IAEE
WWW.IAEE.ORG
INTERNATIONAL ASSOCIATION *for* ENERGY ECONOMICS

IAEE Energy Forum

First Quarter 2012 International Association for Energy Economics

President's Message

Let me begin by saying that I feel honored to have been elected President of IAEE, and that I really look forward to chairing the Council of this truly global organization during 2012. I think that IAEE is a great association with significant potential to contribute to the development of energy economics as an academic discipline, as well as to the development of more efficient and equitable energy and environmental policies at the national and international level. Let me also take this opportunity to thank my predecessor, Mine Yücel, for her outstanding work for the IAEE during her term as President.

Next a few words of presentation: Since 1984 I am professor of economics at the Stockholm School of Economics (SSE). In 2004 I was appointed President of SSE, with my second term expiring in June 2012. Most of my research has been related to energy and environmental economics, often with a strong policy orientation. In the 1990's I was very much involved in the electricity market reform in Sweden. For more than 20 years I have been Chairman of the Swedish Affiliate of IAEE. Last year I had the pleasure and pain of being General Conference Chair of IAEE´s International Conference, held in Stockholm in June.

Upon reflection I think that the Stockholm conference illustrated several important features of IAEE. One observation is that a large number of the delegates were students or young researchers, and many of them presented excellent papers. That shows that energy economics and closely related fields attract many talented young researchers and that lots of interesting research is being produced. Moreover, the large number of energy economics PhD students and young PhDs suggests that IAEE has a significant potential in terms of membership growth.

A second observation is that many of the most well-known and influential academics in the field of energy economics were present in Stockholm. This is exactly as it should be at a conference organized by an organization that aims to be "the leading international professional association in energy economics and related disciplines". Yet it remains to make presence at the IAEE international conferences a "must" for all the leading academics in the field. In fact I see this as one of the major challenges during my term as President of IAEE.

A third observation is that several top level representatives of major energy companies and energy related organizations attended the conference, and played important roles as speakers and moderators. I think that this is also exactly as it should be. That is because I see IAEE as an important meeting place, physical or virtual, for energy professionals in academia, business and government. Thus we should continue to attract leading individuals from these three camps to our conferences and make sure that they interact in a constructive way.

A major step in the direction of fostering interaction between energy professionals in academia, business and government is the launch of IAEE's new journal, *Economics of Energy & Environmental Policy (EEEP).* With *EEEP, The Energy Journal* and *IAEE Energy Forum* I think that IAEE has a very suitable mix of outlets for energy related research, updates on current energy issues and comments and suggestions on energy and environmental policy matters.

I often hear that academics too seldom participate in the public debate on economic policy matters, including energy and environmental policy matters. Part of the reason is

(continued on page 2)

IAEE INTERNATIONAL ASSOCIATION *for* ENERGY ECONOMICS
WWW.IAEE.ORG

CONTENTS

Editor: David L. Williams

PRESIDENT'S MESSAGE *(continued from page 1)*

probably lack of suitable channels for the kind of contributions that academics and other professionals in the energy field can make. With *EEEP* a new opportunity has been created. I hope that many energy professionals in the IAEE network will grasp this opportunity.

Lars Bergman

IAEE Mission Statement

The International Association for Energy Economics is an independent, non-profit, global membership organisation for business, government, academic and other professionals concerned with energy and related issues in the international community. We advance the knowledge, understanding and application of economics across all aspects of energy and foster communication amongst energy concerned professionals.

We facilitate:

- Worldwide information flow and exchange of ideas on energy issues
- High quality research
- Development and education of students and energy professionals

We accomplish this through:

- Providing leading edge publications and electronic media
- Organizing international and regional conferences
- Building networks of energy concerned professionals

Editor's Notes

This issue focuses primarily on shale gas and related aspects. However, interspersed among these articles are several very interesting articles on other energy related issues. Read on:

Vlad Ivanenko and Benjamin Schlesinger note that shale gas resources in Eastern Europe are exceptionally promising, and exploitation activities have begun, especially in Poland. Nonetheless, they trace a number of risks and uncertainties that confront drillers – including complexities in transferring foreign technologies, unknowns concerning the environmental benefits and consequences, the halting pace of implementation of the European Union's energy policies, and the absence of pipeline and buyer competition. Solutions are suggested with an emphasis on developing constructive alliances and alleviating institutional barriers in ways that would help expedite movement of shale gas resources to markets.

Matthew Hulbert explains that Beijing has a new energy problem, and it's called Brussels. The Libyan impasse has made abundantly clear that the U.S. is no longer willing to safeguard Europe's energy interests. If China wants to maintain pressure on key suppliers, it must secure both ends of the consumer pipeline. This means seriously considering a Beijing-Brussels energy pact.

Robert Hoffman notes that oil prices are now more volatile than ever but the impact on the economy appears to have diminished. He reviews the research that has attempted to quantify this relationship and specifically articles that provide a point estimate of this key elasticity.

Christopher Robart notes that higher water requirements in the development and production of shale resources make lifecycle water management scenarios, including water treatment and recycling, more attractive than conventional approaches to oilfield water management. He provides the detail by discussing an actual anaysis for a client in the Eagle Ford shale play in south Texas.

Ross McCracken writes that forecasts for tight oil output are growing and new discoveries are being made. Peak demand has arrived in the OECD well before peak production. The result is to flatten the famous bell curve of U.S. geologist Marion King Hubbert and push peak oil back into a distant future. But if there's more oil, it means that concerns over price, supply security and climate are no longer aligned.

Philip Andrews-Speed looks at Beijing traffic congestion and forecasts it to get worse before it gets better. He suggests that the source of the problem lies in policy decisions and non-decisions going back to the 1980s in which urban expansion around the road rather than rail, and private car ownership expansion were set in motion. It could be another 20 years before sustainable improvement in urban transport conditions occur.

Maximilian Kuhn and Frank Umbach write that unconventional gas has changed the global energy landscape. It has not only increased energy security and brought energy independency in some instances, but it also has wider implications for global energy markets and consequently on foreign policy. They discusses the global implication of gas and unconventional gas in particular.

Jeroen de Joode, Arjan Plomp and Özge Özdemir write that shale gas in Europe could potentially be a big thing, especially in particular regions. Whereas test drillings need to confirm the presence of technical recoverability and further research is needed on socio-economic aspects this article illustrates that shale gas developments may have substantial implications for regional gas balances, gas flows and infrastructure requirements throughout Europe.

Gordon Little reports on shale gas production in Ukraine. If this turns out to be viable, the geopolitical effects will ripple through Europe. Russia's energy grip will be loosened, and commercial opportunities will balloon.

DLW

The 35th Annual IAEE International Conference
24-27 June 2012
Perth, Western Australia
Perth Convention and Exhibition Centre

Conference Theme

Energy markets evolution under global carbon constraints: Assessing Kyoto and looking forward

Objectives and Aims

The objective of the conference is to examine the dynamism of the world energy sectors in the context of what effect the Kyoto Process, which ends in 2012, had on the energy markets, technologies, and systems of the world. Also of interest is what technological and market developments occurred in spite of the Process? In other words, will the energy world of 2012 and beyond be purely the product of reactions to the Kyoto Protocol, or were there strong undercurrents of change that flowed throughout the period that would have occurred regardless? And from this examination, what may we reasonably expect for the near- to intermediate-future? Plenary sessions will examine these questions from industry, government, and academic perspectives.

Overview

The conference will address the full range of energy issues that may be expected to be commanding the attention of academics, analysts, policy-makers, and industry participants in 2012, looking both forward and back. In addition to all major fields of energy economics and policy typically covered, other possible topics include:

- Greenhouse gas policy after Kyoto
- Energy supply and demand security
- A growing role for nuclear
- The role of unconventional energy resources
- Price volatility
- Renewable and alternative sources of energy
- Carbon capture and sequestration
- Policy consideration in a carbon constrained world
- Distributed generation
- Energy efficiency in primary commodity production
- Resources sector taxation policy
- Developments in LNG markets
- Harmonization of cross-border energy regulations
- Evolving geopolitics of oil and gas
- Emissions modelling
- Emission trading schemes
- The econometrics of oil and gas markets
- The economics of climate change
- Risk mitigation methodologies
- Reserves, production, and peaks
- Energy development and the environment

Platinum Sponsor

Australia LNG

General Conference Chair

Ronald D. Ripple, PhD
Professor of Energy Economics
Curtin University, Perth, Australia
r.ripple@curtin.edu.au

Program Co-Chairs

Anthony (Tony) D. Owen, PhD
Santos Professor of Energy Resources
School of Energy and Resources
University College London
Adelaide, Australia
Tony.Owen@ucl.ac.uk

Daniel J. Packey, PhD
Associate Professor and Head
Department of Mineral and Energy Economics (DMEE)
Curtin University, Perth, Australia
d.packey@curtin.edu.au

PhD Program Chair

Helen Cabalu-Mendoza, PhD
Associate Professor and Head
Department of Economics
Curtin University, Perth Australia
h.cabalu@curtin.edu.au

The Location: Perth, Western Australia

The conference will be hosted at the Perth Convention and Exhibition Centre. Visit the following website for a 3-minute online video of some of the wonders of Perth and the surrounding region: http://pcb.com.au/our-services/convention-tool-kit/destination-dvd.aspx. Come enjoy this beautiful part of the world, in one of the most dynamic energy development regions of the globe. We look forward to your company and active participation in the 35th IAEE International Conference in Perth, June 24-27, 2012.

Call for Papers

We are pleased to announce the Call for Papers for the 35th International Association for Energy Economics conference to be held 24-27 June 2012 at the Perth Convention and Exhibition Centre in Perth, Australia. **The deadline for abstract submission is 13 January 2012.**

We will be accepting proposals for two different structures of conference presentations. We will have the typical concurrent session paper presentations, and we will augment these with a limited number of extended presentations with formal discussants. The typical sessions include up to five papers and presentations are limited to 15 minutes, including Q&A. The extended presentation sessions will include not more than three papers, with each allocated 30 minutes, including discussant and Q&A.

Paper abstracts for the typical concurrent sessions shall follow the format of the Abstract Template, which may be downloaded at www.business.curtin.edu.au/creme/AbstractTemplate.doc, (ticking the appropriate choice). The abstract should be one to two pages in length, and it must include: a) keywords, b) overview, c) methods, d) results, e) conclusions, and f) references. NOTE: All abstracts must conform to the abstract format presented in the abstract template. Authors will be notified by 16 March 2012 of the status of their papers. **We strongly encourage industry and government submission with economics and policy focus.**

The extended presentation paper proposals **require a near-final draft of the completed paper** on the 13 January 2012 deadline submission date. In addition to a complete paper, one author of each paper must commit to being a discussant of another extended paper. Use the AbstractTemplate as your cover page (ticking the appropriate box); completing just the title, author(s), and keywords sections.

Concurrent session abstracts and extended presentation papers should be in either Microsoft Word or PDF format and sent to IAEE.Perth.Abstracts@curtin.edu.au.

Best Student Paper Award: the IAEE is pleased to announce the continuation of its Best Student Paper Award program in 2012. The top energy economics paper award will receive US$1000, and the three runners-up will each receive US$500. All four students will also receive waivers for their conference registration. Complete information for this competition, including submission details, may be requested from David Williams at iaee@iaee.org, or found at www.iaeeperth2012.org.

Contact information

Ronald D. Ripple, PhD, Director
Centre for Research in Energy
and Minerals Economics
Curtin University
GPO Box 1987
Perth, Australia 6845
Email: r.ripple@curtin.edu.au
Phone: (61 8) 9266 3935
Web: business.curtin.edu.au/creme

Conference registration fees (all fees are in Australian dollars, inclusive of 10% GST)

	Early (before 1 May 2012)	**Normal** (1 May 2012 & after)
Speakers/Chairs/ Discussants (Members)	A$770	A$855
Speakers/Chairs/ Discussants (Non-members; includes membership)	A$850	A$935
IAEE members	A$855	A$940
Non-Members	A$1,045	A$1,155
Students	A$440	A$440
Guests	A$440	A$440

31ST USAEE/IAEE NORTH AMERICAN CONFERENCE / NOV. 4-7, 2012 / SHERATON AUSTIN, TEXAS

CONFERENCE OVERVIEW

The sustainability of global long term energy demand, supply, and energy diversity is in question in light of growing demand for energy in China, India, Brazil, and other emerging economies, increasing awareness of environmental issues, and the need to find new ways to address related concerns. Further uncertainties are raised by changing world events such as the global debt crisis, the Arab Spring, and the impact of Japan's tsunami and earthquake disasters on the development of nuclear energy. These and other issues challenge the transition toward a sustainable energy era where the current energy needs are met without compromising the energy needs of future generations, and they also create opportunities.

If there is a need to guide this transition, what type of roadmap should be developed to show a desired path to energy sustainability? To what extent will the roadmap be determined by drivers such as public and private investment, government and environmental policy, technological innovation, and research and development funding? Furthermore, what roles will be played in this transition by conventional and non-conventional fossil fuels; renewable energy resources such as wind, solar, geothermal, and biomass; distributed resources and storage; energy efficiency; electric vehicles; and the smart grid?

This conference is intended not only to address these questions but also to address possible challenges and opportunities for the transition to such a sustainable energy era. With its record of energy innovation and accessibility, Austin, Texas is an ideal setting for bringing together key players in the global energy and transportation industries, government, and academia to address questions and concerns raised in several plenary and concurrent sessions. Those interested in organizing sessions should propose a topic and possible speakers to Robert Borgstrom, Concurrent Session Chair (robertborgstrom2@gmail.com). The conference will also provide networking opportunities through workshops, public outreach and student recruitment.

HOSTED BY

Central Texas Association for Energy Economics

TOPICS TO BE ADDRESSED INCLUDE:

Conventional and Unconventional Gas and Oil Supplies

- Changing World Oil Supply/ Demand Balance
- Protection of Offshore Resources Versus Oil Supplies
- Exploration and Drilling Cost Concerns
- Future Utilization of Fossil Resources in Other High Value Added Products

Markets and Drivers of Renewable Energy

- Government's Promotional Role
- Integration of Solar and Wind Generation In Power Dispatch
- Mass Production for End-Use Distributed Renewable Resources
- Capital Markets – Financing Renewable Resources

Energy Efficiency – Defining and Meeting Realistic Goals

- Building Controls and Cost Allocation
- Energy Efficiency Rules for Government Sponsored Home Loans
- Tightening Standards
- The Minimal Energy Society – Danish Model
- New and Improved Automobile Efficiency Standards

Economic Analysis Methods and Assumptions

- Energy Data Sources
- EIA Reliability Amid Shale Gas Data Difficulties
- Private Surveys
- Smart Meter Consumption Data and Analysis

Role of Government in Transitioning to a Sustainable Energy Era

- Issues in Energy Regulation and Uncertainties
- Renewable Portfolio Standards (RPS)
- Goals and Standards Toward Energy Sustainability
- Incentive Mechanism to Enhance Energy Sustainability
- Financial Regulations and their Impacts on Energy Trading
- Market and Exchange Trading Efficiencies

Changing Geography of Energy Demand

- China
- India
- New Industrial Asia and South America
- North America and Europe
- Developing Countries

Climate Change Concerns

- Pros and Cons of Delaying a Decision
- Policies Compatible with Economic Slowdown
- Intergenerational Considerations
- Can Developing World Benefit from Additional Environmental Regulation?

Natural Gas – Bridge Fuel to More Natural Gas?

- Shale Gas Revolution and Water Issues
- LNG Trade
- Global Gas Contracts vs. Spot Market Trading
- Role of Gas in Meeting Renewable Portfolio Standard or CO_2 Emission Standards

Global Petroleum Security and Pricing

- OPEC Policies in a Changing World
- Oil Supply Crisis Due to Political Instabilities in Producing Countries
- Strategic Oil Storage Policies

Electricity

- EPA's New Standards and Coal Power Plant Trade-Offs
- Natural Gas and Wind Generation – Competition or Integration?
- Adequacy of Transmission Capacity to Accommodate Massive Renewable Resource Expansion
- Market Design and Efficiency
- Electricity Pricing, Fuel Pricing and Policy
- Wind and Solar Market Penetration Issues
- Role of Demand Response in Addressing Resource Adequacy and Reliability Issues

Energy Capital Investment & Allocation

- Wind
- Solar
- Nuclear
- End-Use Distributed Resources and Storage
- Infrastructure

Energy Infrastructure

- Capital Investment Requirements
- Costs of Capital
- Pipeline and Transmission Line Financing, Regulatory and Right-of-Way Issues

Energy Technology and Innovation

- Supply Expansion
- New Energy Technologies (Distributed Generation and Storage)
- Cost Reduction
- Demand and Efficiency
- Role of Smart Meters in Enhancing Smart Pricing and Value Added Services

Issues in Moving Beyond Petroleum in Transportation

- Short-Range vs. Long-Range Electric Cars
- Electric Vehicles in Mass Transportation
- Is Natural Gas Fuel of Choice to Replace Gasoline?
- Ethanol and Biodiesel

Energy and Wealth Distribution

- Can Energy Sustainability Be Consistent with Economic Growth?
- Can Developing World Benefit from Additional Environmental Regulation?
- Can New Energy Technologies Reduce the Gap between Industrialized and Developing Countries?

Energy and Water Issues

- Impact of Drought on Energy Generation
- Water Usage of Different Electric Generation Technologies
- Hydro Generation

Energy and Food

- Energy Consumption by Food Industry
- Food Waste Reduction and Energy Savings

WITH SUPPORT FROM

USAEE United States Association for Energy Economics
IAEE International Association for Energy Economics www.iaee.org
CAEE
AMEE

31st USAEE/IAEE NORTH AMERICAN CONFERENCE

CALL FOR PAPERS

We are pleased to announce the Call for Papers for the 31st USAEE/IAEE North American Conference to be held November 4-7, 2012, at the Sheraton Austin Hotel at the Capitol, Austin, Texas, USA. **The deadline for receipt of abstracts is May 31, 2012.**

There will be two categories of Concurrent Session Paper Presentations:

1) Reports on Current Research

This Category provides a forum for the presentation and discussion of papers that describe an analysis that has either been completed by the author since the last USAEE Annual Conference or very near completion.

Authors wishing to make presentations at the conference under this category will submit an Abstract that describes, briefly, a research project that is of significance within the field of energy economics and of general interest to the membership at large.

The Abstract must be no more than two pages in length and must include each of the following sections:

a. Overview—A concise statement of the research problem including its background and the extent of its significance (*e.g.*, locally, regionally, globally)

b. Methodology

c. Results

d. Conclusions

e. References

2) Reports on Case Studies of Applied Energy Economics

This Category provides a forum for the presentation and discussion of professional activities in the field of energy economics that have been completed by the author since the last USAEE Annual Conference or is an ongoing professional activity of the author.

Authors wishing to make presentations at the conference under this category will submit an Abstract that briefly describes an issue, problem or other challenge within the field of energy economics that is of interest to the Association's membership and that the author has addressed by personal, professional involvement (*e.g.*, field work, research and/or analysis).

The Abstract must be no more than two pages in length and must include each of the following sections:

a. Overview of the topic including its background and the extent of its significance (e.g., locally, regionally, globally) including a statement of the author's responsibility in addressing the matter.

b. Methodology. How the matter was addressed.

c. Results or current status of ongoing situations.

d. Conclusions. Lessons learned, and next steps.

e. References are optional.

Please note that the Abstract is not intended to be the proposition of either a "Desk Study" or an activity that the author intends to undertake only after the Abstract Committee has accepted the topic.

Also, presentations in this category are intended to facilitate the sharing of professional experiences and lessons learned, however, presentations that overtly advertise or promote proprietary products and/or services are unacceptable. Those who wish to distribute promotional literature and/or have exhibit space at the Conference are invited to avail themselves of sponsorship opportunities – please see www.usaee.org/usaee2012/sponsors.html.

Please visit www.usaee.org/USAEE2012/AbstractTemplate.doc to download an abstract template. All abstracts must conform to the format structure outlined in the abstract template. Abstracts must be submitted online by visiting www.usaee.org/USAEE2012/submissions.aspx. Abstracts submitted by e-mail or in hard copy will not be processed.

At least one author of an accepted paper must pay the registration fees and attend the conference to present the paper. The corresponding author submitting the abstract must provide complete contact details—mailing address, phone, fax, e-mail, etc. Authors will be notified by July 20, 2012, of their paper status. Authors whose abstracts are accepted will have until September 7, 2012, to submit their full papers for publication in the conference proceedings. While multiple submissions by individuals or groups of authors are welcome, the abstract selection process will seek to ensure as broad participation as possible: each speaker is to present only one paper in the conference. No author should submit more than one abstract as its single author. If multiple submissions are accepted, then a different co-author will be required to pay the reduced registration fee and present each paper. Otherwise, authors will be contacted and asked to drop one or more paper(s) for presentation.

Since the Austin meeting falls on election day, U.S. members are urged to either vote early or by absentee ballot, depending on the election rules of their state.

STUDENTS

Students may submit an abstract for the concurrent sessions. The deadline for abstracts is May 31, 2012. Also, students may submit a paper for consideration in the Dennis J. O'Brien USAEE Best Student Paper Award Competition (cash prizes plus waiver of conference registration fees). The paper submission has different requirements and a different deadline. The deadline for submitting a paper for the Student Paper Awards is July 6, 2012. Visit www.usaee.org/usaee2012/paperawards.html for full details.

Student participation is also sought via the Poster Session. In this highly interactive event, students set up a stall around a poster and present the key results of their recent academic working a quickly repeated series of short sessions that allow for real time Q&A with the conference delegates. **Abstracts for the Poster Session must be submitted by the deadline of May 31, 2012** and must be relevant to the conference themes. Posters and the presentations will be judged by an academic panel and a cash prize will be awarded to the student with the best poster presentation. Students will be notified by July 20, 2012, of their poster status. Students whose abstracts are accepted will have until September 7, 2012, to submit their final poster electronically (pdf) for publication in the conference proceedings.

Posters for actual presentation at the conference must be brought by the student directly to the conference venue and must be in ANSI E size (34in. wide x 44in. high) in portrait format.

Students may also inquire about our scholarships covering conference registration fees. Visit www.usaee.org/usaee2012/students.html for full details.

TRAVEL DOCUMENTS

All international delegates to the 31st USAEE/IAEE North American Conference are urged to contact their respective consulate, embassy or travel agent regarding the necessity of obtaining a visa for entry into the U.S. If you need a letter of invitation to attend the conference, contact USAEE with an email request to usaee@usaee.org. The Conference strongly suggests that you allow plenty of time for processing these documents.

VISIT OUR CONFERENCE WEBSITE AT: WWW.USAEE.ORG/USAEE2012/

NIGERIAN ASSOCIATION FOR ENERGY ECONOMICS

Affiliate of International Association for Energy Economics

5TH ANNUAL NAEE/IAEE INTERNATIONAL CONFERENCE

ENERGY TECHNOLOGY AND INFRASTRUCTURE FOR SUSTAINABLE DEVELOPMENT

SHERATON HOTEL, ABUJA, NIGERIA

April 23-24, 2012

CALL FOR PAPERS

CONFERENCE OBJECTIVES:

After a decade of energy sector and economy-wide reforms, many developing countries, especially those in Africa, are confronted with the challenges of selecting and funding the appropriate technology and requisite infrastructure to deliver reliable and adequate energy services for sustainable human development. Appropriate choices of energy technology and infrastructure are arguably critical for these countries to realize the goal of sustainable development. The relative small size of these economies coupled with the more difficult conditions confronting availability of finance for energy infrastructure, in high cost environment that is so common in Africa, in the aftermath of the recent global financial crisis, present peculiar challenges to energy planners, managers and policy makers in these countries. The 5th NAEE/IAEE Conference will bring together energy sector specialists from the energy industry, academia, public institutions, regional and international organizations and non-governmental organizations to discuss the linkage between energy technology options, infrastructure development and sustainable human development. The central theme is sustainable energy development anchored on adequate supply of energy infrastructure that can deliver cost effective, adequate, reliable, and efficient energy services to meet the energy needs of consumers as well as eliminate the problems of low energy access. Further, discussions of international experiences and best practices in successful developing countries during the conference are expected to offer pragmatic examples of how to resolve inadequate energy infrastructure challenges to African countries.

CALL FOR PAPERS: We are pleased to announce the **Call for Papers** for the 5th International Conference of the NAEE to be held **23-24 April 2012** in the capital city of Nigeria, Abuja. You are cordially invited to submit proposals for presentations at the concurrent sessions on a range of topics including, but not limited to, those highlighted below. **Deadline for submission of abstracts is October 31, 2011.** All submitted abstracts should not exceed two pages, and must include the following sections: overview, methods, expected results and references. Those interested in organizing sessions should propose topic and possible speakers to: Engr. Dave Dogo, Program Chairman (p) +234-805-502-7475, (e) meanduk@gmail.com and Professor Adeola Adenikinju Conference Chairman (p) +234-802-344-0018, (e) adeolaadenikinju@yahoo.com.

Conference Themes and Topics: The following is a list of suggested topics that are of interest, but suggestions outside these topics are encouraged and will be considered.

Energy Infrastructure and Technology Options
Energy Conservative & Efficiency
Oil and Gas Infrastructure
Climate Change and the Energy Industry
Clean Energy Technologies
Energy, Poverty and Sustainable Development
Energy Planning and Policy
Energy and the Economy
Public Private Partnerships in Energy

Local Content and Technology

Energy Infrastructure and Regional Market Integration
Human Capital and Energy Infrastructure Development
Electricity Infrastructure
Energy Pricing, Investment and Financing
Renewable Energy Technologies and Infrastructure
Energy Infrastructure and Security of Supply
Energy Modeling
Energy Access
Legal and Regulatory Issues in Energy Infrastructure Development
Energy Infrastructure Development and Risk Sharing

Political Economy of Shale Gas Industry in Eastern Europe

By Vlad Ivanenko and Benjamin Schlesinger*

In general, natural resource development proceeds when producers define advantageous projects, investors find them profitable, lenders accept the risks, and communities decide they can live with the externalities. With greater degrees of risk and uncertainty in any of these enablers, higher returns must be secured to attract capital and, similarly, communities may become more involved configuring and approving projects. All the while, the surrounding legal, regulatory and business framework may help to steer the path taken by the resource development and may become crucial as the risks and uncertainties rise.

The situation with the nascent shale gas industry in Eastern Europe is no exception to this formulation. In spite of promising preliminary assessments, producers face a number of uncertainties that force especially careful decision-making. Communities may welcome the prospective benefits of incremental gas production but nonetheless remain concerned over environmental consequences that are unknown or poorly understood. In this situation, it is the political will, or the lack of it, that may tip the balance to one or another side. In a region as diverse as Eastern Europe, first movers may reap significant benefits but may also experience considerable risk.

We begin this discussion with a review of prospects for shale gas development in Eastern Europe, we then consider the local political situation, discuss impediments that must be overcome and, finally, conclude with policy options that may contribute to timely and profitable development of shale gas resources in the region, while minimizing the environmental risks.

Shale Gas Prospects in Eastern Europe

In April 2011, the U.S. Energy Information Administration (EIA) released estimates of technically recoverable shale gas in 32 countries, four of which are located in Eastern Europe (see Table 1). Location of the key prospects are illustrated in Figure 1.

Country	2009 Natural Gas Market (Tcf)[1] Production	Consumption	Imports (Exports)	Proved Natural Gas Reserves (Tcf)[2]	Technically Recoverable Shale Gas Resources (Tcf)[3]
Poland	0.21	0.58	64%	6	187
Ukraine	0.72	1.56	54%	39	42
Lithuania	-	0.10	100%	-	4
Russia (Kaliningrad)	-	0.02	98%	-	19

Table 1 - Estimated Shale Gas Resources in Selected Eastern European Countries

Sources: 1. EIA, 2011. International Energy Statistics, March (apart from Kaliningrad's data that come from EuropeAid, 2007. Kaliningrad Fuel and Energy Balance Final Report, February); 2. Oil and Gas Journal, Dec. 6, 2010, p. 46-49; 3. Advanced Resources International, Inc., 2011. World Shale Gas Resources: An Initial Assessment of 14 Regions outside the United States, April 2011.

The information in Table 1 suggests a highly positive outlook for shale gas, particularly in Poland, with an estimated 187 Tcf of technically recoverable resources. One must keep in mind the limitations of EIA's assessment, however, as it is based on geological similarities between shale plays in the U.S. and formations in other countries for which log data are available. Consequently, Eastern Europe's shale gas prospects are hypothetical at this point, and must await the results of exploratory drilling and analysis. Thus far (at year-end 2011), Poland is the most advanced in this respect, with more than 100 wells, while the other three countries are far behind, e.g., media reports indicate that only about a dozen shale wells have been drilled in promising shale fields in Hungary and Ukraine. Shale well drilling in other Eastern European countries has yet to commence, although preparatory work is evidently ongoing.

Results of drilling operations thus far appear mixed. Halliburton conducted initial hydraulic fracturing operations for the Polish Oil and Gas Company (PGNiG) at the Markowola-1 well in August 2010; discouraging results suggested that the fracturing technology needed to be adapted to geological conditions more specific to Poland. Also in 2010, ExxonMobil withdrew from Hungary, which had been considered promising, after failing to discover commercial quantities of shale gas. On the other hand, three local producers – PGNiG in Poland, RAG Rohol-Aufschungs in Hungary, and Kulczyk Oil Ventures in Ukraine – have each claimed field successes. While commercial production has yet to evolve, exploratory programs are continuing in light of the region's considerable potential.

* Vlad Ivanenko is a Senior Economist with Natural Resources Canada. Benjamin Schlesinger is President of Benjamin Schlesinger and Associates. Ben Schlesinger may be reached at bschles@bsaenergy.com
See footnotes at end of text.

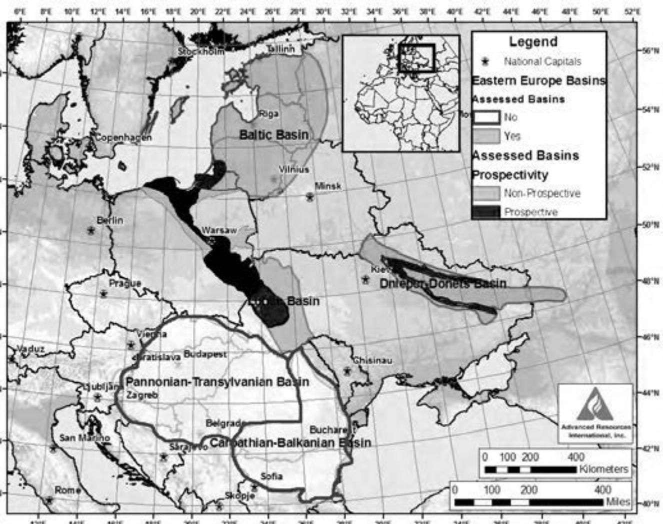


Figure 1 - Location Shale Gas Prospects in Eastern Europe

Source: Advanced Resources International, Inc., 2011. World Shale Gas Resources: An Initial Assessment of 14 Regions outside the United States, April 2011.

Local Institutional Environment: Incentives and Roadblocks

The political framework in Eastern Europe vis-à-vis shale well drilling may be thought of as a two-layered structure. The first layer is formed by European Commission (EC) energy policy goals for the European Union (EU) as a whole, including Eastern European members. The second layer consists of national governments and their in-country priorities. These two sets of goals do not necessarily converge, which alone may pose exploration and development (E&D) uncertainties. We consider below how the interactions among the foregoing play out with respect to shale gas development in the region.

In its Third Energy Directive concerning natural gas, the EU spelled out an energy strategy aimed at establishing a unified, secure European gas market. To this end, the EU proposed five policies: to force incumbent companies having a de facto monopoly position to unbundle their merchant functions from their transportation operations, to encourage investments in interconnectors across external borders, to diversify gas supply both through pipelines and liquefied natural gas (LNG) terminals, to streamline rules and procedures for projects of European interest, and to foster competition so that consumers have access to gas energy at affordable prices. These goals echo and strengthen those contained in earlier EU gas directives, many of which remain to be implemented.

While national preferences for the region may diverge from country to country, there are some commonalities within Eastern Europe. All local governments claim to seek a measure of supply diversity to minimize delivery and dependence risks arising out of their critical dependence on Russian gas, although all recognize that stable supplies from Russia will remain critical to the region's gas industries. Regional energy authorities recognize that natural gas is a low-carbon substitute for coal and oil in a variety of end-uses, but the need to minimize energy expenditures takes priority over environmental concerns. They appreciate that Russia's gas supply deliveries to Western Europe will become more stable and reliable with completion of the North-Stream Pipeline but they sense that there is no comparable "silver bullet" available for Eastern Europe. As a consequence, gas supplies to the region will need to be diversified and strengthened in other ways, e.g., by timely development of in-country resources and increased reliance on LNG (although also imported).

The foregoing discussion suggests some daylight exists between the EU's directives and individual country needs. Indeed, that fact that national energy institutions throughout Europe's gas industries have often followed their own policy goals, or have only slowly adapted to EU objectives, further complicates the local gas business environment vis-à-vis shale gas. For example, while accepting in principle the idea of unbundling gas infrastructure from the commodity itself – a process that the U.S., Canada and the UK have completed – some individual countries have sought to retain national control over local gas commodity and infrastructure chains. Some have continued to foster national gas 'champion' companies that have phased in third-party access (TPA) only in measured steps over many years, if at all.

For example, were TPA in effect on Poland's pipelines, they could offer shale producers (and any other indigenous gas suppliers) a broadened market reach that might stimulate and, indeed, accelerate development, all other things equal. Moreover, the air quality, low carbon, and other environmental benefits of natural gas tend to be subsumed in countries that must, instead, encourage economic growth as a priority, particularly in Eastern Europe. Countering this, almost all countries of the region (except the Czech Republic and Hungary) have a negative trade balance in goods, thus they see in local gas production an opportunity to reduce significant expenses on purchasing imported supplies. Finally, expansion of gas transportation infrastructure in Eastern Europe is complicated by risks relating to market uncertainties, ownership/financing, and permitting complexities, e.g., we note continuing difficulties in advancing the inter-Baltic "Amber" pipeline proposed by Poland.

Moving Forward in the Fields – Issues and Barriers

The uncertainty surrounding prospects for shale gas in the Eastern Europe and complex political environment suggest that, for the time being, shale gas development must proceed largely on a basis of private investment, e.g., venture capital funds. Poland constitutes a notable exception. Its government actively supports shale E&D investments of domestic petroleum companies such as PGNiG, Orlen, and Lotos. Although these firms possess sufficient cash flow to sustain shale gas drilling, their financial position is far from that of major producers, thus they must operate conservatively as they are unable to diversify the risk of potential failure. This has kept domestic programs relatively modest, e.g., Natural Gas Europe (2011) reports that Orlen will drill only six shale gas test wells through 2013 at the total cost of $150 million.

The presence of foreign venture capital has enabled some drilling programs to proceed in Poland, especially where risks of E&D in Poland may be offset by North American operations. For example, the Quantum Fund associated with Hungarian-born financier George Soros has invested about $100 million in San Leon Energy and BNK Petroleum specifically for these North American companies' shale gas projects in Poland. While beneficial, such involvement alone is insufficient for wide-scale E&D as Quantum Fund's total placement appears adequate to drill about no more than a half dozen wells (at costs comparable to Orlen's).

High E&D costs are of general concern for the region. Sikora (2011) finds the low intensity of drilling to be the key factor driving the average cost of gas extraction services in Poland up to 3-4 times higher than in North America. The problem is not necessarily caused by any challenging local business climate in Poland, but relates more to the fact that a host of shale gas-related technologies are continuing to evolve rapidly and change greatly in North America, despite its relatively advanced shale gas drilling industry. Indeed, North American shale drilling expertise is not necessarily portable from one field in to another in the U.S. and Canada, let alone to Eastern European geological formations. Instead, techniques must be carefully adapted to individual fields and circumstances.

Beyond the foregoing technology transfer questions, natural gas demand and contracting uncertainties pose yet another challenge to Eastern European shale gas development. Since producers cannot yet determine their costs of shale gas E&D and production levels, they will undoubtedly need some form of price and volume assurance. In European gas markets, these are normally arranged through long-term take-or-pay contracts, with prices indexed to petroleum products. Yet the European market is evolving at present, with a counter-play of contract and spot traded markets, which tend to intersect from time to time. Uncertain demand for natural gas (current EU forecasts differ radically) and a surfeit of already-contracted volumes undermine the ability of buyers to enter into new long-term gas sales agreements.

In addition, the outlook for European gas prices is uncertain, with volatility increasing through the interaction of spot and contract markets, as one market, then the other, sets prices. First, in pursuit of supply diversity, the EU-27 has increased its LNG imports from 12.8 million tons per annum (mtpa) in 2002 to 56.2 mtpa in 2010 (UNSD, 2011). The growth in LNG imports, coupled with decreased demand for natural gas during the recession of 2008-9, led to a decrease in the average European price of gas from $563 per thousand cubic meters (103m3) in October 2008 to $236 per 103 m3 in July 2009. Then, as the economy improved, contract pricing resumed its leadership and the average had moved back to $403 per 103 m3 by October 2011 (World Bank, 2011).

The contract pricing of incumbent gas sellers into the region, particularly of Gazprom as key supplier, represent another unknown to shale producers. Vysotsky (2010) claims that Gazprom's national exit border netback price is no more than around $100 per 103 m3, or $2.83 per MMBtu, which is below the current Henry Hub price of about $3.08 per MMBtu (ICE, for December 14, 2011 trades). It is likely that Eastern Europe's nascent shale gas producers will require market prices in excess of this level. Alternative gas pipeline projects have been proposed for the region, but these do not appear to be forthcoming, although interest within the region in securing LNG imports remains high. Eastern Europe has not constructed new gas pipelines since the collapse of the Soviet bloc, apart from interconnectors designed to facilitate the transit of natural gas from Russia to Western Europe. Even if shale gas producers will get access to existing pipelines, therefore, these may be in need of major repair.

A final issue is one of infrastructure development. Funds are needed to construct roads and other infrastructure necessary for shale gas development, but some local governments may consider these too costly to finance internally.

European Priorities and Shale Gas Development

On the positive side of the ledger, the EC maintains several programs that may potentially benefit shale gas development. First, reducing greenhouse gases (GHG) emissions is an EU priority that can boost demand in Eastern Europe, even if countervailing priorities reduce demand elsewhere, e.g., subsidies to renewables. For example, according to World Bank (2011) Poland generated 88 percent of its electricity from coal in 2010. Switching Polish power plants to natural gas, a cleaner fuel that accounted for 3 percent of total electricity generation in 2010, would reduce EU-wide GHG emissions, the target on which the EC sets a firm limit of 20 percent of 1990 levels by 2020. This approach requires that the EC concludes an assessment of the GHG footprint of shale gas development, a process that has been slow, even if it could be expedited if the U.S. and Canadian governments combine efforts with the EC regulators. At the moment, the uncertainty surrounding environmental consequences of hydraulic fracturing prompts certain countries to accept "do-it-alone" approach.

The costs of shale gas shipping can be reduced if the EU's Priority Interconnection Plan were to take into consideration potential new plays. The plan envisions the construction of pipelines necessary to link together national gas transmission networks for the reason of energy security. The construction of a trans-European pipeline along lines of the proposed "Germany-Poland-Baltic" system, listed as one of the plan's priorities could potentially be routed to connect shale fields in Poland to the German gas market. Since the funds for construction come from the European investment banks (EIB and EBRD), it is essential to prove commercial shale gas reserves in northern Poland before the pipeline may be considered investment grade and thereby merit the needed loans.

Yet, the most helpful impetus for shale gas projects in Eastern Europe may come from the resolution of uncertainties hindering its prospects. Different stakeholders in the projects read the situation differently and, sometimes, in the way that impedes their cooperation. For example, regional governments have expectations that the shale gas development will address a host of issues unrelated to their commercial use, ranging from plugging the holes in local budgets, to meeting environmental goals, to advancing contract negotiations with Gazprom. Unsurprisingly, players often prefer to hold their cards close to the chest in light of competition, emerging regulations and market volatility. Instead, frank consultations among current and prospective suppliers, buyers and local regulators, followed with firm guarantees confirmed by international agreements, may be the more promising avenue.

Further, the involvement of independent intermediaries could help stakeholders, be they governments, producers, or local communities, follow the agreed rules of the game. For example, the U.S. sponsors the Global Shale Gas Initiative with the goal of facilitating transfer of shale gas technologies and thereby fostering commercial opportunities for American firms operating in the region. The Initiative does this by aiding national governments with technical expertise and regulatory standards that are consistent with U.S. experience already tested in shale plays, and sharing timely knowledge as it evolves. Beyond this, EU Agency for the Cooperation of Energy Regulators and the EU of the Natural Gas Industry (Eurogas) can bring technology and financial parties to the table, as well as provide preliminary peer review of national shale gas regulations. Going forward, Eurogas would then be in a position to prevent future misunderstandings, and arbitrate if conflicts between producers and authorities arise. On the side of suppliers, Gazprom can usefully participate by contributing to mutual understanding of future changes in market value affected by uncertainty surrounding shale gas prospects in Eastern Europe.

End Note

The future of shale gas development in Eastern Europe remains promising but uncertain. Shale gas production may remain on the fringes of the region's energy sector, perhaps complementing regional fuel balances, or it may become a major factor in supplying energy to the EU, as has taken place in North America. Either way, timely resolution of the kinds of risks and uncertainties discussed in this paper is important for each player in the Eastern European natural gas market as, frankly, few can benefit from the status quo.

Footnotes

[1] The absence of log data may explain why reserves for central and southern parts of the region (from Slovakia and Hungary to Serbia and Bulgaria) have not been evaluated.

[2] For example, Naftna Industrija Srbje (NIS), a subsidiary of Russia's GazpromNeft, prepares for shale gas exploration in western Romania.

[3] Ukraine is not a member of the EU.

[4] See Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC.

[5] Hsieh (2011) reports that only five land rigs available in Poland can be used to drill deep shale gas wells.

[6] For example, the Polish government has abandoned the idea to introduce the shale gas development as "a common European project" fearing delays associated with the EC regulatory hearings.

References

Natural Gas Europe (2011). *Moving to Diversify: Orlen Starts Shale Gas Drilling*, October 24th, accessed December 15, 2011 at http://www.naturalgaseurope.com/orlen-commences-shale-gas-drilling-as-a-step-to-diversification-3170.

Hsieh, Linda (2011). "European shale gas: a long road ahead", *Drilling Contractor Magazine*, July/August.

Sikora, Andrzej (2011). "Developing a Competitive Service Industry in Europe", presentation at the *Global Shale Gas Plays Forum*, Krakow, Poland, September 7-9.

UNSD (United Nations Statistics Division, 2011). *COMTRADE database,* accessed November 13, 2011 at http://comtrade.un.org/db/dqQuickQuery.aspx

Vysotsky, Vladimir (2010). *How Can the Development of Shale Gas Affect the Global Energy Market?,* online release by Gazprom dated May 13, accessed December 15, 2011 at http://gazprom.ru/press/comments/428290/, (in Russian).

World Bank (2011). *Global Economic Monitor (GEM) Commodities*, accessed November 15, 2011 at http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=1175

Member-Get-A-Member Campaign

12th IAEE European Energy Conference

Energy challenge and environmental sustainability

Fist Announcement and Call for Papers

Venice, September 9-12, 2012

The 12th IAEE European Energy Conference "**Energy challenge and environmental sustainability**" will be organized in Venice, on September 9-12, 2012, in the Ca' Foscari University campus, by the A.I.E.E - Italian Association of Energy Economists with the support of Fondazione Eni Enrico Mattei.

The Conference aims at providing a forum for an analysis of the new developments and a new vision of the future. No better stage can be imagined for this discussion than the magic and fragile environment of Venice, one of the most beautiful cities in the world.

The general programme of the Conference

Sunday 9/9

10.00–17.00	IAEE Council Meeting
16.00–18.00	**Registration**
18.00	***Welcome Reception***
20.30–22.00	IAEE Council Dinner

Monday 10/9

08.00–18.00	**Registration**
08.00–09.00	European Affiliate Breakfast Meeting Student Breakfast Meeting
09.30–10.30	**Opening Plenary Session**
10.30–11.00	*Coffee Break*
11.00–12.30	**Dual Plenary Sessions**
12.30–14.00	*Lunch*
14.00–15.30	Concurrent Sessions (7–8 meeting rooms)
15.30–16.00	*Coffee Break*
16.00–17.30	Concurrent Sessions
19.00–22.30	***Gala Dinner*** - Torcello Island (boat trip)

Tuesday 11/9

08.00–18.00	**Registration**
08.00–09.00	Energy Journal Board of Editors Breakfast Meeting Daegu Conference Planning Breakfast Meeting
09.00–10.30	**Dual Plenary Sessions**
10.30–11.00	*Coffee Break*
11.00–12.30	Concurrent Sessions
12.30–14.00	*Lunch*
14.00–15.30	**Dual Plenary Sessions**
15.30–16.00	*Coffee Break*
16.00–17.30	Concurrent Sessions
20.00–22.30	***Conference Dinner*** - Ca' Foscari Palace courtyard

Wednesday 12/9

08.00–09.00	EEEP Board of Editors Breakfast Meeting Dusseldorf Conference Planning Breakfast Meeting
09.00–10.30	Concurrent Sessions
10.30–11.00	*Coffee Break*
11.00–12.30	Concurrent Sessions
12.30–13.30	**Closing Session**

The plenary sessions may cover the following topics:

Energy supply and security; Economic recovery and the evolution of energy demand; Climate change and the new GHG emission limitation regime; Toward Independent markets for energy commodities?; Environmental threats and opportunities for energy systems; Re-thinking nuclear power; The closing session will try to make sense of the results of the discussions throughout the Conference.

The "call for papers": the topics of the papers to be presented in the concurrent sessions

Among other include:
Extending the horizons of energy regulation in Europe - Learning by doing: cost reductions for RES - Technological development: the roadmap approach - Energy storage and its effects on the market - Changes in the geo-political situation after North Africa - Smart grids and smart meters - Unbundling in the gas sector - Market instruments for energy efficiency - Non-conventional hydrocarbon supplies - A sectorial approach to energy efficiency in industry - The European automotive industry and the challenge of energy for transportation - The NIMBY syndrome for RES - The formation of prices in gas and electricity markets - Energy from biomass and the EU agricultural policy - Energy poverty in developed countries - Access to energy in developing countries - Nuclear industry after Fukushima - The impact of PV on the merit order - Renewable energy policies - Sustainable communities and citizen-led activities - The "resource curse" - Energy innovation and patenting.

Abstract submission started on November 7 , 2011 - the deadline is on April 9, 2012

Authors will be notified by **May 22, 2012** of their paper status. Authors whose abstracts are accepted will have to submit their full -length papers by **July 1st 2012** for publication on the conference website.

The conference website http://www.iaeeu2012.it will provide precise information regarding the format and modality for submitting the abstracts and information regarding the conference registration fees and student scholarship funds.

Arrangements will also be made for special rates with hotels of various categories near the conference venue.
In addition to a highly professional program, the conference will be an opportunity for delegates and accompanying persons to enjoy visiting Venice.

for any questions regarding the Conference you can contact:
AIEE Conference Secretariat:
Phone +39-06-3227367 - Fax 39-06-3234921, e-mail: assaiee@aiee.it; info@iaeeu2012.it
http://www.iaeeu2012.it

Brussels Beijing Bet

By Matthew Hulbert*

The Libyan fracas has been a major wakeup call for anyone thinking Europe had morphed into being a serious geopolitical actor. What's less obvious is that Tripoli's toils will have a serious impact on the upstream energy landscape across Europe. That's not just because Europe lost 1.5mb/d of sweet oil production making its way across the Mediterranean and around 16% of EU15 gas – but because the West, and more notably NATO, has shown its weakened energy hand. The Alliance can't provide the necessary security blanket for European political incentives to play out across adjacent oil producing states. That clearly goes for North Africa, and even more concretely for the Middle East and Central Asia – two of Europe's supposed four energy 'corridors' Brussels was attempting to open up. The idea was, of course, a good one: diversify supplies in order to reduce structural dependence on Russian gas in terms of volume and price. But the execution has been lousy. European military indecision will ironically result in far greater dependence on Russian hydrocarbons, precisely because the security seal is too politically leaky for upstream producers to take Europe seriously. From Brussels to Berlin, Paris to Prague, Europe has no real choice but to go 'long' on Moscow to secure its vital oil and gas supplies.

The crux of Europe's problem starts in America, of course. The U.S. is no longer willing to stand guarantor for European energy interests. As Secretary of Defence Robert Gates put it, Libya is 'not a vital interest to the U.S.' and Washington has treated it accordingly. Energy independence is back in DC fashion, which means Europe will be left to settle its own energy scores. So, time for a fundamental European rethink on energy policy and security? Yes. Not unless Europe really wants to try and go it alone. But fundamental must mean fundamental, which requires looking towards China. Instead of trying to politically attract producer states by offering a security and political presence the EU can't provide, Brussels should work from the demand side of the pipeline: most notably with Beijing. That's how a strategic energy policy could be forged, through an 'ASEUN' Asian-EU consumer partnership, not relying on the broken security architectures of old.

NATO – Cart and Horse

If NATO was going to get serious about energy provision, it only ever had one role to fulfil: to be seen as a credible source of security for producer states sitting aside European borders (and in some cases, beyond) to let political and commercial games play out towards European markets. That meant providing 'negative' security incentives to keep producer regimes on the political straight and narrow, or indeed offering positive security pulls for producers willing to look beyond their traditional external mentors. For upstream players in Central Asia, the Gulf and Maghreb, security issues really do matter.

Obviously blame can't just sit on NATO's shoulders. Governance small talk from the EU hasn't exactly helped in the rough and tumble energy world. If Europe really wanted serious upstream supply agreements in Central Asia and the Middle East they were trading the wrong currency. Democracy and human rights – no. Solid security guarantees and handsome commercial agreements – yes. That's the main 'swap agreement' oil producers have traded in decades past, and it's the one (for better or worse) that they still regard as legal tender.

That probably sounds brutal to some, but ask the simple question: Why has China been able to break the Russian mould in Central Asia opening up oil and gas pipelines from Kazakhstan, Uzbekistan and Turkmenistan? Why has Beijing turned the Middle East into a 'Chimerican lake' of ebbing U.S. power and increased Chinese oil flows? Governance reform wasn't part of the pitch: Political certainty from growing Chinese economic influence and power was - both on a bilateral and regional (Shanghai Cooperation Organization) basis. It's the only reason Central Asian leaders dared to go against Moscow's long held strategy of monopolising Eurasia supplies for (re)export purposes. It's also the only reason the Gulf States are happy to look for a plan B beyond U.S. demand and U.S. military supply. Asia is the obvious option.

Consumers – Not Producers

The logical conclusion is that Europe is never going to cut the mustard getting producer states onboard without a revolution in upstream acquisition – the latest Commission penchant to construct a Trans-Caspian Pipeline between Turkmenistan and Azerbaijan to feed Europe markets will no doubt provide the latest example of such flops. The logic is clear; stop trying to get producers onside in an increasingly competitive and nasty upstream game that Europe is incapable of

* Matthew Hulbert is a Senior Research Fellow, in the Clingendael International Energy Programme at the Netherlands Institute of International Relations. He may be reached at mhulbert@clingendael.nl

playing, and start aligning your interests with the major energy consumer of tomorrow: China. That's how pressure will be applied in producer states, by forming a credible consumer consensus safeguarding demand side interests; not hoping and wishing that producers will magically fall into political and commercial line to enhance European supply. Just as China has taken a free ride on U.S. security cover over the past decade, it's time for Europe to play smart and free ride China – at least in the political realm.

Many will argue 'nonsense'; Europe should still look to the U.S. to reinvigorate NATO and provide the political clout Brussels needs to open up new energy supplies. This is an argument that used to have merit. Washington has long taken European energy supplies far more seriously than Europe has. It's the only reason the BTC pipeline was built, and why fresh Central Asian and Middle Eastern supplies have ever prospectively been raised. But that was then, this is now; America is understandably adopting an increasingly 'isolationist' energy policy. It's floating on a bed of unconventional gas production; it can see massive potential in Canadian tar sand production, and will increasingly open up its own offshore projects to enhance security of supply while drawing on Latin American output. The furthest Washington is likely to go looking for oil is Western Africa these days, primarily because it sits directly over the pond – 'geopolitical dredging' will not be required.

As for the 'Broader' Middle East, it's not really been about consuming the bulk of Gulf oil for some time now in the U.S. It was about ensuring the safe flow of hydrocarbons to global markets in the East and West as the geo-economic and geopolitical lynchpin of the world - a role that America is no longer fully willing, or indeed able, to perform. If Libya has shown the true costs of the Iraq war in terms of depleted U.S. political capital, then Tripoli (and associated regional turmoil) will probably play out through dwindling U.S. clout in Iran, Iraq, Syria and Turkey; not to mention the Gulf. Washington has not just been a political bystander in the Arab Spring, but something of a military 'prisoner'. China holds the U.S. pursue strings across the board, which means that Beijing will ultimately decide how much America can and can't spend on defence, and how long it can perform a global military role. Default will be logical outcome should the U.S. fail to understand this dynamic.

That leaves Europe in a very difficult energy position. It was always assumed the U.S. would stand guarantor of European energy interests, but it's increasingly clear the U.S. will slowly drop out of the Eurasian energy game. No U.S. = no serious security cover to reassure producers that exporting West towards Europe is a politically smart thing to do – either in Central Asia or the Middle East. Hence it's time for NATO to stop talking about energy security and start facilitating a serious discussion as to how Europe can politically position itself for a robust energy future. That means putting 'politics' back into energy supplies and taking 'security' out – if we keep pretending the latter is a serious option, it won't just make Europe look internationally incredulous, it will seriously impede negotiations with China towards a more effective 'ASEUN' energy policy. Like it or not, Beijing is Europe's best energy bet should consumers want to secure mutually vested interests. Getting Chinese blessing and Chinese support for European initiatives will be crucial to re-establishing a European stake in the energy world.

Look at the Map

Tabling an 'ASEUN' club is where things would get interesting, of course. The core argument is that 'arbitrage' (commercial and political) works one of two ways – either in favour of producers or consumers. Rarely do both sides get what they want. Rarely do producer-consumer interests align. We know that producers have a strong record of cooperation (OPEC is one example), GASPEC might one day be another. We also know that consumer cooperation tends to be feeble – the IEA can't yet boast India or China amongst its ranks. But assuming that consumers want stable supplies, stable prices and a broad diversity of supply, it's clear that Europe could gain considerably through enhanced co-operation with China, particularly as both consumers will need to heavily draw on Russian hydrocarbon reserves in the future. Just take a brief look at the map and it's clear that Moscow sits at the geographical heart of the Brussels-Beijing energy relationship.

Not surprisingly, China is already ahead of the European game – and massively so. Despite all the headlines about Chinese forays in Africa and further afield in Latin America, Beijing has been very smart to diversify its supply options closer to home – both from the Middle East and Central Asia in order to counterbalance and hedge political and price risks involved. Contractual relations with China have been remarkably stable as a result. Chinese 'ownership' of South East Asia and Australasia helps in this respect, of course, but if Central Asia and the Middle East constitute China's 'energy belt', and Africa and Latin America provide the 'secondary braces', it's clear that Beijing deems that nothing short of an iron clad 'belt and braces' approach is needed to nail down its other major future source of Eurasian supply, Russia.

The fact that China has only belatedly brought the 1.6bn/d ESPO oil pipeline to fruition from Russia's East with a tentative memorandum of understanding between CNPC and Gazprom in place for gas, tells us two things. The first is that China doesn't trust Russia on price (hence some of the long project delays), the second is that China will only really look to Russian supplies once it has a sufficiently strong position in Central Asia and the Gulf to keep Moscow on the straight and narrow. Unlike Europe, China is well aware that Russia would like nothing more than to feed European and Chinese markets to maximise political and economic rents between East and West, while maintaining its historic stranglehold on Central Asian supplies.

Fortunately for Europe, that's logistically very tricky for Russia to pull off, and more importantly, it's a game Beijing is not about to play – it will strive to conduct price and politics over Moscow on China's terms, and indeed towards other MENA and Central Asian producers in turn. But the key difference is that China has worked hard to prevent dependence on any one producer state. Europe is rapidly heading in the other direction. Not only has it lost its security credentials, it hasn't gained upstream supply agreements in Central Asia; it hasn't cemented its MENA position, or indeed considered bilateral price collusion implications that Gazprom's creeping internationalisation strategy could entail. That's all while Europe's industrial giant, Germany, refuses to contemplate the energy (in)security that the Russo-German 'NordStream' pipeline will create for Eastern Europe - or what kind of implications its recent nuclear phase out will have. The proposed merger between RWE and Gazprom should provide a pretty good idea given it will wipe out RWE's support for the Nabucco pipeline as well. The Russian inspired South Stream pipeline will gain ground as a result. Left to Berlin – let alone Brussels, Russian arbitrage would become a self fulfilling prophecy between East and West. China is the only factor preventing this overall outcome, but that's by no means sufficient to prevent structural European supply dependency on Russia at our end of the pipeline.

China's Call – Deals for Everyone?

Assuming Europe is brave enough to float the ASEUN idea, would China go for it? Beijing is well placed to leverage multiple producers to its own ends, irrespective of consumer co-operation with Europe. China could go on snapping up the bulk of new supplies wherever they crop up, leaving the old energy world in its wake. A case of 'your supply', 'your problem'? Perhaps; but China is nothing if not strategic. (In)formal consumer cooperation with Europe could have benefits for the Middle Kingdom, and here's why:

If China made clear to Central Asian producers that it had no problem with Europe taking a seat at the table, and would actually find it desirable for some supplies to head West, this would help 'triangulate' the Great Game. It's clearly not in China's interests to see Central Asian supplies being boiled down to a two way Sino-Soviet power play, Beijing would have nobody to third party its tussles to. More importantly, letting Europe in on the Central Asia act would give the EU a far freer hand when dealing with Russia. And it's Moscow that really matters for China in terms of future Eurasian volume and bulk. If Russia gets Europe over the barrel, Moscow would inevitably try and use this as collateral to squeeze a little tighter on Sino-Soviet energy relations at some stage. That's irrespective of how well covered China thinks it might be in terms of exclusive access to Eastern Siberian fields. ASEUN would not only enhance European and Chinese interests over Russia, it would ensure that more players could balance the overall risk in Central Asia by reducing the prospects of price collusion between Russia and Central Asian producers.

Likewise in the MENA region – encouraging key producers to feed European markets rather than purely heading East has merit. The same elasticity of supply arguments clipping Russian (and Central Asian) wings apply – which in turn would hedge Russian and Central Asian bargaining positions against those of the Gulf. Just as importantly, it's in everyone's geopolitical interests to get Europe back into the MENA game. As it stands, geopolitical frictions in the region are becoming a binary U.S.-Sino option as far as external powers are involved. Assuming the Arab flag will inexorably follow Chinese trade, the potential for miscalculation and misinterpretation between the U.S. and China is acute. If the U.S. takes assertive action to shore things up one day, it could easily be read as a last ditch power play in Beijing, rather than residual responsibilities to fill growing power gaps. Make Europe part of the overall equation, and U.S. decline would seem a natural evolution for a nation recalibrating its global footprint and interests, not a dramatic East of Suez moment. MENA states would also feel more comfortable feeding European markets alongside those in the East. They get healthy premiums on the sweet grades produced in North Africa shipped across the Mediterranean, and it goes without saying that LNG heavyweights such as Qatar, should never put their supply side eggs in a single demand side basket.

The obvious quid pro quo for Washington would be a freer hand to cement its energy position in the Americas – chips that Beijing would be happy to trade in places like Venezuela if it held the energy whip hand in the Middle East. China would also be less precious about West African supplies going over the pond, at least if Beijing had first dibs on any new finds in East Africa and the Indian Ocean. The overall logic is, therefore, clear. Europe has utility for China and vice-a-versa in the Middle East, with the added bonus that eventual U.S. departure from the Gulf would be more valedictory in nature than cataclysmic.

Know Your Place

But for any of this to work, Europe needs to understand that it is the junior partner. That shouldn't be too hard considering that China will increasingly backstop the European economy in years to come. Debt, foreign investment flows and demand will all emanate from Asian shores. And yes, that will come with political strings attached as far as Chinese trade, currency and arms issues are concerned. He who pays the piper ultimately calls the tune, which directly links to the fact that Europe must understand that the U.S. security umbrella is only going to shrink from hereon in. A political strategy to engage China on energy issues isn't a mere policy option, it's now an absolute imperative. Thinking Europe can cling onto the U.S. and magically jump towards China at a time of its choosing isn't just strategically stupid, it would seriously impair energy interests in the short to medium term. Assuming India would act as some kind of proxy for Western energy interests against China is similarly dud thinking. If anything, Delhi is transfixed with how to improve energy relations with Beijing, not sever them.

And that's really the whole point here: energy security is no longer achieved through military dominance, naval force projections or even boots on the ground. For Europe, energy security depends on its ability to exploit Chinese influence in Central Asia as a hedge against Russia, while working toward a consumer-driven market to enhance security of supply from the Middle East and beyond. Europe so far only has the imagination to try and talk to its prospective suppliers, not work hand in hand with consumers at the other end of the pipeline. This will, of course, mean accepting Beijing's commercial rules in return for political support if it does so, a ride that any consumer state should consider taking. U.S. security cover is rapidly shrinking; Chinese commercial clout is growing. NATO has run its energy course. The Libyan debacle now has the trappings of a European silver lining, but it will only stick on the energy front if Brussels accepts that it has to turn to the East to tackle the EU's energy dilemma. That means trading supposedly 'guaranteed' returns of European 'security' for the potential gains of Sino politics. A strategic shift that is certainly as bold, as it might one day prove necessary.

Estimates of Oil Price Elasticity

By Robert Hoffman*

Introduction

This review is focused on research that attempted to quantify the impact of oil prices on GDP / GNP and specifically articles that provide a point estimate of this key elasticity. In general, the empirical research has generated an evolving impression about the magnitude of oil-price effects on aggregate economic activity.

Researchers found that during the period starting after World War II and extending through the 1970s oil price shifts had a very large impact on economic activity. Point estimates of oil price elasticity were as high as -0.29 – suggesting that a 10% increase in the price of oil would translate into a 2.9% decline in real GNP.

When data from the 1980s was added to the sample period, estimates of the elasticity fell sharply. In fact during the mid-1980s the structural relationship appeared to change and researchers began to entertain the possibility that oil prices had an asymmetric impact on economic activity. Oil price increases continued to have a negative (albeit smaller) impact on economic activity; however, large oil price declines failed to produce an economic boom.

Research conducted over the last decade note that oil prices have become more volatile while the impact on the economy appears to have continued to diminish. Point estimates of the elasticity based on macroeconomic model simulation where the impact of the shock can be isolated, produce results that are as low -0.02 in year 1 and -0.05 in year 2. In this instance a 10% increase in the price of oil would result in a year 1 decline in real GDP of just 0.2% and a year 2 decline of 0.5%.

Several authors have tried to explain the economy's reduced sensitivity to oil price spikes. One strand of this research emphasizes the response of monetary policy in determining the output and core inflation impacts of an oil price shock. These researchers used both VAR models and econometric model simulations and produced results confirming that central bank response to oil price shocks has fundamentally changed over the years and that this shift has mitigated much of the negative impacts on real GDP and contributed to the reduction in the oil price elasticity.

Estimates of the Oil Price Elasticity

James Hamilton

Two articles by Hamilton published in the early 1980s were very influential in convincing economists that oil price increases are important contributors to recessions. His articles relied on the statistical concept of Granger causality to test for directions of effect in the setting of recurrent shocks. He found that exogenous shocks to oil prices had significant effects on real activity in the United States in samples that end before 1973.

Hamilton's first article on the topic in 1983 took a simple approach, he estimated a log-linear relationship between GDP growth and lagged oil prices. For this investigation his full sample period was 1948 to 1980. To investigate the stability of the relationship he separated the full sample into two sub-periods: 1948 to 1972 and 1973 to 1980. He found a statistically significant relationship for both periods. In addition he found that estimation of the full period yielded smaller coefficients than either sub-period. For the period from 1949 to 1972, the oil-price coefficients at the second, third, and fourth lags are -0.082, -0.170, and -0.177. For the period 1973 to 1980, those coefficient values are -0.038, -0.078, and -0.115.

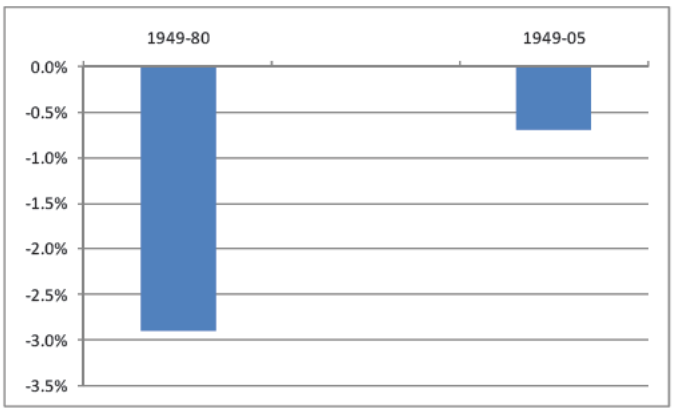


Figure 1
Real GDP Impact 4 quarters after a 10% Oil Price Increase

An article by Hamilton in 2000 provided clear evidence of an asymmetric relationship. He found that oil price increases are much more important than oil price decreases, and increases have significantly less predictive content if they simply correct earlier decreases.

In 2005 Hamilton updated some of his estimates and found that the statistical significance of the relationship falls as one adds more data. He found that a

* Robert Hoffman is a Senior Consultant with IHS Consluting, IHS Global Insight. He can be reached at robert.hoffman@ihsglobalinsight.com This research was funded by the Energy Information Administration (EIA). The findings and views, however, do not reflect those of the EIA.

regression over the period from 1949 to 1980 would predict that GDP growth would be 2.9% lower (at an annual rate) four quarters after a 10% oil price spike. While the regression estimated over the period from 1949 to 2005 would predict only 0.7% slower growth. Hamilton interpreted his results to suggest a linear relationship is either mis-specified or unstable.

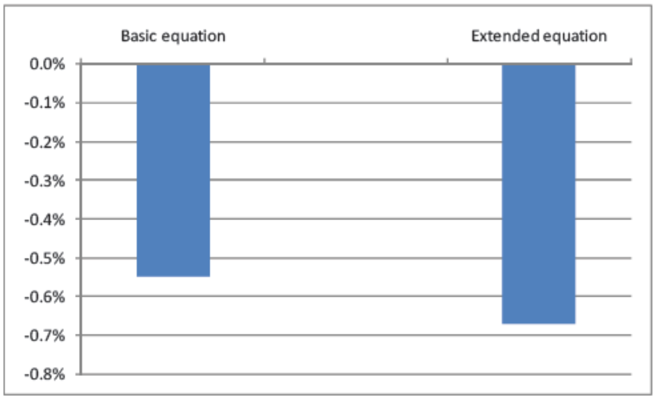


Figure 2
Real GNP Impact of a 10% Oil Price Increase

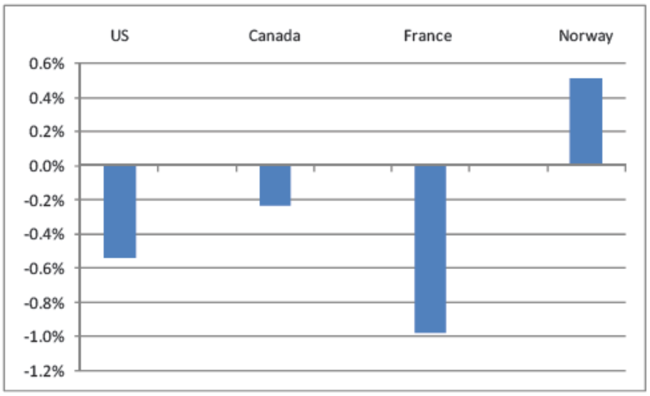


Figure 3
Real GDP Impact of a 10% Oil Price Impact for Various Countries

Javier Mory

His 1993 article explored the asymmetric macroeconomic responses to oil price changes. He estimated a simple regression of GNP on the oil price, with a one-year lag. Using a sample period of 1951 to 1990, he obtained a GNP elasticity of -0.0551 which was highly significant statistically. He did not, however, control for other influences in that regression.

In subsequent regressions (extended version) he included separate variables for oil price increases and decreases. He also controlled for government purchases and M2 money supply. In this case over the same period the GNP elasticity was somewhat larger at -0.0671 and was also statistically significant.

Knut Mork

In his 1994 article Mork extended Hamilton's original work and allowed oil price shocks to have asymmetric effects. His research findings inferred that oil price increases reduced real output while oil price declines had no effect. His estimate of the elasticity was -0.054 based on the period from 1967 to 1992 - very similar to the one produced by Mory. The elasticity for other OECD countries over the same period was quite different. For Canada the elasticity was about half the size (-0.024). It was considerably larger for France (-0.098). In the case of Norway the elasticity was positive at 0.051. Norway is a large producer and exporter of oil. In this case a 10% increase in oil prices is associated with a 0.5% increase in real GDP.

Mork's research also found a statistically significant negative elasticity for oil price increases and non-significant positive elasticity for price decreases.

Mark Hooker

Federal Reserve economist Mark Hooker (1996) concluded that the relationship uncovered by Hamilton had broken down in the mid-1980s when a large decline in oil prices did not result in an output boom. He explored data for the period from 1948 to 1994. He found a structural break-point in the relationship at 1973 - a drastically weakened relationship between oil prices and GDP, unemployment rate and the rate of overall inflation over the period 1973 to 1994. He found that neither GDP growth nor unemployment Granger-caused by oil prices in this later period. His efforts to explain this finding by possible endogeneity of oil prices and several versions of asymmetry hypotheses were negative - no macroeconomic variable Granger causes oil prices in the later period.

In a 2002 article Hooker analyzes empirically the changing weight of oil prices as an explanatory variable in a traditional Phillips curve specification for the U.S. economy. He finds that pass-through from oil to prices has become negligible since the early eighties, but cannot find evidence for a significant role of the decline in energy intensity, the deregulation of energy industries, or changes in monetary policy as a factor behind that lower pass-through.

Robert Rasche and John Tatom

Articles by Rasche and Tatom (1977 and 1981) estimated an aggregate Cobb-Douglas production function for the United States and several other OECD nations. The authors explain that energy price shocks alter the incentives for firms to employ energy resources and alter their optimal methods of production. Energy-using capital is rendered obsolete by an energy price increase and the optimal usage of the existing stock is altered and production switches to less-energy-intensive technologies. The reduced capacity output of the economy is usually referred to as a decline in potential or natural output.

The authors state that domestic aggregate demand is affected due to a change in net imports of oil. The direction and extent of effects depend on the country's net oil export status. Net oil exporting countries experience an increase (decrease) in aggregate demand when oil prices rise (fall). The effect on net oil importing countries is exactly the opposite. Net oil exporting countries like Canada and the UK receive a boost to aggregate demand and output / employment from a spike in oil prices.

The impacts on productivity tend to work in the same direction regardless of the oil trade status of the country. An increase in oil prices has a negative impact on productivity. The theory suggests that energy price shocks should affect the productivity of capital and labor resources similarly across countries. The authors' second article provides evidence for this using production function estimates for Canada, Germany, France, Japan and the UK.

The estimation period for their study was from 1949 to 1978. The estimated equations were based on the first-order condition for firms' profit maximization. They substituted the price of energy for its quantity, but used quantities for labor and capital. The estimated coefficient in this case is interpreted as the long-run elasticity. Their estimate of the energy price-GNP elasticity for the United States was -0.070. The estimated impact was highest in Japan (-0.171) and lowest in Germany (-0.019). Their other estimates included UK (-0.035), Canada (-0.044) and France (-0.041). The oil price elasticity is lower in Canada and the UK given their net oil exporting status.

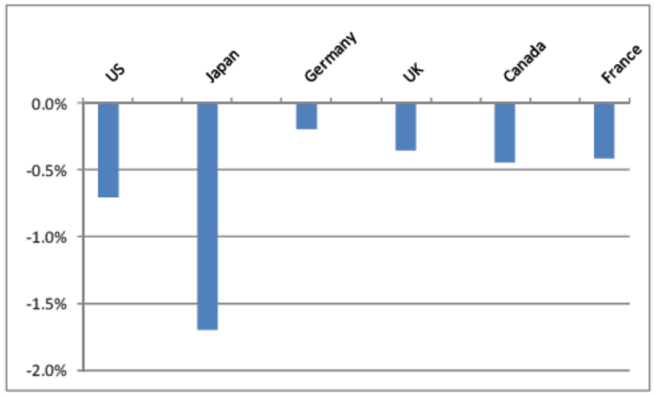


Figure 4
Real GDP Impact of a 10% Oil Price Increase for Various Countries

Rati Ram and David Ramsey

An article by Ram and Ramsey (1989) also took a production function approach (Cobb-Douglas specification) to estimating the elasticity. Their estimates for the United States are somewhat unique in that they distinguish between privately owned and publicly owned capital. A relative energy price variable is also incorporated and the estimation period is from 1948 to 1985. They obtained statistically significant energy price-GNP elasticity estimates that ranged between -0.074 and -0.069, depending on the disaggregation of public capital.

David Smyth

An article by Smyth (1993) investigates asymmetric impacts using a model of price 'rachet' effects. The basic equation structure also takes a Cobb-Douglas production function. The economy's response to three possible price movements is considered: price increases below the historic maximum price, price increases above the historic maximum price as well as price decreases. Three separate slope coefficients are estimated. In addition three separate intercept terms are allowed for. The inputs used are labor and private capital, and the price of energy. Annual observations over the period from 1952 to 1990 are used.

Smyth obtained a non-significant positive elasticity (0.020) for price decreases, a non-significant negative elasticity (-0.018) for price increases below the historic maximum price, and a significant negative elasticity (-0.052) for price increases above the historic maximum. He interprets the first two estimates as effectively zero. The overall results imply that energy price changes within the range of previous experience has no effect on aggregate output, however, oil price increases above that range have a sharp, negative impact on aggregate output.

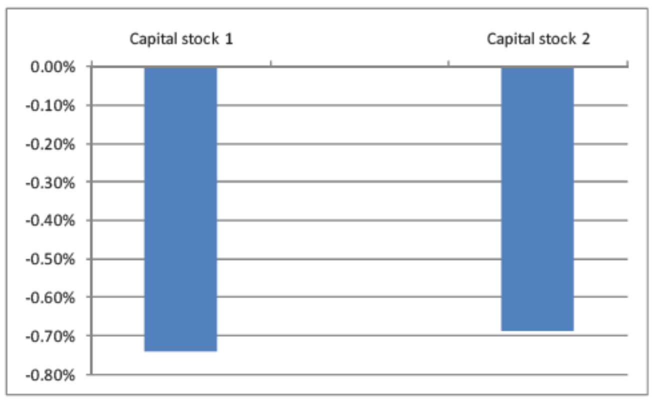


Figure 5
Real GNP Impact of a 10% Oil Price

Micha Gisser and Thomas Goodwin

Their 1986 article estimated equations involving real GNP, general price level, unemployment rate and real investment. They regressed each of those variables independently on contemporaneous and four lags of the M1 money supply, the high employment federal expenditure measure of fiscal policy, and the nominal price of crude oil. They use quarterly data over the period from 1961 to 1982. The coefficients of the contemporaneous oil price and those of the third and fourth quarterly lags were highly significant in the GNP equation, negative in sign, cumulatively larger than the corresponding coefficients on fiscal policy and half the cumulative magnitude of the money supply coefficients. The oil price variables also had significant positive coefficients in the price level and unemployment rate equations and significant negative coefficients (contemporaneous and third and fourth lags) in the investment equation. The values of the significant oil price coefficients in the GNP equation were -0.020 (contemporaneous), -0.030 and -0.049 for the third and fourth quarterly lags, and -0.11 for the cumulative impact.

David Reifschneider, Robert Tetlow and John Williams

The January 1999 issue of the Federal Reserve Bulletin reported simulation results using the Federal Reserve Board's large-scale model (FRB/US) of a rise in oil prices on the U.S. economy. The authors simulated the effect on the U.S. economy from a $10 permanent increase in the price of a barrel of oil relative to the price of all other goods that gradually builds up over 1 year. They found that if the Fed were to keep the real federal funds rate constant, the level of GDP would be below its baseline trend by 0.2 percentage points after 1 year and by 0.4 percentage points after two years. In ten years the level of real GDP would be 0.3 percentage points below its baseline trend.

Jose De Gregorio, Oscar Landerretche and Christopher Neilson

In their 2007 article the authors provide a variety of estimates of the degree of pass-through from oil prices to inflation, and its changes over time, for a large set of countries. In addition to estimates of Phillips curves along the lines of Hooker (2002), they also provide evidence based on rolling VARs and focus exclusively on the effects on inflation. Their paper also examines a number of potential explanations, including a change in the response of the exchange rate (in the case of non-U.S. countries), and the virtuous effects of being in a low inflation environment.

Ben Bernanke, Mark Watson and Mark Gertler

This 1997 article starts with the idea that oil, and energy costs in general, are too small relative to the economy's total production costs to have the significant impact on economic activity that is found by other researchers. The authors posit that part of the recessionary impact of an increase in oil prices arise from the subsequent monetary contraction. The approach uses a VAR system with data from 1965 to 1995. The authors consider an oil price shock under two alternative scenarios - the first with, and the second- without a monetary policy response. They find that the absence of an endogenous restrictive monetary policy results in higher output and prices and the effects on output are quantitatively large. A non-responsive monetary policy manages to eliminate most of the output effects of the oil price shock within the first 8-10 months. This article provides analysis that suggests monetary policy has been the primary reason that oil price increases have had negative output effects in the U.S.

Nigel Gault

In 2011 Chief U.S. Economist for IHS Global Insight, Nigel Gault, used a macroeconomic model simulation to quantify the impact of a permanent $10/barrel increase in oil prices from the current price of about $100/barrel. The author finds that if this rise in the oil price is fully passed through, it will result in an increase of 24 cents in the price at the pump. The direct effects of a $10/barrel rise in crude oil prices is an increase in consumer price index of 0.38%, an increase in the consumption deflator of 0.28% and a decrease in disposable income of 0.26%. Assuming no change in the volume of gasoline purchased, the result is a $30 billion increase in the consumer gasoline bill.

Gault notes that if consumers cut spending on gasoline in response to the higher price, this reduces incomes elsewhere in the economy and this in turn decreases spending (the macroeconomic model's induced impacts). The first-year real GDP and real consumer spending impacts would be a decline of 0.21% relative to the baseline. In year two, the effect builds and real GDP and real consumer spending fall by 0.52% and 0.51% respectively (relative to baseline). This is consistent with an oil price elasticity of -0.021 in year 1 and -0.052 in year 2. Real disposable income falls by 0.40% in year one and 0.53% in year two, while the CPI rises by 0.46% in the first year and climbs a bit higher in the second year of the shock. Importantly, Gault assumed no policy response by the Federal Reserve so that the federal funds interest rate stays at its current very low setting in 2012.

Ben Hunt, Peter Isard and Doug Laxton

IMF economists employed the multi-country model MULTIMOD to analyze the macroeconomic effects of oil price shocks in industrial countries. They distinguish between temporary, more persistent and permanent shocks. They focus on the key role of monetary policy in influencing macroeconomic outcomes. The article identifies five key channels through which oil price increases can pass through into core inflation and a possible explanation asymmetric relationship between oil prices and economic activity. The authors note that the MULTIMOD-based analysis of oil-price shocks hinges critically on the nature of wage/price behavior in a particular country and the monetary policy reaction function (monetary policy rule). MULTIMOD contains a real-wage catch-up relationship that is related to the bargaining process, it contains a key parameter that reflects the degree to which workers resist a reduction in their real consumption wage. The real-wage catch-up is a key parameter in determining the pass-through of an oil price shock to core inflation. It is unique for each country. The authors' findings suggest that if core inflation does not respond to oil price increases then there might be no need for monetary policy to tighten, in which case the effects on real economic activity could be minimal and this would reduce the oil price elasticity.

References

Bernanke, B. S., M. Gertler, and M. Watson, "Systematic Monetary Policy and the Effects of Oil Price Shocks", Presented at the Brookings Panel on Economic Activity, March 27-28, 1997, Washington, DC.

Gault, N., "Oil Prices and the U.S. Economy: Some Rules of Thumb", published in IHS Global Insight Bulletins- Perspective Article (2011).

Gisser, M.,and T. H. Goodwin. "Crude Oil and the Macroeconomy: Tests of Some Popular Notions," Journal of Money, Credit, and Banking 18 (1986): 95-103.

Hamilton, J. D. "Oil and the Macroeconomy since World War II," Journal of Political Economy 91 (1983): 228-248.

Hamilton, J. D., "What Is an Oil Shock?" Journal of Economics, Volume 113, Issue 2, April 2003, p. 363-398.

Hooker, Mark A., "What Happened to the Oil Price-Macroeconomic Relationship?," Journal of Monetary Economics 38 (1996), 195-213.

Hunt, B., Isard, P., and D. Laxton, "The Macroeconomic Effects of Higher Oil Prices," IMF Working Paper, January 2001.

Jones, D.W, and P.N. Leiby, "The Macroeconomic Impact of Oil Price Shocks: A Review of Literature and Issues," January 1996.

Mork, K. A., "Oil and the Macroeconomy when Prices Go Up and Down: An Extension of Hamilton's Results", Journal of Political Economy, Volume 91 (1989), p. 740-744.

Mork, K. A., Ø. Olsen, and H. T. Mysen. "Macroeconomic Responses to Oil Price Increases and Decreases in OECD Countries," Energy Journal 15(4) (1994): 19-35.

Mory, J. F. "Oil Prices and Economic Activity: Is the Relationship Symmetric?" Energy Journal 14(4) (1993): 151-161.

Reifschneider, D., Tetlow, R., and J. Williams, "Aggregate Disturbances, Monetary Policy and the Macroeconomy: the FRB/US Perspective," Federal Reserve Bulletin, January 1999.

Ram, R., and D. D. Ramsey. "Government Capital and Private Output in the United States; Additional Evidence," Economics Letters 30 (1989): 223-226.

Rasche, R. H., and J. A. Tatom. "Energy Price Shocks, Aggregate Supply and Monetary Policy: The Theory and the International Evidence," in K. Brunner and A. H. Meltzer, eds., Supply Shocks, Incentives and National Wealth, Carnegie-Rochester Conference Series on Public Policy 14 (1981): 9-93.

Smyth, D. J. "Energy Prices and the Aggregate Production Function," Energy Economics 15 (1993): 105-110.

Broaden Your Professional Horizons

Join the

International Association for Energy Economics

In today's economy you need to keep up-to-date on energy policy and developments. To be ahead of the others, you need timely, relevant material on current energy thought and comment, on data, trends and key policy issues. You need a network of professional individuals that specialize in the field of energy economics so that you may have access to their valuable ideas, opinions and services. Membership in the IAEE does just this, keeps you abreast of current energy related issues and broadens your professional outlook.

The IAEE currently meets the professional needs of over 3400 energy economists in many areas: private industry, non-profit and trade organizations, consulting, government and academe. Below is a listing of the publications and services the Association offers its membership.

• **Professional Journals:** *The Energy Journal* is the Association's distinguished quarterly publication published by the Energy Economics Education Foundation, the IAEE's educational affiliate. *Economics of Energy & Environmental Policy* is a new journal published twice a year. Both journals contains articles on a wide range of energy economic and environmental issues, as well as book reviews, notes and special notices to members. Topics addressed include the following:

Alternative Transportation Fuels	Energy Management	Natural Gas Topics
Conservation of Energy	Energy Policy Issues	Natural Resource Issues
Electricity and Coal	Energy Security	Nuclear Power Issues
Emission Trading	Environmental Issues & Concerns	Renewable Energy Issues
Energy & Economic Development	Hydrocarbons Issues	Sustainability of Energy Systems
Energy & Environmental Development	Markets for Crude Oil	Taxation & Fiscal Policy

• **Newsletter:** The IAEE *Energy Forum*, published four times a year, contains articles dealing with applied energy economics throughout the world. The Newsletter also contains announcements of coming events, such as conferences and workshops; gives detail of IAEE international affiliate activities; and provides special reports and information of international interest.

• **Directory:** The Online Membership Directory lists members around the world, their affiliation, areas of specialization, address and telephone/fax numbers. A most valuable networking resource.

• **Conferences:** IAEE Conferences attract delegates who represent some of the most influential government, corporate and academic energy decision-making institutions. Conference programs address critical issues of vital concern and importance to governments and industry and provide a forum where policy issues can be presented, considered and discussed at both formal sessions and informal social functions. Major conferences held each year include the North American, European and Asian Conferences and the International Conference. IAEE members attend a reduced rates.

• **Proceedings**: IAEE Conferences generate valuable proceedings which are available to members at reduced rates.

To join the IAEE and avail yourself of our outstanding publications and services please clip and complete the application below and send it with your check, payable to the IAEE, in U.S. dollars, drawn on a U.S. bank to: International Association for Energy Economics, 28790 Chagrin Blvd., Suite 350, Cleveland, OH 44122. Phone: 216-464-5365.

- -

_____**Yes**, I wish to become a member of the International Association for Energy Economics. My check for $80.00 (U.S. members $100 - includes USAEE membership) is enclosed to cover regular individual membership for twelve months from the end of the month in which my payment is received. I understand that I will receive all of the above publications and announcements to all IAEE sponsored meetings.

PLEASE TYPE or PRINT

Name: ______________________________

Position: ______________________________

Organization: ______________________________

Address: ______________________________

Address: ______________________________

City/State/Zip/Country: ______________________________

Email: ______________________________

Mail to: IAEE, 28790 Chagrin Blvd., Ste. 350, Cleveland, OH 44122 USA or
Join online at http://www.iaee.org/en/membership/

1/12Forum

Water Management Economics in the Development and Production of Shale Resources

By Christopher J. Robart*

Introduction

Water management has always been an important activity in the development and production of oil/gas resources. Moderate volumes of water are required as an input for multiple activities in conventional oil/gas development. Additionally, water is produced by all oil/gas wells, ranging from minimal volumes early in the life of a well (a 1 to 1 ratio of water to oil is typical) to large volumes late in the life of a well (a 15 to 1 ratio of water to oil is typical), although actual volumes vary widely across wells and during the life of a well. However, water's importance has increased dramatically with emergence of wide-scale development of shale resources for oil and gas production.

The innovation that has been most critical in making the development of shale resources economically viable, multi-stage hydraulic fracturing ("fracing"), has also dramatically changed water needs. Fracing requires large volumes of water as an input into the well (typical volumes range from 10,000 barrels to 200,000 barrels per well). Between 10% and 40% of the water pumped into the well during hydraulic fracturing returns to the surface ("flowback water") in the first 30 to 60 days of the life of the well. In order to maintain production rates over the life of a well, it is common practice to refrac wells one or more times, typically at 3- to 5-year intervals. Finally, a larger number of wells must be drilled to effectively drain a shale field than a conventional oil/gas field. All of these factors amount to a massive volume of water that must be managed over the life of a shale field, significantly more than is typical in the development and production of a conventional field.

Managing all of the water going into and flowing out of a shale well is complex and costly. Water used for hydraulic fracturing must be sourced, transported, and stored, often with many intermediate steps in between. The water coming out of the shale well (both high volume flowback water and lower volume produced water, collectively referred to as "effluent") must be stored, transported, and either disposed via injection well or treated for reuse or surface discharge. Additionally, the water coming out of a well varies widely in quality, but none can be considered clean without significant treatment to remove salt, hydrocarbons, bacteria, and other minerals. The problem of how to manage water in the context of shale development and production can most aptly be referred to as a "logistical nightmare."

Figure 1 provides an overview of the segments in the water lifecycle in the development and production of shale resources, along with the most common approaches to managing water in each segment.

A major challenge with water management in the context of shale development and production is that the long-term costs are not well understood. Shale development did not become common until around 2005 and few companies have experience in managing shale wells for greater than 10 years. Another problem in understanding water management costs is that water expenditures are generally not comprehensively grouped into a single accounting category, so many companies are not aware of their true long-term lifecycle water management costs.

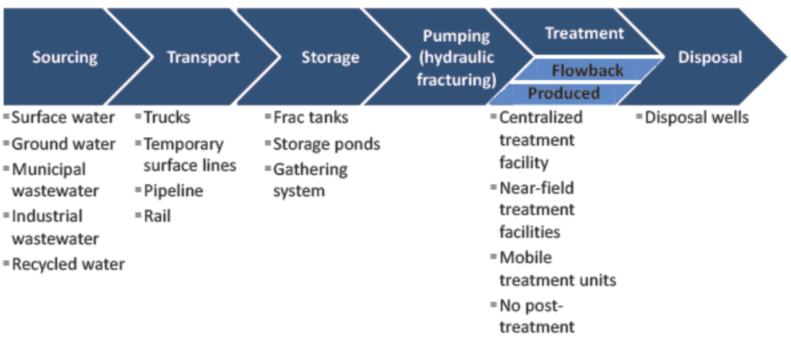


Figure 1
Water Management Segments in the Development and Production of Shale Resources

Statement of Problem

An E&P client asked PacWest for help in developing a comprehensive picture of their true lifecycle water management costs. The client was in the early stages of exploring its acreage in the Eagle Ford shale play in south Texas. The client had prior experience developing shale plays but never at the scale proposed for the Eagle Ford.

In general the client had been managing water according to what we will call the "status quo" scenario – sourcing water from surface water (lakes or rivers) or water wells, transporting water by truck to the well site, storing water in storage ponds or frac tanks, fracing, capturing effluent in frac tanks, transporting effluent by truck, and disposing of effluent in injection wells.

Due to water shortages and disposal problems, some E&Ps have begun to

* Christopher Robart is a Principal with PacWest Consulting Partners. He may be reached at crobart@pacwestcp.com
See footnote at end of text.

recycle effluent via water treatment systems and reuse the treated water for additional fracs. However, water treatment is costly and, if water management systems involving water treatment are not designed carefully, costs can quickly become uneconomic. Ultimately the client wished to understand whether the unprecedented scale at which it would be operating justified investment in a long-term water treatment system in the Eagle Ford shale play.

Methodology

PacWest developed a multi-factor economic model to forecast long-term lifecycle water management costs under various water treatment scenarios. Since logistics and transportation account for a large proportion of water management costs, it is important to consider the geographic layout of the water management system. However, since the client is still in the exploration/appraisal phase, in lieu of a detailed drilling plan, we developed a series of hypothetical water treatment scenarios based upon the geography of the client's leaseholdings in the Eagle Ford.

The economic model plots the entire water management lifecycle, from water sourcing to final reuse or disposal over the long-term, detailing costs associated for each segment of water management activities for each unique water management scenarios. Each scenario is built using multiple dynamic variables that can be programmed according to changes in various activity levels and other relevant segment and full-cycle assumptions and constraints. These costs are aggregated by water management segment and forecast out over five- and 20-year time horizons. These cash flows are then discounted to estimate the medium- and long-term costs to support management decision-making.

Overview of Scenarios

PacWest developed six water treatment scenarios and evaluated the lifecycle water management costs for each over a five-year and 20-year time horizon using discounted cash flow analysis. However, for the purpose of this paper we have presented only three scenarios. We have also modified key operational inputs (particularly the drilling schedule) into the model to maintain client confidentiality. All three scenarios assume initiation of drilling activities in January 2011 with one rig added each month until the rig count reaches 20 in August 2012. The rig count stays constant until June 2014, and decreases by one rig each month until January 2016 when the final rig ceases drilling. The total number of wells drilled between January 2011 and December 2016 is 1,367. Scenario 1 was chosen to provide a baseline assessment of the status quo approach to water management. Scenario 2 and Scenario 3 were chosen as the highest potential scenarios involving water treatment after considering the geographic, geologic, and operational constraints in the Eagle Ford. The map in Figure 2 provides a visual illustration of the geography while the table in Figure 3 provides an overview of the key features of each water management scenario.[1]

The results of the economic analysis (see Figure 4 below) are unequivocal. The two water management scenarios involving treatment and recycling of flowback and produced water result in significantly lower long-term costs than the status quo scenario. The lowest-cost scenario is construction of four near-field water treatment facilities for frac flowback water and produced water (Scenario 2), with a present value of $1,562 million. Scenario 3, use of mobile treatment units for frac flowback water and construction of four near-field treatment facilities for produced water, was slightly more expensive than Scenario 2, with a present value of $1,613 million. Both water management scenarios involving water treatment and recycling are considerably less expensive than the status quo approach to water management – 42% less expensive in the case of Scenario 3 and 44% less expensive in the case of Scenario 2.

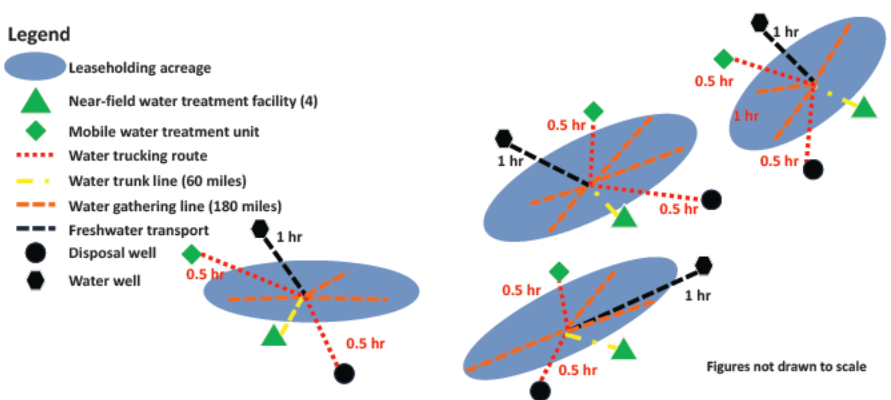


Figure 2
Sanitized Map of Eagle Ford Water Management Scenarios

The difference in total cost between the status quo scenario and the scenarios involving water treatment is primarily due to a reduction in transportation costs. Transportation accounts for $1,761 million, nearly 63% of total costs in Scenario 1, driven mostly by the cost of transporting effluent to disposal via truck. Transportation costs were reduced dramatically in the water treatment scenarios, by 73% in Scenario 2 and 75% in Scenario 3. Transportation accounts for only 31% of total costs in Scenario 2 and only 28% of total costs in Scenario 3. The massive savings in transportation costs is due to a dependence on pipelines for transportation of water rather than trucks.

Disposal costs are also reduced significantly in the scenarios with water treatment. Disposal of effluent into injection wells accounts for $463 million, nearly 17% of total costs in Scenario 1. By recycling water and minimizing the total volumes of water requiring disposal via injection well, disposal costs are reduced to roughly 6% of total costs in both Scenario 3 and Scenario 3.

H_2O Management Segment	Scenario 1	Scenario 2	Scenario 3
Sourcing of H_2O	H_2O wells	H_2O wells/recycled H_2O	H_2O wells/recycled H_2O
Transport of fresh H_2O	Temporary surface line	Temporary surface line	Temporary surface line
Storage of fresh H_2O	Storage ponds	Storage ponds	Storage ponds
Treatment	None	Near-field (4)	Mobile units/near-field (4)
Storage of effluent	Frac tanks	Frac tanks	Frac tanks
Transport of effluent	Truck	Pipeline	Pipeline
Transport of recycled H_2O	N/A	Pipeline	Pipeline

Figure 3
Key Features of Water Management Scenarios

One of the most important differences between the two water management approaches is the increase in capital expenditures in the scenarios involving water treatment. Scenario 1 emphasizes operating expenditures with minor exceptions for water sourcing (internally owned water wells) and water storage (internally owned storage ponds), with capital expenditures amounting to only $11 million, or 0.4% of total costs. The water treatment scenarios require a much greater investment in up-front capital expenditures. Total capital expenditures amount to $186 million in Scenario 2 and $184 million in Scenario 3. The source of the additional costs is investment in water transportation and water treatment infrastructure. Figure 5 below provides a detailed breakdown of capital expenditures for each water management scenario.

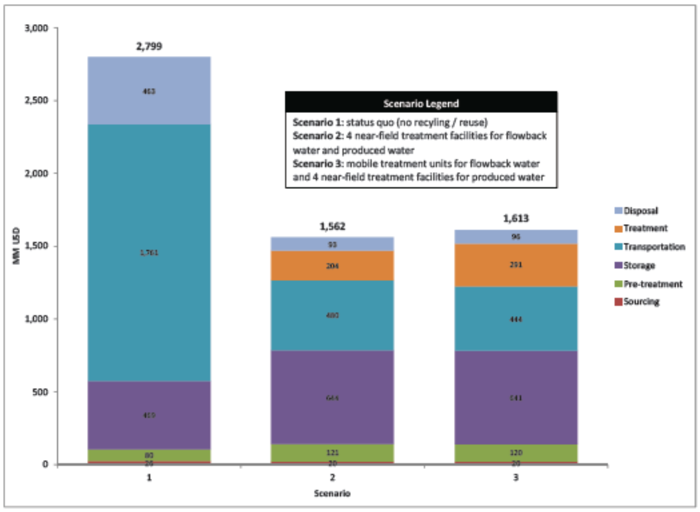


Figure 4
Present Value of Water Management Scenario Costs (2011-2030)

Conclusions and Recommendations

The results of our economic analysis show that, over the long-term, the large volumes of water managed in the development and production of shale resources justify investments in water treatment infrastructure. The results of the model presented in this paper assume a relatively large scale of activity (1,367 wells drilled over 5 years) but even at a significantly smaller scale the economic outcome of the model remains stable. A series of scenarios were tested in which drilling activity was significantly scaled down and even at a peak average rig count of 3 rigs and a total well count of 290 wells the two scenarios involving water treatment were roughly 20% less expensive than the status quo scenario.

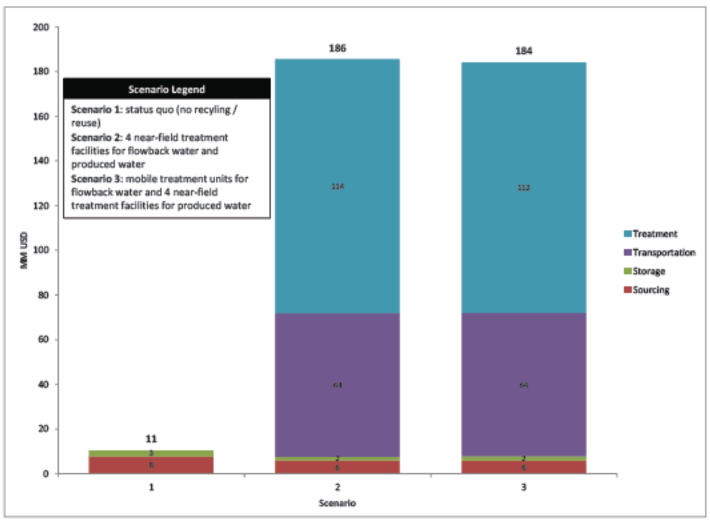


Figure 5
Present Value of Water Management Scenario Capital Expenditures (2011-2030)

Lifecycle water management in the development and production of shale resources presents a significant opportunity for cost savings. If operators are willing to take a longer-term view by committing investments to up-front capital expenditures to reduce long-term operating expenditures, then the economics are compelling.

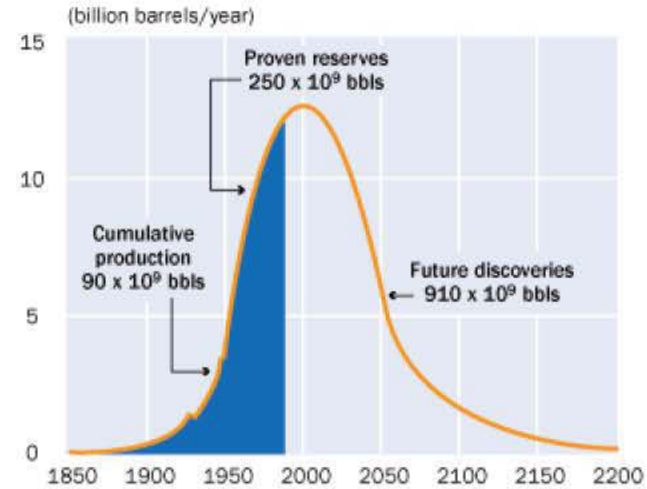
Outside of the tangible economics costs and benefits that the model assesses, there are other intangible factors to consider when making water management decisions. The traditional status quo approach to water management will continue to be challenged from a public perception, operational, regulatory, and environmental perspective.

(continued on page 31)

Tight Gas to Tight Oil: Squashing Hubbert's Bell Curve

By Ross McCracken*

In 1865, the eminent British economist William Stanley Jevons pointed out in his treatise *The coal question; An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal Mines*, "the painful fact that such a rate of growth will before long render our consumption of coal comparable with the total supply." Jevons was ahead of his time making the peak oil argument for coal.

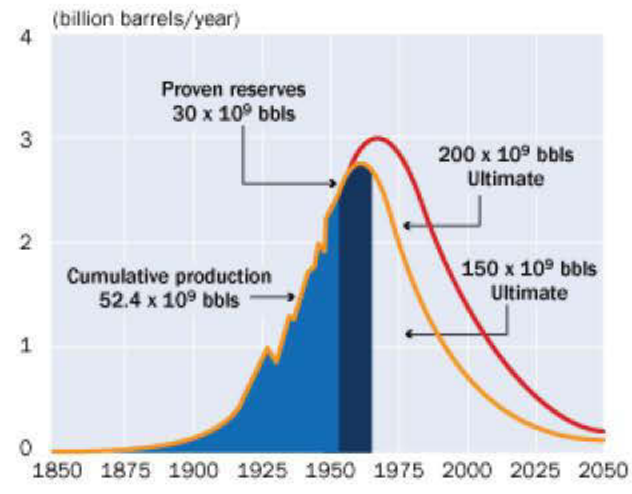


Note: Hubbert based his 1956 prediction on initial world reserves of 1.25 trillion barrels of crude oil. Today, **remaining** reserves are larger than this at an estimated 1.317 trillion barrels. However, Hubbert estimated peak production in 2000 at 12.5 billion barrels a year, while world crude production in 2007 is likely to be two and a half times greater at an estimated 31.3 billion barrels.

Ultimate World Crude Oil Production

(based upon initial reserves of 1,250 billion barrels

Source: Nuclear Energy and the Fossle Fuels, M. King Hubbert, 1956



Ultimate U.S. Crude Oil Production

(based on assumed initial reserves of 150 & 200 billion barrels)

Source: Nuclear Energy and the Fossle Fuels, M. King Hubbert, 1956

In 1956, the eminent U.S. geologist Marion King Hubbert said in his paper *Nuclear Energy and the Fossil Fuels*, "On the basis of the present estimates of the ultimate reserves of petroleum and natural gas, it appears that the culmination of world production of these products should occur within half a century."

The big difference between the two was that while Jevons was at best out on his timing by a century or two, Hubbert was to all intents and purposes proved right. U.S. oil production peaked in 1970, to be followed by natural gas in 1973.

Bell Curves

Hubbert reasoned that what was true for U.S. oil was true for world oil production. A finite resource cannot be produced indefinitely at a continually ever greater rate of production. His argument was highly seductive and mathematically elegant.

He constructed a bell curve that put world peak oil production, rather too neatly perhaps for someone writing in the 1950s, at the year 2000. He assumed initial world reserves of 1.25 trillion barrels and peak production at 12.5 billion barrels a year, which equates to about 34 million b/d.

Today, even remaining proved oil reserves, at 1.38 trillion barrels, are larger than his initial assumption for the total resource, suggesting a much later peak, but consumption is almost three times as great, suggesting a much earlier peak. (A caveat here is that OPEC's official reserve estimates are highly unreliable and most likely exaggerated, but no-one is sure by how much). Oil consumption this year is expected to amount to somewhere in the region of 90 million b/d.

More importantly though, a facet of the bell curve is that even if the total resource figure (represented by the area contained by the bell curve) is expanded -- even doubled -- the point of peak production doesn't shift that much into the future. A model produced by UKERC in 2009 showed that doubling the ultimate recoverable resource would only push peak oil out by about 30 years. That study suggested a global peak was likely to occur before 2030, with a significant risk of supply constraints before 2020.

The acceptance of the bell curve also implies a rather dramatic drop-off in production post-peak, a development which, if the world was caught unprepared, could cause major economic dislocation. These fears found one of their most fantastical expressions in the 2007 film *A Crude Awakening: the Oil Crash,* which predicted a coming Armageddon and the reversion of society to an Amishesque agrarian economy of donkey driven carts.

Yet, as oil prices sky-rocketed in 2008, peak oil theory gained in legitimacy, underpinned by the inescapable logic that a finite resource cannot be produced indefinitely at an increasing rate of production. And at the level of individual

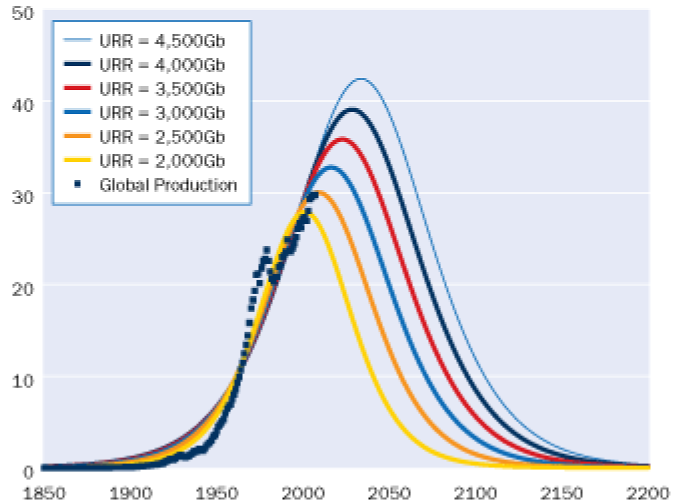
* Ross McCracken is Managing Editor of *Energy Economist* in London. He may be reached at ross_mccracken@platts.com Jake Rudnitsky, Robert Perkins and Gianluca Baratti contributed to this article which is reprinted from the *Energy Economist.*

conventional oil provinces, such as the North Sea, Hubbert again appeared pretty much correct.

Tight Gas to Tight Oil

However, Hubbert's theory seems to be going the way of Jevons for two reasons: first, the ultimate recoverable resource does indeed seem to be expanding; and second, in some countries at least, peak demand appears to have arrived before peak production.

The impact of the first development is to increase the volume under the bell curve, while the effect of the second is to squash it. The effect of both combined is to push the real peak in oil production way out into the distant future. The related forces driving this are high oil prices and technology.



Oil Peak Using Different URR Assumptions
Source: UKERC 2009

In April, the U.S. Energy Information Administration published a report on shale gas reserves that is likely to prove one of the most influential energy reports of all time. It said that the world's technically recoverable shale gas resource for 32 countries was 6,622 Tcf of gas in contrast to proved natural gas reserves of 1,001 Tcf. It did not include some of the most prolific gas bearing regions of the world, for example areas in Africa, the Middle East or Russia.

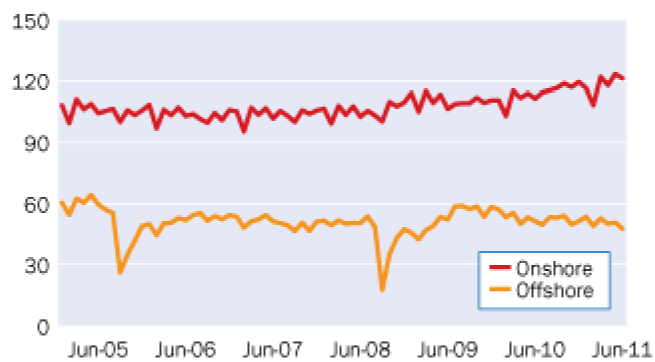
The implication of the report was that countries previously thought either to have little or no gas to speak of and heading towards ever-increasing import dependency had an alternative. For countries like Poland, South Africa, Argentina and China, the results are potentially transformational in terms of their previously assumed energy trajectories.

Underpinning this estimate was the United States' own experience, in which a future dependent on LNG imports had suddenly morphed into one of abundant and cheap domestic gas supply. Directional drilling and hydraulic fracturing had delivered new life to the U.S. gas industry and the figures were there to prove it. Having peaked in 1973 at 59.5 Bcf/d, U.S. natural gas production was heading back towards new highs, reaching 59.1 Bcf/d in 2010 on a rising trend.

The success of shale gas meant U.S. gas prices dropped -- they were near \$3.50/MMBtu in December -- and completely decoupled from oil, which over 2011 has seen its highest average prices ever based on the international Dated Brent benchmark. It didn't take long for the shale gas pioneers to realize that the liquids produced alongside shale gas were more valuable than the gas itself and that some shale plays were much more liquid-rich than others.

The new drilling techniques could equally well be applied to oil trapped in tight, low porosity formations. There was a dramatic shift in focus from shale gas to liquids -- tight gas had become tight oil. The number of rigs drilling for oil in the U.S. in 2011 became higher than for gas, inverting the historical relationship.

A look at U.S. liquids production shows that onshore production has reversed its downward trend. Some forecasts suggest that the Bakken shale formation in the northern U.S. could produce 1 million b/d by 2015 and that the Eagle Ford shale could produce similar amounts by 2020. Other shale plays could add a further 1 million b/d over the same 2020 time frame.



Monthly U.S. Oil Production (millions barrels)
Source:EIA

Shale Goes Worldwide

As the U.S. shale gas experience unleashed a frenzy of exploration worldwide, companies internationally have been quick to look at both the liquid and gas potential of their new plays. In November, Spain's Repsol announced that it expected to invest \$20 billion in a huge shale oil and gas discovery in Argentina. The company's Argentine unit YPF said it had found nearly 1 billion equivalent barrels of recoverable shale oil at the Loma La Lata field in northern Patagonia.

The Loma La Lata discovery lies in a 428 square kilometer area, a fraction of the 12,000 sq km concession which Repsol is exploring in the vast Vaca Muerta formation. The field currently produces 5,000 boe/d of shale oil and gas from 15 vertical wells, but Repsol planned to start horizontal drilling late in 2011, and is targeting production of some 350,000 barrels of oil over the lifetime of each well.

According to Repsol's chief financial officer Miguel Martinez, the field contains 741 million barrels of light oil with an API of 40-45° and the production cost should be around $26-$29/b. The remainder is heavy oil. Repsol is also starting to produce oil from a similar-sized, nearby area in the same basin that could rival the Loma La Lata field in size.

And if the potential is large in Argentina and the U.S., it is huge in Russia. Several companies are researching how to extract oil from the huge Bazhenov formation in West Siberia, which some geologists estimate may hold 50 billion mt (365 billion barrels) of recoverable reserves. Russia's subsoil agency Rosnedra projects that output from Bazhenov could reach 1.7 million b/d by 2030 -- nearly a fifth of current Russian production. Rosnedra foresees output growing to 1.1 million mt by 2015 and to 15.4 million mt by 2020, according to the Russian news agency Prime.

How much tight oil exists worldwide, what the recovery rates will be and how much it will cost to produce remain open questions. (Repsol's estimate for Loma La Lata of $26-$29/b is way below what is currently viewed as the marginal cost of production for oil sands, for example). Organizations like OPEC and the International Energy Agency are fairly cautious in their initial assessments, but there seems to be a significant disconnect between this conservatism and what U.S. companies involved in tight oil plays in the U.S. think is achievable -- just as there was with shale gas.

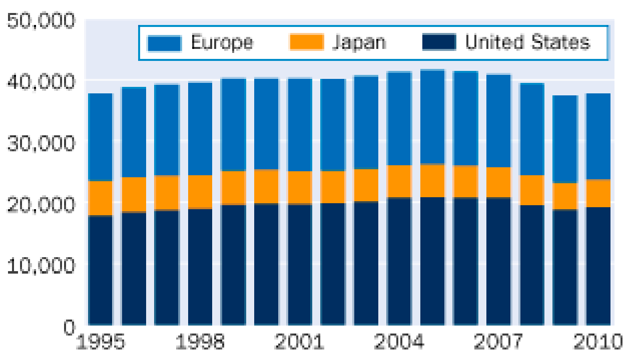
In short, tight oil may make a very significant contribution to a much enlarged recoverable oil resource. The Bazhenov formation alone contains more potentially recoverable reserves than Saudi Arabia's proved conventional reserves.

Peak Demand

The other side of the equation is peak demand. In its World Energy Outlook 2011, published in November, the IEA sees world oil demand growing from 87 million b/d in 2010 to 99 million b/d in 2035 under its New Policies Scenario. But there are marked regional differences. All demand growth comes from non-OECD countries, while oil demand in the OECD contracts. The OECD, it seems, hit peak oil demand some time ago.

The advent of peak oil demand in the OECD reflects the combination and alignment of multiple policy drivers: a response to high prices, concern over increasing dependence on oil imported from a dwindling band of major exporters, and the need to reduce greenhouse gas emissions. The past five years have seen a policy and price-led upsurge in alternative technologies designed to eradicate demand for oil. The introduction of biofuels to the fuel pool, combined with more fuel efficient vehicles and greater energy efficiency more broadly, is giving way to longer-term solutions such as electric cars.

While recession following the financial crisis has exaggerated the drop in OECD oil consumption, there is a clear underlying trend in permanent price-driven demand destruction. European oil demand peaked in 2006 pre-financial crisis. Japanese oil consumption has been on a downward trend since 1996, although the Fukushima nuclear disaster may produce a temporary upturn this year and next. U.S. oil consumption rose in 2010 from 2009, but remains below the peak of 2005.



Regional Oil Consumption (million b/d)
Source: BP Statistical Review of World Energy 2011

What matters for peak oil is world demand and that is expected to continue rising, but of all the possible future scenarios two might be set against the prevalent view of ever-rising non-OECD demand. First is that the non-OECD might see peak demand earlier than the OECD in respect of relative levels of economic development. Just as Europe and Japan have different levels of vehicle usage, there is no iron law of development that China must have the same number of cars per person as the United States. Second, is that the OECD contraction proves much deeper than is currently expected, perhaps as a result of much higher than expected uptake of electric cars, perhaps in the short-term as a result of renewed recession.

That a large proportion of the consumption side of the oil market is on a downward trend suggests not necessarily that the world is approaching the top of Hubbert's bell curve, but that the overall path of world consumption is more semi-circular than bell shaped. Combine this with much more available oil, and peak oil not only recedes into the future, but there is no sudden cataclysmic drop off in production.

Crystal Balls

Predicting peak oil looks like the extrapolation of conditions prevalent in the 2005-2009 period into the immediate future. Arguing that tight oil and peak demand have changed that outlook is simply to extrapolate from a changed present. Neither have much value as forecasts. The fact is that if tight oil does, over the next decade, change the course of the oil market, it implies softer oil prices than currently expected. That in itself will have an impact on the incentive to reduce oil consumption.

However, the lesson for both Jevons and Hubbert is that what technology achieved in the late 1800s with respect to coal, and what may now be occurring for oil, it can do again. The surface of subsalt potential has arguably only been scratched, while beyond tight oil lies the prospect of the confusingly named oil shale -- kerogen containing rock which is different to the tight oil found in shale plays. The problem is not a lack of resource, but a clash of economics versus environmental policy which will be played out in terms of investment levels.

If there is no, or perhaps less, danger of running out of oil, then it throws into sharp relief the interaction of energy and climate policy. Up until now, these have been broadly aligned. Lower oil consumption meant a reduction in energy insecurity, prices and carbon emissions. If oil is cheap and more widely available, then reductions in oil use will have to be justified on climate grounds alone.

It is too early to proclaim tight oil the game changer on a world scale that shale gas has been for a single country, the United States, but it is much easier to replicate processes than create them from scratch. Moreover, Repsol's find in Argentina could transform the company's fortunes; other oil companies' CEOs will take note.

Water Management Economics.. (continued from page 27)

There has already been a major public backlash to shale gas development activities in the Marcellus play due to water management issues. Intermittent shortages of water hauling trucks in the Bakken and the Eagle Ford have already created challenges to daily operations for many operators. Shortages of water in the Eagle Ford due to drought conditions have also made water acquisition difficult and led local cities and counties to think twice about allowing E&Ps to source water from their municipal water systems. It's critical that E&Ps of the future consider both intangible factors, along with tangible economic benefits, as outlined in this paper, when evaluating their options for oilfield water management.

E&P Decision-Making Tool

This economic model was not conducted as an academic exercise, but as a tool to facilitate management decision-making. Since the initial water modelling exercise, we have continued to refine the model and have since applied it to evaluate water economics for other E&P shale resources. The model has now reached a level of maturity to support rapid water cost modelling of multiple water management scenarios. When combined with a better understanding of existing water management operations and costs, the model can serve as a critical tool to quickly understanding the costs and implications of E&P long-term water management operations.

Footnotes

[1] The acreage layout has been simplified and geographic details removed to maintain client confidentiality.

Beijing Traffic Congestion: Recent Moves are Too Little, Too Late

By Philip Andrews-Speed*

Modernisation and economic development brings many benefits to society and individuals, of which mobility is one. Yet, as Beijing and many other large cities around the world are finding, the private search for increased mobility actually leads to creeping immobility as average traffic speeds in peak periods plummet towards levels found in nineteenth-century cities where private transport was by horse-drawn carriage - about 15 kilometres per hour in London. Though Beijing may boast today an average peak period speeds of nearly 25 kilometres per hour, this is set to fall to London's levels by 2015.

At the end of 2010 there were 4.7 million registered vehicles in Beijing city, an additional 700,000 having been added during 2010 at a rate of 2,000 per day. In comparison 2009 saw an additional 550,000 vehicles. Altogether some 1.9 million vehicles have been registered in the city over the last four years.

Though this rate of growth is impressive, it is over-shadowed by vehicle sales at national level. Sales of passenger cars nationwide in 2009 rose by 53% to 10.3 million and total vehicle sales that year rose by 46% to 13.6 million. Provisional data for 2010 indicate the sales of passenger cars reached 13.7 million, up by 33%, and total vehicle sales broke through the 18 million threshold, up 32%.

Coming back to Beijing, though the rate of growth of vehicle sales is lower than the national average, the last two years of growth have had a dramatic impact on traffic congestion and travel times, despite the commissioning of several new subway rail lines. At the end of 2010, the Beijing Municipal Government decided to act by reducing the number of vehicle registrations in 2011 to just 240,000, some 34% of the total for 2010. The registrations will be decided by a monthly lottery, and entry to the lottery by private individuals will be restricted to those officially resident in Beijing. At the same time, vehicles without a Beijing registration will not be permitted to enter the city during rush hour. These rules supplement an existing scheme which blocks each car from entering the urban area on one working day each week, depending on the license plate number.

But, for every measure there is a counter-measure. Though the car salesman in Beijing may be down-hearted, the car rental agencies are likely to see a boom in business, as those who are unsuccessful in the lottery and those from out of town seek access to a vehicle.

But these actions are just tinkering on the margins of the problem. Given that traffic congestion in modern cities is not a recent phenomenon, but goes back several decades, one has to ask how Beijing (and some other Chinese cities) reached its current state of pervasive and growing traffic congestion.

In my view, the source of the problem lies in policy decisions and non-decisions taken in 1980s and 1990s. Let us first look at the automobile industry. In the 1980s China's government took steps to boost the quantity and quality of domestic vehicle production, in part through the establishment of joint ventures with foreign manufacturers. But, despite private ownership of vehicles being permitted since 1984, most new vehicles were for the commercial or government sectors.

In 1994, the government announced a strategy which was intended to make the automobile industry of one a few 'pillar' industries to become competitive in international markets. This required that private car ownership be encouraged. As a consequence, not only did total vehicle production rise, but, more significantly, the proportion of saloon cars expanded from about 8% in 1990 to about 60% today. Deliberate government policy and the individual aspirations of the newly affluent middle classes have thus converged.

But car ownership is not the same as car use in urban areas. So we must look at the transport policies of Beijing city. At the end of 2010, Beijing had 14 metro lines totalling 336 km, of which five suburban lines totalling 108 km opened on 31st December 2010. The city has a target of 560 km by 2015 and 1000 km by 2020.

But this surge of subway rail construction is only a recent phenomenon. The early development of the Beijing metro system was very slow. The first 28 km was opened in 1981. Another 16 km was added in 1984. In the period 1991 to 2000, further extensions took the total to about 55 km, on just two lines. The suburban railway system today comprises just one line, 86 km long opened in 2008. An additional six lines total 360 km are to be completed by 2020.

In contrast Beijing has five multi-lane ring roads totalling some 500 km, mainly constructed between 1990 and 2009, and the city acts as a hub to nine expressways and eleven national highways. Each day a total of some 20,000 buses are out on the city's roads, along some 500 routes. Meanwhile a combination of pollution, congestion and

* Philip Andrews-Speed is an independent energy policy analyst based in Dundee, Scotland.

the use of cycle lanes by motor vehicles has reduced the proportion of Beijing's population using bicycles from 80% twenty-five years ago, to 20% today.

Thus, the current situation we see today has clear roots in deliberate government policies, dating back to the 1980s and 1990s, to design Beijing's urban expansion around the road rather than the rail and to promote private car ownership. The consequences for congestion and pollution may be unintended, but they are real just the same.

Beijing, and other cities, have placed themselves in a state which the social scientists call 'path-dependency'. The trajectory of the urban transport system today was determined by decisions made many years ago, and changing that trajectory becomes progressively more difficult as time goes on. The recent actions of Beijing's government are worthy steps, but you should not be surprised if another ten or twenty years pass before we see a marked and sustainable improvement in urban transport conditions in this city.

IAEE/Affiliate Master Calendar of Events

(Note: All conferences are presented in English unless otherwise noted)

Date	Event, Event Title and Language	Location	Supporting Organizations(s)	Contact
2012				
January 26-27	7th Spanish AEE Conference *Call for Papers Open until November 13* www.aeee.es/en/activities.php	Pamplona, Spain	SAEE	Enrique Loredo Fernandez eloredo@uniovi.es
February 20-22	3rd IAEE Asian Conference *Growing Energy Demand, Energy Security and the Environment in Asia*	Kyoto, Japan	IEEJ	Kenichi Matsui kmatsuijr@aol.com
April 23-24	5th NAEE/IAEE Conference Energy Technology and Infrastructure for Sustainable Development	Abuja, Nigeria	NAEE	Adeola Adenikinju adeolaadenikinju@yahoo.com
June 24-27,	35th IAEE International Conference *Energy Markets Evolution under Global Carbon Constraints: Assessing Kyoto and Looking Forward*	Perth, Australia	AAEE/IAEE	Ron Ripple r.ripple@curtin.edu.au
September 9-12	12th IAEE European Conference *Energy Challenge and Environmental Sustainability*	Venice, Italy	AIEE/IAEE	Edgardo Curcio e.curcio@aiee.it
November 4-7	31st USAEE/IAEE North American Conference *Transition to a Sustainable Energy Era/ Opportunities and Challenges*	Austin, Texas	USAEE/CTAEE/IAEE	USAEE Headquarters usaee@usaee.org
2013				
April 8-9	4th ELAEE Conference Theme TBA	Montevideo, Uruguay	LAAEE/IAEE	Marisa Leon melon@adme.com.uy
June 16-20	36th IAEE International Conference *Energy Transition and Policy Challenges*	Daegu, Korea	KRAEE/IAEE	HoesungLee hoesung@unitel.co.kr
July 28-31	32nd USAEE/IAEE North American Conference *The Commercial-Government Interface of Energy Development*	Anchorage, Alaska	USAEE/IAEE	USAEE Headquarters usaee@usaee.org
August 18-21	13th IAEE European Conference *Energy Economics of Phasing Out Carbon and Uranium*	Dusseldorf, Germany	GEE/IAEE	Georg Erdmann georg.erdman@tu-berlin.de

The Triple "A" Argument for Natural Gas

By Maximilian Kuhn and Frank Umbach*

Until a few years ago, declining indigenous natural gas production in the U.S. and Europe led to consuming markets seeking more distant supplies, delivered in the form of LNG, often from stranded or displaced sources. Future dependencies on a few countries--notably Russia, Qatar, Iran, Turkmenistan, and Australia--that control the bulk of conventional gas reserves were expected. Energy security issues arose out of the concerns over import dependents on these countries and supply disruptions therefrom. Historically, the use of the "energy weapon" as a political tool has often created tensions between suppliers and consuming countries. The fact that 63 percent of conventional gas reserves are located in regions other than the Middle East increases the appeal of gas to governments wishing to reduce their energy dependency on this region. The dramatic rise in unconventional gas over the last decade has changed the market in unanticipated ways.

Unconventional gas (shale gas, tight gas, and coal-bed methane) developments are not really a (r-) evolution but rather an evolution of utilizing modern techniques and combining two key technologies– horizontal drilling and "slick water" hydraulic fracturing–which finally cracked the shale rock and thus cracked the code for opening up major North American shale gas resources.[1] The release of unconventional gas resources triggered what can be called a revolution in global gas markets. Unconventional gas not only transformed the U.S. energy market, and in particular the natural gas market, it was also the tipping-point of a fundamental change in global gas markets. Not only has it provided a solution to American supply concerns, it also affected global spot gas prices. In this way, natural gas is evolving from a local, stationary, non-residential commodity into a mobile, international, primary product similar to crude oil. At the same time, a significant change in the incremental flexibility of global deliveries of liquefied natural gas (LNG) has occurred. LNG has become a key component of the U.S. and European energy mix.

In sum, the combination of three factors: (1), a drop in demand linked to the global recession; (2), an increase in U.S. non-conventional shale gas production; and (3), the arrival of new LNG delivery capacity has created a sudden abundance of natural gas.

Today, in the U.S. the combination of enhanced LNG transportation and increases in delivery capacity, together with current and expected shale gas supplies, have changed the gas landscape and resulted in the freeing up of some previously contracted LNG volumes bound for the U.S. Global liquefaction capacity is expected to be up sharply this year and outpace demand for LNG. In 2009-2010, an additional 9 billion cubic meters of liquefaction capacity came online. These additional volumes created an excess supply in the market with an immediate impact on spot market prices and on the need for imports (both pipeline and LNG). Some contracted LNG will be forced to go to U.S. terminals, even if demand is not there.[2] This would force Henry-Hub (HH) spot gas prices to go down further and keep U.S. near-term prices range-bound ($4-8/mmcf). Thus, North American LNG gas prices, which are naturally connected to the Henry Hub spot market prices, will lead to low marginal prices for LNG in other markets like Europe and Asia.

As a consequence of these developments, today's distinct regional gas markets—where demand is more or less fully satisfied by national or regional supply—will become more integrated under the impact of the transitory "gas glut", more flexible forms of trade like liquefied natural gas (LNG), dramatic increases in U.S. unconventional gas production, global shopping for resources by an energy-hungry China, and through the continuing liberalization and integration process of the EU energy markets. In addition, unconventional gas shifts the focus from major conventional production regions back to the national level–from globalization to localization–so to speak; it turns the traditional picture of natural gas being transported from producing to consuming countries through pipelines upside down, as unconventional gas can now be developed close to demand centers. The advantage of unconventional gas is that it is a domestic, national source of fuel supply, which enhances the energy security of each country. Thus, traditional views about geographic distribution, politically unstable producer countries and about 'energy security' in general are clearly being challenged.

As witnessed, the energy world is undergoing major shifts in all its fundamentals areas: supply, demand, infrastructure, economics, and international compe-

* Maximilian Kuhn is Chief Editor, EUCERS Strategy Papers and a Research Associate at the Centre for Energy, Marine Transportation and Public Policy (CEMTPP), School of International and Public Affairs (SIPA), Columbia University. Frank Umbach is Associate Director of EUCERS as well as Senior Associate and Head of the Program "International Energy Security" at the Centre for European Security Strategies (CESS GmbH) in Munich-Berlin. The authors are solely responsible for any errors of fact or interpretation and the views expressed in this paper are solely those of its authors. Maximilian Kuhn may be reached at maximilian.kuhn@kcl.ac.uk .
See footnotes at end of text.

tition. In addition, climate change mitigation efforts and the setting of a price for carbon have major implications for energy policy in general and for natural gas policy in particular. This emerging ‘new world’ will require adjustment from industry, governments, and from new technology providers. Gas market participants will need to understand markets and pricing structures more intimately and will have to invest in diversification for both supply and demand to achieve greater strategic flexibility. The current balance of forces is far from stable; changes-- irrespective of the outcome--will have a significant impact on transatlantic relations, national economies, and, ultimately, on consumers.

In light of such uncertainties, the emerging global gas market can be summarized in one word: volatile.

However, looking at these developments from a market cycle perspective they become less surprising. In their study on “the Dynamics of Energy Systems” Cesare Marchetti and Nebojsa Nakicenovic developed a mathematical model for the long-term pattern of energy change in industrial economies.[3] As Montgomery writes: “The Machetti-Nakicenovic theory showed each energy source rising, peaking, and then falling as a series of partly overlapping, symmetrical curves, one replacing another, like waves smoothly running upon a shore – oil ascending as coal declines, then cresting and collapsing as it is replaced by natural gas, which then gives way to some future source (solar energy and fusion were mentioned).”[4] Robert A. Hefner III further adapted this model in the 1990s but saw it as a “progression from solids (wood and coal), to liquids (mainly oil), and finally to gases (natural gas and hydrogen), a progression that would lead to […] an ‘age of energy gases’”.[5] The way Hefner sees the development of the energy cycles in the context of human development can be seen in Figure1,The Age of Energy Gases. This illustrates, Hefner idea by taking into account Marchetti and Nakicenovic work, how the waves of energy transition took place over time and how “over time we have been de-carbonizing or we might say have been “hydrogenising” our energy consumption.”[6]

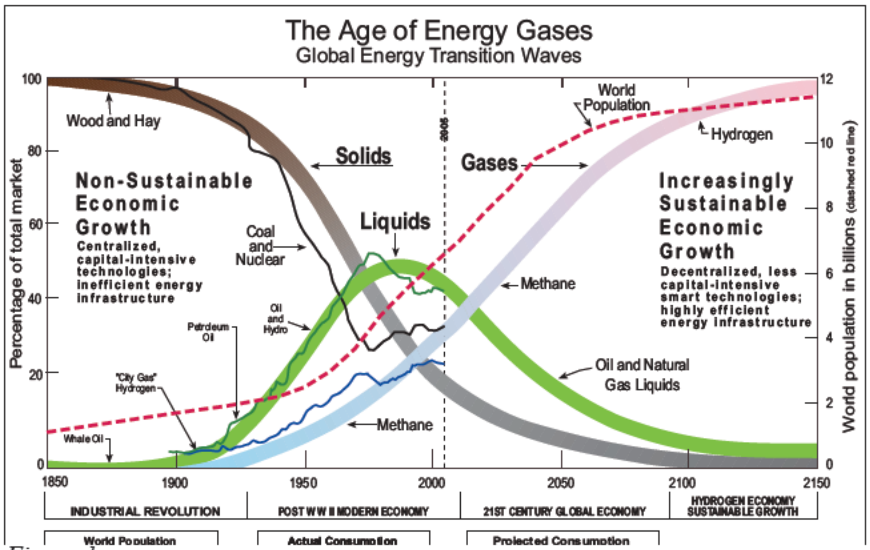


Figure 1

The Age of Energy Gases

Source: Robert A. Hefner III (2007), The Age of Energy Gases. Page 12-13.

As Hefner, rightly states, natural gas should not be seen in the “long-held concept of ‘oil and gas’ where ‘gas’ comes second, as a little valued by-product of oil”.[7] In fact, he argues, natural gas is a better fuel for a number of reasons:

Firstly, natural gas is chemically simple, with four hydrogen atoms and only one carbon in contrast to oil which is chemically complex and contains more dirty carbon.

Secondly, due to its chemical status gas is lighter than air, and its leaking from the Earth’s crust apparently does not have as negative effect on the environment as oil.

Thirdly, also attributed to its chemical status, natural gas is compressible, unlike oil.[8]

Putting forward a triple “A” argument for natural gas, it is:

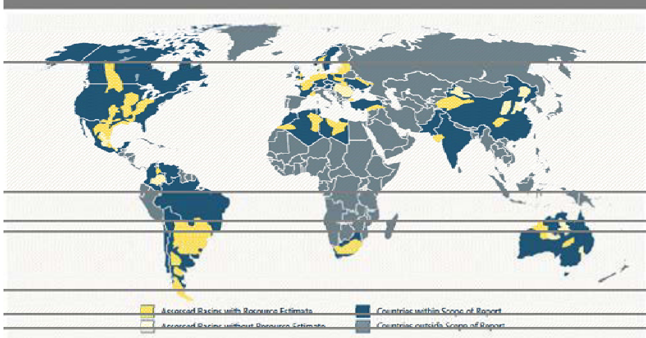
- Acceptable,
- Abundant,
- Affordable.

Acceptable, due to its lower emissions and because it burns cleaner than coal or oil. Abundant, as natural gas resources can be “produced from all the volumes of rocks that contain oil, as well as vast volumes of rocks, particularly tight sandstones, shales and coals that contain no oil, the global volumes of sediments capable of producing natgas commercially are at least twice and probably closer to several times the volumes of rocks capable of oil production.”[9] The rise of commercial gas reserves, by almost 30 percent over the last decade, has to some extent proven this assumption. However, in general this is due to the fact that oil companies have begun to search, explore, and produce gas in its own right and due to technological advances in developing and transporting natural gas.

Consequently, with fewer constraints on the supply side and rapidly falling costs of production, as seen in the U.S. “shale gale,” natural gas is becoming one of the most affordable fuels. Moreover, natural gas will become more relevant for the renewable energy industry as *Green Gas* or so called SNG (Synthetic or Substitute Natural Gas), can provide storage for and also transport energy by using already existing infrastructure. Natural gas will provide a balancing option for renewable energy and the possibility to store and save electricity through conversion into gas.[10] Thus, gas will not only be a bridge to a sustainable future energy mix, but will be a component in the provision of energy security.[11]

Current studies show that the global potential, especially in the key demand centers for natural gas, is substantial.[12] Besides the direct market effect, the development of unconventional gas also has foreign policy implications for supplier countries.

Unconventional Gas – Here, There, Everywhere



Europe (in bcm)	
France	5 097
Germany	226
Nederland	481
Norway	2 350
UK	566
Denmark	651
Sweden	1 160
Poland	5 295
Turkey	424
Ukraine	1 189
Lithuania	113
Others	538

South America (in bcm)	
Venezuela	311
Columbia	538
Argentina	2191
Brazil	6399
Qiile	1812
Uruguay	594
Paraguay	1755
Bolivia	1359

North America (in bcm):	
USA	2441
Canada	1784
Mexico	1444

Asia (in bcm)	
China	
Indie	1 783
Indonesia	1444

Own graphic, adapted from: EIA, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, Washington D.C. (U.S. Department of Energy), April 2011, p. 2.

Foreign Policy Implications of (unconventional) Gas[13]

The impact of the shale gas buzz is even greater. It is not only about the radical change of the energy industry, but also about the political and international relations effects of these developments. Unconventional gas has become the new “elephant in the room”, with global geopolitical implications that have caused a chain reaction: European gas prices are being renegotiated and revised. It has also caused an average of 15 percent of Gazprom’s supplies to be delinked from oil-indexation. Yet, as Dieter Helm puts it, the implications are greater still: relatively cheap and abundant gas, along with the carbon advantage of gas, makes “nuclear and coal relatively more expensive than currently assumed.” “By switching from coal to gas, emissions can be quickly reduced at a very low cost”. Indeed, making gas a major transition fuel will help renewable energy efforts to reduce emissions at a low cost and quickly in order to mitigate the impact of climate change.[14]

Unconventional gas has helped to shift the balance from a seller-dominated market to one dominated by buyers. Unconventional gas is nowadays the “new policy” option for European countries, giving buyers more leverage to renegotiate high Russian oil-indexed gas price demands that are included in long-term contracts. Thus, unconventional gas, even without being produced in Europe, puts a certain price cap on high Russian gas prices, as it can become a potential source of diversification, particularly if Russian gas prices are higher than the break-even point for European unconventional gas. All this has the potential to make unconventional gas development economically feasible and, politically speaking, more appealing. Unconventional gas, and shale gas in particular, has become a negotiating tool for Europe in a changing gas market that is enhancing the region’s energy security by diversifying energy sources and enabling the prioritization of a domestically located resource.

Consequently, regardless of how the outlook for European unconventional gas development looks – and whether or not unconventional gas will become affordable and sustainable in the mid-to-long term in Europe – shale gas has already changed the European market, even before a single well has been drilled or a single molecule of unconventional gas extracted from European basins.

Summary

In sum, as a consequence of recent developments, gas prices are becoming de-linked from the oil price through a combination of three factors: recession, U.S. unconventional production, and LNG capacity

Furthermore, unconventional gas, particularly in the U.S., has become cheaper to produce than most conventional gas, especially if it contains natural gas liquids (NGL). This makes gas the most compatible available energy source for consumers and the best bridge towards a renewable and sustainable energy system.

As recent studies have shown, the unconventional gas resource base is bigger than that of conventional gas resources and is abundantly located worldwide. It may extend the gas availability up to 250 years worldwide and at least 60 years in Europe.

Earlier anticipated hurdles for replicating the U.S. shale gas (r-)evolution in Europe can be overcome by time, technical advancements, the right regulatory framework, and a favorable fiscal and pricing mechanisms. However, market structure and environmental policies remain critical components in determining if unconventional gas production will take place to a greater extent. In this context public acceptance is crucial for unconventional gas development. Education, involvement and engagement with the public are needed to understand the risks and benefits.

Groundwater contamination in the EU is unlikely to occur due to fracking itself. The likely cause of early contamination, is drilling fluids or fracturing fluids spilled on the ground or overflowing/leaking from storage pits where it then infiltrates downwards to shallow groundwater and poses a risk. But good oil field practices and state-of-the-art cementation and fracture monitoring techniques should prevent drilling fluids, hydraulic fracturing fluids, or natural gas from leaking into the permeable aquifer and contaminating groundwater.

With further technological improvements the potential to develop more environmentally friendly drilling technologies will offer a way to cope with the many water issues related to drilling and reduce these obstacles over time. Moreover, in comparison to the U.S., European rock strata containing unconventional gas resources are generally located deeper in the earth and beneath the groundwater.

As portrayed, unconventional gas is a political asset. As a major domestic fuel – similar to renewables – it increases energy security and reduces import dependencies while it also can help fulfill political agendas and solve regional and local development issues.

In the medium term, unconventional gas has the potential to change the industry structure. The oversupply of gas helps in the liberalization process of the European market. Therefore, it has major implications for conventional gas suppliers – like Russia – and the European Union as well.

Consequently, regardless of how the outlook for European unconventional gas development looks today, and regardless of whether or not unconventional gas becomes affordable and sustainable in the mid-to-long term in Europe, shale gas has already changed the European market. This is true even before a single well has been drilled, or a single molecule of unconventional gas has been produced from European basins.

Footnotes

[1] The following analysis is based on Maximilian Kuhn and Frank Umbach, "Strategic Perspectives of Unconventional Gas: A Game Changer with Implications for the EU`s Energy Security." A EUCERS Strategy Paper, Vol. 01, No. 01, May 2011 (London: EUCERS/King's College, 2011). (available at: http://www.eucers.eu/wpcontent/uploads/EUCERS_Strategy_Paper_1_Strategic_Perspectives_of_Unconventional_Gas.pdf)

[2] Gas Matters (Gas Stragegies, 2010), "Shale Gas in Europe: A Revolution in the Making."

[3] See Scott L. Montgomery (Chicago; London: University of Chicago Press, 2010), *The Powers That Be : Global Energy for the Twenty-First Century and Beyond,* 23-24. And C. Marchetti, Nebojsa Nakicenovic et al. (Laxenburg, Austria: International Institute for Applied Systems Analysis, 1980), *The Dynamics of Energy Systems and the Logistic Substitution Model.*

[4] Montgomery (2010), *The Powers That Be : Global Energy for the Twenty-First Century and Beyond,* 24.

[5] Ibid. and For further reading on the future potential of natural see Robert A. Hefner III, "The Age of Energy Gases: The Importance of Natural Gas in Energy Policy," speech and paper by Robert A. Hefner III at the Aspen Institute's Aspen Strategy Group's conference "The Global Politics of Energy," Aspen, Colorado, August 2007. Available at: http://www.ghkco.com/downloads/ASG-ImportanceofNaturalGasinEnergyPolicy08.07.doc And Robert A. Hefner (Oklahoma City: The GHK Company, 2007), "The Age of Energy Gases," in *The Importance of Natural Gas in Energy Policy*.

[6] Hefner (2007), "The Age of Energy Gases", 12-13.

[7] ——— (2007), "The Age of Energy Gases".

[8] Ibid., 4-5.

[9] Ibid.

[10] Referred to as the Methanation.

[11] For further information see: S. N. G. Symposium and Technology Institute of Gas ("Papers on Substitute Natural Gas from Hydrocarbon Liquids") (Chicago, 1973); Synthetic Natural Gas (Sng) from Coal and Biomass: A Survey of Existing Process Technologies, Open Issues and Perspectives, INTECH Open Access Publisher, http://www.intechopen.com/articles/show/title/synthetic-natural-gas-sng-from-coal-and-biomass-a-survey-of-existing-process-technoligies-open-issue; Energy United States. Dept. of, Laboratory National Energy Technology et al. (2009), "Production of Substitute Natural Gas from Coal," United States. Dept. of Energy ; distributed by the Office

of Scientific and Technical Information, U.S. Dept. of Energy, http://www.osti.gov/servlets/purl/993826-aTrqoP/; Planning American Gas Association and Group Analysis (Arlington, Va.: American Gas Association, 1978), *Sng Fact Book*; H. Boerrigter and R. W. R. Zwart (Petten: Netherlands Energy Research Foundation, 2004), *High Effiency Co-Production of Fischer-Tropsch (Ft) Transportation Fuels and Substitute Natural Gas (Sng) from Biomass.*

[12] Based upon Umbach, Kuhn, "Unconventional Gas Resources: A Transatlantic Shale Alliance?", in: David Koranyi (Ed.), Transatlantic Energy Futures. Strategic Perspectives on Energy Security, Climate Change and New Technologies in Europe and the United States, Center for Transatlantic Relations, Paul H. Nitze School of Advanced International Studies, John Hopkins University, Washington D.C. 2011, pp. 207-228

[13] Based upon Umbach, Kuhn, "Unconventional Gas Resources: A Transatlantic Shale Alliance?", in: David Koranyi (Ed.), Transatlantic Energy Futures. Strategic Perspectives on Energy Security, Climate Change and New Technologies in Europe and the United States, Center for Transatlantic Relations, Paul H. Nitze School of Advanced International Studies, John Hopkins University, Washington D.C. 2011, pp. 207-228.

[14] Dieter Helm (2010), The Coming of Shale Gas: the Implications for Oil and Energy http://www.terrafirma.com/Alternative-perspective-page/articles/295.html This is in contrast to a report from the Tyndall Centre arguing against shale gas in particular as a transition fuel and highlighting the potential risks to human health and the environment. See: Wood. R., Gilbert P., et al: 2011, Shale gas: a provisional assessment of climate change and environmental impacts. A report commissioned by the Cooperative and undertaken by researchers at the Tyndall Centre, University of Manchester See also Robert W. Hogath, Renee Santoro, Anthony Ingraffea (2011), "Methane and the Greenhouse-Gas Footprint of Natural Gas from Shale Formations", Climate Change (Springerlink.com), 12 April 2011; critical comments to this "biased" study - see "Five Things to Know About the Cornell Shale Study", European Energy Review, 27 April 2011 (originally in: Energy in Depth) and Gregory C. Staple/Joel N. Swisher (2011), "The Climate Impact of Natural Gas and Coal-Fired Electricity: A Review of Fuel Chain Emissions Based on Updated EPA National Inventory Data", American Clean Skies Foundation (www.cleanskies.org), 19 April 2011.

Implications of European Shale Gas Developments for the EU Gas Market: A Model Based Analysis

By Jeroen de Joode, Arjan Plomp and Özge Özdemir*

Background

The shale gas boom in the U.S. in the past decade has led to expectations and fears in Europe: expectations with respect to the possible contribution shale gas deposits in Europe can make to European gas needs in the future and thereby ease Europe's security of supply concerns, and fears with respect to the risks attached to European shale gas developments based on incidents in the U.S. (e.g., local ground water pollution, safety hazards) and the sustainability of shale gas activities at large. In response, some EU countries have imposed a de facto moratorium on shale gas developments (e.g., France) whereas others have welcomed a large number of test drillings for shale gas (e.g., Poland).

Estimates of the presence of shale gas deposits in Europe vary and similarly, there is large uncertainty exists regarding the costs of bringing this gas to market. The possible risks involved in producing shale gas deposits across Europe needs to be thoroughly assessed, and also the degree to which shale gas is a sustainable energy source in comparison with alternatives needs to be analyzed. But irrespective of these issues, also the desirability (or need) to develop shale gas resources from an economic market perspective needs to be addressed. Without proper information on this aspect policy maker's decisions on shale gas developments across Europe are bound to be flawed.

Based on the scarce available information, and for the moment ignoring political decisions that are or may be made across different EU member states, this article tries to assess the possible implications of shale gas developments in Europe for the EU gas market. How do shale gas developments contribute to security of supply in the EU and its member states in next decades? How may developments affect the sourcing of gas consumption across the EU? And: what are the implications for infrastructure use and investment requirements? These are the type of questions addressed in this contribution.

Methodology and Assumptions

In order to quantify the possible impact of future shale gas developments in the EU we use an economic optimization model that covers the EU gas market and its neighboring regions. The use of market models to simulate (future) gas market developments is not new, but an application to the potentially high-impact development of large-scale shale gas production has not been researched thus far. The lack of an application to the case of shale gas prospects may be explained by the scarce availability of commercially recoverable shale gas estimates and production cost data. We use an existing multi-complimentarity problem (MCP)-based model of the European gas market that features endogenous investment decision-making, distinguishes between different demand periods within a year, has a timeframe until 2050 and is able to reflect different degrees of upstream market power.[1] The model endogenously determines required investment in new gas infrastructure over time using a net present value based rule. However, assumptions need to be made regarding investment in new gas production capacity over time. The model simulates market operations given available gas resources and gas demand nodes across Europe and provides optimal market outcomes in terms of matching supply and demand. In doing so it takes into account the fact that the natural gas market is not a fully competitive market: it allows gas suppliers room for exercising market power. This leads to gas prices across Europe lying above the level of total costs of delivery. In order to simulate future gas market developments various assumptions need to be made.

First of all, an existing scenario framework that is developed in the European research project SUSPLAN[2] provides a suitable context for assessing shale gas developments (Auer et al. 2009). This project assessed the energy infrastructure implications of different energy transition paths to 2050. The most relevant aspect of this framework for the analysis on shale gas is the range in gas demand projections derived from the scenarios. We particularly use the high gas demand scenario that shows a continuing increase in gas demand in Europe until 2050, and the low gas demand scenario where gas demand peaks around 2030 and steeply declines until 2050[3]. With climate policy being one of the key drivers for the future role of gas in the energy mix it is important to mention here that long-term sustainability targets are not met in this particular high gas demand scenario, but are met in the low gas demand scenario. As will become clear, the impact of shale gas penetration in the markets is different for both scenarios. Figure 1 presents the two gas demand trajectories until 2050 used

* Jeroen de Joode, Arjan Plomp and Özge Özdemir are with the Policy Studies Unit, Energy Research Centre of the Netherlands (ECN), the Netherlands. de Joodea may be reached at dejoode@ecn.nl, +31-224-568250.
See foonotes at end of text.

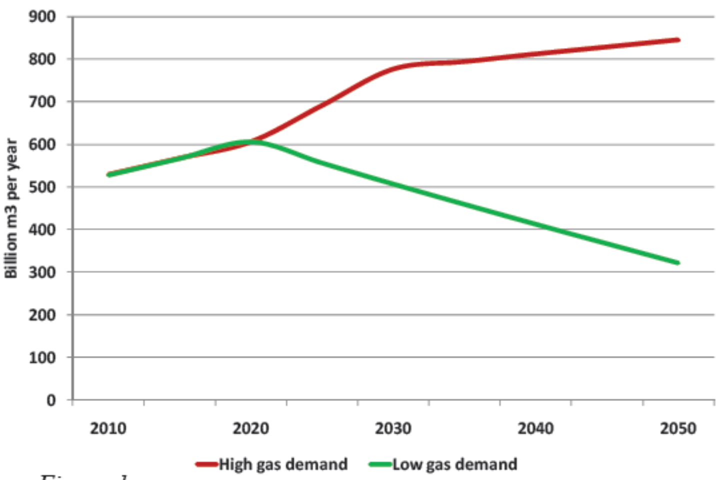


Figure 1
Scenarios for EU gas demand until 2050 (Source: SUSPLAN, De Joode et al. (2011))

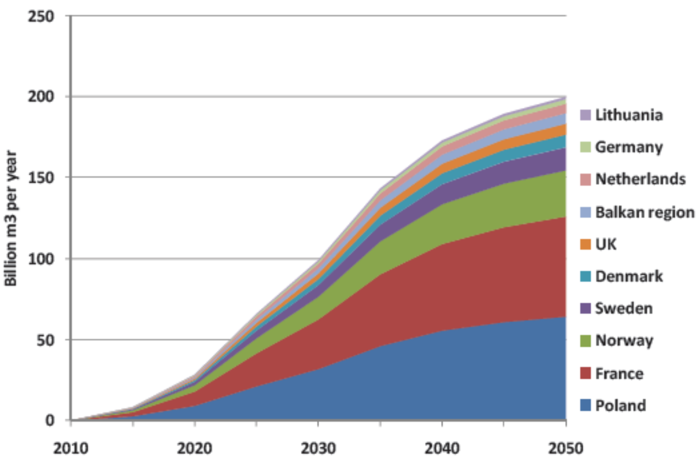


Figure 2
Installed shale gas production capacity across EU (Source: own calculations based on EIA (2011) and Geny (2010))

in this analysis. We refer to De Joode et al. (2011) for a full description of scenario assumptions and data input.

Second of all, we need to make assumptions on the availability of shale gas deposits, the rate of investment in shale gas production assets, and the cost of producing shale gas across Europe. Firstly, we use EIA estimates (EIA 2011) for technically recoverable shale gas resources to identify the potential shale gas producing countries in Europe. Secondly, we use *high but not totally unrealistic production levels* for shale gas in 2010 and 2030 provided by Gény (2010) to construct a possible trajectory for investments in shale gas production capacity for Europe in total for the time period until 2050. Total realized capacity is allocated to the countries with shale gas potential as estimated by EIA (2011) on a pro-rata base. Figure 2 illustrates the shale gas production capacity that is assumed to come on stream over time, which is exogenously fed into the simulation model. Thirdly, we assume that the cost of producing shale gas is in the range of 7-12 €-cent per m^3 (IEA 2010), with the higher end of the range applicable to shale gas produced at maximum production capacity. These cost assumptions are uniform across all countries and are about 3 to 4 times higher than the cost of conventional gas production.

In this analysis we focus on the *substitution-effect* of shale gas developments, and not on the *demand-side-effect*. In other words, while keeping gas demand at the level of, respectively, the high and low gas demand scenarios we analyse shifts on the supply-side. Theoretically, the increased availability of (shale) gas resources could give rise to lower (local) gas prices and an increase in demand, but this effect is not assessed in this article.

Results

Decrease of EU Import Dependency

The impact of the increasing shale gas production capacity can be derived from comparing simulation results for the high and low gas demand storylines with and without the assumed trajectory of investment in shale gas production assets. As may be expected this leads to an increase in indigenous shale gas supplies that replaces gas supply previously contracted outside the EU. Regardless of the gas demand scenario the level of import dependency of the EU as a whole is reduced both in absolute import volumes and percentage wise. This result is illustrated by Figure 3. This observation can be explained by a substitution of the most expensive external gas supplies (reflecting production as well as transportation costs) for local unconventional gas supplies: this varies across EU member states as becomes clear below. However, with the assumed realization of shale gas production capacity the EU will still be largely dependent on external gas suppliers in the future.

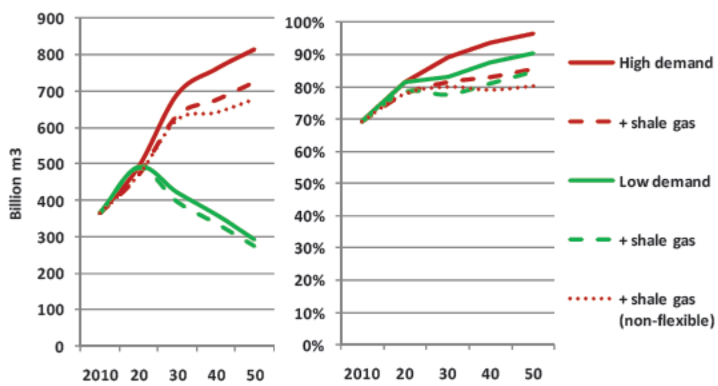


Figure 3
EU import dependency in absolute and relative terms across scenarios (Source: own calculations)

The supply countries that experience a decline in gas exports in particular are LNG producing countries such as Nigeria, Qatar and Egypt, and, to much lesser extent, Algeria and Russia. In the low gas demand scenario there is considerable less substitution of imported gas with indigenous shale gas as the much lower gas demand gives rise to relatively lower prices, which already pushed the high supply cost options out of the supply curve in the situation without shale gas.

Significant Changes in Gas Flow Patterns in Some Parts of the EU

Since a large part of the European shale gas prospects are located in countries with previously little or no gas production the increasing penetration of shale gas across the EU significantly affects EU internal gas flows as well. Figure 4 illustrates the impact of shale gas production in a high gas demand scenario in 2050 by depicting the incremental changes in net yearly gas flows compared with the situation with no shale gas production at all. Note that the incremental changes in gas flows may vary across seasons. Below we sketch some of the implications for infrastructure investment. Whereas increased production from the relatively more limited shale gas deposits in the UK, the Netherlands and Norway basically (partly) compensate for the declining conventional gas production, the large presence of shale gas in Poland and France gives rise to changing gas flow patterns in those regions. Whereas French shale gas is partly exported to Italy, Belgium and the Netherlands, Polish shale gas is exported to other central and eastern European countries that previously relied mostly on Russian gas imports. In order to accommodate these gas flows new gas pipeline investments are required for French interconnections with Italy and Germany, and Polish interconnections with Central Europe and the Baltic states. In the low gas demand scenario the little gas produced from shale gas deposits hardly affects infrastructure investment requirements since shale gas is predominantly consumed within the borders of the producing country.

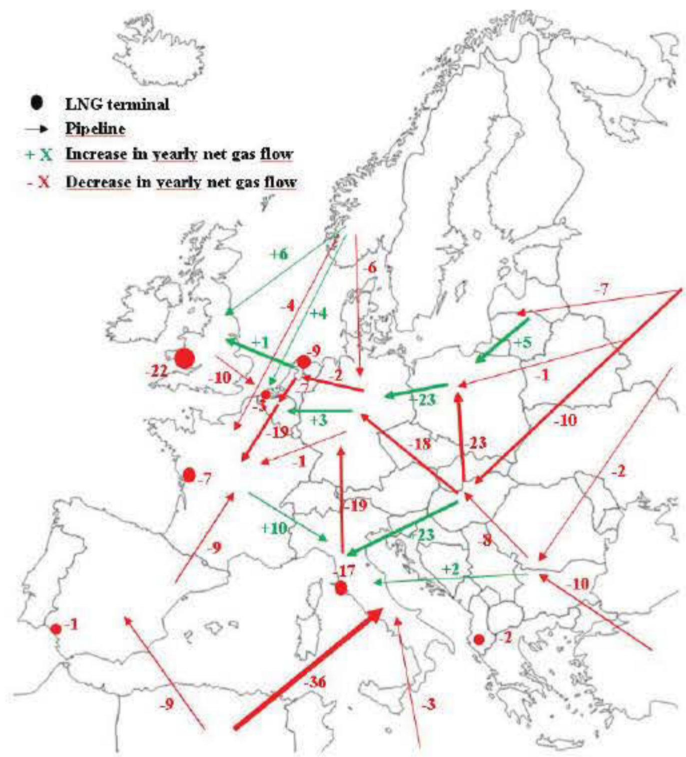


Figure 4
Incremental changes in yearly net gas flows in 2050 due to shale gas production in a high gas demand scenario (in billion m3 per year) (Source: own calculations)

Higher Level of Gas Supply Diversification and Smaller Import Dependency at Member State Level

The presence of shale gas resources across Europe leads to new dynamics in European gas trade with new gas producers not solely producing for domestic consumers but also for neighboring countries: gas producing countries may at the same time import and export gas, just as is the practice on the current gas market. The newly added shale gas production capacity significantly impacts the import dependency of countries – as measured by the gap between national gas demand and production – varies largely across countries (see Figure 5). Shale gas production in Germany reduces German import dependence somewhat, while UK shale gas production is by no means capable of compensating for declining conventional UK gas production.

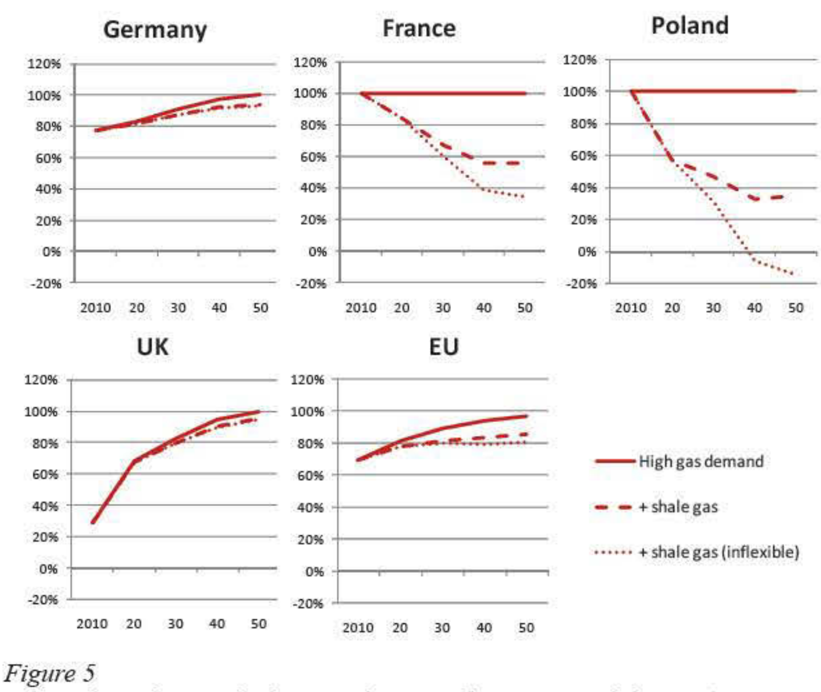


Figure 5
Import dependency of selection of EU member states and the EU (Source: own calculations)

However, shale gas production in Poland and France proves a *game changer*: Poland could become self-sufficient in the second half of the period until 2050 in a high gas demand scenario and France reduces its import dependency by more than 40%. In a low gas demand future the impact becomes negligible since the little gas demand that still needs to be served is accommodated by relatively cheaper conventional gas supplies from Norway or Russia. The general message that may be taken from these results is that the figures for the EU as a whole cannot tell the whole story for individual EU member states.

Assumptions on Shale Gas Production Flexibility Matter for Simulated Market Outcomes

Although the above results show a significant impact of shale gas developments on the gas demand/supply balance in the EU we find that the total amount of shale gas produced over the years is less than what actually could be produced based on the assumed development of shale gas production assets over the same period. When simulating the impact of shale gas it turns out that in the low demand periods it is cheaper to import gas from outside Europe than to use available shale production capacity. This is explained by the higher level of production costs for shale gas, which is not sufficiently compensated by the relatively higher costs for transportation incurred when importing gas from outside the EU (i.e., no substitution of imported gas with shale gas in summer). This obviously poses the question whether the investment in shale gas production capacity as assumed is realistic. Generally, gas production fields need to produce at a relatively constant rate throughout the year and are not capable of providing high levels of seasonal flexibility – some exceptions exist, of course. Although the model is not capable of simulating endogenous investment in production assets we instead assessed the impact of the assumed shale gas production investments on the market while imposing a limit on the production flexibility of shale gas production throughout the year. Assuming an 80% minimum production level – which may still be considered quite flexible compared with conventional gas fields – we find the level of shale gas production to significantly increase. This basically strengthens the substitution effects and consequences for gas supply diversification and import dependency at the member state level as described above. The dotted lines in Figures 3 and 5 show how this imposed limitation affects results.

Concluding Remarks

Although the overall impact of possible shale gas developments on EU security of gas supply in terms of import dependency is intuitive, the performed modelling analysis shows that due to the particular distribution of technically recoverable shale gas resources across EU member states, the impact on the individual member state can vary largely.

The fact that a considerable share of shale gas resources is located in countries that previously had little or no gas production may have large implications for gas flow patterns across Europe, especially in France and neighbouring countries and Poland and Central/Eastern Europe. This has consequences for future gas infrastructure investment requirements on specific cross-border interconnections that would not generally attract attention in scenarios where shale gas resources are excluded.

Results on the market impact of shale gas developments are to a large extent dependent on the overall level of gas demand and the gas demand trajectory towards 2050. Whereas a high demand trajectory allows for a significant penetration of shale gas in the market, a low gas demand trajectory gives rise to an unfavourable position for shale gas due to the relatively stronger competition from *cheap* supplies.

This points to an aspect that is to be researched further: the *demand-effect* of the large-scale availability of shale gas deposits. The availability of large volumes of shale gas may itself trigger more demand for gas and thus make a higher gas demand scenario more likely in the future (i.e., the *demand effect* of shale gas). However, no conclusions can be drawn here since the analysis focussed on the *substitution effect* of shale gas.[4]

Finally we would like to stress that this analysis is based on very scarce information on shale gas resource availability and EU shale gas production cost estimates. Planned test drillings, predominantly in Poland, in the next years will need to provide more and better information that can then be used to analyse larger gas market implications. Furthermore, although we ignored non-economic issues such as environmental pollution, safety risks, sustainability features of shale gas and public acceptance at large we do acknowledge that these are crucial for the possibility of shale gas developments in Europe in the future. We refer to Gény (2010) for a comparison of a number of these issues for the case of the U.S. and Europe. However, it is likely that even with all relevant information concerning the key aspects of shale gas activities on the table, future political choices across EU member states will still differ due to different prioritisation of public policy goals.

Acknowledgement

The research underlying this article is supported by the Energy Delta Gas Research Program (EDGaR). In addition we have benefited from work performed under the project SUSPLAN (EC 7th Framework Programme, grant agreement no 218960.

Footnotes

[1] A more elaborate description of the model is provided in de Joode and Özdemir (2010) and de Joode et al. (2011).

[2] We refer to www.susplan.eu for further information. The project is financed by the European Commission (EC) under the 7th Framework Programme, grant agreement no 218960.

[3] The SUSPLAN scenario framework consists of four different 'storylines' that are labelled by different colours. In this shale gas analysis we have used the 'Red' storyline (high gas demand scenario) and the 'Green' (low gas demand scenario) respectively.

[4] This has been analysed in a report from Resources for the Future (Brown et al. 2010) for the US case. They find that especially climate policy plays an important role when analysing the impact of shale gas on investment choices in the energy mix.

References

Auer, H, K. Zach, G. Totschnig, and L. Weissensteiner (2009) Storyline Guidebook: Definition of a Consistent Storyline Framework, SUSPLAN Guidebook Deliverable D2.1.

Brown, S., S. Gabriel, and R. Egging (2010) Abundant Shale Gas Resources: Some Implications for Energy Policy, Resources for the Future, April 2010.

De Joode and Özdemir (2010) Demand for Seasonal Gas Storage in Northwest Europe until 2030: Simulation Results with a Dynamic Model, Energy Policy, Vol. 38, Issue 10, pp. 5817-5829, October 2010.

De Joode, J., Ö. Özdemir, K.Veum, A. Van der Welle, G. Migliavacca, A. Zani, and A. L'Abbate (2011) Trans-national Infrastructure Developments on the Electricity and Gas market, SUSPLAN Deliverable D3.1.

EIA (2011) World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States, US Energy Information Agency (EIA), April 2011.

Gény (2010) Can Unconventional Gas be a Game Changer in European Gas Markets?, Oxford Institute for Energy Studies, NG 46, December 2010

IEA (2010) Medium-Term Oil and Gas Markets 2010, International Energy Agency (IEA).

Welcome New Members

The following individuals joined IAEE from 10/1/11 to 12/31/11

Naeem Adibi
CPE
FRANCE

Om Agrawal
CANADA

Wail Al Jaafari
Saudi Aramco Oil Co
SAUDI ARABIA

Mahdi Aladel
Saudi Aramco
SAUDI ARABIA

Thamer Alenezi
Saudi Aramco Oil Company
SAUDI ARABIA

Marwan Al-Faleh
Saudi Aramco
SAUDI ARABIA

Faisal Alhajji
Saudi Aramco
SAUDI ARABIA

Nader Al-Juhani
Saudi Aramco
SAUDI ARABIA

Ammar Alnahwi
Saudi Aramco
SAUDI ARABIA

Tareq Alnuaim
Saudi Aramco
SAUDI ARABIA

Aqeel Alonazi
Ma'aden Co
SAUDI ARABIA

Waleed Alrumaih
King Abdullah Petroleum Studies
SAUDI ARABIA

Tayyip Altay
ITU
TURKEY

Nourah Al Twairqi
SAUDI ARABIA

Hanns Anders
Pacific Gas and Electric
USA

Mark Andor
GERMANY

Federico Aresu
University Bocconi, Milan
ITALY

Toshihide Arimura
Sophia University
JAPAN

John Asafu-Adjaye
University of Queensland
AUSTRALIA

Nader Ashoor
SAUDI ARABIA

David Audi
Troposphere Capital LLC
USA

Jerome Audrain
Universite d Orleans Laboratoire
FRANCE

Mustafa Ayoin
TURKEY

Sefik Bagdadioglu
FortisBC Energy
CANADA

Fernanda Bagnaresi
ITALY

James Bambino
New York University
USA

Patricia Baran
ANP
BRAZIL

Markus Bareit
CEPE ETH Zurich
SWITZERLAND

Manuel Baritaud
IEA
FRANCE

Joey Barr
USA

Parisa Bastani
University of Cambridge and MIT
UNITED KINGDOM

Heloisa Borges Bastos Esteves
ANP
BRAZIL

Olivier Beaufils
FRANCE

Raphael Berger
AREVA
FRANCE

Jochen Blessing
GERMANY

Laurent Blondeau
Areva
FRANCE

Kai-Gerhard Bosch
Deutsche Bank AG
GERMANY

Emmanuel Branche
EDF
FRANCE

E Russell Braziel
RBN Energy LLC
USA

Pamela Broadley
BP
UNITED KINGDOM

Martin Buedenbender
GERMANY

Muzaffer Nafiz Burdurlu
TURKEY

Juerg Buri Schwerzerische
Energie Stiftung
SWITZERLAND

Shenghua Cai
Institute of Policy and Management
CHINA

Edward Cape
The Sapphire Group LLC
USA

Ben Caplan
Boardwalk Pipeline Partners
USA

Michaela Carstei
Atlantic Council
USA

Henri Chambon
EDF
FRANCE

Ali Chehrehsaz
Terra Verde Renewable Partners
USA

Yuanyuan Chen
NORWAY

Pierre Jean Cherret
Supelec
FRANCE

Amandine Chevalier
IFPEN
FRANCE

Wen Hao Chua
Energy Studies Institute
SINGAPORE

Myles Collins
Southern California Edison
USA

Jesús Cuadros
Osinergmin
PERU

Thierry De Bresson
Tio Tinto Alcan
FRANCE

Laeticia De Maack
IFP
FRANCE

Dario Gianluigi De Maio
IMT Lucca Inst for Advanced Studie
ITALY

Anusha de Silva
USA

Niccolo De Simone
Tirreno Power
ITALY

Philipp Dees
Institut für Wirtschaftswissenschaf
GERMANY

William Demarest
Husch Blackwell LLP
USA

Christian Deperthuis
CGEMP
FRANCE

Michel Derdevet
RTE
FRANCE

Birgit Dieckmann
Swissgrid AG
SWITZERLAND

Desislava Dimkova
GERMANY

Yazid Dissou
University of Ottawa
CANADA

Marin Draga Claudia
CGEMP
FRANCE

Loic Drugeault
AREVA
FRANCE

Ryan Duman
USA

Thibaud Duplantier
FRANCE

Claire Durkin
URS Corporation
UNITED KINGDOM

Niels Ehlers
GERMANY

Wolfgang Elsenbast
Bundesmat fur Energie
SWITZERLAND

Murathan Erol
Mogaz Petrol Gas lari AE
TURKEY

Benoit Esnault
CRE
FRANCE

Riemer Faber
CPB
NETHERLANDS

Valerie Faudon
AREVA
FRANCE

Jean Francois Faugeras
EDF
FRANCE

Jeremy Foster
Imperial College London
UNITED KINGDOM

Charlotte Fourcroy
FRANCE

Jennifer Fox
ClimateWorks
USA

David John
Frenkil Van Ness Feldman
USA

Nele Friedrichsen
GERMANY

Jeremy Gallet
EDF
FRANCE

Francesco Ganda
Idaho National Laboratory
USA

Olivier Gantois
UFIP
FRANCE

Cecile George
CRE
FRANCE

Frederic Gonand
CRE
FRANCE

Thomas Grand
AREVA
FRANCE

Katharina Grave
GERMANY

Garen Grigoryan
Pacific Gas and Electric
USA

Stephane Gronier
Credit Agricole
FRANCE

Volkswirt Gross
Max Planck Institute of Economics
GERMANY

Michael Grossmann
AREVA
FRANCE

Morwenna Guichoux
CGEMP
FRANCE

Hermann Guss
GERMANY

Djoni Hartono
University of Indonesia
INDONESIA

Satoru Hashimoto
Hitotsubashi University
JAPAN

Christopher Haubrich
Cameco Corporation
CANADA

Tim Hildebrandt
GERMANY

Heiti Hoffschmidt
Kiewit Energy Company
USA

Noriko Ito
CGEMP
FRANCE

Andreas H Jahn
Energy Economist
GERMANY

Cleveland Jones
Univ of the State of Rio de Janeiro
BRAZIL

Laurent Joudon
EDF
FRANCE

Philippe Kavafyan
AREVA
FRANCE

Fazil Kayikci
Yildiz Technical University
TURKEY

Ashleigh Keene
Energy Center of Wisconsin
USA

Dogan Keles
Inst for Industrial Production
GERMANY

Jan Horst Keppler
CGEMP
FRANCE

Sylvie Koziel
INDICTA
FRANCE

Nadia Kpondjo
FRANCE

Lado Kurdgelashvili
Center for Energy and Env Policy
USA

Hamsatu Kwajaffa
Energy Commission of Nigeria
NIGERIA

Joachim Lang
GERMANY

Cesar Lanza Suarez
Tecnova IS
SPAIN

Lucile Le Pautremat
Université Paris Dauphine
FRANCE

Stephen Lecourt
FRANCE

Oskar Lecuyer
CIRED
FRANCE

Sebastien Leger
McKinsey
FRANCE

Jin Liu
BREE
AUSTRALIA

Robert Liubov
FRANCE

Kathleen Loa
USA

Stefano Lucchini
ENI SpA
ITALY

Jean Francois Macary
AREVA
FRANCE

Cecile Maisonneuve
AREVA
FRANCE

Mindy Mallory
University of Illinois
USA

Matteo Manera
Fondazione Eni Enrico Mattei
ITALY

Trina Martynowicz
US EPA
USA

Fabio Menten
IFP
FRANCE

Roland Meyer
Jacobs University Bremen
GERMANY

Stephane Monpon
CGEMP
FRANCE

Frederick Morris
KPMG LLP
USA

Carlos Murillo
Canadian Energy Research Institute
CANADA

Vick Natrajan
Chevron
USA

Sebastián Navarro Rodriguez
University of Oklahoma
USA

Francois Nguyen
National Energy Board
CANADA

Steven Nguyen
Navigant Consulting Inc
USA

Vigen Nikogosian
GERMANY

Frederic Novel-Cattin
FRANCE

Kingsley Obinna Omeihe
UNITED KINGDOM

Ravshonbek Otojanov
London Metropolitan University
UNITED KINGDOM

Esedghene Owede
University of Surrey
UNITED KINGDOM

Craig Parsons
JAPAN

Paula Carvalho
Pereda University of Sao Paulo
BRAZIL

Casey Petroff
USA

Olivier Philippe
ESCP Master
FRANCE

Elliot Pickering
HC
USA

Benjamin Piven
USA

Marie-Anne Plagnet
EDF
FRANCE

Micaela Ponce
GERMANY
Henri Prevot
FRANCE

Ruth Protpakorn
USA

Jean Puga
FRANCE

Bernardo Rangoni
ITALY

Milos Ribic
Expansion Capital Partners
USA

Liubov Robert
FRANCE

Alexandra Roberts
Greenwich School of Management
UNITED KINGDOM

Jaime Rodriguez
NGP Energy Capital Management
USA

Tim Ronkartz
GERMANY

Raphael Rosen
Carbon Lighthouse
USA

Heinz Ruetter
Ruetter and Partner
SWITZERLAND

Chirag Sabunani
Wood Mackenzie
USA

Anshuman Sahoo
Stanford University
USA

Saghar Saidi Boroujeni
CGEMP
FRANCE

Joanne Salazar
Phoenix Park Gas Processors Ltd
TRINIDAD & TOBAGO

Sascha Samadi
GERMANY

Gervasio Santos
Federal University of Bahia
BRAZIL

Phillip Scheib
GERMANY

Sascha Scherer
GERMANY

Burkhard Schnorrenberg
GERMANY

Dagmar Schoke
Centralschwerz kraftwake AG
SWITZERLAND

Kenza Sekkat
CGEMP
FRANCE

Hossain Seraj
Ryerson University
CANADA

Thibault Servan
AREVA
FRANCE

Thomas Sexton
US Air Force
USA

Daniele Sogni
Progepiter
ITALY

Boris Solier
CGEMP
FRANCE

Valerie Speth
GERMANY

Priya Sreedharan
E3
USA

Paul Straub
Claremont Creek Ventures
USA

Boris Supiot
Areva
FRANCE

Gabor Takacs
Eckberg Consulting Ltd
HUNGARY

Ryuta Takashima
Chiba Institute of Technology
JAPAN

Pham Thao
CGEMP
FRANCE

Karlsson Therése
Swedish Energy Agency
SWEDEN

Christopher Tholstrup
CT Consulting LLC
USA

Jameson Thornton
Pacific Gas and Electric Company
USA

Damir Tokic
ESC Rennes
FRANCE

Brandon Tracy
USA

Raphael Trotignon
CGEMP
FRANCE

Nicholas Varilone
Gustavson Associates
USA

Phillip Vogel
GERMANY

Stefan von Gruenigen
econcept AG
SWITZERLAND

Dimitrios Vortelinos
University of Lincoln
UNITED KINGDOM

Zanna Vovk
GERMANY

Xin Wang
Univ des Sciences et Tech Cite Scie
FRANCE

Akihiro Watabe
Kanagawa University
JAPAN

Florian Weber
Technische Universität München
GERMANY

Gabriel Wolf
USA

Siang Leng Wong
SINGAPORE

Ali Yassine
American University of Beirut
LEBANON

Hongtao Yi
Florida State University
USA

Lubna Younis
Saudi Aramco
SAUDI ARABIA

Goneng Yucel
TU Delft
NETHERLANDS

Blaise Zandoli
USA

How Would the Development of Shale Gas Resources in Ukraine Impact Europe's (energy) Security?

By Gordon LIttle*

Ukraine should set the targetubling its production of oil and gas within a decade and become self-sufficient in energy. – Anders Aslund & Oleksander Paskhaver

Natural gas is increasingly appearing crucial to a future where growing energy demand is to be tempered with reductions in carbon emissions. The 2010 World Economic Outlook forecasts global primary energy demand to increase 36% by 2035, or between 1.2% to 1.4% per annum. While fossil fuels are expected to supply more than one half of this growing demand, natural gas is the only fossil fuel expected to be consumed in greater quantities than today.[1]

Ensuring uninterrupted natural gas supplies is thus going to be a pivotal part of energy security arrangements. Although there is currently a glut of natural gas globally, it is expensive and volatile to transport. Accessing this commodity domestically is preferable to importing it long distances or even relying on neighboring gas-exporting nations, which can cut their exports at any time. In 2006 and 2009, the European Union (EU) – the world's largest net gas importer – learned this bitter lesson. Gas exports via pipeline from Russia via Ukraine were reduced, then cut, depriving the continent of 20% of its gas supply for a fortnight during winter.[2] A state of emergency was declared. Energy security reemerged as a priority issue for Europe's future. This paper examines future European energy security arrangements from the perspective of new gas sources, focusing particularly on shale gas production in Ukraine.

Unconventional Gas Sources are Already Playing an Important Role in Geopolitics

The world's natural gas reserves stand at around 6,621.2 trillion cubic feet (tcf), with about two-thirds in the Middle East and Russia. With technology improvements in exploration and production, producible gas reserves have grown by as much as 50% since 1989. Conventional gas represents the majority, but unconventional sources play a large part. In fact, unconventional sources are forecast to meet a third of global gas production by 2035. Shale gas is one of these unconventional sources.

Shale gas is natural gas from shale rock formations. While it is more difficult to tap and produce than conventional gas, it can add significantly to a country's own gas reserves, improving its energy security outlook. How much will shale change the picture of global gas reserves? It is hard to tell, but many think it could be revolutionary. According to Amy Myers Jaffe, "shale gas will revolutionize the industry—and change the world—in the coming decades. It will prevent the rise of any new cartels. It will alter geopolitics".[3] Likewise, for Kenneth B. Medlock, shale "dramatically changes the dynamics at the negotiating table and geopolitically."[4]

The United States affords an example of the effect of shale gas on geopolitics. Since the commercial production of domestic shale gas mid-decade, the United States' reserves have increased up to 35%. Shale gas contributes at least one tenth of the country's dry gas production. Big international energy companies have already invested billions of dollars in shale production. Now, with shale gas production depressing U.S. gas prices (down 14% in 2010), budgets are down for countries that rely on gas exports, such as Russia.[5] This means Russia loses some leverage on the geopolitical chessboard, increasing the relative influence of the United States. Meanwhile, cheaper American gas can help decrease the role of coal in electricity production, or oil in transportation, in preference to natural gas. If this could displace some oil imports, it would help reduce the trade deficit.[6]

In Europe, shale gas could have equivalent, or more important effects. The EU has already been diversifying its energy supply in order to avoid repeating the gas crises of 2006 and 2009. Its main avenues to supply diversification are increased energy efficiency, renewables investment and new gas and oil pipelines. Shale exploration could become another. The EU is the only place in the world with an emissions trading scheme, pricing carbon in order to make lower emitting sources more competitive. Investment in renewable sources has been prolific, though driven as much by carbon sensitivity as energy security. The EU has set a target of 20% of energy from renewable sources by 2020, including a 10% share specifically in the transport sector.

The EU has also pursued oil and gas pipeline diversification, such as the 3,300km Nabucco Pipeline which would bring up to 31bcm of gas from the Cas-

* Gordon Little is a graduate student at New York University. He may be reached at gordontlittle@gmail.com
See footnotes at end of text. Contact author for bibliography.

pian region to Europe without transiting Russia. Pipelines, however, are slow and expensive to construct. Nabucco negotiations since 2002 have proceeded at a glacial pace, and there is competition from alternative pipeline projects such as the Russian-backed South Stream Pipeline. Construction of South Stream is slated to start in 2013, with a total estimated capacity of 63cbm, considerably higher than Nabucco.[7] However, neither pipeline project is guaranteed. This makes the advent of shale gas a welcome opportunity for the EU as another pillar in improving energy security, and several EU countries have already provided prospecting and exploration licenses for shale gas to major oil and gas companies.[8]

Shale gas in Europe is, however, no panacea.[9]

First, shale gas production exists so far only in the United States. European geology is less favorable to shale exploration, there are few tax breaks and the service industry for onshore drilling lags behind that in the United States.[10] Second, there is considerable environmental skepticism regarding shale gas drilling. Scientific research into the hydraulic fracturing ("fracking") procedure, integral to accessing the gas, has so far been unable to categorically disprove concerns that it pollutes underground aquifers.[11] Given the prevailing environmental sensitivities in Europe, there would likely be considerable debate before signing production agreements that could have potentially disastrous environmental effects. Third, shale gas deposits are spread over wider areas, requiring a greater number of wells to be drilled if gas is to be accessed. This presents problems to countries that have high population density (at least more than the United States) such as France or Germany. Fourth, it is unclear how long shale gas fields actually remain viable. As shale gas wells have only been in operation in the United States for three to four years, it is not possible to forecast long-term output, hence clouding investment decisions.

Shale Gas in Ukraine: New Perspectives on European (energy) Security?

There is much speculation (and possibly just hype) into whether there could be a shale revolution in Europe, but one underexplored area is the possible impact of a Ukrainian shale gas industry on European geopolitics. Ukraine is important to Europe because it is the transit country for 80% of Russia-EU gas exports, supplying one-quarter of EU gas demand. Ukraine is also the easternmost border of the EU, comprising a population of forty-six million people who, generally speaking, hope to see themselves as part of the Union someday.

But Ukraine is also a Former Soviet Union country with persistent ties, both economic and psychological, to Russia. Russia has been able to exert continued control over Ukrainian politics in part due to Ukraine's gas dependence (60% of its own gas demand is met by Russia). Russia sees Ukraine as vital because it contributes much of its own geopolitical power. Thus, for Russia, sway over Ukraine's economy and politics, or at least sidelining Euro-Atlantic influence there, is crucial.

Ukraine's 2010 election that brought President Victor Yanukovich to power definitively ended the country's half-decade experiment in overtly pro-Western leadership. It is still impossible to predict whether a pro-Russian outlook will overcome Ukrainian politics, or whether in twenty years Ukraine will be considered more a part of Europe than today. But given Ukraine's expansive energy pipeline network and its geography bordering Europe and Russia, energy developments in that country will ripple through the continent.

Estimated Shale Gas Reserves in Ukraine are Substantial

Ukraine presently has 34.7tcf of conventional proven gas reserves.[12] At 2009 production rates, that would give Ukraine about 50 years of natural gas supply. If the current production rate doubles over time, as planned by the Ukrainian government, Ukraine will still import a significant amount of gas (though down from 60% today) while further depleting its reserves.[13] Improved energy intensity of local industry would slow this (Ukraine's energy intensity is 2.5 times that of Europe), but reserve growth will still be important in the longer term.[14] This is where shale reserves can play an important role.

Exploration of shale in the Ukraine is yet to be undertaken, so finding accurate reserve estimations is difficult. The following estimations by Stig-Arne Kristoffersen provide an idea of Ukraine's shale potential. Natural gas reserves are predominantly found in Ukraine's eastern Donbas region (Figure 1), where there is a $22,500km^2$ potential source rock area.[15] In comparison, the Barnett Shale in Texas, believed to contain America's largest shale producible reserves, is $13,000km^2$.[16]

Not all of the sub-basins in the Dnieper-Donets are optimal for shale production, but Kristoffersen estimates gas in place is between 12.5 to 1,813.5tcf. At a recovery factor of 20% (based on U.S. shale production), recoverable gas resource potential is 2.5 to 363tcf.[17] This, of course, is

Figure 1
Dnieper-Donets Basin

an extraordinary range, the higher end being more than ten times Ukraine's current proven conventional gas reserves.

Kristoffersen has also estimated that 31,027 wells would be required for the nine most promising sub-basins, the majority (75%) horizontal. His cost estimates for wells for Ukraine, based on American shale production, are between US$3.2 million to $465 billion. In terms of gas revenue, using Ukraine's gas purchasing rate from Russia (US$4.46/MBTU mid-2010) as a benchmark, the market value of Ukraine's shale would be considerably higher: between US$10.3 billion and $1.5 trillion. Again, the size of Kristoffersen's range makes it hard to estimate reliably. However, taking into account Ukraine's current gas purchases from Russia (US$8.5 billion in 2010), producing only 1-5% of Ukraine's shale potential would "create an added value for Ukraine in the range of US$500 million to $750 million per year in freed capital".[18]

It is not possible yet to verify Kristoffersen's estimates. However, significant interest by major oil and gas companies in Ukraine's shale potential indicates widespread anticipation of substantial shale resources. Moreover, TNK-BP and Shell have already made inroads there.

Geopolitical Implications of Ukrainian Shale Gas

The geopolitical implications of Ukrainian shale gas production would spread across Ukraine, Russia and the EU. According to Kristoffersen, shale gas production could annually free up US$500 to $750 million in Ukraine from reduced Russian gas imports. But it would not take shale gas production to free Ukraine from Russian natural gas import dependence. If Ukraine were to halve its energy consumption relative to GDP, as Poland and Slovakia have, Ukraine would not need to import any natural gas.[19] This in itself would be a major coup for Ukraine, as its reliance on continued Russian supply opens it to political manipulation.

Instead, the primary shale gas value would derive from it being an export commodity to Europe. By the time shale is producible in significant quantities (let's say 2025), today's contracts between European buyers and Gazprom would be on the point of expiry. Then on, increased export revenue could flow into Ukraine's national budget. A stronger national budget, all things equal, could improve social spending, reduce deficit financing or boost savings or investment in the best scenarios. As an export industry is built, the country could attract billions of dollars of inward investment, boosting job creation and tax revenues. A happy corollary would be to reduce Russia's prolific influence in the Ukrainian energy sector.

Shale gas resources - if exploration proves them viable - will attract investment from the major oil companies. As U.S. companies predominantly have the expertise in shale development, their involvement would be necessary for Ukrainian production. This might break open the monopolistic arrangement presently stifling Ukraine's energy sector. Indeed, ExxonMobil and ConocoPhillips are already prospecting in Poland and Germany, and Shell has expressed interest. These companies operate under more transparent business practices than Ukrainian state-owned enterprises, and would be less likely to be directly complicit in overt corruption. Moreover, these oil companies would insist on stable taxation arrangements, the broad establishment of which would attract smaller foreign energy companies' interest in Ukraine, resulting in added direct investment. In the United States, a number of smaller companies are already playing significant roles in shale production, breaking open a sector previously dominated by the majors. Why couldn't this be the story elsewhere?

With Russian influence in Ukraine curtailed by Ukraine's gas independence, Russia's energy leverage over the EU would be weakened. Increased European investment and trade with Ukraine, not only in gas, would build ties between the EU and Ukraine while loosening them with Russia. As Ukraine gained in strategic and economic importance to the EU, European policy would have to become focused on anchoring Ukraine away from Russia. This could be achieved in the medium term by acceleration into the Schengen-zone, concluding the prospective free trade agreement, or even breakthroughs on the EU's Eastern Partnership agenda.[20]

How much this is achievable though is questionable. Russia will likely remain a significant global power thanks to ample revenues flowing from oil and gas contracts to an energy-hungry Asia.[21] It is likely to remain extremely wary of a Ukraine that is edging definitively into Europe. And at any rate, Ukraine will not lose its historic, cultural or linguistic ties to Russia any time soon. Ukraine also has poor demographics (an ageing and unhealthy population) so does not present the same commercial opportunities to the EU as, say, Turkey. The EU, even if unencumbered by Russia's energy politicking, would still share strong commercial ties with Russia. The German-Russian bilateral relationship is also robust and the Russian-German Nord Stream Pipeline gives Russia a new gas route into Europe that bypasses Ukraine while allowing Germany to sell the gas onward to Eastern Europe. But if Ukrainian shale gas becomes a critical non-Russian pillar of European energy diversification, a deepening of the EU-Ukraine relationship is to be expected.

A further avenue to be explored is whether a new domestic resources industry would divert Ukraine down the path of the feared 'resource curse.' This is a concept exposing how poor economic performance, unbalanced growth, impoverished populations, weak states and authoritarian regimes often emerge as negative consequences of mineral or commodity abundance in developing countries.[22] As Paul Collier describes it, "resource-rich countries need good government decisions even more than other societies. But those riches make it more difficult to build the needed institutions."[23] Could a new resource industry direct Ukraine away from economic reforms?

Even before significant shale gas reserves are proven, Ukraine already suffers from inefficient and corrupt national institutions, an ineffective regulatory system, stifling bureaucracy, under-capacity economic growth, low GDP per capita, and a history of authoritarian leadership.[24] Ukraine ranks 146th out of 180 countries in Transparency International's 2009 Corruption Perception Index and 142nd out of 183 countries in the World Bank's Doing Business Index. Ukraine's energy sector in particular is poorly functioning, being a confluence of competing domestic and international public and private interests. There is a distinct lack of transparency and efficient business practice.

Naftogaz, Ukraine's state-owned energy corporation, has been running at a loss for several years and owes several billion dollars in outstanding debt to domestic and international creditors. It is unlikely that the current structure of government proprietorship within the energy industry could effectively manage new resource revenues from domestic shale gas exploration. Thus the potential economic benefits of shale gas could be more harmful than beneficial – the prediction of the resource curse framework.

On the other hand, perhaps it comes down to whether or not Ukraine were to allow international companies to operate in shale gas exploration and production. That in itself could define the country's ability to capably absorb gas revenues. Because foreign expertise at the early stages is crucial to shale gas production, Ukraine would probably be unable to manage the whole process with state-controlled entities. Judging by Ukraine's preliminary agreement with TNK-BP, the country looks likely to allow foreign players to take a role. But whether Ukraine would be able to develop clear tax protocols and reduce opportunity for graft and corruption remains to be seen. "Lousy domestic policy remains the single greatest impediment to gas investments in Ukraine," believes Ed Chow, of the Center for Strategic and International Studies (CSIS).[25] Thus there is much riding on the decisions and negotiations between Ukraine's government and exploration companies.

The Path Less Travelled By…

Ukraine is a long way from shale production, even if preliminary exploration proves viable. Conventional gas production, indeed even offshore production in the Black Sea, offers a more feasible opportunity at this stage than shale gas. But the positives of shale may, as time proceeds, render it desirable for Ukraine and for Europe.

It would be naïve to think that Ukraine's energy industry, or its entire economy, would somehow be able to swiftly reform based on shale gas production. Rather, it seems likely that economic reform would have to precede significant shale gas investment. There are also a plethora of other factors that will be important to the role of shale in Ukraine, such as developments in alternative energy technologies, progress on new pipeline construction, even shale developments within the EU itself.

Nonetheless, considering the future energy needs of Europe and Asia, the potential for Ukrainian shale gas production must be seriously considered by Europe. The EU must prepare for game changers in the energy environment (that stretch beyond pipeline accidents), and nurture those that could be positively transformational such as Ukrainian shale. It can do this by continuing to press for Ukrainian energy industry reform, and by supporting shale gas exploration within Ukraine through financial support to the big oil and gas companies, and lobbying on their behalf. Poland will be an important leader – it already has substantial investment in Ukraine, is exploring shale gas domestically, and would thus stand to benefit from expanding energy investments into Ukraine. If Ukraine does turn out to have sizeable producible shale reserves, the EU will be thankful in the future for improved engagement and planning for it today.

Footnotes

[1] IEA. World Energy Outlook 2010: Executive Summary. France: IEA/OECD, 2010. P5

[2] Kirsten Westphal. Russian Gas, Ukrainian Pipelines, and European Supply Security. Berlin: SWP, 2009. P9

[3] Amy Myers Jaffe. 'Shale Gas Will Rock the World'. Wall St Journal. 10th May 2010.

[4] Kenneth Medlock. Shale Gas: A Game–Changer With Global Implications. Baker Institute. Oct 6th 2009.

http://bakerinstitute.org/publications/EF-WWT-MedlockShaleGas-100609.pdf

[5]Anna Shiryaevskaya. 'Putin's Global Gas Plan Falters as Gazprom Dithers on LNG'. Bloomberg. 4th Aug 2010.

[6] See also: Robert Manning. Shale Gas Could Transform Energy Geopolitics. Atlantic Council. 7th Dec 2009. http://www.acus.org/new_atlanticist/shale-gas-could-transform-energy-geopolitics

[7] Anna Shiryaevskaya & E. Konstantinova. 'Gazprom, Bulgaria Sign Accord on South Stream Pipeline'. Bloomberg. 13th Nov 2010.

[8] UpstreamOnline.com. 'Germany quietly dishes out onshore blocks'. Upstreamonline.com. 3rd Nov 2010. http://www.upstreamonline.com/live/article235416.ece

[9] Details presented here are only a brief overview – for deeper insight see: Paul Stevens. The Shale Gas Revolution: Hype and Reality. London: Chatham House, 2010.

[10] Paul Stevens. The Shale Gas Revolution: Hype and Reality. London: Chatham House, 2010.

[11] For insight into the environmental debate over fracking, see: David Biello. 'What the Frack? Natural Gas from Subterranean Shale Promises U.S. Energy Independence--With Environmental Costs'. Scientific American. 30th Mar 2010.

[12] BP. BP Statistical Review of World Energy 2010. London: BP, 2010. P22. (Conventional reserves exclude shale).

[13] On June 11th 2010, Deputy Prime Minister Andrey Klyuyev announced that the Ukrainian government planned to double domestic gas production over the next 10 years to 40 bcm annually.

[14] Kirsten Westphal. Op Cit. P12

[15] Stig-Arne Kristoffersen. Gas Shale Potential in Ukraine: An Assessment of a Large Opportunity. Kentucky: Lulu.com. 2010. P17

[16] Schlumberger. Taking Shale Gas Knowledge Global. Website. 11th May 2010. http://www.slb.com/news/inside_news/2010/2010_0511_taking_shale_gas_knowledge_global.aspx

[17] Stig-Arne Kristoffersen. Op Cit. P18

[18] Ibid. P22

[19] Anders Aslund & Paskhaver, Oleksander. Proposals for Ukraine 2010 – Time for Reforms. Independent International Experts Commission. 2010. P45

[20] For an overview of the partnership, see: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1858

[21] Recent energy deals between China and Russia in 2010 total over US$8 billion, and Chinese Premier Wen Jiabao in November 2010 called on the two nations to further open their markets to each other.

[22] Pauline Jones Luong & Weinthal, E. Oil is Not a Curse. New York: Cambridge UP, 2010. P1

[23] Paul Collier. The Plundered Planet. New York: Oxford UP, 2010. P59

[24] Jan Neutze & Karatnycky, A. Corruption, Democracy, and Investment in Ukraine. The Atlantic Council of the United States, October 2007. P10

[25] Marone, J. 'Shale gas may help nation reduce its reliance on Russian energy imports'. Kyiv Post. 2nd April 2010.

Publications

Public-Private Partnerships: Case Studies in Infrastructure Development, Sidney M. Levy (2011). 416 pages. Price: US$120.00. Contact: ASCE Book Orders, PO Box 79404, Baltimore, MD 21279-0404 USA. Phone: 1-800-548-2723. Fax: 1-703-295-6300. Email: pubsful@asce.org URL: www.asce.org/pubs

Calendar

27-29 February 2012, Nuclear Energy One Year after Fukushima at Wilton Park, Steyning, UK. Contact: Susan Bruce, Conference Delivery Manager, Wilton Park, Wiston House, Steyning, West Sussex, BN44 3DZ, United Kingdom. Phone: 44 (0) 1903 817789. Fax: 44 (0) 1903 815244 Email: susan.bruce@wiltonpark.org.uk URL: http://www.wiltonpark.org.uk/en/conferences/policy-programmes/climate-change-and-energy/?view=Conference&id=701733082

13-14 March 2012, Energy Storage - International Summit for the Storage of Renewable Energies at Düsseldorf Exhibition Centre's Congress Center CCD. South. Contact: Miriam Hegner, Solarpraxis/Messe Düsseldorf, Düsseldorf, 40476. Phone: +49 (0)30 726 296-304. Fax: +49 (0)30 726 296-309 Email: Miriam.hegner@solarpraxis.de URL: http://www.energy-storage-online.de/

19-23 March 2012, International Gas Value Chain at Groningen. Contact: Joël Darius, Coursemanager, Energy Delta Institute, Laan Corpus den Hoorn 300, Groningen, Groningen, 9728 JT, Netherlands. Phone: 003150 524 8316 Email: darius@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/introduction-programmes/international-gas-value-chain

26-27 March 2012, Asia 2012 - Water Resources and Renewable Energy Development in Asia IV at Chiang Mai, Thailand. Contact: Mrs. Margaret Bourke, Conference Project Manager, Aqua media International Ltd, PO Box 285, Wallington, Surrey, SM6 6AN, United Kingdom. Phone: 44-20-8773-7244. Fax: 44-20-8773-7255 Email: mb@hydropower-dams.com URL: www.hydropower-dams.com

26-29 March 2012, 15th Annual Power & Electricity World - Africa 2012 at Johannesburg, South Africa. Contact: Conference Organizer, Terrapinn. Phone: 27-0-11-463-6001. Fax: 27-0-11-463-6903 Email: enquiry.za@terrapinn.com URL: www.terrapinn.com/powerafrica

15-18 April 2012, 39th International Energy Conference and 33rd International Area Conference at Boulder, CO. Contact: Dorothea H. El Mallakh, Director, ICEED, 850 Willowbrook Road, Boulder, CO, 80302, USA. Phone: 303-442-4014. Fax: 303-442-5042 Email: iceed@colorado.edu URL: www.iceed.org

16-17 April 2012, 4th Annual Maghreb/Middle East Renewable Energy Summit 2012 at Casablanca. Contact: r.raj@magenta-global.com.sg, Marketing Manager, Magenta Global, Singapore. Phone: 65 6391 2530 Email: r.raj@magenta-global.com.sg URL: www.magenta-global.com.sg/MMERenewableEnergy2012

17-20 April 2012, European Energy Conference at Maastricht. Contact: Benita Lipps, European Science Foundation, Brussels, Belgium. Phone: +32 2 533 2020 Email: e2c@esf.org URL: http://www.energy-conference.eu

6-8 May 2012, 20th Annual Middle East Petroleum & Gas Conference at Kingdom of Bahrain. Contact: Conference Organizer, 2012 Secretariat, MPGC. Phone: 65-6338-0064. Fax: 65-6338-4090 Email: mpgc@cconnection.org URL: http://www.cconnection.org/conference/MPGC/2012/MPGC2012Home.html

7-9 May 2012, Energiemarkten at Groningen. Contact: Joël Darius, Coursemanager, Energy Delta Institute, Laan Corpus den Hoorn 300, Groningen, 9728 JT, Netherlands. Phone: 003150 524 8316 Email: darius@energydelta.nl URL: http://www.energydelta.org/mainmenu/executive-education/introduction-programmes/energiemarkten-2

24-27 June 2012, 35th IAEE Intl Conference: Energy Markets Evolution Under Global Carbon Constraints - Assessing Kyoto and Looking Forward at Perth, Australia. Contact: Ron Ripple, AAEE, Australia Email: r.ripple@curtin.edu.au

28-29 August 2012, International Water Resource Economics Consortium at Stockholm, Sweden. Contact: John Joyce, Mgr Water Resource Economist, Stockholm International Water Institute, Sweden. Phone: 46-8-522-139-89 Email: john.joyce@swi.org URL: www.worldwaterweek.org

9-12 September 2012, 12th IAEE European Conference at Venice, Italy. Contact: Edgardo Curcio, AIEE, Italy Email: e.curcio@aiee.it

10-12 September 2012, ICCE 2012: International Conference on Clean Energy at Quebec city, Canada. Contact: ICCE2012@iaemm.com, Quebec, Quebec, Canada URL: http://iaemm.com/ICCE_Home

19-20 September 2012, BIEE 9th Academic Conference at St Johns College , Oxford, UK. Contact: Debbie Heywood, BIEE, United Kingdom. Phone: +44 (0)1296 747916 Email: admin@biee.org URL: www.biee.org

4-7 November 2012, 31st USAEE/IAEE North American Conference - "Transition to a Sustainable Energy Era: Opportunities and Challenges" at Austin, Texas. Contact: David Williams, Executive Director, USAEE, 28790 Chagrin Blvd., Suite 350, Cleveland, Ohio, 44122, USA. Phone: 216-464-2785. Fax: 216-464-2768 Email: usaee@usaee.org URL: www.usaee.org

20-21 February 2013, The 9th International Energy Conference 20-21 Feb 2013 Tehran-Iran at IICC Conference Center, Tehran , Iran. Contact: M.Reza Taqavi, Coordinator Secretary, Iran National Energy Committee, No.2, Shahid Saghafi alley (Golestan 1st), Derakhti Blvd., Dadman Blvd., Shahrak e Gharb.1468764844-Tehran / IRAN, Tehran, Iran (Islamic Republic of). Phone: (0098-21)-22366140,22366230, 22366911, 22366943, 22366948. Fax: (0098-21)-22367789 Email: intl@irannec.com URL: www.irannec.com

16-19 April 2013, LNG 17 at Houston, TX, USA. Contact: Jay Copan, Executive Director, LNG 17, USA. Phone: 919-740-7799 Email: jcopan@lng17.org URL: www.ing17.org

16-20 June 2013, 36th IAEE International Conference: Energy Transition and Policy Changes at Daegu, Korea. Contact: Hoesung Lee, KRAEE, Korea Email: hoesung@unitel.co.kr

28-31 July 2013, 32nd USAEE/IAEE North American Conference - "The Commercial-Governmental Interface of Energy Development" at Anchorage, Alaska. Contact: David Williams, Executive Director, USAEE, 28790 Chagrin Blvd., Suite 350, Cleveland, Ohio, 44122, USA. Phone: 216-464-2785. Fax: 216-464-2768 Email: usaee@usaee.org URL: www.usaee.org

INTERNATIONAL ASSOCIATION *for* ENERGY ECONOMICS
WWW.IAEE.ORG

IAEE ENERGY FORUM

Volume 21, First Quarter, 2012

The *IAEE Energy Forum* is published quarterly in February, May, August and November, by the Energy Economics Education Foundation for the IAEE membership. Items for publication and editorial inquiries should be addressed to the Editor at 28790 Chagrin Boulevard, Suite 350, Cleveland, OH 44122 USA. Phone: 216-464-5365; Fax: 216-464-2737. Deadline for copy is the 1st of March, June, September and December. The Association assumes no responsibility for the content of articles contained herein. Articles represent the views of authors and not necessarily those of the Association.

Advertisements: The *IAEE Energy Forum*, which is received quarterly by over 3800 energy practitioners, accepts advertisements. For information regarding rates, design and deadlines, contact the IAEE Headquarters at the address below.

Membership and Subscription Matters: Contact the International Association for Energy Economics, 28790 Chagrin Boulevard, Suite 350, Cleveland, OH 44122, USA. Telephone: 216-464-5365; Fax: 216-464-2737; e-mail: IAEE@IAEE.org; Homepage: http://www.iaee@iaee.org

IAEE Energy Forum
Energy Economics Education Foundation, Inc.
28790 Chagrin Boulevard, Suite 350
Cleveland, OH 44122 USA

PRSRT STD
U.S. POSTAGE
PAID
Hanover, PA
Permit No. 4