

Short Course and Workshop on

SHALE GAS MONETIZATION:

Potential Opportunities in the US

and Lessons Learned from the Qatari Experience with Natural Gas

March 26-28, 2014

La Torretta, Lake Conroe, Montgomery, Texas 77356

<http://www.latorrettalakeresort.com/>

Workshop Chairs

Nimir Elbashir, Texas A&M University at Qatar

Mahmoud El-Halwagi, Texas A&M University

Kenneth Hall, Texas A&M University at Qatar

Sponsors



Overview:

The substantial growth in shale gas production in the US is expected to entail significant investments and gains to the US energy, chemical, and petrochemical industries. Substantial opportunities exist for shale gas monetization. The identification and planning of these opportunities require collaborative efforts among governmental, industrial, and academic entities. Additionally, the academic institutions must adapt to provide industry with skilled engineers and scientists capable of supporting and to advancing this emerging market.

The purpose of this workshop is to bring together experts from academia, industry, and government to discuss opportunities and needs in shale gas monetization in the US. The workshop will also discuss lessons learned from Qatar's experience in natural gas monetization. Qatar's current reserves of natural gas are estimated to be around 22 trillion cubic meters, the third largest in the world. The State of Qatar monetized its rich non associated natural gas reserves in several ways to become the "The Gas Processing World Capital". The country has attracted major global corporations to invest in shale gas monetization. Examples include the world's largest facilities in gas-to-liquid (GTL) and liquefied natural gas (LNG) production in addition to a well-integrated supply chain of chemicals and petrochemicals.

Short Course:

A short course in the form of two tutorials will be given on the first day (March 26, 2014) to cover the following topics:

1. Tutorial I: "Natural Gas Monetization: Technology Fundamentals and the Potentials" by Dr. Nimir Elbashir, Texas A&M University-Qatar
2. Tutorial II: "Theoretical and Experimental Evaluation of Natural Gas Properties" by Dr. Mert Atilhan, Qatar University

Workshop:

The workshop (March 27-28, 2014) will offer the following:

1. Discussion of supply chain, environmental, and safety issues associated with the emerging shale gas industry in the US.
2. Review of recent progress in natural gas monetization highlighting Qatar's experience its relevance to the US shale gas industry.
3. Identification of future educational, workforce training, and research opportunities, directions, and emerging trends in shale gas monetization.
4. Description of current and future challenges in developing, adapting, and commercializing emerging technologies in the area shale gas monetization.
5. Networking and discussion opportunities among junior and senior academic, industrial, and government attendees.

SHORT COURSE

TUTORIAL I

NATURAL GAS MONETIZATION: TECHNOLOGY FUNDAMENTALS AND THE POTENTIALS

8:30 a.m. – 12:00 p.m.

March 26, 2014

Tutorial Description: This short course highlights the important role natural gas is playing in the energy market and the potentials to grow. The course covers description to the major natural monetization processes with emphasis on the comparison between the dominating ones (Liquefaction of Natural Gas (LNG) versus Gas-to-Liquid (GTL) technology). The course will highlight the global demand for natural gas products and the potential to diversify the monetization technologies depend on the region and the demand specifically after the emerging of shale gas as new player in the energy market. This course highlights on the quantity and quality of ultra-clean fuels from natural and their potentials to play a role in transportation fuels. The course will provide a broad, but well integrated topics that cover technologies, economics, products (chemical and fuels), and risks facing the monetization technologies while using both technical and non-technical languages to make it suitable for a multi-disciplinary audience. The course material will include PowerPoint presentations, and short videos besides a range of sources to supplement, case studies and group exercises.

Keywords: Natural Gas, Gas-to-Liquid (GTL) technology, Liquefied Natural Gas, Commercial Technologies for Natural Gas Monetization

Instructor: Dr. Nimir Elbashir



Dr. Elbashir is an Associate Professor at Texas A&M University at Qatar (TAMUQ). He has over 16 years of research (Texas A&M, BASF R&D and others) and teaching experience (Texas A&M, Auburn, King Saud and others). His research activities are mainly focused on design of advanced reactors and processes for the XTL technology (coal-to-liquid, gas-to-liquid and biomass-to liquid), and development of catalysts for the petrochemical and environmental industry. He holds several US and European patents and tremendous publications in form of peer reviewed journal articles and

conference proceedings as well as conference and industry technical reports publications. He is currently leading several projects in natural gas processing in collaboration with researchers from eight prestigious universities around the globe and with scientists from world-leading industries.

Tutorial II

Theoretical and Experimental Evaluation of Natural Gas Properties

1:00 – 4:30 p.m.

March 26, 2014

Tutorial Description: This short course focuses on the important aspects of multi-component gas mixture property determination benchmarks in particular to natural gas mixtures. The course covers the rule of thumb methods to determine the properties including density, viscosity and phase behavior. Comparisons of the very widely used equation of state predictions with respect to benchmark equations and actual laboratory data for natural gas mixtures will be shared to highlight the importance of the property prediction in custody transfer monetization. The course will have technical content that will help both decision makers and operators to see the what is the latest state-of-the-art in the field of applied thermodynamics applied to natural gas processing. Course material will be conveyed through PowerPoint presentation and printed handouts will also be available.

Keywords: Natural Gas, Thermodynamics, PVT, Equation of State, High Pressure

Instructor: Dr. Mert Atilhan



Dr. Atilhan obtained his MS and PHD degrees from Texas A&M University in Chemical Engineering. He is currently an Associate Professor at Qatar University and Adjunct Professor at Texas A&M University at Qatar in Department of Chemical Engineering. His research activities are mainly focused on applied thermodynamics, which includes very high accuracy PVT measurements, equation of state development, VLE systems, natural gas hydrate

equilibrium and inhibition. Moreover, Dr. Atilhan has funded research projects in carbon dioxide capture through porous material, ionic liquids and olefin/paraffin separation through ionic liquid membranes. He has more than 50 publications in the last 5 years in the focus areas that are mentioned above. Up to date he secured research grant more than \$ 7M in the field of his research expertise. He was honored by “The Best Researcher of the Year Award” in Qatar University in 2008 and 2011.

WORKSHOP

March 27-28, 2014

Thursday, March 27, 2014

- 7⁴⁵-8¹⁵ Registration
- 8¹⁵-8³⁰ Opening remarks: Organizing committee
- 8³⁰-9¹⁵ Keynote Presentation I
- 9¹⁵-9⁴⁵ Coffee Break/Networking
- 9⁴⁵-10³⁰ Keynote Presentation II
- 10³⁰-11¹⁵ Keynote Presentation III
- 11¹⁵-12⁰⁰ Keynote Presentation IV
- 12⁰⁰-13⁰⁰ Lunch
- 13⁰⁰-13⁴⁵ Keynote Presentation V
- 13⁴⁵-15⁰⁰ Short Presentations (on poster session)
- 15⁰⁰-17⁰⁰ Poster Session (refreshments will be provided)

Friday, March 28, 2014

- 8³⁰-9¹⁵ Keynote Presentation VI
- 9¹⁵-10⁰⁰ Keynote Presentation VII

10⁰⁰-10³⁰ Coffee Break/Networking

10³⁰-12⁰⁰ Panel Discussion/Wrap-up Session

12⁰⁰-13⁰⁰ Lunch

13⁰⁰ Adjourn

KEYNOTE PRESENTATIONS AND SPEAKERS

Opportunities in Chemical Engineering: Domestic Shale Gas

Dr. Sharon Robinson
Oak Ridge National Laboratory

and

Dr. Bruce Eldridge
Process Science and Technology Center
University of Texas, Austin

Dr. Sharon Robinson has thirty years of experience working at Oak Ridge National Laboratory (ORNL). She has held a number of positions at ORNL ranging from research to program planning to management in technical areas of nuclear and fossil energy, energy efficiency, and environmental management. She has supported the DOE energy efficiency programs in various capacities since the mid-1990s and has coordinated a series of national workshops where technical experts from industry, academia, and government identify future research needed to address problems in the chemical and related industries. She received her B.S. in Chemical Engineering from Tennessee Technological University in 1980. She obtained her M.S. and Ph.D. degrees in Chemical Engineering at the University of Tennessee in 1985 and 1992, respectively.



Dr. R. Bruce Eldridge



Dr. Eldridge currently serves as Program Head of the James R. Fair Process Science and Technology Center and as a Distinguished Senior Lecturer in the Department of Chemical Engineering at The University of Texas at Austin. In his capacity as PSTC Head he coordinates the activities of a full-time technical staff and oversees a research effort with a yearly budget exceeding \$ 1mm. As Distinguished Senior Lecturer, Eldridge teaches courses covering traditional chemical engineering concepts in fluid flow, heat and mass transfer, and process design.

Outside the university, Eldridge is a Fellow of AIChE and has served as Chair of the AIChE Separations Division and Chair of the Bartlesville, Oklahoma AIChE chapter. Awards include Young Engineer of the Year from the Oklahoma Society of Professional Engineers, membership in the University of Arkansas Academy of Chemical Engineering, and recipient of the Stice, Wissler, Schechter undergraduate teaching award from the UT Department of Chemical Engineering.

Natural Gas to Liquid Transportation Fuels (GTL): Process Synthesis, Global Optimization, and Supply Chain Strategies

Dr. Christodoulos A. Floudas
Department of Chemical and Biological Engineering
Princeton University



Dr. Floudas is the **Stephen C. Macaleer '63 Professor in Engineering and Applied Science, Professor of Chemical and Biological Engineering at Princeton University**, Faculty in the Center for Quantitative Biology at Princeton University's Lewis-Sigler Institute, Associated Faculty in the Program of Computational and Applied Mathematics at Princeton University, Department of Operations Research and Financial Engineering at Princeton University, and the Andlinger Center for Energy and the Environment. He earned his B.S.E. in 1982 at Aristotle University of Thessaloniki, Greece, completed his Ph.D. in December 1985 at Carnegie Mellon University. Professor Floudas is the author of two graduate textbooks, *Nonlinear Mixed-Integer Optimization (Oxford University Press, 1995)*, and *Deterministic Global Optimization (Kluwer Academic Publishers, 2000)*. He has co-edited ten monographs/books, has over 270 refereed publications, and is the chief co-editor of the *Encyclopedia of Optimization (Kluwer Academic Publishers, 2001; 2nd edition, Springer, 2008)*. He is the recipient of numerous awards and honors for teaching and research that include the NSF Presidential Young Investigator Award, 1988; the Engineering Council Teaching Award, Princeton University, 1995; the Bodossaki Foundation Award in Applied Sciences, 1997; the Best Paper Award in Computers and Chemical Engineering, 1998; the Aspen Tech Excellence in Teaching Award, 1999; the 2001 AIChE Professional Progress Award for Outstanding Progress in Chemical Engineering; the 2006 AIChE Computing in Chemical Engineering Award; the 2007 Graduate Mentoring Award, Princeton University; Member of National Academy of Engineering, 2011; One thousand Global Experts, China 2012-2015; SIAM Fellow, 2013; TIAS Fellow and Eminent Scholar, 2013-2014; AIChE Fellow, 2013; and National Award and HELORS Gold Medal, 2013.

The Impact of Shale Gas in the Chemical Industry

Dr. Jeffrey J. Siirola



Dr. Jeff Siirola retired in 2011 as a Technology Fellow at Eastman Chemical Company in Kingsport Tennessee where he had been for more than 39 years. He now holds half time positions as Professor of Engineering Practice at Purdue University and Distinguished Service Professor of Sustainable Energy Systems at Carnegie Mellon University. Dr. Siirola received a BS in chemical engineering from the University of Utah in 1967 and a PhD in chemical engineering from the University of Wisconsin-Madison in 1970. His areas of interest include chemical process synthesis, computer-aided conceptual process engineering, design theory and methodology, chemical process development and technology assessment, resource conservation and recovery, sustainable development and growth, carbon management, and chemical engineering education. Dr. Siirola just completed two terms as Secretary of ABET. He is also a trustee and past president of CACHE (Computer Aids for Chemical Engineering Education), and a member of the American Chemical Society, the Association for the Advancement of Artificial Intelligence, and the American Society for Engineering Education. He has served on numerous National Research Council, National Science Foundation, and Department of Energy panels, and on the advisory boards of several journals and chemical engineering departments. Dr. Siirola is a member of the National Academy of Engineering and was the 2005 President of the American Institute of Chemical Engineers.

Resource-Efficient Catalytic Technologies for Shale Gas Upgrading

Dr. Bala Subramainam



Dr. Bala Subramaniam is the Dan F. Servey Distinguished Professor of Chemical Engineering at the University of Kansas (KU). He has also held visiting professorships at the Institute of Process Engineering, ETH, Zürich, Switzerland and the University of

Nottingham, United Kingdom. Dr. Subramaniam's primary research interests are in catalysis, reaction engineering and crystallization with near-critical fluids, with emphasis on developing sustainable processes for fuels and chemicals. Dr. Subramaniam is the founding Director of the Center for Environmentally Beneficial Catalysis (CEBC) and a co-founder of CritiTech, Inc., a pharmaceutical company with a mission to commercialize the production of fine-particle compounds. Dr. Subramaniam serves as an associate editor of *ACS Sustainable Chemistry and Engineering*, and on the editorial boards of several journals. He has also served as the President of ISCRE, Inc., and serves on the Board of Directors of the Organic Chemical Reactions Society (ORCS). Dr. Subramaniam has received several awards for teaching and research, including the Dow Outstanding Young Faculty Award from the American Society for Engineering Education (ASEE); the Higuchi Research Achievement Award, the highest recognition for research given by the University of Kansas; and a "Chemcon Distinguished Lectureship Award" from the Indian Institute of Chemical Engineers. He is also a Fellow of the AIChE.

Impact of Shale Gas on Energy Efficiency and Smart Manufacturing

Dr. Thomas Edgar

George and Gladys Abell Chair in Engineering
McKetta Department of Chemical Engineering
University of Texas at Austin



Thomas F. Edgar is Professor of Chemical Engineering at the University of Texas at Austin and Director of the UT Energy Institute. Dr. Edgar received his B.S. degree in chemical engineering from the University of Kansas and a Ph.D. from Princeton University. For the past 40 years, he has concentrated his academic work in process modeling, control, and optimization, with over 200 articles and book chapters. Edgar has co-authored two leading textbooks: *Optimization of Chemical Processes* (McGraw-Hill, 2001) and *Process Dynamics and Control* (Wiley, 2010) and has received major awards from AIChE and ASEE. Dr. Edgar was the 1997 President of AIChE. Tom Edgar is co-founder of the *Smart Manufacturing Leadership Coalition* (SMLC; <https://smart-process-manufacturing.ucla.edu/>), which developed a research roadmap to address smart, zero-emission, energy-efficient manufacturing. SMLC recently received an \$8 million award from the Energy Efficiency and Renewable Energy program of DOE to develop software for saving energy in two industrial test beds. Other multidisciplinary projects he directs include research projects on sustainable power grids funded by Pecan Street/DOE and NSF IGERT, as well as a study on maximizing energy efficiency in combined heat and power plants.

Process Safety Applications for Emerging Issues in the Gas Industry

Dr. Sam Mannan

Mary Kay O'Connor Process Safety Center

Texas A&M University



Dr. M. Sam Mannan is Regents Professor in the Chemical Engineering Department and Director of the Mary Kay O'Connor Process Safety Center at Texas A&M University. The mission of the Center is to improve safety in the chemical process industry by conducting programs and research activities that promote safety as second nature for all plant personnel in their day-to-day activities. Before joining Texas A&M University, Dr. Mannan was Vice President at RMT, Inc., a nationwide engineering services company. Dr. Mannan is a registered professional engineer in the states of Texas and Louisiana and is a Certified Safety Professional. His experience is wide ranging, covering process design of chemical plants and refineries, computer simulation of engineering problems, mathematical modeling, process safety, risk assessment, inherently safer design, critical infrastructure vulnerability assessment, aerosol modeling, and reactive and energetic materials assessments.

Dr. Mannan is the recipient of numerous awards and recognitions including the American Institute of Chemical Engineers *Service to Society Award*, the Texas A&M University Association of Former Students' *Distinguished Achievement Award for Teaching*, the Texas Engineering Experiment Station *Research Fellow*, the Texas A&M University Dwight Look College of Engineering *George Armistead, Jr. '23 Fellow*. In 2003, Dr. Mannan served as a *consultant to Columbia Accident Investigation Board*. In 2006, he was named the inaugural holder of the T. Michael O'Connor Chair I. In 2007, he was elected Fellow of the American Institute of Chemical Engineers. In December 2008, the Board of Regents of Texas A&M University System recognized Dr. Mannan's exemplary contributions to the university, agency, and to the people of Texas in teaching, research and service by naming him Regents Professor of Chemical Engineering. Dr. Mannan is a Guest Professor at the Nanjing University of Technology and the China University of Petroleum in Qing Dao. In September 2011, the Technical University of Łódź, Poland, conferred the *Doctoris Honoris Causa* on Dr. Mannan. In 2012, Dr. Mannan was awarded the Bush Excellence Award for Faculty in Public Service.

A Fischer-Tropsch Gas-to-Liquid Technology for Small-Scale Applications

Mark Peters, Diane Hildebrandt, David Glasser, Wayne Stocks, Andrew Ross-Innes

Material and Process Synthesis (MaPS) Engineering, University of South Africa

Dr. Mark Peters

Consulting and Research Engineer

Material and Process Synthesis (MaPS) Engineering

University of South Africa



Dr. Mark Peters is a qualified Chemical (Process) Engineer, having received his B.Sc. (Eng) *cum laude* in 2003 and Ph.D. (Chem. Eng.) in 2008 from the University of the Witwatersrand, Johannesburg, South Africa. The research for his Ph.D. thesis formed the basis of a book published by John Wiley & Sons. The book is entitled *Membrane Process Design Using Residue Curve Maps*, and was published in 2011. Mark is also a co-author of a second book called *Understanding Distillation Using Column Profile Maps*, also published by Wiley, in 2013.

He is currently a Consulting and Research Engineer at the Material and Process Synthesis (MaPS) group, based at UNISA. Although a research group, MaPS is not purely academic, with a track-record of practical industrial work, especially in the field of process engineering and energy efficiency. Mark is involved in many diverse projects, but his main focus has been on the commercialization of small-scale (1-1000bbl/day) Fischer Tropsch Facilities for the conversion of carbon-to-energy (coal/natural gas/waste/biomass conversion to liquid fuels and electricity). His job responsibilities include all aspects involved with developing novel energy-efficient processes: conceptual design, feasibility studies, PFDs, P&IDs, HAZOPs, equipment specifications and sizing, as well as marketing, attracting clients and investors, contracts and project management.

He has previously worked for Sasol Technology as a Process Engineer in the LTFT Catalysis group at R&D in Sasolburg. He has also lectured courses to undergraduates at University of the Witwatersrand in Design and Multi-component Separations, as well as supervised numerous postgraduate students in chemical engineering. Mark was short-listed as a finalist in the 2012/2013 BHP Billiton NSTF Awards in the category of Emerging Researcher.

Registration Form
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and Lessons Learned from the Qatari Experience with Natural Gas
March 26-28, 2014
 La Torretta Lake Resort and Spa, Lake Conroe, Montgomery, Texas 77356
<http://www.latorrettalakeresort.com/>

Full Name:
 Address:
 City: State: Zip: Country:
 Phone: Email Address:

Registration Fees

	Early Registration (Before 02/24/2014)	Regular Registration	Amount Enclosed
Short Course on March 26, 2014*	\$200	\$275	\$
Workshop on March 27 and 28, 2014**	\$300	\$375	\$
Combined Registration of Short Course and Workshop	\$450	\$600	\$

*A short course in the form of two tutorials will be given to cover: "Natural Gas Monetization: Technology Fundamentals and the Potentials" and "Theoretical and Experimental Evaluation of Natural Gas Properties." The registration fee covers the two tutorials, electronic files of the course materials, two coffee breaks, and lunch.

** The registration fee covers the attendance of the keynote presentations, short presentations, and poster session, electronic files of the workshop materials, coffee breaks, and lunches.

Guest Registration

Includes entry to coffee breaks and three lunches \$150.00

Name of Guest:

Total amount enclosed/to be charged (payment must be in USD) \$ _____

Method of Payment:

A&M University)

- Check/money order (made to the Chemical Engineering Department, Texas A&M University)
- Visa
- Mastercard
- Discover
- American Express

Credit Card Authorization

Name on Card: Card Number: Expiration Date: CVV#:
Authorized Signature: _____ Zip Code: _____

Cancellation Policy: Registration cancellations received before March 12, 2014 will receive a full refund, less a \$100 administrative fee. All cancellations request must be made in writing. Cancellations received after March 12, 2014 are nonrefundable.

Please Email/mail your registration and direct your questions to:

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E-Mail: El-Halwagi@TAMU.edu

Lodging

The short course and workshop will take place at La Torretta, Lake Conroe, Montgomery, Texas 77356: <http://www.latorrettalakeresort.com/>

Reservations should be made directly with the hotel. A special lodging rate of \$129/night plus taxes has been negotiated with La Torretta with a cutoff date of February 24, 2014. For the special rate, please mention the “Texas A&M Workshop.”