



## INDUSTRIAL TECHNOLOGIES PROGRAM

### Wireless Sensor Network

### Advanced Energy Management Solution for Industrial Motors

Electric motor-driven systems used in industrial processes consume an estimated 679 billion kWh – or 23% of all electricity sold in the United States. To counter such immense energy use, advanced energy management monitoring and diagnostic systems have been implemented in large electric motors (those greater than 200 HP), with the results being dramatic energy savings, economic benefits, and reduced environmental impacts. However, industrial motor energy use could be further reduced by up to 18% if methods that are typically used on larger motors were more widely deployed.



*By replacing periodic manual checkups with continuous wireless monitoring, industries could save up to 18% of the energy consumed by motor systems.*

Applying monitoring and diagnostic systems to smaller motors is a logical next step. However, communication networks in use for larger motors use conventional field wiring, which is expensive and not practical for smaller motors. In order to monitor smaller motors, a cost-effective communication network that can quickly collect, inspect, and diagnose information on the motors is needed. To address this issue, Eaton Corporation is leading an effort to research, test, develop, and deploy a self-configuring wireless sensor network (WSN) that operates within a range of open wireless protocols and integrates with advanced energy management software.

Research for this project will focus on three areas. First, smart sensors with embedded intelligence will be developed. The new sensors will be designed to measure such parameters as voltage, current, and temperature at an installation cost that is significantly less than that of current options. Then, issues critical to the success of wireless networking – such as the network’s robustness, security, ability to self-configure, and cost-effectiveness – will be addressed. Finally, research will be conducted to ensure that the network’s energy management, diagnostic, and control systems are able to take into account the full complexity of the plants being monitored.



### Applications and Benefits

The technology developed from this project will have far-reaching benefits for plant managers and industry beyond energy savings and environmental gains. These benefits include:

- Ultra-low power design.
- Drastically reduced installation costs.
- Dramatically reduced maintenance.
- Reduction in installation and infrastructure costs by up to 84%.
- Application in other fluid and mechanical power systems, not just motors.

## Project Plans and Progress

**Project History:** This project was awarded under the Sensors, Controls and Automation Crosscutting Technologies solicitation. The award was signed in the spring of 2004.

The project is performed in three phases that focus on baseline system development, concept feasibility, and concept validation.

Phase I focused on the creation of a baseline WSN suitable for operation in an industrial environment. During this phase, researchers have:

- Derived and documented WSN requirements.
- Investigated, assessed, and documented alternative solutions.
- Developed design specifications.
- Built the wireless system test bed.
- Developed a test plan and performed baseline tests.

Phase II will extend the baseline by addressing issues that are critical to fielding a robust wireless industrial network. During this phase, researchers will:

- Develop and evaluate concepts to enable wireless modules to be either ultra-low or zero power for use beyond the electrical system.
- Increase the robustness of self-configuration and routing algorithms.
- Address packaging issues.
- Implement security to meet industrial needs.
- Conduct tests to evaluate the performance of WSN.

Phase III will focus on conducting field tests. During this phase, researchers will:

- Develop final plans to bring the new product – the packaging and creation of which will be funded by Eaton – to market.
- Identify applications that will benefit industry.
- Implement design advances to enhance performance.
- Develop product roll-out plan for WSN manufacturing, marketing, and commercial introduction.



*Industrial facilities installing motor monitoring systems can save up to 84% in installation and infrastructure costs by using wireless networks instead of conventional field wiring. Maintenance costs are also much lower for the wireless system.*

## Project Partners

Eaton Corporation (Lead organization)

Red Wing Technologies, Inc.

Georgia Institute of Technology

BP

International Paper

Weyerhaeuser

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## A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



**U.S. Department of Energy**  
**Energy Efficiency**  
**and Renewable Energy**

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

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