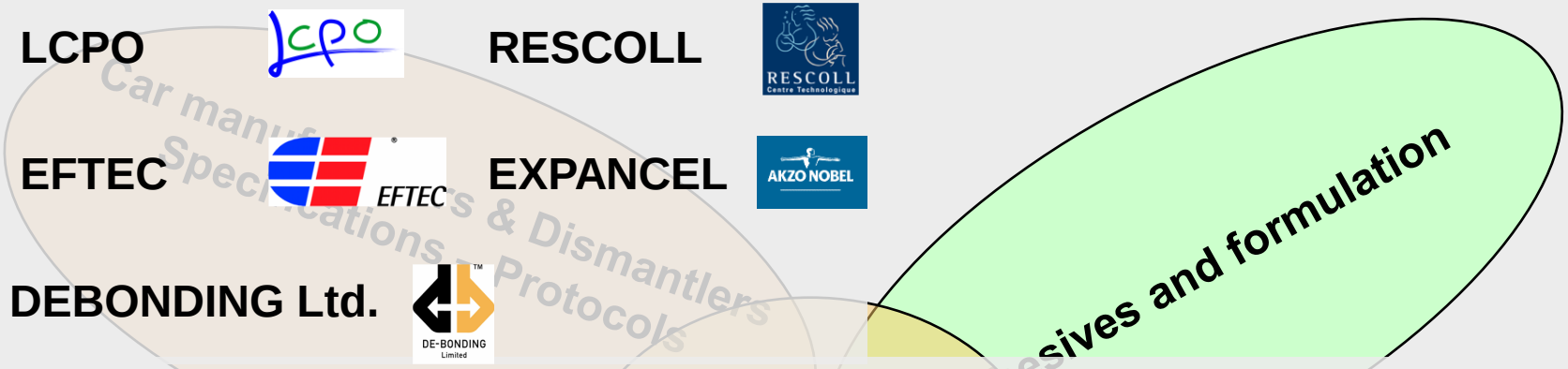
Research Axes

LCPO **RESCOLL**

EFTEC **EXPANCEL**

DEBONDING Ltd.



Adhesives and Active Systems:

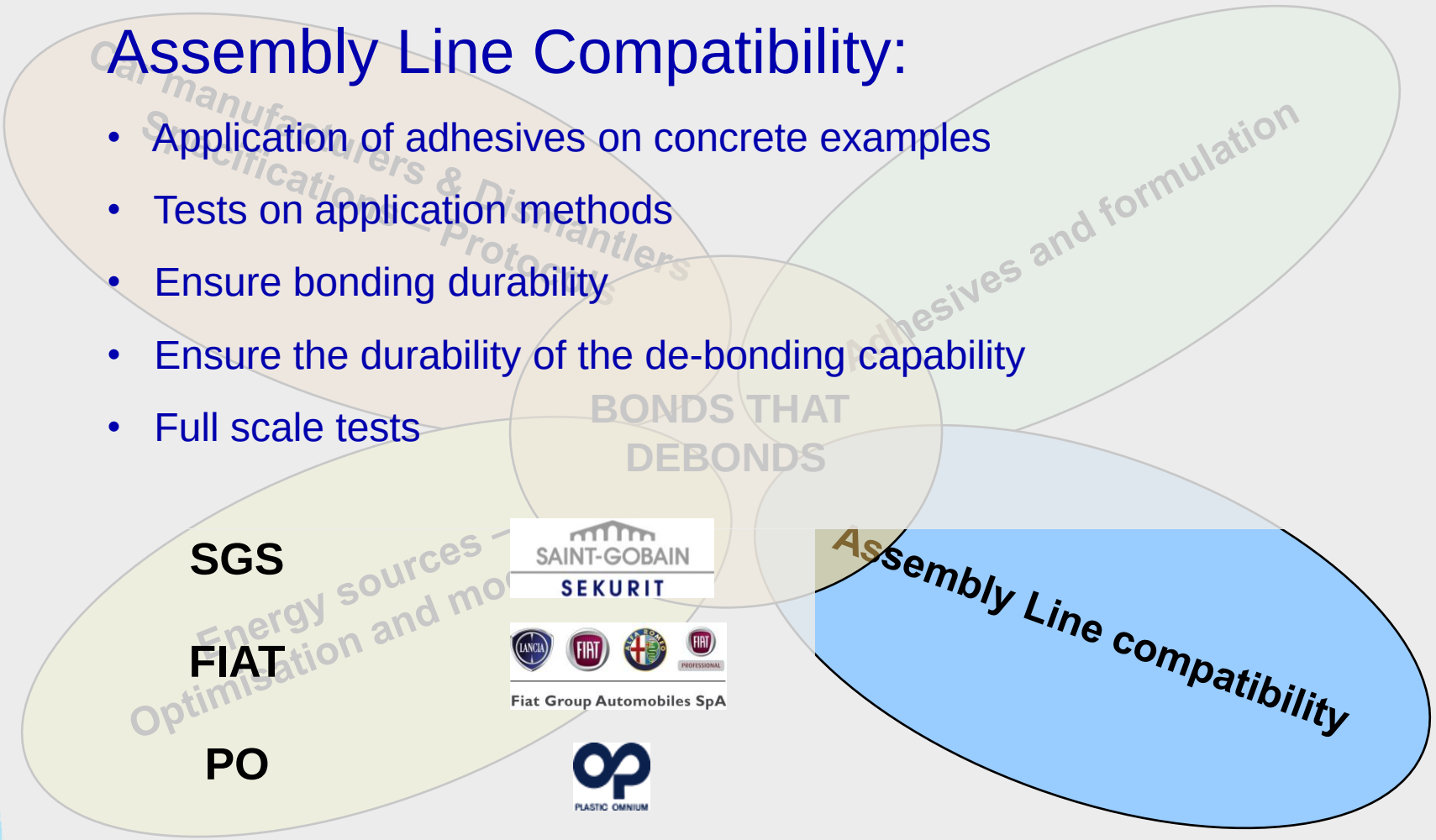
- Integration of active systems within adhesive (thermo-expandable microspheres, blowing agents…)
- Formulation of adhesives

ECODISM goals and main outcomes

Research Axes

Assembly Line Compatibility:

- Application of adhesives on concrete examples
- Tests on application methods
- Ensure bonding durability
- Ensure the durability of the de-bonding capability
- Full scale tests



SGS

FIAT

PO

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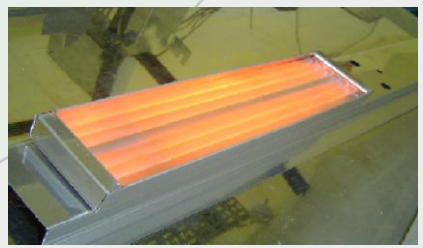
Research Axes

Energy sources – Optimisation and modelling:

- Selection of Adapted Activation Sources (IR, UV, MicroWave…)
- Computer Modelling of delivering method energy
- Computer Modelling of the debonding Process



Energy sources – Optimisation and modelling

INASMET

CERAMICX

Ceramicx Ireland Ltd.
Infrared Ceramic & Quartz Heating Systems for Industry

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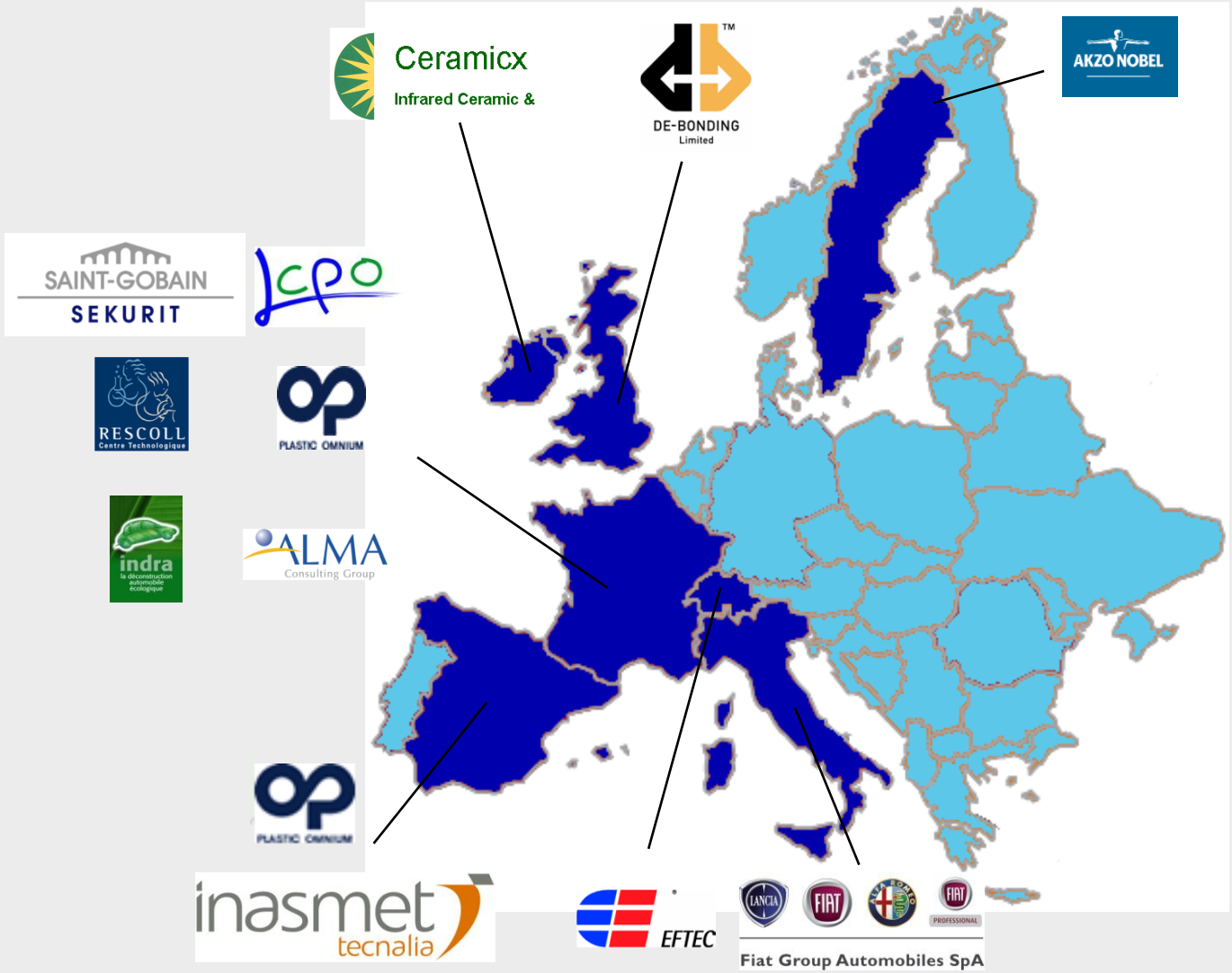
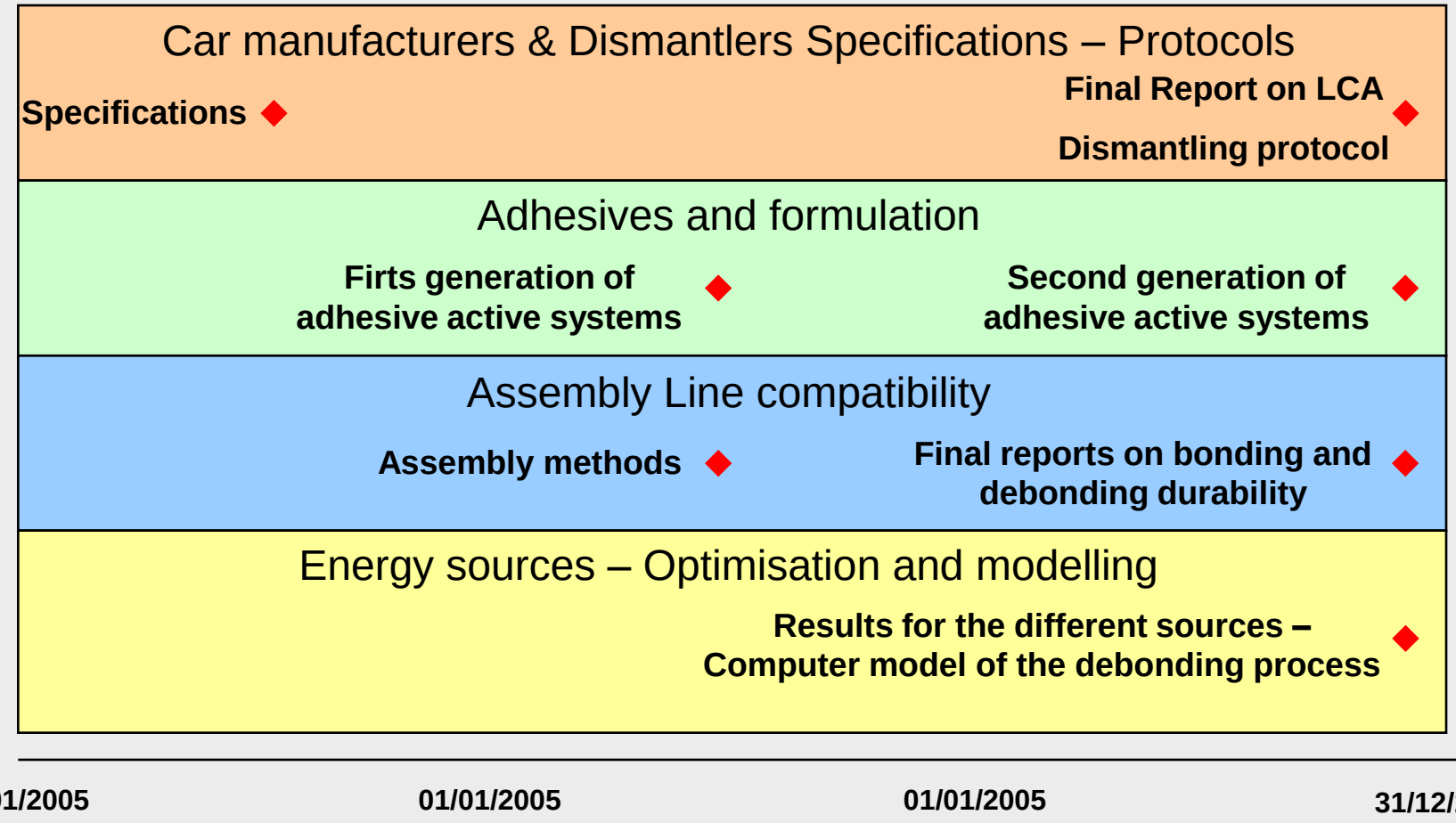
- Ecodism Project members :



ECODISM goals and main outcomes

Roadmap



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ELV Context

Between **9** and **12** million cars are discarded each year in EU. It creates an important amount of non-metallic waste which ends up in landfills.

Automotive Shredder Residue (ASR) reduction is of prime importance. EC Directive 2000/53 fixes strict targets concerning the reuse, recovery and recycling of materials in ELVs:

	2006	2015
Reuse and recycling (% of vehicle weight)	**80 %**	**85 %**
Reuse and recovery (% of vehicle weight)	**85 %**	**95 %**

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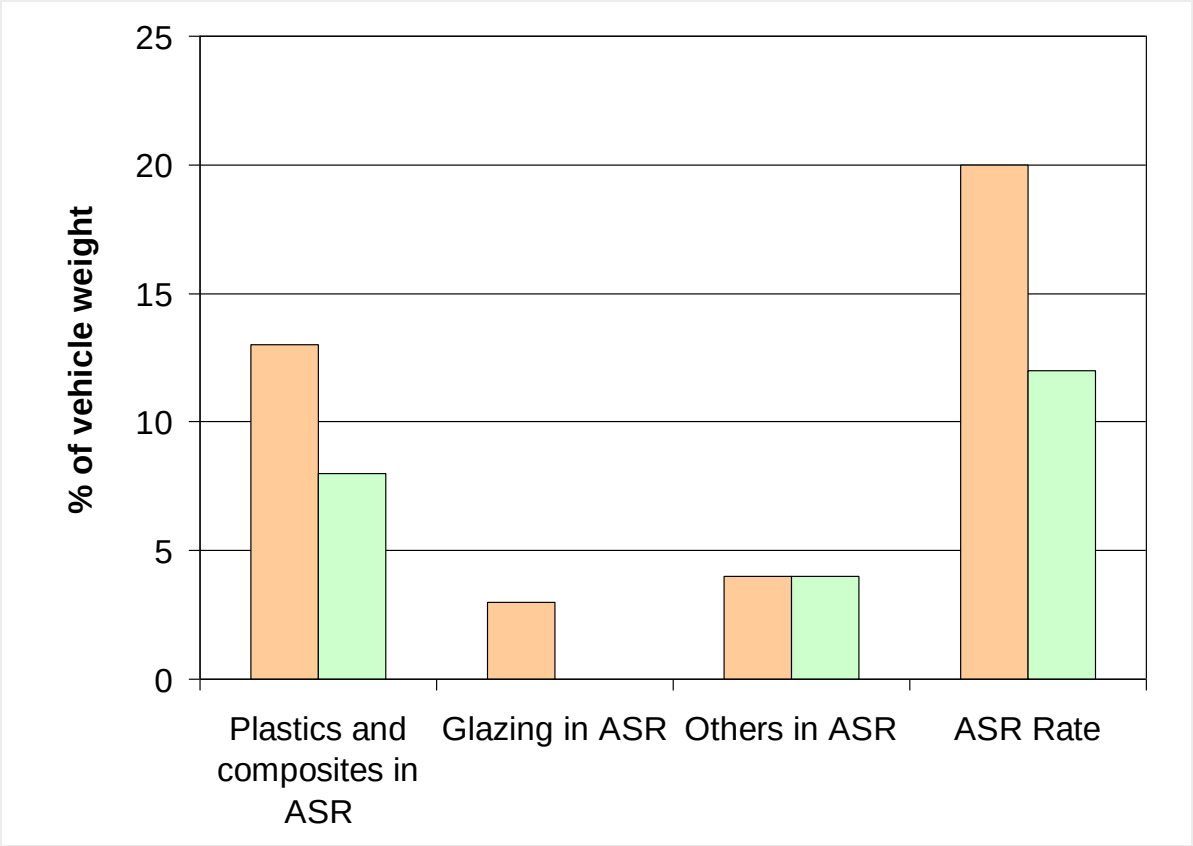
Motivations

Dismantling of some parts may lead to direct ASR reduction



ECODISM goals and main outcomes

Motivations : example of car glazings

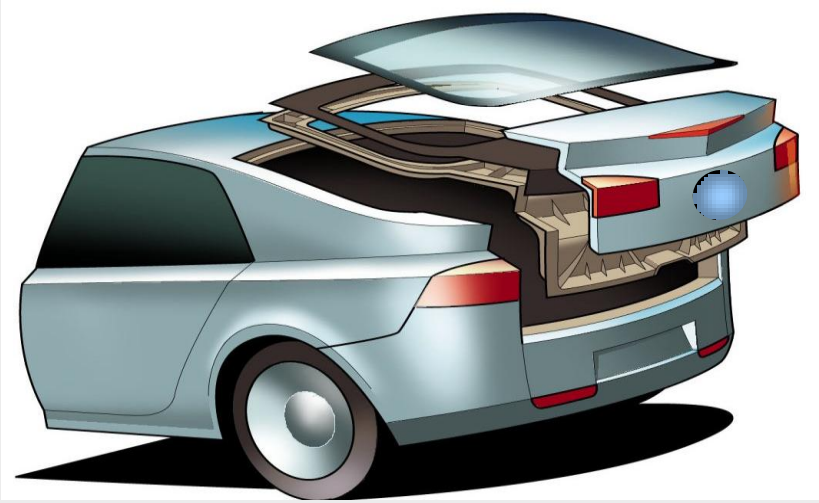
- Car glass represents to-day ~3% of the weight of a car
- although car glass quite easy to recycle back to glass furnaces as cullet (Insulated glass ; containers)..
- …glass is currentlly not recycled and goes to ASR

- it represents ~ 300 000 T of glass cullet lost, all along the ELV chain !!!
- ECODISM will enhance possiblities of clean dismantling and easy recuperation of glass bonded parts

ECODISM goals and main outcomes

Motivations : example of plastic tailgates

➢ Interesting composite for tailgates now is by assembling a SMC backing (ensuring structure) and PP covershield (external durability), by bonding



➢ recyclibility requirements of car maker's is to allow separations of both at ELV

➡ ECODISM provides direct solutions

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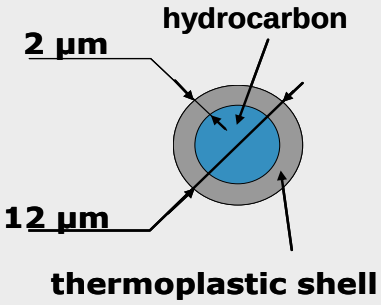
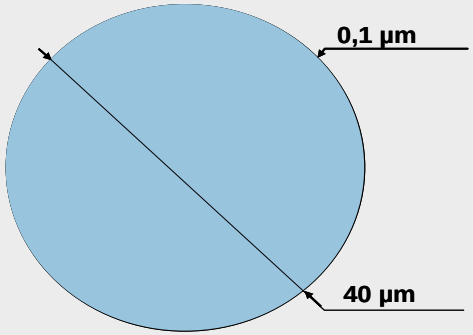
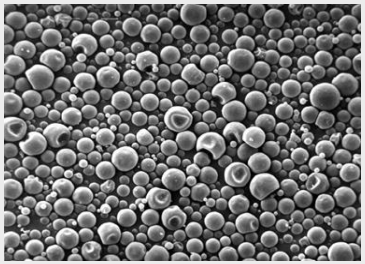
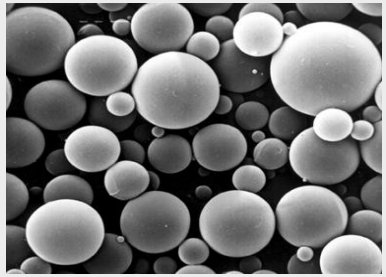
- Active system 1:

Thermo-Expandable Microspheres (TEMs), by





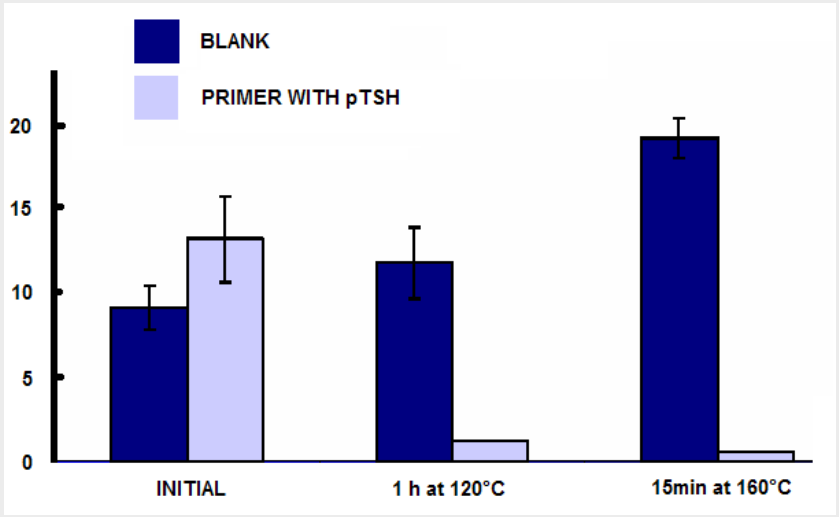




➢ Microspheres are embedded in the primer

ECODISM goals and main outcomes

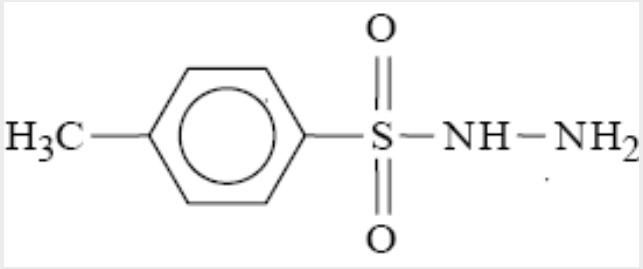
- Active system 2 : Chemical agents : Indar, by



Lap shear test on Al/Primer/Epoxy/Al

Example: pTSH molecule

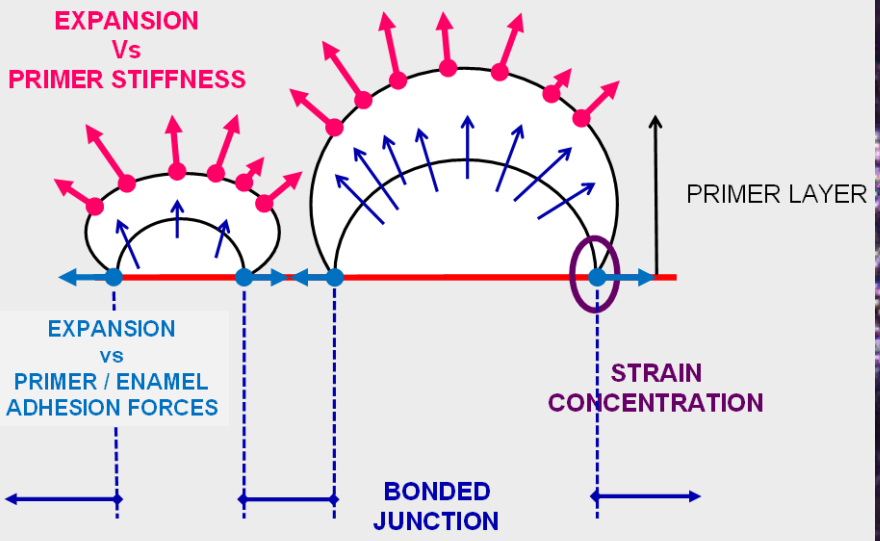
(Melting Point = 105-110°C)

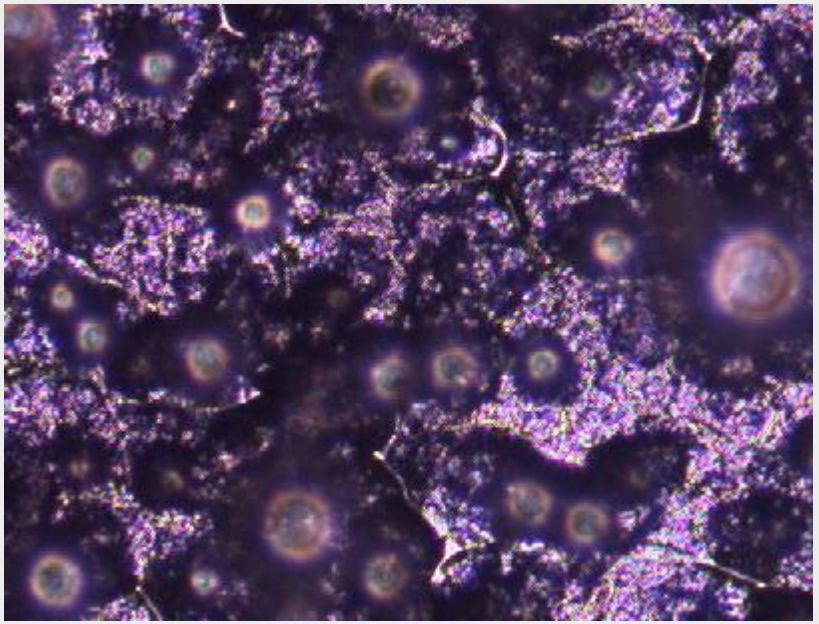


- **Melting -> Migration** at the interface **-> Decomposition** of the agent
- After **Cooling**: **Weak Cohesion Layer**
- 2 possibilities: **Bulk Formulation** or **Primer Integration**

ECODISM goals and main outcomes

TEMs activation = primer expansion

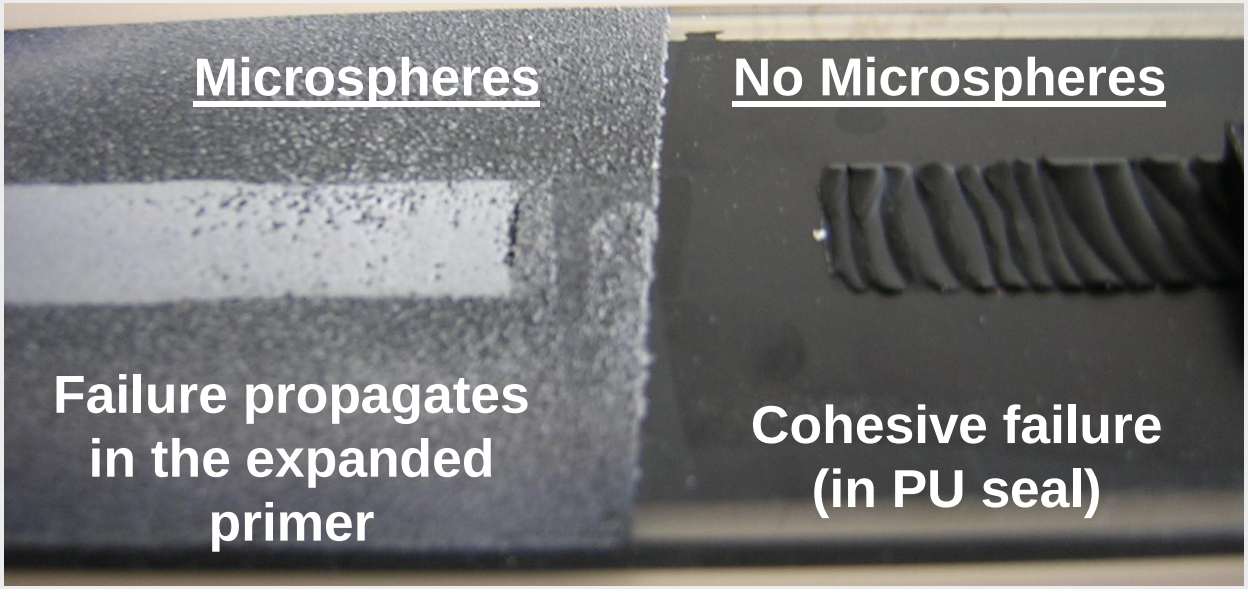




- **in depht studies at LCPO**
- **Dedicated grade of TEM to expanse in 170°C range (Akzo Nobel)**
- **Expansion of the primer layer occurs after Infra-Red heating up to 170°C**

ECODISM goals and main outcomes

- Microspheres activation = primer expansion

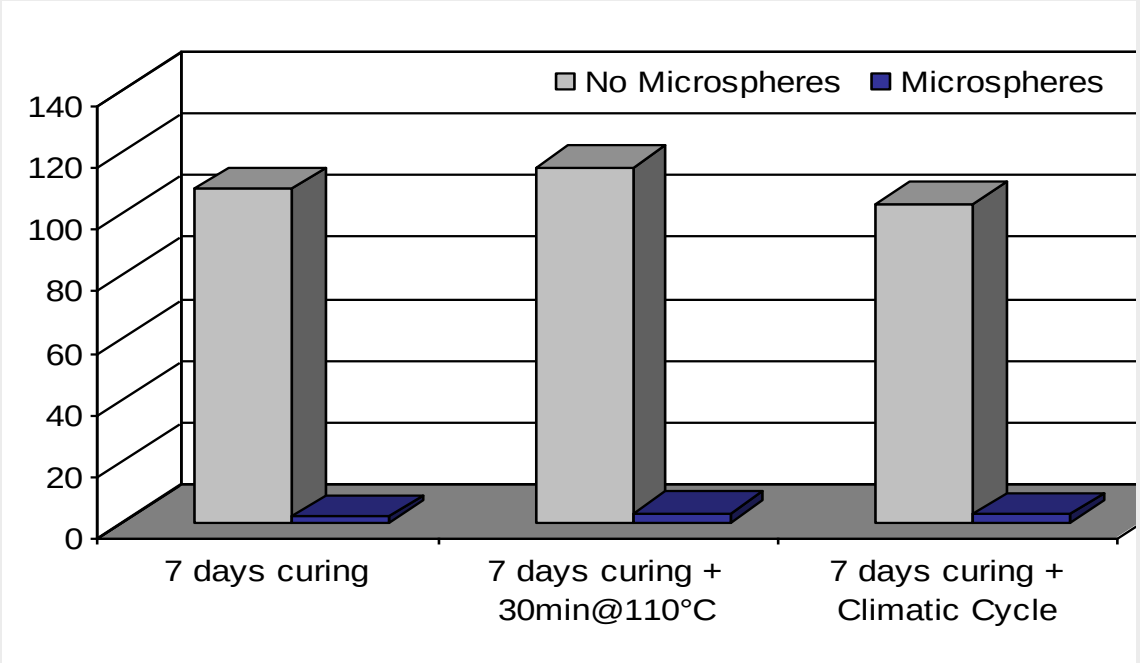


➢ **Decrease in mechanical properties after activation, allowing easy distachement**

ECODISM goals and main outcomes

Durability of debonding function

Peel strength after activation

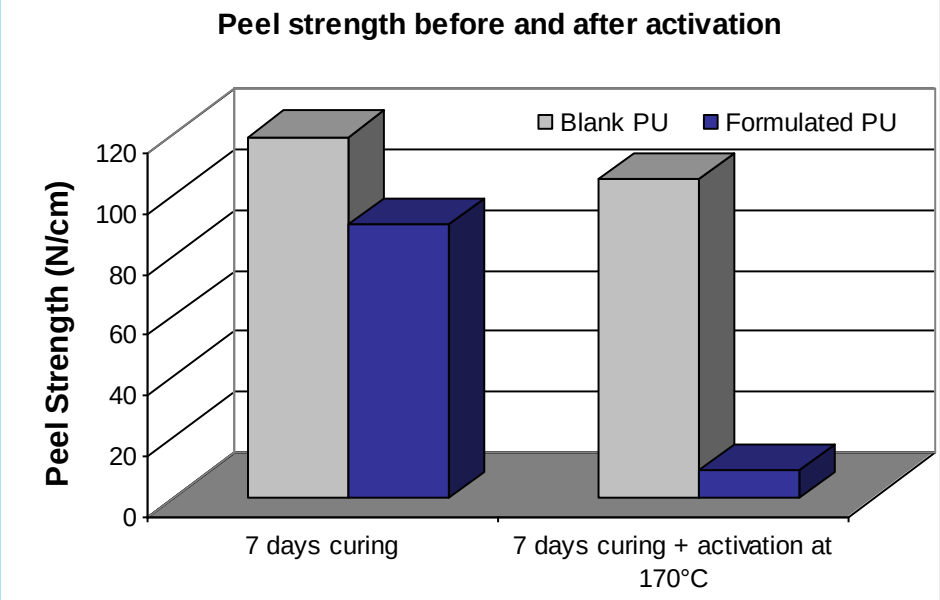


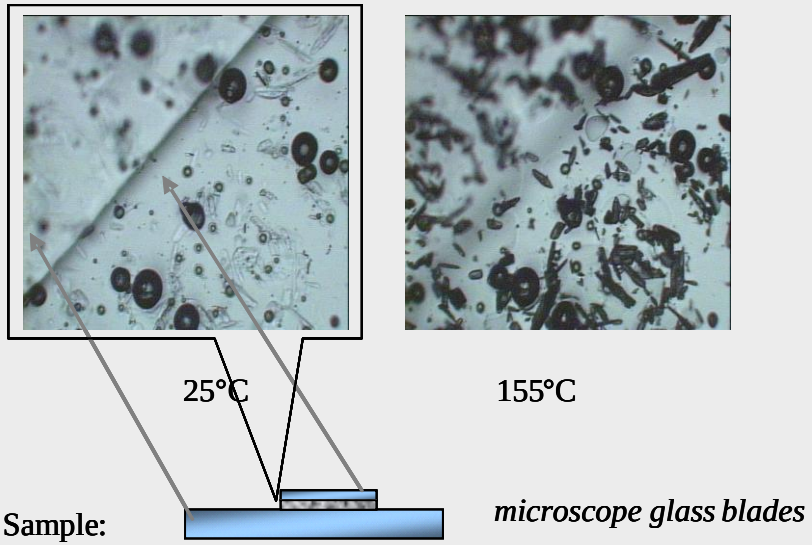
- **Microspheres expand even after aging tests**
- **De- bonding properties are maintained, after 15 years ageing in a car**

ECODISM goals and main outcomes

Active system 2 : Indar :

- **2 to 30% of suitable chemical agent mixed in PU adhesive**





- **Efficiency of the activation**
- **Stability of the Adhesive**

ECODISM goals and main outcomes

- Active systems maybe packed in commercial adhesives

Stability of the modified primer with TEM's (EFTEC)

Results:

-Stability of at least 3 months at ambient temperature

- No primer gelling

- Microspheres still Active after storage

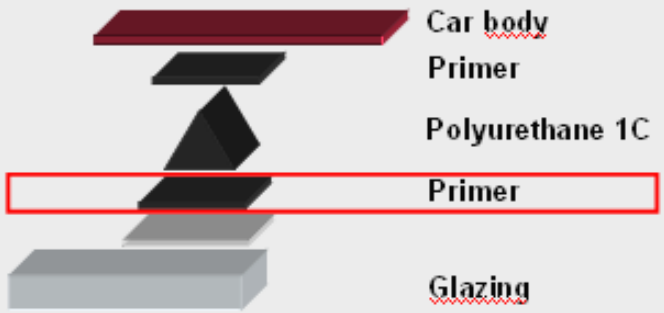
- Microspheres still expand after deposition of the 2C primer & a storage period of 3 months

Same statement for Active system 2 (Indar)

ECODISM goals and main outcomes

Car assembly line compatibility

- Application of those adhesives in car assembly line (Fiat)
- comply with industrial application mean
- comply to car maker's specifications



ECODISM goals and main outcomes

Activation methods

- Key issue to bring energy at the proper location
- Inasmet has investigated different ways IR ; UV, Microwaves; Induction
- Inasmet developed a computer tool (“THERMAL”) to easily calculate transient temperature distribution in joints.
- IR selected as the best method for the glass case
- Induction heating maybe an alternative solution with glass when bonded to metallic frame

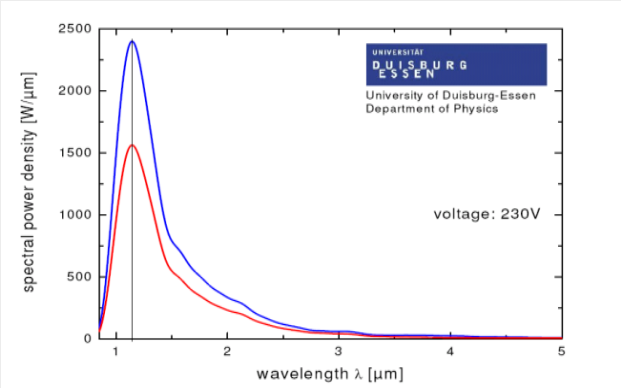
But :

- IR direct heating on plastic demonstrated as not possible (Inasmet ; LCPO ; Rescoll)

ECODISM goals and main outcomes

Activation methods : IR : Ceramicx inputs

- Analytical study made with glass to explain the thermal transfers : the IR radiation is absorbed by the glass and the ceramic black frame. Activation of the TEMs takes place by thermal conduction from the black enamel, not radiation

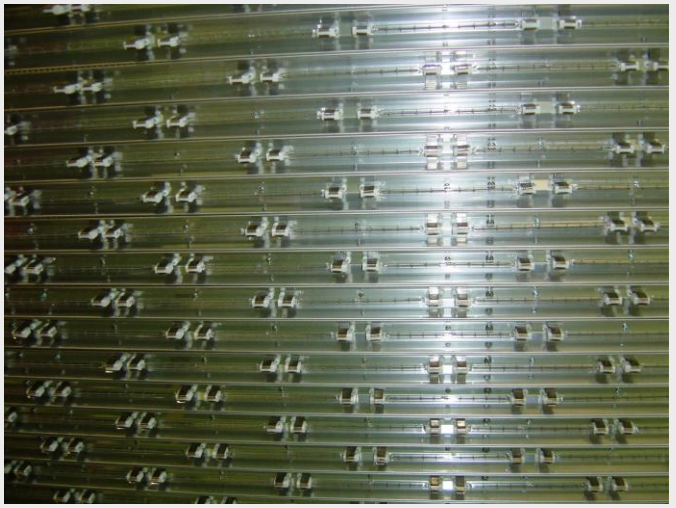


- Ceramicx designs quartz halogen IR emitters to support this assessment, and for the use of the different entities of the project
- Conception and realisation of lamp panel tool
- Scale 1 trials on glass are OK

ECODISM goals and main outcomes

Lamp panel tool from Ceramicx

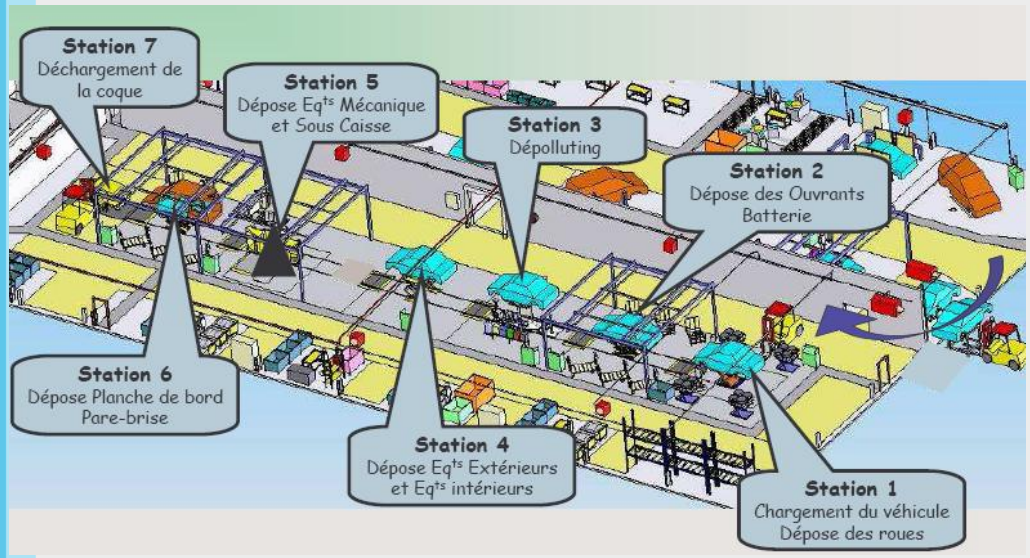
Panel holding 188 heater elements, all individually monitered
Prior Calibration of the system ensures to get homogeneous temperature all around the glass



ECODISM goals and main outcomes

Dismantling trials (Glass)

→System has been installed in Re-Source Industry (dismantling plant)



Succesful results with both active system solutions, on Windshield and Backlite of FIAT Grande Punto.

ECODISM goals and main outcomes

Dismantling trials (Glass)

Easy dismantling , by hand, after 90 sec IR radiation for backlite, and 150 sec for windshield

ECODISM goals and main outcomes

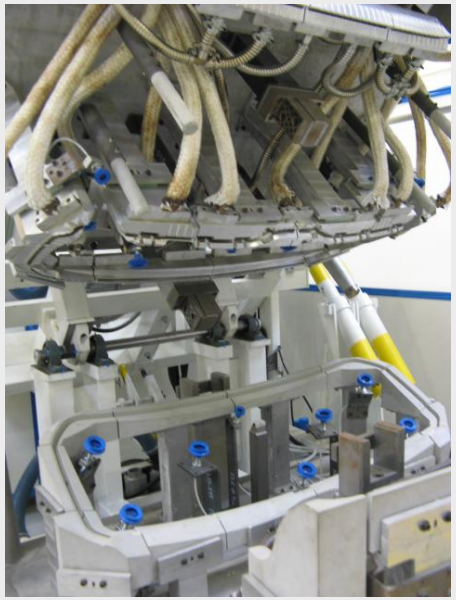
Lab trials (plastic hatchback)

- Thermal activation : IR not possible : behavioral of PP skin > 140°C
- Transposition of the results for glass not possible
- Indar technology gives best results
  - Indar within adhesive
  - Heating by hot plate through SMC side : 1min20s needed to reach the activation temperature (165-170°C)
  - 2min activation time needed to observe visual dismantling of the bonded parts

ECODISM goals and main outcomes

Dismantling trials (plastic hatchback) : PO and Rescoll

- Thermal activation was provided by same mould (see below) initially designed for bonding the PP on SMC component

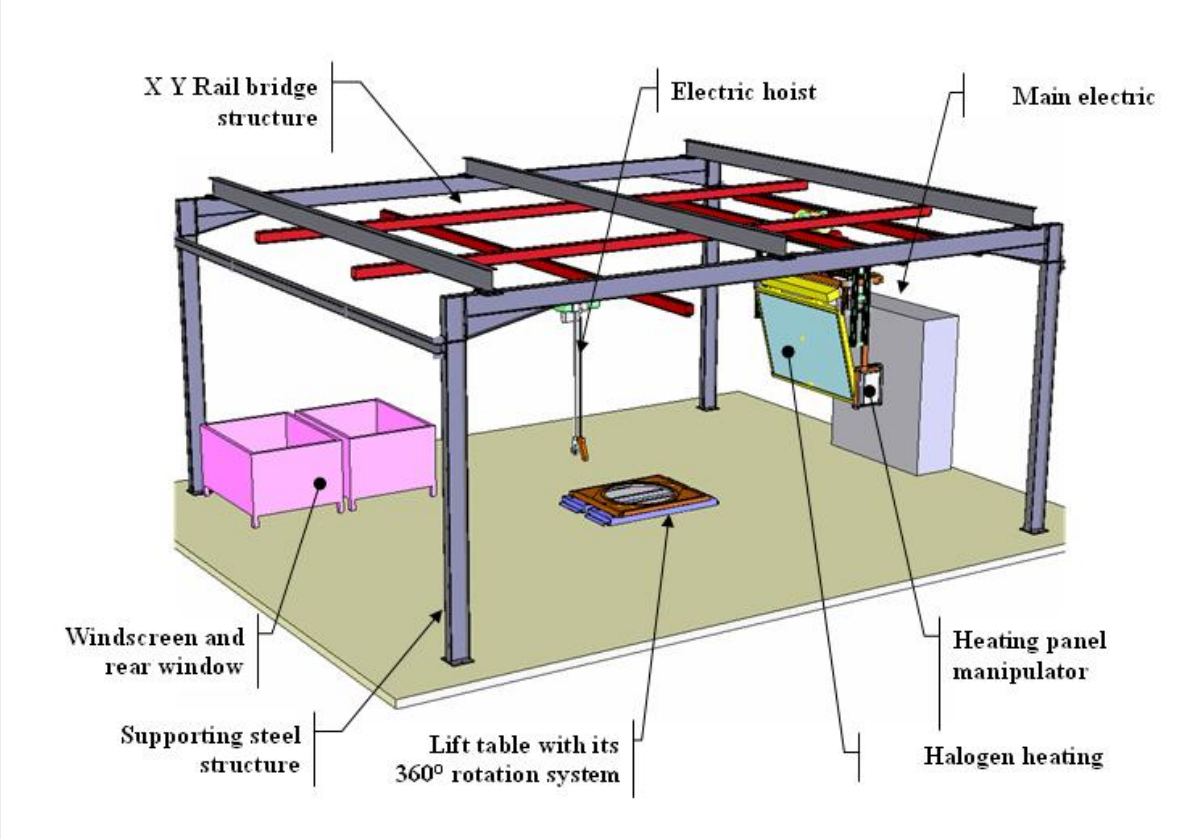


- after heating at the target temperature for 2 to 3minutes, dismantling by hand (after cooling) of the different parts was possible. The kind of failure observed were similar to those obtained with the lab tests.
- The SMC frame was easily dismantled from the PP skin and relatively clean from residual adhesive. No visual degradation of the parts was noticed.

ECODISM goals and main outcomes

Outlined dismantling protocole : Glass / IR method

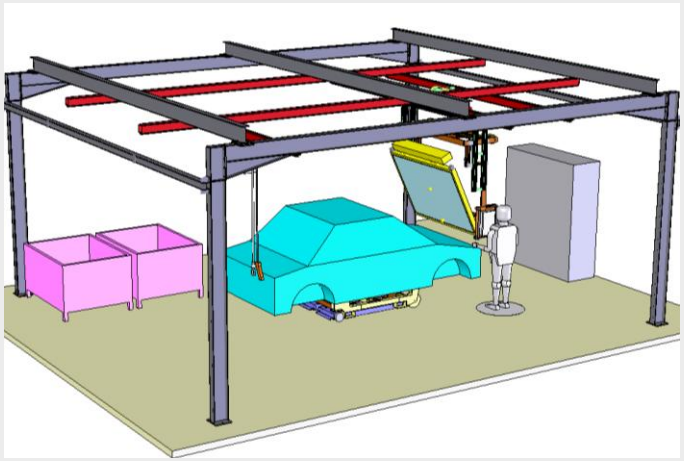
Plans of windscreen and rear window removal workstation (by Re-source)



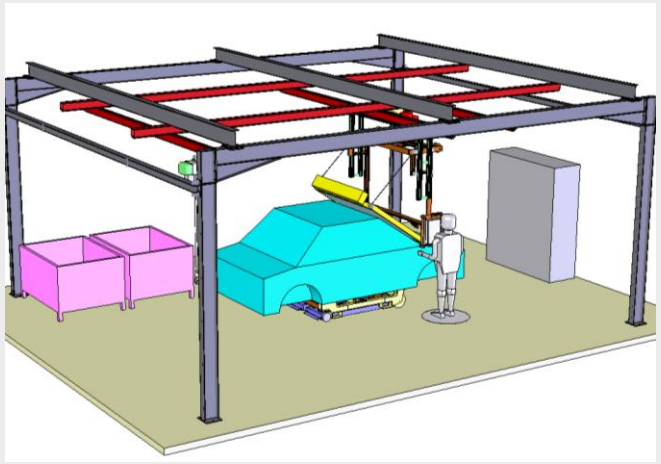
ECODISM goals and main outcomes

Outlined dismantling protocole : Glass / IR method

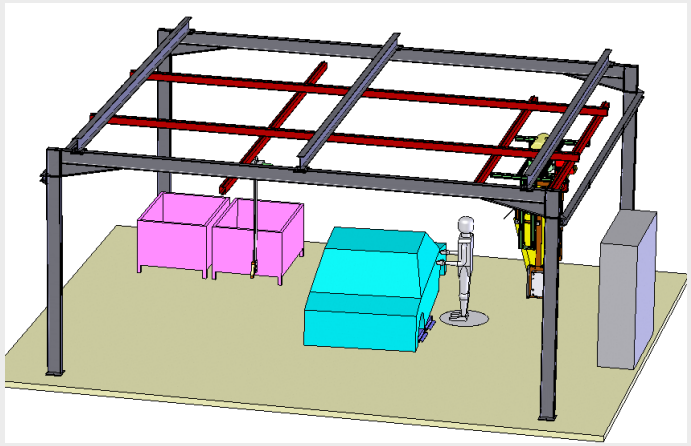
STEP 1



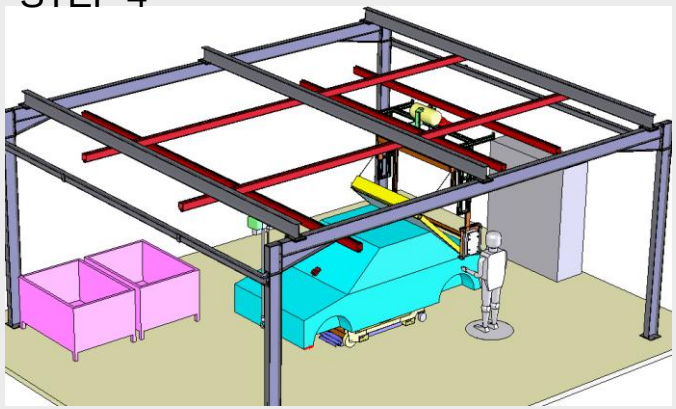
STEP 2



STEP 3



STEP 4



ECODISM goals and main outcomes

LCA and LCC study

Study performed by Fiat, using internally developed tools :

- LCA (Life Cycle Analysis): tool to evaluate the **environmental** impact of an industrial process considering the whole life of product:

  Raw materials ; Production; Energy consumption; Use phase ; End of life

- LCC (Life Cycle Cost): tool to evaluate the **economical** impact of an industrial process

  Fabrication costs ; Maintenance costs ; Waste management costs

ECODISM goals and main outcomes

LCA and LCC: evaluation

Glass dismantling methods:

Case 1: Manual dismantling (piano wire)

Case 2: Traditional dismantling with electric tool

Case 3: Dismantling as in Re – Source plant

- **Windscreen: cutting of the glass / Backlight: glass brittle breaking**

Case 4: Dismantling with active systems – one lamp moving around the glass

Case 5: Dismantling with active systems – static group of lamps disposed around the glazing – all lamps switched in (non optimised)

Case 6: Dismantling with active systems – static group of lamps in heating panel – just lamps needed (optimised calculation)

Case 7: Dismantling heating with induction

ECODISM goals and main outcomes

LCA and LCC: evaluation

Glass dismantling methods:

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Ecodism method is the best:
Best LCC performances / Only way to have an unique tool for each car glazing

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Main conclusions

- Both active systems (TEMs and Indar) are OK for Glass ✔
- Active systems may be packed in commercial adhesives ✔
- Such adhesives are compatible with car assembly lines ✔
- Dismantling glass by IR method ✔
- LCA/LCC assess the validity of this method ✔
- Indar more proper method for plastic hatchback ✔
- Dismantling Plastic hatchback using Indar agents and heating in the same tool used for bonding ✔
- ECODISM significant contribution to world science of Adhesion ✔

ECODISM goals and main outcomes

Dissemination : main facts

- Presentation at Pollutec Paris in Nov. 2007 (JL Bravet)
- Scientific paper presented at 31th Adhesion Society Meeting, Austin, US, Feb 2008 (Prof. E.Papon)
- Scientific paper presented at 2007' French Adhesion days, Biarritz, France, sept. 2007 (Prof. E.Papon)
- Scientific paper will be presented at EURADH' 2008 (Oxford, UK) (Prof. E.Papon)
- 2008 TRA Conference, April 24th, 2008, Ljubljana, Slovenia
- ECODISM Final event - April 17th , Romorantin, France

ECODISM goals and main outcomes

- Ecodism final event Romorantin April 17th, 2008

ECODISM goals and main outcomes

- In Memoriam…

Prof. Giovanni Manfrè
(1933-2007)

Thanks for your attention !!!

jlouis.bravet@saint-gobain.com