



EVALUATION OF REJUVENATING AGENTS

The Norwegian Asphalt
Association Conference - NABin 2015

E6
Bohuslän

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PEAB
NORDENS SAMHÄLLSBYGGGARE

Background

- An interest/need to increase the amount of recycled asphalt pavement (RAP) in new mixes.
- Limitations due to aged and brittle binder in the RAP.
- Hot in-place recycling (remixing) and repeated remixing.

Background

- Rejuvenating agents may enable an increased use of RAP.
- A number of rejuvenators exist on the market.
- The use of rejuvenators is not common in Sweden.

Objectives

- Evaluate and compare the performance of different rejuvenating agents.
- Improve quality of remixed pavements.
- Increase the use of techniques that is environmental friendly and saves resources.

Project layout

- Phase 1
 - Laboratory testing to evaluate rejuvenators
- Phase 2



Content

- Phase 1 - Evaluation of 4 rejuvenating agents
 - Function as rejuvenators
 - Economy
- Pilot study to phase 2
 - Emulsion with rejuvenators

Methodology

- Function as rejuvenators
 1. Recover binder from RAP
 2. Rejuvenate the binder to a 70/100
 3. Perform testing before and after aging (RTFOT)

Compare test results to virgin 70/100 binder

Products

- Rheofalt
- Storflux
- Nygen 910
- Rapfix



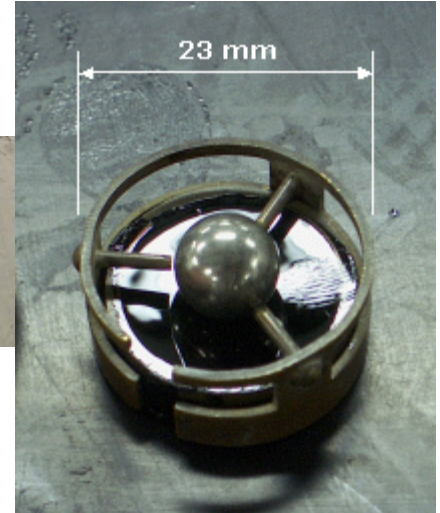
Laboratory testing

- Penetration
- Ring & Ball
- RTFOT
- Fraass breaking point
- Kinematic and dynamic viscosity



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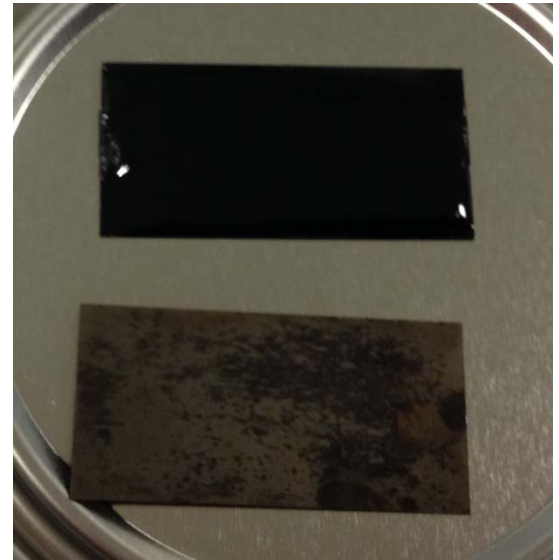
Laboratory testing

- Penetration
- Ring & Ball
- RTFOT
 - Rolling Thin Film Oven Test, aging from production to paved construction
- Fraass breaking point



Laboratory testing

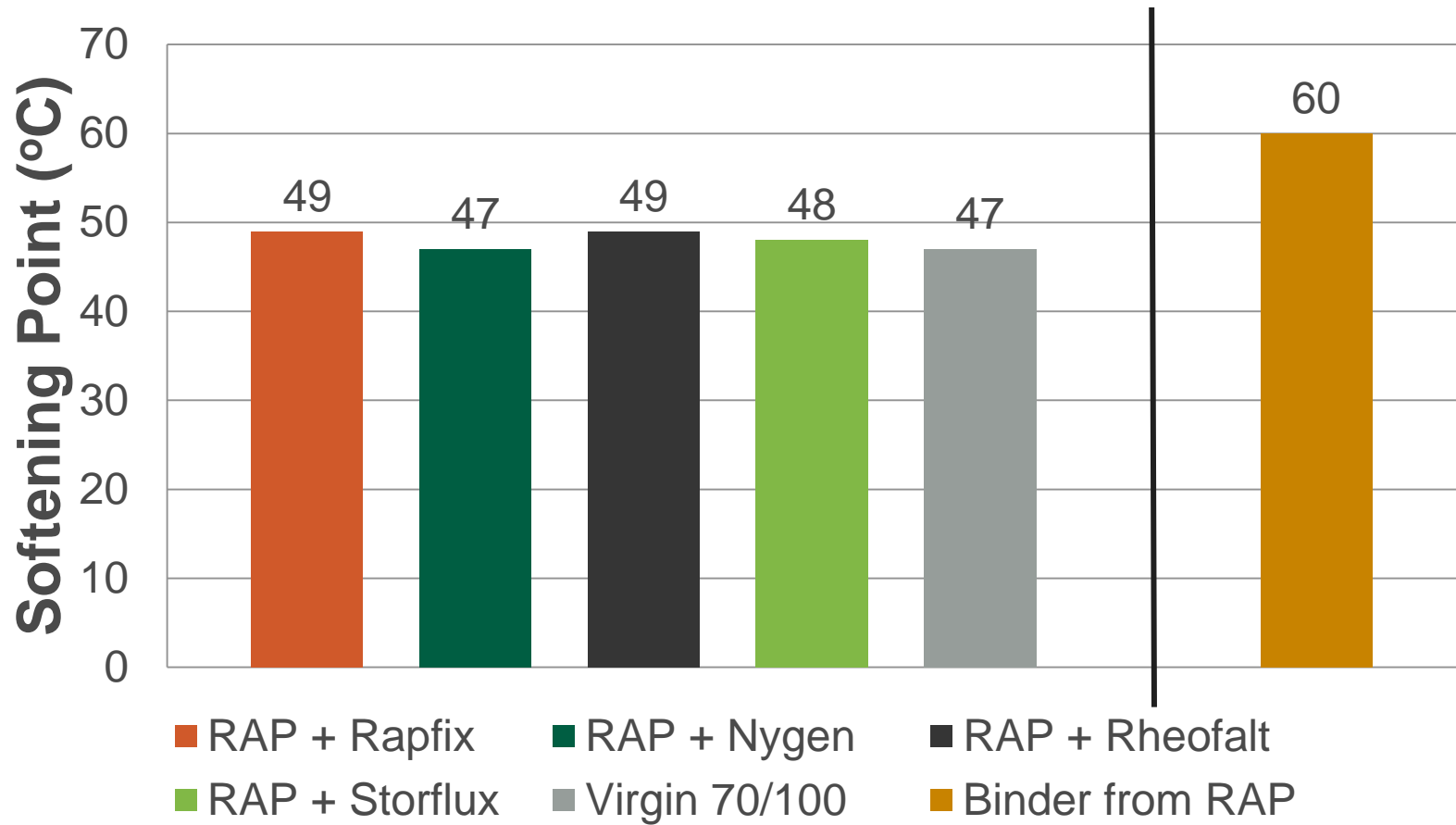
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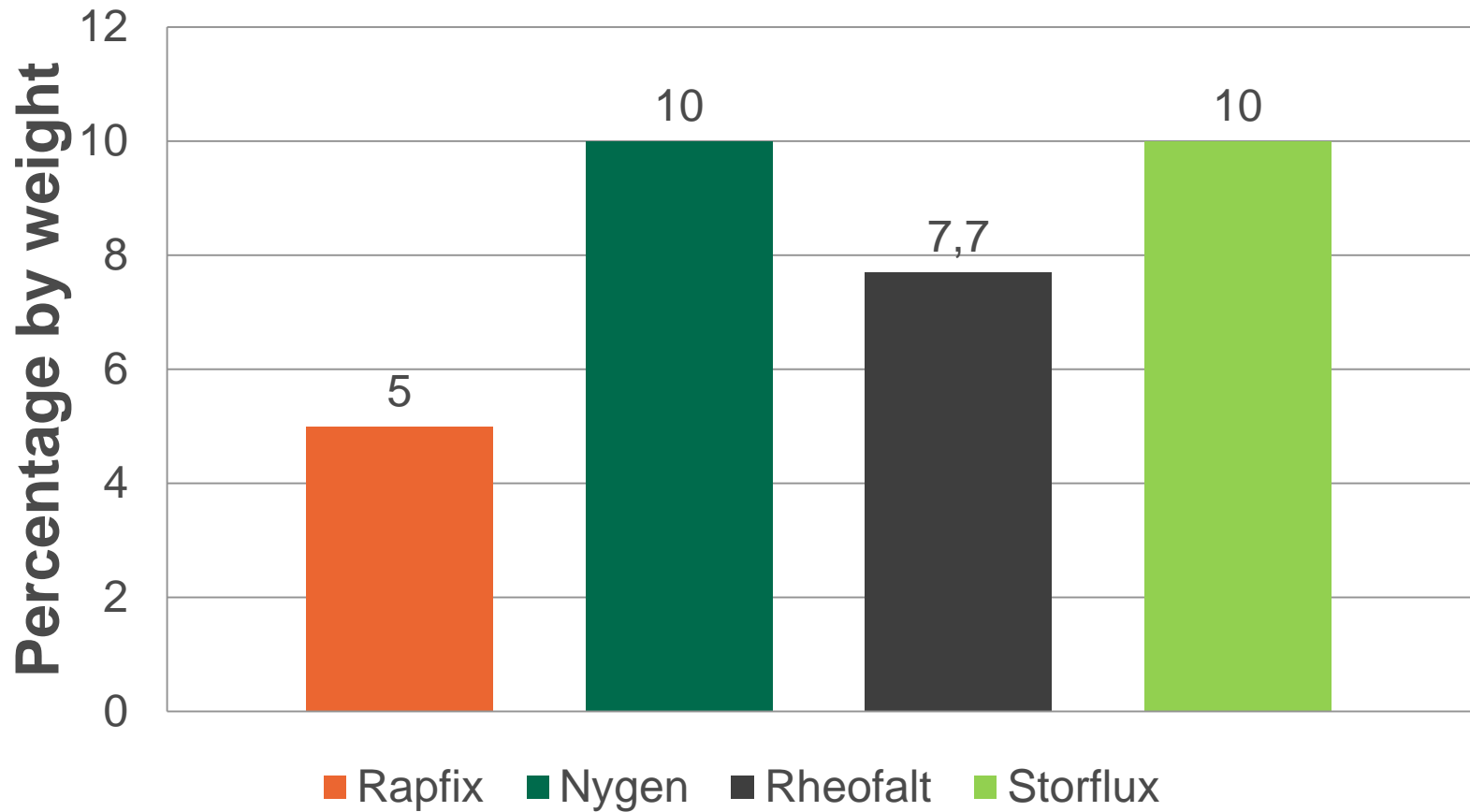
Laboratory testing

- Penetration
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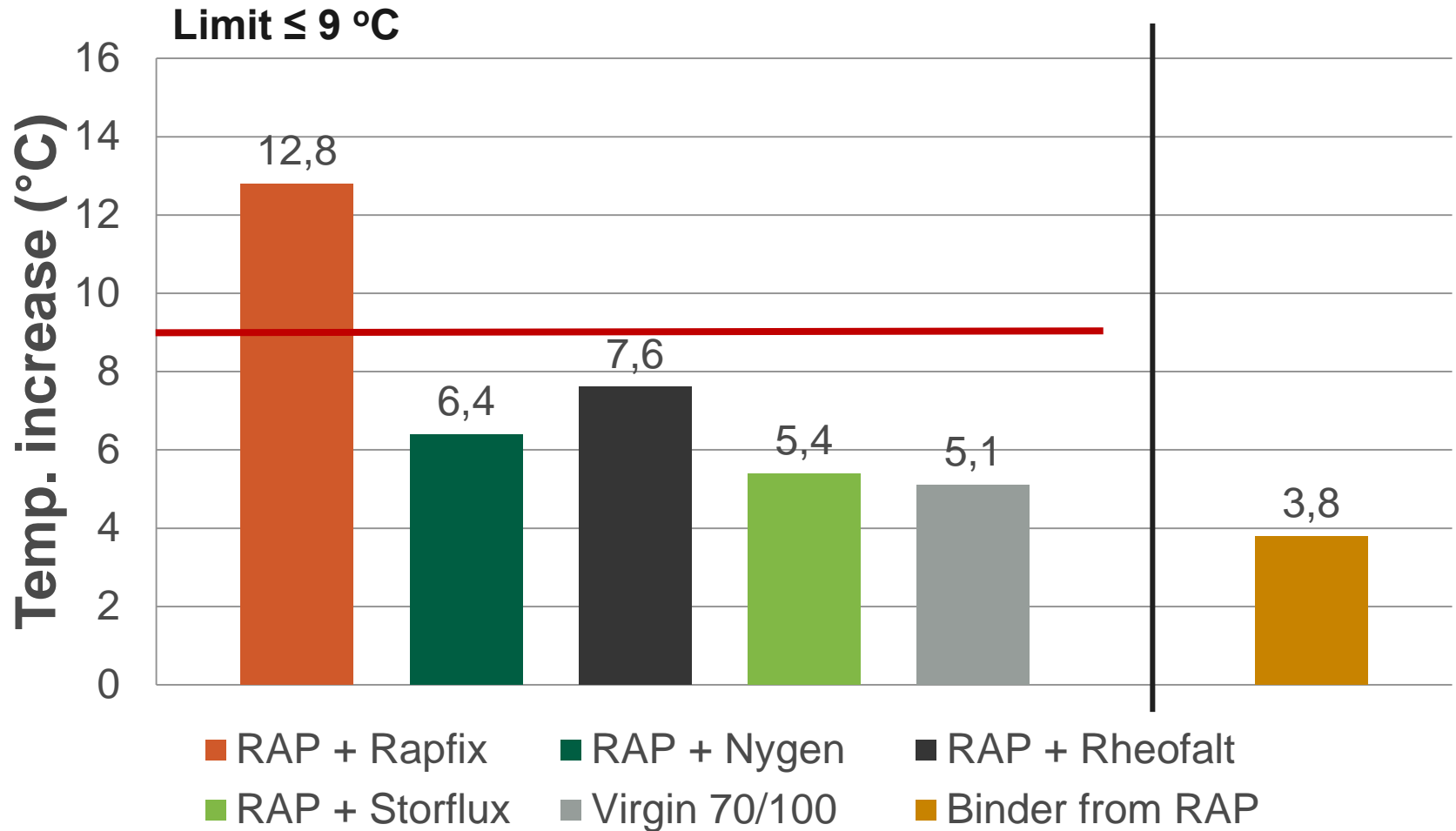
Ring & Ball



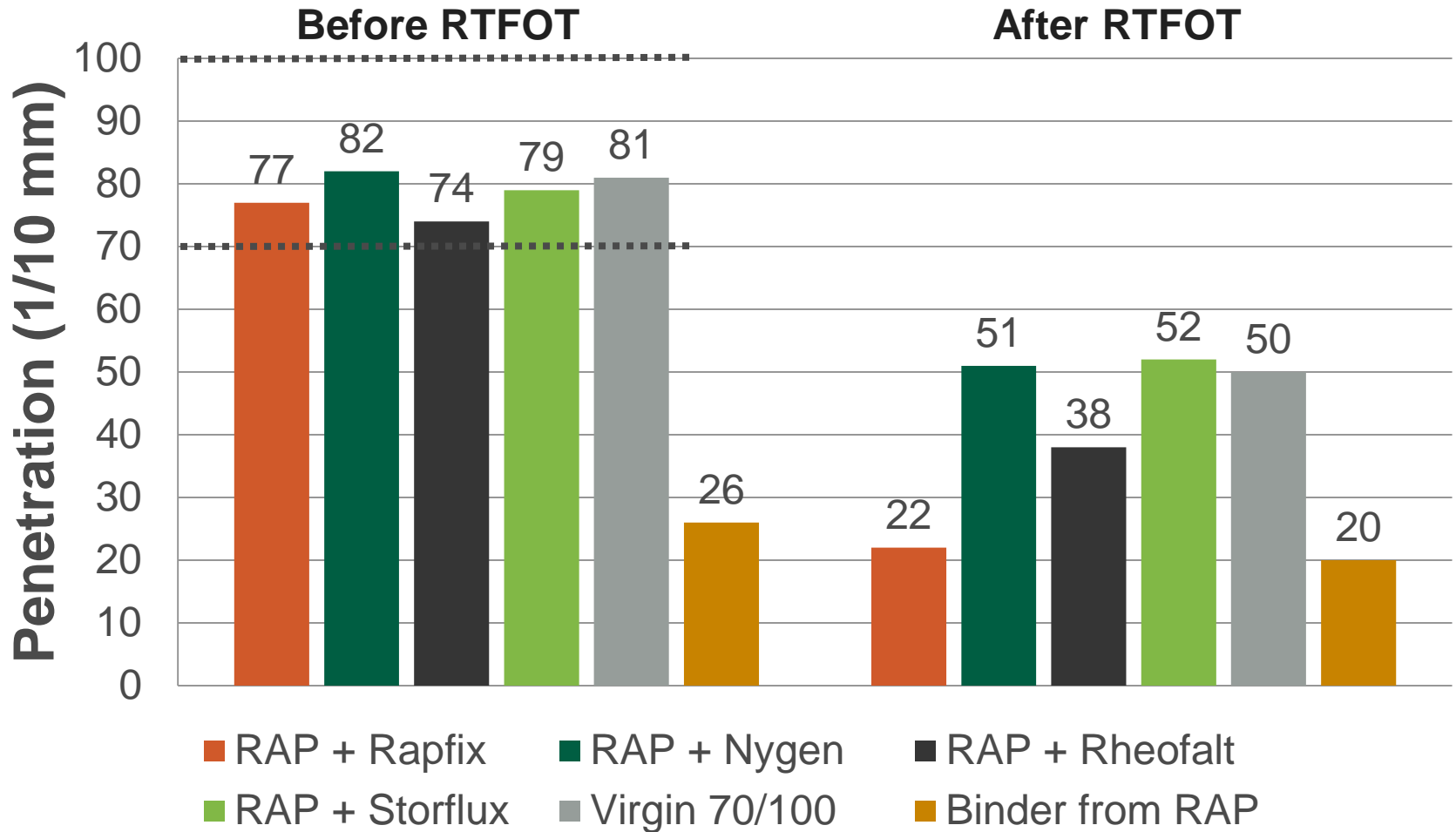
Dosage of rejuvenating agents



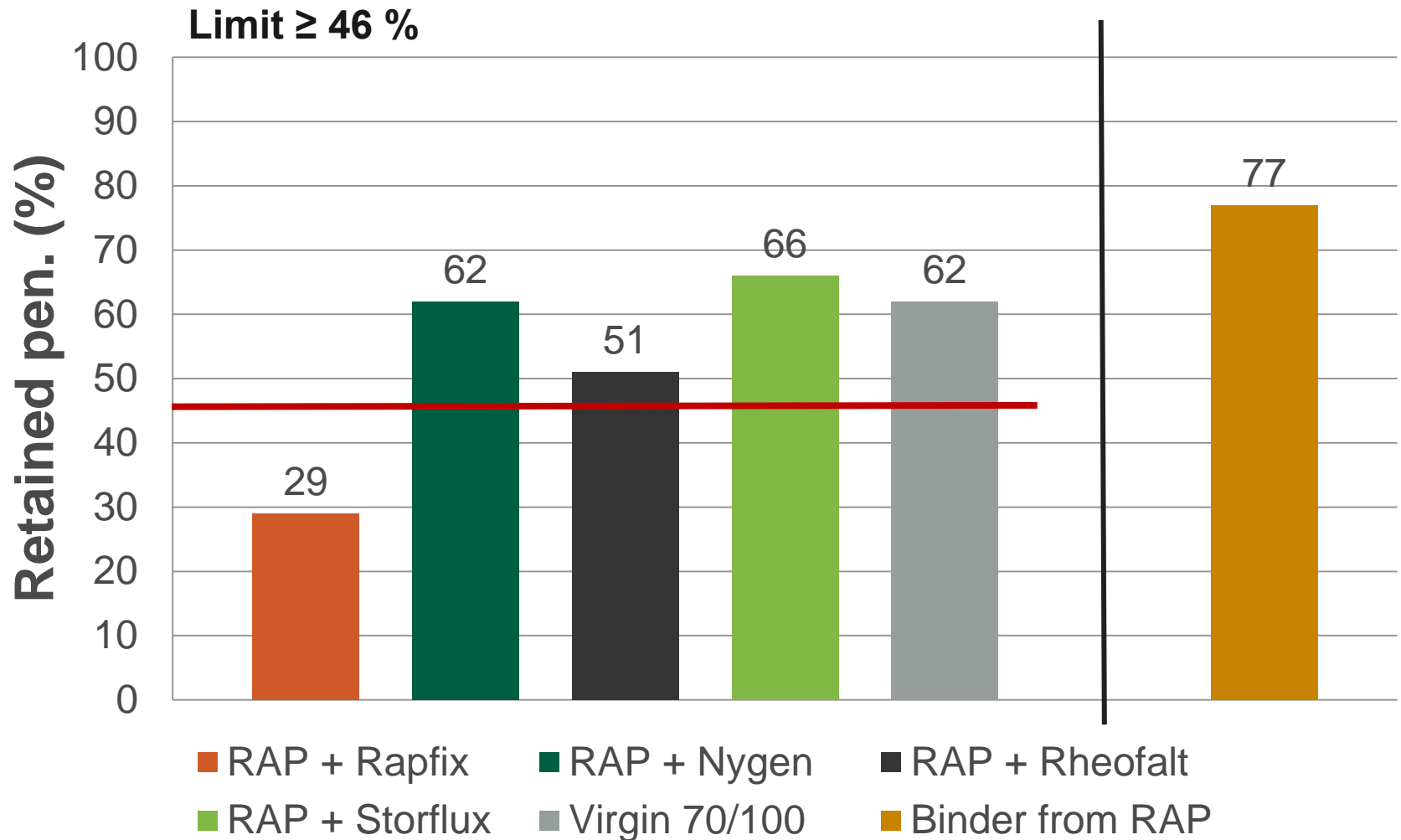
Ring & Ball after RTFOT



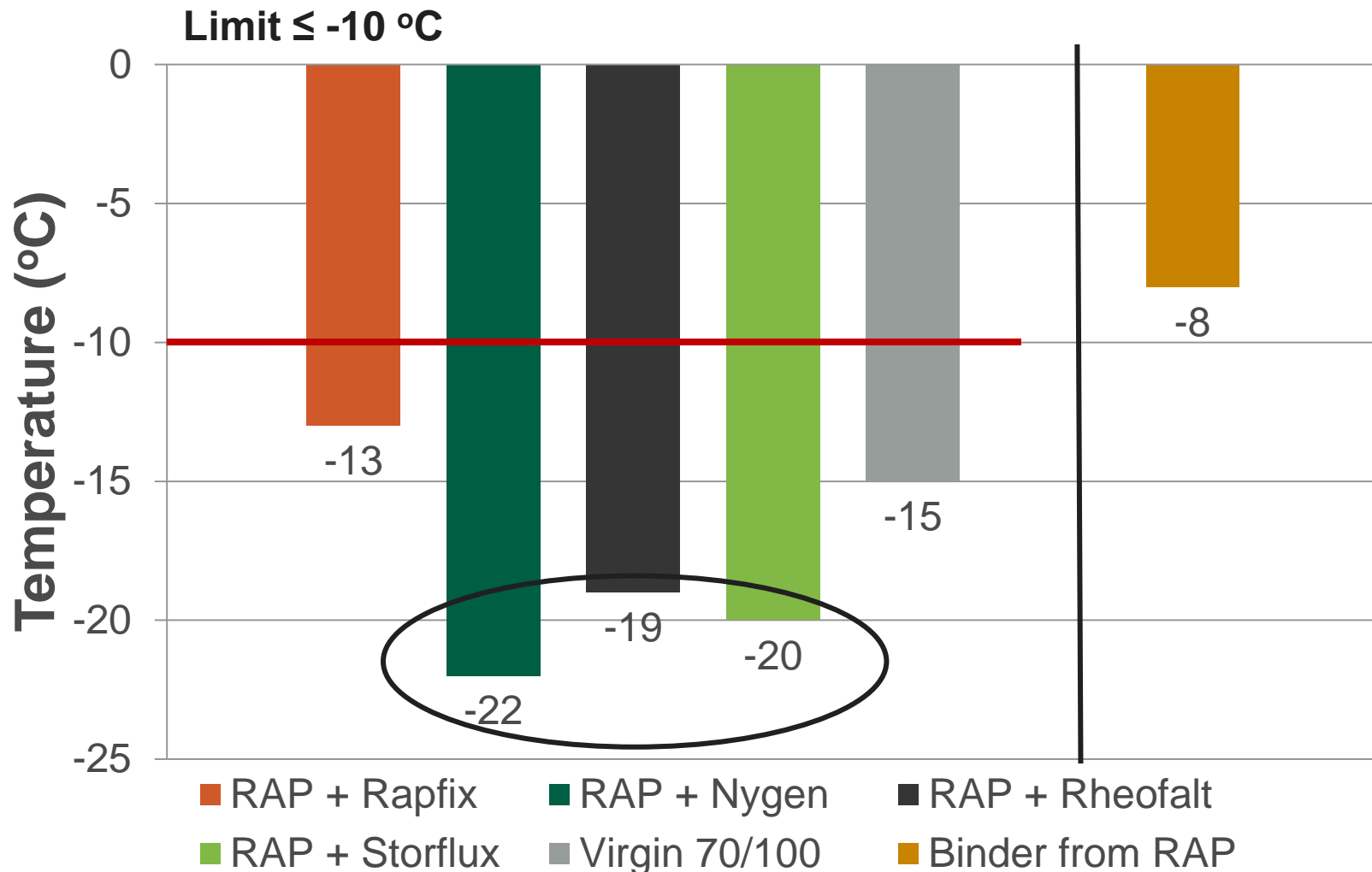
Penetration before and after RTFOT



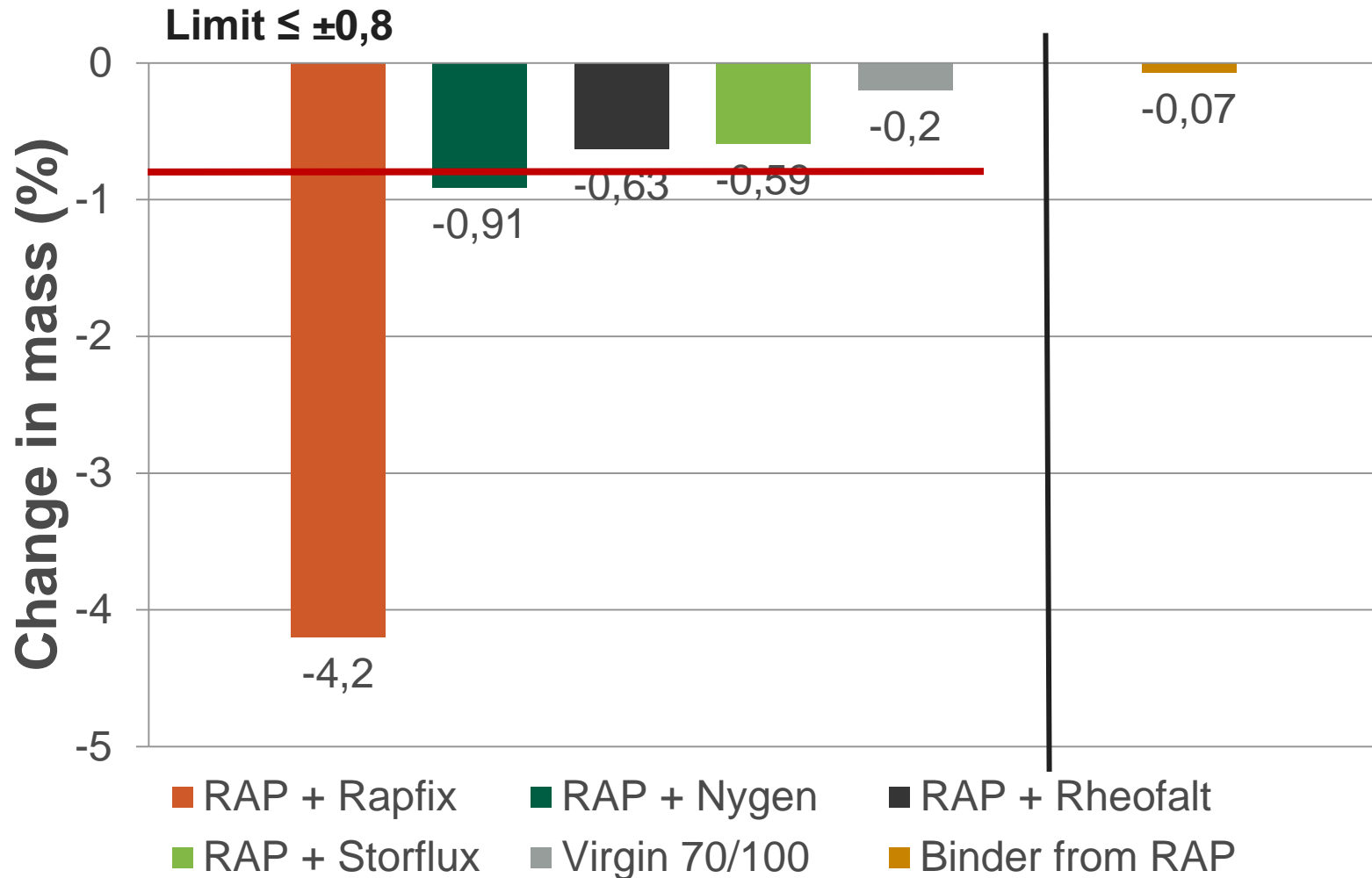
Retained penetration after RTFOT



Fraass breaking point



Change in mass after RTFOT



Summary of results

	Rapfix	Nygen 910	Rheofalt	Storflux
Dosage (%)	5	10	7,7	10
Increase of softening point (°C)	Fail	Pass	Pass	Pass
Retained penetration (%)	Fail	Pass	Pass	Pass
Fraass (°C)	Pass	Pass	Pass	Pass
Kinematic viscosity (mm²/s)	Pass	Pass	Pass	Pass
Dynamic viscosity (Pa·s)	Pass	Pass	Pass	Pass
Change in mass (%)	Fail	Fail	Pass	Pass

Pass



Fail

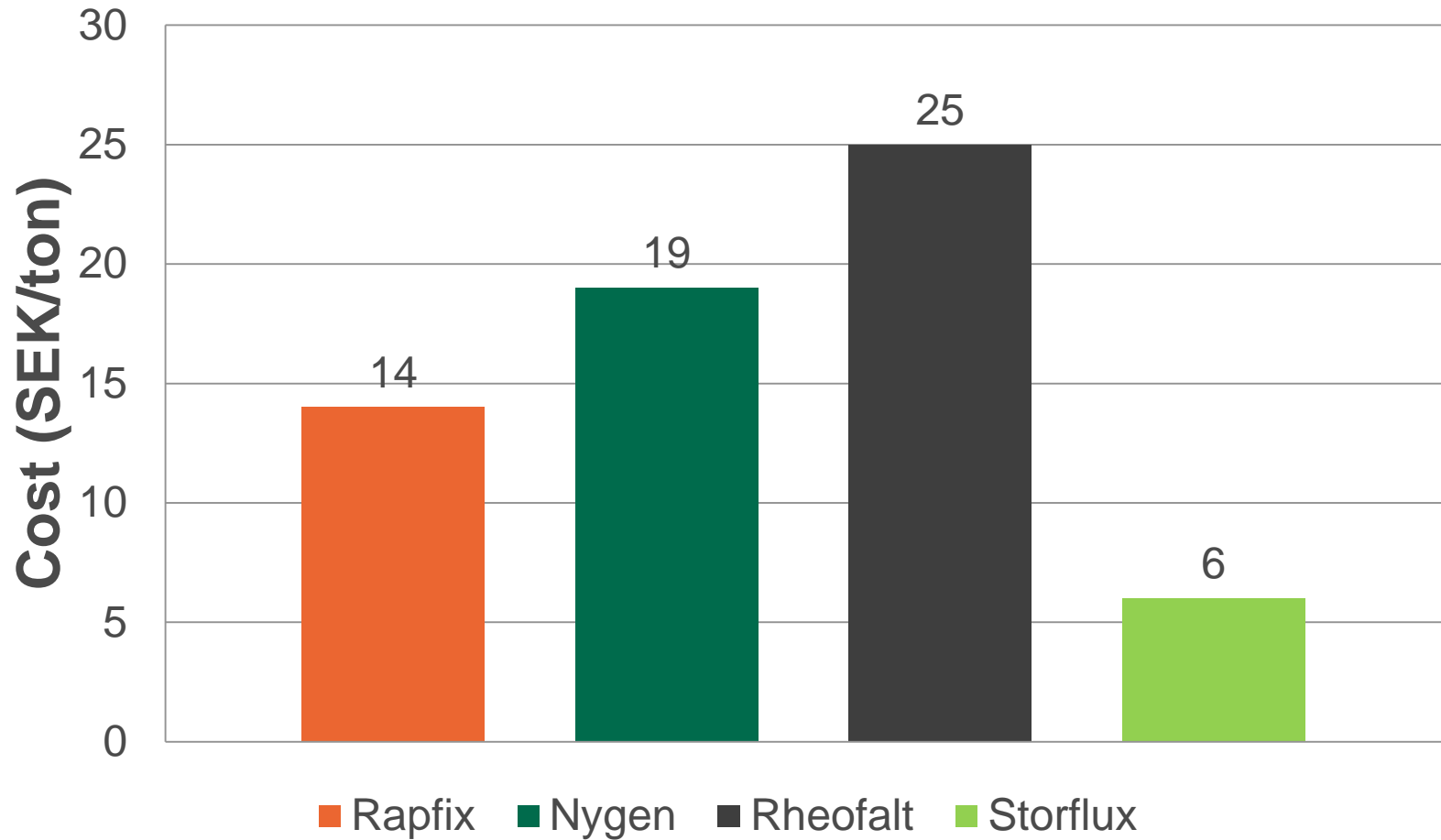


Economy

- Calculation based on:
 - Dosage to reduce the softening point of RAP binder from 60 °C to ~48 °C (70/100 binder)
 - Binder content 5 %
 - Material costs only (Binder, aggregates, RAP and rejuvenator)
 - The difference between a mix including:
RAP with rejuvenator - RAP without rejuvenator

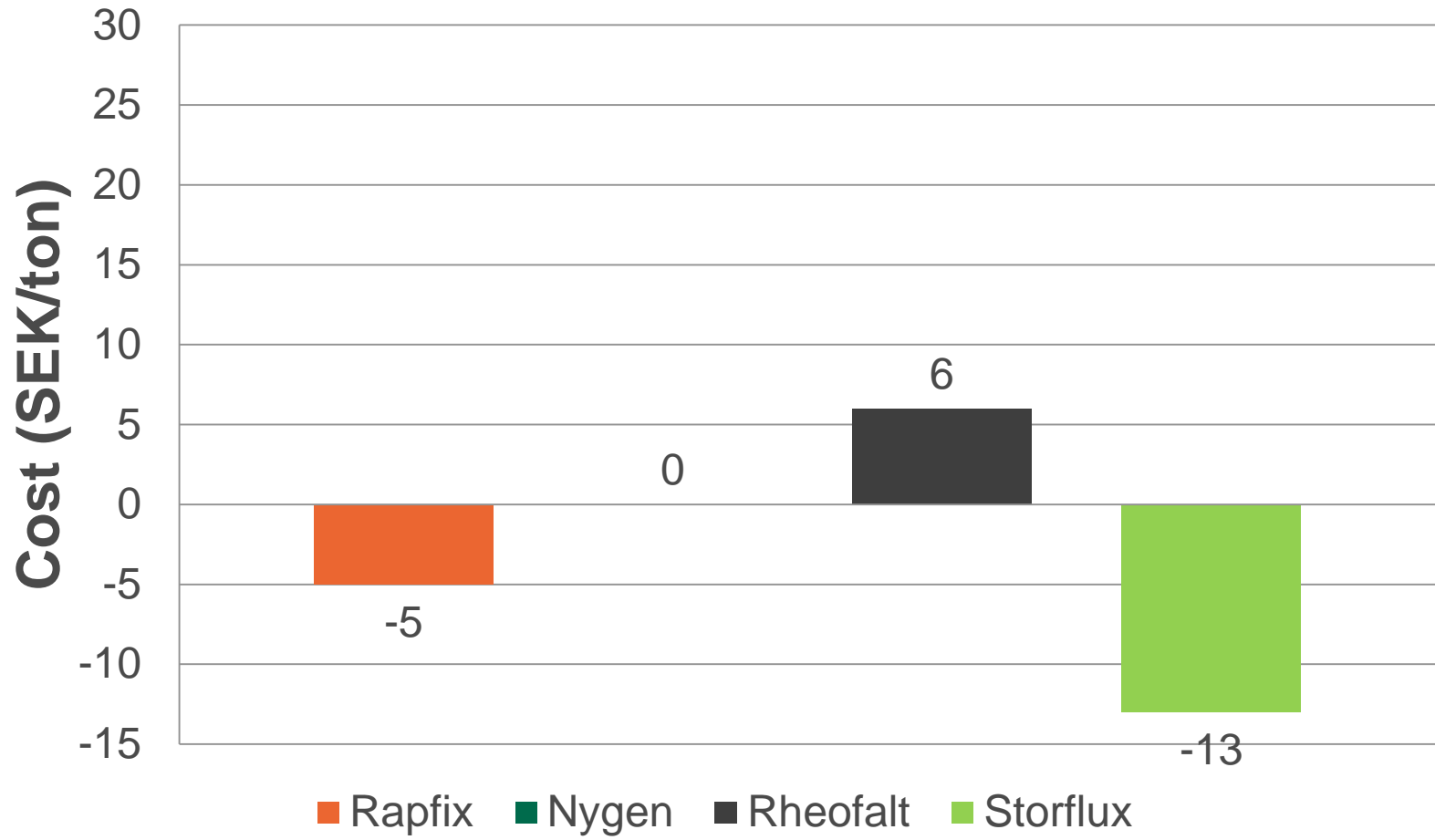
Economy

Cost = (30 % RAP + rej.) - (30 % RAP)



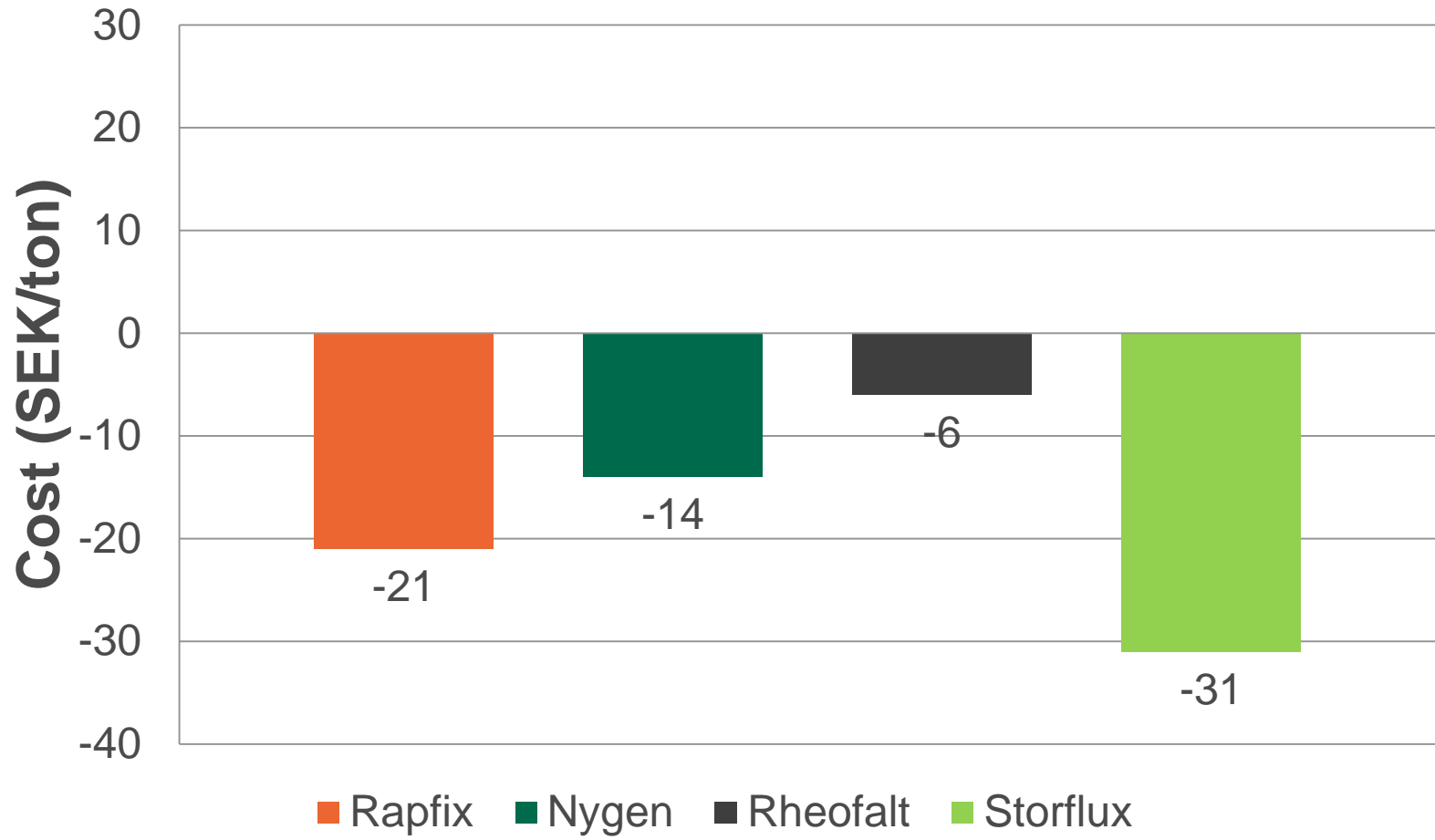
Economy

$$\text{Cost} = (30 \% \text{ RAP} + \text{rej.}) - (20 \% \text{ RAP})$$



Economy

$$\text{Cost} = (40\% \text{ RAP} + \text{rej.}) - (20\% \text{ RAP})$$



Summary of phase 1

- Promising rejuvenating agents for use in production has been identified.
- Economy and performance.
- The results may lead to increased use of RAP.
- Further testing to see effects on deformation characteristics (DSR, Wheel track, E^*).

Emulsions for phase 2

- 2 out 4 rejuvenating agents evaluated so far.
- An SBS emulsion with 1 of the rejuvenators.
- Stable product

Thank you!