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Benefits of Energy Efficiency Programs for Residential Buildings in Bahrain

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Abstract:

This paper outlines the approach and the cost-effectiveness potential for designing and retrofitting residential buildings to be energy-efficient in Bahrain. The analysis is focused on residential buildings since these buildings consume over 48% of the total electricity used in Bahrain. The optimization analysis has the benefit to assess both at the individual building and the national building stock levels, the potential of the application of currently proven measures and technologies to improve the energy efficiency of the building sector in Bahrain. A sequential search technique is utilized to optimize the design of residential buildings in Manama in order to minimize life cycle energy costs using a wide range of energy efficiency measures. In the analysis, design features of air-conditioned single-family homes are considered including orientation, window location and size, glazing type, wall and roof insulation levels, lighting fixtures, appliances, and efficiencies of heating and cooling systems. Based on the optimization results, the potential energy use savings obtained for the optimal designs as well as the size of the photovoltaic panels required for net-zero energy residential building designs are estimated for Bahrain. Then, the economic and environmental impacts of developing and enforcing a more stringent building energy efficiency code are evaluated for Bahrain. The analysis indicates that the development and enforcement of a more stringent building energy efficiency code improve the energy productivity of buildings as well as the country with reduction of over 320 GWh in annual electricity consumption and 87 MW in peak demand. The analysis extended to the existing residential building stock indicates that Bahrain has the potential to cost-effectively decrease its energy consumption in the building sector by 62% with a reduction of 55% in its electrical peak demand in the future compared to the business as usual scenario.

Keywords: Bahrain, Energy-Efficient Measures, Life Cycle Cost, Net-Zero Energy, Optimization, PV System, Residential Buildings

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