

International Symposium on Life Cycle Assessment and Construction

Session : LCA case studies and methods for infrastructures

Environmental Evaluation of Grave Emulsion

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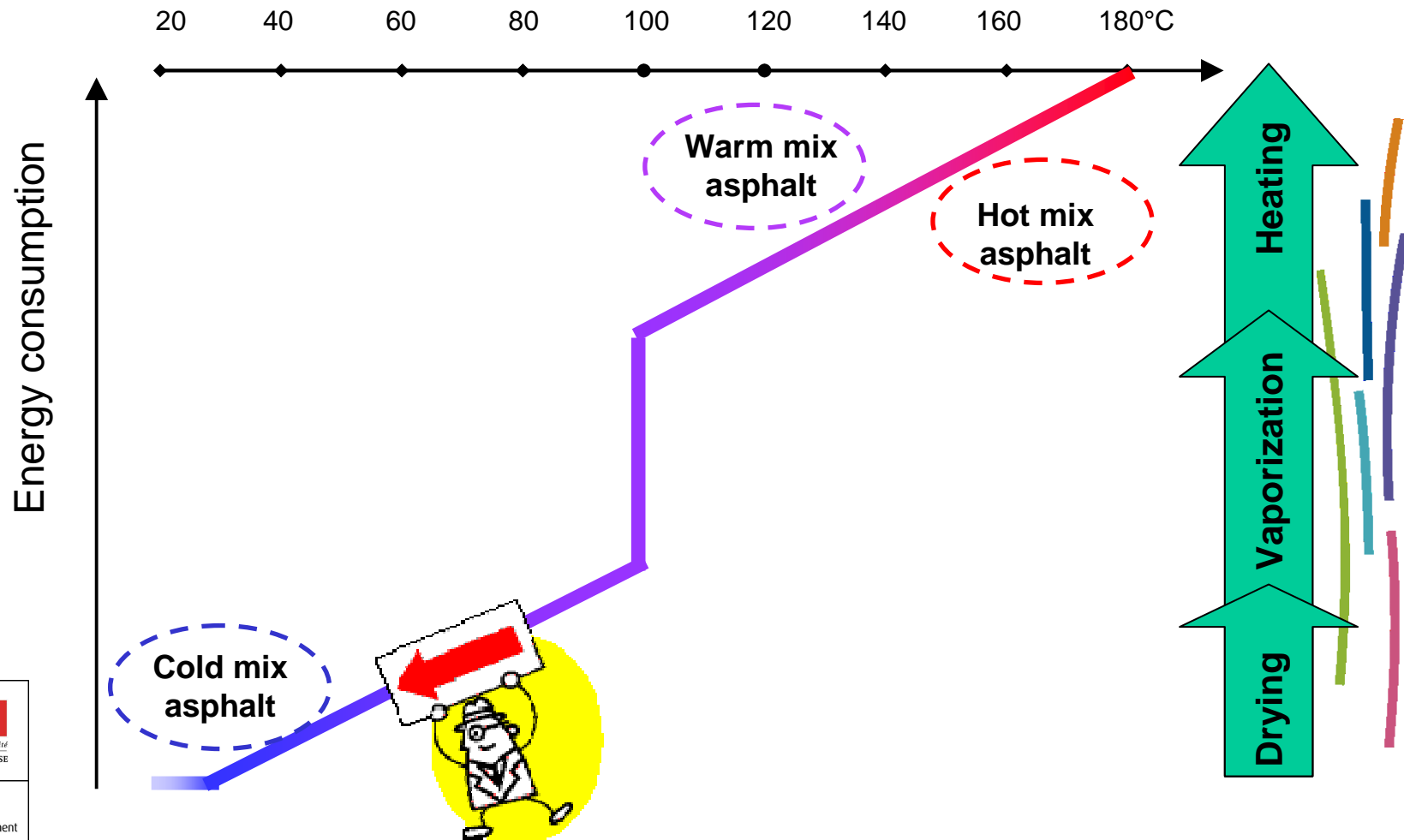
Background

- Existing data on « traditional » materials (hot mix asphalts)
- Lack of data for « alternative » materials (hot with recycling, warm, cold materials treated by bitumen emulsion)

➤ Specific data gathering on an experimental site (IFSTTAR research program)

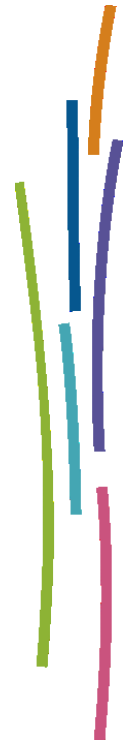


Manufacturing: cold / hot mixes

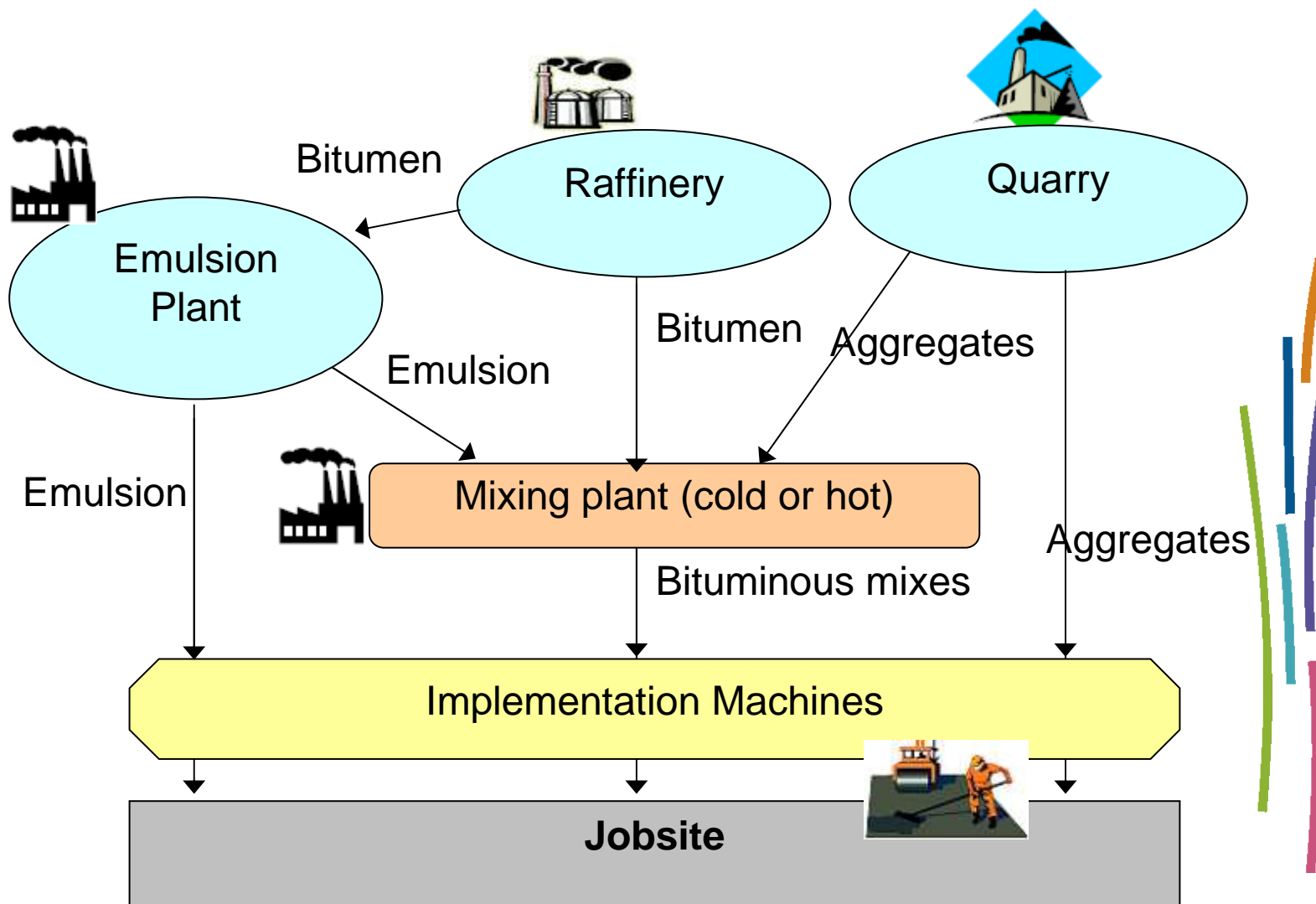


Organisation of the study

- Environmental system
- Data gathering
- Calculation on materials
- Calculation on maintenance scenarios



Environmental system



Data gathering

- actual sites: emulsion plant + cold mixing plant + jobsites
 - ✓ Consumption of energy (gas, fuel, electricity) and raw material
 - ✓ tons of materials manufacturing
 - ✓ Operating time for manufacturing and mixing plant, and implementation machines



ECORCE Software

- Software developed by IFSTTAR
- Projects defined by Layers
 - Geometry
 - Density
 - Constituents (%)
 - Transportation distances
- Outputs
 - global indicators (energy, greenhouse gas emissions)
 - eutrophication, acidification, formation of ozone: POCP, ecotoxicity, impacts on human health (toxicity)

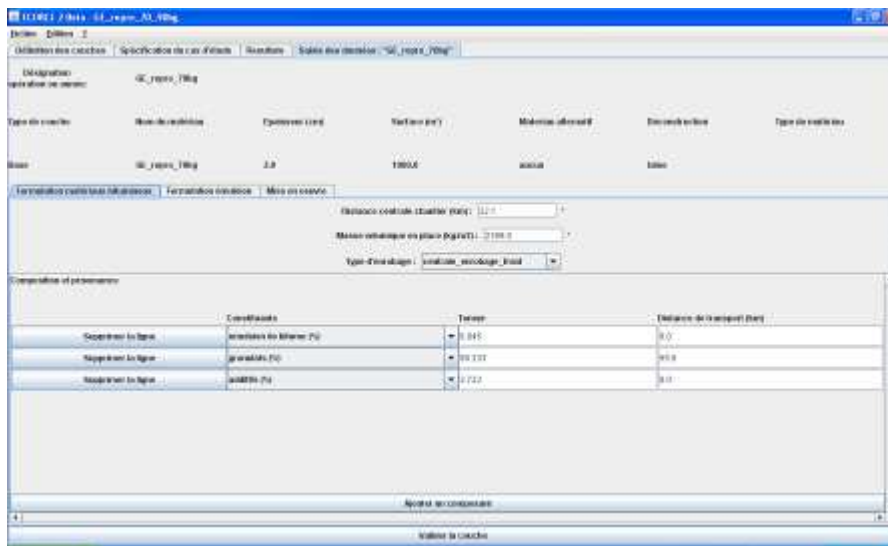


 **Data ?**

Calculation - hypothesis

Project: 1000 m2 (actual experimental jobsite)

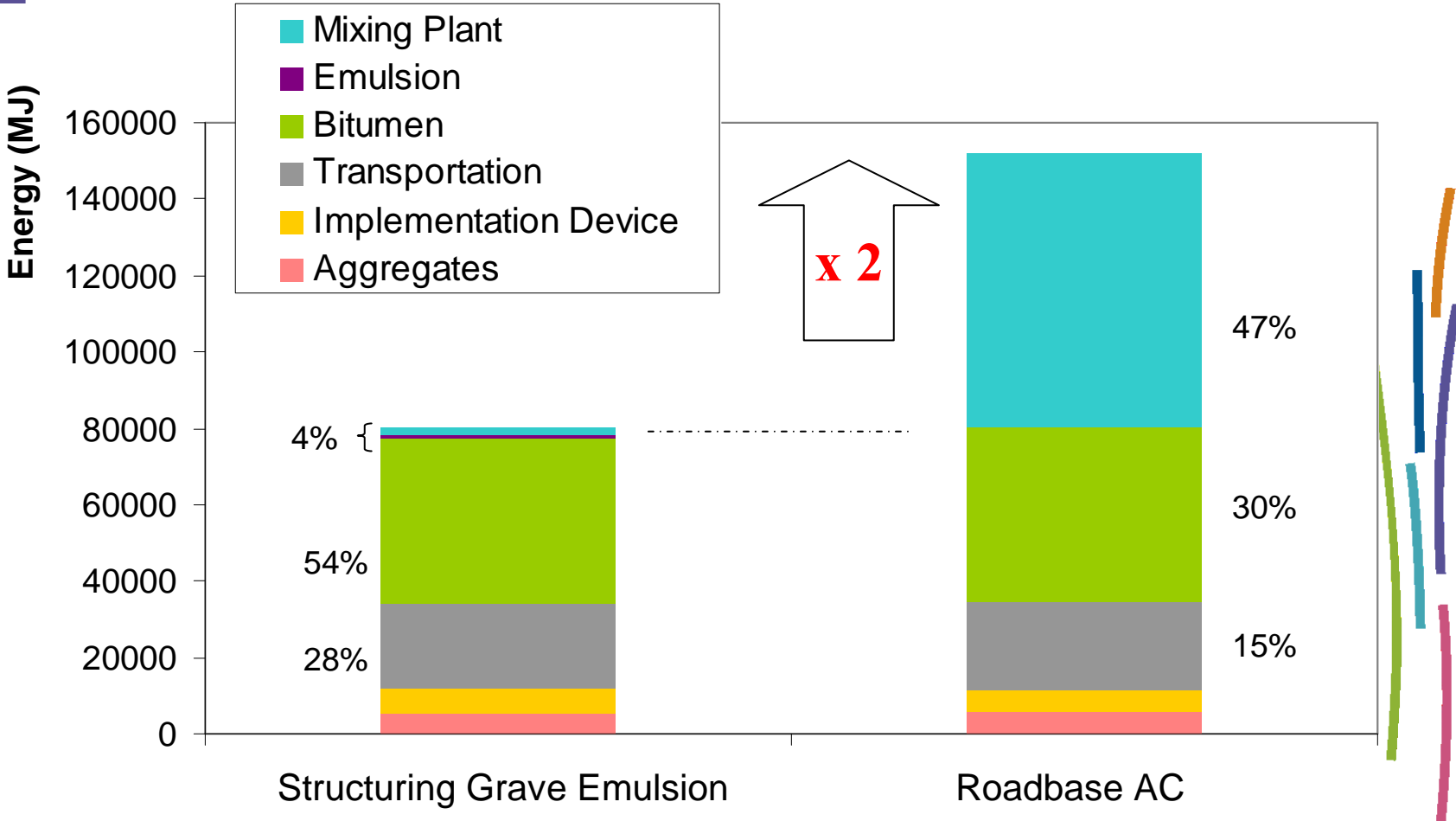
Transportation distances	(km)	Transportation distances	(km)
Quarry (cold or hot mixes) / mixing plant	55	Refinery / hot mixing plant	323
Mixing plant / jobsite	22	Refinery / emulsion manufacture	323
Quarry (surface dressing) / jobsite	78	Emulsion manufacture / cold mixing plant	0
Storage area (machnies) / jobsite	22	Emulsion manufacture / jobsite	22



local context:
Brittany Region



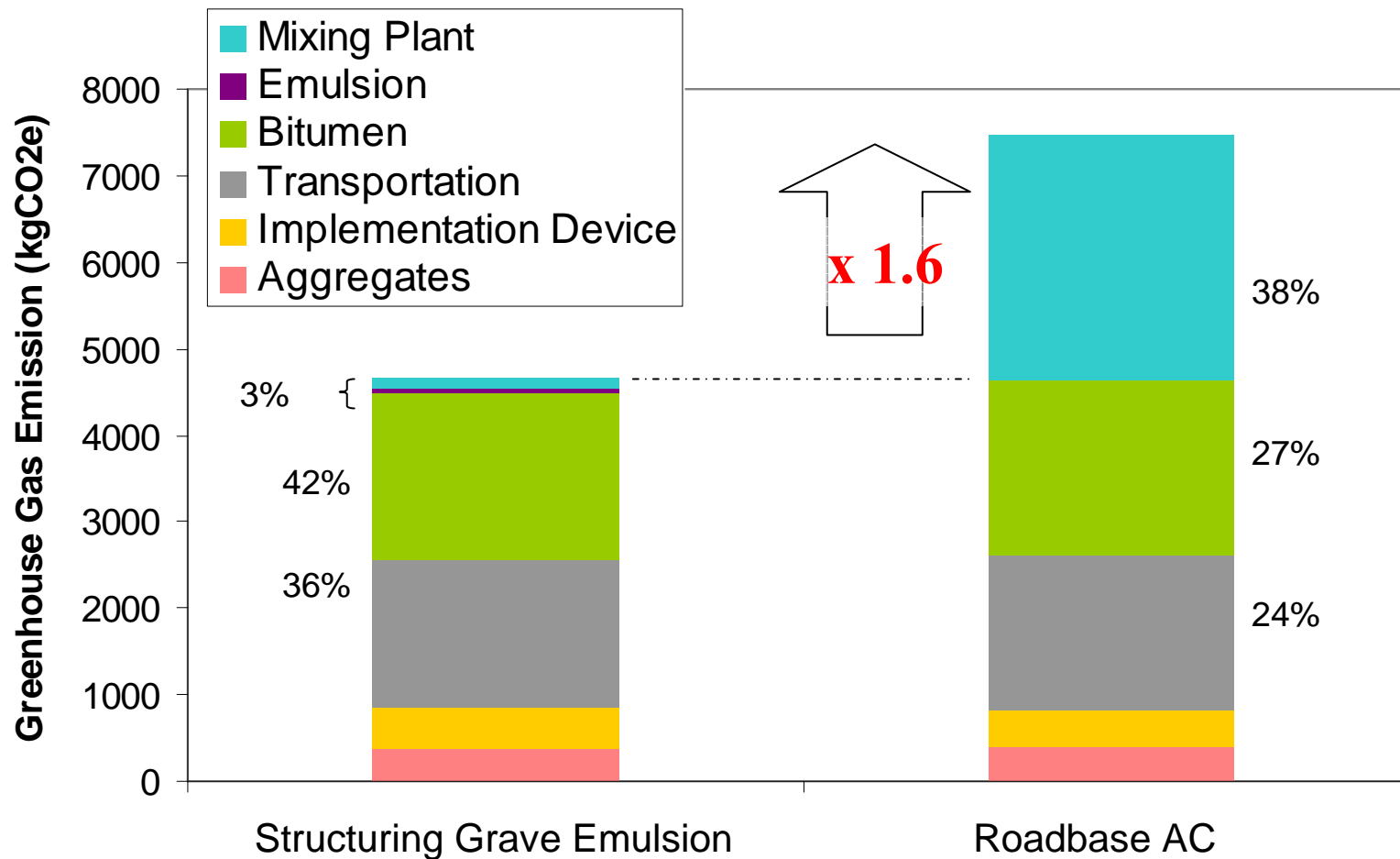
Energy consumption for grave emulsion and hot mix asphalt



Thickness of layers: 10 cm



GHG emission for grave emulsion and HMA



Thickness of layers: 10 cm



Structures - reshaping

Slightly distorted road: Reshaping 50 kg/m² + wearing course

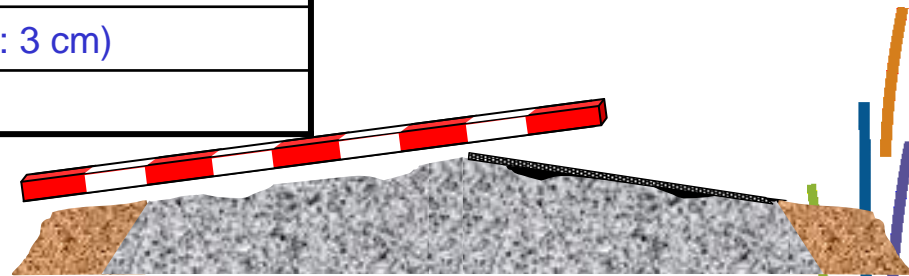
Base / wearing courses

GER (50 kg/m²) + Double Layer surface dressing (DSD)

GER (50 kg/m²) + Dense cold mix (DCM : 3 cm)

Thick layer AC (TLAC : 6cm)

GER : Grave Emulsion for Reshaping



Highly distorted road: Reshaping 90 kg/m² + wearing course

Base / wearing courses

GER (90 kg/m²) + Double Layer surface dressing (DSD)

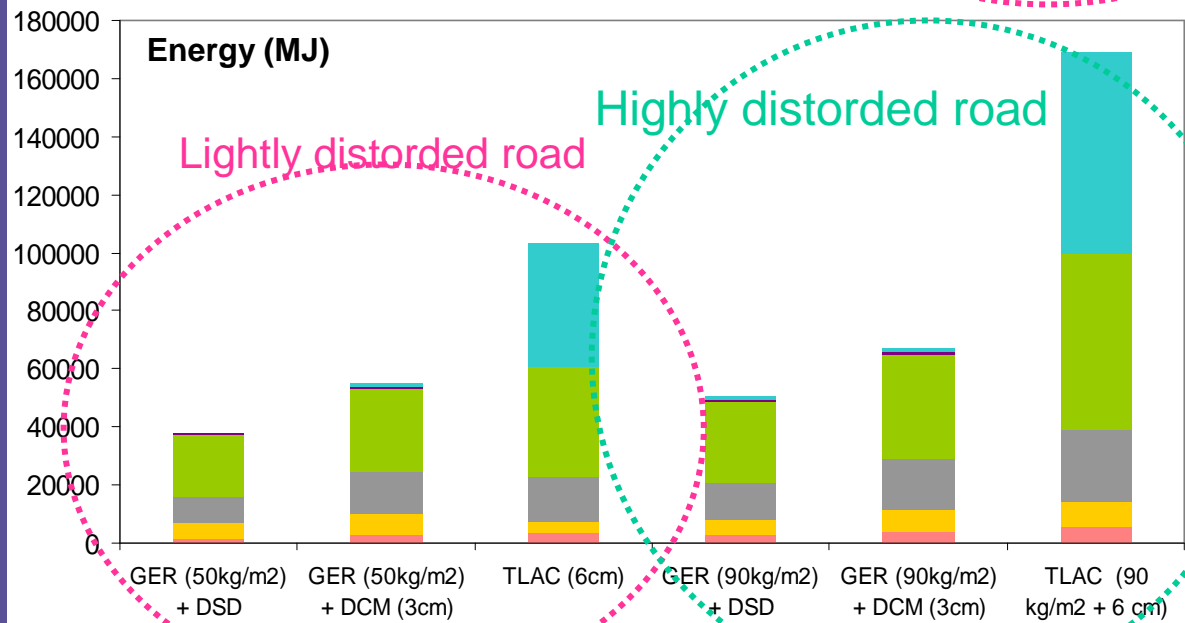
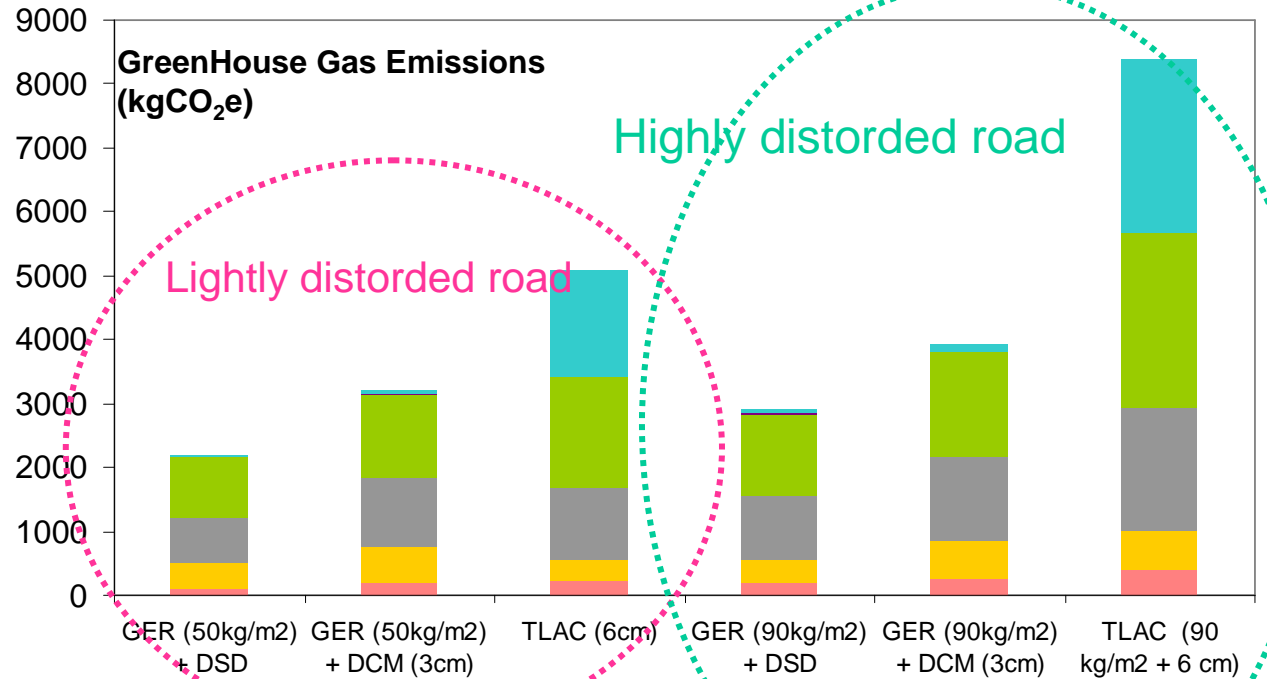
GER (90 kg/m²) + Dense cold mix (DCM : 3 cm)

Reshaping with Thick layer AC : 90 kg/m² + 6 cm



Results

Reshaping:
Light / high
deformations

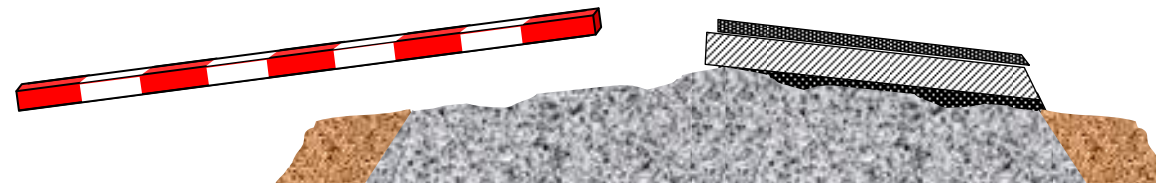


- Aggregates
- Implementation device
- Transportation
- Bitumen
- Emulsion
- Mixing plant

Structures - strengthening

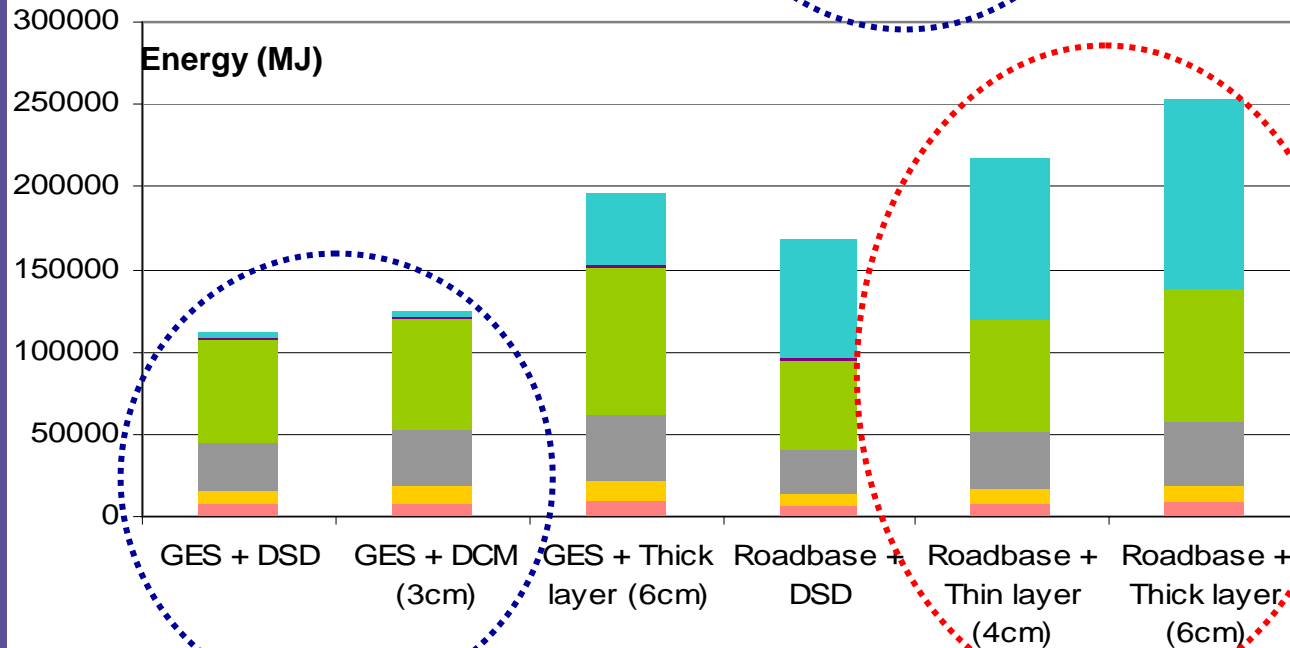
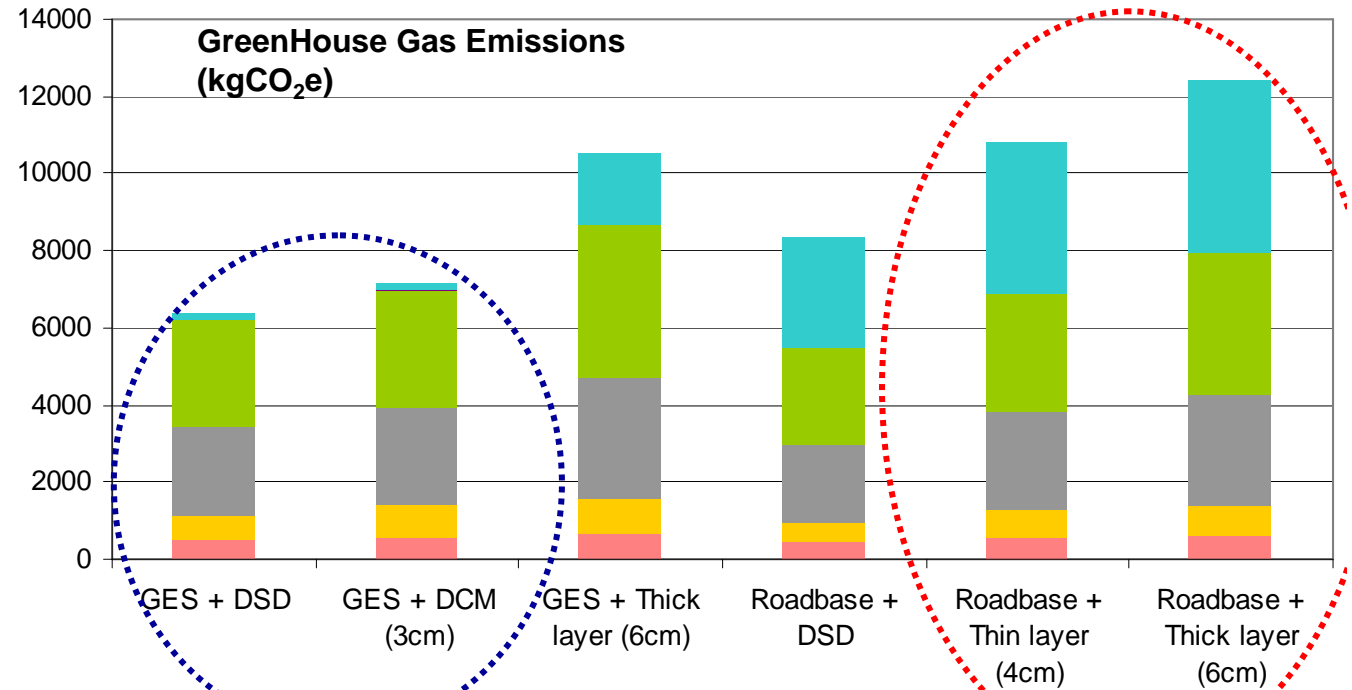
Strengthening: regravelling + wearing course

<i>Base / wearing courses</i>
Structuring Grave Emulsion (GES) (12 cm) + DSD
Structuring Grave Emulsion (GES) (12 cm) + Dense Cold Mix (DCM: 3 cm)
Structuring Grave Emulsion (GES) (12 cm) + Thick Layer AC (6 cm)
Roadbase AC (10 cm) + DSD
Roadbase AC (10 cm) + Thin Layer AC (4 cm)
Roadbase AC (10 cm) + Thick Layer AC (6 cm)



Results

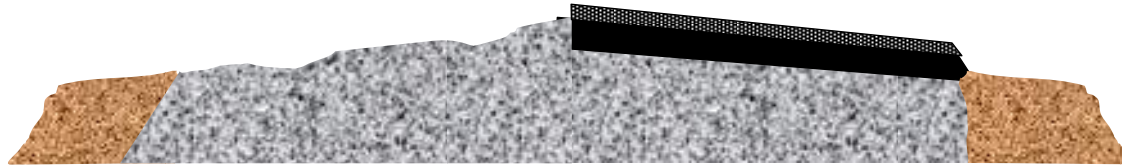
Strengthening:
regravelling
+ wearing course



- Aggregates
- Implementation device
- Transportation
- Bitumen
- Emulsion
- Mixing plant

GES : 12 cm
Roadbase AC : 10 cm

Cold In-place Recycling

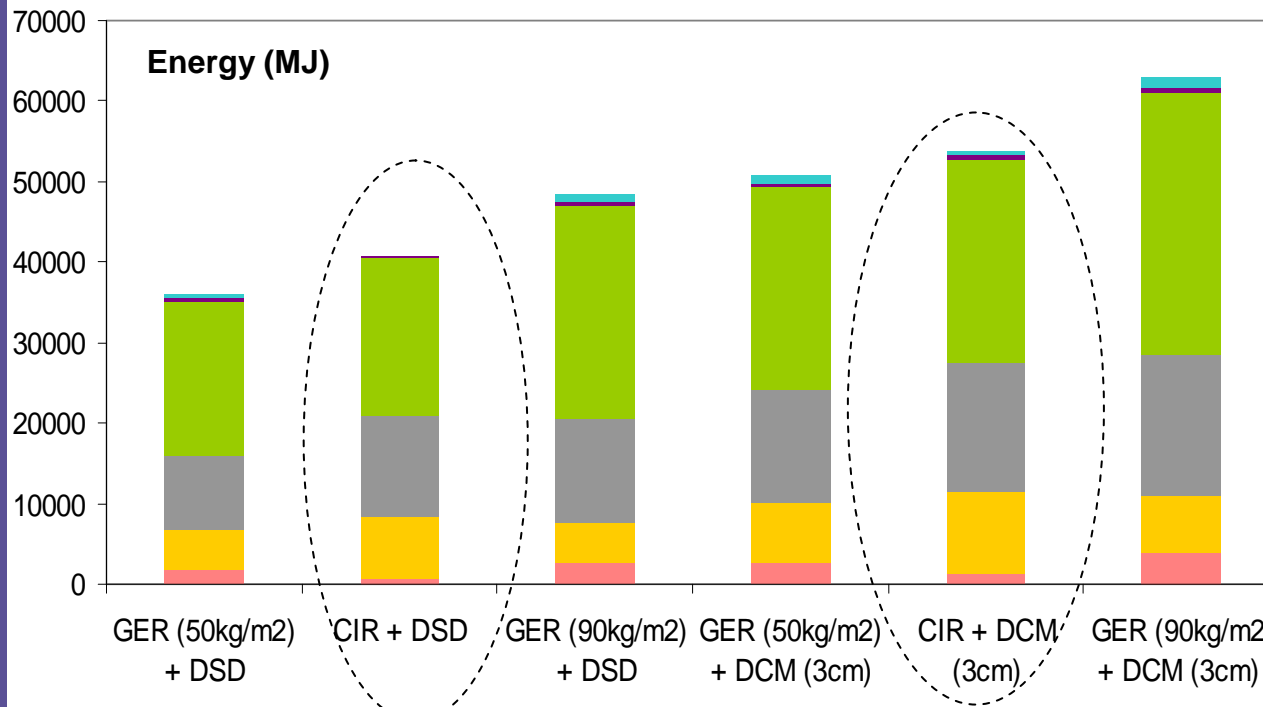
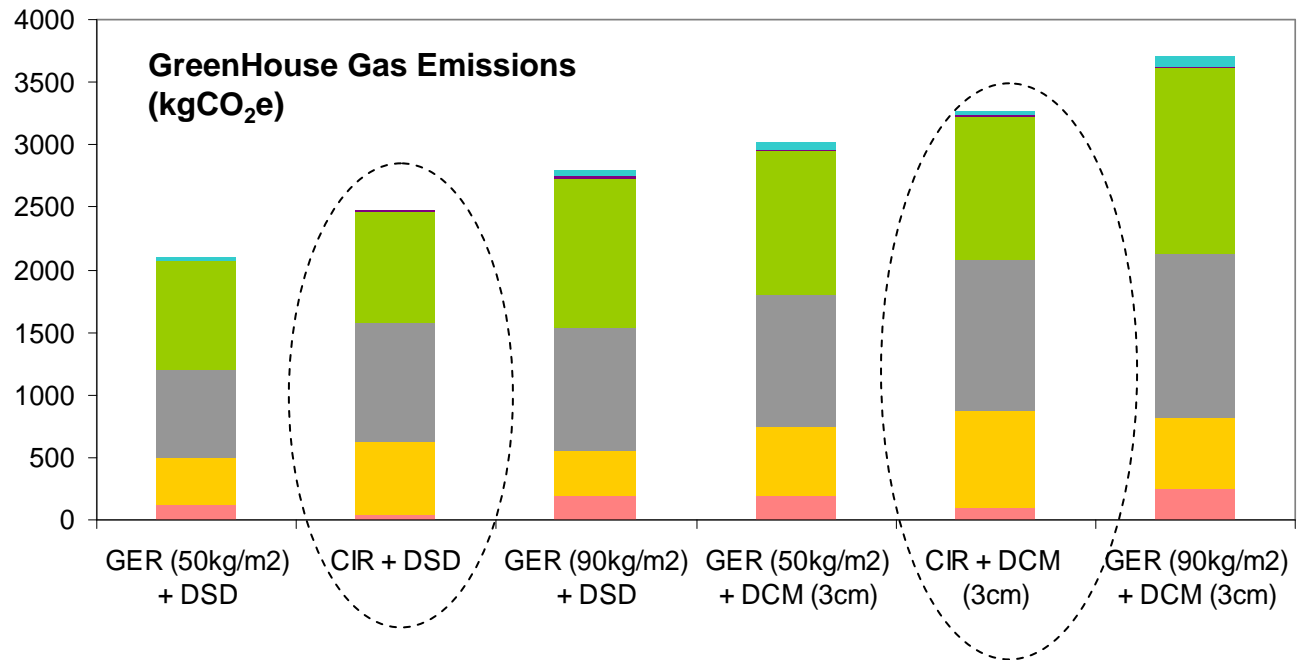


- Reshaping (thickness \approx 6 cm)
- Use of existing materials (aggregates)
- Requires a wearing course
 - Double Layer surface dressing / Dense cold mix (3 cm)
- Requires specific machines (a few in France), specific bitumen emulsion
 - Transportation distances (local context)



Results

Cold In-Place Recycling (CIR)



- Aggregates
- Bitumen
- Emulsion
- Mixing plant
- Implementation device
- Transportation

Conclusions

- ECORCE “tool”: multitude of road materials and techniques
- Cold materials: Data gathering and use
 - calculations on materials
 - Via layers / thickness / scenarios (French regional guides)
- Confirmation of interest of cold materials



Perspectives

- ECORCE: distribution french road administration
- local impacts (additives), impacts on environment (emulsifiers : water from breaking of emulsion)
- Mechanical behaviour of cold materials treated with bitumen emulsion: lifetime

➤ IFSTTAR Research projects

