Multidisciplinary Campus Demonstration of a Biomass Alliance with Natural Gas

Alex E.S.Green, Mechanical and Aerospace Engineering,
Wayne H. Smith, School of Forest Resources and Conservation
Alan W. Hodges, Food and Resource Economics
University of Florida
Gainesville, Florida 32611

ABSTRACT: Recent increases in imports and prices of natural gas are posing threats to university budgets as well as to the U.S. economy and trade balance. The possibility of using local biomass with natural gas thus could have many campus, local, regional and national benefits. To facilitate an alliance involving these two fuels we use an analytic cost estimation (ACE) method to determine natural gas (NG) prices at which a biomass integrated gasification (BIG) co-generation (CG) systems can deliver electricity at costs competitive with strict natural gas (NG) systems. The analysis is essentially based on the approximate linear relationship between cost of electricity, COE (Y) and cost of fuel COF(X) seen in many detailed cost analyses, i.e., $Y = K + SX$. Here Y = COE is in ct/kwh and X = COF is in $/Mbtu (M stands for million) and K is the COE when the fuel comes free. The constant K reflects the capital investment, normal rate of owner return, the operation and maintainance (O&M) cost and in this application also educational benefits of the facility. The slope S of the Y(X) line is in ct/kwh/$/Mbtu or 10,000btu /kwh and approximately relates to the efficiency (Ef) by $S = 32.14/Ef$. A number of university campuses in the United States have NGCG systems that provide combined heat and power to their buildings. Synthetic gas (syngas) was widely used before cheap natural gas became available after World War II. Natural gas prices are projected to continue to rise because of depletion and syngas prices to decrease because of BIG technology advances. This paper focuses on the development of a multidisciplary platform for a campus educational and research effort to minimize the cost of electricity and heat on the campus while demonstrating appropriate green fuel technologies based upon use of biomass to supplement or replace natural bass. Biomass stores are abundant, in many rural areas, particularly in north Florida. The biomass supply side of the study will report on the many factors that influence X = COF including the economic availability of biomass, the delivery costs of farm and forest residues, energy crops and other suitable sources such as campus organic landscaspe debris and paper and other available cellulosic material. Engineering will focus on the many factors that influence the S or Ef, in terms of thermodynamic analyses of the available facility or potentially retrofitted facilities. Economic analyses will also address the many factors that effectively reduce K. The development of multidiscipinary student and faculty team to investigate the various factors involved in assessing the benefits of such a campus project will be a major part of the study and could be part of a curriculum on renewable energy for co-generation. Under the land grant university mission of the University of Florida, the new knowledge will be extended to interested stakeholders that can apply the technology of local biomass production, delivery and use for energy while providing jobs, stabilizing local economies and reducing our dependence on imported fuels.