

# Preface

## Subject

The growing awareness of energy demand and concerns about climate change from within the manufacturing industry as well as the public and legislators has created the concept of sustainable manufacturing. The purpose of sustainable manufacturing is to process resources into products while keeping the equilibrium with ecological, social, and financial systems. Smart energy management is a key component required to realize sustainable manufacturing where analytics are considered as an effective means to achieve the smart energy management. Although analytics have been popularly used by energy utility companies in the energy-sourcing sector, the energy-consuming sector including the manufacturing industry has little benefit to date from analytics due to the lack of suitable tools and applications.

This book is written to introduce analytical tools and applications with illustrative examples with an attempt to address issues and problems raised during the process of realizing smart energy management for sustainable manufacturing focused on automotive manufacturing industry. This book would be distinguishable because it targets the energy management of automotive manufacturing facilities, which involves most types of manufacturing technology and various levels of energy consumption. Through illustrative applications of analytics to automotive manufacturing, this book will demonstrate how analytical tools can help improve energy management processes including forecasting, consumption, performance analysis, and emerging new technology identification as well as investment decision for establishing smart energy consumption practices. Analytical tools introduced in the book include stochastic frontier analysis, data envelopment analysis, machine learning for pattern detection and recognition, activity-based forecasting, stochastic optimization as well as energy process simulation.

This book also details practical energy management systems in the last two chapters to round out the theory portions in earlier chapters, making it a valuable resource for professionals involved in real energy management processes.

## Audience and Style

The intended audience of this book includes:

- Graduate school students including engineering programs, technology management programs, and MBA programs
- Third/fourth-year undergraduate students pursuing environment engineering, mechanical engineering, civil engineering, industrial engineering, and management information system (MIS) degrees
- Practitioners in the areas of energy and environment management with an interest in using data or model-driven analytics

This book uses mathematical formulations of various analytical solutions aligned with smart energy management processes including forecasting, simulation, performance analysis, decision making, and operation. However, this book emphasizes the practical application of theories and interpretations of the mathematical formulations by introducing various illustrative examples. Moreover, this book provides exercises at the end of each chapter and manuals for Excel Solver, Python and EnergyPlus<sup>TM</sup> in Chaps. 2, 5, and 7, allowing readers to implement the presented procedures and applications in their projects and studies.

Instructors may use this unique book style to bring in rich learning benefits for students. If a student is a working professional involved in real energy management processes, he/she may replicate procedures presented in this book to implement new projects in his/her facility or practice. If a student is a full-time student without practical experience, meanwhile, he/she can earn rich industry knowledge, therefore, become better prepared for future industry carrier.

## Acknowledgements

The book reflects intuitions, experiences and material that the authors have acquired from real-world projects. We would like to thank numerous people who had been involved in those projects.

Our special thanks to Mr. Anthony Doyle, Senior Editor, Engineering at Springer London, for his kind invitation in publishing this book and also to all of those involved in the publication process.

We also would like to thank to our family members for their support and encouragement through the preparation of this book: Ki-Won Oh, Alex Oh, and Frances Hildreth.

March 2016

Seog-Chan Oh  
Alfred J. Hildreth  
GM Warren Tech Centre

Analytics for Smart Energy Management

Tools and Applications for Sustainable Manufacturing

Oh, S.-C.; Hildreth, A.J.

2016, XI, 295 p. 117 illus., 96 illus. in color., Hardcover

ISBN: 978-3-319-32728-0