Mining and mineral processing have occurred since the earliest times, producing materials for the manufacture of all types of useful objects, devices, shelter, and infrastructure. Half a century ago, it became paramount to mine and process minerals while protecting the environment and insuring the sustainability of Earth's resources.

Today, the multinational extraction and processing industry is making another step toward sustainability by refining present technologies that often result in waste. This waste can be commercially costly and environmentally hazardous when released into the air, ground, and water; in addition, significant amounts of minerals or metals can be lost to waste. The industry's goal is now to devise new reprocessing, recycling, and protection methods that comply with demands for responsible and sustainable business practice which could also turn hazardous waste into a profit generator.

Paul F. Duby is a prominent researcher in the areas of applying electrochemical principles and technologies to improve and design new mineral processing protocols. Examples of his and his students' work include a patent on fuel-assisted electrolytic metal extraction that lowers energy consumption and carbon dioxide emissions; a process to remove heavy metals and other contaminants like arsenic from sediments or from wastewaters; a recycling method that uses electrolysis on industrial waste to recover heavy metals and solar cell material; and a chemistry modification that improves hydrometallurgical processes.

His contributions to the reduction of energy consumption include the use of more efficient anodes for the production of metals in aqueous solutions and the electrolysis of mixtures of molten chlorides for the production of heavy metals or rare earths. The modeling of a hybrid system consisting of a high-temperature fuel cell and gas turbines that converts about 75 percent of the low heating value of natural gas to electric energy is an example of improvement of the efficiency of a power plant.

Corrosion and the resulting degradation of materials properties are natural processes that affect sustainability. Professor Duby has contributed to a better understanding of corrosion typically found on super alloys used on plane engines and steels for non-traditional power plants, and was part of the consulting faculty engineering team that designed and supervised the testing of and development of a rehabilitation and maintenance program for the Williamsburg Bridge in New York City.

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Driving Efficiency and Sustainability into Materials Processing and Energy

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