

*A Summary of **MOTOR Efficiency** in the **USA***

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Motor Summit 2007

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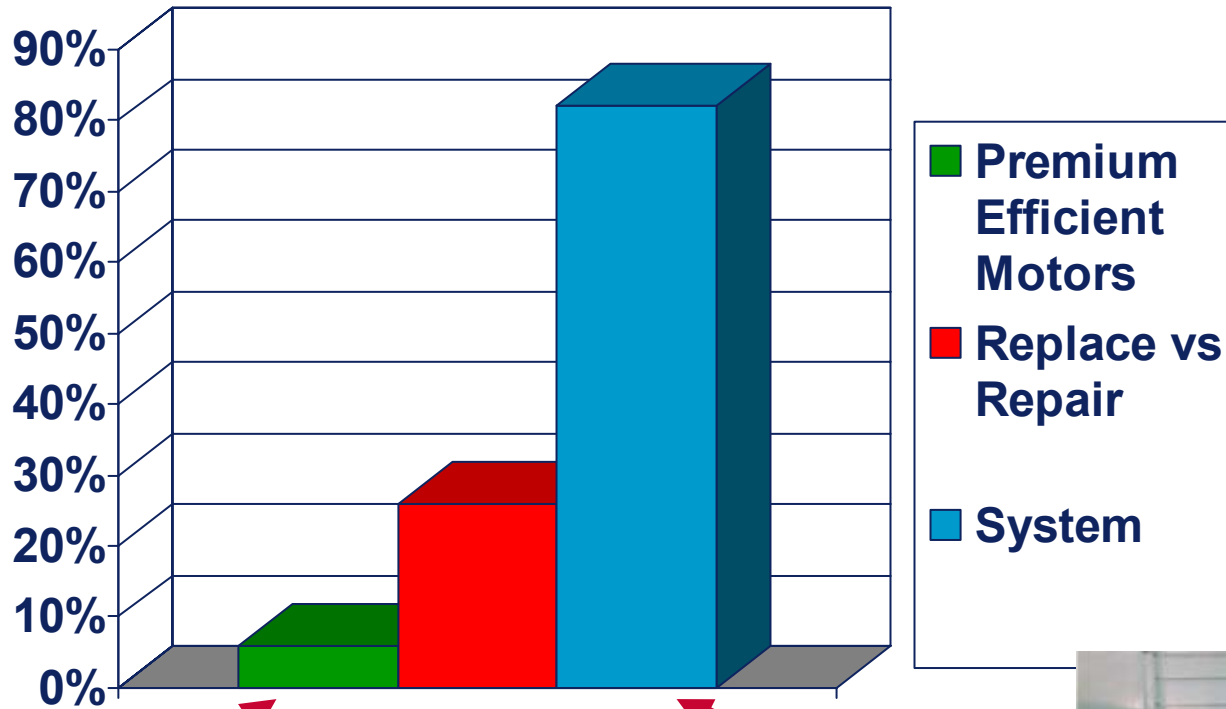
Variety of Electric Motors



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MOTOR TECHNOLOGIES

The energy savings opportunity



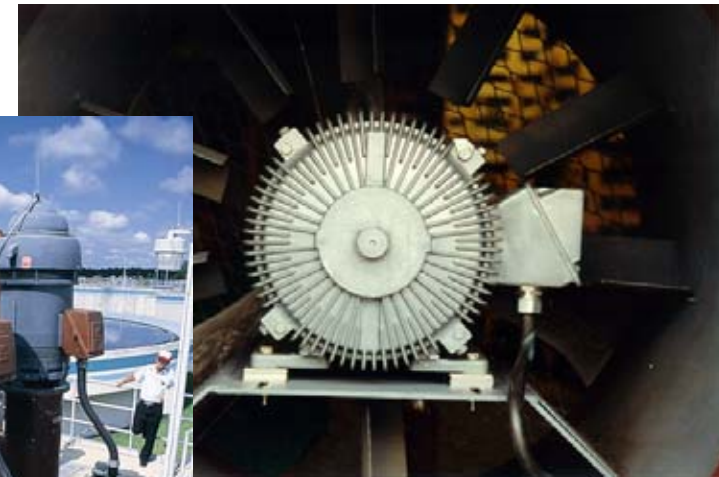
Savings Options



Motors and Applications

1 HP to 500 Horse Power

- Industrial and commercial
- Pumps
- Fans
- Material Handling



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Market Conditions and Upsides

- Four to five times as many motors are repaired as replaced
- Today's applications demand greater motor performance
- Energy costs continue to rise helping reduce efficient motor payback period
- Reducing energy costs helps individual companies and a countries compete in the global market –energy cost is cost

Regulatory Options Driving Energy Policy Act Of 1992

- Continue with a voluntary approach allowing market to recognize efficient motor value and decide
- Allow states to regulate and adjust product and distribution channels accordingly
- Regulate most categories of electric motors regardless of savings potential and expense
- Select and regulate a segment of categories based on economic justification and technical feasibility

Regulatory Issues Check List- Motors

- **1] What product will be covered?**
- **2] What efficiency level will be used?**
- **3] What performance test method will be required?**
- **4] How will test labs be evaluated and accredited?**
- **5] What label requirement will be used?**
- **6] How will compliance be enforced?**
- **7] How much time will be allowed from enactment to implementation?**
- **8] How will future reviews be addressed?**

Efficiency Elements	1992	1997	2001	2005	2007	2008	2011
Covered product	Defined	Implement	Unchanged	Unchanged FEMP	Unchanged FEMP	Unchanged FEMP	?
Efficiency levels	Defined	Implement	NEMA Premium	NEMA Premium	NEMA Premium	NEMA Premium	?
Test Method	Defined	Implement	Unchanged	Unchanged	Unchanged	Unchanged	?
Lab required	Defined	Implement	Unchanged	Unchanged	Unchanged	Unchanged	?
Compliance enforce	Defined	Implement	Unchanged	Unchanged	Unchanged	Unchanged	?
Timing	Defined	Implement	Voluntary	Voluntary	Voluntary	Voluntary	?
Revisions	Defined			FEMP Added	Discussion Begins	Future Legislation	?

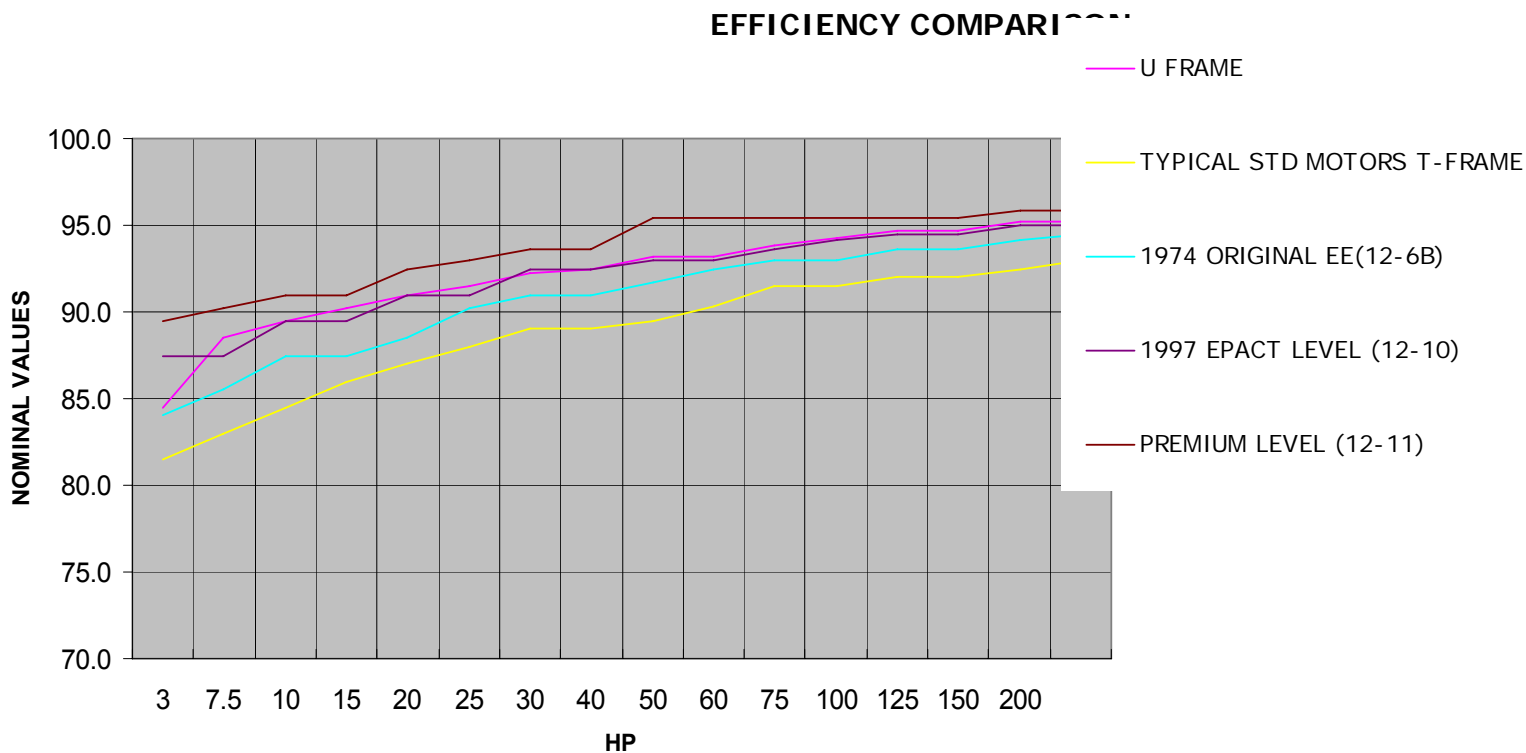
Evolution of Motor Efficiency USA

Covered Product

- Product categories as defined by MG 1
 - General purpose
 - Definite purpose
 - Special purpose
- Economically justifiable
 - Largest single segment
 - Capital spread over high volume
- Technically feasible
 - Most standard design
 - By and large no mechanical change needed



Various Efficiency Levels Exist Within MG 1



Test methods use IEEE 112 method B

Operating cost of Epact Motor per Year

Annual Operating Cost

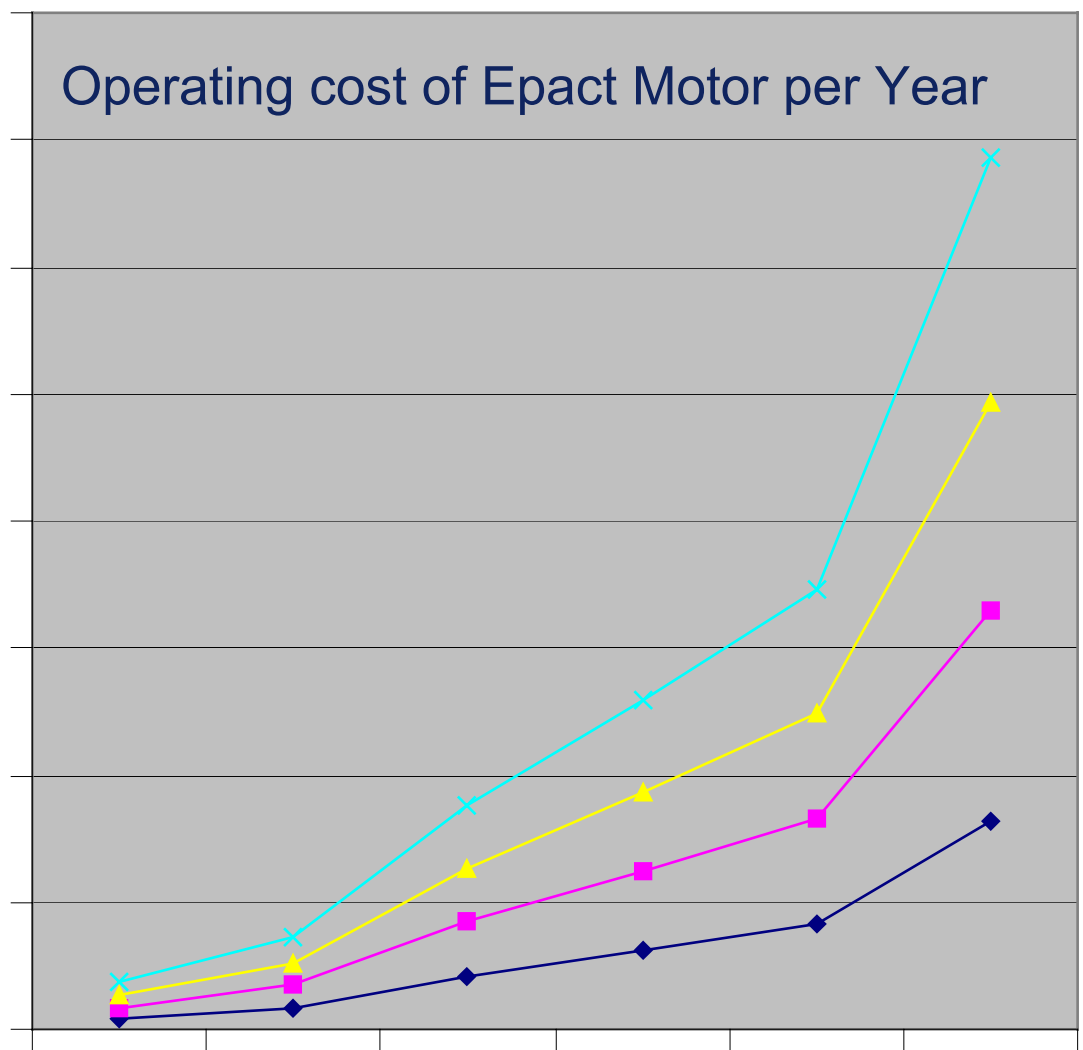
Annual Operating Hours

- 2100
- 4200
- 6300
- 8760

\$80,000
\$70,000
\$60,000
\$50,000
\$40,000
\$30,000
\$20,000
\$10,000
\$-








10 20 50 75 100 200

Motor Size, HP



Labeling and Identification

- NEMA nominal efficiency definitions exist within MG1

CATALOG # D5E2D			MODEL # AD77		
SHAFT END BRG 6206-2ZJ/C3			OPP END BRG 6205-2ZJ/C3		
FR 184T		TYPE FD		ENCL DP	
PH 3 ^{MAX} AMB 40 °C ID# L01-AD77-M					
INSUL CLASS F		DUTY CONT WT		BAL	
HZ 60 HP5.00 RPM 1760			HZ 50 HP 5.00 RPM 1445		
SF 01.15 DESIGN B CODE J			SF 01.00 DESIGN B CODE G		
GUARANTEED EFFICIENCY 85.5		MAX KVAR 2.50		GUARANTEED EFFICIENCY 81.5	
NEMA NOM EFFICIENCY 87.5		NOM PF 84.0		MAX KVAR 2.00	
VOLTS 208-230/460			VOLTS 190/380		
FLAMPS 13.90-13.40/6.70			FLAMPS 15.80/7.90		
SF AMPS			SF AMPS		
			   		
MADE IN MEXICO			EMERSON MOTOR COMPANY		
			ST LOUIS, MO  *AD77*		
422702-002					

Compliance and Enforcement

- Manufacturers accredit labs or use third party labs for testing
- Data required for 113 “basic models”
 - Submission to Department of Energy
 - Tested samples indicated
 - DOE issued “compliance number”
- Compliance test parameters determined
 - Department of Energy enforcement actions
 - Due process
 - Written notice and modification of non-compliant product
 - Remedies may include judicial restraining order

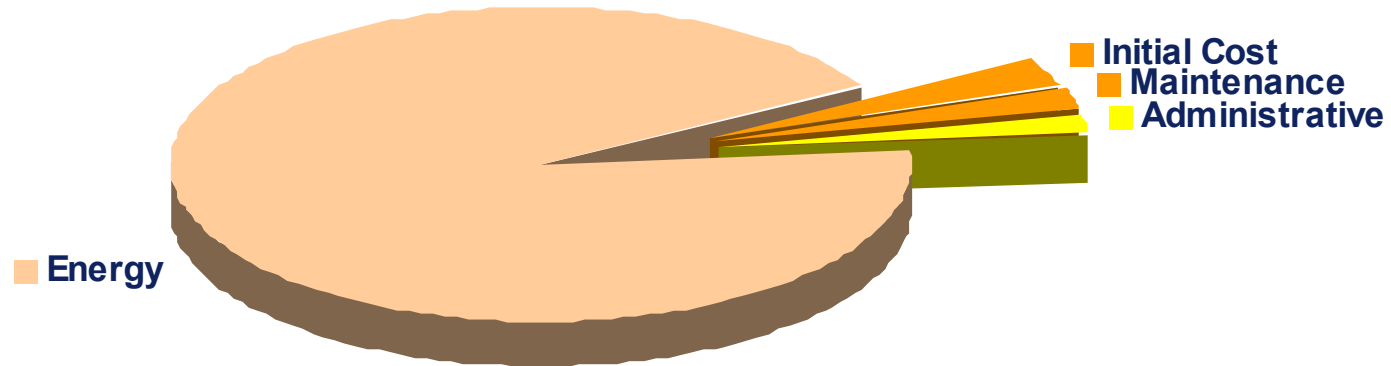
Actual DOE filing from a US motor manufacturer

HP	Number of Poles	Least Efficient Basic Model	TYPE	Nominal Full Load Efficiency	HP	Number of Poles	Least Efficient Basic Model	TYPE	Nominal Full Load Efficiency
1	4	H1E2D	Enclosed	82.5	30	2	H30E1DS	Enclosed	91.0
1	6	H1E3D	Enclosed	80.0	30	4	H30E2E	Enclosed	92.4
1-1/2	2	H32E1D	Enclosed	82.5	30	6	H30E3E	Enclosed	91.7
1-1/2	4	H32E2D	Enclosed	84.0	40	2	H40E1ES	Enclosed	91.7
1-1/2	6	H32E3D	Enclosed	85.5	40	4	H40E2E	Enclosed	93.0
2	2	H2E1D	Enclosed	84.0	40*	6	H40E3E	Enclosed	93.0
2	4	H2E2D	Enclosed	84.0	50	2	H50E1ES	Enclosed	92.4
2	6	H2E3D	Enclosed	86.5	50	4	H50E2E	Enclosed	93.0
3*	2	H3E1D	Enclosed	85.5	50	6	H50E3E	Enclosed	93.0
3	4	H3E2D	Enclosed	87.5	60	2	H60E1ES	Enclosed	93.0
3	6	H3E3D	Enclosed	87.5	60	4	H60E2E	Enclosed	93.6
5*	2	H5E1D	Enclosed	87.5	60	6	H60E3E	Enclosed	93.6
5	4	H5E2D	Enclosed	87.5	75	2	H75E1ES	Enclosed	93.0
5	6	H5E3D	Enclosed	87.5	75	4	H75E2E	Enclosed	94.1

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Revisions	Defined			FEMP Added	Discussion Begins	Future Legislation	?

Evolution of Motor Efficiency USA

Lifetime Motor Costs Are the Key



Dependent upon motor size energy cost
and number of operating hours
5000HP .6% adds \$38,000/year operating cost

Why NEMA Premium?

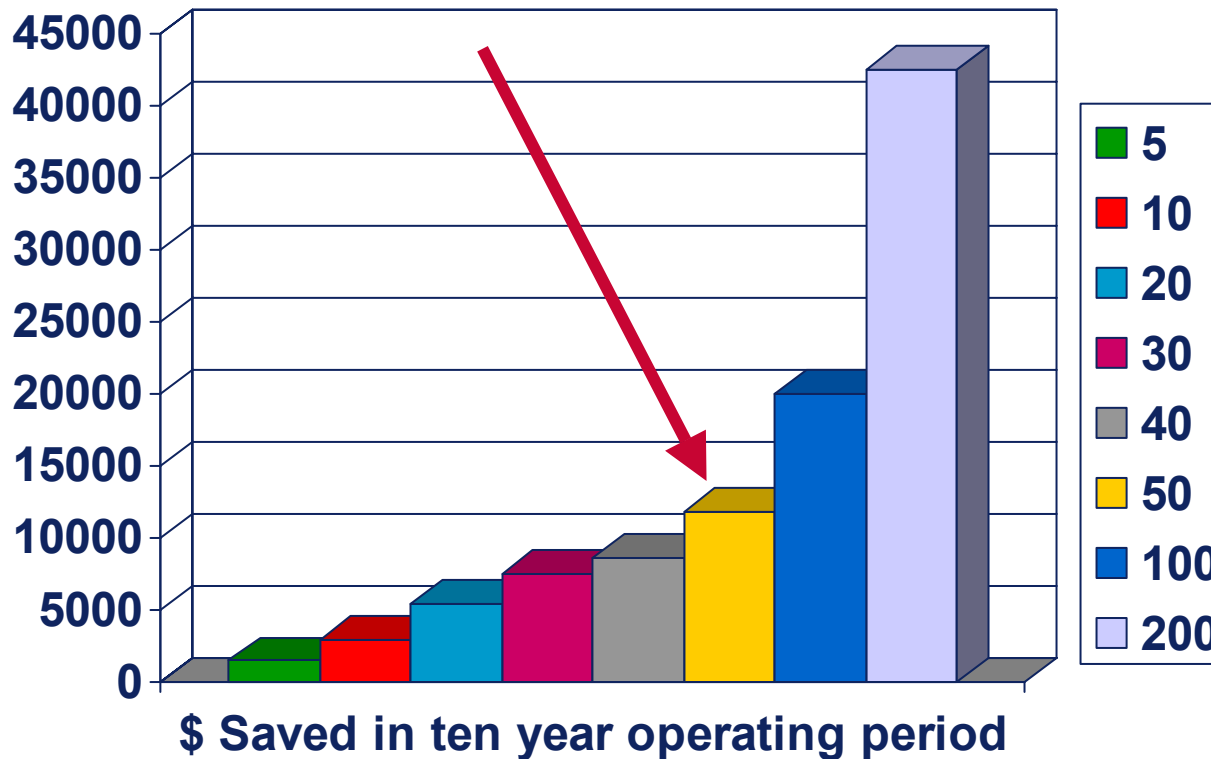
- Some customers wanted more efficient products
- Power utilities paid rebates based on performance
- End user standards called out various levels of efficiency
- Multiple premium efficiency definitions caused market confusion and added cost to all
- Non Motor manufacturers began to develop standards
- The answer



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Premium Savings Over Ten Years

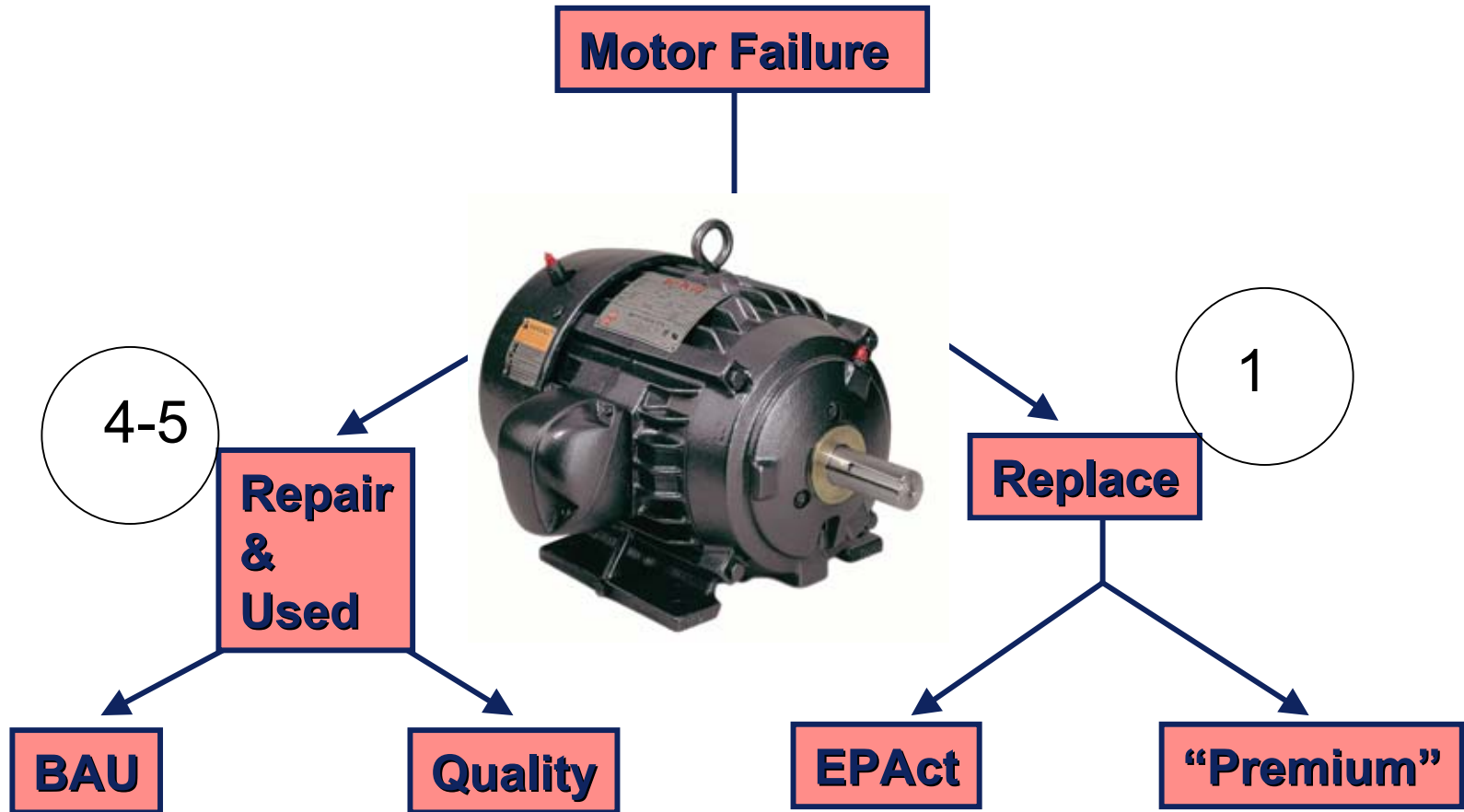


A 50hp motor can save the equivalent of a significant labor cost reduction over ten years

Motor Facts

- Industrial motors can have a 20 to 30 year service life
- The average IHP motor is repaired 3 or more times in it's life [source EASA]
- The average IHP motor uses 4 to 6 times it's original cost in electricity per year
- Epa regulations covers less than 75% of motors sold today
- Environmental groups estimate over 4-5 million units are repaired each year

A Motor User's Decision To Replace Failed Motors can save thousands of dollars in unnecessary operating costs



Source ACEEE IHP

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NEMA Premium Plan



- Establish a national motor efficiency **Identity!**
- NEMA Premium is a registered trade mark
- Expand scope of product to include a much greater number of potential units
- Create a testing and labeling scenario that is consistent with existing federal energy code
- Add NEMA premium to MG1 in two new tables as an ANCI standard
- Align utility rebates and state energy programs to use/refer to NEMA Premium

NEMA Premium Plan Continued

- Provide an opportunity for NEMA and non-NEMA manufacturers to participate
- Require all participating manufacturers to sign a memo of understanding before using the trade NEMA Premium mark
- Maintain as an industry motor efficiency standard
- Promote NEMA Premium to a wide range of trade associations, global government and utility groups
- Grow market using the worlds most recognized motor brand
- Expand to other NEMA section products

MOU – Memo of Understanding

- General Terms and Conditions
 - Why, how, use of mark
- Definitions
- Term of Memo
 - Termination event
- Partners Responsibilities
 - Supplying data, testing method
- NEMA Responsibilities
 - Promotion of the program
- Conflict Resolution
 - Notification process formalities

NEMA
Premium™



NEMA Premium

- Product scope expanded beyond existing federal regulations
 - 1-500HP low and medium [2,4,6 pole] voltage motors
 - Definite and special purpose motors
 - Manufacturers and distributors can affectivity apply program to MRO as well as Capital project requirements
 - Rely on existing federal energy code for labeling and testing criteria

NEMA
Premium



Federal Energy Management Program

- A key provision in the recent federal energy legislation requires that all federal agencies utilize a premium efficiency definition when purchasing energy-consuming products and systems, including electric motors. The energy law also requires that Federal Energy Management Program (FEMP) -designated products be clearly identified and prominently displayed in any inventory or listing of products by the U.S. General Services Administration (GSA) or the U.S. Defense Logistics Agency (DLA).

**IHP Motors Installed base of
35 million units in the USA**

**NEMA Premium
400k units /year
25% of units shipped**

**New units shipped each
year 1.6 million**

**Estimated 4- 5 million units
Repaired each year**

Move from Epact to NEMA Premium

Replace instead of repair energy saved

HP Range	Annual units	GWh /year	Replace vs Repair
1-5	987852	66	131
6-20	435039	126	252
21-50	122427	59	118
51-100	43109	25	101
101-200	23508	17	67
201-500	11821	20	121
Total	1623756	313	791

Savings based on weighted adoption rate [ACEEE]



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Test Method	Defined	Implement	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Lab required	Defined	Implement	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Compliance enforce	Defined	Implement	Unchanged	Unchanged	Unchanged	Unchanged	Unchanged
Timing	Defined	Implement	Voluntary	Voluntary	Voluntary	Voluntary	Regulation
Revisions	Defined			FEMP Added	Discussion Begins	Legislation Enacted	Revisions Implement

Evolution of Motor Efficiency USA

Motor Efficiency in USA Conclusion

- Basic product definition determined once then evolved over time
- Test standards set and held constant
- Labeling agreed to early and held constant
- Test labs requirements determined early in process and held constant
- Additional products and levels mutually determined
- Future implementation schedule determined to allow manufactures necessary time to adopt



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USA Future Efficiency Gains

- Add seven categories of low volume motors not included in Epact92
- Move 1-200 Horse power general purpose to NEMA Premium efficiency levels
- Add 201 to 500 horse power at MG 1 12-11 efficiency levels
- Offer tax incentives to manufacturers and end users who accelerate implementation of NEMA Premium products
- Method to be used legislation
- Timing to be 36 months from enactment



Proposed Future Regulations

- Move all general purpose product to NEMA Premium levels [MG1 12-12]
- Add seven categories of motors not included in original Epact92 [MG1 12-11]
 - ⑩ U-Frame Motors
 - ⑩ Design C Motors
 - ⑩ Close-coupled pump motors
 - ⑩ Footless motors
 - ⑩ Vertical solid shaft normal thrust (tested in a horizontal configuration)
 - ⑩ 8-pole motors (~900 rpm)
 - ⑩ All poly-phase motors with voltages up to 600 volts other than 230/460 volts
- Add 201 to 500 horse power low voltage general purpose design “B” at [MG1 12-11] levels

Proposed Future Regulations continued

- Implement changes 36 months from enactment or accelerate adoption through tax incentive
- 1. *Manufacturer Production Incentive* –
- a.) Motor manufacturers would receive a credit for the eligible production of 1 to 500 horsepower, premium efficiency (that meet efficiency levels specified in NEMA MG-1 (2006) Tables 12-12 or 12-13) general or definite purpose motors manufactured or shipped to the United States within 36 months from the date of enactment of this provision
- 2. *Motor Purchase Incentive* –
- a.) End-use customers purchasing low and medium-voltage motors of 1 to 500 horsepower meeting premium efficiency levels NEMA MG-1 (2006) Tables 12-12 or 12-13) would receive a tax credit per horsepower for motors purchased and installed in facilities in the United States.

NEMA Technical Activities

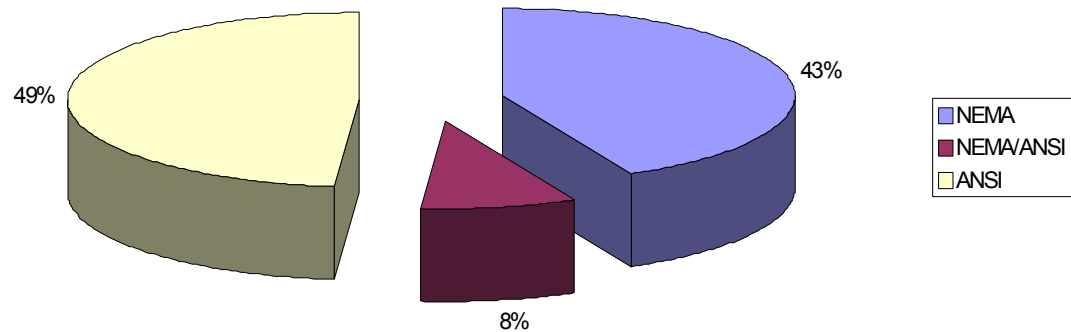
- **Provides technical support to the sections**
- **Manages the development of standards**
- **Develops and coordinates member positions**
- **Manages NEMA Field Program**
- **Obtains regional and international support for standards and conformity assessment positions**
- **Addresses emerging technology issues**
- **Managing NTCIP standards initiative:**
 - **National Transportation Communications for ITS Protocol**

Domestic Standards Development

- Staff expertise in the development and maintenance of product standards and application guides**
- “Fast Track” standard production cycle of 12 months or less**
- Initiatives for new and emerging technologies**
- Over 300 representatives on committees of other national organizations**

Domestic Standards Development

- **236 NEMA Standards Publications**
 - Standards
 - Guides
 - Papers
- **46 ANS/NEMA Standards**
- **266 American National Standards**
- **Total = 548**



Developing and Advocating Technical Positions

- **Forum for members to develop industry positions to outside organizations such as UL, NFPA, ASTM, IEEE, etc.**
- **Coordination of industry positions reflective of members' needs**
- **Technical interface with NEMA's government relations programs**
- **Structure to support and advocate NEMA views**

Regional and International Standards Development

Regional Standards Development

- **CANENA standards harmonization (Canada, Mexico, USA)**
 - Management of 72 CANENA harmonization projects supported by 24 NEMA Sections
 - 28 Tri-National and 13 Bi-National standards published
 - Leadership through CANENA Secretariat
- **Creation of a uniform North American market**
- **Harmonized negotiating positions with IEC/ISO**

Regional and International Standards Development

International Standards Development

- **Development and adoption of international (IEC and ISO) standards**
- **Structure to support and advocate US positions**
 - **TAG Administrator: 56 IEC and 7 ISO TAGs**
 - **8 Secretary and 6 Chairmanship positions**
 - **29 NEMA Sections participate in 59 IEC TCs/SCs**

Regional and International Standards Development

International Standards Development (cont.)

- **Promotion of globally harmonized standards**
 - inclusion of North American requirements
 - address new or existing technologies
 - global relevance initiative

– **One international standard that can be adopted in all markets to unify design and manufacture around the world**

– **Coordination with US agencies to enforce adherence to WTO's Technical Barriers to Trade**

Conformity Assessment

(testing, certification, quality systems registration)

- **“One standard, one test, accepted everywhere”**
- **Development of global conformity assessment systems that affect NEMA members**
 - **IECEE CB Scheme; IECEx Scheme**
 - **USNC and IEC policy committees**
- **Promotion of the expansion of IEC conformity assessment schemes to non-IEC members**
- **NEMA Conformity Assessment Guide**

Emerging Technologies

- **Panel includes CTO's of major member companies**
- **Early focus on intelligent systems, alternative energy sources, green technologies, MEMS technologies, nanotechnologies**
- **Articles, web seminars, conferences, bulletin boards, standards, advocacy, business information.**
- **NEMA holds US TAG for IEC TC 113 on nanotech.**
- **NEMA has Council on Nanotechnologies**