Authors: **Fosheim, J., Baum, C., Borth, B., Gruenwald, B., Nasserifar, P., VanHeeren, G., Krueger, K.*, Palumbo, R.***
***Advisors**

Department: Mechanical Engineering

Faculty Sponsors: Palumbo, R., Beyers, E., Diver, R. (Diver, Solar LLC), Duncan, S., Fosheim, J., Kissinger, P. (Purdue University), Nudehi, S., Ogland-Hand, J., Saks, L. (Chrysler Corporation), Schoer, J., Schrader, A., Venstom, L.

Title: *Environmental and Economically Conscious Magnesium Production: Solar Thermal Electrolytic Production of Mg from MgO*

Abstract:

One method to improve the fuel efficiency of American made vehicles is to reduce vehicle weight by substituting steel components with lighter magnesium (Mg) components. Unfortunately, U.S. produced Mg currently costs approximately $3.31 per kg, over seven times the price of steel. Furthermore, Mg production has a staggering energy and environmental impact, consuming up to 102 kW-hr/kg-Mg of energy and producing 36 kg of CO_2/kg-Mg.

To reduce the overwhelming economic and environmental impact of Mg, a new solar thermal electrolytic process has been developed for the production of Mg from MgO. Through this process, liquid Mg is produced in a solar reactor utilizing both thermal and electrical energy. At elevated temperatures, the thermal energy from concentrated sunlight reduces the required electrical work below that of current processes. The reactor absorbs the concentrated solar energy, heating a molten salt-MgO mixture in an electrolytic cell. Electricity is then supplied to the cell, producing liquid Mg and CO.

It is estimated that this new process will produce Mg at $2.50 per kg, with costs decreasing as the technology is further developed. This process requires approximately 8.3 kW-hr/kg-Mg of energy and produces only 3.44 kg of CO_2/kg-Mg, large reductions compared to current processes.