Figures

1.1	Energy intensity (1965–2018)	page 3
1.2	Total final energy consumption by source for the world	4
1.3	Total per capita primary energy consumption around the world (2022)	5
1.4	Total energy consumption by sector for Switzerland	6
1.5	Total energy consumption by sector for India	7
1.6	Global greenhouse gas emission by sector in 2016	8
1.7	Annual fossil fuel carbon dioxide emissions (2023)	9
1.8	Average PM2.5 concentrations in the most polluted capital cities in the	
	world in 2019 and 2020	13
1.9	Energy transition and changes in the energy mix	15
1.10	Electricity production mix for an industrialised country	16
1.11	Energy transition and greenhouse gas emissions	17
1.12	Types of renewable energy	18
2.1	Negative externality	24
2.2	Positive externality	26
2.3	Impact of bias on market equilibrium	37
2.4	Energy policy and climate policy goals	40
2.5	Dimensions of sustainable development	43
3.1	Optimisation of consumption	52
3.2	Cost minimisation in the production of energy services	52
3.3	Optimisation of energy service production using isoquants	53
3.4	Energy service optimisation using isoquants and isocosts	54
3.5	Optimisation of energy service production with fixed capital stock using	
	isoquants	55
3.6	Steps for estimating the energy demand and capital stock demand model	ls 58
3.7	Finding the optimal choice of inputs	66
3.8	Impact of price increase on capital and energy demand of firms	66
4.1	Investments in different energy functions	74
4.2	The life cycle net cash flows of an investment	75
4.3	Estimated average external costs for different technologies in the EU	88
4.4	Levelised cost of energy (LCoE) by technology aggregated over	
	twenty-four countries	88
4.5	A typical learning curve	90
4.6	Learning curves for renewable energy technologies	91

4.7	Steps in doing a social cost–benefit analysis	94
4.8	Incremental social benefits for air quality	96
5.1	Energy efficiency and productive efficiency	103
5.2	Inefficient use of technology	103
5.3	Inefficient combination of inputs	104
5.4	Use of obsolete technology	105
5.5	Energy intensity at the household level	107
5.6	Frontier demand curve and inefficiency	108
5.7	Stochastic frontier demand curve and inefficiency	109
5.8	Lifetime costs	112
5.9	Different decision-making strategies	118
5.10	Simple rebound effects	121
5.11	Rebound effect and production and consumption of energy services	122
6.1	Market forms	128
6.2	Typical average cost curve shapes	129
6.3	Economies of scale and density	130
6.4	Average distribution cost	133
6.5	Different producers and resource rents (marginal costs = average costs)	137
6.6	Natural monopoly	138
6.7	Natural monopoly and rate of return regulation	139
6.8	Short-run optimal situation of a firm operating in perfect competition	143
6.9	Electricity functions	144
6.10	Traditional market organisation	145
6.11	Modern market organisation: wholesale competition	145
6.12	Modern market organisation: retail competition	146
6.13	Equilibrium on the day-ahead market	147
6.14	A typical merit order curve	148
6.15	Short-run monopolistically competitive firm	151
6.16	Long-run monopolistically competitive firm	151
6.17	Cartel behaviour	153
6.18	Multi-plant monopolist strategy of cartel operation	154
6.19	Dominant firm model	156
6.20	OPEC	156
7.1	Goals of energy policy and climate policy	163
7.2	Strategies of energy policy	164
7.3	Types of energy and climate policy instruments	165
7.4	Public energy and climate policy instruments	166
7.5	Private energy and climate policy instruments	167
7.6	Types of environmental taxes	169
7.7	Welfare loss without considering externalities of meat production	171
7.8	Product tax on meat produced	172
7.9	Marginal abatement cost	173
7.10	Emission tax	174
7.11	Emission tax at the aggregate level	175

7.12	Equilibrium abatement with an emission tax	176
7.13	Introduction of an energy tax on the market for energy-efficient	
	technologies	178
7.14	Environmental tax reform	180
7.15	Introduction of a subsidy	183
7.16	Fixed price feed-in-tariff	185
7.17	Non-variable premium price feed-in-tariff	185
7.18	Variable premium price feed-in-tariff	186
7.19	A cap-and-trade system	188
7.20	Demand for energy efficiency by rational and bounded rational consumers	192
7.21	Optimal solution considering subsidy	193
7.22	Market for coal	201
8.1	Impact of the introduction of energy consumption restriction	206
8.2	Functioning of pollution standards	207
8.3	Standards and non-uniform MAC	208
8.4	Impact of implementing standards	209
8.5	Impact of emission and pollution standards	210
8.6	Effects of energy standards	212
8.7	Impact of adoption of energy-efficient technologies	212
8.8	Energy standards and heterogeneous market benefits	213
8.9	Impact of pricing strategy and time restrictions	215
8.10	The case of boundedly rational households	216
9.1	Welfare loss without considering externalities of electricity produced by	
	coal plant	223
9.2	Dynamic efficiency and heating costs	224
9.3	Randomised controlled trial	234
9.4	Elements of the RCT on monetary information	235
9.5	Information sheet on the efficiency of washing machines	236
9.6	Introduction of subsidy for energy-efficient renovations	238
9.7	Regression discontinuity design (RDD)	241