## Contents

**Preface**

Foreword .......................................................... iii

**Green Software Services**

Green Software Services: From Requirements to Business Models  
Schahram Dustdar, Fei Li, Hong-Linh Truong, Sanjin Sehic, Stefan Nastic, Soheil Qanbari, Michael Vögler, and Markus Claëßens — *TU Vienna, Austria* .................................................. 1

Green Web Services: Improving Energy Efficiency in Data Centers via Workload Predictions  
Massimiliano Menarini, Filippo Seracini, Xiang Zhang, Tajana Rosing, and Ingolf Krüger — *UC San Diego, USA* .................. 8

Investigating the Impacts of Web Servers on Web Application Energy Usage  
Irene Manotas, Cagri Sahin, James Clause, Lori Pollock, and Kristina Winbladh — *University of Delaware, USA* ..... 16

Energy-Efficiency Indicators for e-Services  
Jeroen Arnoldus, Joris Gresnigt, Kay Grosskop, and Joost Visser — *Software Improvement Group, Netherlands; Logius, Netherlands; Radboud University Nijmegen, Netherlands* .................. 24

**Metrics and Measurements**

SEFLab: A Lab for Measuring Software Energy Footprints  
Miguel A. Ferreira, Eric Hoekstra, Bo Merkus, Bram Visser, and Joost Visser — *Software Improvement Group, Netherlands; Hogeschool van Amsterdam, Netherlands; Radboud University Nijmegen, Netherlands* .................. 30

A Method for Characterizing Energy Consumption in Android Smartphones  
Luis Corral, Anton B. Georgiev, Alberto Sillitti, and Giancarlo Succi — *Free University of Bolzano, Italy* .................. 38

A Systematic Literature Review for Software Sustainability Measures  
Coral Calero, Manuel F. Bertoa, and Ma Ángeles Moraga — *University of Castile–La Mancha, Spain; University of Malaga, Spain* .................. 46

Towards Application-Specific Impact Specifications and GreenSLAs  
Colin Atkinson and Thomas Schulze — *University of Mannheim, Germany* .................. 54

**Green Software Lifecycle**

Energy-Directed Test Suite Optimization  
Ding Li, Cagri Sahin, James Clause, and William G. J. Halfond — *University of Southern California, USA; University of Delaware, USA* .................. 62

Who Is the Advocate? Stakeholders for Sustainability  
Birgit Penzenstadler, Henning Femmer, and Debra Richardson — *TU Munich, Germany; UC Irvine, USA* .................. 70

Green Software Engineering with Agile Methods  
Markus Dick, Jakob Drangmeister, Eva Kern, and Stefan Naumann — *Trier University of Applied Sciences, Germany* .................. 78