

## Article

# Teaching Energy Economics in the GCC: A Synergistic Approach between Engineering and Economics

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**Abstract:** Issues related to safe and abundant energy production have been prominent in recent years. This is particularly true when society considers how to increase the quality of life by providing low-cost energy to citizens. A significant concern of the Gulf Cooperation Council (GCC) relates to the environmental effects of energy production and energy use associated with climate change. Efforts to reduce fossil fuel use and increase the use of renewable energy, together with the price volatility of fossil fuels, have seriously impacted the economics of many oil-producing countries, particularly the Gulf States, which has led to efforts to make their economies more diverse and less dependent on oil production. In this article, we introduce a multidisciplinary energy economics course developed at the Missouri University of Science and Technology that can be easily adopted by GCC universities to enhance future generations' understanding of energy challenges.

**Keywords:** energy policy; energy economics; renewable energy; fossil energy; nuclear energy; hybrid energy; teaching



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## 1. Introduction

The question of how the Gulf States can expand their economies to reduce economic dependence on oil production is an engineering question, an economic question, and ultimately, an issue of information and education. The collaboration between engineering and economics focuses on the importance of economic diversification in energy and how to reduce dependence on oil while making GCC economies more resilient to oil price shocks.

Collective efforts from science, social science, and engineering are required to address the complex issue of improving social welfare, maintaining sustained economic growth, diversifying the economy and energy portfolio, and strengthening energy resilience in the GCC. Universities play an active role in the socioeconomic development of society, as they are sensitive to market demands and global trends [1]. We reacted to this broad energy debate several years ago by developing a course in energy economics at the Missouri University of Science and Technology (Missouri S&T) to provide a deeper understanding of the energy issues discussed above. With this paper, we aim to introduce and illustrate the design of the course and prepare the next global generation for the upcoming energy-related challenges. Our approach has been to link the scholarly disciplines of engineering and economics to provide an educational system to inform college students about the core energy issues debated worldwide. This course encourages open discussion about energy policies that countries may consider pursuing to bring the most significant benefit to their citizens. This course is available online and can easily be adopted by universities in the Gulf States.

Efforts have been made to enhance the teaching and understanding of energy-related topics in the literature. Energy-related issues were comprehensively discussed within the scope of economists by the authors of [2–4], who developed one of the earliest works

# Economics A Synergetic Approach

**M Tight**



## **Economics A Synergetic Approach:**

**Economics**, 1972     *Economics*, 1972     **Economics: a Synergetic Approach** Bernard J. McCarney, 1972

**Economics: a Synergetic Approach. Written and Edited by Bernard J. McCarney, Virginia Lee Owen** Bernard Joseph MACCARNEY (and OWEN (Virginia Lee)), 1972     **Synergetic Economics** Wei-Bin Zhang, 2013-03-07 Synergetic Economics presents a new advance in analytical economics It deals with problems related to time and change in economic systems including complex aspects such as the effects of nonlinearity instability bifurcation and chaos in economic evolution The author argues that economic systems may run through a hierarchy of instabilities in which more and more structural patterns evolve Such instabilities are caused by changes in the external parameters of the system They may lead to new spatial temporal patterns of the system A number of explicit examples are provided to show how such behavior can occur in various dynamic economic systems Analytical methods are also presented to cope with nonlinear problems Of particular interest are sudden structural changes the existence of regular and irregular oscillations the role of random factors in economic evolution and the effects of time scales and rates of adjustment of economic variables in economic analysis The author carefully examines the implications of nonlinear phenomena for decision making and for economic development in general     **The Evolutionary Foundations of Economics** Kurt Dopfer, 2005-05-23 It is widely recognised that mainstream economics has failed to translate micro consistently into macro economics and to provide endogenous explanations for the continual changes in the economic system Since the early 1980s a growing number of economists have been trying to provide answers to these two key questions by applying an evolutionary approach This new departure has yielded a rich literature with enormous variety but the unifying principles connecting the various ideas and views presented are as yet not apparent This 2005 volume brings together fifteen original articles from scholars each of whom has made a significant contribution to the field in their common effort to reconstruct economics as an evolutionary science Using meso economics as an analytical entity to bridge micro and macro economics as well as static and dynamic realms a unified economic theory emerges     **A Network Approach in Strategic Management: Emerging Trends and Research Concepts** Beata Barczak, Tomasz Kafel, Pierpaolo Magliocca, 2021 **PURPOSE** The analysis of the literature shows that the attempts to conceptualize the strategic aspects of the network bring a significant impact on the development of research on organizational networks This article aims to analyze the new trends in strategic management and in particular on the possibility of exploring the network approach in strategic management through the existing literature and the presentation of the new contributions of the following articles published in the current issue **METHODOLOGY** The article is descriptive in character thus it is based on a literature review and its constructive critics A narrative literature review was used to present the main assumptions and features of the network approach in strategic management along with an indication of emerging trends and new directions Also the identification of theoretical foundations for understanding the processes of strategic change in inter organizational

networks and the proposition of the way to understand network strategy were presented FINDINGS The research included in this issue shows that from a network perspective business strategy plays an important role in guiding the development of individual relationships and networks Exploring the network approach in strategic management allows one to adopt the category of network strategy which can be described through the coexistence of cooperation and competition

IMPLICATIONS FOR THEORY AND PRACTICE Considerations lead to the conclusion that the business strategy must be expressed in terms of potential changes in the network in which the company operates taking into account its current and selected position in the network Despite the fact that the current state of research on organizational networks in the theory of strategic management shows that this approach is already quite well established on the basis of the analysis of research results concerning the conceptualization of strategic aspects of the network the existing problems and limitations were identified ORIGINALITY AND VALUE The main problems related to the exploration of the network approach and the

resulting consequences for the definition of the network strategy were indicated Also the combination of an organizational and economic approach with the logic of competitive advantage and relational annuity The demonstration that the network perspective in strategic management allows for a more complete understanding of the strategic behavior of modern enterprises Keywords network network strategy network approach strategic management Table of Contents Network approaches and strategic management Exploration opportunities and new trends 7 Beata Barczak Tomasz Kafel Pierpaolo Magliocca Networks and network strategies New theorization based upon a systematic literature review 37 Rossella Canestrino Amir Forouharfar Direct and moderation effects on U S apparel manufacturers engagement in network ties 67 Nancy J Miller Carol Engel Enright David A Brown Mapping of a science and technology policy network based on social network analysis 115 Esmaeel Kalantari Gholamali Montazer Sepehr Ghazinoory Synergetic effects of network interconnections in the conditions of virtual reality 149 Kateryna Kraus Nataliia Kraus Olena Shtepa Complexity continuity and strategic management of buyer supplier relationships from a network perspective 189 Martin Pech Draho Van ek Jaroslava Pra kov Interfirm network structure and firm resources Towards a unifying concept 227 Jesse Karjalainen Aku Valtakoski Ilkka Kauranen

*DEVELOPMENT OF MARKETING AT AGRICULTURAL AND PROCESSING ENTERPRISES*

Bondarenko V., Sidorenko V., Hryshchenko A., Vyshnivska B., Nahorna O., Barylovych O., Riabchyk A., Zikranets M., Zbarskyi V., Mastylo A., Avramenko R., Galchynska J., Havryliuk Y., Kalkovska I., Heraimovych V., Humenyuk I., Golovnina O., Grydzhuk I., 2024-04-16 All rights reserved Printed in the United States of America No part of this publication may be reproduced distributed or transmitted in any form or by any means or stored in a data base or retrieval system without the prior written permission of the publisher The content and reliability of the articles are the responsibility of the authors When using and borrowing materials reference to the publication is required

*Socio-Economic Impacts of Landmines in Southern Kurdistan* Almas Heshmati, Nabaz T. Khayyat, 2012-12-19 The Kurdistan Region of Iraq has been massively

contaminated by landmines and unexploded ordnance This will continue to be a major obstacle for development and economic growth particularly in the rural border communities The mines were used systematically by the central Baathist government in its efforts to depopulate the Kurdistan Region and to weaken the Kurds demands for regional self determination This work investigates the magnitude of the landmine problem in the region and the landmine action activities undertaken to rehabilitate reconstruct and develop the region In addition to that this work emphasizes the social health educational and economic impacts of landmines as well as the legal consequences In order to achieve the abovementioned objectives this work is divided into fifteen chapters After providing an introduction and background to the landmine problem the authors discuss the scope of the problem both in the Kurdistan Region and internationally The methods of dealing with mines and their consequences are reviewed The issues of landmine action impact surveys factors influencing the survey process and mine actions activities are also discussed A comprehensive review of the outcome of the problem of landmines in the Kurdistan Region has been conducted The nature and characteristics of the problems faced by Kurds are discussed in more detailed form by looking at case studies Here the economic social and health impacts of landmines in the region are assessed The issues of the human security and political impacts of landmines are further addressed followed by an assessment of mine action resources and its progress education and various preventive measures Finally a number of policy recommendations are provided to prevent the use of mines in the future and to take legal action against landmine users for clearance rehabilitation and compensation issues

**Economics and Engineering of Unpredictable Events** Caterina De Lucia,Dino Borri,Atif Kubursi,Abdul Khakee,2022-03-07 In recent decades the intensification of unpredictable events including the Covid 19 outbreak Brexit trade warfare religion inspired terrorism and civil wars and climate change has resulted in serious loss of human lives and property a decrease in biodiversity and natural hazards with long term negative impacts on environment and impeded social and economic development Economics and Engineering of Unpredictable Events Modelling Planning and Policies provides an integrated view of the management of unpredictable events incorporating three major perspectives economic management environmental planning and engineering models Contributors from economics planning regional science and engineering address key questions including How resilient are human societies and their habitats What should societies do to shift from being vulnerable to being more resilient And what role should planning and policies play to protect communities and the natural environment The chapters cover academic debates conceptual reflections case studies methods and strategy development with particular reference to mitigation and adaptation in face of unpredictable events This book is of particular interest to readers of economic policy urban and regional planning and engineering

**Human Ecology** Markus Nauser,Dieter Steiner,2002-11 Arguing for environmentally sustainable lifestyles this envisages a new kind of consciousness based on the notion of the individual as an agent mediating between society and the environment

Landmarks for Spatial Development Stanislav Martinat,Vikas Kumar,André Torre,Yuliya

Lavrikova, Evgeny Kuzmin, 2023-08-10 The book explores the uneven spatial distribution of territory resources and its implication for the sustainable development of regions and cities The authors analyze the features of the localization of assets paying attention to both the manifested factors and the conditions that determine the specificity of the current spatial organization On the basis of multivariate analysis gravity models clustering method as well as the evaluation of concentration parameters the authors propose various approaches to systematize territorial units paying special attention to the peculiarities of their economic structure resource diffusion barriers and quality of life parameters The obtained results indicate the need for a differentiated approach in the choice of guidelines for the transformation of the socio economic space allowing the researchers to propose various transformation models for differing regions Thus this book presents spatial organization models for different regional economies highlighting various approaches to achieving the Sustainable Development Goals and reducing inequality The book seeks to balance the benefits of polarized development with the need to avoid significant interregional disparities At the same time the book offers various solutions for differentiating territories distinguishing different spatial elements and determining the most appropriate transformation options The results obtained may be of interest to scholars in regional and spatial science as well as to professionals in the field of territorial development management

**Integration and Clustering for Sustainable Economic Growth** Elena G. Popkova, Valentina E. Sukhova, Aleksey F. Rogachev, Yulia G. Tyurina, Olga A. Boris, Valentina N. Parakhina, 2017-02-28 This book describes the importance of integration and clustering in creating sustainable economic growth Modern economic conditions demonstrate the need for governmental stimulation of cluster initiatives in entrepreneurship and make it necessary to study the experience of developed countries in the sphere of stimulation of cluster initiatives in entrepreneurship and to offer recommendations for improving the system of state stimulation of these initiatives The authors conclude that at present innovational economy is an economic system that functions on the basis of business networks as this model offers innovational cooperation between specialists from various scientific and technical spheres between organizations of various sizes large medium and small and between groups of various types of companies Cluster strategy in modern global practice is one of the most important tools of public policy for increasing the competitiveness of national economies This means that the most competitive spheres develop on the basis of the cluster principle and support for cluster building increases a country's economic competitiveness

**Complexity and Self-Organization in Social and Economic Systems** Fukang Wang, Michele Sanglier, 2012-12-06 The Instituts Internationaux de Physique et de Chimie fondis par E Solvay and the Institute of Nonequilibrium systems of Beijing Normal University jointly sponsored a conference on The Complexity and Self organization in Socio economic Systems on October 17 20 1994 at Beijing China The purpose of the conference was to explore the complexity and evolutionary laws of socio economic systems through nonlinear dynamic systems and self organization theory The conference was chaired by Professor M Sanglier and Professor Fang Fukang and was introduced by

the Nobel prize winner Professor I Prigogine and the vice director of the Chinese National System Reform Committee Mr Wu Jie The conference was held at an important time On the one hand the research in the natural sciences about the evolution of complex systems has made great progress modern scientific theories such as nonlinear dynamic system theory and self organization theory are becoming more and more mature and a series of methods dealing with these complex systems are being developed which enable us to understand and study non equilibrium uncertainty and instability On the other hand human societies around the world witness a general increase of connectedness interactivity and an increase of reaction speeds to decisions In this context the deterministic linear way of thinking becomes more and more inadequate and this stimulates the development of non linear science

*Economics, Evolution and the State* Kurt Dopfer, 2005-01-01 This book focuses on the emerging field of evolutionary economic policy highlighting the interface between the state markets and the evolutionary complexity of modern economies The contributors explore the possibilities and limitations of governance and provide a unique platform for the advancement of modern evolutionary economic theory

New Institutions for Socio-Economic Development Elena G. Popkova, Elena Zavyalova, 2021-06-08 The strategies and practical approaches for socio economic development are undergoing systemic changes under the influence of new developments in global economic systems and markets The most significant factors influencing such changes are connected to the start of the Fourth Industrial Revolution Industry 4 0 which is impacting all economic systems to a greater or lesser extent The creation of the digital economy and transition to Industry 4 0 particularly increases the significance of hi tech for socio economic development Secondly there is now a transition underway from a period of unlimited globalization and comprehensive integration to more limited globalization and selective economic integration The growing importance of regionalization on the global economic system is manifested in the formation and rapid development of new integration unions at the regional or country level e g the EU and the EAEU and company level e g regional sectoral economic clusters special economic areas technological parks and innovative networks Thirdly there s an urgent need for faster innovation which leads to the formation of more innovative economies The global financial crisis drew attention to the problems of managing sustainability and achieving balance in socio economic development The formation and exponential growth of the information society based on digital technologies is now stimulating the growth and significance of corporate social and environmental responsibility as a prerequisite for entrepreneurial success Thus the paradigm of socio economic development is changing from absolute rationality economic effectiveness and stability which has historically been associated with problems of stagnation to responsibility limited and socially oriented rationality and dynamism quick innovative development based on leading technologies This book aims to provide a scientific substantiation for this new paradigm

Foundations of Economic Change Andreas Pyka, Uwe Cantner, 2017-11-15 The book illustrates the considerable advances in modern evolutionary economics and addresses core questions of economic behaviour interaction of heterogeneous actors in uncertain

environments and the possibility of aggregating observations on a macro economic level It presents the foundations of economic change as the major building blocks of an economic approach that focusses on complex processes driven by endogenous innovation as well as crisis The theoretical considerations are complemented by econometric studies to demonstrate the relevance of evolutionary economic thinking to improve our understanding of the most challenging issues related to economic growth and development

**Innovations in Sustainable Agricultural Systems, Agriculture 4.0 and Precision Agriculture. Volume 1** Irina Samoylenko,Toshpulot Rajabov,2025-11-01 This book delves into the transformative technologies and practices that are shaping the future of agriculture emphasizing the importance of sustainability Key themes explored in the book include I Digital Agricultural Techniques Tools and Systems which highlight the role of data analytics and automation in optimizing farm operations II Sustainable Development of Agricultural and Food Production focusing on regenerative practices that promote soil health and enhance food security III Economic Ecological and Social Systems for Human Development examining how integrated approaches can enhance rural livelihoods and community resilience IV Sustainability in Animal Husbandry and Veterinary Practice addressing innovations that improve animal welfare while minimizing environmental impacts This book serves as an invaluable resource for researchers farmers policymakers and students providing a multidisciplinary perspective on how innovative agricultural practices can lead to a sustainable and resilient food system

*The Oxford Handbook of Law and Economics* Francesco Parisi,2017-04-27 Covering over one hundred topics on issues ranging from Law and Neuroeconomics to European Union Law and Economics to Feminist Theory and Law and Economics The Oxford Handbook of Law and Economics is the definitive work in the field of law and economics The book gathers together scholars and experts in law and economics to create the most inclusive and current work on law and economics Edited by Francisco Parisi the Handbook looks at the origins of the field of law and economics tracks its progression and increased importance to both law and economics and looks to the future of the field and its continued development by examining a cornucopia of fields touched by work in law and economics The uniqueness of its breadth depth and convenience make the volume essential to scholars students and contributors in the field of law and economics

*Brain Dynamics* Hermann Haken,2006-11-22 Twenty Five Years of Springer Series in Synergetics The year 2002 marks the 25th anniversary of the Springer Series in Synergetics It started in 1977 with my book Synergetics An Introduction Nonequilibrium Phase Transitions and Self Organization in Physics Chemistry and Biology In the near future the 100th volume of this series will be published Its success has been made possible by the contributions of outstanding authors who presented their quite often pioneering results to the science community well beyond the borders of a special discipline Indeed interdisciplinarity is one of the main features of this series But interdisciplinarity is not enough The main goal is the search for common features of self organizing systems in a great variety of seemingly quite different systems or still more precisely speaking the search for general principles underlying the spontaneous formation of spatial temporal or functional



structures The objects studied may be as diverse as lasers and fluids in physics pattern formation in chemistry morphogenesis in biology brain functions in neurology or self organization in a city As is witnessed by several volumes great attention is being paid to the pivotal interplay between deterministic and stochastic processes as well as to the dialogue between theoreticians and experimentalists All this has contributed to a remarkable cross fertilization between disciplines and to a deeper understanding of complex systems The timeliness and potential of such an approach are also mirrored among other indicators by numerous interdisciplinary workshops and conferences all over the world

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