Warm mixtures: State of art and Experiences in France

Technical and environmental approaches

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Warm mixtures state of art in France

- Introduction
- Main technologies used in France
- Results from the worksites

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Introduction

- Context
  - Environmental policy
    - Rio, Kyoto, Copenhagen
    - Dangerous substances
- Starting point :
  - In Europe : first experiment 2000
  - In France : 2004
    - Performance based approach
    - Innovation protocols
  - ➔ about 1 M tons
    - » 40 M tons

All major road companies have a patented process: COLAS, EUROVIA, EIFFAGE

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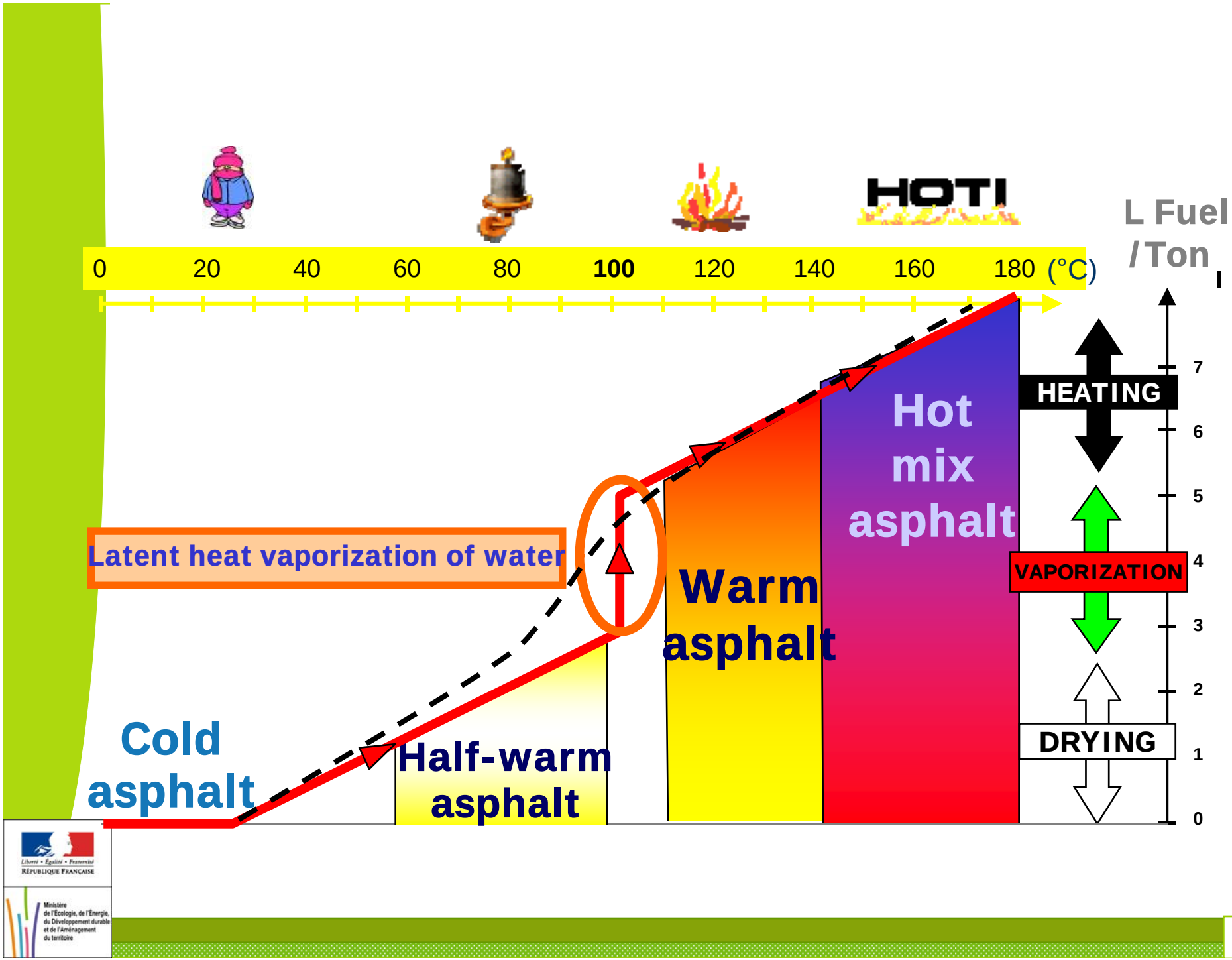
Most used technologies

- Warm Mixture Asphalt  110°C <=> 140°C
- Half Warm Asphalt  70°C <=> 99°C
- Hot Mix Asphalt 

130°C <=> 180°C


HOT!
0 20 40 60 80 100 120 140 160 180 (°C)
L Fuel /Ton
7
6
5
4
3
2
1
0
HEATING
VAPORIZATION
DRYING
Latent heat vaporization of water
Cold asphalt
Half-warm asphalt
Warm asphalt
Hot mix asphalt

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Main technologies: Θ > 100°C

- TEMPERA ® Aspha-min
  - Zeolite additive
  - Foaming effect
- TEMPERA EVOTHERM DAT ®
  - Dispersed Asphalt Technology
  - MEADWESTVACO USA
    - Watery solution injected in line in the binder
- 3E LT ®
  - Special additive agent
  - Rheology of the binder

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ASPHAMIN

- Zeolite
  - Crystalline hydrated aluminium silicate : 20% of crystalline water
  - Added in same time as the bitumen 0,3% by total mass of mixture
  - About 100°C water is released ➔ foaming effect ➔ increases the volume of the binder ➔ increases workability for about a 5 hour period
  - Compaction 110°C ➔ benefit :30°C

Evotherm DAT

- Dispersed Asphalt Technology 
  - MEADWESTVACO
  - Cationic Emulsion and additives, with only a small amount of water
  - Injection in the binder pipe just before the mixer (3kg/T).

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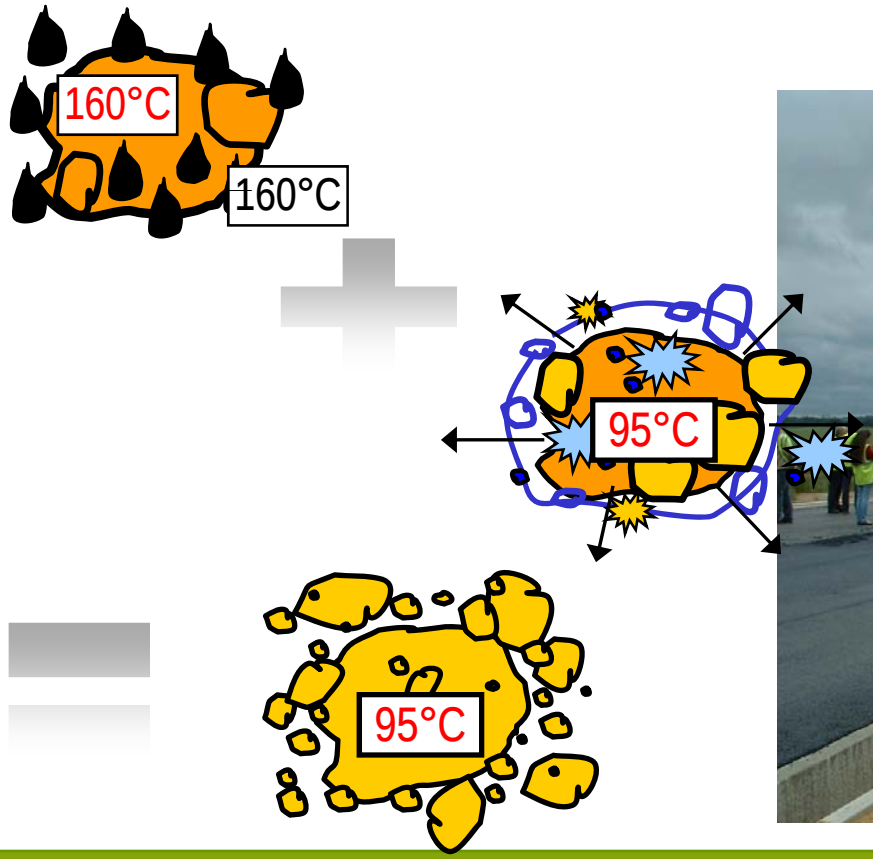
Main technologies: Θ < 100°C

•LEA-CO ®



ECOMAC ®

- Cold mixture
- Reheated in a « warmer drum »
- Compaction about 50°C
- Monitored trial section in progress (2010 program)

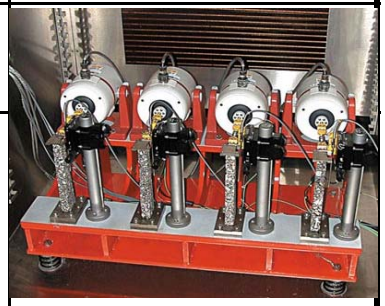
Warm mixtures
State of art in France
Results from the worksites

- Mechanical characteristics of the mixes
- Environmental Data

Warm mixtures state of art in France

Results from the worksites
Mechanical characteristics

- Observatory group
- Monitored trial sections
- Specimen preparation
  - From the industrial process

Property	Result (comparison with HMA)	
Void content	= or 4% higher	
Moisture sensitivity	- 0,1	
Rutting resistance	= or 2% higher	
Stiffness	= or 15% lower	
Fatigue	6 µdef lower (1 result)	

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From the Worksite

Environmental data

- Measurement on the plant

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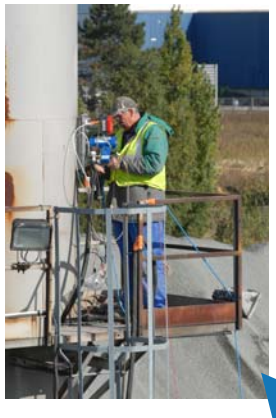
Environmental data from the plant

Environmental measurements devices



- Gas electricity consumption
- Gas emission
  - 02, CO2, CO, NOx, CH4
  - Flux chamber

(Polycyclic Aromatic Hydrocarbon (PAHs), particles not considered)

Prélèvement et analyse des gaz cheminée

- Thermocouple
- Tube de Pitot (pressions statique et dynamique)
- Sonde
- Analyseur 02 sur gaz humide
- Ligne de prélèvement chauffée (180°C pour éviter la condensation)
- Analyseur FID (Mercury 901)
- Condenseur à effet Pelletier
- Analyseur multigaz (PG250 Horiba)

Measurement of gas emission

- FID (Mercury 901)
- multigaz analyser (PG250 Horiba)
- Ambient hygrometry
- Ambient temperature
- Gas velocity
- Pressure (Pitot tubes)
- =➔ to calculate the flow rate and the mass emission rates

Chambre à flux


KIMO

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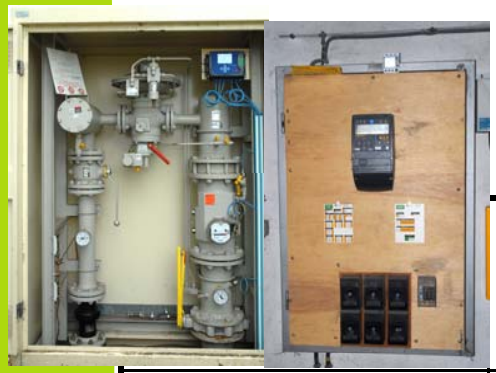
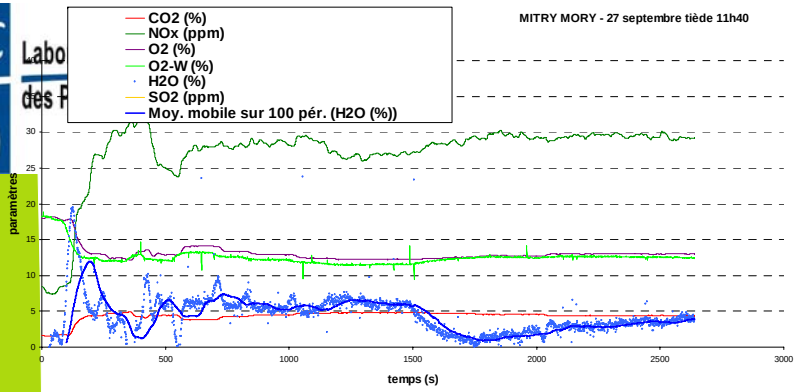
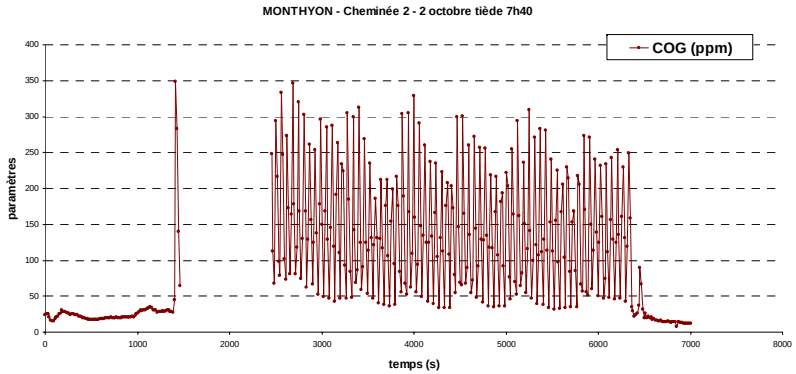
Environmental data from the plant



Energy consumption

	Manufacture		Transport + laying		TOTAL	
10^3 MJ	Hot	1/2W	Hot	1/2W	Hot	1/2W
Gas	102	46				
Fuel	0	0	6,1	6,2		
Electricity	3,6	3,1				
Total	106	49	6,1	6,2	132,6	75,9
Reduction	53%		0%		43%	





Emission of air contaminants

	Manufacture		Transport + laying		Reduction
10^3 kg	Hot	1/2W	Hot	1/2W	
CO2 10^3 kg	5	1,8	1,81	1,82	47%
C0 10^3 kg	3,7	3,7	5	5	0%
NMGOC kg	4,7	2,2	2,5	2,4	36%
NOx kg	1,5	0,4	23,2	23,2	4%
CH4 kg	0,6	0,9			+50%

Calcul des impacts environnementaux

- $I = \Sigma \alpha i \; Ci \times mi$
- αi coefficient d'allocation: contribution du composant i
- Ci coefficient de contribution d'1 kg
- mi masse du composant émis

- Description of the impact assessment methodology (Goedkoop 1995)

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Environmental data from the plant

Environmental indicators

	Manufacture		Transport + laying		Reduction
.	Hot	1/2W	Hot	1/2W	
GWP Mg eq	5	1,8	1,89	1,90	47%
POCP kg eq	3,0	1,9	1,25	1,21	27%
AP kg eq	0,53	0,15	3,5	3,5	9%
EI kg eq	0,05	0,01	0	0	10%

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Environmental impact indicators:

(Production + Transportation + Placing)

Global Warming Potential **-47%**

(kg equivalent CO2)

Photo Chemical Ozone Creation Potential **-27%**

(kg equivalent ethylen)

Acidification Potential **-9%**

(kg equivalent SO2)

Toxicity not measured (PAHs°

Eutrophication Index **-10%**

(kg equivalent PO4)

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GENERAL CONCLUSIONS

- Performances of WMA/HWMA are about the same as those of HMA (careful for the compaction)
- Long terme durability to be confirmed

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GENERAL CONCLUSIONS

Lower production temperatures permitt:

- Decreasing the energy consumption
- Decreasing the environmental impact

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More research needed

- New techniques continue to be developped
  - New assessments
- Environmental aspects will become more and more important
  - Studies have to be completed :Toxicity and ecotoxicity to be evaluated (PAH particles)
- Will WMA replace HMA?

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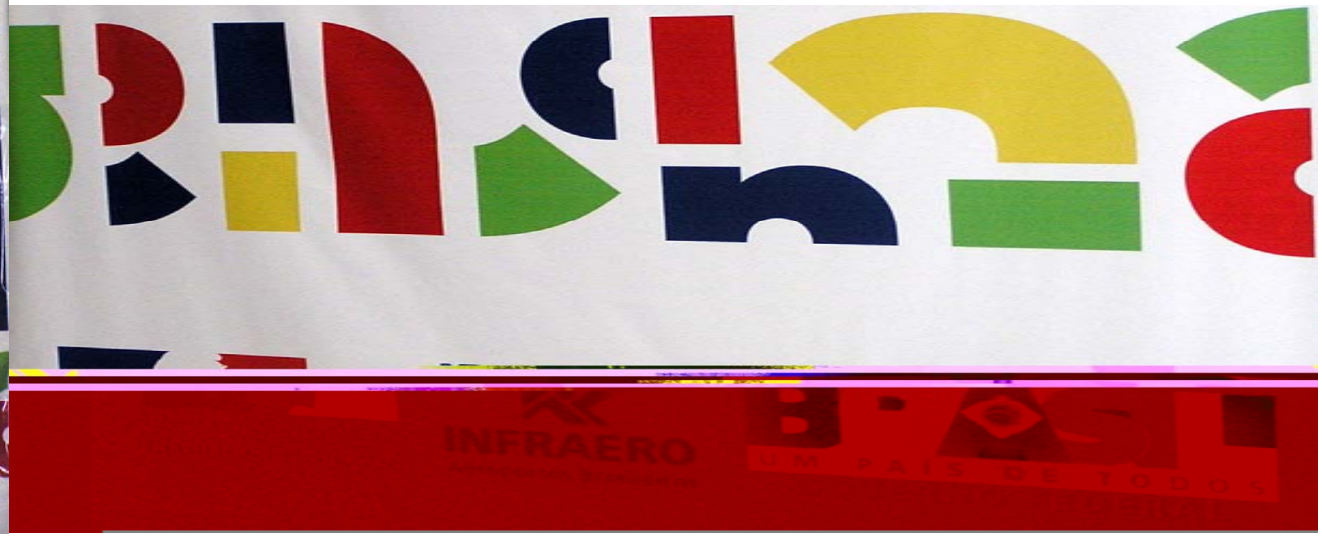
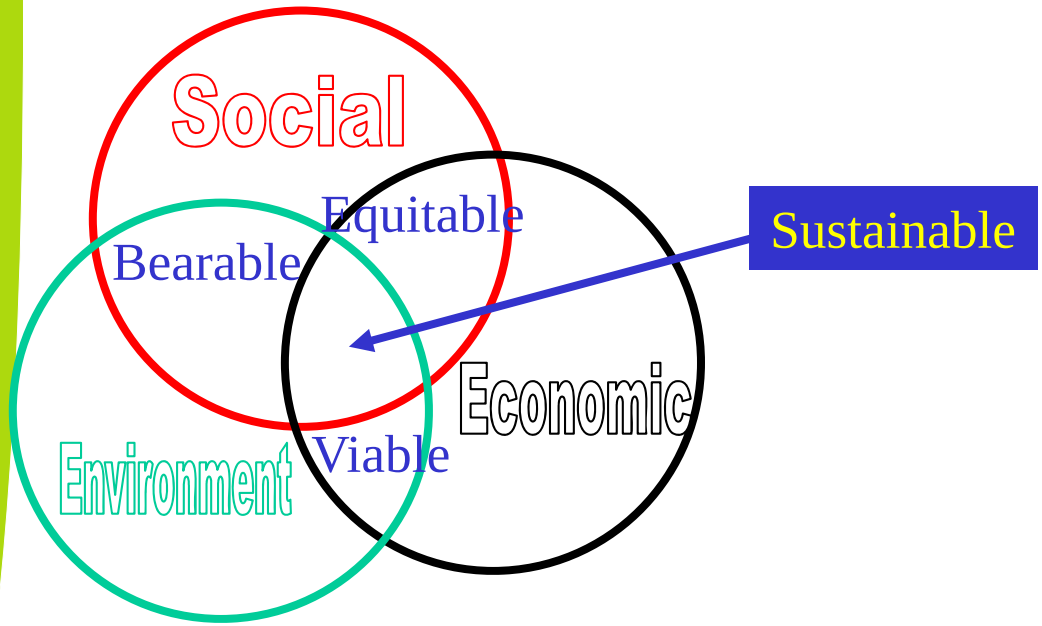
Thank you for your attention

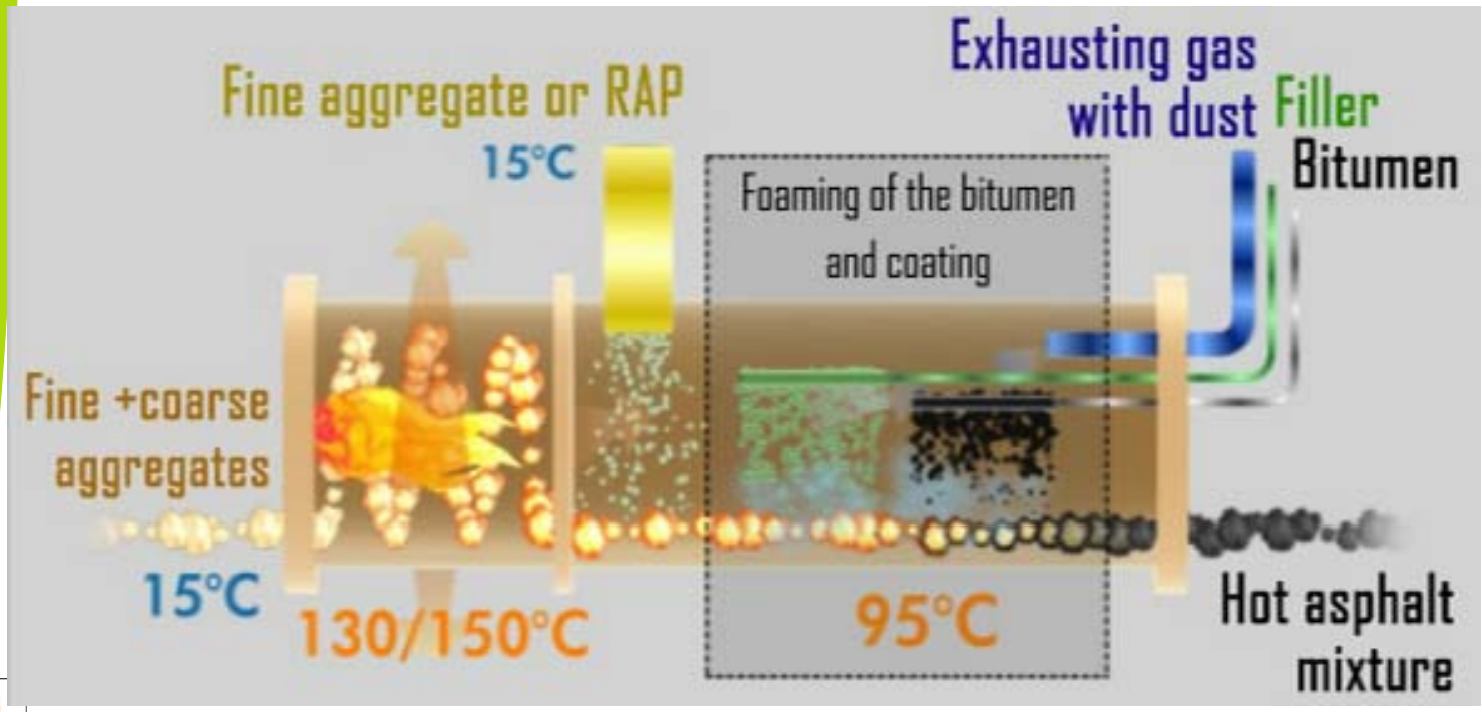


Sustainable development



To meet the need of the present without compromising the ability of future generations to meet their own need

EBE in a Drum


Fine aggregate or RAP
15°C
Exhausting gas
with dust
Filler
Bitumen
Foaming of the bitumen
and coating
Fine +coarse
aggregates
15°C
130/150°C
95°C
Hot asphalt
mixture

Comparison between tranport cooling for hot asphalt and LEA mixture