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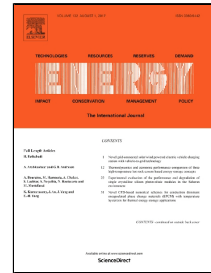
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PII: S0360-5442(17)31214-8  
DOI: 10.1016/j.energy.2017.07.039  
Reference: EGY 11227  
To appear in: *Energy*  
Received Date: 12 May 2017  
Revised Date: 29 June 2017  
Accepted Date: 08 July 2017

Please cite this article as: Wei Cai, Fei Liu, Jun Xie, Peiji Liu, Junbo Tuo, A tool for assessing the energy demand and efficiency of machining systems: Energy benchmarking, *Energy* (2017), doi: 10.1016/j.energy.2017.07.039

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# A tool for assessing the energy demand and efficiency of machining systems: Energy benchmarking

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## Abstract

Energy benchmarking has been recognized as an effective analytical methodology and management tool to improve energy efficiency and performance. Many approaches to energy benchmarking have been applied in various fields. Machining systems, which are widely distributed and consume large amounts of energy with low efficiency, possess considerable potential for reductions in energy consumption. However, current research regarding the use of energy benchmarking for machining systems is insufficient due to the complexity and variety of energy consumption processes used in these systems. This paper proposes the use of energy benchmarking to strengthen the evaluation of energy demand and achieve efficiency improvements for machining systems. First, it analyses drivers for energy benchmarking and their characteristics. Next, an energy benchmarking framework for machining systems is presented. Then the concepts of static, dynamic, single-objective, multi-objective, product-based, and process-based energy benchmarking are discussed from three different perspectives: the motion, object, and application level. This lays a theoretical foundation for further energy benchmarking research. Finally, methods for developing energy benchmarking are also addressed including the prediction method, statistical analysis, and expert decision. The application of these methods to a real machining plant allows an analysis of the practicability of potentially saving energy through benchmarking.

**Keywords:** Energy benchmarking; Machining systems; Energy assessments; Energy demand; Energy efficiency; Energy consumption

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