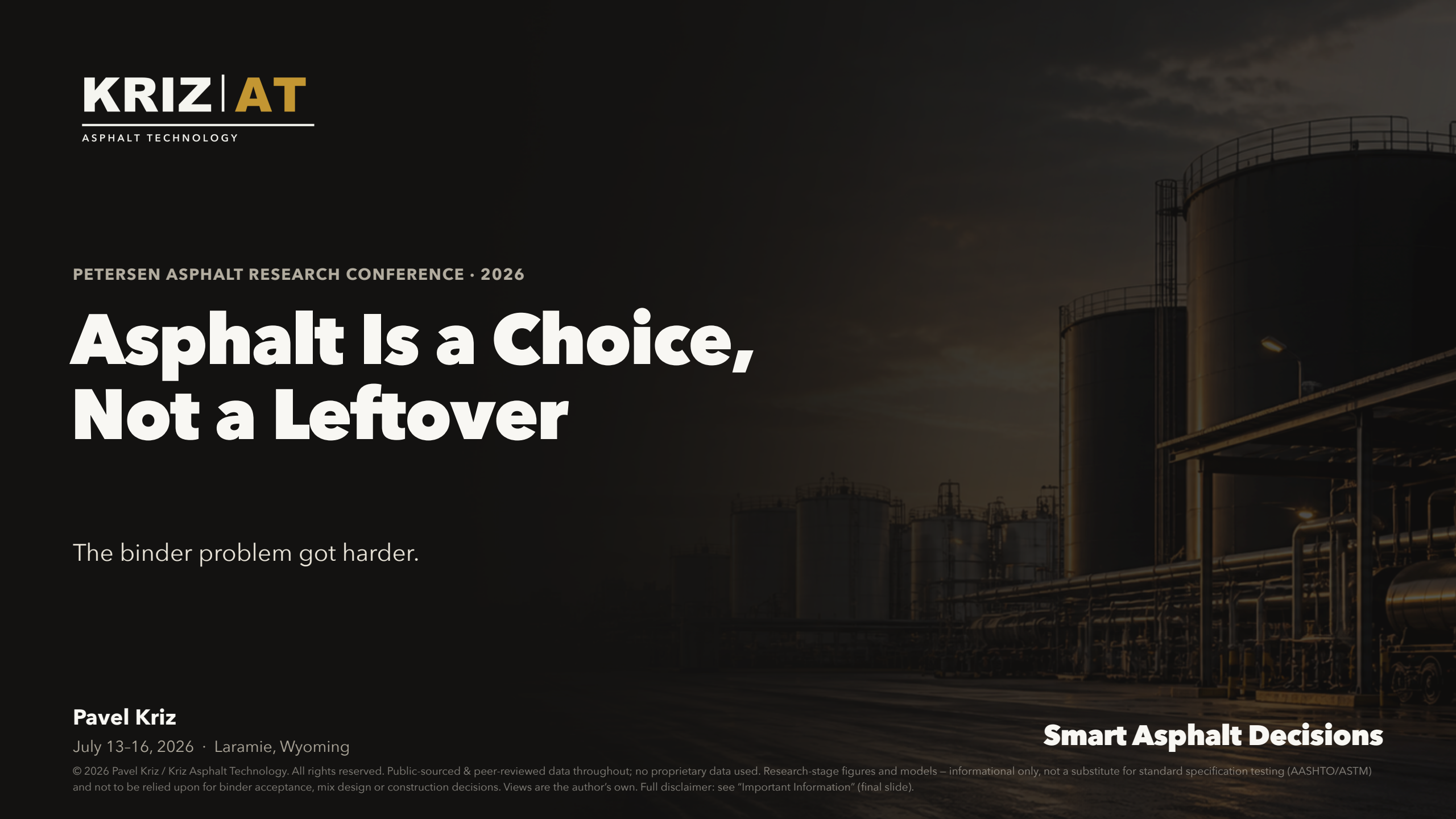
KRIZ | AT
ASPHALT TECHNOLOGY



PETERSEN ASPHALT RESEARCH CONFERENCE · 2026

Asphalt Is a Choice, Not a Leftover

The binder problem got harder.

Pavel Kriz

July 13–16, 2026 · Laramie, Wyoming

Smart Asphalt Decisions

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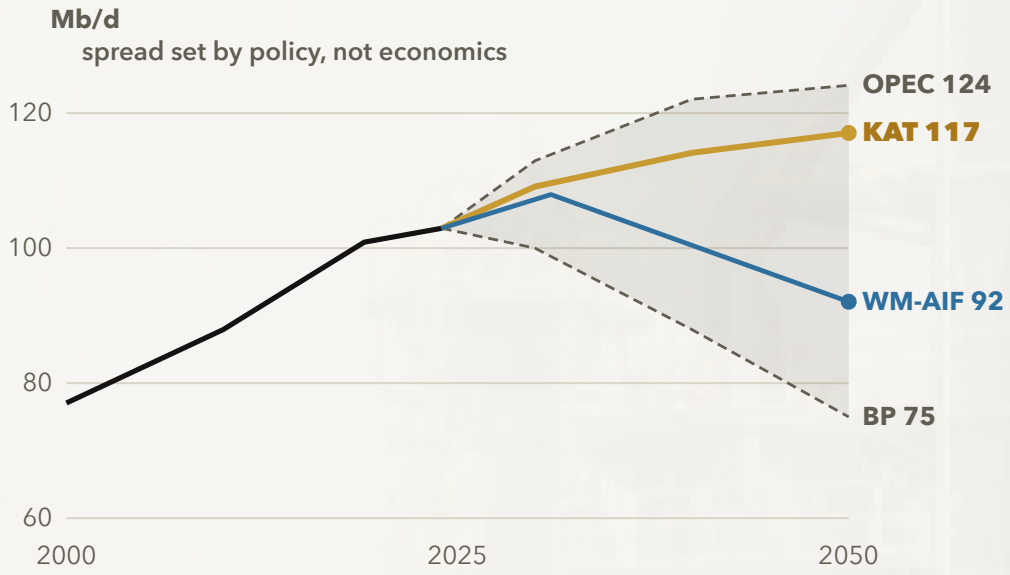
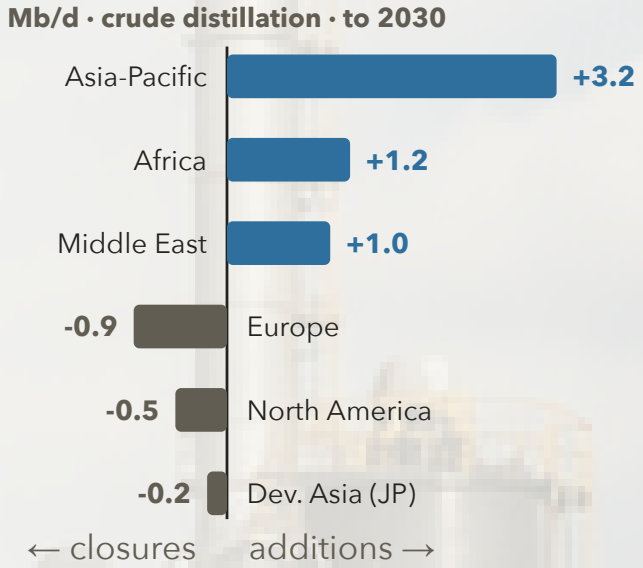
Refining moves east and upgrades the barrel harder – peak demand or not?

- **Oil demand: forecasts fan wide – a plateau, not a cliff**



- **Refining still grows – in Asia, the Gulf, Africa**

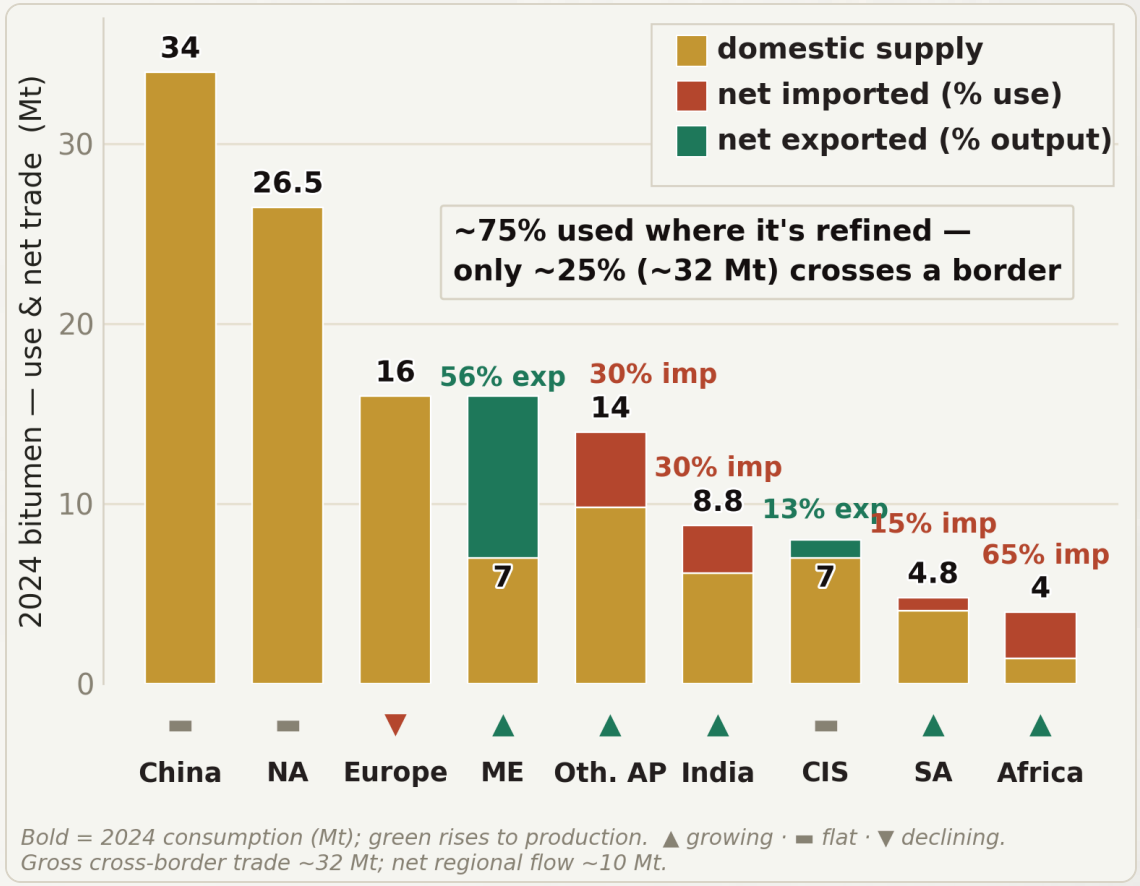


New refining keeps landing in Asia, the Gulf and Africa – **and it upgrades the barrel harder.**

Global. Demand: ExxonMobil Global Outlook 2025, IEA WEO 2025 (STEPS/CPS), OPEC WOO 2025–26, BP 2025 – scenario range; gold = KAT synthesis. Wood Mackenzie × Asphalt Institute Foundation (Jan 2025) base case (WM-AIF): oil demand peaks ~108 Mb/d in 2031, eases to ~92 by 2050. Refining, Mb/d crude distillation: additions OPEC WOO 2025 (to 2030); expected closures IEA Oil 2025 (to 2030).

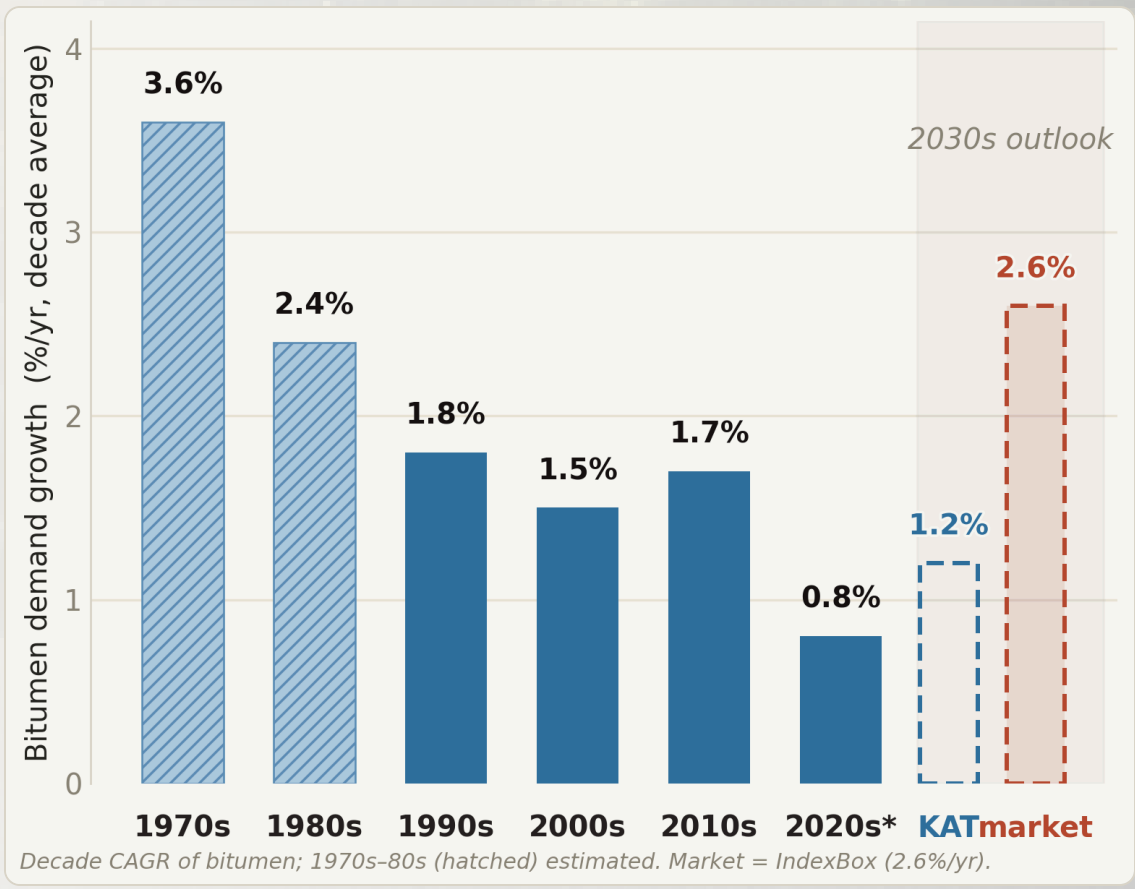
Where asphalt is used – and how fast it's growing.

CONSUMPTION & NET TRADE BY REGION · 2024



Bold = 2024 consumption (Mt); green rises to production. ▲ growing · ▬ flat · ▼ declining.
Gross cross-border trade ~32 Mt; net regional flow ~10 Mt.

DEMAND GROWTH BY DECADE

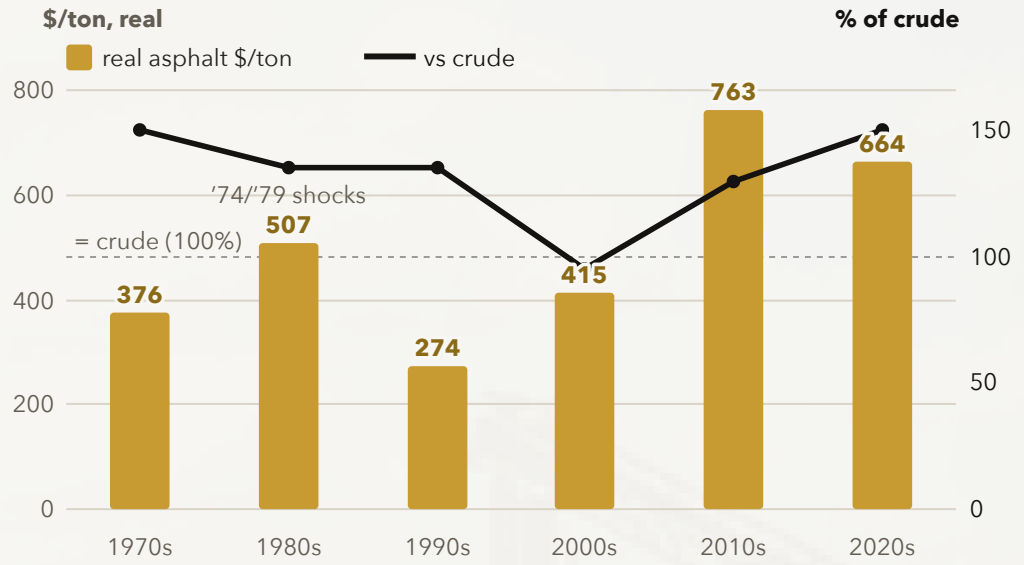


Decade CAGR of bitumen; 1970s–80s (hatched) estimated. Market = IndexBox (2.6%/yr).

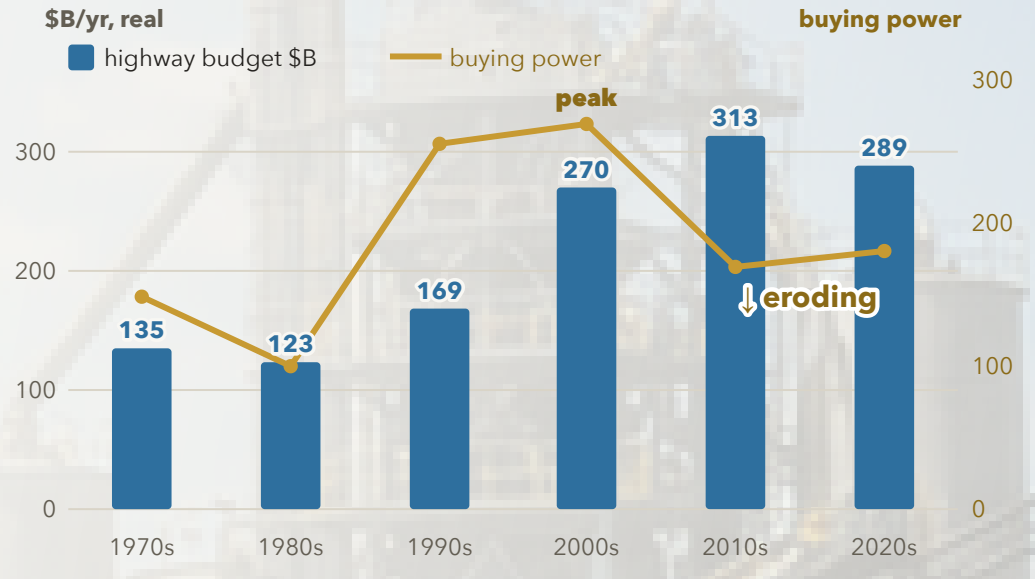
2024 consumption bottom-up (NOT IS-230): US – EIA; India – PPAC; China – NBS + customs; Europe – EAPA; Middle East / Africa / SE Asia – UN Comtrade (HS 2713.20) + national; ~122 Mt. Bars = domestic supply / net imports / net-export surplus. Decade growth = CAGR of global bitumen; 1970s–80s estimated; 2030s = KAT view. Charts = KAT.

Asphalt: record real cost, past peak affordability.

- **Supply side: refinery stress makes asphalt dear**



- **Customer side: the budget's buying power has peaked**



Asphalt gets dear whenever refining is stressed — most refiners have bigger worries than binder.
Meanwhile the buyer's dollar buys less asphalt than it did in the 2000s.

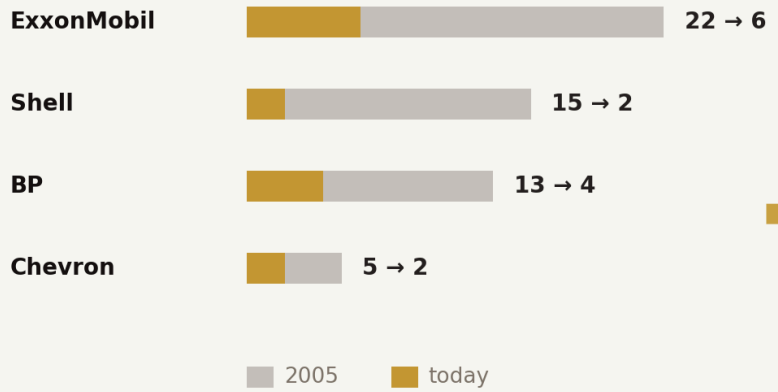
Even the Asphalt Institute Foundation's own 2025 study (Wood Mackenzie) frames this as a price-and-priority squeeze — ***not yet a physical shortage.***

US, decade averages, 2026 dollars. Left: real asphalt price $/ton (EIA SEDS asphalt price, CPI-U deflated) + asphalt as % of crude (EIA SEDS ÷ EIA crude first-purchase). Right: real US highway spending, all govts, $B/yr (FHWA, CPI-U deflated) + buying power = real budget ÷ real asphalt price, index 1980s=100; 1970s–80s interpolated (low confidence).

Most of the majors stepped out of bitumen – a few stayed.

NO. OF BITUMEN-REFINING SITES

the four largest IOC portfolios · 2005 → today

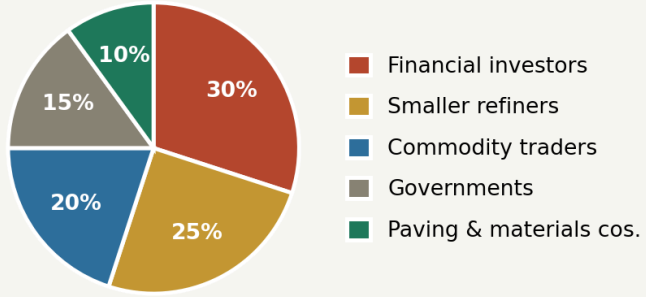


55 → 14 sites (−75%)

custody has changed

THE NEW CUSTODIANS

share of transferred sites, by count



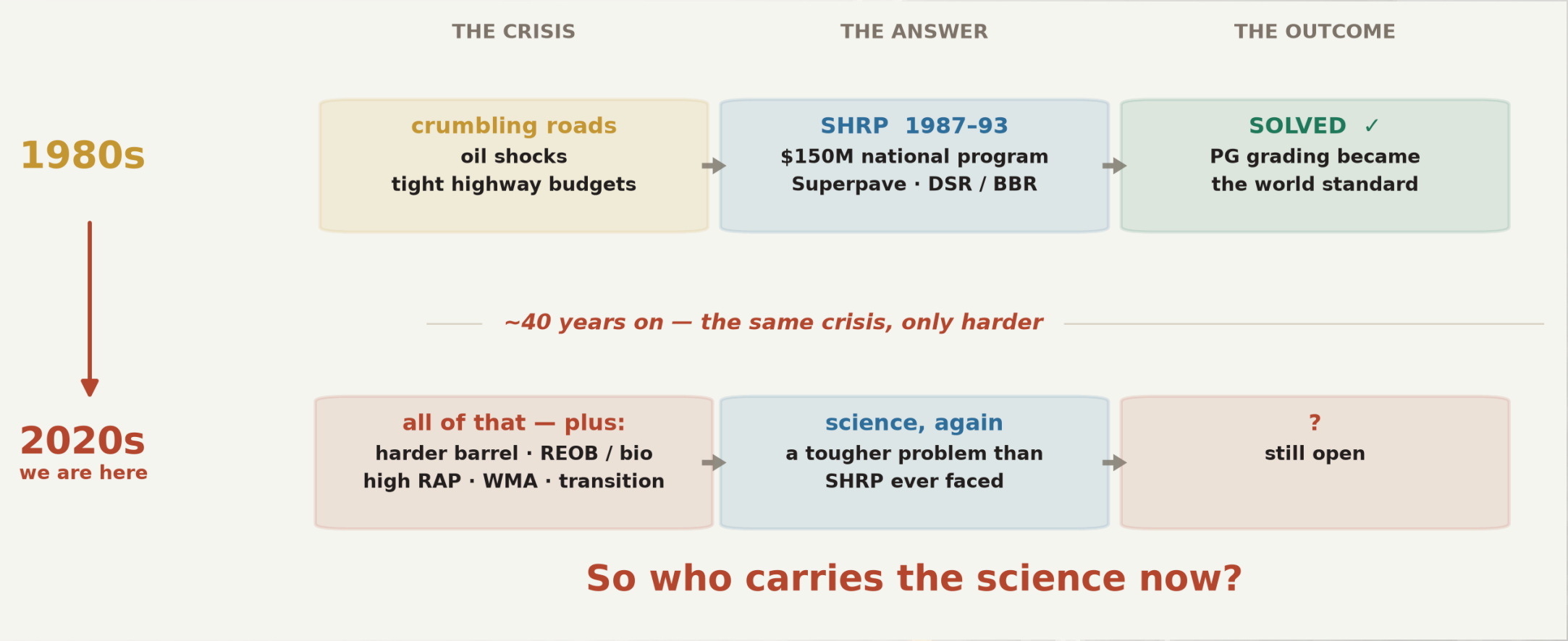
SIGNIFICANT PLAYERS LEFT — A FEW STAYED

Most of the firms present at the birth of modern asphalt technology — deep expertise, trusted brands — have stepped back or sold out.

A few stayed committed — led by TotalEnergies, the one still-global major — for now; the custodians must earn credibility more than ever.

Public divestiture record (company releases, SEC filings, OGJ / Argus / ICIS), 2005–2026. Site counts = bitumen-capable refineries (majors publish no bitumen tonnage). Custodian shares ≈ by count of transferred assets, KAT classification – directional. The majors that built modern binder science (Exxon/Imperial, Shell, BP, Chevron) largely exited or scaled back; a few stayed committed: TotalEnergies is the only still-global major in bitumen (reputable R&D lab, global Styrelf brand); Marathon and Valero are the top-two US producers; and Nynas is a global specialty-bitumen specialist (now majority Bitumina-owned) – for now. KAT compilation & analysis.

The 1980s, again – only harder.

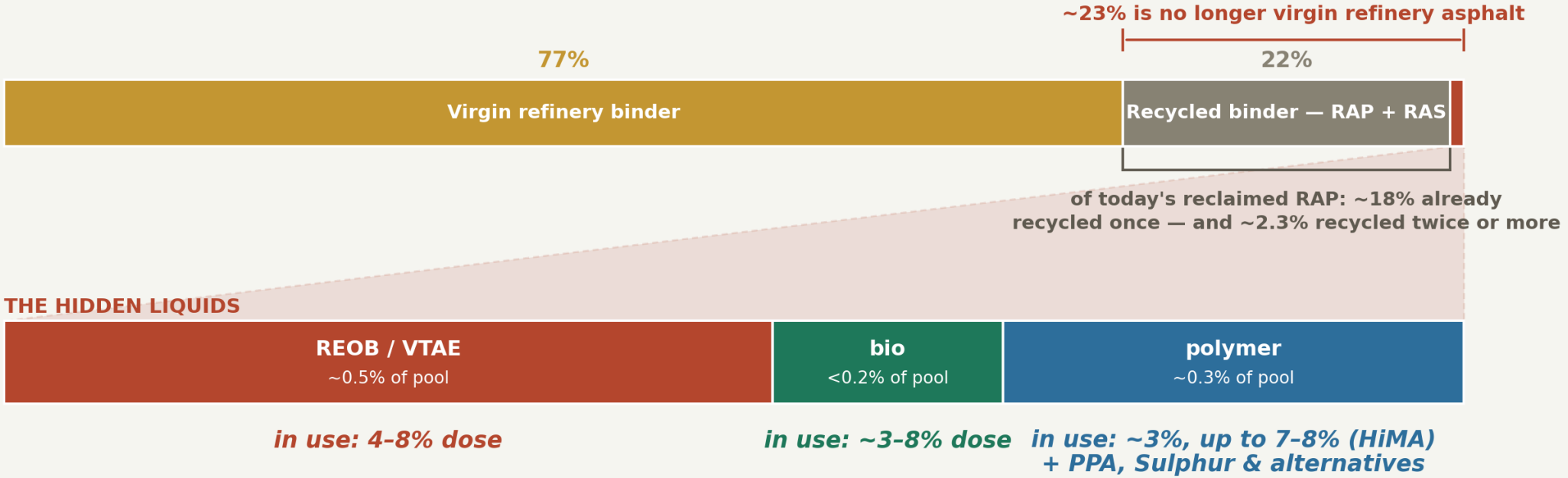


SHRP = Strategic Highway Research Program (US Congress, 1987–93; ~$150M, ~$50M asphalt) → Superpave / AASHTO PG grading, DSR & BBR. Present-day stressors: KAT synthesis.

The binder hides its chemistry – until it crosses a cliff.

WHAT IS IN THE BINDER IN THE ROAD

by source — 100% of the pool



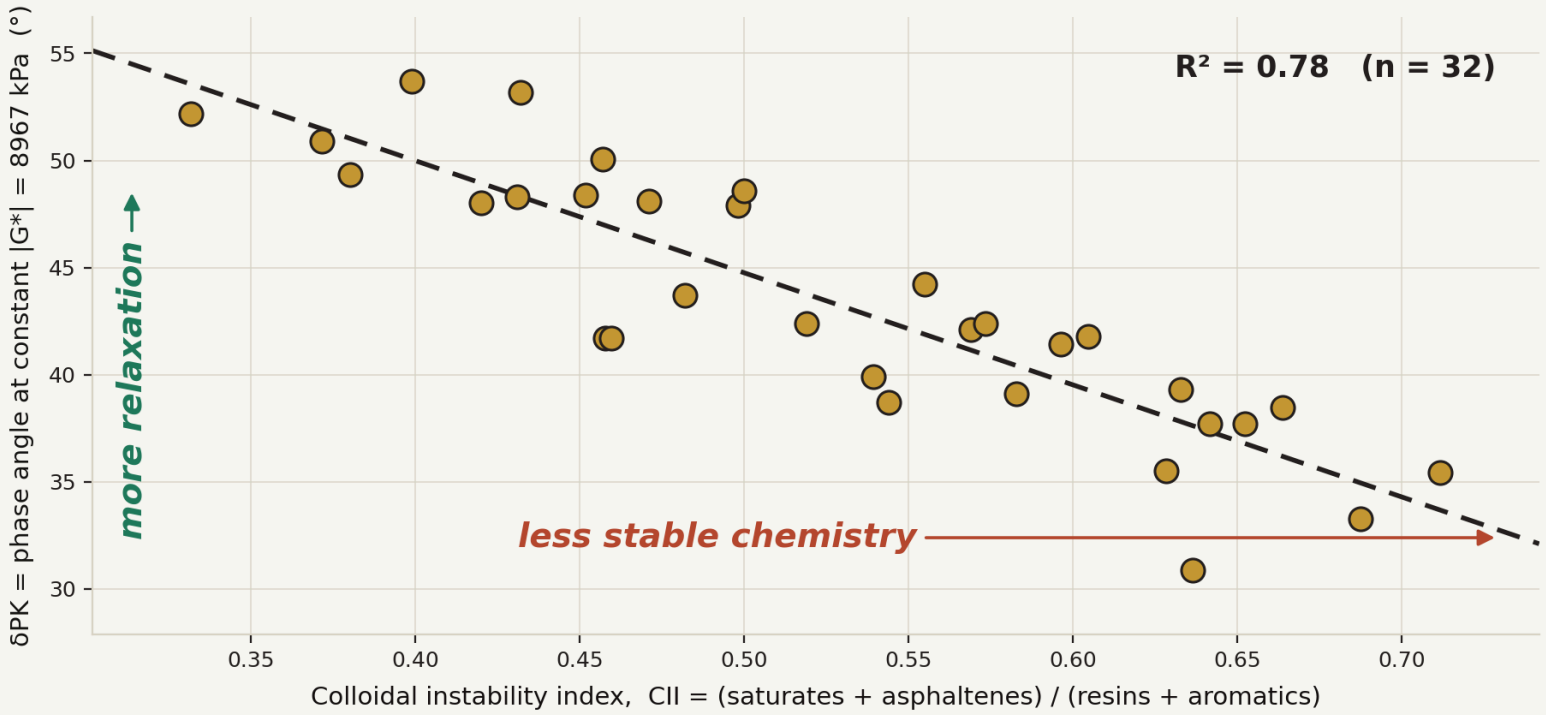
Composition is already complex — pool averages understate the real dose.

NAPA IS-138 2023 (RAP 96.1 Mt @ 21.9%; RAS 0.16 Mt); virgin = residual, sums to 100%. REOB/VTAE: FHWA HIF-23-043 & AI IS-235. Bio: product/academic data, no national survey. Polymer ~10% of mixtures: NAPA Table 14 (static cost-model input, not measured – conservative default); dose: FHWA HIF-12-030 (also basis for PPA/Sulphur alternatives). RAP re-recycling: NAPA RAP-rate 2007–24 + 15-yr cycle model (≥2× needs pre-2001 assumptions). RAS too young to be re-recycled. KAT analysis.

Composition alone predicts how a binder relaxes.

COLLOIDAL CHEMISTRY → RELAXATION

32 aged & modified binder blends (CTAA 2023, Kriz et al.) · one composition number, across aging and modification



THE READ

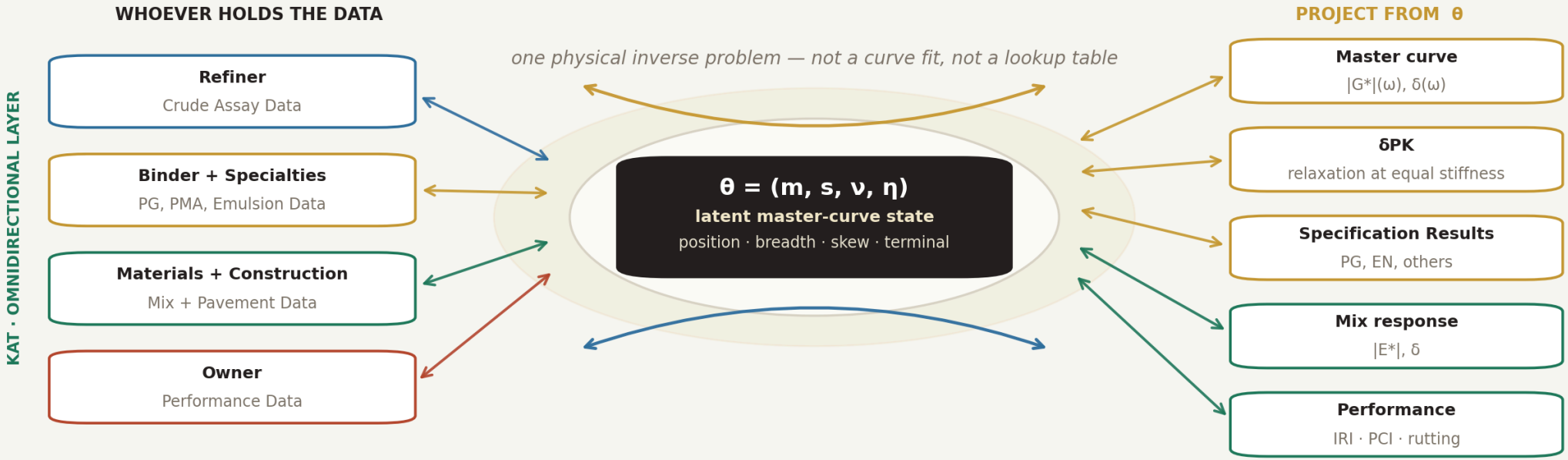
More colloidally unstable binder → lower phase angle → less able to relax stress → earlier cracking.

Kriz, Noël, Campbell, Grant, Brownie, "Efficient and Effective Specification for Asphalts of Today," 68th CTAA Conference, Charlottetown PE, Nov 2023, © CTAA. CII from SAR-AD composition (Gaestel index); δPK = phase angle at constant |G*| = 8967 kPa (7 blends across 5 aging states; n = 32 with complete composition + rheology). A second, independent line of the same principle – binder aging follows a single oxidation mechanism whose only variable is the amount of reactive material, set by the crude: Petersen, Transportation Research Circular E-C140 (2009); Glaser, Planche et al., Transportation Research Record 2370 (2013), DOI 10.3141/2370-08.

One θ-state connects crude, tests and performance.

ANY CUSTOMER · ANY INPUT → θ → ANY OUTPUT

θ is the common state, grounded in physical viscoelasticity — every measurement constrains it; uncertainty travels with it



ANY STARTING POINT, ANY COMBINATION — ONE INTERCONNECTED ASPHALT SYSTEM

θ = (m, s, ν, η): a latent master-curve state (Richards-sigmoid transition position & breadth, skew ν, viscous-terminal η). Any credible evidence stream – crude assay, rundown DSR, BBR/cold-DMA, mix or field feedback – constrains the same state; every property is then projected from that state with uncertainty carried forward. Per-criterion validation (DSRoT / DSRrT / DSRpT / BBRmT / BBRST; mix response vs Hirsch & Rowe) on this form is in progress. Inference, blend rules, tolerances & parameters are KAT-proprietary.

The model we chose was proposed at this conference – in 2008.

RICHARDS · 1959
flexible growth-curve form
J. Experimental Botany

→

PELLINEN-WITCZAK · 2003
sigmoidal master curve
for MIXTURES · ASCE

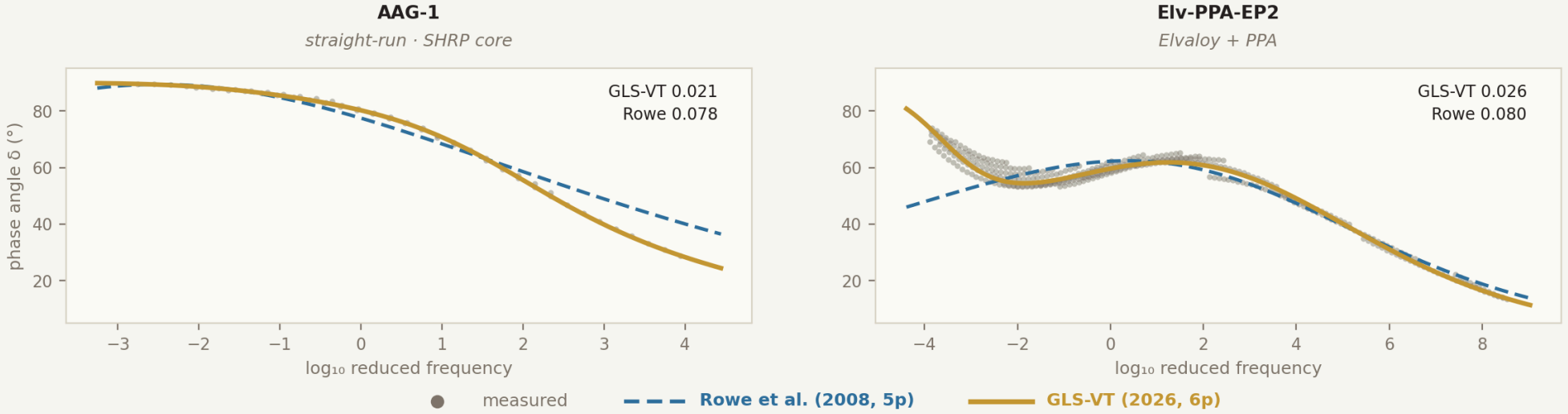
→

★ THIS CONFERENCE, 2008
ROWE ET AL. · 2008
generalized logistic
binder mastics & mixtures

→

★ THE NEW STEP
KRIZ & JASSO · 2026
+ one viscous-terminal term
Extends to binders

$$\frac{1}{G^*} = \frac{1}{G^*_{\text{Rowe GLS}}} + \frac{1}{i\omega\eta}$$



Fit panels compare GLS-VT (6p) with Rowe et al.'s generalized-logistic sigmoid (5p, 2008) – the form GLS-VT extends, first presented at this conference in 2008 – on public binders AAG-1 (SHRP core, MRL) straight-run and Elv-PPA-EP2 (Jasso, M., PhD Thesis, U of Calgary) modified. GLS-VT's added viscous-terminal term fits tighter on both: straight-run AAG-1 Rowe 0.078 vs GLS-VT 0.021; modified Elvaloy+PPA Rowe 0.080 vs GLS-VT 0.026. RMSE = gpgpp, dex; from the committed shootout per-curve fits.

From crude to pavement – one physical state closes the loop.

CRUDE → θ → MIX → PAVEMENT

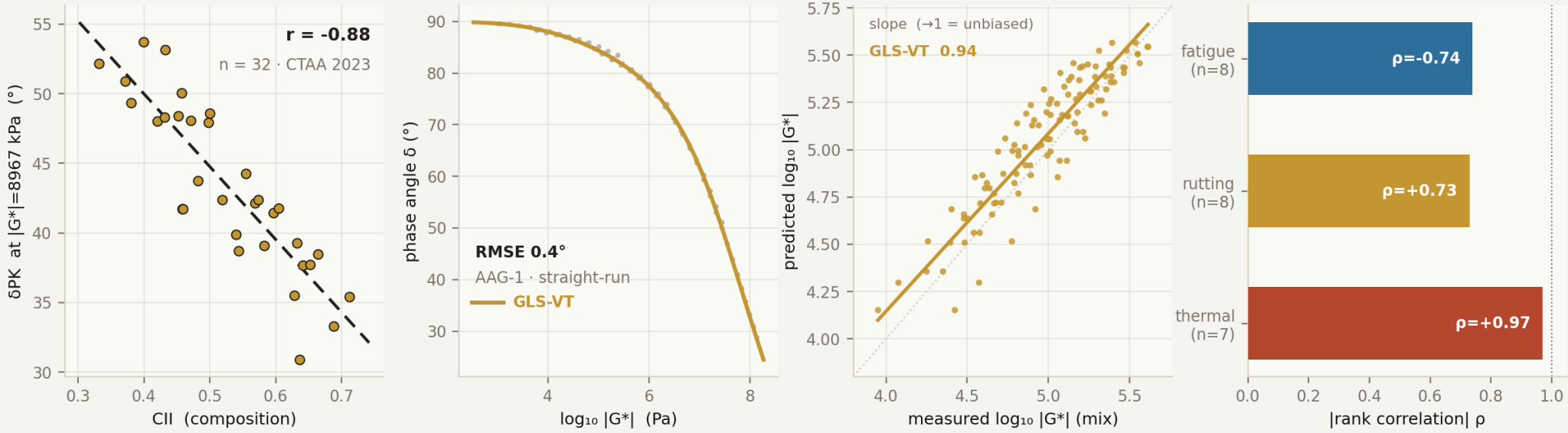
θ = (m, s, ν, η) — one physical state links composition, rheology, mix response and pavement distress

CRUDE CHEMISTRY
→ binder rheology

BINDER STATE θ
black-space · newest model

MIX STIFFNESS |G*|
GLS-VT binder input · A-388

MIX → DISTRESS
rank correlations · SHRP A-388



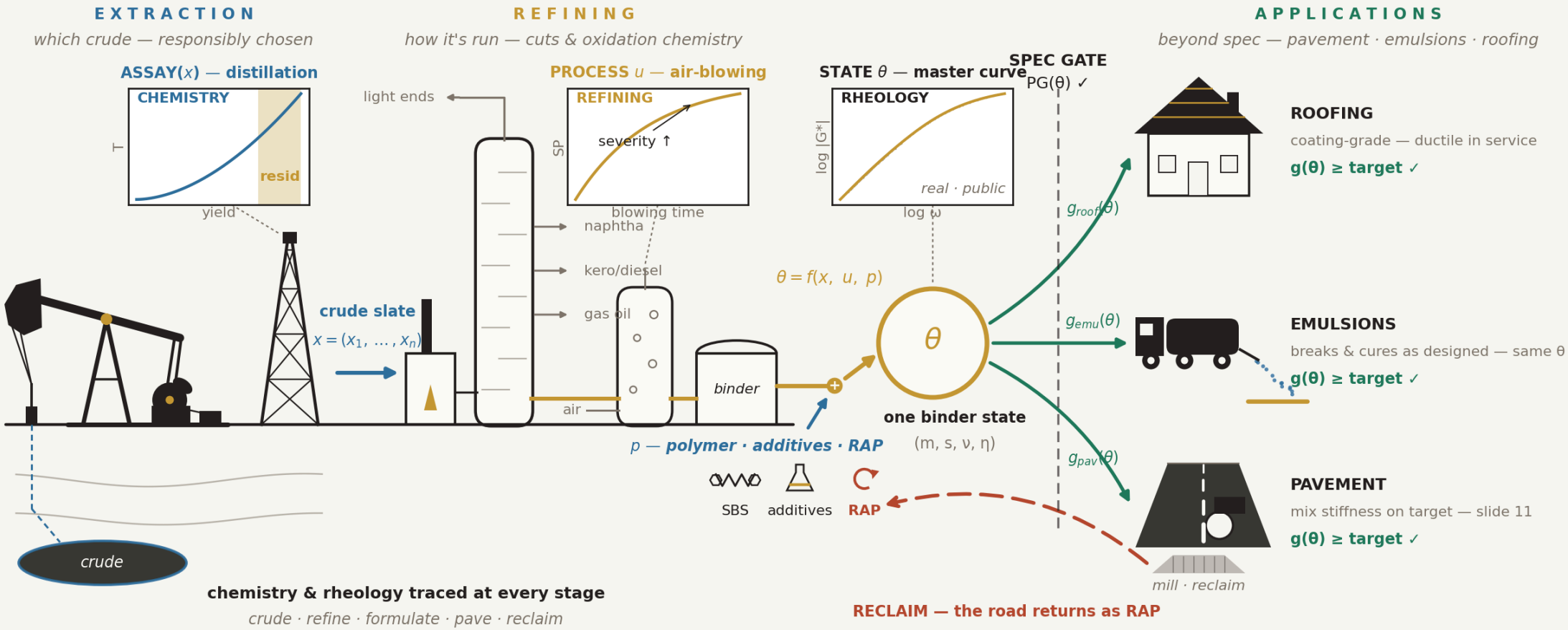
CRUDE → θ → MIX → PAVEMENT

Certify only what the data earns.

SHRP core-8 (n=7–8) — directional, not robust at this sample size

Panel 1: CTAA 2023 (n=32, r=-0.88), as slide 8. Panel 2: GLS-VT black-space fit, RMSE 0.4°, public SHRP core AAG-1 (straight-run). Panel 3: SHRP A-388 mix frequency-sweep (n=112, 20°C isotherm) – binder input refit to GLS-VT (8 SHRP core binders, raw NCHRP master curves); two-path mix architecture unchanged, params recalibrated & scored out-of-sample (slope ≈ 0.94, near-unbiased). Panel 4: SHRP core-8 distress rank correlations (fatigue/rutting/thermal, n=7–8, directional). θ = (m, s, v, η); inference, blend rules & tolerances are KAT-proprietary.

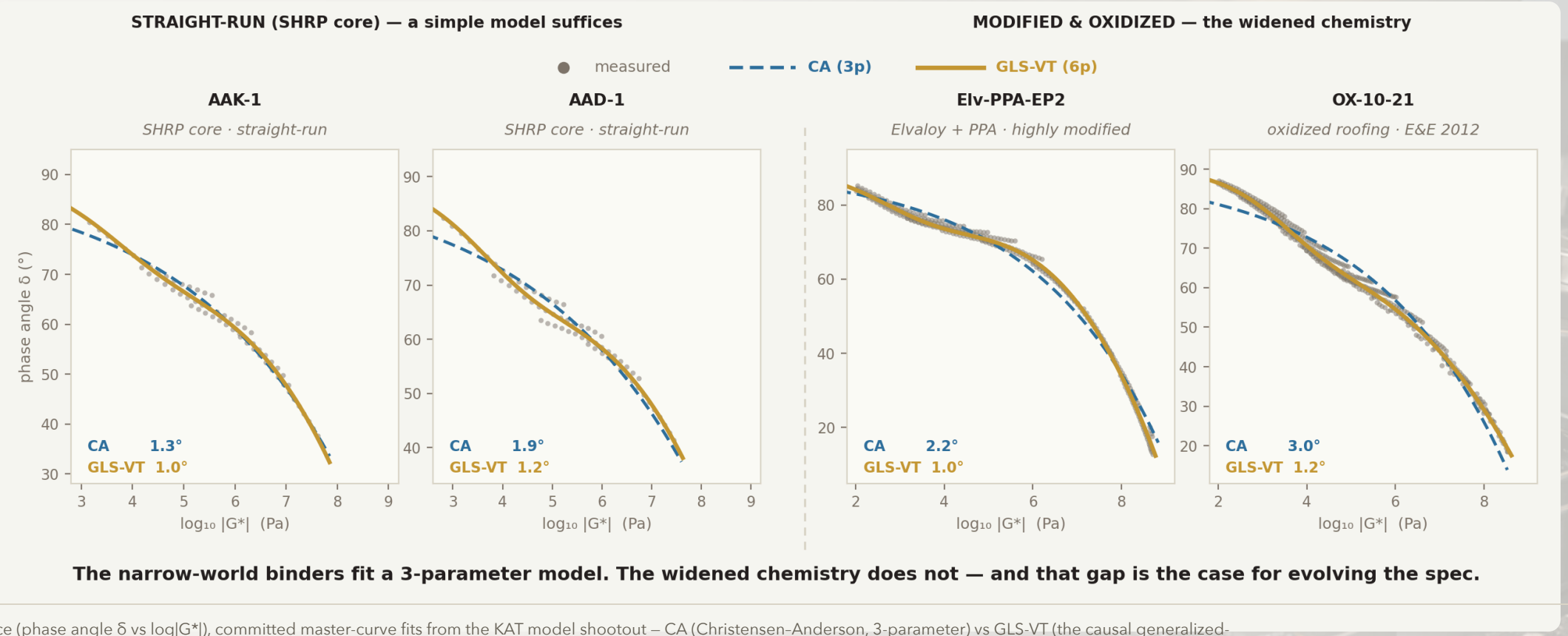
Follow the Asphalt DNA – from crude to performance.



Schematic – illustrative, no fitted coefficients. One physical state θ (chemistry × rheology, slides 9–11) is traced across the whole lifecycle: crude assay (x) → refining process (u) → formulation (p: polymer, additives, RAP) → θ → application projections g_k; then reclaimed pavement returns as RAP and re-enters the same state. Assay & air-blowing cards schematic; master-curve card = real public binder (Jasso PhD, slide 10's exact-causal fit). Refining × chemistry × rheology are three fields rarely held by one person – connecting them end-to-end is the differentiator. The same state also lets a producer optimize slate, operation & formulation against every end use at once. Inference, projections & tolerances are KAT-proprietary.

The world the spec was built for has widened.

The chemistry outgrew the simple models the old world got by with — the case for evolving the spec, not a rebuke of it.



Black space (phase angle δ vs log|G*|), committed master-curve fits from the KAT model shootout — CA (Christensen–Anderson, 3-parameter) vs GLS-VT (the causal generalized-logistic + viscous terminal, 6-parameter, slide 10). Binders: SHRP core straight-run (AAK-1, AAD-1; public MRL), a Jasso PhD modified binder (Elv-PPA-EP2; academic), and an oxidized roofing bitumen published in Kriz, Brownie, Blahey, Sokol, Grant, Cointe, Boussad & Shirts, "Rheological Assessment of Neat Paving, Air Rectified Paving and Oxidized Roofing Bitumen," 5th Eurasphalt & Eurobitume Congress, Istanbul (2012). Both models track the straight-run cores; on the modified and oxidized binders CA misses the structure (RMSE 2.2°/3.0° → GLS-VT 1.0°/1.2°). RMSE values trace to the committed per-curve fit table. A changed world, not a fault of the spec.

Where this leaves us.

01 THE WORLD

Most of Big Oil walked out of the binder. The barrel got harder, the pool more complex, and the stewards who kept it honest have thinned.

02 THE SCIENCE

But the science is real and connected — composition sets the rheology, and **one physical state** links crude, binder, pavement and reclaim, end to end.

03 THE CALL

The spec was built for a narrower world. Time to write the chemistry back into it — SHRP Next Gen.

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Be responsible.
Warrant performance with science you can defend.

Refining · chemistry · rheology — integrated. The tools behind this talk: a crude-to-performance predictor, a rheology engine, and an ISO 17025 + AASHTO R18 lab system.

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Smart Asphalt Decisions

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