

B

# ASEAN Energy Demand

Trends and Structural Change

Ang Beng Wah



INSTITUTE OF SOUTHEAST ASIAN STUDIES

YANNA SHIP  
FOUNDATION  
TAYASAAN  
KEMIMPINAN  
PERDANA

# ASEAN

## Energy Demand

### Trends and Structural Change

Ang Beng Wah

This is the first in-depth study of how energy has been consumed in the ASEAN region. It provides a description of the changes in the structure of energy demand that accompany the growth of the ASEAN economies and analyses their interactions. Making available a great deal of information which until now is highly scattered, it deals with four specific aspects of energy demand — trends in commercial energy consumption, economic growth and energy demand, non-commercial energy use, and energy consumption by end-use.

This study will be of interest to analysts, in academic and research institutions, government and the energy industries, who are concerned with energy management and planning, energy conservation, and demand forecasting in ASEAN and developing countries in general.





# **ASEAN Energy Demand**

The **Institute of Southeast Asian Studies** was established as an autonomous organization in May 1968. It is a regional research centre for scholars and other specialists concerned with modern Southeast Asia, particularly the multi-faceted problems of stability and security, economic development, and political and social change.

The Institute is governed by a twenty-two-member Board of Trustees comprising nominees from the Singapore Government, the National University of Singapore, the various Chambers of Commerce, and professional and civic organizations. A ten-man Executive Committee oversees day-to-day operations; it is chaired by the Director, the Institute's chief academic and administrative officer.



PERDANA  
LEADERSHIP  
FOUNDATION  
YAYASAN  
KEPIMPINAN  
PERDANA

# **ASEAN**

# **Energy Demand**

## **Trends and Structural Change**

**Ang Beng Wah**  
*National University of Singapore*

PUSTAKA PERDANA



1001470



INSTITUTE OF SOUTHEAST ASIAN STUDIES



Published by  
Institute of Southeast Asian Studies  
Heng Mui Keng Terrace  
Pasir Panjang  
Singapore 0511

*All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the Institute of Southeast Asian Studies.*

© 1986 Institute of Southeast Asian Studies

---

### Cataloguing in Publication Data

---

Ang Beng Wah

ASEAN energy demand: trends and structural change.

1. Energy consumption—ASEAN.

I. Title.

HD9502 A92A58      1986

ISBN 9971-988-43-7 (hard cover)

ISBN 9971-988-56-9 (soft cover)

---

*The responsibility for facts and opinions expressed in this publication rests exclusively with the author and his interpretations do not necessarily reflect the views or the policy of the Institute or its supporters.*

---

Typeset by Times Graphics, Singapore

Printed in Singapore by Chong Moh Offset Printing Pte Ltd

# Contents

---

List of Figures **vii**

List of Tables **viii**

Preface **x**

- 1 Introduction **1**
- 2 Trends in Commercial Energy Consumption **6**
  - Regional Commercial Energy Consumption **6**
  - Consumption in Individual Countries **10**
  - Growth of Commercial Energy Consumption **23**
  - Electricity **27**
- 3 Economic Growth and Energy Demand **34**
  - Energy and Economic Growth **34**
  - Energy Prices **39**
  - Income and Price Elasticities **44**
  - Inter-Country Comparisons of Energy-Output Ratio **49**
- 4 Patterns of Non-Commercial Energy Consumption **55**
  - Main Consumption Characteristics **55**
  - Measuring Non-Commercial Energy Consumption **60**
  - Non-Commercial Energy Demand Estimation **62**
  - The Demand-Supply Balance **68**
- 5 Structure of Sectoral Energy Demand **72**
  - The Changing Structure of Sectoral Energy Demand **72**
  - Transport **80**
  - Industry **90**
  - Household and Commercial **101**
  - The Energy Sector and Fuels for Non-Energy Use **106**
- 6 Summary and Conclusion **110**
  - Summary of Findings **110**
  - Implications on Energy Demand Management **117**

|   |     |
|---|-----|
| Appendix A  | 124 |
| Time-Series Energy Consumption Data: Definitions<br>and Methodology     |     |
| Appendix B  | 132 |
| Sectoral Energy Demand: Data Collection,<br>Definitions and Methodology |     |
| Bibliography  | 145 |
| Data Sources  | 150 |

# List of Figures

---

|      |  |    |
|------|--|----|
| 2.1  | ASEAN: Commercial Energy Consumption by Fuel Type, 1960–80                                     | 9  |
| 2.2  | ASEAN: Fuel Shares in Commercial Energy Consumption, 1960–80                                   | 9  |
| 2.3  | Indonesia: Commercial Energy Consumption by Fuel Type, 1960–80                                 | 11 |
| 2.4  | Indonesia: Fuel Shares in Commercial Energy Consumption, 1960–80                               | 11 |
| 2.5  | Malaysia: Commercial Energy Consumption by Fuel Type, 1960–80                                  | 15 |
| 2.6  | Malaysia: Fuel Shares in Commercial Energy Consumption, 1960–80                                | 15 |
| 2.7  | Philippines: Commercial Energy Consumption by Fuel Type, 1960–80                               | 17 |
| 2.8  | Philippines: Fuel Shares in Commercial Energy Consumption, 1960–80                             | 17 |
| 2.9  | Singapore: Commercial Energy Consumption by Fuel Type, 1960–80                                 | 20 |
| 2.10 | Singapore: Fuel Shares in Commercial Energy Consumption, 1960–80                               | 20 |
| 2.11 | Thailand: Commercial Energy Consumption by Fuel Type, 1960–80                                  | 22 |
| 2.12 | Thailand: Fuel Shares in Commercial Energy Consumption, 1960–80                                | 22 |
| 2.13 | Commercial Energy Consumption per Capita in ASEAN Countries, 1960–80                           | 26 |
| 2.14 | GDP per Capita in ASEAN Countries, 1960–80   | 26 |
| 2.15 | Commercial Energy Consumption in ASEAN Countries and Overall Consumption, 1960–80              | 28 |
| 2.16 | Country Shares in Commercial Energy Consumption in ASEAN, 1960–80                              | 28 |
| 2.17 | Electricity Production in ASEAN Countries and Total Production in ASEAN, 1960–80               | 30 |
| 2.18 | Electricity Production per Capita in ASEAN Countries, 1960–80                                  | 30 |
| 2.19 | Shares of Commercial Energy Consumption for Electricity Generation in ASEAN Countries, 1960–80 | 32 |
| 3.1  | Commercial Energy Consumption per Unit of GDP for ASEAN Countries, 1960–80                     | 36 |

# List of Tables

---

|     |   |    |
|-----|---|----|
| 1.  | Units and Conversion Factors  | 4  |
| 2.1 | Total Oil Consumption and Total and per Capita Commercial Energy Consumption in ASEAN, Developing Countries, OECD and the World, 1980                 | 7  |
| 2.2 | Share of ASEAN in World Commercial Energy Consumption, 1960-80  | 8  |
| 2.3 | Rates of Growth of Commercial Energy Consumption and GDP, and Energy Coefficients in ASEAN Countries and Various Other Countries, 1960-73 and 1974-80 | 24 |
| 2.4 | Rates of Growth of Electricity Production and Electricity Coefficients in ASEAN Countries, 1960-73 and 1974-80  | 29 |
| 3.1 | Real Import Prices of Crude Oil in Indices  | 40 |
| 3.2 | Estimated Real Fuel Prices in Indices for ASEAN Countries   | 41 |
| 3.3 | Malaysia: Real and Current Prices of Petroleum Products, Imported Crude Oil and Electricity, 1970-80  | 42 |
| 3.4 | Indonesia: Domestic Prices of Petroleum Products, Costs of Living Index in Jakarta and Crude Petroleum Prices, 1972-80                                | 44 |
| 3.5 | Prices of Petroleum Products 1980: Indonesia and Pulau Bukom, Singapore   | 46 |
| 3.6 | Estimates of Income and Price Elasticities of the Demand for Commercial Energy  | 47 |
| 3.7 | Energy-Output Ratios for ASEAN Countries and Selected Industrialized Countries  | 51 |
| 4.1 | Distribution of Households by Type of Fuels Used for Cooking in ASEAN Countries   | 57 |
| 4.2 | Energy Use in Cooking in Rural Households in Indonesia, 1980  | 59 |
| 4.3 | Malaysia: Variations in Energy Needs in Domestic Cooking According to Household Income  | 60 |
| 4.4 | Estimates of Domestic Energy Requirements in Cooking in Rural Areas of ASEAN Countries, and in Singapore  | 64 |
| 4.5 | Commercial Energy and Estimated Non-Commercial Energy Consumption in ASEAN Countries  | 66 |

|      |  |     |
|------|--|-----|
| 4.6  | Non-Commercial Energy Consumption Estimates for ASEAN Countries by Various Studies                               | 67  |
| 5.1  | Energy Consumption by Sector in ASEAN Countries, 1960, 1972 and 1980   | 74  |
| 5.2  | Cross-Country Comparisons of Energy Consumption by Sector 1980   | 78  |
| 5.3  | Electricity Consumption by Sector in ASEAN Countries, 1960, 1972 and 1980  | 79  |
| 5.4  | Energy Use for Transport and Related Transport Statistics in ASEAN Countries, 1980                               | 82  |
| 5.5  | Ratio of Gasoline to Motor Diesel Prices in ASEAN Countries  | 87  |
| 5.6  | Estimated Energy Intensities of Passenger and Freight Transport by Mode in the ASEAN Region, 1980                | 88  |
| 5.7  | Modal Split of Passenger Traffic and Freight Traffic in Malaysia, 1980   | 89  |
| 5.8  | Commercial Energy Consumption in Industry in ASEAN Countries, 1980   | 90  |
| 5.9  | Estimated Rates of Growth of Industrial Energy Use and Industrial Output in ASEAN Countries, 1960-72 and 1972-80 | 92  |
| 5.10 | Structure of Manufacturing Industry in ASEAN Countries   | 96  |
| 5.11 | Energy per Value-Added by Sector in Industry   | 98  |
| 5.12 | Energy Costs as a Percentage of Industrial Production Costs  | 100 |
| 5.13 | Average per Capita Energy Consumption in the Household and Commercial Sector in ASEAN Countries, 1980            | 102 |
| 5.14 | Variations in Household Electricity Use According to Household Income, Malaysia                                  | 103 |
| 5.15 | Household Electricity Usage in Singapore   | 104 |
| 5.16 | Average Household Energy Consumption and Mean Household Income by Type of Premise, Singapore                     | 105 |
| 5.17 | Energy Own-Use and Losses in the Energy Sector in ASEAN Countries, 1980  | 107 |
| A1   | Energy Equivalents of Fuels  | 131 |
| B1   | ASEAN Energy Balance: General Format   | 141 |
| B2   | ASEAN Energy Balance, 1960   | 142 |
| B3   | ASEAN Energy Balance, 1972   | 143 |
| B4   | ASEAN Energy Balance, 1980   | 144 |

# Preface

---

Energy demand is one of the most difficult areas to study on energy in developing countries because of the paucity of good data. It is, therefore, not surprising that our current understanding of energy use in developing countries is fairly limited compared to that for the industrialized world. Yet knowledge of the structure and the mechanisms of change in energy use is crucial to energy planning and policy formulation. In particular, it assists planners and policy makers in assessing future energy requirements, fuel substitution, and policies for energy production, use and conservation.

As a contribution to energy demand studies in developing countries, this book deals with how energy has been used in five ASEAN countries, namely, Indonesia, Malaysia, the Philippines, Singapore and Thailand. It concentrates on four major aspects of energy use: trends in commercial energy consumption, energy demand and economic growth, non-commercial energy use, and energy consumption by end-use. The analysis is based on energy data collected from sources which until now are highly scattered and uncoordinated. One main objective is to provide a description of the changes in the structure of energy demand that accompany the growth of these economies and to analyse their interactions. Another objective is to make inter-country comparisons to identify systematic differences in energy use. By accounting energy demand in a harmonized manner, this book is able to provide a consistent picture of the mechanisms of change in energy use in these countries.

The main body of this work was completed in 1984 at the Institute of Southeast Asian Studies (ISEAS) but much of the energy data was collected and analysed between 1977 and 1983 while I was with the Cambridge Energy Research Group (CERG) in the Cavendish Laboratory of Cambridge University. I am indebted to several individuals who have contributed their time or sources of information, without whom this book could not have been completed in its present form. I wish to thank Richard Eden and Richard Bending of CERG, Joe Stanislaw of Cambridge (USA) Energy Research Associates, Sir Austin Robinson of Cambridge University, Gareth Price, Alan Clarke and Hans DuMouline (formerly) of Shell International, John Mitchell of British Petroleum, and William Humphrey and Irfan ul Haque of the World Bank. I am grateful to ISEAS for providing me with financial support and to the Director, Kernial Singh Sandhu, for his kind assistance at all times. My thanks should also go to Agustin

Kintanar, Jr. and Hans Christoph Rieger of the ASEAN Economic Research Unit of ISEAS. All the persons mentioned are, of course, by no means responsible for my views and conclusions expressed in this book.

The study relies heavily on official data, both published and unpublished, and unpublished data kindly provided by several energy industries. I am indebted to Shell International and British Petroleum and their subsidiaries in the ASEAN region, ESCAP of the United Nations, the World Energy Conference, the National Electricity Board of Malaysia, Petronas, the National Energy Administration of Thailand, the Public Utilities Board of Singapore, and the Ministry of Energy of the Philippines.

Last, but not least, I wish to thank Triena Ong and Pauline Khng, respectively managing editor and editor of ISEAS, for performing the complicated task of manuscript co-ordination, and the support staff of the Institute.

Ang Beng Wah

