

Navigating Energy Trilemma For **NET ZERO 2050** Transition

Editors
Norazana Ibrahim
Asiah Nusaibah Masr



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Navigating Energy Trilemma For **NET ZERO 2050** Transition

Achieving Net Zero by 2050 demands disruptive technologies and actionable strategies and this book delivers both. Featuring original research from prominent Malaysian lecturers and researchers, the volume explores advanced approaches in carbon capture, biomass valorization, green solvent systems, and sustainable coatings. Each chapter presents real-world applications, from utilizing pineapple waste biochar for CO₂ removal to designing surfactants for enhanced oil recovery. More than a collection of academic insights, this book is a call to action for researchers, professionals, and policy-makers dedicated to climate resilience. Its interdisciplinary focus bridges gaps between chemistry, environmental science, and engineering offering readers not just knowledge, but inspiration. Whether you're advancing sustainability in academia or industry, this book will inform and energize your mission.



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Publisher
UTM Press



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www.penerbit.utm.my

2025

First Edition 2025
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Editor/Editors: **NORAZANA IBRAHIM & ASIAH NUSAIBAH MASRI**
Editor Penyelaras/Acquisition Editor: **RASYIQAH ABDUL RANI**
Pereka Kulit /Cover Designer: **FAHAMIN ABDUL GHANI**

Diatur huruf oleh /Typeset by:
NORAZANA IBRAHIM & ASIAH NUSAIBAH MASRI
Faculty of Chemical & Energy Engineering
UNIVERSITI TEKNOLOGI MALAYSIA
81310 UTM Johor Bahru,
Johor Darul Ta'zim, MALAYSIA

Diterbitkan di Malaysia oleh/
Published in Malaysia by:
PENERBIT UTM PRESS
UNIVERSITI TEKNOLOGI MALAYSIA
81310 UTM Johor Bahru,
Johor Darul Ta'zim, MALAYSIA
(Ahli Majlis Penerbitan Ilmiah Malaysia (MAPIM) dan
Persatuan Penerbit Buku Malaysia (MABOPA)
no. keahlian 9101)

Dicetak di Malaysia oleh/
Printed in Malaysia by:
JASAMAX ENTERPRISE
No.16, Jalan Kebudayaan 2,
Taman Universiti,
81300 Skudai,
Johor Darul Ta'zim,
MALAYSIA



Cataloguing-in-Publication Data
Perpustakaan Negara Malaysia
A catalogue record for this book is available from the
National Library of Malaysia
ISBN 978-983-52-2181-1

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PREFACE

In the global pursuit of a sustainable future, this book serves as a timely academic contribution addressing the multi-faceted challenges of achieving net zero emissions by 2050. The book brings together a diverse group of researchers to present insights into novel technologies and emerging trends in carbon capture, renewable energy, biomass utilization, and sustainable materials. These chapters aim to advance our understanding of environmental technologies and promote interdisciplinary collaboration across chemical, environmental, and energy engineering.

The impetus for compiling this work emerged from the urgent need for research-based solutions to climate change, especially in the Southeast Asian region where industrial growth and environmental responsibility must coexist. This volume is tailored for academics, researchers, and industry professionals seeking practical, scalable innovations that align with global sustainability goals.

This book is intended for a broad but specialized readership working at the intersection of sustainability, engineering, and climate action. It will be particularly valuable to academics and researchers in chemical engineering, environmental engineering, materials science, and energy systems who are exploring emerging technologies for decarbonization. Graduate students conducting research on carbon capture, biomass utilization, sustainable materials, or environmental policy will find the chapters especially useful as foundational references and as sources of methodological insight.

We express our sincere gratitude to the contributing authors for their dedication, commitment, and scholarly contributions, as well as to the editorial team for their meticulous efforts in ensuring the scientific rigor, clarity, and coherence of this publication. The book is structured across eight chapters, each presenting a standalone study that encapsulates distinct aspects of sustainability research—From innovative materials

and carbon capture technologies to energy system optimisation and policy perspectives. Yet, when read collectively, these chapters form a cohesive and integrated narrative that reflects the broader vision of energy transition and sustainable development. Readers are encouraged to approach the book according to their specific research interests or to engage with it as a whole for a more comprehensive understanding of the interconnected pathways towards a low-carbon future.

As editors with backgrounds in sustainable process engineering and environmental management, we hope this book inspires meaningful application and further research. Let this work serve not only as a repository of knowledge but also as a catalyst for change.

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Universiti Teknologi Malaysia

2025