



Providing Vehicle OEMs Flexible Scale to Accelerate Adoption of Electric Drive Vehicles

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Remy, Inc.

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Project ID: ARRAVT025

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Overview

Timeline

Start: December 17th, 2009

End: December 16, 2012

Status: Approx. 8% complete

Barriers and Risks

- Market/Volume
- Manufacturing Expansion
- Supply
- New Product Design
- Partner Integration

Budget

Total: \$120,400,000

DOE Share: \$60,200,000

Contractor Share: \$60,200,000

Partners (subawardee)

Phoenix International

(division of John Deere)

Project Lead: Kevin Larson



Objectives

- Accelerate the adoption and use of electric drive vehicles in the market by developing a standardized platform of lower cost, higher performance hybrid electric motors and controls
- Invest in the expansion or refurbishment of U.S. based manufacturing facilities, as well as new product tooling and engineering, production and test equipment, and product commercialization



Approach

Technical Feasibility:

- The new motor and inverter products proposed in the project are based on an extension of existing product and process technology.
- Remy has been producing rotating electrical products for over 100 years and hybrid electric drive motors since 2003.
- Phoenix has been producing electronic controls for over 20 years.

Ability to Complete Facility:

- Manufacturing processes, including site expansions and supply chain management, are well-established at both Remy and Phoenix International.
- Phase I of the project began with the refurbishment of existing facilities to support initial production capacity.
- Phase II of the project includes the establishment of a new facility to support high volume production.



Approach

Ability to Deliver Commercial Ready Product:

- For this project, many of the target customers are Remy's existing customers (for starters and alternators) in both the automotive and heavy duty market where Remy has the leading share in North America.
- These customers have been very enthusiastic regarding Remy's new approach to reduce costs through creating a family of standardized electric drive motors, and have launched new product development efforts with Remy.

Ability to Estimate Costs:

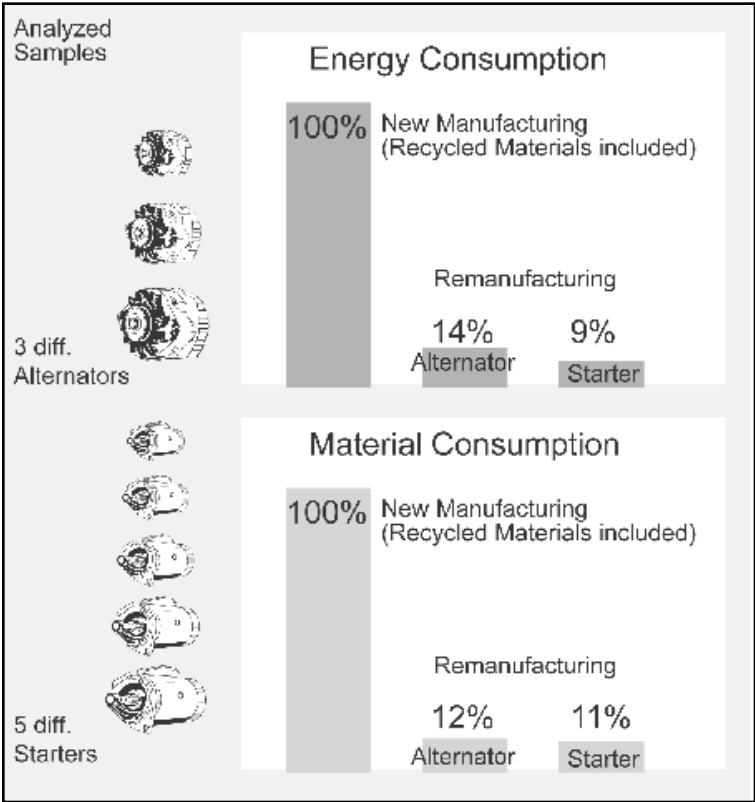
- Remy's facilities planning group provided direction for the manufacturing site costs based on several previous plant relocations in the United States.
- Phoenix International has very current costs for site expansion and equipment having commissioned a new power electronics facility in January of 2009.
- Since the new product designs are extensions of existing products, these are very accurate estimates.
- Material prices were reviewed by global purchasing and supplier quality teams at both companies, who confirmed or revised prices from established suppliers.

Ability to Recycle:

- Remy is the largest U.S. remanufacturer of starter and alternator products, recycling and refurbishing 4 to 5 million units per year in its two U.S. facilities in Virginia and Oklahoma.
- Planning for such recycling of hybrid motors is already underway in joint meetings between Remy, its customers, and its suppliers.
- Remy has standard workflow procedures in all of its manufacturing operations which define and control the segregation and recycling of various scrap raw materials used in its process, including byproduct materials and nonconforming products.
- Phoenix International's recycling plan is to leverage Remy's existing capability in the product recycling area.
- If re-manufacturing is called for, the inverter parts could be returned to Phoenix facilities for rebuild or Phoenix could supply the required subcomponents back to Remy to facilitate the remanufacturing.
- In cases where scrapping of the inverter is called for; the housing and bus bar metals are recyclable.

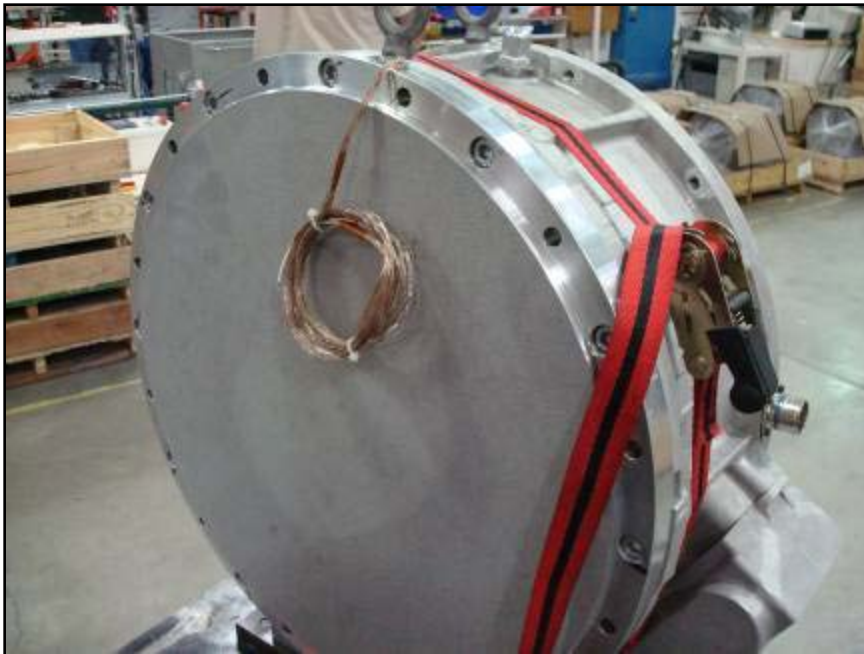
Recycling Experience:

- Remy's world class environmentally friendly remanufacturing processes minimize energy and raw material usage and reduce landfill waste and air pollution.
- As evidenced by the figure below, this remanufacturing process utilizes eighty to ninety percent less energy than a conventional starter and alternator manufacturing process.



Concept Design Samples:

- Sample hardware has been produced that represents an improved and scaled up design based on current hybrid products.
- First motor samples were provided to our lead customer in April 2010.



Concept Design Samples:

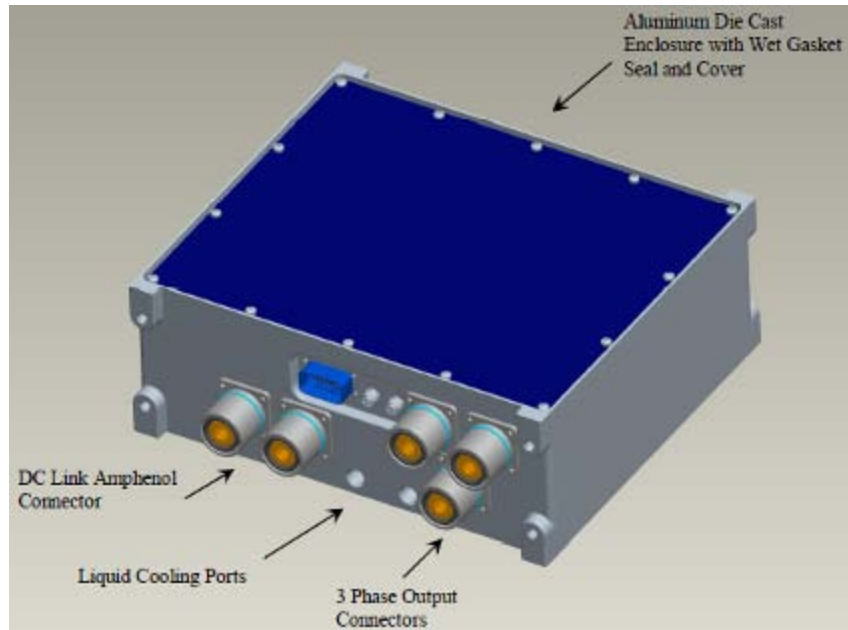
- The first motor samples have been tested on existing test stands to confirm design performance.
- While the test stand could not operate the motor to it's maximum rated performance, the measured test points matched the design intent very closely and confirmed the design calculations.



Existing Motor Test Stand

Inverter Samples:

- Concept stage sample inverters have been produced by Phoenix International.
- Work is currently underway at Remy's test equipment vendor to integrate the Phoenix inverter into a motor test stand.





Collaborations

Phoenix International:

- Remy has collaborated with Phoenix International as a subawardee to this grant.
- The inverters will be developed and put in production by Phoenix International at a location in Fargo, ND.
- The inverter sizes required will match the motor sizes needed in the marketplace.
- The motors and inverters are typically matched to various customer requirements such as peak power of the motor and available voltage of the DC source.
- Inverter development will follow the same typical steps as the motor development with the delivery of prototypes and production devices availability at the same time.
- This will provide the customer with a matched set of motor and inverter drive systems.

2010:

- Complete concept stage hardware validation for base motor and inverter products
- Produce additional concept stage hardware with expanded product features to match market requirements
- Install additional motor test capacity at Remy

2011:

- Complete development stage hardware validation for base motor and inverter products
- Install initial production capacity
- Forecast market demand for additional production capacity

2012:

- Complete production stage hardware validation for base motor and inverter products
- Start production at initial production facility
- Expand production capacity to a new facility based on market demand



Summary

- Accelerating the adoption and use of electric drive vehicles in the market.
- Developing a standardized platform of lower cost, higher performance hybrid electric motors and controls.
- Building on the proven success of existing product and process technologies.
- Matching product features and production capacity to real market requirements.
- Delivering technical accomplishments on time.