

Chapter II

Introduction

Welcome to the 2nd edition of *The Economics of the International Coal Trade*. This book introduces the reader to the global coal business—its importance, its source, its global demand, supply and trade, its use, its environmental impact and its future. Coal does not appear to be a popular subject today, which may explain the relatively scant attention it receives in the scientific community and in its economic analysis. When I published *The Renaissance of Steam Coal* in 2010, it was one of the first books on the subject. It was written during 2006–2008 in the middle of the commodity super cycle. Today, the world has changed, but has the coal business or its future changed? And if so, how?

Apart from giving an in-depth overview of the global coal business, in this book I argue that coal is far from “dead”, quite the contrary. Many of my key messages below go against popular beliefs and against how both the media and politics portray matters:

1. The importance of coal will further increase in both absolute and relative terms. The only reason why coal has not already increased in relative terms during the last decade is because of the unexpected, and in a way lucky, shale gas revolution in the US.
2. We cannot stop the advance of coal. We can only make this process as environmentally sustainable as humanly possible. Therefore, mankind has no choice but to embrace coal as the “bridge” from the Oil Age to the Solar Age (through the “New Energy Revolution”)—a time when mankind can truly harvest and utilize the sun’s energy both economically and safely.
3. Industrialized nations have to invest in coal and burn coal more efficiently in order to truly help the global environment. Yes, coal has undoubted negative environmental effects, and here we have to focus on technology and investment to help address these.
4. I argue that man-made CO₂ has no effect on global temperatures and that fossil fuels do not influence the global climate. Nevertheless, the average CO₂ efficiency of coal use has decreased during the past decade. It is hard to believe that today

coal is burnt less efficiently than it was 10 years ago! Why? Because “The West” (almost) stopped investing in coal and delivering help to “The East” to build cleaner power plants (see Fig. IV.14 Coal burn today is less environmentally friendly than a decade ago on page 121).

To be very clear, I am not arguing that coal is the cleanest form of power generation. In fact, the world needs to continue to invest in and research viable alternatives to coal, as wind and current solar technology are not yet the solution. I am saying: ***“wake up, coal will be around for decades to come and it will gain in importance. Deal with it and don’t fight it, because you won’t stop it. In fact, you are in danger of making the environmental situation even worse by ignoring coal—or worse—shutting coal off”.***

As the Economist put it eloquently in its 6th June 2015 edition: “Coal may be unpopular, but it is not doomed. Its share of world primary energy use is falling from a peak of 30% in 2010, but only to a likely 25% in 2035, according to BP’s annual energy forecast”.

This book will examine the global supply and demand of coal, it will introduce the source of coal and the use of coal. It will detail the coal producing and exporting countries as well as coal importing countries. The book will be useful to energy economists, businessmen, politicians, university professors, high school teachers, students and anyone with an interest in how the world is powered.

2.1 Prelude

The world today depends on the fossil fuels: oil, coal, and gas (in that order of importance) for 80% of its primary energy. When early humans tamed fire a few hundred thousand years ago, wood—and biomass for that matter—became their primary energy sources. Only during the Industrial Revolution and after the invention of the steam engine about 200 years ago, did coal take over the leading role from biomass. As a result, coal accounted for over 60% of the world’s primary energy by the early 1900s.

Our current age is often referred to as the Oil Age (or the end thereof), which seems appropriate when we consider that just over 30% of the world’s primary energy still comes from oil. However, today almost 30% of the world’s primary energy, and more than 40% of the world’s electricity comes from coal (please refer to Fig. III.1 Global shares of primary energy and electricity 2012 on page 42). Experts predict that coal will overtake oil within this decade as the most important source of energy. In addition, about two thirds of the world’s steel is produced using coal. Another little-known fact is that coal accounts for 60% of the energy required for global cement production and therefore our construction industry depends on it (see Fig. II.1 below).

Estimated global usage of coal 2013

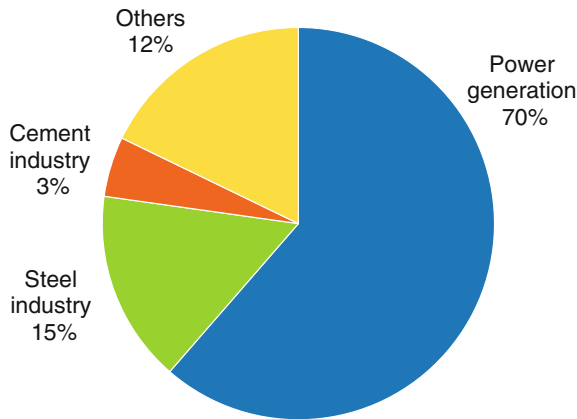


Fig. II.1 Coal use by industry (estimate)
Sources Schernikau estimates based on own research and analysis, Schernikau 2010, VDKi 2006–2015, Ritschel/Schiffer 2007, and IEA Energy Outlook 2007–2014

The World Coal Institute projected a decade ago that coal will again become the primary source of energy in the future (see Fig. II.2 below) The illustration may not be fully up-to-date considering the North American shale gas revolution of the past few years, and the far faster development of renewable energy. However, it clearly demonstrates the past and also the future of energy, with the IEA predicting that coal will overtake oil as the most important fuel for primary energy. It also demonstrates in an impressive way that future electricity demand will largely be met by coal as a fuel, at least for decades to come.

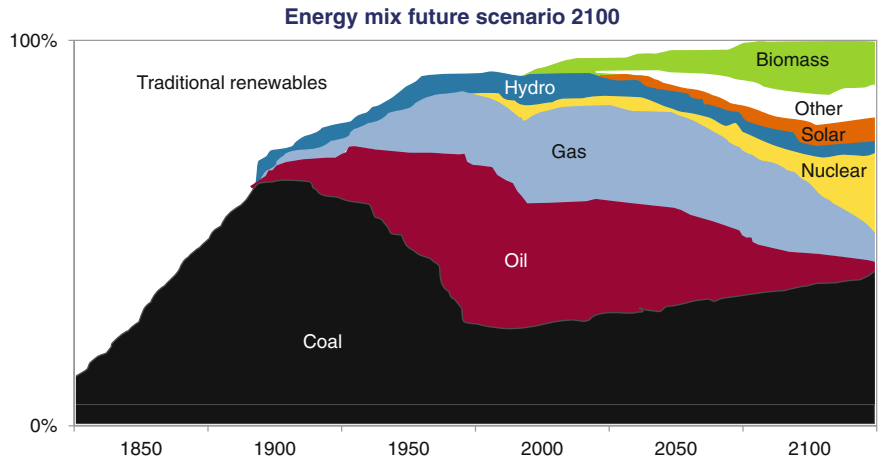


Fig. II.2 Historic and future world primary energy mix: scenario 2100
Source World Coal Institute, www.wci-coal.org

The other—and in my view more extreme—view is that of the Bloomberg New Energy Finance company (BNEF 2015). The company predicts that absolute coal-fired power generation peaks in about a decade's time in mid-2020 and that Solar will receive US\$ 3,7 trillion of investments between 2015 and 2040 (this compares to US\$ 1,5 trillion investments in coal between 2014 and 2035) leading to an unprecedented solar panel installation. Please refer to Section 4.8.6 Non-Hydro Renewables: Wind, Biomass, Solar and Other on page 154.

The world's appetite for energy is still far from being met. By 2030, an additional 5+ billion people will require access to sufficient power. Today, in 2016, over 1,5 billion people (or over one-fifth of the world's 7,3 billion inhabitants) are still without access to electricity. By the way, 400 million people without any electricity at all live in India. Of the remainder, over 2 billion people are dependent on a primitive or erratic electricity supply. This translates to a total of **3,5 billion people (or almost 50% of the world's population) who lack proper access to energy in 2015!** In addition, by 2030 the world's population is expected to have reached 8–9 billion. By then, over 1 billion people will still lack access to electricity. As such, it is expected that there will be **over 2 billion new power customers in the next 15 years.** This is more people than live today in the whole of China and Europe together (Schernikau 2010, IEA Statistics 2012 and 2014, Forbes 2014, and VDKi 2006–2015). Bloomberg reminds us that by 2050, 3 billion people will enter business class and as a result energy is attached to them.

As an example, Sadhvi Sharma wrote in December 2015 that India has 300 billion tons of coal available—the fifth largest reserve in the world. India plans to open one mine per month over the next five years. None of this is a bad thing. Clean coal (and its combustion) is not a polluter; it is an abundant energy source—energy that can drive human activity and push development in low-income countries. Coal has been crucial to lifting millions out of poverty in India and China over the past two decades. Building schools and roads, powering villages, towns and commercial centers, supplying food and sustaining production—all this depends on readily available energy. Between 2004 and 2011, the number of poor people in India fell from over 400 million to 270 million. In addition, India will add 400 million people over the next 30 years making the total requiring electricity a staggering almost 700 million. Since India won its independence from Britain, life expectancy in the country has doubled. In 2013, India eradicated the scourge of polio. All of this is an offshoot of coal-fired development. Of course, there is still much further to go. It is unacceptable that in the 21st century millions of Indians still live below the poverty line and a quarter of the population still lives in darkness, without electricity.

The international strategy consulting firm The Boston Consulting Group has tellingly named a series of its successful economic consumer studies “The Next Billion Consumers”, indicating the huge growth in demand with which the energy industry is faced. The growth in energy demand is primarily driven by non-OECD countries such as China and India (see Fig. II.3 below). In fact, 96% of the growth from 2013 to 2035 will come from Non-OECD countries. This is extremely impressive and very relevant to the coal market. The Western world simply has to recognize where the growth will come from and what this means in terms of the technologies being employed in those places. Investment in fossil fuels, and most importantly coal, is needed to make the electrification of the developing world as environmentally clean as possible.

We can expect significant improvements in productivity due to technological advances over the next 50 years. The European Commission (European Commission 2006, p12) estimates in its reference projection that the world economy will increase fourfold in that period. At the same time, the world’s energy consumption is projected to increase only by a factor of 2,2 from about 10 Gtoe (gigatons of oil equivalent) in 2006 to about 22 Gtoe in 2050. However, “only” is a relative term as this task is more than difficult enough for the human race and the environment. The question remains, where will this energy come from... until the Solar Age—the New Energy Revolution—has begun or occurred?

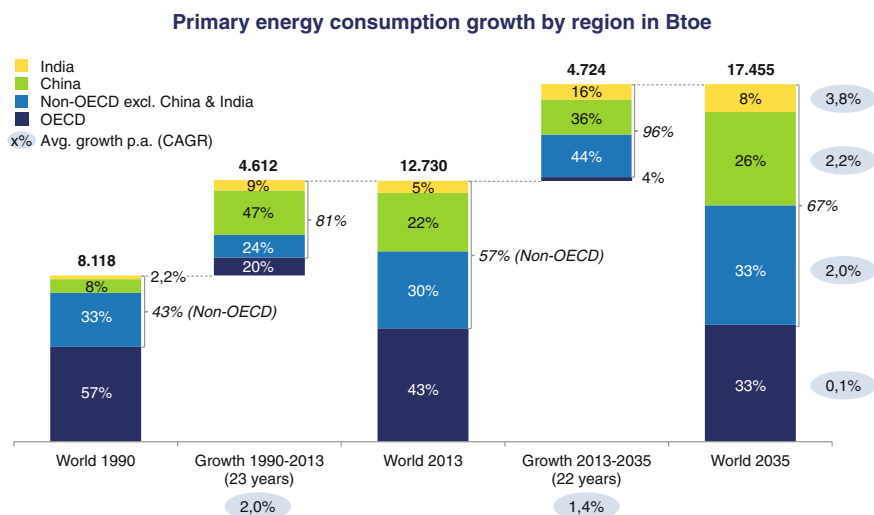


Fig. II.3 Comparison of energy demand growth until 2035: OECD/Non-OECD
 Sources BP Energy Outlook 2015; IEA; Schernikau analysis

In the 1990s, certain events and market phenomena created a false sense of energy security in the Western world (see Yaxley 2006). The Berlin Wall fell, and

with it a decades-old political system. The victory of the international coalition in the first Gulf War and further European Union expansion deepened the false sense of geopolitical security. There was also a tendency to misinterpret energy policy as an extended arm of climate policy. Politics and modern environmentalism increasingly regarded coal and nuclear energy as a scapegoat. This attitude was coupled with an overestimation of the short- and mid-term potential of renewable energy. Over-capacity in coal, oil and gas led to low fossil fuel commodity prices in the late 1990s and early 2000s, which in turn resulted in a dangerous oversight of the unequal distribution of resources and the limitation of energy resources across the planet. The resulting lack of investment by producers led to false expectations by consumers.

However, the new millennium also brought with it a set of new circumstances. In the first decade of the third millennium, there was a growing need to reassess energy policy and to become aware of the importance of fossil fuels, especially coal, and our reliance on them. The threat of terrorism has increased dramatically in recent years, introducing a new type and concept of enemy in the West. Also, more political problems and rising instability in supplying countries have shaken the Western world. Oil, coal and gas prices skyrocketed again, raising questions about the impact of monopolistic and oligopolistic markets on the world economy, and as a result, about the role of governments and protectionism. Today, renewable energy sources are being re-evaluated and their potential estimated more realistically than in the 1990s and in the first decade of this millennium. Commodity prices had corrected downward, in fact over-corrected until prices started to increase again in 2016. This was primarily caused by the slowing of the Chinese economic boom that had impacted every aspect of the world.

As a result, commodity prices increased sharply (see Fig. II.4 below). Along with this increase, by summer 2008 coal prices has reached previously unsurpassed levels. A tripling of prices within one year (see Fig. II.5 below) occurred, before they fell again to still historically high levels in 2009, before starting their ascent until 2011. During this time investments into commodities and coal rose sharply, creating an overcapacity which resulted in the unavoidable: price drops from 2011 until 2016 (Fig. II.4).

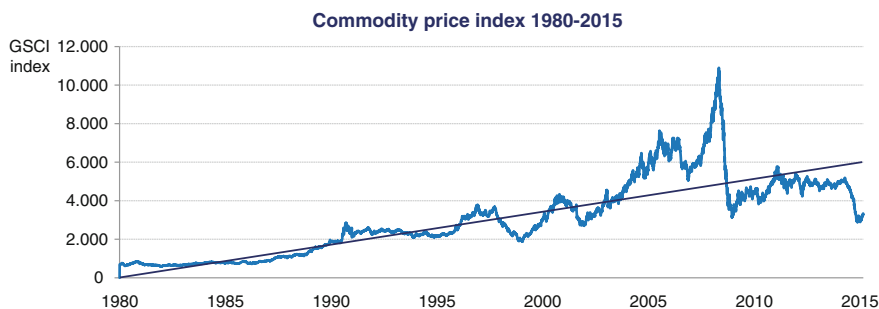


Fig. II.4 GSCI development 1980–2015

Sources Schernikau analysis; GSCI; UBS

Since 2011, commodity prices, and with them coal prices have experienced a prolonged price decline that many call the End of the Commodity Super Cycle. The cause can be analyzed and may include a combination of slowing Chinese growth, over-investment, global uncertainty, the US shale gas revolution and so on. While I will touch upon many of these aspects in this book, it does not change the main message around coal: There is no way around coal until the New Energy Revolution starts the “Solar Age”.

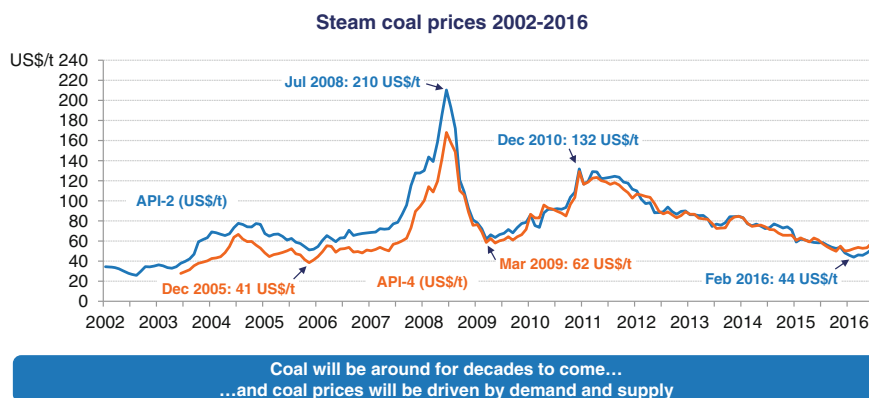


Fig. II.5 Coal price developments 2000–2016

Sources Schernikau analysis; McCloskey Coal Price Index

In the coming decades there will be no way around coal. I propose that governments and organizations spend more time and financial and human capital on developing technologies to improve the world’s power plant park, and on finding newer and better ways of producing and transporting fossil fuel resources rather than fighting coal (in Germany this fight can be seen to be parallel to the fight against nuclear energy). There is no question that the world needs every MWh sourced from renewable energy. However, for the foreseeable future, renewable energy will not satisfy the world’s hunger for energy. Since coal’s lifetime far surpasses that of other fossil energy resources (see Fig. IV.34 Static range of global fossil energy fuels 2013 on page 161) it will become increasingly important, especially once politics realize—or are at least given impartial information about—the fact that man-made CO₂ does not cause global warming.

There is increasing evidence that coal will not only remain one of the key sources for meeting our energy demand but will actually gain in importance. This renaissance of coal as a resource warrants a more scientific study of the subject. The technological aspects of coal production were studied in great detail in the last century. Much is known about both the underground and surface mining of coal. We also know a lot about its physical and chemical characteristics as well as the

path to further improving the efficiency of coal-fired power plants. However, much less research has so far been conducted on coal markets and the coal trade. The information available on the economics of the global coal trade is very limited although it has substantially increased in the past decade. The coal market remains a relatively private and closed market, partly as a result of the general public's antipathy towards coal. Coal has only been traded on an international level since the early 1980s, a development that was sparked by the oil crises of 1973 and 1979. Today, 1,2 billion tons of a total 7,2 billion tons of coal produced is traded internationally. However, even today politics and the scientific community lack the same level of knowledge about coal as they have (or can refer to) in the cases of oil, gas, nuclear and especially renewable energy sources (see Stanford 2008 and VDKi).

The need for further economic analysis of the coal market is demonstrated by an increase in research activity to better understand the economics of coal as a resource. A variety of institutions, including Deutsches Institut für Wirtschaftsforschung (DIW) as well as EURACOAL and a number of Universities in Germany, the US, Sweden, Poland, and Japan have stepped up their efforts to study the importance of coal in the last decade. These efforts have declined since 2011 when coal and commodities ceased to be the flavor of the day and prices started declining.

I argue that coal will fill the gap between the Oil Age and the often referred to “Solar Age” of the future, a time when renewable energy sources will satisfy the majority of the planet's hunger for electricity, and for energy in general. In filling this gap, coal competes head-on with other sources of energy, but coal has the major advantage of being available in a relatively free market, with its supply coming from both developed and developing countries alike.

The Achilles' heel of coal is the justified environmental concerns that surround it. Currently, coal generates more CO₂ per MWh of electricity produced than any other fossil fuel. With about 43% or 14 Gt of the total of almost 32 Gt global energy man-made CO₂ emissions stemming from coal, environmental risks demand the development of “clean coal” technology (IEA—CO₂ 2014). For more detail regarding global CO₂ emissions and why I argue that they don't matter for our climate, please refer to Chapter VIII Environment—CO₂ and Coal, Geopolitics and Policy on page 293). Independent of the need to step up efforts for the cleaner production and use of coal, it is crucial that the world increases the speed at which renewable energy sources are being developed. At the same time, it is crucial that the Western world, including the US and Germany at the forefront, stop fighting coal and instead help to make the burning of coal both more efficient and more environmental friendly by investing in clean combustion technologies.

I have analyzed the problem of increased inefficiency of burning coal on a global scale in Section 4.5 starting on page 120. In summary, the amount of CO₂ emitted for each MWh of electricity generated from coal increased by 2,2% over an 8-year period from 2004 to 2012. Let me repeat: today we burn coal less efficiently than a decade earlier. My hypothesis is that this phenomenon is caused by the West's ignorance of the importance of coal. Instead of investing in more efficient coal-fired power plant technology, the West abandons coal and lets the East or Asia (the new world) do what they want without the support of the West.

In summary, the objective of this book is to answer the following key questions:

- Can coal fill the energy gap until the full arrival of the Solar Age, especially when it is compared to oil, gas and nuclear resources?
- What relative coal price levels can we expect? Will the price of coal continue to become more volatile, especially as we are now near the export production capacity of steam coal? In the long-term, will coal prices remain more stable than the prices of other fossil fuels, especially when considering the large reserves of coal?
- How do markets with increasing marginal cost curves (i.e. commodities, including coal) behave differently from markets with constant marginal cost (i.e. standard factory-based industries)? How will consolidation affect the coal market with an increasing marginal cost curve?
- What does the world need to do to counter the environmental problems associated with the burning of coal?
- How does energy man-made CO₂ really affect our climate?

This book is also meant to contribute to (1) further professionalization, (2) higher transparency, and (3) greater efficiency of the coal trading industry.

2.2 Book Structure and Market Definition

2.2.1 Book Structure

This book focuses on the supply and demand side of the global sea-borne steam coal market. Also, the importance of coal to the international power market is explored. The scope of this study encompasses the years 2014 and 2015. Based on the available data, research, and analyses, I give a view of the future for the next 20–30 years.

I use economic theory to analyze various aspects of the market. Industrial economics as well as resource depletion and price formation theories are also employed. I use standard econometrics in the analysis of quantitative data.

The empirical data used to analyze the coal market is based on primary research and qualitative data. Between 2006 and 2015, I had over 1.000 discussions with industry experts and market participants in almost all countries around the world that are relevant to coal. During August and October 2008, I conducted an Online Coal Market Survey using an internet-based online survey provider <http://www.onlineumfragen.com>. Of the 500 coal experts contacted for this survey, 200 responded. The questions were tested on a group of 10 test subjects in two pre-tests with two interviewers and were optimized over a period of 3 months. The first edition of the book still includes a nonlinear equilibrium coal market model WorldCoal which was programmed in a General Algebraic Modeling System (GAMS) for the qualitative analysis of the global steam coal market.

Between 2006 and 2008, I employed Economic Game Theory in order to analyze the Cournot competition model (Schernikau 2010). I extended the Cournot model to work with increasing marginal cost rather than only constant marginal cost. The Cournot model with increasing marginal cost allows the description of the industry structure of raw material markets such as the coal market. Figure II.6 below summarizes the structure of this book, which I amended since the publishing of the first edition.

Chapter III details the sources of coal, including an analysis of coal as a resource and a regional analysis of coal reserves. Chapter IV looks at the use of coal and its current role in power generation. Coal power plant technologies as well as environmental issues surrounding the use of coal will be explored before reaching the core of this study where—building on the previous chapters—I analyze the global steam coal market and its supply and demand. In Chapter V, I discuss details about the various supply and demand regions. In Chapter VI, I give an introduction to the freight market, a very relevant component to any global commodity market. In Chapter VII, I focus on the real global trading business and its market participants, coal derivatives and general investment sentiment. Chapter VIII explores the geopolitical situation including environmental aspects of using coal. It focuses on CO₂ and the current quest against coal. In Chapter IX, I attempt to summarize the book's findings and draw conclusions for the future of the international steam coal market.

The Appendices include further details on various aspects of the coal market. It also contains a first time ever in-depth overview of all physical and chemical coking coal characteristics.

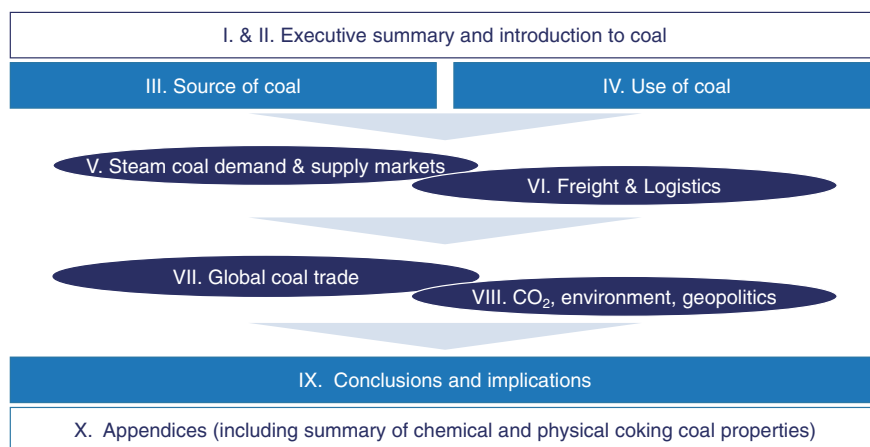


Fig. II.6 Structure of this book

Source Schemnikau

2.2.2 Market Definition

This book analyzes the global sea-borne steam coal trade. This market encompasses all steam coal (steam coal equals hard coal minus coking coal) traded by sea. It therefore does not include the coal used within one country or the coal transported across land borders, the so-called “green border trade”.

The world produced over 7 billion tons of hard coal in 2015, of which 1,2 billion tons were traded internationally. The green border trade totalled 91 million tons. The remaining 1,1 billion tons traded by sea comprised 271 million tons of coking coal and 833 million tons of steam coal—the focus of this study (VDKi and Fig. II.7 below). Steam coal includes all bituminous and most subbituminous coals as well as anthracite. Not included are coking coal and classic lignite coal. For further details please refer to Section 3.3 Classification of Coal on page 44.

The supply for the global sea-borne steam coal market is measured by the production for export. The capacity is measured by the sum of all export mine capacities. The demand is measured by sea-borne trade. In this study of the demand side, I focus on the power industry’s coal consumption but also mention cement and other industrial consumers (please also refer to Fig. II.1 Coal use by industry on page 31).

This research focuses on the global market. We can do this since Li 2008 and Warell 2007 have shown that the Atlantic and Pacific coal markets are co-integrated. The traditional separation of the Atlantic and Pacific steam coal markets faded in the past decade. The steam coal market has thus become a global market and is relatively unified in terms of economics. This has been supported by the fall in freight rates. While I will show that the coal trade market is not perfectly competitive, the law of one price acts as a guiding principle for defining the market. Selectively, I may refer to European data as a proxy for the global market. Data

availability in this market is imperfect and the available sources are not always consistent. Wherever possible I have opted to use the definitions and key figures compiled by The German Coal Importer Association in Hamburg (Verein der Deutschen Kohleimporteure, VDKi) and by Perret Associates.

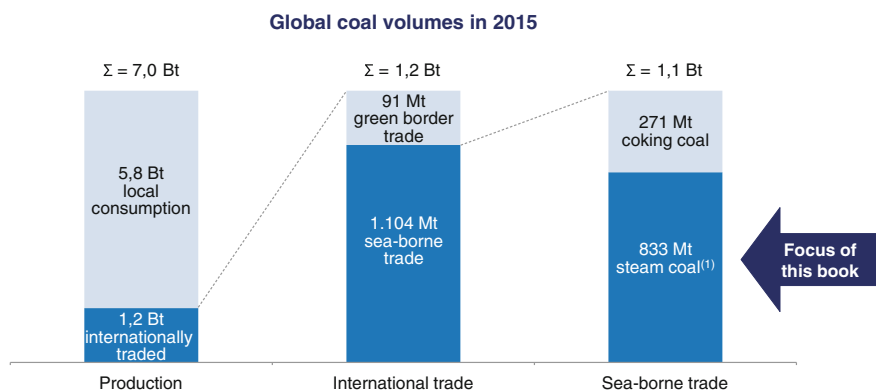


Fig. II.7 Focus of this book: over 800 million tons of traded steam coal

(1) Excluding subbituminous coal from Indonesia to India

Source Schernikau analysis based on VDKi 2015/2016

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