

TECHNICAL COMPARATIVE REVIEW

Regenerative Suspension Systems

A comparative technical review of ClearMotion, Audi eROT, and Gravity Driven Industries

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Three serious efforts have attempted to convert suspension motion into electrical energy: ClearMotion, formerly Levant Power out of MIT; Audi's eROT program; and Gravity Driven Industries. ClearMotion and Audi each demonstrated the underlying physics, then made a deliberate engineering choice to prioritize ride comfort over energy generation — a choice validated by ClearMotion's 2025 entry into volume production as a software-defined chassis company. Gravity made the opposite choice: an architecture optimized for energy capture at commercial-vehicle scale. The energy-generation lane was not closed by failure. It was vacated by choice.

Two Ways to Treat Suspension Energy

Active architecture — ClearMotion, Audi eROT

Active systems place a controllable actuator at each corner and use software to command wheel motion in real time, counter-actuating against road inputs to cancel unwanted body motion. Energy recovery, where present, is a byproduct of an actuator that is fundamentally there to do work on the vehicle. These systems are sophisticated and effective at their purpose, ride quality, but they consume net energy to operate and carry the cost and integration burden of an active control loop at every wheel.

Passive-capture architecture — Gravity

Gravity lets the road do the work: suspension compression drives a positive-displacement hydraulic pump, fluid is routed through accumulators to a manifold, and the resulting flow spins an impulse turbine coupled to a generator. There is no real-time active valving, no per-wheel control loop, and no software commanding the suspension. The result is a system whose purpose is generation, not a comfort actuator with a recovery feature bolted on. The stabilization benefits Gravity provides are genuine, but they are a consequence of the architecture rather than its objective.

The Prior Efforts

ClearMotion — energy first, then a deliberate pivot to comfort

ClearMotion began at MIT as Levant Power with a bold premise: regenerate energy from vehicle shocks while improving ride quality. Early test data suggested on the order of 1 kW per shock in rough off-road or military duty cycles. Over time the company made a clear-eyed commercial decision that the value was in comfort, acquired Bose's active-suspension intellectual property, and re-identified as a software-defined chassis business. That decision has been vindicated: ClearMotion reached volume production in 2025 supplying its CM1 active-suspension system for a next-generation electric vehicle program. It is a successful company, and it is now, unambiguously, a ride-quality company. The relevant takeaway is not that ClearMotion failed. It is that a capable, well-funded team with a generation-capable architecture concluded that comfort was the better business, and in doing so left the energy-generation category open.

Audi eROT — a validated experiment, never productized

Using rotary dampers and lever-arm actuation, Audi reported roughly 100 to 150 W average on rough roads with theoretical peaks above 600 W, within a 48-volt mild-hybrid framework. The results were instructive precisely because they were modest: a relatively light passenger vehicle on typical roads does not present enough sustained suspension input to make generation a primary value proposition. Audi treated eROT as a supplemental feature and never took it to production. The eROT data is useful third-party confirmation of a principle Gravity's architecture is built around: generation yield scales with vehicle mass and road input, which is exactly why the commercial-vehicle platform is the right target.

Engineered for Generation at Commercial-Vehicle Scale

Why Class 8 is the right target — the physics

Audi's modest passenger-car numbers and Gravity's commercial-vehicle target are not in conflict; they are the same physics evaluated on opposite ends of the mass-and-input spectrum. A Class 8 tractor is favorable on every variable that matters:

- **Motion ratio near 1:1** — vertical struts mean nearly every road input reaches the shock directly, versus roughly 0.6 on a typical independent recreational platform.
- **Effectively rigid tires** — steer tires at 100+ psi provide little secondary absorption, so input passes to the strut rather than being damped at the contact patch.
- **Large axle loads** — on the order of 20,000 lb front-axle loading means inputs carry substantial energy and must be reacted by the suspension.
- **Continuous, repeatable highway input** — sustained operating hours on consistent road profiles, versus intermittent trail or street duty.
- **Favorable component sizing** — larger hydraulic components run more efficiently and leave room for a properly sized, accessible generator.

This is why Gravity does not claim meaningful generation on smooth pavement with a light vehicle — that is the low-yield regime Audi documented. Gravity's claim is the opposite and more defensible

one: a heavy vehicle accumulating continuous real-world road input over thousands of operating hours is a sustained, capturable energy source.

System Figures

The central differentiator is not a larger output claim; it is one established by an independent Tier-1 firm on manufacturer data, stated by basis of evidence, and labeled honestly.

Status	Figure	Basis
MEASURED	415 W peak	Operating vehicle under actual driving conditions, instrumented closed-course testing. Establishes that the full conversion chain functions on a moving vehicle.
MODELED	32 kW gross	Mean gross hydraulic capture, Class 8 platform. Pratt Miller Engineering model on Peterbilt 589 road profile data. Technical figure; never presented as output.
MODELED	10 kW net	Continuous net electrical output after conversion losses. The commercial figure.
MODELED	20,000 kWh / vehicle / year	10 kW net across a 2,000-hour annual duty cycle — a conservative long-haul baseline.
UNMEASURED	Class 8 physical output	No full-scale test has been conducted. Closing this gap is the purpose of the funded demonstration program.

Gross and net are distinct quantities and are never combined. The measured prototype result establishes the conversion architecture; it is not a commercial output claim. Commercial-scale figures are modeled and are labeled as such throughout.

Comparative Matrix

Dimension	ClearMotion	Audi eROT	Gravity
Primary objective	Ride comfort	Ride improvement; recovery secondary	Energy generation at scale
Architecture	Active electro-hydraulic, per-wheel software control	Rotary damper and generator, lever-arm	Passive hydraulic capture, impulse turbine
Energy relationship	Net consumer	Minor net recovery	Net producer
Reported output	~1 kW per shock, early rough-road data	~100–150 W average; under 600 W peak	32 kW gross / 10 kW net, Class 8, modeled
Independent basis	Production OEM programs, comfort	Internal Audi testing	Pratt Miller Engineering on Peterbilt manufacturer data
Control complexity	High	Medium	

Dimension	ClearMotion	Audi eROT	Gravity
			Low — no real-time active valving
Scaling with mass and distance	Not the design goal	Low, light vehicles	High — heavier and longer means more output
Retrofit capable	No — OEM-integrated	No	Yes — designed for it
Market status	Volume production, comfort	Concept; not productized	Pre-commercial; Class 8 validation in progress
Intellectual property	Active-suspension and Bose IP	Internal OEM IP	Five issued U.S. patents; 19-country coverage

ClearMotion figures reflect early GenShock-era data; the company's current production systems are comfort-focused. Gravity's Class 8 output is modeled; commercial field validation is in progress.

A Different Class of Machine

ClearMotion's trajectory is a case study in disciplined commercial focus: a generation-capable team that recognized comfort as the stronger market and executed to volume production. Audi's eROT validated the science and correctly judged that a light passenger vehicle is the wrong platform to build a generation business on. Both outcomes point to the same conclusion: the suspension energy-generation category was left open not because the physics fails, but because the platform and priorities required to pursue it were a poor fit for those companies.

Gravity was built specifically for that category and that platform. Its architecture is a net energy producer rather than a comfort actuator; its target is the heavy, high-utilization vehicle where suspension input is abundant; its output is modeled by a Tier-1 firm on real manufacturer data and labeled as such; and its position is protected by five issued U.S. patents across 19 countries. It is not a better active suspension. It is a different class of machine — a power source that happens to live where the suspension used to only waste heat.

Gravity Driven Industries public edition. Figures stated by basis of evidence: measured on physical hardware, modeled in engineering simulation, or identified as not yet measured. Consistent with GDI System Figures — Current Reference v1.1, September 15, 2026.

v3.1 — public edition: internal-distribution marking removed; bench-top figure removed from System Figures; counterparty personnel names removed.