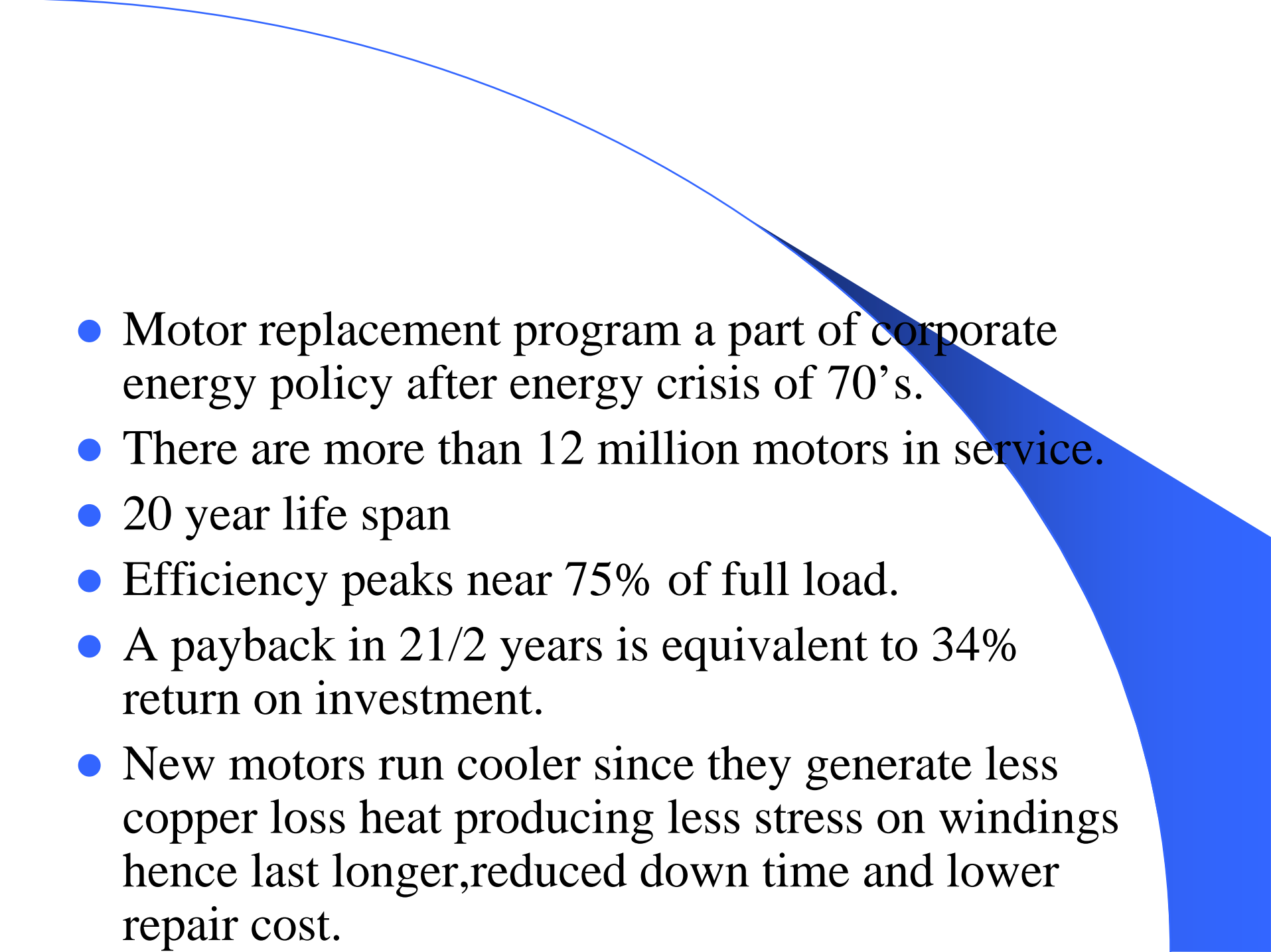
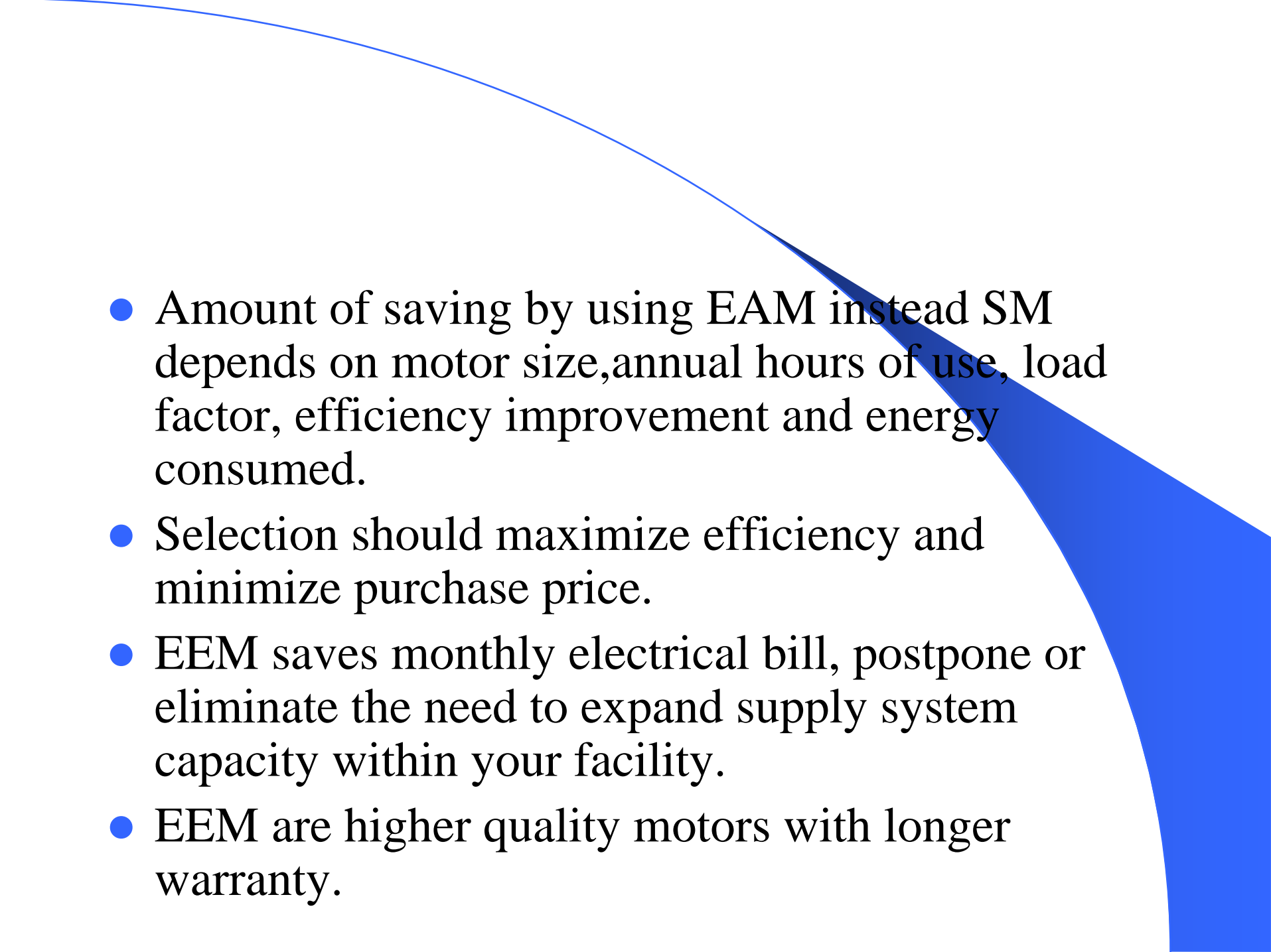


What is an energy efficient motor?

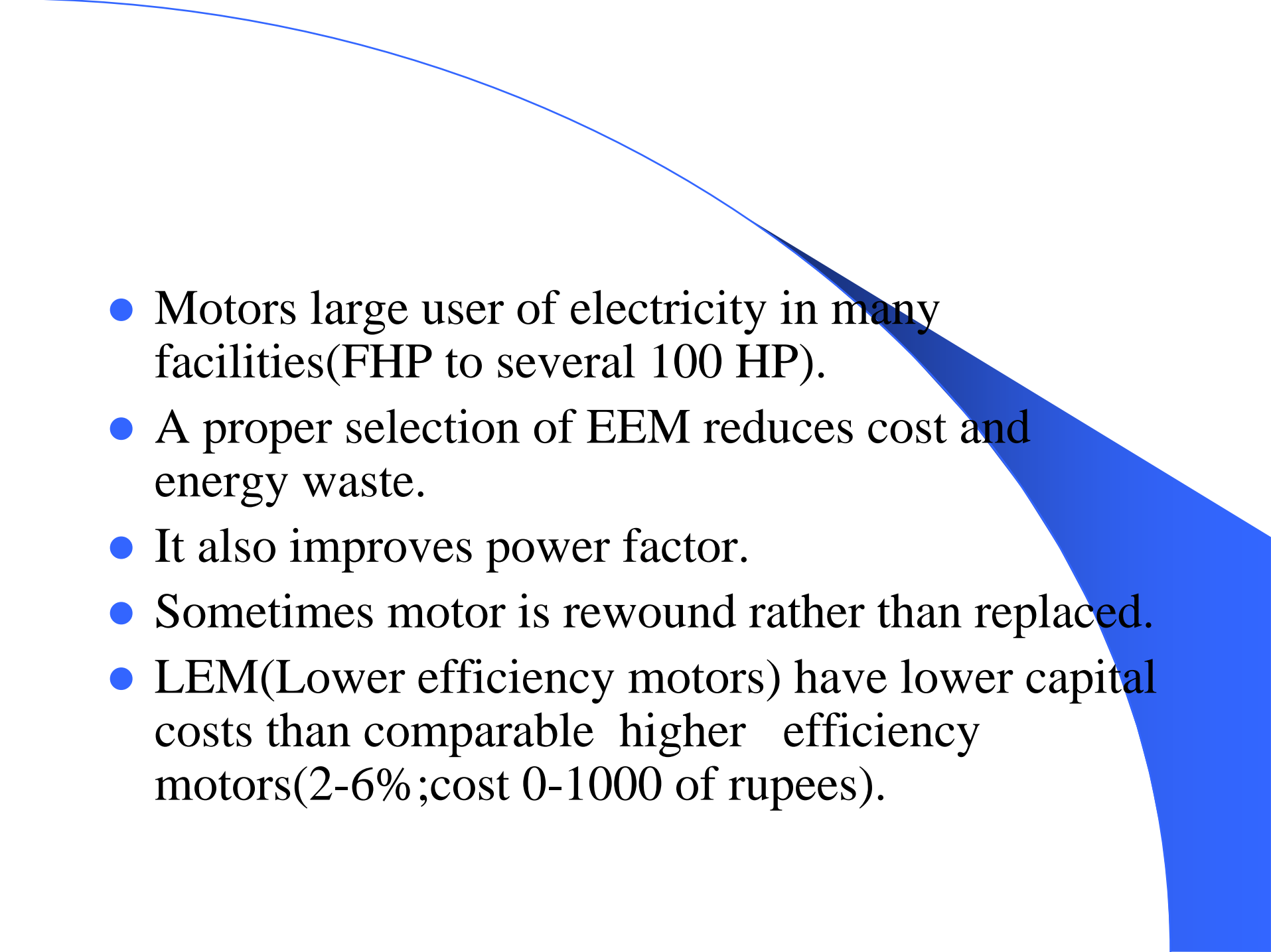
- It produces same shaft output power but uses less electrical input power than a standard efficiency motor (high/premium efficiency motor)
- Both single phase and three-phase motors available.
- Maintenance requirement is same but more reliable.
- They cost 15-30% more than standard motor.

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- Motor replacement program a part of corporate energy policy after energy crisis of 70's.
 - There are more than 12 million motors in service.
 - 20 year life span
 - Efficiency peaks near 75% of full load.
 - A payback in 2 1/2 years is equivalent to 34% return on investment.
 - New motors run cooler since they generate less copper loss heat producing less stress on windings hence last longer, reduced down time and lower repair cost.

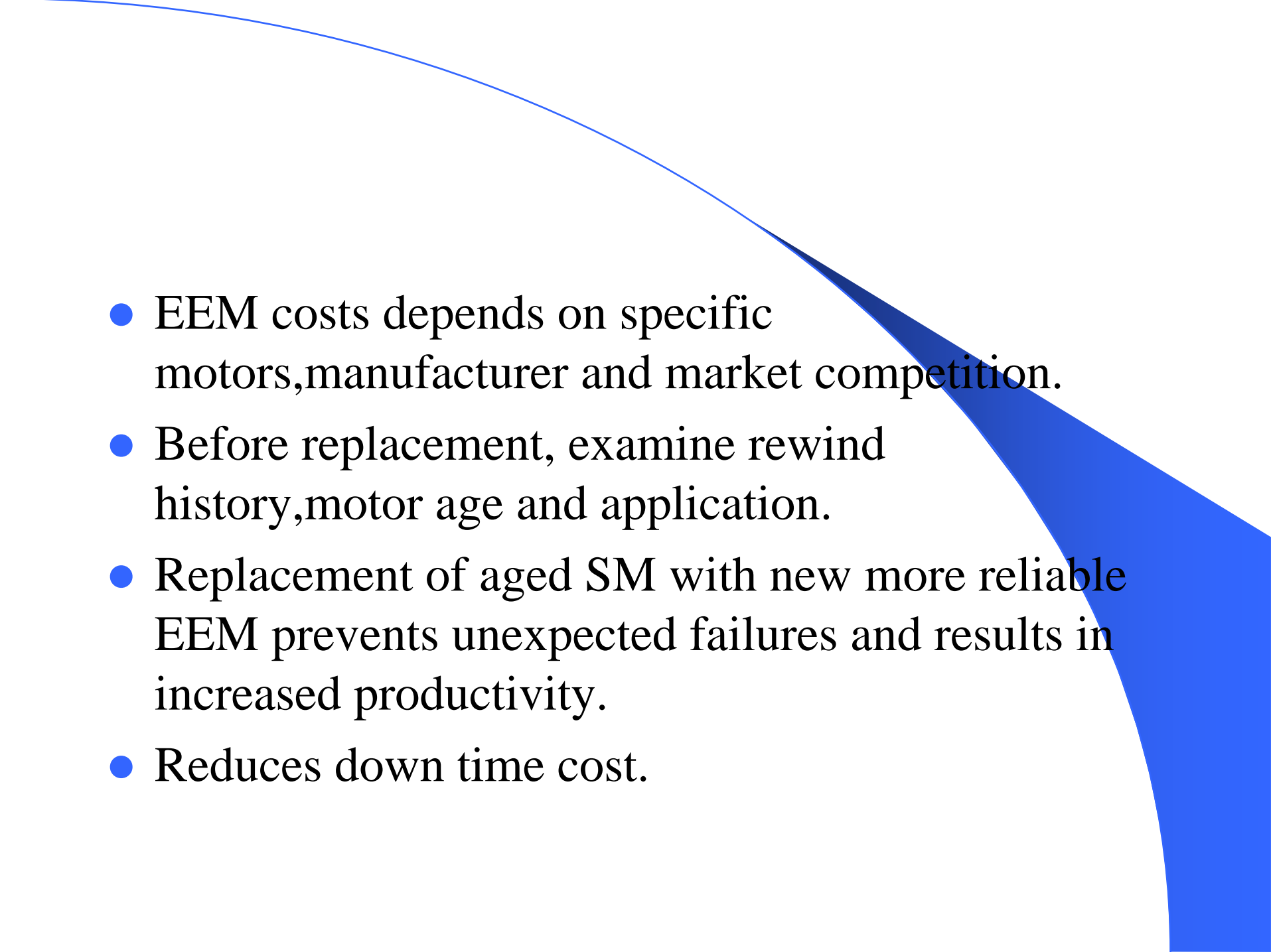
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- Amount of saving by using EAM instead SM depends on motor size, annual hours of use, load factor, efficiency improvement and energy consumed.
 - Selection should maximize efficiency and minimize purchase price.
 - EEM saves monthly electrical bill, postpone or eliminate the need to expand supply system capacity within your facility.
 - EEM are higher quality motors with longer warranty.

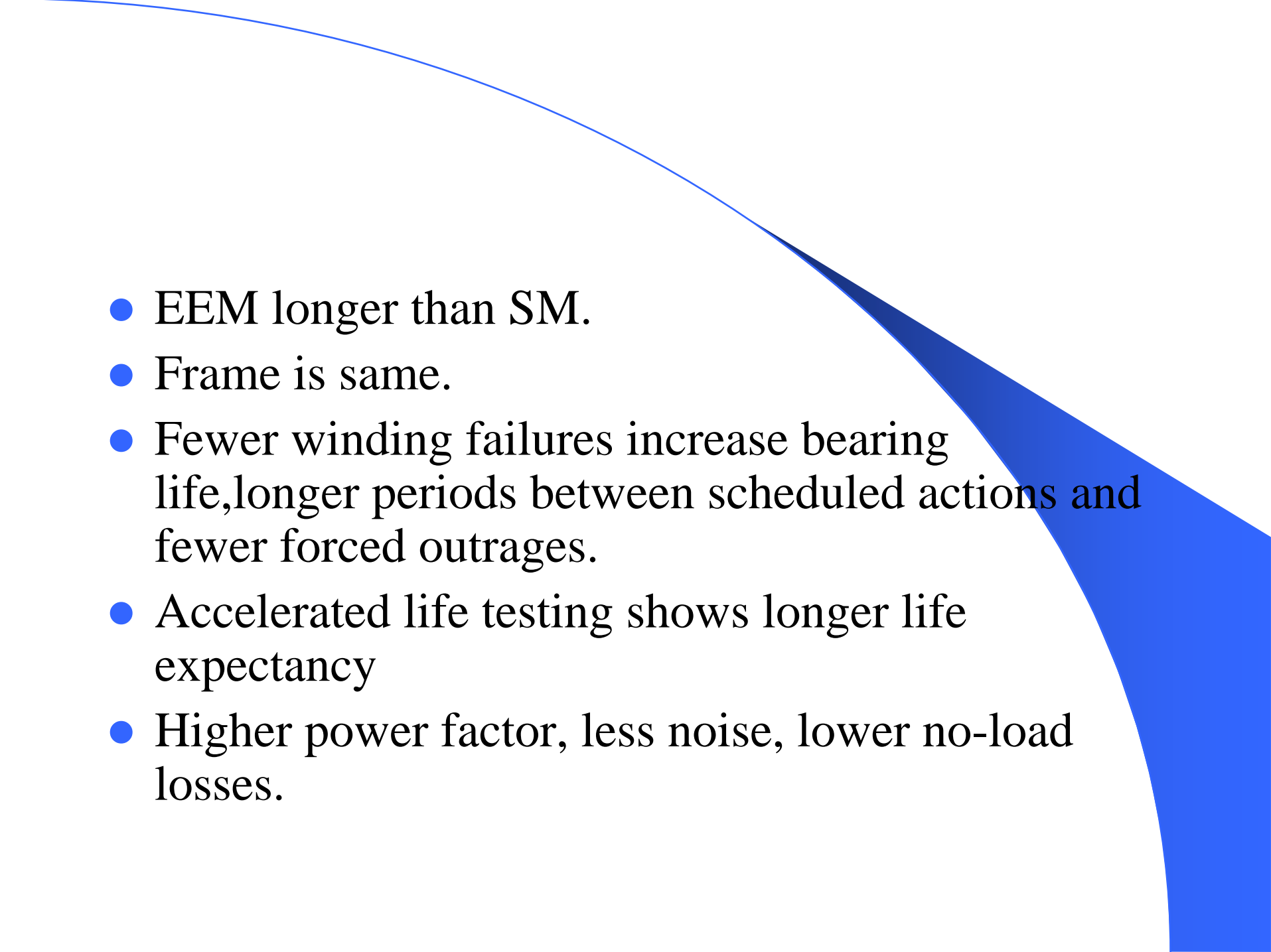
When to choose EEM

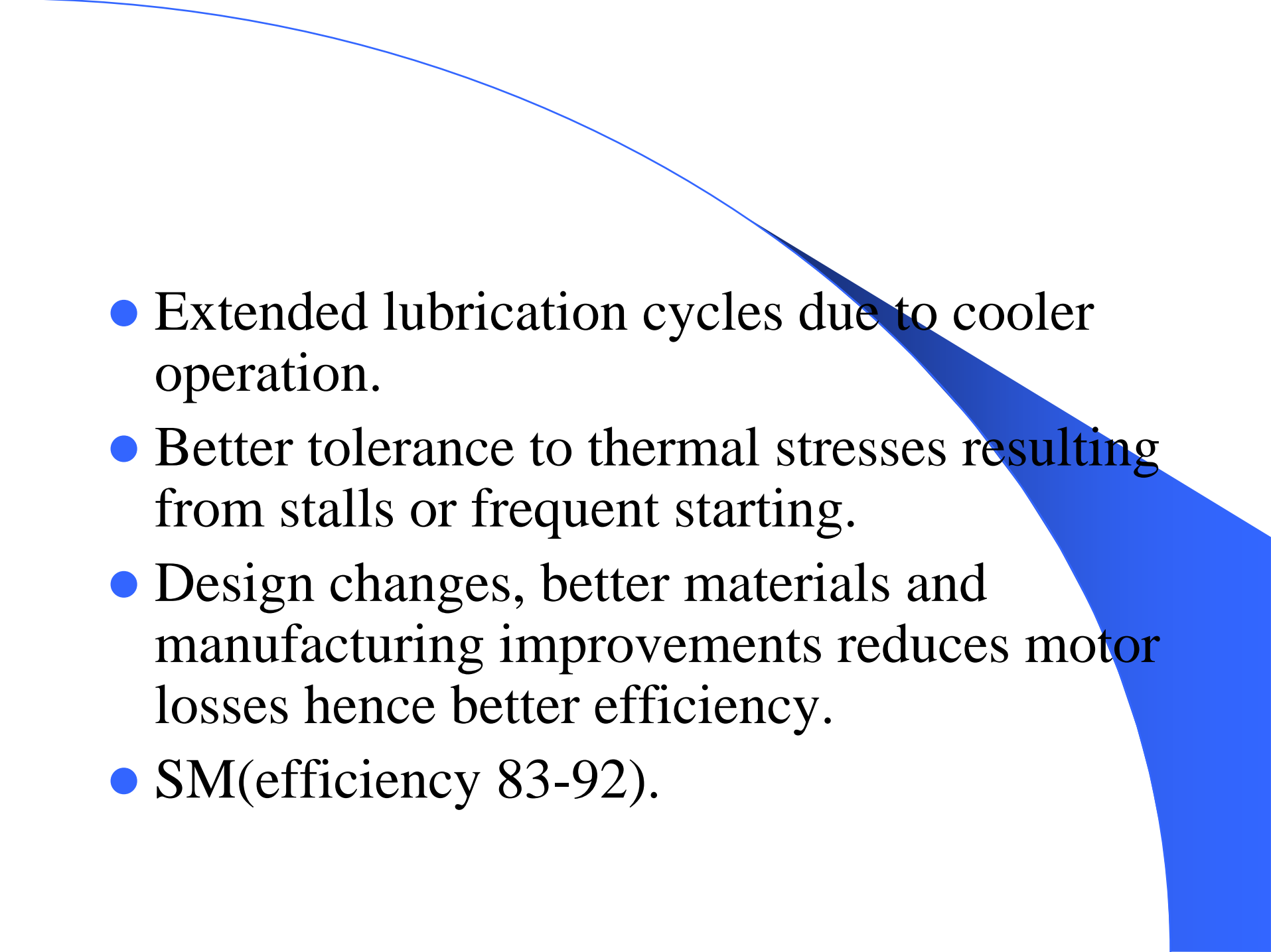
- When purchasing the new motor.
- In-place of rewinding failed motors.
- To retrofit and operable but inefficient motor for energy conservation savings.
- Grossly oversized and under-loaded motors must be replaced by EEM.
- As part of an energy management or preventive maintenance program.

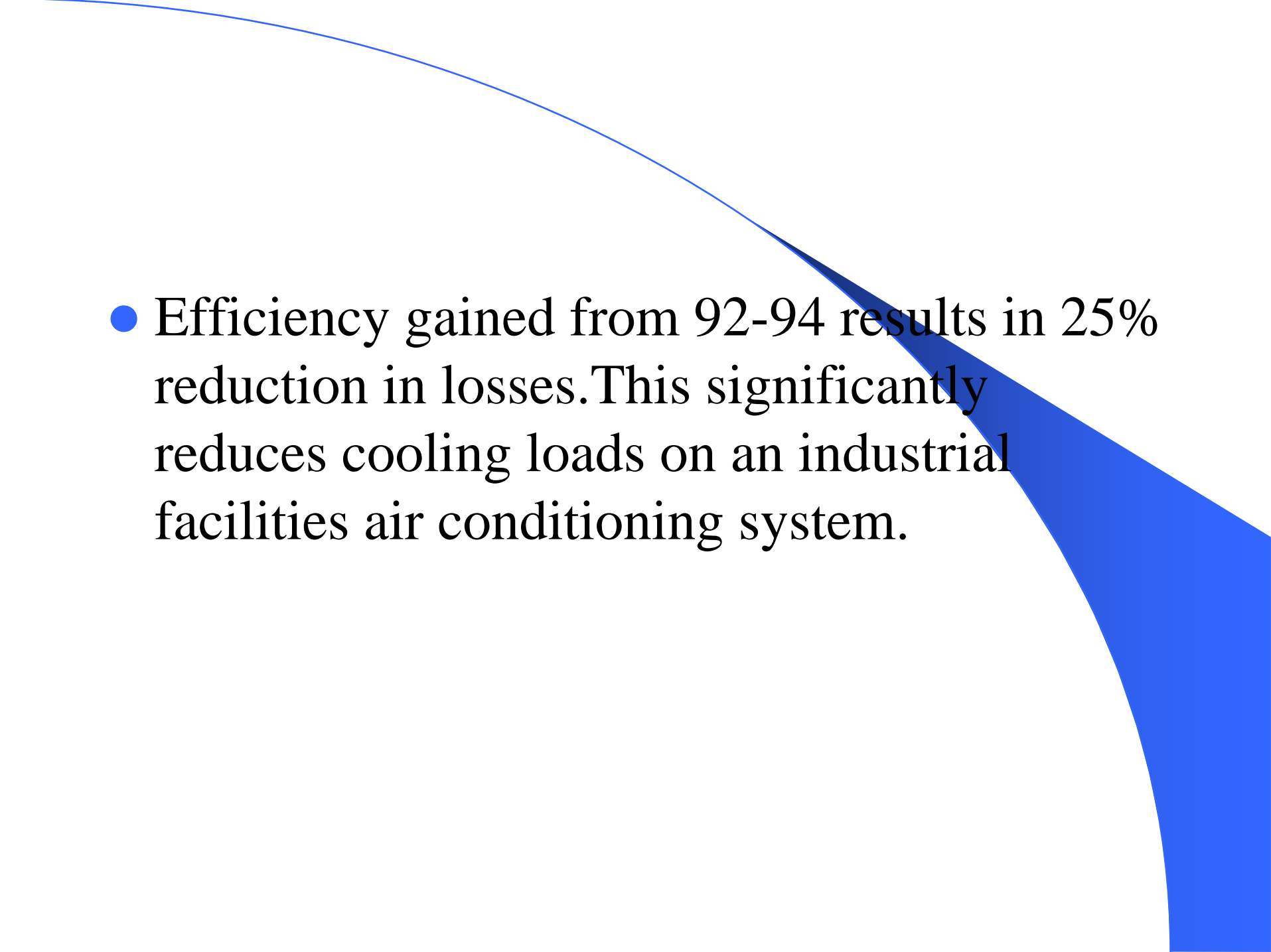
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- Motors large user of electricity in many facilities(FHP to several 100 HP).
 - A proper selection of EEM reduces cost and energy waste.
 - It also improves power factor.
 - Sometimes motor is rewound rather than replaced.
 - LEM(Lower efficiency motors) have lower capital costs than comparable higher efficiency motors(2-6%;cost 0-1000 of rupees).

- Selection of motors on lowest quotation could be an expensive mistake.
- DOE/ERDA user friendly software.
- Best practice website([www.oit.doe.gov/bestpractices/ motors](http://www.oit.doe.gov/bestpractices/motors) to download a motor software (1-800-862-2086).
- As operating cost/hours of operations go down, payback time goes up.

- 
- EEM costs depends on specific motors, manufacturer and market competition.
 - Before replacement, examine rewind history, motor age and application.
 - Replacement of aged SM with new more reliable EEM prevents unexpected failures and results in increased productivity.
 - Reduces down time cost.

- 
- EEM longer than SM.
 - Frame is same.
 - Fewer winding failures increase bearing life, longer periods between scheduled actions and fewer forced outages.
 - Accelerated life testing shows longer life expectancy
 - Higher power factor, less noise, lower no-load losses.

- 
- Extended lubrication cycles due to cooler operation.
 - Better tolerance to thermal stresses resulting from stalls or frequent starting.
 - Design changes, better materials and manufacturing improvements reduces motor losses hence better efficiency.
 - SM(efficiency 83-92).

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- A decorative blue curved line starts at the top left and arcs across the top of the slide. A large, solid blue shape, resembling a quarter-circle or a thick wedge, is positioned on the right side of the slide, partially overlapping the text.
- Efficiency gained from 92-94 results in 25% reduction in losses. This significantly reduces cooling loads on an industrial facilities air conditioning system.

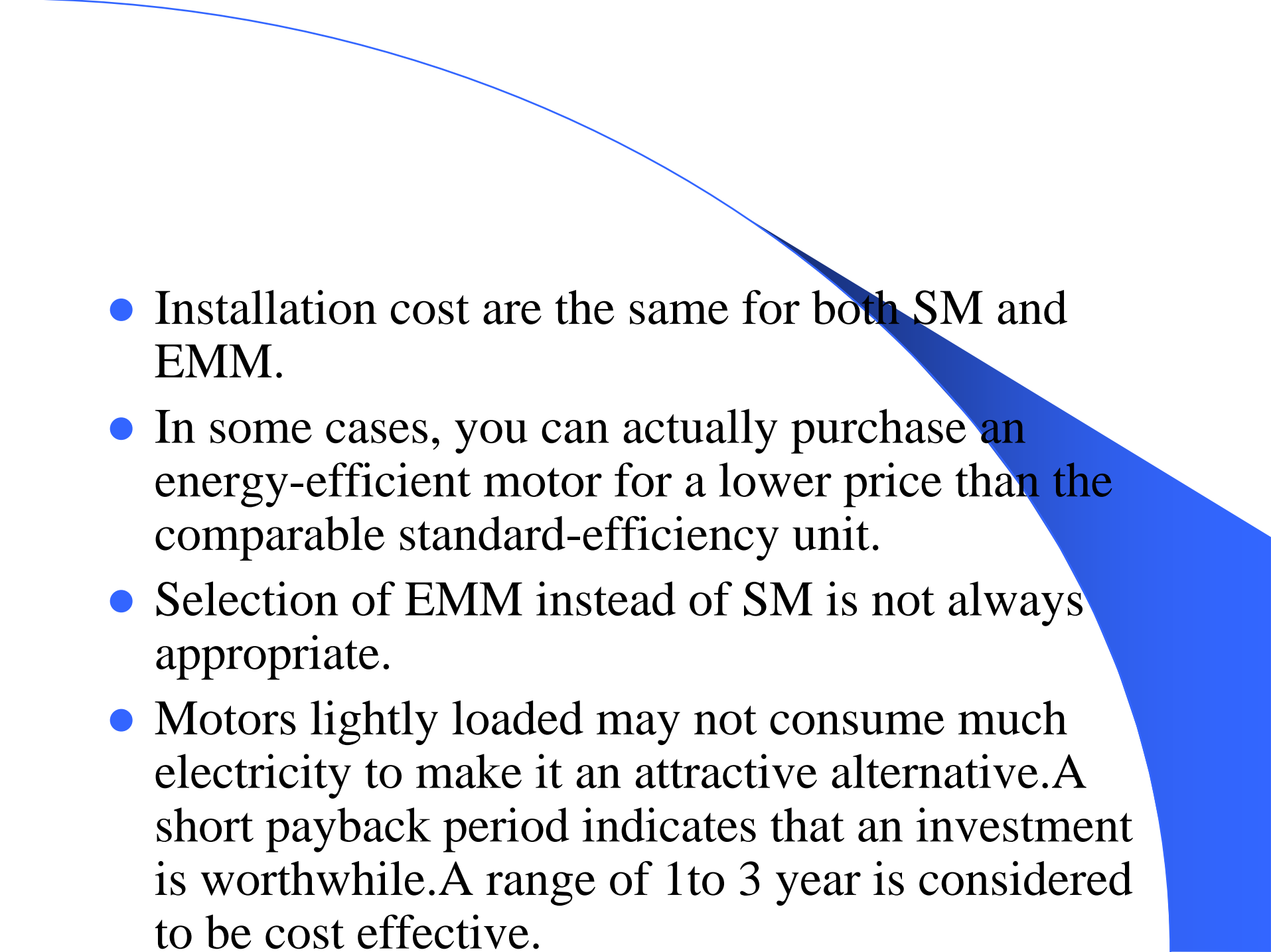
Motor Efficiency Testing Standards

- IEEE 112 –1984(United States)
- IEC 34-2 (International Electrotechnical Commission)
- JEC – 37 (Japanese Electrotechnical Committee)
- BS – 269(British)
- C-390(Canadian Standards Association)
- ANSI C50.20 same as IEEE 112(United States)

- The efficiency of premium efficiency motors improved dramatically in the 1980's as energy costs increased and a demand for energy-conserving motors developed.

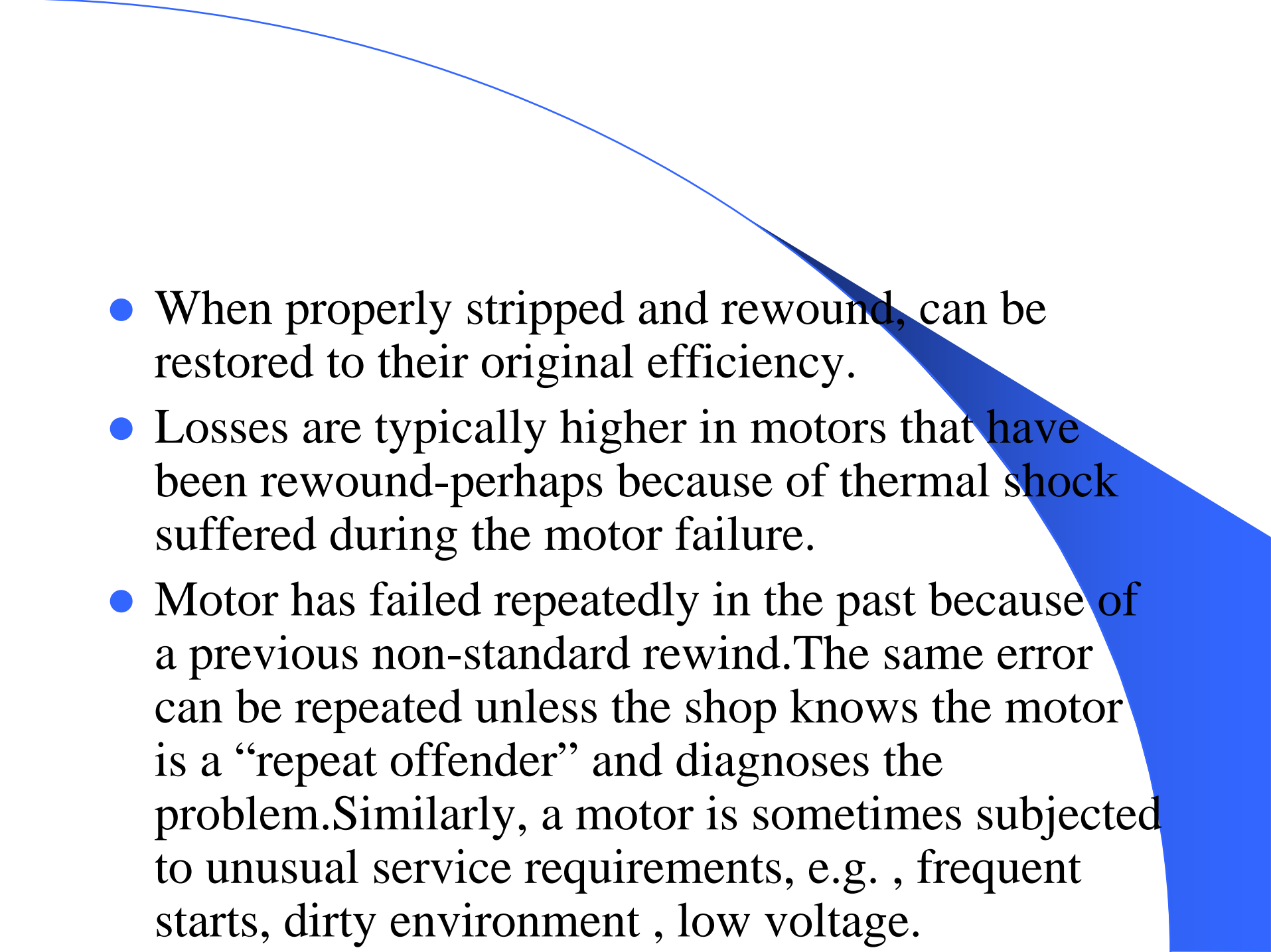
- History of Motor Efficiency Improvements.

	1994	1955	1965	1981	1991
HP					
7.5	84.5	87	84	91	91.7
100	91.5	92	92	95	96.2

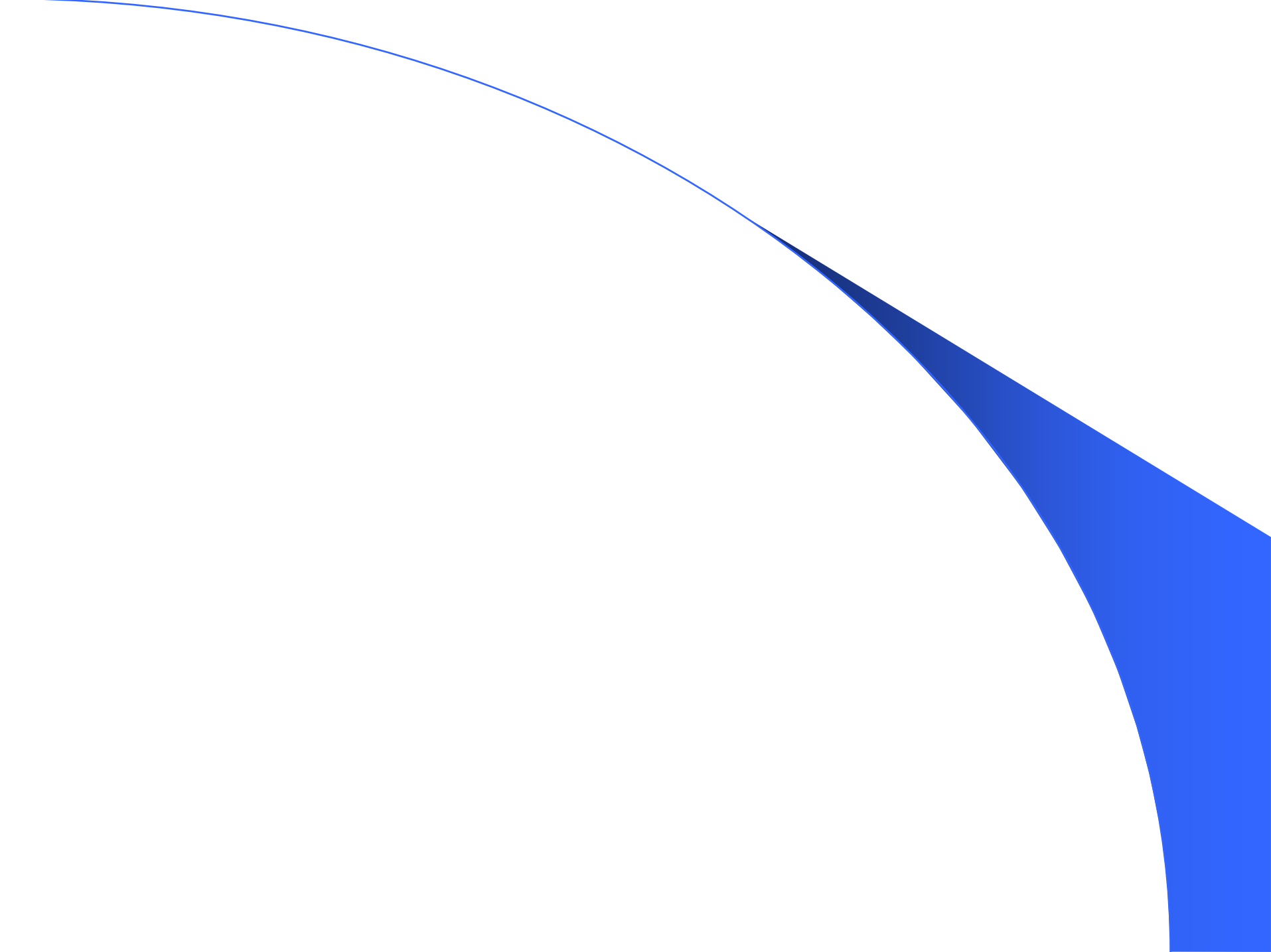
- 
- Installation cost are the same for both SM and EMM.
 - In some cases, you can actually purchase an energy-efficient motor for a lower price than the comparable standard-efficiency unit.
 - Selection of EMM instead of SM is not always appropriate.
 - Motors lightly loaded may not consume much electricity to make it an attractive alternative. A short payback period indicates that an investment is worthwhile. A range of 1 to 3 year is considered to be cost effective.

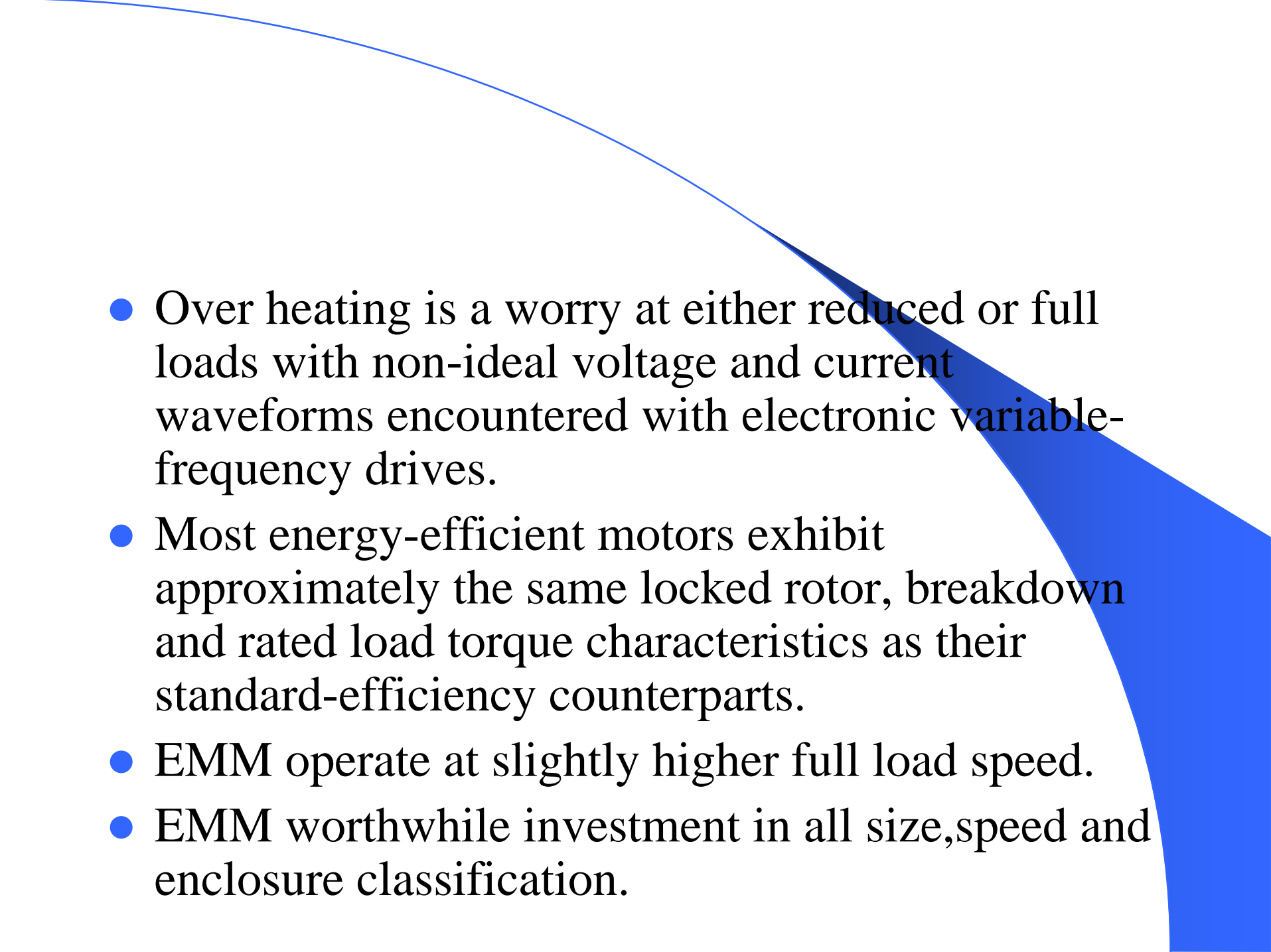
Motor failure and rewind scenario

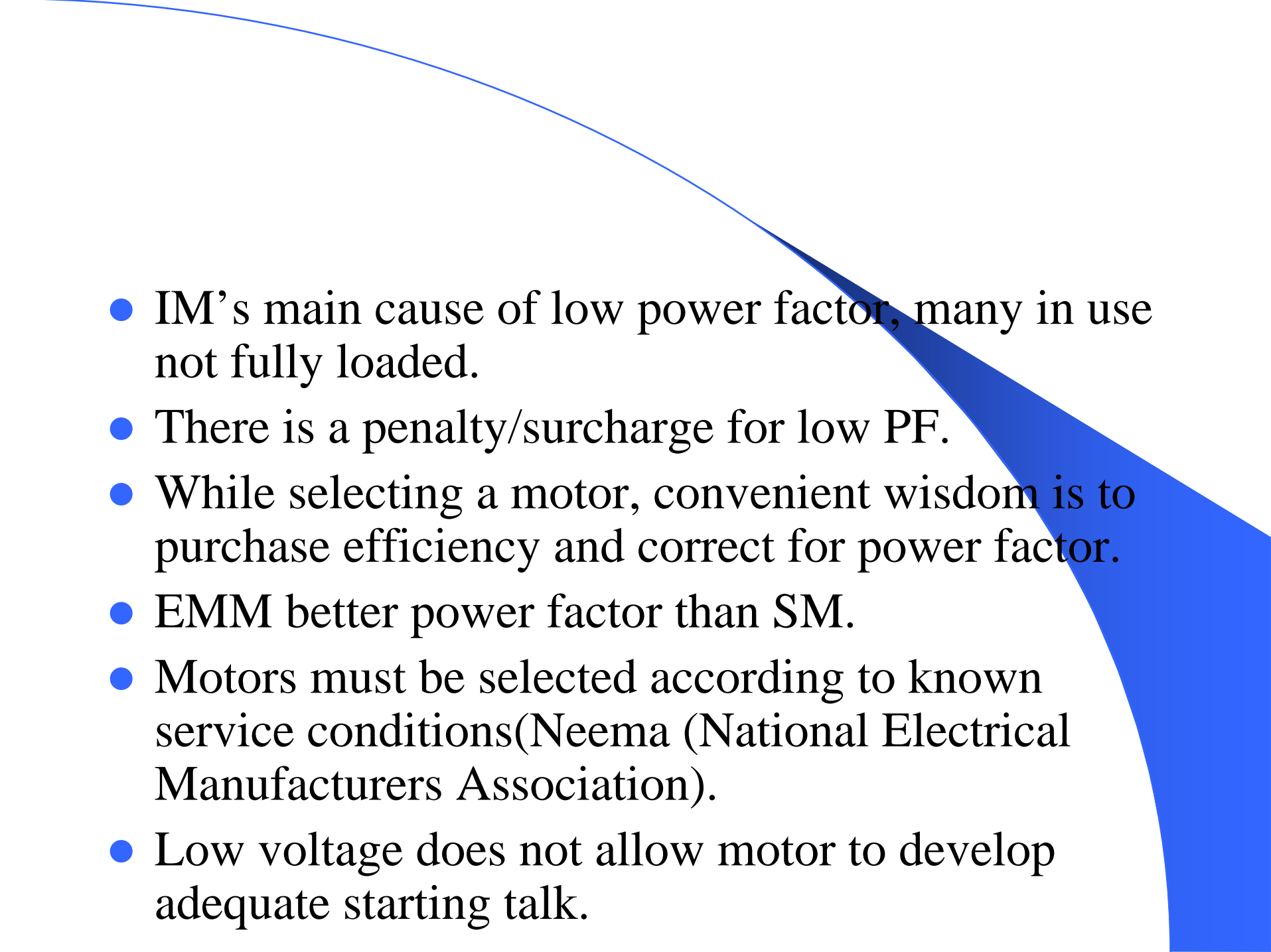
- A motor failure or burnout produces 3 alternatives:-
 1. To rewind the failed motor.
 2. Purchase a new SM.
 3. Purchase an EEM replacement motor.
- For high efficiency rewind, replace aluminum with copper.
- Sometimes Stator is heated to a temperature high enough to burn out its winding insulation.
- The repair shop should determine and eliminate the cause for motor failures.

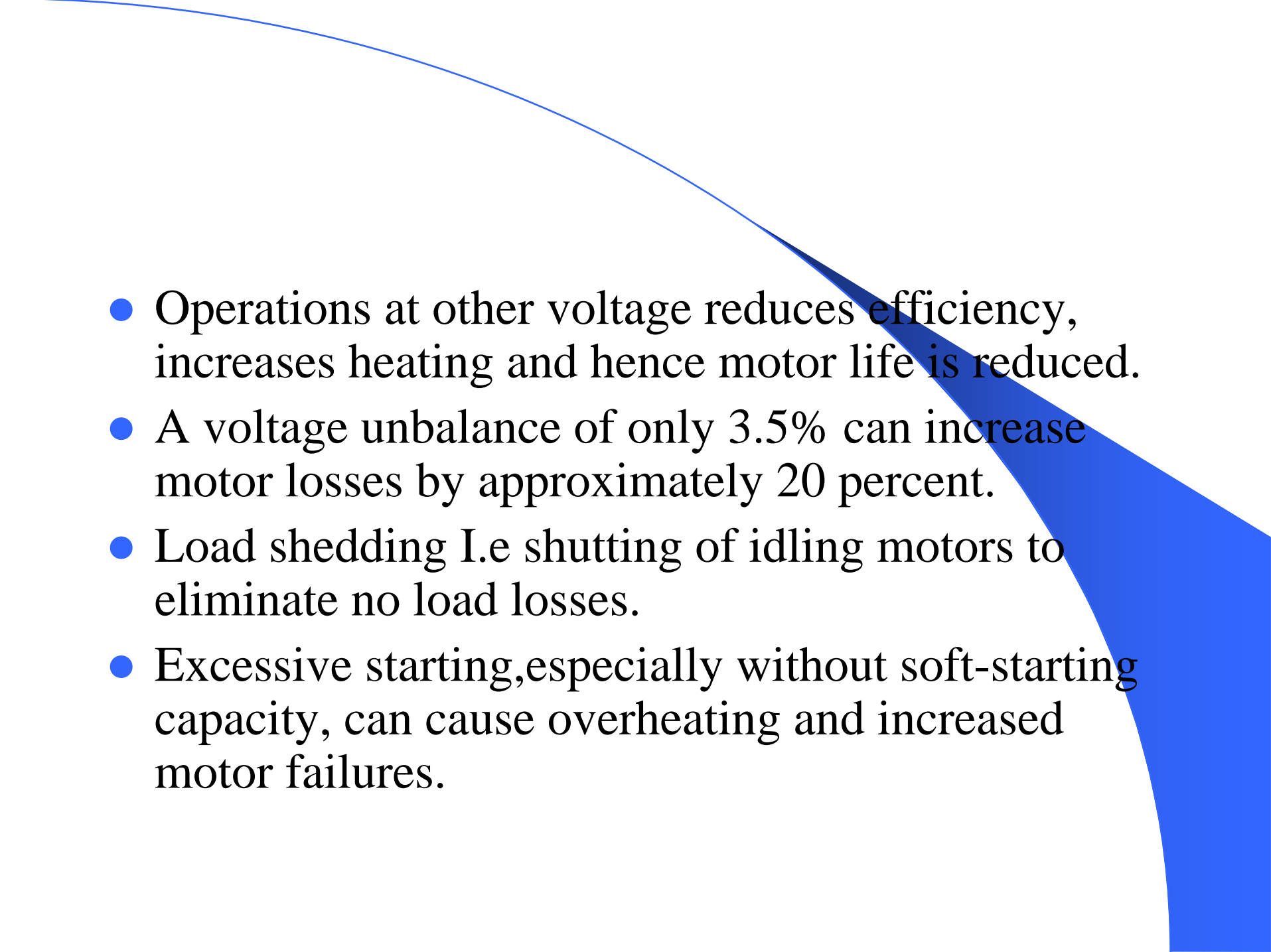
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- When properly stripped and rewound, can be restored to their original efficiency.
 - Losses are typically higher in motors that have been rewound-perhaps because of thermal shock suffered during the motor failure.
 - Motor has failed repeatedly in the past because of a previous non-standard rewind. The same error can be repeated unless the shop knows the motor is a “repeat offender” and diagnoses the problem. Similarly, a motor is sometimes subjected to unusual service requirements, e.g. , frequent starts, dirty environment , low voltage.

- Always use a qualified rewind shop.
- Motor less than 100 HP, more than 15 year old best to replace.
- Rewind cost exceeds 65% by the new motor.
- If energy cost is more and operation 4000 hours per year, EMM is worthwhile.
- Motors that are over-sized and thus lightly loaded suffer both efficiency and power factor reduction penalties.



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- Over heating is a worry at either reduced or full loads with non-ideal voltage and current waveforms encountered with electronic variable-frequency drives.
 - Most energy-efficient motors exhibit approximately the same locked rotor, breakdown and rated load torque characteristics as their standard-efficiency counterparts.
 - EMM operate at slightly higher full load speed.
 - EMM worthwhile investment in all size, speed and enclosure classification.

- 
- IM's main cause of low power factor, many in use not fully loaded.
 - There is a penalty/surcharge for low PF.
 - While selecting a motor, convenient wisdom is to purchase efficiency and correct for power factor.
 - EMM better power factor than SM.
 - Motors must be selected according to known service conditions (NEMA (National Electrical Manufacturers Association)).
 - Low voltage does not allow motor to develop adequate starting torque.

- 
- Operations at other voltage reduces efficiency, increases heating and hence motor life is reduced.
 - A voltage unbalance of only 3.5% can increase motor losses by approximately 20 percent.
 - Load shedding I.e shutting of idling motors to eliminate no load losses.
 - Excessive starting, especially without soft-starting capacity, can cause overheating and increased motor failures.

CONCLUSION

- In this talk we have discussed, when to select EMM as against SM, selection procedure , operation and burnout prevention(failures).

REFERENCES

- B.C Hydro. “High-Efficiency Motors.” Power Smart Brochure.
- Energy-Efficient Electric Motor Handbook by Gilbert A Mc-coy.
- D.P.Kothari & I.J.Nagrath – Electric Machines, 3rd edition, Tata-Mc-GrawHill, New Delhi , 2004.

THANKYOU

A decorative graphic consisting of a thin blue line that curves from the left side of the frame towards the bottom right, where it transitions into a solid blue shape that resembles a stylized, curved arrow or a portion of a larger graphic.