Electrical Energy Efficiency

Copper Development Association

Copper's Role in Sustainable Energy Efficiency

Northeast Ohio AEE
April 29, 2010

Richard E. deFay
Project Manager
Sustainable Energy Efficiency
Copper Development Association, Inc

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Overview

- *Who is CDA*
- *Antimicrobial Copper*
- *Motor Efficiency Standards*
- *The Copper Rotor Motor*
- *EISA - future motor policy, purchases, improvements*
- *Resources*

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Copper Development Association, Inc.

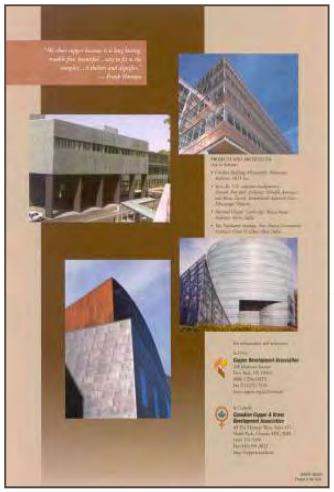
CDA, is the market development, engineering and information services arm of the copper industry, chartered to enhance and expand markets for copper and its alloys in North America.

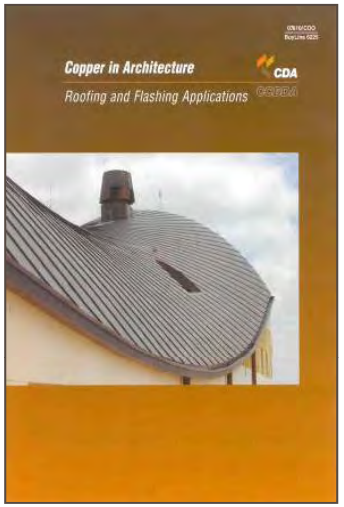
We have different & diverse specialties.

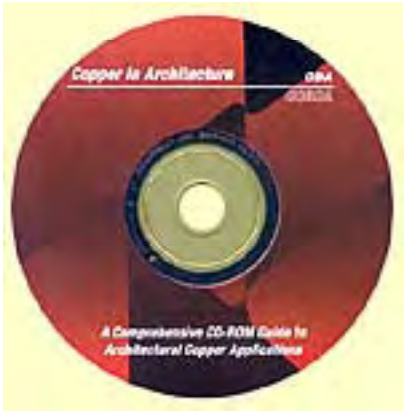
Copper Development Association

Building & Construction - Architecture

- Seminars
- Design Assistance
- Installer Training
- Research
- Testing & Evaluation







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Copper in Architecture: Gutters & Flashing

Copper in Architecture: Interiors

Copper in Architecture: Interiors

Bethel Woods Performing Arts: Bethel, NY

Bethel Woods Performing Arts: Bethel, NY

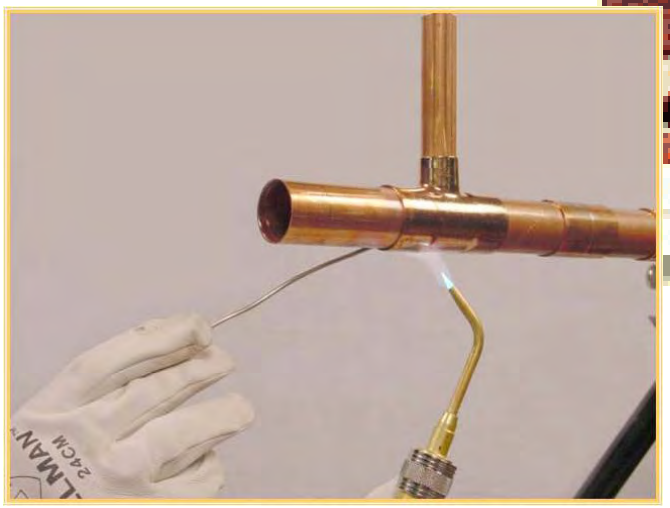
Enduring

Properties | **Design** | **Systems** | **Alloys** | **Resources** | **Options**

Copper in Architecture Award 2009 Winners

Building & Construction – Tube & Fitting

- Providing training and technical assistance
- Training the trainers to train



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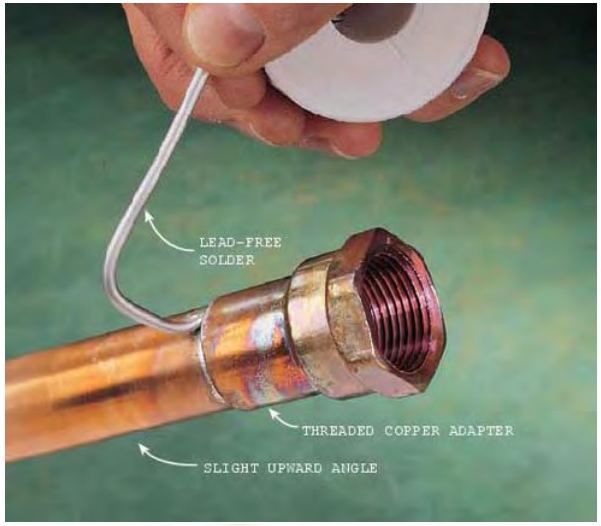
Building & Construction – Tube & Fitting

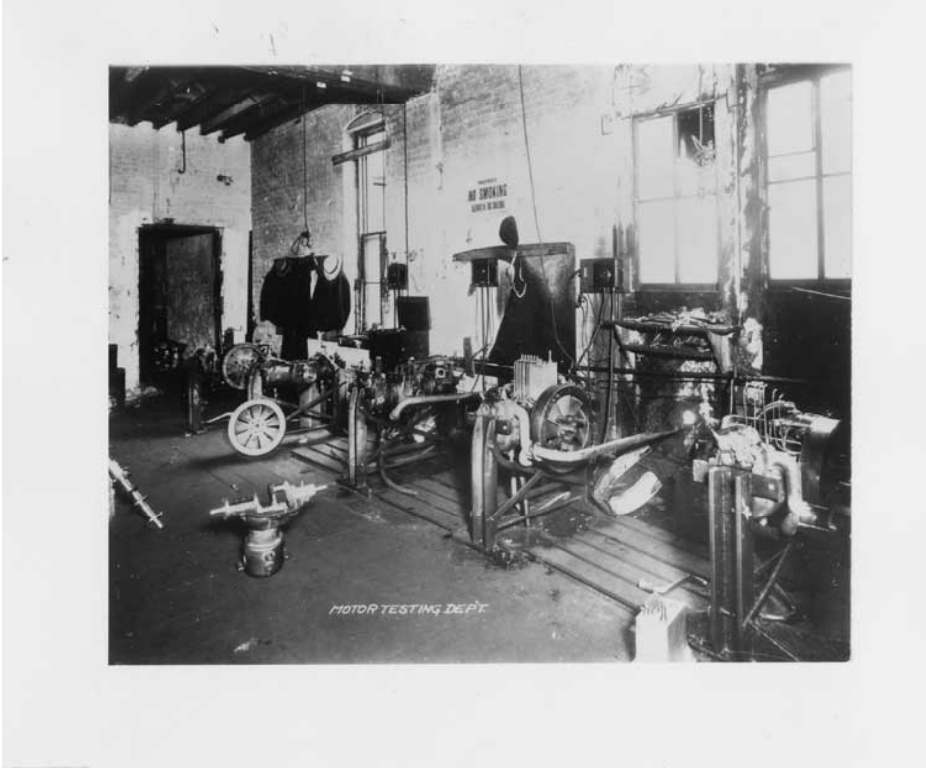
- Teaching proper soldering and brazing techniques to benefit us all.

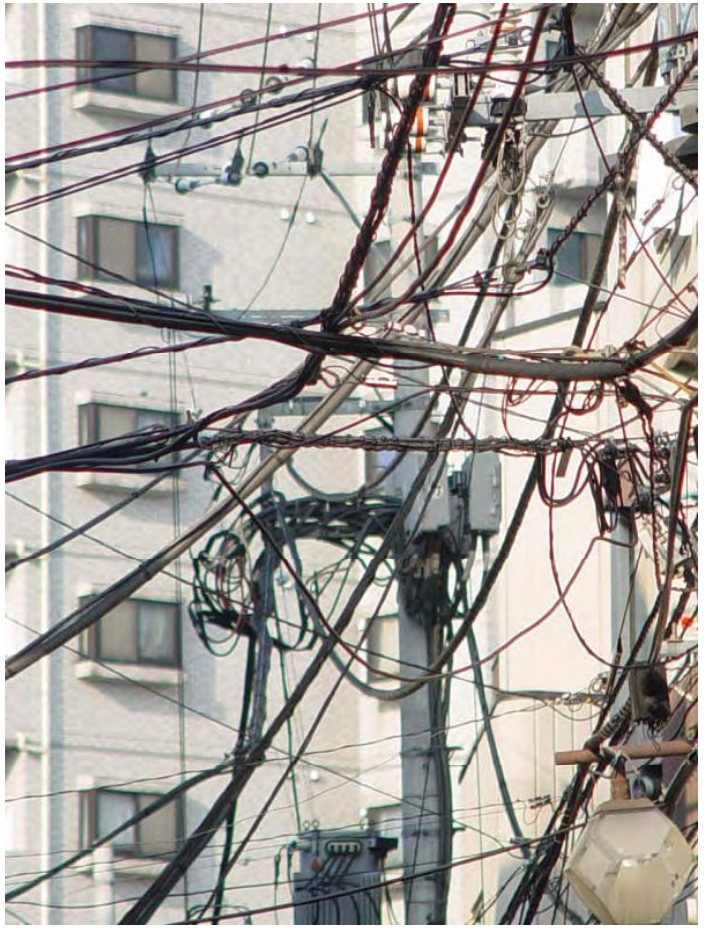


Building & Construction – Electrical

Building & Construction – Electrical

- Instrumental in sophisticated system design using the most up-to-date equipment at our disposal





Just seeing if you are paying attention!

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Building & Construction - Electrical

- Headed up by:
  David Brender, P.E.
  National Program Manager

- Recipient of the 2009 *International Power Quality Leadership Award* for his contributions to the field of power quality. The award was presented at the annual Power Quality & Reliability Conference held last March in Las Vegas.

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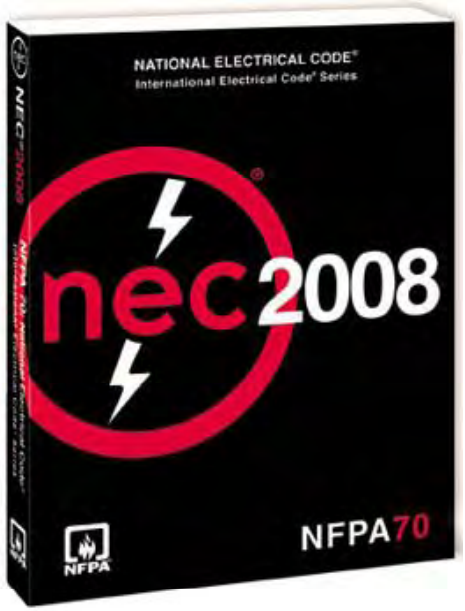
Building & Construction – Electrical

- Active on NEC code committees
- Recognized expertise with Power Quality issues
- Electrical energy efficiency
- Providing resources & training



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Building & Construction – Electrical

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Building & Construction – Electrical

- With the high price of copper….
- Stealing copper
- Can be risky & very dangerous

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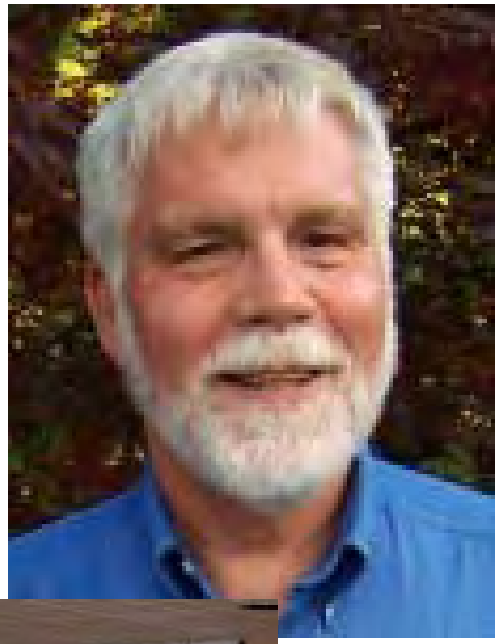
Health & Environment

- Capably headed by Joseph Gorsuch, Manager, Health and Environmental Sciences
- A longtime contributor to the imaging industry with Eastman Kodak and a committed environmental scientist,
- Recipient of the 2009 International Imaging Industry Association Achievement Award



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Health & Environment

- Coordinates research on copper's health & environmental impact
- Monitors states for water quality standards
- Offers expert witness testimony in environmental court cases

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Sustainable Energy Efficiency

- Motors
- Transformers
- Energy Efficiency
- Sustainable/renewable energy

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Sustainable Energy Efficiency

To speak at:

- Conferences
- Trade Shows
- Workshops
- Seminars/CEU Credits
- Conventions

About:

- Energy Efficiency
- Energy Efficient Motors
- MotorMaster+ Software
- Transformers
- Public Health

And the relationship to copper

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Sustainable Energy Efficiency

- Motor Management Training/MotorMaster+
- Influence legislation to improve efficiency standards
- DOE (ALLY Partner)

U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Industrial Technologies Program

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Sustainable Energy Efficiency

- Coordinate with International Colleagues
- Work closely with other groups

Motor Decision Matter℠

The Association of Energy Engineers

ACE3

EMA

IEEE

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Antimicrobial – Public Concern

SUPERBUG 'TO KILL 150,000'

SUNDAY EXPRESS CRUSADE

CLEAN UP OUR KILLER WARDS

Minister orders his health chief: Solve deadly NHS crisis

URGENT action to combat the killer hospital bug MRSA was demanded last night by Health Secretary John Reid.

He acted as a leading expert warned the infection could kill 150,000 patients over the next two years.

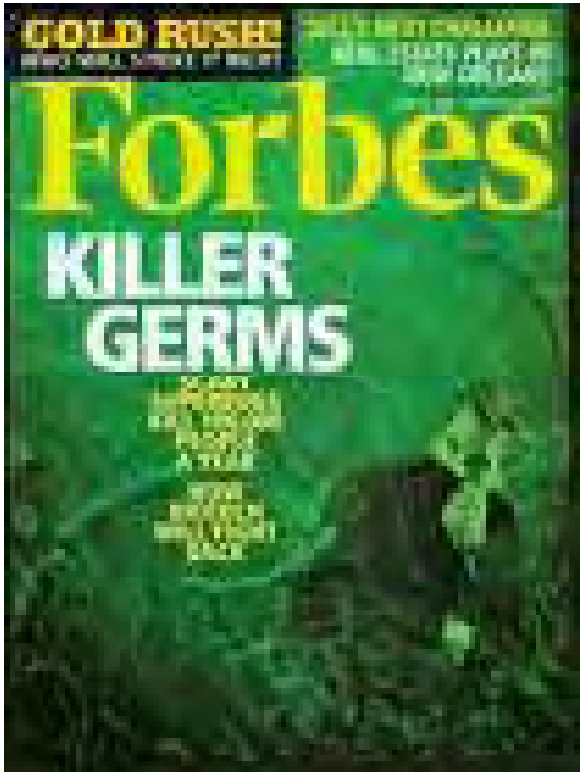
Dr Reid asked the Chief Medical Officer, Sir Liam Donaldson, to bring forward publication of his report into the spread of MRSA "as a matter of urgency". The report is expected to heavily criticise hospital hygiene standards and call for a major shake-up in the way wards are cleaned.

The move comes as Professor Hugh Pennington,

EXCLUSIVE

By Lucy Johnston and Michael Knapp

TURN TO PAGE 5



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Antimicrobial - Hospital-Acquired Infections

- Infect 2 million people in hospitals each year
- Cause 100,000 people to die annually
- Cost the healthcare industry $20 billion

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Background

- Egypt (2000 BC) Sterilize water
- France (Mid 1800's) – Copper workers immune to Cholera epidemic
- India (Today) – Brass water jugs eliminate E. coli

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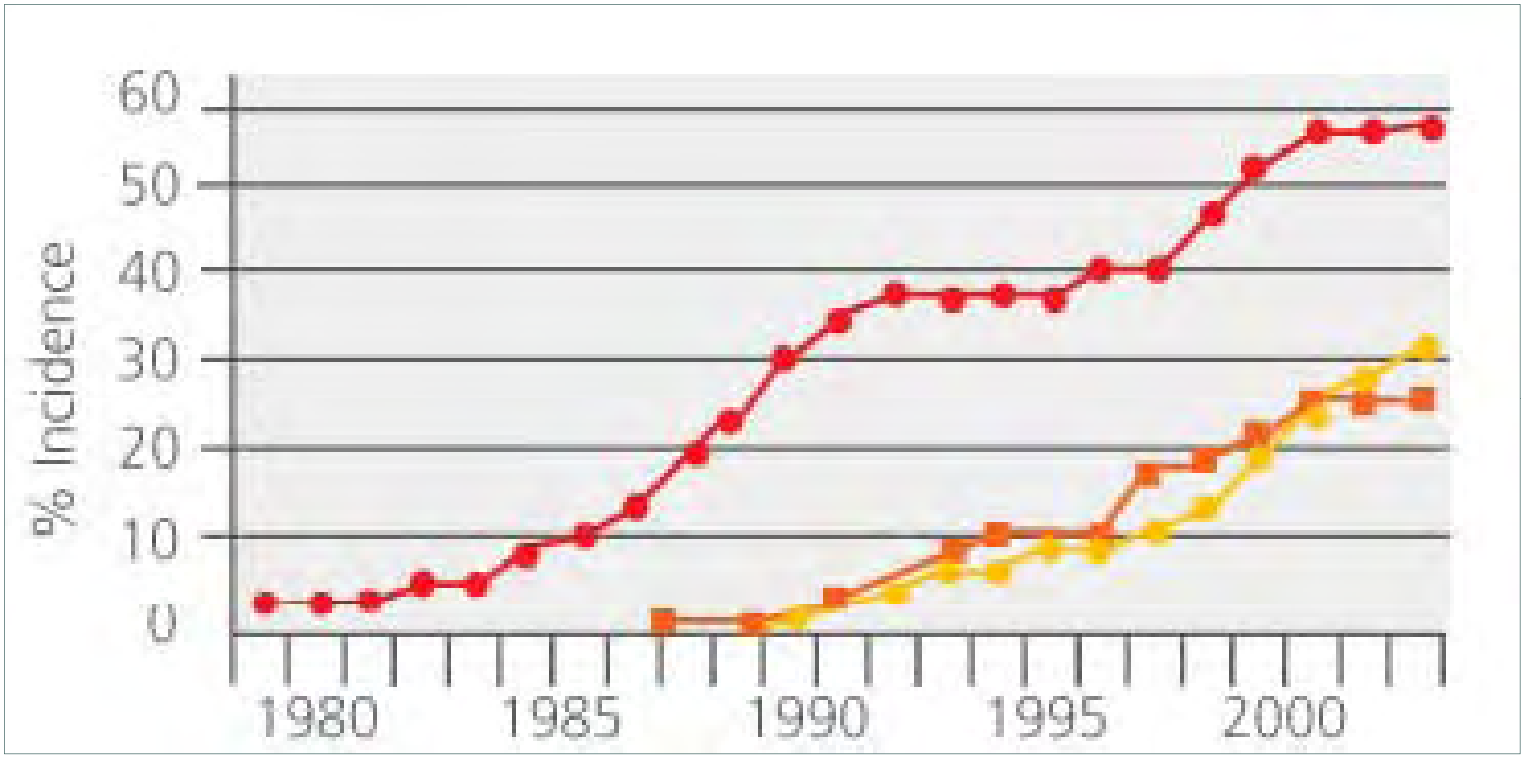
Antimicrobial - Hospital-Acquired Infections



MRSA – Methecillin Resistant Staphylococcus Aureus

VRE – Vancomycin Resistant Enterococcus

FQRP – Fluoroquinolone Resistant Pseudomonas Aeruginosa

Infectious Diseases Society of America, as derived from data collected by the Centers for Disease Control and Prevention.

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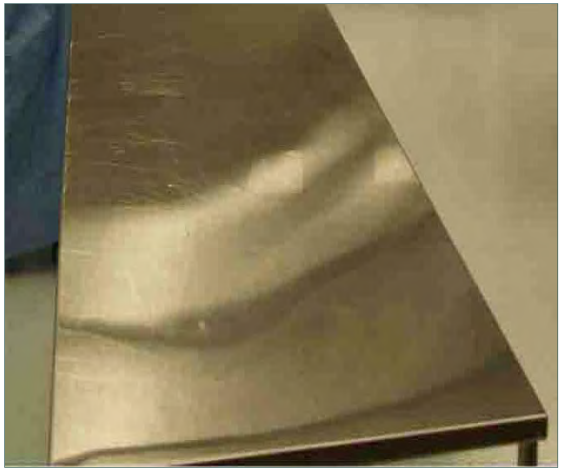
Hospital-Acquired Infections

Even though healthcare furnishings
are designed to be
easily cleaned...



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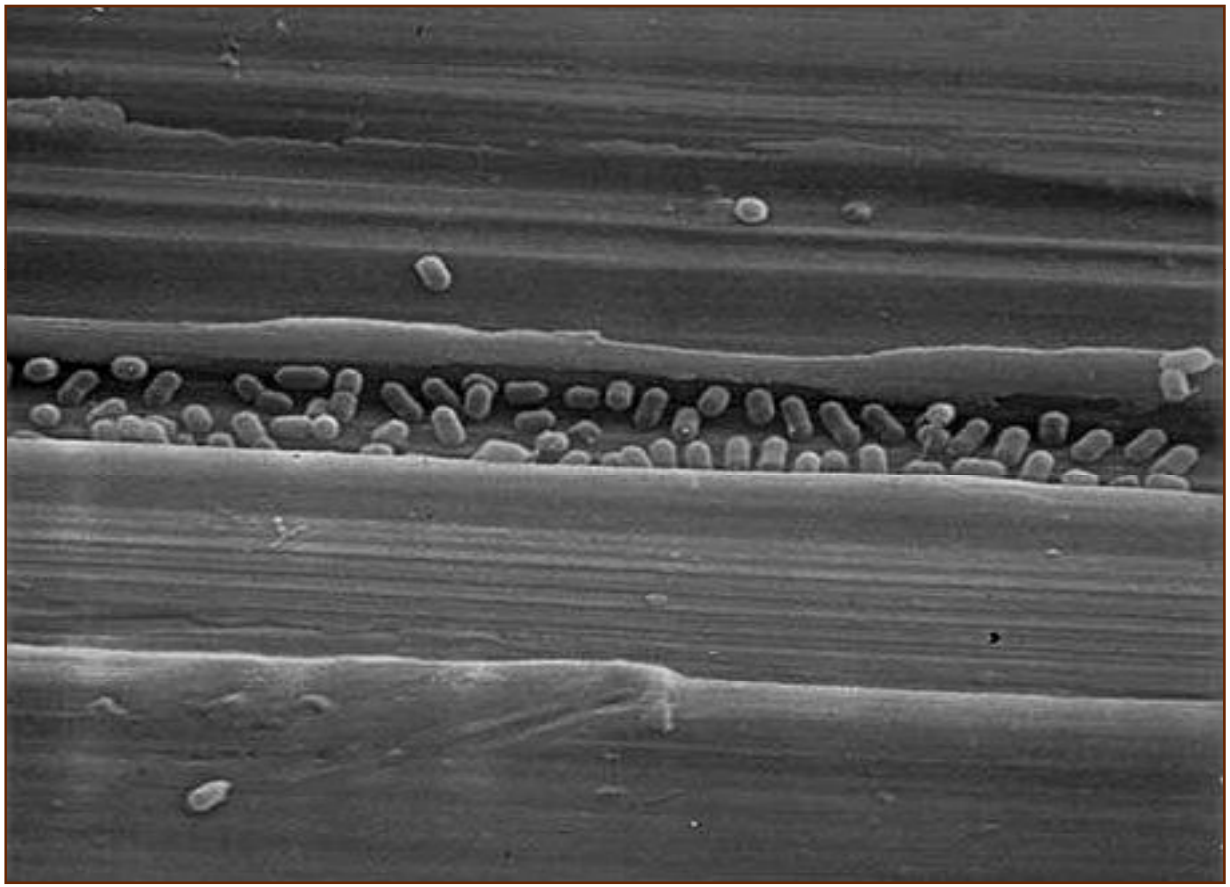
Hospital-Acquired Infections



Bacteria can survive in scratches on many surfaces, but copper is different..

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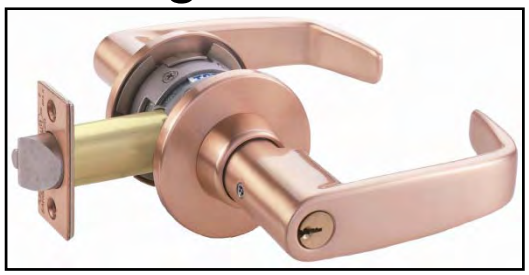
72 hours after inoculation with *E. coli*:

Brass Lockset

Little bacterial growth



Stainless Steel Lockset

Heavy bacterial contamination

Doorknobs: A Source of Nosocomial Infection?
by P. J. Kuhn, Diagnostic Medicine, Nov/Dec 1983

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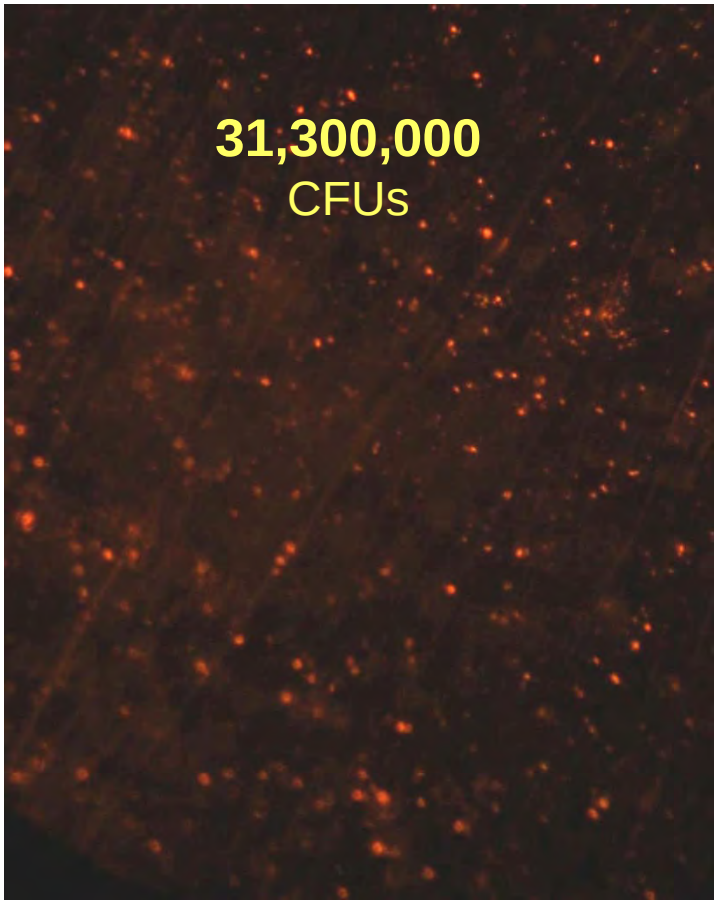
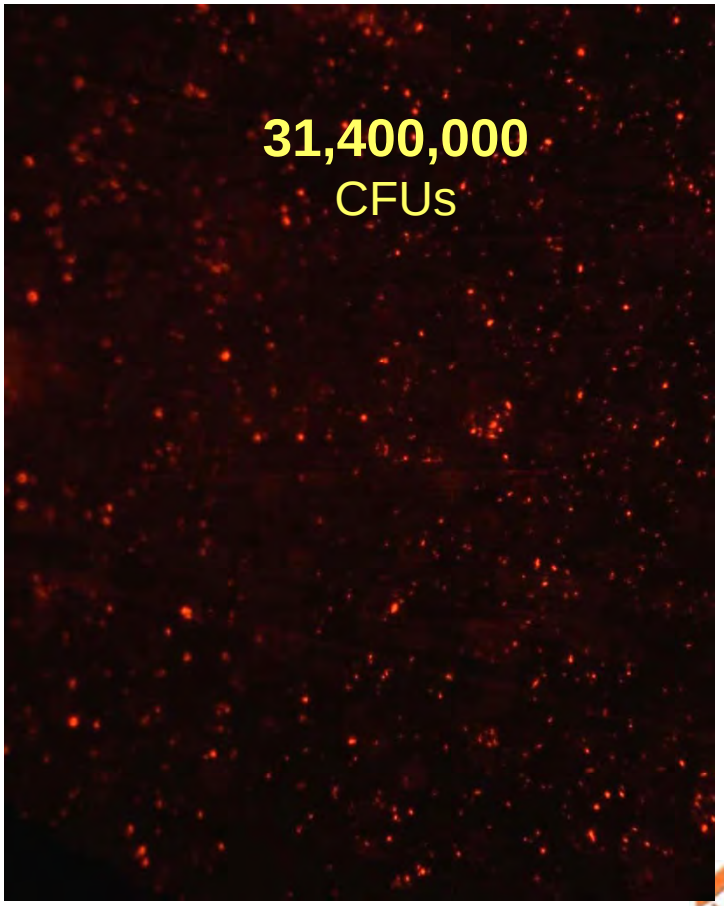
E. Coli O157:H7

Time
0 minutes

Stainless Steel



Copper



Epifluorescence Images after Staining with Viability Fluorophore CTC

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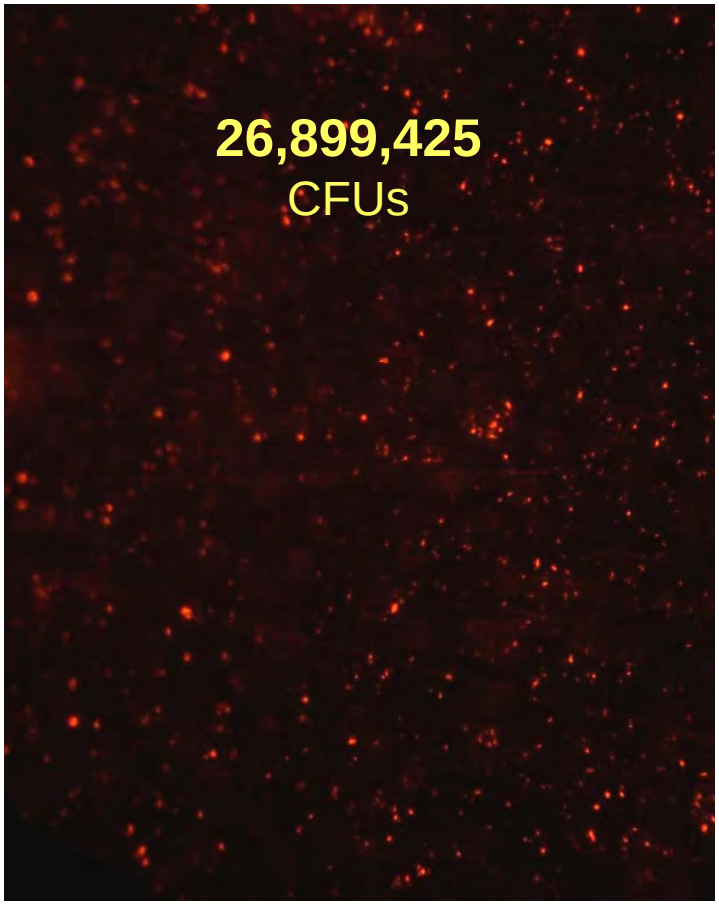
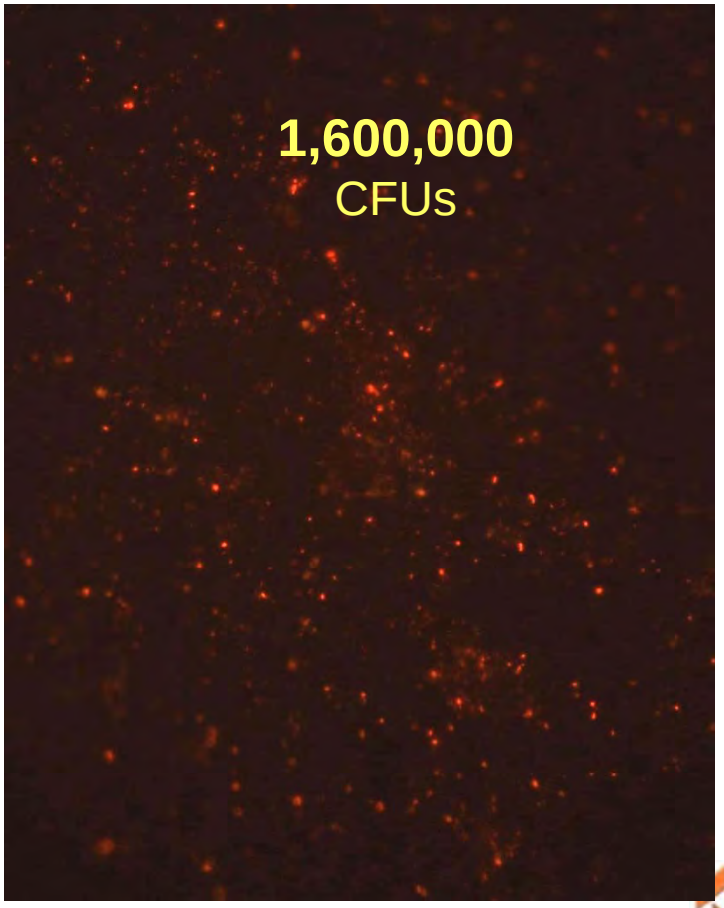
E. Coli O157:H7

Time
30 minutes

Stainless Steel



Copper



Epifluorescence Images after Staining with Viability Fluorophore CTC

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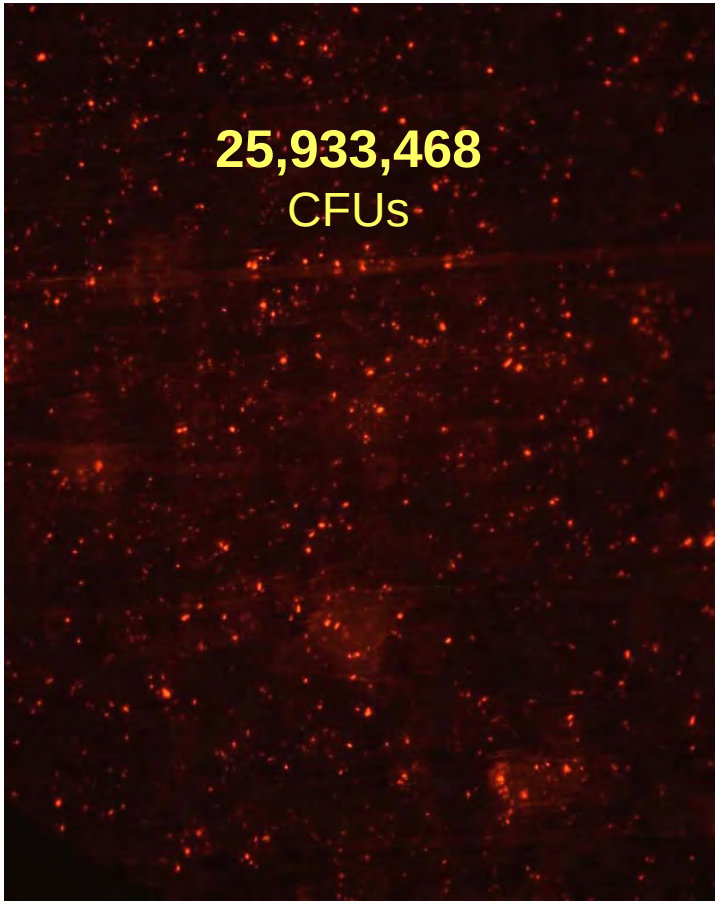
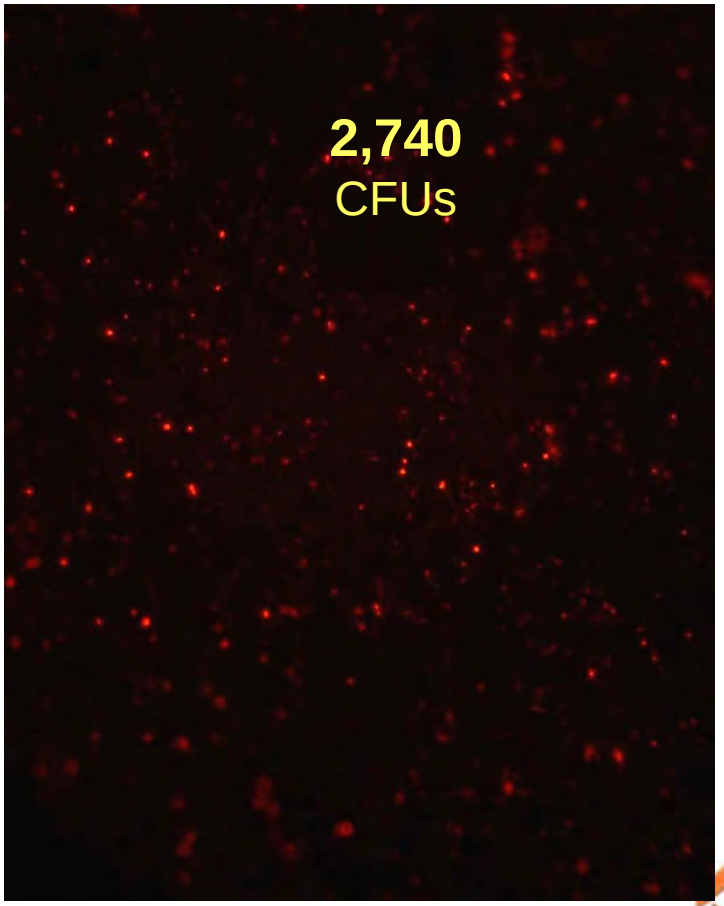
E. Coli O157:H7

Time
60 minutes

Stainless Steel



Copper



Epifluorescence Images after Staining with Viability Fluorophore CTC

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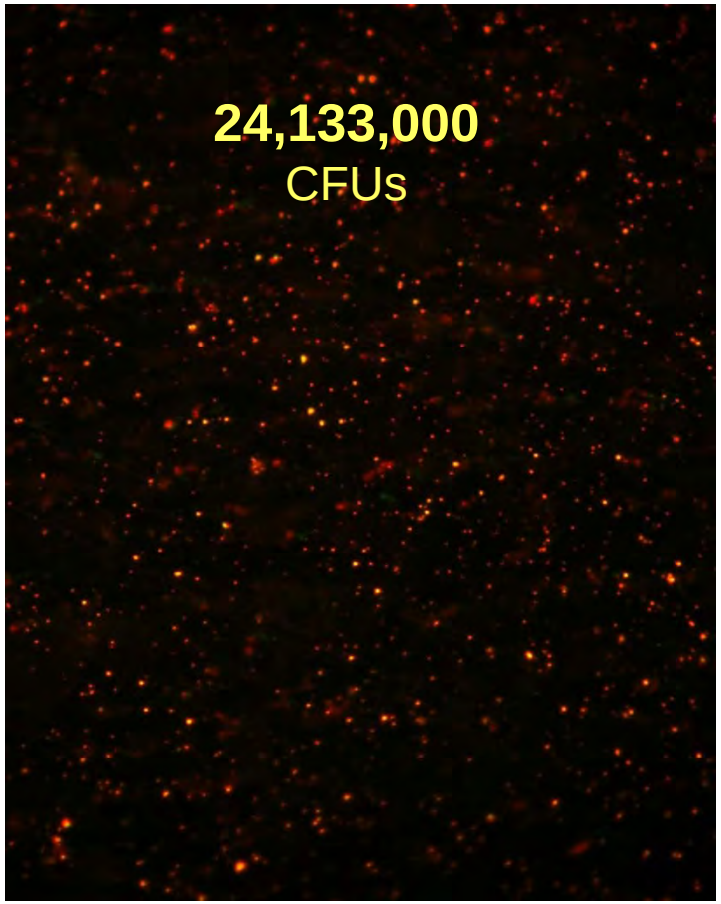
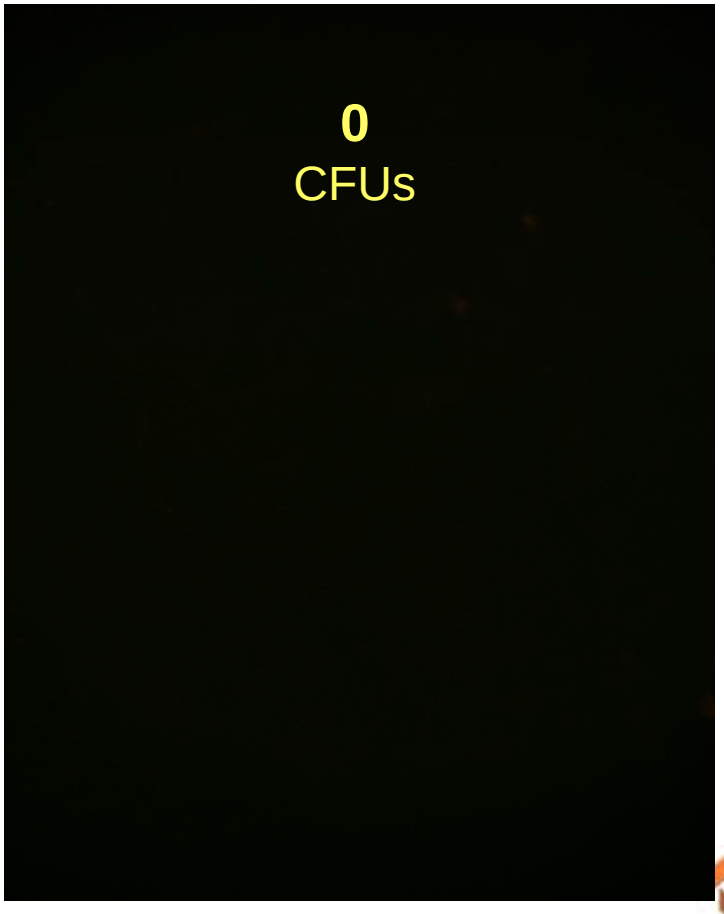
E. Coli O157:H7

Time
90 minutes

Stainless Steel



Copper



Epifluorescence Images after Staining with Viability Fluorophore CTC

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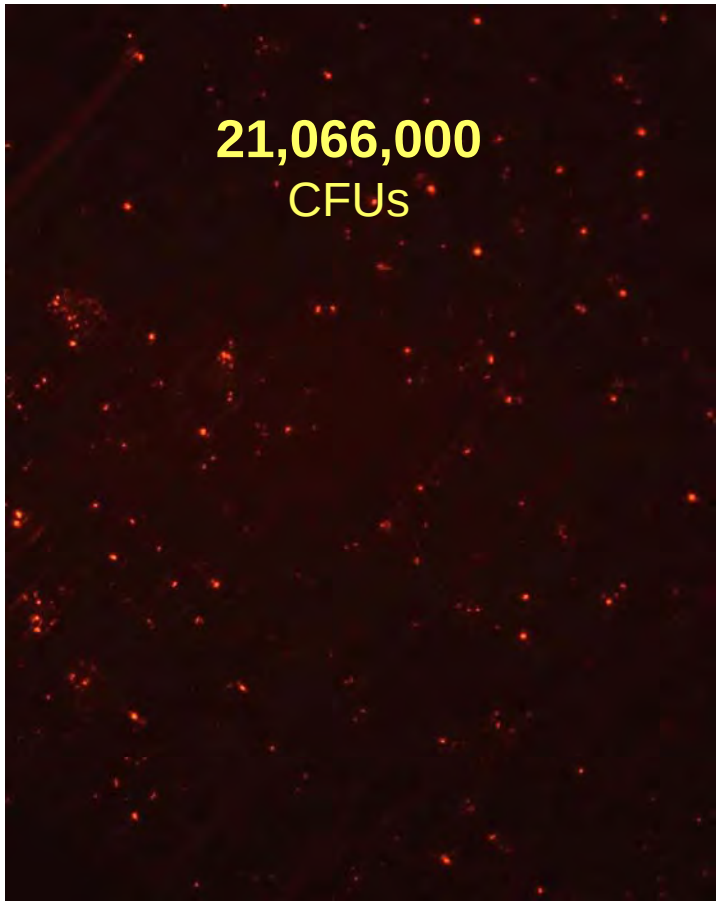
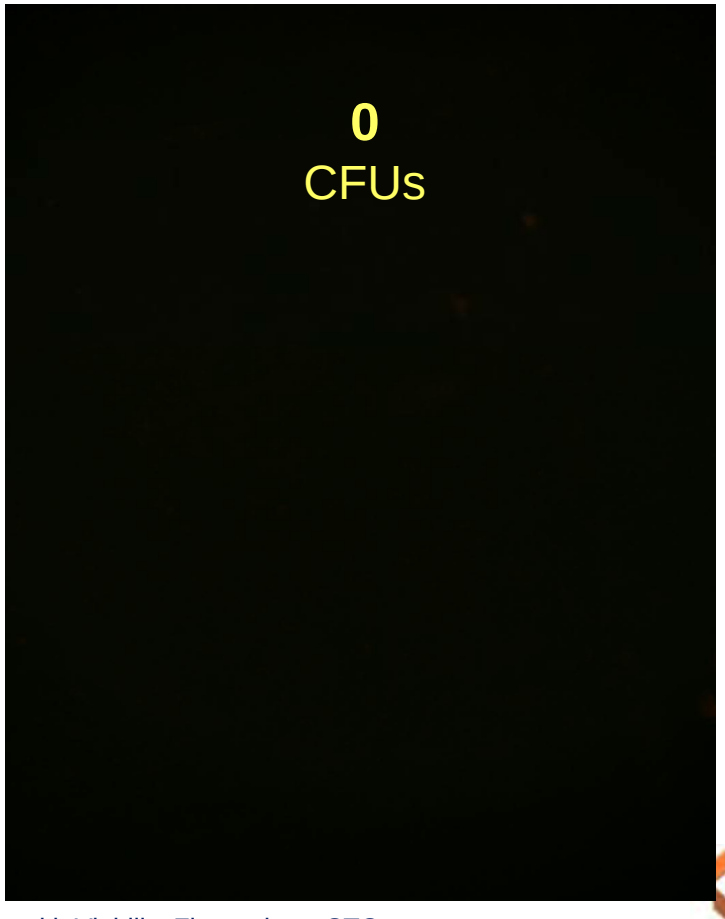
E. Coli O157:H7

Time
120 minutes

Stainless Steel



Copper



Epifluorescence Images after Staining with Viability Fluorophore CTC

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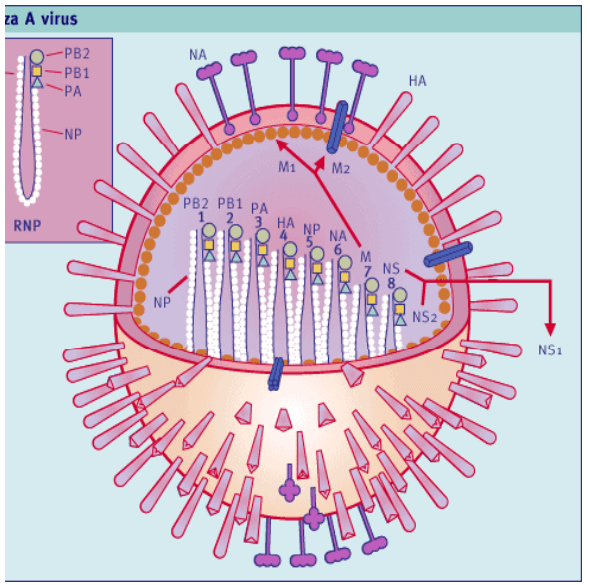
Viruses

Influenza A



- Approximately 25 % of the U.S. population gets ill from this virus annually

- The U.S. Centers for Disease Control estimates that this virus affects 35 to 50 million people per year, leading to 20,000 to 40,000 deaths

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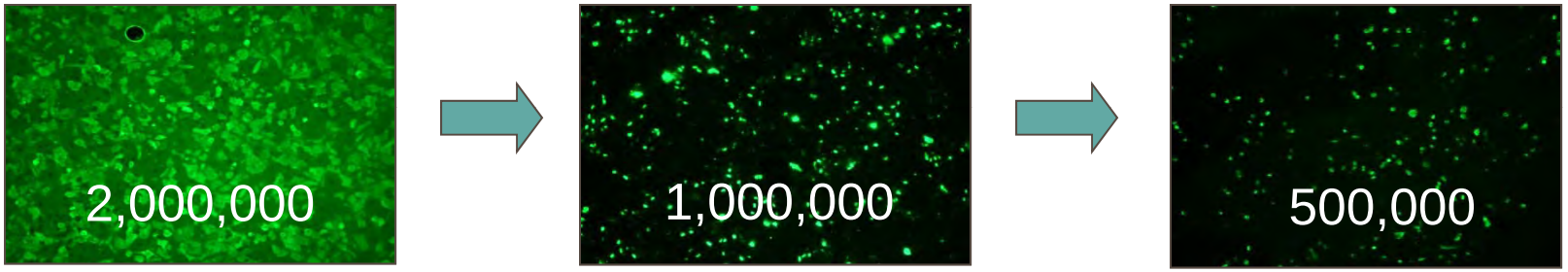
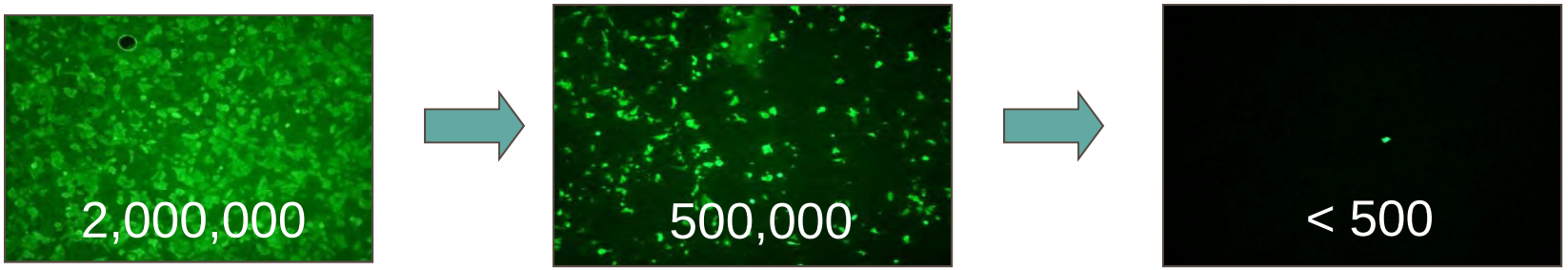
Influenza A

Stainless Steel Samples: 6 hours



Copper (C110) Samples: 6 hours



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Fungi

Aspergillus niger

- Pathogenic fungi often found on moist HVAC components

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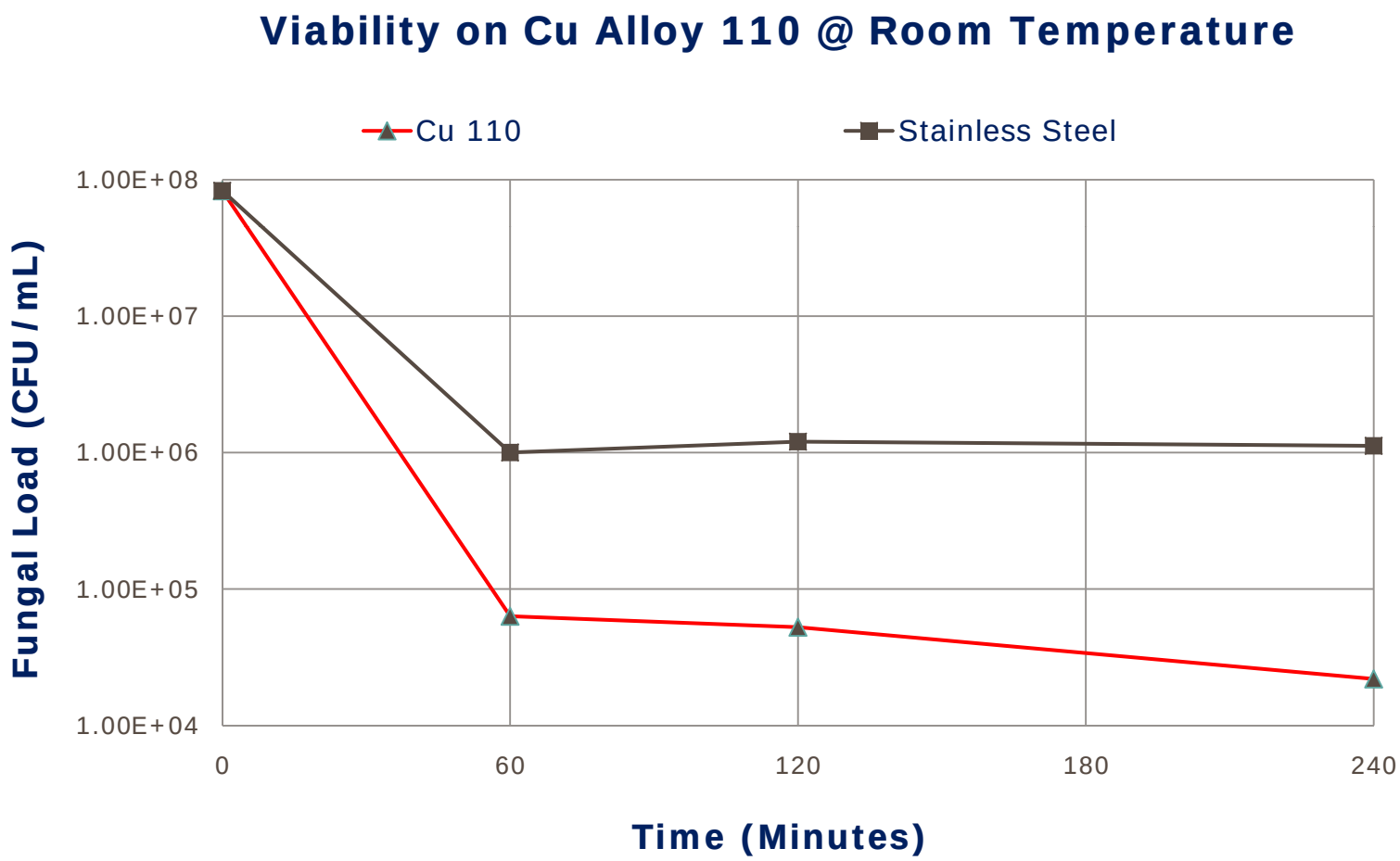
Aspergillus Niger



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C. diff

Clostridium difficile

- Deadly gram positive bacteria, highly resilient and antibiotic resistant

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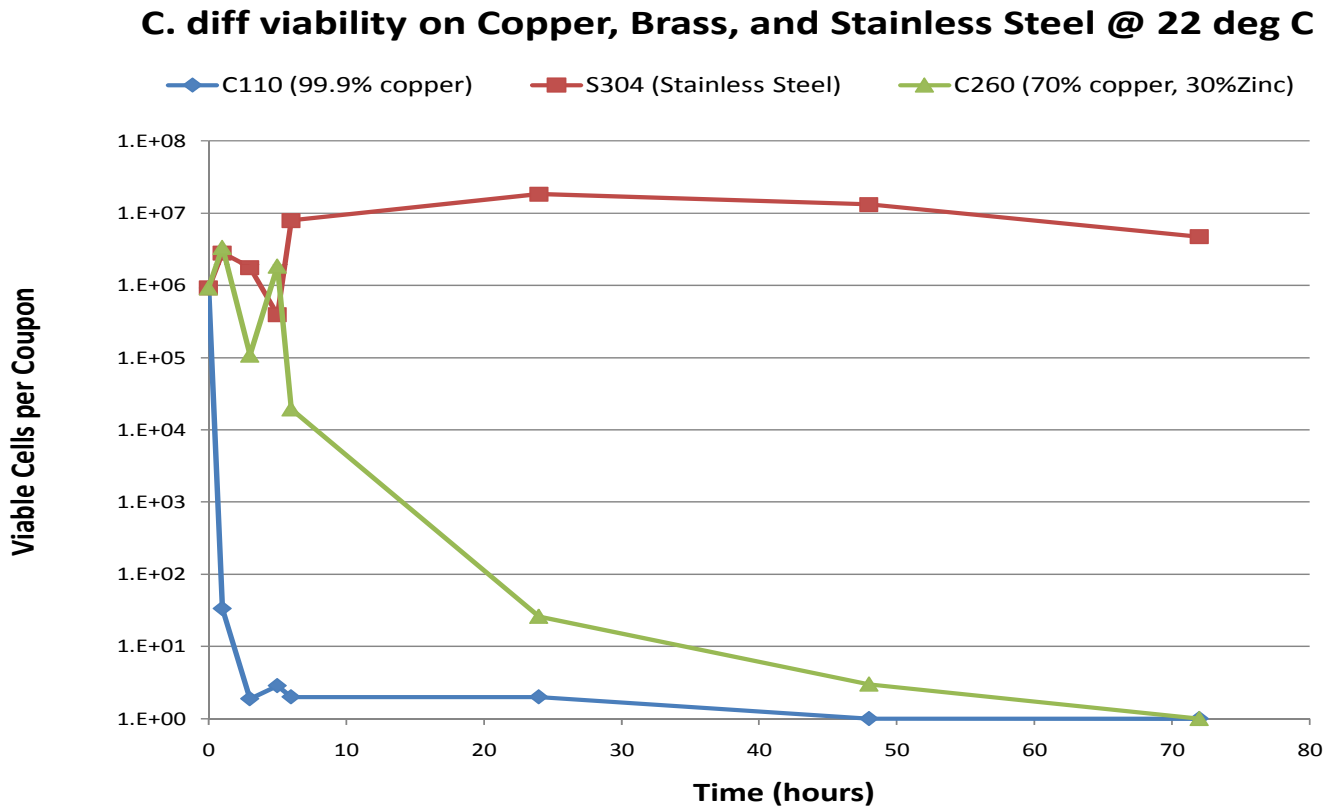
C. diff



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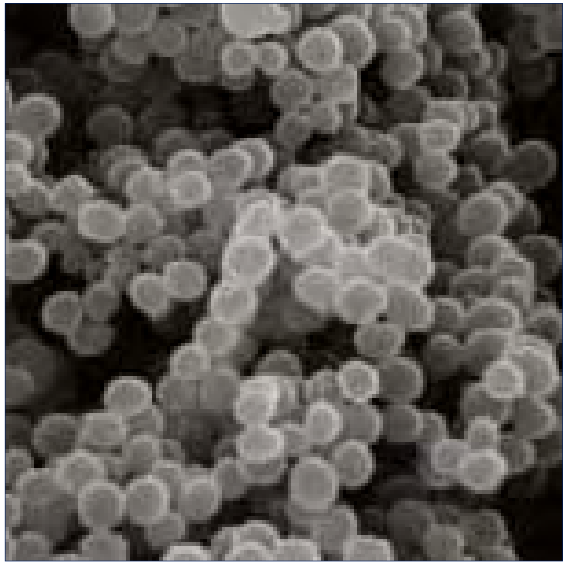
Bacteria

MRSA: Methicillin-resistant staphylococcus aureus

- An Antibiotic-resistant "Superbug"
- One of the most serious and widespread hospital-acquired infections



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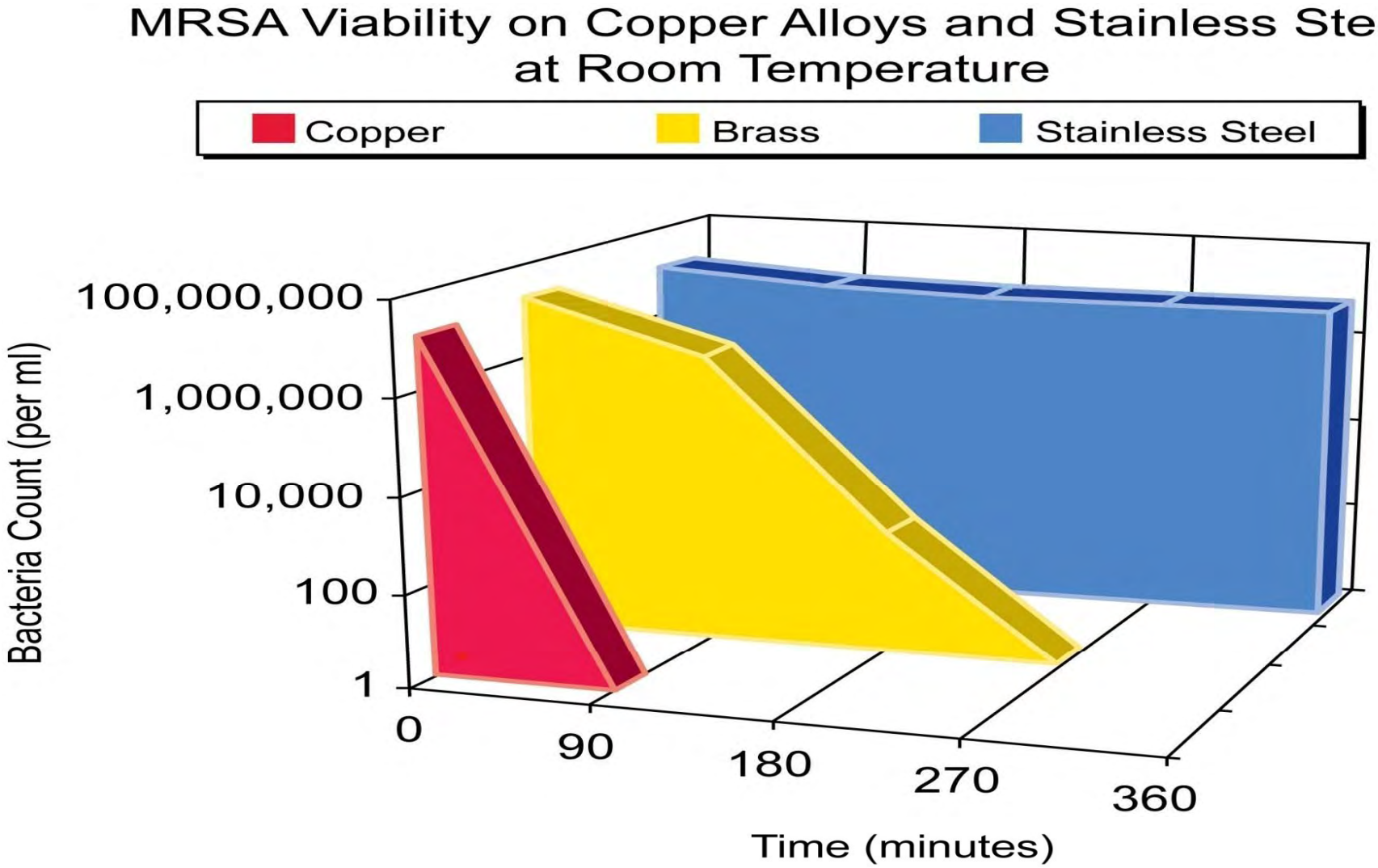
Antimicrobial - studies show:



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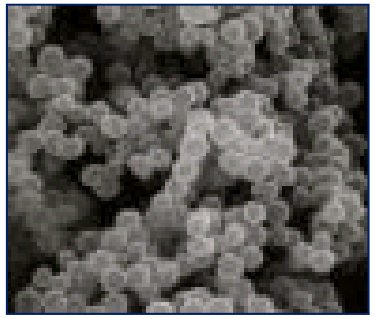
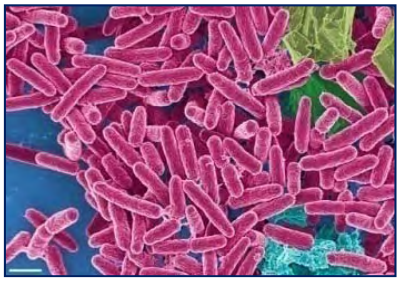
Evidence-Based Design



- *Staphylococcus aureus*
- *Enterobacter aerogenes*
- *Escherichia coli* O157:H7
- *Pseudomonas aeruginosa*
- Methicillin-Resistant *Staphylococcus aureus* (MRSA)



<u>Tested copper alloys killed >99.9% within 2 hrs</u>

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Peer-Reviewed & Published

Metal Ions in Biology and Medicine: Vol. 10.Eds Ph. Collery, I. Maymard, T. Theophanides, L. Khassanova, T. Collery. John Libbey Eurotext, Paris © 2008 pp 185-190

Antimicrobial regulatory efficacy testing of solid copper alloy surfaces in the USA

Harold T. Michels* and Douglas G. Anderson**

*Copper Development Association Inc., 260 Madison Avenue, New York, NY 10016, USA, hmichels@cda.copper.org

**ATS-Labs, 1285 Corporate Center Drive, Eagan, MN 55121, USA

Journal of Hospital Infection (2006) 63, 289–297

Available online at www.sciencedirect.com

SCIENCE DIRECT

ELSEVIER

www.elsevierhealth.com/journals/jhin

Potential use of copper surfaces to reduce survival of epidemic meticillin-resistant *Staphylococcus aureus* in the healthcare environment

J.O. Noyce [a,*], H. Michels [b], C.W. Keevil [a]

[a] Environmental Healthcare Unit, University of Southampton, Southampton, UK
[b] Copper Development Association Inc., New York, NY, USA

Received 25 April 2005; accepted 6 December 2005
Available online 2 May 2006

Available online at www.sciencedirect.com

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INTERNATIONAL JOURNAL OF Food Microbiology

ational Journal of Food Microbiology 105 (2005) 445–454

www.elsevier.com/locate/ijfoodmicro

l of *Escherichia coli* O157 on a range of metal surfaces

A. Wilks [a,*], H. Michels [b], C.W. Keevil [a]

e Unit, School of Biological Sciences, University of Southampton, Bassett Crescent East, Southampton, SO16 7PX UK
elopment Association Inc., 260 Madison Avenue, New York, NY 10016, USA

eptember 2004; received in revised form 22 January 2005; accepted 11 April 2005

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EPA Registration

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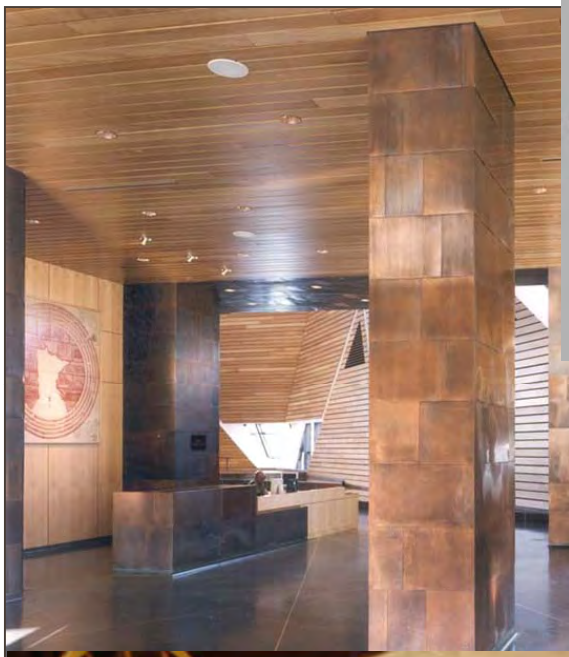
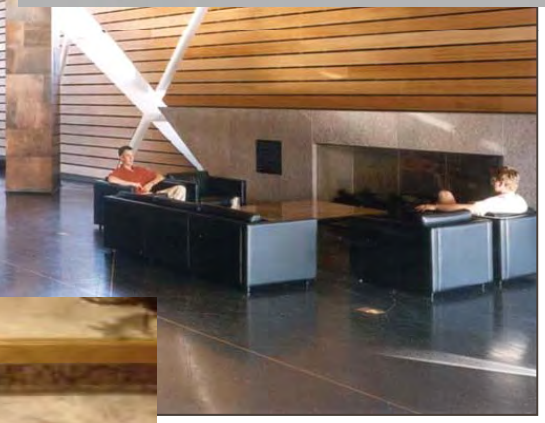
Antimicrobial – EPA Registration

NEW YORK—The U.S. Environmental Protection Agency (EPA) has approved the registration of antimicrobial copper alloys, with public health claims. These public health claims acknowledge that copper, brass and bronze are capable of killing 5 specific, harmful, potentially deadly bacteria. Copper, a solid surface material received this type of EPA registration, which is supported by extensive antimicrobial efficacy testing. February 29, 2008





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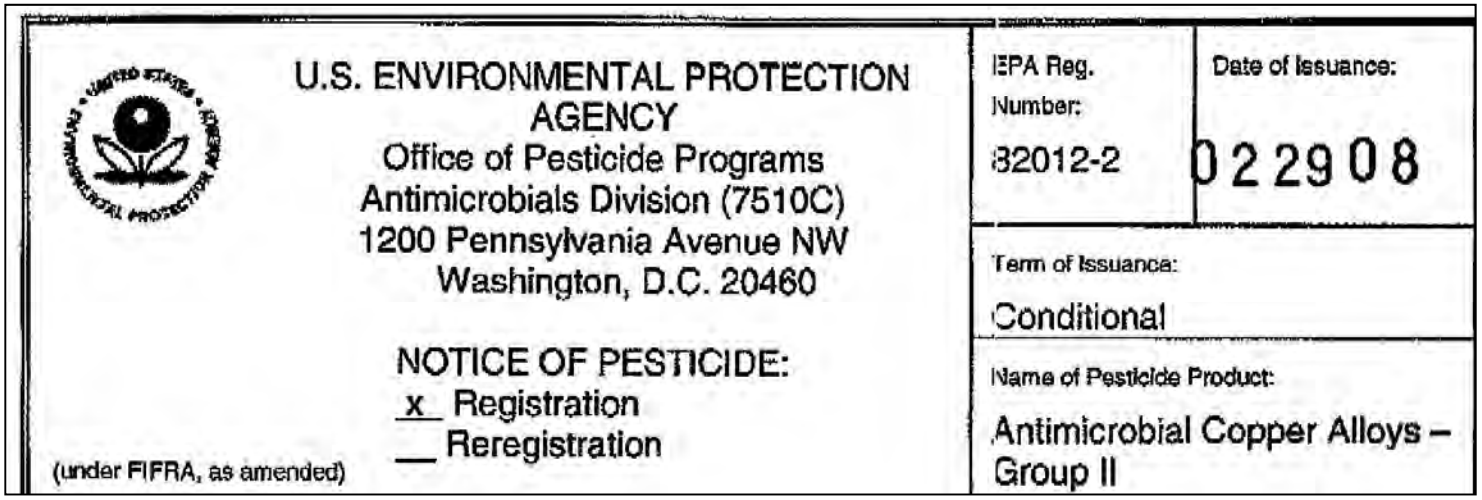
Results

- CDA registers copper alloys with U.S. EPA
  - 281 alloys
  - Public health claims
  - Help protect the public from disease-causing bacteria



U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Pesticide Programs
Antimicrobials Division (7510C)
1200 Pennsylvania Avenue NW
Washington, D.C. 20460

NOTICE OF PESTICIDE:
x Registration
__ Reregistration
(under FIFRA, as amended)

EPA Reg. Number: 32012-2

Date of Issuance: 022908

Term of Issuance: Conditional

Name of Pesticide Product: Antimicrobial Copper Alloys – Group II

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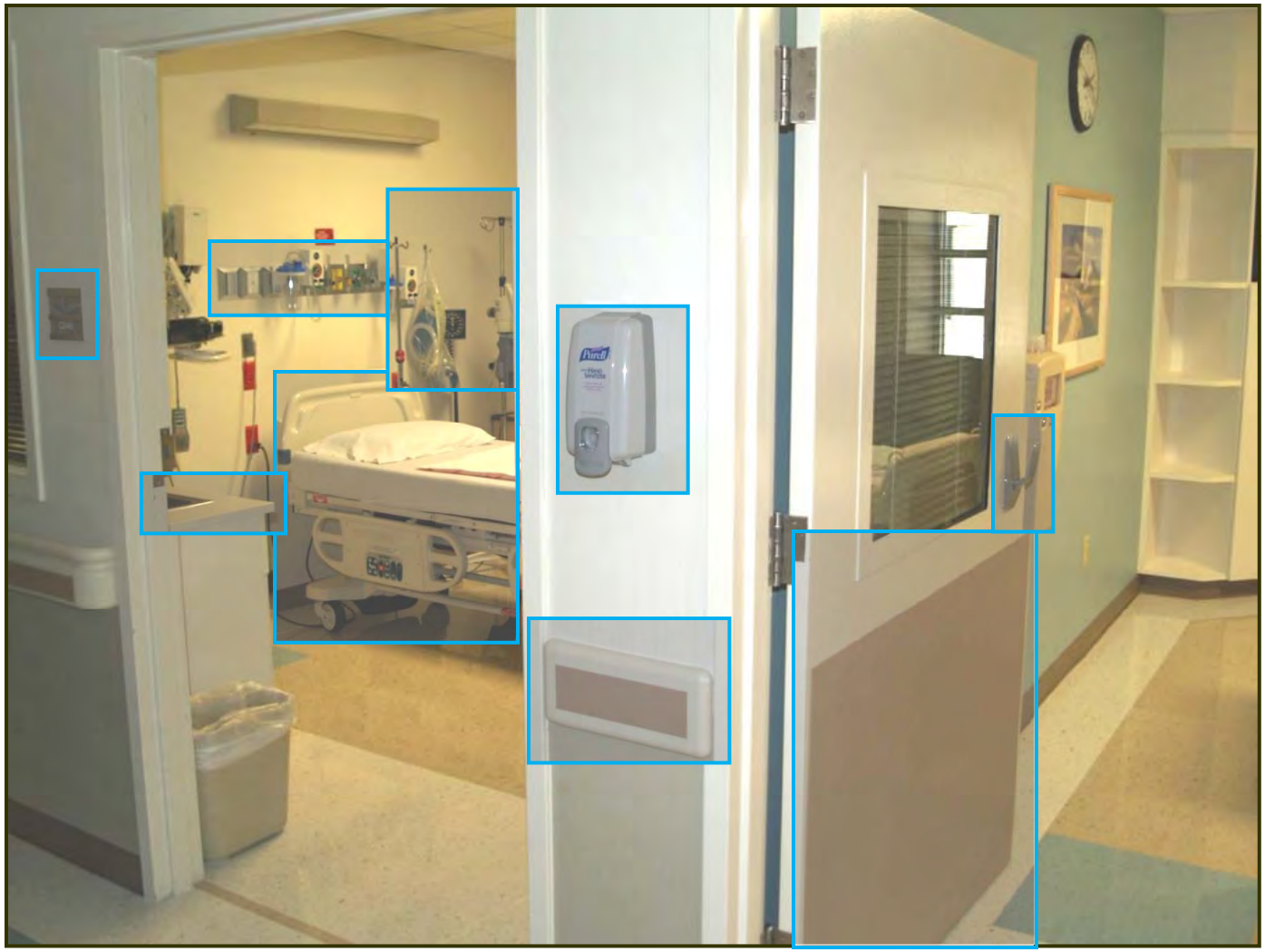
Antimicrobial - Applications



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Antimicrobial - Applications

Commercial Bronze	Cartridge Brass	Silicon Bronze	C72500	Copper	Red Brass	Naval Brass	Copper Niclel	Nickel Silver
90% Copper	70% Copper	97% Copper	88% Copper	99.9% Copper	85% Copper	60% Copper	87% Copper	65% Copper

Key Points

- Copper is inherently antimicrobial and it kills harmful bacteria
  - Can't be coated, must be cleaned
- 281 copper alloys are registered with the EPA
  - Public health claims against 5 disease causing bacteria
- Copper's antimicrobial effectiveness will never wear off over time

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Let’s Talk Energy Efficiency & Motors

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NY experience

- NYSERDA Motor Program Audits
  - Conducted 78 motor audits of small to medium Industrial facilities
  - 7,995 motors were inventoried (85% not NEMA Premium)
  - 4,128 motors (51%) meet end-user payback requirements for replacing with NEMA Premium at failure
  - 950 motors (11%) meet end-user requirements for immediate replacement with NEMA Premium
  - Identified potential savings of 7.9 gWh and 1.0 mW
  - Opportunity - Work with management to amend purchasing policy

(Courtesy APT)

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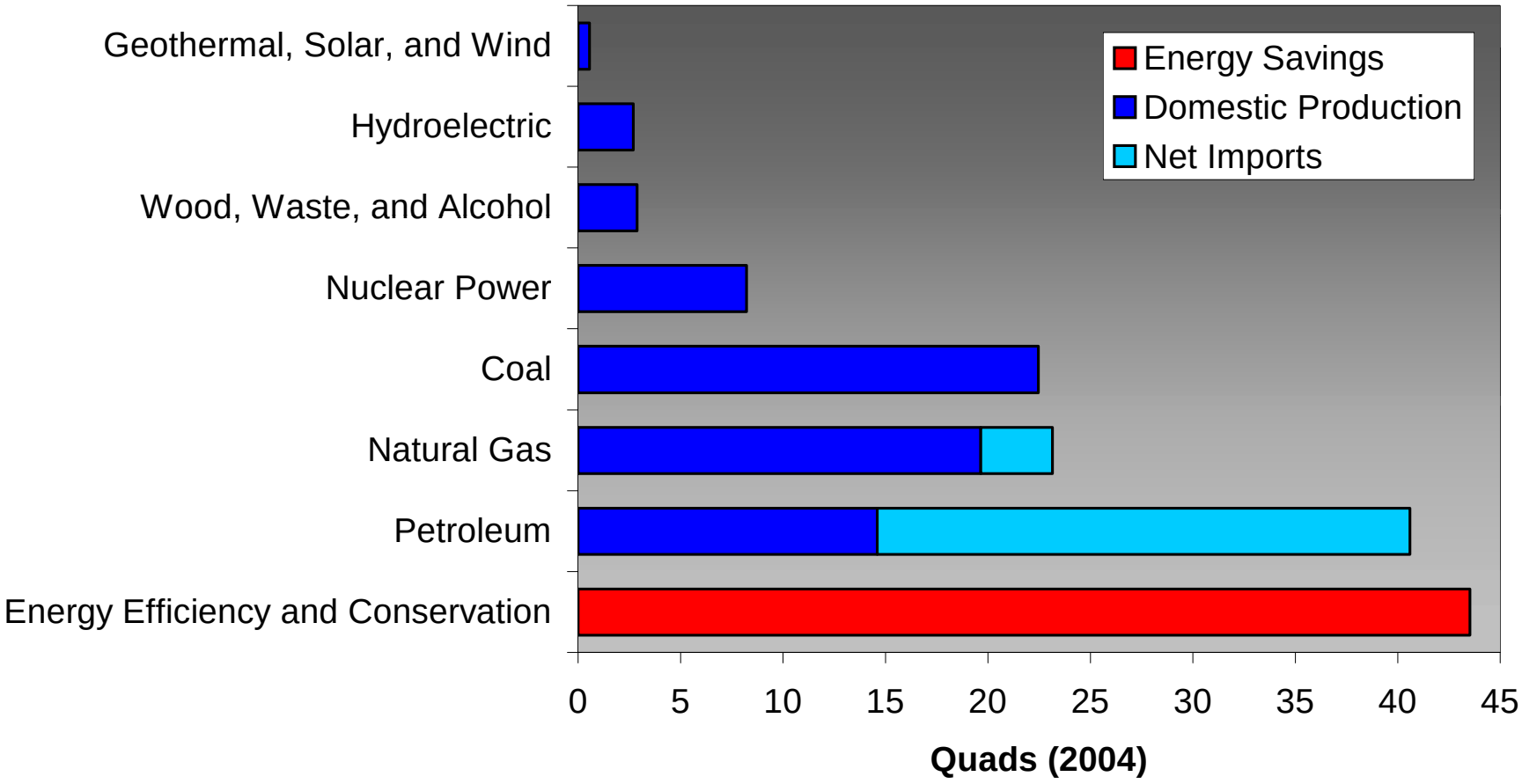
Efficiency: America's 1st Energy Resource



Source: Neal Elliott, PhD. ACEE

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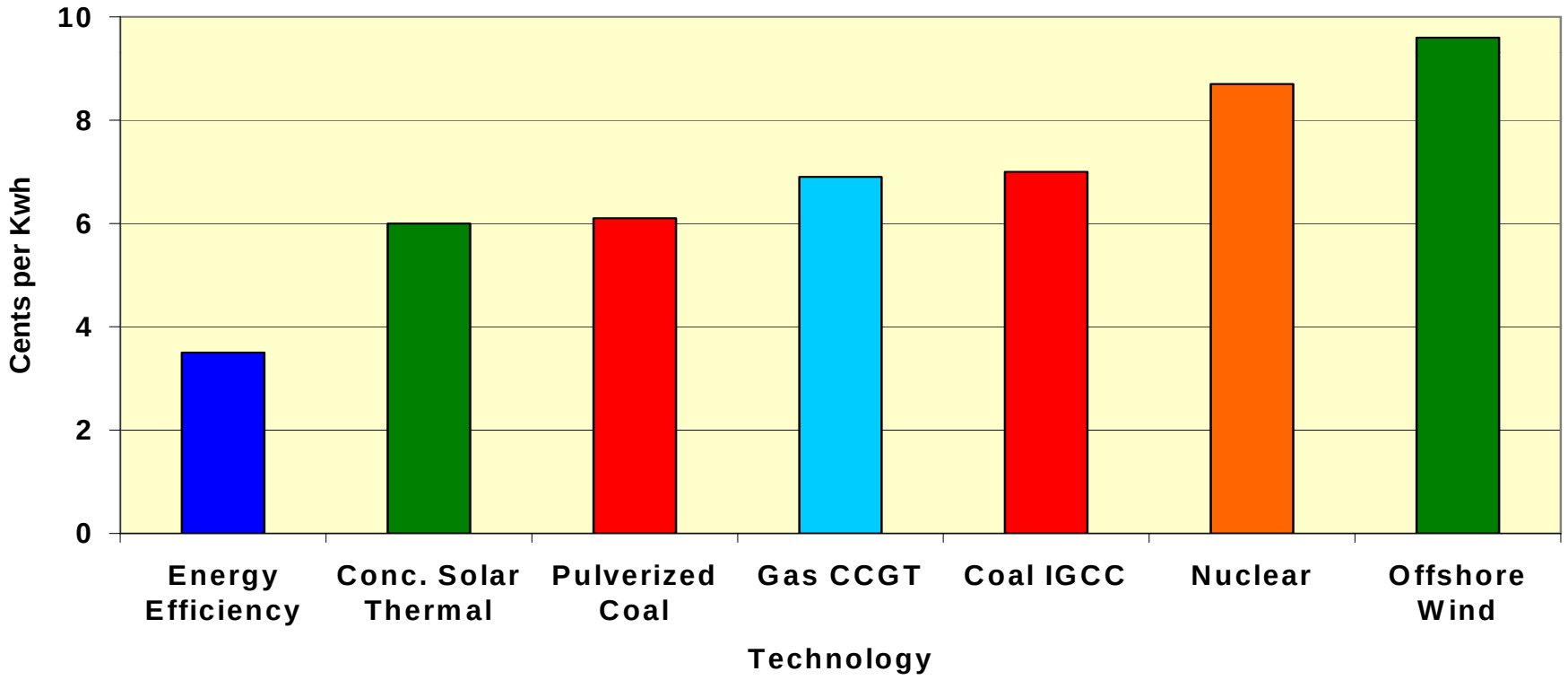
Cost of Electricity Resources



Source: Neal Elliott, PhD., ACEEE 2006, EPRI 2006

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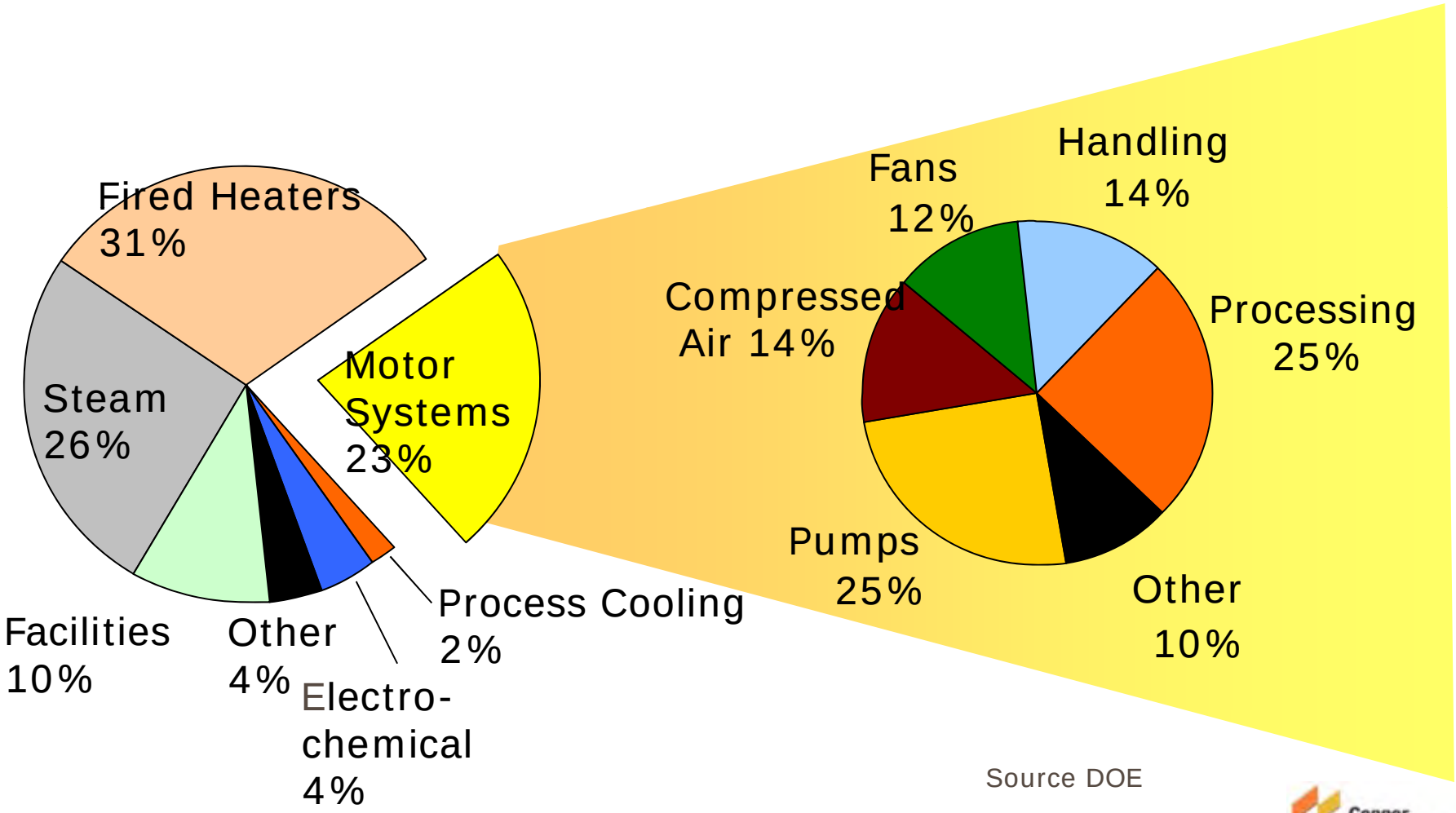
Manufacturing & Mining Energy Use



Source DOE

Includes electricity generation/distribution/transmission losses

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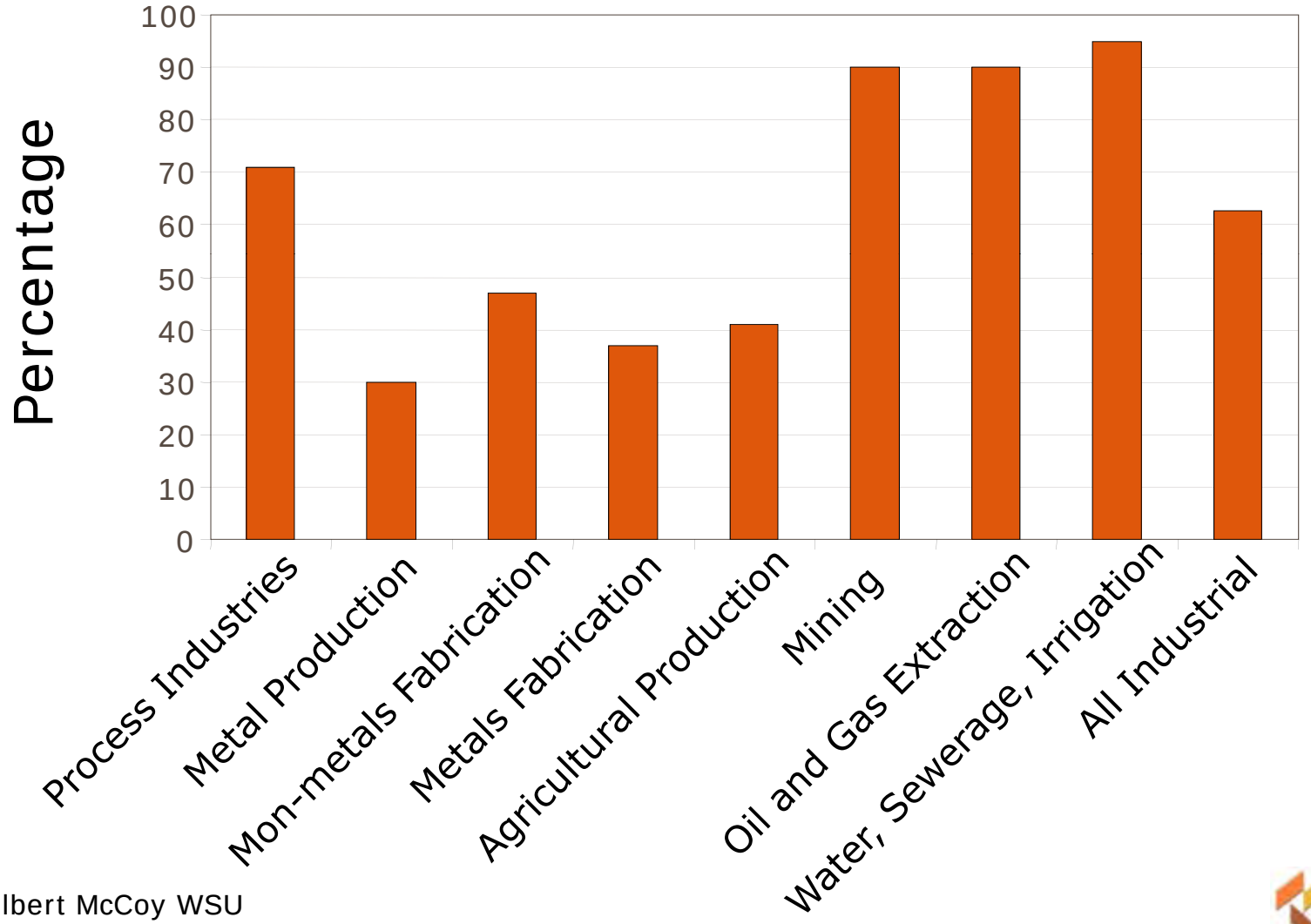
Percent of Electric Energy Driving Motors



Source: Gilbert McCoy WSU

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Why motors matter

- To an industrial facility
  - Motors represent a major investment
  - To Purchase (Capital cost)
  - To run (Operating cost)
  - At failure (Downtime, lost productivity

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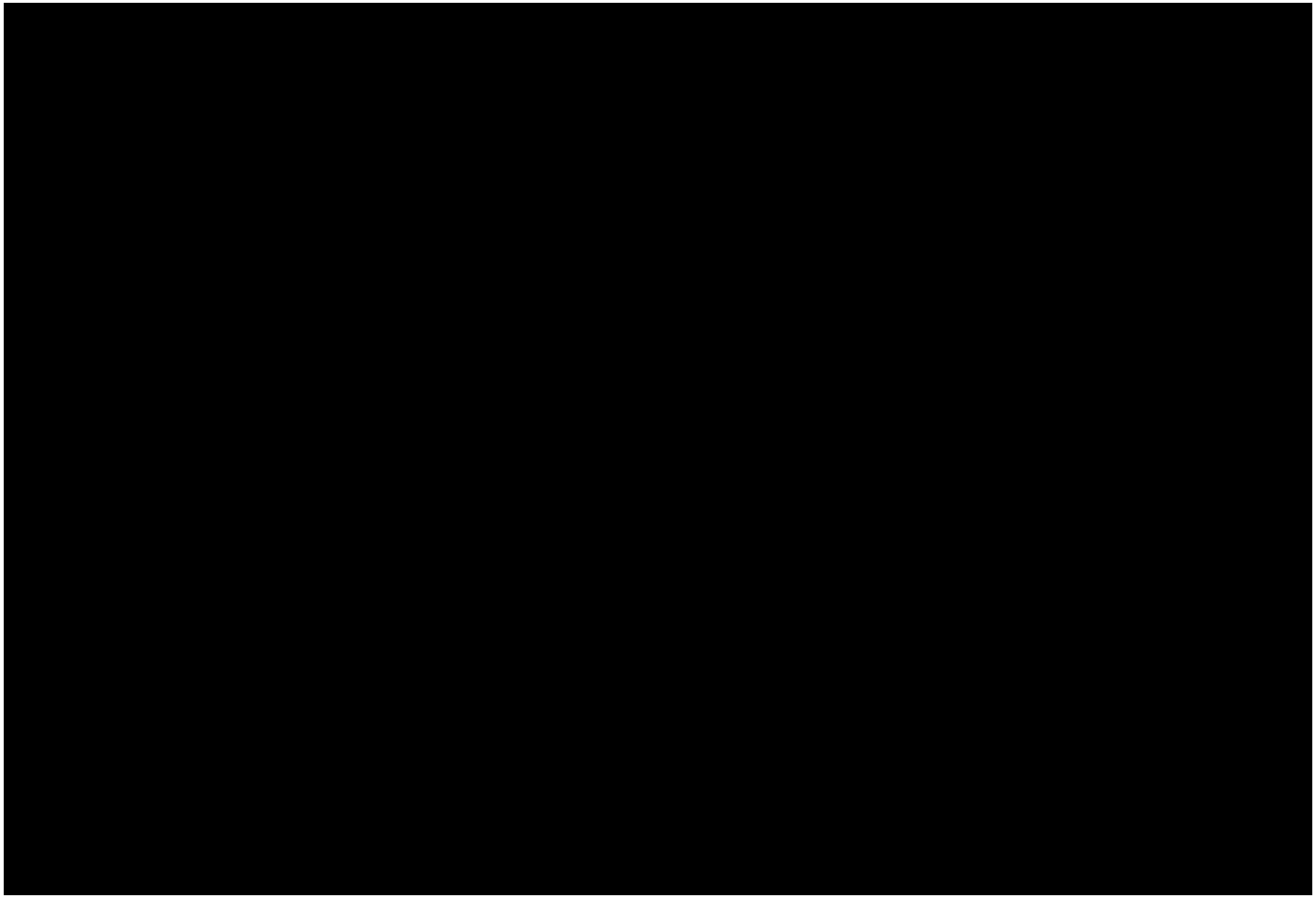
Why motors matter



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Motor background

- US – 1.8 Million 3-phase, 1-200 HP motors are sold each year.

These motors consume 679 ***Billion*** kWh/yr

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Motor background: continued

- HVAC motors can account for 30 to 50% of commercial energy use
- And motors can account for up to 65% of Industrial energy use…..
- A 1% efficiency gain =
  - …6.7 Tera Watt hours saved
  - …$670 Million Dollars annually in electric costs saved
  - …the elimination of 80 million tons of carbon emissions
  - …The equivalent of over 13 million barrels of oil.

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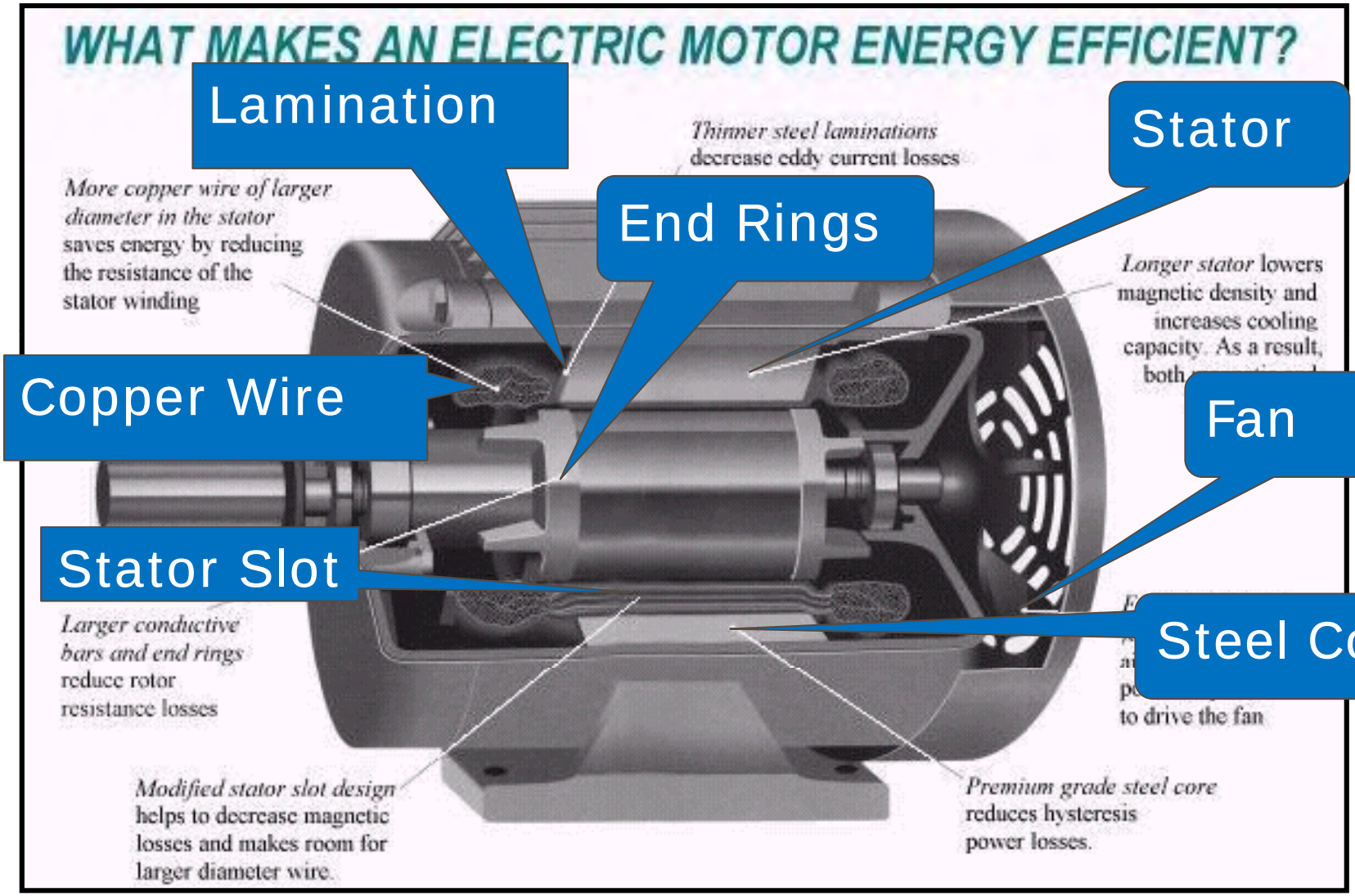
Key ingredients



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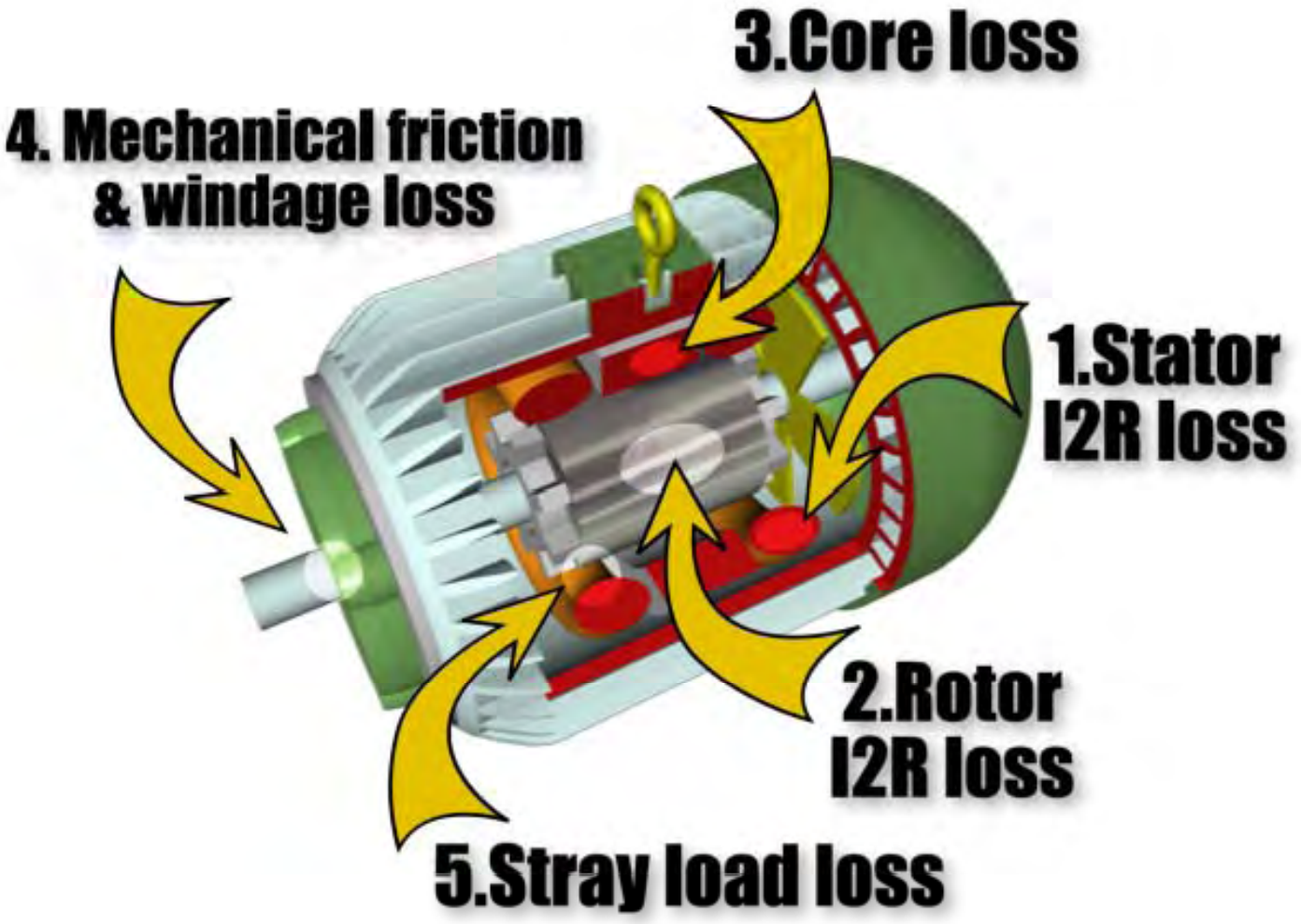
Motor Heat Losses



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Motor Heat Losses

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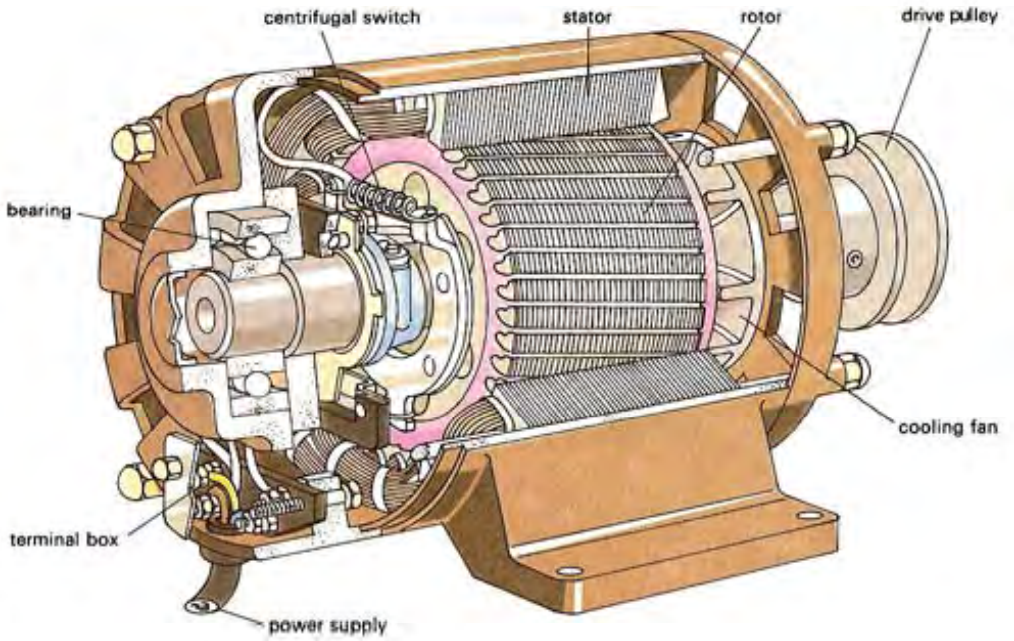
Motor Efficiency Standards

- Standard Efficient
- EPAct 92
- NEMA Premium
- Above NEMA Premium



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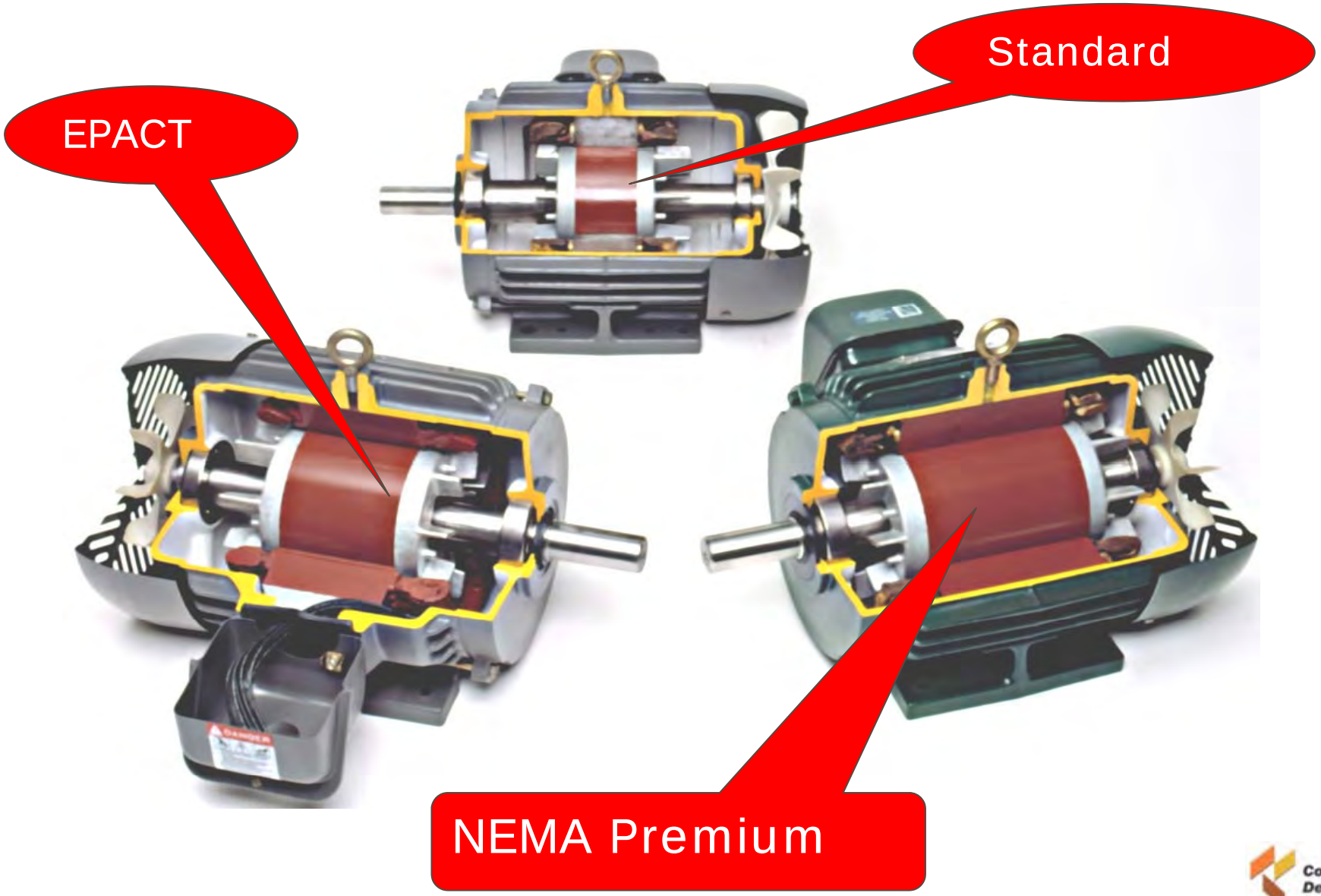
How they are made: amount of copper, size of rotor



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Background: EPAct motors

- Energy Policy Act of 1992
- General purpose
- 1-200 HP
- 3 phase (220/460/575 volt)
- NEMA design “A” & “B”
- ODP & TEFC
- 1200, 1800, 3600 RPM

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NEMA Premium

- Standard for premium efficient motors adopted by manufacturers
- .5 to 4% more efficient than EPAct
- Run cooler
- Extended warranties
- Claims of reduced downtime and increased reliability
- Simple payback
- **Less expensive to operate**

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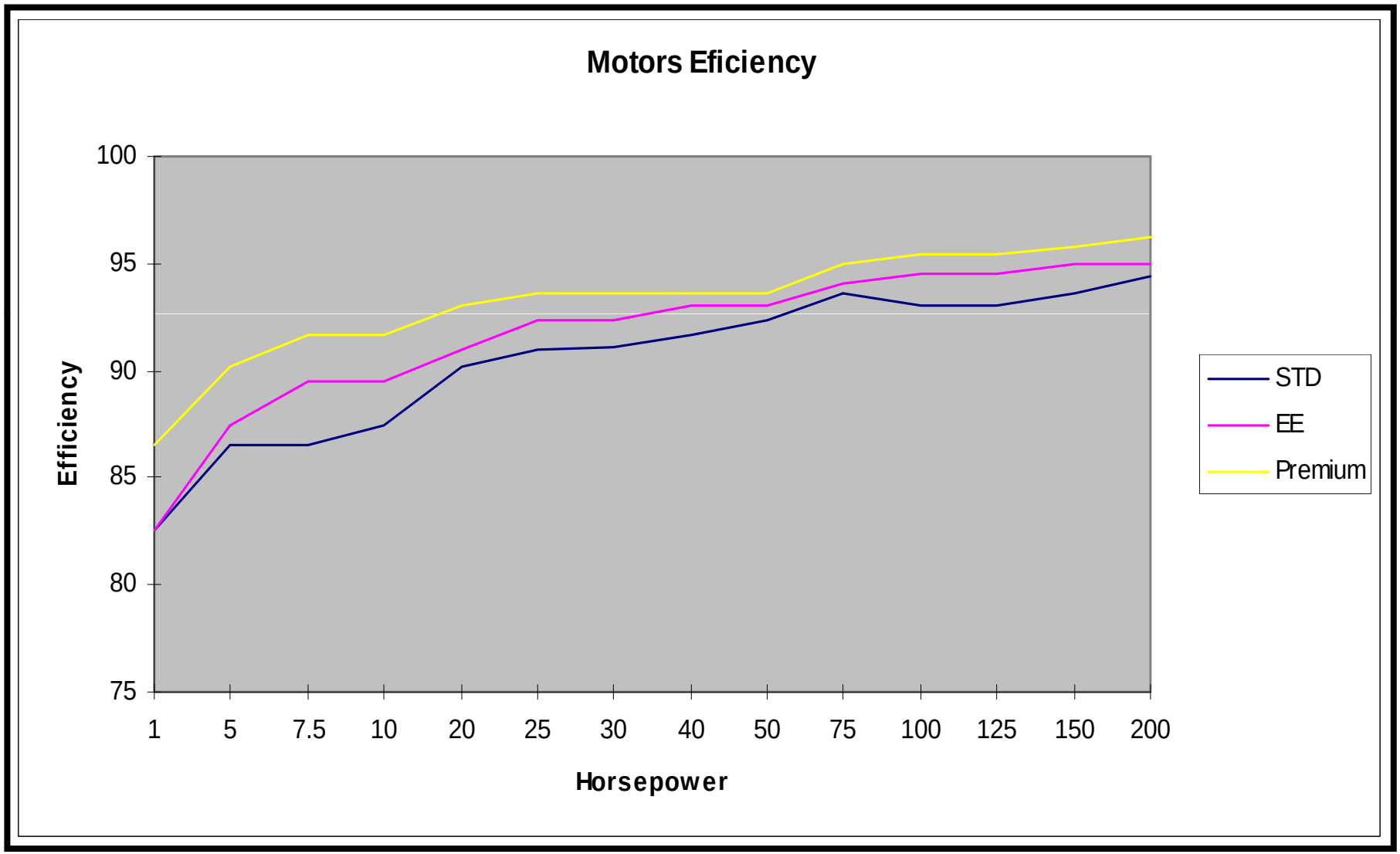
Three levels of efficiency



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Are DOE standards sufficient?

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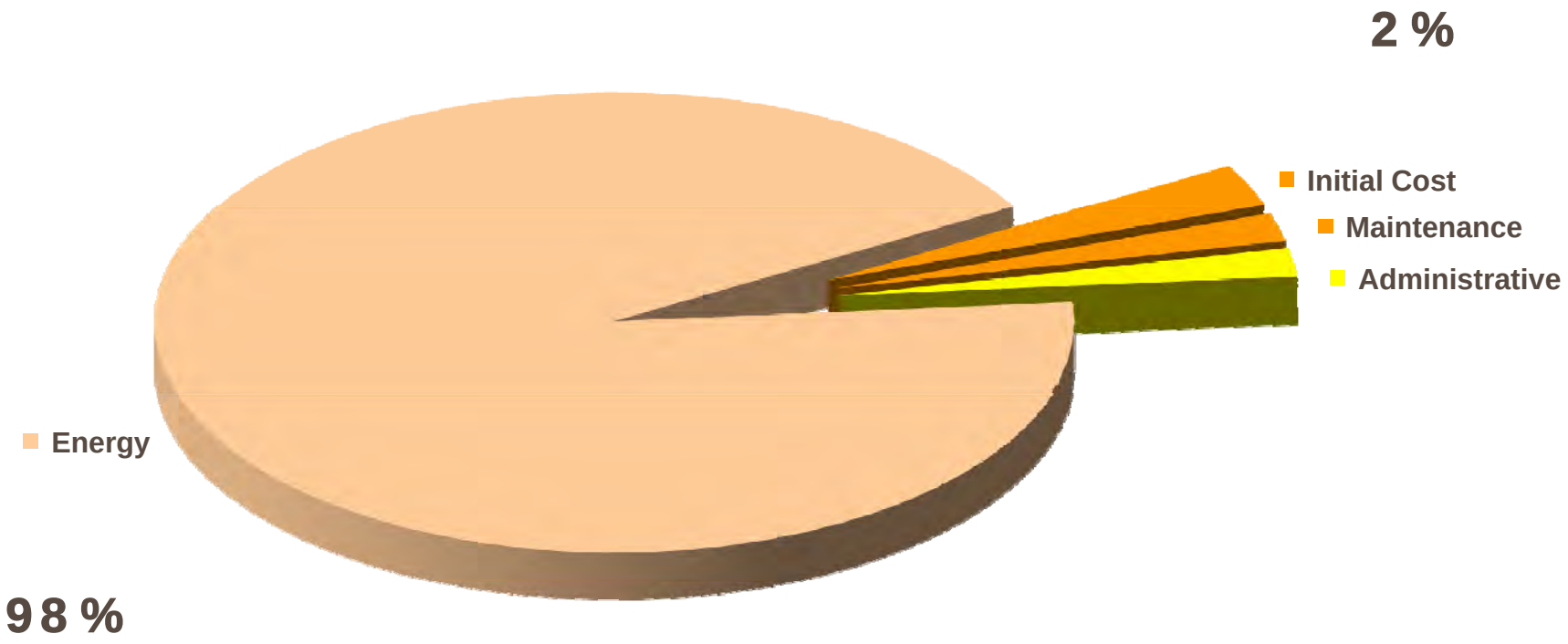
Did you know



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Thus.....

- If the purchase price of a motor represents 2% of the cost of ownership
- And the operating cost represents 98%
- The question that needs to be addressed...

Which is more important to control?

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If you had to guess…

- How much does it cost to run a 40 HP EPAct efficient motor

- Assume 8760 hours/year at $0.10 kWh

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Answer

- Just shy of $20,000.00

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Thus:

- If a motor cost less than $2,000.00 to purchase
- And you pay 10 times its cost to run it each year

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Compare that to

You owning a car that cost $400,000 to purchase but……..

Cost you over $4,000,000 a year to operate?

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It's not about first cost

- If a 100 HP TEFC EPACT motor costs ~ $6,300.00
  - It costs ~$38,985 to operate per year!

(or 623% of first cost)

@ $.054/kWh & $4.87/kW, 8150 hrs/yr, 100% load

Now consider a car: First cost ~ $25,000

At $3.00/gal, annual fuel costs are about $2,500 or 10% of the purchase price of the vehicle driving 20,000 miles/year @ 24 mpg

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Equivalent rate of use

- If a car used energy at the same ratio of first cost to annual operating cost as a motor:
  - ---It would have to be driven about 216,375 miles every two months or
  - ---Gasoline would have to be priced at $311.58/gal

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Life Cycle Cost Analysis

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If you remember one thing, remember this:

- It is not about first cost
- It's about life cycle cost

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Energy efficient motors

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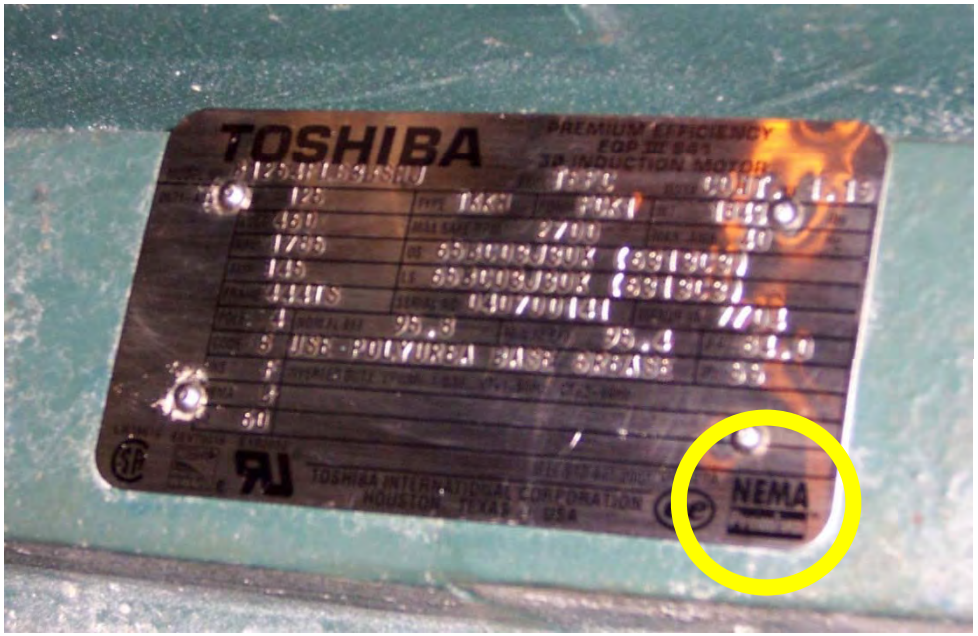
Motors: How do we find efficient motors

- NEMA premium label where it appears



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Are you aware…

- The NEMA label is voluntary

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Motors: How do we find efficient motors

- NEMA premium label where it appears
- MotorMaster+ software

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Motors: How do we find efficient motors

- NEMA premium label where it appears
- MotorMaster+ software
- Manufacturer's literature
- Many available motors exceed NEMA premium efficiencies

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Caveat:

- Premium efficient motors have:
  - Different speed
  - Starting torque
  - Starting current characteristics

- All engineering parameters must be taken into account when considering motor replacement

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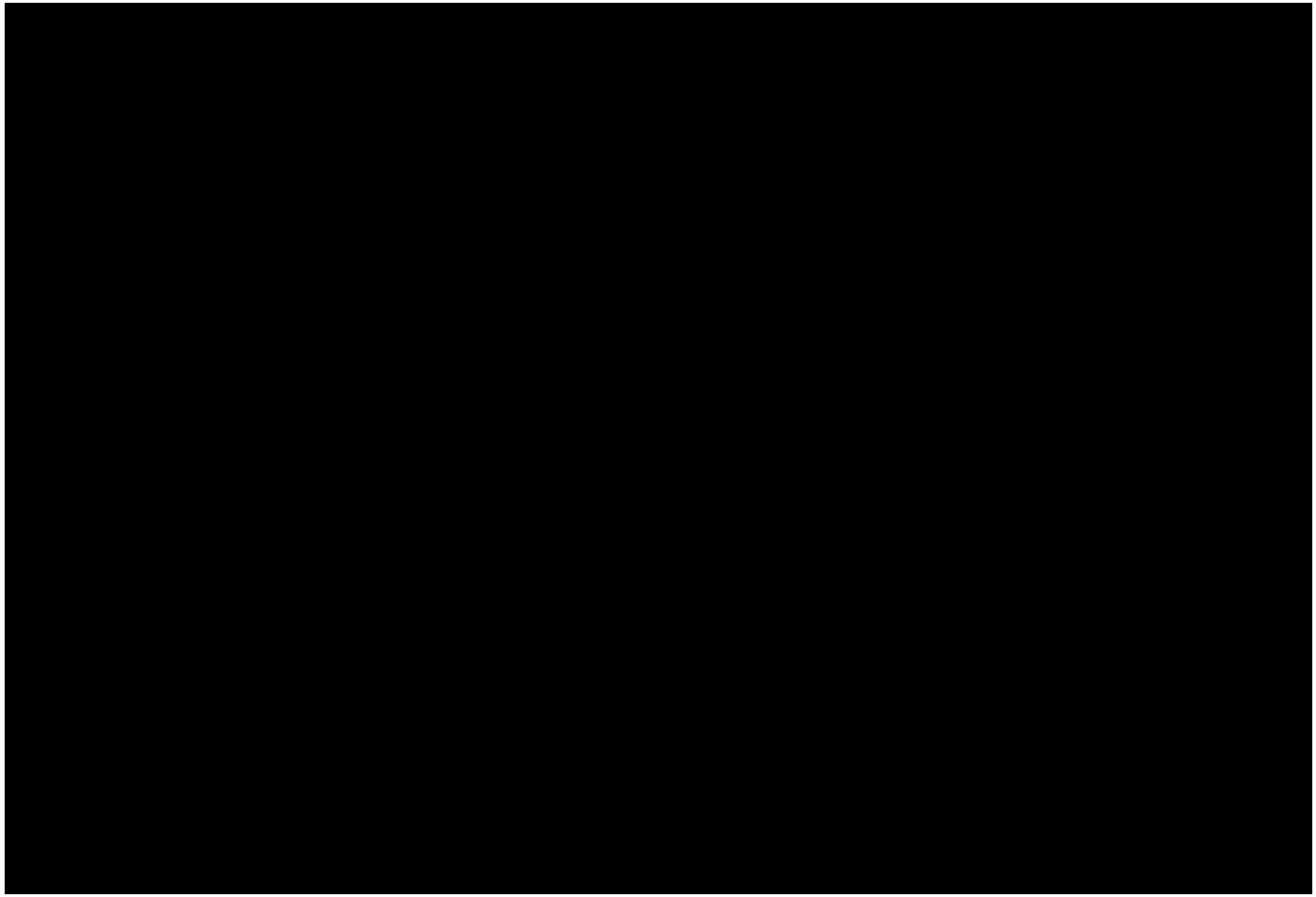
Caveat



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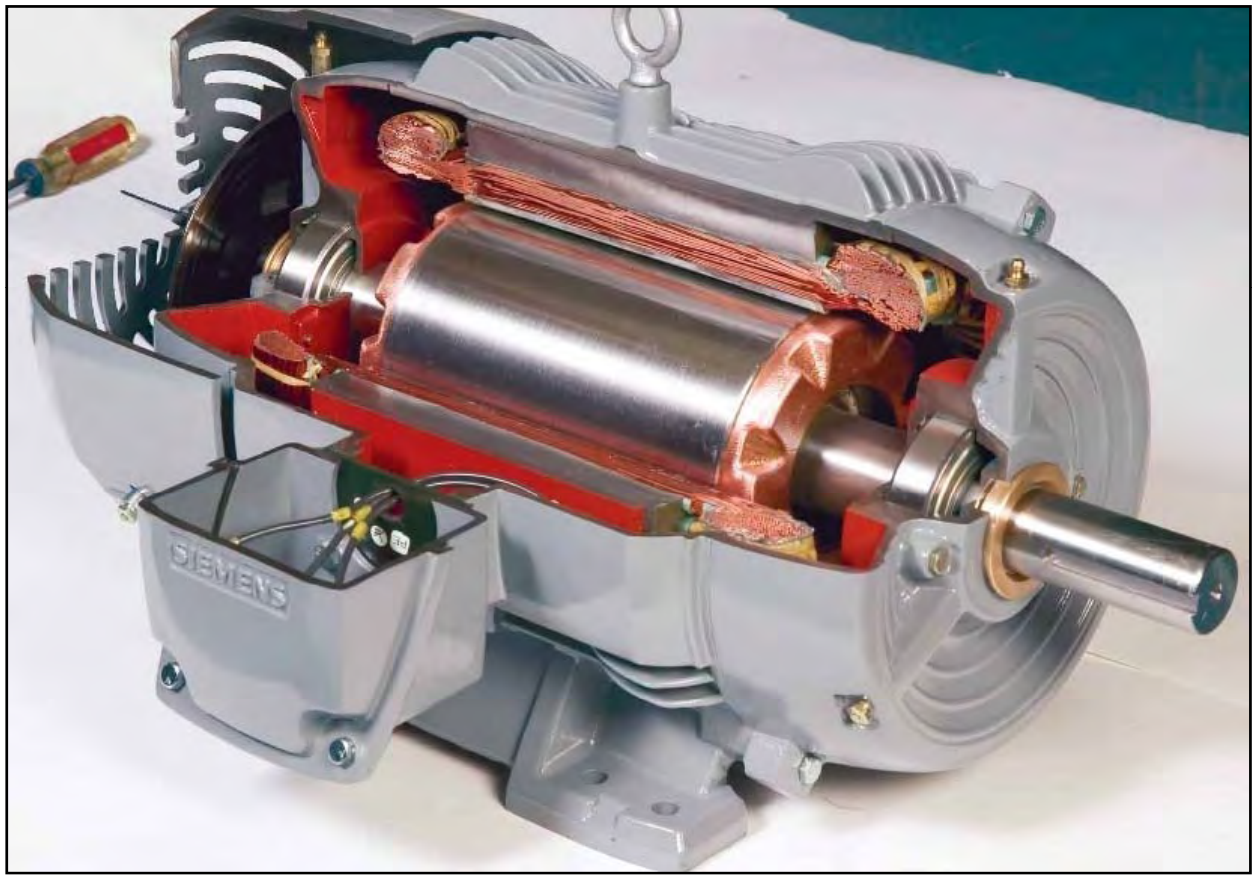
The cast copper rotor motor



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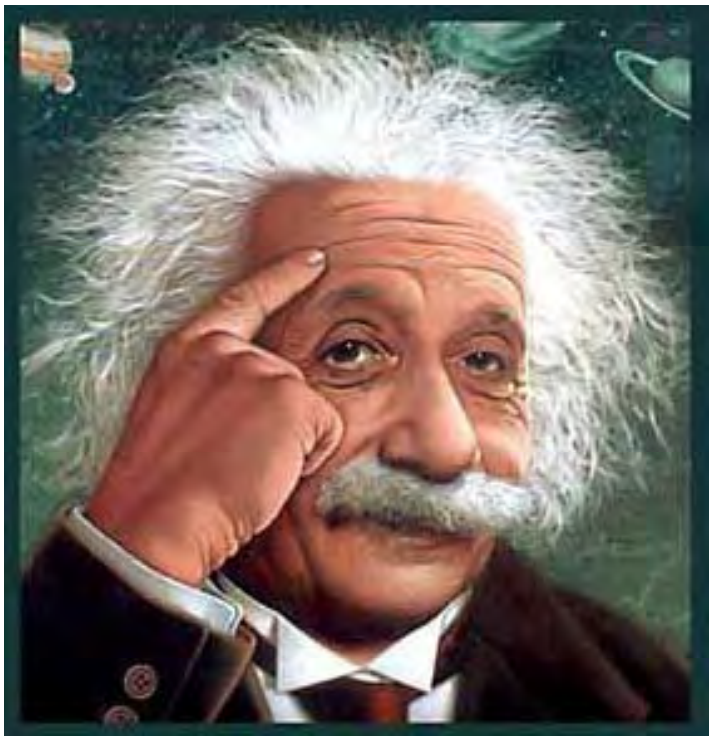
In our design

- Everything should be made as simple as possible, but not simpler



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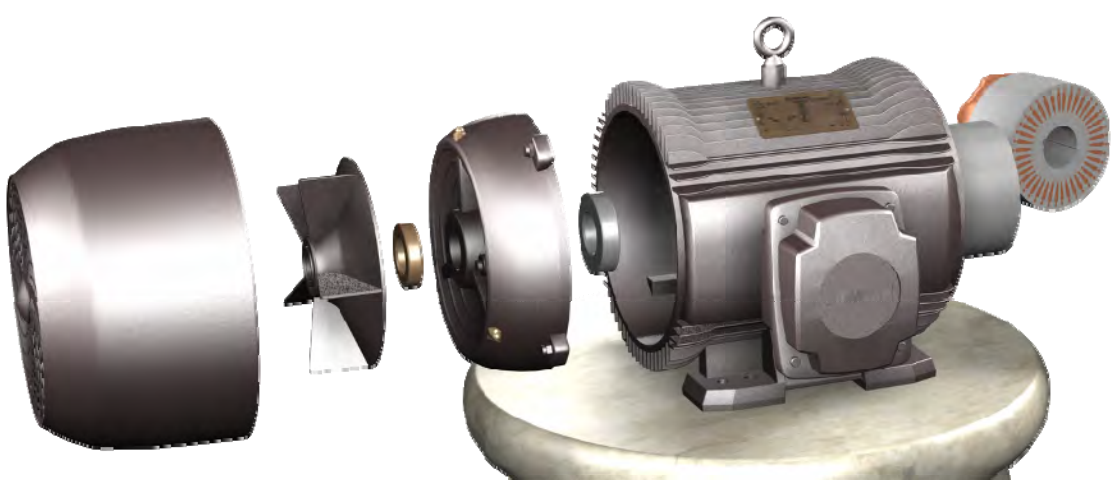
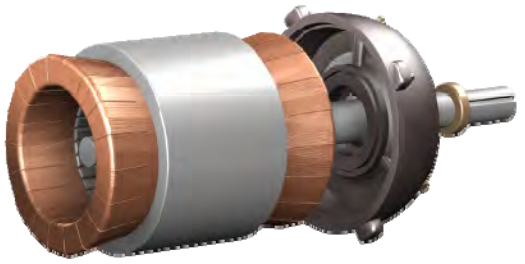
The cast copper rotor motor





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Cross-section of cast-copper rotor

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Above NEMA Premium

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Our design objective

- Electric Motor Efficiency Improvement

- Development of mold (die) materials and processing for cost effective mass production of a copper rotor motor

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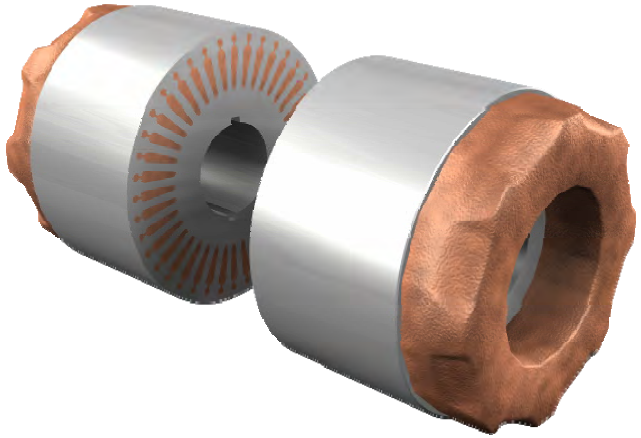
Mold considerations

- Previously, die cast copper rotors had not been economical to make because:
  - The melting point of CU (1083C) made die casting more difficult than using AL (660C) because of the much higher temperature requirements



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Die material testing

- Many problems occurred with traditional mold materials:
  - High temperature requirement to melt copper
  - Substantial latent heat
  - Thermal shock
  - Thermal fatigue (heat checking)
  - High operating temperature meant loss of die strength
  - In previous attempts, molds lasted only a few shots

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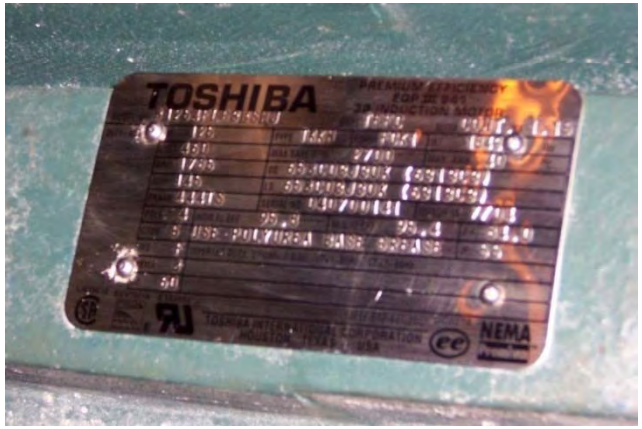
Conductivity of CU – 60% higher than AL

- Using a copper rotor instead of aluminum, of the same motor design, an additional 10-15% reduction of motor losses (input/output method)could be achieved

- This loss reduction translates to between a 1% to 5% increase in motor nameplate efficiency

- Resulting in:
  - Reduced energy consumption
  - Reduced environmental impact
  - Reduced motor weight



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Advantages of the CRM

Scenarios for Manufacturers and Users

- Improvement in motor electrical energy efficiency to reduce user operating costs
- Reduction in potential motor size and/or weight at a given efficiency – manufacturer advantage
- Reduction in overall premium motor manufacturing cost at a given efficiency (especially for high efficiencies)

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Implications for improvement

- In motor efficiency:
  - Would create a “Super” or “Ultra” premium efficient motor product
  - With above NEMA premium efficiencies
  - By replacing the AL rotor with CU

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Die casting of pure copper

- Improved die life has now been achieved with a solid solution strengthened nickel-base alloy die inserts operated at elevated temperature (CDA, Inc. development)
- In Europe, FAVI, S.A. has die cast thousands of copper rotors using their proprietary technology
- Siemens A G, has produced thousands for their recently commercialized 1 hp through 20 hp motors

Economical production of copper rotors is now done routinely

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Commercialization of the CRM

- More than 500,000 units are in service at this time
- SEW Eurodrive - now offer lines of both 60 Hz EPAct in the US and 50 Hz EFF1 industrial drives with CRM's in Europe
- Siemens - now offers 1-20 hp 60 Hz CRM's in North America and because of demand, added manufacturing capacity in Mexico. They also offer 50 Hz CRM's for Europe and other areas
- Ramco Electric Motors of Greenville, OH plays a significant role in the cast copper rotor market for both military and commercial applications

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Commercialization of the CRM

- India – high efficiency agricultural water pumps offered with the CRM

- China is close to completing development of the CRM through a joint project with Yunnan Copper and one of their motor manufacturers

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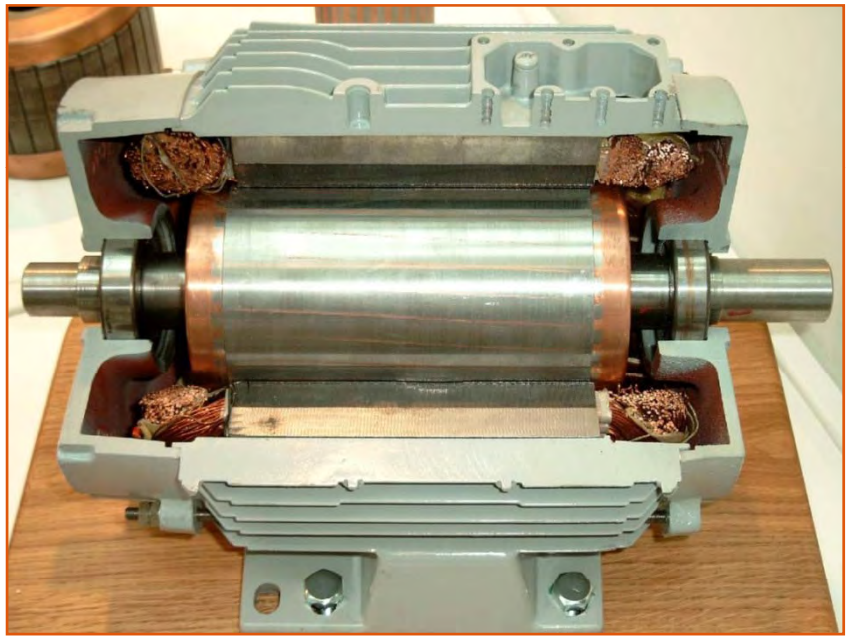
Drive motors

- Optimized with copper rotor
- SEW-Eurodrive has introduced a commercial line of energy efficient motors with die-cast copper rotors from fractional through 37 kW (50 hp)
- Motors above 3 kW were redesigned to optimally utilize Cu



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NYCO Minerals

- Has seen electric rates more than double from $.04/kWh to $.09/kWh in a few years
- Began installing 150 Siemens 1-20 HP IEEE 841 Copper Rotor Motors in January 2007

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NYCO Minerals

- Initial investment ~$80,000.00
- Expected payback between 2-3 years, some much sooner

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NYCO Minerals

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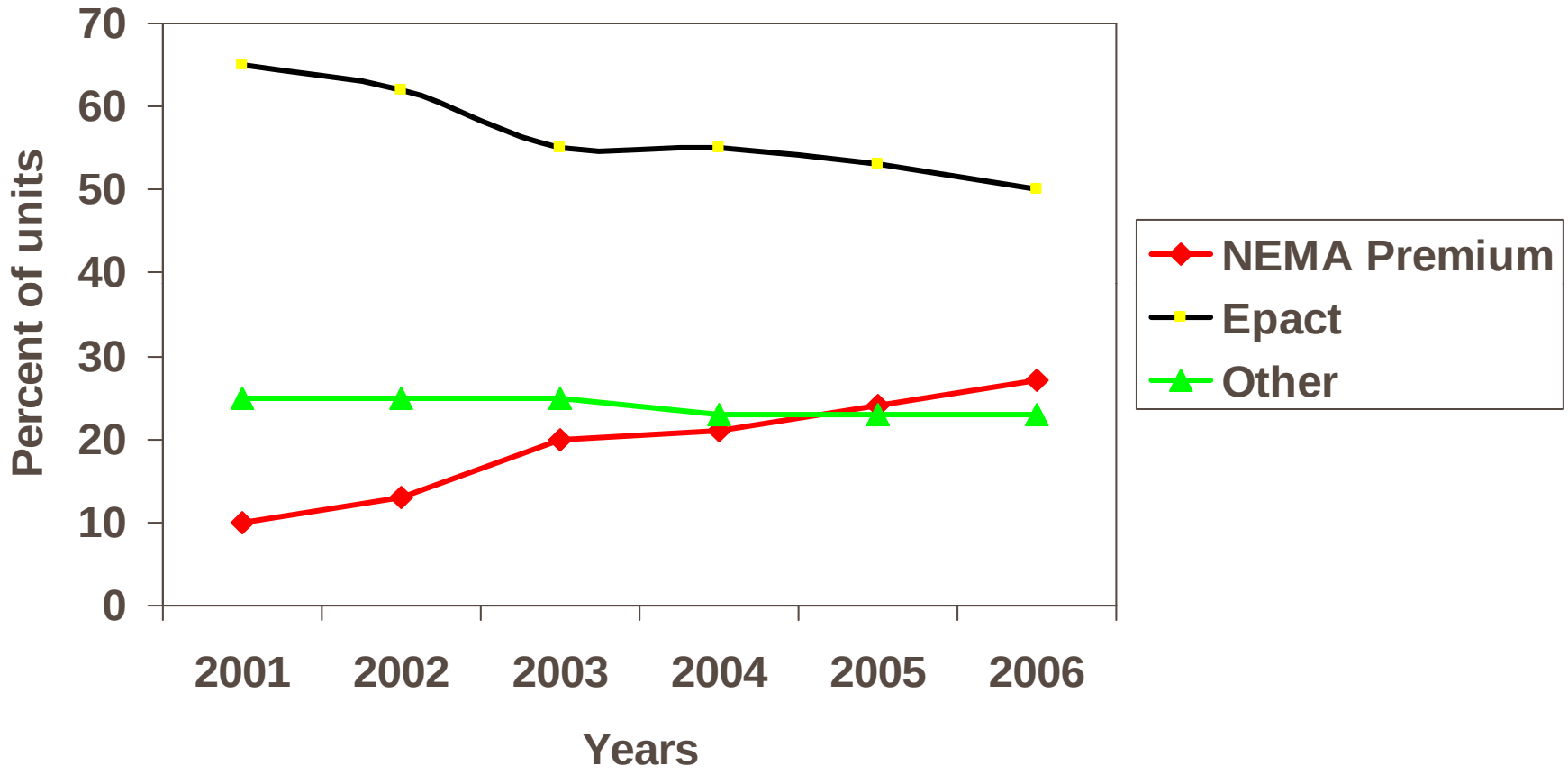
Historic efficiency trend 2001- 2006



Market penetration after six years
of voluntary programs
plateaus at 20-25%

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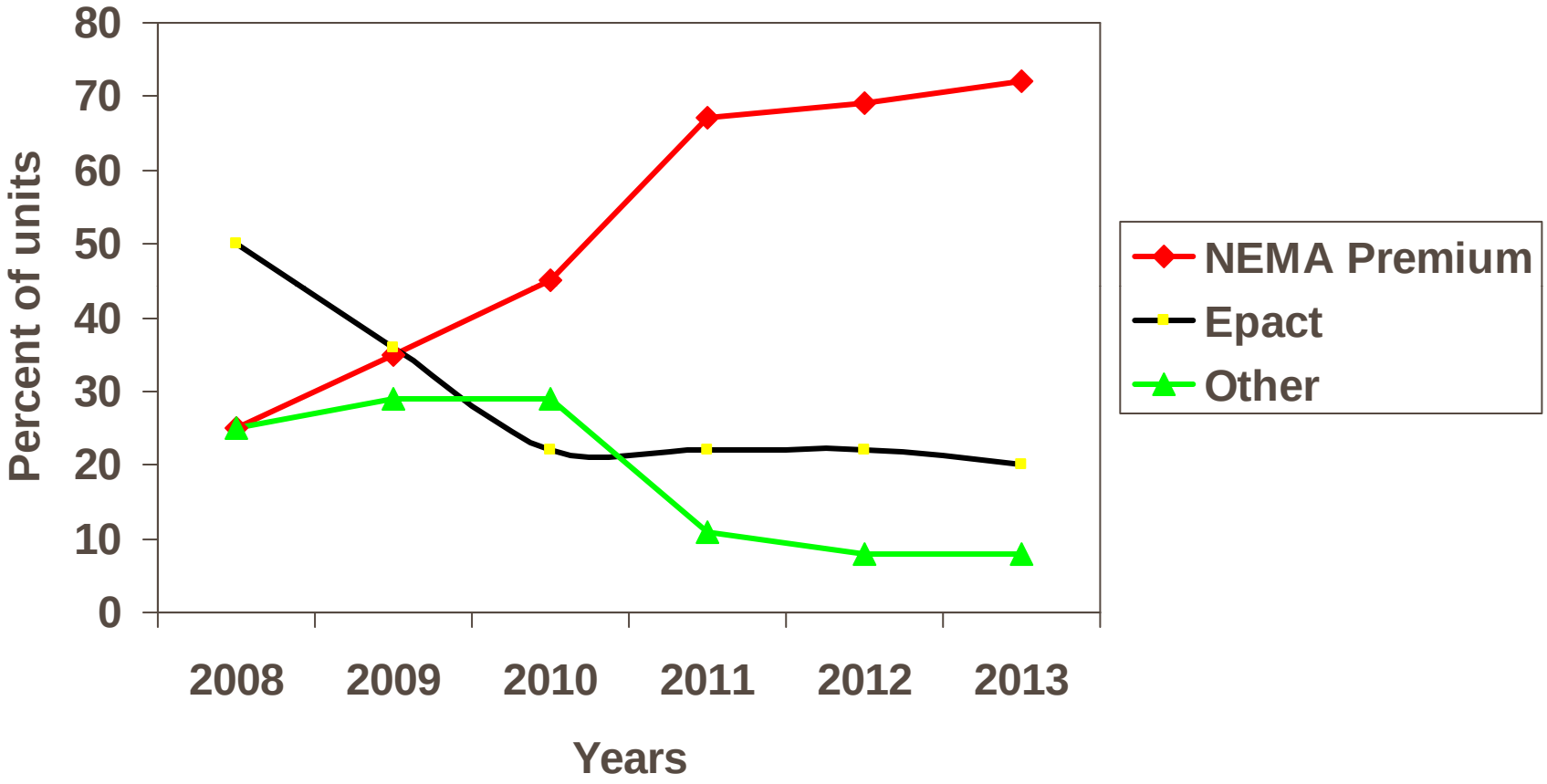
EISA Implications-Future efficiency expected 2008- 2013



Regulatory forecast model
1 TO 200HP LVAC Reaches OEM Markets

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And finally

- While we speak
  - Some motor manufacturers in other countries are adopting the copper rotor motor technology for commercialization
  - Companies in the US (Baldor, Emerson for example)are adopting other means of improvement using permanent magnet motors, more copper and switched reluctance technology.
- While we have pushed the envelope with motor efficiency, a motor systems approach is the direction we as a country are heading

Three-phase SR Drive® stator and rotor

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Congressional activity

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Energy Independence & Security Act (EISA):
Signed into law, December 19, 2007

Move all general purpose motors to NEMA premium levels (MG1 12-11)

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Energy Independence & Security Act (EISA):
Signed into law, December 19, 2007

- Add seven categories of motors not included in original EPAct legislation
  - EPAct 92 MG1 12-11
  - U Frame
  - Design C
  - Closed couple pump motors
  - Footless motors
  - Vertical solid shaft normal thrust (tested in a horizontal configuration)
  - 8 pole motors (900 RPM)
  - All polyphase motors with voltages up to 500 volts other than 230/460

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Also included are

- 201 – 500 HP motors, low voltage, general purpose, design “B” at MG1 12-11 levels

- Changes to be implemented in 36 months from enactment
  - December 19, 2010

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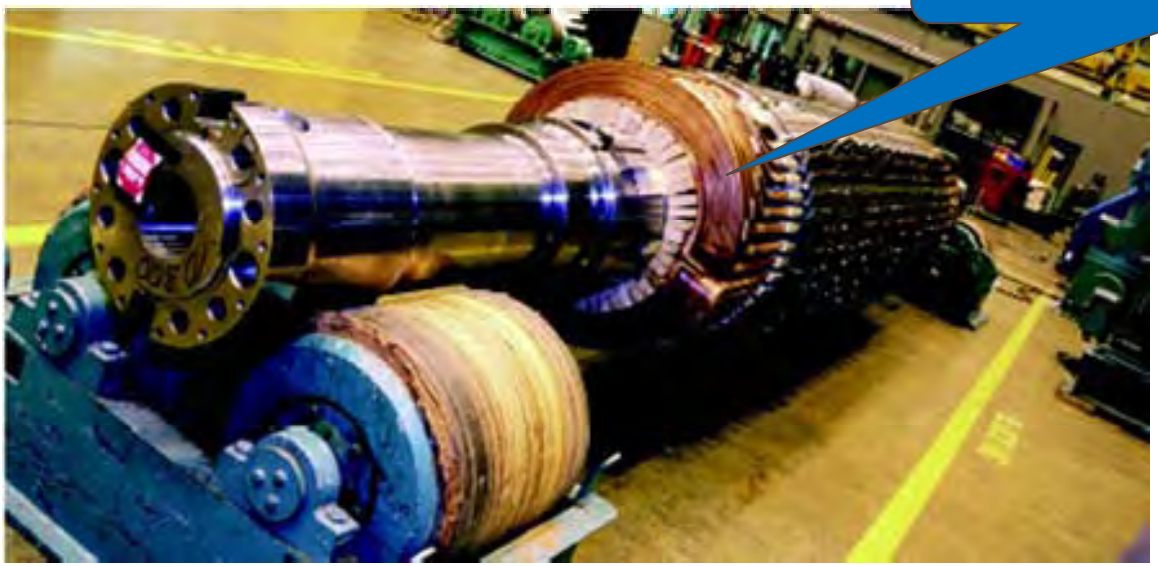
And finally

- While we speak
  - Some motor manufacturers in other countries are adopting the copper rotor motor technology for commercialization
  - Companies in the US are adopting other technologies using permanent magnet motors



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Other technologies coming to market

- Companies in the US (Baldor, Emerson for example)are adopting other means of improvement using permanent magnet motors, more copper and switched reluctance technology.

- While we have pushed the envelope with motor efficiency, a motor systems approach is the direction we as a country are heading

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NEMA Phase Three
beyond motors to system energy recognition

- Reducing industrial plant energy costs through motor driven system optimization

- Making energy systems (e.g. motor, steam, compressed air, pumping, and process heating) more reliable, cost-effective, and energy-efficient

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NEMA Phase Three
beyond motors to system energy recognition

- Develop and achieve corporate energy management goals that improve industrial profitability and competitiveness

- Determine and select energy-efficient equipment from qualified product categories

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NEMA Phase Three
beyond motors to system energy recognition

- Developing plans for cost-effective efficiency measures that have management and financial support so that they will be implemented

- Use information and technical support for the Save Energy Now program, a new DOE initiative to help plants improve their efficiency through outreach and on-site assessments

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Why wait

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Waiting cost you

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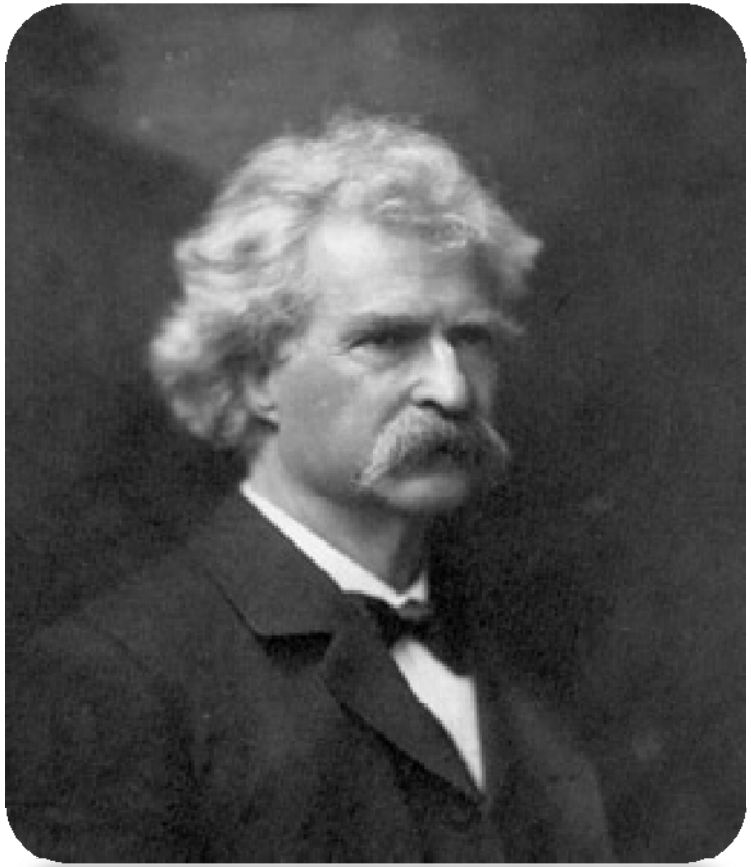
Mark Twain



I’m all in favor of progress….

I’m just opposed to change

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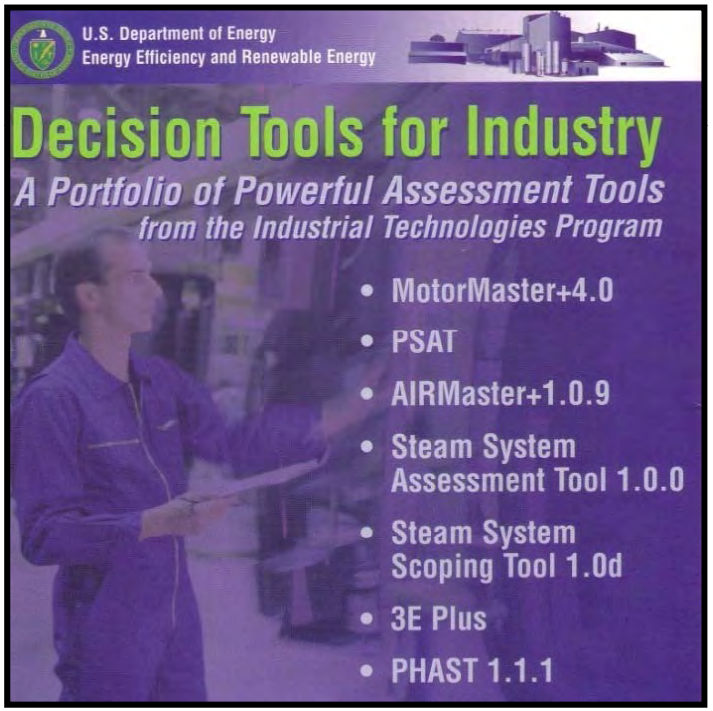
What tools are available

Motor Decision Matters

Motor Decisions Matter

www.motorsmatter.org

MotorMaster+



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Motor Decisions Matter

- *Motor Decisions Matter℠ is a national public-awareness campaign sponsored by a consortium of electric utilities, industry trade associations, and others. MDM and its sponsoring organizations provide support for companies interested in motor management.*

- A resource for motor planning tools and aids

- An excellent web site with valuable resources

- www.motorsmatter.org

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Who is Motor Decision Matters

- ABB Inc.
  www.abb.com/motors &drives
- Alliant Energy
  www.alliantenergy.coms
- Austin Energy
  www.austinenergy.com
- Advanced Energy
  www.advancedenergy.org
- BC Hydro
  www.bchydro.com
- ComEd, a division of Exelon Corp.
  www.exeloncorp.com
- Copper Development Association
  www.copper.org
- Electrical Apparatus Service Association (EASA)
  www.easa.org
- Long Island Power Authority
  www.lipower.org
- m
- MidAmerican Energy Company
  www.midamericanenergy.com
- National Grid
  www.nationalgrid.com
- Northwest Energy Efficiency Alliance
  www.nwalliance.org
- NSTAR Electric and Gas
  www.nstar.com
- Pacific Gas & Electric
  www.pge.com
- New York State Energy Research and Development Authority
  www.nyserda.org
- Sacramento Municipal Utility District
  www.smud.org
- Southern California Edison
  www.sce.com
- U.S. Department of Energy
  www.doe.gov
- Xcel Energy
  www.xcelenergy.co

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MDM objectives

- To educate senior decision makers about the benefits of motor planning and management
- To make motor management a standard practice
- To provide resources and tools to assist you

Motor Decisions Matter
www.motorsmatter.org

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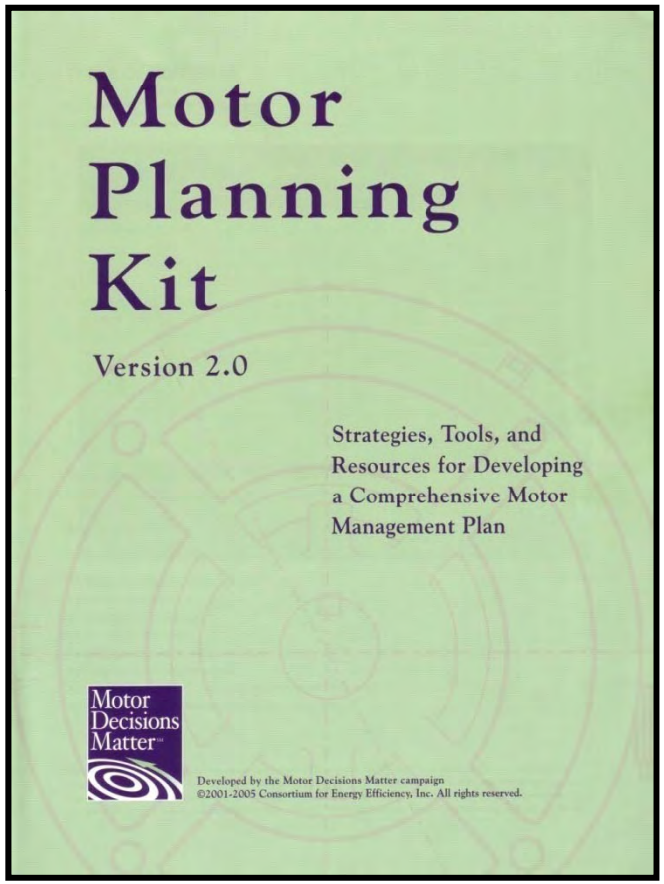
Motor Planning Guide

- A guideline to motor management providing:
  - Strategies
  - Tools
  - Resources
  - Examples



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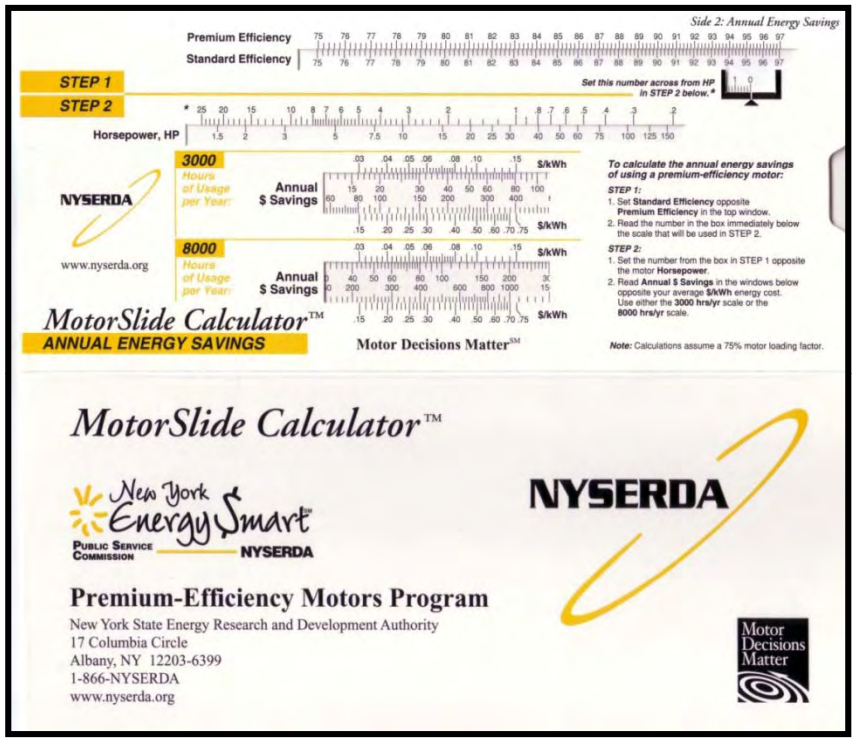
Motor slide calculator

- An excellent tool when a computer is unavailable
- Side 1 calculates the approximate annual energy cost of operating a motor for either 3,000 or 8,000 hours



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Motor slide calculator

- Side 2 calculates the approximate annual energy savings by comparing a NEMA premium motor with a less efficient one

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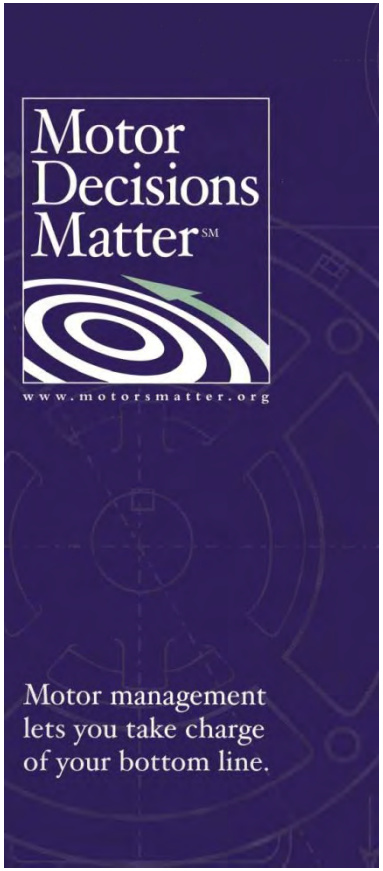
Motor management brochure

- A brochure to better help you manage your motor inventory
- To become more proactive
- Take charge of reducing expenses & increasing motor efficiency



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1-2-3 approach to motor management

- Available on their website and downloadable
- Calculates energy cost and potential energy savings
- Calculates (and compares) the financial impact of repairing or replacing motors
- Determines the payback periods for NEMA Premium. Calculates return-on-investment and net present value.

Motor Decisions Matter
www.motorsmatter.org

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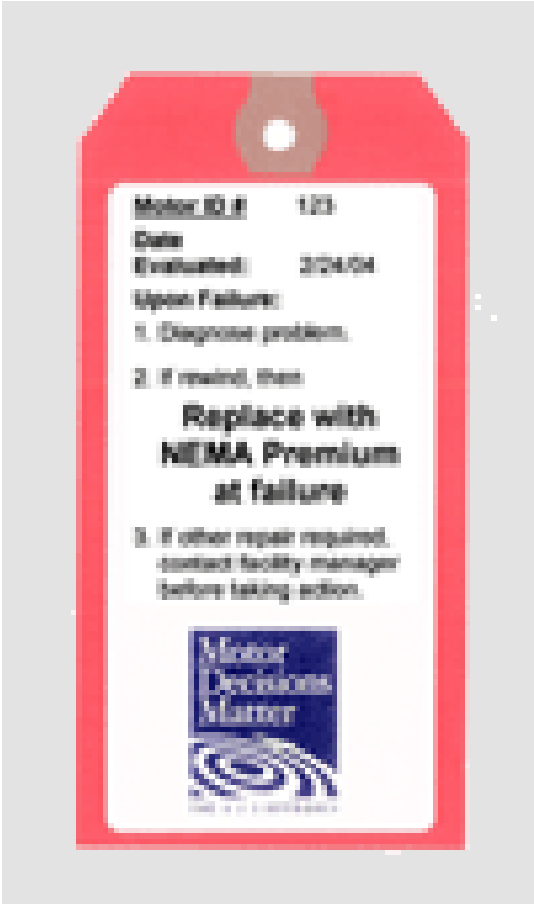
1-2-3 approach to motor management

- Print tags that identify the best repair/replace options for each motor



Motor Decisions Matter
www.motorsmatter.org

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Summary page

The 1·2·3 Approach to Motor Management: Summary

Company Information			
Company Name	Nestle	Contact	Buddy Jones

1·2·3 Service Provider Information			
Company Name	Illinois Electric	Phone	618.451.6900
Contact Name	Ron Keppel	E-Mail	ron@illinoiselectric.com

Summary of Results

	Sample Motor					Grand Total
	1	2	3	4	5	
Location	Line #1	Line #1	Line # 1	Line # 1	Line # 1	
Date Evaluated	06/11/04	06/11/04	06/11/04	06/11/04	06/11/04	
Quantity of Similar Motors	30	50	10	5	10	105
Gross Connected Horsepower	1500	1000	1250	1000	750	5500
Cumulative Yearly Operating Hours	90,000	125,000	36,000	12,500	65,000	328,500
Cumul. Current Annual Energy Cost	$230,194	$135,636	$225,050	$124,333	$255,211	$970,425
Decision	Replace with NEMA Premium at Failure	Replace with NEMA Premium at Failure	Replace with NEMA Premium at Failure	Replace with EPAct at Failure	Replace with NEMA Premium at Failure	
Cumulative Capital Investment	$58,890	$36,700	$55,000	$35,735	$33,980	$220,305
Cumulative Annual Energy Savings	$17,051	$15,314	$13,918	$6,544	$26,484	$79,311
Average Simple Payback Period	1.10	0.83	1.87	1.80	0.51	1.22
Average Return on Investment	58.4%	78.6%	30.4%	32.1%	126.8%	65.2%

The Bottom Line

To improve the efficiency of the representative motors in your facility, INVEST	$220,305
In energy costs each year, your organization could SAVE	$79,311
Over five years, these annual savings could total	$396,557
And the average RETURN ON INVESTMENT based on incremental costs for this project would be	65.2%

Notes

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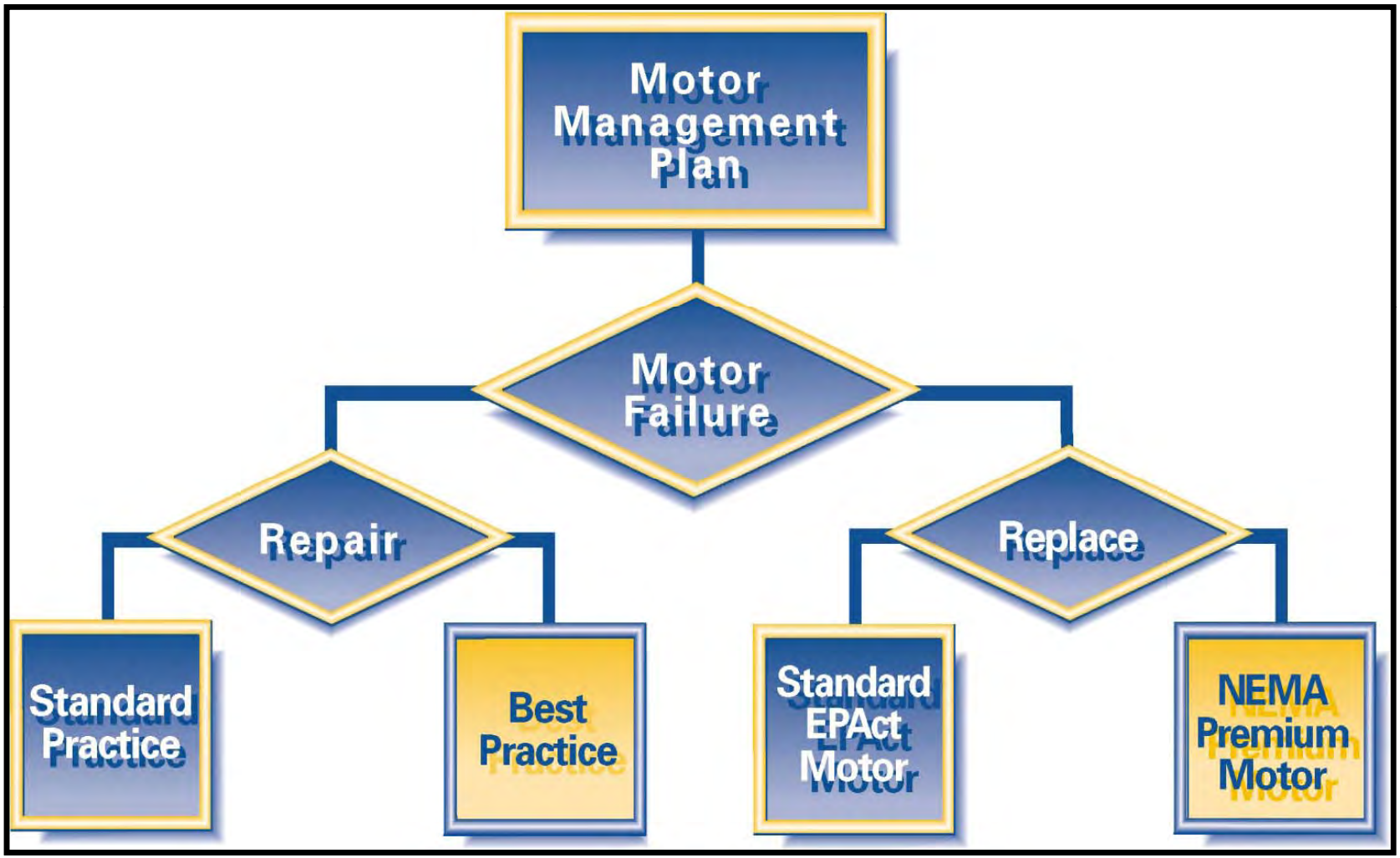
Motor decision tree



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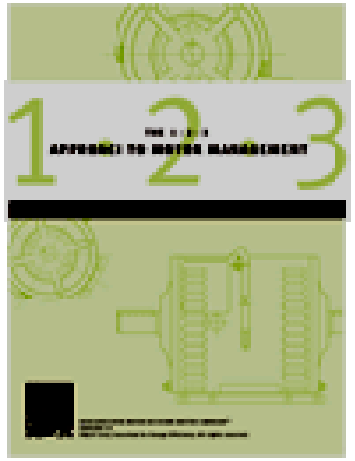
1-2-3 Vs. MotorMaster+

1-2-3:

- Simplified
- Requires nameplate data to compare
- Prints labels/tags



MotorMaster+:

- Database of nameplates
- Partial load information
- Computes payback, ROI, energy & cost savings, etc.

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What is MotorMaster+

- Developed by WSU
- Financed by the DOE OIT
- A database of over 27,000 motors
- It enables the comparison of a payback for a NEMA premium motor:
  - An EPAct motor
  - A rewind scenario
  - A retrofit (replacement)
- It is also an excellent management tool that helps you inventory motors and track maintenance

Washington State University Extension

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MotorMaster+

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The most frequently used

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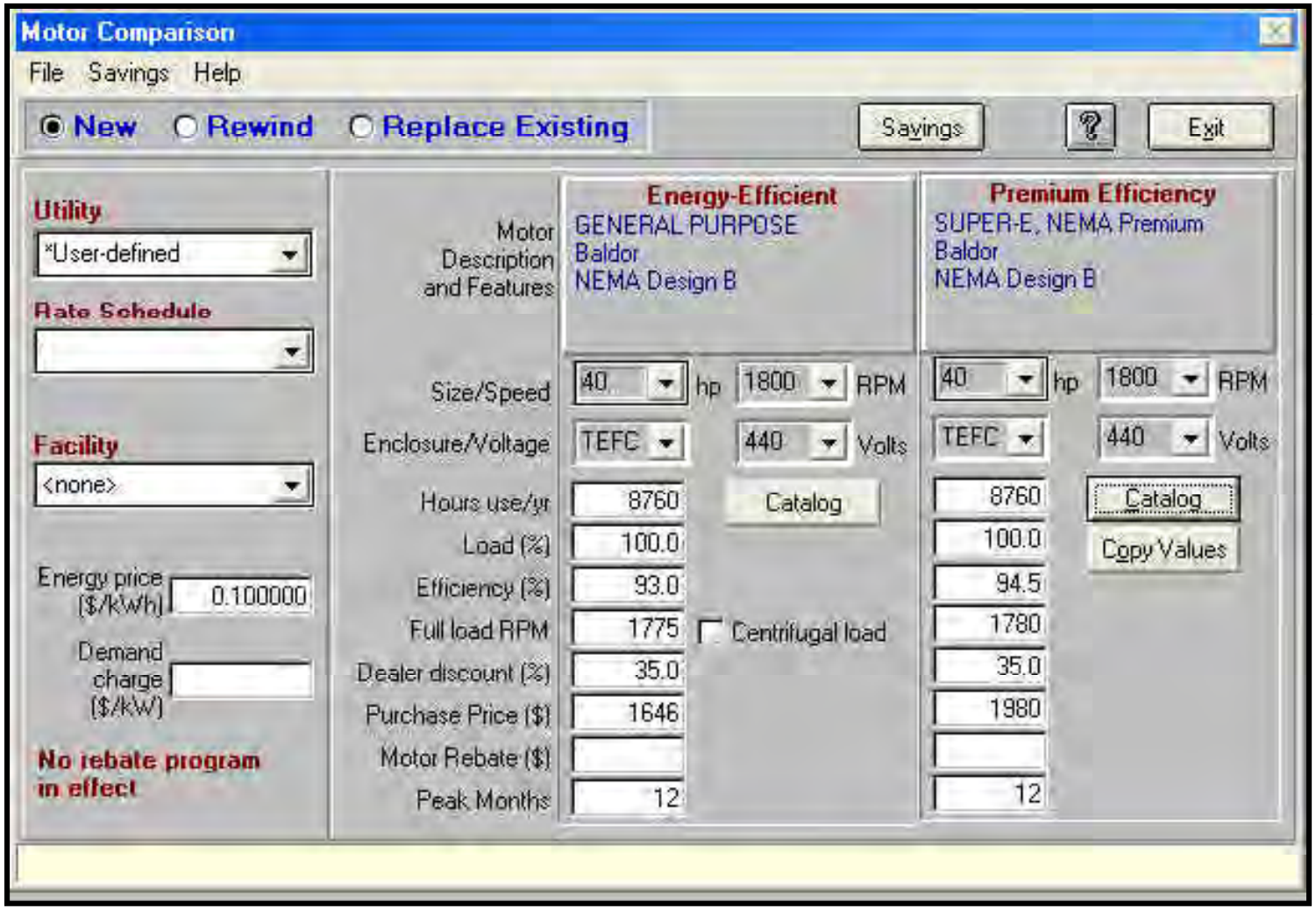
EPAct comparison



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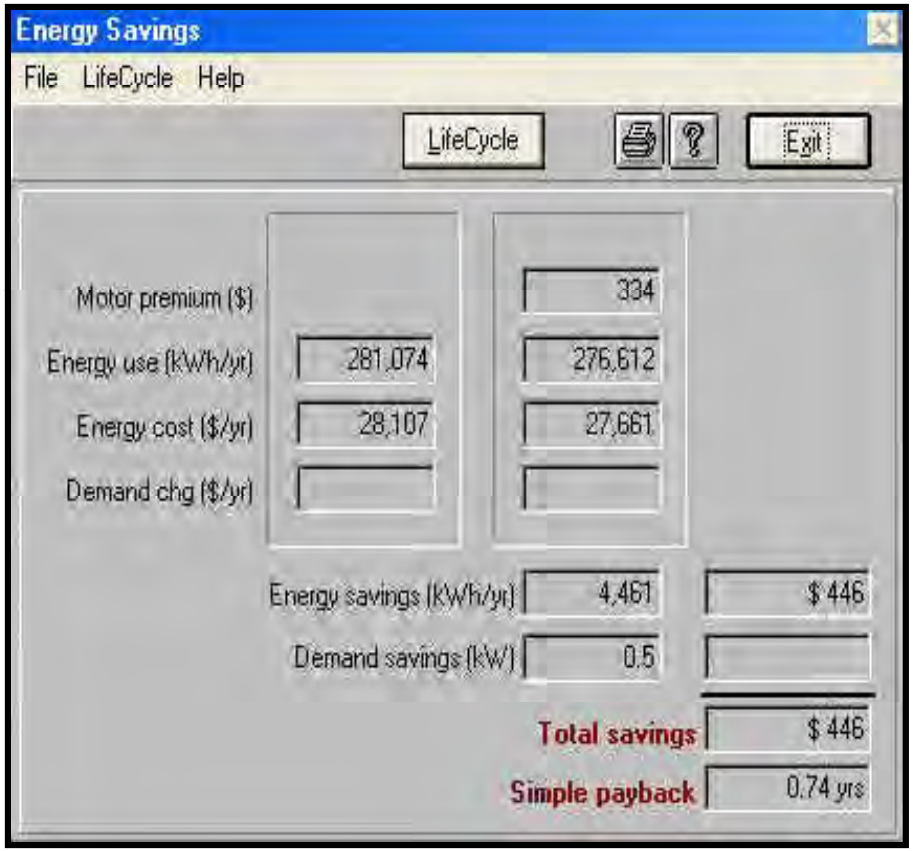
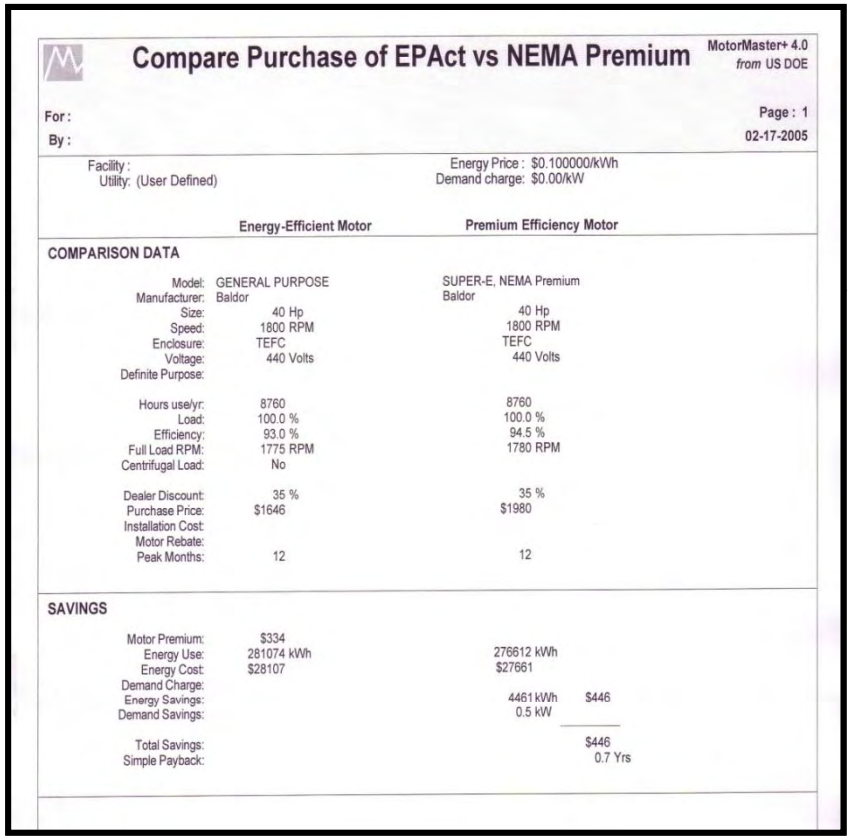
EPAct comparison





Compare Purchase of EPAct vs NEMA Premium

MotorMaster+ 4.0 *from* US DOE

For :
By :

Page : 1
02-17-2005

Facility :
Utility: (User Defined)

Energy Price : $0.100000/kWh
Demand charge: $0.00/kW

	Energy-Efficient Motor	Premium Efficiency Motor
COMPARISON DATA		
Model:	GENERAL PURPOSE	SUPER-E, NEMA Premium
Manufacturer:	Baldor	Baldor
Size:	40 Hp	40 Hp
Speed:	1800 RPM	1800 RPM
Enclosure:	TEFC	TEFC
Voltage:	440 Volts	440 Volts
Definite Purpose:		
Hours use/yr:	8760	8760
Load:	100.0 %	100.0 %
Efficiency:	93.0 %	94.5 %
Full Load RPM:	1775 RPM	1780 RPM
Centrifugal Load:	No	
Dealer Discount:	35 %	35 %
Purchase Price:	$1646	$1980
Installation Cost:		
Motor Rebate:		
Peak Months:	12	12
SAVINGS		
Motor Premium:	$334	
Energy Use:	281074 kWh	276612 kWh
Energy Cost:	$28107	$27661
Demand Charge:		
Energy Savings:		4461 kWh $446
Demand Savings:		0.5 kW
Total Savings:		$446
Simple Payback:		0.7 Yrs

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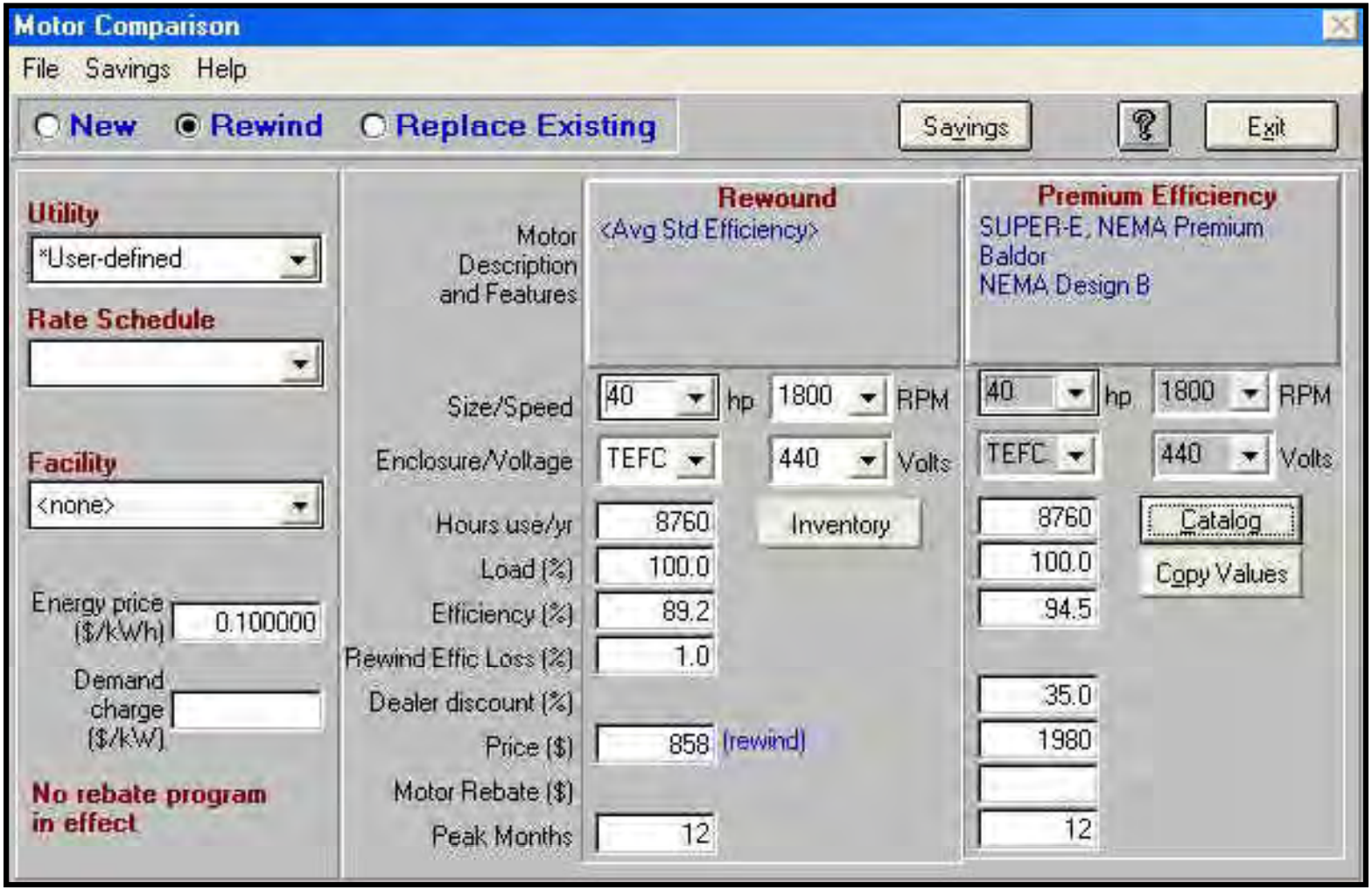
Rewind comparison



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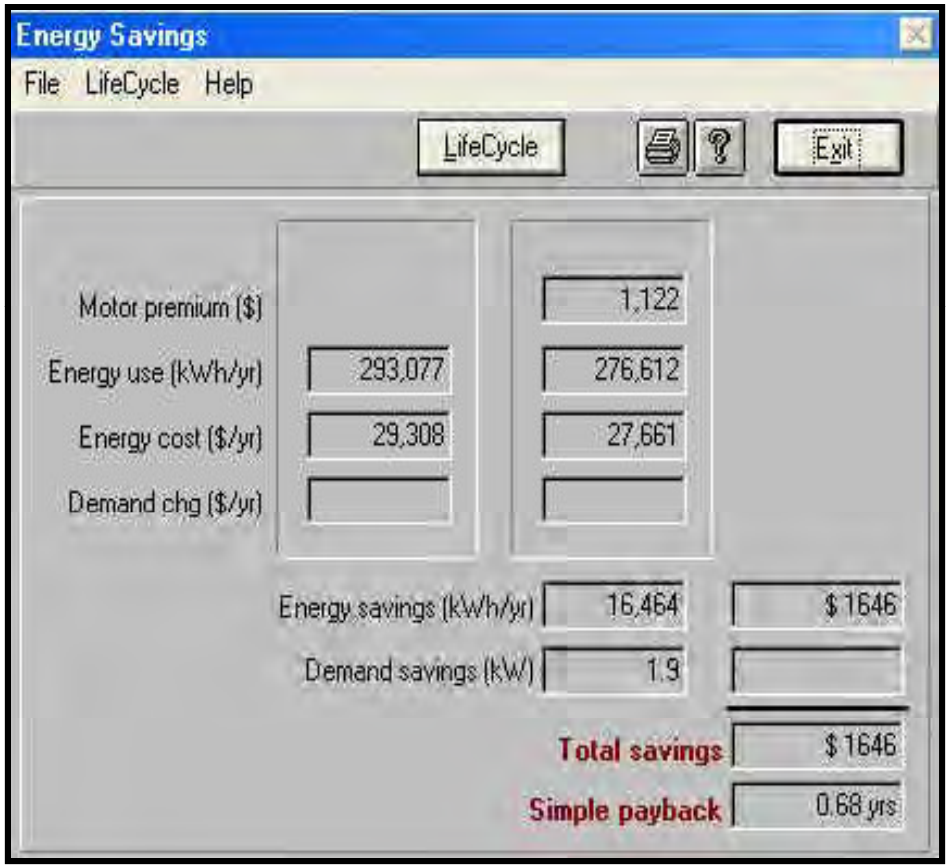
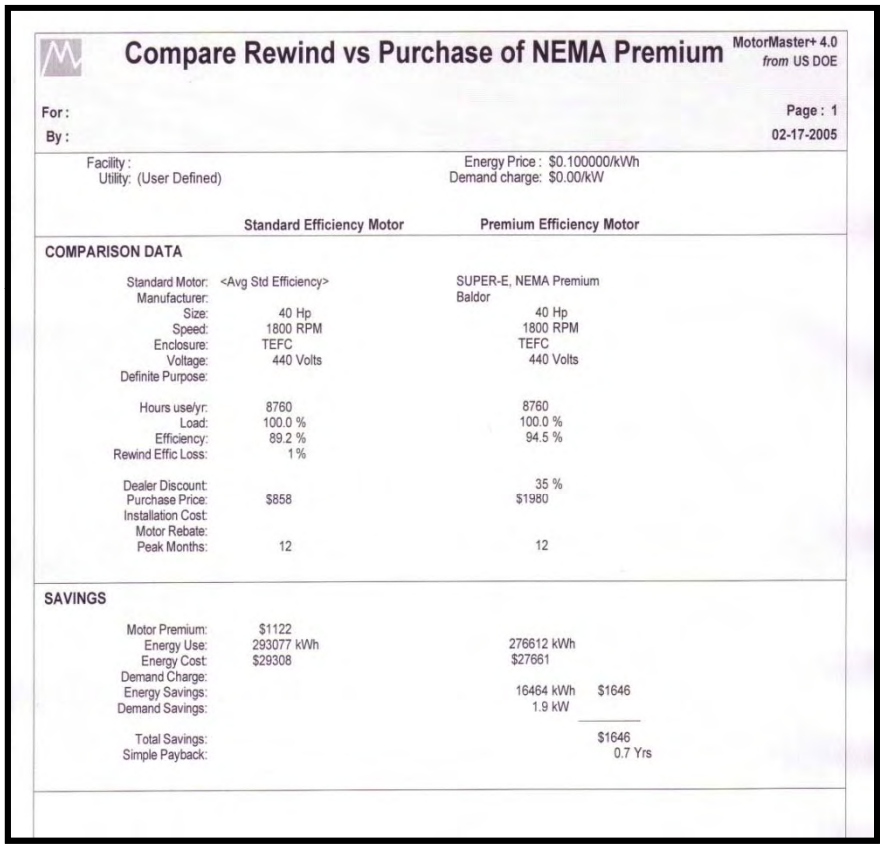
Rewind comparison





Compare Rewind vs Purchase of NEMA Premium

MotorMaster+ 4.0 *from* US DOE

For :
By :

Page : 1
02-17-2005

Facility :
Utility: (User Defined)

Energy Price : $0.100000/kWh
Demand charge: $0.00/kW

	Standard Efficiency Motor	Premium Efficiency Motor
COMPARISON DATA		
Standard Motor:	<Avg Std Efficiency>	SUPER-E, NEMA Premium
Manufacturer:		Baldor
Size:	40 Hp	40 Hp
Speed:	1800 RPM	1800 RPM
Enclosure:	TEFC	TEFC
Voltage:	440 Volts	440 Volts
Definite Purpose:		
Hours use/yr:	8760	8760
Load:	100.0 %	100.0 %
Efficiency:	89.2 %	94.5 %
Rewind Effic Loss:	1 %	
Dealer Discount:		35 %
Purchase Price:	$858	$1980
Installation Cost:		
Motor Rebate:		
Peak Months:	12	12
SAVINGS		
Motor Premium:	$1122	
Energy Use:	293077 kWh	276612 kWh
Energy Cost:	$29308	$27661
Demand Charge:		
Energy Savings:		16464 kWh $1646
Demand Savings:		1.9 kW
Total Savings:		$1646
Simple Payback:		0.7 Yrs

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Repair vs. replace

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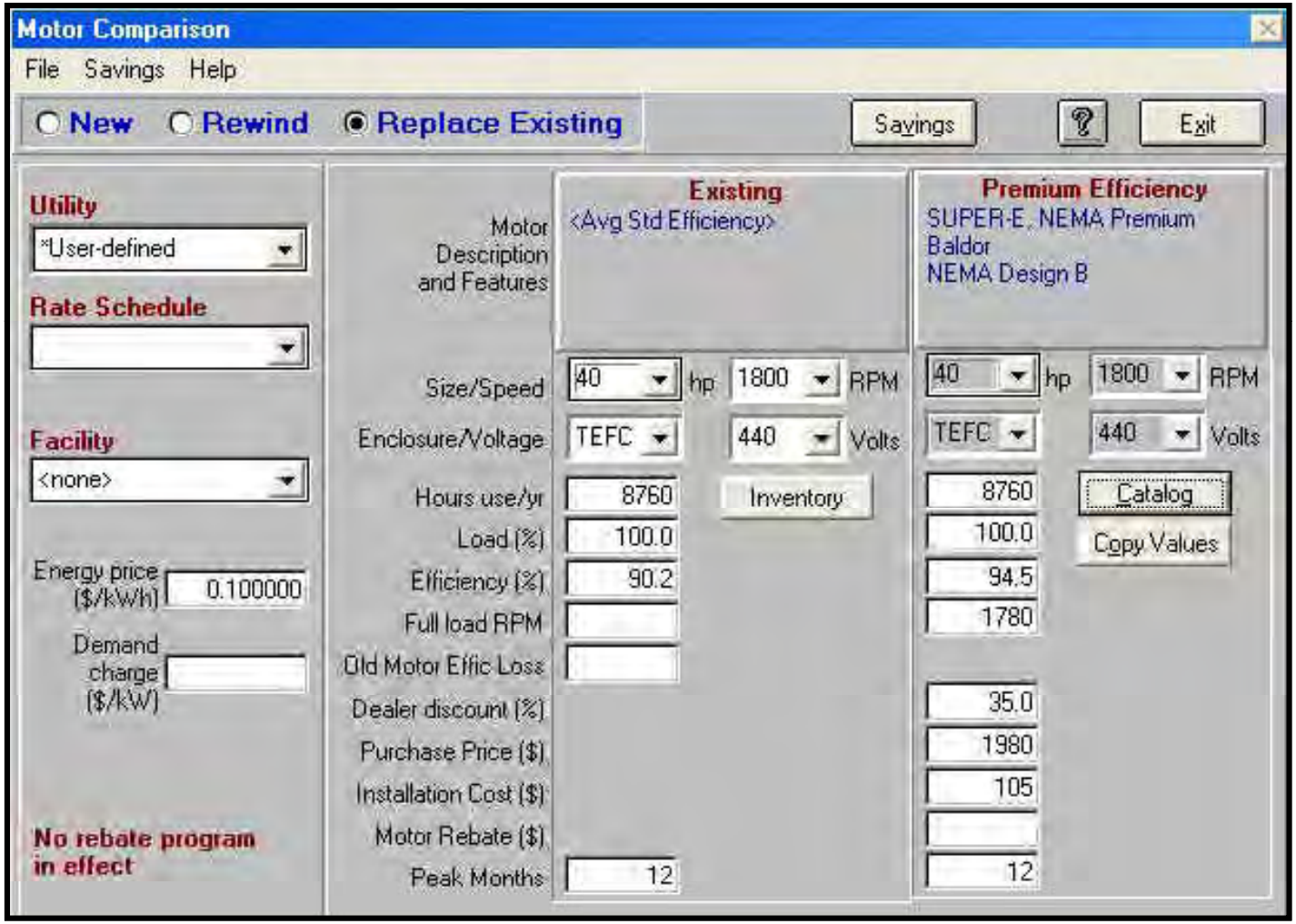
Replace existing



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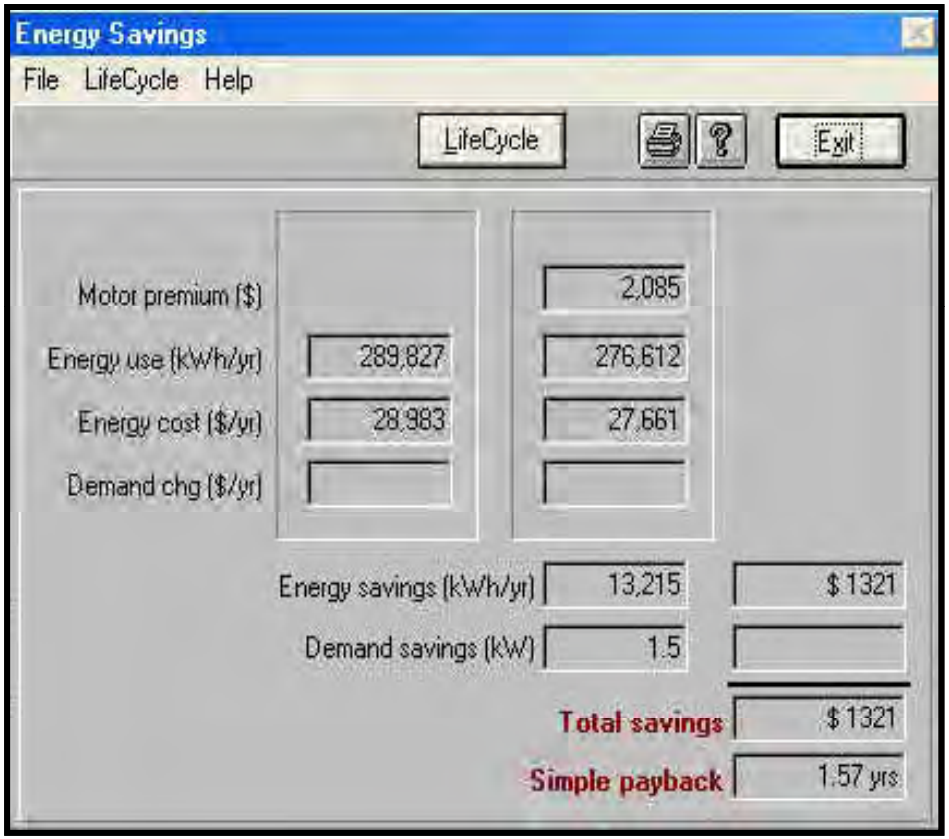
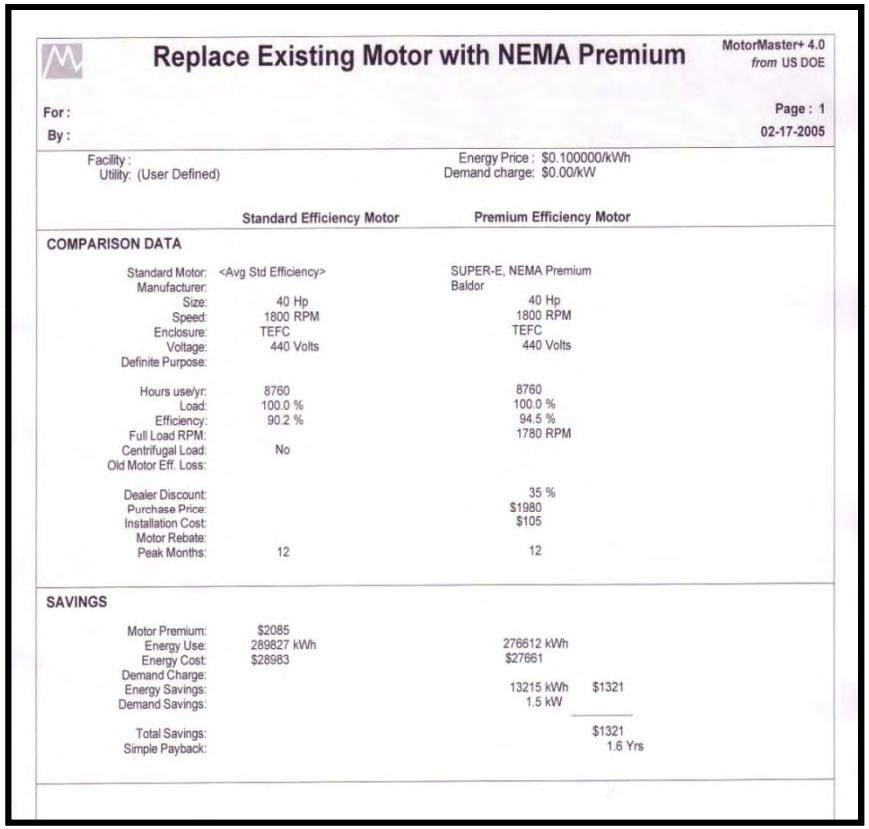
Replace existing





Replace Existing Motor with NEMA Premium

MotorMaster+ 4.0 *from* US DOE

For :
By :

Page : 1
02-17-2005

Facility :
Utility: (User Defined)

Energy Price : $0.100000/kWh
Demand charge: $0.00/kW

	Standard Efficiency Motor	Premium Efficiency Motor	
COMPARISON DATA			
Standard Motor:	<Avg Std Efficiency>	SUPER-E, NEMA Premium	
Manufacturer:		Baldor	
Size:	40 Hp	40 Hp	
Speed:	1800 RPM	1800 RPM	
Enclosure:	TEFC	TEFC	
Voltage:	440 Volts	440 Volts	
Definite Purpose:			
Hours use/yr:	8760	8760	
Load:	100.0 %	100.0 %	
Efficiency:	90.2 %	94.5 %	
Full Load RPM:		1780 RPM	
Centrifugal Load:	No		
Old Motor Eff. Loss:			
Dealer Discount:		35 %	
Purchase Price:		$1980	
Installation Cost:		$105	
Motor Rebate:			
Peak Months:	12	12	
SAVINGS			
Motor Premium:	$2085		
Energy Use:	289827 kWh	276612 kWh	
Energy Cost:	$28983	$27661	
Demand Charge:			
Energy Savings:		13215 kWh	$1321
Demand Savings:		1.5 kW	
Total Savings:			$1321
Simple Payback:			1.6 Yrs

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EASA resources -motor repair & rewinding

- www.easa.com
- Find the latest industry information.
- Download white papers and informative booklets.
- Find out about upcoming seminars.
- Join EASA.

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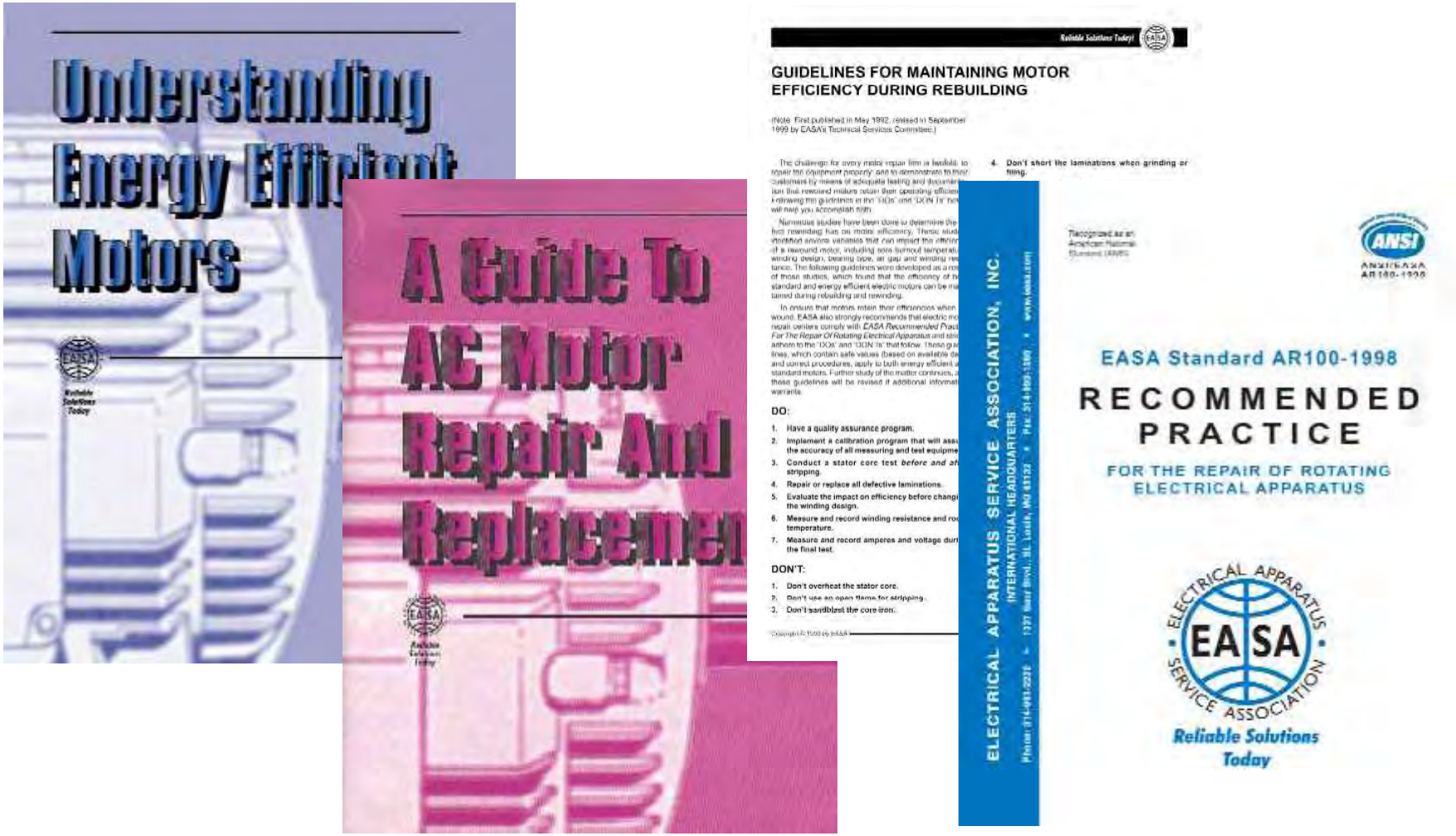
EASA resources - motor repair & rewinding -



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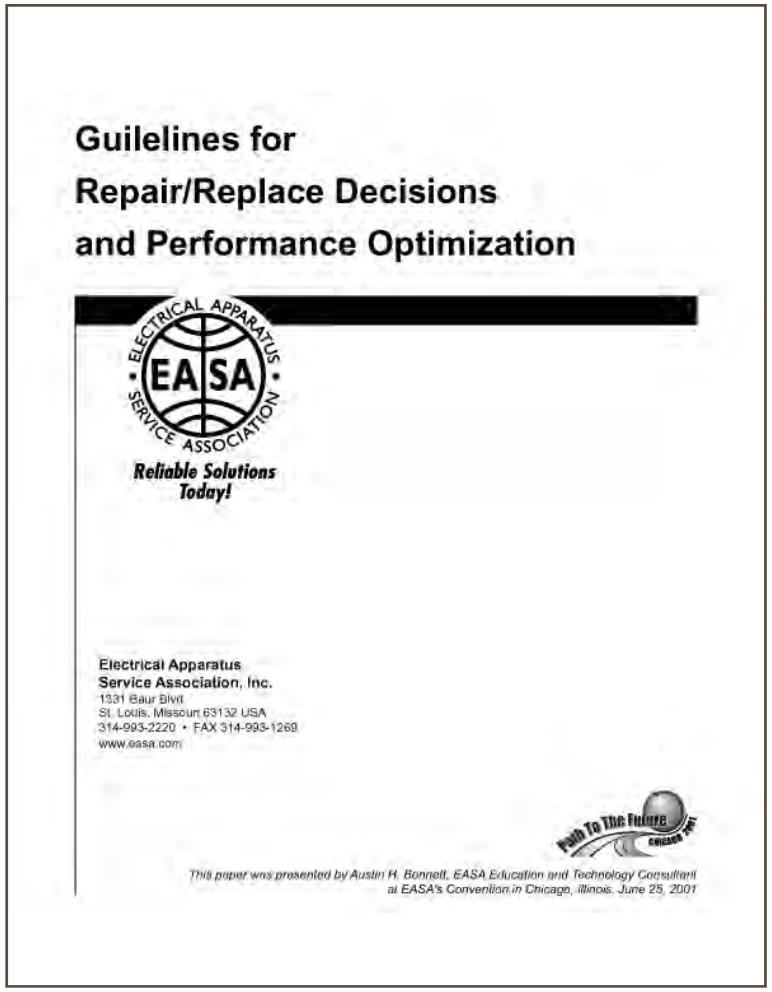
Resources for - Repair/Replace Decision



Guilelines for
Repair/Replace Decisions
and Performance Optimization

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www.easa.com

Path To The Future

This paper was presented by Austin H. Bonnett, EASA Education and Technology Consultant at EASA's Convention in Chicago, Illinois, June 25, 2001

- Guideline for implementing EASA Recommended Practices to ensure that repair will not degrade motor performance.

- Available at www.easa.com

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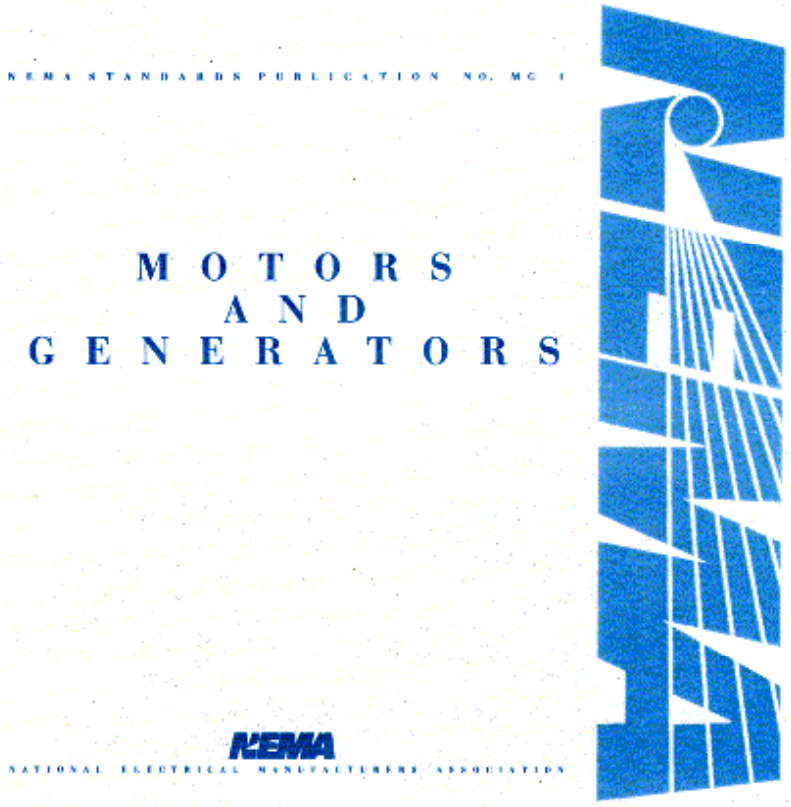
Motor Standards and Definitions

- National Electrical Manufacturers Association promulgates standards for electric motors in its NEMA Standards Publication MG 1.



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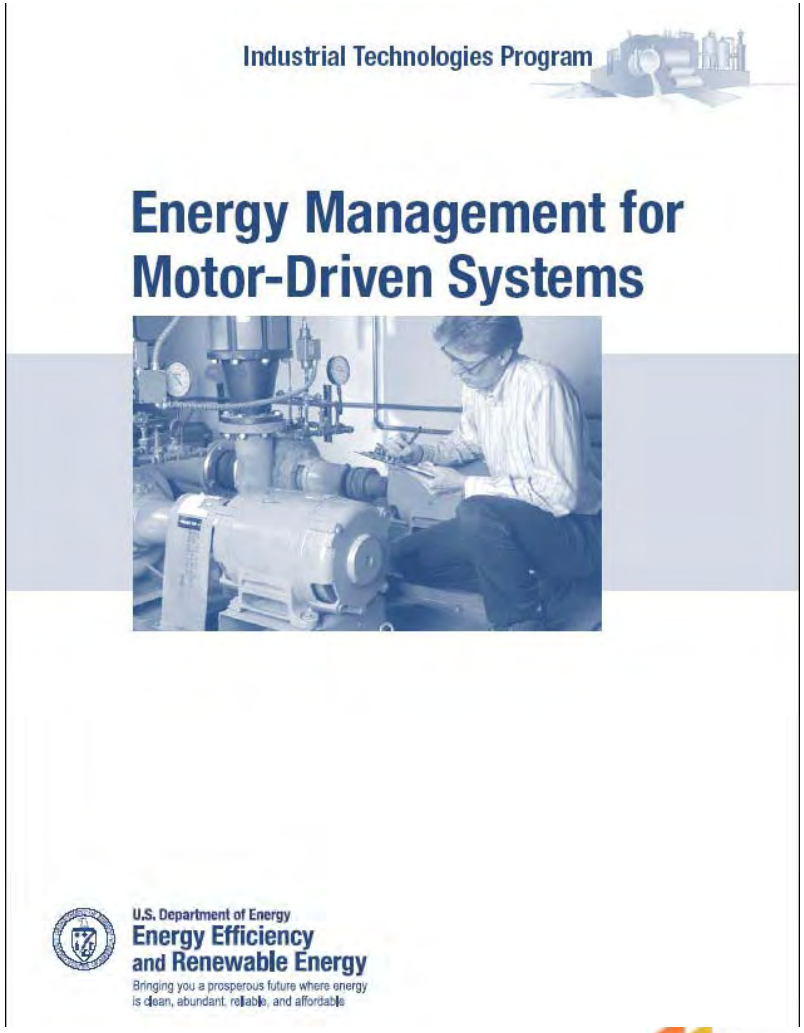
U.S. DOE Energy Management for Motor Driven Systems

- This book is a very comprehensive guide to managing your electric motor systems for an improved bottom line.



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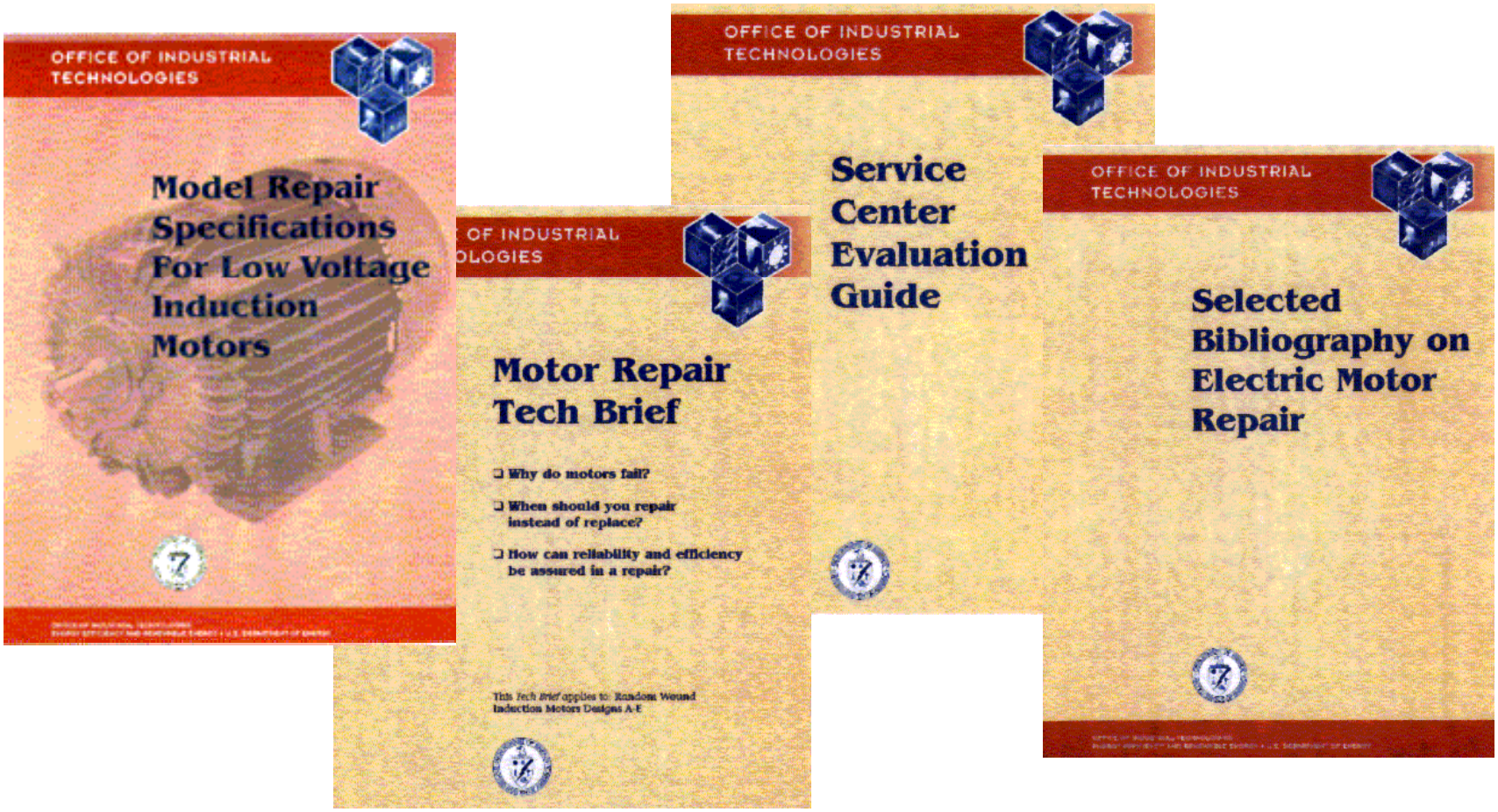
Resources - Motor Repair & Rewinding



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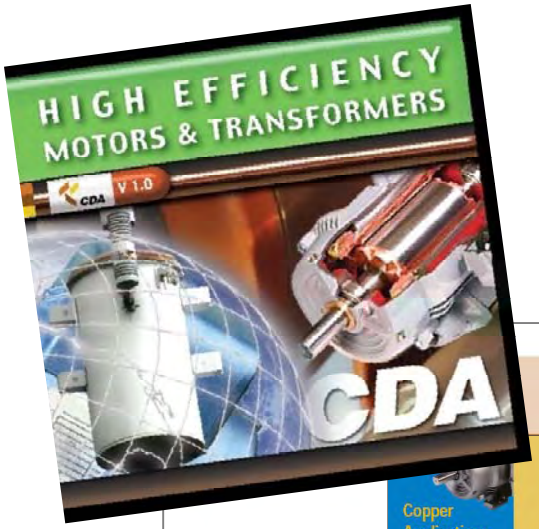
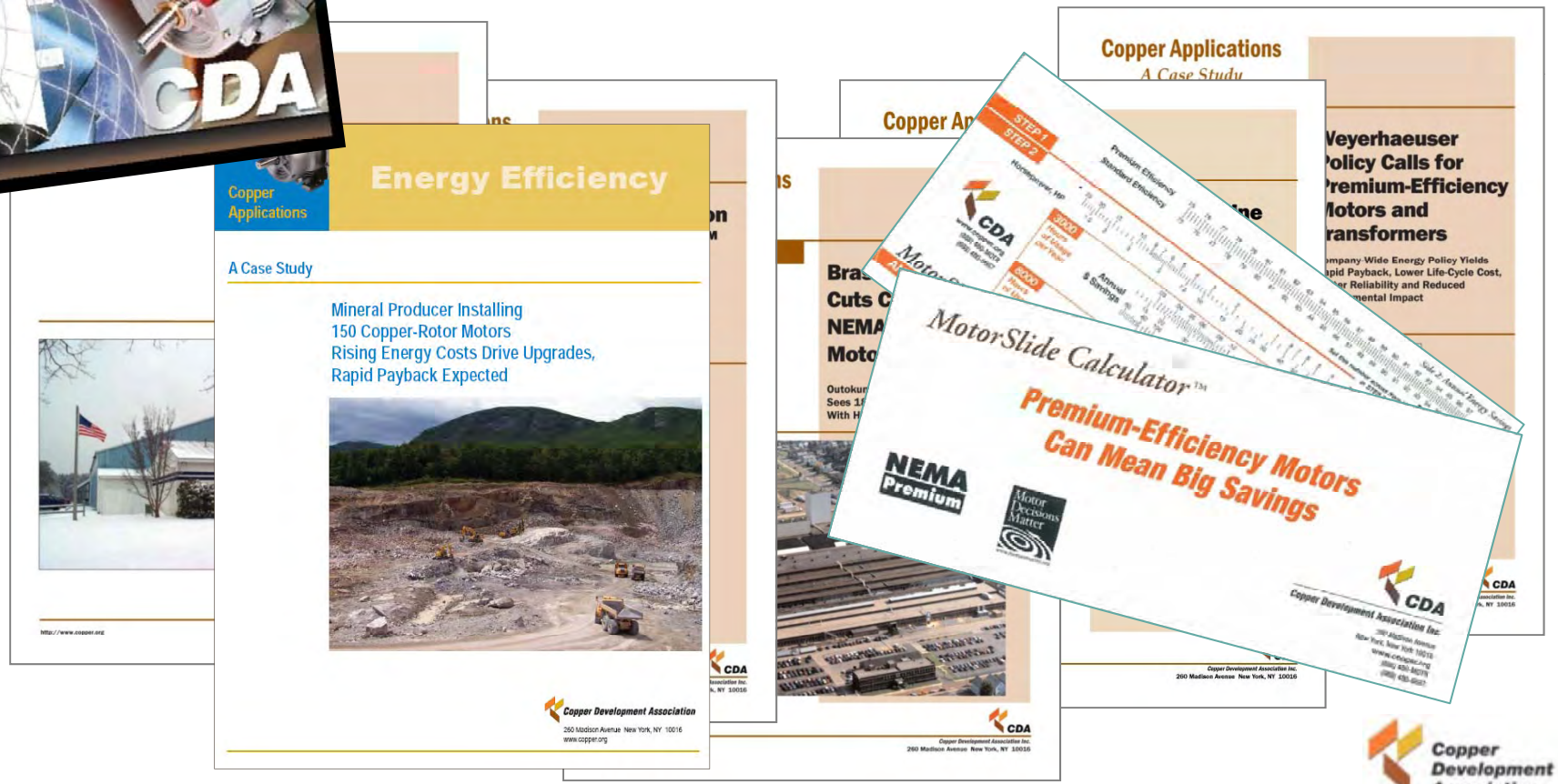
Literature



- Case histories
- CD ROM, Motor slide calculator
- Free to USA addresses



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CDA resources

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Please visit our website at…

www.copper.org

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Thank You

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585-533-2408

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