1 General Summary .......................................................... 1

1.1 Global Trends in the Natural Gas Industry ................. 1
   1.1.1 Abundant Resources, and a Greater Role for Natural Gas in the Future ........... 1
   1.1.2 Changes to the Global Trade and Pricing, and a More Interconnected Market ...... 2
   1.1.3 Falling Oil Prices and Their Effect on Natural Gas Markets—but no Great in the Price of Imported Gas in China in the Medium to Long Term .................. 3
   1.1.4 China’s Share of the Global Natural Gas Market Is Slowly Growing—China Must Become an Active Player in the International Natural Gas Market .................. 5

1.2 China’s Natural Gas Supply and Demand and Its Primary Challenges ...................... 6
   1.2.1 The Chinese Economy’s New Normal ............ 6
   1.2.2 Growth Natural Gas Demand in China ........ 6
   1.2.3 Potential to Expand Domestic Natural Gas Supply and Import Capacity in China ...... 7
   1.2.4 Key Problems Facing the Development of the Natural Gas Industry ............... 9

1.3 China’s Natural Gas Industry Development Strategy for the Next 15 Years .................. 11
   1.3.1 National Strategy and Policy Are Crucial for Natural Gas Industry Development in China .................. 11
   1.3.2 Strategic Objectives of High Efficiency, Safety and Sustainability .................. 13
   1.3.3 Clearly Defined Channels and Targets of the Natural Gas Industry ............... 14

1.4 Raising Efficiency and Supporting Improved Policies to Expand Natural Gas Use .......... 16
1.4.1 Strengthen Environmental Regulation, Improve Resource Utilisation Efficiency, Substitute Natural Gas for Coal ........................................ 17
1.4.2 Improve Planning and Technological Standards, and Promote the Development of Natural Gas Transportation ........................................ 18
1.4.3 Improve the Pricing Mechanism, Making the Development of Natural Gas Electrical Power Generation Justifiable. ....................... 19
1.4.4 Adjust Gas Prices for Residential and Chemical Industry Use, and Reduce Cross-Subsidies for Different Users ................................. 21

1.5 Measures to Ensure a Safe and Efficient Gas Supply ........................................ 22
1.5.1 Attracting New Players to Resource Exploitation to Expand Natural Gas Production ........................................ 22
1.5.2 Achieving Import Diversification, Safeguarding the Security of Natural Gas Imports. ........................................ 27
1.5.3 Accelerating the Construction of Pipeline Network, Promoting Network Interconnectivity ........................................ 29
1.5.4 Accelerate the Construction of Natural Gas Reserve Facilities and Implement Corresponding Institutional Reform ......................... 32
1.5.5 Improve Technology Capacity and Strengthen the Long-Term Development Capability ........................................ 35

1.6 Constructing a Modern Natural Gas Market Mechanism and Management System ........................................ 36
1.6.1 Liberalisation of the Upstream Sector and True Import Liberalisation ........................................ 36
1.6.2 Step-by-Step Natural Gas Price Reform, Accelerated Construction of Natural Gas Trade Hubs ........................................ 38
1.6.3 Clear Allocation of Functions and Robust Supervision to Support Unbundling and Third-Party Access ........................................ 40
1.6.4 Strengthen Energy Resource Management, Establish a Regulatory System and Build Regulatory Capacity ........................................ 42
1.6.5 Support the Development of Professional Services and Technological Companies; Use Market Forces to Promote the Expansion of the Division of Labour ........................................ 43

1.7 Deepen the Laws and Regulations System of the Gas Sector, and Establish a Sound Legal System ........................................ 44
PART I Analysis of Natural Gas Demand

2 Developments in Global Natural Gas Consumption
  2.1 Major Factors Affecting Natural Gas Consumption Growth in Other Countries
    2.1.1 Proportion of Energy Consumption of Natural Gas in Various Countries
    2.1.2 Breakdown of Natural Gas Consumption Growth in Seven Benchmark Countries
    2.1.3 The Importance of Fuel Switching in Natural Gas Demand Growth
  2.2 Primary Factors Motivating Switching from Other Fuels to Natural Gas
    2.2.1 Various Approaches to Natural Gas Replacement
    2.2.2 Analysis of Driving Factors in OECD Member Countries Switching to Natural Gas
    2.2.3 Further Analysis of Motivating Factors for a Country to Switch to Natural Gas
    2.2.4 Summary
  2.3 The Influence of Natural Gas Price on Demand
    2.3.1 The Relationship Between Natural Gas Price Changes and Changes in Demand in OECD Countries Is not Pronounced
    2.3.2 Limited Effect on Demand of Difference in Price Between Natural Gas and Other Energy Sources
  2.4 Current State of Natural Gas Use in China and Future Trends
    2.4.1 Sector Distribution and Total Gas Consumption in China Since 2000
    2.4.2 Mid- to Long-Term Energy and Natural Gas Development Plans in China
    2.4.3 Mid- to Long-Term Natural Gas Development Trends for China Based on International Experiences

3 Potential for Natural Gas to Act as a Substitute Fuel in China
  3.1 Power Generation: Cost Comparison of Gas as a Substitute for Coal in Power Generation
    3.1.1 Direct Cost Comparison Between Gas Generation and Coal Generation
    3.1.2 Other Factors Influencing the Competitiveness of Gas-Fired Power Generation
    3.1.3 Conclusions Regarding the Prospects of Gas Replacing Coal in Power Generation
  3.2 Transport: Analysis of Natural Gas as a Substitute for Diesel
3.2.1 Primary Motivators for Natural Gas to Replace Diesel ................................................. 83
3.2.2 Natural Gas Oil Replacement Price Tolerance in the Urban Transport Sector .................. 84
3.2.3 Commercial Vehicle Natural Gas Diesel Replacement Price Tolerance .......................... 85
3.2.4 Ship Transport Natural Gas Diesel Replacement Price Tolerance .................................. 86
3.2.5 General Factors in the Transportation Market Relating to Gas Replacement of Diesel ......... 87
3.2.6 Potential Prospects for Transportation Market Natural Gas Demand .......................... 88

3.3 Urban Use: Assessment of Price Tolerance for Natural Gas to Replace Other Fuels ............... 89
3.3.1 Price Tolerance is Relatively High for Residential Usage of Natural Gas ....................... 89
3.3.2 Price Tolerance is also Quite Resilient in Commercial Service Natural Gas Use ............... 91
3.3.3 Price Tolerance is Weak for Centralised Urban Heating Using Natural Gas ................... 91

3.4 Industrial Use: Cost Comparison of Natural Gas Replacing Other Energy Sources ................. 92
3.4.1 Price Tolerance is Very Low for Replacement of Fuel Oil by Natural Gas in the Glass Industry .............................................................. 92
3.4.2 Price Tolerance is Relatively Weak for the Ceramics Industry for Replacement of Coal Gas by Natural Gas ................................................... 93
3.4.3 Natural Gas Price Tolerance is Relatively Poor for Steam Production as a Replacement for Coal ................................................................. 93

3.5 Chemicals: Potential for Increased Natural Gas Use in the Production Process .................. 94
3.5.1 Price Tolerance of Natural Gas is Extremely Low for the Manufacture of Synthetic Ammonia ................................................................. 94
3.5.2 Price Tolerance of Natural Gas is Very Weak for the Manufacture of Methanol ............... 94
3.5.3 Price Tolerance of Natural Gas is Very Strong for the Manufacture of Hydrogen ............... 95

3.6 China’s Natural Gas Demand Curve and Ways to Increase Natural Gas Consumption .......... 95
3.6.1 China’s Natural Gas Prices in 2013 ........................................................................... 95
3.6.2 Natural Gas Demand Curve for China in 2013 ....................................................... 96
3.6.3 Implementation Model of Effective Demand and Actual Natural Gas Consumption Based on Natural Gas Price Reform Targets .................. 98
4 Environmental and Social Value of Natural Gas

4.1 Losses Caused by Atmospheric Pollution in China

4.1.1 Atmospheric Pollution is a Key Cause of Death in China

4.1.2 Losses from Injury to Health Caused by Atmospheric Pollution in China Account for 3–12% of GDP

4.2 The Environmental Value of Natural Gas as a Substitute for Coal

4.2.1 Environmental Pollution and Economic Losses Incurred During Coal Production

4.2.2 Environmental Pollution and Economic Loss During Coal Transportation

4.2.3 Estimates of Environmental Pollution and Economic Losses Arising from Coal Use

4.2.4 Environmental Value Assessment for Natural Gas Substituting Coal

4.3 Social Value of Natural Gas as a Substitute for Coal

4.3.1 Social Loss of Coal Production

4.3.2 Social Loss of Coal Use

4.3.3 Social Value Assessment of Natural Gas as a Substitute for Coal

4.4 China’s Achievements in Energy Conservation and Emissions Reduction

4.4.1 Targets and Main Measures for Sulphur Dioxide Emission Reduction During the Period of the 12th Five-Year Plan

4.4.2 Emissions Reduction Results Achieved During the 11th Five-Year Plan Period

4.4.3 Enormous Potential for Natural Gas to Substitute for Coal in Industrial Fuel and Residential Heating

5 Analysis of Medium- to Long-Term Natural Gas Demand and Supply

5.1 The Natural Gas Supply-Demand Model

5.1.1 Basic Characteristics of the Model

5.1.2 Main Intensifications and Adjustments Made Towards Studies of Natural Gas in This Model

5.2 Simulation Scenarios for Analysis Simulations of Natural Gas Demand

5.2.1 Key Assumptions of the Standard Scenario

5.2.2 Key Assumptions of the Policy-Driven Scenario

5.3 Natural Gas Supply and Demand in the Standard Scenario

5.3.1 Speed of Economic Growth and International Comparison
6.5.2 Optimise the Electricity Pricing Scheme, and Increase the Economical Natural Gas Power Generation .......................... 148
6.5.3 Strengthen Planned Guidance to Promote Natural Gas in Transportation ......................................................... 149
6.5.4 Reduce Cross-Subsidisation Between Different Users, and Encourage Industrial and Commercial Natural Gas Use ............... 150
6.5.5 Extend Carbon Emission Trading Rights, and Actualise the Environmental Value of Natural Gas .......................... 151

PART II Analysis of Gas Supply for China

7 China’s Natural Gas Resource Potential and Production Trends .................................................................................. 155

7.1 Natural Gas Resource Potential ......................................................... 155
7.1.1 Resource Potential for Chinese Conventional and Unconventional Natural Gas .................................................. 155
7.1.2 Changes in Natural Gas Resource Assessments ................................ 155
7.2 Proved Natural Gas Reserves ......................................................... 157
7.2.1 Conventional Natural Gas ......................................................... 157
7.2.2 Coalbed Methane ................................................................ 158
7.2.3 Shale Natural Gas ................................................................ 158
7.3 Growth of Natural Gas Production ................................................ 159
7.3.1 Conventional Natural Gas ......................................................... 159
7.3.2 Coalbed Methane ................................................................ 159
7.3.3 Shale Natural Gas ................................................................ 161
7.4 Conventional and Unconventional Natural Gas Production Forecasts ............................................................................. 161
7.4.1 2020 Production Volume Forecast .......................................... 161
7.4.2 2030 Annual Production Forecast .......................................... 162
7.5 Accelerating the Development of China’s Domestic Natural Gas Resources .............................................................. 163
7.5.1 Clarify Development Paths ......................................................... 163
7.5.2 Adjust Lowest Exploration Commitments .............................. 164
7.5.3 Maintain Reasonable Prices ....................................................... 164
7.5.4 Establish Trade Mechanisms and Trade Platforms for Proved Natural Gas Reserves ............................................. 165
7.5.5 Accelerate Development of Unconventional Natural Gas ................................................................................... 165

8 International Natural Gas Supply and Quantities Available to China ............................................................................. 197

8.1 Preface ......................................................................................... 197
8.2 Current and Future Sources of Global Natural Gas Supply .............................................................. 198
8.2.1 Current and Projected Global Natural Gas Resources ........................................ 198
8.2.2 Global LNG Trade Development ................................................................. 199
8.2.3 Trends in Global LNG Trade ..................................................................... 199
8.2.4 Developments in the Global LNG Export Market ........................................ 199
8.2.5 Growing Natural Gas Demand in China, India and Other Emerging Markets .......... 201
8.2.6 The Influence of Oil Price Declines Future Natural Gas Trade .......................... 202

8.3 China’s Current Natural Gas Imports and Future Trends ...................................... 204
8.3.1 China’s Current Natural Gas Imports ......................................................... 204
8.3.2 Potential Source Nations for China’s Future LNG Imports ................................. 205
8.3.3 Trends in China’s Future Natural Gas Imports ............................................. 208

8.4 China’s Natural Gas Trade Policies and Recommendations for Reform ..................... 215
8.4.1 China’s Current Natural Gas Trade Policies ................................................. 215
8.4.2 Recommendations for Adjustments to China’s Natural Gas Trade Policy ............... 217

8.5 Conclusions for Chinese Natural Gas Supply and Availability .............................. 221

9 Analysis of China’s Natural Gas Infrastructure Development Strategy ........................ 233
9.1 Current Development of Natural Gas Infrastructure ........................................... 233
9.1.1 Current State of Infrastructure Development ............................................... 233
9.1.2 Assessment of Development Levels and Existing Problems .............................. 235
9.2 Opportunities and Challenges ........................................................................ 237
9.2.2 Policy Catalyses Rapid Development of the Natural Gas Industry ...................... 238
9.2.3 The Atmospheric Pollution Prevention Action Plan ......................................... 238
9.2.4 Existing Pipeline Network Capabilities Are Insufficient .................................. 238
9.2.5 Peak Shaving Capabilities Are Severely Lacking ........................................... 238
9.2.6 Increasing Pressure for Safe Operations ....................................................... 239

9.3 Natural Gas Infrastructure Development Strategy .............................................. 239
9.3.1 Guiding Considerations ............................................................................ 239
9.3.2 Development Objectives .......................................................................... 239
9.3.3 Development Strategy ............................................................................. 240

9.4 Standardising Infrastructure Planning and Diversifying Investment ......................... 244
9.4.1 Infrastructure Construction Planning and Project Progress Oversight 244
9.4.2 Promote Construction of Entities and Investment Diversification 244
9.5 Establishing Fair Third-Party Access to Infrastructure 245
9.5.1 Create the Conditions for Third-Party Access 245
9.5.2 Establish Open and Transparent Oil and Gas Management and Operation Release Platforms 246

10 Analysis of China’s Peak Shaving and Natural Gas Storage Systems 247
10.1 Importance of Natural Gas Reserves for Peak Shaving 247
10.2 Issues and Challenges 248
10.2.1 Rapid Increase in Natural Gas Consumption and Peak Period Demand 248
10.2.2 Gas Reserve Peak Shaving Capabilities Insufficient 249
10.3 Key Objectives and Considerations Going Forward 253
10.3.1 Basic Considerations 253
10.3.2 Major Objectives 253
10.4 Recommendations for Developing Natural Reserves for Peak Shaving 254
10.4.1 Accelerate the Formulation of Natural Gas Peak Shaving Emergency Response Plans 254
10.4.2 Emphasise Gas Reserve Facility Legal and Regulatory Construction 254
10.4.3 Accelerate Natural Gas Peak Shaving Emergency Reserve Facility Construction 254
10.4.4 Formulate Proactive Tax and Price Policies 255
10.4.5 Accelerate Gas Reserve Management System Reforms 256
10.4.6 Establish Prompt and Flexible Warning Systems for Emergency Response 256

PART III Creation of Natural Gas Market Mechanisms and Reform of Natural Gas Management Systems

11 China’s Current Natural Gas Market Mechanisms and Regulatory System 261
11.1 Current State of Natural Gas Market Mechanisms 261
11.1.1 Natural Gas Upstream Market 261
11.1.2 Natural Gas Midstream Market 263
11.1.3 Natural Gas Downstream Market 269
11.2 Current State of China’s Natural Gas Regulatory Systems 269
11.2.1 Upstream Market Administrative System ........................................ 269
11.2.2 Midstream Market Administrative System ...................................... 275
11.2.3 Downstream Market Administrative System .................................... 278

11.3 Challenges Faced by the Current System ........................................... 280
11.3.1 Over-Centralisation of Mineral Rights and Lack of Exploration ............ 280
11.3.2 Bundling of Infrastructure, Low Utilisation and Blocking Access to Upstream Markets ................................................................. 281
11.3.3 Irrational Pricing Mechanisms, Which Dampen Incentive to Build Gas Storage ................................................................. 282
11.3.4 Downstream Pipeline Operator Regional Monopolies and Cross-Subsidising Between Different Users ....................................................... 283
11.3.5 Incomplete Supervisory Systems and Insufficient Supervisory Capability ................................................................. 283

12 International Experience of Liberalisation and Evolution of Natural Gas Markets ................................................................. 287
12.1 Incentivising New Entrants and Establishing Competitive Natural Gas Markets ................................................................. 287
12.2 Opening the Upstream Sector to Competition ........................................ 287
12.3 Orderly and Gradual Implementation of Pipeline Access Policies ................ 289
12.4 Third-Party Access: The First Step to Infrastructure Reform .................... 291
12.5 Unbundling: An Important Element of Liberalisation of Natural Gas Markets ................................................................. 293
12.6 Natural Gas Pricing Reform as Part of the Market Liberalisation and Development Process ................................................................. 294
12.7 The Role of Natural Gas Trading Markets ............................................. 296
12.8 Establishment of an Independent and Legally Protected Regulatory System ................................................................. 299
12.9 A Roadmap for Natural Gas Market Reform ........................................ 301

13 Regulatory System Reform to Support Natural Gas Market Liberalisation ................................................................. 303
13.1 Direction of Reforms ................................................................. 303
13.2 Key Pillars of Reform ................................................................. 304
13.2.1 Pillar I: Establish a Diversified, Competitive, Open, Orderly Modern Natural Gas Market System ................................................................. 304
13.2.2 Pillar II: Create a Pricing System that Reflects the Extent of Scarcity of Resources, the Market Relationships of Supply and Demand and Environmental Externality and a Green Financial and Taxation System ................................................................. 305
13.2.3 Pillar III: Establish a Service-Centred Natural Gas Administration with a Legal Basis ................................................................. 306
13.3 Reform Objectives ................................................................. 307
14 Roadmap for Natural Gas Market Liberalisation and Regulatory Reform 

14.1 Roadmap .................................................. 309
14.1.1 Upstream Sector Roadmap ......................... 309
14.1.2 Midstream Roadmap ................................. 310
14.1.3 Downstream Roadmap ............................... 311
14.2 Key Measures .............................................. 312
14.2.1 Creation of Market Systems .......................... 313
14.2.2 Completion of a Natural Gas Pricing Mechanisms ................................. 315
14.2.3 Removal of Pipeline Transport Bottlenecks .... 315
14.2.4 Further Regulatory Reform ........................... 317
14.2.5 Further Reform of the State-Owned Oil and Gas Companies ............... 320
14.2.6 Establish and Improve the Services Market .... 321

15 Policy Measures and Safeguards to Support Natural Gas Market Liberalisation and Regulatory Reform .... 323

15.1 Create and Complete a Natural Gas Legislative Framework ........................................ 323
15.2 Deepen Reform of Oil and Gas Regulations .................................................. 324
15.3 Deepen Reform of the Fiscal and Tax Systems ............................................... 325
15.4 Establish and Complete a Natural Gas Data Management System ...................... 327
15.4.1 Data Submission ......................................... 327
15.4.2 Standardised Data Management ....................... 328
15.4.3 Database Development and Information Disclosure ........................................ 328
15.5 Increase Reform and Technical Innovation in the Natural Gas Sector ................. 328
15.6 Expand International Energy Co-operation .................................................. 330

PART IV International Experience from the Development of Gas Markets Globally

16 International Development Trends .................................................. 335
16.1 Global Natural Gas Markets ............................................... 335
16.2 International Experiences of Liberalising the Natural Gas Value Chain ................. 336
16.3 Liberalisation of Different Segments of the Natural Gas Value Chain .................... 337
16.4 Natural Gas Energy Security and Social Influence ........................................... 338

17 The Global Natural Gas Market .................................................. 345
17.1 An Overview of the Global Energy Market ............................................... 345
17.2 Factors Driving Demand ........................................... 348
17.2.1 The Main Factors Driving Demand ............................................... 348
17.2.2 Natural Gas Price Elasticity and China ........................................... 349
17.3 Supply and Demand Imbalances

17.3.1 Summary of Global Resources

17.3.2 Regional Imbalances

17.3.3 Inter-regional Natural Gas Trade

17.3.4 Unconventional Natural Gas Resources

17.4 Pricing

17.4.1 Current Pricing Regulations

17.4.2 The Relationship Between the Price of Natural Gas and the Price of Oil

17.4.3 Chinese Pricing Mechanisms

17.4.4 The Influence of Chinese Demand on the World Market

18 An Overview of International Regulatory Experience

18.1 Regulatory Reform

18.1.1 The Reasons for Regulation

18.1.2 The Process of Market Liberalisation Across the Natural Gas Value Chain

18.2 Market Liberalisation

18.2.1 Core Initiatives for Liberalisation

18.2.2 Political and Economic Factors of Market Liberalisation

18.2.3 The Impact of Market Liberalisation on Domestic Mining

18.2.4 Market Liberalisation and Ancillary Policies

18.3 Case Studies of Natural Gas Market Liberalisation

18.3.1 Case Study 1: United States

18.3.2 Case Study 2: Europe

18.3.3 Case Study 3: United Kingdom

18.3.4 Case Study 4: Japan

18.3.5 Case Study 5: South Korea

19 A Close Look at the Natural Gas Industry Chain

19.1 The Upstream Segment: Fiscal Policies and Licensing Systems

19.1.1 International Taxation and Licensing Systems Regulating Upstream Production

19.1.2 Case Study 1: The United States—Leasing, Taxation and Development of Information Sharing

19.1.3 Case Study 2: Australia—Licensing, Finance and Taxation, and Third-Party Access

19.1.4 Case Study 3: Argentina—The Special Licensing System and Encouraging Investment

19.1.5 Case Study 4: Mexico—Reopening the Market and Round Zero Tender
19.2 The Midstream Segment: Building Infrastructure and Managing Access ........................................ 434
  19.2.1 Balancing Third-Party Access and Investment Incentives ........................................... 437
  19.2.2 International Experience of Managing Midstream Asset Access .................................. 438
  19.2.3 Case Study 1: The UK North Sea—The Framework for Negotiated Third-Party Access .......... 441
  19.2.4 Case Study 2: Japan and Singapore LNG—National Power and the Influence of Oligopoly ...... 444
  19.2.5 Case Study 3: The United States—Master Limited Partnerships .................................... 449

19.3 Unbundling Midstream Infrastructure .................................................. 451
  19.3.1 Models of Unbundling .................................................. 453
  19.3.2 Key Insights from the Case Studies .................................................. 453
  19.3.3 Case Study 1: The UK—The Long and Difficult Road to Spinoff .................................. 457
  19.3.4 Case Study 2: Europe—The Step-by-Step Progression Towards Spinoff and the Multitude of Choices .................................................. 458
  19.3.5 Case Study 3: Japan—Market Characteristics Restricting Unbundling .................................. 460
  19.3.6 Unbundling LNG Terminals and Gas Storage Facilities .............................................. 461

19.4 The Downstream Segment: Natural Gas Trading Hubs and the Liberalisation of Wholesale Natural Gas Markets ........................................ 462
  19.4.1 Pros and Cons of Natural Gas Hubs ........................................ 463
  19.4.2 The Important Inspiration of International Experience in the Development of Natural Gas Trading Hubs ........................................ 465
  19.4.3 Case Study 1: The United States—Regional Price Balances and Short-Term Pricing ............ 466
  19.4.4 Case Study 2: Continental Europe—Market Conditions for Natural Gas Hub Development ........................................ 466
  19.4.5 Case Study 3: The UK—Two Natural Gas Market Reform Bills .................................... 467
  19.4.6 Establishing Natural Gas Hubs in China ........................................ 468

Bibliography .................................................. 473

Further Reading ........................................ 475
China's Gas Development Strategies
; (Eds.)
2017, XLVIII, 477 p. 184 illus., 181 illus. in color.,
Hardcover
ISBN: 978-3-319-59733-1