



BOOK REVIEWS

Carbon Capture and Storage: Technologies, Policies, Economics, and Implementation Strategies, by KING ABDULLAH PETROLEUM STUDIES, SAUD M. AL-FATTAH, MURAD F. BARGHOUTY, and BASHIR O. DABBOUSI, (Leiden, The Netherlands: CRC Press, 2011), 404 pages. ISBN 978-0-415-62084-0. Hardback.

The global energy system is large and complex, and any plan to reduce greenhouse gases (GHGs) must overcome its massive inertia to produce and consume fossil fuels. One important technology that has the potential of achieving substantial reductions in carbon dioxide emissions is carbon capture and storage (CCS), which consists of three subsystems: carbon dioxide capture, transportation, and geological storage. It is, however, not sufficient to have a feasible technical solution; it is also necessary to have the right economic incentives and enough political will.

According to the King Abdullah Petroleum Studies and Research Center (KAPSARC), CCS is one of the keys to any economically feasible decrease in GHG emissions for two reasons. First, the intensity of carbon dioxide emissions in the fossil fuel cycle is increasing due to the increasing share of unconventional fossil fuels. Second, carbon dioxide release is unavoidable in many industries such as cement, iron and steel, all of which are fundamental to economic development.

The objective of this book, which reads more like a report, is to provide a practical path for the widespread adoption of CCS. According to the statistics presented in KAPSARC, approximately 80% of global energy demand is met by fossil fuels. The International Energy Agency (IEA) issued a “Blue Map” setting out various CCS goals needed to meet major reductions in GHG emissions.¹ By the year 2020, the IEA concludes that 100 CCS facilities are needed and 3,000f by 2050, a thirty-fold increase. Half of these facilities should be in non-power generation and the majority should be in non-Organization for Economic Co-operation and Development (OECD) countries. The current status of CCS is that worldwide there are a handful of active, large-scale demonstration facilities.

KAPSARC makes an important contribution by describing and connecting the technical, economic, policy and political issues that need to be resolved if CCS is to become a major player in reducing carbon dioxide emissions. This book has three major parts: the case for CCS; a technical description of the CCS capture, separation, transportation and storage subsystems; and the drivers of CCS development. It is not until Part Three, Chapter 7 that presents the eco-

1. IEA, “Energy Technology Perspectives 2008,” IEA/OECD, Paris, 2008.

nomics of CCS, which focuses on the engineering costs of the various CCS subsystems and Chapter 8, which addresses environmental and safety concerns.

Seventy percent of GHGs come from the energy (25% heat and electricity production, 15% transportation, and 30% from industry), 25% from land-use change and 5% from non-combustion industrial processes. Of the fossil fuels, coal is the most carbon and pollution intensive, and coal's widespread abundance and low cost will very likely make it a critical component of future electricity production particularly in emerging economies. CCS is not, however, just for coal-fired power plants (or just for power plants), although it is more difficult and expensive to capture carbon dioxide from natural gas-fired power plants because the carbon dioxide in the emission stream is less concentrated than the emission stream from coal plants.

CCS is a suite of technologies that originated in the oil, gas and chemical industries. A rough cost breakdown for each of these subsystems is 70%, 20% and 10% respectively. Although ability to transport carbon dioxide is a mature technology, the capture and geological storage requires advances. The CCS infrastructure should involve regional infrastructures with pooling strategies, including marine transport in many locations, to lower costs and reduce CCS technical and financial risks that developers face.

For CCS to be a viable and significant solution, KAPSARC concludes that both a price on carbon and major reduction in CCS costs are needed, including reducing the major energy penalty that occurs in capturing and conditioning the carbon dioxide. CCS is also water intensive, which raises both cost and environmental challenges. KAPSARC acknowledges that different countries will pursue different policy approaches, but suggests financing for the demonstration stage, replaced by incentives such as a price on carbon emissions for the commercial stage.

In addition to reducing costs, public safety concerns with the underground storage of carbon must be addressed. A risk-assessment methodology that is recognized worldwide as a standard does not yet exist and needs to be developed. Also, a "no-leak" regulatory standard for carbon dioxide geological storage should be put in place, which requires a dynamic approach to risk assessment consisting of real-time monitoring and control that are improved over the life of the storage location. To overcome local resistance to siting storage facilities, local communities need to understand the local economic benefits of CCS facilities otherwise their communities are exposed to a risk, even if tiny, without any commensurate benefits. Carbon dioxide can be a valuable industrial feedstock and is used in enhanced oil recovery operations.

The book raises several important international CCS related issues. One is that disagreements among countries regarding who is responsible for greenhouse gas emissions, producer or consumer countries, must be resolved in order to put in place the policies and financial incentives needed to have widespread deployment of CCS. Assigning responsibilities is, of course, linked to countries' emission targets, which has been one of the major stumbling blocks in interna-

tional negotiations. Furthermore, without a clean development mechanism, according to KAPSARC, CCS will be limited to OECD countries and therefore limits the ability of CCS to reduce global carbon dioxide emissions.

Scaling up CCS, as well as other mitigation technologies, is an enormous challenge that simultaneously requires technical advances, cost reductions, and new policies. KAPSARC lays out a roadmap for a massive CCS system build out but without political will, CCS will be a road not taken.

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The Pricing of Internationally Traded Gas, edited by JONATHAN P. STERN (Oxford: Oxford Institute for Energy Studies, 2012) 530 pages, ISBN 978-0-199-66106-0, Hardback, £50.

Academics have argued over how “black gold” should be priced ever since it became widely used by domestic and commercial consumers in the nineteenth century. In comparison, scholars have neglected the study of gas pricing. Although there have been many publications on the subject of domestic gas pricing, particularly in the United States since the 1970s, very little work has been produced on pricing internationally traded gas in the light of market liberalization. Even international energy organizations, such as the International Energy Agency and the Energy Charter Secretariat, have only ever produced a handful of reports the subject.

Jonathan Stern, Senior Research Fellow and chairman of the Natural Gas Research Programme at the Oxford Institute for Energy Studies, and his contributors drawn from academia and commerce, have attempted to fill this gap with a timely volume analysing the impact of liberalization on international gas pricing. Stern stresses that this is ‘the first academic book in any language to be entirely devoted to the pricing of internationally traded gas’ but tackles the subject primarily from a geographical point of view. The book starts with two chapters on analytical and historical issues, followed by nine geographic chapters covering North American, Continental Europe, CIS, the Middle East and Africa, Latin America, South-east Asia, India, China, and Asian LNG, and ends with three concluding chapters on the impact of globalization on gas pricing. Although the volume’s overall conclusion that the forces of liberalization and globalization are shifting gas pricing towards being determined by supply and demand metrics is sound, the geographical structure of the book means the lack of focus on global markets and the influence of politics on gas pricing is disappointing.

In the first chapter, Christopher Allsopp and Jonathan Stern argue that the central analytical issue in gas pricing is the transition towards a pricing system

based more on economic forces and supply and demand metrics. In the second thematic chapter, Stern follows the history of gas pricing developments up to the year 2000, arguing that the shift from cost and oil related pricing towards market based pricing has resulted in a shift from long term gas supply contracts to shorter term ones.

Michelle Michot Foss's third chapter on gas pricing in North America assesses the impact of the shale gas revolution on the liberalization of that market and questions the notion that this will result in high levels of LNG exports. The section on politics in this chapter could have delved deeper into the role of policy on this question, particularly Washington's traditional hostility to hydrocarbon exports.

In the fourth chapter, the editor and Howard Rogers convincingly attack the argument that oil and gas related prices will reconverge in the European market in the long run because of demand and supply metrics. While in the fifth chapter, James Henderson, Simon Pirani, and Katja Yafimava describe the failure of Russian and CIS exporters to retain European-linked prices in the Middle East and China, although, again, the role of geopolitics between Russia and China in the Far East could have been emphasised more as a driver of this process.

The sixth chapter, written by Hakim Darbouche on the Middle East and Africa is unusual in its focus on Sub-Saharan Africa, which is often overshadowed in the literature in favour of the Middle East. Although the chapter rightly concludes that artificially low energy prices in these countries are unsustainable, the continent's history of riots when energy subsidies are removed, from Egypt to South Africa, suggests that populist politics will delay this change further.

Anouk Honoré and David Ledesma have also provided an interesting look at the less well studied area of gas pricing in Latin America and the Caribbean in Chapter 7, with a particular focus on the impact of political pressure on pricing in the region. Then follow four chapters on gas pricing in Asia; Chapter 8 by Ledesma on pricing in Southeast Asia, Chapter 9 by Anupama Sen on India, Chapter 10 by Michael Chen in China, and Chapter 11 by Andy Flower and Jane Liao on LNG pricing in Asia. The regional method of analysis used in Chapter 11 by Flower and Liao is particularly interesting in the context of the Far East as a net-importer of gas. A pan-Asian approach in Chapters 8-10 could have also added value to these contributions.

In Chapter 12, Rogers argues that there are three conditions which are needed for an integrated gas market to start to appear. They are given as a sufficiency of: quantities of flexible or divertible natural gas, liquidity in the market for gas supplies to be diverted to satisfy various levels of supply, and demand across the world. Laura El-Katiri and Honoré discuss in Chapter 13 whether the world is heading towards the global or regional cartelisation of pricing, and particularly investigates the history of the Gas Exporting Countries Forum (GECF). In their interesting piece of political analysis, they conclude that the GECF appears not to be seeking influence over the global supply and price of gas in the way that OPEC has come to control the price for oil. Instead, they suggest, it more narrowly attempts to defend the financial interests of its members.

The overall conclusion Stern draws at the end of the volume is that, although it is impossible to predict how far, or by how much, gas prices will rise in the next decade, globalization will create greater unpredictability in prices in the near future. Whilst this overall argument is convincing, the regional and geographical structure of the book meant it was difficult to incorporate much analysis on the role of regional and global political issues in gas pricing and there is little focus on future supplies. The impact of politics on gas pricing, from the need of Russia's government to balance its budget in order to retain political credibility, to the energy price riots in Africa, means that non-economic influences on pricing will continue to remain important for many years to come. Readers of this volume will find a good overall analysis of the increasing role of economic and supply and demand factors on gas pricing, but the lack of focus on the continued impact of politics leaves room for further research by other scholars.

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