

ROUTLEDGE FOCUS

POWER INTERCONNECTION IN SOUTHEAST ASIA

Anthony David Owen, Anton
Finenko, and Jacqueline Tao

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Focus

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Power Interconnection in Southeast Asia

Providing an analysis of multilateral power markets, this book examines power interconnection in Southeast Asia, especially among the ASEAN countries.

It uses evolutionary experience of electricity interconnection and trade in three international markets that have relevance for ASEAN to draw upon common global themes. Specifically, it compares the Southern African Power Pool, the European grid, and Nord Pool. Discussing the progress made among ASEAN countries in regional energy integration, with a particular focus on the Greater Mekong Sub-region interconnection, it also examines the recently announced interconnection concept between Lao People's Democratic Republic, Thailand, Malaysia, and Singapore.

Exploring the challenges facing ASEAN interconnection of power grids in the context of previous experience elsewhere in the world, this book presents a template for appropriate best practice in terms of technical, political, and financial requirements. It will therefore be of value to decision makers interested in the political economy of energy in Southeast Asia, as well as academics working on Energy Politics and Southeast Asian Politics.

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Power Interconnection in Southeast Asia

**Anthony David Owen,
Anton Finenko, and
Jacqueline Tao**

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Abbreviations and acronyms

ACE	ASEAN Centre for Energy
ACER	Agency for the Cooperation of Energy Regulators
ADB	Asian Development Bank
AEC	ASEAN Economic Community
AEMI	ASEAN Energy Market Integration
AERN	ASEAN Energy Regulators' Network
AIMS	ASEAN Interconnection Master Plan Studies
APAEC	ASEAN Plan of Action for Energy Cooperation
APG	ASEAN Power Grid
APGCC	ASEAN Power Grid Consultative Committee
ASEAN	Association of South-East Asian Countries
BBL	Billion Barrels
CBA	Cost-Benefit Analysis
CEC	Copperbelt Energy Corporation
CEE	Central and Eastern Europe
CEER	Council of European Energy Regulators
CfD	Contract for Difference
CHP	Combined Heat and Power
CO ₂	Carbon Dioxide
COD	Commercial Operations Date
COMESA	Common Market for Eastern and Southern Africa
CSG	China Southern Power Grid
CWE	Central and Western Europe
DIS	Directorate of Infrastructure and Services
DRC	Democratic Republic of the Congo
DSOs	Distribution System Operators
EC	European Commission
EDC	Electricité du Cambodge
EDL	Electricité du Laos
EDL-Gen	EDL-Generation

x *Abbreviations and acronyms*

EDM	Electricidade de Mozambique
EE	Economic Exchange
EGAT	Electricity Generating Authority of Thailand
EIA	Energy Information Administration
EMA	Energy Market Authority, Singapore
EMC	Energy Market Company
ENTSO-E	European Network of Transmission System Operators for Electricity
EPAD	Electricity Price Area Differentials
EPPO	Energy Policy and Planning Office
ERC	Energy Regulatory Commission
ERIA	Economic Research Institute for ASEAN and East Asia
ERRA	Energy Regulators Regional Association
ESI	Energy Studies Institute, Singapore
ETS	Emissions Trading Scheme
EU	European Union
EU-ETS	European Union Emission Trading Scheme
FPM	Forward Physical Market
FPM-M	Forward Physical Market – Monthly
FPM-W	Forward Physical Market – Weekly
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GMS	Greater Mekong Sub-region
Gt	Gigaton
GW	Gigawatts
GWh	Gigawatt-hour
HAPUA	Heads of ASEAN Power Utilities/Authorities
HPP	Hydropower Plant
HVAC	High-voltage Alternating Current
Hz	Hertz
ICEM	International Centre for Environmental Management
ICER	International Confederation of Energy Regulators
IEA	International Energy Agency
IEEJ	Institute of Energy Economics, Japan
IGSO	Independent Grid System Operator
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
IREP	Institute of Renewable Energy Promotion
ISO	Independent System Operator
ITCs	Independent Transmission Companies
ITO	Independent Transmission Operator
KAS	Konrad-Adenauer-Stiftung

Kton	Kiloton
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
Lao	PDR Lao People's Democratic Republic
LEC	Lesotho Electricity Corporation
LHSE	Lao Holding State Enterprise
LMB	Lower Mekong Basin
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LTMS	Lao PDR, Thailand, Malaysia, and Singapore
MD	Maximum Demand
MEA	Municipal Electricity Agency
MEDREG	Association of Mediterranean Energy Regulators
MEM	Ministry of Energy and Mines
MFO	Medium Fuel Oil
mmBtu	Million British Thermal Units
MMT	Million Metric Ton
MoE	Ministry of Energy
MoF	Ministry of Finance
MOTRACO	Mozambique Transmission Company
MoU	Memorandum of Understanding
Mt	Million Tonnes
MTI	Ministry of Trade and Industry, Singapore
Mtoe	Million Tonnes Oil Equivalent
MW	Megawatt
MWh	Megawatt-hour
NARUC	National Association of Regulatory Utility Commissioners
NordREG	Nordic Energy Regulator
NP	Non-operating Members
NRAs	National Regulatory Agencies
O&M	Operation and Maintenance
OP	Operating Members
OTC	Over the Counter
PCI	Projects of Common Interest
PEA	Provincial Electricity Agency
PIDA	Programme for Infrastructure Development in Africa
PP	Power Purchase
PPA	Power Purchase Agreement
PRC	People's Republic of China
PV	Photovoltaic
RECS	Regional Economic Communities

REMIT	Regulation on Energy Market Integrity and Transparency
RERA	Regional Electricity Regulators Association
RM	Malaysian Ringgit
RPCC	Regional Power Coordinating Center
RPTCC	Regional Power Trade and Coordinating Committee
SADC	Southern African Development Community
SADCC	Southern African Development Coordination Conference
SAPP	Southern African Power Pool
SB	Single Buyer
SEC	Swaziland Electricity Company
SNEL	Societe Nationale d'Electricite
SPP	Small Power Producer
SPV	Special-Purpose Vehicle
SRMC	Short-Run Marginal Cost
TAGP	Trans-ASEAN Gas Pipeline
TAU	Technical and Administrative Unit
TBA	To Be Advised
TBC	To Be Confirmed
tcf	Trillion Cubic Feet
TNB	Tenaga Nasional Berhad
toe	Tonnes of Oil Equivalent
TPA	Third-party Access
TSOs	Transmission System Operators
TWh	Terawatt-hour
TYNDPs	Ten-Year-Network-Development-Plans
UK	United Kingdom
UN	United Nations
UNSCR	United Nations Security Council Resolution
US\$	US Dollar
USAID	United States Agency for International Development
USc	US Cents
VRE	Variable Renewable Energy
VSPP	Very Small Power Producer
XBID	Cross-Border Intraday Market Project
ZESA	Zimbabwe Electricity Supply Authority
ZESCO	Zesco Limited

Introduction

The demand for electricity is steadily increasing in Southeast Asian countries as the result of ongoing economic and population growth. Although these countries have abundant and diversified energy resources, the uneven distribution of these resources and different stages of economic development between individual countries make addressing growing demand requirements challenging. The International Energy Agency (IEA) estimates that the Association of Southeast Asian Nations (ASEAN) will need to deploy, in aggregate, 354 gigawatts (GW) of additional capacity for power generation by 2040 which would require investments of US\$618 billion in generation and US\$690 billion in the transmission and distribution sectors.¹

The ASEAN Plan of Action for Energy Cooperation (APAEC) recognizes that integrating power grids and enabling cross-border electricity trade can help ASEAN member states address their regional energy challenges. Interconnections create positive impacts in terms of ensuring energy security and power system reliability, while also creating economic opportunities and the formation of new partnerships. Specifically, there is growing interest for the potential of utilizing hydropower resources in the Lower Mekong region to not only power countries in the region, but also to supplement increasing electricity demand requirements in neighbouring Thailand, Malaysia, and Singapore.

Drawing upon some common themes across three international examples of interconnected grids, we draw lessons for pursuing integration activities between Lao PDR, Thailand, Malaysia, and Singapore (LTMS) and discuss possible approaches for establishing a wider common market for electricity in ASEAN.

The book analyses the development of power interconnection in Southeast Asia and, more specifically, ASEAN, focusing on the proposed interconnection between LTMS. In our analysis, we provide an overview of the evolution of electricity interconnection and trade in three international markets we believe to be relevant for ASEAN, specifically, Southern African

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Power Pool (Chapter 2), European electricity markets (Chapter 3), and Nord Pool (Chapter 4). We also discuss the progress among ASEAN countries in regional energy integration with a particular focus on the Greater Mekong Sub-region (GMS) interconnection, the first significant project in ASEAN that involves several countries' trading power.

In the review of the experience of selected regional electricity markets around the world, we identify some key elements of integration that emerged independently as those markets have evolved. These are as follows:

- Coordinated physical infrastructure development;
- Standardized and harmonized rules of operation;
- Some form of market competition; and
- Empowered governing or coordinating institutions.

Prioritization of these elements and the sequence of steps to achieve them are not straightforward, as they depend on current circumstances of the regional market's environment and history. As such, these elements are still undergoing development in the international markets under review in this book.

Market integration in Europe adopted a top-down integration approach, capitalizing on the legal system of the European Union (EU) and mature country power networks. In contrast, Nordic and Southern African markets developed on an incremental and voluntary basis, driven by the utilities themselves: a bottom-up approach. Given diverse regional circumstances in ASEAN, and the absence of an overarching legal system like in the EU, we believe that the latter approach is more suitable for ASEAN than the EU model.

The importance of coordinated infrastructure development is particularly important in markets with growing electricity demand, such as the Southern African Power Pool (SAPP) and ASEAN. Insufficient generation and transmission infrastructure in Southern Africa seriously limit the progress of the otherwise successfully evolving market and undermine the benefits of market integration. Lack of infrastructure development there is driven by non-cost-reflective tariffs, low market transparency, and weak protection of third-party investors. These aspects deserve consideration by ASEAN, where the required generation capacity is expected to double by 2040.

Another important question is whether deregulated electricity sectors in particular ASEAN countries create barriers for cross-border power trade. While this is a matter of national policy in each sovereign country, we note that deregulated markets facilitate cross-border power trade only at a fairly advanced stage and thus are not a limiting factor during the early stages. Nevertheless, separation of generation and transmission is highly