

Life Cycle Metrics for Comparing Alternative Electricity Generating Technologies

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The use of energy and the production of electricity are known to contribute significantly to global sustainability challenges such as non-renewable resource depletion, greenhouse gas production, and acidification. Renewable energy sources are being promoted to address these issues. LCA offers a useful framework for evaluating the full costs and benefits of alternative renewable technologies. Key life cycle metrics supporting differentiation of electricity generating technologies include: energy ratio (net energy ratio and external energy ratio); net emissions of greenhouse gases; net acidification potential of emissions; total life cycle cost (private and social); and total land area requirements. These metrics, derived from life cycle inventory results, help clarify the societal tradeoffs associated with competing energy technology options.

In this paper we consider several “cradle to grid” LCI studies of renewable and nonrenewable electricity generating technologies relative to the proposed life cycle metrics. Technologies considered include: coal fired boilers; natural gas boilers and turbines; willow biomass gasification, direct fire, and co-firing with coal; and building integrated photovoltaics. The results of this investigation support enhanced understanding of the potential role of renewable technologies in a sustainable energy portfolio.