GPG FINDINGS **043**

NOVEMBER 2019

SOFTWARE-CONTROLLED SWITCHED RELUCTANCE MOTOR

OPPORTUNITY

Why is GSA interested in smart motors?

38% OF ELECTRICITY IS USED BY MOTORS IN U.S. COMMERCIAL BUILDINGS[1]

56% OF MOTORS ARE < 5 HP[2]

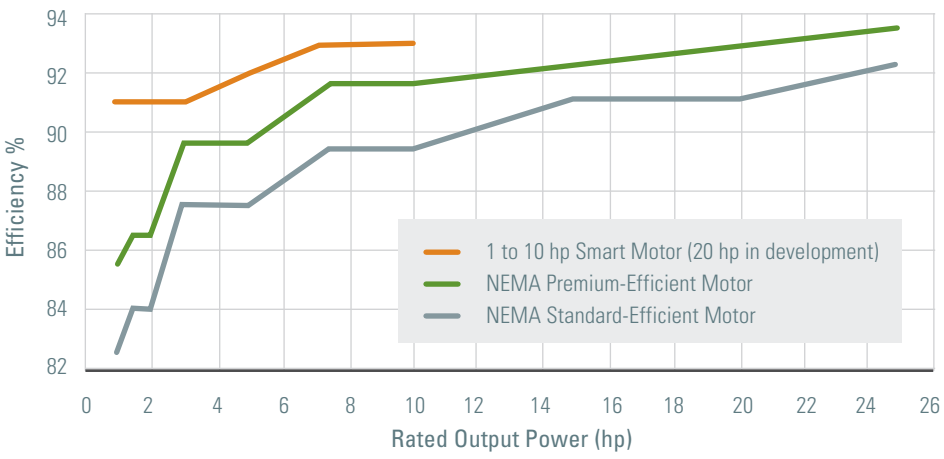
TECHNOLOGY

What are smart motors?

SOFTWARE-CONTROLLED SWITCHED RELUCTANCE MOTOR WITH VARIABLE-FREQUENCY DRIVE (VFD)

REAL-TIME CLOUD-BASED MONITORING AND CONTROL

Smaller motors offer greater relative savings



M&V

Where did Measurement and Verification occur?

OAK RIDGE NATIONAL LABORATORY (ORNL) assessed a 10 hp smart motor on a chilled water pump application at the Land Port of Entry in San Ysidro, California. A concurrent National Renewable Energy Laboratory (NREL) assessment of a 1.5 hp motor took place on condenser fans in a refrigeration system at a Walmart in Lakeside, Colorado. Technology was provided by Software Motor Company.

RESULTS

How did the 10 hp smart motor perform in M&V?

MORE
EFFICIENT UNDER ALL CIRCUMSTANCES
4% avg. savings compared to a premium-efficient motor & VFD.[3]
33% for 1.5 hp motor compared to a standard-efficient motor & VFD (NREL assessment)[4]

O&M
INSTALLATION COMPARABLE
Reduced maintenance. Drop-in motor replacement[5]

REMOTE
MONITORING & CONTROL
Possible but not tested. *NREL assessment showed successful fault-detection and control*[6]

Immediate Payback When Replaced at End-of-Life

44% less expensive than a code-compliant premium-efficiency motor and VFD

	Premium Motor + VFD	Smart Motor (Retrofit)	Smart Motor (End-of-Life)
10 hp motor cost ($)+	$4,375	$2,430	$1,945 less expensive
Installation ($)++	$948	$948	$0, no change
Technology electricity use (kWh/yr)	31,700 kWh	30,400 kWh	1,300 kWh annual energy savings
Technology electricity @ GSA avg. $0.11/kWh ($/yr)	$3,516	$3,371	$145 annual cost savings @ $0.11/kWh
Simple payback (yrs)		**23**	**Immediate**

+ Premium motor ($1,756) and VFD ($2,619) cost provided by San Ysidro LPOE. Smart motor cost provided by manufacturer; does not include volume discounts. EISA 2007 mandates 1-to-200 hp premium-efficiency motors. GSA's facilities standards guide, the P100, requires a VFD on all motors larger than 5 hp.

++ Labor cost provided by San Ysidro LPOE: 12 hours @ $79/hr. Pump application requires laser alignment to align pump and motor.

DEPLOYMENT

When does the study recommend deploying smart motors?

END-OF-LIFE REPLACEMENT

Also consider retrofits for: fixed-speed motors; motors < 5 hp; and applications with lower installation costs, such as motors that control fans

[1] *Energy-Efficiency Policy Opportunities for Electric Motor-Driven Systems*, International Energy Agency, Paul Waide and Conrad U. Brunner, 2011, p.11 [2] *Premium Efficiency Motor Selection and Application Guide*, U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, February 2014, p.1-5 [3] *Laboratory Evaluation and Field Demonstration of High Rotor Switched Reluctance Motor Technology*, Brian Fricke, Mahabir Bhandari (ORNL), October 2019, p.32 [4] *Evaluation of High Rotor Pole Switched Reluctance Motors to Control Condenser Fans in a Commercial Refrigeration System*, Grant Wheeler, Michael Deru (NREL), June 2019, p.18 [5] ORNL Report, October 2019, p.37 [6] NREL Report, June 2019, p.19