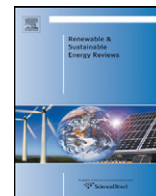




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Sustainable energy systems: Role of optimization modeling techniques in power generation and supply—A review

Aqeel Ahmed Bazmi^{a,b}, Gholamreza Zahedi^{a,*}^a Process Systems Engineering Centre (PROSPECT), Chemical Engineering Department, Faculty of Chemical Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor Bahru, Malaysia^b Biomass Conversion Research center (BCRC), Department of Chemical Engineering, COMSATS Institute of Information Technology, Lahore, Pakistan

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ABSTRACT

Electricity is conceivably the most multipurpose energy carrier in modern global economy, and therefore primarily linked to human and economic development. Energy sector reform is critical to sustainable energy development and includes reviewing and reforming subsidies, establishing credible regulatory frameworks, developing policy environments through regulatory interventions, and creating market-based approaches. Energy security has recently become an important policy driver and privatization of the electricity sector has secured energy supply and provided cheaper energy services in some countries in the short term, but has led to contrary effects elsewhere due to increasing competition, resulting in deferred investments in plant and infrastructure due to longer-term uncertainties. On the other hand global dependence on fossil fuels has led to the release of over 1100 GtCO₂ into the atmosphere since the mid-19th century. Currently, energy-related GHG emissions, mainly from fossil fuel combustion for heat supply, electricity generation and transport, account for around 70% of total emissions including carbon dioxide, methane and some traces of nitrous oxide. This multitude of aspects play a role in societal debate in comparing electricity generating and supply options, such as cost, GHG emissions, radiological and toxicological exposure, occupational health and safety, employment, domestic energy security, and social impressions. Energy systems engineering provides a methodological scientific framework to arrive at realistic integrated solutions to complex energy problems, by adopting a holistic, systems-based approach, especially at decision making and planning stage. Modeling and optimization found widespread applications in the study of physical and chemical systems, production planning and scheduling systems, location and transportation problems, resource allocation in financial systems, and engineering design. This article reviews the literature on power and supply sector developments and analyzes the role of modeling and optimization in this sector as well as the future prospective of optimization modeling as a tool for sustainable energy systems.

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* Corresponding author. Tel.: +607 553583; fax: +607 5566177.

E-mail address: grzahedi@cheme.utm.my (G. Zahedi).