Transportation & Innovation Expo
Leonard Lincoln
Director of Sales Odyne

Transportation & Innovation Expo
Medium and Heavy-Duty Plug-In Electric Vehicles

Available Today
Plug-in hybrid systems for Commercial Trucks since 2007

- Plug-in hybrid drive systems and idle reduction
- Approved and endorsed
- PHEV systems in 70+ fleets, 50+ Patents granted or pending
Areas for improvement with current combustion only technology:

• Inefficient – fuel may be difficult to transport and very expensive
• Loud – especially during idle when personnel are near vehicle
• Higher maintenance – idling engines create extra wear
• Slow – improved acceleration may be beneficial
• Hot – thermal signature during driving and idling
• Lack of electrical power – electronics and export power
• Fumes when next to vehicle
Benefits of current combustion only technology:

• High power and energy density – diesel fuel lighter than batteries
• Fuel available and relatively plentiful – can be transported and delivered
• Reliable – base diesel engine technology over 100 years old, well known and tested
• Service – maintenance and service parts typically available
• Cost – relatively stable cost for engine, low NRE costs (non recoverable engineering costs)
Electrification as a Solution

Odyne plug-in hybrid electric (PHEV) systems improve vehicle driving fuel efficiency, improve acceleration, supply AC electric power for vehicle equipment or tools without a separate diesel generator, and heat / cool the vehicle cab efficiently.

Hybrid launch assist and regenerative braking, Export power from battery system

U.S. Patents: 8978798, 7830117, 7427156, 8818588, 8115450, 7471066, 7323272, 8408341, 8905166, 9283954, 9081680, 9643593; Canada Patents: 2531302, 2531295, 2532410, 2693536, 2702089, 2751753; Additional Patents: China (2), France (2), Germany (2), Japan (1), South Korea (1), U.K. (2); Pending patents: 20
Odyne Solution
Flexible and Minimally Intrusive

Flexible
Modular Patented Design, installs using kit
Complements Powertrain
Multiple OEM and Application platforms

Minimally Intrusive
Hybrid Power through existing PTO port
Only Allison Approved ePTO & PHEV
Retains Warranty

*Technology protected by 50 patents granted
Quiet engine off power

Hydraulic

Air

Electric
Electrification Benefits

- Operates as hybrid during driving, improves acceleration, fuel economy & emissions
- Zero emission stationary work mode
- Can Field Recharge for uninterrupted jobsite use
- Flexible solution for diesel & spark ignited (gasoline/CNG) powertrains

<table>
<thead>
<tr>
<th>Fuel Use / GHG</th>
<th>NOx Emissions</th>
<th>Noise</th>
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<tr>
<td>40-65%</td>
<td>71-96%</td>
<td>&gt;15 dB</td>
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Features and Benefits of Odyne PHEV systems

**Modular battery system:** 10 kWh, 20 kWh, 30 kWh, 40 kWh available
- Quieter work site, keeps engine off longer
- Reduces engine maintenance due to lower idle time
- Built for extreme conditions IP67
- Recharged by grid or by engine

**Electric motor:** up to 42 kW (56 hp) continuous, 70 kW (95 hp) peak
- Better acceleration and more power for equipment

**High exportable power using battery:** capable of supporting up to 6 to 14.4 kW
- Replace separate engine driven generators
Features and Benefits of Odyne PHEV systems

Industry standard plug-in charging with engine backup

- Convenience of 110V charging or faster 220V from EVSE
- Conforms to safety standards: SAE J1772
- Does not require grid charging, enables storm response

System consistency within fleets

- Same components across most applications
- Standardized training, service, and product
Truck Electrification Available Today

- Lower Fuel Consumption
- Quiet Stationary Operation
- Improved acceleration
- Exportable Power
- Lower Engine Maintenance
- Works with existing powertrain
- Installs using a kit on new or retrofit applications
- Many Applications
- Next Steps
Odyne’s current PHEV system can provide the following features, based upon options and subject to packaging, weight and other restrictions:

- Launch assist
- Regenerative braking
- Export power: 6 kW, 12 kW or 14.4 kW
- Low emissions heat without the engine
- Electrical air conditioning
- Battery options: 10 kWh, 20 kWh, 30 kWh, 40 kWh
- Grid or engine recharging of the battery system
- Retains Allison Transmission warranty
- Ability to be installed as a kit on existing vehicles or new vehicles
- Engine off low speed creep (Future)
Which of these benefits are more important?

- Up to 50% reduction in fuel consumption
- Quiet stationary power
- Improved acceleration
- Reduced engine maintenance & low electrical system maintenance
- Reduced thermal signature when stationary
- Reduced thermal signature in engine-off low speed creep mode (future)
- Up to 95% reduction in NOx
- Each unit could be a portable generator (6 kW to 14.4 kW or higher)
- Optional ability to operate hydraulic pumps or compressors with engine off
- Kit that complements the existing powertrain with an Allison transmission
- Ability to install systems on existing trucks in the field or new trucks
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