TransPower
Company Overview

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(858) 248-4255
TransPower’s mission is to become a dominant supplier of clean energy storage, energy conversion, and power control solutions for heavy automotive and stationary applications.

- Core product offering: flexible building blocks that can be cost-effectively applied to many different applications

- Company is differentiated by:
  - Immense breadth and depth of intellectual property
  - Remarkably experienced core management team
  - Culture of passion and innovation
Total System Solutions
• ElecTruck™ electric drive system
• Grid-Saver™ stationary energy storage system
• Future: hybrid-electric and fuel cell drive systems

Business is driven by total system solutions for vehicle and stationary energy applications

Integrated Subsystems
• Energy storage subsystems
• Vehicle control subsystems
• Motive drive subsystems
• Electrically-driven accessory subsystems

Complex subsystems are core to Company IP; can be integrated into systems or sold separately

Components
• Inverter-Charger Units
• Propulsion modules
• Automated manual transmissions
• Control modules
• Electrical and mechanical parts

Numerous proprietary components can be packaged into systems/subsystems or sold individually
<table>
<thead>
<tr>
<th>Function: Energy Storage</th>
<th>Function: Energy Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology:</strong> Mile-Max™ Battery Module</td>
<td><strong>Technology:</strong> EPiC™ Inverter-Charger Unit</td>
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<tr>
<td>• Low-cost lithium-ion cells</td>
<td>• Combines motor control and charging functions</td>
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<tr>
<td>• Advanced battery management</td>
<td>• Grid-compatible</td>
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<tr>
<td>• Tens of kW to MW of energy storage</td>
<td>• TransPower funded development, co-owns IP with EPC Power Corp.</td>
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<tr>
<td>• Easily reconfigurable to a range of electric vehicle, hybrid vehicle, and stationary energy storage applications</td>
<td>• Proprietary technologies supply higher power in a smaller package, at lower cost than commercially available solutions</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Function: Power Transmission</th>
<th>Function: Power Control</th>
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<tbody>
<tr>
<td><strong>Technology:</strong> Automated Manual Transmission</td>
<td><strong>Technology:</strong> EVCon™ Control Architecture</td>
</tr>
<tr>
<td>• Automatic shifting using efficient manual transmissions</td>
<td>• High and low-voltage power distribution</td>
</tr>
<tr>
<td>• Proprietary software matches electric motor and transmission speed</td>
<td>• DC-to-DC conversion</td>
</tr>
<tr>
<td>• Significantly improves vehicle efficiency and drivability</td>
<td>• Model-based design and CAN-based controls, easily modified for different mobile and stationary applications</td>
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</tbody>
</table>
### TARGETED VEHICLE APPLICATIONS

**On-Road Vehicles**
- Port Drayage Trucks
- Other Class 8 Trucks
- School Buses
- Transit Buses

**Off-Road Vehicles**
- Yard Tractors
- Conventional Rail
- Linear Motor Rail
## DEMONSTRATION VEHICLE PROJECTS

<table>
<thead>
<tr>
<th>Class 8 Electric Yard Tractor</th>
<th>Fleet Status</th>
<th>Project Partners</th>
<th>Vehicle Features</th>
</tr>
</thead>
</table>
|                               | • 2 completed and tested in 2013  
• 3 under contract for delivery in 2014 | • HEB  
• IKEA  
• APL Terminals  
• Port of Los Angeles | • 80,000 lb.+ capacity  
• 154 kWh battery subsystem  
• 8-12 hour/50-mile range  
• Onboard battery charger  
• High efficiency validated via dynamometer testing |

<table>
<thead>
<tr>
<th>Class 8 Electric Drayage Truck</th>
<th>Fleet Status</th>
<th>Project Partners</th>
<th>Vehicle Features</th>
</tr>
</thead>
</table>
|                               | • 1 Pilot Truck complete and in service  
• 7 under contract for delivery in 2014 | • California Energy Commission  
• Port of LA  
• U.S. DOE  
• TTSI | • 80,000 lb.+ capacity  
• 215 kWh battery subsystem  
• 75-100-mile operating range  
• Onboard battery charger  
• High performance under diverse conditions |

<table>
<thead>
<tr>
<th>Electric School Bus</th>
<th>Fleet Status</th>
<th>Project Partners</th>
<th>Vehicle Features</th>
</tr>
</thead>
</table>
|                     | • 1 demonstration vehicle complete and in service  
• 6 under contract for 2015 delivery | • California Air Resources Board  
• San Diego APCD | • Goal is to build largest electric school bus with greatest operating range  
• Same drive system components as Class 8 truck and tractor drive systems |

<table>
<thead>
<tr>
<th>Class 8 Natural Gas Hybrid Truck</th>
<th>Fleet Status</th>
<th>Project Partners</th>
<th>Vehicle Features</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 1 demonstration vehicle in development</td>
<td>South Coast Air Quality Mgt District</td>
<td>Battery-dominant hybrid with extended zero-emission operating range</td>
</tr>
</tbody>
</table>
ELECTRIC VEHICLE PRODUCT OFFERING
PRINCIPAL ELECTRIC VEHICLE PRODUCTS

• **Integrated Battery Energy Storage System**
  – Lithium-ion cells with advanced battery management
  – Combination of low cost and high performance
  – Modular design for use in many applications

• **High-Power Inverter-Charger Unit (ICU)**
  – Combines functions of inverter and charger
  – Controls main drive motor(s)
  – Recharges batteries – no need for offboard charger

• **Main Propulsion Unit (MPU)**
  – Electric drive motor combined with transmission
  – Unique “automated manual transmission” delivers high efficiency and performance across wide speed range

• **Electrically-Driven Accessory Subsystem**
  – Powers steering, braking, air conditioning systems
  – Eliminates need for engine-driven accessories

• **Vehicle Control System**
  – Optimizes performance of above components
  – Adaptable to a wide range of vehicles
Electric energy on demand for vehicle and stationary applications

- **Fully integrated turn-key package**
  - Lithium-ion cells
  - Structural support
  - Electrical connections
  - Battery management system (BMS)
  - Safety systems

- **Competitive advantages**
  - High energy density
  - Low cost
  - Modular – can address many needs
  - Salvage value of vehicle modules for stationary applications

Enabled by major advances and cost reductions in lithium battery technology
Unique product combining functions of inverter and charger

• Latest technologies
  – Advanced IGBTs
  – High switching frequency
  – Liquid-cooled heat sinks
  – “Smart inverter” functionality for grid applications

• Competitive advantages
  – Compact and lightweight
  – Low cost
  – Multi-function – eliminates need for external battery chargers that can cost more than $100,000
  – Similar designs for vehicle and stationary applications

Inverter-Charger Unit, developed in partnership with EPC Power Corp.

Advances the state of the art in both inverter and battery charger technology with a single device
Significant improvement in vehicle efficiency and performance

- **Key propulsion innovation**
  - Automatically shifts gears as vehicle torque and speed demands change
  - Utilizes proprietary control software and electronics
  - Compatible with various conventional manual transmissions

- **Competitive advantages**
  - Broadens vehicle performance range
  - Greatly improves efficiency and electric operating range
  - Superior performance and lower cost than customized direct-drive motors

*Transmission equipped with TransPower Automated Manual Transmission shifter*

**Major step toward meeting the demanding performance and power requirements of large electric vehicles**
High power and torque at a fraction of the cost

- **Low cost design**
  - Mass-produced motors
  - Mass-produced combiner
  - Inexpensive coupling
  - Developed in collaboration with Quantum Technologies

- **Competitive advantages**
  - Compact and lightweight
  - Low cost
  - Adaptable to many vehicle applications
  - Highly flexible and maintainable

Main propulsion unit rated at 300 kW

A reliable, inexpensive main propulsion unit for large electric and hybrid-electric vehicles
Efficient power for accessories without engine-driven belts

- Efficient, low cost design
  - Oil-less scroll compressor
  - Direct drive hydraulic pump
  - High voltage operation

- Competitive advantages
  - Eliminates need for engine-driven accessories
  - Compatible with many electric and hybrid-electric vehicles
  - High efficiency
  - Low cost
  - Quiet
  - Low maintenance

Power for steering, braking, and other accessories without engine-driven power take-off units

Integrated Power Control and Accessory Subsystem housing electrically-driven accessory components.
**Reliable, efficient control of the integrated electric drive system**

**EVCON™ central control unit.**

- **CAN-based architecture**
  - Seamless integration with standard truck systems
  - Facilitates integration of new components

- **Competitive advantages**
  - Reliable operation
  - Simplifies maintenance
  - Maximizes component efficiency and operating life
  - Enables rapid integration of new components and technologies

**Adaptable control system that can accommodate and optimize performance of many different components**
• Electric Class 8 Drayage Trucks
  – First prototype completed – October 2011
  – Enhanced capability commercial Pilot Truck in service in L.A./Long Beach port region
  – Demonstration fleet of 7 drayage trucks funded and to be deployed in 2014

• Electric Class 8 Yard Tractors
  – Initial testing of two tractors completed
  – Unprecedented performance demonstrated in dynamometer and in-service tests
  – Three additional tractors funded and to be deployed in California in 2014

• Other Projects
  – Economical Electric School Bus – first bus completed and in service since March 2014
  – Battery-dominant natural gas-hybrid Class 8 truck to be completed in 2015
  – “Rail-Saver” system for locomotives*

* Funding proposed but not yet committed
ELECTRIC CLASS 8 ON-ROAD TRUCKS

• One of the highest power electric road vehicles in the world
  – Two 150 kW motors
  – Two Inverter-Charger Units
  – High capacity battery pack (200+ kWh)

• 2014 Plan
  – 8 battery-electric trucks to be deployed
    • Pilot Truck already in service and demonstrating unprecedented performance
    • 7 additional trucks to be placed into port drayage service in 2014
  – Key demonstration goals
    • High performance and reliability
    • $50,000/year in fuel savings
    • Readiness to begin high-rate manufacturing in 2015

Enhanced capability electric Pilot Truck

First of seven electric Class 8 drayage trucks to feature additional improvements
• Off-road variant of Class 8 truck drive system
  – Single 150 kW motor
  – Single Inverter-Charger Unit
  – 1-2 battery strings (up to 215 kWh)
  – 6-speed automated manual transmission

• Product Status
  – First two demonstration vehicles completed
    • Superior efficiency and operating range demonstrated in dynamometer and in-service tests in 2013
    • Lessons learned from 2013 have been incorporated into a new design
  – Additional vehicles to demonstrate new design in 2014
    • IKEA distribution center (1 tractor)
    • Eagle Marine Terminals/Port of Los Angeles (2 tractors)
• Dynamometer tests conducted at UC Riverside in March 2013
  ➢ Various test cycles run
  ➢ Battery discharge/capacity test performed
  ➢ 1.69 kWh/mile efficiency while hauling 40,000 lb. GVW load
  ➢ 2.55 kWh/mile with 80,000 GVW

• In-service tests performed at HEB distribution center in San Antonio from April through July 2013
  – Operating range of more than 13 hours and greater than 50 miles
  – Ability to carry total loads of 100,000 lb. at speed of greater than 40 mph
  – Significant reduction in energy and operating costs
ECONOMICAL ELECTRIC SCHOOL BUS (EESB)

• **First Prototype Electric Bus**
  – Convert existing Thomas Built Saf-T-Liner HDX school bus to electric drive
  – Demonstrate bus in service with several school districts
  – Establish foundation for future large scale manufacturing of electric buses

• **First Prototype Performance**
  – 50-60 mile operating range
  – Easy to recharge with minimal changes to bus maintenance facilities
  – Superior road performance
  – Zero emissions and less expensive to operate

• **Future Plans**
  – 6 Type C buses to be converted to electric drive in 2015
  – Additional projects being pursued

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Key participants

- California Air Resources Board (ARB): funded first bus
- San Diego Air Pollution Control District: coordinated first bus project
- Clinton Global Initiative: arranging new 6-bus demonstration
- California Energy Commission and South Coast Air Quality Management District: funding new 6-bus demonstration
• “Battery Fuel Car” provides energy for locomotion
• Supplements diesel locomotive – doesn’t replace it
• Enables zero-emission operation for up to 150 miles
• Proposal being considered by a major locomotive manufacturer and grant funding agency
OTHER CURRENT AND PLANNED VEHICLE PROJECTS

• Electric “Reach-Stacker”
  – Built for use by Termalift at Port of San Diego
  – Lifts and stacks cargo containers
  – Operating since February 2014

• “Zero-Emission Recycled Electric” (ZERE) Bus
  – Battery-electric transit bus using same components as Class 8 truck/tractor drive system
  – Concept developed in partnership with Complete Coach Works – proposed but not yet funded

• Fuel Cell Hybrid Buses and Trucks
  – Combine hydrogen fuel cells and battery-electric drive to achieve greater operating range
  – Seeking opportunity to enter market

• Several other confidential truck and bus projects
STATIONARY ENERGY STORAGE BUSINESS
“Grid-Saver”™ Fast Energy Storage System

Provides fast demand response to maintain grid stability

- **Less Expensive**
  - Lower cost lithium-ion batteries
  - Low cost, efficient inverters
  - Commonality with vehicle systems

- **Modular and Flexible**
  - Power output of 5-100 MW
  - Energy storage of 1-100 MWh
• Develop and demonstrate prototype Grid-Saver™ stationary energy storage system
  – Develop base module
    • 1-2 MW peak power output
    • ~1 MWh of energy storage
  – Demonstrate at a utility-scale renewable energy site
    • Wind or solar installation with 10 MW or more of generating capacity
    • Demonstrate ability to compensate for fluctuations in power output
    • Demonstrate other grid stabilization capabilities (e.g., frequency regulation)

• Project started in October 2011
  – California Energy Commission providing $2M in funding
  – EPC – developing inverters jointly with TransPower
  – General Atomics – engineering support
  – Redhorse Corporation – engineering support
GRID-SAVER™ BATTERY MODULE DERIVED FROM MILE-MAX™

- 24 lithium iron phosphate cells
- Each rated at 180 Ah, 3.2 VDC nominal
- Equipped with Orion battery monitoring system to monitor and record voltage and temperature of each individual cell
- Cell balancing to be provided
- 11 of these modules connected in series will provide 152 kWh of total energy storage at a nominal voltage of 845 VDC
- 11-module strings can be connected in parallel to supply many hundreds of kWh of energy storage
Contract awarded to TransPower from New York City Transit in December 2012

To be delivered in late 2013

Will stabilize third rail voltage as trains enter and exit stations

Energy savings could be significant

Will provide backup option to energize and move trains during power outages

Future versions can connect to grid and provide ancillary services
BENEFITS OF COMMON BUILDING BLOCKS

• Higher production rates $\rightarrow$ lower production costs
• Use of standardized maintenance tools and spare parts
• Easier to integrate renewable energy and electric vehicles
• Reuse vehicle batteries in stationary systems

Common battery module
Common inverter-charger architecture
TRANSPower Key Personnel

Michael Simon
President & CEO

- 35 yrs. Experience
- Director of Commercial Business Development, General Atomics
- Co-Founder & Co-CEO, ISE Corp.
- Program Manager, General Dynamics

Dr. James Burns
Chief Scientist

- 30 yrs. Experience
- Department Head, Southern Utah Univ.
- Department Head, San Diego State University
- Senior Engineer, General Dynamics

Dr. Paul Scott
VP, Advanced Technologies

- 55 yrs. Experience
- Chief Scientific Officer, ISE Corp.
- Consultant, Stuart Energy
- Professor, MIT and USC

Jurgen Schulte
Chief Engineer

- 20 yrs. Experience
- Chief Engineer, ISE Corp.
- Engineering manager at BAE Systems and Voith Turbo

Harold Meyer
VP, Manufacturing

- 35 yrs. Experience
- VP Operations, Bluways USA
- Director of Vehicle Servicing, ISE
- Veteran, U.S. Navy

Joshua Goldman
VP, Business Development

- 15 yrs. Experience
- Marketing Manager, ISE Corp.
- VP, Business Development, Proterra
- VP, Business Development, DesignLine

Alexander Myers
Comptroller

- 4 yrs. Experience
- Bachelors in Economics
- Former Intern, Nexxus Technology Incubator

Frank Falcone
Director, Powertrain Engineering

- 20 yrs. Experience
- Vehicle Systems Engineer, Argonne National Laboratory
- Former Chair, EcoCAR Challenge Technical Steering Committee

Tom Bartley
Director, Strategic Development

- 45 yrs. Experience
- Marketing Manager, ISE Corp.
- Senior Scientist, Netrologic
- Project Manager, Loral Instrumentation
SUMMARY

• TransPower is developing significant value, in part by acquiring government R&D contracts from numerous sources
  – >$15M in funding commitments received to date
  – Wide range of vehicle and stationary energy projects and products
  – Investments are resulting in:
    ➢ Industry-leading IP in several strategically important areas
    ➢ Acquisition of capital assets, including machinery, tools, vehicles
    ➢ Development of a strong team and corporate infrastructure

• A broad array of new products is emerging that can begin generating substantial commercial sales within the next 1-2 years
  – Core building blocks: battery modules, inverters, automated manual transmissions, and associated software and controls
  – Other specialized products: electrically-driven accessories, vehicle integration kits, integrated stationary energy storage systems, etc.
  – Early vehicle testing is yielding unprecedented results