

# Electric Submersible Pump

## Situation Overview

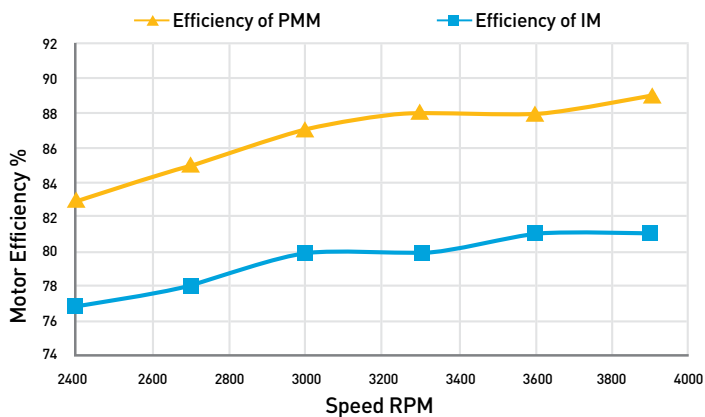
Due to increasing well depth, the energy return on investment for oil extraction in the United States has fallen by more than 80 percent since 1930. In California, eight to ten percent of all oil production wells use Electric Submersible Pumps and Progressive Cavity Pumps powered by Induction Motors.

Studies show that replacing Induction Motors (IM) with Permanent Magnet Motors (PMMs) yields energy and cost savings and improves energy return on investment.

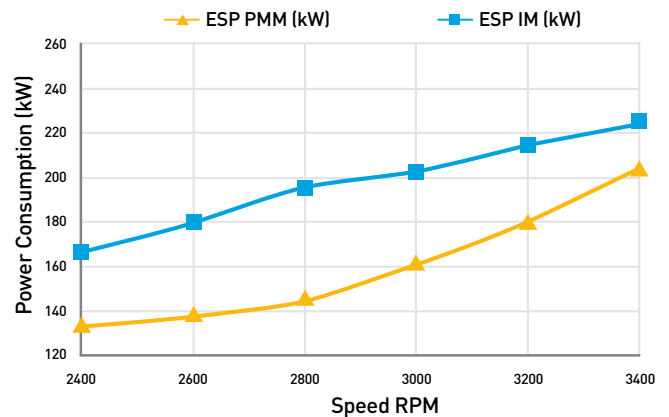
- PMMs use 10 to 15 percent less power for the same production than their IM counterparts.
- Additional advantages are reduced size, more favorable thermal operating conditions and performance in harsh environments.

## Field Study Results

Tests show that PMMs are more efficient and result in lower electrical resistance with no slip. PMMs also provide almost twice as much horsepower per rotor, effectively reducing the size and weight of Electric Submersible Pumps (ESP), which is important for down-hole pumps.



**MOTOR EFFICIENCIES AT VARIOUS SPEEDS**



**ENERGY COST OF PRODUCTION COMPARISON**

Above left shows the results of laboratory tests [IEEE Paper No. PCIC-2012-39].



## Savings Summary

The table to the right provides estimated energy and peak demand savings of replacing an IM with a PMM.

- Project type is replacement upon burnout or new construction
- Average motor loading is 50 percent
- Annual operating hours are 8640 hours (24/7 operation with five days of maintenance/year)
- Average increase in overall system efficiency is 10 percent
- Incremental cost of a PMM and required controls is 15 percent of the baseline cost

| Motor Size (HP) | Peak Demand Savings (kW) | Annual Energy Savings (kWh) | Incremental Cost (\$) | Estimated Incentive (\$) |
|-----------------|--------------------------|-----------------------------|-----------------------|--------------------------|
| 25              | 1.17                     | 10,071                      | 1,279                 | 981                      |
| 50              | 2.33                     | 20,142                      | 1,842                 | 1,842                    |
| 75              | 3.50                     | 30,213                      | 2,396                 | 2,396                    |
| 100             | 4.66                     | 40,284                      | 2,941                 | 2,941                    |
| 150             | 6.99                     | 60,426                      | 4,002                 | 4,002                    |
| 200             | 9.33                     | 80,568                      | 5,027                 | 5,027                    |
| 300             | 13.99                    | 120,852                     | 6,965                 | 6,965                    |
| 400             | 18.65                    | 161,136                     | 8,756                 | 8,756                    |

## PG&E Incentives and Assistance

Incentives are based on annual energy (kWh) savings and peak demand (kW) actually achieved. For an ESP project, the customized incentive rate is listed below and capped at 100% of incremental measure cost:

- \$0.08 per annual kWh reduction
- \$150 per peak period kW reduction

## For More Information

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