Beyond Fuel Savings

The Full Economics of Reducing TRU Runtime

A total-value analysis of fuel, resale, and fleet capital economics for refrigerated trailers

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Executive Summary

Refrigerated trailer value erodes by the hour, not the year. Transport refrigeration unit (TRU) runtime hours, not trailer age nor tractor mileage, are the primary variable that dealers and buyers use to value a used reefer when it changes hands. A trailer that runs harder simply gets older faster, regardless of its year of manufacturing.

PolyFrost®, ChillSkyn's passive radiative cooling coating, reduces TRU runtime by 15 to 20 percent via a reduction in the thermal load the refrigeration unit must work against. That runtime reduction creates three quantifiable value streams over a trailer's ownership life:

1. **Fuel savings.** Less TRU runtime consumes less diesel, generating direct operating savings every year the trailer is in service.
2. **Resale value and TRU-level capital deferral.** Fewer accumulated runtime hours over the ownership period support stronger resale valuations and defer the capital expenditure associated with a TRU rebuild.
3. **Deferred capital on whole-trailer asset replacement.** The same runtime reduction that defers a TRU rebuild also defers the far larger capital outlay of trailer replacement. Valued in present-dollar terms, this is the single largest value stream in this analysis.

A fourth value stream, **operational resilience**, is important but harder to price. More stable supply and return air temperatures and reduced strain during extreme heat events reduce a fleet's exposure to temperature-related cargo claims. This benefit is discussed alongside the three quantified streams but is excluded from the dollar totals below, as its magnitude is specific to each fleet’s operating profile.

In this paper, these three value streams are sized using a fleet profile of 2,500 TRU runtime hours per year over a six-year ownership cycle. Under that profile, a fleet with no runtime mitigation in place accumulates 15,000 hours at the point where resale value begins to decline significantly, and reaches the 20,000-hour TRU end-of-life threshold – the point that typically triggers whole-trailer replacement – at year eight. A 15 to 20 percent runtime reduction moves that same trailer into a materially stronger resale position, or extends service life by approximately 1.4 to 2.0 years before that replacement threshold is reached.

Fuel savings accrue during ownership; resale value and capital deferral are realized at the point of exit or replacement. At a representative 10 percent cost of capital, the three streams together represent a total quantified opportunity of roughly $21,000 to $28,000 per trailer over a six-year cycle, with deferred whole-trailer replacement capital as the largest single component. The sections that follow build this figure one value stream at a time, then bring it together in Section 8.

1. The Problem: Reefer Value Erodes by the Hour, Not the Year

TRU hours, the total engine hours logged since new, are the primary metric experienced buyers and dealers use to judge a used reefer's worth, cutting across model year, brand, and cosmetic condition to reveal its true mechanical position.

This distinction matters because reefer hours and tractor mileage do not move together. A tractor pulling a reefer trailer can show 600,000 miles while the trailer's refrigeration unit shows 22,000 hours. Reefers run whenever the load needs to stay cold, during dock waits, yard staging, and layovers, independent of whether the truck is moving. One asset may look road-ready while the other is approaching the end of its useful life.

The reason hours matter more than age is mechanical. The major components in a TRU, such as the compressor, alternator, and fuel system, degrade based on runtime, not calendar age. A trailer that sits more and runs less simply wears less, whatever its model year says.

Buyers increasingly evaluate used reefers this way. A newer trailer with a high-hour unit routinely requires more immediate maintenance than an older trailer with a lower-hour unit and a strong service history. This is why hours, not model year, have become the figure experienced buyers ask for first.

2. Quantifying the Curve

Because hours, not age, drive wear, resale value should track a predictable curve tied to the TRU's service life rather than the trailer's calendar age. The depreciation model used in this paper, derived from the TRU's typical share of new trailer value and its service-life-to-rebuild curve, maps that decline into four practical brackets (full calculation in Section 5):

TRU Hours	Market Position
Under 12,000	Great resale window. Dealers and retail buyers pay full value.
12,000 – 15,000	Still marketable, but value begins to dip.
15,000 – 20,000	Value drops significantly. Maintenance costs ramp up.
20,000+	Resale value drops to salvage pricing. Major component failure becomes likely.

Depreciation model developed for this paper, based on TRU value share and service-life data; see Section 5 for the underlying calculation.

This bracket structure explains why the TRU's typical service life, 15,000 to 20,000 hours before a rebuild or replacement is required, coincides precisely with the point where resale value declines sharply. The wear that ends a TRU's useful life is the same wear that erodes what a buyer is willing to pay for the trailer.

Overlay a standard fleet duty cycle on this curve and the exposure becomes clear. At 2,500 run hours per year, a six-year ownership cycle lands a trailer at exactly 15,000 accumulated hours, the

top edge of the “still marketable” bracket and the entry point to the range where value drops significantly. A fleet running a conventional six-year replacement schedule is, unknowingly, trading in at precisely the point on the curve where buyers start discounting hardest.

3. The Lever: What a 15 to 20 Percent Runtime Reduction Actually Does

Reducing TRU runtime moves a trailer's position on the hours curve in one of two ways, depending on how a given fleet manages replacement.

Path A: Same exit timing, better resale position

A fleet that trades or replaces trailers on a fixed calendar schedule benefits from arriving at that exit point with fewer accumulated hours.

Runtime Reduction	Effective Hrs / Yr	Hours at Year 6	Resale Bracket
Baseline	2,500	15,000	Value drops significantly (top edge)
15%	2,125	12,750	Still marketable, mild dip
20%	2,000	12,000	Great resale window

Assumes 2,500 baseline TRU run hours per year and a 6-year ownership cycle.

At the high end of the range, a trailer exits ownership in the low end of the “great resale” bracket rather than the high end of the “value drops significantly” bracket, a full bracket and a half of improved resale positioning on an unchanged ownership timeline.

Path B: Same wear ceiling, extended service life

A fleet that runs trailers until a wear threshold is reached, rather than on a fixed calendar, benefits instead from delaying the date that threshold is hit.

Runtime Reduction	Years to 15,000 Hrs	Extra Runway	Years to 20,000 Hrs	Extra Runway
Baseline	6.0	—	8.0	—
15%	7.1	+1.1 yrs	9.4	+1.4 yrs
20%	7.5	+1.5 yrs	10.0	+2.0 yrs

Path A and Path B are not competing arguments. They are the same underlying mechanism, hours avoided, expressed as two different outcomes depending on what a fleet does at the replacement decision point. Section 10 addresses which path applies to which fleet type in more detail; fleets on a fixed trade cycle land in Path A, and fleets that run equipment to wear land in Path B.

4. Value Stream One: Direct Fuel Savings

Fleet operators run on tight operating ratios (OR), where every reduction in fixed or variable cost flows directly to the bottom line. Reducing TRU runtime lowers diesel consumption directly, generating operating savings every year a trailer is in service, rather than only at resale. With the runtime-reduction mechanism established, Sections 4 through 7 quantify each value stream in the order it is realized.

Assumptions

- Baseline TRU fuel burn: 0.8 gal / hr
- Run hours: 2,500 / yr
- Ownership cycle: 6 years
- Runtime reduction: 17.5% (midpoint of the 15–20% range)

Fuel Consumption	Baseline	With 17.5% Reduction
Annual TRU fuel burn	2,000 gal / yr	1,650 gal / yr
6-year total fuel burn	12,000 gal	9,900 gal
Fuel saved over 6 years	—	~2,100 gal

Diesel Price	Annual Savings	6-Year Lifetime Savings
$3.00 / gal	$1,050 / yr	$6,300
$3.50 / gal	$1,225 / yr	$7,350
$4.00 / gal	$1,400 / yr	$8,400

TRUs run on off-road, dyed diesel, which is exempt from federal and state on-road fuel taxes and is typically $0.30 to $0.50 per gallon below standard on-road diesel. Fuel savings scale linearly with diesel price; a fleet can substitute its own current or forecast diesel cost to localize this figure.

At every price point in this range, fuel savings alone represent a material annual operating benefit, realized independently of and in addition to the resale and capital deferral value streams covered next.

5. Value Stream Two: Resale Value and TRU-Level Capital Deferral

Hours saved translate into resale value preserved

Applying the runtime reduction to the resale curve established in Section 2 yields a range of preserved value per trailer. The TRU accounts for roughly 30 to 35 percent of a new trailer's value. That value declines steadily over the unit's 15,000 to 20,000 hour service life until the trailer reaches

the end of its marketable life. This relationship implies a wear cost of roughly $1.00 to $1.65 per TRU hour (see Appendix for methodology).

Runtime Reduction	Hours Saved (6 Yrs)	Value Preserved @ $1.00 / hr	Value Preserved @ $1.65 / hr
15%	2,250 hrs	$2,250	$3,713
20%	3,000 hrs	$3,000	$4,950

The same hours meter also governs the TRU rebuild decision

Fewer accumulated hours also delay the point at which the TRU itself needs a rebuild or replacement, independent of what happens to the trailer body.

Capital Event	Trigger Point	Cost Avoided / Deferred	Deferral from 15–20% Reduction
TRU rebuild or replacement	~15,000–20,000 hrs	$15,000–$25,000	~1.1–2.0 extra years

This TRU-level deferral is the smaller component of the capital story. Section 6 quantifies the larger effect, on the whole trailer rather than just its refrigeration unit.

6. Value Stream Three: Deferred Capital on Whole-Trailer Replacement

Reducing TRU wear defers not only a TRU rebuild but the much larger capital outlay to replace the whole trailer. Valued in present-dollar terms, this is the largest of the three quantified value streams in this paper.

Fleets rarely replace a trailer because of a worn-out trailer body. In practice, trailer retirement is driven by TRU end of life, typically in the 15,000 to 20,000 hour range, at which point a TRU rebuild on an aging asset stops making economic sense and the fleet opts for whole-trailer replacement instead. The same runtime reduction that delays a TRU rebuild also delays this larger capital outlay, since both are governed by the same accumulated hours.

This value stream needs to be measured differently from fuel savings or resale value. Fuel savings are an annual cash benefit; deferring a trailer purchase does not eliminate the cost, but postpones it. The correct way to value a postponed cash outflow is the time value of money: a dollar spent two years from now is worth less today than a dollar spent now, because the fleet retains the use of that capital, or avoids the financing cost of borrowing it, in the meantime.

Sizing the deferral

Using the 20,000-hour TRU end-of-life threshold — the point that most directly triggers whole-trailer replacement — a 15 to 20 percent runtime reduction extends service life as follows:

Runtime Reduction	Years to 20,000 Hrs	Extra Runway vs. Baseline
Baseline	8.0	—
15%	9.4	+1.4 yrs
20%	10.0	+2.0 yrs

At the top of the range, a fleet defers the purchase of a new trailer by a full two years.

Valuing the deferral

Method

$$Deferral\ value = Trailer\ price - \left[\frac{Trailer\ price}{(1 + Cost\ of\ capital)^{years\ deferred}}\right]$$

This is the standard present-value treatment of a delayed capital outlay: the fleet keeps the purchase price working elsewhere, or avoids financing it, for the length of the deferral.

Applied to a representative $90,000 new trailer price, within the $60,000–$90,000+ market range established in Section 5, across a representative cost-of-capital range for commercial trailer financing:

Cost of Capital	Deferral Value @ 15% Reduction (+1.4 yrs)	Deferral Value @ 20% Reduction (+2.0 yrs)
8%	$9,190	$12,840
10%	$11,240	$15,620
12%	$13,200	$18,250

Cost-of-capital range reflects typical commercial trailer financing and dealer lending rates (roughly 8–12%) for qualified commercial borrowers. A fleet should substitute its own actual cost of capital or financing rate for precision.

At a representative 10 percent cost of capital, a fleet achieving the full 20 percent runtime reduction and extending service life by two years defers roughly $15,620 in present-value terms on a single trailer, by retaining or avoiding the financing of that capital for two additional years. At the 17.5 percent midpoint assumption, the equivalent figure is approximately $13,440.

This is the largest of the three quantified value streams in this analysis, and it scales directly with trailer price and a fleet's actual cost of capital. A fleet financing new equipment at the higher end of the commercial lending range, or a fleet with higher opportunity cost of capital, will see a larger effect than the figures shown here.

This figure is as useful on the front end of an acquisition decision as it is at disposal. Knowing the deferral value in advance informs how a fleet models the economics of a new trailer purchase, structures its financing, or times its capital budget, not just how it plans for eventual resale.

7. Value Stream Four: Operational Resilience

Alongside the three quantified value streams established in Sections 4 through 6, reduced TRU runtime produces operational benefits that are real but harder to price precisely. These are presented here as directional, risk-reducing effects rather than dollar figures, and should be evaluated with the same methodological transparency as the estimates in Sections 4 through 6.

- **Supply and return air stability.** A TRU that cycles less to hold temperature runs a steadier duty cycle, which reduces the temperature swings most likely to compromise product quality or trigger a cold-chain excursion.
- **Reduced extreme-heat claims exposure.** A trailer with more thermal margin during high-ambient conditions is less exposed during extreme heat, when temperature-related cargo claims are most likely to occur.
- **Lower GHG emissions and carbon accounting benefit.** Less TRU runtime means less diesel burned and fewer associated greenhouse gas emissions, relevant both to a fleet's own Scope 1 reporting and to the Scope 3 reporting of shippers and customers elsewhere in the supply chain, an area of growing focus in Europe and increasingly on customer scorecards in North America.

Where a fleet has its own claims history or pilot-level temperature data, that data should be used to move these effects from qualitative to quantified in future revisions of this analysis.

8. Total Opportunity Across a 6-Year Ownership Cycle

Bringing the three quantified value streams together — using the 17.5% midpoint runtime reduction assumption, a representative $3.50/gal off-road diesel price, and a 10% cost of capital for the deferred trailer purchase — yields a total quantified savings opportunity per trailer:

Value Stream	6-Year Impact
Fuel savings (at $3.50/gal off-road)	$7,350
Resale value preserved / TRU-level capital deferral	$2,250 – $4,950
Deferred capital, whole-trailer replacement (at 10% cost of capital)	$11,240 – $15,620
Operational resilience	Unquantified — reduced claims exposure, temperature stability
Total quantified opportunity	**~$20,840 – $27,920**

Deferred whole-trailer capital is shown at a representative 10% cost of capital; see Section 6 for the full 8–12% sensitivity range. Figures scale with a fleet's actual financing rate and trailer price.

Deferred whole-trailer capital is the largest single component of this total, consistent with its significantly larger dollar base relative to fuel savings or TRU rebuild costs. This is a total value opportunity figure, not a payback calculation. It is intentionally presented independent of PolyFrost

pricing, which varies by fleet size and program structure, so that the underlying savings case stands on its own and can be paired with a fleet-specific cost quote.

9. Supporting Evidence

The 15 to 20 percent runtime reduction range used throughout this paper is grounded in field pilot data. A 76-day, 611-hour field pilot on a single reefer trailer recorded a 20 percent reduction in daytime TRU load and a 17 percent reduction in nighttime load, with average duty cycle dropping from 49.4 percent before coating to 39.7 percent after. That pilot generated approximately 15,000 operating data points. Repeat orders from the same operator have since extended the performance evidence base beyond the initial test window.

Additional proof-of-concept work in Pachuca De Soto, Mexico, demonstrated the underlying thermal mechanism, with coated surface temperatures running up to 90°F (50°C) below uncoated surfaces under direct sun.

The strongest independent validation in this evidence base comes from Mesilla Valley Transportation Solutions (MVTS), an independent fuel-economy testing and certification organization based in Las Cruces, New Mexico. MVTS operates as an unbiased third-party testing entity, receiving no commission from the sale of products it tests, and uses proprietary high-precision test methods accurate to +/-0.2%. MVTS Certified™ testing of a ChillSkyn-coated refrigerated trailer against an uncoated control, conducted under controlled side-by-side conditions, found a 14.62 percent improvement in fuel economy, consistent with the runtime reduction range used elsewhere in this paper, though the MVTS test measures overall fuel economy rather than TRU duty cycle specifically. The same test recorded a maximum external roof temperature reduction of 77.4°F (43°C) on the coated trailer, averaging 29.7°F (16.5°C) across the test period, nighttime hours included. The full test report is publicly available from MVTS.

Field validation footprint

The runtime reduction range used in this paper draws on field pilots and proof-of-concept trials conducted by ChillSkyn across a range of ambient conditions and fleet types, building a broader evidence base for the 15 to 20 percent reduction assumption:

- Jackson, Mississippi, USA – field pilot, high-humidity Southeast U.S. climate
- Monterrey, Mexico – field validation, arid northern Mexico industrial climate
- Videira, Santa Catarina, Brazil – field validation, subtropical Southern Brazil climate
- Chapecó, Santa Catarina, Brazil – field validation, subtropical Southern Brazil climate

This geographic spread, spanning humid subtropical conditions in the Southeast U.S. and Southern Brazil alongside the arid industrial climate of northern Mexico, supports treating the 15 to 20 percent runtime reduction as a representative range across operating conditions rather than a result specific to one climate or one fleet.

This evidence base supports the runtime reduction range as a working assumption. It does not yet include a matched-pair resale price study isolating coated versus uncoated trailers at equivalent hours, which remains the most direct way to validate the resale value claims in Section 5 with market transaction data rather than a derived proxy.

10. Implications by Buyer Type

Section 3 established which path, resale positioning or extended service life, applies to which kind of fleet. This section identifies which value stream should lead the conversation for each buyer type, and what to ask internally to confirm it.

Fleets on a fixed replacement schedule

For fleets on Path A, the deferred whole-trailer capital in Section 6 is less directly applicable, since the replacement date does not move. The resale value stream in Section 5 is the primary value stream to lead with. The practical question to bring to a fleet or leasing team is what return value they are currently assuming at standard exit hours, since that is the baseline a reduced-runtime trailer would improve upon.

Owner-operators and fleets that run to wear

For fleets on Path B, the deferred capital stream in Section 6 is the dominant value stream, since these are the fleets that defer the purchase decision rather than realizing value at a fixed exit point. The relevant internal question is what financing or opportunity cost of capital the fleet carries, since that rate, not the 10 percent figure used for illustration in this paper, determines the real magnitude of the deferral value.

OEMs and channel partners

For manufacturers and dealers considering PolyFrost as a factory or pre-delivery specification, the relevant argument spans both buyer types at once: a lower-runtime trailer is easier to sell on a lifetime economics argument and later supports a stronger resale reputation for the brand as those same trailers reach the used market. This makes runtime reduction a specification-level decision rather than a fleet-level retrofit choice.

11. Conclusion

The three value streams in this paper compound rather than compete. Fuel savings show up in the operating budget every year a trailer is on the road. Resale value shows up once, at trade-in, for fleets that exit on a fixed schedule. Deferred capital shows up as a delayed, smaller cash requirement for fleets that run equipment until it wears out. Most fleets are only budgeting for the first of the three.

That gap is the finding worth acting on: a 15 to 20 percent reduction in TRU runtime is worth roughly $21,000 to $28,000 per trailer over a standard six-year cycle, and the largest share of that figure sits in a capital-deferral effect that most fleets are not currently tracking at all, as a purchase not yet made generates no invoice and needs no approval.

Which stream matters most depends on how a fleet manages replacement — fixed schedule or run-to-wear — as Section 10 lays out. What does not depend on that choice is the underlying mechanism: fewer accumulated hours, valued consistently across fuel, resale, and capital, on the same asset, over the same ownership period.

Frequently Asked Questions

Does TRU runtime affect a reefer trailer's resale value?

Yes. TRU hours, not trailer age, are the number buyers and dealers use to value a reefer when it changes hands, since the major wear components degrade on runtime rather than calendar time. A trailer with fewer accumulated hours resells for materially more than an otherwise identical trailer with a high-hour TRU, even when both are the same model year.

How much can reducing TRU runtime save on fuel over a trailer's life?

On a standard fleet profile of 2,500 TRU run hours per year, a 15 to 20 percent runtime reduction saves roughly 1,800 to 2,400 gallons of off-road diesel over a six-year ownership cycle, worth $6,300 to $8,400 at $3.50 per gallon (see Section 4).

Is it better to extend a reefer trailer's service life or replace it on schedule?

It depends on how the fleet already operates. Fleets on a fixed replacement schedule capture more value from an improved resale position at the same exit date. Fleets that run equipment until it wears out capture more value from delaying the replacement itself. The latter is typically the larger benefit in present-dollar terms, since it defers a major capital outlay rather than improving a trade-in price (see Section 10).

How should a refrigerated fleet think about optimizing operating cost?

Operating cost for a reefer fleet should be evaluated as fuel, maintenance, and downtime together, not fuel in isolation, since the equipment choices that reduce TRU runtime generally reduce all three at once. Fleets typically run on tight operating ratios (OR), so even small, compounding reductions in fixed and variable cost can have a disproportionate effect on overall performance. The highest-leverage opportunities are usually those that reduce how hard the refrigeration unit has to work, rather than those that only reduce the price paid per gallon.

Why do both operating expense and capital expense matter in fleet equipment decisions?

Operating expense savings, such as fuel and maintenance, show up every year and are easy to track. Capital expense effects, such as resale value and replacement timing, show up once, years away, and are easy to overlook. A decision evaluated on operating expense alone can miss the larger of the two effects, since capital deferral or resale improvement often outweighs annual savings when measured over a full ownership cycle.

How should fleet operators evaluate new technology for its impact on both opex and capex?

A complete evaluation asks three questions: What does it do to annual operating cost? What does it do to the asset's resale value or wear profile at exit? And what does it do to the timing of the next

capital purchase? Technology assessed only on operating savings will understate its true value if it also extends equipment life or changes its value at resale.

Appendix: Methodology and Caveats

Resale value proxy ($1.00 – $1.65 per TRU hour)

This figure is derived by treating the TRU's estimated share of new trailer value (roughly 30 to 35 percent, or approximately $20,000 to $30,000 of a $60,000 to $90,000+ trailer) as depreciating over its typical 15,000 to 20,000 hour service life, with the rebuild cost as the residual floor. It is a reasoned estimate built from published price ranges and typical service-life figures, not a regression against matched-pair sale prices of coated and uncoated trailers. It should be described internally and externally as directionally supportive of the resale argument, not cited as a validated market rate.

New trailer price range

The $60,000 to $90,000+ new trailer range is supported by industry pricing data as of early 2026. The $90,000 figure used in Section 6 sits within this range and should be updated against a current fleet-spec quote where one is available.

Deferred whole-trailer capital ($9,190–$18,250)

This figure is the present value of postponing a $90,000 capital outlay by 1.4 to 2.0 years, calculated as

$$Deferral\ value = Trailer\ price - \left[\frac{Trailer\ price}{(1 + Cost\ of\ capital)^{years\ deferred}}\right]$$

The 8 to 12 percent cost-of-capital range reflects published commercial trailer financing and dealer lending rates for qualified borrowers, not a fleet-specific figure. This is a standard corporate finance treatment of a delayed cash outflow, not a market-observed figure, and a fleet's own financing rate or internal hurdle rate should be substituted for precision. This value stream assumes the fleet's actual replacement trigger is TRU condition rather than a fixed depreciation schedule, lease-return date, or other calendar-driven policy; where that assumption does not hold for a given fleet, this value stream should be discounted or removed.

Fuel savings assumptions

The 0.8 gal/hr baseline TRU burn rate and 2,500 annual run-hour assumptions are representative fleet figures and should be replaced with fleet-specific data where available, since actual duty cycle varies by load type, route profile, climate, and trailer age.

Runtime reduction range

The 15 to 20 percent range is based on ChillSkyn field pilot results. Actual performance will vary by fleet, route, and climate, and should not be represented as a guaranteed outcome for any individual fleet without fleet-specific validation data.

Operational resilience claims

Claims regarding supply and return air stability and reduced extreme-heat cargo claims exposure are presented as directional and risk-based, not as quantified guarantees, pending fleet-specific claims or temperature data.

Sources

Independent testing

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Technology & Maintenance Council (TMC), American Trucking Associations, IR-2022-1: North American Refrigerated Trailer Survey Report, 2022.

O Trucking, Reefer Trailer Cost: New vs Used Prices & Total Cost of Ownership, 2026. https://otrucking.com/resources/guides/reefer-trailer-cost/

ChillSkyn field validation data

Refrigerated Trailers Life Extension, Las Cruces, NM (2025): https://www.chillskyn.com/success-stories/reefer-trailers/

Stationary reefer field pilot, North Carolina, USA (Aug–Oct 2025): https://www.chillskyn.com/success-stories/static-storage-reefers/

Proof-of-concept trial, Pachuca de Soto, Mexico (June 2025): https://www.chillskyn.com/success-stories/temperature-sensitive-cargo/

Field validation: Jackson, MS; Monterrey, Mexico; Videira and Chapecó, Brazil (data available on request).