# CONTENTS

Preface xv

Nomenclature xix

## 1 Electricity Regulation and Deregulation

1.1. The Electricity Industry: Restructuring and Deregulation 1
1.2. From Monopolies to Markets 2
1.3. Why Restructuring and Deregulation Now? 3
1.4. Regulation is Still Required 4
1.5. What Lessons Can Be Learned from International Experiences? 6
   1.5.1. Starting Points and Motivations for Deregulation 9
   1.5.2. Structural Changes and System Operation 10
   1.5.3. Design of Wholesale Markets and Market Institutions 11
   1.5.4. Retail Competition and Customer Choice 12
1.6. Conclusions 12

## 2 Electricity Economics

2.1. What is a Market? 15
   2.1.1. Competitive versus Noncompetitive Markets 15
   2.1.2. The Market Mechanism 16
   2.1.3. Elasticity 18
2.2. Cost and Supply 20
   2.2.1. Economic Cost versus Accounting Cost 20
   2.2.2. Total, Average, and Marginal Costs 21
   2.2.3. Economies and Diseconomies of Scale and Scope 24
2.3. Profit Maximization 25
   2.3.1. What is Profit? 25
   2.3.2. What is Economic Efficiency? 29
2.4. Social Surplus: Consumer and Producer Surplus 29
2.5. Market Power and Monopoly 30
   2.5.1. Maximizing Profit under Monopoly 30
   2.5.2. Deadweight Loss from Monopoly Power 31
2.5.3. Response to the Exercise of Monopoly Power: Regulation and Antitrust

Exercise 2.1. Linear and Logarithmic Demand Functions 34
Exercise 2.2. A Shift in Demand and a New Equilibrium Price (a Cobweb Model) 35
Exercise 2.3. Returns to Scale in Production and Cost 37
Exercise 2.4. Calculating a Regulated Tariff 40
Exercise 2.5. Calculating Social Surplus under Competition and Regulation 41
Exercise 2.6. Calculating Deadweight Loss under Monopoly 42

3 The Cost of Capital 43

3.1. What is the Cost of Capital? 43
3.2. Net Present Value 45
    3.2.1. Discounting to the Present 46
    3.2.2. Net Present Value 48
    3.2.3. Assessing Cash Flows under the Net Present Value Rule 49
3.3. Alternative Methods of Project Evaluation 51
    3.3.1. Payback Analysis 51
    3.3.2. Average Return on Book Value 52
    3.3.3. Internal Rate of Return 52
3.4. Risk and Return 53
    3.4.1. Financial Instruments 55
    3.4.2. Capital Structure and the Cost of Capital 58
Exercise 3.1. Risk and Diversification 58
Exercise 3.2. Risk Aversion 62
Exercise 3.3. The Capital Asset Pricing Model 68
Exercise 3.4. Certainty Equivalent Discount Rates 70
Exercise 3.5. Calculating the Internal Rate of Return 74

4 Electricity Regulation 75

4.1. Introduction to Economic Regulation 75
    4.1.1. Regulatory Policy Variables 76
    4.1.2. The Regulatory Process 78
4.2. Rate-of-Return Regulation 80
4.3. Performance-Based Ratemaking 83
    4.3.1. Sliding Scale 84
    4.3.2. Revenue Caps 85
    4.3.3. Price Caps 86
    4.3.4. Some Problems with Incentive Regulation 87
4.4. Rate Structure 88
    4.4.1. Introduction to Tariff Regulation 88
    4.4.2. Marginal Cost Pricing, Multipart Tariffs, and Peak-Load Pricing 89
5 Competitive Electricity Markets

5.1. Overview
5.2. Wholesale Power Markets
   5.2.1. The Poolco Market
   5.2.2. Contracts for Differences
   5.2.3. Physical Bilateral Trading
   5.2.4. Transmission Ownership and System Operation
   5.2.5. Ancillary Services
5.3. Market Performance and Investment
   5.3.1. Generation Expansion and Monitoring
   5.3.2. Nodal and Zonal Transmission Pricing
   5.3.3. Transmission Planning and Investment
5.4. Customer Choice and Distribution Regulation
   5.4.1. Customer Choice and Retail Competition
   5.4.2. Real-Time Prices and Retail Services
   5.4.3. Retail Access Tariffs
   5.4.4. Distribution Company Regulation
Exercise 5.1. Determining Dispatch in a Poolco Market
Exercise 5.2. Determining Dispatch Based on Physical Bilateral Contracts
Exercise 5.3. Generator Revenues and Long-Run Capacity
Exercise 5.4. Generator Profits with and without a Contract for Differences
Exercise 5.5. The Value of Transmission Expansion between Two Zones
Exercise 5.6. Calculate Nodal Prices in a Three-Bus Transmission System

6 The Californian Power Sector
Ryan Wiser, Steven Pickle, and Afzal S. Siddiqui

6.1. General Description of the California Power System
   6.1.1. Generation
   6.1.2. Transmission and Interconnections
   6.1.3. Distribution
   6.1.4. Consumption
   6.1.5. Concentration Levels
CONTENTS

6.1.6. Plant Investment 133
6.1.7. Electricity Prices 133
6.1.8. Economic and Energy Indices 134

6.2. The New Regulatory Framework 135
   6.2.1. U.S. Federal Legislation and Regulation 135
   6.2.2. California State Regulation and Legislation 137

6.3. The Wholesale Electricity Market and Institutions in California 140
   6.3.1. The Power Exchange 140
   6.3.2. The Independent System Operator 144
   6.3.3. Bilateral Trading 145

6.4. Transmission Access, Pricing, and Investment 146
   6.4.1. Access Charges 147
   6.4.2. Transmission Congestion Charges 147
   6.4.3. Transmission Losses 149
   6.4.4. Investment and Planning 149

6.5. Distribution Network Regulation and Retail Competition 149
   6.5.1. Regulation of the Distribution Network 150
   6.5.2. Remuneration for Regulated Distribution Activities 150
   6.5.3. Retail Competition 151

   6.6.1. Stranded Costs 153
   6.6.2. Market Power 154
   6.6.3. Public Purpose Programs 155
   6.6.4. Customer Protection and Small Customer Interests 156

6.7. Market Experience and the Energy Crisis 156
   6.7.2. The Electricity Crisis 157
   6.7.3. The Causes of the Electricity Crisis 158
   6.7.4. Solutions and Conclusions 159

7. The Norwegian and Nordic Power Sectors 161
   Helle Grønli

   7.1. General Description of the Norwegian Power System 161
      7.1.1. Generation 161
      7.1.2. Transmission 162
      7.1.3. Distribution 163
      7.1.4. Consumption 164
      7.1.5. Economic Indices 164
      7.1.6. General Economic and Energy Indices 166

   7.2. The New Regulatory Framework 167
      7.2.1. The Energy Act of 1990: Objectives and Consequences 168
      7.2.2. The Energy Act of 1990: Specifics 169

   7.3. The Wholesale Electricity Market 170
      7.3.1. The Energy Markets 171
7.3.2. Zonal Pricing 172
7.3.3. Ancillary Services 173
7.3.4. Bilateral Trading 173
7.4. Transmission/Distribution Access, Pricing, and Investment 174
7.4.1. Overall Principles: The Point of Connection Tariff 174
7.4.2. Transmission Tariffs 176
7.4.3. Distribution Tariffs 177
7.5. Distribution Network Regulation and Retail Competition 178
7.5.1. Rate of Return Regulation, 1991-1997 178
7.5.2. Incentive-Based Regulation Starting January 1, 1997 178
7.5.3. Retail Competition—Important Developments 182
7.6. Aspects of the Regulatory Process in Norway 184
7.6.1. The Inter Nordic Exchange 184
7.6.2. Congestion Management in the Scandinavian Area 185

8 The Spanish Power Sector 187
8.1. General Description of the Spanish Power System 187
8.1.1. Structure of the Industry 187
8.1.2. Generation 187
8.1.3. Transmission 188
8.1.4. Distribution 189
8.1.5. Consumption 189
8.1.6. Concentration Levels and Economic Indices 190
8.1.7. General Economic and Energy Indices for Spain 194
8.2. The New Regulatory Framework 194
8.2.1. Background 194
8.2.2. The 1997 Electricity Law 198
8.2.3. Further Regulations 199
8.3. The Wholesale Electricity Market 200
8.3.1. General Market Institutions 200
8.3.2. Structure of the Wholesale Market 201
8.3.3. The Daily Market 201
8.3.4. The Intraday Markets 202
8.3.5. Network Constraint Management Procedures 202
8.3.6. The Ancillary Service Markets 203
8.3.7. Capacity Payments 203
8.3.8. Bilateral Trading 203
8.3.9. International Exchanges and External Agents 204
8.4. Transmission Access, Pricing, and Investment 204
8.4.1. Remuneration of Transmission Activities 204
8.4.2. Transmission Network Charges 205
8.4.3. Transmission Losses 205
8.4.4. Investment and Planning 206
8.5. Distribution Network Regulation and Retail Competition 206
8.5.1. Remuneration of Regulated Distribution Activities 206
8.5.2. Distribution Losses 207
8.5.3. Distribution Network Charges 208
8.5.4. Power Quality Regulation 208

8.6. Particular Aspects of the Regulatory Process in Spain 210
8.6.1. Estimated Stranded Costs 210
8.6.2. The Stranded Costs: Methodology for Recovery 211
8.6.3. The General Settlement Procedure: Regulated Tariffs and Revenues 212

9 The Argentine Power Sector 217

9.1. General Description of the Argentine Power System 217
9.1.2. Transmission 218
9.1.3. Distribution 219
9.1.4. Consumption 220
9.1.5. Electricity Tariffs 221
9.1.6. Economic and Energy Indices 221

9.2. The Regulatory Framework 221
9.2.1. Background 221
9.2.2. The New Electricity Law 222
9.2.3. Regulatory Authorities 223
9.2.4. The Privatization Process in Argentina 224

9.3. The Wholesale Electricity Market 224
9.3.1. Market Participants 226
9.3.2. Energy Market and Economic Dispatch 226
9.3.3. Capacity Payments 227
9.3.4. Cold Reserve and Ancillary Services 227
9.3.5. Generator Revenues 228
9.3.6. Scheduling, Dispatch, and Settlement 228
9.3.7. Bilateral Contracts 228

9.4. Transmission Access, Pricing, and Investments 229
9.4.1. Transmission Charges 229
9.4.2. Penalties for Unavailability of the Transmission Assets 230
9.4.3. Transmission Concessions 231
9.4.4. Transmission Expansion 231

9.5. Distribution Regulation 232
9.5.1. Distribution Concessions 233
9.5.2. Evaluation of Distribution Costs 234
9.5.3. Regulated Tariff Customer Categories 235
9.5.4. Cost Allocation in Regulated Tariffs—An Example of a User Tariff 236

9.6. Particular Aspects of the Regulatory Process in Argentina 238
9.6.1. Regulation of Power Quality after Privatization of Distribution

Glossary

References

Author Index

Subject Index

About the Authors
Introduction to electricity economics. 8. The use of electricity in Norwegian households. 35 31 30. 25 20 17. 15.

9. Load curves for consumption. 20000 18000 16000 14000 12000 10000. 8000 1 3 5 7 9 11 13 15 17 19 21 23

Hours. Wed.20.07 Mon.24.01 Sun.17.07 Sun.23.01. GWh. Introduction to electricity economics. 10. Power System Economics Notes.


to Measure Electricity V volt The unit of electrical pressure A amp The unit of electrical current W watt Power (Energy per hour) h hour

Time Wh watt-hour Energy k kilo 1000. Used in kW, kWh and kV. M mega 1,000,000. John Wiley & Sons Electricity Economics Written
originally as a manual for the Federal Energy Commission to train regional rate regulators, .. Product #: 978-0-471-23437-1 Regular
price: $120.56 $120.56 In Stock. Electricity Economics. Regulation and Deregulation. Rothwell, Geoffrey S. / GÁÁmez, TomÁÁs.