STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

In the Matter of:

PROPOSED AMENDMENT TO 20.6.2 NMAC (Copper Rule) No. WQCC 12-01(R)

EXHIBIT BRACK – 5
Copper
Essential for Green

Stephen T. Higgins
May 12, 2010
Copper Turns Green
Wind Turbines Have High Cu Content

High Efficiency Motor
1,362 kg/MW

Electrical Grounding
454 kg/MW

Source: Homepower.com and Copper Development Assoc.
Wind farms require 50% more capacity to produce the same amount of electricity annually.

It takes 160 wind turbines at 7.5MW in a wind farm to equal the power production of one 800 MW conventional plant.
• Copper intensity in terms of internal connections in the photovoltaic cells is very similar to carbon based generation
• Solar power supplements traditional generation and therefore, conserves energy and reduces CO₂
• At a plant level, copper intensity would far exceed carbon based generation due to the additional capacity needed to supply an equitable amount of power in terms of MW
“A **smart grid** delivers electricity from suppliers to consumers using digital technology to save energy, reduce cost and increase reliability.”
- Wikipedia

What does Smart Grid mean for copper?
- Main impact area: enabler for Distributed Generation & Renewable Energy which are more copper intensive
- Further impact in communication devices, data wiring, power quality

- Stimulus package in the U.S. includes $11.5B for grid upgrades.
• Based on estimates made by Leonardo Energy in 2005, these six economies comprised 70% of the global market.
• At the time, these six markets had approximately 83 million transformers installed based on a low first cost method, meaning lower efficiency.
• The top six economies would save 161 TWh of energy annually with high efficiency transformers
• This translates to more than 200 TWh globally and 100M tonnes of CO2
For a 10 hp Motor of different efficiencies, copper content is:

<table>
<thead>
<tr>
<th>Type</th>
<th>Copper Content (kg)</th>
<th>Efficiency Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>8.6</td>
<td>+58%</td>
</tr>
<tr>
<td>Premium</td>
<td>9.6</td>
<td>+75%</td>
</tr>
</tbody>
</table>

The International Energy Agency estimates:
- Motors and motor driven systems consume 40% of electricity worldwide.
- Motors as a percentage of industrial electricity demand is thought to be as high as 60-70%.

If all economies used best practice motor “systems” electricity consumption by 2030 would decline by 10%, eliminating as much as 3000 Terawatt Hours (Terawatt = 10^{12} W) of demand and from 1.3 to 1.8 giga-tonnes of CO_{2}.

Let us start with carbon. What is 1.8 Giga-tonnes of CO_{2}?
- More than 500 coal-fired plants of 500MW each
- About 1.5 x current emissions from energy of India, or of Japan
- 300 times current U.S. wind energy capacity
- 3 times the much-touted energy savings from phasing out incandescent lights in favor of compact fluorescent bulbs, or CFLs

Interesting, but now let us make it simple to understand. What is 3000TWh?
- That represents about 75% of current yearly US electricity demand... 75%

Let us ask again what is 1.8 giga-tonnes of CO_{2}?

Answer: about twice the Kyoto protocol if all countries were to meet their targets. So, the motor market provides grand potential...for copper and for funding of copper promotion.
• ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping us all save money and protect the environment through energy efficient products and practices.

**Heating & Cooling**
• Geothermal heat pumps add 340 kg of Cu and reduce energy costs by 45%
• Energy Efficient air conditioners reduce costs by 14%
  • Multi-unit management is more efficient and drives copper

**Water Heating**
• Solar supplemented water heating is much more efficient and adds 500 kg or more in copper
• Tankless water heaters save 8% - 34% (depending on use)

**Energy Efficient Appliances**
• Refrigerators are 20% more efficient
• Dishwashers 10%
  • Utilize high efficiency motors
Similar drivers to Residential efficiency, but more profound in commercial applications.

U.S. building
   40% of U.S. energy; 71% of U.S. electricity
   25% of the carbon solution for the U.S.

LEED certified floor space is rising exponentially. Not just a climate change argument, also an economic argument. Studies show LEED certified buildings command:
   10% rental premium
   30% sales price premium

US Green Building Council membership up from 500 in 2000 to 12,000 members now

Green Buildings make economic sense:
Green is helping to increase the copper content in new vehicles. With the push to hybrid power trains and greater electrical functionality, copper will find increased use for:

- Electric motors
- Wiring and connectors
- Steering
- Brakes
- Power electronics and
- Battery technology

The superior conductivity of copper makes it the material of choice for these electrical applications.
As the evolution of vehicles increasingly eliminate the internal combustion engine (ICE), more copper is needed to power the zero emission vehicles.
Antimicrobial Copper

A new market for an ancient application...

Brass mutka from rural India

“Infections acquired during hospital stays kill more people than breast cancer, auto accidents and AIDS combined.”

- Dan Childs, ABC News, Medical Unit
In the U.S. alone, on average there are 3 million hospital acquired infections annually (you go into the hospital with an ailment or injury and come out with a potentially deadly infection)
  - About 110,000 of those infections result in death
  - Conservative estimates put the cost of fighting those infections at $30 billion
Copper is the only material to be registered by the US EPA for its inherent antimicrobial health benefits
Copper has been tested on some of the deadliest, most problematic bacterial strains including:
  - MRSA
  - e Coli
  - Staph
  - Others
Studies of “clean” touch surfaces reveal that bacteria (Colony Forming Units) remain present.
- The bed hand rail – 18,000 CFU/100cm²
- Side of the bed rail – 8,400
- Touch pads on equipment – 3,000 to 4,000
- Administrative three ring binders – 2,320 CFU/100cm²
- Exposure becomes pathogenic at 50 CFU’s.

And we expect to see more copper touch surfaces in health care and educational facilities as demand for antimicrobial copper products increases. In addition to the products you see here, CDA is also working with companies to manufacture IV stands, door and window hardware, computer keyboards and even exercise equipment.
• Copper is, pretty much, **indestructible**

• Copper has a very long life

  • Life Cycle of **New** Copper Scrap ~ 30 Days

  • Life Cycle of **Old** Copper Scrap
    - Electrical plants and machinery 30 years
    - Non-electrical machinery 15 years
    - Housing 45 years
    - Transportation 10 years
    - **Average** ~25 years
Copper has improved quality of life since the beginning of civilization

- Malleable & Ductile
- Corrosion Resistant
- Aesthetics
- Electrical Conductivity
- Thermal Conductivity
- Essential Nutrient for Life
- Antimicrobial
- Recyclable

Essential for Green