

# Hydraulic Hybrids from Rexroth: Hydrostatic Regenerative Braking System HRB



Recover Energy – Reduce Emissions



# A Win-Win for Operators and the Environment

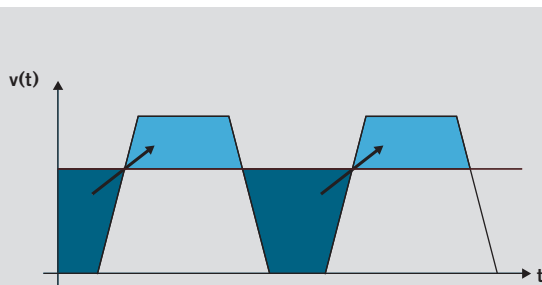
Dwindling resources, increasing environmental awareness, and above all, rising fuel prices are affecting business decisions as never before. The HRB Hydrostatic Regenerative Braking System helps meet increasingly strict environmental regulations – and reduces operating costs by saving fuel. The HRB system will provide superior return on investment – whether you're a fleet operator of refuse trucks or shuttle buses, a construction firm, a municipal operation running school or public transit buses, or a loading dock or port operator.



# Hybrid: Two Pulling Together

“Hybrid” has its origin in the Greek language and means: “Mixture or combination of two things.” Hybrid vehicles use two types of energy to attain optimum propulsion. Combustion engine demand is reduced by hybrid technology, giving the user two big advantages: lower fuel consumption and a significant reduction in emissions. The most common hybrid technologies are electric and hydraulic hybrids.

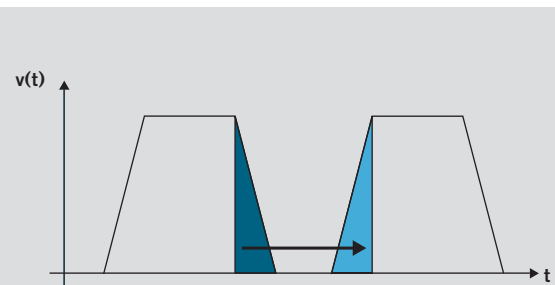
## Characteristics of an electric hybrid:



Excess motor power is continuously accumulated in a battery over a longer time period (blue) and accessed as needed (light blue).

- High energy density and low power density: The battery can absorb a great deal of energy, but the charge time is relatively long, so it is not possible to fully recapture the braking energy.
- Energy is stored in batteries.
- Typically found in passenger cars.
- More detailed information about electric hybrid technology can also be found at the Bosch Web page [www.bosch.de](http://www.bosch.de) under “Hybrid Technology”.

## Characteristics of a hydraulic hybrid:



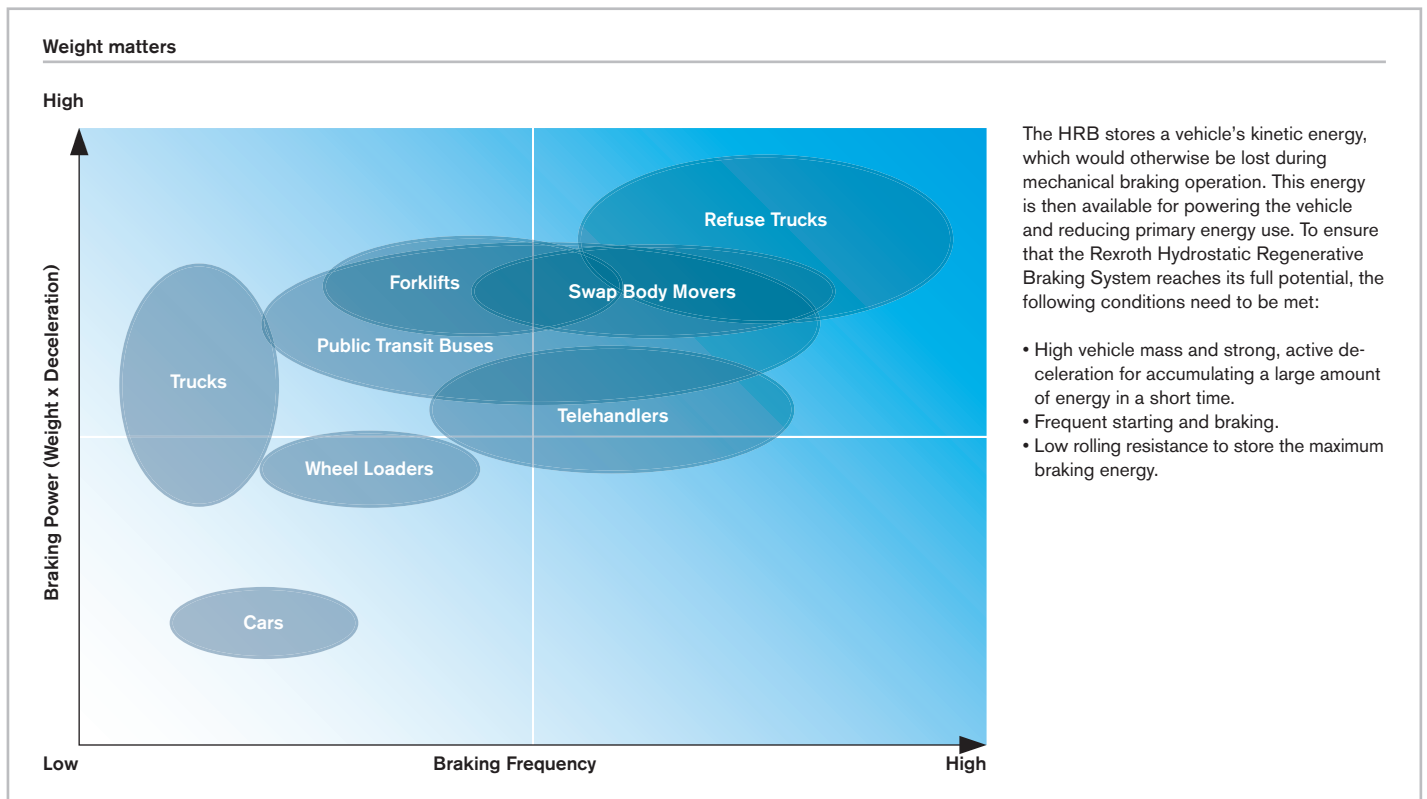
The kinetic energy from braking is fed to a hydraulic accumulator (blue) and immediately reused for starting (light blue).

- High power density and low energy density: There are limits to the amount of energy the system can accumulate. However, it takes less time to collect and store this energy, which can be called upon as needed.
- The full braking energy is then fed to a hydraulic accumulator and stored.

Hydraulic hybrids are ideal for vehicles with frequent, short start-stop cycles, such as public transit buses, refuse trucks, forklifts, pneumatic tire rollers, telehandlers, swap body movers and much more.

# Innovation and Quality Complement Each Other

The Rexroth focus on high-end hydraulic solutions, and our unique product line, is the basis for the HRB – combining proven components with a new, innovative braking and drive concept. That means high production quality – and a variety of existing components allowing Rexroth to tailor a hydraulic hybrid system to your design requirements. We also have extensive knowledge and experience in electronic control of complex systems. The end result is that we can offer a custom-tailored hydraulic hybrid powertrain that fits the needs of your application.





#### Advantages of the HRB

##### Environment

- Fewer harmful emissions, less pollution.
- Help in meeting future emissions and environmental requirements.
- Reduced brake wear, lower braking noise, and less brake dust.

##### Function

- High functional reliability and low risk of failure.
- Simple maintenance and long service life.
- Ideal solution for new systems or retrofits.

##### Costs

- Significant reduction in operating costs.
- Durable Rexroth components reduce maintenance needs.
- More economical than other hybrid concepts.

##### Energy

- Reduced fuel consumption to preserve energy.
- Fuel-neutral system – can be combined with diesel, gasoline, or other types of motors.
- Increased vehicle range.

#### Optimal energy use with parallel HRB

For heavy vehicles with short, succeeding start-stop cycles, Rexroth offers the Hydrostatic Regenerative Braking Systems for capturing the braking energy.

The parallel HRB was developed especially for vehicles with no hydrostatic drive. The HRB components are installed in the vehicle as an ancillary system.

## HRB parallel – for Vehicles with a Mechanical Drive Train

The parallel HRB is a hydraulic hybrid for vehicles with no hydrostatic transmission: For example, vehicles used in refuse collection and public transit buses. Use of an HRB system results in significant fuel savings of up to 25% and improved acceleration – depending on the focus of the application.



School Buses

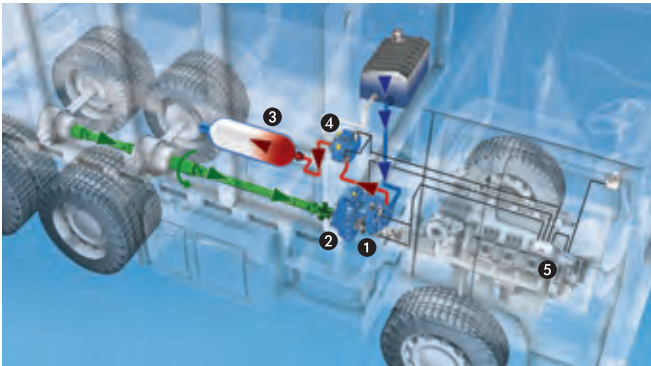


Shuttle Buses



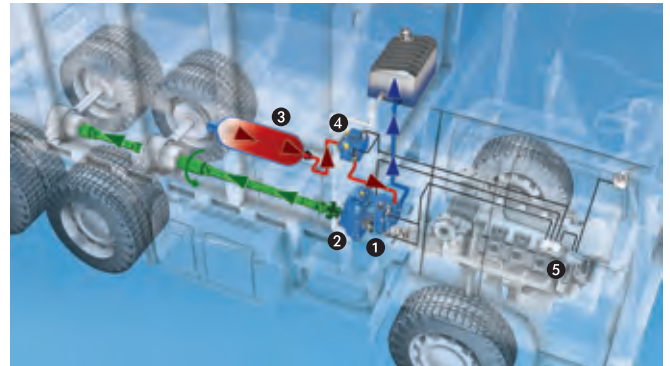
City Buses

**How the parallel HRB works**



**Storing braking energy**

The hydraulic axial piston unit ❶ is coupled to the mechanical drive train through a gearbox ❷. When braking, the axial piston unit converts kinetic into hydraulic energy and pumps hydraulic fluid into the pressure accumulator ❸, increasing the pressure in the accumulator.



**Reusing the stored energy to assist the vehicle drive**

The pressurized hydraulic fluid in the accumulator drives the axial piston unit, which now acts like a motor. Hydraulic energy is converted into kinetic energy. The axial piston unit remains coupled to the mechanical drive train until the pressure accumulator is discharged. The valve control block ❹ controls the filling and discharge cycle and protects the accumulator from excessive pressure. The electronic controller ❺ operates the HRB. In "normal" drive mode the Hydrostatic Regenerative Braking System is decoupled.

**Components of the parallel HRB**



Axial Piston Unit A4VSO + Gearbox, Hydraulic Pressure Accumulator, Pressure Relief Valve, Valve Control Block HIC, Electronic Controller RC



**Calculated fuel savings for a refuse truck (empty weight 16 t) during operation**

Annual operating hours	1,300	1,820	2,340
Fuel savings (liters per year)	2,925	4,095	5,265
CO <sub>2</sub> reduction (kg per year)	7,750	10,850	13,950

**Simulated cost savings using the example of a refuse collection truck\***

On a refuse truck (empty weight approximately 16 tons) the use of the parallel HRB can result in saving of up to 2.25 liters (0.59 gallons) of fuel per hour. The annual operating costs can thereby be reduced significantly – without even taking into account the additional savings potential of reduced brake wear.

> The higher the fuel prices, the sooner your HRB pays for itself.

\* For the simulation Rexroth uses the "AMESim" simulation tool.

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