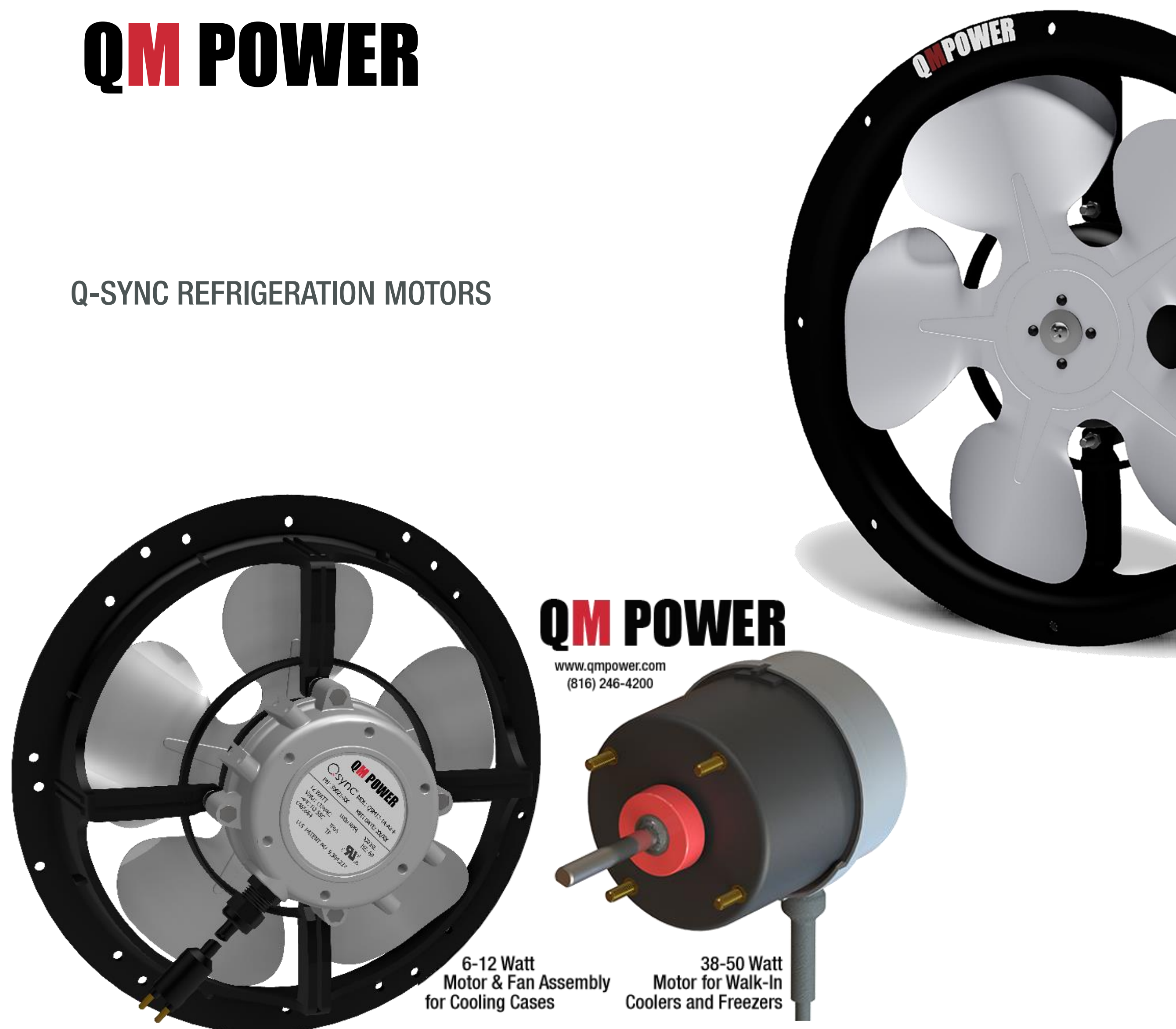


# Permanent Magnet Synchronous Motors for Commercial Refrigeration

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Q-SYNC REFRIGERATION MOTORS



6-12 Watt Motor & Fan Assembly for Cooling Cases

38-50 Watt Motor for Walk-In Coolers and Freezers

- Innovative Permanent Magnet Motors which run synchronous to the “Grid frequency” saving 25-45% energy compared to ECMs

- Eliminates the power conversion to DC needed for conventional permanent magnet motors (ECMs).

- Result is a simpler reliable motor with increased energy efficiency and power factor than current state of the art ECMs.

- Launched 6-12 W and 38-50 W motor in 2015 and 2016, respectively for refrigeration display cases and walk-in coolers.

- Q-Sync 73-85% efficiency with power factor >0.85 (compared to ECMs which are 50-65% efficient and Power factor of 0.45-0.70)

San Diego Gas & Electric and AESC Emerging Technologies Program : Project ID ET15SDG1061

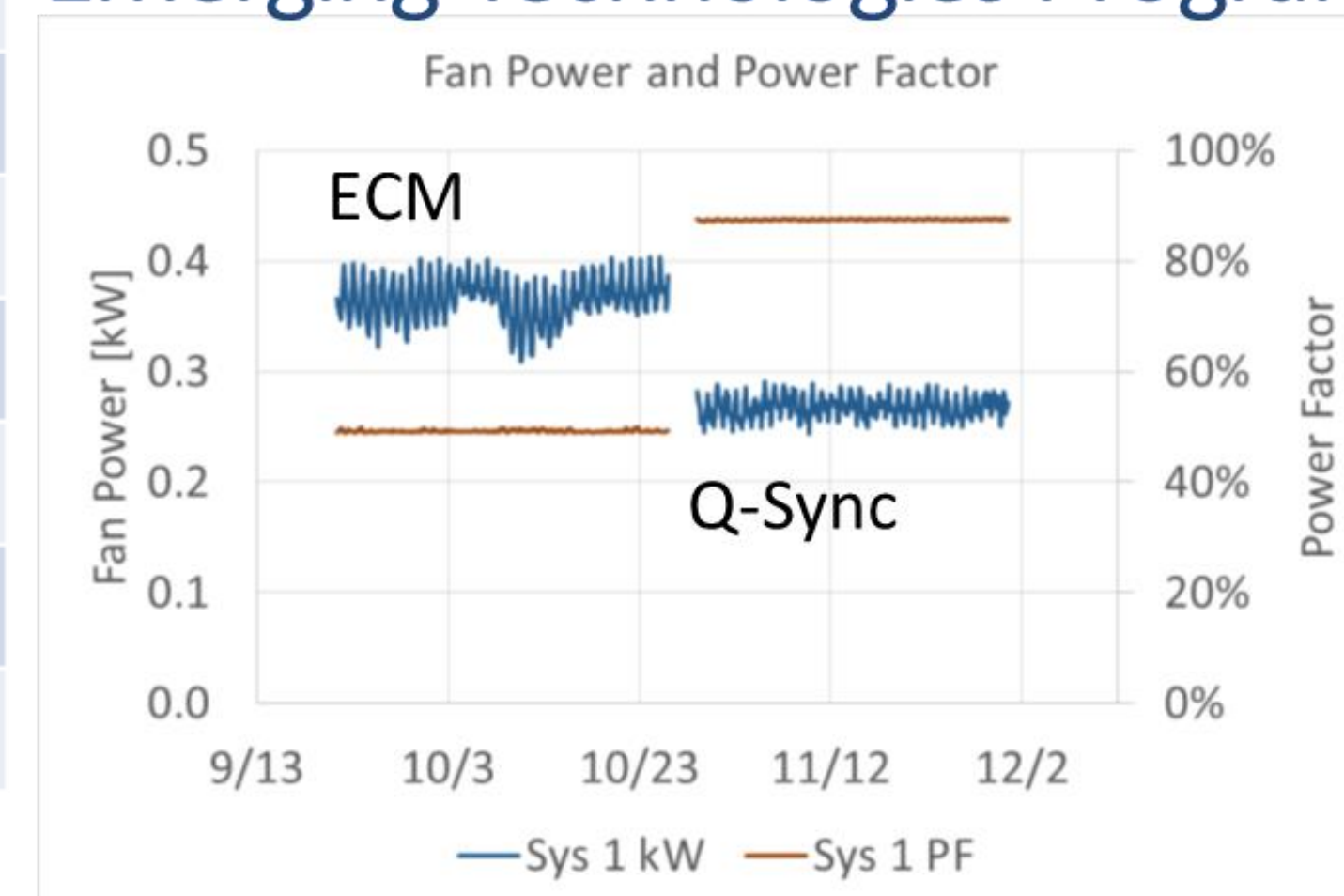
## 2018 ORNL Validation Update

### FIELD TESTS:

#### Refrigerated display case— full store retrofit (Q-Sync vs ECM)

Display case description	Pre-retrofit ECM (per motor)			Post-retrofit Q-Sync (per motor)			Difference (%)		
	Current (A)	Real power (W)	Power factor	Current (A)	Real power (W)	Power factor	Current	Real power	Power factor
ECM Incumbents									
Cheese: fresh, blocks and shredded	0.324	23.6	0.602	0.133	13.9	0.861	-59.1	-41.3	43.0
Diary: butter and tofu	0.306	22.0	0.596	0.129	13.6	0.864	-57.8	-38.4	44.9
Dairy, juice and eggs	0.269	22.5	0.691	0.110	11.6	0.872	-59.3	-48.4	26.2
Grab & go beverages	0.306	21.8	0.590	0.126	13.1	0.859	-58.8	-39.8	45.6
Beer	0.293	20.2	0.572	0.122	12.9	0.876	-58.5	-36.0	53.1
Produce: salad greens	0.302	22.9	0.631	0.145	15.1	0.863	-51.8	-33.9	36.8
Produce	0.297	24.3	0.673	0.159	17.2	0.891	-46.5	-28.9	32.4
Wine	0.309	22.3	0.599	0.132	14.0	0.872	-57.3	-37.4	45.5

Field tests show 30-50% lower power consumed than ECMs



Power and Power factor for Refrigeration unit with 18 fans  
ECM → Q-Sync



Total Power across 173 motors on site  
ECM → Q-Sync

