

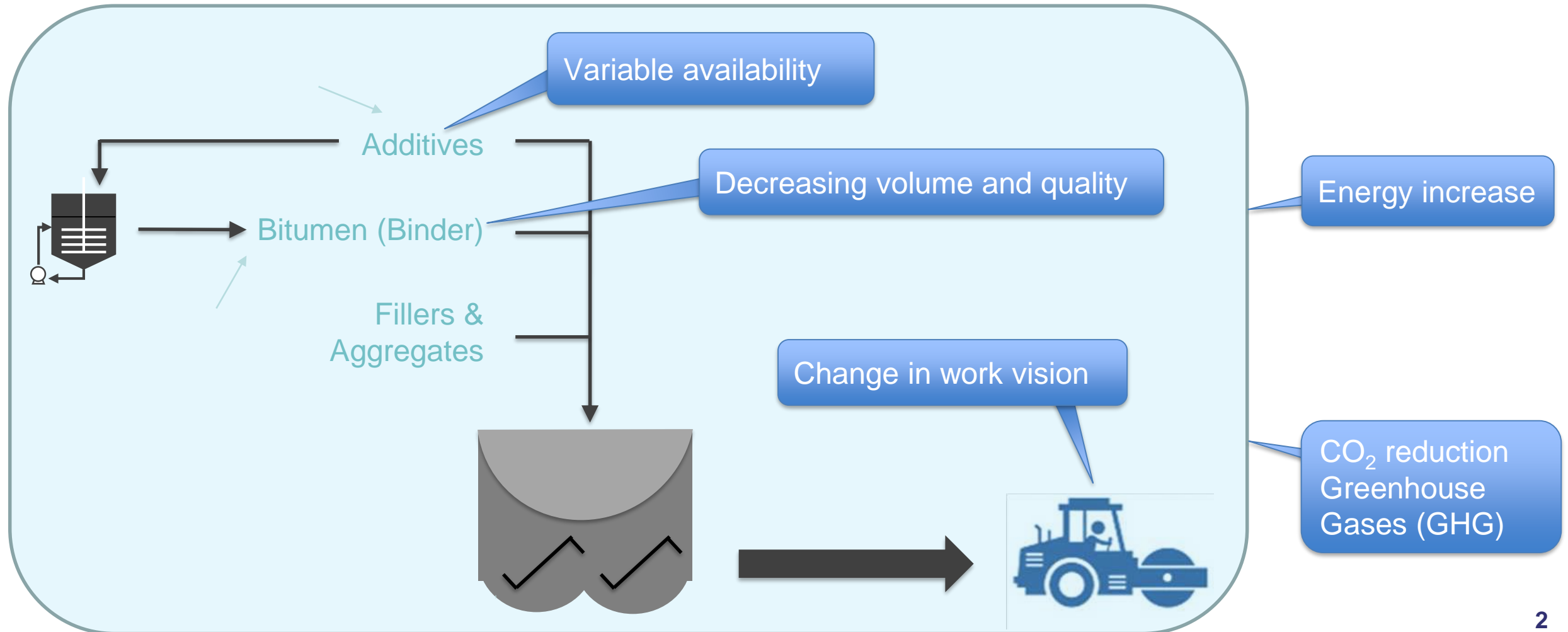
# **Warm Mix Technology with Enhanced Workability Time**

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**Motto: Let's asphalt out of the crisis**

## ASPHALT INDUSTRY FACES NEW CHALLENGES



## EXAMPLES OF GHG REDUCTION INITIATIVES

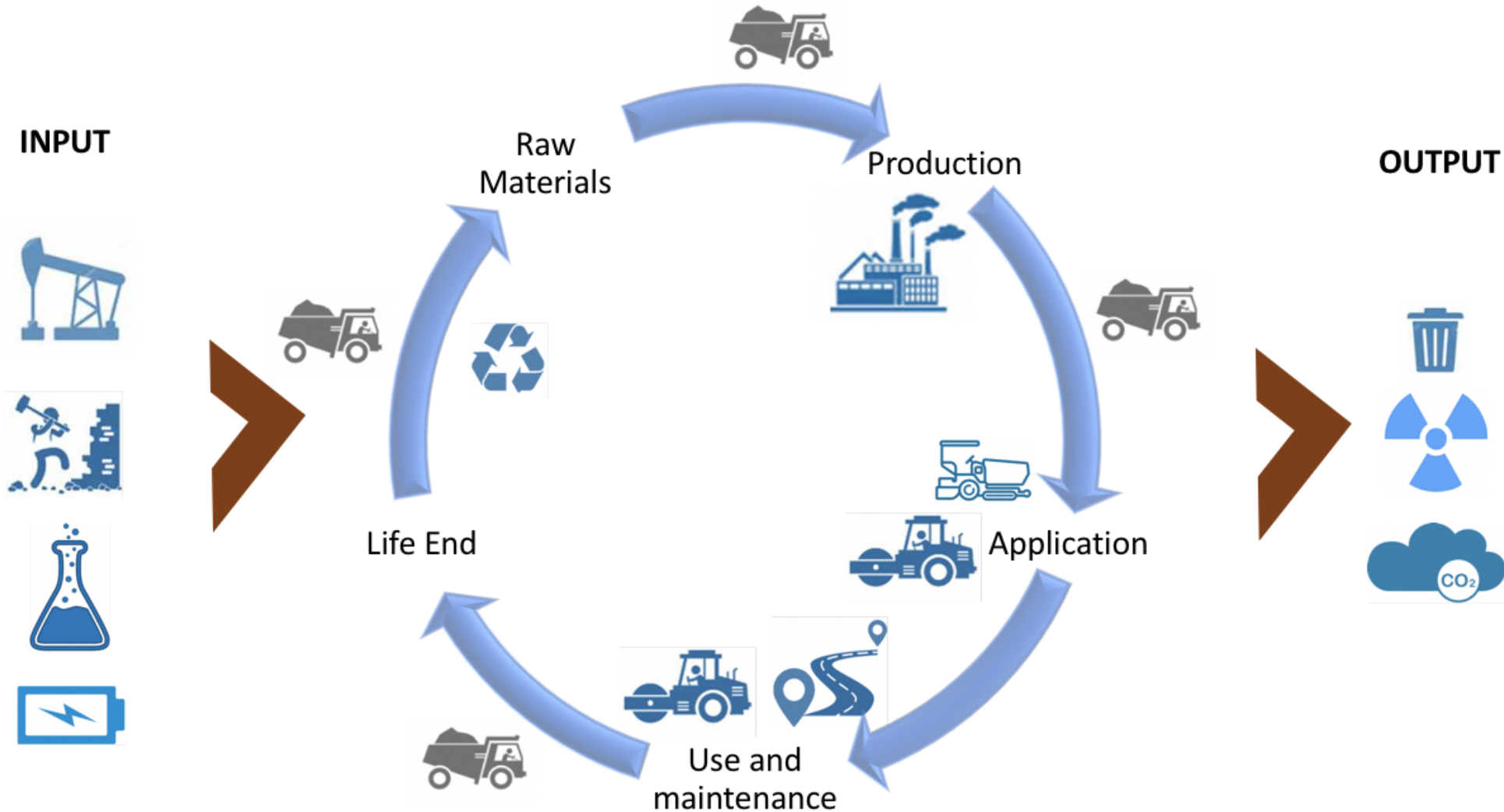
### Financial incentives from some authorities

- ➔ Reduction of temperature of production of the mixes
- ➔ Increase of RAP content in mixes
- ➔ Electricity running equipments
- ➔ Biofuels instead of heavy fuel or natural gas

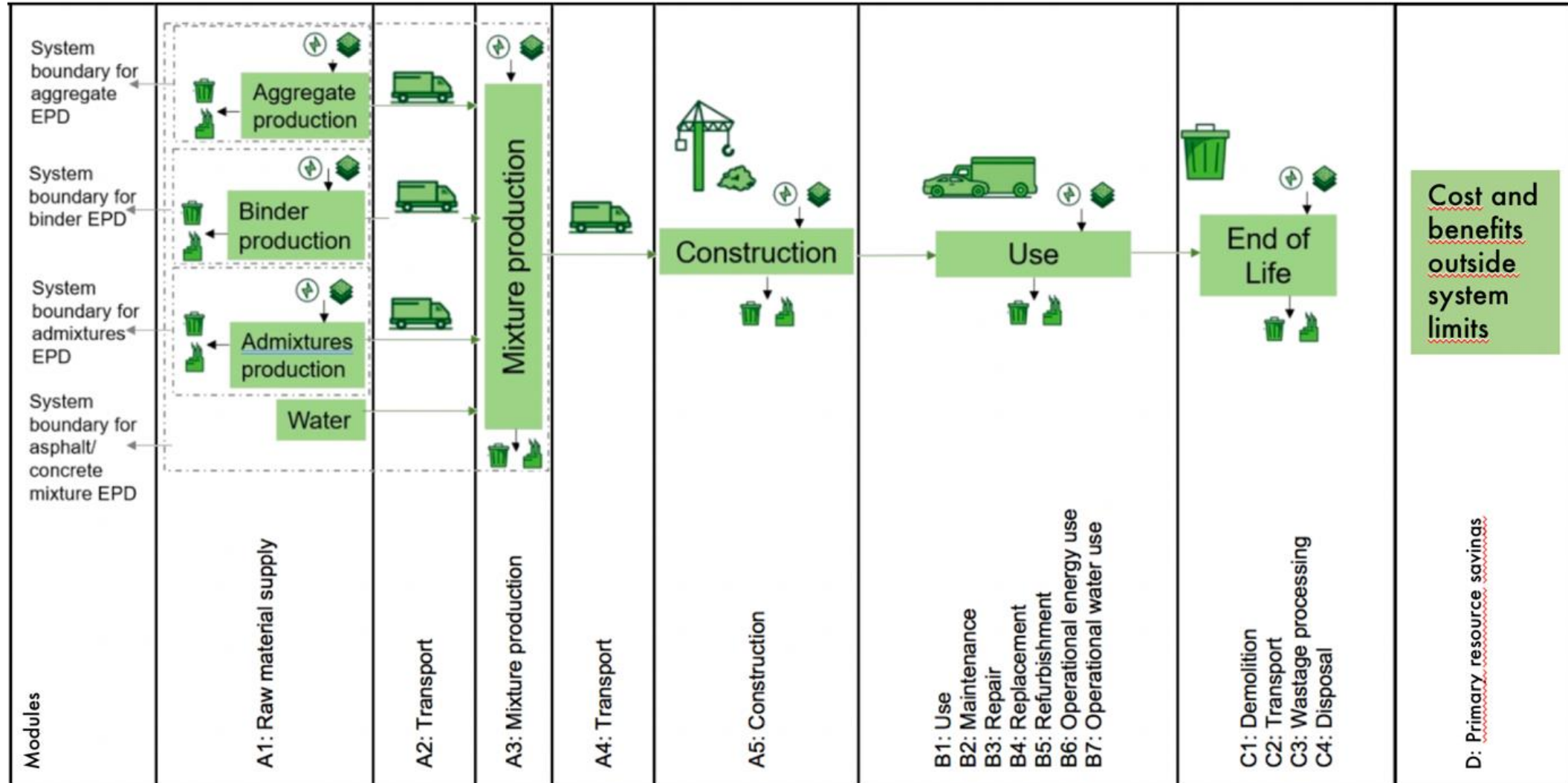
### Green Public Procurement

- ➔ Norway : 25% of asphalt contracts awarded in 2021 had an environmental criteria
- ➔ Netherlands : LCA employed to reduce bidding price
- ➔ France and Belgium : demonstration projects or local adapted tenders
- ➔ Lower GHG is considered as a bonus deducted from the bidding price

## LIFE CYCLE ANALYSIS (LCA)



## APPLICATION TO ASPHALT (ISO 15804+A2)



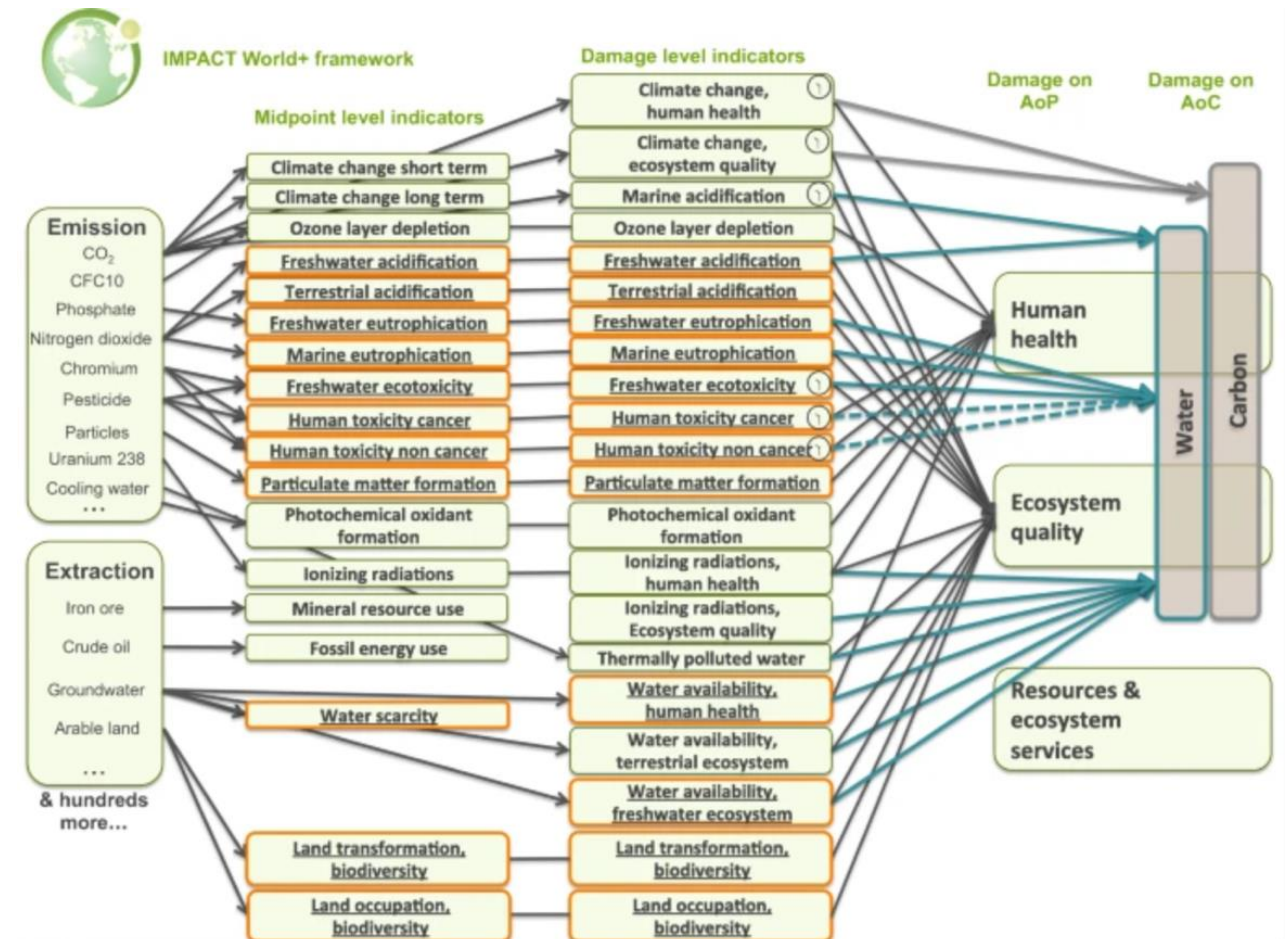
## EPD (ENVIRONMENTAL PRODUCT DECLARATION)

### Calculation

- ➔ For each module, inventory of inputs (energy and raw materials) and outputs (wastes and gas emissions)
- ➔ Compilation to calculate the extraction (input) and emission (output) values
- ➔ These values are translated into impact indicators
- ➔ Made by independant certified consultants

### Indicators

- ➔ Multiple nature



## WHICH INDICATOR TO USE ?



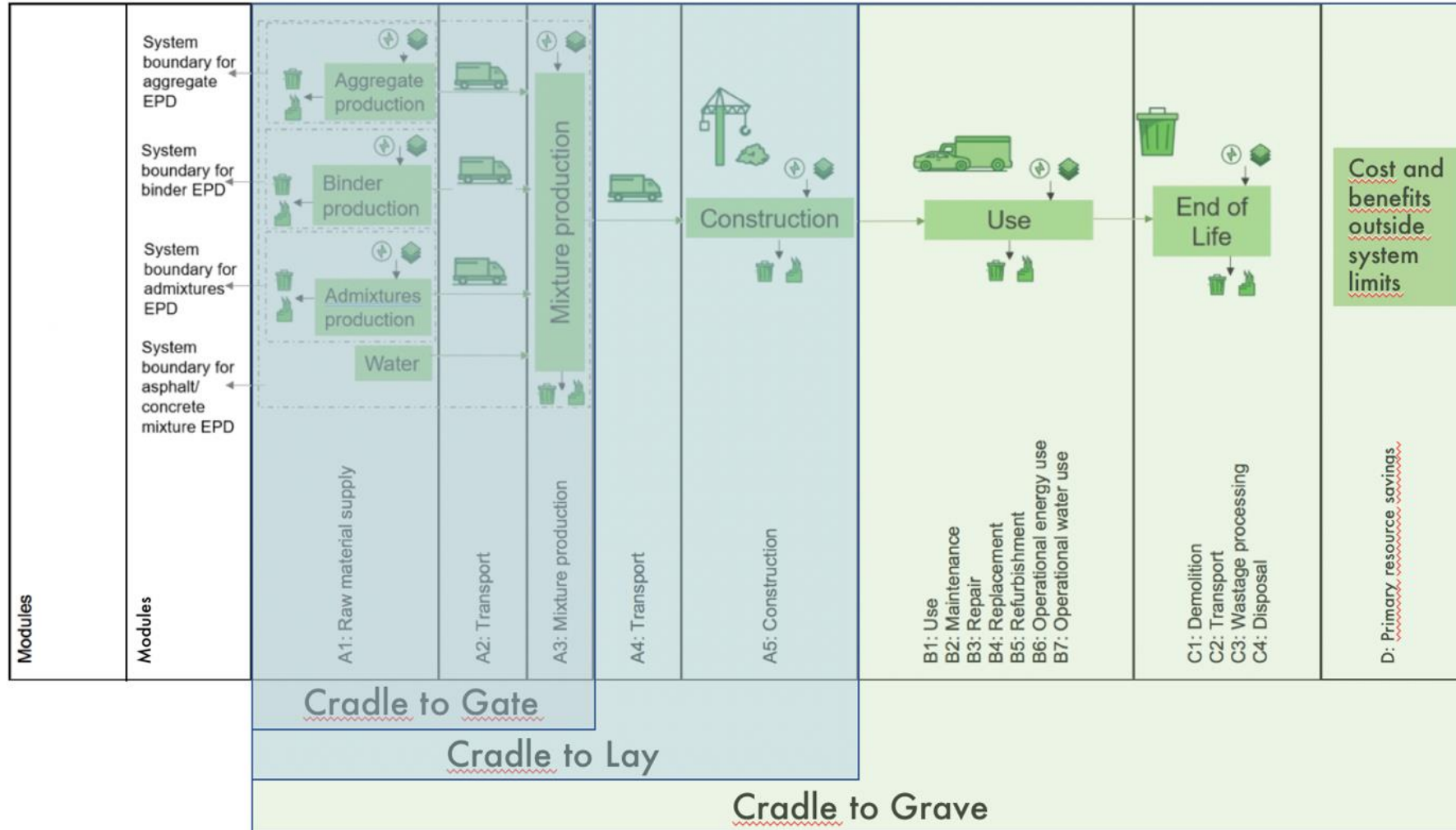
### Examples

- ➔ Eurovia : 4 indicators - consumption of virgin aggregates, exhaustion of fossil resources, climate change and ozone layer destruction
- ➔ Seve, French paving industry LCA evaluation software : 9 indicators
- ➔ BRRC (Belgium) : 11 indicators – 5 for environmental, 2 for performance, 3 for social, 1 for economic

### In practice

- ➔ Most road agencies focus on CO<sub>2</sub>eq produced

## WHICH LIMIT FOR CALCULATION OF EPD ?



### Cradle to Grave

- ➔ Limited in practice to Cradle to Gate
- ➔ CO<sub>2</sub>eq indicator is not enough
- ➔ Durability to be taken into account

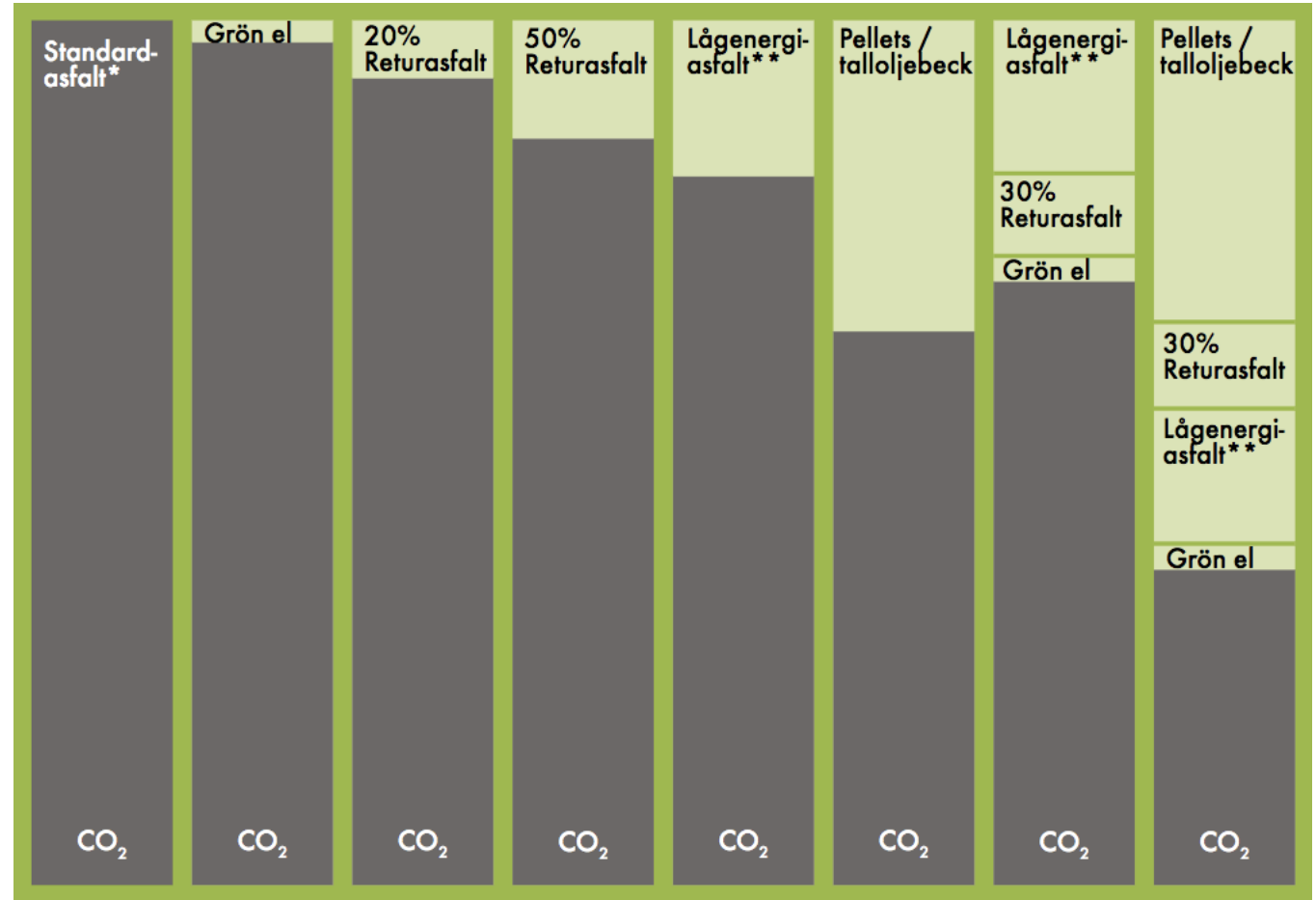


## EPD USES

### Tenders

### Eco-conception playing with :

- ➔ Recycling
- ➔ Warm mix
- ➔ Cold mix
- ➔ Bitumen reduction/substitution
- ➔ Biobased Additives
- ➔ Electricity for heating tanks, trucks, paving equipment
- ➔ Biofuels instead of natural gas, heavy or domestic fuel oils
- ➔ Mobile asphalt plants/on-site recycling



## WARM MIX TECHNOLOGIES

### Second largest impact on CO<sub>2</sub> reduction

- ➔ -25°C means around 20% CO<sub>2</sub> abatement
- ➔ -50°C means around 25/30% CO<sub>2</sub> abatement

### Different physico-chemistries

- ➔ Foam (including zeolite) : bitumen is expanded in the form of foam, usually with steam around 100°C, allowing a good coating of the aggregates
- ➔ Waxes : they reduce the viscosity of the bitumen, authorizing handling at lower temperature
- ➔ Liquid surface agents : by reducing the angle of contact between bitumen and aggregates, they improve wettability of aggregates and facilitates coating at a lower temperature

## NEW PATENTED\* WAX : VALOWAX™ CRH

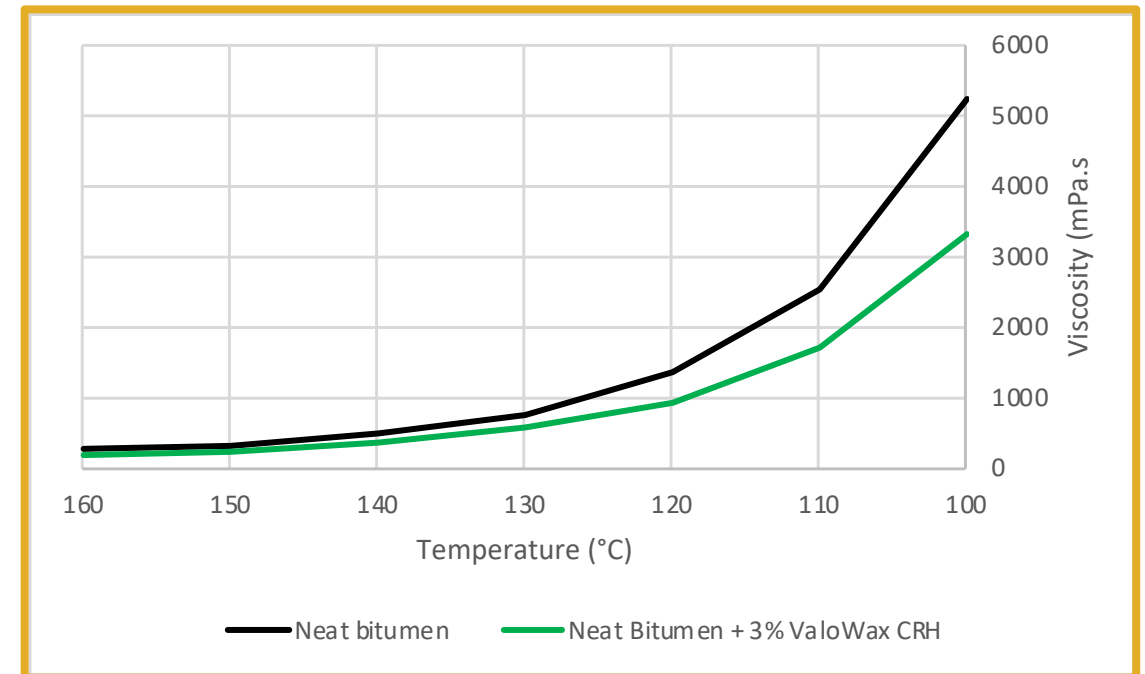
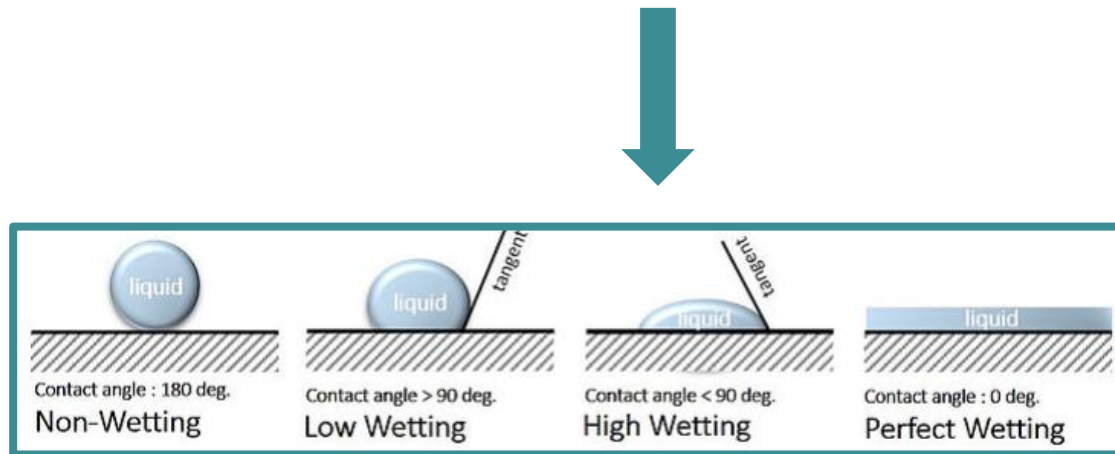
### Main features

- ➔ Biobased
- ➔ No change in R&B and Pen of bitumen
- ➔ 84°C transition temperature
- ➔ 20 to 30°C reduction of production temperature of asphalt mix
- ➔ Good mechanical performances of asphalt mixes
- ➔ Extended workability time, suitable for hand application or long distance jobs
- ➔ Combination possible with other warm mix technologies
- ➔ Solid product : 1 to 5% vs. bitumen
- ➔ No degradation in time of bitumen treated with ValoWax™ CRH

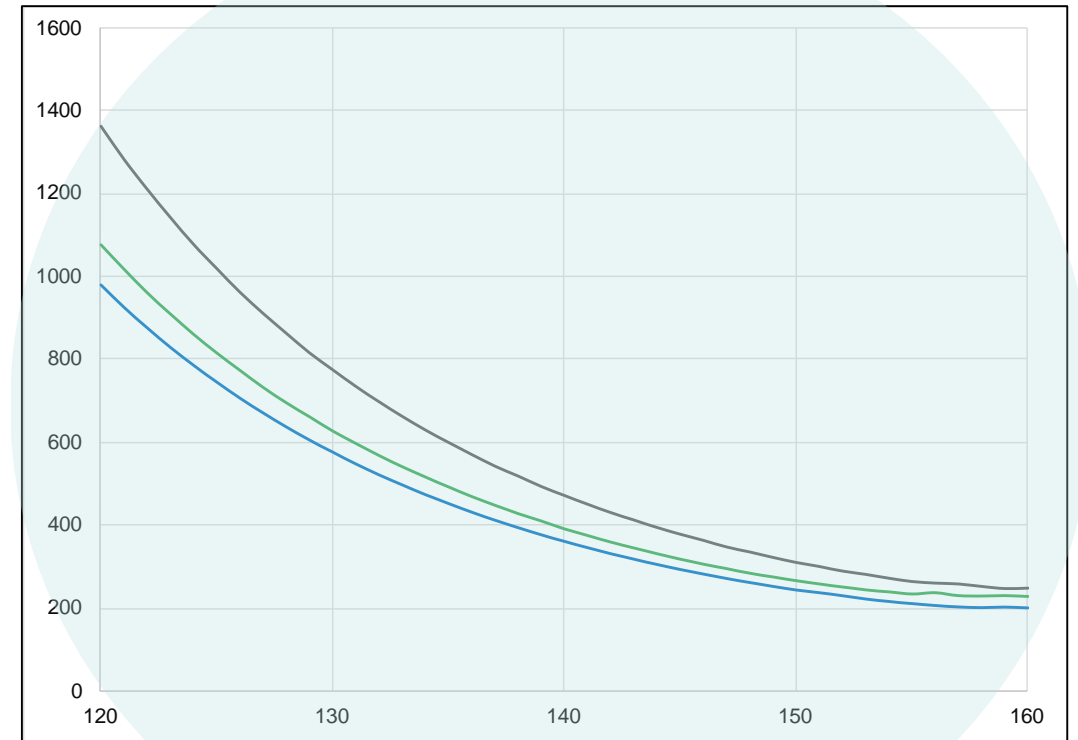
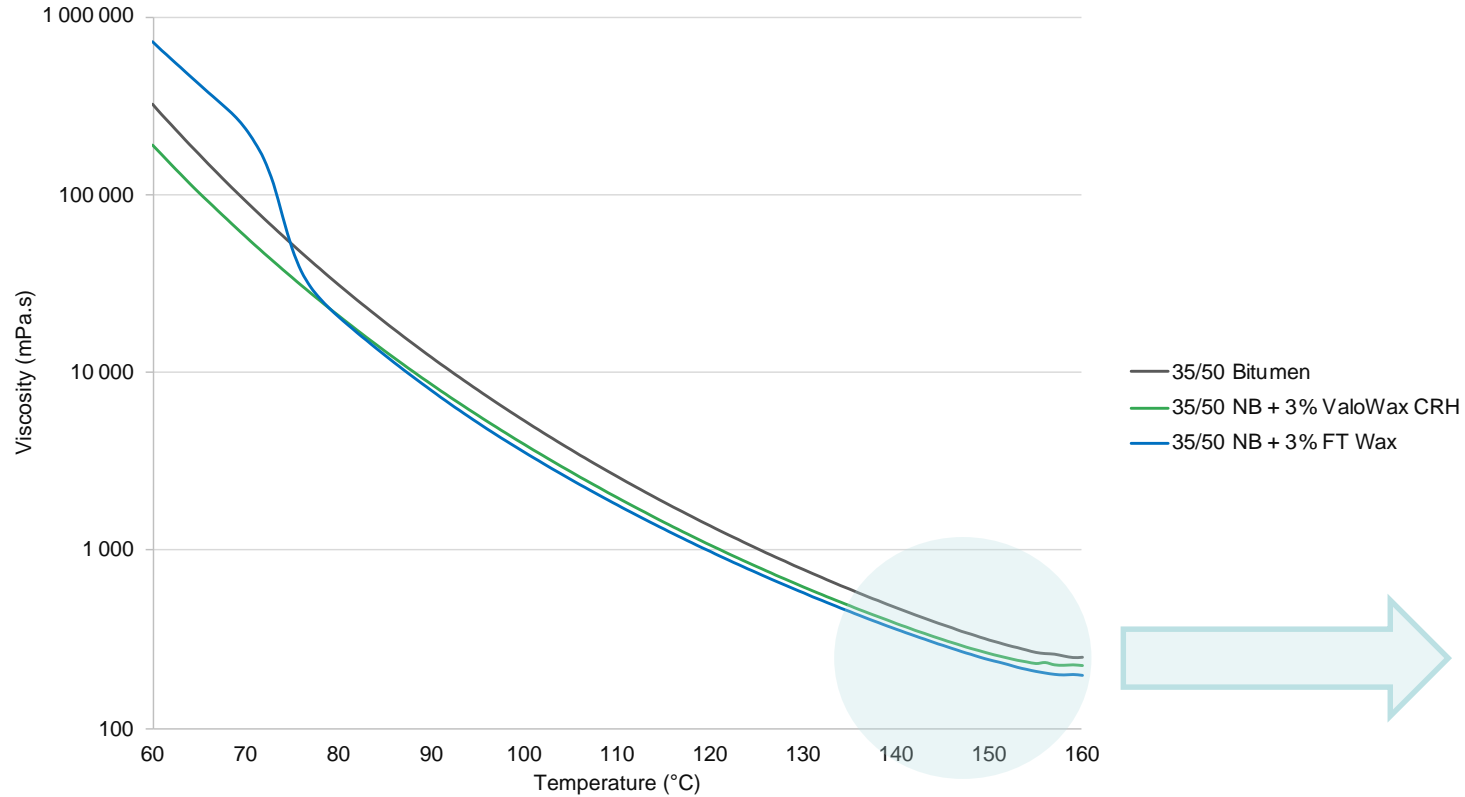
## VALOWAX™ CRH MECHANISMS OF ACTION

Cumulated effect of wax and liquid surface agent

- ➔ Reduction of bitumen **viscosity**
- ➔ Change of **contact angle** aggregates/bitumen

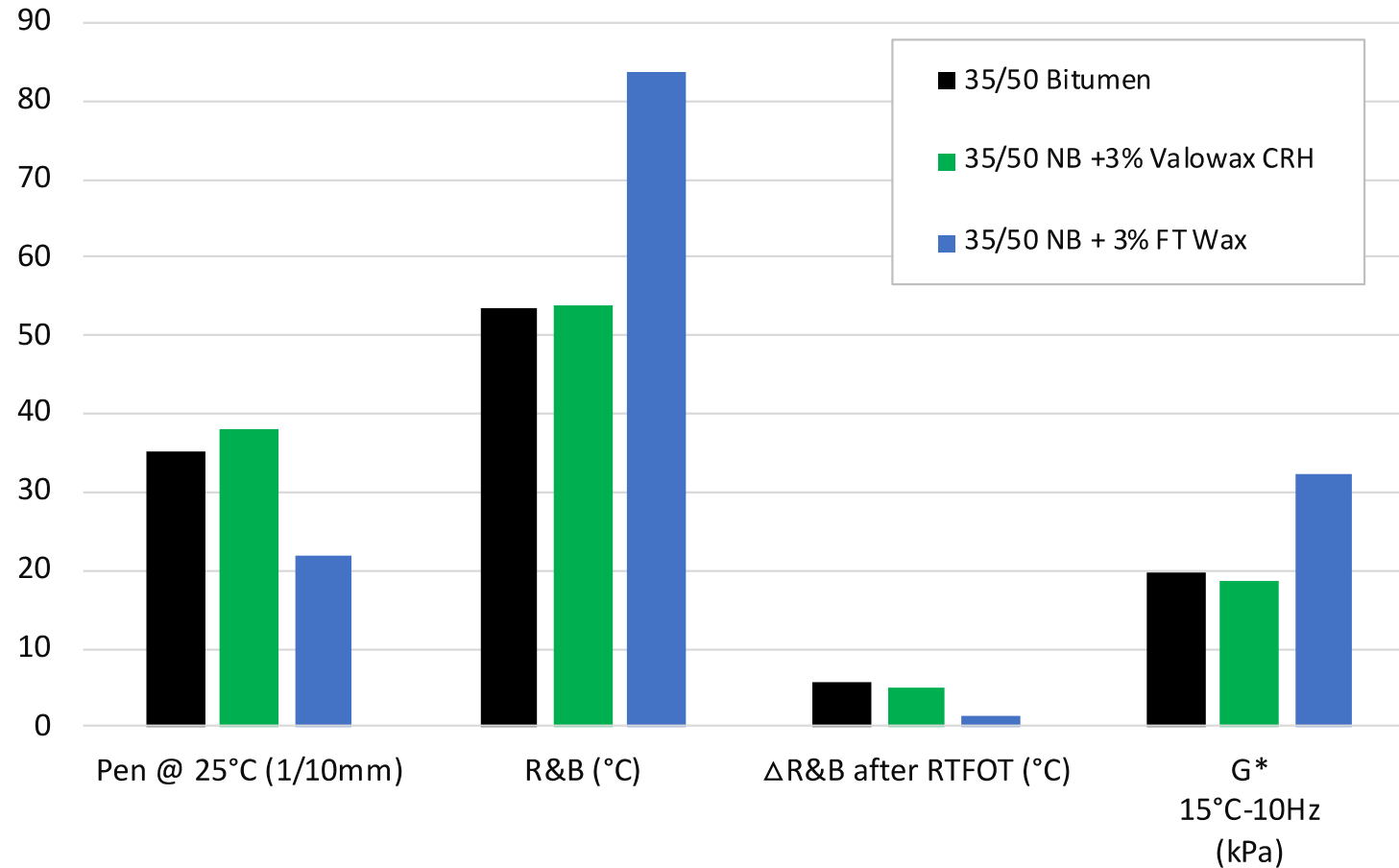


## IMPACT ON VISCOSITY



➔ Viscosity reduction similar to Fisher Tropesch wax

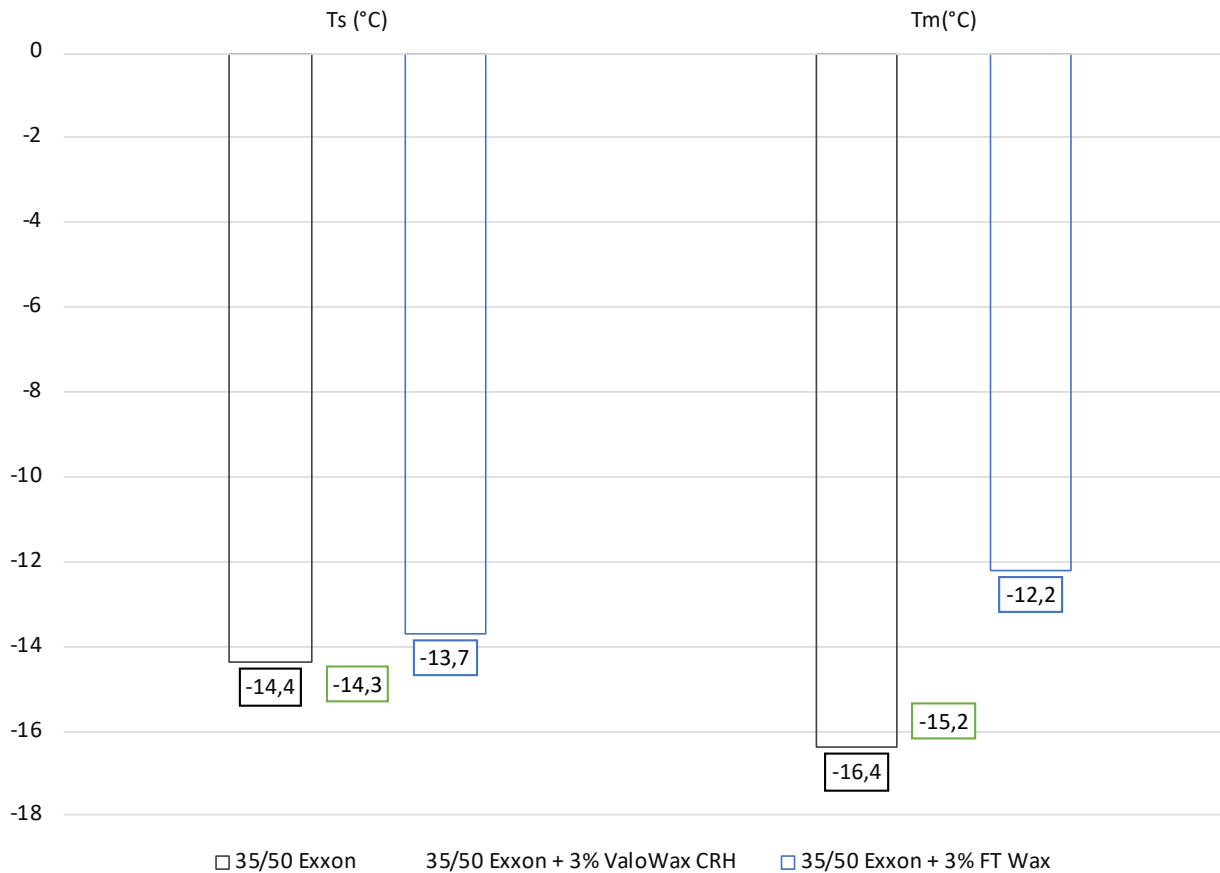
## IMPACT ON PENETRATION AND SOFTENING POINT



➔ No change in Pen and Softening Point : opposite to FT (Fisher Tropsch) wax

## IMPACT ON COLD PROPERTIES

Cold Properties - Bending Beam Rheometer



	35/50	35/50 + 3% CRH	35/50 + 3% FT
$\Delta T_c$ (°C)	2	0.9	-1.6

➔ Small impact on BBR

## MECHANICAL PROPERTIES OF ASPHALT MIX

	% additive	PCG Compactibility NF EN 12697-31 (%voids)	Water resistance NF EN 12697-12 (%ITSR)	Rutting resistance NF EN 12697-22 (%rut)		Restrained thermal shrinkage NF EN 12697-46		Stiffness Modulus IT-CY NF EN 12697- 26 (MPa)
				After 30 000 cycles	After 10 000 cycles	Breaking temperature (°C)	Tensile stress (MPa)	
Specification	-	5 < V60 < 10	>70%	-	< 5%	-	-	> 7000
Hot mix asphalt	-	9,5	92	3,1	2,8	- 21,4	3,63	11 520
Warm mix asphalt with CRH modified bitumen	3,5% vs bitumen  2kg/t asphalt mix	9	99,9	4,0	3,6	- 21,2	4,58	12 590

### Standard 0/10 French BBSG

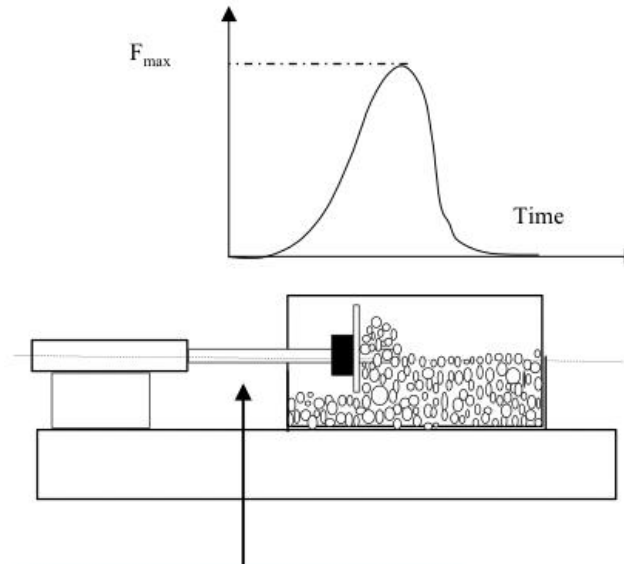
- ➔ 6/10 : 41.7%
- ➔ 2/6 : 20.8%
- ➔ 0/2 : 30.3%
- ➔ Filler : 1.9%
- ➔ 35/50 : 5.3%  
with 3.5% CRH



## WORKABILITY TESTS



Freundl mixer



Lever arm exerting a thrust shear



Mold containing an asphalt mix

Nynas workability test

## COMPARISON OF VARIOUS WARM MIX TECHNOLOGIES

### EB10 standard urban asphalt

- ➔ manufactured in 5 conditions
- ➔ 12 Tons batches
- ➔ Workability measured at the lab and in the field

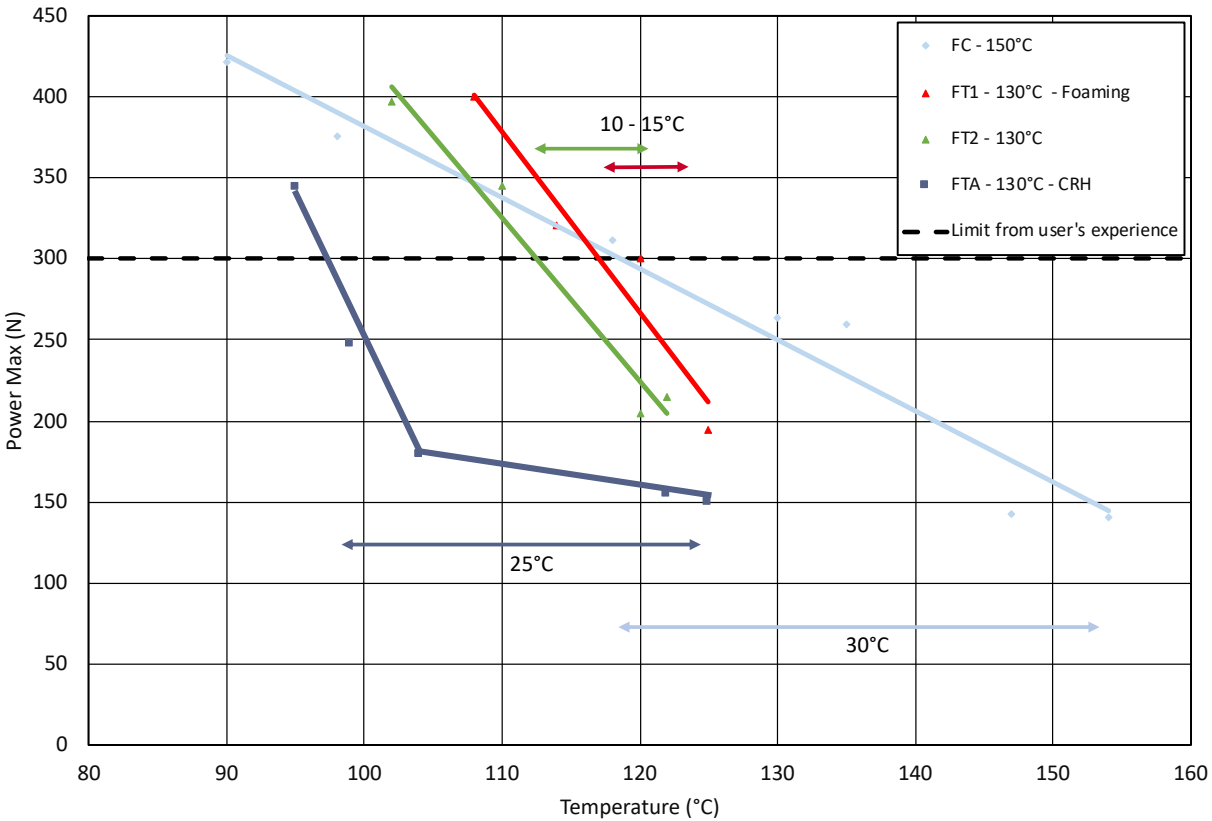
FC	FT1	FT2	FTA	FTA30
Hot	Warm	Warm	Warm	Warm
150°C	130°C	130°C	130°C	130°C
No additive	Foam	No additive	ValoWax CRH	ValoWax CRH
10% RAP	10% RAP	10% RAP	10% RAP	30% RAP

Asphalt composition	FC, FT1, FT2, FTA	FTA30
6/10 alluvial	27.6%	22.4%
2/6 alluvial	25.4%	19.8%
0/2 alluvial	28.6%	22.3%
Limestone filler	3.3%	1.6%
RAP	10%	30%
50/70 Bitumen	5.1%	3.9%
Total Bitumen	5.6%	5.6%

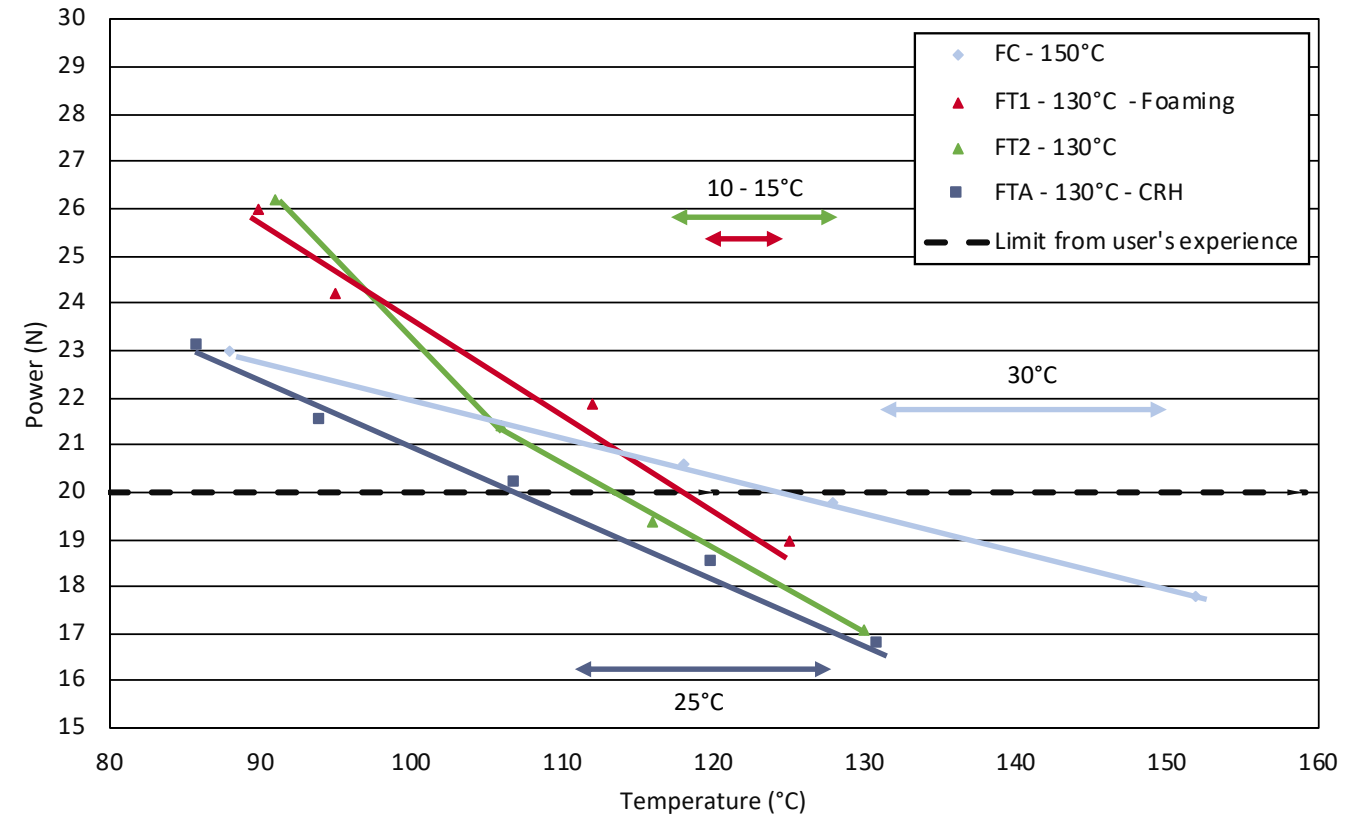


## WORKABILITY AT THE LAB

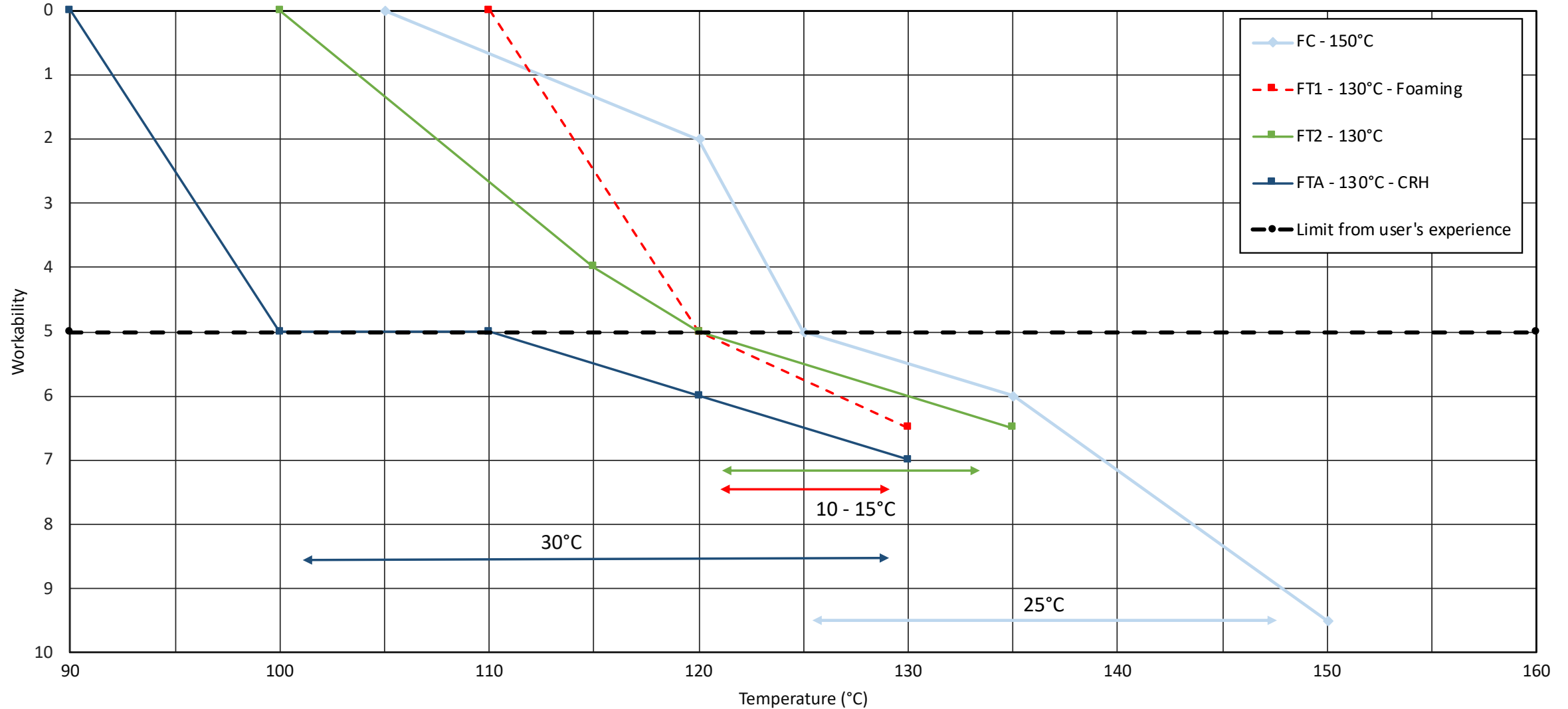
### Nynas



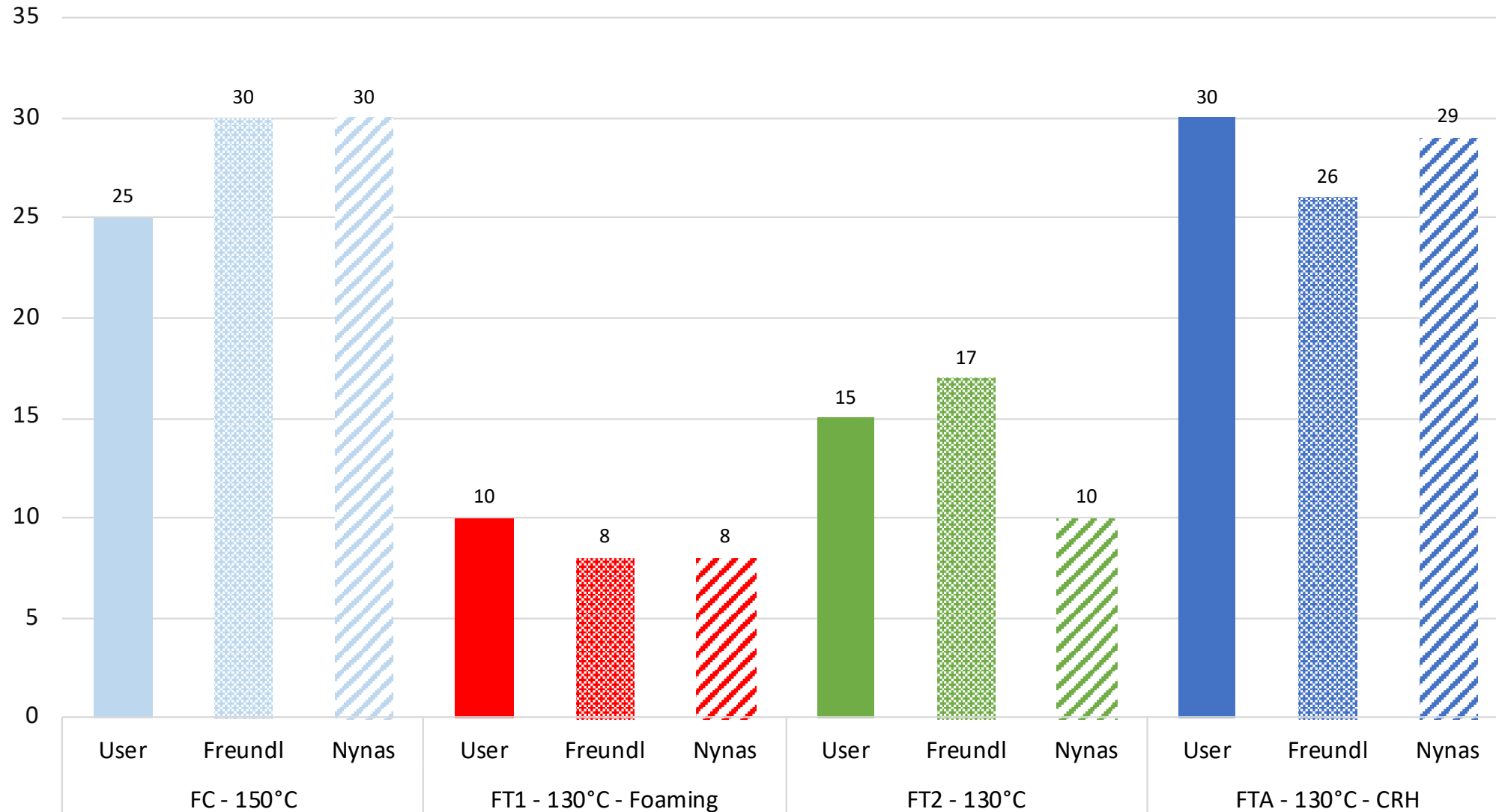
### Freundl



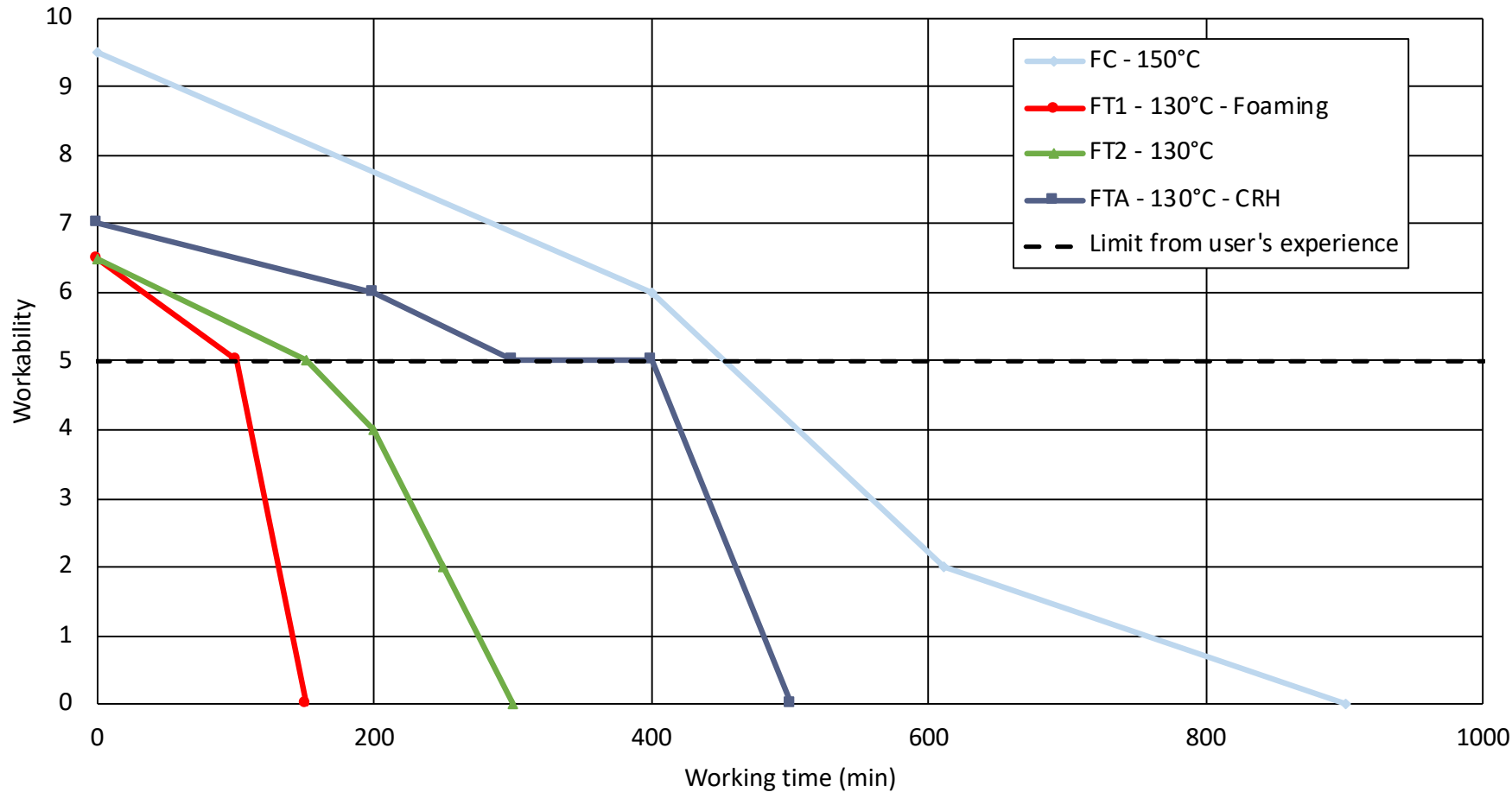
## WORKABILITY IN THE FIELD



## WORKABILITY TEMPERATURE RANGES



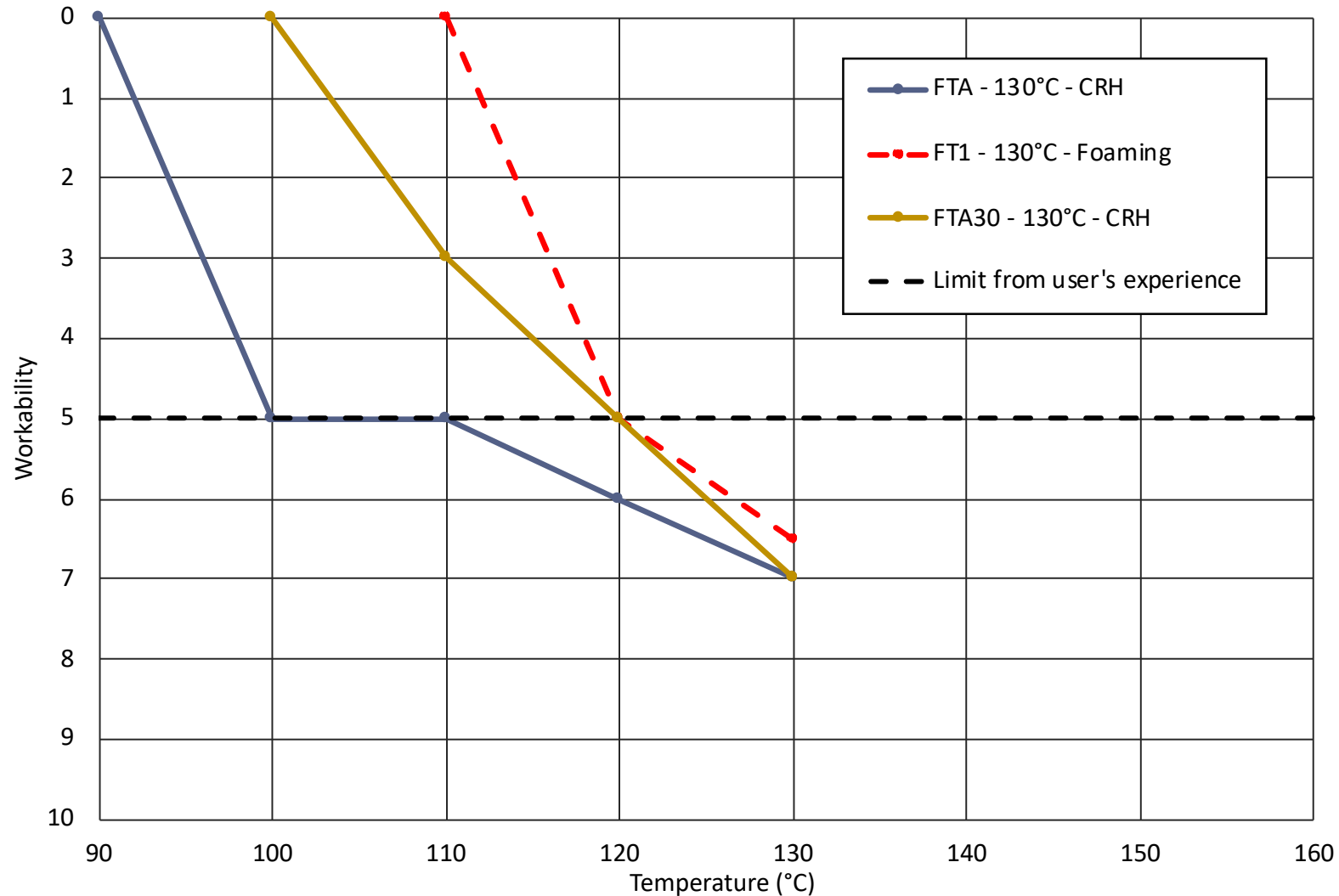
## WORKABILITY TIMES



**Extensive workability time with ValoWax™ CRH particularly suitable for :**

- Hand application
- Long transport times

## IMPACT OF RAP CONTENT



**Workability temperature range of ValoWax™ CRH with 30% RAP is equivalent to foam with 10% RAP**

## CONCLUSIONS

### EPD

- ➔ Promising tool to introduce an environmental criteria in tenders so as to reduce GHG emissions
- ➔ Adjustments still necessary with respect to the scope of the LCA and the impact indicators used

### Asphalt eco-conception

- ➔ Warm mix is the second largest option to reduce GHG emissions

### ValoWax™ CRH

- ➔ Biobased warm mix additive
- ➔ No impact on penetration and softening point
- ➔ Good mechanical performances of the asphalt mix
- ➔ Extended workability time, similar to hot mix
- ➔ Particularly suitable for manual lay-down and long-distance transport