

Contents

1	Prologue	1
2	Introduction	3
2.1	Concept	3
2.2	Historic Outline.	4
2.2.1	North America	4
2.2.2	Europe	5
2.2.3	Russia	5
2.2.4	Japan	6
2.2.5	South-East Africa	6
2.2.6	Global LNG.	6
2.3	Preliminary Overview—Development from Scratch	7
	References	9
3	Market Data	11
3.1	Primary Energy Consumption	11
3.2	Reserves.	12
3.3	Production	13
3.4	Consumption	14
3.5	Trade and Prices	14
3.6	Physical Capacities	20
3.6.1	Transportation	20
3.6.2	Underground Storages	21
3.6.3	LNG	21
	References	24
4	Non-economic and Non-commercial Fundamentals	25
4.1	Technical Properties.	26
4.1.1	Reference Conditions	26
4.1.2	(Chemical) Composition	28
4.1.3	Physical Properties	30
4.1.4	Specifications and Interchangeability of Natural Gases.	33
4.1.5	Environmental Effects	36

4.2	Sources	39
4.2.1	Natural Sources	39
4.2.2	Excursus: Upstream—Exploration and Production	43
4.2.3	Anthropogenic Production of ‘Natural’ Gas	50
4.3	Usages	51
4.3.1	Residential and Commercial	51
4.3.2	Industrial	53
4.3.3	Electricity Generation	54
4.3.4	Transportation	56
4.3.5	Others	57
	References	57
5	Economic and Commercial Fundamentals	59
5.1	Product	60
5.1.1	Natural Gas—Commodity and Capacity	60
5.1.2	Competing Fuels and Interdependencies	61
5.2	Value Chain	62
5.3	Regulation	63
5.4	Security of Supply	70
5.5	Market Models	72
5.5.1	Traditional	73
5.5.2	Transitional	75
5.5.3	Competitive—‘Modern’ Markets	76
5.5.4	Excursus: Trading Instruments	81
	References	91
6	Sales Along the Value Chain	93
6.1	Players	94
6.2	Supply and Demand	95
6.2.1	Demand	95
6.2.2	Supply	98
6.3	Contracts	100
6.3.1	Quantities and Flexibilities	100
6.3.2	Price	112
6.3.3	Hardship	135
6.3.4	Term	135
6.3.5	Delivery Point	136
6.3.6	Quality	137
6.3.7	Nominations	138
6.3.8	Other Commercially Relevant (Contractual) Elements of Commodity Deliveries	140
6.3.9	Standard Contracts	142
6.3.10	Categorization of Deliveries and Contracts	143
	References	146
7	Transportation	149
7.1	General	149
7.2	Outline of Physical Transportation and Assets	151
7.2.1	Pipeline	151
7.2.2	LNG	155

7.3	Costs	157
7.3.1	Pipeline	157
7.3.2	LNG	160
7.4	Players	160
7.5	Pipeline-Capacity Reservation Systems and Pricing Systems	161
7.5.1	Capacity Reservation	161
7.5.2	Pricing	163
7.6	Contracts	166
7.6.1	Pipeline Contracts	167
7.6.2	LNG Transportation Contracts	173
7.6.3	Standard Contracts	173
7.6.4	Categorization of Natural Gas Transportation Contracts	174
	References	177
8	Storage	179
8.1	General	179
8.2	Functions	180
8.2.1	Balancing of Demand Fluctuations	180
8.2.2	Provision of Security of Supply	181
8.2.3	Optimization	181
8.3	Outline of Physical Storage and Assets	182
8.3.1	Types of Storages	182
8.3.2	Surface Facilities	185
8.4	Storage Parameters	186
8.5	Players	188
8.6	Contracts	188
8.6.1	Products	188
8.6.2	Pricing	190
8.6.3	Other Contractual Elements	194
8.6.4	Standard Contracts	196
8.6.5	Categorization	196
	References	197
9	Portfolio Management	199
9.1	Historical Development	200
9.2	Portfolio Optimization and Management—Traded Markets	204
	References	205
10	Epilogue	207
	Appendix A: Additional Recommended Literature	209
	Appendix B: Units and Prefixes	211
	Appendix C: Symbols and Abbreviations	217

4.2	Sources	39
4.2.1	Natural Sources	39
4.2.2	Excursus: Upstream—Exploration and Production	43
4.2.3	Anthropogenic Production of ‘Natural’ Gas	50
4.3	Usages	51
4.3.1	Residential and Commercial	51
4.3.2	Industrial	53
4.3.3	Electricity Generation	54
4.3.4	Transportation	56
4.3.5	Others	57
	References	57
5	Economic and Commercial Fundamentals	59
5.1	Product	60
5.1.1	Natural Gas—Commodity and Capacity	60
5.1.2	Competing Fuels and Interdependencies	61
5.2	Value Chain	62
5.3	Regulation	63
5.4	Security of Supply	70
5.5	Market Models	72
5.5.1	Traditional	73
5.5.2	Transitional	75
5.5.3	Competitive—‘Modern’ Markets	76
5.5.4	Excursus: Trading Instruments	81
	References	91
6	Sales Along the Value Chain	93
6.1	Players	94
6.2	Supply and Demand	95
6.2.1	Demand	95
6.2.2	Supply	98
6.3	Contracts	100
6.3.1	Quantities and Flexibilities	100
6.3.2	Price	112
6.3.3	Hardship	135
6.3.4	Term	135
6.3.5	Delivery Point	136
6.3.6	Quality	137
6.3.7	Nominations	138
6.3.8	Other Commercially Relevant (Contractual) Elements of Commodity Deliveries	140
6.3.9	Standard Contracts	142
6.3.10	Categorization of Deliveries and Contracts	143
	References	146
7	Transportation	149
7.1	General	149
7.2	Outline of Physical Transportation and Assets	151
7.2.1	Pipeline	151
7.2.2	LNG	155

7.3	Costs	157
7.3.1	Pipeline	157
7.3.2	LNG	160
7.4	Players	160
7.5	Pipeline-Capacity Reservation Systems and Pricing Systems	161
7.5.1	Capacity Reservation	161
7.5.2	Pricing	163
7.6	Contracts	166
7.6.1	Pipeline Contracts	167
7.6.2	LNG Transportation Contracts	173
7.6.3	Standard Contracts	173
7.6.4	Categorization of Natural Gas Transportation Contracts	174
	References	177
8	Storage	179
8.1	General	179
8.2	Functions	180
8.2.1	Balancing of Demand Fluctuations	180
8.2.2	Provision of Security of Supply	181
8.2.3	Optimization	181
8.3	Outline of Physical Storage and Assets	182
8.3.1	Types of Storages	182
8.3.2	Surface Facilities	185
8.4	Storage Parameters	186
8.5	Players	188
8.6	Contracts	188
8.6.1	Products	188
8.6.2	Pricing	190
8.6.3	Other Contractual Elements	194
8.6.4	Standard Contracts	196
8.6.5	Categorization	196
	References	197
9	Portfolio Management	199
9.1	Historical Development	200
9.2	Portfolio Optimization and Management—Traded Markets	204
	References	205
10	Epilogue	207
	Appendix A: Additional Recommended Literature	209
	Appendix B: Units and Prefixes	211
	Appendix C: Symbols and Abbreviations	217

Appendix D: Glossary	225
Appendix E: Flexibility Definition	233
Appendix F: Equivalence of Additive and Multiplicative Formulae	239
Index	241