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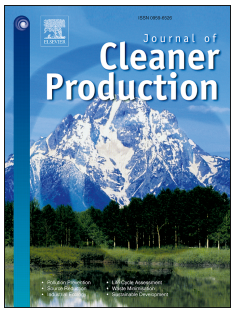

Energy-conscious unrelated parallel machine scheduling under time-of-use electricity tariffs

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Energy-conscious unrelated parallel machine scheduling under time-of-use electricity tariffs

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Abstract: This paper investigates an energy-conscious unrelated parallel machine scheduling problem under time-of-use (TOU) electricity pricing scheme, in which the electricity price varies throughout a day. The problem lies in assigning a group of jobs to a set of unrelated parallel machines and then scheduling jobs on each separate machine so as to minimize the total electricity cost. We first build an improved continuous-time mixed-integer linear programming (MILP) model for the problem. To tackle large-size problems, we then propose a two-stage heuristic. Specifically, at the first stage, jobs are assigned to machines aiming at minimizing the total electricity cost under the preemptive circumstance. At the second stage, the jobs assigned to each machine are scheduled using an insertion heuristic. Computational results on a real-life instance for turning process and random test instances demonstrate that the proposed MILP approach is able to solve small-size problems while the two-stage heuristic is appropriate for large-size problems. The case study for turning process also reveals that the proposed optimization approaches can contribute to cleaner production.

Keywords: Energy-conscious scheduling; Unrelated parallel machines; Time-of-use (TOU) tariffs; Electricity cost; Two-stage heuristic

1. Introduction

The rapid development of global economy has been demanding more energy and the shortage of energy is threatening the overall development of many countries. Energy saving has attracted huge attention in recent years due to the fact that a large proportion of resources for energy generation are nonrenewable (Tacconi, 2000) and that energy consumption has grown by as much as 300% over the last 50 years (Park et al., 2009). Inappropriate usage of energy has also brought about the serious problem of excessive