

# CNG Hydraulic Hybrid Refuse Truck RD&D Project

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# Roles in the CNG Hydraulic RD&D Project

- NYC Department of Sanitation – Purchase CNG 25 Yard Rear Loading CNG Refuse Truck; place into fleet and use for 12 months, provide certified emissions lab/dynamometer
- Crane Carrier – Truck Manufacturer with Cummins Westport ISL G engine
- Bosch Rexroth – Hydraulic Hybrid HRB system manufacturer and integrator
- National Grid – fund the Bosch Rexroth HRB system and testing through the NGrid Technology and Innovation R&D Funds
- New West Technologies – perform all testing in accordance with the Hybrid Truck Users Forum (HTUF) testing protocol

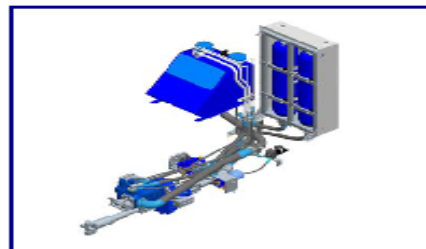
# The Bosch Hydrostatic Regenerative Braking (HRB) System – How it Works



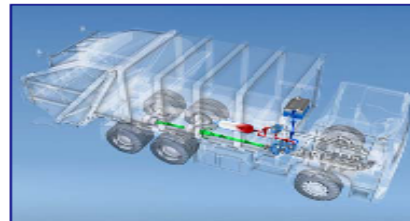
## Bosch Rexroth Hydraulic Hybrid Technology in Refuse Truck



### Bosch Rexroth Hybrid Drivetrain

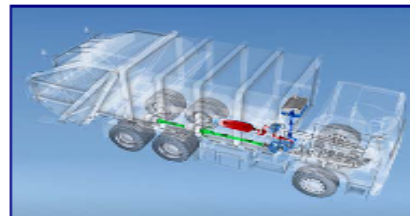


## Bosch Rexroth Hydrostatic Regenerative Braking (HRB) System How it works:



When **braking**, the variable axial displacement unit converts kinetic into hydraulic energy and pumps hydraulic fluid into an accumulator:

A gearbox links a hydraulic variable axial piston unit to the mechanical drive train (drive shaft) to convert kinetic into hydraulic energy when braking. The axial variable piston unit acts here like a pump and converts the released braking energy into hydraulic energy by loading a hydraulic bladder accumulator with hydraulic fluid. This process is controlled by an electronic controller from Rexroth together with a hydraulic valve manifold.



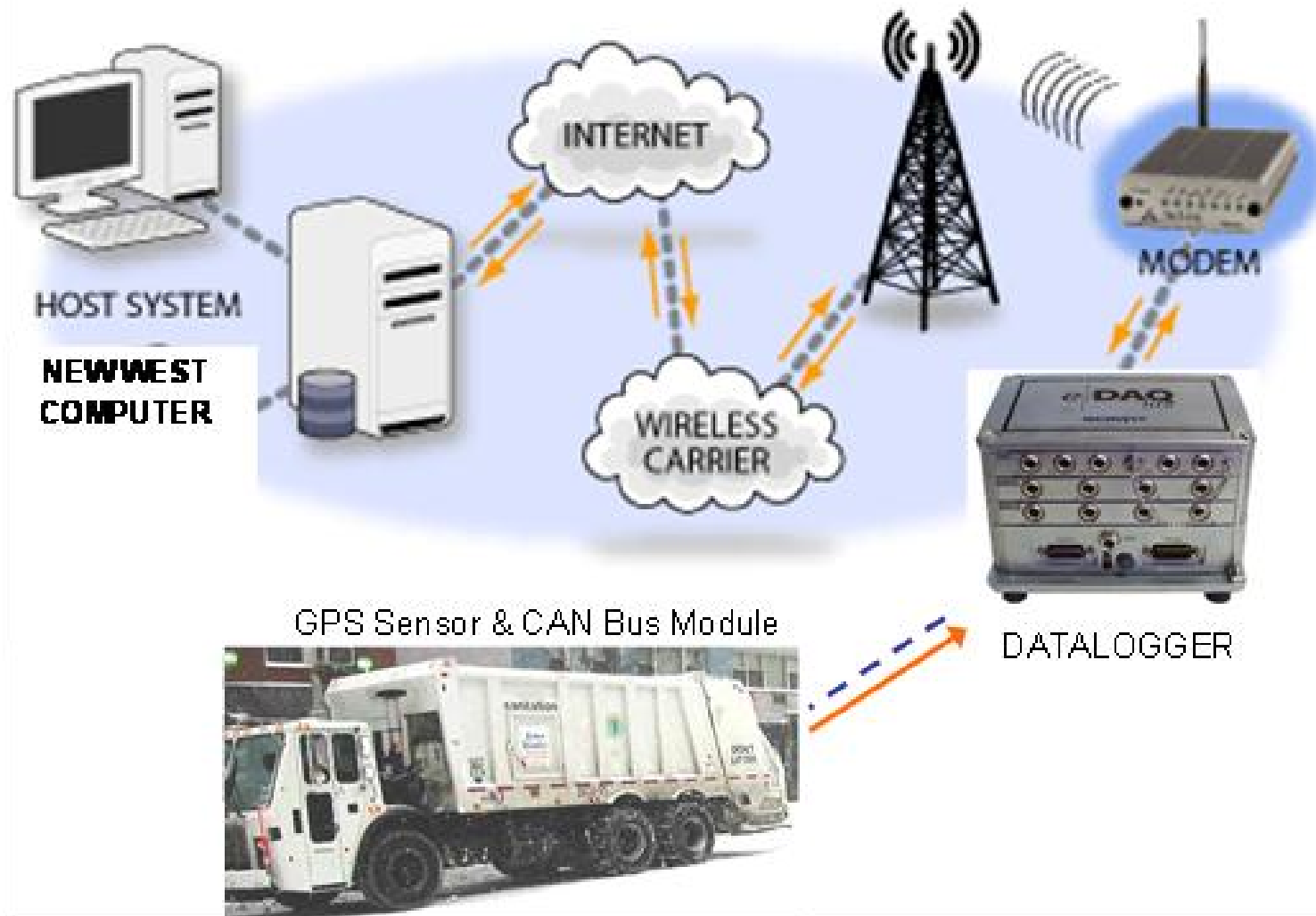
During **acceleration** the pressurized hydraulic fluid in the accumulator drives the variable axial displacement unit, which then works like a motor.

During acceleration the entire process is reversed: The pressurized fluid is discharged in a controlled manner from the accumulator and flows back through the variable axial piston unit. The latter is driven by the fluid flow and, acting like a motor, gives up its energy to the mechanical drive train. A pressure relief valve in the system ensures the highest level of safety for both processes.

# New West Technologies Deliverables

<b>New West Task</b>	<b>New West Deliverable</b>	<b>Deliverable Date</b>
<b>Task 1: Develop On-Road Performance/Dynamometer Test Protocols for CNG-HHV</b>	<b>On-Road and Dynamometer Test Protocol Documents</b>	<b>Within 1 month of contract initiation.</b>
<b>Task 2: Develop Field Demonstration Data Acquisition Plan for CNG-HHV</b>	<b>Data Acquisition Plan Document</b>	<b>Within 1 month of contract initiation.</b>
<b>Task 3: Perform On-Road Performance Testing on CNG-HHV</b>	<b>On-Road Performance Testing Summary Report</b>	<b>Within 1 month of completing on-road performance testing on CNG-HHV</b>
<b>Task 4: Long-Term Field Testing (1-yr) for CNG-HHV</b>	<b>Instrument Truck and Collect Data</b>	<b>---</b>
<b>Task 5a: Develop Interim Report for CNG-HHV</b>	<b>Interim Report</b>	<b>Within 2 months of collecting 6 months of in-use data on CNG-HHV</b>
<b>Task 5b: Develop Final Report for CNG-HHV</b>	<b>Final Report (Draft and Final)</b>	<b>Within 2 months of collecting 12 months of in-use data on CNG-HHV</b>
<b>Task 6: Project Management /Reporting for CNG-HHV</b>	<b>Monthly Progress Reports and conference call minutes</b>	<b>Monthly progress reports; conference call minutes within one week of call</b>

# New West - Data Collection Process



# Parameters for Analysis and Reporting

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- Total Operational hours
- Total service miles
- Average fuel economy (mpg)
- Average fuel consumption (gph)
- Average engine torque and speed
- Average vehicle availability
- Average vehicle driving speed
- Percent idle time
- Percent compaction time

# Parameters for Analysis and Reporting

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- Percent of time hybrid system engaged (as applicable)
- Percent regenerative braking use
- Percent launch assist use
- Vehicle faults recorded
- Percent regenerative braking use (as applicable)
- Percent launch assist use (as applicable)
- Ambient temperature
- Use of accessories (A/C, heater)

# Other Refuse Trucks being Tested with HTUF Protocol

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All Units in the New York City Department of Sanitation Fleet

- 1 Baseline Diesel (has HRB system off)
- 1 Diesel HRB Hydraulic Hybrid
- 1 Diesel Electric Hybrid with ISE system
- 1 CNG HRB Hydraulic Hybrid
- Potential to add a baseline CNG

# Goals, Objectives and Expected Benefits

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- A true “apples to apples” in-service testing and data analysis
- Commercially available CNG Hydraulic Hybrid System
- Position CNG as a “Hybrid” Alternative
- Support the NYC Department of Sanitation Hybrid Program and Alternative Fuel Vehicle Program
- Improved fuel economy, efficiency, performance
- Improved power and torque
- Quieter operation

# Questions?



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