

Gawdat Bahgat

# ENERGY SECURITY

An Interdisciplinary Approach

The background of the book cover is a composite image. On the left, there is an offshore oil rig in the ocean. In the center, a stylized world map is composed of white dots. On the right, there is a control room with many monitors and equipment. The bottom of the cover has a dark blue grid pattern.

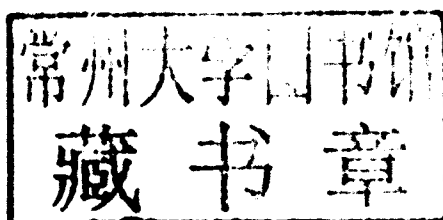
 WILEY

# ENERGY SECURITY

## AN INTERDISCIPLINARY APPROACH

**Gawdat Bahgat**

*National Defense University  
Washington, DC, USA*



 **WILEY**

A John Wiley and Sons, Ltd., Publication

This edition first published 2011  
© 2011 John Wiley & Sons, Ltd

*Registered office*

John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom

For details of our global editorial offices, for customer services and for information about how to apply for permission to reuse the copyright material in this book please see our website at [www.wiley.com](http://www.wiley.com).

The right of the author to be identified as the author of this work has been asserted in accordance with the Copyright, Designs and Patents Act 1988.

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, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Designations used by companies to distinguish their products are often claimed as trademarks. All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book. This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is sold on the understanding that the publisher is not engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

*Library of Congress Cataloging-in-Publication Data*

Bahgat, Gawdat.

Energy security : an interdisciplinary approach / Gawdat Bahgat.  
p. cm.

Includes bibliographical references and index.

ISBN 978-0-470-68904-2 (hardback)

1. Energy policy. 2. Energy development. 3. Power resources. I. Bahgat, Gawdat. II. Title.

HD9502.A2B335 2011

333.79--dc22

2010046393

A catalogue record for this book is available from the British Library.

Print ISBN: 9780470689042

ePDF ISBN: 9780470980187

oBook ISBN: 9780470980170

ePub ISBN: 9780470980163

Set in 10/12pt Times by Aptara Inc., New Delhi, India

Printed and bound in Singapore by Markono Print Media Pte Ltd

# **ENERGY SECURITY**

# About the Author

Dr. Gawdat Bahgat is a professor at the Near East South Asia Center for Strategic Studies, National Defense University, in Washington, DC, United States of America. Dr. Bahgat has taught political science and international relations at several universities. His areas of expertise include energy security, counter-terrorism, proliferation of weapons of mass destruction, international political economy, the Middle East, the Caspian Sea and Central Asia, and US foreign policy.

Dr. Bahgat is the author of seven books and about 200 scholarly articles. His work has been translated into several foreign languages. He has been invited to and presented papers at conferences in Australia, Europe, and the Middle East, and is a frequent contributor to several media outlets. He holds a PhD in political science from Florida State University, an MA in Middle Eastern Studies from American University in Cairo, and a BA in political science from Cairo University.

# Preface

Energy is the lifeblood of civilization. Both as individuals and nation states we depend heavily on energy. In almost everything we do, we rely on one or several sources of energy. Many people and governments used to take the availability of energy sources for granted. Our deepening reliance on energy and the rise of a combination of geopolitical, geological, and environmental challenges have cast doubt on this assumption that energy will always be there. Little wonder that energy security has become a major concern to almost all countries in the world.

In recent years policy-makers and scholars have examined different aspects of energy security. These include production, consumption, reserves, refining, shipping, and investment among others. Indeed, the last few decades have witnessed a proliferation of political and academic conferences, industry journals, and books on energy security. Each side has sought to promote its interests with little ground for neutrality and objectiveness.

I have been working on energy for more than two decades. The policy of energy, at national and international levels, and the growing literature are immensely stimulating. For a long time, consumers and producers perceived their interests as mutually exclusive. Since the early 1990s, a consensus has emerged that there is common ground. Long-term stability of energy markets and prices is generally seen as more favorable than short-term gains by one side or the other. These shared interests are the main theme of the analysis in this volume. In all the following chapters I argue that interdependence is the underlying characteristic of today's energy markets.

This book reflects what I learned in my teaching, research, and consulting in more than 20 years. The first chapter introduces readers to some of the major themes and concepts used in this study. This is followed by a close examination of energy outlooks in the major producing and consuming regions. In the last part the analysis focuses on the two most important international energy organizations – the Organization of Petroleum Exporting Countries and the International Energy Agency. The concluding chapter summarizes the main findings and discusses the International Energy Forum as an embodiment of the emerging cooperation between producers and consumers. In this volume the concept of energy security is addressed from both consumers' and producers' perspectives.

In my decades-long journey of learning, teaching, researching, and writing about energy I have accumulated a huge debt to many colleagues, friends, and students. In writing this book I had the privilege of working with the most professional editorial team at John Wiley & Sons, Ltd. In particular I would like to thank Clarissa Lim, Neville Hankins, and Shalini Sharma. Nicky Skinner gave me unlimited support at crucial stages while writing

the book and Simone Taylor's encouragement inspired me to transform my abstract thoughts into a book proposal.

Writing a book is a huge adventure, with so many ups and downs. Professional and personal support from family and close friends is crucial in this undertaking. I would like to thank Helen Hooker, Sandra Dickson, Beth Sims, Theresa McDevitt, Helen Wedlake, and Patrizia Bassani. Finally, I would like to thank my friends and colleagues at the Near East South Asia Center for Strategic Studies, the National Defense University. Despite all the assistance I have received in the course of writing this book, all errors of facts or judgment are mine alone.

# Acknowledgements

To Sandra Dickson, Beth Sims, and Theresa McDevitt: thank you for your love and support all these years.



# List of abbreviations

3-D	Three-dimensional
ACG	Azeri, Chirag, and deep-water Guneshli
ACOTA	Africa Contingency Operations Training and Assistance
AEC	Atomic Energy Commission
AFRICOM	US–Africa Command
AIOC	Azerbaijan International Operating Company
ANILCA	Alaska National Interest Lands Conservative Act
ANWR	Arctic National Wildlife Refuge
AOC	Arabian Oil Company
APEC	Asia-Pacific Economic Cooperation
Aramco	Arabian–American Oil Company
Bcf	Billion cubic feet
Bcm	Billion cubic meters
B/d	Barrels per day
BG	British Gas
BI	Baku Initiative
BP	British Petroleum
BPS	Baltic Pipeline System
BTC	Baku–Tbilisi–Ceyhan
BTE	Baku–Tbilisi–Erzurum
CABC	China–Africa Business Council
CADfund	China–Africa Development Fund
CASOC	California–Arabian Standard Oil Company
CCP	Caspian Coastal Pipeline
CCS	Carbon Capture and Storage
CEO	Chief Executive Officer
CERM	Coordinated Emergency Response Measures
CERT	Committee on Energy Research and Technology
CNOOC	China National Offshore Oil Corporation
CNPC	China National Petroleum Corporation
CPC	Caspian Pipeline Consortium
CTL	Coal-to-liquids
DOE	Department of Energy
DST	Daylight Saving Time

---

EC	European Commission
ECG	Energy Cooperation Group
ECO	Economic Cooperation Organization
ECT	Energy Charter Treaty
EGAS	Egyptian Natural Gas Holding Company
EGPC	Egyptian General Petroleum Corporation
EIA	Energy Information Administration
EISA	Energy Independence and Security Act
ELG	Energy Leading Group
ENEF	European Nuclear Energy Forum
EO	Executive Order
EPA	Environmental Protection Agency
EPCA	Energy Policy and Conservative Act
EPSA	Exploration and Production-Sharing Agreement
ESPO	East Siberia Pacific Ocean
ESSAP	Energy Security and Solidarity Action Plan
ETS	Emission Trading Scheme
EU	European Union
EURATOM	European Atomic Energy Community
FOCAC	Forum on China–Africa Cooperation
FSR	Former Soviet Republics
F–T	Fischer–Tropsch
GCA	Gaffney, Cline and Associates
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GECF	Gas Exporting Countries Forum
GIF	Generation IV International Forum
GNEP	Global Nuclear Energy Partnership
GNP	Gross National Product
GoM	Gulf of Mexico
IAEA	International Atomic Energy Agency
ICT	Industrialized and Other High-Income Countries and Territories
IEA	International Energy Agency
IEF	International Energy Forum
IEP	International Energy Program
ILSA	Iran–Libya Sanctions Act
INOC	Iraq National Oil Company
INOGATE	Interstate Oil and Gas Transport to Europe
IOCs	International Oil Companies
IPC	Iraqi Petroleum Company
JODI	Joint Oil Data Initiative
JV	Joint Venture
KMG	KazMunaiGaz
KRG	Kurdistan Regional Government
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas

Mcf	Million cubic feet
MEND	Movement for the Emancipation of Niger Delta
MEPI	Middle East Partnership Initiative
MGS	Master Gas System
MMS	Minerals Management Service
Mmt	Million metric tons
MOU	Memorandum of Understanding
MPLA	Popular Movement for the Liberation of Angola
NATO	North Atlantic Treaty Organization
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NGO	Non-Governmental Organization
NGVs	Natural Gas Vehicles
NIOC	National Iranian Oil Company
NIORPDC	National Iranian Oil Refining, Production, and Distribution Company
NNPC	Nigerian National Petroleum Corporation
NOC	National Oil Corporation (Libya)
NOCs	National Oil Companies
NPC	National Petroleum Commission
NPT	Non-Proliferation Treaty
NRC	Nuclear Regulatory Commission
NSCSA	National Shipping Company of Saudi Arabia
OCS	Outer Continental Shelf
OECC	Organization for European Economic Cooperation
OECD	Organization for Economic Cooperation and Development
OFID	OPEC Fund for International Development
OLADE	Latin American Organization for Energy Cooperation
OPEC	Organization of Petroleum Exporting Countries
PEZ	Pipeline Exclusion Zone
PSA	Production-Sharing Agreement
PSI	Pan-Sahel Initiative
Sabir	Saudi Basic Industries Corporation
SCO	Shanghai Cooperation Organization
SEQ	Standing Group on Emergency Questions
SGD	Standing Group for Global Energy Dialogue
Sinopec	China Petroleum and Chemical Corporation
SLT	Standing Group on Long-Term Cooperation
SOCAR	State Oil Company of Azerbaijan Republic
SOM	Standing Group on the Oil Market
SPR	Strategic Petroleum Reserve
TAP	Trans-Adriatic Pipeline
Tapline	Trans-Arabian Pipeline
Tcf	Trillion cubic feet
TGI	Turkey–Greece Interconnector
TOE	Ton Oil Equivalent
ToP	Take-or-Pay

TPC	Turkish Petroleum Company
TSB	Technical Service Basis
TSC	Technical Services Contract
TSCTI	Trans-Sahara Counter-Terrorism Initiative
UAE	United Arab Emirates
UK	United Kingdom
ULCCs	Ultra Large Crude Carriers
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNITA	National Union for the Total Independence of Angola
UNSC	United Nations Security Council
US	United States
USAID	United States Agency for International Development
USGS	United States Geological Survey
VLCCs	Very Large Crude Carriers
WTI	West Texas Intermediate
WTO	World Trade Organization

# Glossary

This glossary explains some of the technical terms that are used in this book or that readers are likely to encounter. It does not purport to be at all comprehensive.

**Acquisition (foreign crude oil):** All transfers of ownership of foreign crude oil to a firm, irrespective of the terms of that transfer. Acquisitions thus include all purchases and exchange receipts as well as any and all foreign crude acquired under reciprocal buy–sell agreements or acquired as a result of a buy-back or other preferential agreement with a host government.

**Alternative-fuel vehicle:** A vehicle designed to operate on an alternative fuel (e.g., compressed natural gas, methane blend, electricity). The vehicle could be either a dedicated vehicle designed to operate exclusively on alternative fuel or a non-dedicated vehicle designed to operate on alternative fuel and/or a traditional fuel.

**Barrel of oil:** Standard oil industry measure of volume: 1 barrel is equivalent to 42 US gallons (159 liters).

**Biofuels:** Liquid fuels and blending components produced from biomass feedstocks, used primarily for transportation.

**Biomass:** Organic non-fossil material of biological origin constituting a renewable energy source.

**Brent blend:** The principal grade of UK North Sea crude oil in international oil trading. Used as the “marker” for other North Sea grades which trade at differentials to it, reflecting quality and location.

**British thermal unit:** The quantity of heat required to raise the temperature of 1 lb of liquid water by 1°F at the temperature at which water has its greatest density (approximately 39°F).

**Buy-back oil:** Crude oil acquired from a host government whereby a portion of the government’s ownership interest in the crude oil produced in that country may or should be purchased by the producing firm.

**Carbon dioxide (CO<sub>2</sub>):** A colorless, odorless, non-poisonous gas that is a normal part of the earth’s atmosphere. It is a product of fossil-fuel combustion as well as other processes. It is considered a greenhouse gas as it traps heat radiated by the earth into the atmosphere and thereby contributes to the potential for global warming.

**Climate change:** A term used to refer to all forms of climatic inconsistency, but especially to a significant change from one prevailing climatic condition to another.

**Coal:** A readily combustible black or brownish-black rock whose composition consists of more than 50% by weight and more than 70% by volume of carbonaceous material. It is formed from plant remains that have been compacted, hardened, chemically altered, and metamorphosed by heat and pressure over geological time.

**Coal gasification:** The process of converting coal into gas. The basic process involves crushing coal to a powder, which is then heated in the presence of steam and oxygen to produce a gas. The gas is then refined to reduce sulfur and other impurities.

**Concession:** The operating right to explore for and develop petroleum fields in consideration for a share of production in kind (equity oil).

**Conventional oil:** Crude oil that, at a particular time, can be technically and economically produced through a well, using normal production practice and without altering the natural viscous state of the oil. Non-conventional oil is more expensive to explore and develop, although there have been major cost reductions in the past few years.

**Crude oil:** A mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities.

**Deregulation:** The elimination of some or all regulations from a previously regulated industry or sector of an industry.

**Diesel fuel:** A fuel composed of distillates obtained in petroleum refining operation or blends of such distillates with residual oil used in motor vehicles.

**Downstream:** That part of the petroleum industry that involves refinery, transportation, and marketing operations as contrasted with upstream operations of exploration, development, and production.

**Dry hole:** An exploratory or development well found to be incapable of producing either oil or gas in sufficient quantities to justify completion as an oil or gas well.

**Dubai:** A grade of crude oil which has effectively replaced Saudi Light as the “marker” crude oil in the Persian Gulf.

**Energy efficiency:** Refers to programs that are aimed at reducing the energy used by specific end-use devices and systems, typically without affecting the services provided.

**Energy source:** A substance, such as oil, natural gas, or coal, that supplies heat or power. Electricity and renewable forms of energy, such as wood, waste, geothermal, wind, and solar, are considered to be energy sources.

**Enriched uranium:** Uranium in which the U-235 isotope concentration has been increased to greater than the 0.711% of U-235 present in natural uranium.

**Ethanol:** A clear, colorless, flammable alcohol. Ethanol is typically produced biologically from biomass feedstocks such as agricultural crops and cellulosic residues from agricultural crops or wood. It can also be produced chemically from ethylene.

**Flared:** Gas disposed of by burning in flares usually at the production sites or at gas processing plants.

**Fossil fuel:** An energy source formed in the earth's crust from decayed organic material. The common fossil fuels are coal, natural gas, and oil.

**Futures market:** A trade center for quoting prices on contracts for the delivery of a specified quantity of a commodity at a specified time and place in the future.

**Gallon:** A volumetric measure equal to 4 quarts (231 cubic inches; 3.79 liters) used to measure fuel oil.

**Gas:** A non-solid, non-liquid combustible energy source.

**Gas-to-liquids:** A process that combines the carbon and hydrogen elements in natural gas molecules to make synthetic liquid petroleum products, such as diesel fuel.

**Gasification:** A method for converting coal, petroleum, biomass, wastes, or other carbon-containing materials into a gas that can be burned to generate power or processed into chemicals and fuels.

**Geothermal energy:** Hot water or steam extracted from geothermal reservoirs in the earth's crust. This water or steam can be used for geothermal heat pumps, water heating, or electricity generation.

**Global warming:** An increase in the near-surface temperature of the earth. Global warming has occurred in the distant past as the result of natural influences, but the term is today most often used to refer to the warming that some scientists believe is taking place as a result of increased anthropogenic emissions of greenhouse gases.

**Greenhouse gases:** Those gases, such as carbon dioxide and methane, that prevent long-wave radiant energy from leaving the earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.

**Henry hub:** A pipeline hub on the Louisiana Gulf coast. It is the delivery point for the natural gas futures contract on the New York Mercantile Exchange.

**Hydrocarbon:** An organic chemical compound of hydrogen and carbon in the gaseous, liquid, or solid phase.

**Kerosene:** A light petroleum distillate that is used in space heaters, cooking stoves, and water heaters and is suitable for use as a light source when burned in wick-fed lamps.

**Kyoto Protocol:** The result of negotiations at the Third Conference of the Parties in Kyoto, Japan, in December 1997. The Kyoto Protocol sets binding greenhouse gas emissions targets for countries that sign and ratify the agreement.

**Liquefied natural gas:** Natural gas (primarily methane) that has been liquefied by reducing its temperature to  $-260^{\circ}\text{F}$  ( $-162^{\circ}\text{C}$ ) at atmospheric pressure.

**Liquefied petroleum gas:** A light hydrocarbon material which is gaseous at atmospheric temperature and pressure but which can be liquefied by mild pressurization to facilitate transportation, storage, and handling.

**Majors:** Generally, the vertically integrated, international oil companies.

**Manhattan Project:** The US government project that produced the first atomic weapons during World War II. The project started in 1942 and formally ended in 1946.

**Methane:** A colorless, flammable, odorless hydrocarbon gas which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes.

**Mineral:** Any of the various naturally occurring inorganic substances, such as metals, salt, sand, stone, sulfur, and water, usually obtained from the earth.

**Mineral rights:** The ownership of the minerals beneath the earth's surface with the right to remove them. Mineral rights may be conveyed separately from surface rights.

**Mining:** An energy consuming subsector of the industrial sector that consists of all facilities and equipment used to extract energy and mineral resources.

**Natural gas:** A gaseous mixture of hydrocarbon compounds; methane is the primary one.

**Natural gas, associated–dissolved:** The combined volume of natural gas which occurs in crude oil reservoirs either as free gas (associated) or as gas in solution with crude oil (dissolved).

**Natural gas liquids:** Those hydrocarbons in natural gas that are separated from the gas as liquids through the process of absorption, condensation, adsorption, or other methods in gas processing or cycling plants.

**Natural gas, non-associated:** Natural gas not in contact with significant quantities of crude oil in a reservoir.

**Natural reservoir pressure:** The energy within an oil or gas reservoir that causes the oil or gas to rise unassisted by other forces to the earth's surface when the reservoir is penetrated by an oil or gas well.

**New York Mercantile Exchange:** The most successful market for oil futures contracts on which very large volumes of heating oil and crude oil (WTI grade) in particular are traded. It has considerable influence on the physical trade.

**Nominal price:** The price paid for a product or service at the time of the transaction. Nominal prices are those that have not been adjusted to remove the effect of changes in the purchasing power of the dollar; they reflect buying power in the year in which the transaction occurred.

**Non-associated natural gas:** Natural gas that is not in contact with significant quantities of crude oil in the reservoir.

**Non-renewable fuels:** Fuels that cannot be easily made or "renewed," such as coal, natural gas, and oil.

**Nuclear fuel:** Fissionable materials that have been enriched to such a composition that, when placed in a nuclear reactor, will support a self-sustaining fission chain reaction, producing heat in a controlled manner for process use.

**Nuclear reactor:** An apparatus in which a nuclear fission chain reaction can be initiated, controlled, and sustained at a specific rate. A reactor includes fuel (fissionable material), moderating material to control the rate of fission, a heavy-walled pressure vessel to house the



reactor components, shielding to protect personnel, a system to conduct heat away from the reactor, and instrumentation for monitoring and controlling the reactor's systems.

**Offshore reserves and production:** Reserves and production that are in either state or federal domains, located seaward of the coastline.

**Oil:** A mixture of hydrocarbons usually existing in the liquid state in natural underground pools or reservoirs.

**Oil reservoir:** An underground pool of liquid consisting of hydrocarbons, sulfur, oxygen, and nitrogen trapped within a geological formation and protected from evaporation by the overlying mineral strata.

**Oil shale:** A sedimentary rock containing kerogen, a solid organic material.

**Oil stocks:** Stocks that include crude oil, unfinished oils, natural gas plant liquids, and refined petroleum products.

**Oil well:** A well completed for the production of crude oil from at least one oil zone or reservoir.

**OPEC pricing:** OPEC collects pricing data on a "basket" of seven crude oils – Algeria's Saharan Blend, Indonesia's Minas, Nigeria's Bonny Light, Saudi Arabia's Arab Light, Dubai's Fateh (or Dubai), Venezuela's Tia Juana Light, and Mexico's Isthmus (a non-OPEC crude oil) – to monitor world oil market conditions.

**Outer continental shelf:** Offshore federal domain.

**Ozone:** A molecule made up of three atoms of oxygen. It provides a protective layer shielding the earth from harmful ultraviolet radiation.

**Parent company:** The parent company of a business entity is an affiliated company which exercises ultimate control over that entity, either directly or indirectly through one or more intermediaries.

**Petrochemical feedstocks:** Chemical feedstocks derived from petroleum principally for the manufacture of chemicals, synthetic rubber, and a variety of plastics.

**Petrochemicals:** Organic and non-organic compounds and mixtures that include chemicals, cyclic intermediates, plastics and resins, synthetic fibers, dyes, pigments, detergents, surface active agents, carbon black, and ammonia.

**Petroleum:** A broadly defined class of liquid hydrocarbon mixtures. The term includes crude oil, lease condensate, unfinished oils, refined products obtained from the processing of crude oil, and natural gas plant liquids.

**Petroleum products:** Products obtained from the processing of crude oil, natural gas, and other hydrocarbon compounds. They include unfinished oils, liquefied petroleum gases, pentanes plus, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, petroleum coke, asphalt, road oil, still gas, and miscellaneous products.

**Petroleum refinery:** An installation that manufactures finished petroleum products from crude oil, unfinished oils, natural gas liquids, other hydrocarbons, and alcohol.